6.0 WATER

6.1 Introduction

This chapter of the remedial Environmental Impact Assessment Report (rEIAR) provides an assessment of the hydrological (surface water) and hydrogeological (groundwater) aspects of a quarry at Ballynabarny, Recross, Co. Wicklow (the 'Site'). It supports an application for Substitute Consent for the existing quarry at the Site by ECT Sand and Gravel (the 'Applicant').

6.1.1 Technical Scope

The technical scope of this assessment is to consider the potential impacts and effects that changes in activities at the Site (as detailed in Chapter 2.0, Project Description) may have had on the water environment throughout the review period (see Section 6.1.2). The assessment considers the potential sources of change resulting from varying 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.

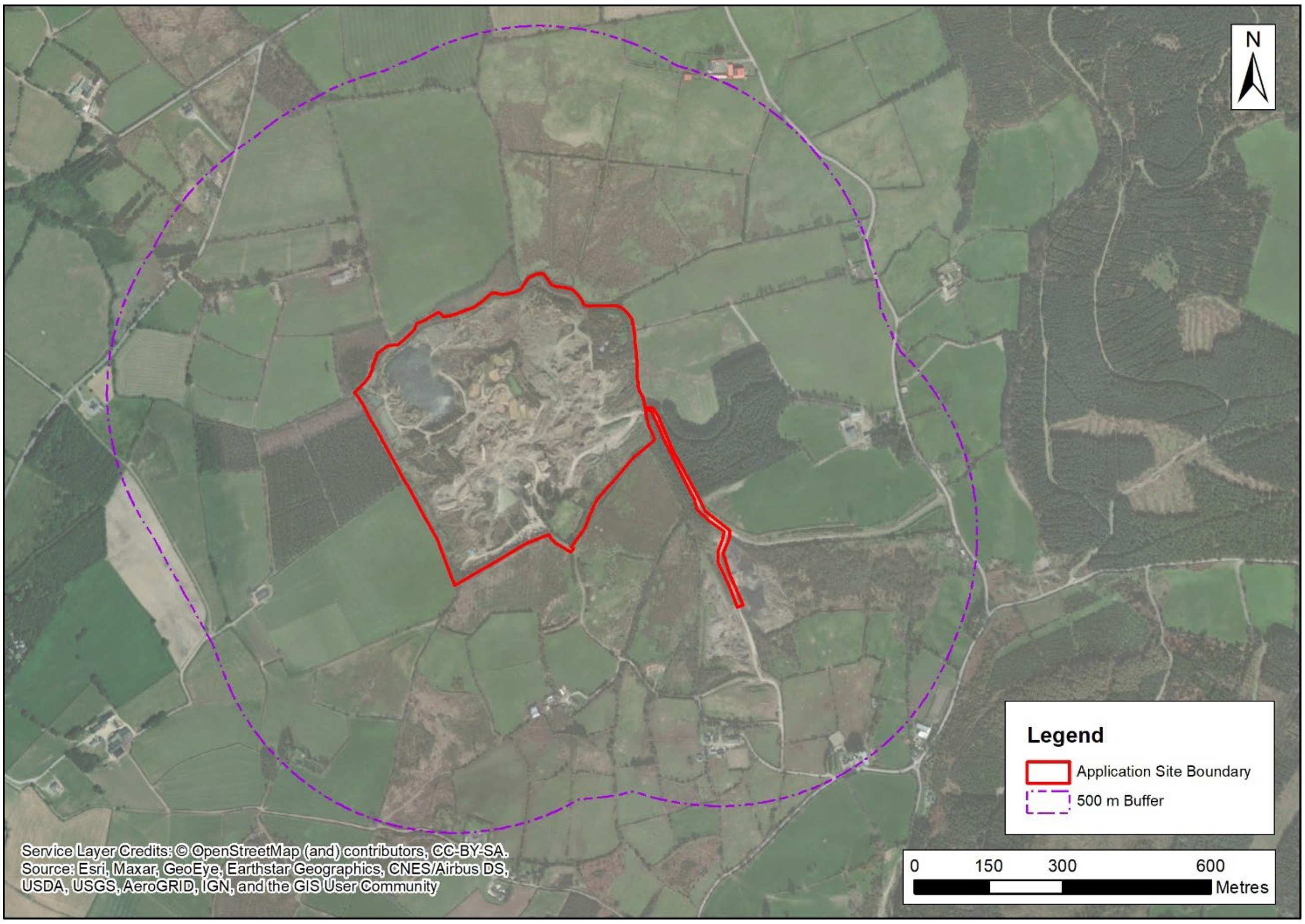
The potential effects of secondary changes in the water environment on land, people, ecology (including water dependent habitats or ecological receptors) and infrastructure are considered further in the following chapters of the rEIAR:

- Chapter 3.0 – Populations and Human Health;
- Chapter 4.0 – Ecology and Biodiversity;
- Chapter 12.0 – Material Assets; and
- Chapter 13.0 – 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 temporal scope of the assessment covers the period of February 1990 ('baseline conditions') to the present day ('current conditions'). This timeframe of 1990 to 2022 is subsequently referred to as the 'review period'. The assessment establishes what the baseline water environment conditions were for the Site and then assesses what impacts may have occurred due to subsequent activities at the Site during the review period. The geographical study area for the assessment covers the area within the Site boundary and a buffer zone that nominally extends to 0.5 kilometres (km) 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 have been affected by changes associated with the Site activities.



Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA. Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 6-1: Site Boundary (red) and 500 m Buffer Zone (purple). Aerial Photography from 202

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. The overarching EIA legislation under which this assessment is required is addressed separately in Chapter 1.0 (Introduction, Scope and Methodology).

6.2.1 Legislation and Guidance

In addition to the Regulations that underpin the Environmental Impact Assessment (EIA) process (see Chapter 1.0, Introduction, Scope and Methodology), this assessment has been made with cognisance to relevant guidance, advice and legislation relating to the water environment, which have been used to steer the focus of the baseline information collection, the categorisation of receptor sensitivities, and the mitigation measures that have been included.

- 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; and

    - 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.

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:

- 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 Pleanala on carrying out Environmental Impact Assessment (August 2018).

- Land contamination risk management[1](LCRM) (October 2020), formerly Contaminated Land Report (CLR) 11 Model Procedures for the Management of Contaminated Land (2004), which presents guidance on the management of land contamination and the risk assessment needed to estimate its severity. The guidance details the concept of source-pathway-receptor linkages and the use of generic assessment criteria that are used in this assessment.

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[1] https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm. Accessed May 2022, last updated April 2021.

- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions).
- 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 (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).
- Scottish and Northern Irish Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs) – these, although not Irish guidance, provide environmental good practice guidance for activities such as oil and chemical storage, works in or near water, works on construction sites, and dealing with spills and pollution incidents.

6.2.2 National and Local Policy

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 outlines the measures that will be taken to improve the water quality in Ireland’s groundwater and surface water. The draft RBMP for Ireland 2022-2027 (Department of Housing, Local Government and Heritage, 2022), which is currently in the consultation phase, outlines that key measures are required to:

- Reduce the loss of fertilisers and soil from farmland into water;
- Reduce the physical impacts on water bodies – caused by the drainage of lands and rivers and the presence of barriers (weirs, dams, etc.);
- Ensure continued investment in urban and rural water services; and
- Protect water bodies from future deterioration.

The draft RBMP for Ireland 2022-2027 also highlights that impacts on waterbodies by mining and quarrying is typically “related to sediment, with dewatering from mining operations also impacting on the quality of our waters”.

There is currently no local area plan for Ballinabarney and the closest local area plan, Rathdrum 2017-2023 (Wicklow County Council, 2017), does not extend to the Ballinabarney area. However, the draft Wicklow County Development Plan 2022-2028 (Wicklow County Council, 2022), which is currently in the consultation phase, incorporates relevant policies and objectives for the area. Specific policies and objectives relating to the protection of the water environment and management of surface water and groundwater include the following:

- Strategic Objective, Extractive Industry: To support and facilitate the exploitation of County Wicklow’s natural aggregate resources in a manner, which does not unduly impinge on the environmental quality, and the visual and residential amenity of an area.

- Objective CPO 9.51: To facilitate and encourage the exploration and exploitation of minerals in the County in a manner, which is consistent with the principle of sustainability and protection of residential, environmental and tourism amenities.
- Objective CPO 13.1: To ensure and support the implementation of the EU Groundwater Directive and the EU Water Framework Directive and associated River Basin and Sub-Basin Management Plans and Blue Dot Catchment Programme, to ensure the protection, improvement and sustainable use of all waters in the County, including rivers, lakes, ground water, coastal and estuarine waters, and to restrict development likely to lead to a deterioration in water quality.
- Objective CPO 13.2: To prevent development that would pollute water bodies and in particular, to regulate the installation of effluent storage and disposal systems in the vicinity of natural water bodies or development that would exacerbate existing underlying water contamination.
- Objective CPO 13.3: To minimise alterations or interference with river / stream beds, banks and channels, except for reasons of overriding public health and safety (e.g. to reduce risk of flooding); a buffer of generally 25 metres along watercourses should be provided (or other width, as determined by the Planning Authority having particular regard to 'Planning for Watercourses in the Urban Environment' by Inland Fisheries Ireland for urban location) free from inappropriate development, with undeveloped riparian vegetation strips, wetlands and floodplains generally being retained in as natural a state as possible.
- Objective CPO13.4: To ensure that any development or activity with the potential to impact on ground water has regard to the GSI Groundwater Protection Scheme.
- Objective CPO 13.5: To ensure compliance with and to implement the provisions of the Nitrates Directive in so far as it falls within the remit of the Council to do so.
- Objective CPO 13.9: To protect existing and potential water resources of the County, in accordance with the EU Water Framework Directive, the River Basin Management Plans, the Groundwater Protection Scheme and source protection plans for public water supplies.
- Objective CPO 14.01: To support the implementation of recommendations in the OPW Flood Risk Management Plans (FRMPs), including planned investment measures for managing and reducing flood risk.

6.3 Assessment Methodology and Significance Criteria

This section presents the method used to assess the impacts and effects of activities at the Site during the review period 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 and inspection of the surrounding area in April 2022 and July 2022.
- Field monitoring and sampling campaigns carried out by Golder in 2020 to 2022.
- Correspondence with the Applicant/Site Owner and Site staff.
- Desktop reviews of previous site-specific reports by:
    - AWN Consulting Limited ('AWN', 2016; 2017);
    - PD Lane Associates (2009; 2015); and

  - White Young Green (‘WYG’, 2009).
- Desktop reviews of literature and publicly available information (including interactive mapping services).
- Review of historic surface water monitoring information obtained from the EPA.
- Review of historic planning applications for the Site and surrounding area.
- Review of available aerials imagery (1993, 1995, 2000, 2004, 2009, 2011, 2015 and 2021).

A full list of references is provided in Section 6.15.

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. A summary of the stages involved is included below:

1) Confirm 1990 baseline and subsequent conditions–determine the 1990 baseline conditions and identify any changes throughout the review period. 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 have occurred to each receptor as a result of the Site activities during the review period, identify source-pathway receptor linkages, and assign the magnitudes of impact. This stage takes into account embedded design mitigation, 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 remedial measures if it is considered necessary to reduce the initial magnitude of the impact and associated effect significance further.
6) Assess the residual impact magnitude and residual effect significance after all remedial measures are applied.
7) Identify any monitoring that maybe required to measure the success of the remedial measures.

Stages 1 and 2 have been completed using available information specific to the Site, published literature and guidance, historical records, datasets and studies and additional monitoring data collected specifically to support this rEIAR chapter. 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 2022 Guidelines on the Information to be Contained in EIARs and adapted based on the additional guidance outlined in Section 6.2.1, such as those by the NRA and IGI. The descriptions for value (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 have occurred at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor (i.e. a conceptual site model). This follows the method of preliminary risk assessment that is widely presented in some of the guidance documents listed in Section 6.2.1, such as the LCRM guidance.

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 - or supports an internationally important feature. WFD river designation of 'High' and in hydraulic connectivity with the Site. Human health receptors. 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 2and 5 residential or commercial properties or locally important infrastructure (e.g. local roads) from flooding.
Negligible	Very low importance and rarity, local scale. 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 Typical 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.

Magnitude of impact (change)		Typical description
		Significant pollution of the water environment, which is 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 Development and is likely to occur at or near the Development itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s) (e.g. the Development results in a change in 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 areas or away from the Development.

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

- Temporary – effect likely to last less than 1year without intervention;
- Short term – effect likely to last 1to 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 are usually long-term or permanent and irreversible, such as changes to the groundwater flow regimes caused by changes to the properties of the subsurface.

A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted, removed 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, supporting evidence is provided in the topic chapters 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.

Following the assessment of the level of effect significance, remedial measures are presented that will be used to further avoid, preventor reduce the magnitude of the potential impact (Stage 5). If necessary, the significance of the effect taking into account the remedial measures is then assessed (Stage 6) to give the residual effect significance. Any monitoring that will be required to measure the success of the remedial measures is also presented in Section 6.10 (Stage 7).

Residual effects of ‘large’ or ‘profound’ significance are considered to be ‘significant’ for the purposes of this assessment. The effects of the Development are also considered cumulatively with those that could foreseeably have resulted from other known developments that have occurred in the assessment study area (see Section 6.11 and Chapter 13.0, Interactions).

6.4 Baseline and Subsequent Conditions (1990 to 2022)

This Section presents a summary of the baseline (1990) and subsequent conditions (up to July 2022) 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 located on the hillside at Ballynabarney North and Bolagh Lower, Redcross, County Wicklow, Ireland. The subject lands have been used for quarrying prior to 1990 and to date. Quarrying in the area is likely to have been occurring since the 1940s.

The land surrounding the Site is predominantly agricultural as well as plantation woodland, ‘heath’/scrub and one-off roadside housing and farmyards. The Site is bounded by streams to the north and east of the Site and dry field drains exist within hedgerows to the south and west.). Aerial photographs which show the quarry and the immediately surrounding land during the review period are presented in Figure 6-2 to Figure 6-5.

Regionally, the Site is situated ca. 3.5 km southeast of Rathdrum, and ca. 3.5 km northwest of Redcross. Other notable land uses in the regional vicinity of the Site are Balleese Wood Quarry (ca. 2.3 km west), Ballinclare Quarry (ca. 4 km northeast) and the historical Tigroney West (‘Avoca’) mine (ca. 2.8 km southwest).

Figure 6-2: Aerial Photos of the Site in 1993 and 1995

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community and Ordnance Survey Ireland 1993 Orthophotography. Licence No. CYAL50192220.

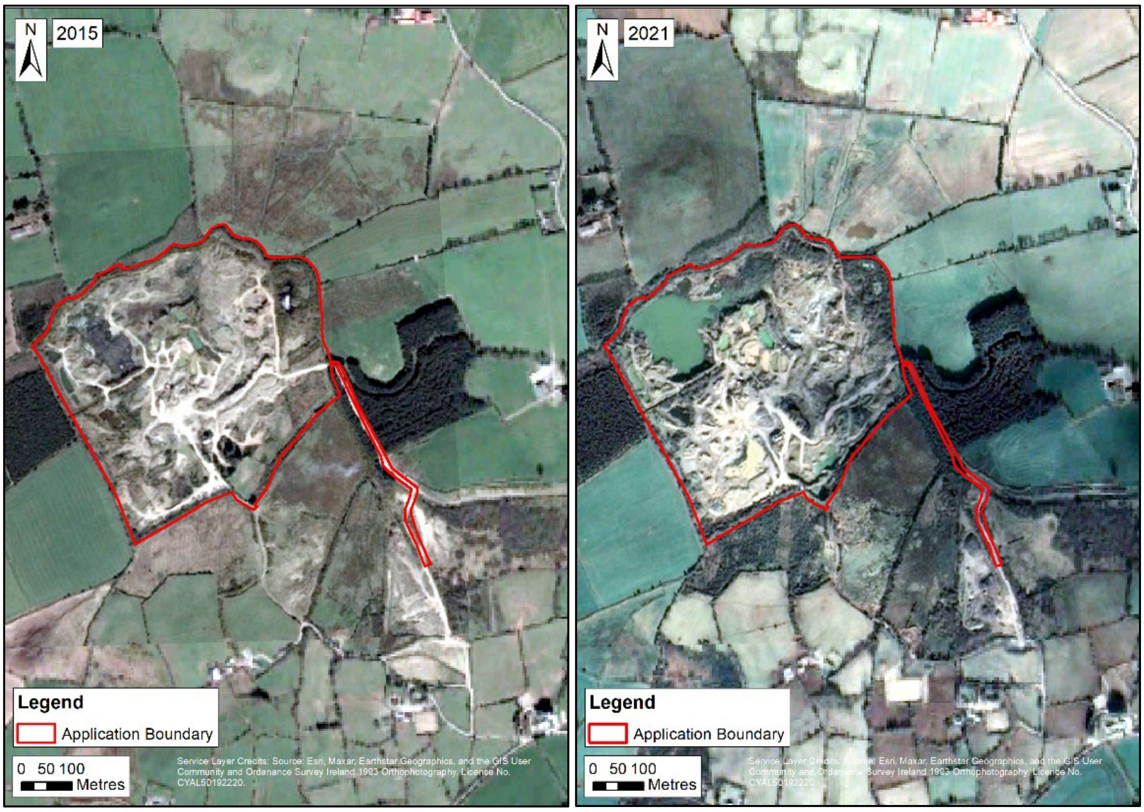
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community and Ordnance Survey Ireland 1993 Orthophotography. Licence No. CYAL50192220.

Figure 6-3: Aerial Photos of the Site in 2000 and 2004

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community and Ordnance Survey Ireland 1993 Orthophotography. Licence No. CYAL50192220.

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community and Ordnance Survey Ireland 1993 Orthophotography. Licence No. CYAL50192220.

Figure 6-4: Aerial Photos of the Site in 2009 and 2011



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Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community and Ordanance Survey Ireland 1993 Orthophotography. Licence No. CYAL50192220.

Figure 6-5: Aerial Photos of the Site in 2015 and 2021

6.4.2 Site Topography

The Site is situated in a low-lying area at ca. 125 mOD of the local undulating landscape bound in the north, south and east by topographic highs. To the north a topographic high reaches ca. 183 mOD, to the south ca. 210 and to the east ca. 217. These peaks form a topographical divide.

The baseline topography at 1990 is presented in Substitute Consent Planning Application Drawing 02 – Baseline Conditions. The landform at this time was a hillside with the central site area sitting at an elevation of ca. 130 mOD and a maximum elevation of ca. 132 mOD to the southwest of the site area. The ground elevation can be seen to slope away from the raised central area towards to natural watercourses and field drains located along the perimeters of the site (minimum elevation ca. 119 mOD).

The topography in 2022 is presented in Substitute Consent Planning Application Drawing 03 - Existing Conditions. The current landform at the site has been heavily altered by extraction and has an average working depth of 114 mOD. In general, the topography at the Site is higher in the south, peaking at ca. 128 mOD along the southern boundary. Within the areas of extraction, the ground is observed to slope from the southern areas towards the northeast corner and then towards the lowest elevation excavated area in the northwest corner (ca.111 mOD). Elevations along the west, north and eastern perimeters are unchanged and still slope towards the perimeter streams and drains (minimum elevation remains ca. 119 mOD).

6.4.3 Site Layout, Water Requirements and Management

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

- Along with haul roads and areas of stockpiling, the Site, over the period of this assessment, comprised the following main types of area:

  - Administration areas – largely concentrated in southern part of the Site – comprising car parking, office buildings (with canteen and toilet), septic tank, workshop/machinery shed, tool shed, storage containers and bunded diesel tanks on concrete slabs, well and pumphouse.
  - A central mineral processing area – comprising washing and screening plant with associated stockpiles, electrical control room, storage container, a diesel generator container and electrical substation.
  - The excavation area(s) – comprising the working area(s) at any point in time.
  - Water and overburden management areas – comprising temporary silt storage area and settlement ponds adjacent to the processing plant.
- At baseline, in 1990 the extraction area has been determined to extend to ca. 0.75 ha. and had an average working depth of 124 mOD. The extraction area expanded initially in a westerly and northerly direction up to 2000, then lateral expansion occurred in all directions between 2000 and 2009.
- In 2022, the extraction area is shown to have expanded laterally to ca. 20.16 ha. with an average working depth of ca. 114 mOD.
- The surrounding local landscape, both currently (2022) and at baseline (1990) is drained to the northwest by a series of interconnected streams and field drains.
- The extraction of sand and gravel is currently (2022), taking place to the east and northeast of the plantsite and is reported by ECT to not yet encountered the water-table. Historically limited extraction took place below the water-table, but this ceased in 2008, with the resulting waterbody located to the northwest of the plantsite.
- Dewatering was required where extraction took place below the water table (predominantly pre-2008). The Applicant notes that groundwater was generally encountered at the interface between bedrock and the sand and gravel deposits. This was observed to be ca. 114 mOD within the northeastern area of the Site and at elevations below 114 mOD as excavations moved towards the northwest.
- Encountered groundwater was pumped from the northwest waterbody to a series of gravity-fed settlement ponds prior to discharge via a stone soakaway to the stream located along the northern site boundary (see Figure 6-6. When actively pumping, discharge rates to the stream of 36 l/s were estimated by WYG (2009).
- Limited dewatering of the northwest waterbody has occurred since 2008. The Applicant notes that the waterbody is pumped intermittently to maintain water levels below the elevation of the pumping station (ca. 113m). No records for water abstraction or discharge rates in 2022 are available.
- A toilet and associated septic tank exists on-site in 2022 with a sufficient capacity to cater for the PE equivalent of average 30 persons arising from; full time site employees, contractors and additional visitors.
- There is an abstraction well (DW1) within a pumphouse located adjacent to the administration area. Water from the well has been used to provide potable water and to service on-site welfare facilities since at least 2008.
- Water for the washing of aggregate is sourced from the on-site waterbody,and is recycled through a closed-loop system via a series of silt ponds which are periodically emptied. Once dried, the silt from the ponds is used in the restoration in the south-east of the Site. This closed-loop system has been in place in the current (2022) location since approximately 2003 when aggregate washing commenced.
- A wheelwash was installed along the current access road in 2016 and is a concrete basin and grate design. Wash water is contained within the basin and topped up with clean water where required.

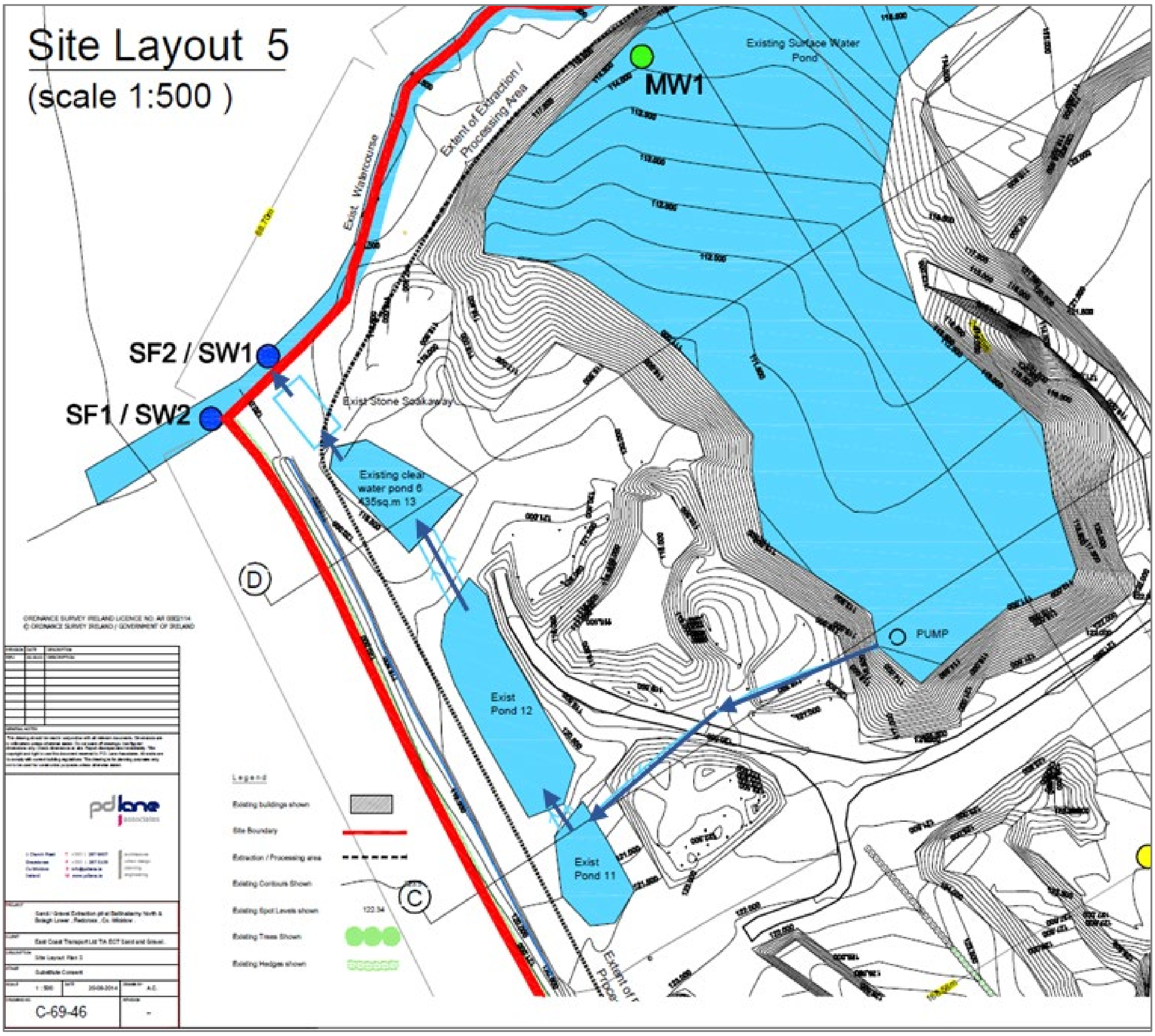

Figure 6-6: Route for Discharge of Quarry Water to Stream (after PD Lane, 2015)

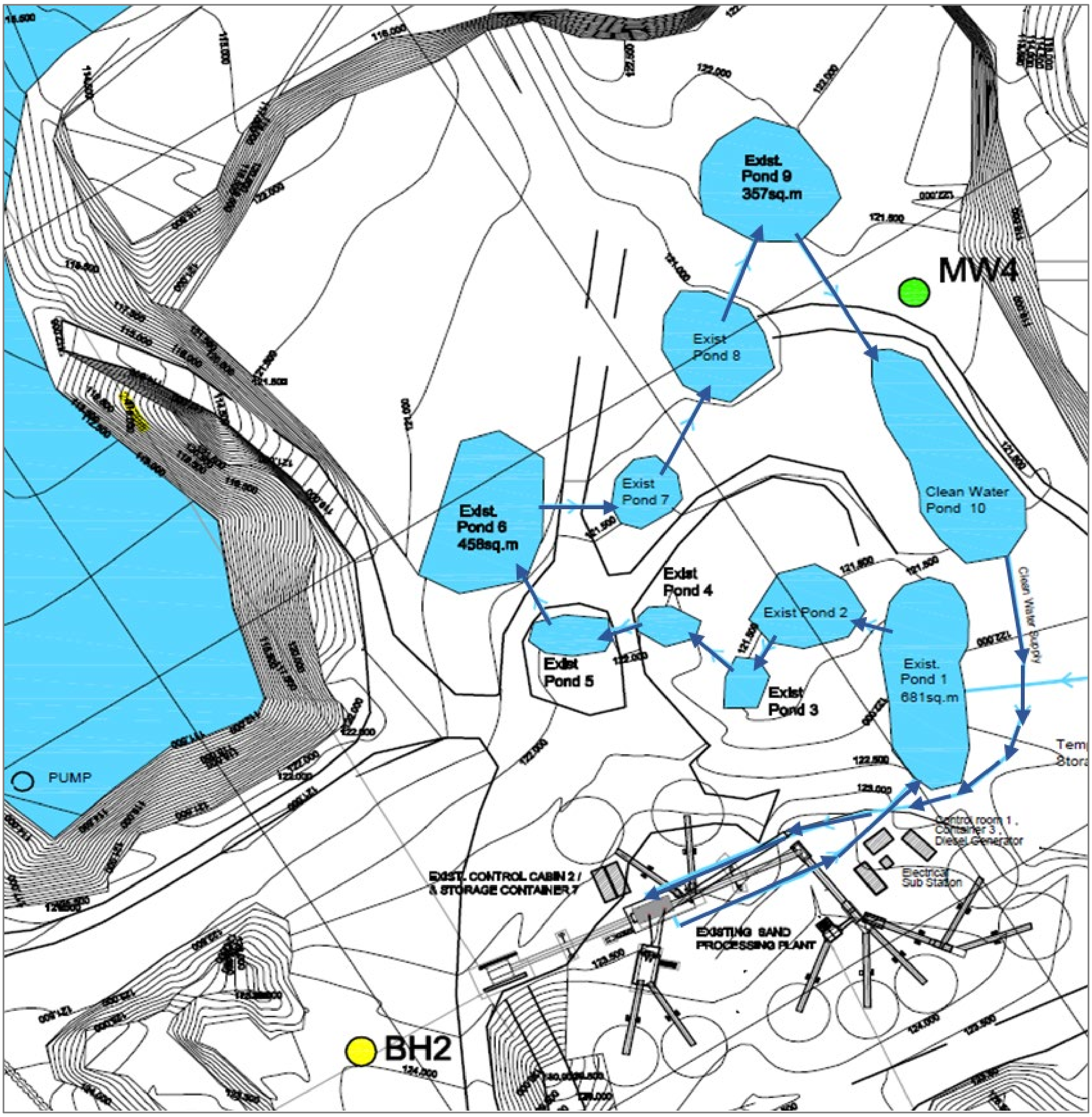

Figure 6-7: Closed-Loop System of Settlement Ponds for Washing Plant (after PD Lane, 2015)

6.4.4 Geology

The geology of the Site is presented in detail in Chapter 5.0 of this EIAR (Land, Soils and Geology).

6.4.4.1 Quaternary Deposits

According to GSI records (GSI, 2022), there are three principal Quaternary age deposits found at the Site:

- Sandstone and shale derived sands and gravel (Lower Paleozoic) (GLPSsS);
- Sandstone and shale derived Till (Lower Paleozoic) (TLPSsS); and
- Alluvium undifferentiated (A)

Lake sediments undifferentiated (L) are found beyond the Site boundary in the local area. The thickness of the gravels vary across the Site reaching thicknesses up to 12 m (WYG, 2009).

A map of the quaternary deposits is presented as Figure 6-8.

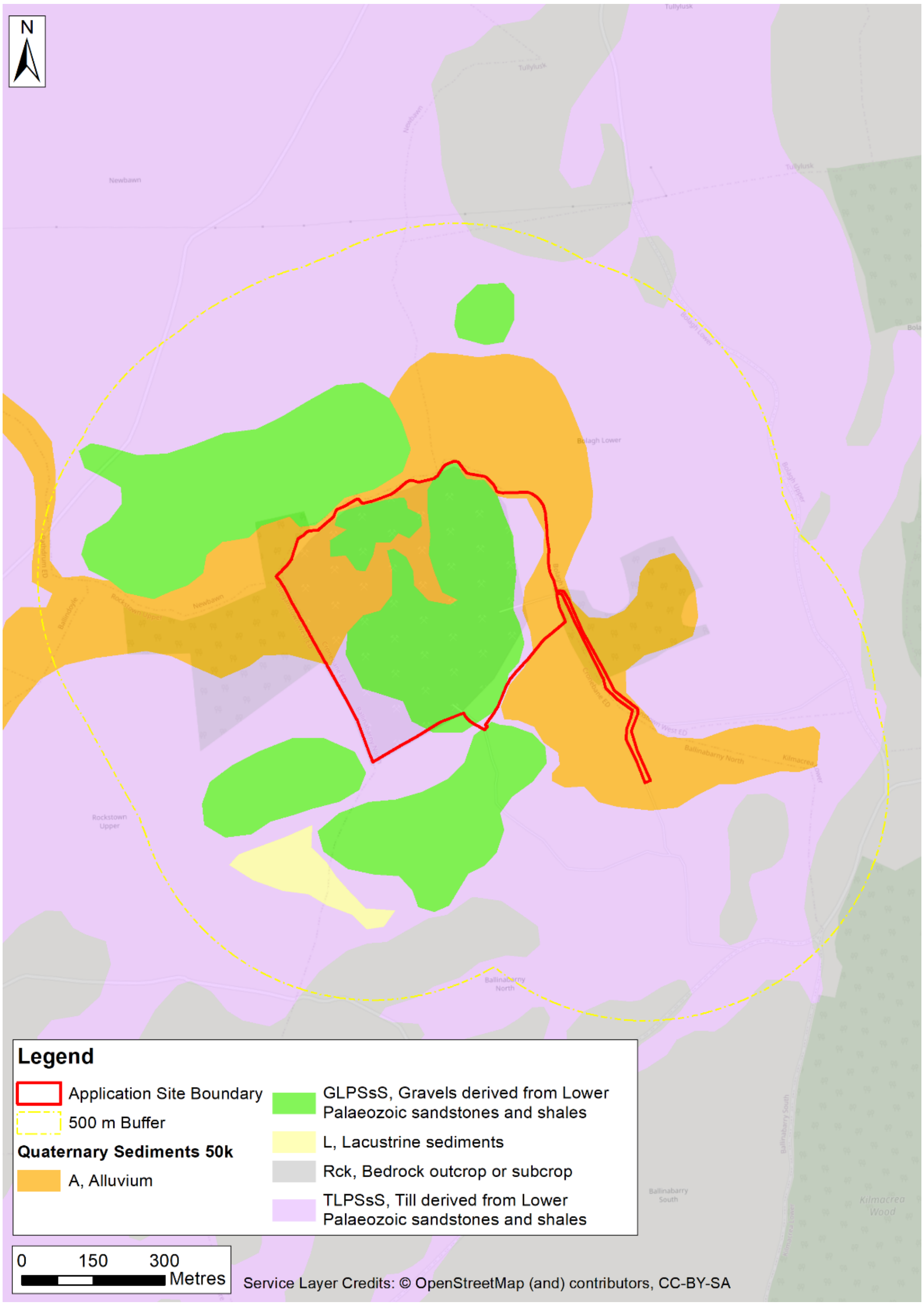

Figure 6-8: Superficial Geology (after GSI, 2022)

6.4.4.2 Bedrock

GSI records (GSI, 2022) show that the bedrock geology underlying the Site is dominated by rocks in the Kilmacrea Formation which consist of an Ordovician dark grey Slate with minor pale Sandstones (Figure 6-9).

During a site walkover (PD Lane Associates, 2015) coarse grained Diorite bedrock was observed at a small number of locations.

Avoca Formation, Maulin Formation and Oaklands Formation as well as Dolerite and Diorite are found in the surrounding region. The area is heavily faulted with faults following a general north to south (and north-northwest to south-southwest) structural trend (PD Lane Associates, 2015).

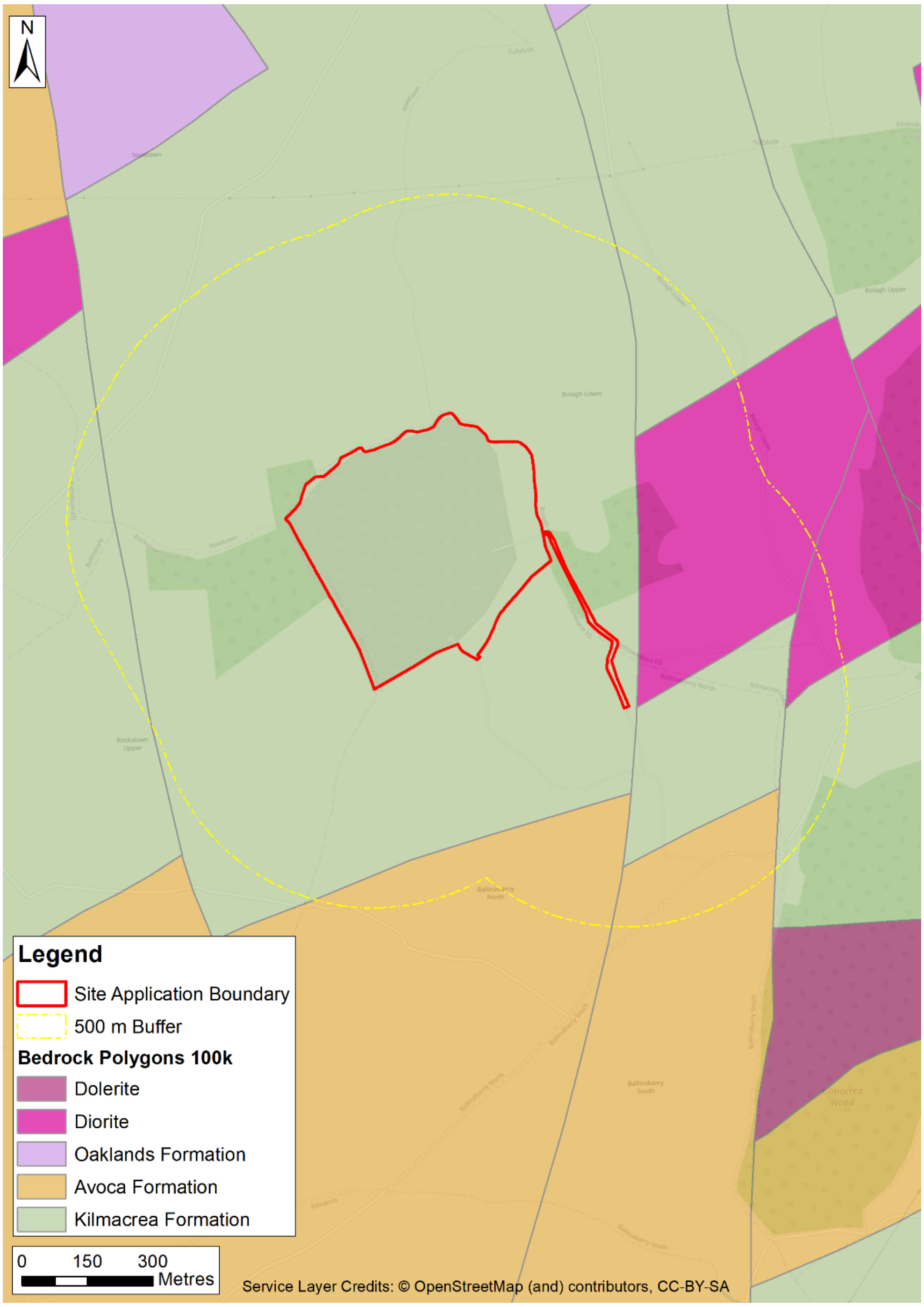

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Figure 6-9: Bedrock Geology 1:100,000 (after GSI, 2022)

6.4.5 Surface Water – Hydrology

6.4.5.1 Rainfall and Climate Data

Table 6-5 presents rainfall data recorded at the Kilbride (Togher) meteorological station (number 4024) which is located approximately 6 km to the southeast of the Site, for the period 2005-2021 (Met Eireann, 2022). The station began operation in August 2004 therefore no data is available prior to this.

The rainfall recorded at the Kilbride (Togher) meteorological station consistently fluctuates through the dataset period, with a calculated average of 1,000.85 millimetre per annum (mm/a) and a range of 748.2 (2011) to 1,312.2 (2009) mm/a. There is no increasing or decreasing trend in rainfall over the dataset period.

Evaporation or evapotranspiration data is not available at Kilbride (Togher) meteorological station. The closest station which records evaporation or evapotranspiration data is located at the Oak Park station, near Carlow (approx. 50km west of the site and therefore not appropriate for use at this site).

GSI mapping (2022) indicates an effective rainfall (rainfall minus actual evapotranspiration) of approximately 752 – 778 mm/year across the Site footprint and the surrounding areas.

Table 6-5: Yearly Rainfall Data for Kilbride (Togher) Station no 4024 (Met Eireann, 2022)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rainfall (mm/a)	900.30	985.20	823.00	1050.70	1312.20	940.50	748.20	1104.90	951.60
Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	
Rainfall (mm/a)	1294.70	1124.70	822.80	865.10	1002.30	1035.90	1074.00	978.40	

6.4.5.2 Local Surface Water Flows

On-Site Surface Water

Surface water features on-site include a pit lake waterbody formed in the northwest excavated area and a series of settlement ponds located directly west of the pit lake. The pit lake occupies an area previously used for sand and gravel extraction below the water table, it marks the lowest point in the quarry at ca. 111 mOD. The waterbody now provides a series of diverse habitats, as well as supplies water for use on-site (see Section 6.4.3). The washing of aggregate is recycled through a closed-loop system via associated silt ponds which are periodically topped up with water from the quarry pond.

Surface water on the site predominantly infiltrates to ground or drains towards the northwest waterbody. There are noted to be small and localised areas of surface water pooling that form in localised depressions around the Site.

The Site is bounded on all sides by either the Newbawn stream or field drains (Figure 6-10), both of which drain to the northwest and are predominantly fed by rainfall runoff from higher topographical areas. The field drains are reported by the applicant to be predominantly dry. The Newbawn stream starts approximately 750m upstream of entering the Site with a small catchment area fed by springs and surface water runoff.

The groundwater investigation conducted by WYG (2009) concluded that onsite dewatering directly impacts the adjacent Newbawn stream. During Phase 1 (northern area), Phase 2 (along the western boundary) and Phase 4 (along the southern boundary) reduction in flow in the stream is expected prior to quarry discharge. This was observed during Phase 1 where total discharge from the quarry to the river was estimated as 36 l/s. During Phase 3 (eastern boundary) a further reduction in flow is expected during dewatering, estimated to represent 25% of total stream flow.

Figure 6-10: Approximate Location of Newbawn Stream (Blue Arrows) & Field Drains (Grey Dashed Line)

Flow measurements of the Newbawn stream were obtained in 2008 (WYG, 2009) and 2016 (AWN, 2016) and were again recorded by Golder in June and July 2022.

WYG (WYG, 2009) reported that in 2008:

- Four measurements were taken along the stretch of the Newbawn stream running adjacent to the northern site boundary;
- Flow in the north-east was observed to reduce from 128 litres per second (l/s) to 67 l/s towards the central stretch of the stream;
- Flow rates increased further west along the boundary, increasing to 112 l/s immediately upstream of the discharge point; and
- Flow rates immediately downstream of the discharge point increased to 148 l/s, inferring a discharge rate of 36 l/s from the site.

AWN (2016) monitored flows in the Newbawn along the eastern and northern boundary of the site during February 2016 (locations SW1 to SW4 in Figure 6-11):

- Flows increased from 54 l/s at the most upgradient, south-eastern location (SW4) to 72 l/s at the north-eastern monitoring point (SW3).
- Flows were observed to have increased to 106 l/s immediately upgradient of the site discharge point (SW1) and increased again to 138 l/s immediately downgradient of the discharge point (SW2).

- Flow rates are generally noted to be slightly lower than those reported for 2008, although this could be attributable to seasonal variation or differences in weather at the time of monitoring. It is noted that the catchment area upstream of the site is small and the flow rates are likely heavily influenced by the weather and seasonality.
- The AWN report found that there was no loss of flow along the section of Newbawn stream that circumnavigates the Site. As the central area of the northern boundary was not monitored in 2016, it is not clear whether a reduction in flows were occurring along this stretch, as seen in 2008. It is noted however that dewatering at the site reduced after the working area was no longer located below the water table.

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Figure 6-11: 2016 Water Monitoring Locations (AWN Consulting Limited, 2016)
Note: some surface water locations were monitored for flows and/or quality in 2008, 2021 and 2022.

Recent flow monitoring was carried out by Golder in June and July 2022, with monitoring locations presented in Figure 6-12. Monitoring was carried out at five locations during a Site walkover in June 2022: SW1A (located approximately 50 m upstream of SW1 shown in Figure 6-11), SW2, SW3 and SW4 (as shown in Figure 6-11) and SW4A (located approximately 10 m downstream of SW4 shown in Figure 6-11). Monitoring was carried out at seven locations in July 2022: SW1A, SW2, SW3, SW4, SW4B (located approximately 50 m upgradient of SW4 shown in Figure 6-11), SW5 and SW6 (SW5 and SW6 are both located along the northern boundary of the site).

The full results of the flow monitoring are presented in Appendix 6-2 and photographs of the June 2022 walkover are provided in Figure 6-13. The key observations of the 2022 flow monitoring are summarised as follows:

- As noted in previous monitoring rounds, flows in the Newbawn stream in June 2022 are observed to decrease along the eastern boundary (from 9.0 l/s at SW4 to 3.3 l/s at SW3) before increasing along the northern boundary (18.6 l/s at SW1A) and increasing again downgradient of the Site discharge point (23.5 l/s at SW2).
- Flow rates in July 2022 were generally observed to be similar or marginally lower than those observed in June 2022. However, the flow rates at SW1A and SW2 were higher in July 2022 (26.2 l/s and 73.7 l/s respectively) than in June 2022 (18.6 l/s and 23.5 l/s respectively). These differences may be attributable to differing discharge patterns from the Site or other off-site recharges to the stream.

- Flow rates in 2022 are observed to be lower when compared to 2016 data, although it is noted that this is applicable to both upstream and downstream flow measurements.
- It is noted that the 2016 measurements were taken in February (i.e. wet season) whilst the 2022 measurements were taken in June and July (i.e. dry season) and therefore the differences in flow rates could also be attributable to seasonal variability over a small catchment area.
- It is also noted that surface water flows across the south-east of the country are reported to be falling during 2022, with 58% of monitoring stations observing “below-normal” or “particularly low” flows during May 2022 (EPA, 2022a). No rainfall was noted immediately before or during the 2022 monitoring visits.
- Further monitoring is required to confirm current (2022) flow conditions during both wet and dry seasons. Monthly flow monitoring is scheduled from June 2022 to May 2023 to confirm.

The stream was also noted to be flowing when surface water quality samples were taken in 2020 and 2021, although flow measurements were not recorded for all sampling rounds.

Figure 6-12: June and July 2022 – Surface Water Flow and/or Quality Monitoring Locations

	
General stream conditions.	*Section along northwest of the quarry.*
	
Discharge point from quarry.	*Upgradient to the quarry.*

After the discharge point, downgradient to the quarry. Stream starts to slowly dip in elevation westwards.

Figure 6-13: Photographs of Flows in the Newbawn Stream in June 2022.

Local Surface Water Features

The Site is located within the Ovoca-Vartry catchment which forms part of the Easter River Basin District. The river network in the area surrounding the Site is shown in Figure 6-14.

The Newbawn runs along the eastern and northern boundary of the Site. The Newbawn flows westwards ca. 3.75 km until it joins the River Avonmore. The Avonmore then flows ca. 3.5 km directly south where it joins the Avonbeg, forming the Avoca which flows ca. 15 km southeast until reaching the Irish Sea.

Prior to reaching the Avonmore, the Newbawn is fed by the north-easterly flowing Timullin tributary located ca. 0.5 from the Site. It is later fed by the southerly flowing Cunniamstown Little, Balleese Upper and Mountlusk tributaries, located ca. 0.5, 1.45, 1.9 and 2 km respectively from the Site.

Based on the available data and mapping, it is thought that flow directions in the local river network are likely to have remained largely unchanged since 1990.

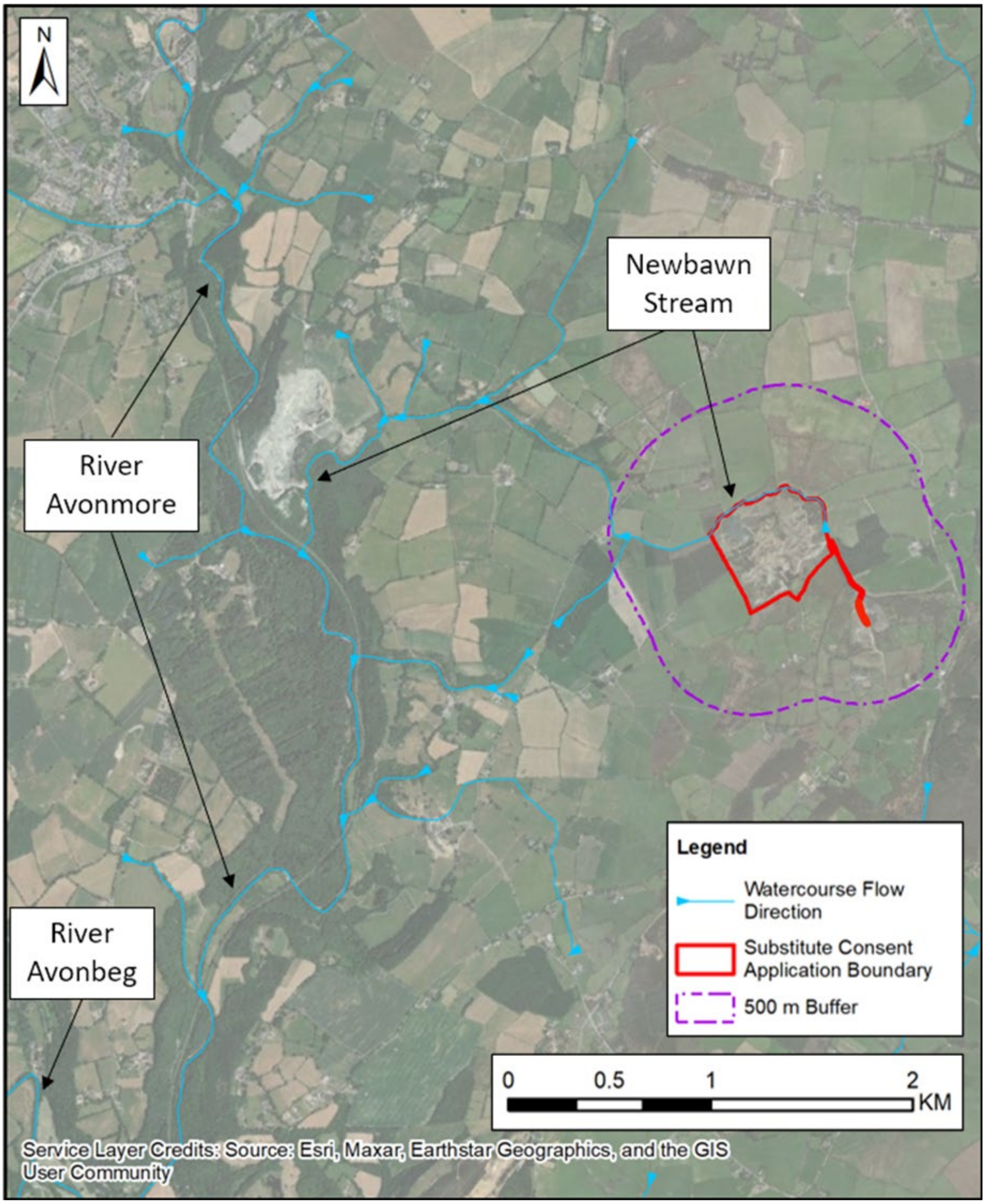


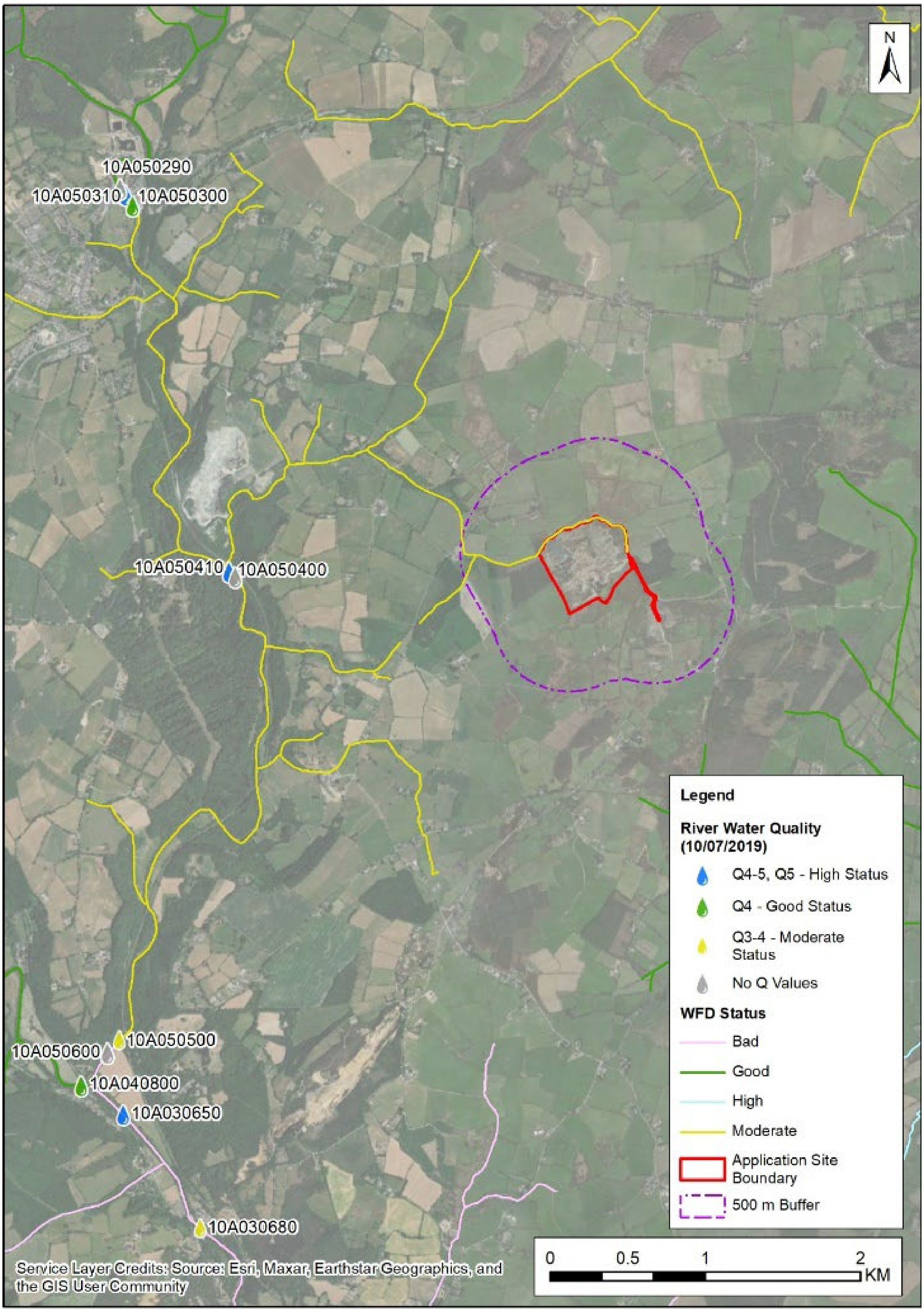
Figure 6-14: Local River Network and Flow Directions in the Vicinity of the Site (after GSI, 2022)

6.4.5.3 Local Surface Water Quality

The local surface water quality through the review period has been derived using a combination of publicly available data, historic monitoring records requested from the EPA and Site-specific monitoring carried out at select locations through the review period.

Publicly Available Information - EPA

The WFD Status and River Quality (Q) values of each of the rivers, as assigned by the EPA, are shown spatially in Figure 6-15 and summarised in Table 6-6 and Table 6-7.



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 6-15: Local River WFD Designations, EPA River Quality Values, EPA Monitoring Stations (after EPA, 2022b)

Table 6-6: Summary of WFD Status in Surface Water Features Close to the Site (EPA, 2022b)

European Code	Name	Data Type	WFD Status
IE_EA_10A050300	AVONMORE_060 (far upgradient of site)	River Waterbody WFD Status 2013-2018	Good
		River Water Quality Status: 2010-2012	Good
IE_EA_10A050500	AVONMORE_070 (both upgradient and immediately downgradient of site)	River Waterbody WFD Status 2013-2018	Moderate
		River Water Quality Status: 2010-2012	Good
IE_EA_10A030700	AVOCA_010 (far downgradient of site)	River Waterbody WFD Status 2013-2018	Bad
		River Water Quality Status: 2010-2012	Poor
IE_EA_10A040800	AVONBEG_040 (not hydraulically connected to site; merges with the Avonmore)	River Waterbody WFD Status 2013-2018	Good
		River Water Quality Status: 2010-2012	Good

Table 6-7: Summary of River Q Value in Surface Water Features Close to the Site (EPA, 2022b)

Station ID	Station Name	Data Type	River Q Value	Q Value Status
RS10A050300	Avonmore_060 - Rathdrum Bridge	River Q Value (2020)	4 – 5	High
RS10A050310	Avonmore_060 - Rathdrum Bridge (RHS)	River Q Value (2009)	4	Good
RS10A050400	Avonmore_070 - 3km d/s Rathdrum	River Q Value (1985)	5	High
RS10A050500	Avonmore_070 - Lion's Bridge	River Q Value (2020)	4	Good
RS10A030650	Avoca_010 - 0.1km d/s Avonbeg R confl	River Q Value (1986)	5	High
RS10A030680	Avoca_010 - 1km d/s Avonbeg R confl	River Q Value (2003)	3 – 4	Moderate
RS10A040800	Avonbeg_040 - Meetings Bridge	River Q Value (2020)	4	Good

WFD status of the Avonmore is classified as ‘high’ upstream of the Site, northwards of Rathdrum (‘Avonmore_060’). The stretch of the Avonmore from Rathdrum to the Avoca (‘Avonmore_070’) is classified as ‘moderate’. This includes the tributaries of the Newbawn, Timullin, Kingston, Cunniamstown Little, Balleese Upper and Mountlusk streams. The site is located within the local catchment of the Newbawn and therefore the wider WFD catchment of the ‘Avonmore_070’. The downstream Avoca is classified as ‘bad/poor’, demonstrating the WFD status progressively deteriorates downstream. Where the Avonmore meets the Avoca it is noted as a Historically Polluted Site (EPA, 2022b).

Stations in the vicinity of the Site demonstrate ‘good’ to ‘high’ Q value status. At the nearest monitoring station to the Site (Avonmore Station RS10A050400) the river Q value was last measured in 1985 as 5 (‘high’). Upstream at Avonmore Station RS10A050300 and RS10A050310 the Q values were measured as 4 (‘good’) and 4 – 5 (‘high’) in 2020 and 2009, respectively. Downstream at Avonmore Station RS10A050500 a Q value of 4 (‘good’) was measured in 2020. At the beginning of the Avoca a Q value of 5 (‘high’) was observed in 1986 at Station RS10A030650 and a Q value of 3-4 (‘moderate’) was observed 1 km downstream of the start of the Avoca at Station RS10A030680 in 2003.

EPA surface water quality monitoring data from 1995 to 2021 is available from a number of monitoring station for the River Avonmore and Avoca (Table 6-7). The EPA dataset includes a range of parameters for assessing the surface water quality, including: biological oxygen demand (BOD), conductivity, chloride, dissolved oxygen, nitrates, nitrites, ortho-phosphate, pH, temperature, total hardness, alkalinity, total phosphorus, suspended solids, total oxidised nitrogen (TON), total ammonium, ammonia, beryllium, boron, aluminium, potassium, calcium, vanadium, chromium, iron, manganese, nickel, cobalt, copper, zinc, arsenic, selenium, molybdenum, silver, cadmium, tin, antimony, barium, thallium, lead, thorium and uranium. A number of chlorinated solvents, pesticides and polycyclic aromatic hydrocarbons (PAH) were also analysed for within waters of the Avonbeg (Station 10A040800) but are unavailable for the Avonmore. A tabulated and graphical summary of detected determinands are presented in Appendix 6.1.

Based on the EPA dataset the following observations are made:

- Alkalinity as $CaCO_3$ concentrations were generally consistent from 1995 to 2015 with elevated levels found for Monitoring Station 10A050500 (1995, 2003 and 2006). From 2015 to 2022 alkalinity levels have remained consistently lower.
- Ammonia concentrations at all monitoring stations appeared to decline from 1995 to 2009, then gradually increase from 2009 to 2021.
- BOD concentrations at all monitoring stations showed very little variability from 1995 to 2021.
- Chloride concentrations at all monitoring stations have generally decreased from 1995 to 2022.
- Conductivity in the samples has remained relatively consistent at all monitoring stations from 1995 to 2022.
- Dissolved Oxygen levels have generally increased from 1995 to 2022 at all monitoring stations. From 2016 to 2022 concentrations have increased significantly at Monitoring Station 10A040800.
- Nitrate concentrations have been recorded from 1995 to 2000 and 2016 to 2022 (no data is available from 2000 to 2016). Concentrations at all monitoring stations show a slight decrease over the monitoring period.
- Nitrite concentrations at all monitoring stations showed very little variability from 1995 to 2021. Anomalous elevated levels were recorded at Monitoring Station 10A040800 and 10A050400 in 2006.
- Ortho-Phosphate concentrations have spiked at several monitoring stations throughout the monitoring period 1998 to 2021. The elevated readings are shown to drop back to normal on all occasions.
- pH levels at all monitoring stations are generally consistent ranging from 5.6 to 7.2.
- Recorded temperature at all monitoring stations is generally consistent ranging from 9.06°C to 15°C. An outlier exist at Monitoring Station 10A050500 (20.2°C in 1995).

- Total Oxidised Nitrogen has shown a generally decreasing trend across all monitoring stations from 2005 to 2022. The data ranges from 0.49 mg/l to 1.56 mg/l.
- Hydrocarbons were not analysed for at the monitoring stations of interest along the Avonmore_070.
- A single faecal coliform sample was taken from the monitoring stations of interest along the Avonmore_070. The sample taken in August 2019 reported the presence of no coliforms (0 no./100ml).

2008 – 2017 Surface Water Quality Investigations

In February 2008, the quarry discharge point off site, as well as two monitoring points (approx. 25m apart) upstream and downstream of the discharge point (SW1 and SW2 respectively, see Figure 6-11), were sampled for a number of parameters. The results were summarised by PD Lane (2015) and are presented in Table 6-8 below. The results for suspended solids were interpreted by PD Lane (2015) to indicate that the quarry discharge to the Newbawn stream has undergone adequate settlement prior to discharge to the receiving stream.

Table 6-8: Summary of Discharge and Surface Water Samples in February 2008 (from PD Lane, 2015)

Sampling point	Discharge to Stream point	Upstream of Discharge (SW1)	Downstream of Discharge (SW2)	Drinking water Standards	Surface water threshold values
Date	20/02/2008	20/02/2008	20/02/2008	2007	2009
Ammoniacal Nitrogen (mg/l)	<0.08	<0.08	<0.08	0.3	-
Nitrate (mg/l)	13	14	15	50	-
Suspended Solids (mg/l)	2	10	18	-	-
B.O.D. (mg/l)	2	<2	<2	-	-
Oils, Fat & Greases	<2	<2	<2	-	-

In March 2008 further analysis of surface water samples was conducted at monitoring locations SW1 and SW2 (see Figure 6-11), downgradient of the quarry (PD Lane Associates, 2015). The suite analysed included coliforms, metals, hydrocarbons and major ions among others. In both samples orthophosphate as PO4 was found to be marginally in exceedance of the drinking water standard (0.03 mg/l) with a value of 0.05 mg/l. The results also indicated the level of dissolved manganese in SW2 (55 µg/l) was slightly in exceedance of the drinking water standard at 50 µg/l. There were no further exceedances of guideline values in either sample and, hydrocarbons were not reported above the limit of detection.

As part of previous investigations at the quarry Site, surface water monitoring was carried out in 2016 and 2017 (AWN Consulting Limited, 2016, 2017) on the nearby waterbodies. These water quality assessments were carried out to assess the quality of the surface waters within the vicinity of the quarry Site as part of a proposed planning/Substitute Consent application.

The results of the surface water sampling were compared by AWN Consulting Limited against guideline values from the European Communities Environmental Objectives (Surface Waters) Regulations S.I. 272 of 2009. In addition, the Salmonid Water Regulations S.I. 293 of 1988 were used for comparison.

From the 2016 investigation, the water quality was found to be good, with generally low levels of inorganics and metals. Microbiological faecal coliform levels were found to be slightly elevated in upstream location SW4; AWN interpreted this to possibly be due to the proximity of agricultural lands in the vicinity.

Exceedances of the Surface Water Regulations were recorded by AWN on 13/03/2016 for copper at downstream monitoring locations. Concentrations of 0.11 mg/l in SW1 and 0.14 mg/l in SW2 (Figure 6-11) were found, exceeding the regulation value of 0.005 where hardness ≤100 mg/l CaCO$_3$ or 0.03 where hardness >100 mg/l CaCO$_3$. Copper concentrations appear to have reduced since, with all samples recorded in 2020-2021 at less than the limit of detection (<0.007 mg/l).

Surface water quality testing in 2017 was limited, completed for TSS and Mineral Oil only. Hydrocarbons were not reported above the LOD in either of the two sample locations (SW1 and SW2, Figure 6-16).

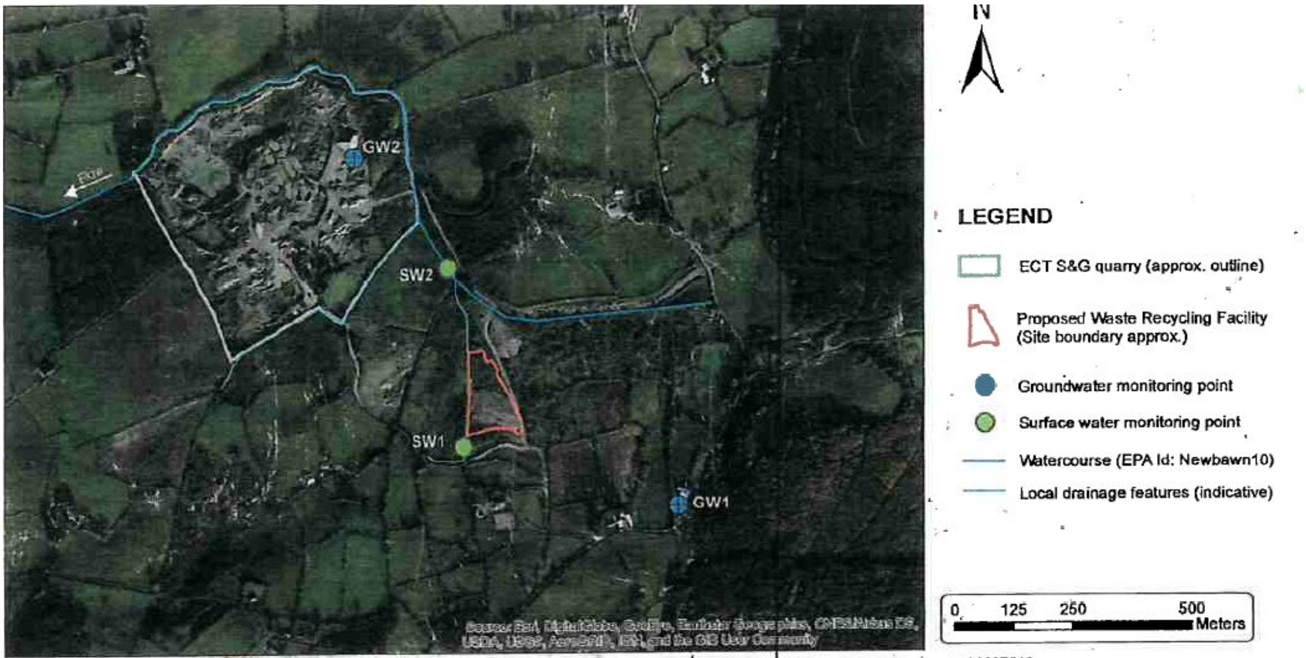


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Figure 6-16: 2017 Water Monitoring Locations (AWN Consulting Limited, 2017)

2020 – 2022 Surface Water Quality Investigations

In September 2020 surface water samples were taken by Golder in support of an application at the adjacent waste recycling facility. Samples were taken from the following locations shown on Figure 6-17:

- SW1 – upgradient;
- SW2 – upgradient; and
- SW3 – downgradient.

In July 2021 surface water samples were taken by Golder from the following locations shown on Figure 6-11:

- SW2 – downgradient;
- SW3 – cross-gradient; and
- SW4 – upgradient.

In July 2022 surface water samples were taken by Golder from the following locations shown on Figure 6-12:

- SW1A[2] – downgradient
- SW2 – downgradient
- SW3 – cross-gradient
- SW4 – upgradient
- SW10 – upgradient

Figure 6-17: 2020 Surface Water Monitoring Locations

Note: red line boundary not applicable to this substitute consent application.

Each sample was tested at UKAS accredited Element Materials Technology laboratory for the following parameters:

- Dissolved metals: Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Copper, Iron (2022 only), Lead, Magnesium, Manganese (2022 only), Mercury, Nickel, Potassium, Selenium, Sodium, Vanadium and Zinc;
- GRO (>C4-C8), GRO (>C8-C12), GRO (>C4-C12), MTBE, Benzene, Toluene, Ethylbenzene, m/p Xylene, o-Xylene;
- Extractable Petroleum hydrocarbons (C8-C40);

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[2] SW1A referred to as SW1 in the laboratory results recorded on 08/07/2022.

- Sulphate as SO4, Chloride, Nitrate as NO3, Nitrate as NO2, Ortho Phosphate as PO4, Nitrate as N, Nitrite as N, Ortho Phosphate as P;
- Ammoniacal Nitrogen as N, Ammoniacal Nitrogen as NH4, Hexavalent Chromium, Total Dissolved Chromium III;
- Total Alkalinity as CaCO3;
- COD (Settled); and
- Total Suspended Solids.

In addition to the above, the July 2022 samples were tested at INAB accredited City Analysts Limited laboratory for the following microbiological parameters:

- *Clostridium perfringens*;
- Coliforms;
- *Escherichia coli*;
- *Enterococci*;
- TVC at 22°C; and
- TVC at 37°C.

The results of the surface water quality analysis at the Site are presented in Appendix 6.2 and compared with the Environmental Quality Standards (EQS) for inland surface waters, as outlined in the European Communities Environmental Objectives (Surface Water) Regulations S.I. No.272/2009 including amendment S.I. No.386/2015 and, European Communities (Quality of Salmonid Waters) Regulations 1988 (SI 293 of 1988)[3].

The maximum allowable concentration (MAC) for inland water EQS values have been applied as more than two samples would be required to establish an average (AA) concentration for comparison against the AA EQS values. Where a screening value does not exist the UK EQS were applied (Freshwaters specific pollutants and operational EQS and Freshwaters priority hazardous substances, priority substances and other pollutants[4]). Full screening results are presented as Appendix 6.2. The laboratory certificates for the results are included in Appendix 6.3.

Surface water is generally shown to be of good quality from 2020 – 2022 with only a few exceedances of the standard values during the 2020 and 2022 monitoring period. Orthophosphate, copper and hydrocarbons were all observed to be less than the limit of detection in the 2020-2022 surface water samples, showing an improvement on the previous monitoring in 2008 and 2016.

Exceedances of the European Communities (Quality of Salmonid Waters) Regulations 1988 in the surface water quality from 2022 were recorded on 08/07/2022 for nitrite (threshold value 0.05 mg/l) in surface monitoring points SW1A (0.07 mg/l) and SW3 (0.07 mg/l) and for total suspended solids (threshold value 25 mg/l) in SW1A (36 mg/l) and SW2 (29 mg/l). In addition to the above exceedances, it should be noted that the limit of detection

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[3] Provided for comparative purposes only. The site-adjacent Newbawn stream and downstream Avonmore and Avoca rivers are not classed as salmonid waters within S.I. No. 293/1988. The closest salmonid waters identified within the regulations are the Rivers Slaney and Vartry, both of which are not in hydraulic connectivity with the site.

[4] www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit#screening-tests-freshwaters, accessed in April 2022, last updated in February 2022.

for dissolved mercury (0.1 µg/l) exceeds the MAC EQS of 0.07 µg/l, however dissolved mercury was found to be less than the limit of detection in all of the samples.

Nitrite in the Newbawn stream is considered unlikely to derive from activities at the Site, but rather from off-site agricultural activities. Similarly, given the lack of earthworks activity in the vicinity of SW1A and SW2 during July 2022 (working areas were located in the east and southern areas of the site at the time of sampling), the source of the suspended solids is thought to be derived from off-site sources.

It is noted that the stretch of the Newbawn stream located adjacent to the Site boundary is located relatively close to the source of the watercourse and therefore has a relatively small catchment area for runoff and baseflow contribution. This stretch of the stream may be susceptible to elevated concentrations during times of lower summer (dry season) flows due to a lower dilution potential. The stretch of the Newbawn stream which is reported (An Bord Pleanala, 2015) to host salmon and trout populations is located approximately 2 km downstream of the site boundary (see Section 6.4.7) and therefore is likely to receive significant additional runoff and baseflow (i.e. potential for dilution) from larger catchment areas downstream of the Site. Marginal exceedances of the salmonid water criteria (SI 293 of 1988) in these upstream locations are therefore unlikely to cause significant degradation of water quality in the downstream watercourse.

In addition to the water chemistry analysis, five locations were analysed for microbiological parameters in July 2022. *Clostridium perfringens, Escherichia coli, Enterococci*, coliforms, TVC at 22ºC and TVC at 37ºC were all present in both upstream and downstream locations. Concentrations of the microbiological parameters were lower in SW10 (located approximately 250 m upgradient of the Site boundary) when compared to the other locations. However, higher concentrations of microbiological parameters were also recorded in SW4 than in SW10, a location also considered upgradient of site. The presence of microbiological parameters are again likely attributable to nearby agricultural activities rather than on-site activities.

6.4.6 Groundwater – Hydrogeology

6.4.6.1 Local Aquifers and their Properties

The superficial deposits (alluvium, Lower Palaeozoic derived gravels and lacustrine sediments) in the vicinity of the Site are not designated as an aquifer by the GSI, with the closest gravel aquifer located ca. 4.5 km to the south-west (GSI, 2022).

The GSI aquifer designation (GSI, 2022) for bedrock underlaying the Site is shown in Figure 6-18. Bedrock underlying the footprint of the Site (Kilmacrea Formation) falls within the catchment of the Wicklow groundwater body which is defined as ‘good’ water quality under the WFD and has a designation of ‘PP’ or ‘poorly productive bedrock’ (GSI, 2022). The aquifer underlying the Site is categorised as ‘LI’ or ‘Locally Important Aquifer’, described by the GSI (GSI, 2017) as:

- A limited and relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability which tends to decrease further with depth.
- A shallow zone of higher permeability may exist within the top few metres of more fractured/weathered rock, and higher permeability may also occur along fault zones.
- These zones may be able to provide larger ‘locally important’ supplies of water. In general, the lack of connection between the limited fissures results in relatively poor aquifer storage and flow paths that may only extend a few hundred metres.
- Due to the low permeability and poor storage capacity, the aquifer has a low ‘recharge acceptance’.
- Some recharge in the upper, more fractured/weathered zone is likely to flow along the relatively short flow paths and rapidly discharge to streams, small springs and seeps.

- Groundwater discharge to streams (‘baseflow’) can significantly decrease in the drier summer months.

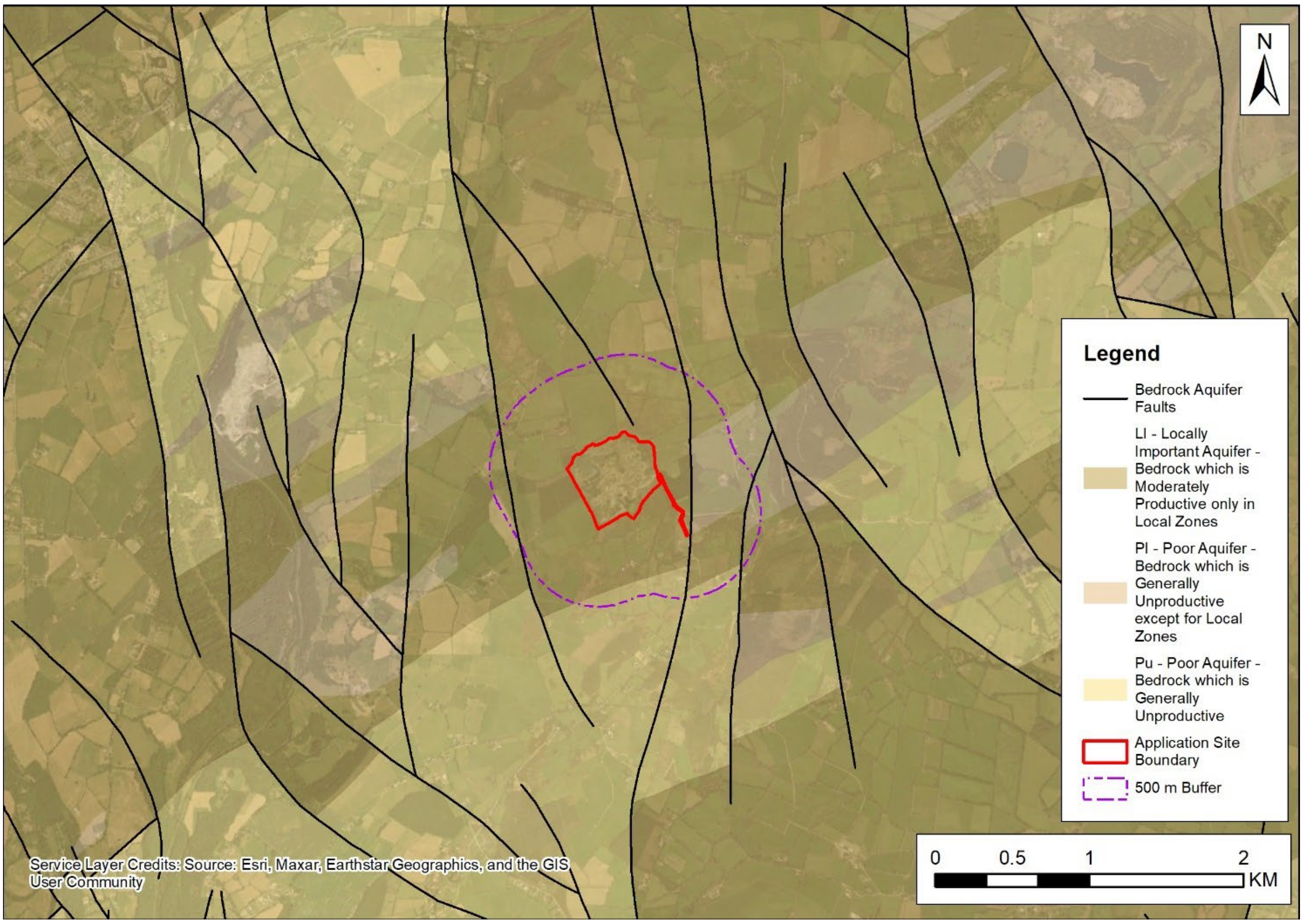


Figure 6-18: GSI Bedrock Aquifer Designations (after GSI, 2022)

Bedrock of the Avoca Formation is located ca. 0.5 km south and 1.1 km northwest of the Site and is classified as a ‘Pu’ poor aquifer, which is described as generally unproductive. Diorite bedrock located ca. 0.5 km east and 1.5 km west of the Site is classified as a ‘Pl’ poor aquifer, which is described as generally unproductive except for local zones. Bedrock of the Oaklands Formation ca. 1 km north and 3.6 km southwest of the Site is classified as ‘LI’ locally important aquifer, which is described as moderately productive only in local zones.

Given the limited interconnectivity of fractures within the Kilmacrea formation, it is interpreted that the site is unlikely to be in hydraulic connectivity with the aquifers of the Avoca, Oaklands and Diorite Formations.

Wicklow County Council (2003) indicate a transmissivity for the Kilmacrea and Oakland formations of between 5 and 130 m^2/d and report that permeabilities decrease rapidly with depths exceeding 30 m. On-site aquifer testing has been conducted on Site by WYG (2009). A short pumping test was completed on borehole DW1 in December 2008 to determine the transmissivity of the bedrock aquifer. The analysis indicates a transmissivity of ca. 0.4 m^2/d, which is noted to be less than those reported elsewhere by Wicklow County Council (2003) for the Kilmacrea formation. The permeability of the gravels at the Site were estimated to be 8.7 m/d by WYG (2009).

Groundwater Vulnerability (DELG/EPA/GSI, 1999) defines how easily groundwater may be contaminated by human activities. According to the GSI online mapping tool (GSI, 2022) the footprint of the Site is classified as both ‘moderate’ and ‘high’ (Figure 6-19). Areas where excavation has taken place and superficial deposits removed are classified as ‘high’ as apposed to areas which remain unexcavated as ‘moderate’. Areas where bedrock is exposed, e.g. lowest areas of quarry floor, may be elevated to ‘extreme’ in vulnerability.

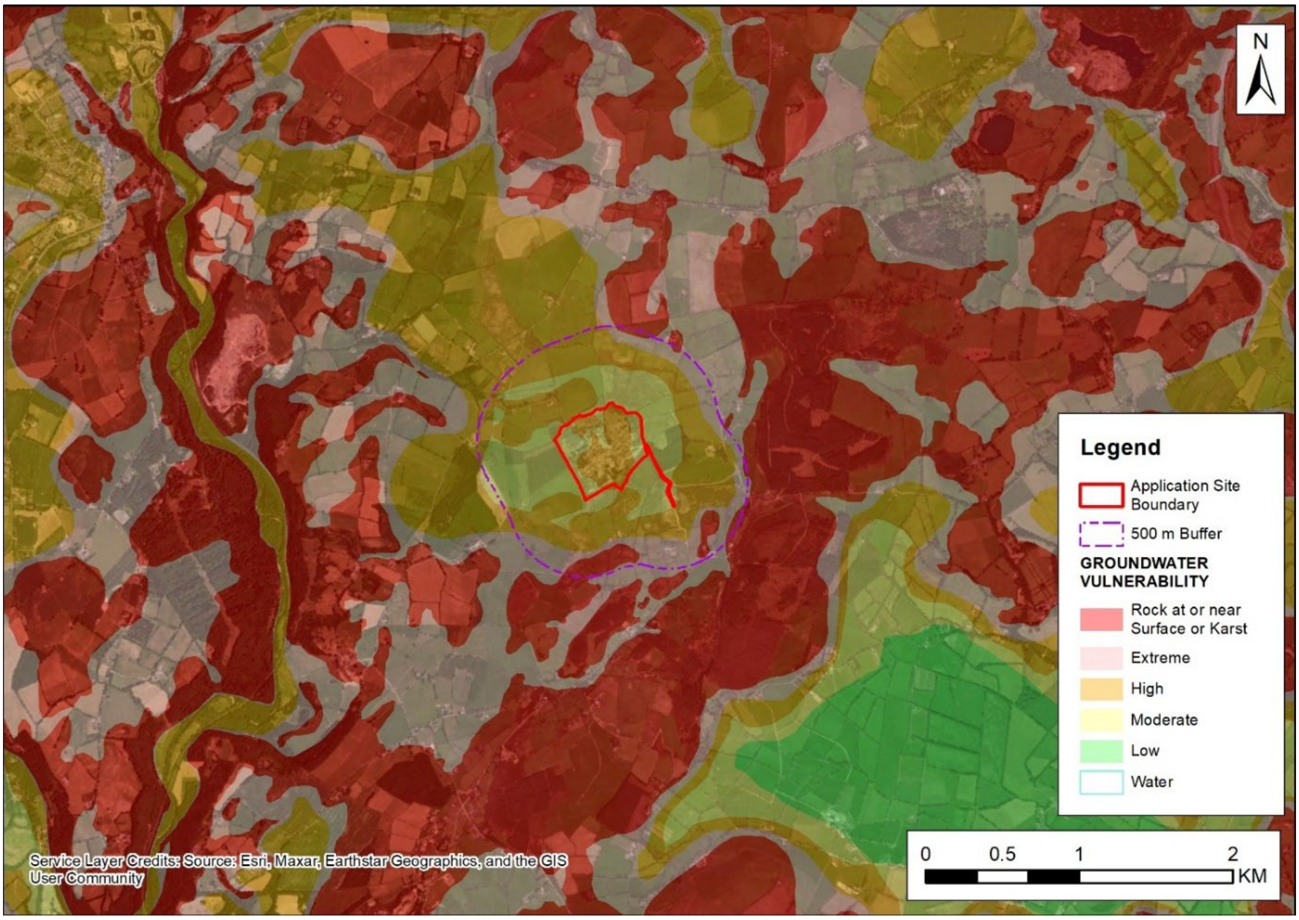


Figure 6-19: Groundwater Vulnerability Map (after GSI, 2022)

Soils and subsoils under the footprint of the Site are classified by GSI mapping as being alluvium, Lower Palaeozoic derived gravels and lacustrine sediments. These deposits have a potential recharge coefficient of 22.5%, 85% and 60%, respectively. The ability of the bedrock aquifer to accept all available groundwater recharge is considered to be low to moderate and therefore the groundwater recharge map presents a maximum allowable estimated recharge to bedrock of (GSI, 2022).

6.4.6.2 Local Groundwater Elevation

Aerial photography from 1993, 1995 and 2000 (Figure 6-2 and Figure 6-3) suggests that there was no pond formation in the areas of extraction activities and therefore significant quantities of groundwater had not yet been encountered at the Site. The average working depth at this time was ca. 124 mOD and therefore the potential piezometric surface across the quarried area in 1995 is assumed to have an elevation of less than 124 mOD.

Ponded water was observed to first form in the pit area between 2000 and 2004 (Figure 6-3) and is thought to be formed of both ponded surface water and groundwater. Groundwater was first used for the washing of aggregate in 2003 and is reported by the Applicant to have been first encountered around this time as excavation of sand and gravels dipped in elevation to the northwest creating a low depression in that corner where the pond formed. Evidence of water pooling can be seen in the central area of the Site in 2004, assumed to be settling ponds. In the northwest of the Site the most significant waterbody is observed in 2004 where extraction was known to be taking place below the water-table. In 2008, extraction below the water table ceased with the resulting waterbody in the northwest having increased in size by 2009 (Figure 6-4).

From 2011 to 2015 (Figure 6-4 and Figure 6-5) the waterbody is observed to be present and appears to be suppressed in elevation and extent when compared to aerial imagery from 2021 (Figure 6-5), which shows the northwest pond at its largest extent to date. Level Surveys indicate a pond level of 113 mOD, which is likely to represent a managed groundwater level plus captured rainfall and runoff. If groundwater was no longer managed, then it is expected that the pond would eventually stabilise between 113 mOD and 114 mOD.

2008 – 2016 Groundwater Elevation Investigations

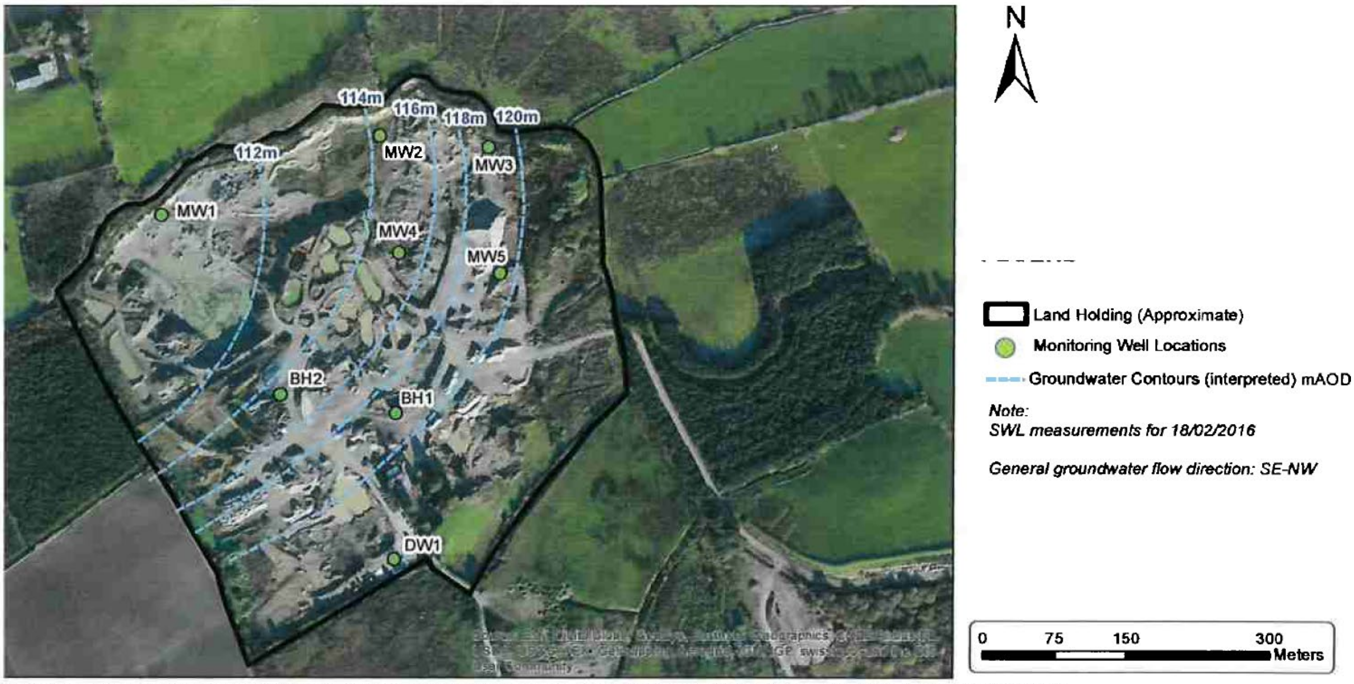
Prior to 2008, three groundwater boreholes existed within the Site (DW1, BH1 & BH2). DW1 being the only abstraction borehole. A further 5 groundwater monitoring boreholes (MW1, MW2, MW3, MW4 & MW5) were drilled by WYG in 2008. The location of the boreholes can be seen on Figure 6-11.

Groundwater elevations were recorded by WYG in 2008 and later by AWN in 2014 and 2016. Groundwater elevations are presented in Table 6-9 and a groundwater contour plot from 2016 is presented in Figure 6-20. Groundwater contour plots were also produced by WYG (2008) showing groundwater to flow west/northwest across the site.

A dewatering assessment was carried out by WYG in 2009 and concluded that the cone of depression expected for the site may extend up to 160 m from the quarry to the south-east and between 45-60 m in the south-west. Drawdown was not predicted to occur north of the site due to predicted recharge from the Newbawn stream.

Table 6-9: Groundwater Elevations (WYG, 2009; PD Lane, 2015)

Borehole ID	Borehole Elevation (mOD)	Water Table 10/11/2008		Water Table 04/07/2014		Water Table 18/02/2016	
		(mbtoc)	(mOD)	(mbtoc)	(mOD)	(mbtoc)	(mOD)
DW1	126.83	4.43	122.40	5.80	121.03	-	-
BH1	127.01	9.95	117.06	9.10	117.91	7.73	119.28
BH2	122.76	8.25	114.51	8.26	114.50	8.22	114.54
MW1	112.15	2.0	110.15	No access	No access	No access	No access
MW2	116.49	0.11	116.38	No access	No access	No access	No access
MW3	123.37	3.5	119.87	4.53	118.84	4.11	119.26
MW4	121.32	4.5	116.82	7.16	114.16	6.63	114.69
MW5	122.99	2.5	120.49	4.79	118.20	-	-



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Note: Drawing is for illustrative purposes only; Do not scale

Figure 6-20: Groundwater Elevation Contours, February 2016 (from AWN, 2016).

2020 – 2022 Groundwater Elevation Investigations

Groundwater elevations were recorded in boreholes periodically by Golder from July 2020 to July 2022. A hydrograph of the groundwater elevations in the boreholes over this period is shown in Figure 6-21 and tabulated monitoring data is provided in Appendix 6.4.

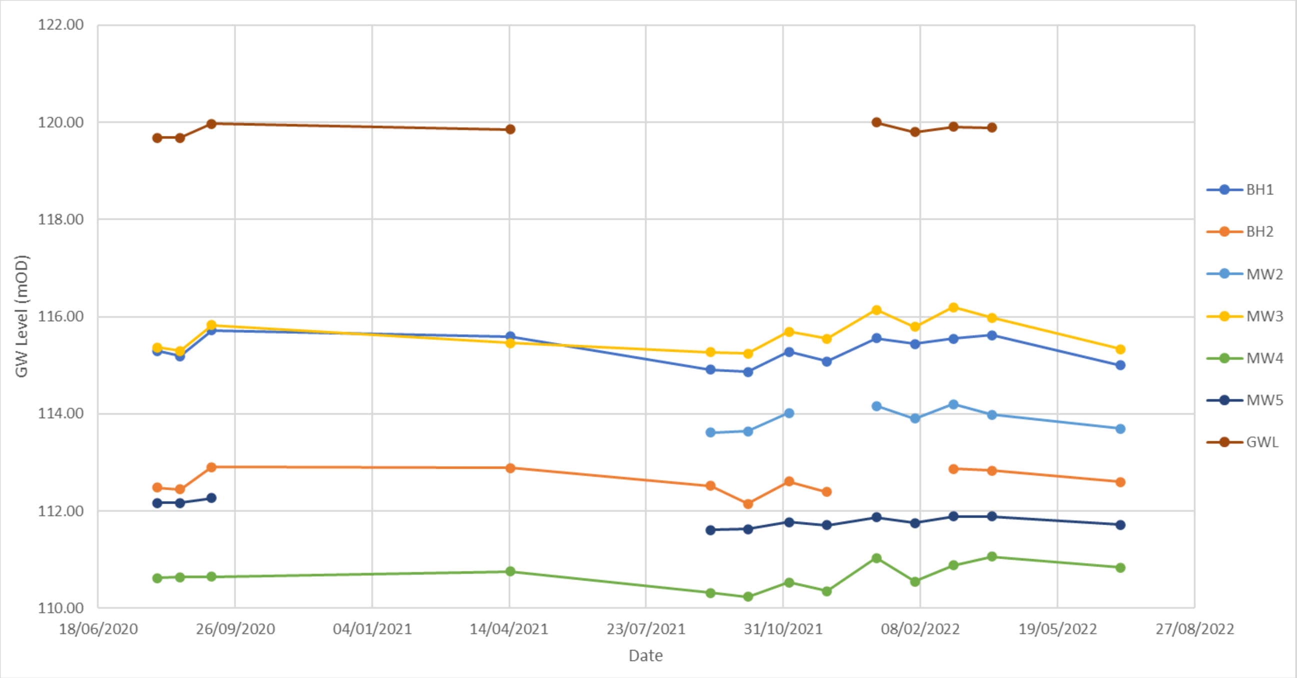

Figure 6-21: Groundwater Elevation (mOD) 2020-2022

Seasonality can be seen in groundwater, with water levels in BH1, BH2, MW2, MW3, MW4 and MW5 displaying an increasing trend from late summer 2021 to late spring 2022 before decreasing through the drier early summer months. Little variation is observed in groundwater levels from GWL.

The following observations were noted during the monitoring period:

- DW1 could not be accessed due to the wellhead installation.
- MW1 was not able to be accessed throughout the monitoring period due to overgrowth of vegetation.
- MW2 was not able to be accessed during the monitoring due to overgrowth of vegetation and/or flooding.
- MW5 was recorded as blocked on 15/04/2021 due to the inner piping of the borehole being damaged.

Figure 6-22 presents groundwater contour plots derived for selected monitoring rounds with the most complete datasets and to provide an overview of any seasonal variation. Survey data from July 2022 has been used to provide the ground level reference datum for all contour plots presented.

Groundwater elevation contours for the 2020-2022 period are generally lower when compared to those of 2008 and 2016. This may be due to the long-term effect of pumping at the site. When compared to the current (2022) site topography survey data (see Substitute Consent Application Drawing 03), the interpreted groundwater elevation contours (Figure 6-22) are observed to be several metres below the ground level. A small cone of depression caused by dewatering / pumping can be observed in the contours, extending towards the east and south-east of the northwest waterbody.

Slight variation can be observed within the 2020-2022 groundwater contours but typically groundwater is observed to decrease from an upgradient elevation of ca. 117 mOD at the south-eastern site boundary to a downgradient elevation of ca. 112-113 mOD close to the northwest boundary. Groundwater elevations within the 2020-2022 period typically ranged by up to 1 m, likely due to seasonal variation but may also be influenced by whether pumping from the northwest waterbody was occurring at the time of measurement.

Historic groundwater elevations (ca. 120 mOD in 2008) for borehole MW5 exceed the current elevation of the quarry floor in some areas to the west of borehole MW5 (ca. 116-118 mOD). Similarly, the current quarry floor to the north-east of DW1 (ca. 118-119 mOD) is below the historic groundwater elevation at DW1 (ca. 122 mOD). Should the periodic pumping at the site cease, and groundwater allowed to fully rebound, then it is expected that the current flooded area may expand slightly eastwards, and potentially a smaller flooded area may form at the southern boundary to the northeast of DW1. It is not expected that the whole quarried area would flood and any flooding is expected to remain within the footprint of the site due to the elevated ground profiles around the perimeter (minimum elevation of ca. 120 mOD in the south and 122 mOD in the north respectively).

Figure 6-22: Groundwater Elevation (mOD) Contours 2020-2022 (aerial imagery from 21/72020).

6.4.6.3 Local Groundwater Quality

Site-specific groundwater quality data is not available for the Site in 1990, however it is noted that quarrying activities, were likely operating above the groundwater table.

Groundwater quality has been reported during previous investigations by WYG in 2008 and later by AWN in 2016 and 2017. Golder subsequently carried out groundwater quality sampling in 2020 and 2021.

The boreholes discussed in this section are classified as follows with regards to their location (see Figure 6-11 and Figure 6-16):

- BH1 (downgradient / cross-gradient of site activities)
- BH2 (downgradient / cross-gradient of site activities)

- MW3 (downgradient / cross-gradient of site activities)
- MW4 (downgradient / cross-gradient of site activities)
- MW5 (downgradient / cross-gradient of site activities)
- DW1 (upgradient / cross-gradient of site activities)
- GW1 (upgradient of site activities)
- GWL (upgradient of site activities)

It is noted that MW1 and MW2 (both downgradient / cross-gradient of site activities) could not be monitored.

2008 – 2016 Groundwater Quality Investigations

Groundwater quality at the Site has been presented in three previous investigations:

- WYG (2009) sampled groundwater from supply well DW1 in 2008 (see Figure 6-11 for location);
- AWN (2016, sampled groundwater from boreholes BH1, BH2, MW3, MW4, MW5 and DW1 in 2016 (see Figure 6-11 for locations); and
- AWN (2017) sampled groundwater from boreholes GW1 (upgradient private well tap) and MW5[5] in 2017 (see Figure 6-16 for locations).

WYG (2009) analysed for parameters outlined in drinking water regulations SI 278 of 2007 as well as for Diesel Range Organics (DRO) and mineral oils. DRO and mineral oils were tested due to detection in March 2008 at BH2 in elevated concentrations. The results of the sampling indicated the water was generally of very good quality. No detection of microbial or DRO contamination was found. An exceedance of the drinking water quality threshold was recorded for Manganese (944 ug/l) which is noted by WYG to be typically high in Irish groundwaters and stated:

"*There are no particular toxicological connotations with elevated manganese, the thresholds are aesthetic and apply mainly for staining (EPA, 2001). As the water will not be used to clean fabrics this should not be a problem.*"

AWN (2016) targeted testing suite included faecal coliforms, total coliforms, BOD, turbidity, total suspended solids, inorganics, metals, Diesel Range Organics and Mineral Oil. Results were compared against European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI 9 of 2010) and Environmental Protection Agency's Draft Interim Guidelines Values (GVs) for the Protections of Groundwater, 2003 (EPA IGV).

AWN (2016) reported elevated counts of faecal coliform in MW4 (>100 cfu/100ml) and BH2 (20 cfu/100ml). BH2 is located down-gradient of the on-site septic tank. Iron concentrations were recorded above the EPA IGV (200 ug/l) for BH1 (210 ug/l), BH2 (240 ug/l) and MW3 (31 mg/l). Manganese was reported at concentrations above the EPA IGV (50 ug/l) for locations MW3 (1700 ug/l), MW4 (170 ug/l) and DW1 (620 ug/l). No exceedances in the concentrations of other metals, Diesel Range Organics or Mineral Oil were found.

AWN (2017) tested for faecal coliforms, total coliforms, electrical conductivity, pH, dissolved solids, inorganics, metals and Mineral Oil. The results were compared to Drinking water Standards SI No. 122 of 2014, Groundwater Regs SI No.9 of 2016; S.I. No. 366 of 2016 and EPA Interim Guideline Values, 2003.

The key results of the groundwater sample testing by AWN (2017) were an exceedance of the Drinking Water standard and IGV for faecal coliform counts in MW5 (12 cfu/100ml), pH in GW1 (5.5 pH units) lower than the

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[5] Referred to as "GW2" within AWN report (2017).

threshold value of 6.5 pH units and mineral oil in MW5 (19 ug/l) exceeding limit of 10 ug/l. No other exceedances were reported for inorganics or metals (including iron and manganese).

2020 – 2022 Groundwater Quality Investigations

Groundwater samples were collected by Golder from onsite boreholes BH1, BH2, MW3, MW5 and upgradient borehole GWL during August 2020, September 2021 and July 2022. Each sample was tested at UKAS accredited Element Materials Technology laboratory for the following parameters:

- Dissolved metals: Aluminium (2020 only), Arsenic, Barium (2021 only), Beryllium (2021 only), Boron (2021 only), Cadmium, Calcium, Chromium, Copper, Iron (excluding 2021), Lead, Magnesium, Manganese (excluding 2021), Mercury, Nickel, Potassium, Selenium, Sodium (2021 only), and Zinc;
- Total Hardness (Dissolved as CaCO3) (2020 only);
- GRO (>C4-C8) (2021 only), GRO (>C8-C12) (2021 only), GRO (>C4-C12) (2021 only);
- Methyl Tertiary Butyl Ether, Benzene, Toluene, Ethylbenzene, m/p Xylene, o-Xylene, Surrogate Recovery Toluene D8 (2020 only), Surrogate Recovery 4-Bromofluorobenzene (2020 only);
- Extractable Petroleum Hydrocarbons (EPH, C8-C40);
- Sulphate as SO_4, Chloride, Nitrate as NO_3 (excluding 2020), Nitrite as NO_2 (excluding 2020), Ortho-Phosphate as PO_4 (excluding 2020), Nitrate as N (2021 only), Nitrite as N (2021 only), Ortho-Phosphate as P (2021 only), Total Oxidised Nitrogen (2020 only);
- Ammoniacal Nitrogen as N (2021 only), Ammoniacal Nitrogen as NH4, Hexavalent Chromium (2021 only), Total Dissolved Chromium III (2021 only), Total Alkalinity as CaCO3, Dissolved Oxygen (2020 only), Electrical Conductivity (2020 only), pH (2020 only), Total Organic Carbon (2020 only), Total Dissolved Solids (2020 only), COD (Settled) (excluding 2020), Total Suspended Solids (excluding 2020); and

In addition to the above, a July 2022 sample from the on-site supply borehole (DW1) was tested at INAB accredited City Analysts Limited laboratory for the following Microbiological parameters:

- *Clostridium perfringens*;
- Coliforms;
- *Escherichia coli*;
- *Enterococci*;
- TVC at 22ºC; and
- TVC at 37ºC.

The results of the groundwater quality analysis at the Site are presented below and compared with the European Communities Environmental Objectives (Groundwater) Regulations regarding groundwater status, S.I. No.9/2010 (as amended by S.I. No.366/2016); where a screening value does not exist, the S.I. No. 122/2014 – European Union (Drinking Water) Regulations 2014 (as amended by S.I. No. 464/2017) is applied. Full screening results are presented as Appendix 6.2 and laboratory certificates are included in Appendix 6.3.

Ortho-phosphate and copper, both of which have exceeded threshold values in surface water previously, were found to be below the limit of detection in all 2020 and 2022 groundwater samples.

The laboratory limit of detections for Dissolved Mercury, Benzene and EPH (C8-C40) exceed their regulation thresholds. However, concentrations for these parameters when tested across all samples were found to be less than the limit of detection.

Exceedances of European Communities Environmental Objectives (Groundwater) Regulations 2010 for Ammoniacal Nitrogen (threshold value of 0.065 as NH_4-N) were recorded in all samples from boreholes MW3 and MW5 on 17/08/2020 and GWL, MW3, MW5 and BH2 on 27/07/2021. Elevated concentrations are observed both upgradient and downgradient of the site, however the maximum recorded concentration of 0.59 mgNH4/l was recorded in borehole MW5 on 17/08/2020. As there is no on-site chemical store of ammonia and no blasting of rock at the site (a common source of ammoniacal nitrogen at quarries), the exceedances are considered to be either natural (decaying organic matter such as debris or leaf-litter) or derived from off-site sources.

Similar to 2016, exceedances of the EU Drinking Water Regulations for Total Dissolved Iron (threshold value 200 µg/l) were recorded on 17/08/2020 for boreholes MW3 (833 µg/l), MW5 (24,970 µg/l), BH1 (552 µg/l) and GWL (607 µg/l). Likewise, exceedances of the EU Drinking Water Regulations 2014 for Dissolved Manganese (threshold value 50 µg/l) were recorded on 17/08/2020 for boreholes MW3 (149 µg/l), MW5 (2471 µg/l), BH2 (54 µg/l), BH1 (912 µg/l) and GWL (1326 µg/l) and on 08/07/22 in DW1 (579 µg/l).

It is noted that whilst iron and manganese concentrations upgradient (GWL) of the Site are elevated in 2020-2022, the highest concentrations were observed on-site (MW5). Whilst it is not uncommon for elevated concentrations of iron and manganese to occur naturally in Irish aquifers (see discussion below), this may also indicate an additional on-site source of metal loading (e.g. rusting equipment) or that the extraction/washing activities on-site is mobilising previously stable metals.

Elevated concentrations of manganese were observed in the July 2022 sample for upgradient abstraction borehole DW1, with 2022 concentrations (579 µg/l) being lower than those previously reported in 2008 (944 ug/l). The July 2022 sample from DW1 showed compliance with all other drinking water criteria tested (including microbiological parameters)

Guidance issued by the Health Service Executive (HSE, 2019) reports that manganese is found naturally in groundwater and the most likely source of manganese in drinking water. Similarly to that reported by WYG in 2009 (after EPA, 2001), the threshold value of 50 mg/l is reported by HSE to derive mainly based on taste and staining criteria. However, the HSE also state that concentrations above 120 µg/l can pose a risk to neurological health, particularly for vulnerable groups, such as: babies in the womb, infants / young children, the elderly or individuals with liver disease or anaemia. The HSE also notes that adults and older children who are not part of these vulnerable groups are unlikely to suffer any negative effects from drinking water with elevated manganese for short periods of time.

Whilst there have been no reports of on-site neurological illnesses and the majority of on-Site personnel are likely to be healthy, non-elderly, non-pregnant, adults, the exceedance of both the 50 µg/l and 120 µg/l threshold values for manganese indicates that the on-site supply may not be suitable for continued use. It is therefore recommended that either the use of only bottled water is implemented at the Site or that water treatment options to reduce manganese concentrations (such as aeration) are explored going forward.

6.4.7 Designated Sites

The Site is located in the WFD (Water Framework Directive) Wicklow groundwater body (Wicklow IE_EA_G_076, which is generally described as poorly productive and of 'good' water quality) and the WFD surface water catchment for the Ovoca-Vartry.

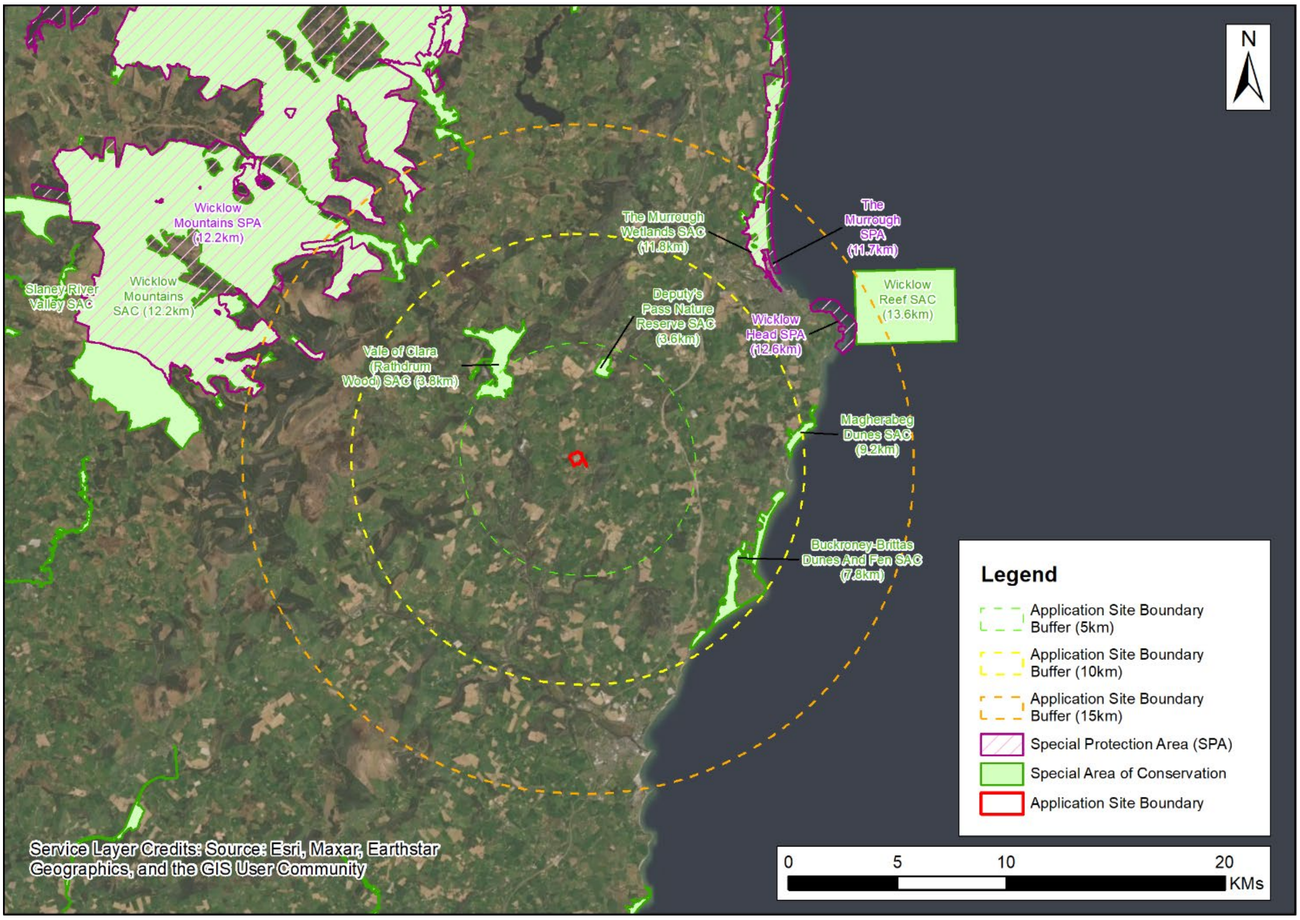
The EPA dataset (EPA, 2022b) identifies the regional Wicklow groundwater body as "Groundwater in Salmonid Regs" (i.e. groundwater which provides baseflow to salmonid waters identified within S.I. No. 293/1988). However, this is not applicable to the groundwater local to the Site as the site-adjacent Newbawn stream and downstream Avonmore and Avoca rivers are not classed as salmonid waters within S.I. No. 293/1988. The closest salmonid waters identified within the regulations are the Rivers Slaney and Vartry, both of which are unlikely to be in hydraulic connectivity with groundwater local to the site.

Whilst not listed within the salmonid water regulations, it should be noted that the River Avonmore is reported by the East Regional Fisheries Board (ERFB) to have populations of salmon and trout (ERFB, 2022), with Inland Fisheries Ireland (2017) also reporting their presence close to Laragh (Inland Fisheries Ireland, 2017), upstream of where the Newbawn stream joins the Avonmore and approximately 13 km north-east of the Site. The 2015 Inspectors Report (An Bord Pleanala, 2015) states that salmonid species are present within the “Balleese Stream” (assumed to be the downstream length of the Newbawn stream located adjacent to Balleese Wood, located approximately 2 km downstream of the Site boundary).

National Parks & Wildlife Service (NPWS) designated site data encompass sites Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). The closest designated sites are:

- Glenealy Woods (Site Code 001756) is situated ca. 3.5 km to the north of the Site with Deputy’s Pass Nature Reserve (Site Code 000717) located within it. Glenealy Woods are considered a Proposed Natural Heritage Area (pNHA) and Deputy’s Pass SAC.
- The Vale of Clara (Rathdrum Woods) (Site Code 000733) is located ca. 4.2 km to the northwest of the Site and is considered both a SAC and pNHA.
- The Avoca River Valley (Site Code 001748) located ca. 7.3 km south of the Site is a pNHA.
- Ballinacor Wood ca. 7.5 km west of the Site considered a pNHA.
- The Murrough Wetlands SAC ca. 11.8 km north of the Site.
- Wicklow Mountains SAC and SPA ca. 12.2 km northwest of the Site.

The aforementioned designated sites are presented in Figure 6-**23** (and detailed further in Chapter 4.0, Ecology and Biodiversity).



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 6-23: International Statutory Designations surrounding the site, including 5, 10, and 15 km buffers

6.4.8 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 and no recorded flood events in the immediate vicinity of the Site (OPW, 2022).

Past flood events have been recorded along the Avonmore ca. 2.5 km northwest of the Site in Rathdrum in 2011, and downstream from the Site at Lions Bridge ca. 4 km southwest of the Site in 1986. A stretch of the Avonmore in proximity to Lions Bridge has been identified as an Area for Further Assessment (AFA) to progress the development of a Flood Relief Scheme for the Avoca (OPW, 2022).

Within the site boundary, the northwestern quarry area has been excavated to below the water table, and as such experiences surface water and groundwater flooding in this area. This flooding is managed when necessary to maintain the water level in the pond to ca. 113 mOD. If pumping were to cease, then groundwater would be expected to rebound over time to an elevation of ca. 114 mOD in the northernmost areas of the Site, extending the flooded area slightly beyond it's current extent. The 2022 topography (see Substitute Consent Application Drawing 3) shows that perimeter elevations of the Site generally have an minimum elevation of 120 mOD, limiting the risk of off-site flooding. Further discussion is provided in Section 6.4.6.2.

6.4.9 Local Water Users and Wastewater Systems

On a regional scale, GSI mapping (2022) indicates that there are no groundwater source protection zones within the Site boundary. The nearest groundwater source protection zone, the Redcross Public Water Supply Scheme, is located ca. 3.5 km to the southeast (and upgradient) of the Site (See Figure 6-24; GSI, 2022).

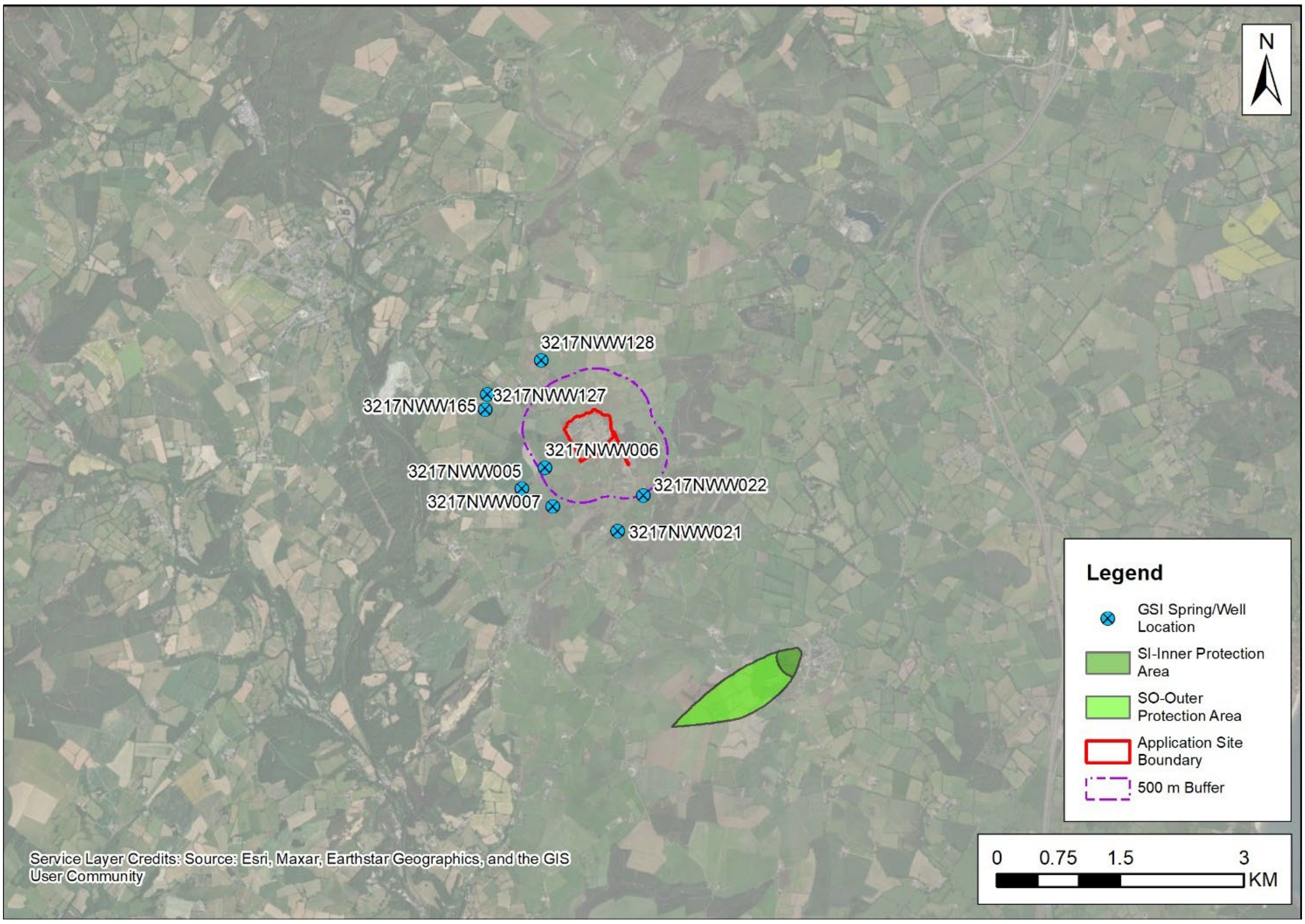


Figure 6-24: Regional Groundwater Source Protection Zones, Abstraction Boreholes and Springs (after GSI, 2022)

A domestic well survey undertaken by WYG in 2008 (as reported in PD Lane, 2015) identified a total of 12 domestic wells within a 1 km radius of the site (Table 6-10). The closest off-site well (ca. 373 m distance) was noted to be outside of the the maximum cone of depression extent of 160 m (calculated in WYG, 2009).

Table 6-10: Summary of Domestic Wells from March 2008 (as reported in PD Lane, 2015)

Well No.	Owner	Well Use	Depth (m)	Water level (m)	Distance to Quarry (approx. m)	Comments
DW1	V Cousins	Canteen & Toilet	73.0	4.43	On-site	Inside pump house
DW2	G Arthur	Domestic	42	1.69	373	-
DW3	Rented House	Domestic	-	-	802	Well is sealed
DW4	S Byrne	Farm/Domestic	-	10.08	952	Very hard water
DW5	C Martin	Domestic	42	2.00	761	-
DW6	J Hudson	Farm	-	-	985	Well is sealed
DW7	T Morrisey	Domestic	-	-	902	Well is sealed
DW8	S Womington	Farm	33	2.35	575	-
DW9	S Womington	Farm	33	5.733	907	-

Well No.	Owner	Well Use	Depth (m)	Water level (m)	Distance to Quarry (approx. m)	Comments
DW10	S Womington	Farm	33	8.97	987	-
DW11	S Womington	Farm	n/a	0.43	766	Shallow spring well
DW12	J Kilbery	Domestic	45	4.09	889	-

Abstraction wells listed by the GSI (2022) within 1 km proximity to the Site are summarised in Table 6-10. These wells are for domestic water supply only. There are no known complaints from neighbouring properties regarding their water supplies throughout the review period.

Table 6-11: Abstraction wells within 1 km vicinity of the Site

GSI Name	Easting	Northing	Source Use	Yield (source) cubic metres per day
3217NWW128	321630	187270	Domestic use only	27
3217NWW127	320950	186670	Domestic use only	33
3217NWW165	320980	186860	Domestic use only	50

Irish Water does not supply public water services to the site or properties immediately adjacent to it. Groundwater is used locally for domestic water supply in areas not serviced by the public mains water. Similarly, foulwater sewers are not present at the site or in the local area. There are interpreted to be a number of private wells and septic tanks located in the vicinity of the Site. A review of Wicklow County Council Planning Applications (2022) within a 1 km radius of the Site found ca. 36 applications in relation to private wastewater systems, septic tanks, bored wells, and drainage. A list of applications can be seen in Appendix 6.5.

6.4.10 Water Balance

As discussed in Section 6.4.6, groundwater is used at the Site for various activities. Detailed records of water usage on Site are not available, however using professional judgement and following discussion with the Applicant, estimates of operational water requirements in 2022 are provided in Table 6-12.

Table 6-12: 2022 Estimated Site Operational Water Usage

Site Use	Abstraction Source	Estimated Usage (m^3/day)	Estimated Usage (m^3/year)*
Hand washing and toilet flushing	Borehole DW1	2	520
Drinking water	Borehole DW1	0.5	130
Wheel wash facilities	Borehole DW1	0.5	130
Aggregate washing	Northwest Waterbody	250	65,000
	Total Volumes Required	256	65,780

**Assumes operational use of 5 days a week, 260 days per year.*

An estimate of the groundwater flow into the western pit under pumped conditions has been calculated using Darcy's Law (Oxford Reference, 2022) and is presented in Table 6-13. The calculated groundwater inflow to the northwest pond of 0.36 m^3/day is noted to be low and whilst not unexpected for a poorly productive aquifer, there is potential for actual inflows to be up to an order of magnitude higher.

Table 6-13: 2022 Estimate of Groundwater Flow into the Northwest Pond Under Pumped Conditions.

Parameter	Value	Units	Source of Value
Transmissivity (T)	0.4	m^2/day	Estimated from on-site testing data
Thickness of saturated bedrock aquifer (b)	30	m	Assumed based on literature (Wicklow County Council, 2003)
Hydraulic Conductivity (K)	1.33×10^{-2}	m/day	Transmissivity (T) divided by saturated aquifer thickness (b)
Area (A)	246	m^2	Length of upgradient pit wall (L) multiplied by pond depth (D)
Hydraulic Gradient (i)	0.11	-	Estimated based on 2022 groundwater elevations for boreholes GWL (~119 mOD) and BH2 (~113 mOD)
Height of groundwater above quarry floor (D)	2	m	Assumed adjacent groundwater elevation (~113 mOD minus quarry floor of ~111 mOD)
Length of upgradient quarry walls (L)	123	m	Estimated from site topography map
Flow (Q) into pond	0.36	m^3/day	Calculated using Darcy's Law (Q=KAi)
Flow (Q) into pond	131	m^3/year	Calculated using Darcy's Law (Q=KAi)

A simplistic Site-wide water balance is presented in Table 6-14 and estimates that after Site water requirements are met, then up to an additional 667 m^3/day of water may be required to be managed by the Site (e.g. via ponding or discharge to the culvert) to maintain the pond water level following periods of prolonged rainfall. It is however noted that operational water use is not well defined and recorded measurements would provide greater insight. Groundwater inflows to the quarry are noted to be much lower than the surface water runoff on-site.

Table 6-14: 2022 Site-Wide Water Balance

Parameter		Value	Units	Source
1	Average rainfall	1,000.85	mm/year	Average of 2005 – 2021 data for Kilbride (Togher) station 4024 (Met Eireann, 2022)
2	Effective rainfall	765	mm/year	Average of estimated recharge (GSI, 2022)
3	Recharge to groundwater	200	mm/year	Maximum recharge capacity (GSI, 2022)
4	Available rainfall (after recharge)	565	mm/year	(2) minus (3)
5	Groundwater flow into northwest pond	131	m^3/year	As per Table 6-13
6	Operational site area	201,600	m^2	Estimated (20.16 hectares)
7	Available water	114,035	m^3/year	(4) multiplied by (6) + (5)
8	Site operational usage	65,780	m^3/year	As per Table 6-12
9	Residual water ponded or discharged to stream	48,255	m^3/year	(7) minus (8)
10	Residual water ponded or discharged to stream	667	m^3/day	Operates periodically following periods of prolonged rainfall

6.5 Hydrological and Hydrogeological Conceptual Model

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

Water enters the Site through direct rainfall precipitation and via the movement of groundwater through the subsurface which predominantly flows from southeast to northwest, coincident with local topography. Local surface water features are predominantly fed by rainfall runoff from higher topographical areas which collect in natural gullies and form headwaters for tributaries to larger streams and rivers. The topography of the Site and the surrounding area means that surface water runoff from the Site (e.g. in the event of flooding from the Site) could discharge into the Newbawn stream (located along the east and northern site boundary) and eventually the Avonmore river (although significant attenuation capacity is noted within the existing excavated area).

Open water is present in the deepest excavated area of the Site in the north-west. This waterbody (and groundwater) is noted to be at a lower elevation than the adjacent Newbawn stream which passes along the eastern and northern site boundaries. The lowest elevation areas of the Site also intersects the groundwater table and therefore the ponded water is considered to be a mix of groundwater, recharge from the Newbawn stream and rainfall. Once present in the quarried area this water mass will be subject to evaporation and will provide some recharge to the underlying bedrock. Rainfall on other areas of the Site will either runoff towards the northwest waterbody or infiltrate the ground, where it will be subject to evapotranspiration or become groundwater. The stripping and/or removal of unsaturated ground will have lowered the ability of the Site to accept recharge to ground in excavated areas.

Groundwater within the sand and gravel deposits is not considered to be an aquifer due to the limited lateral extent and thickness of the deposits. Any groundwater within the sand and gravel deposits are unlikely to be in direct hydraulic connectivity with the Newbawn stream, although may receive recharge from the Newbawn stream via the unsaturated zone. Groundwater flow within the sand and gravel deposits will be intergranular and reduced in clayey areas.

Flow in the bedrock is likely to be predominantly confined to bedding planes, faults and fractures due to the nature of the bedrock. No faults are reported to cross the Site. Connectivity of fracture sets within the bedrock is expected to be low, with limited lateral connectivity (few hundred of meters from the Site) and decreasing hydraulic conductivity with depth as weathering of the rock reduces (rapidly reducing after 30 m depth). There may be zones of increased hydraulic conductivity in the unexcavated upper weathered zones which can allow for rapid infiltration of rainwater.

Under baseline conditions, groundwater within the sand and gravel deposits and shallow fractured bedrock likely received some recharge from the stream. The amount of recharge to groundwater will be limited by the potential of the deposits and bedrock to receive recharge. Whilst flows rates within the Newbawn stream are not well defined, it is noted that any impact due to dewatering on flows downgradient of the Site may be offset due to Site discharges to the stream via the settlement ponds. The catchment of the Newbawn upstream of the Site is noted to be small, with the headwaters located close to the eastern boundary of the Site.

The local catchment area for both surface water and groundwater are likely bounded upgradient by the topographic divide in the vicinity of Kilmacrea / Oakwood and downgradient by extent of the bedrock which is connected to the Site via fractures (likely small, maximum hundreds of metres distance). Groundwater at the site is not interpreted to be in direct (subterranean) hydraulic connectivity with the Avonmore River due to the distance of the waterbody (several kilometres from the Site). However, as part of the water management on the Site, water abstracted from the northwest waterbody is periodically discharged to the Newbawn stream following periods of prolonged rainfall, via settlement ponds. This offers a potential pathway for contamination, although surface water quality monitoring to date has generally observed good quality water and best practice measures relating to hydrocarbons are employed at the Site.

6.6 Selection of Sensitive Receptors

Taking into account 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 6.15.

Table 6.15: Water Receptors

Receptor	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 locally important aquifer with low measured transmissivity and limited fracture connectivity (maximum of hundreds of metres). Water quality is considered to be of "good" WFD status. On-site abstraction borehole used as a potable supply for drinking water and operational supply. Abstraction has only dewatered area close to the pit due to limited off-site hydraulic connectivity. No loss of productivity observed in the on-site abstraction borehole. Local supplies are generally low yield, supporting single household domestic properties.	Low
Surface Water – quality and availability due to use as a resource and wider regulatory requirement to maintain good quality status.	Downgradient river (River Avonmore) is classified as Good by WFD and likely in hydraulic connectivity with the Site via discharge to the Newbawn Stream from settlement ponds. Water quality of discharges from the Site and in the receiving Newbawn stream have generally been of good quality. Salmonid populations are reported to be present within the lower Newbawn Stream, although neither the Newbawn stream nor the River Avonmore are identified within the Salmonid Water regulations. Impacts on water quantity are likely localised to the stretch of the Newbawn located along the northern and eastern boundaries of the Site. Any downstream impacts on flows are likely to be partially offset by discharges to the Newbawn from the Site's settlement ponds.	Medium
Flooding – changes in presence and water flows for on-Site plant, on-site infrastructure and facilities or infrastructure downstream of the Site.	Site not in surface water flood risk area. Site is not at risk of flooding under pumped conditions and has significant capacity within the excavated areas for attenuation and containment during heavy rainfall events should pumping cease. If flooding were to occur, topography is such that flooding would be directed towards the Newbawn stream.	Low

Receptor	Reasoning	Sensitivity
	Limited infrastructure or facilities are located adjacent to the Newbawn downstream of Site and are of local importance.	
Human Health – existing on-Site water users, water availability and quality	On-site borehole used to supply drinking water to a small number of individuals and is located upgradient of Site activities. Potable supply could be replaced by bottled water without any loss to Site functionality.	High
Human Health – existing off-Site water users, water availability and quality	Existing water well users are located adjacent to the Site but are not considered to be in hydraulic connectivity with the Site. Irish Water public mains water supply is not present close to the site.	N/A (no pathway)
Natura 2000 Designated Sites – degradation of protected sites due to changes in water quality or quantity	Nearest designated sites are 3.5 km from the Site and not considered to be in hydraulic connectivity with the Site.	N/A (no pathway)

6.7 Characteristics of the Development

The main characteristics of the development with regards to water are described in Sections 6.4.1 to 6.4.3. The following working methods are also considered to be of relevance to the assessment of impacts on water:

- Water collected in the northwest waterbody is periodically discharged to the Newbawn stream via a series of settlement lagoons located at the north-west corner of the Site.
- Water supply for the washing/screening plant was/is recycled from the system of settling lagoons/ponds where water was circulated in a closed loop system within the central part of the quarry. These ponds were regularly cleaned out of sediment build-up. Flocculant chemicals are not added to the water.
- The silt from these settling lagoons/ponds was excavated periodically and stockpiled temporarily near the processing plant until it was in a condition that is suitable for handling and transport. The material is kept within the quarry for use in restoration.
- Wastewater from the welfare facilities was discharged via the on-site septic tank – the contents of which were periodically tankered of-Site as needed. The septic tank had sufficient capacity to cater for the PE equivalent of average 30 persons arising from full time site employees, contractors and additional visitors.
- The quarry has not had a permanent wheel-wash facility for trucks departing the Site for that majority of the rEIAR assessment period, and there has, therefore, been no need to dispose of settled sediments that would otherwise have been associated with this type of dust suppression and cleaning system. A concrete basin and grate wheel wash was installed in 2016 on the access road. This is part of the neighbouring recycling facility development, but is also used by the quarry vehicles.
- Diesel kept on Site was generally only used by on-site vehicles. The maintenance workshop/machinery shed and yard area was originally powered by a diesel generator, but the power supply was later converted to 3-phase. There were two 2,500 litre double-skinned diesel tanks; one empty tank used as a back-up and another with on average approximately 300 litres stored. There were also two 3,000 litre double-skinned gas oil storage tanks; one tank empty as a back-up and the other storing on average 300 litres of gas oil fuel.
- Lubricant engine oil was generally stored within the maintenance workshop/machinery shed area. The engine oil was typically kept in standard sized drums. Waste oil was stored within designated Intermediate Bulk Containers (IBCs) that were temporarily located to the east of the maintenance workshop prior to disposal off-site.
- No hydrocarbon interceptor exists at the Site.
- It is understood that generally no other waste materials were stored with the study area.
- Although the quarried product may be used in concrete, concrete was not manufactured or sold at the site.
- Restoration will use the stored soils and sub-soils to return the land to agricultural use.

6.7.1 Embedded Mitigation

The following elements of the Project Description (Chapter 2) and the operational processes that were followed at the Site are considered to provide some historical and current mitigation of the potential impacts on water:

- The material was/is excavated mechanically – no blasting has taken place.
- The removal of soils and other overburden took place gradually in phases and the material was stored on-Site for use in restoration. Restoration has already started in the south-eastern corner of the Site.
- Topsoil stripped at the Site was not stored in mounds higher than 3 m and was not moved in wet conditions (PD Lane, 2009).

- Silt that was dredged from the bottom of the central settlement ponds was stored at least 5 m away from any watercourses and on land that has slopes away from the watercourse (PD Lane, 2009). Run-off from silt storage was directed to a holding/settlement pond.
- Once dried, the silt from the central settlement lagoons/ponds was stored on-Site for use in the restoration of the Site.
- Discharges from the northwest waterbody are made via the settlement lagoons in the northwest corner of the site, allowing for settlement of suspended solids and for precipitation of dissolved metals.
- The washing plant is located on concrete hardstanding, limiting the potential for the release of oils and lubricants to ground.
- The contents of the septic tank were periodically tankered of-Site as needed. There have been no known issues with the septic tank and the system was serviced annually.
- Fuel storage was typically in double skinned tanks located on concrete aprons in the maintenance area. Refuelling occurred at these tanks over a concrete apron. Fuel for the Site was delivered regularly as bulk liquid by a dedicated mobile tanker.
- Oils, chemicals and admixtures were ordered and used as needed (avoiding large quantities being stored on Site).
- No flocculants were required to be added to waters to encourage precipitation and settlement of solids.
- Used oil and chemical containers were stored within the maintenance area for disposal by a licensed contractor.
- Intermediate Bulk Containers, in which waste oil was stored, were sealed and it is understood that their integrity were monitored by on-site personnel.
- The waste arising on-site comprised municipal waste from staff welfare activities and was disposed of via domestic waste collection.
- Scrap metal arising on-site was stored within a designated area at the Site prior to collection by a licensed waste contractor.
- Sludge from the wheel wash was taken off-Site for disposal at an appropriate facility.
- Perimeter fencing was actively maintained to ensure that the risk of injury to civilians was minimised. The entrance gate was locked and controlled by the Site management.

6.8 Potential Effects

The main activities which have been conducted during the development of the Site since 1990 and may cause an impact upon the water environment are as follows:

- Earthwork activities (e.g. excavation of quarry, movement of material);
- Pumping and dewatering of the quarry area;
- Discharge to the adjacent Newbawn stream;
- Washing and sorting of excavated sand and gravel;
- Use, maintenance and parking of mechanical plant on the Site for excavation activities;
- Storage of hydrocarbons associated with the refuelling; and
- Use of welfare facilities and holding tank.

Without mitigation additional to that which is already embedded in the Site infrastructure and design, the Site has the potential to have caused the following impacts over the review period:

- Changes in groundwater or surface water quality due to screening and washing activities (including settlement ponds);
- Changes in surface water or groundwater quality from wastewater generated by on-site welfare 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/oil storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles;
- Changes in surface water quality due to discharges from the northwest waterbody via the settlement ponds;
- Changes in the suitability of the on-site abstraction borehole for drinking water supply;
- Changes in groundwater levels and flow directions as a result of pumping; and
- Changes in surface water flows in the adjacent Newbawn stream.

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 6.15. This assessment takes consideration of the embedded mitigation.

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

- Limited off-Site hydraulic connectivity of groundwater has likely limited the potential for migration of contaminants from the Site and localised any drawdown to within or immediately adjacent to the Site boundary throughout the review period;
- Any reduction of flow within the Newbawn stream along the northern or eastern Site boundary was/is likely partially offset downstream due to Site discharges;
- The upgradient location of the on-site abstraction well in relation to the main Site activities;
- Whilst manganese (likely to be naturally occurring) exceeded its drinking water threshold value, all other parameters are observed to be lower than their respective drinking water criteria within the on-site supply. Manganese concentrations were also observed to reduce over time;
- Low or undetected concentrations of hydrocarbons in groundwater and surface water throughout the review period and the presence of embedded mitigation to prevent contaminant migration;
- The small number of exceedances of groundwater threshold values (selected metals and ammoniacal nitrogen) are typically not observed within surface water (except for copper in 2016, which was observed both upgradient and downgradient of the Site discharge point);
- Only a few exceedances of surface water EQS threshold values for inland waters were observed (typically metals) in 2008-2015 surface water quality data, with no exceedances in 2020-2022 samples;
- Only samples taken in July 2022 (nitrite and suspended solids) marginally exceed the salmonid water regulations (S.I. No. 293/1988), with no other exceedances observed in surface waters throughout the review period. The source of the exceedances are interpreted to be from off-site sources; and

- There is generally good quality of water in the River Avonmore observed throughout the review period (see Section 6.4.5.3 and Appendix 6.1).

Table 6.16: Evaluation of Initial Impacts and their Effect Significance

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect*
Operational	Groundwater	Low	Change in groundwater quality due to screening and washing activities (including settlement ponds).	Low (adverse), direct, short term, reversible	Imperceptible or slight
			Change in groundwater quality from wastewater generated by on-Site welfare units and wheel wash facilities.	Negligible (adverse), direct, short term, reversible	Imperceptible
			Change in groundwater quality from uncontrolled material storage.	Negligible (adverse), direct, short term, reversible	Imperceptible
			Change in groundwater quality caused by hydrocarbon leaks from fuel/oil storage tanks or the unmanaged spillage of fuels or lubricants from plant or vehicles.	Negligible (adverse), direct, short term, reversible	Imperceptible
			Changes in groundwater levels and flow directions as a result of pumping.	Low (adverse), direct, short term, reversible	Imperceptible or slight
	Surface Water	Medium	Change in surface water quality due to screening and washing activities (including settlement ponds).	Negligible (adverse), indirect, short term, reversible	Imperceptible or slight
			Change in surface water quality from wastewater generated by on-Site welfare units and wheel wash facilities.	Negligible (adverse), indirect, short term, reversible	Imperceptible or slight
			Change in surface water quality from uncontrolled material storage.	Negligible (adverse), indirect, short term, reversible	Imperceptible or slight
			Change in surface water quality caused by hydrocarbon leaks from fuel/oil storage tanks or the unmanaged spillage of fuels or lubricants from plant or vehicles.	Negligible (adverse), indirect, short term, reversible	Imperceptible or slight
			Changes in surface water quality due to discharges from the northwest waterbody via the settlement ponds;	Negligible (adverse), indirect, short term, reversible	Imperceptible or slight
			Changes in surface water flows in the adjacent Newbawn stream	Medium (adverse), indirect, short term, reversible	Moderate
	Flooding	Low	Changes in surface water flows in the adjacent Newbawn stream	Negligible (adverse), indirect, temporary, reversible	Imperceptible
	Human Health	High	Change in the suitability of the onsite abstraction borehole for drinking water supply.	Negligible (beneficial), indirect, short term, reversible	Slight
			Change in exposure of staff to elevated manganese in water.	Negligible (adverse), indirect, short term, reversible	Slight

** Taking account of embedded mitigation*

Combined with the negligible, low or medium sensitivity of the identified receptors, the potential adverse effects caused by the Site through the review period are generally **imperceptible or slight, except for potential changes in flows in the adjacent Newbawn stream, which is classified as a moderate adverse effect.**

6.9 Remedial Measures Required

The potential effects are generally shown to be **imperceptible or slight**, except for the effects on flows in the Newbawn stream which are **moderate**; see Section 6.8. In order to further mitigate the effects associated with the Development as it currently stands on the water environment and human health, the following additional remedial mitigation measures should be carried out:

- An Environmental Management System (EMS) or Working Plan for the Site should be developed to establish good record keeping of incidents, record water uses for future activities and clearly embed mitigation practices and routine monitoring (see Section 6.12) into the Site practices;
- The effect of pumping/discharges upon the Newbawn stream warrants further monitoring to confirm current conditions (see also monitoring recommendations in Section 6.12);
- Pumping/discharges from the northwest waterbody should be minimised where possible. It may be possible to raise the height of the pump to allow for the water level to rebound further;
- Regular inspections of on-site equipment and tanks should be carried out to check for rusting and leaching of metals to ground;
- An emergency spill kit (including absorbers) should be available for use in the event of an accidental spill on the quarry floor and key personnel trained in its use;
- Treatment to lower manganese concentrations within the on-site water supply (DW1) is recommended and the supply should be routinely tested to assess ongoing suitability as the source of drinking water. Otherwise, only bottled water should be used at the Site;
- The on-site waterbodies should be inspected regularly for signs of any hydrocarbon contamination; and
- Maintenance and refuelling of vehicles and plant on Site should continue to be carried out on hardstanding;

6.10 Residual Effects

The assessment concludes that the existing Development has not given rise to significant adverse effects on the water environment at or surrounding the Site during the review period of 1990 to 2022. In all cases the residual adverse effect is **not significant and not greater than moderate.** The potential moderate adverse effect on flows within the Newbawn stream warrants further monitoring to confirm current (2022) conditions (see monitoring recommendations in Section 6.12).

6.11 Cumulative Effects

There is potential for the effects caused by the Site to have cumulative effects with the following:

- Groundwater abstraction could combine with adjacent residential properties to dewater the aquifer;
- Hydrocarbons and suspended solids captured in the northwest waterbody and discharged via the settlement ponds could combine in the River Avonmore with sources arising from runoff from the upstream Rathdrum area and any local residential or agricultural fuel stores; and
- Effects on surface water quality could combine with any upstream discharges from the nearby C&D waste facility and combine with any downstream discharges from the Ballese Wood Quarry (where the Newbawn stream discharges to the River Avonmore) and again further downstream with the poor discharges from

the Avoca Mine area, which is a historically polluted site (close to the confluence of the Rivers Avonmore and Avonbeg to form the River Avoca).

However, due to the predominant lack of hydraulic connectivity for groundwater, the large catchment area for the River Avonmore and the **not significant and not greater than moderate** nature of the effects assessed, there is considered to be limited potential for cumulative impacts to occur.

6.12 Monitoring

The following water monitoring is recommended to be carried out at the Site going forward, to monitor and allow mitigation of any future effects caused by continuation of the works:

- Groundwater level – where accessible, groundwater levels should be monitored at all borehole locations (BH1, BH2, MW1-MW5, GWL and DW1) and also at the on-Site ponds (northwest water body and northwest settlement ponds) on a minimum of a six-monthly basis (wet and dry season) to monitor the effects of pumping and dewatering from the excavated areas.
- Surface water level / flow rate – the depth of water and associated flow rates within the Newbawn stream should be monitored on a minimum of a monthly basis (reducing to quarterly after the first 12 months) during dewatering to confirm the occurrence and magnitude of effects due to pumping and dewatering from the excavated areas. Monitoring locations should be established within the Newbawn stream:
  - Immediately upstream of the Site (SW4 on Figure 6-11);
  - Immediately upstream of the discharge point (SW2 on Figure 6-11);
  - Immediately downstream of the discharge point (SW1 on Figure 6-11); and
  - At spatially distributed locations along the stretches of the stream which run along the northern and eastern Site boundaries (including SW3 on Figure 6-11).
- Groundwater quality – groundwater quality should be monitored on a minimum of an annual basis to capture any impacts on water quality. Where accessible, monitoring should be completed at the on-site monitoring boreholes (BH1, BH2, MW1-MW5) and the upgradient monitoring borehole (GWL).
- Drinking water quality – if treatment is applied, the on-site potable water supply well (DW1) should be tested on a minimum annual basis to assess the ongoing suitability for drinking water supply.
- Surface water quality – monthly quality samples should be collected at the discharge point to assess the quality of water leaving the Site. Quality samples should also be obtained from the existing surface water monitoring locations (SW1-SW4 on Figure 6-11) on a minimum annual basis to allow for ongoing assessment of water quality within the Newbawn stream.
- Abstraction, usage and discharge volumes – daily records of abstractions, discharges and on-Site water usage should be kept going forward, in order to appropriately characterise water movements on-Site and off-Site.

6.13 Difficulties Encountered

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

- There is no available groundwater quality or elevation data from 1990.
- There is no surface water quality data from 1990.

- The pre-quarrying groundwater elevation is not known and an estimated 'rest' groundwater elevation is based on interpretation of aerial photography, topographical surveys and observations during excavations.
- Assumptions have been made as to the infrastructure associated with the residential properties located in close vicinity to the southern boundary.
- Whilst spot sampling has occurred, flows within the Newbawn stream have not been routinely monitored throughout the review period, limiting the verification of any dewatering impacts on flows over time. However, monthly flow monitoring has begun and is scheduled between June 2022 and May 2023 to confirm.
- Water abstraction, operational use and discharge rates are not measured on-Site and are therefore estimated.

6.14 Summary and Conclusions

This assessment considers the potential impacts and effects on the water environment over the period of operation at the quarry Site since 1990.

Efforts were made to establish baseline conditions from 1990 and any changes in the quality of the water environment at the Site during the operational period since then, through desk-based review of available groundwater and surface water data, accessing publicly available data and, interrogation of recent groundwater and surface water quality data.

The main receptors that could be affected by changes to the water environment due to activities undertaken at the Site through the review period were identified and potential effects were assessed. Receptor linkages are limited by the low potential for hydraulic connectivity of groundwater at the Site with the surrounding area. Identified receptors in hydraulic connectivity with the Site were groundwater, surface water, on-site human health and flood risk areas. Receptor pathways for Natura 2000 sites and off-site human health were not identified.

Known design and embedded mitigation measures were considered during the initial assessment of impacts and effects. Where additional mitigation measures could be incorporated to reduce any impacts and effects further, these were identified. A residual assessment of impacts and effects was not required and there were no potential cumulative effects identified.

A small number of difficulties were encountered during this assessment (such as lack of early baseline data) and recommendations for ongoing monitoring at the Site have been presented.

In summary, the significance of effects arising to selected receptors resulting from the different potential impact sources are mostly predicted to be **negligible, slight or moderate and therefore not significant** in terms of this assessment. Further data collection and assessment of changes in flows within the Newbawn stream is warranted and monthly flow monitoring is scheduled between June 2022 and May 2023.

6.15 References

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APPENDIX 6.1

EPA Water Quality Data

Appendix 6-1: Summary of Available River Quality Data 1995-2021

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A030680	Alkalinity (as CaCO3)	2002	1	15	15	15	mg/l
10A030680	Alkalinity (as CaCO3)	2003	1	20	20	20	mg/l
10A030680	Alkalinity (as CaCO3)	2007	12	10	17.5	25	mg/l
10A030680	Alkalinity (as CaCO3)	2008	20	10	16.5	23	mg/l
10A030680	Alkalinity (as CaCO3)	2009	10	10	15.8	18	mg/l
10A030680	Alkalinity (as CaCO3)	2010	10	6	10	15	mg/l
10A030680	Alkalinity (as CaCO3)	2011	12	13	16.33333333	20	mg/l
10A030680	Alkalinity (as CaCO3)	2012	12	8	12.66666667	17	mg/l
10A030680	Alkalinity (as CaCO3)	2013	12	10	15	28	mg/l
10A030680	Alkalinity (as CaCO3)	2014	12	12	15.66666667	24	mg/l
10A030680	Alkalinity (as CaCO3)	2015	12	10	11.83333333	13	mg/l
10A030680	Alkalinity (as CaCO3)	2016	10	5.6	7.58	8.6	mg/l
10A030680	Alkalinity (as CaCO3)	2017	10	6.3	9.6	13.7	mg/l
10A030680	Alkalinity (as CaCO3)	2018	10	5.4	10.16	15.2	mg/l
10A030680	Alkalinity (as CaCO3)	2019	10	7.9	9.54	12.7	mg/l
10A030680	Alkalinity (as CaCO3)	2020	8	6.3	9.525	12.8	mg/l
10A030680	Alkalinity (as CaCO3)	2021	10	10.6	12.14	14.5	mg/l
10A030680	Aluminium - filtered	2020	8	39	116.25	230	µg/l
10A030680	Aluminium - filtered	2021	10	33	52.4	85	µg/l
10A030680	Ammonia	2001	1	0.01	0.01	0.01	mg/l
10A030680	Ammonia	2003	2	0.005	0.0125	0.02	mg/l
10A030680	Ammonia	2005	10	0.0082	0.01302	0.032	mg/l
10A030680	Ammonia	2007	12	0	0.006833333	0.016	mg/l
10A030680	Ammonia	2008	18	0	0.01	0.021	mg/l
10A030680	Ammonia	2009	10	0	0.0068	0.014	mg/l
10A030680	Ammonia	2010	10	0.003	0.0066	0.012	mg/l
10A030680	Ammonia	2011	12	0.006	0.010666667	0.014	mg/l
10A030680	Ammonia	2012	12	0.003	0.010833333	0.015	mg/l
10A030680	Ammonia	2013	12	0.007	0.015166667	0.025	mg/l
10A030680	Ammonia	2014	12	0.003	0.011833333	0.017	mg/l
10A030680	Ammonia	2015	12	0.001	0.012666667	0.026	mg/l
10A030680	Ammonia	2017	2	0.021	0.021	0.021	mg/l
10A030680	Ammonia	2019	2	0.027	0.027	0.027	mg/l
10A030680	Barium - filtered	2020	8	5.6	6.35	7.1	µg/l
10A030680	Barium - filtered	2021	10	5.3	5.56	6.2	µg/l
10A030680	BOD	2001	1	1.549999952	1.549999952	1.549999952	mg/l
10A030680	BOD	2002	2	1	1.585000038	2.170000076	mg/l
10A030680	BOD	2003	2	1	1	1	mg/l
10A030680	BOD	2005	11	0.56	1.502727273	3.4	mg/l
10A030680	BOD	2006	2	2.4	2.55	2.7	mg/l
10A030680	BOD	2007	12	0.9	1.35	1.8	mg/l
10A030680	BOD	2008	20	0.5	1.33	1.9	mg/l
10A030680	BOD	2009	10	0.7	0.98	1.3	mg/l
10A030680	BOD	2010	10	0.8	1	1.2	mg/l
10A030680	BOD	2011	12	0.8	1.25	2	mg/l
10A030680	BOD	2012	12	0.3	0.666666667	1.1	mg/l
10A030680	BOD	2013	12	0.3	0.67	1.02	mg/l
10A030680	BOD	2014	12	0.4	0.505	0.7	mg/l
10A030680	BOD	2015	12	0.6	1.15	2.1	mg/l
10A030680	BOD	2020	2	1.2	1.2	1.2	mg/l
10A030680	Cadmium - filtered	2020	8	0.08	0.1025	0.13	µg/l
10A030680	Cadmium - filtered	2021	10	0.07	0.082	0.1	µg/l
10A030680	Calcium - filtered	2020	8	2	3.125	4.1	mg/l
10A030680	Calcium - filtered	2021	10	3.2	3.88	4.9	mg/l
10A030680	Chloride	2002	1	9	9	9	mg/l
10A030680	Chloride	2003	2	9	9.355000019	9.710000038	mg/l
10A030680	Chloride	2005	10	6.4	10.26112	14.7	mg/l
10A030680	Chloride	2006	10	7.1	9.159	11.8	mg/l
10A030680	Chloride	2007	12	8.2	9.616666667	11	mg/l
10A030680	Chloride	2008	10	6.92	9.044	10	mg/l
10A030680	Chloride	2016	10	7.34	7.906	9.06	mg/l
10A030680	Chloride	2017	10	6.44	9.11	10.5	mg/l
10A030680	Chloride	2018	10	9.07	11.314	13	mg/l
10A030680	Chloride	2019	10	8.44	10.548	12.1	mg/l
10A030680	Chloride	2020	8	7.18	9.7775	12.5	mg/l
10A030680	Chloride	2021	10	8.45	9.734	10.7	mg/l
10A030680	Colour	2002	1	80	80	80	Hazen
10A030680	Conductivity	2001	1	61.79999924	61.79999924	61.79999924	µS/cm
10A030680	Conductivity	2002	2	52	58	64	µS/cm
10A030680	Conductivity	2003	2	64	70	76	µS/cm
10A030680	Conductivity	2006	10	44.4	63.31	85.5	µS/cm
10A030680	Conductivity	2007	12	60.6	69.5	77	µS/cm
10A030680	Conductivity	2008	20	53	65.52	82.3	µS/cm
10A030680	Conductivity	2009	10	54	64.1	74.5	µS/cm
10A030680	Conductivity	2010	10	45	71.8	119	µS/cm
10A030680	Conductivity	2011	12	36	61.83333333	77	µS/cm
10A030680	Conductivity	2012	12	29	55.5	70	µS/cm
10A030680	Conductivity	2013	12	47	66.66666667	99	µS/cm
10A030680	Conductivity	2014	12	57	72.16666667	102	µS/cm
10A030680	Conductivity	2015	12	42	52.66666667	66	µS/cm
10A030680	Conductivity	2016	10	45	52.6	63	µS/cm
10A030680	Conductivity	2017	10	41	64.8	82	µS/cm
10A030680	Conductivity	2018	10	56	78.6	96	µS/cm

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A030680	Conductivity	2019	10	59	74	84	µS/cm
10A030680	Conductivity	2020	8	47	67.25	83	µS/cm
10A030680	Conductivity	2021	10	64	74.4	85	µS/cm
10A030680	Copper - filtered	2020	8	1.6	5.625	12	µg/l
10A030680	Copper - filtered	2021	10	1	1.32	1.7	µg/l
10A030680	Dissolved Organic Carbon	2019	10	2.8	4.92	7.6	mg/l
10A030680	Dissolved Organic Carbon	2020	8	2.6	4.75	8	mg/l
10A030680	Dissolved Organic Carbon	2021	10	2.6	3.42	4.9	mg/l
10A030680	Dissolved Oxygen	2001	1	102	102	102	% Saturation
10A030680	Dissolved Oxygen	2002	2	99	99.5	100	% Saturation
10A030680	Dissolved Oxygen	2003	2	103	103.5	104	% Saturation
10A030680	Dissolved Oxygen	2005	11	96.3	99.86363636	106.2	% Saturation
10A030680	Dissolved Oxygen	2006	20	8.81	55.816	104	% Saturation
10A030680	Dissolved Oxygen	2007	12	97	100.5333333	104	% Saturation
10A030680	Dissolved Oxygen	2008	20	98.2	100.62	104.8	% Saturation
10A030680	Dissolved Oxygen	2009	10	98	99.3	101.6	% Saturation
10A030680	Dissolved Oxygen	2010	10	97.7	99.44	104.4	% Saturation
10A030680	Dissolved Oxygen	2011	12	98	100.0166667	104	% Saturation
10A030680	Dissolved Oxygen	2012	12	97	100.25	104	% Saturation
10A030680	Dissolved Oxygen	2013	12	97.8	100.3833333	103	% Saturation
10A030680	Dissolved Oxygen	2014	12	92.1	99.06666667	102.3	% Saturation
10A030680	Dissolved Oxygen	2015	12	95.3	99.5	101.6	% Saturation
10A030680	Dissolved Oxygen	2016	10	97	100.8	105	% Saturation
10A030680	Dissolved Oxygen	2017	10	100	102.6	108	% Saturation
10A030680	Dissolved Oxygen	2018	8	87	95.5	101	% Saturation
10A030680	Dissolved Oxygen	2019	10	93	101	108	% Saturation
10A030680	Dissolved Oxygen	2020	8	94	101.75	108	% Saturation
10A030680	Dissolved Oxygen	2021	10	100	103.8	106	% Saturation
10A030680	Dissolved Oxygen	2001	1	11.43999958	11.43999958	11.43999958	mg/l
10A030680	Dissolved Oxygen	2002	2	10.18000031	10.22000027	10.26000023	mg/l
10A030680	Dissolved Oxygen	2003	2	11.10000038	11.17000008	11.23999977	mg/l
10A030680	Dissolved Oxygen	2005	11	9.7	11.00909091	12.2	mg/l
10A030680	Dissolved Oxygen	2007	12	10.09	11.43833333	13.06	mg/l
10A030680	Dissolved Oxygen	2008	20	10.17	11.143	12.31	mg/l
10A030680	Dissolved Oxygen	2009	10	10.16	11.262	12.14	mg/l
10A030680	Dissolved Oxygen	2010	10	9.65	11.574	13.48	mg/l
10A030680	Dissolved Oxygen	2011	12	9.4	11.47	13.5	mg/l
10A030680	Dissolved Oxygen	2012	12	9.7	11.31	12.16	mg/l
10A030680	Dissolved Oxygen	2013	12	9.93	11.45833333	12.4	mg/l
10A030680	Dissolved Oxygen	2014	12	10.54	11.36833333	12.28	mg/l
10A030680	Dissolved Oxygen	2015	12	9.62	11.205	12.74	mg/l
10A030680	Dissolved Oxygen	2016	10	10	11.48	12.7	mg/l
10A030680	Dissolved Oxygen	2017	10	10.6	11.28	12.2	mg/l
10A030680	Dissolved Oxygen	2018	8	8.5	11.325	13.1	mg/l
10A030680	Dissolved Oxygen	2019	10	10.3	11.54	12.9	mg/l
10A030680	Dissolved Oxygen	2020	8	10.6	10.925	11.5	mg/l
10A030680	Dissolved Oxygen	2021	10	10.4	11.5	12.6	mg/l
10A030680	Hardness	2002	1	18	18	18	mg/l
10A030680	Hardness	2003	1	20	20	20	mg/l
10A030680	Iron - filtered	2020	8	48	107	160	µg/l
10A030680	Iron - filtered	2021	10	36	65	110	µg/l
10A030680	Lead - filtered	2020	8	0.62	2.58	4.3	µg/l
10A030680	Lead - filtered	2021	10	0.7	1.03	1.5	µg/l
10A030680	Magnesium - filtered	2020	8	0.99	1.4475	1.8	mg/l
10A030680	Magnesium - filtered	2021	10	1.5	1.74	2.1	mg/l
10A030680	Manganese - filtered	2020	8	8.1	11.275	15	µg/l
10A030680	Manganese - filtered	2021	10	6.4	7.64	9.6	µg/l
10A030680	Mercury - filtered	2020	4	0.024	0.048	0.072	µg/l
10A030680	NH3-N-num	2006	10	0.01	0.04755	0.34	mg/l
10A030680	Nitrate	2016	10	0.39	0.534	0.91	mg/l
10A030680	Nitrate	2017	8	0.56	0.8475	1.1	mg/l
10A030680	Nitrate	2018	10	0.34	0.922	1.3	mg/l
10A030680	Nitrate	2019	10	0.62	1.114	1.8	mg/l
10A030680	Nitrate	2020	8	0.37	0.615	0.82	mg/l
10A030680	Nitrate	2021	10	0.42	0.788	1.1	mg/l
10A030680	Nitrite	2003	2	0.005	0.0051	0.0052	mg/l
10A030680	Nitrite	2005	10	0.0021	0.00471	0.005	mg/l
10A030680	Nitrite	2007	12	0.002	0.003333333	0.005	mg/l
10A030680	Nitrite	2008	18	0.002	0.003888889	0.007	mg/l
10A030680	Nitrite	2009	10	0.002	0.0028	0.004	mg/l
10A030680	Nitrite	2010	10	0.001	0.0026	0.004	mg/l
10A030680	Nitrite	2011	12	0.001	0.003166667	0.006	mg/l
10A030680	Nitrite	2012	12	0	0.001883333	0.004	mg/l
10A030680	Nitrite	2013	12	0.001	0.003166667	0.007	mg/l
10A030680	Nitrite	2014	12	0.0001	0.00485	0.012	mg/l
10A030680	Nitrite	2015	12	0.003	0.004833333	0.008	mg/l
10A030680	Nitrite	2018	2	0.00432	0.00432	0.00432	mg/l
10A030680	Nitrite	2019	2	0.0063	0.0063	0.0063	mg/l
10A030680	Ortho-Phosphate	2001	1	0.016000001	0.016000001	0.016000001	mg/l
10A030680	Ortho-Phosphate	2002	1	0.063000001	0.063000001	0.063000001	mg/l
10A030680	Ortho-Phosphate	2003	2	0.005	0.01	0.015	mg/l
10A030680	Ortho-Phosphate	2005	11	0.005	0.024090909	0.076	mg/l
10A030680	Ortho-Phosphate	2006	3	0.011	0.019	0.033	mg/l
10A030680	Ortho-Phosphate	2007	12	0.005	0.007833333	0.01	mg/l

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A030680	Ortho-Phosphate	2008	20	0.002	0.0075	0.015	mg/l
10A030680	Ortho-Phosphate	2009	10	0.004	0.0062	0.007	mg/l
10A030680	Ortho-Phosphate	2010	10	0	0.003	0.005	mg/l
10A030680	Ortho-Phosphate	2011	12	0.001	0.005166667	0.011	mg/l
10A030680	Ortho-Phosphate	2012	12	0.003	0.005333333	0.009	mg/l
10A030680	Ortho-Phosphate	2013	12	0.002	0.006833333	0.016	mg/l
10A030680	Ortho-Phosphate	2014	12	0.002	0.007166667	0.015	mg/l
10A030680	Ortho-Phosphate	2015	12	0.002	0.006666667	0.012	mg/l
10A030680	Ortho-Phosphate	2021	2	0.014	0.014	0.014	mg/l
10A030680	pH	2001	1	6.739999771	6.739999771	6.739999771	pH units
10A030680	pH	2002	2	6.510000229	6.635000229	6.760000229	pH units
10A030680	pH	2003	2	6.190000057	6.755000114	7.320000172	pH units
10A030680	pH	2005	11	5.77	6.661818182	7.63	pH units
10A030680	pH	2006	10	5.99	6.745	8.41	pH units
10A030680	pH	2007	12	5.84	6.97	7.95	pH units
10A030680	pH	2008	20	5.71	6.098	6.89	pH units
10A030680	pH	2009	10	6.09	6.434	6.71	pH units
10A030680	pH	2010	10	5.54	6.222	6.86	pH units
10A030680	pH	2011	12	5.91	6.445	6.9	pH units
10A030680	pH	2012	12	5.79	6.255	6.7	pH units
10A030680	pH	2013	12	5.66	5.863333333	6.24	pH units
10A030680	pH	2014	12	5.14	5.665	5.92	pH units
10A030680	pH	2015	12	5.49	6.006666667	6.91	pH units
10A030680	pH	2016	10	6.3	6.86	7.4	pH units
10A030680	pH	2017	10	6.4	6.82	7.1	pH units
10A030680	pH	2018	10	6.5	6.8	7	pH units
10A030680	pH	2019	10	6.7	6.92	7.2	pH units
10A030680	pH	2020	8	6.5	6.875	7.1	pH units
10A030680	pH	2021	10	7	7.1	7.2	pH units
10A030680	Potassium - filtered	2020	8	0.34	0.565	0.78	mg/l
10A030680	Potassium - filtered	2021	10	0.49	0.532	0.57	mg/l
10A030680	Sodium - filtered	2020	8	4.4	5.525	7.1	mg/l
10A030680	Sodium - filtered	2021	10	4.9	5.62	6.9	mg/l
10A030680	Strontium - filtered	2020	8	10	14.75	21	µg/l
10A030680	Strontium - filtered	2021	10	14	15.8	19	µg/l
10A030680	Temperature	2001	1	9.899999619	9.899999619	9.899999619	°C
10A030680	Temperature	2002	2	12.5	13.44999981	14.39999962	°C
10A030680	Temperature	2003	2	12	12.19999981	12.39999962	°C
10A030680	Temperature	2005	11	6.3	11.29090909	16.3	°C
10A030680	Temperature	2006	10	6.3	11.01	20.1	°C
10A030680	Temperature	2007	12	4.5	9.666666667	14	°C
10A030680	Temperature	2008	20	6.4	10.59	14.7	°C
10A030680	Temperature	2009	10	4.8	9.8	14	°C
10A030680	Temperature	2010	10	2.6	9.14	15.1	°C
10A030680	Temperature	2011	12	3.2	9.6	16.5	°C
10A030680	Temperature	2012	12	7.5	10.48333333	15.3	°C
10A030680	Temperature	2013	12	5.3	9.366666667	17.4	°C
10A030680	Temperature	2014	12	5.8	9.6	13.6	°C
10A030680	Temperature	2015	12	5.2	10.06666667	16.3	°C
10A030680	Temperature	2016	10	4.3	9.92	14.8	°C
10A030680	Temperature	2017	10	6.8	11.24	15.6	°C
10A030680	Temperature	2018	10	4.1	9.22	17	°C
10A030680	Temperature	2019	10	5.3	9.74	16.7	°C
10A030680	Temperature	2020	8	8.1	11.6	15.7	°C
10A030680	Temperature	2021	10	7	10.8	15.1	°C
10A030680	Total Ammonium	2006	4	0.02	0.103875	0.34	mg/l
10A030680	Total Hardness	2005	11	10	18.72727273	30	mg/l CaCO3
10A030680	Total Hardness	2006	10	12	31.2	60	mg/l CaCO3
10A030680	Total Hardness (as CaCO3)	2007	12	20	26.16666667	32	mg/l
10A030680	Total Hardness (as CaCO3)	2008	20	13	19.94	25	mg/l
10A030680	Total Hardness (as CaCO3)	2009	10	14	21	37	mg/l
10A030680	Total Hardness (as CaCO3)	2010	10	8	19.6	34	mg/l
10A030680	Total Hardness (as CaCO3)	2011	12	11	18.5	26	mg/l
10A030680	Total Hardness (as CaCO3)	2012	12	7	17.33333333	21	mg/l
10A030680	Total Hardness (as CaCO3)	2013	12	11	20.83333333	48	mg/l
10A030680	Total Hardness (as CaCO3)	2014	12	17	20.66666667	29	mg/l
10A030680	Total Hardness (as CaCO3)	2015	12	11	15.16666667	20	mg/l
10A030680	Total Hardness (as CaCO3)	2016	10	13	14.2	16	mg/l
10A030680	Total Hardness (as CaCO3)	2017	10	14	18.8	23	mg/l
10A030680	Total Hardness (as CaCO3)	2018	10	10	19.4	26	mg/l
10A030680	Total Hardness (as CaCO3)	2019	10	15	24	47	mg/l
10A030680	Total Hardness (as CaCO3)	2020	8	11	18	28	mg/l
10A030680	Total Hardness (as CaCO3)	2021	10	15	19.2	23	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2005	11	0.465	0.9342	1.31	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2006	10	0.47	1.053	1.49	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2007	12	0.73	1.003333333	1.41	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2008	20	0.61	0.969	1.48	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2009	10	0.79	0.996	1.18	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2010	10	0.32	0.852	1.26	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2011	12	0.24	0.866666667	1.41	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2012	12	0.41	0.853333333	1.16	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2013	12	0.37	0.826666667	1.09	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2014	12	0.54	0.828333333	1.06	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2015	12	0.23	0.523333333	0.86	mg/l

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A030680	Total Oxidised Nitrogen (as N)	2016	10	0.39	0.534	0.91	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2017	8	0.56	0.8725	1.2	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2018	10	0.34	0.924	1.3	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2019	10	0.62	1.114	1.8	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2020	8	0.37	0.615	0.82	mg/l
10A030680	Total Oxidised Nitrogen (as N)	2021	10	0.42	0.788	1.1	mg/l
10A030680	True Colour	2007	12	30	48.33333333	100	Hazen
10A030680	True Colour	2008	20	25	61	110	Hazen
10A030680	True Colour	2009	10	30	53	70	Hazen
10A030680	True Colour	2010	10	2.5	46.5	100	Hazen
10A030680	True Colour	2011	12	20	55.83333333	110	Hazen
10A030680	True Colour	2012	12	25	56.66666667	110	Hazen
10A030680	True Colour	2013	12	43	55.5	102	Hazen
10A030680	True Colour	2014	12	40	51.5	67	Hazen
10A030680	True Colour	2015	12	50	95.33333333	172	Hazen
10A030680	True Colour	2016	10	38	59.8	75	mg/litre Pt Co
10A030680	True Colour	2017	10	21	56.4	124	mg/litre Pt Co
10A030680	True Colour	2018	10	12	31.6	59	mg/litre Pt Co
10A030680	True Colour	2019	10	29	56.2	98	mg/litre Pt Co
10A030680	True Colour	2020	8	22	54.75	101	mg/litre Pt Co
10A030680	True Colour	2021	10	22	31.6	48	mg/litre Pt Co
10A030680	Un-ionised Ammonia	2001	1	0.000122757	0.000122757	0.000122757	mg/l
10A030680	Un-ionised Ammonia	2003	2	-1E-04	6.48056E-06	0.000112961	mg/l
10A030680	Vanadium - filtered	2021	2	1	1	1	µg/l
10A030680	Zinc - filtered	2020	8	26	32.75	43	µg/l
10A030680	Zinc - filtered	2021	10	22	24.2	28	µg/l
10A040800	1,1,2,2-Tetrachloroethane	2009	1	0.1	0.1	0.1	µg/l
10A040800	1,2,3-Trichlorobenzene	2009	1	0.1	0.1	0.1	µg/l
10A040800	1,2,4-Trichlorobenzene	2009	1	0.1	0.1	0.1	µg/l
10A040800	1,2,4-Trimethylbenzene	2009	2	0.1	0.1	0.1	µg/l
10A040800	1,3,5-Trimethylbenzene	2009	1	0.1	0.1	0.1	µg/l
10A040800	1,3-Dichlorobenzene	2009	1	8.4	8.4	8.4	µg/l
10A040800	1,4-Dichlorobenzene	2009	1	0.1	0.1	0.1	µg/l
10A040800	2,4-D	2009	1	0.09	0.09	0.09	µg/l
10A040800	2,6-Dichlorobenzamide	2012	2	0.074	0.075	0.076	µg/l
10A040800	4-Isopropyltoluene	2009	1	0.1	0.1	0.1	µg/l
10A040800	Alkalinity (as CaCO3)	2006	2	20	20	20	mg/l
10A040800	Alkalinity (as CaCO3)	2007	10	5	13.5	25	mg/l
10A040800	Alkalinity (as CaCO3)	2008	20	6	12.1	22	mg/l
10A040800	Alkalinity (as CaCO3)	2009	16	7	11.5625	18	mg/l
10A040800	Alkalinity (as CaCO3)	2010	15	5	11.66666667	19	mg/l
10A040800	Alkalinity (as CaCO3)	2011	17	5	10.17647059	18	mg/l
10A040800	Alkalinity (as CaCO3)	2012	18	8	11.72222222	18	mg/l
10A040800	Alkalinity (as CaCO3)	2013	18	5	11.61111111	17	mg/l
10A040800	Alkalinity (as CaCO3)	2014	18	5	10.27777778	17	mg/l
10A040800	Alkalinity (as CaCO3)	2015	8	9	11.625	15	mg/l
10A040800	Alkalinity (as CaCO3)	2016	12	4.1	8.641666667	12.7	mg/l
10A040800	Alkalinity (as CaCO3)	2017	11	4.1	9.209090909	13.4	mg/l
10A040800	Alkalinity (as CaCO3)	2018	12	4.8	10.1	15.2	mg/l
10A040800	Alkalinity (as CaCO3)	2019	12	4.9	8.841666667	12.7	mg/l
10A040800	Alkalinity (as CaCO3)	2020	12	4.6	9.683333333	13.8	mg/l
10A040800	Alkalinity (as CaCO3)	2021	12	3.5	8.775	14.4	mg/l
10A040800	Alkalinity (as CaCO3)	2022	2	5.7	8.2	10.7	mg/l
10A040800	Aluminium - filtered	2018	12	24	71.58333333	170	µg/l
10A040800	Aluminium - unspecified	2009	8	67	127.25	206	µg/l
10A040800	Aluminium - unspecified	2012	12	47	89.83333333	187	µg/l
10A040800	Ammonia	2007	7	0	0.053428571	0.32	mg/l
10A040800	Ammonia	2008	16	0	0.0169375	0.07	mg/l
10A040800	Ammonia	2009	8	0	0.004275	0.01	mg/l
10A040800	Ammonia	2010	14	0	0.016071429	0.06	mg/l
10A040800	Ammonia	2011	12	0	0.01675	0.05	mg/l
10A040800	Ammonia	2012	11	0	0.017090909	0.08	mg/l
10A040800	Ammonia	2013	13	0.003	0.013153846	0.043	mg/l
10A040800	Ammonia	2014	6	0	0.006666667	0.018	mg/l
10A040800	Ammonia	2015	8	0.001	0.017625	0.046	mg/l
10A040800	Ammonia	2017	1	0.021	0.021	0.021	mg/l
10A040800	Ammonia	2018	1	0.11	0.11	0.11	mg/l
10A040800	Ammonia	2019	3	0.022	0.024	0.027	mg/l
10A040800	Ammonia	2020	1	0.048	0.048	0.048	mg/l
10A040800	Ammonia	2021	2	0.021	0.0255	0.03	mg/l
10A040800	Anthracene	2018	1	0.191	0.191	0.191	µg/l
10A040800	Apparent colour	2007	3	65	82.33333333	91	Hazen
10A040800	Apparent colour	2008	12	10	75.33333333	280	Hazen
10A040800	Apparent colour	2009	12	12	54.16666667	149	Hazen
10A040800	Apparent colour	2010	12	6	45.41666667	184	Hazen
10A040800	Arsenic - unspecified	2012	4	0.6	0.7	0.8	µg/l
10A040800	Barium - filtered	2018	12	6	7.05	8.2	µg/l
10A040800	Barium - unspecified	2012	12	4.5	7.008333333	11.1	µg/l
10A040800	Benzo(a)pyrene	2009	5	0.003	0.0146	0.052	µg/l
10A040800	Benzo(a)pyrene	2018	1	0.199	0.199	0.199	µg/l
10A040800	Benzo(b)fluoranthene	2009	2	0.012	0.0345	0.057	µg/l
10A040800	Benzo(b)fluoranthene	2018	2	0.01	0.1045	0.199	µg/l
10A040800	Benzo(g,h,i)perylene	2009	1	0.019	0.019	0.019	µg/l
10A040800	Benzo(g,h,i)perylene	2012	5	0.002	0.0044	0.009	µg/l

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A040800	Benzo(g,h,i)perylene	2018	1	0.252	0.252	0.252	µg/l
10A040800	Benzo(k)fluoranthene	2009	2	0.005	0.016	0.027	µg/l
10A040800	Benzo(k)fluoranthene	2018	2	0.03	0.1005	0.171	µg/l
10A040800	BOD	2006	2	2.4	2.975	3.55	mg/l
10A040800	BOD	2007	6	0.75	1.28	2.6	mg/l
10A040800	BOD	2008	12	0.8	1.35	2	mg/l
10A040800	BOD	2009	9	0.5	1.544444444	3	mg/l
10A040800	BOD	2010	7	1	2	5	mg/l
10A040800	BOD	2011	6	0.8	1.266666667	2	mg/l
10A040800	BOD	2012	8	0.5	1.225	3	mg/l
10A040800	BOD	2013	7	0.3	0.931428571	2	mg/l
10A040800	BOD	2014	6	0.2	0.485	0.9	mg/l
10A040800	BOD	2015	8	0.7	1.15	1.8	mg/l
10A040800	BOD	2016	3	1	1.1	1.2	mg/l
10A040800	BOD	2017	1	1.1	1.1	1.1	mg/l
10A040800	BOD	2018	2	1	1.2	1.4	mg/l
10A040800	BOD	2019	5	1	1.18	1.4	mg/l
10A040800	BOD	2020	1	1	1	1	mg/l
10A040800	BOD	2021	2	1.1	1.6	2.1	mg/l
10A040800	Boron - unspecified	2012	1	54	54	54	µg/l
10A040800	Cadmium - filtered	2018	12	0.04	0.063333333	0.09	µg/l
10A040800	Cadmium - unspecified	2009	1	0.1	0.1	0.1	µg/l
10A040800	Cadmium - unspecified	2012	2	0.1	0.2	0.3	µg/l
10A040800	Calcium - filtered	2018	12	2.2	4.308333333	6.4	mg/l
10A040800	Calcium - unspecified	2009	12	2	4.166666667	6	mg/l
10A040800	Calcium - unspecified	2012	12	2.4	4.266666667	5.3	mg/l
10A040800	Chloride	2006	10	5.82	8.48	10.1	mg/l
10A040800	Chloride	2007	9	6.5	8.311111111	10.1	mg/l
10A040800	Chloride	2008	17	4.6	9.119411765	17.9	mg/l
10A040800	Chloride	2009	12	5.7	7.975	10.3	mg/l
10A040800	Chloride	2010	11	1.7	6.727272727	8.7	mg/l
10A040800	Chloride	2011	11	5.8	7.163636364	8.8	mg/l
10A040800	Chloride	2012	12	4.9	7.408333333	8.2	mg/l
10A040800	Chloride	2013	11	6.9	8.3	10	mg/l
10A040800	Chloride	2014	12	7	9.166666667	11	mg/l
10A040800	Chloride	2015	12	6	8.75	11	mg/l
10A040800	Chloride	2016	12	5.45	7.639166667	8.97	mg/l
10A040800	Chloride	2017	12	5.01	8.155833333	10.2	mg/l
10A040800	Chloride	2018	12	7.16	9.940833333	12.9	mg/l
10A040800	Chloride	2019	12	6.24	8.864166667	11.2	mg/l
10A040800	Chloride	2020	12	5.86	8.756666667	10.8	mg/l
10A040800	Chloride	2021	12	4.14	8.101666667	10.8	mg/l
10A040800	Chloride	2022	2	7.88	9.14	10.4	mg/l
10A040800	Cobalt - filtered	2018	1	1.7	1.7	1.7	µg/l
10A040800	Cobalt - unspecified	2009	1	1	1	1	µg/l
10A040800	Conductivity	2006	10	41.5	64.85	73.2	µS/cm
10A040800	Conductivity	2007	10	41	58.04	73.6	µS/cm
10A040800	Conductivity	2008	22	33	72.14090909	237	µS/cm
10A040800	Conductivity	2009	17	40	60.49411765	73	µS/cm
10A040800	Conductivity	2010	17	32	59.47058824	76	µS/cm
10A040800	Conductivity	2011	18	25	55.09444444	70	µS/cm
10A040800	Conductivity	2012	18	26	60.44444444	75	µS/cm
10A040800	Conductivity	2013	18	38	63.66666667	87	µS/cm
10A040800	Conductivity	2014	18	47	67.27777778	81	µS/cm
10A040800	Conductivity	2015	18	31	55.94444444	77	µS/cm
10A040800	Conductivity	2016	12	34	55.66666667	71	µS/cm
10A040800	Conductivity	2017	12	28	60.91666667	78	µS/cm
10A040800	Conductivity	2018	12	49	74.58333333	113	µS/cm
10A040800	Conductivity	2019	12	41	67.25	83	µS/cm
10A040800	Conductivity	2020	12	32	65.08333333	80	µS/cm
10A040800	Conductivity	2021	12	27	57.91666667	80	µS/cm
10A040800	Conductivity	2022	2	46	62	78	µS/cm
10A040800	Copper - filtered	2018	3	1	1.133333333	1.2	µg/l
10A040800	Copper - unspecified	2009	2	1	1	1	µg/l
10A040800	Copper - unspecified	2012	10	0.5	1.5	3.9	µg/l
10A040800	Di(2-ethylhexyl) phthalate (DEHP	2009	5	0.08	0.21	0.4	µg/l
10A040800	Dissolved Organic Carbon	2012	6	2	4.166666667	10	mg/l
10A040800	Dissolved Organic Carbon	2018	12	2.2	3.858333333	9.2	mg/l
10A040800	Dissolved Oxygen	2007	10	96	100.8	105	% Saturation
10A040800	Dissolved Oxygen	2008	22	92	100.25	107	% Saturation
10A040800	Dissolved Oxygen	2009	14	92	99.48571429	103	% Saturation
10A040800	Dissolved Oxygen	2010	17	83.6	97.21764706	107	% Saturation
10A040800	Dissolved Oxygen	2011	18	74	98.22222222	107.7	% Saturation
10A040800	Dissolved Oxygen	2012	18	94.9	101.4611111	114.3	% Saturation
10A040800	Dissolved Oxygen	2013	18	89.5	98.45555556	102.9	% Saturation
10A040800	Dissolved Oxygen	2014	18	93.9	99.52222222	103.3	% Saturation
10A040800	Dissolved Oxygen	2015	18	92.9	99.71666667	104.6	% Saturation
10A040800	Dissolved Oxygen	2016	12	98	101.5	107	% Saturation
10A040800	Dissolved Oxygen	2017	12	97	103.0833333	108	% Saturation
10A040800	Dissolved Oxygen	2018	12	96	102.8333333	109	% Saturation
10A040800	Dissolved Oxygen	2019	12	89	101.4166667	109	% Saturation
10A040800	Dissolved Oxygen	2020	12	94	103.4166667	108	% Saturation
10A040800	Dissolved Oxygen	2021	12	101	103.75	108	% Saturation
10A040800	Dissolved Oxygen	2022	2	107	108.5	110	% Saturation

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A040800	Dissolved Oxygen	2007	10	9.8	11.16	12.2	mg/l
10A040800	Dissolved Oxygen	2008	22	9.5	11.29409091	13.1	mg/l
10A040800	Dissolved Oxygen	2009	14	8.9	10.94642857	12.3	mg/l
10A040800	Dissolved Oxygen	2010	17	8.7	10.55294118	14.2	mg/l
10A040800	Dissolved Oxygen	2011	18	5.8	11.00555556	13.5	mg/l
10A040800	Dissolved Oxygen	2012	18	9.6	11.36111111	14	mg/l
10A040800	Dissolved Oxygen	2013	18	9.1	10.97	12.6	mg/l
10A040800	Dissolved Oxygen	2014	18	9.7	11.24166667	12.65	mg/l
10A040800	Dissolved Oxygen	2015	18	9.2	11.08444444	12.5	mg/l
10A040800	Dissolved Oxygen	2016	12	10.1	11.6	13.5	mg/l
10A040800	Dissolved Oxygen	2017	12	10.4	11.66666667	13.2	mg/l
10A040800	Dissolved Oxygen	2018	12	9.7	11.775	13	mg/l
10A040800	Dissolved Oxygen	2019	12	8.9	11.725	13.7	mg/l
10A040800	Dissolved Oxygen	2020	12	10.4	11.9	14.1	mg/l
10A040800	Dissolved Oxygen	2021	12	10.6	12.16666667	13.4	mg/l
10A040800	Dissolved Oxygen	2022	2	12.3	12.45	12.6	mg/l
10A040800	Dissolved Oxygen	2006	20	9.7	56.3065	104	% Saturation
10A040800	Ethylbenzene	2009	1	0.2	0.2	0.2	µg/l
10A040800	Fluoranthene	2009	5	0.005	0.0316	0.097	µg/l
10A040800	Fluoranthene	2018	3	0.024	0.122	0.308	µg/l
10A040800	Fluoride	2010	3	0.05	0.063333333	0.09	mg/l
10A040800	Fluoride	2011	1	0.05	0.05	0.05	mg/l
10A040800	Fluoride	2012	3	0.06	0.07	0.08	mg/l
10A040800	Glyphosate	2009	2	0.1	0.495	0.89	µg/l
10A040800	Hexachlorobutadiene	2009	1	0.1	0.1	0.1	µg/l
10A040800	Indeno(1,2,3-c,d)pyrene	2009	2	0.007	0.0245	0.042	µg/l
10A040800	Indeno(1,2,3-c,d)pyrene	2012	8	0.001	0.003625	0.008	µg/l
10A040800	Indeno(1,2,3-c,d)pyrene	2018	2	0.007	0.141	0.275	µg/l
10A040800	Iron - filtered	2018	12	36	74.16666667	190	µg/l
10A040800	Iron - unspecified	2009	9	64	90.44444444	136	µg/l
10A040800	Iron - unspecified	2012	12	49	102.4166667	255	µg/l
10A040800	Lead - filtered	2018	12	0.52	1.9075	5.8	µg/l
10A040800	Lead - unspecified	2009	12	1	3.166666667	6	µg/l
10A040800	Lead - unspecified	2012	12	1	3.641666667	10.8	µg/l
10A040800	Magnesium - filtered	2018	12	1	1.675	2.4	mg/l
10A040800	Magnesium - unspecified	2009	12	1	1.583333333	2	mg/l
10A040800	Magnesium - unspecified	2012	12	1.05	1.615	2.09	mg/l
10A040800	Manganese - filtered	2018	11	5	14.3	23	µg/l
10A040800	Manganese - unspecified	2009	12	4	16.58333333	30	µg/l
10A040800	Manganese - unspecified	2012	12	5	14.5	23	µg/l
10A040800	Mecoprop	2009	1	0.12	0.12	0.12	µg/l
10A040800	Mecoprop	2012	1	0.1	0.1	0.1	µg/l
10A040800	Mercury - filtered	2018	1	0.031	0.031	0.031	µg/l
10A040800	meta + para-Xylene	2009	1	0.4	0.4	0.4	µg/l
10A040800	n-Butylbenzene	2009	1	0.1	0.1	0.1	µg/l
10A040800	NH3-N-num	2006	10	0.01	0.01	0.01	mg/l
10A040800	Nickel - filtered	2018	2	2.6	141.3	280	µg/l
10A040800	Nickel - unspecified	2009	1	1	1	1	µg/l
10A040800	Nickel - unspecified	2012	11	0.6	0.772727273	1	µg/l
10A040800	Nitrate	2016	12	0.3	0.646666667	1.2	mg/l
10A040800	Nitrate	2017	10	0.32	0.913	1.3	mg/l
10A040800	Nitrate	2018	12	0.45	1.170833333	2.6	mg/l
10A040800	Nitrate	2019	12	0.39	1.008333333	2	mg/l
10A040800	Nitrate	2020	12	0.2	0.920833333	1.4	mg/l
10A040800	Nitrate	2021	12	0.25	0.7475	1.2	mg/l
10A040800	Nitrate	2022	2	0.82	1.01	1.2	mg/l
10A040800	Nitrite	2007	6	0	0.001166667	0.002	mg/l
10A040800	Nitrite	2008	9	0.0002	0.002911111	0.008	mg/l
10A040800	Nitrite	2009	5	0.0003	0.00146	0.003	mg/l
10A040800	Nitrite	2010	5	0.002	0.0024	0.003	mg/l
10A040800	Nitrite	2011	6	0	0.0025	0.006	mg/l
10A040800	Nitrite	2012	6	0	0.002	0.004	mg/l
10A040800	Nitrite	2013	6	0.001	0.002166667	0.005	mg/l
10A040800	Nitrite	2014	6	0	0.002333333	0.006	mg/l
10A040800	Nitrite	2015	6	0.002	0.004	0.005	mg/l
10A040800	Nitrite	2018	1	0.0209	0.0209	0.0209	mg/l
10A040800	Nitrite	2019	1	0.00546	0.00546	0.00546	mg/l
10A040800	Ortho-Phosphate	2006	1	0.01	0.01	0.01	mg/l
10A040800	Ortho-Phosphate	2007	9	0	0.034778222	0.16	mg/l
10A040800	Ortho-Phosphate	2008	18	0.000002	0.007505111	0.026	mg/l
10A040800	Ortho-Phosphate	2009	8	0.000002	0.003252	0.008	mg/l
10A040800	Ortho-Phosphate	2010	9	0.001	0.004555556	0.01	mg/l
10A040800	Ortho-Phosphate	2011	9	0.001	0.005444444	0.009	mg/l
10A040800	Ortho-Phosphate	2012	7	0.003	0.006285714	0.012	mg/l
10A040800	Ortho-Phosphate	2013	8	0.002	0.005125	0.008	mg/l
10A040800	Ortho-Phosphate	2014	6	0.001	0.007	0.022	mg/l
10A040800	Ortho-Phosphate	2015	7	0.002	0.007857143	0.013	mg/l
10A040800	Ortho-Phosphate	2021	1	0.014	0.014	0.014	mg/l
10A040800	ortho-Xylene	2009	2	0.2	0.3	0.4	pH units
10A040800	pH	2006	10	5.61	6.467	7.66	pH units
10A040800	pH	2007	10	5.87	6.903	8.2	pH units
10A040800	pH	2008	22	5.91	7.066818182	8.1	pH units
10A040800	pH	2009	17	6	7.09	8	pH units
10A040800	pH	2010	17	5.8	6.837058824	8	pH units

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A040800	pH	2011	18	5.87	7.22	8	pH units
10A040800	pH	2012	18	5.58	6.663888889	7.7	pH units
10A040800	pH	2013	17	5.77	6.947647059	7.9	pH units
10A040800	pH	2014	18	5.69	6.631666667	7.8	pH units
10A040800	pH	2015	18	5.09	6.456111111	7.6	pH units
10A040800	pH	2016	12	5.6	6.641666667	7.4	pH units
10A040800	pH	2017	12	5.8	6.875	7.4	pH units
10A040800	pH	2018	12	6.2	6.75	7.2	pH units
10A040800	pH	2019	12	6.4	6.716666667	7	pH units
10A040800	pH	2020	12	6.1	6.791666667	7.2	pH units
10A040800	pH	2021	12	5.9	6.708333333	7	pH units
10A040800	pH	2022	2	6.6	6.75	6.9	pH units
10A040800	Potassium - filtered	2018	12	0.31	0.546666667	0.7	mg/l
10A040800	Potassium - unspecified	2012	12	0.37	0.571666667	1.01	mg/l
10A040800	Silver - unspecified	2012	1	0.6	0.6	0.6	µg/l
10A040800	Simazine	2009	1	0.02	0.02	0.02	µg/l
10A040800	Sodium - filtered	2018	12	4.9	6.641666667	8	mg/l
10A040800	Sodium - unspecified	2009	12	4	4.916666667	6	mg/l
10A040800	Sodium - unspecified	2012	12	3.7	5.041666667	6.1	mg/l
10A040800	Strontium - filtered	2018	10	10	16.2	21	µg/l
10A040800	Strontium - unspecified	2012	12	10.7	14.91666667	18.4	µg/l
10A040800	Sum 4_IWW: Benzo[b]fluoranthe	2009	2	0.017	0.0505	0.084	µg/l
10A040800	Sum 4_IWW: Benzo[b]fluoranthe	2018	2	0.04	0.205	0.37	µg/l
10A040800	Sum 5_IWW: Benzo[g,h,i]perylen	2009	2	0.007	0.034	0.061	µg/l
10A040800	Temperature	2006	9	3.3	10.25555556	16.3	°C
10A040800	Temperature	2007	10	6.1	10.88	14.4	°C
10A040800	Temperature	2008	22	4.8	13.60909091	79	°C
10A040800	Temperature	2009	17	2.8	10.07647059	16.9	°C
10A040800	Temperature	2010	17	3.2	9.205882353	16.9	°C
10A040800	Temperature	2011	18	3.3	10.57777778	18	°C
10A040800	Temperature	2012	18	5	9.605555556	14.1	°C
10A040800	Temperature	2013	18	5.2	10.56111111	17.8	°C
10A040800	Temperature	2014	18	5.7	10.03333333	15.4	°C
10A040800	Temperature	2015	18	4.9	10.36111111	16.1	°C
10A040800	Temperature	2016	12	4	9.775	16.8	°C
10A040800	Temperature	2017	12	5	10.04166667	14.7	°C
10A040800	Temperature	2018	12	4.4	9.691666667	15.9	°C
10A040800	Temperature	2019	12	3.3	9.3	15.6	°C
10A040800	Temperature	2020	12	3.4	9.225	14.4	°C
10A040800	Temperature	2021	12	4.9	9.058333333	14.5	°C
10A040800	Temperature	2022	2	9.1	9.15	9.2	°C
10A040800	Thorium - unspecified	2009	1	2	2	2	µg/l
10A040800	Toluene	2009	5	0.1	0.36	0.8	µg/l
10A040800	Total Hardness	2006	10	20	21.8	26	mg/l
10A040800	Total Hardness (as Ca)	2008	6	5	8.5	13	mg/l
10A040800	Total Hardness (as Ca)	2009	1	10	10	10	mg/l
10A040800	Total Hardness (as Ca)	2010	1	12	12	12	mg/l
10A040800	Total Hardness (as Ca)	2013	1	14	14	14	mg/l
10A040800	Total Hardness (as Ca)	2014	1	29	29	29	mg/l
10A040800	Total Hardness (as CaCO3)	2007	6	12	20	26	mg/l
10A040800	Total Hardness (as CaCO3)	2008	10	15	26.9	95	mg/l
10A040800	Total Hardness (as CaCO3)	2009	5	9	18	27	mg/l
10A040800	Total Hardness (as CaCO3)	2010	5	8	15.8	21	mg/l
10A040800	Total Hardness (as CaCO3)	2011	6	14	18.83333333	26	mg/l
10A040800	Total Hardness (as CaCO3)	2012	6	6	15.5	21	mg/l
10A040800	Total Hardness (as CaCO3)	2013	6	10	17.33333333	26	mg/l
10A040800	Total Hardness (as CaCO3)	2014	11	13	27.27272727	89	mg/l
10A040800	Total Hardness (as CaCO3)	2015	18	8	14.33333333	20	mg/l
10A040800	Total Hardness (as CaCO3)	2016	9	13	17.44444444	21	mg/l
10A040800	Total Hardness (as CaCO3)	2017	12	10	17.41666667	27	mg/l
10A040800	Total Hardness (as CaCO3)	2018	11	13	20.81818182	28	mg/l
10A040800	Total Hardness (as CaCO3)	2019	12	11	18.5	29	mg/l
10A040800	Total Hardness (as CaCO3)	2020	11	12	18.63636364	23	mg/l
10A040800	Total Hardness (as CaCO3)	2021	10	13	18.6	24	mg/l
10A040800	Total Hardness (as CaCO3)	2022	2	10	15.5	21	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2006	10	0.44	1.395	1.9	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2007	9	0.58	1.055555556	1.66	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2008	22	0.3	1.061818182	1.72	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2009	17	0.5	1.056470588	1.4	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2010	17	0.292	0.895411765	1.4	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2011	18	0.031	0.756166667	1.5	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2012	18	0.3	0.977222222	1.9	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2013	18	0.28	0.959055556	1.7	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2014	18	0.27	0.976111111	1.6	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2015	17	0.2	0.803529412	1.4	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2016	12	0.3	0.645833333	1.2	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2017	10	0.32	0.913	1.3	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2018	12	0.45	1.17	2.6	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2019	12	0.39	1.009166667	2	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2020	12	0.2	0.92	1.4	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2021	12	0.25	0.7475	1.2	mg/l
10A040800	Total Oxidised Nitrogen (as N)	2022	2	0.82	1.01	1.2	mg/l
10A040800	True Colour	2007	6	7.5	37.91666667	90	Hazen
10A040800	True Colour	2008	10	10	33	80	Hazen

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A040800	True Colour	2009	5	15	26	45	Hazen
10A040800	True Colour	2010	5	7.5	34	100	Hazen
10A040800	True Colour	2011	18	10	40.38888889	140	Hazen
10A040800	True Colour	2012	18	15	41.55555556	140	Hazen
10A040800	True Colour	2013	18	10	31	99	Hazen
10A040800	True Colour	2014	9	15	31.44444444	79	Hazen
10A040800	True Colour	2015	6	36	90	158	Hazen
10A040800	True Colour	2014	6	18	37.83333333	74	mg/litre Pt Co
10A040800	True Colour	2015	12	10	41.5	132	mg/litre Pt Co
10A040800	True Colour	2016	12	8	38.66666667	108	mg/litre Pt Co
10A040800	True Colour	2017	12	11	46.16666667	161	mg/litre Pt Co
10A040800	True Colour	2018	12	7	26.91666667	83	mg/litre Pt Co
10A040800	True Colour	2019	12	17	50.08333333	128	mg/litre Pt Co
10A040800	True Colour	2020	12	10	36.83333333	137	mg/litre Pt Co
10A040800	True Colour	2021	12	9	41.25	140	mg/litre Pt Co
10A040800	True Colour	2022	2	12	29.5	47	mg/litre Pt Co
10A040800	Uranium - unspecified	2012	1	0.1	0.1	0.1	µg/l
10A040800	Zinc - filtered	2018	12	13	19.16666667	30	µg/l
10A040800	Zinc - unspecified	2009	12	13	18.58333333	22	µg/l
10A040800	Zinc - unspecified	2012	11	8.7	23.39090909	48.3	µg/l
10A050300	Alkalinity (as CaCO3)	1996	3	4	9.666666667	20	mg/l
10A050300	Alkalinity (as CaCO3)	1997	2	10	12.5	15	mg/l
10A050300	Alkalinity (as CaCO3)	1998	2	10	12.5	15	mg/l
10A050300	Alkalinity (as CaCO3)	1999	3	10	11.66666667	15	mg/l
10A050300	Alkalinity (as CaCO3)	2000	2	5	10	15	mg/l
10A050300	Alkalinity (as CaCO3)	2002	1	15	15	15	mg/l
10A050300	Alkalinity (as CaCO3)	2003	1	15	15	15	mg/l
10A050300	Alkalinity (as CaCO3)	2006	2	15	17.5	20	mg/l
10A050300	Ammonia	1996	3	0.04	0.056666667	0.08	mg/l
10A050300	Ammonia	1997	2	0.01	0.06	0.11	mg/l
10A050300	Ammonia	1998	2	0.02	0.075	0.13	mg/l
10A050300	Ammonia	1999	3	0.01	0.02	0.03	mg/l
10A050300	Ammonia	2000	2	0.031	0.0655	0.1	mg/l
10A050300	Ammonia	2003	3	0.017000001	0.018233333	0.0197	mg/l
10A050300	Ammonia	2005	11	0.01	0.014045455	0.0327	mg/l
10A050300	BOD	1996	3	0.6	1.233333333	1.6	mg/l
10A050300	BOD	1997	2	0.65	1.075	1.5	mg/l
10A050300	BOD	1998	2	1.12	1.18	1.24	mg/l
10A050300	BOD	1999	3	0.87	1.253333333	1.65	mg/l
10A050300	BOD	2000	2	0.52	0.625	0.73	mg/l
10A050300	BOD	2002	2	1	1.690000057	2.380000114	mg/l
10A050300	BOD	2003	3	1	1.316666683	1.950000048	mg/l
10A050300	BOD	2005	12	0.53	1.185833333	1.69	mg/l
10A050300	BOD	2006	3	2	2.23	2.4	mg/l
10A050300	Chloride	1996	3	9	9.666666667	10	mg/l
10A050300	Chloride	1997	2	10	10.5	11	mg/l
10A050300	Chloride	1998	2	9.5	11.25	13	mg/l
10A050300	Chloride	1999	3	9.5	10.83333333	11.5	mg/l
10A050300	Chloride	2000	2	9	10.5	12	mg/l
10A050300	Chloride	2002	1	10	10	10	mg/l
10A050300	Chloride	2003	2	9	9.315000057	9.630000114	mg/l
10A050300	Chloride	2005	11	8.2	9.105090909	10.046	mg/l
10A050300	Chloride	2006	10	7	9.307	11.21	mg/l
10A050300	Colour	1996	3	15	40	64	Hazen
10A050300	Colour	1997	2	40	50	60	Hazen
10A050300	Colour	2002	1	100	100	100	Hazen
10A050300	Colour	2003	1	50	50	50	Hazen
10A050300	Conductivity	1996	3	36.27	44.7	60.48	µS/cm
10A050300	Conductivity	1997	2	63	65.475	67.95	µS/cm
10A050300	Conductivity	1998	2	54.6	63.25	71.9	µS/cm
10A050300	Conductivity	1999	3	54.7	56.6	58.6	µS/cm
10A050300	Conductivity	2000	2	48.7	63.55	78.4	µS/cm
10A050300	Conductivity	2002	1	57	57	57	µS/cm
10A050300	Conductivity	2003	3	57	63	67	µS/cm
10A050300	Conductivity	2006	10	45.2	61.81	82.9	µS/cm
10A050300	Dissolved Oxygen	1996	3	102	102.6666667	104	% Saturation
10A050300	Dissolved Oxygen	1997	2	95	97	99	% Saturation
10A050300	Dissolved Oxygen	1998	2	90	95	100	% Saturation
10A050300	Dissolved Oxygen	1999	3	98	103.6666667	113	% Saturation
10A050300	Dissolved Oxygen	2000	2	98	99	100	% Saturation
10A050300	Dissolved Oxygen	2002	2	96	97	98	% Saturation
10A050300	Dissolved Oxygen	2003	3	98	98.66666667	100	% Saturation
10A050300	Dissolved Oxygen	2005	12	94.3	100.7583333	111	% Saturation
10A050300	Dissolved Oxygen	2006	20	9.5	55.684	102.7	% Saturation
10A050300	Dissolved Oxygen	1996	3	9.7	11.36666667	13	mg/l
10A050300	Dissolved Oxygen	1997	2	10.17	10.505	10.84	mg/l
10A050300	Dissolved Oxygen	1998	2	10.42	10.57	10.72	mg/l
10A050300	Dissolved Oxygen	1999	3	9.36	11.15	12.16	mg/l
10A050300	Dissolved Oxygen	2000	2	9.72	10.625	11.53	mg/l
10A050300	Dissolved Oxygen	2002	2	9.899999619	10.18999958	10.47999954	mg/l
10A050300	Dissolved Oxygen	2003	3	10.13000011	11.04000028	12.06000042	mg/l
10A050300	Dissolved Oxygen	2005	12	8.74	11.10083333	12.8	mg/l
10A050300	Hardness	1996	3	8	9.333333333	12	mg/l
10A050300	Hardness	1997	2	14	14	14	mg/l

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050300	Hardness	1998	2	45	85	125	mg/l
10A050300	Hardness	1999	3	50	70	100	mg/l
10A050300	Hardness	2000	2	60	60	60	mg/l
10A050300	Hardness	2002	1	16	16	16	mg/l
10A050300	Hardness	2003	1	12	12	12	mg/l
10A050300	NH3-N-num	2006	10	0.01	0.012	0.03	mg/l
10A050300	Nitrate	1996	3	0.5	0.733333333	1	mg/l
10A050300	Nitrate	1997	2	0.8	1	1.2	mg/l
10A050300	Nitrate	1998	2	0.8	0.95	1.1	mg/l
10A050300	Nitrate	1999	3	0.7	0.866666667	1	mg/l
10A050300	Nitrate	2000	2	0.64	0.7575	0.875	mg/l
10A050300	Nitrite	2003	2	0.0036	0.0043	0.005	mg/l
10A050300	Nitrite	2005	12	0.0037	0.004891667	0.005	mg/l
10A050300	Ortho-Phosphate	1998	2	0.0133783	0.0156624	0.0179465	mg/l
10A050300	Ortho-Phosphate	1999	3	0.0058734	0.012508167	0.0192517	mg/l
10A050300	Ortho-Phosphate	2000	2	0.013	0.0275	0.042	mg/l
10A050300	Ortho-Phosphate	2002	1	0.01	0.01	0.01	mg/l
10A050300	Ortho-Phosphate	2003	3	0.005	0.008	0.012	mg/l
10A050300	Ortho-Phosphate	2005	12	0.0035	0.007016667	0.024	mg/l
10A050300	Ortho-Phosphate	2006	1	0.018	0.018	0.018	mg/l
10A050300	pH	1996	3	5.71	6.026666667	6.5	pH units
10A050300	pH	1997	2	6.34	6.73	7.12	pH units
10A050300	pH	1998	2	6.18	6.36	6.54	pH units
10A050300	pH	1999	3	6.28	6.633333333	7.33	pH units
10A050300	pH	2000	2	7.04	7.13	7.22	pH units
10A050300	pH	2002	2	6.309999943	6.38499999	6.460000038	pH units
10A050300	pH	2003	3	6.039999962	6.283333302	6.659999847	pH units
10A050300	pH	2005	12	5.69	6.4925	7.63	pH units
10A050300	pH	2006	10	5.8	6.397	7.25	pH units
10A050300	Temperature	1996	3	4.5	11.4	19.3	°C
10A050300	Temperature	1997	2	9.6	11.3	13	°C
10A050300	Temperature	1998	2	8.8	10.65	12.5	°C
10A050300	Temperature	1999	3	7.2	11.96666667	17.1	°C
10A050300	Temperature	2000	1	15.1	15.1	15.1	°C
10A050300	Temperature	2002	2	12.30000019	12.75	13.19999981	°C
10A050300	Temperature	2003	3	6.099999905	11.86666663	19.60000038	°C
10A050300	Temperature	2005	12	6.2	10.975	18.5	°C
10A050300	Temperature	2006	10	3.1	10.39	16.8	°C
10A050300	Total Ammonium	2006	1	0.03	0.03	0.03	mg/l
10A050300	Total Hardness	2006	10	12	17.2	22	mg/l
10A050300	Total Hardness	2005	12	8	15	26	mg/l CaCO3
10A050300	Total Oxidised Nitrogen (as N)	2005	12	0.37	0.791975	1.21	mg/l
10A050300	Total Oxidised Nitrogen (as N)	2006	9	0.27	0.905555556	1.24	mg/l
10A050300	Un-ionised Ammonia	2003	3	-1E-04	-1E-04	-1E-04	mg/l
10A050300	Alkalinity (as CaCO3)	1995	2	10	12.5	15	mg/l
10A050300	Ammonia	1995	2	0.02	0.135	0.25	mg/l
10A050300	BOD	1995	2	0.1	1.75	3.4	mg/l
10A050300	Chloride	1995	2	15	15	15	mg/l
10A050300	Colour	1995	2	44	53	62	Hazen
10A050300	Conductivity	1995	2	62.82	65.79	68.76	µS/cm
10A050300	Dissolved Oxygen	1995	2	101	104.5	108	% Saturation
10A050300	Dissolved Oxygen	1995	2	10.2	11.65	13.1	mg/l
10A050300	Hardness	1995	2	28	39	50	mg/l
10A050300	Nitrate	1995	2	1.1	1.6	2.1	mg/l
10A050300	Nitrite	1995	1	0.001	0.001	0.001	mg/l
10A050300	pH	1995	2	6.64	6.74	6.84	pH units
10A050300	Temperature	1995	2	4.3	11.9	19.5	°C
10A050400	Alkalinity (as CaCO3)	1996	3	2	9	20	mg/l
10A050400	Alkalinity (as CaCO3)	1997	2	15	15	15	mg/l
10A050400	Alkalinity (as CaCO3)	1998	2	15	15	15	mg/l
10A050400	Alkalinity (as CaCO3)	1999	3	10	10	10	mg/l
10A050400	Alkalinity (as CaCO3)	2000	2	10	12.5	15	mg/l
10A050400	Alkalinity (as CaCO3)	2003	1	15	15	15	mg/l
10A050400	Alkalinity (as CaCO3)	2007	6	10	15	20	mg/l
10A050400	Alkalinity (as CaCO3)	2008	10	10	14.2	23	mg/l
10A050400	Alkalinity (as CaCO3)	2009	5	12	13.8	16	mg/l
10A050400	Alkalinity (as CaCO3)	2010	4	11	15	21	mg/l
10A050400	Alkalinity (as CaCO3)	2011	6	13	16.83333333	21	mg/l
10A050400	Alkalinity (as CaCO3)	2012	6	9	13.66666667	18	mg/l
10A050400	Alkalinity (as CaCO3)	2013	6	11	15.83333333	27	mg/l
10A050400	Alkalinity (as CaCO3)	2014	6	12	15.16666667	20	mg/l
10A050400	Alkalinity (as CaCO3)	2015	6	9	11.83333333	13	mg/l
10A050400	Alkalinity (as CaCO3)	2016	5	6.5	8.36	10.9	mg/l
10A050400	Alkalinity (as CaCO3)	2017	5	7.2	8.98	12.5	mg/l
10A050400	Alkalinity (as CaCO3)	2018	5	4.6	8.88	14.3	mg/l
10A050400	Alkalinity (as CaCO3)	2019	5	8	9.86	11.9	mg/l
10A050400	Alkalinity (as CaCO3)	2020	4	7.5	10.5	13.4	mg/l
10A050400	Alkalinity (as CaCO3)	2021	5	9.3	10.76	13.2	mg/l
10A050400	Ammonia	1996	3	0.06	0.06	0.06	mg/l
10A050400	Ammonia	1997	2	0.05	0.08	0.11	mg/l
10A050400	Ammonia	1998	2	0.07	0.11	0.15	mg/l
10A050400	Ammonia	1999	3	0.03	0.03	0.03	mg/l
10A050400	Ammonia	2000	2	0.022	0.033	0.044	mg/l
10A050400	Ammonia	2003	3	0.018999999	0.025033333	0.028999999	mg/l

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050400	Ammonia	2007	6	0	0.015666667	0.048	mg/l
10A050400	Ammonia	2008	9	0	0.015555556	0.035	mg/l
10A050400	Ammonia	2009	5	0	0.0058	0.01	mg/l
10A050400	Ammonia	2010	4	0	0.00955	0.023	mg/l
10A050400	Ammonia	2011	6	0.014	0.022	0.047	mg/l
10A050400	Ammonia	2012	6	0.004	0.009166667	0.023	mg/l
10A050400	Ammonia	2013	14	0.001	0.013714286	0.039	mg/l
10A050400	Ammonia	2014	15	0	0.012266667	0.03	mg/l
10A050400	Ammonia	2015	10	0.002	0.0115	0.024	mg/l
10A050400	Ammonia	2016	10	0.02	0.02	0.02	mg/l
10A050400	Ammonia	2017	12	0.02	0.023416667	0.036	mg/l
10A050400	Ammonia	2018	8	0.02	0.023875	0.028	mg/l
10A050400	Ammonia	2019	1	0.02	0.02	0.02	mg/l
10A050400	Ammonia	2020	1	0.028	0.028	0.028	mg/l
10A050400	BOD	1996	3	0.5	0.933333333	1.4	mg/l
10A050400	BOD	1997	2	0.74	1.22	1.7	mg/l
10A050400	BOD	1998	2	1.15	1.26	1.37	mg/l
10A050400	BOD	1999	3	0.91	1.34	1.72	mg/l
10A050400	BOD	2000	2	0.14	0.39	0.64	mg/l
10A050400	BOD	2003	3	1	1	1	mg/l
10A050400	BOD	2007	6	0.76	1.08	1.3	mg/l
10A050400	BOD	2008	10	0.9	1.36	1.9	mg/l
10A050400	BOD	2009	5	0.7	1.08	1.5	mg/l
10A050400	BOD	2010	4	1.1	1.175	1.4	mg/l
10A050400	BOD	2011	5	0.9	1.42	1.7	mg/l
10A050400	BOD	2012	6	0.5	0.733333333	1	mg/l
10A050400	BOD	2013	14	0.2	0.746428571	1.3	mg/l
10A050400	BOD	2014	14	0.2	0.707857143	1.2	mg/l
10A050400	BOD	2015	10	0.3	1.02	2.1	mg/l
10A050400	BOD	2016	10	0.5	0.94	1.3	mg/l
10A050400	BOD	2017	11	0.7	1.045454545	1.4	mg/l
10A050400	BOD	2018	9	0.7	1.144444444	1.9	mg/l
10A050400	BOD	2019	1	2	2	2	mg/l
10A050400	Chloride	1996	3	9	10	11	mg/l
10A050400	Chloride	1997	2	11	11	11	mg/l
10A050400	Chloride	1998	2	10.5	11.25	12	mg/l
10A050400	Chloride	1999	3	10.5	10.83333333	11.5	mg/l
10A050400	Chloride	2000	2	11	12	13	mg/l
10A050400	Chloride	2003	2	9	9.449999809	9.899999619	mg/l
10A050400	Chloride	2007	6	6.9	9.35	11.7	mg/l
10A050400	Chloride	2008	5	7.33	9.146	10.1	mg/l
10A050400	Chloride	2016	5	6.54	8.34	9.27	mg/l
10A050400	Chloride	2017	5	7.92	9.502	10.6	mg/l
10A050400	Chloride	2018	5	9.24	11.868	13.5	mg/l
10A050400	Chloride	2019	5	8.91	10.442	11.7	mg/l
10A050400	Chloride	2020	4	8.38	10.37	11.4	mg/l
10A050400	Chloride	2021	5	9.02	9.94	10.6	mg/l
10A050400	Colour	1996	3	15	40.66666667	70	Hazen
10A050400	Colour	1997	2	40	50	60	Hazen
10A050400	Colour	2003	1	45	45	45	Hazen
10A050400	Conductivity	1996	3	37.71	51.75	79.56	µS/cm
10A050400	Conductivity	1997	2	67.7	68.905	70.11	µS/cm
10A050400	Conductivity	1998	2	58.6	68.4	78.2	µS/cm
10A050400	Conductivity	1999	3	56.3	59.6	64	µS/cm
10A050400	Conductivity	2000	2	55.2	69.2	83.2	µS/cm
10A050400	Conductivity	2003	3	65	69.66666667	73	µS/cm
10A050400	Conductivity	2007	6	48.9	62.43333333	76	µS/cm
10A050400	Conductivity	2008	10	50	63.23	82.5	µS/cm
10A050400	Conductivity	2009	5	53	61.2	73	µS/cm
10A050400	Conductivity	2010	4	45	59.75	80	µS/cm
10A050400	Conductivity	2011	6	50	65.66666667	84	µS/cm
10A050400	Conductivity	2012	6	27	53.5	69	µS/cm
10A050400	Conductivity	2013	14	47	65.65714286	90	µS/cm
10A050400	Conductivity	2014	15	45	65.58	85.7	µS/cm
10A050400	Conductivity	2015	10	44	56.8	76	µS/cm
10A050400	Conductivity	2016	15	38	55.83333333	74	µS/cm
10A050400	Conductivity	2017	16	37	57.5625	79	µS/cm
10A050400	Conductivity	2018	15	52	74.33333333	95	µS/cm
10A050400	Conductivity	2019	5	58	74.4	84	µS/cm
10A050400	Conductivity	2020	4	54	72	88	µS/cm
10A050400	Conductivity	2021	5	63	68.8	77	µS/cm
10A050400	Dissolved Oxygen	1996	3	103	109	119	% Saturation
10A050400	Dissolved Oxygen	1997	2	95	96.5	98	% Saturation
10A050400	Dissolved Oxygen	1998	2	89	94.5	100	% Saturation
10A050400	Dissolved Oxygen	1999	3	97	100	104	% Saturation
10A050400	Dissolved Oxygen	2000	2	96	98	100	% Saturation
10A050400	Dissolved Oxygen	2003	3	98	99	101	% Saturation
10A050400	Dissolved Oxygen	2007	6	95	99.83333333	104	% Saturation
10A050400	Dissolved Oxygen	2008	10	99.6	101.26	102	% Saturation
10A050400	Dissolved Oxygen	2009	5	100	101.82	104.6	% Saturation
10A050400	Dissolved Oxygen	2010	4	98	101.25	103	% Saturation
10A050400	Dissolved Oxygen	2011	6	95	99.33333333	102	% Saturation
10A050400	Dissolved Oxygen	2012	6	99	100	102	% Saturation
10A050400	Dissolved Oxygen	2013	14	97.5	99.88571429	103.3	% Saturation

River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050400	Dissolved Oxygen	2014	15	88.1	99.04	107.1	% Saturation
10A050400	Dissolved Oxygen	2015	10	100	101.26	103.2	% Saturation
10A050400	Dissolved Oxygen	2016	15	98	100.0133333	103	% Saturation
10A050400	Dissolved Oxygen	2017	16	95.3	101.275	105	% Saturation
10A050400	Dissolved Oxygen	2018	15	97	101.9	111.4	% Saturation
10A050400	Dissolved Oxygen	2019	5	84	98	106	% Saturation
10A050400	Dissolved Oxygen	2020	4	100	103	108	% Saturation
10A050400	Dissolved Oxygen	2021	5	102	106.6	110	% Saturation
10A050400	Dissolved Oxygen	1996	3	9.8	12.03333333	13.2	mg/l
10A050400	Dissolved Oxygen	1997	2	10.09	10.47	10.85	mg/l
10A050400	Dissolved Oxygen	1998	2	10.35	10.48	10.61	mg/l
10A050400	Dissolved Oxygen	1999	3	9.29	10.78666667	11.8	mg/l
10A050400	Dissolved Oxygen	2000	2	9.65	10.575	11.5	mg/l
10A050400	Dissolved Oxygen	2003	3	9.329999924	10.78666655	12.05000019	mg/l
10A050400	Dissolved Oxygen	2007	6	9.7	10.98333333	12.2	mg/l
10A050400	Dissolved Oxygen	2008	10	9.9	11.149	12.5	mg/l
10A050400	Dissolved Oxygen	2009	5	10.4	11.422	12.44	mg/l
10A050400	Dissolved Oxygen	2010	4	9.6	11.525	14.2	mg/l
10A050400	Dissolved Oxygen	2011	6	9.8	11.46666667	13.7	mg/l
10A050400	Dissolved Oxygen	2012	6	9.3	10.71666667	12.2	mg/l
10A050400	Dissolved Oxygen	2013	14	8.8	11.02928571	12.89	mg/l
10A050400	Dissolved Oxygen	2014	15	9.45	11.126	13.16	mg/l
10A050400	Dissolved Oxygen	2015	10	9.61	11.079	11.97	mg/l
10A050400	Dissolved Oxygen	2016	15	9.18	10.98333333	12.6	mg/l
10A050400	Dissolved Oxygen	2017	16	9.7	11.161875	13.03	mg/l
10A050400	Dissolved Oxygen	2018	15	9.4	11.692	14.1	mg/l
10A050400	Dissolved Oxygen	2019	5	9.2	11.08	12.5	mg/l
10A050400	Dissolved Oxygen	2020	4	10.4	11.25	12.6	mg/l
10A050400	Dissolved Oxygen	2021	5	10.2	11.56	12.5	mg/l
10A050400	Hardness	1996	3	10	11.33333333	12	mg/l
10A050400	Hardness	1997	2	14	15	16	mg/l
10A050400	Hardness	1998	2	45	85	125	mg/l
10A050400	Hardness	1999	3	50	70	100	mg/l
10A050400	Hardness	2000	2	60	60	60	mg/l
10A050400	Hardness	2003	1	16	16	16	mg/l
10A050400	Nitrate	1996	3	0.5	0.8	1	mg/l
10A050400	Nitrate	1997	2	0.9	1.05	1.2	mg/l
10A050400	Nitrate	1998	2	0.9	1.05	1.2	mg/l
10A050400	Nitrate	1999	3	0.7	0.933333333	1.1	mg/l
10A050400	Nitrate	2000	2	0.87	0.9075	0.945	mg/l
10A050400	Nitrate	2016	4	0.51	0.58	0.7	mg/l
10A050400	Nitrate	2017	5	0.31	0.614	0.95	mg/l
10A050400	Nitrate	2018	5	0.35	0.766	1.3	mg/l
10A050400	Nitrate	2019	5	0.55	0.748	0.98	mg/l
10A050400	Nitrate	2020	3	0.48	0.726666667	0.91	mg/l
10A050400	Nitrate	2021	5	0.4	0.784	1.3	mg/l
10A050400	Nitrite	2003	2	0.0041	0.00455	0.005	mg/l
10A050400	Nitrite	2007	6	0	0.002	0.003	mg/l
10A050400	Nitrite	2008	9	0.003	0.003666667	0.006	mg/l
10A050400	Nitrite	2009	5	0.002	0.0026	0.003	mg/l
10A050400	Nitrite	2010	4	0.002	0.003	0.004	mg/l
10A050400	Nitrite	2011	6	0.002	0.004	0.005	mg/l
10A050400	Nitrite	2012	6	0	0.002166667	0.004	mg/l
10A050400	Nitrite	2013	14	0.001	0.003214286	0.008	mg/l
10A050400	Nitrite	2014	15	0	0.00484	0.025	mg/l
10A050400	Nitrite	2015	10	0.001	0.004	0.008	mg/l
10A050400	Nitrite	2016	10	0.005	0.005	0.005	mg/l
10A050400	Nitrite	2017	11	0.005	0.005090909	0.006	mg/l
10A050400	Nitrite	2018	3	0.005	0.0189	0.0307	mg/l
10A050400	Ortho-Phosphate	1998	2	0.0202306	0.02463565	0.0290407	mg/l
10A050400	Ortho-Phosphate	1999	3	0.0143572	0.0192517	0.0254514	mg/l
10A050400	Ortho-Phosphate	2000	2	0.025	0.0315	0.038	mg/l
10A050400	Ortho-Phosphate	2003	3	0.012	0.013	0.014	mg/l
10A050400	Ortho-Phosphate	2007	6	0.004	0.008166667	0.012	mg/l
10A050400	Ortho-Phosphate	2008	10	0.004	0.0098	0.025	mg/l
10A050400	Ortho-Phosphate	2009	5	0.006	0.0064	0.007	mg/l
10A050400	Ortho-Phosphate	2010	4	0	0.00325	0.006	mg/l
10A050400	Ortho-Phosphate	2011	6	0.004	0.0095	0.026	mg/l
10A050400	Ortho-Phosphate	2012	6	0.004	0.0055	0.009	mg/l
10A050400	Ortho-Phosphate	2013	14	0.002	0.006642857	0.015	mg/l
10A050400	Ortho-Phosphate	2014	15	0	0.0068	0.021	mg/l
10A050400	Ortho-Phosphate	2015	10	0.002	0.007	0.013	mg/l
10A050400	Ortho-Phosphate	2016	10	0.01	0.0109	0.016	mg/l
10A050400	Ortho-Phosphate	2017	11	0.01	0.011363636	0.021	mg/l
10A050400	Ortho-Phosphate	2018	5	0.001	0.0116	0.019	mg/l
10A050400	Ortho-Phosphate	2020	1	0.053	0.053	0.053	mg/l
10A050400	Ortho-Phosphate	2021	1	0.013	0.013	0.013	mg/l
10A050400	pH	1996	3	5.8	6.633333333	7.58	pH units
10A050400	pH	1997	2	6.56	6.83	7.1	pH units
10A050400	pH	1998	2	6.52	6.56	6.6	pH units
10A050400	pH	1999	3	6.35	6.693333333	7.27	pH units
10A050400	pH	2000	2	7.01	7.08	7.15	pH units
10A050400	pH	2003	3	6.199999809	6.4733332	6.829999924	pH units
10A050400	pH	2007	6	6.04	6.461666667	7.03	pH units

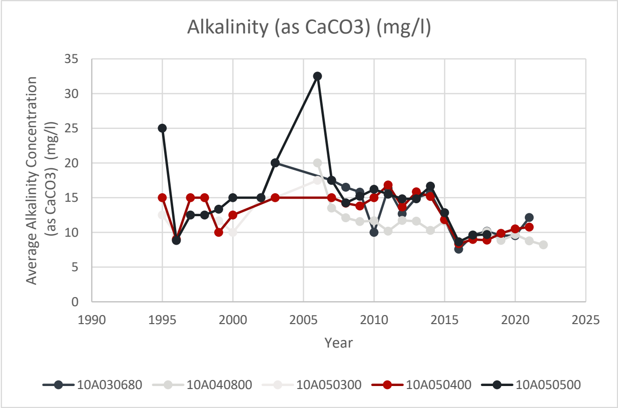
River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050400	pH	2008	10	6.03	6.674	7.29	pH units
10A050400	pH	2009	5	6.52	6.674	6.87	pH units
10A050400	pH	2010	4	6.26	6.68	7.22	pH units
10A050400	pH	2011	6	6.25	6.645	6.98	pH units
10A050400	pH	2012	6	5.8	6.37	6.77	pH units
10A050400	pH	2013	14	5.84	6.492857143	7.01	pH units
10A050400	pH	2014	15	6.04	6.344	6.98	pH units
10A050400	pH	2015	10	5.99	6.504	7.05	pH units
10A050400	pH	2016	15	6.2	6.885333333	8.07	pH units
10A050400	pH	2017	16	6.46	6.938125	7.44	pH units
10A050400	pH	2018	15	6.4	6.968	7.31	pH units
10A050400	pH	2019	5	6.7	6.9	7.1	pH units
10A050400	pH	2020	4	6.7	6.975	7.2	pH units
10A050400	pH	2021	5	7	7.18	7.3	pH units
10A050400	Temperature	1996	3	4.4	11.26666667	19.1	°C
10A050400	Temperature	1997	2	9.6	11.45	13.3	°C
10A050400	Temperature	1998	2	9	10.8	12.6	°C
10A050400	Temperature	1999	3	7.3	11.93333333	17.1	°C
10A050400	Temperature	2000	2	9.7	12.5	15.3	°C
10A050400	Temperature	2003	3	6	11.70000013	19.20000076	°C
10A050400	Temperature	2007	6	5.9	10.96666667	14.7	°C
10A050400	Temperature	2008	10	6.3	10.84	15.3	°C
10A050400	Temperature	2009	4	4.9	9.575	13.9	°C
10A050400	Temperature	2010	4	2.2	10.225	15.4	°C
10A050400	Temperature	2011	6	2.8	9.566666667	15.6	°C
10A050400	Temperature	2012	6	7.1	10.13333333	15.2	°C
10A050400	Temperature	2013	14	4.8	10.70714286	20.6	°C
10A050400	Temperature	2014	15	5.8	10.61333333	16.1	°C
10A050400	Temperature	2015	10	5.2	10.55	17.4	°C
10A050400	Temperature	2016	15	5.5	11.72666667	20.2	°C
10A050400	Temperature	2017	16	5.6	10.86875	15.5	°C
10A050400	Temperature	2018	15	3	9.706666667	19.4	°C
10A050400	Temperature	2019	5	4.9	10.18	18.3	°C
10A050400	Temperature	2020	4	8.5	11.5	13.7	°C
10A050400	Temperature	2021	5	8.1	12.02	16.2	°C
10A050400	Total Hardness (as CaCO3)	2007	6	10	18.33333333	32	mg/l
10A050400	Total Hardness (as CaCO3)	2008	10	13	20.62	46	mg/l
10A050400	Total Hardness (as CaCO3)	2009	5	14	17.2	21	mg/l
10A050400	Total Hardness (as CaCO3)	2010	4	11	14.75	19	mg/l
10A050400	Total Hardness (as CaCO3)	2011	6	16	20.66666667	26	mg/l
10A050400	Total Hardness (as CaCO3)	2012	6	10	15.33333333	19	mg/l
10A050400	Total Hardness (as CaCO3)	2013	6	11	19.66666667	39	mg/l
10A050400	Total Hardness (as CaCO3)	2014	6	14	19.5	26	mg/l
10A050400	Total Hardness (as CaCO3)	2015	6	12	13.16666667	15	mg/l
10A050400	Total Hardness (as CaCO3)	2016	5	12	14.6	16	mg/l
10A050400	Total Hardness (as CaCO3)	2017	5	12	15.8	19	mg/l
10A050400	Total Hardness (as CaCO3)	2018	4	16	18.75	24	mg/l
10A050400	Total Hardness (as CaCO3)	2019	5	17	19.8	23	mg/l
10A050400	Total Hardness (as CaCO3)	2020	4	13	16	21	mg/l
10A050400	Total Hardness (as CaCO3)	2021	5	12	17.4	20	mg/l
10A050400	Total Nitrogen	2013	8	0.5	0.69875	0.99	mg/l
10A050400	Total Nitrogen	2014	10	0.5	0.892	1.27	mg/l
10A050400	Total Nitrogen	2015	6	0.5	0.975	1.25	mg/l
10A050400	Total Nitrogen	2016	10	0.57	0.7799	1.11	mg/l
10A050400	Total Nitrogen	2017	11	0.5	0.559363636	0.7	mg/l
10A050400	Total Nitrogen	2018	10	0.4	0.89	1.3	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2007	6	0.48	0.905	1.24	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2008	10	0.52	0.846	1.31	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2009	5	0.74	0.878	1.02	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2010	4	0.31	0.6875	1.12	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2011	6	0.33	0.808333333	1.14	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2012	6	0.38	0.651666667	0.97	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2013	14	0.42	0.773285714	1.17	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2014	15	0.28	0.734666667	1.21	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2015	10	0.23	0.523	0.82	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2016	14	0.27	0.565928571	0.82	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2017	16	0.2	0.49375	0.95	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2018	12	0.24	0.685833333	1.3	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2019	5	0.55	0.748	0.98	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2020	4	0.48	0.7825	0.95	mg/l
10A050400	Total Oxidised Nitrogen (as N)	2021	5	0.4	0.784	1.3	mg/l
10A050400	Total Phosphorus (as P)	2013	5	0.013	0.021	0.026	mg/l
10A050400	True Colour	2007	6	25	79.16666667	190	Hazen
10A050400	True Colour	2008	10	35	68	125	Hazen
10A050400	True Colour	2009	5	35	62	80	Hazen
10A050400	True Colour	2010	4	20	60	100	Hazen
10A050400	True Colour	2011	6	25	53.33333333	90	Hazen
10A050400	True Colour	2012	6	35	62.5	110	Hazen
10A050400	True Colour	2013	14	28	58.14285714	105	Hazen
10A050400	True Colour	2014	15	22	55.8	93	Hazen
10A050400	True Colour	2015	10	35	89.8	175	Hazen
10A050400	True Colour	2016	5	42	66.2	124	mg/litre Pt Co
10A050400	True Colour	2017	5	28	56.8	96	mg/litre Pt Co
10A050400	True Colour	2018	5	11	39.6	68	mg/litre Pt Co

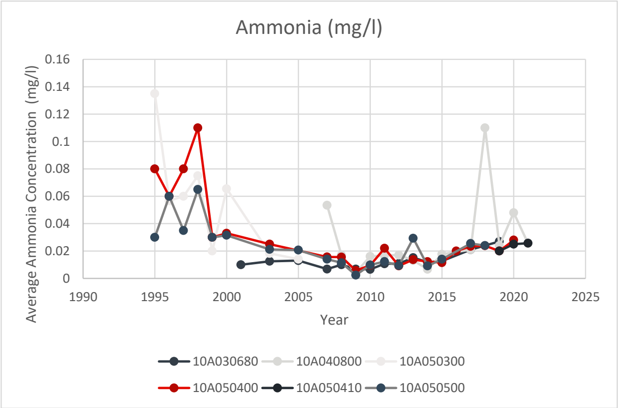
River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050400	True Colour	2019	5	36	63.2	124	mg/litre Pt Co
10A050400	True Colour	2020	4	25	49.5	85	mg/litre Pt Co
10A050400	True Colour	2021	5	28	37.4	46	mg/litre Pt Co
10A050400	Un-ionised Ammonia	2003	3	-1E-04	3.25559E-05	0.000109035	mg/l
10A050400	Alkalinity (as CaCO3)	1995	2	15	15	15	mg/l
10A050400	Ammonia	1995	2	0.02	0.08	0.14	mg/l
10A050400	BOD	1995	2	1	2	3	mg/l
10A050400	Chloride	1995	2	15	15.5	16	mg/l
10A050400	Colour	1995	2	44	44	44	Hazen
10A050400	Conductivity	1995	2	57.78	60.03	62.28	µS/cm
10A050400	Dissolved Oxygen	1995	2	101	101.5	102	% Saturation
10A050400	Dissolved Oxygen	1995	2	9.6	11.35	13.1	mg/l
10A050400	Hardness	1995	2	22	41	60	mg/l
10A050400	Nitrate	1995	2	1.1	1.15	1.2	mg/l
10A050400	Nitrite	1995	1	0.001	0.001	0.001	mg/l
10A050400	pH	1995	2	6.72	6.97	7.22	pH units
10A050400	Temperature	1995	2	4.3	12.05	19.8	°C
10A050410	Ammonia	2019	1	0.02	0.02	0.02	mg/l
10A050410	Ammonia	2020	8	0.02	0.025	0.03	mg/l
10A050410	Ammonia	2021	7	0.02	0.025714286	0.04	mg/l
10A050410	BOD	2019	9	0.5	0.844444444	1.2	mg/l
10A050410	BOD	2020	10	0.5	0.79	1.1	mg/l
10A050410	BOD	2021	10	0.5	0.84	1.4	mg/l
10A050410	Conductivity	2019	10	45	63	76	µS/cm
10A050410	Conductivity	2020	10	44	70	84	µS/cm
10A050410	Conductivity	2021	10	54	66.1	77	µS/cm
10A050410	Dissolved Oxygen	2019	10	98	103.6	111	% Saturation
10A050410	Dissolved Oxygen	2020	10	100	103.6	114	% Saturation
10A050410	Dissolved Oxygen	2021	10	101	103.7	106	% Saturation
10A050410	Dissolved Oxygen	2019	10	9.9	11.52	13	mg/l
10A050410	Dissolved Oxygen	2020	10	9.7	11.75	14.8	mg/l
10A050410	Dissolved Oxygen	2021	10	10.4	11.8	13.5	mg/l
10A050410	Nitrite	2019	4	0.005	0.00625	0.007	mg/l
10A050410	Nitrite	2020	1	0.005	0.005	0.005	mg/l
10A050410	Nitrite	2021	1	0.006	0.006	0.006	mg/l
10A050410	Ortho-Phosphate	2019	3	0.01	0.01	0.01	mg/l
10A050410	pH	2019	10	6.28	6.85	7.3	pH units
10A050410	pH	2020	10	5.8	6.64	7.2	pH units
10A050410	pH	2021	10	6.2	6.83	7.4	pH units
10A050410	Temperature	2019	10	5.1	10.8	15.7	°C
10A050410	Temperature	2020	10	4	10.16	17	°C
10A050410	Temperature	2021	10	5.1	10.38	16.5	°C
10A050410	Total Nitrogen	2019	10	0.7	1.12	1.6	mg/l
10A050410	Total Nitrogen	2020	2	1	1.05	1.1	mg/l
10A050410	Total Nitrogen	2021	10	0.6	0.87	1.4	mg/l
10A050410	Total Oxidised Nitrogen (as N)	2019	9	0.38	0.682222222	1.04	mg/l
10A050410	Total Oxidised Nitrogen (as N)	2020	10	0.2	0.63	1.1	mg/l
10A050410	Total Oxidised Nitrogen (as N)	2021	10	0.2	0.6	0.9	mg/l
10A050500	Alkalinity (as CaCO3)	1996	3	4	8.833333333	17.5	mg/l
10A050500	Alkalinity (as CaCO3)	1997	2	10	12.5	15	mg/l
10A050500	Alkalinity (as CaCO3)	1998	2	10	12.5	15	mg/l
10A050500	Alkalinity (as CaCO3)	1999	3	10	13.33333333	15	mg/l
10A050500	Alkalinity (as CaCO3)	2000	2	15	15	15	mg/l
10A050500	Alkalinity (as CaCO3)	2002	1	15	15	15	mg/l
10A050500	Alkalinity (as CaCO3)	2003	1	20	20	20	mg/l
10A050500	Alkalinity (as CaCO3)	2006	2	25	32.5	40	mg/l
10A050500	Alkalinity (as CaCO3)	2007	6	15	17.5	20	mg/l
10A050500	Alkalinity (as CaCO3)	2008	10	10	14.25	18	mg/l
10A050500	Alkalinity (as CaCO3)	2009	5	9	15.2	20	mg/l
10A050500	Alkalinity (as CaCO3)	2010	5	12	16.2	20	mg/l
10A050500	Alkalinity (as CaCO3)	2011	6	11	15.5	21	mg/l
10A050500	Alkalinity (as CaCO3)	2012	6	10	14.83333333	19	mg/l
10A050500	Alkalinity (as CaCO3)	2013	6	11	14.83333333	18	mg/l
10A050500	Alkalinity (as CaCO3)	2014	6	13	16.66666667	22	mg/l
10A050500	Alkalinity (as CaCO3)	2015	6	11	12.83333333	15	mg/l
10A050500	Alkalinity (as CaCO3)	2016	5	6.9	8.64	11.2	mg/l
10A050500	Alkalinity (as CaCO3)	2017	5	7.4	9.62	13.3	mg/l
10A050500	Alkalinity (as CaCO3)	2018	5	5	9.68	15.4	mg/l
10A050500	Ammonia	1996	3	0.05	0.06	0.07	mg/l
10A050500	Ammonia	1997	2	0.01	0.035	0.06	mg/l
10A050500	Ammonia	1998	2	0.03	0.065	0.1	mg/l
10A050500	Ammonia	1999	3	0.02	0.03	0.05	mg/l
10A050500	Ammonia	2000	2	0.029	0.0315	0.034	mg/l
10A050500	Ammonia	2003	3	0.012	0.021166667	0.0285	mg/l
10A050500	Ammonia	2005	11	0.01	0.0207	0.091	mg/l
10A050500	Ammonia	2007	6	0	0.014	0.047	mg/l
10A050500	Ammonia	2008	9	0	0.011444444	0.033	mg/l
10A050500	Ammonia	2009	5	0	0.0024	0.007	mg/l
10A050500	Ammonia	2010	5	0	0.0098	0.026	mg/l
10A050500	Ammonia	2011	6	0.007	0.012333333	0.018	mg/l
10A050500	Ammonia	2012	6	0.004	0.009333333	0.023	mg/l
10A050500	Ammonia	2013	6	0.008	0.029333333	0.098	mg/l
10A050500	Ammonia	2014	6	0.001	0.009166667	0.015	mg/l
10A050500	Ammonia	2015	6	0.007	0.014	0.025	mg/l

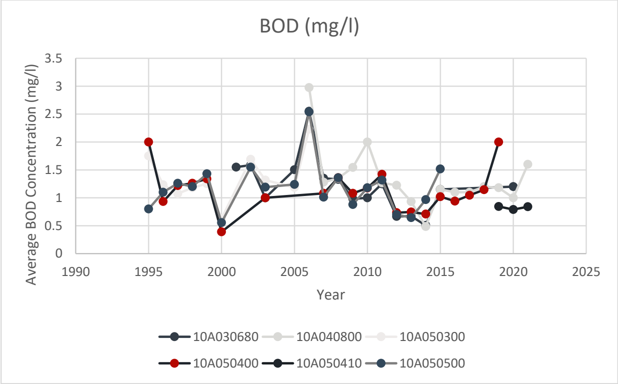
River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050500	Ammonia	2017	2	0.023	0.0255	0.028	mg/l
10A050500	Ammonia	2018	1	0.024	0.024	0.024	mg/l
10A050500	BOD	1996	3	0.4	1.1	1.5	mg/l
10A050500	BOD	1997	2	0.92	1.26	1.6	mg/l
10A050500	BOD	1998	2	1.03	1.2	1.37	mg/l
10A050500	BOD	1999	3	0.93	1.43	2.17	mg/l
10A050500	BOD	2000	2	0.17	0.555	0.94	mg/l
10A050500	BOD	2002	2	1	1.549999952	2.099999905	mg/l
10A050500	BOD	2003	3	1	1.190000017	1.570000052	mg/l
10A050500	BOD	2005	12	0.96	1.24	2	mg/l
10A050500	BOD	2006	2	2.38	2.54	2.7	mg/l
10A050500	BOD	2007	6	0.61	1.011666667	1.3	mg/l
10A050500	BOD	2008	10	0.8	1.36	2	mg/l
10A050500	BOD	2009	5	0.7	0.88	1	mg/l
10A050500	BOD	2010	5	1	1.18	1.6	mg/l
10A050500	BOD	2011	6	0.9	1.316666667	1.8	mg/l
10A050500	BOD	2012	6	0.4	0.7	1	mg/l
10A050500	BOD	2013	6	0.4	0.643333333	0.96	mg/l
10A050500	BOD	2014	6	0.4	0.966666667	2.7	mg/l
10A050500	BOD	2015	6	0.7	1.516666667	2.2	mg/l
10A050500	Chloride	1996	3	9	10	11	mg/l
10A050500	Chloride	1997	2	9	10.5	12	mg/l
10A050500	Chloride	1998	2	8.5	10.75	13	mg/l
10A050500	Chloride	1999	3	9.5	10.5	11.5	mg/l
10A050500	Chloride	2000	2	11	11.5	12	mg/l
10A050500	Chloride	2002	1	10	10	10	mg/l
10A050500	Chloride	2003	2	9	9.432499886	9.864999771	mg/l
10A050500	Chloride	2005	11	8.5	9.556754545	10.2	mg/l
10A050500	Chloride	2006	10	7.1	9.6	11.65	mg/l
10A050500	Chloride	2007	6	7.8	9.383333333	11.6	mg/l
10A050500	Chloride	2008	5	7.27	9.234	11.1	mg/l
10A050500	Chloride	2016	5	6.8	8.426	9.3	mg/l
10A050500	Chloride	2017	5	8.2	9.766	10.7	mg/l
10A050500	Chloride	2018	5	9.38	11.976	13.5	mg/l
10A050500	Colour	1996	3	15	34	68	Hazen
10A050500	Colour	1997	2	40	50	60	Hazen
10A050500	Colour	2002	1	70	70	70	Hazen
10A050500	Colour	2003	1	50	50	50	Hazen
10A050500	Conductivity	1996	3	38.43	47.97	64.17	µS/cm
10A050500	Conductivity	1997	2	68	68.785	69.57	µS/cm
10A050500	Conductivity	1998	2	58.9	69.7	80.5	µS/cm
10A050500	Conductivity	1999	3	57.9	62.4	69.2	µS/cm
10A050500	Conductivity	2000	2	54.2	68.1	82	µS/cm
10A050500	Conductivity	2002	1	72	72	72	µS/cm
10A050500	Conductivity	2003	3	69	72.66666667	76	µS/cm
10A050500	Conductivity	2006	10	47.6	68.03	92.2	µS/cm
10A050500	Conductivity	2007	6	51.8	64.41666667	78.2	µS/cm
10A050500	Conductivity	2008	10	26	62.33	85.3	µS/cm
10A050500	Conductivity	2009	5	54	62.6	74	µS/cm
10A050500	Conductivity	2010	5	46	61.6	84	µS/cm
10A050500	Conductivity	2011	6	54	66.01666667	82	µS/cm
10A050500	Conductivity	2012	6	28	55.5	73	µS/cm
10A050500	Conductivity	2013	6	49	66.16666667	94	µS/cm
10A050500	Conductivity	2014	6	56	66.83333333	84	µS/cm
10A050500	Conductivity	2015	6	45	55.33333333	66	µS/cm
10A050500	Conductivity	2016	5	44	57	66	µS/cm
10A050500	Conductivity	2017	5	54	65.6	81	µS/cm
10A050500	Conductivity	2018	5	55	83.2	130	µS/cm
10A050500	Dissolved Oxygen	1996	3	100	103.3333333	105	% Saturation
10A050500	Dissolved Oxygen	1997	2	98	98	98	% Saturation
10A050500	Dissolved Oxygen	1998	2	91	95.5	100	% Saturation
10A050500	Dissolved Oxygen	1999	3	97	100.3333333	103	% Saturation
10A050500	Dissolved Oxygen	2000	2	98	99	100	% Saturation
10A050500	Dissolved Oxygen	2002	2	100	100	100	% Saturation
10A050500	Dissolved Oxygen	2003	3	99	99.33333333	100	% Saturation
10A050500	Dissolved Oxygen	2005	12	97	102.55	116	% Saturation
10A050500	Dissolved Oxygen	2006	20	9.8	56.3135	105	% Saturation
10A050500	Dissolved Oxygen	2007	6	96	100.5	104	% Saturation
10A050500	Dissolved Oxygen	2008	10	99.1	101.31	104	% Saturation
10A050500	Dissolved Oxygen	2009	5	100	101.64	103.6	% Saturation
10A050500	Dissolved Oxygen	2010	5	98	102.4	105	% Saturation
10A050500	Dissolved Oxygen	2011	6	96	99.5	102	% Saturation
10A050500	Dissolved Oxygen	2012	6	100	100.6666667	103	% Saturation
10A050500	Dissolved Oxygen	2013	6	99	101.2833333	102.7	% Saturation
10A050500	Dissolved Oxygen	2014	6	92.5	98.91666667	101.9	% Saturation
10A050500	Dissolved Oxygen	2015	6	100.5	101.3	102.2	% Saturation
10A050500	Dissolved Oxygen	2016	5	100	101	102	% Saturation
10A050500	Dissolved Oxygen	2017	5	99	102	106	% Saturation
10A050500	Dissolved Oxygen	2018	5	100	103.2	108	% Saturation
10A050500	Dissolved Oxygen	1996	3	9.5	11.46666667	13.2	mg/l
10A050500	Dissolved Oxygen	1997	2	10.04	10.605	11.17	mg/l
10A050500	Dissolved Oxygen	1998	2	10.35	10.545	10.74	mg/l
10A050500	Dissolved Oxygen	1999	3	9.27	10.77333333	11.95	mg/l
10A050500	Dissolved Oxygen	2000	2	9.79	10.595	11.4	mg/l

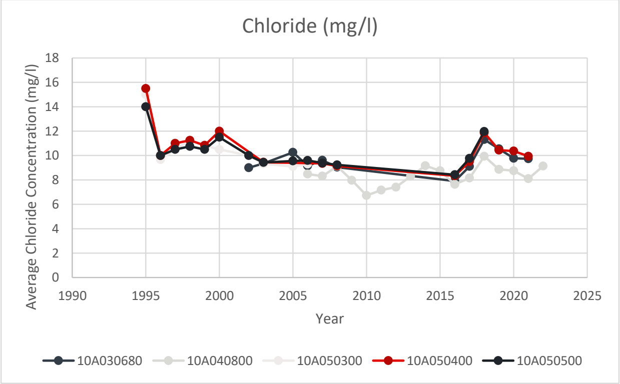
River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050500	Dissolved Oxygen	2002	2	10.32999992	10.46000004	10.59000015	mg/l
10A050500	Dissolved Oxygen	2003	3	9.149999619	10.76999982	12.13000011	mg/l
10A050500	Dissolved Oxygen	2005	12	9.04	11.1775	12.9	mg/l
10A050500	Dissolved Oxygen	2007	6	9.8	11.1	12.3	mg/l
10A050500	Dissolved Oxygen	2008	10	9.8	11.18	12.6	mg/l
10A050500	Dissolved Oxygen	2009	5	10.4	11.38	12.4	mg/l
10A050500	Dissolved Oxygen	2010	5	9.6	11.82	14.3	mg/l
10A050500	Dissolved Oxygen	2011	6	9.8	11.48333333	13.7	mg/l
10A050500	Dissolved Oxygen	2012	6	9.3	10.75	12.2	mg/l
10A050500	Dissolved Oxygen	2013	6	9.76	11.32666667	12.2	mg/l
10A050500	Dissolved Oxygen	2014	6	10	11.22333333	12.7	mg/l
10A050500	Dissolved Oxygen	2015	6	10.1	11.25333333	12.08	mg/l
10A050500	Dissolved Oxygen	2016	5	10.1	11.44	12.8	mg/l
10A050500	Dissolved Oxygen	2017	5	9.9	11.4	12.9	mg/l
10A050500	Dissolved Oxygen	2018	5	9.6	11.88	14.2	mg/l
10A050500	Hardness	1996	3	10	12	16	mg/l
10A050500	Hardness	1997	2	16	17	18	mg/l
10A050500	Hardness	1998	2	45	85	125	mg/l
10A050500	Hardness	1999	3	50	70	100	mg/l
10A050500	Hardness	2000	2	55	57.5	60	mg/l
10A050500	Hardness	2002	1	22	22	22	mg/l
10A050500	Hardness	2003	1	18	18	18	mg/l
10A050500	NH3-N-num	2006	10	0.01	0.0122	0.032	mg/l
10A050500	Nitrate	1996	3	0.5	0.8	1	mg/l
10A050500	Nitrate	1997	2	1	1.15	1.3	mg/l
10A050500	Nitrate	1998	2	0.9	1.15	1.4	mg/l
10A050500	Nitrate	1999	3	0.7	0.966666667	1.1	mg/l
10A050500	Nitrate	2000	2	0.79	1	1.21	mg/l
10A050500	Nitrate	2016	5	0.2	0.542	0.84	mg/l
10A050500	Nitrate	2017	5	0.35	0.672	1.1	mg/l
10A050500	Nitrate	2018	5	0.34	0.986	1.5	mg/l
10A050500	Nitrite	2003	2	0.0048	0.0049	0.005	mg/l
10A050500	Nitrite	2005	12	0.0022	0.004766667	0.005	mg/l
10A050500	Nitrite	2007	6	0.001	0.002333333	0.004	mg/l
10A050500	Nitrite	2008	9	0.002	0.003888889	0.006	mg/l
10A050500	Nitrite	2009	5	0.002	0.0028	0.004	mg/l
10A050500	Nitrite	2010	5	0.002	0.003	0.004	mg/l
10A050500	Nitrite	2011	6	0.001	0.003166667	0.005	mg/l
10A050500	Nitrite	2012	6	0	0.002016667	0.004	mg/l
10A050500	Nitrite	2013	6	0.002	0.0035	0.008	mg/l
10A050500	Nitrite	2014	6	0.0002	0.0067	0.023	mg/l
10A050500	Nitrite	2015	6	0.003	0.005333333	0.008	mg/l
10A050500	Nitrite	2018	1	0.00714	0.00714	0.00714	mg/l
10A050500	Ortho-Phosphate	1998	2	0.0094627	0.01713075	0.0247988	mg/l
10A050500	Ortho-Phosphate	1999	3	0.0117468	0.016858833	0.026104	mg/l
10A050500	Ortho-Phosphate	2000	2	0.015	0.0185	0.022	mg/l
10A050500	Ortho-Phosphate	2002	1	0.024	0.024	0.024	mg/l
10A050500	Ortho-Phosphate	2003	3	0.017000001	0.0181	0.019300001	mg/l
10A050500	Ortho-Phosphate	2005	12	0.005	0.013216667	0.05	mg/l
10A050500	Ortho-Phosphate	2006	2	0.011	0.016	0.021	mg/l
10A050500	Ortho-Phosphate	2007	6	0.003	0.009166667	0.013	mg/l
10A050500	Ortho-Phosphate	2008	10	0.003	0.009	0.019	mg/l
10A050500	Ortho-Phosphate	2009	5	0.004	0.0058	0.007	mg/l
10A050500	Ortho-Phosphate	2010	5	0	0.0044	0.01	mg/l
10A050500	Ortho-Phosphate	2011	6	0.003	0.006333333	0.01	mg/l
10A050500	Ortho-Phosphate	2012	6	0.003	0.005333333	0.009	mg/l
10A050500	Ortho-Phosphate	2013	6	0.002	0.007166667	0.013	mg/l
10A050500	Ortho-Phosphate	2014	6	0.003	0.008166667	0.02	mg/l
10A050500	Ortho-Phosphate	2015	6	0.004	0.010666667	0.015	mg/l
10A050500	Ortho-Phosphate	2018	1	0.001	0.001	0.001	mg/l
10A050500	pH	1996	3	5.88	6.536666667	7.33	pH units
10A050500	pH	1997	2	6.79	6.95	7.11	pH units
10A050500	pH	1998	2	6.59	6.655	6.72	pH units
10A050500	pH	1999	3	6.42	6.723333333	7.22	pH units
10A050500	pH	2000	2	7.05	7.085	7.12	pH units
10A050500	pH	2002	2	6.449999809	6.5	6.550000191	pH units
10A050500	pH	2003	3	6.25	6.556666692	6.920000076	pH units
10A050500	pH	2005	12	5.89	6.554166667	7.62	pH units
10A050500	pH	2006	10	6.04	6.409	6.87	pH units
10A050500	pH	2007	6	5.96	6.485	7.03	pH units
10A050500	pH	2008	10	6.15	6.724	7.33	pH units
10A050500	pH	2009	5	6.61	6.78	7.11	pH units
10A050500	pH	2010	5	6.42	6.764	7.28	pH units
10A050500	pH	2011	6	6.26	6.751666667	7.14	pH units
10A050500	pH	2012	6	5.87	6.436666667	6.79	pH units
10A050500	pH	2013	6	5.96	6.418333333	7.02	pH units
10A050500	pH	2014	6	6.11	6.27	6.56	pH units
10A050500	pH	2015	6	6	6.383333333	7.1	pH units
10A050500	pH	2016	5	6.2	6.48	6.8	pH units
10A050500	pH	2017	5	6.8	6.94	7.1	pH units
10A050500	pH	2018	5	6.3	6.9	7.4	pH units
10A050500	Temperature	1996	3	4.7	11.4	19.1	°C
10A050500	Temperature	1997	2	9.7	11.7	13.7	°C
10A050500	Temperature	1998	2	9.2	10.85	12.5	°C

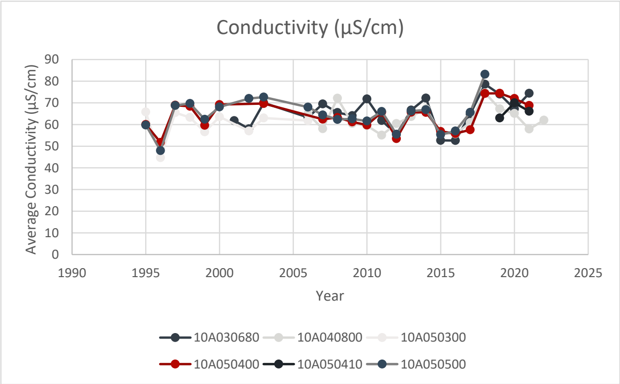
River Monitoring Station	Analyte	Year	No of Samples	Minimum	Average	Maximum	Units
10A050500	Temperature	1999	3	7.5	11.96666667	16.9	°C
10A050500	Temperature	2000	2	10	12.7	15.4	°C
10A050500	Temperature	2002	2	12.80000019	13.1500001	13.5	°C
10A050500	Temperature	2003	3	6.199999809	12.03333314	20	°C
10A050500	Temperature	2005	12	5.9	11.51666667	18.5	°C
10A050500	Temperature	2006	10	3.1	10.54	17.2	°C
10A050500	Temperature	2007	6	6	10.93333333	14.9	°C
10A050500	Temperature	2008	10	6.5	11.01	15.8	°C
10A050500	Temperature	2009	4	4.7	9.575	14	°C
10A050500	Temperature	2010	5	2.3	9.72	15.5	°C
10A050500	Temperature	2011	6	3	9.766666667	15.8	°C
10A050500	Temperature	2012	6	7.2	10.28333333	15.4	°C
10A050500	Temperature	2013	6	4.9	9.416666667	18.4	°C
10A050500	Temperature	2014	6	5.9	10.08333333	15	°C
10A050500	Temperature	2015	6	5.1	9.45	14.7	°C
10A050500	Temperature	2016	5	5.6	10.26	15.1	°C
10A050500	Temperature	2017	5	5.6	11	15.5	°C
10A050500	Temperature	2018	5	4.1	9.86	19.8	°C
10A050500	Total Ammonium	2006	1	0.032	0.032	0.032	mg/l
10A050500	Total Hardness	2006	10	12	20	24	mg/l
10A050500	Total Hardness	2005	12	12	17.5	26	mg/l CaCO3
10A050500	Total Hardness (as CaCO3)	2007	6	14	21	30	mg/l
10A050500	Total Hardness (as CaCO3)	2008	10	12	21.78	46	mg/l
10A050500	Total Hardness (as CaCO3)	2009	5	15	18.4	25	mg/l
10A050500	Total Hardness (as CaCO3)	2010	5	10	15.2	21	mg/l
10A050500	Total Hardness (as CaCO3)	2011	6	14	19.16666667	23	mg/l
10A050500	Total Hardness (as CaCO3)	2012	6	8	16.16666667	21	mg/l
10A050500	Total Hardness (as CaCO3)	2013	6	13	18.16666667	28	mg/l
10A050500	Total Hardness (as CaCO3)	2014	6	14	18.33333333	23	mg/l
10A050500	Total Hardness (as CaCO3)	2015	6	12	13.5	16	mg/l
10A050500	Total Hardness (as CaCO3)	2016	5	13	14.6	16	mg/l
10A050500	Total Hardness (as CaCO3)	2017	5	14	17	21	mg/l
10A050500	Total Hardness (as CaCO3)	2018	4	17	20.25	26	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2005	12	0.42	0.956233333	1.52	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2006	10	0.29	1.119	1.52	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2007	6	0.63	0.981666667	1.31	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2008	10	0.55	0.922	1.43	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2009	5	0.74	0.954	1.16	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2010	5	0.34	0.764	1.18	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2011	6	0.42	0.883333333	1.3	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2012	6	0.45	0.753333333	1.09	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2013	6	0.4	0.8	1.25	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2014	6	0.5	0.758333333	0.95	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2015	6	0.23	0.498333333	0.77	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2016	5	0.2	0.54	0.83	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2017	5	0.35	0.672	1.1	mg/l
10A050500	Total Oxidised Nitrogen (as N)	2018	5	0.34	0.986	1.5	mg/l
10A050500	True Colour	2007	6	25	80	200	Hazen
10A050500	True Colour	2008	10	30	66.5	125	Hazen
10A050500	True Colour	2009	5	35	62	80	Hazen
10A050500	True Colour	2010	5	20	59	100	Hazen
10A050500	True Colour	2011	6	25	51.66666667	90	Hazen
10A050500	True Colour	2012	6	35	60.83333333	100	Hazen
10A050500	True Colour	2013	6	28	59.16666667	102	Hazen
10A050500	True Colour	2014	6	42	55.5	78	Hazen
10A050500	True Colour	2015	6	54	111.5	172	Hazen
10A050500	True Colour	2016	5	38	63	116	mg/litre Pt Co
10A050500	True Colour	2017	5	27	59.4	102	mg/litre Pt Co
10A050500	True Colour	2018	5	10	38.6	70	mg/litre Pt Co
10A050500	Un-ionised Ammonia	2003	3	-1E-04	-1.66314E-05	0.000150106	mg/l
10A050500	Alkalinity (as CaCO3)	1995	1	25	25	25	mg/l
10A050500	Ammonia	1995	1	0.03	0.03	0.03	mg/l
10A050500	BOD	1995	1	0.8	0.8	0.8	mg/l
10A050500	Chloride	1995	1	14	14	14	mg/l
10A050500	Colour	1995	1	42	42	42	Hazen
10A050500	Conductivity	1995	1	59.76	59.76	59.76	µS/cm
10A050500	Dissolved Oxygen	1995	1	100	100	100	% Saturation
10A050500	Dissolved Oxygen	1995	1	10	10	10	mg/l
10A050500	Hardness	1995	1	24	24	24	mg/l
10A050500	Nitrate	1995	1	1.1	1.1	1.1	mg/l
10A050500	pH	1995	1	6.94	6.94	6.94	pH units
10A050500	Temperature	1995	1	20.2	20.2	20.2	°C

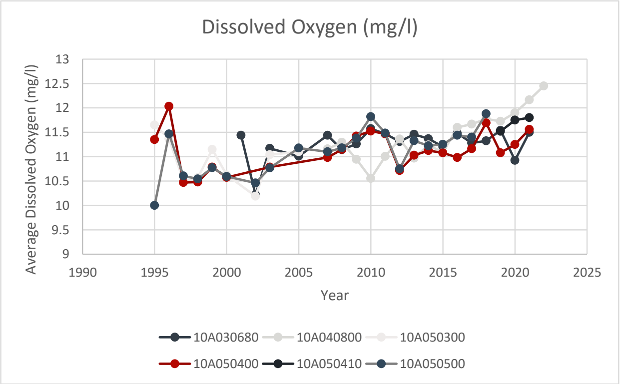

Alkalinity (as CaCO3) (mg/l)
Average Alkalinity Concentration (as CaCO3) (mg/l)
35
30
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050500

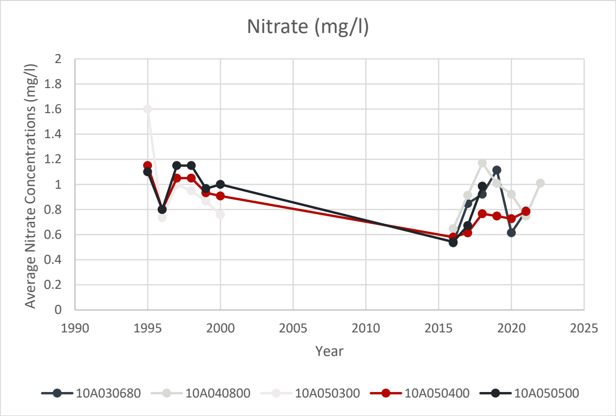

Ammonia (mg/l)
Average Ammonia Concentration (mg/l)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500

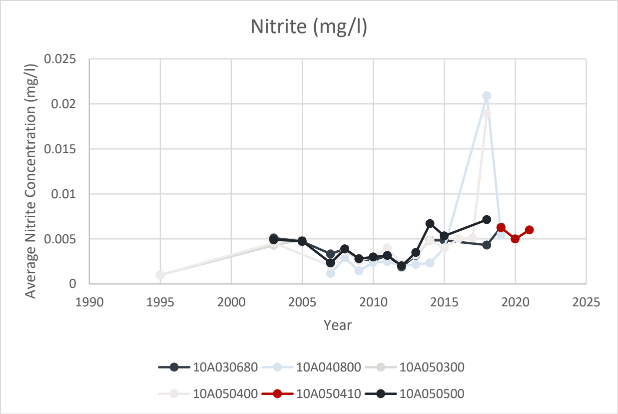

BOD (mg/l)
Average BOD Concentration (mg/l)
3.5
3
2.5
2
1.5
1
0.5
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500

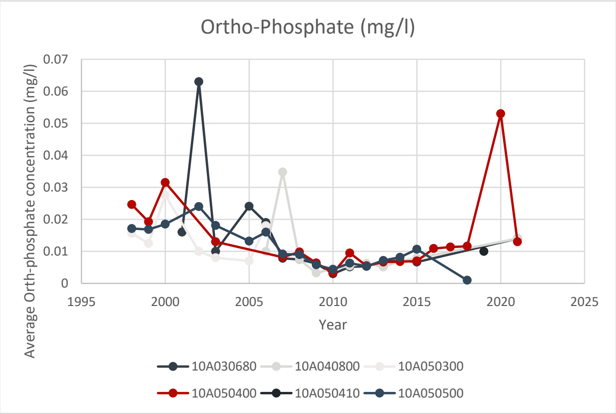

Chloride (mg/l)
Average Chloride Concentration (mg/l)
18
16
14
12
10
8
6
4
2
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050500

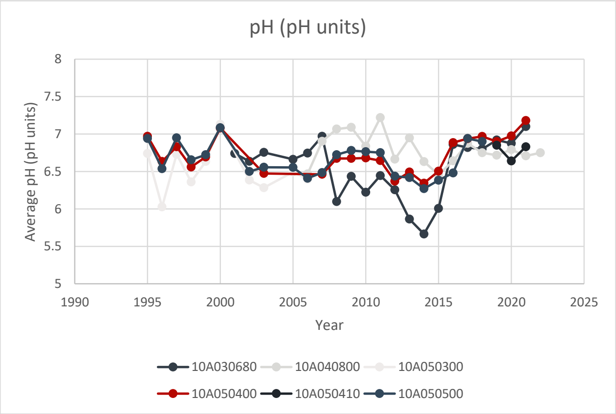

Conductivity (µS/cm)
Average Conductivity (µS/cm)
90
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500

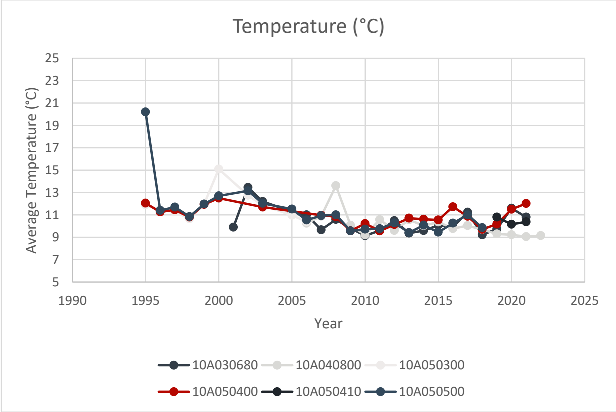

Dissolved Oxygen (mg/l)
Average Dissolved Oxygen (mg/l)
13
12.5
12
11.5
11
10.5
10
9.5
9
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500

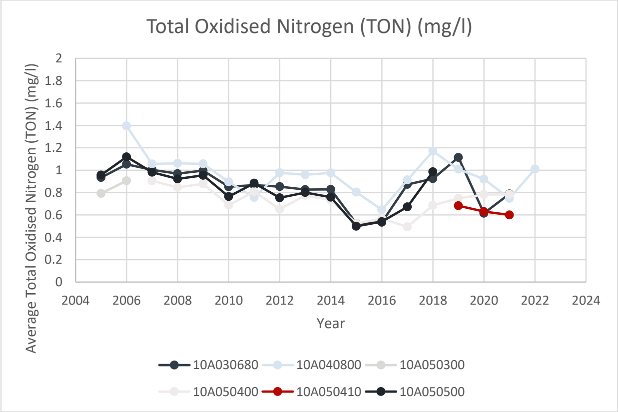

Nitrate (mg/l)
Average Nitrate Concentrations (mg/l)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050500


Nitrite (mg/l)
Average Nitrite Concentration (mg/l)
0.025
0.02
0.015
0.01
0.005
0
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500


Ortho-Phosphate (mg/l)
Average Orth-phosphate concentration (mg/l)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500


pH (pH units)
Average pH (pH units)
8
7.5
7
6.5
6
5.5
5
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500


Temperature (°C)
Average Temperature (°C)
25
23
21
19
17
15
13
11
9
7
5
1990
1995
2000
2005
2010
2015
2020
2025
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500


Total Oxidised Nitrogen (TON) (mg/l)
Average Total Oxidised Nitrogen (TON) (mg/l)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year
10A030680
10A040800
10A050300
10A050400
10A050410
10A050500

APPENDIX 6.2

2020-2021 Water Monitoring Results & Screening

Appendix 6.2.1: Screening of 2020-2021 Surface Water Samples

Parameter	Units	LOD	Maximum Allowable Concentration (MAC)					SW1	SW2	SW3	SW4	SW3	SW2	SW1A	SW2	SW3	SW4	SW10
			SI 272 of 2009	SI 286 of 2015			SI 293 of 1988											
			EQS for Inland SW	EQS for Inland SW	UK EQS Freshwater Specific Pollutants	UK EQS Freshwater Priority Hazardous Substances	European Communities (Quality of Salmonid Waters) Regulations 1988	09/09/2020	09/09/2020	09/09/2020	27/07/2021	27/07/2021	27/07/2021	08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022
Dissolved Arsenic	µg/l	<2.5	-	-	-	-	-	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	-
Dissolved Barium	µg/l	<3	-	-	-	-	-	21	16	13	14	7	10	10	10	11	12	-
Dissolved Beryllium	µg/l	<0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
Dissolved Boron	µg/l	<12	-	-	-	-	-	<12	<12	13	14	<12	21	<12	<12	<12	<12	-
Dissolved Cadmium [1]	µg/l	<0.5	Variable	Variable	-	Variable	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
Dissolved Calcium	mg/l	<0.2	-	-	-	-	-	15.1	19.2	14.2	24.5	16.8	17	21.8	21.7	28.3	27.1	-
Total Dissolved Chromium	µg/l	<1.5	-	-	-	-	-	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	-
Dissolved Copper [1]	µg/l	<7	-	-	-	-	Variable	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	-
Total Dissolved Iron	µg/l	<20	-	-	-	-	-	-	-	-	-	-	-	287	270	151	199	-
Dissolved Lead	µg/l	<5	-	14	-	14	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
Dissolved Magnesium	mg/l	<0.1	-	-	-	-	-	3.6	4.5	5.3	6.5	8.8	8	8.0	8.0	6.9	6.3	-
Dissolved Manganese	µg/l	<2	-	-	-	-	-	-	-	-	-	-	-	20	13	88	75	-
Dissolved Mercury	µg/l	<1	0.07	0.07	-	0.07	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Dissolved Nickel	µg/l	<2	-	34	-	34	-	<2	<2	3	<2	<2	3	<2	<2	<2	<2	-
Dissolved Potassium	mg/l	<0.1	-	-	-	-	-	1.2	1.9	1.7	2	1.7	2.1	2.0	2.0	1.8	1.6	-
Dissolved Selenium	µg/l	<3	-	-	-	-	-	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dissolved Sodium	mg/l	<0.1	-	-	-	-	-	8	9.5	9.1	10.1	10.7	11.2	11.3	11.3	11.3	11.1	-
Dissolved Vanadium	µg/l	<1.5	-	-	-	-	-	<1.5	<1.5	<1.5	1.7	<1.5	<1.5	2.4	<1.5	<1.5	<1.5	-
Dissolved Zinc [1, 2]	µg/l	<3	-	-	-	-	Variable	6	7	10	6	8	7	<3	<3	<3	<3	-
GRO (>C4-C8)	µg/l	<10	-	-	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
GRO (>C8-C12)	µg/l	<10	-	-	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
GRO (>C4-C12)	µg/l	<10	-	-	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Methyl Tertiary Butyl Ether	µg/l	<5	-	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
Benzene	µg/l	<5	50	50	-	50	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
Toluene	µg/l	<5	-	-	380	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
Ethylbenzene	µg/l	<5	-	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
m/p-Xylene	µg/l	<5	-	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
o-Xylene	µg/l	<5	-	-	-	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
EPH (C8-C40)	µg/l	<10	-	-	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Sulphate as SO4	mg/l	<0.5	-	-	-	-	-	16.7	16.4	15.9	13.3	16.9	16.6	14.8	14.8	19.7	19.7	-
Chloride	mg/l	<0.3	-	-	-	-	-	13.2	16.5	15	17.9	15.7	15.8	16.3	16.9	16.4	17.1	-
Nitrate as NO3	mg/l	<0.2	-	-	-	-	-	13.7	6.3	11.8	3.5	5.8	5.8	8.2	7.9	5.1	5.4	-
Nitrite as NO2	mg/l	<0.02	-	-	-	-	0.05	<0.02	<0.02	<0.02	<0.02	0.04	0.04	0.07	0.05	0.07	0.02	-
Ortho Phosphate as PO4	mg/l	<0.06	-	-	-	-	-	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.07	0.08	0.06	<0.06	-
Nitrate as N	mg/l	<0.05	-	-	-	-	-	3.1	1.43	2.66	0.8	1.3	1.32	1.86	1.78	1.16	1.22	-
Nitrite as N	mg/l	<0.006	-	-	-	-	0.05	<0.006	<0.006	<0.006	<0.006	0.012	0.011	-	-	-	-	-
Ortho Phosphate as P	mg/l	<0.03	-	-	-	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-
Ammoniacal Nitrogen as N	mg/l	<0.03	-	-	-	-	-	<0.03	0.03	0.03	0.05	0.06	0.07	0.05	0.04	0.09	0.05	-
Ammoniacal Nitrogen as NH4	mg/l	<0.03	-	-	-	-	1	<0.03	0.04	0.04	0.07	0.08	0.09	0.07	0.05	0.12	0.07	-
Hexavalent Chromium	ug/l	<6	-	-	-	-	-	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	-
Total Dissolved Chromium III	ug/l	<6	32	-	32	-	-	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	-
							-											-
Total Alkalinity as CaCO3	mg/l	<1	-	-	-	-	-	30	52	40	84	76	72	66	90	76	72	-
COD (Settled)	mg/l	<7	-	-	-	-	-	<7	15	12	16	10	8	63	189	228	94	-
Total Suspended Solids	mg/l	<10	-	-	-	-	25	<10	<10	16	<10	<10	<10	36	29	<10	12	-
Clostridium perfringens	cfu/100ml	<1	-	-	-	-	-	-	-	-	-	-	-	12	11	5	1	3
Coliforms	MPN/100ml	<1	-	-	-	-	-	-	-	-	-	-	-	> 2419.6	> 2419.6	> 2419.6	> 2419.6	> 2419.6
Escherichia coli	MPN/100ml	<1	-	-	-	-	-	-	-	-	-	-	-	1732.9	2419.6	1732.9	2419.6	224.7
Enterococci	cfu/100ml	<1	-	-	-	-	-	-	-	-	-	-	-	50	57	120	150	11
TVC @ 22°C	cfu/ml	<1	-	-	-	-	-	-	-	-	-	-	-	28200	16800	16400	11600	10300
TVC @ 37°C	cfu/ml	<1	-	-	-	-	-	-	-	-	-	-	-	2030	1940	2810	2150	690

Exceeds screening value
Limit of detection exceeds screening value
'-' No Value

1. Screening value is variable dependent on the hardness of the water as CaCO3 (mg/l). However, all measured values are either less than limit of detection or less than the lowest standard value.

2. Screening values for total zinc used in lieu of a screening values for dissolved zinc.

Appendix 6.2.2: Screening of 2020-2021 Groundwater Samples

Parameter	Units	LOD	S.I. No. 366/2016 - European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016.	S.I. No. 122/2014 - European Union (Drinking Water) Regulations 2014.	MW3	MW5	BH2	BH1	GWL	GWL	BH1	BH2	MW5	MW3	DW1
					17/08/2020	17/08/2020	17/08/2020	17/08/2020	17/08/2020	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	08/07/2022
Dissolved Aluminium	µg/l	<20	150	200	<20	<20	<20	<20	<20	-	-	-	-	-	-
Dissolved Arsenic	µg/l	<2.5	7.5	10	3.8	<2.5	<2.5	2.9	7	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Dissolved Barium	µg/l	<3	-	-	-	-	-	-	-	35	<3	4	8	22	7
Dissolved Beryllium	µg/l	<0.5	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Boron	µg/l	<12	750	1000	-	-	-	-	-	12	<12	<12	<12	<12	<12
Dissolved Cadmium	µg/l	<0.5	3.75	5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Calcium	mg/l	<0.2	-	-	41.9	50.4	48.1	25.1	33.7	35.4	26.7	44.5	46.9	47.3	35.7
Total Dissolved Chromium	µg/l	<1.5	37.5	50	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Dissolved Copper	µg/l	<7	1500	2000	<7	7	<7	<7	<7	<7	<7	<7	<7	<7	<7
Total Dissolved Iron	µg/l	<20	-	200	833	24970	85	552	607	-	-	-	-	-	<20
Dissolved Lead	µg/l	<5	7.5	10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Dissolved Magnesium	mg/l	<0.1	-	-	15.6	16.4	19.3	9.2	10.9	10.3	9.2	17.8	17.8	16.8	11.5
Dissolved Manganese	µg/l	<2	-	50	149	2471	54	912	1326	-	-	-	-	-	579
Dissolved Mercury	µg/l	<1	0.75	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dissolved Nickel	µg/l	<2	15	20	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2
Dissolved Potassium	mg/l	<0.1	-	-	2.9	1.5	2	1.4	1.4	1.4	1.1	1.9	2.1	1.4	1.6
Dissolved Selenium	µg/l	<3	-	10	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dissolved Sodium	mg/l	<0.1	150	200	13.3	12.1	12.7	9.4	10.7	9.9	9.2	11.9	13	10.7	10.9
Dissolved Vanadium	µg/l	<1.5		-						<1.5	<1.5	<1.5	<1.5	1.9	<1.5
Dissolved Zinc	µg/l	<3	75	-	<3	3	<3	<3	5	4	<3	<3	<3	5	24
Total Hardness Dissolved (as CaCO3)	mg/l	<1	-	-	170	195	201	101	130	-	-	-	-	-	-
GRO (>C4-C8)	µg/l	<10	-	-	-	-	-	-	-	<10	<10	<10	<10	<10	<10
GRO (>C8-C12)	µg/l	<10	-	-	-	-	-	-	-	<10	<10	<10	<10	<10	<10
GRO (>C4-C12)	µg/l	<10	-	-	-	-	-	-	-	<10	<10	<10	<10	<10	<10
Methyl Tertiary Butyl Ether	µg/l	<5	10	-	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<5	<5	<5	<5	<5
Benzene	µg/l	<5	0.75	1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5
Toluene	µg/l	<5	525	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	µg/l	<5	-	-	<1	<1	<1	<1	<1	<5	<5	<5	<5	<5	<5
m/p-Xylene	µg/l	<5	-	-	<2	<2	<2	<2	<2	<5	<5	<5	<5	<5	<5
o-Xylene	µg/l	<5	-	-	<1	<1	<1	<1	<1	<5	<5	<5	<5	<5	<5
Surrogate Recovery Toluene D8	%	<0	-	-	93	93	93	97	97	-	-	-	-	-	-
Surrogate Recovery 4-Bromofluorobenzene	%	<0	-	-	101	101	101	104	103	-	-	-	-	-	-
EPH (C8-C40)	µg/l	<10	7.5	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sulphate as SO4	mg/l	<0.5	187.5	250	5.7	12.4	19.2	20.4	20.2	21.4	20.4	21.9	16.8	7.5	12.1
Chloride	mg/l	<0.3	187.5	250	12.9	12.1	10.3	15	13.2	12.8	15.7	11.5	13.4	12.5	12.6
Nitrate as NO3	mg/l	<0.2	37.5	50	<0.2	0.3	1.7	1.5	<0.2	<0.2	0.8	2.3	0.4	<0.2	<0.2
Nitrite as NO2	mg/l	<0.02	0.375	0.5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.09	<0.02	<0.02
Ortho Phosphate as PO4	mg/l	<0.06	-	-	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Nitrate as N	mg/l	<0.05	8.47[1]	-	-	-	-	-	-	<0.05	0.18	0.51	0.09	<0.05	<0.05
Nitrite as N	mg/l	<0.006	0.114[1]	-	-	-	-	-	-	<0.006	<0.006	<0.006	0.027	<0.006	<0.02
Ortho Phosphate as P	mg/l	<0.03	-	-	-	-	-	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Total Oxidised Nitrogen as N	mg/l	<0.2	-	-	<0.2	<0.2	0.4	0.3	<0.2	-	-	-	-	-	-
Ammoniacal Nitrogen as N	mg/l	<0.03	0.065	-						0.05	0.03	0.1	0.08	0.33	<0.03
Ammoniacal Nitrogen as NH4	mg/l	<0.03	0.065[3]	-	0.11	0.59	<0.03	<0.03	0.05	0.07	0.04	0.13	0.1	0.42	<0.03
Hexavalent Chromium	µg/l	<6	-	-	-	-	-	-	-	<6	<6	<6	<6	<6	<6
Total Dissolved Chromium III	µg/l	<6	37.5	-	-	-	-	-	-	<6	<6	<6	<6	<6	<6
Total Alkalinity as CaCO3	mg/l	<1	-	-	204	166	172	76	106	122	94	188	204	198	136
Dissolved Oxygen	mg/l	<1	-	-	2	4	4	4	4	-	-	-	-	-	-
Electrical Conductivity @25C	uS/cm	<2	1875	2500[2]	420	371	462	239	293	-	-	-	-	-	-
pH	pH units	<0.01	-	-	7.11	7.71	7.89	6.94	7	-	-	-	-	-	-
Total Organic Carbon	mg/l	<2	-	No abnormal change	<2	<2	<2	<2	<2	-	-	-	-	-	-
Total Dissolved Solids	mg/l	<35	-	-	224	190	229	147	199	-	-	-	-	-	-
COD (Settled)	mg/l	<7	-	-	-	-	-	-	-	<7	<7	<7	9	10	88
Total Suspended Solids	mg/l	<10	-	-	-	-	-	-	-	147	87	36	511	53	<10
Clostridium perfringens	cfu/100ml	<1	-	0	-	-	-	-	-	-	-	-	-	-	<1
Coliforms	MPN/100ml	<1	-	0	-	-	-	-	-	-	-	-	-	-	<1
E.coli	MPN/100ml	<1	-	0	-	-	-	-	-	-	-	-	-	-	<1
Enterococci	cfu/100ml	<1	-	0	-	-	-	-	-	-	-	-	-	-	<1
TVC @ 22°C	cfu/ml	<1	-	No abnormal change	-	-	-	-	-	-	-	-	-	-	65
TVC @ 37°C	cfu/ml	<1	-	-	-	-	-	-	-	-	-	-	-	-	46

Exceeds Screening Value

Limit of detection exceeds screening value

'NAC' No Abnormal Change

'-' No Value

[1] *Converted from Nitrate as NO3 and Nitrite as NO2*

[2] *Conductivity at 20C*

[3] *Threshold value for ammoniacal nitrogen as N applied*

Appendix 6.2.3: Groundwater and Surface Water Field Parameters, August and September 2020

Sample ID	LOD	Units	BH1	BH2	GWL	MW3	MW4	MW5	SW1	SW2	SW3
Sample Date			17/08/2020	17/08/2020	17/08/2020	17/08/2020	17/08/2020	17/08/2020	10/09/2020	10/09/2020	10/09/2020
Temperature		Celcius	10.53	12.01	10.44	10.44	n/a	12.54	13.85	14	15.31
pH	<0.01	pH units	7.12	7.35	6.96	6.84	n/a	7.41	6.13	6.4	6.94
Electrical Conductivity @25C	<2	uS/cm	232.87	416.3	292.43	449.52	n/a	355.53	168.34	202.34	192.4
ORP		mV	83.5	37.3	46.1	-191	n/a	-30	220.9	184.6	140.1
DO	<0	mV	1.39	0.55	0.63	0.63	n/a	5.46	9.14	8.26	9.45
Colour			Orangey	Orangey	Clear	Clear	n/a	Dark grey	Clear	Clear	Very light brown
Odour			None	None	Organic	Organic	n/a	Slight organic	None	None	None

Appendix 6.2.4: Groundwater and Surface Water Field Parameters, July 2021

Sample ID	LOD	Units	BH1	BH2	GWL	MW3	MW5	SW02	SW03	SW04
Sample Date			28/06/2021	28/07/2021	28/07/2021	28/07/2021	28/07/2021	28/07/2021	28/07/2021	28/07/2021
Temperature		Celcius	8.67	10.07	8.7	10.63	9.37	16.38	17.98	14.73
pH	<0.01	pH units	7.35	7.58	7.15	7.09	7.56	7.87	7.51	7.89
Electrical Conductivity @25C	<2	uS/cm	254.44	402.94	300.97	465.33	403.95	283.05	267.96	254.53
ORP		mV	12.8	80.8	6.7	-228.9	-219.1	89.8	85.2	102.9
DO	<0	mV	3.32	3.32	0.35	1.75	1.2	8.83	8.48	7.75
Colour			Orangey	Orangey	Clear	Clear	Light brown	Clear	Clear	Clear
Odour			None	None	Stagnant	Strong stagnant	Stagnant	None	Slight stagnant	None
Notes			Silty	Silty	Silty					

Appendix 6.2.5: Groundwater and Surface Water Field Parameters, July 2022

Sample ID	LOD	Units	SW1A	SW2	SW3	SW4	SW10	DW1
Sample Date			08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022	08/07/2022
Temperature		Celcius	4.61	5.3	5.02	4.43	6.19	8.99
pH	<0.01	pH units	7.41	7.71	7.34	7.24	7.02	7.22
Electrical Conductivity @25C	<2	uS/cm	147.38	150.23	151.6	152.96	164.76	212.51
ORP		mV	350.7	329.7	371.1	367.9	409.9	382.5
DO	<0	ppm	13.08	12.92	11.21	11.54	8.38	1.77
Odour			None	None	None	None	Organic	None
Notes			No sheen, slightly turbid	No sheen, slightly turbid	No sheen, slightly turbid	No sheen, clear	No sheen, slightly turbid	No sheen, clear

Appendix 6.2.6: Surface Water Flow Monitoring, June & July 2022

Location	Date	Stream Width	Stream Depth	Velocity 1	Velocity 2	Velocity 3	Flow 1*	Flow 2*	Flow 3*	Average Flow	Notes
		mm	mm	m/s	m/s	m/s	l/s	l/s	l/s	l/s	
SW1A	11/06/2022	1800	175	0.036	0.082	-	11.3	25.8	-	18.6	Upstream (50m) of the discharge point (approx. opposite MW1). The elevation of the steam bed starts to fall west.
	04/07/2022		150	0.126	0.126	0.039	34.0	34.0	10.5	26.2	
SW2	11/06/2022	1300	200	0.097	0.084	-	25.2	21.8	-	23.5	Downstream of the discharge point but no visible discharge being undertaken. The elevation of the stream bed naturally drops after the discharge point causing the flow rate to increase.
	04/07/2022		145	0.377	0.441	0.355	71.1	83.1	66.9	73.7	
SW3	11/06/2022	500	175	0.039	0.036	-	3.4	3.2	-	3.3	Downstream of two inflow drains/tributary streams. Tributary streams are observed to be very low flow.
	04/07/2022		70	0.063	0.09	0.057	2.2	3.2	2.0	2.5	
SW4	11/06/2022	700	200	0.072	0.056	-	10.1	7.8	-	9.0	Immediately downstream of a twinpipe culvert (450mm) where the stream enters the quarry boundary from the south-east.
	04/07/2022		110	0.055	0.06	0.064	4.2	4.6	4.9	4.6	
SW4A	11/06/2022	750	200	0.037	0.036	-	5.6	5.4	-	5.5	Approximately 10 m downstream of SW4, as the stream turns along eastern face.
SW4B	04/07/2022	600	60	0.093	0.085	0.065	3.3	3.1	2.3	2.9	Upstream of the site boundary and approximately 50m upstream of SW4.
SW5	04/07/2022	1400	50	0.283	0.181	0.082	19.8	12.7	5.7	12.7	Located on the northern boundary, approximately midway between SW1A and SW6
SW6	04/07/2022	1700	70	0.093	0.067	0.102	11.1	8.0	12.1	10.4	Mid-point along the northern boundary.

**Calculated using formula Q=V*A, where Q = flow, V = velocity and A = cross-sectional area (i.e. stream depth * stream width)*

APPENDIX 6.3

2020-2021 Laboratory Certificates

Element Materials Technology
Unit 3 Deeside Point
Zone 3
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Deeside
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Golder Associates Ltd
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

UKAS TESTING
4225

Attention : Ruth Treacy

Date : 26th August, 2020

Your reference : 19132866

Our reference : Test Report 20/11075 Batch 1

Location : ECT S&G Rathdrum

Date samples received : 19th August, 2020

Status : Final report

Issue : 1

Five samples were received for analysis on 19th August, 2020 of which five 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:

Ed Moore B.ENG
Scheduling Manager

Client Name:	Golder Associates Ltd	**Report :** **Liquid**
Reference:	19132866	
Location:	ECT S&G Rathdrum	
Contact:	Ruth Treacy	**Liquids/products:** V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	20/11075	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								
Sample ID	MW3	MW5	BH2	BH1	GWL								
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								
Sample Date	17/08/2020	17/08/2020	17/08/2020	17/08/2020	17/08/2020								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1						LOD/LOR	Units	Method No.
Date of Receipt	19/08/2020	19/08/2020	19/08/2020	19/08/2020	19/08/2020								
Dissolved Aluminium #	<20	<20	<20	<20	<20						<20	ug/l	TM30/PM14
Dissolved Arsenic #	3.8	<2.5	<2.5	2.9	7.0						<2.5	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium #	41.9	50.4	48.1	25.1	33.7						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	7	<7	<7	<7						<7	ug/l	TM30/PM14
Total Dissolved Iron #	833	24970$_{AA}$	85	552	607						<20	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5						<5	ug/l	TM30/PM14
Dissolved Magnesium #	15.6	16.4	19.3	9.2	10.9						<0.1	mg/l	TM30/PM14
Dissolved Manganese #	149	2471	54	912	1326						<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	2	<2						<2	ug/l	TM30/PM14
Dissolved Potassium #	2.9	1.5	2.0	1.4	1.4						<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3						<3	ug/l	TM30/PM14
Dissolved Sodium #	13.3	12.1	12.7	9.4	10.7						<0.1	mg/l	TM30/PM14
Dissolved Zinc #	<3	3	<3	<3	5						<3	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	170	195	201	101	130						<1	mg/l	TM30/PM14
Methyl Tertiary Butyl Ether #	<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	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5						<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1						<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2	<2	<2	<2						<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1						<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	93	93	93	97	97						<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	101	101	101	104	103						<0	%	TM15/PM10
EPH (C8-C40) #	<10	<10	<10	<10	<10						<10	ug/l	TM5/PM30
Sulphate as SO4 #	5.7	12.4	19.2	20.4	20.2						<0.5	mg/l	TM38/PM0
Chloride #	12.9	12.1	10.3	15.0	13.2						<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	<0.2	0.3	1.7	1.5	<0.2						<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<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	<0.06						<0.06	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	<0.2	<0.2	0.4	0.3	<0.2						<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.11	0.59	<0.03	<0.03	0.05						<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	204	166	172	76	106						<1	mg/l	TM75/PM0
Dissolved Oxygen	2	4	4	4	4						<1	mg/l	TM58/PM0
Electrical Conductivity @25C #	420	371	462	239	293						<2	uS/cm	TM76/PM0
pH #	7.11	7.71	7.89	6.94	7.00						<0.01	pH units	TM73/PM0
Total Organic Carbon #	<2	<2	<2	<2	<2						<2	mg/l	TM60/PM0

Client Name:	Golder Associates Ltd	**Report :**	**Liquid**
Reference:	19132866		
Location:	ECT S&G Rathdrum		
Contact:	Ruth Treacy	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	20/11075		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						LOD/LOR	Units	Method No.
Sample ID	MW3	MW5	BH2	BH1	GWL								
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								
Sample Date	17/08/2020	17/08/2020	17/08/2020	17/08/2020	17/08/2020								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1								
Date of Receipt	19/08/2020	19/08/2020	19/08/2020	19/08/2020	19/08/2020								
Total Dissolved Solids [#]	224	190	229	147	199						<35	mg/l	TM20/PM0

Notification of Deviating Samples

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT S&G Rathdrum
Contact: Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 20/11075						

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.: 20/11075

SOILS

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.

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.

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.

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.

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.

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, this result is not accredited.
*	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
AA	x5 Dilution

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
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			
TM20	Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	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	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	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			
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 (comparabl	PM0	No preparation is required.	Yes			
TM58	APHA SMEWW 5210B:1999 22nd Edition. Comparible with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as am	PM0	No preparation is required.				
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 20/11075

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
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

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

Attention :	Ruth Treacy
Date :	22nd September, 2020
Your reference :	19132866
Our reference :	Test Report 20/12400 Batch 1
Location :	ECT Sand + Gravel
Date samples received :	14th September, 2020
Status :	Final report
Issue :	1

Three samples were received for analysis on 14th September, 2020 of which three 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:

Simon Gomery BSc
Project Manager

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand + Gravel
Contact: Ruth Treacy
EMT Job No: 20/12400

Report : **Liquid**

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

EMT Sample No.	1-6	7-12	13-18								LOD/LOR	Units	Method No.
Sample ID	SW1	SW2	SW3										
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G										
Sample Date	09/09/2020	09/09/2020	09/09/2020										
Sample Type	Surface Water	Surface Water	Surface Water										
Batch Number	1	1	1										
Date of Receipt	14/09/2020	14/09/2020	14/09/2020										
Dissolved Arsenic #	<2.5	<2.5	<2.5								<2.5	ug/l	TM30/PM14
Dissolved Barium #	21	16	13								<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5								<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	13								<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5								<0.5	ug/l	TM30/PM14
Dissolved Calcium #	15.1	19.2	14.2								<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5								<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7								<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5								<5	ug/l	TM30/PM14
Dissolved Magnesium #	3.6	4.5	5.3								<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1								<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	3								<2	ug/l	TM30/PM14
Dissolved Potassium #	1.2	1.9	1.7								<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3								<3	ug/l	TM30/PM14
Dissolved Sodium #	8.0	9.5	9.1								<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5								<1.5	ug/l	TM30/PM14
Dissolved Zinc #	6	7	10								<3	ug/l	TM30/PM14
GRO (>C4-C8) #	<10	<10	<10								<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10								<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10								<10	ug/l	TM36/PM12
MTBE #	<5	<5	<5								<5	ug/l	TM36/PM12
Benzene #	<5	<5	<5								<5	ug/l	TM36/PM12
Toluene #	<5	<5	<5								<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	<5								<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	<5								<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	<5								<5	ug/l	TM36/PM12
EPH (C8-C40) #	<10	<10	<10								<10	ug/l	TM5/PM30
Sulphate as SO4 #	16.7	16.4	15.9								<0.5	mg/l	TM38/PM0
Chloride #	13.2	16.5	15.0								<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	13.7	6.3	11.8								<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02								<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	<0.06								<0.06	mg/l	TM38/PM0
Nitrate as N #	3.10	1.43	2.66								<0.05	mg/l	TM38/PM0
Nitrite as N #	<0.006	<0.006	<0.006								<0.006	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	<0.03								<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03	0.03	0.03								<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	<0.03	0.04	0.04								<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6								<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6								<6	ug/l	TM0/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand + Gravel
Contact: Ruth Treacy
EMT Job No: 20/12400

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										
Sample ID	SW1	SW2	SW3										
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G										
Sample Date	09/09/2020	09/09/2020	09/09/2020										
Sample Type	Surface Water	Surface Water	Surface Water										
Batch Number	1	1	1								LOD/LOR	Units	Method No.
Date of Receipt	14/09/2020	14/09/2020	14/09/2020										
Total Alkalinity as CaCO3 $^{\#}$	30	52	40								<1	mg/l	TM75/PM0
COD (Settled) $^{\#}$	<7	15	12								<7	mg/l	TM57/PM0
Total Suspended Solids $^{\#}$	<10	<10	16								<10	mg/l	TM37/PM0

Client Name:	Golder Associates Ltd		**Matrix : Liquid**
Reference:	19132866		
Location:	ECT Sand + Gravel		
Contact:	Ruth Treacy		

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
20/12400	1	SW1		1-6	EPH	Sample received in inappropriate container

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.: 20/12400

SOILS

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.

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.

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.

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.

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.

ABBREVIATIONS and ACRONYMS USED

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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, this result is not accredited.
*	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

EMT Job No: 20/12400

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			
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	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	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 re	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 (comparabl	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 (comparabl	PM0	No preparation is required.	Yes			
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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Attention :	Ruth Treacy
Date :	30th April, 2021
Your reference :	19132866
Our reference :	Test Report 21/6020 Batch 1
Location :	ECT Sand & Gravel
Date samples received :	22nd April, 2021
Status :	Final report
Issue :	1

Four samples were received for analysis on 22nd April, 2021 of which four 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:

Simon Gomery BSc
Project Manager

Element Materials Technology

Client Name:	Golder Associates Ltd	**Report :**	**Liquid**
Reference:	19132866		
Location:	ECT Sand & Gravel		
Contact:	Ruth Treacy	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	21/6020		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							LOD/LOR	Units	Method No.
Sample ID	GWL	BH1	BH2	MW3									
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									
Sample Date	16/04/2021	16/04/2021	16/04/2021	16/04/2021									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	22/04/2021	22/04/2021	22/04/2021	22/04/2021									
Dissolved Arsenic #	4.2	<2.5	<2.5	<2.5							<2.5	ug/l	TM30/PM14
Dissolved Barium #	29	<3	<3	19							<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12							<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Dissolved Calcium #	30.2	41.5	27.2	46.3							<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7							<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5							<5	ug/l	TM30/PM14
Dissolved Magnesium #	9.5	18.0	9.5	14.9							<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1							<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2							<2	ug/l	TM30/PM14
Dissolved Potassium #	1.3	1.6	1.2	1.5							<0.1	mg/l	TM30/PM14
Dissolved Selenium #	4	<3	<3	<3							<3	ug/l	TM30/PM14
Dissolved Sodium #	9.8	11.9	9.4	11.1							<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Zinc #	4	<3	<3	<3							<3	ug/l	TM30/PM14
GRO (>C4-C8) #	<10	<10	<10	<10							<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10							<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10							<10	ug/l	TM36/PM12
MTBE #	<5	<5	<5	<5							<5	ug/l	TM36/PM12
Benzene #	<5	<5	<5	<5							<5	ug/l	TM36/PM12
Toluene #	<5	<5	<5	<5							<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	<5	<5							<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	<5	<5							<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	<5	<5							<5	ug/l	TM36/PM12
EPH (C8-C40) #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
Sulphate as SO4 #	20.2	16.3	21.3	5.0							<0.5	mg/l	TM38/PM0
Chloride #	13.5	10.6	16.8	13.4							<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	<0.2	6.5	0.9	<0.2							<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<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							<0.06	mg/l	TM38/PM0
Nitrate as N #	<0.05	1.47	0.21	<0.05							<0.05	mg/l	TM38/PM0
Nitrite as N #	<0.006	<0.006	<0.006	<0.006							<0.006	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	<0.03	<0.03							<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	0.05	<0.03	<0.03	0.28							<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.07	<0.03	<0.03	0.36							<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6							<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6							<6	ug/l	TM0/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: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand & Gravel
Contact: Ruth Treacy
EMT Job No: 21/6020

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H$_2$SO$_4$, 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							LOD/LOR	Units	Method No.
Sample ID	GWL	BH1	BH2	MW3									
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									
Sample Date	16/04/2021	16/04/2021	16/04/2021	16/04/2021									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	22/04/2021	22/04/2021	22/04/2021	22/04/2021									
Total Alkalinity as CaCO3$^{\#}$	110	184	98	206							<1	mg/l	TM75/PM0
COD (Settled)$^{\#}$	<7	8	<7	18							<7	mg/l	TM57/PM0
Total Suspended Solids$^{\#}$	80	82	96	54							<10	mg/l	TM37/PM0

Element Materials Technology **Notification of Deviating Samples**

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand & Gravel
Contact: Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 21/6020						

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.: 21/6020

SOILS

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.

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.

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.

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.

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.

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, this result is not accredited.
*	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: 21/6020

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

Attention : Ruth Treacy

Date : 10th August, 2021

Your reference : 19132866

Our reference : Test Report 21/11721 Batch 1

Location : ECT Sand & Gravel

Date samples received : 2nd August, 2021

Status : Final report

Issue : 1

Eight samples were received for analysis on 2nd August, 2021 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.

Authorised By:

Simon Gomery BSc
Project Manager

Client Name:	Golder Associates Ltd	**Report :**	**Liquid**
Reference:	19132866		
Location:	ECT Sand & Gravel		
Contact:	Ruth Treacy	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle $H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$
EMT Job No:	21/11721		

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	43-48					
Sample ID	GWL	BH1	BH2	MW5	MW3	SW4	SW3	SW2					
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	V H HN P G					
Sample Date	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021					
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground 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	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021					
Dissolved Arsenic#	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5			<2.5	ug/l	TM30/PM14
Dissolved Barium#	35	<3	4	8	22	14	7	10			<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	14	<12	21			<12	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	ug/l	TM30/PM14
Dissolved Calcium#	35.4	26.7	44.5	46.9	47.3	24.5	16.8	17.0			<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#	<7	<7	<7	<7	<7	<7	<7	<7			<7	ug/l	TM30/PM14
Dissolved Lead#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM30/PM14
Dissolved Magnesium#	10.3	9.2	17.8	17.8	16.8	6.5	8.8	8.0			<0.1	mg/l	TM30/PM14
Dissolved Mercury#	<1	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	<2	<2	<2	<2	<2	3			<2	ug/l	TM30/PM14
Dissolved Potassium#	1.4	1.1	1.9	2.1	1.4	2.0	1.7	2.1			<0.1	mg/l	TM30/PM14
Dissolved Selenium#	<3	<3	<3	<3	<3	<3	<3	<3			<3	ug/l	TM30/PM14
Dissolved Sodium#	9.9	9.2	11.9	13.0	10.7	10.1	10.7	11.2			<0.1	mg/l	TM30/PM14
Dissolved Vanadium#	<1.5	<1.5	<1.5	<1.5	1.9	1.7	<1.5	<1.5			<1.5	ug/l	TM30/PM14
Dissolved Zinc#	4	<3	<3	<3	5	6	8	7			<3	ug/l	TM30/PM14
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
MTBE#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
Benzene#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
Toluene#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
Ethylbenzene#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
m/p-Xylene#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
o-Xylene#	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
EPH (C8-C40)#	<10	<10	<10	<10	<10	<10	<10	<10			<10	ug/l	TM5/PM30
Sulphate as SO4#	21.4	20.4	21.9	16.8	7.5	13.3	16.9	16.6			<0.5	mg/l	TM38/PM0
Chloride#	12.8	15.7	11.5	13.4	12.5	17.9	15.7	15.8			<0.3	mg/l	TM38/PM0
Nitrate as NO3#	<0.2	0.8	2.3	0.4	<0.2	3.5	5.8	5.8			<0.2	mg/l	TM38/PM0
Nitrite as NO2#	<0.02	<0.02	<0.02	0.09	<0.02	<0.02	0.04	0.04			<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4#	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06			<0.06	mg/l	TM38/PM0
Nitrate as N#	<0.05	0.18	0.51	0.09	<0.05	0.80	1.30	1.32			<0.05	mg/l	TM38/PM0
Nitrite as N#	<0.006	<0.006	<0.006	0.027	<0.006	<0.006	0.012	0.011			<0.006	mg/l	TM38/PM0
Ortho Phosphate as P#	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N#	0.05	0.03	0.10	0.08	0.33	0.05	0.06	0.07			<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4#	0.07	0.04	0.13	0.10	0.42	0.07	0.08	0.09			<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6	<6	<6	<6			<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6	<6	<6			<6	ug/l	TM0/PM0

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand & Gravel
Contact: Ruth Treacy
EMT Job No: 21/11721

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	43-48					
Sample ID	GWL	BH1	BH2	MW5	MW3	SW4	SW3	SW2					
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	V H HN P G					
Sample Date	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021	27/07/2021					
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground 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	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021	02/08/2021					
Total Alkalinity as CaCO3 #	122	94	188	204	198	84	76	72			<1	mg/l	TM75/PM0
COD (Settled) #	<7	<7	<7	9	10	16	10	8			<7	mg/l	TM57/PM0
Total Suspended Solids #	147	87	36	511	53	<10	<10	<10			<10	mg/l	TM37/PM0

Client Name:	Golder Associates Ltd
Reference:	19132866
Location:	ECT Sand & Gravel
Contact:	Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 21/11721						

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.: 21/11721

SOILS

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.

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.

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.

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.

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.

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.

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			
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			
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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Customer

John Moran

Golder Associates Ireland Limited
Town Centre House
Dublin Road
Naas
Co. Kildare
W91 TD0P

Certificate Of Analysis

Job Number: 22-26064
Issue Number: 1
Report Date: 11 July 2022

Site: ECT Ballinabarrey
PO Number: Not Supplied
Date Samples Received: 08/07/2022

Please find attached the results for the samples received at our laboratory on 08/07/2022.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By: Louise Morrow **Authorised Date:** 11 July 2022

Louise Morrow

Notes are not INAB accredited

Results relate only to the items tested.
Information on methods of analysis and uncertainty of measurement is available on request.
Any opinions or interpretations indicated are outside the scope of our INAB accreditation.
This test report shall not be reproduced except in full or with written approval of City Analysts Limited.

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Certificate Of Analysis

Customer

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Report Reference: 22-26064

Report Version: 1

Site: ECT Ballinabarrey

Sample Description: SW1

Sample Type: Surface

Lab Reference Number: 660602

Date of Sampling: 08/07/2022

Time of Sampling: 08:45

Date Sample Received: 08/07/2022

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	08/07/2022	Clostridium perfringens	12	cfu/100ml	-
D/D1201#	08/07/2022	Coliforms	> 2419.6	MPN/100ml	-
D/D1201#	08/07/2022	E.coli	1732.9	MPN/100ml	-
D/D1205#	09/07/2022	Enterococci	50	cfu/100ml	-
D/D1208#	08/07/2022	TVC @ 22°C	28200	cfu/ml	-
D/D1208#	09/07/2022	TVC @ 37°C	2030	cfu/ml	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:
PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.
For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.
NAC & ATC - No abnormal change and acceptable to customers.
TVC - Total viable count
Site D = Analysed at City Analysts Dublin. Site S = Analysed at City Analysts Shannon

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Report Reference: 22-26064

Report Version: 1

Site: ECT Ballinabarrey

Sample Description: SW2

Sample Type: Surface

Lab Reference Number: 660603

Date of Sampling: 08/07/2022

Time of Sampling: 08:30

Date Sample Received: 08/07/2022

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	08/07/2022	Clostridium perfringens	11	cfu/100ml	-
D/D1201#	08/07/2022	Coliforms	> 2419.6	MPN/100ml	-
D/D1201#	08/07/2022	E.coli	2419.6	MPN/100ml	-
D/D1205#	09/07/2022	Enterococci	57	cfu/100ml	-
D/D1208#	08/07/2022	TVC @ 22°C	16800	cfu/ml	-
D/D1208#	09/07/2022	TVC @ 37°C	1940	cfu/ml	-

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Note:
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Report Reference: 22-26064

Report Version: 1

Site: ECT Ballinabarrey

Sample Description: SW3

Sample Type: Surface

Lab Reference Number: 660604

Date of Sampling: 08/07/2022

Time of Sampling: 10:30

Date Sample Received: 08/07/2022

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	08/07/2022	Clostridium perfringens	5	cfu/100ml	-
D/D1201#	08/07/2022	Coliforms	> 2419.6	MPN/100ml	-
D/D1201#	08/07/2022	E.coli	1732.9	MPN/100ml	-
D/D1205#	09/07/2022	Enterococci	120	cfu/100ml	-
D/D1208#	08/07/2022	TVC @ 22°C	16400	cfu/ml	-
D/D1208#	09/07/2022	TVC @ 37°C	2810	cfu/ml	-

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Note:
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Report Reference: 22-26064

Report Version: 1

Site: ECT Ballinabarrey

Sample Description: SW4

Sample Type: Surface

Lab Reference Number: 660605

Date of Sampling: 08/07/2022

Time of Sampling: 10:45

Date Sample Received: 08/07/2022

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	08/07/2022	Clostridium perfringens	1	cfu/100ml	-
D/D1201#	08/07/2022	Coliforms	> 2419.6	MPN/100ml	-
D/D1201#	08/07/2022	E.coli	2419.6	MPN/100ml	-
D/D1205#	09/07/2022	Enterococci	150	cfu/100ml	-
D/D1208#	08/07/2022	TVC @ 22°C	11600	cfu/ml	-
D/D1208#	09/07/2022	TVC @ 37°C	2150	cfu/ml	-

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Report Reference: 22-26064

Report Version: 1

Site: ECT Ballinabarrey

Sample Description: SW10

Sample Type: Surface

Lab Reference Number: 660606

Date of Sampling: 08/07/2022

Time of Sampling: 11:00

Date Sample Received: 08/07/2022

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	08/07/2022	Clostridium perfringens	3	cfu/100ml	-
D/D1201#	08/07/2022	Coliforms	> 2419.6	MPN/100ml	-
D/D1201#	08/07/2022	E.coli	224.7	MPN/100ml	-
D/D1205#	09/07/2022	Enterococci	11	cfu/100ml	-
D/D1208#	08/07/2022	TVC @ 22°C	10300	cfu/ml	-
D/D1208#	09/07/2022	TVC @ 37°C	690	cfu/ml	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:
PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.
For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.
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Report Reference: 22-26064

Report Version: 1

Site: ECT Ballinabarrey

Sample Description: DW-Tap

Sample Type: Well

Lab Reference Number: 660607

Date of Sampling: 08/07/2022

Time of Sampling: 10:00

Date Sample Received: 08/07/2022

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	08/07/2022	Clostridium perfringens	< 1	cfu/100ml	<= 0
D/D1201#	08/07/2022	Coliforms	< 1.0	MPN/100ml	<= 0.0
D/D1201#	08/07/2022	E.coli	< 1.0	MPN/100ml	<= 0.0
D/D1205#	09/07/2022	Enterococci	< 1	cfu/100ml	<= 0
D/D1208#	08/07/2022	TVC @ 22°C	65	cfu/ml	<= 100
D/D1208#	09/07/2022	TVC @ 37°C	46	cfu/ml	NAC

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Note:
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Golder Associates Ltd
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Attention : Ruth Treacy

Date : 21st July, 2022

Your reference : 19132866

Our reference : Test Report 22/11419 Batch 1

Location : ECT Sand & Gravel

Date samples received : 12th July, 2022

Status : Final Report

Issue : 1

Five samples were received for analysis on 12th July, 2022 of which five 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:

Paul Boden BSc
Senior Project Manager

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand & Gravel
Contact: Ruth Treacy
EMT Job No: 22/11419

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.	1-7	8-14	15-21	22-28	29-35								
Sample ID	SW2	SW1	DW	SW3	SW4								
Depth													
COC No / misc													
Containers	V H HN N P G	V H HN N P G	V H HN N P G	V H HN N P G	V H HN N P G								
Sample Date	08/07/2022 08:30	08/07/2022 08:45	08/07/2022 10:00	08/07/2022 10:30	08/07/2022 10:50								
Sample Type	Surface Water	Surface Water	Liquid	Surface Water	Surface Water								
Batch Number	1	1	1	1	1						LOD/LOR	Units	Method No.
Date of Receipt	12/07/2022	12/07/2022	12/07/2022	12/07/2022	12/07/2022								
Dissolved Arsenic	-	-	<2.5	-	-						<2.5	ug/l	TM30/PM14
Dissolved Arsenic#	<2.5	<2.5	-	<2.5	<2.5						<2.5	ug/l	TM30/PM14
Dissolved Barium	-	-	7	-	-						<3	ug/l	TM30/PM14
Dissolved Barium#	10	10	-	11	12						<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12						<12	ug/l	TM30/PM14
Dissolved Cadmium	-	-	<0.5	-	-						<0.5	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	-	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium	-	-	35.7	-	-						<0.2	mg/l	TM30/PM14
Dissolved Calcium#	21.7	21.8	-	28.3	27.1						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium	-	-	<1.5	-	-						<1.5	ug/l	TM30/PM14
Total Dissolved Chromium#	<1.5	<1.5	-	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper	-	-	<7	-	-						<7	ug/l	TM30/PM14
Dissolved Copper#	<7	<7	-	<7	<7						<7	ug/l	TM30/PM14
Total Dissolved Iron	-	-	<20	-	-						<20	ug/l	TM30/PM14
Total Dissolved Iron#	270	287	-	151	199						<20	ug/l	TM30/PM14
Dissolved Lead	-	-	<5	-	-						<5	ug/l	TM30/PM14
Dissolved Lead#	<5	<5	-	<5	<5						<5	ug/l	TM30/PM14
Dissolved Magnesium	-	-	11.5	-	-						<0.1	mg/l	TM30/PM14
Dissolved Magnesium#	8.0	8.0	-	6.9	6.3						<0.1	mg/l	TM30/PM14
Dissolved Manganese	-	-	579	-	-						<2	ug/l	TM30/PM14
Dissolved Manganese#	13	20	-	88	75						<2	ug/l	TM30/PM14
Dissolved Mercury	-	-	<1	-	-						<1	ug/l	TM30/PM14
Dissolved Mercury#	<1	<1	-	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel	-	-	<2	-	-						<2	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	-	<2	<2						<2	ug/l	TM30/PM14
Dissolved Potassium	-	-	1.6	-	-						<0.1	mg/l	TM30/PM14
Dissolved Potassium#	2.0	2.0	-	1.8	1.6						<0.1	mg/l	TM30/PM14
Dissolved Selenium	-	-	<3	-	-						<3	ug/l	TM30/PM14
Dissolved Selenium#	<3	<3	-	<3	<3						<3	ug/l	TM30/PM14
Dissolved Sodium	-	-	10.9	-	-						<0.1	mg/l	TM30/PM14
Dissolved Sodium#	11.3	11.3	-	11.3	11.1						<0.1	mg/l	TM30/PM14
Dissolved Vanadium	-	-	<1.5	-	-						<1.5	ug/l	TM30/PM14
Dissolved Vanadium#	<1.5	2.4	-	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Zinc	-	-	24	-	-						<3	ug/l	TM30/PM14
Dissolved Zinc#	<3	<3	-	<3	<3						<3	ug/l	TM30/PM14
GRO (>C4-C8)	-	-	<10	-	-						<10	ug/l	TM36/PM12
GRO (>C4-C8)#	<10	<10	-	<10	<10						<10	ug/l	TM36/PM12
GRO (>C8-C12)	-	-	<10	-	-						<10	ug/l	TM36/PM12
GRO (>C8-C12)#	<10	<10	-	<10	<10						<10	ug/l	TM36/PM12
GRO (>C4-C12)	-	-	<10	-	-						<10	ug/l	TM36/PM12
GRO (>C4-C12)#	<10	<10	-	<10	<10						<10	ug/l	TM36/PM12
MTBE	-	-	<5	-	-						<5	ug/l	TM36/PM12

Client Name: Golder Associates Ltd
Reference: 19132866
Location: ECT Sand & Gravel
Contact: Ruth Treacy
EMT Job No: 22/11419

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.	1-7	8-14	15-21	22-28	29-35								
Sample ID	SW2	SW1	DW	SW3	SW4								
Depth													
COC No / misc													
Containers	V H HN N P G	V H HN N P G	V H HN N P G	V H HN N P G	V H HN N P G								
Sample Date	08/07/2022 08:30	08/07/2022 08:45	08/07/2022 10:00	08/07/2022 10:30	08/07/2022 10:50								
Sample Type	Surface Water	Surface Water	Liquid	Surface Water	Surface Water								
Batch Number	1	1	1	1	1						LOD/LOR	Units	Method No.
Date of Receipt	12/07/2022	12/07/2022	12/07/2022	12/07/2022	12/07/2022								
MTBE #	<5	<5	-	<5	<5						<5	ug/l	TM36/PM12
Benzene	-	-	<5	-	-						<5	ug/l	TM36/PM12
Benzene #	<5	<5	-	<5	<5						<5	ug/l	TM36/PM12
Toluene	-	-	<5	-	-						<5	ug/l	TM36/PM12
Toluene #	<5	<5	-	<5	<5						<5	ug/l	TM36/PM12
Ethylbenzene	-	-	<5	-	-						<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	-	<5	<5						<5	ug/l	TM36/PM12
m/p-Xylene	-	-	<5	-	-						<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	-	<5	<5						<5	ug/l	TM36/PM12
o-Xylene	-	-	<5	-	-						<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	-	<5	<5						<5	ug/l	TM36/PM12
EPH (C8-C40)	-	-	<10	-	-						<10	ug/l	TM5/PM30
EPH (C8-C40) #	<10	<10	-	<10	<10						<10	ug/l	TM5/PM30
Sulphate as SO4	-	-	12.1	-	-						<0.5	mg/l	TM38/PM0
Sulphate as SO4 #	14.8	14.8	-	19.7	19.7						<0.5	mg/l	TM38/PM0
Chloride	-	-	12.6	-	-						<0.3	mg/l	TM38/PM0
Chloride #	16.9	16.3	-	16.4	17.1						<0.3	mg/l	TM38/PM0
Nitrate as NO3	-	-	<0.2	-	-						<0.2	mg/l	TM38/PM0
Nitrate as NO3 #	7.9	8.2	-	5.1	5.4						<0.2	mg/l	TM38/PM0
Nitrite as NO2	-	-	<0.02	-	-						<0.02	mg/l	TM38/PM0
Nitrite as NO2 #	0.05	0.07	-	0.07	0.02						<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4	-	-	<0.06	-	-						<0.06	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	0.08	0.07	-	0.06	<0.06						<0.06	mg/l	TM38/PM0
Nitrate as N	-	-	<0.05	-	-						<0.05	mg/l	TM38/PM0
Nitrate as N #	1.78	1.86	-	1.16	1.22						<0.05	mg/l	TM38/PM0
Ortho Phosphate as P	-	-	<0.03	-	-						<0.03	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	-	<0.03	<0.03						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N	-	-	<0.03	-	-						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	0.04	0.05	-	0.09	0.05						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4	-	-	<0.03	-	-						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.05	0.07	-	0.12	0.07						<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6						<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6						<6	ug/l	TM0/PM0
Total Alkalinity as CaCO3	-	-	136	-	-						<1	mg/l	TM75/PM0
Total Alkalinity as CaCO3 #	90	66	-	76	72						<1	mg/l	TM75/PM0
COD (Settled)	-	-	88	-	-						<7	mg/l	TM57/PM0
COD (Settled) #	189	63	-	228	94						<7	mg/l	TM57/PM0
Total Suspended Solids	-	-	<10	-	-						<10	mg/l	TM37/PM0
Total Suspended Solids #	29	36	-	<10	12						<10	mg/l	TM37/PM0

Client Name:	Golder Associates Ltd
Reference:	19132866
Location:	ECT Sand & Gravel
Contact:	Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 22/11419						

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.: 22/11419

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: 22/11419

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.				
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			
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.				
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.				
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.				

EMT Job No: 22/11419

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
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			
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.				
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.				
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

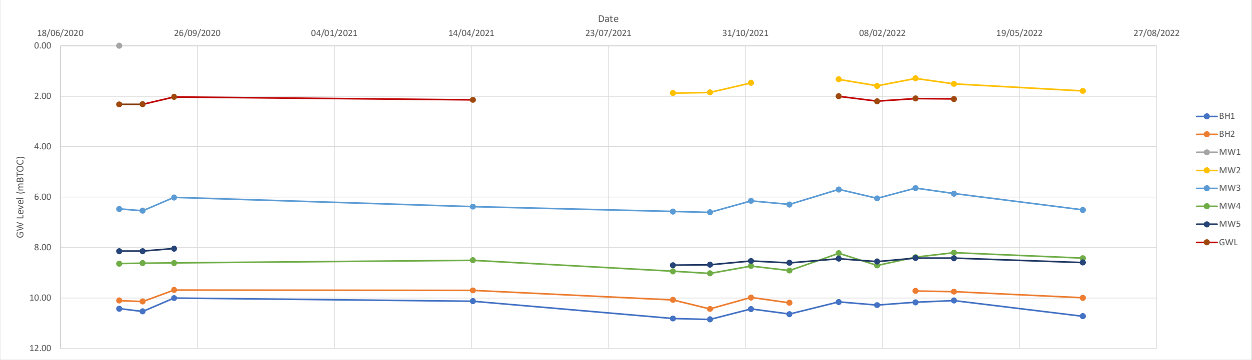
APPENDIX 6.4

2020-2022 Groundwater Level Data

Appendix 6.4.1 - Groundwater Elevation Data (mTOC) 2020-2021

Borehole ID	Borehole Elevation (mOD)	Casing Stickup (m)	Irish Grid		WGS UTM 29U		31/07/2020	17/08/2020	09/09/2020	15/04/2021	08/09/2021	05/10/2021	04/11/2021	02/12/2021	07/01/2022	04/02/2022	04/03/2022	01/04/2022	04/07/2022	Range (m)
			Easting	Northing	Easting	Northing	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	GW mBTOC	
DW1	126.83		322265	186154	689392.49	5866268.26	Not accessible due to well head installation													
BH1	126.678	0.963	322264	186310	689389.32	5866424.20	10.42	10.53	10.00	10.12	10.81	10.85	10.44	10.64	10.16	10.28	10.17	10.10	10.72	0.85
BH2	123.289	0.705	322125	186344	689249.89	5866456.26	10.10	10.14	9.68	9.70	10.07	10.43	9.98	10.19			9.72	9.75	9.99	0.75
MW1	112.15		322001	186489	689123.90	5866599.49	Not accessible due to vegetation or flooding													
MW2	116.49	1.00[2]	322226	186620	689347.02	5866733.59					1.88	1.85	1.47		1.33	1.59	1.29	1.51	1.79	0.59
MW3	123.167	1.33	322355	186583	689476.50	5866698.39	6.47	6.54	6.01	6.38	6.57	6.60	6.15	6.29	5.70	6.05	5.64	5.86	6.51	0.96
MW4	121.101	1.844	322229	186476	689352.02	5866589.67	8.64	8.62	8.61	8.50	8.94	9.03	8.73	8.91	8.22	8.71	8.38	8.20	8.42	0.83
MW5	122.31	2.004	322365	186471	689488.05	5866586.56	8.14	8.14	8.04		8.70	8.68	8.53	8.60	8.44	8.55	8.42	8.42	8.59	0.66
GWL	123.00	1.00[2]	322613[1]	186056	689742.00	5866175.00	2.32	2.32	2.03	2.14					2.00	2.20	2.09	2.11		0.32

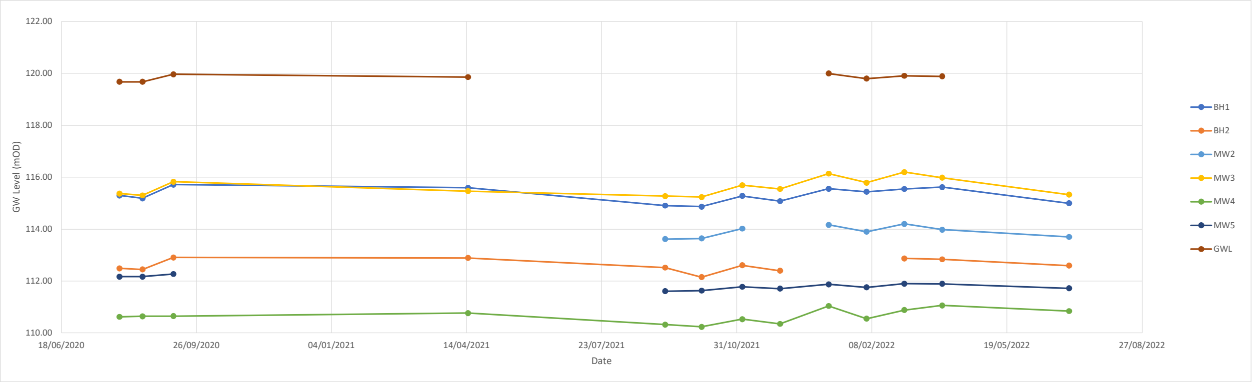
1. Borehole coordinates estimated from DEM data.
2. Stick-up measurements assumed in lieu of recorded measurements.



Appendix 6.4.2 - Groundwater Elevation Data (mAOD) 2020-2021

Borehole ID	Borehole Elevation (mOD)	Casing Stickup (m)	Irish Grid		WGS UTM 29U		31/07/2020	17/08/2020	09/09/2020	15/04/2021	08/09/2021	05/10/2021	04/11/2021	02/12/2021	07/01/2022	04/02/2022	04/03/2022	01/04/2022	04/07/2022	Range (m)
			Easting	Northing	Easting	Northing	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	GW mOD	
DW1	126.83		322265	186154	689392.49	5866268.26	Not accessible due to well head installation													
BH1	126.678	0.963	322264	186310	689389.32	5866424.20	115.30	115.19	115.72	115.59	114.91	114.87	115.28	115.08	115.56	115.44	115.55	115.62	115.00	0.85
BH2	123.289	0.705	322125	186344	689249.89	5866456.26	112.48	112.44	112.90	112.89	112.51	112.15	112.60	112.39			112.87	112.83	112.59	0.75
MW1	112.15		322001	186489	689123.90	5866599.49	Not accessible due to vegetation or flooding													
MW2	116.49	1.00[2]	322226	186620	689347.02	5866733.59					113.61	113.64	114.02		114.16	113.90	114.20	113.98	113.70	0.58
MW3	123.167	1.33	322355	186583	689476.50	5866698.39	115.37	115.30	115.83	115.46	115.27	115.24	115.69	115.55	116.14	115.79	116.20	115.98	115.33	0.96
MW4	121.101	1.844	322229	186476	689352.02	5866589.67	110.62	110.64	110.65	110.76	110.32	110.23	110.53	110.35	111.04	110.55	110.88	111.06	110.84	0.83
MW5	122.31	2.004	322365	186471	689488.05	5866586.56	112.17	112.17	112.27		111.61	111.63	111.77	111.71	111.87	111.76	111.89	111.89	111.72	0.66
GWL	123.00	1.00[2]	322613[1]	186056	689742.00	5866175.00	119.68	119.68	119.97	119.86					120.00	119.80	119.91	119.89		0.32

1. Borehole coordinates and collar elevation estimated from DEM data.
2. Stick-up measurements assumed in lieu of recorded measurements.



APPENDIX 6.5

Local Planning Applications for Boreholes and Septic Tanks

Reference Number	Name	Description	Received Date	Decision Date	Status
953122	Tyrone McNabb	bungalow and septic tank	December 21, 1995	April 14, 1996	Application Finalised
8673	Barry & Sinead McNabb	bungalow, effluent treatment system, recessed entrance, domestic garage and all associated site works	April 22, 2008	December 16, 2008	Application Finalised
953121	Barry McNabb	bungalow and septic tank	December 21, 1995	April 14, 1996	Application Finalised
72124	Celine Kenny	dwelling and effluent treatment system together with associated site works	October 11, 2007	March 16, 2008	Application Finalised
917413	John Kenny	Chalet type dwelling house and septic tank	August 30, 1991	December 30, 1991	Application Finalised
917074	Philip Wheatley	Bungalow and septic tank	May 29, 1991	July 28, 1991	Application Finalised
53064	Paul Dempsey & Dorothy Ledwidge	Constructiion of a dormer dwelling, new entrance, proprietrary wastewater system to EPA guidelines	June 3, 2005	September 1, 2005	Application Finalised
14856	Anthony & Ann Morrissey	house & septic tank	June 28, 2001	December 7, 2001	Application Finalised
14523	Jane Moxley & Thomas Keogh	proposed bungalow and septic tank	April 26, 2001	April 3, 2002	Application Finalised
991405	Kieran Kelly	2 bungalows and septic tanks	October 14, 1999	December 13, 1999	Application Finalised
201006	AJA Dormer & David Woolington	construction of a storey & a half dormer style dwelling, domestic car garage, wastewater treatment system, bored well & all associated site works	October 12, 2020	May 27, 2021	Application Finalised
126319	Harriet O'Connor	fully serviced dwelling house, wastewater treatment plant, private bored well and associated site works	April 25, 2012	October 17, 2012	Application Finalised
2753	Liam Newsome	Bungalow and septic tank	June 2, 2000	November 1, 2000	Application Finalised
3161	Michael Smyth	single storey dwelling, bio disc, sewage treatment plant & associated works	August 21, 2000	October 20, 2000	Application Finalised
41992	Mandie Hughes & Stephen Kinsella	Bungalow, Effluent Treatment System to EPA Standard & Associated Site Development Works	December 14, 2004	August 16, 2005	Application Finalised
3163	Luke Smyth	single storey dwelling, bio disc sewage treatment plant and associated works	August 21, 2000	October 20, 2000	Application Finalised
14208	Geraldine Arthur	bungalow, garage and septic tank	March 2, 2001	November 12, 2001	Application Finalised
3095	George & Shirley Butler	dwelling & septic tank	August 9, 2000	January 23, 2001	Application Finalised
965190	Martin Henehan	bungalow and septic tank	December 19, 1996		Application Finalised
14516	Declan Doyle	bungalow, septic tank & percolation area	April 25, 2001	October 19, 2001	Application Finalised
21791	Garrett Jack Dunne	233 sqm single storey dwelling, 48 sqm single storey garage, vehicular entrance via existing agricultural entrance, bored well, effluent disposal system to current EPA standards, all associated ancillary site development works	July 5, 2021	October 25, 2021	Application Finalised
21139	Katie Dunne	dwelling, garage, waste water treatment system to EPA standards, new entrance and associated site works	February 15, 2021	May 20, 2021	Application Finalised
22169	Amy Dunne	dwelling, waste water treatment system to EPA standards, garage, entrance and associated works	February 21, 2022	August 11, 2022	New Application
52488	Susanne O'Leary & John Gilvarry	Dwelling with services and domestic garage	March 9, 2005	January 26, 2006	Application Finalised
16221	Anthony Redmond	proposed single storey dwelling, garage, waste water treatment system to EPA 2009 standards & entrance	March 3, 2016	May 12, 2016	Application Finalised
114220	Jason Moxley	dwelling, garage, well, proposed secondary treatment system to current EPA 2009 guidelines, percolation area, new entrance and all associated site works	April 5, 2011	November 7, 2011	Application Finalised
3454	M & C Devlin	bungalow and septic tank	October 26, 2000	December 25, 2000	Application Finalised
15292	Belinda Keogh & Stephen Moxley	Dormer bungalow & septic tank	October 11, 2001	August 18, 2002	Application Finalised
18177	Gary & Amanda Dunne	outdoor horse riding arena along with all associated site works and services	February 22, 2018	October 17, 2018	Application Finalised
66690	Wayne Hudson	bungalow with waste water treatment system including percolation area to EPA standards and associated site works	November 16, 2006	January 19, 2007	Application Finalised
988592	Eugene & Fiona Whelan	revised house type, revised entrance and septic tank on approved site	May 20, 1998	October 19, 1998	Application Finalised
964711	May Barry & Esther Byrne	single storey house and septic tank	August 6, 1996	November 25, 1996	Application Finalised
81014	Brian Wheatley	dwelling and permission for new effluent treatment system	June 10, 2008	August 4, 2008	Application Finalised
952506	Brian Savage	Dwelling and reed bed sewerage system	June 2, 1995	September 10, 1995	Application Finalised
71144	Shane Martin	Permission for construction of a bungalow, domestic car garage, waste water treatment system with percolation area, bored well and associated siteworks.	May 29, 2007	February 14, 2008	Application Finalised
54425	Daniel Shannon	demolition of an existing dwellling c920 sq.ft to be replaced with proposed new two storey dwelling c.3530sq.ft, well, effluent treatment system to current EPA guidelines, percolation area, proposed new stone entrance, wing walls, gates and associated si	December 22, 2005	February 24, 2006	Application Finalised