Appendices

BCL Document Reference: BCL/htl/BCNL/009.doc

Quinn Cement Limited

BALLYCONNELL CEMENT PLANT

Ballyconnell, County Cavan

Proposal to use alternative fuels / raw materials at the Cement Plant

Hydrogeological and Hydrological Assessment

March 2016

Report Prepared For:

Enervise Limited
8 Warren Avenue, Boyle,
Co. Roscommon
Tel. +353 87 1321356
Email. info@enervise.ie

Agents For:

Quinn Building Products
Gortmullan, Derrylin,
Co. Fermanagh
BT92 9AU
Tel. 1800 322 122

Consultant Hydrogeologists Limited

Technology Centre
Wolverhampton Science Park, Wolverhampton, WV10 9RU
Tel: 01902 824111, Fax: 01902 824112
email: info@bclhydro.co.uk
web: http://www.bclhydro.co.uk

Company Registration Number: 4043373
Registered in England & Wales. Registered Office: 33 Wolverhampton Road, Cannock.

This Page Intentionally Left Blank

Quinn Cement Limited

BALLYCONNELL CEMENT PLANT

Ballyconnell, County Cavan

Proposal to use alternative fuels / raw materials at the Cement Plant

Hydrogeological and Hydrological Assessment

March 2016

Report Prepared By:

Henry Lister B.Sc. M.Sc.
Senior Hydrogeologist

Report Checked By:

Gavin Chaplin B.Sc. M.Sc.
Senior Hydrogeologist

BCL Consultant Hydrogeologists Limited

Technology Centre
Wolverhampton Science Park, Wolverhampton, WV10 9RU
Tel: 01902 824111, Fax: 01902 824112
email: info@bclhydro.co.uk
web: http://www.bclhydro.co.uk

Company Registration Number: 4043373
Registered in England & Wales. Registered Office: 33 Wolverhampton Road, Cannock.

This Page Intentionally Left Blank

APPENDICES

Appendix 1: Figures

Appendix 2: Water Quality Data

Appendix 3: Fluids Handing Protocol

BCL CONSULTANT HYDROGEOLOGISTS LIMITED

EXPERIENCE & QUALIFICATIONS

BCL is an independent consultancy specialising in all aspects of hydrology and hydrogeology as they relate to minerals extraction, water supply and environmental issues.

Henry Lister (the author of this report) holds a Bachelor of Science (Honours) degree [Applied Geology] conferred by Plymouth University, 1992 and a Master of Science Degree [Groundwater Engineering], Newcastle University, 1994.

BCL has provided specialist services and advice to the extractive industry since 2000. During this time, experience has been gained from involvement in the study of hydrogeological and hydrological systems in connection with planning matters at over 100 quarries throughout the United Kingdom and Ireland.

1 INTRODUCTION

1.1 Background

1.1.1 Quinn Cement Limited (the Applicant) is seeking consent for its "Proposal to increase the range and quantity of alternative fuels and alternative raw materials at the Ballyconnell Cement Plant". Following consultation with regulators, it has been determined that an EIA (update of previous EIS) is required, including a review of the Industrial Emissions Licence (IEL) for the Site.

1.1.2 The Applicant has appointed a specialist consultancy, Enervise Limited (advising on all aspects of Energy and Environmental Projects), to coordinate the production of the EIA and IEL Application (the Application).

1.1.3 Enervise has instructed BCL Consultant Hydrogeologists Limited (BCL) to assess the potential hydrological and hydrogeological impacts associated with the Proposed Development.

1.2 Aim, Scope and Methodology of Assessment

1.2.1 This report presents the findings of a hydrological and hydrogeological Baseline Study and Impact Assessment that is intended to inform consultations during the processing of the Application.

1.2.2 The collection and interpretation of baseline data has facilitated a detailed understanding of the nature of, and interactions between, the groundwater and surface water systems operating at and around the Site.

1.2.3 The understanding of hydrological and hydrogeological conditions has been applied to assess the likely primary impacts of the Proposed Development upon the water environment.

1.2.4 Significant potential impacts identified during the course of investigations have been addressed by the incorporation, at the planning stage, of mitigation measures into the design of the Proposed Development.

1.2.5 Where appropriate, outline monitoring protocols have been advanced to facilitate validation / modification of the effectiveness of mitigation measures.

1.3 Data Sources

1.3.1 Both published and unpublished documents and other sources of information that have been examined include:

i. Ordnance Survey of Northern Ireland (OSNI) topographic map, Discovery Series, sheet number 27, "Upper Lough Erne", at a scale of 1:50,000

ii. Geological Survey of Northern Ireland (GSNI): "Geological Map of Northern Ireland", Solid and Quaternary Editions, 1:250,000-scale.

iii. GSNI solid & drift geology maps (sheet numbers 57 & part of 58: "Lisnaskea"), at 1:50,000-scale, published 2005.

iv. British Geological Survey (BGS) and Department of the Environment for Northern Ireland (DoENI): "Hydrogeological Map of Northern Ireland" and "Groundwater Vulnerability Map of Northern Ireland", both at 1:250,000-scale.

v. Hydrological and hydrogeological data from the Environmental Protection Agency (EPA), the Northern Ireland Environment Agency (NIEA), the Geological Survey of Ireland (GSI) and Cavan County Council (CCC).

vi. Flood Mapping published by the Office of Public Works (OPW) and the Rivers Agency (Northern Ireland).

vii. National Parks and Wildlife Service (NPWS) and Northern Ireland Environment Agency (NIEA): Spatial mapping & citation information for Designated Sites of ecological interest.

viii. Rainfall data from the Climate Enquiries Office at Met Éireann.

ix. Guidance on flood risk assessment, namely: "The Planning System and Flood Risk Management: Consultation Draft Guidelines for Planning Authorities", prepared by the OPW and the Department for the Environment, Heritage and Local Government (DEHLG).

1.3.2 Site specific data include the following:

i. Topographic surveying commissioned by the Applicant.

ii. Geological information from a programme of exploration drilling and geophysics undertaken in the vicinity of the Site.

iii. Groundwater level monitoring data from piezometers operated by the Applicant.

iv. Aquifer hydraulic data obtained by completing small-scale falling head tests and larger scale aquifer test-pumping exercises.

v. Water quality data, derived from laboratory analysis of water samples taken from piezometers and surface watercourses surrounding the Site.

vi. Survey of surface water features within and bordering the Site (31st October to 2nd November 2002 and 13th January to 15th January 2003).

vii. Ongoing programme of hydrometric monitoring (visiting the Site in June 2007, January & July 2008, 2009, 2010, January & August 2011, January, July & November 2012, August 2013, January 2014 & July 2014, January & August 2015 and February 2016).

viii. Documents relating to the Site's Industrial Emissions Licence P0378-02:

- "Firewater Risk Assessment" (ref: 50410) prepared by Verdé Environmental Consultants Ltd in August 2014.
- "Hydrogeological Assessment Report" (ref: 50453) prepared by Verdé Environmental Consultants Ltd in January 2015.
- Annual Environmental Report, 2014 (submitted on 31st March 2015).
- "Soil Investigation (LR014931)" submitted to the EPA by the Applicant on 7th October 2015.

ix. Site layout indicating proposed new equipment (Quinn Cement).

x. Schematic showing proposal for reuse of surface water and firewater retention (Quinn Cement).

xi. Previous reports (prepared by BCL Consultant Hydrogeologists Limited) detailing the hydrogeology of the area, namely:

- "Aughrim and Mucklagh Quarry Complex: Hydrogeological and Hydrological Assessment" (October 2003).
- "Aughrim and Mucklagh Quarry Complex: Hydrology and Hydrogeology – Supplemental Submission to An Bord Pleanála" (September 2005).
- "New Cement Works, Scotchtown, Ballyconnell: Hydrogeological and Hydrological Assessment" (November 2005).

- "Ballyconnell Cement Works - Proposal to use Solid Recovered Fuel for the Cement Plant: Hydrogeological and Hydrological Assessment" (April 2009).

1.4 Report Structure

1.4.1 Baseline data concerning the topography, geology, hydrology and hydrogeology of the study area are presented at *section 2*.

1.4.2 An account of the Proposed Development, including description of intended working methods and water management measures, is given in *section 3*.

1.4.3 Assessment of the potential impacts of the Proposed Development and description of mitigation measures proposed to ameliorate significant such impacts are made in *section 4*.

1.4.4 A summary of the findings of hydrogeological and hydrological assessment together with report conclusions and recommendations are given in *section 5*.

1.4.5 All diagrams referred to by this report are included as *appendix 1*.

2 BASELINE STUDY

2.1 Site Location & Topography

2.1.1 The Site (*figure 1, appendix 1*) is centred upon Irish Grid Reference (IGR) H ^{2}275 ^{3}203; *circa* 1.5 km north of Ballyconnell, County Cavan.

2.1.2 The landholding is located upon the southeast facing aspect of Slieve Rushen Mountain. Ground elevations generally fall to the south, southeast and east of the Site, and rise north-westwards toward the summit of Slieve Rushen.

2.1.3 The summit of Slieve Rushen Mountain, which attains an elevation of some 404 metres above Ordnance Datum (maOD), is situated approximately 4.5 km to the west-northwest of the Site.

2.1.4 Ground elevations within the boundaries of the Site fall from some 110 maOD upon the north-western boundary to some 60 maOD at the southern and eastern boundaries.

2.1.5 The Cement Plant is located upon a strip of land (approximately 250 m in width), which extends across the central part of Site, at an elevation of 80-90 maOD.

2.1.6 The Woodford River (Shannon-Erne Waterway) is some 400 m to the southeast of the Site, at its closest approach. The Woodford River valley has a southwest to northeast orientation.

2.1.7 Low-lying land within the Woodford River Valley is characterised by gently undulating topography and relatively subdued relief, with ground elevations in the region of 50 maOD.

2.1.8 Low rounded hillocks are interspersed with numerous small loughs and streams, which form tributaries to the Woodford River. The river flows generally north-eastwards, discharging into Upper Lough Erne, approximately 8.5 km east northeast of the Site.

2.2 Outline of Proposed Development

2.2.1 It is proposed to improve the sustainability of the cement plant through the use of an increased range of waste-derived alternative raw materials and fuels with the long-term aim of displacing almost all fossil fuels at the plant (a limited proportion of fossil fuels will be required during process start-up and for process optimisation/stabilisation). The use of these alternatives will equate to 300,000 tonnes per annum at maximum substitution.

2.2.2 A range of suitable materials are proposed for acceptance at the plant, which can be summarised as follows:

- Solid Fuels – including Solid Recovered Fuel (SRF), which is currently authorised for use at the plant, as well as a range of suitable fuels derived from other sources including:
  - Meat and Bone Meal (MBM);
  - Tyre Derived Fuel (TDF);
  - Biomass Fuels;
  - Sludges and Filter Cakes.
- Liquid Fuels – including Secondary Liquid Fuel (SLF), which is a blend of organic and solvent wastes mixed to a defined specification, as well as liquid fuels derived from other sources (*e.g.* waste oils).
- Alternative Raw Materials (*e.g.* muds, minerals, sludges).

2.2.3 It is also proposed to include natural gas and petcoke as additional fuels in the licence. This is to provide flexibility for any future fossil fuel requirement.

2.2.4 The technology is based on best knowledge and practice available appropriate to meet with the EU Waste Incineration Directive 2000/76/EC, with particular regard to ensuring compliance with the emission limits specified in this Directive.

2.3 Designated Sites

2.3.1 The NPWS and NIEA maps have been consulted to check for Natural Heritage Areas (NHA), Areas of Special Scientific Interest (ASSI), Special Areas of Conservation (SAC), Special Protected Areas (SPA), Nature Reserves and Ramsar Sites.

2.3.2 Moninea Bog ASSI - SAC (alongside Drumderg Lough, *figure 1*) lies 2 km to the northeast of the Site, at closest approach.

2.3.3 The bog at the summit of Slieve Rushen Mountain (Mullinacre Upper Townland) has NHA status; the boundary of the protected area extends to within 2.5 km of the western margin of the Site.

2.3.4 Lough Oughter and associated loughs (SAC and potential NHA) are at a greater standoff, some 2.6 km to the SE of the Site.

2.3.5 There are no other designated conservation areas within 4 km radius of the Site.

2.3.6 *Section 4.3* examines the potential for impact upon designated sites from the proposed development as well from the existing plant

2.4 Licensed Facilities

2.4.1 Certain activities are licensable under Industrial Emission, Pollution Prevention and Waste Management legislation: (*a*) RoI - Waste Management Licensing Regulations 2004 to 2011; EPA (Integrated Pollution Control)(Licensing) Regulations 2013; EU (Industrial Emissions) Regulations 2013; and (*b*) NI - The Pollution Prevention and Control Regulations (Northern Ireland) 2003; Waste Management Licensing Regulations (Northern Ireland) 2003.

2.4.2 The EPA and NIEA public registers have been consulted to check for local sites carrying out licensed activities.

2.4.3 Aside from the IE licences held by the Quinn Cement Limited and Quinn Therm Limited, the closest licensed site is operated by Eurothane Holdings Limited in Ballyconnell, 2 km to the south of the Site.

2.5 Solid Geology

2.5.1 The geology within and surrounding the Site has been characterised by reference to the mapping and literature cited in *section 1.3*.

2.5.2 The Site is underlain by the Dartry Limestone Formation, which is of Carboniferous (Visean) age (*figure 2a*).

2.5.3 The Dartry Limestone is a dark grey, fine-grained cherty limestone with associated mudstone. The regional thickness of the Dartry Limestone is reported as 220 m, while its outcrop in the vicinity of the Site is some 3-4 km wide.

2.5.4 Boreholes drilled at or towards the foot of Slieve Rushen (in the vicinity of the Site) encountered an extremely weathered upper section of Dartry Limestone directly beneath drift deposits. This weathered section of the Dartry Formation, ranging in thickness between 9 m and 18 m within the boreholes, is present as an almost entirely disaggregated calcareous sand and gravel with no apparent consolidated structure or cohesive strength.

2.5.5 This unit, which is referred to hereafter as "disaggregated limestone", is considered to be hydrogeologically significant due to its considerable thickness and apparent intergranular hydraulic properties (*section 2.9.3*).

2.5.6 The Meenymore Formation overlies the Dartry Limestone and comprises sandstone, siltstone, mudstone and evaporitic / marine limestones. The boundary between the Dartry Limestone and Meenymore Formations is unconformable; its surface expression passing approximately 650 m to the northwest of the Site, at closest approach.

2.5.7 The Dartry Limestone and Meenymore Formations are underlain by the Benbulben Shale Formation, which consists of dark grey fossiliferous mudstone and thin bioclastic limestones.

2.5.8 The formations are found in approximately parallel layers, which dip slightly to the west (with dip measurements of 5-15°) in the vicinity of the Site. Each outcrops in an approximately north-south orientation in the vicinity of the Site, on the eastern side of the Slieve Rushen Mountain.

2.6 Drift Geology

2.6.1 The published mapping data shows the Quaternary drift cover, overlying the solid geology, is of variable composition and extent (*figure 2b*).

2.6.2 The Site (and the valley to the east) is underlain by glaciofluvial ice-contact drift.

2.6.3 Boreholes drilled to the east of the Site encountered a thick interbedded series of sands, sands and gravels, alluvium and clays, extending to a depth of some 15 m below the thin soil cover.

2.6.4 These deposits occur across an irregularly shaped area, generally some 1 km wide and aligned roughly north-south along the break of the slope at the eastern edge of the Site.

2.6.5 To the west of the cement works, the land is indicated to have a till cover, although there are patches where the till is shown to be absent above the Meenymore Formation.

2.6.6 Along most of the line of the Woodford River, the mapped drift deposit is lacustrine alluvium.

2.7 Meteorology

2.7.1 Met Éireann maintains a Synoptic Station at Ballyhaise (IGR H $^{2}45200$ $^{3}11600$).

2.7.2 The 30-year annual average rainfall for this station is 1,006.9 mm, as measured during the period 1981-2010.

2.8 Hydrology

2.8.1 Regional Setting

2.8.1.1 The Site is located upon the southeast-facing slope of Slieve Rushen Mountain, in the catchment of the Woodford River.

2.8.1.2 In the vicinity of the Site, the Woodford River flows generally from south-west to north-east, veering east-northeast. The river is situated some 400 m to the south-east of the Site at its closest approach (*figure 3*).

2.8.1.3 The Woodford River discharges to Upper Lough Erne. Its confluence with the lough is situated approximately 8.5 km east-northeast of the Site.

2.8.1.4 Significant reaches of the Woodford River, including the stretch in closest proximity to the Site, have been canalised to create the Shannon-Erne Waterway. At Cloncoohy (some 1.5 km to the east of the Site), the canal "short-circuits" severe meanders followed by the river channel.

2.8.1.5 Knockadools Springs are located on the northwest side of the Woodford River, some 0.8 to 1.0 km to the east of the Site. Observations made in connection with previous investigations indicate that diffuse spring flow is collected in a network of field drainage ditches, ultimately discharging into the Woodford River.

2.8.1.6 Historic data has been obtained from the OPW for a hydrometric monitoring station at Ballyheady Bridge on the Woodford River (IGR H ^{2}250 ^{3}156), some 5 km SSW/upstream from the Site. During the period 1974-1992, the highest recorded flood level was 53.09 maOD. The OPW data indicates that this level would only be exceeded 1% of the time.

2.8.1.7 On the stretch of river adjacent to the Site, the equivalent flood level is estimated to be some 49 maOD.

2.8.1.8 The most recent water quality data collected by the EPA at Station "Bridge 3 km W of Ballyconnell" indicates that the upstream stretch of watercourse has a High Status (Q value 4-5). Downstream of Ballyconnell, the river is "possibly at risk of not achieving good status".

2.8.2 Local Hydrology

2.8.2.1 The low vertical permeability of the Meenymore Shales has provided the conditions for the development of an extensive peat blanket upstream of the Site.

2.8.2.2 The presence of peat will serve to attenuate rainfall, limiting peak discharges of runoff from the upland catchments. This is reflected in the generally limited development of surface watercourses in the area of the Site; drainage being afforded by relatively minor watercourses, all of which ultimately discharge into the Woodford River. Peat will also provide storage for incident rainfall, providing for the maintenance of surface water flow through prolonged dry periods.

2.8.2.3 During field surveying undertaken between October 2002 and January 2003, flow rates of less than 15 to 20 litres per second (l/s) were observed to be typical, even within downstream sections of watercourses following periods of prolonged and intense rainfall. No significant scouring or channel enlargement was observed, suggesting that the rate of rainfall run-off from the local catchments is regular rather than flashy.

2.8.2.4 Local watercourses are illustrated at *figure 3*. Estimated flow rates within the drainage network at the time of the survey, together with tentative catchment boundaries, are illustrated at *figure 4*.

2.8.2.5 Mucklagh Stream drains the land to the south and west of the Site. The catchment boundary roughly coincides with the haul road at the southwest boundary of the cement works. The stream receives no runoff from Site. Mucklagh Stream converges with Gortoorlan Stream, the confluence being some 500 m to the southwest of the Site, from there draining southwards into Ballyconnell. The confluence with the Woodford River is situated some 2 km to the south of the Site.

2.8.2.6 Gortawee Stream drains eastwards from the flank of the mountain, some 165 m northeast of the cement works, at closest approach. Leaving the high ground of the mountain, the watercourse veers southwards across the lower-lying ground of the Woodford valley. It joins the Woodford River some 0.5 km to the east of the Site.

2.8.2.7 *Surface water runoff arising within the cement works during rainfall events*: Before being discharged off site, the runoff is directed into large covered settlement tanks (*section 3.3*) located immediately to north of the entrance weighbridge. This is to ensure that the suspended solids content of the water is reduced to an acceptable limit (less than 35 mg/l) prior to being discharged into the receiving watercourse. The settlement tanks include flow balancing capacity (to control the rate of discharge during storm events) and oil interceptor facilities. Full details of the discharge schedule are provided in the IE Licence (Reg. No. P0378-02).

2.8.2.8 Discharge from the settlement tanks is made via a pipe, which passes beneath the Ballyconnell-Derrylin road and flows eastwards for some 300 m before reaching its confluence with the Woodford River. The line of the discharge pipe is illustrated upon *drawing QC170512*.

2.8.2.9 The Applicant is proposing to use the water from the settlement tanks for the cement manufacturing process, which would reduce the discharge rate to the Woodford River. The water from the settlement tanks will be recycled back into the cement manufacturing process through a proposed Surface Water Recycling Tank (SWRT), thereby reducing the process water requirements from on-site boreholes.

2.8.2.10 Furthermore, it is proposed to install a separate Fire Water Retention Tank (FWRT) with a capacity of 100 m^3. In the event of a fire, the water discharge from the site can be directed to this tank by opening a valve, which directs the water away from the existing settlement tanks, through a bypass line, to the proposed FWRT. This proposal will significantly reduce the potential volume of water to be disposed of in the event of a fire or spillage accident on site.

2.8.2.11 Full details regarding the sizing of the FWRT are presented in the "Firewater Risk Assessment" (ref: 50410) prepared by Verdé Environmental Consultants Ltd in August 2014.

2.8.2.12 The locations of the SWRT and FWRT are indicated upon the drawing entitled "Water Monitoring and Emission Points", Rev. 3, dated 22nd March 2016 (*appendix 1*).

2.8.3 Surface Water Quality

2.8.3.1 The results of historic surface water quality sampling are detailed in the following reports:

- "New Cement Works, Scotchtown, Ballyconnell: Hydrogeological and Hydrological Assessment" (November 2005), prepared by BCL.
- "Ballyconnell Cement Works - Proposal to use Solid Recovered Fuel for the Cement Plant: Hydrogeological and Hydrological Assessment" (April 2009).
- IE Licence No. P0378-02: Annual Environmental Report, 2014 (submitted on 31st March 2015).

2.8.3.2 More recent data, collected on 20th February 2016, are presented in *appendix 2*.

2.8.3.3 The sampling locations include the Site Discharge Point (SW-1), the Woodford River upstream of the Site (SW-U) and the Woodford River downstream of the Site (SW-D).

2.8.3.4 The Development Proposal involves the use of an increased range of waste-derived alternative raw materials and fuels.

2.8.3.5 The laboratory analysis schedule for the water samples was tailored to reflect this proposal, whereby the storage of materials (in the future) may contain the following possible constituents: Methanol (MeOH), Ethanol (EtOH), Isopropanol (IPA), Ethyl Acetate (EtAc), Tetrahydrofuran (THF), Dimethylformamide (DMF), Isopropylacetate, Toluene, Acetonitrile, Kerosene/oil, C5-C9 alkylated phenols, Acetone, Methyl isobutyl ketone (MIBK), Cyclohexane.

2.8.3.6 As a result, the laboratory schedule was expanded to include Volatile Organic Compounds (VOC), Semi Volatile Organic Compounds (SVOC), Extractable Petroleum Hydrocarbons (EPH), Gasoline Range Organics (GRO), Alcohols, Acetates and Acetonitrile.

2.8.3.7 The laboratory data have been compared with the relevant standards put forward in the EPA Document "Parameters of Water Quality: Interpretation and Standards" (2001); also the more recent consultation paper entitled "Proposals for Regulations establishing Environmental Objectives and Environmental Quality Standards for the classification and management of Surface Waters and requiring the implementation of measures to reduce water pollution and protect and restore Surface Waters", DEHLG, 5th September 2008.

2.8.3.8 With regard to monitoring the risk posed by current operations at the cement works, the key Water Quality Indicators are listed in Section B.2 "Emissions to Water" of the IE Licence (Reg. No. P0378-02). Where tested, these were in compliance with the limits specified in the licence.

2.8.3.9 As outlined above, parameters relating to the Development Proposal include VOC, SVOC, EPH, GRO, Alcohols, Acetates and Acetonitrile. The baseline data for these parameters are below the limit of detection.

2.8.3.10 The Chemical Oxygen Demand (COD) reading at SW-1 in 2016 is more elevated than normal; when compared with the average reading per the Annual Environmental Report for 2014; but the Woodford River is shown to have sufficient assimilative capacity.

2.8.4 Flooding

2.8.4.1 Maps detailing flood defence assets and watercourses as well as historic and predictive flood mapping are published on the OPW and Rivers Agency websites.

2.8.4.2 There is no risk of fluvial flooding at the Site (allowing for climate change). Ground elevation upon the closest stretch of floodplain equates to *circa* 50 maOD, which is 10 m below the lowest point on the Site boundary.

2.8.5 Waterbodies

2.8.5.1 The settlement system serving the cement works is described in more detail in *section 3.3*.

2.8.5.2 There is a small pond located upon the boundary of the landholding at IGR H ^{2}27718 ^{3}20177, some 220 m to the north of the abstraction borehole GW-1 at the Cement Works. This is reported to have formerly been used for collecting rainfall runoff, although it is no longer included in the site settlement system, and is not considered to be of ecological value.

2.8.5.3 There are no other waterbodies within 1 km standoff from the development.

2.8.5.4 The closest such feature is Annagh Lough, which is some 1.7 km to the southeast of the Site (*figure 1*). The cement works and lough are situated on opposite sides of the Woodford River.

2.9 Hydrogeology

2.9.1 Regional Hydrogeology

2.9.1.1 The Dartry Limestone Formation is classified by the GSI as a regionally important, fissured bedrock aquifer on the basis of its large outcrop area and relatively elevated transmissive properties. Due to the presence of a karstic flow component, groundwater flow rates and levels may be anticipated to vary significantly from location to location throughout the region.

2.9.1.2 The principle areas of karstification are identified by the GSI to be located within upland areas to the northwest of the region. Major springs occur several kilometres to the north of Ballyconnell and near Tully Forest in Northern Ireland.

2.9.1.3 In terms of groundwater resource protection, with respect to potentially polluting activities, the Dartry Limestone aquifer of the region is shown to have a high to extreme vulnerability rating.

2.9.1.4 The Quaternary Sands and Gravels are classified as a regionally important, extensive sand/gravel aquifer. The drift aquifers of the region are categorised as moderately to highly vulnerable to potential contamination.

2.9.2 Groundwater Levels

2.9.2.1 Full details of the results of the groundwater level monitoring programme are reported in the BCL document entitled "Groundwater Level Monitoring - Six Monthly Data Statement: up to 10/02/16", dated 22nd February 2016.

2.9.2.2 Further understanding of the baseline regime has been informed by the findings of the groundwater level survey presented in "Hydrogeological Assessment Report" (ref: 50453) prepared by Verdé Environmental Consultants Ltd in January 2015.

2.9.2.3 The available data indicates a south-easterly direction of groundwater flow within the Dartry Limestone, broadly perpendicular to the geological strike and generally concordant with the surface topography. The groundwater contour plan prepared by Verdé is reproduced herein as *figure 5*.

2.9.2.4 Derived piezometric heads around the area of the contact between the Dartry Limestone and the overlying Meenymore Shales approximate to some 125 to 130 maOD. Groundwater levels within the limestone in the vicinity of the Ballyconnell to Derrylin road fall to between 55 maOD and 50 maOD.

2.9.2.5 The inferred south-easterly hydraulic gradient varies between 0.0467 (approximately 1:21) and 0.0583 (approximately 1:17).

2.9.2.6 Based upon the available piezometer data, the typical long-term range between minimum and maximum groundwater levels is between 2 m and 6.5 m.

2.9.3 Hydraulic Conductivity

2.9.3.1 A series of falling head hydraulic conductivity tests were carried out during January 2005 upon five piezometer boreholes installed at the Site.

2.9.3.2 A summary of the findings of the falling head testing, which have been analysed using the Ernst Auger Hole and Bouwer & Rice techniques, are presented below.

Summary Results of Falling Head Aquifer Testing: Hydraulic Conductivity					
Piezometer	PZ 2002/01	PZ 2002/02	PZ 2002/03	PZ 2002/04	PZ 2002/05
Maximum (m/d)	6	-	0.05	0.05	0.5
Minimum (m/d)	5	-	0.01	0.005	0.1
Analysis	Ernst auger hole analysis (water level change in screen).	Piezometer dry, quantitative analysis cannot be undertaken.	Bouwer and Rice slug test analysis (water level change above screen)	Bouwer and Rice slug test analysis (water level change above screen)	Bouwer and Rice slug test analysis (water level change above screen)
Notes	Analysis does not account for collapsed hole in broken stone and clay below base of piezometer (to depth of 72 mbgl)	Slug of water of volume 125 litres drained in 1100 s. Piezometer screen (in bottom 20 m of borehole) in "clay"			
Piezometers under test are partially penetrating through the limestone aquifer. The hydraulic conductivity values are, however, insensitive (maximum range of 5%) to the inaccuracy of the assumed values for the base of the aquifer.					

2.9.3.3 The results of the small-scale falling head testing exercise indicate significant heterogeneity within the sections of aquifer under test.

2.9.3.4 The values obtained from testing are entirely in accordance with the characteristic range of hydraulic conductivity attributable to limestone aquifers as observed during previous similar investigations and as reported elsewhere in literature.

2.9.3.5 A programme of aquifer test pumping conducted in July and August 2005 has informed further assessment of the hydraulic properties of the strata.

2.9.3.6 All tests conducted within the mechanically competent section of the Dartry Limestone produced extremely limited well yields. In contrast, testing of the disaggregated upper profile of the limestone (toward the valley floor east of the Site) produced a significant discharge rate for modest drawdown.

2.9.3.7 Data collected from the test pumping exercise has been analysed to provide values of aquifer hydraulic conductivity. The resultant values are presented below.

Summary Results of Aquifer Test Pumping Programme

Abstraction Well I.D.	Monitoring Well	Transmissivity (m^2/d)		Hydraulic conductivity (m/d)*	
		Early Data	Late Data	Early Data	Late Data
Q05_02	P05_09	2	-	0.033	-
	P05_10	4	-	0.067	-
Q05_04	P05_11	180	-	3.396	
Q05_05**	P05_09	26	2	0.419	0.032
	Q05_02	25	2	0.403	0.032
Q05_06	Q05_06	0.1	-	0.002	-
	Q05_01(d)	0.8	-	0.016	-

* Note: in all cases hydraulic conductivity is calculated from transmissivity applying assumption that effective depth of circulation is limited to base of abstraction borehole.
** Note: late data considered to be more robust due to higher pumping rate and resultant greater stress over wider volume of aquiifer

2.9.3.8 Values of hydraulic conductivity obtained for the competent section of the Dartry Limestone were extremely low, with a representative value, combining all tests, of some 0.03 m/d.

2.9.3.9 For the disaggregated limestone (mantling the solid strata of the valley floor), the calculated value of hydraulic conductivity equated to 3.4 m/d, which is in excess of 100 times greater than that of the mass of the competent limestone.

2.9.4 Relationship between Groundwater within the Dartry Limestone and Surface Watercourses

2.9.4.1 The depth to groundwater (as recorded in the Site piezometers) shows that the watercourses upon the flanks of Slieve Rushen exist a significant distance above the watertable. Thus, these streams cannot accrete flow from groundwater. Nor is there likely to be significant downward leakage, due to (*i*) the presence of low permeability boulder clay mantling the solid strata and (*ii*) the significant stream-bed gradients, resulting in relatively rapid stream velocities.

2.9.4.2 Upon the valley floor, the groundwater flowing within the mechanically competent sections of the Dartry Limestone is in continuity with, and thus laterally recharging, the disaggregated limestone and the drift deposits. Under gravity, there is diffuse seepage from the drift deposits into the Woodford River.

2.9.5 Local Abstractions

2.9.5.1 The abstraction points described below are illustrated upon *figure 5*.

2.9.5.2 The closest private groundwater supply borehole is located at the Kearns' property at Gortoorlan (approximate grid reference ^{2}271 ^{3}200), some 325 m to the southwest of the Site.

2.9.5.3 The Maguire's property at Gortoorlan is also served by an abstraction borehole (grid reference ^{2}2706 ^{3}1988), this being some 500 m southwest of the Site.

2.9.5.4 It is understood that these boreholes abstract from the Dartry Limestone.

2.9.5.5 There is borehole located adjacent to the Ballyconnell to Gortoorlan Road, which is now disused, having historically been operated by Cavan County Council (CCC) for groundwater abstraction. It is sited at grid reference ^{2}2757 ^{3}1939, approximately 500 m to the south of the cement works.

2.9.6 Groundwater Quality

2.9.6.1 The results of baseline groundwater quality sampling are detailed in the following reports:

- "New Cement Works, Scotchtown, Ballyconnell: Hydrogeological and Hydrological Assessment" (November 2005), prepared by BCL.
- "Ballyconnell Cement Works - Proposal to use Solid Recovered Fuel for the Cement Plant: Hydrogeological and Hydrological Assessment" (April 2009).
- "Hydrogeological Assessment Report" (ref: 50453) prepared by Verdé Environmental Consultants Ltd in January 2015.
- IE Licence No. P0378-02: Annual Environmental Report, 2014 (submitted on 31st March 2015).

2.9.6.2 More recent data, collected on 20th February 2016, are presented in *appendix 2*.

2.9.6.3 The sampling locations include GW-1, BH-02, BH-03, BH-04, BH-05 and P05-6 (*figure 5*). GW-1 is the main abstraction well for process water; BH-02, BH-03, BH-04 and BH-05 are peripheral wells, drilled in agreement with the Agency as part of the study informing the "Hydrogeological Assessment Report" completed by Verdé under P0378-02 licence conditions; and P05-06 is an upstream location (replacing BH-01, which has collapsed).

2.9.6.4 As outlined earlier, the laboratory schedule was expanded to include Volatile Organic Compounds (VOC), Semi Volatile Organic Compounds (SVOC), Extractable Petroleum Hydrocarbons (EPH), Gasoline Range Organics (GRO), Alcohols, Acetates and Acetonitrile.

2.9.6.5 The laboratory data have been compared with the relevant standards put forward in the EPA Document "Parameters of Water Quality: Interpretation and Standards" (2001); also the Interim Guideline Values (IGV) as detailed in the EPA's "Interim report towards setting guideline values for the protection of groundwater in Ireland" (2003); Groundwater Regulation Threshold Values under S.I. 9 of 2010; and Drinking Water Regulation under S.I. 122 of 2014.

2.9.6.6 The pH results ranged 5.88 to 7.63. The pH parameter measured in BH-04 (5.88) was slightly below the lower threshold value indicated by the IGV and Drinking Water Standards (DWS). The remaining five pH values remained within the normal range for groundwater.

2.9.6.7 An elevated concentration of dissolved manganese (4,017 µg/l) was reported in the groundwater sample BH-02, exceeding both IGV and drinking water standards. BH-03 and BH-05 presented some low concentrations of dissolved manganese (9 µg/l and 34 µg/l respectively), which did not exceed the relevant standards. In the remaining two groundwater samples, this parameter was below the laboratory detection limit. Manganese is naturally occurring in the limestone bedrock.

2.9.6.8 Dissolved potassium was detected in BH-02 at 18.1 mg/l and BH-05 at 37.9 mg/l. The remaining four groundwater samples presented concentrations of dissolved potassium that were below the recommended limit.

2.9.6.9 The dissolved nickel reading at BH-05 is 23 µg/l, marginally exceeding the IGV and DWS of 20 µg/l. All other nickel data collected during this round of sampling (20th February 2016) and the previous round (August 2014) are in compliance with the standards.

2.9.6.10 Parameters relating to the Development Proposal include VOC, SVOC, EPH, GRO, Alcohols, Acetates and Acetonitrile. The baseline data for these parameters are below the limit of detection.

2.9.6.11 The results for Chemical Oxygen Demand (COD) ranged from 8 mg/l to 67 mg/l. There is no Emission Limit Value (ELV) for COD on the IE Licence; and there is no Groundwater Regulation Threshold Value under S.I. 9 of 2010.

2.9.6.12 In the context of the Water Framework Directive, EPA mapping indicates that the Dartry Limestone Aquifer at Newtown-Ballyconnell is "At risk of not achieving good status".

3 SITE ACTIVITIES

3.1 Proposed Development

3.1.1 A range of suitable materials are proposed for acceptance at the plant, which can be summarised as follows:

- Solid Fuels – including Solid Recovered Fuel (SRF), which is currently authorised for use at the plant, as well as a range of suitable fuels derived from other sources including:
  - Meat and Bone Meal (MBM);
  - Tyre Derived Fuel (TDF);
  - Biomass Fuels;
  - Sludges and Filter Cakes.
- Liquid Fuels – including Secondary Liquid Fuel (SLF), which is a blend of organic and solvent wastes mixed to a defined specification, as well as liquid fuels derived from other sources (*e.g.* waste oils).
- Alternative Raw Materials (*e.g.* muds, minerals, sludges).

3.1.2 It is also proposed to include natural gas and petcoke as additional fuels in the licence. This is to provide flexibility for any future fossil fuel requirement.

3.2 Handling Requirements for Specific Fuels

3.2.1 Meat and Bone Meal

3.2.1.1 Meat and Bone Meal (MBM) is a dried sterilised material produced in rendering facilities from animal tissue not used in food production. Only MBM from Department of Agriculture approved rendering facilities will be accepted at the cement plant. The MBM will have a low moisture content (<10%) and will be of a uniform size.

3.2.1.2 Transport to the cement plant will be via enclosed road tankers.

3.2.1.3 Discharge from the road tanker to the storage silos will be by a pneumatic sealed system incorporating filtration to control the potential for dust and odour emissions during the discharge process.

3.2.1.4 The material in the storage silo will be fed via an enclosed transport system to the kiln system for combustion.

3.2.2 Tyre Derived Fuel

3.2.2.1 Tyre Derived Fuel (TDF) will be produced to an agreed specification by authorised suppliers.

3.2.2.2 Transport to the cement plant will be via tipper trucks or walking floor trailers, which will deliver to the fuel storage bunkers.

3.2.2.3 The TDF will be fed mechanically to the kiln system for combustion.

3.2.3 Liquid Fuels

3.2.3.1 Liquid Fuels will include Secondary Liquid Fuel (SLF), which is a blend of organic and solvent wastes mixed to a defined specification, as well as liquid fuels derived from other sources (e.g. waste oils).

3.2.3.2 The main source of SLF is solvents from the pharmaceutical industry. Other industry sources also produce a variety of high calorific ingredients, which are suitable for blending.

3.2.3.3 Specialist waste management companies collect and blend these ingredients to the fuel specification for the kiln system.

3.2.3.4 The SLF will then be delivered by these specialist waste management companies to the cement plant via enclosed road tankers.

3.2.3.5 In order to prevent spillages during discharge, the liquid fuels will be discharged via a closed system to on-site storage tanks.

3.2.3.6 Furthermore, the storage tanks will be located within a bunded compound.

3.2.3.7 A blanketing gas suppression system will be installed as a fire prevention method.

3.2.3.8 The tanks will be built and installed to the manufacturer's specification.

3.2.3.9 Bunding will be in compliance with EPA requirements and bunds will be regularly inspected. The bunded compound will be integrity-tested as per other bunds at the plant.

3.2.3.10 The liquid fuels will be pumped from the storage silos to the kiln system via a closed loop system, so that there is minimal risk of spillage.

3.2.3.11 In the unlikely event of a fuel spillage, a response plan has been proposed as part of the Emergency Response Procedure for the Site.

3.2.3.12 All areas between the bunded storage compound and the kiln system will be of an impermeable hardstand construction.

3.2.3.13 The bunded compound will be covered in order to limit the potential for rainwater ingression into the bund. This will ensure that contaminated water generation is limited insofar as practicable. Any contaminated water will be disposed of as hazardous waste.

3.2.3.14 The storage tanks will be fitted with a high level alarm to prevent overfilling.

3.2.3.15 Spill kits will be available at the plant and all leaks or spills will be cleaned up immediately.

3.3 Water Management

3.3.1 Water management will continue along the lines of the ongoing procedures at the Site.

3.3.2 The entire Cement Plant Site (10.598 ha) is covered by one catchment area and an extensive drain network diverts all surface water flow into a settlement tank. This tank receives (*i*) water derived from routine wash-down processes and (*ii*) rain water. As such, there are not considered to be any harmful or highly toxic constituents draining into the settlement tank.

3.3.3 The silt settlement system comprises a horizontal flow tank of capacity 5,400 m^3, which allows for a two-hour retention time during peak rainfall. This is to ensure that the suspended solids content of the water is reduced to an acceptable limit (35 mg/l) prior to being discharged into the receiving watercourse.

3.3.4 The tank also incorporates a hydrocarbon interceptor (single compartment) with a volumetric capacity of 305 m^3. This is to ensure compliance with the emission limit for Mineral Oil, which is set at 2 mg/l.

3.3.5 The tank is de-sludged when required and typical sludge volumes at the time of de-sludging are estimated at 100 m^3.

3.3.6 The system had an average discharge rate of 31 m^3/hr in 2014; and 68 m^3/hr in 2015.

3.3.7 Discharge from the settlement tanks is made via a pipe, which passes beneath the Ballyconnell-Derrylin road and flows eastwards for some 300 m before reaching its confluence with the Woodford River. The location of the discharge point for surface water emissions (SW1) is illustrated upon *drawing QC170512*; as is the line of the discharge pipe.

3.3.8 Full details of the discharge process, including emission limits and monitoring regime, are provided in IE Licence No. P0378-02.

3.3.9 The Applicant is proposing to use the water from the settlement tank for the cement manufacturing process, which would reduce the discharge rate to the Woodford River. The water from the settlement tanks will be recycled back into the cement manufacturing process through a proposed Surface Water Recycling Tank (SWRT), thereby reducing the process water requirements from on-site boreholes. Furthermore, it is proposed to install a separate Fire Water Retention Tank (FWRT) with a capacity of 100 m^3. In the event of a fire, the water discharge from the site can be directed to this tank by opening a valve, which directs the water away from the existing settlement tanks, through a bypass line, to the proposed FWRT. This proposal will significantly reduce the potential volume of firewater to be disposed of in the event of a fire or spillage accident on site.

3.3.10 The protocol for the handling, transfer and storage of incoming waste (*section 3.2*), which includes measures for the exclusion of rainwater (by erecting roofed and walled enclosures for the receiving hoppers), is judged to be an effective means of avoiding problems such as the generation and emission of leachate.

3.3.11 It has previously been confirmed that there will be no wastewater arising from the waste incineration process *i.e.* there will be no wet flue gas treatment for the air pollution control device; no boiler water treatment and blowdown; no scrubber liquor; no water from ash quenching; and no discharge of water from the cooling process.

3.3.12 Containment/controlled drainage is required to prevent the unregulated discharge of polluted firefighting water/chemicals (or other wastewater) from the receiving/storage areas. Any contaminated water must be disposed from Site in accordance with the prevailing legislation. Full details are presented in the "Firewater Risk Assessment" (ref: 50410) prepared by Verdé Environmental Consultants Ltd in August 2014.

4 IMPACT ASSESSMENT & RECOMMENDATIONS FOR MITIGATION

4.1 Background

4.1.1 Baseline assessment has facilitated a conceptual understanding of the extant groundwater and surface water regimes operating within and around the Site. This understanding has been applied to assess the potential impacts posed by the Proposed Development upon the water environment.

4.1.2 In common with other operations of this type and scale, it is considered that the Proposed Development has the potential to impact upon the water environment in the following primary ways:

- Abstraction of groundwater, causing a modification of groundwater levels and flow rates/direction within the limestone aquifer.
- Derogation of existing groundwater and surface water quality.
- Modification of existing flooding characteristics.

4.1.3 The foregoing matters are discussed separately below.

4.2 Potential for Modification of Groundwater Levels, Flow Rates and Direction

4.2.1 There are two abstraction boreholes (GW-1 and GW-2), which supply the raw water requirement (cooling water, process water and dust suppression) for the cement manufacturing process; and a separate abstraction well for the lorry wash. The boreholes are installed within the Dartry Limestone Formation.

4.2.2 There will be no change in the demand for water; the pre-existing abstraction rate will be maintained.

4.2.3 In terms of groundwater flow direction, the available data indicates that the disused CCC borehole is located down hydraulic gradient from the New Cement Works, while the Gortoorlan private sources are located across gradient from the Site.

4.3 Potential for Derogation of Existing Groundwater & Surface Water Quality

4.3.1 Overview

4.3.1.1 Although water is used in cement manufacturing, this process does not involve any discharge to surface water or groundwater; instead, water vapour is discharged to the atmosphere in the form of flue gases.

4.3.1.2 Pre-existing risks to water quality include:

- The discharge of surface water run-off from areas of hardstanding.
- Potential contaminant spillages.

4.3.1.3 The proposed use of alternative fuels and raw materials at the cement works does present some additional/new risk to groundwater and surface water quality:

- Risk of accidental runoff from the waste handling, transfer and storage areas *e.g.* water from firefighting.
- There will be no wastewater arising from the waste incineration process.

4.3.2 Surface Water Runoff

4.3.2.1 All surface water runoff arising within the cement works during rainfall events is directed to a settlement tank (*section 3.3*). This is to ensure that the suspended solids content of the water is reduced to an acceptable limit prior to being discharged into the receiving watercourse. The settlement tank includes flow balancing capacity (to control the rate of discharge during storm events) and oil interceptor facilities.

4.3.2.2 The proposed development does not involve any change in the surface water run-off pattern at the cement works *i.e.* no change in the overall size of the rainfall catchment area; no change in the gradient of the area; and no change in the percentage of impermeable area.

4.3.2.3 The pre-existing drainage infrastructure will receive no input of additional/new contaminants within the surface water run-off. Therefore, there will be no reduction in the quality of runoff being discharged off Site. Full details of the discharge schedule for emissions to surface water are provided in the IE Licence (Reg. No. P0378-02). This will protect water quality in downstream receptors (Woodford River) and designated sites, such as Moninea Bog ASSI - SAC (alongside Drumderg Lough, *figure 1*).

4.3.3 Spillages

4.3.3.1 Ammonia and solvents: Appropriate risk assessment is provided in the Verdé "Hydrogeological Assessment Report". This will be updated for additional solvents as and when necessary. All chemicals are stored on bunds assessed every 3 years against EPA guidance "Storage and Transfer of Materials for Scheduled Activities",

4.3.3.2 The operation of mobile and fixed plant presents a risk that pollutants may enter groundwater as a result of hydrocarbon spillage or leakage on Site. Such sources are identified as fuel, lubricating and hydraulic oils. Experience has demonstrated that the risk of such a pollution incident may be minimised by continuing to adhere to the following measures.

- A code of practice for the refuelling of machinery is included within the Environmental Management System and a copy is displayed at the refuelling point. Such work shall be carried out only by trained personnel and take place within a surfaced area equipped with surface water interceptors and bunded tanks.
- Operators check their vehicles on a daily basis and a monthly check is carried out by the supervisor. Operators will report any defect to ensure that repairs are undertaken to that vehicle before it enters the working area.
- Sufficient oil sorbant material (*3M Oil-Sorb* or similar) shall be available on Site to cope with a loss equal to the total fluid content of the largest item of plant.
- Following the use of such oil sorbant material, any contaminated materials shall be disposed from Site in accordance with current tipping legislation.
- Adequate containment is provided for all oils stored on Site; all tanks have secondary skins or are equipped with bunds to the relevant European Standards.

4.3.3.3 The foregoing measures have been incorporated within a fluids handling protocol that is included here at *appendix 3*. It is considered that these measures will provide appropriate mitigation against the potential for derogation of water quality as a result of hydrocarbon spillage.

4.3.3.4 Furthermore, any runoff from Site is directed through oil interceptor facilities prior to discharge off site (*section 4.3.2*). This will protect water quality in downstream receptors (Woodford River) and designated sites, such as Moninea Bog ASSI - SAC (alongside Drumderg Lough, *figure 1*).

4.3.4 Runoff from the Waste Handling, Transfer and Storage areas

4.3.4.1 With regard to the transfer and storage of incoming waste: Full details of the handling requirements for specific fuels are given in *section 3.2*.

4.3.4.2 One of the key objectives is the exclusion of rainwater (by erecting roofed and walled enclosures for the receiving hoppers), which is judged to be an effective means of avoiding problems such as the generation and emission of leachate.

4.3.4.3 Nonetheless, in the event of firefighting (or accidental mixing of waste with rainwater), containment/controlled drainage is required to prevent the unregulated discharge of polluted firefighting water/chemicals (or other wastewater) from the receiving/storage areas.

4.3.4.4 The Applicant is proposing to use the water from the settlement tank for the cement manufacturing process, which would reduce the discharge rate to the Woodford River. The water from the settlement tanks will be recycled back into the cement manufacturing process through a proposed Surface Water Recycling Tank (SWRT), thereby reducing the process water requirements from on-site boreholes. Furthermore, it is proposed to install a separate Fire Water Retention Tank (FWRT) with a capacity of 100 m^3. In the event of a fire, the water discharge from the site can be directed to this tank by opening a valve, which directs the water away from the existing settlement tanks, through a bypass line, to the proposed FWRT. This proposal will significantly reduce the potential volume of firewater to be disposed of in the event of a fire or spillage accident on site. Full details are presented in the "Firewater Risk Assessment" (ref: 50410) prepared by Verdé Environmental Consultants Ltd in August 2014.

4.3.4.5 Any contaminated water must be disposed from Site in accordance with the prevailing legislation.

4.3.4.6 This will protect water quality in downstream receptors (Woodford River) and designated sites, such as Moninea Bog ASSI - SAC (alongside Drumderg Lough, *figure 1*).

4.3.4.7 To confirm the efficacy of these measures, it is recommended that the monitoring schedule be revised to include testing of additional parameters at key locations, namely: the Discharge Point (SW-1); Woodford River (upstream and downstream locations); and the peripheral wells Q05-06 and BH-02 to BH-05. This was the agreed coverage for the Verdé "Hydrogeological Assessment Report" and the additional monitoring on 20th February 2016.

4.3.4.8 The additional chemical species should be appropriate to types of fuel being brought on to the Site. As outlined earlier, the laboratory schedule (*appendix 2*) has been expanded to include Volatile Organic Compounds (VOC), Semi Volatile Organic Compounds (SVOC), Extractable Petroleum Hydrocarbons (EPH), Gasoline Range Organics (GRO), Alcohols, Acetates and Acetonitrile.

4.4 Modification of Existing Flooding Characteristics

4.4.1 Flood Risk Posed by the Proposed Development

4.4.1.1 As described in *section 4.3.2*, all surface water runoff arising within the cement works during rainfall events is directed to a settlement tank. The settlement tank includes flow balancing capacity to control the rate of discharge during storm events. The maximum permitted rate is 3,000 m^3/hr (up to 10,000 m^3/day).

4.4.1.2 The proposed development does not involve any change in the surface water run-off pattern at the cement works. Therefore, the Site operations will not result in any increased risk of flooding on land and properties downstream/downhill from the cement works.

4.4.2 Risk of Fluvial Flooding

4.4.2.1 Maps detailing flood defence assets and watercourses as well as historic and predictive flood mapping are published on the OPW and Rivers Agency websites.

4.4.2.2 There is no risk of fluvial flooding at the Site (allowing for climate change). Ground elevation upon the closest stretch of floodplain equates to *circa* 50 maOD, which is 10 m below the lowest point on the Site boundary.

4.4.3 Risk of Flooding from Land

4.4.3.1 The Proposal Site constitutes a sub-catchment that is largely isolated from runoff from adjacent lands due to the existing surface water drainage network. Mucklagh Stream (*figure 4*) drains the land to the south and west of the Site. The catchment boundary roughly coincides with the haul road at the southwest boundary of the cement works. On the land to the north of the Site, the field ditches and roadway bypass the cement works and discharge directly into Gortawee Stream. Runoff generation is largely limited to rainfall that is directly incident upon the Proposal Site itself.

4.4.3.2 There will be no change in the surface water run-off pattern on the land uphill/upstream from the cement works; therefore, there will be no increased risk of floodwater coming on to Site from the hillside overlooking the cement works.

4.4.4 Risk of Flooding from Groundwater

4.4.4.1 The depth to groundwater (as recorded in the Site piezometers) shows that the watercourses upon the flanks of Slieve Rushen exist a significant distance above the watertable. Thus, these streams cannot accrete flow from groundwater.

4.4.4.2 There is considered to be no risk of flooding from groundwater at the cement works.

5 SUMMARY & CONCLUSIONS

5.1 Baseline Study

5.1.1 Quinn Cement Limited is seeking consent for its "Proposal to increase the range and quantity of alternative fuels and alternative raw materials at the Ballyconnell Cement Plant".

5.1.2 The Site is located upon the southeast facing aspect of Slieve Rushen Mountain. Ground elevations within the boundaries of the Site fall from some 110 maOD upon the north-western boundary to some 60 maOD at the southern and eastern boundaries.

5.1.3 The cement plant is located upon a strip of land (approximately 250 m in width), which extends across the central part of Site, at an elevation of 80-90 maOD.

5.1.4 The Woodford River (Shannon-Erne Waterway) is some 400 m to the southeast of the Site, at its closest approach. Locally, the Woodford River drains from southwest to northeast. Ground elevation upon the closest stretch of floodplain equates to *circa* 50 maOD, which is 10 m below the lowest point on the Site boundary.

5.1.5 All surface water runoff arising within the cement works during rainfall events is piped across to the Woodford River. Before being discharged into the pipe, the runoff is directed through settlement tanks to ensure that the suspended solids content of the water is reduced to an acceptable limit. The settlement tanks include flow balancing capacity (to control the rate of discharge during storm events) and oil interceptor facilities.

5.1.6 With regard to monitoring the risk posed by current operations at the cement works, the key Water Quality Indicators are listed in Section B.2 "Emissions to Water" of the IE Licence (Reg. No. P0378-02). Where tested, these were in compliance with the limits specified in the licence.

5.1.7 Annagh Lough lies some 1.7 km to the southeast of the Site. The cement works and lough are situated on opposite sides of the Woodford River.

5.1.8 There are no other waterbodies within 1 km standoff from the development.

5.1.9 With respect to the hydrogeological setting of the cement works, the Dartry Limestone Formation is classified by the GSI as a regionally important, fissured bedrock aquifer.

5.1.10 The groundwater flow direction is towards the southeast, declining from 130 maOD at the contact between the Dartry Limestone and the overlying Meenymore Shales (650 m to the northwest of the Site), down to 50 maOD in the vicinity of the Ballyconnell-Derrylin Road.

5.1.11 Based upon the available piezometer data, the typical long-term range between minimum and maximum groundwater levels is between 2 m and 6.5 m.

5.1.12 Values of hydraulic conductivity obtained for the competent section of the Dartry Limestone were extremely low, *circa* 0.03 m/d. For the disaggregated limestone (mantling the solid strata of the valley floor), the calculated value of hydraulic conductivity equated to 3.4 m/d.

5.1.13 The watercourses upon the flanks of Slieve Rushen exist a significant distance above the watertable. Thus, these streams cannot accrete flow from groundwater. Upon the valley floor, there is diffuse seepage from the drift deposits into the Woodford River.

5.1.14 In terms of abstraction from the Dartry Limestone, aside from the Applicant's boreholes, the closest private groundwater supply boreholes are located at the Kearns property at Gortoorlan (325 m SW of the Site) and the neighbouring Maguire property (500 m SW of the Site).

5.1.15 There is borehole located adjacent to the Ballyconnell to Gortoorlan Road, which is now disused, having historically been operated by CCC for groundwater abstraction. It is approximately 500 m standoff to the south of the cement works.

5.1.16 Groundwater samples were collected from the monitoring network on 20th February 2016. They were submitted for laboratory analysis to provide a record of background concentrations for key parameters relating to the Development Proposal.

5.1.17 In addition to the Water Quality Indicators given in Section B.2 "Emissions to Water" of the IE Licence (Reg. No. P0378-02), the analysis schedule was expanded to include VOC, SVOC, EPH, GRO, Alcohols, Acetates and Acetonitrile. The baseline data (*appendix 2*) for these new parameters are below the limit of detection.

5.1.18 In the context of the Water Framework Directive, EPA mapping indicates that the Dartry Limestone Aquifer at Newtown-Ballyconnell is "At risk of not achieving good status".

5.2 Proposed Development

5.2.1 It is proposed to improve the sustainability of the cement plant through the use of an increased range of waste-derived alternative raw materials and fuels with the long-term aim of displacing almost all fossil fuels at the plant (a limited proportion of fossil fuels will be required during process start-up and for process optimisation/stabilisation). The use of these alternatives will equate to 300,000 tonnes per annum at maximum substitution.

5.2.2 With regard to the transfer and storage of incoming waste: Full details of the handling requirements for specific fuels are given in *section 3.2*.

5.2.3 One of the key objectives is the exclusion of rainwater (by erecting roofed and walled enclosures for the receiving hoppers), which is judged to be an effective means of avoiding problems such as the generation and emission of leachate.

5.2.4 There will be no wastewater arising from the waste incineration process *i.e.* there will be no wet flue gas treatment for the air pollution control device; no boiler water treatment and blowdown; no scrubber liquor; no water from ash quenching; and no discharge of water from the cooling process.

5.3 Impact Assessment

5.3.1 There are two abstraction boreholes (GW-1 and GW-2), which supply the raw water requirement (cooling water, process water and dust suppression) for the cement manufacturing process; and a separate abstraction well for the lorry wash. The boreholes are installed within the Dartry Limestone Formation.

5.3.2 There will be no change in the demand for water; the pre-existing abstraction rate will be reduced in the context of the surface water re-use proposal; therefore, the current status of neighbouring supplies should be protected.

5.3.3 The current schedule of monitoring of groundwater level within these boreholes will be continued to confirm this assessment.

5.3.4 The risk of spillages will be minimised by enforcing working procedures that conform to the Fluids Handing Protocol as described in this report. Trained personnel will undertake all re-fuelling and maintenance, following relevant environmental standards.

5.3.5 In the unlikely event of a hydrocarbon spillage, a contingency plan will be followed for containing and safely disposing of any contaminant.

5.3.6 All surface water runoff arising within the cement works during rainfall events is directed to settlement tanks. This is to ensure that the suspended solids content of the water is reduced to an acceptable limit prior to being discharged into the receiving watercourse (Woodford River). The settlement tanks include flow balancing capacity (to control the rate of discharge during storm events) and oil interceptor facilities.

5.3.7 The proposed development does not involve any change in the surface water run-off pattern at the cement works *i.e.* no change in the overall size of the rainfall catchment area; no change in the gradient of the area; and no change in the percentage of impermeable area.

5.3.8 The pre-existing drainage infrastructure will receive no input of additional/new contaminants within the surface water run-off. Therefore, there will be no reduction in the quality of runoff being discharged off Site.

5.3.9 With regard to incoming waste handling, transfer and storage areas: The exclusion of rainwater (by erecting roofed and walled enclosures for the receiving hoppers) is judged to be an effective means of avoiding problems such as the generation and emission of leachate.

5.3.10 In the event of firefighting (or accidental mixing of waste with rainwater), containment/controlled drainage is required to prevent the unregulated discharge of polluted firefighting water/chemicals (or other wastewater) from the receiving/storage areas. Any contaminated water must be disposed from Site in accordance with the prevailing legislation.

5.3.11 To confirm the efficacy of these measures, it is recommended that the monitoring schedule be revised to include testing of additional parameters at key locations, namely: the Discharge Point (SW-1); Woodford River (upstream and downstream locations); and the peripheral wells Q05-06 and BH-02 to BH-05. This was the agreed coverage for the Verde "Hydrogeological Assessment Report" and the additional monitoring on 20th February 2016.

5.3.12 The additional chemical species should be appropriate to types of fuel being brought on to the Site. As outlined earlier, the laboratory schedule (*appendix 2*) has been expanded to include Volatile Organic Compounds (VOC), Semi Volatile Organic Compounds (SVOC), Extractable Petroleum Hydrocarbons (EPH), Gasoline Range Organics (GRO), Alcohols, Acetates and Acetonitrile.

5.3.13 The implementation of the treatment systems, engineering measures, fluids handling protocol and monitoring schedule advanced to protect groundwater quality will, in turn, serve to safeguard the surface water environment and water supplies.

5.3.14 This will protect water quality in downstream receptors (Woodford River) and designated sites, such as Moninea Bog ASSI - SAC (alongside Drumderg Lough).

5.3.15 In terms of flood risk, there is no risk of fluvial flooding at the Site (allowing for climate change). Ground elevation upon the closest stretch of floodplain equates to *circa* 50 maOD, which is 10 m below the lowest point on the Site boundary.

5.3.16 The Proposal Site constitutes a sub-catchment that is largely isolated from runoff from adjacent lands due to the existing surface water drainage network. There will be no change in the surface water run-off pattern on the land uphill/upstream from the cement works; therefore, there will be no increased risk of floodwater coming on to Site from the hillside overlooking the cement works.

5.3.17 The depth to groundwater (as recorded in the Site piezometers) shows that the watercourses upon the flanks of Slieve Rushen exist a significant distance above the watertable. There is considered to be no risk of flooding from groundwater at the cement works.

5.3.18 On the basis of baseline study and subsequent impact assessment, there are considered to be no over-riding hydrological or hydrogeological related reasons why the Proposed Development should not proceed in the manner described by the Application. This conclusion assumes that any permission, if granted, should be conditioned by implementation and adherence to any relevant recommendations advanced within this report and other such conditions that may be reasonably imposed by the Planning Authority.

Henry Lister B.Sc., M.Sc.
Senior Hydrogeologist
BCL Consultant Hydrogeologists Limited
March 2016

This Page Intentionally Left Blank

BCL Document Reference: BCL/htl/BCNL/009.doc

Quinn Cement Limited

BALLYCONNELL CEMENT PLANT

Ballyconnell, County Cavan

Proposal to use alternative fuels / raw materials at the Cement Plant

Hydrogeological and Hydrological Assessment

March 2016

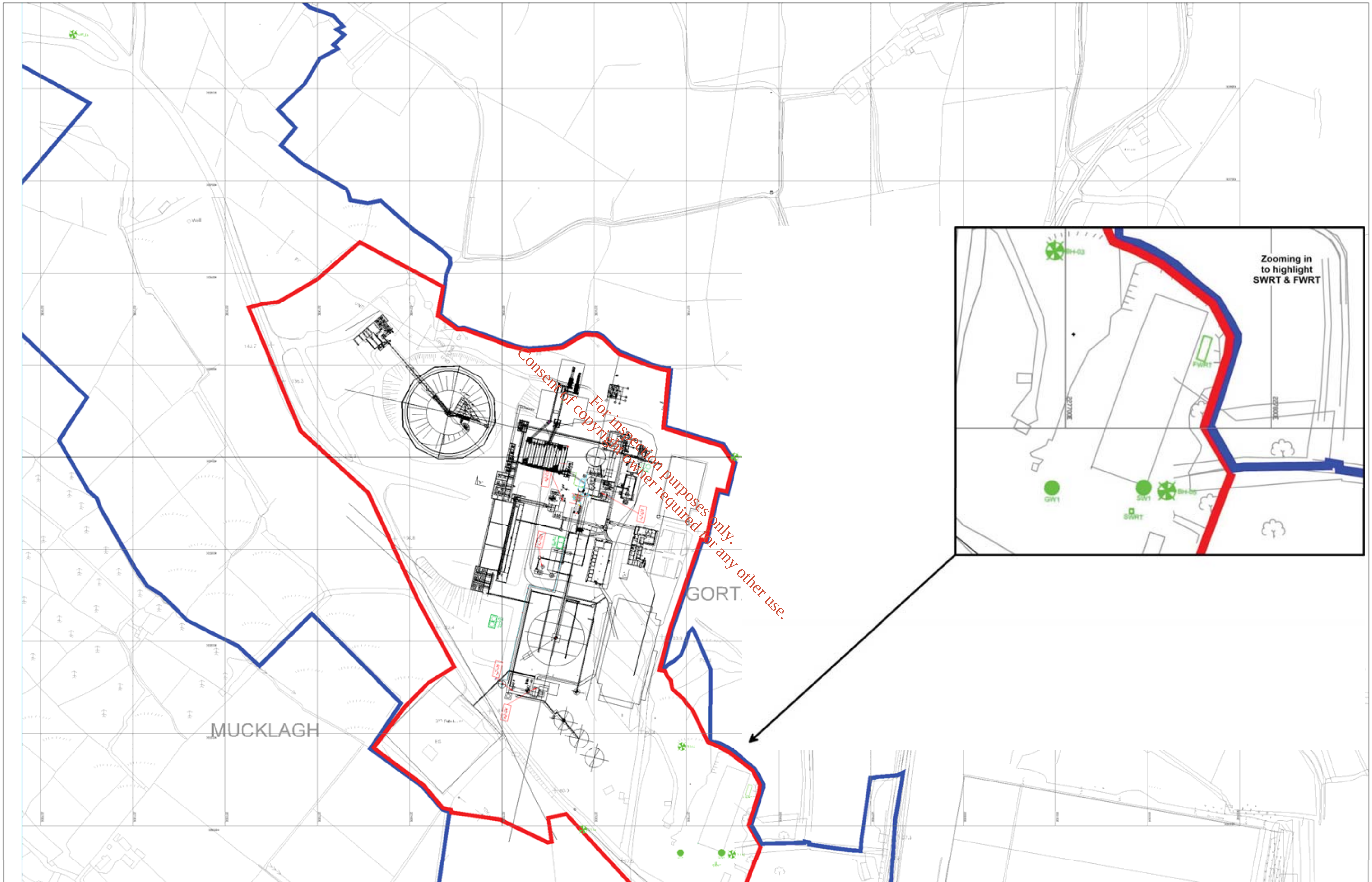
APPENDIX I

Figures

Consultant Hydrogeologists

Technology Centre
Wolverhampton Science Park, Wolverhampton, WV10 9RU
Tel: 01902 824111, Fax: 01902 824112
email: info@bclhydro.co.uk www: http://www.bclhydro.co.uk

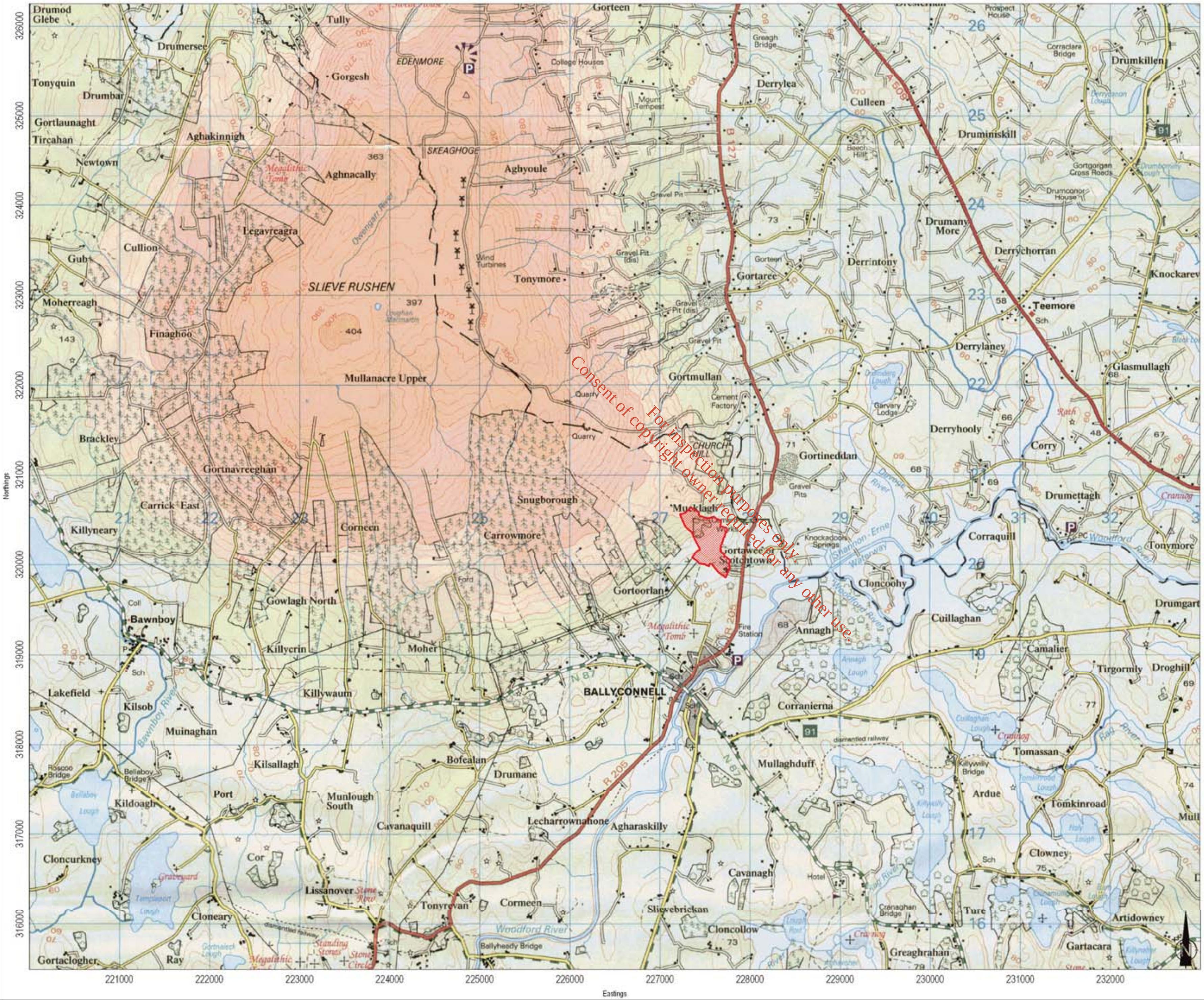
Company Registration Number: 4043373
Registered in England & Wales. Registered Office: 33 Wolverhampton Road, Cannock.



REV		BY	DATE	REFERENCE	NOTES

SEAN QUINN GROUP
SEAN QUINN GROUP,
DERRYLIN,
CO. FERMANAGH,
N. IRELAND, BT92 9AU.
TEL: (013657) 48866.
FAX: (013657) 48800.

PROJECT	ENGINEERED	TITLE	DATE
CEMENT PLANT	SQCPD	WATER MONITORING AND EMMISSION POINTS	6/03/09
	DRAWN SQCPD		REV 3 on 22/03/16
	CHECKED		SHEET 1 of 1
	APPROVED	DWG NO	SCALE NTS



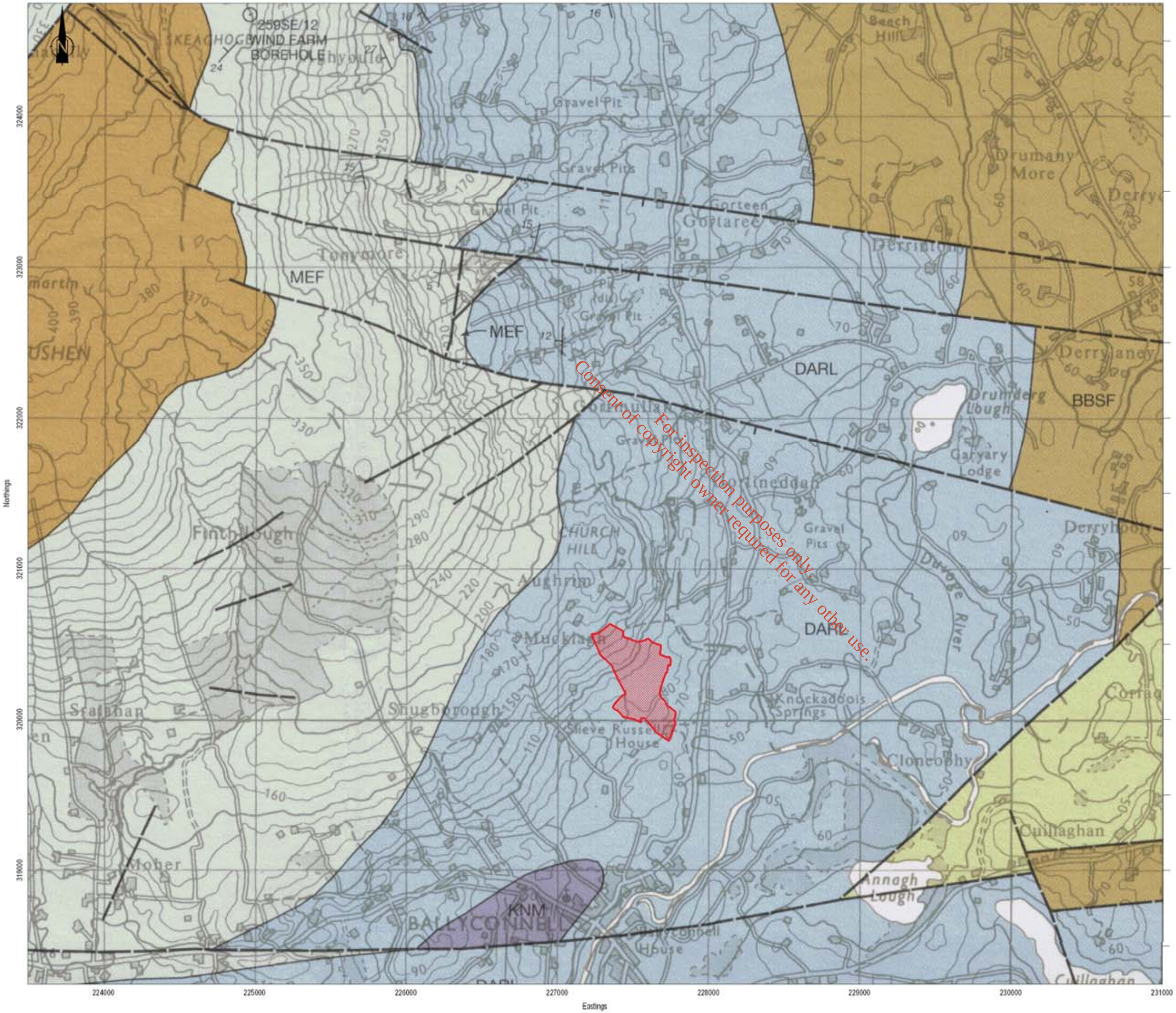
Application Area

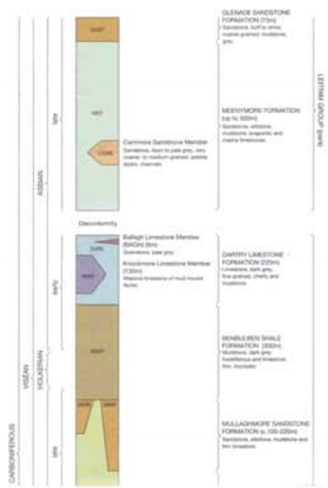
BCL Technology Centre, Wolverhampton Science Park Wolverhampton, WV10 9RU
tel: 01902 824111 fax: 01902 824112
email: info@bclhydro.co.uk
www: http://www.bclhydro.co.uk

Quinn Cement Limited: New Cement Works, Ballyconnell, County Cavan

Site Location

Drawn By:	HL	Scale:	1:40,000
Date:	Mar 2016	Fig No:	1



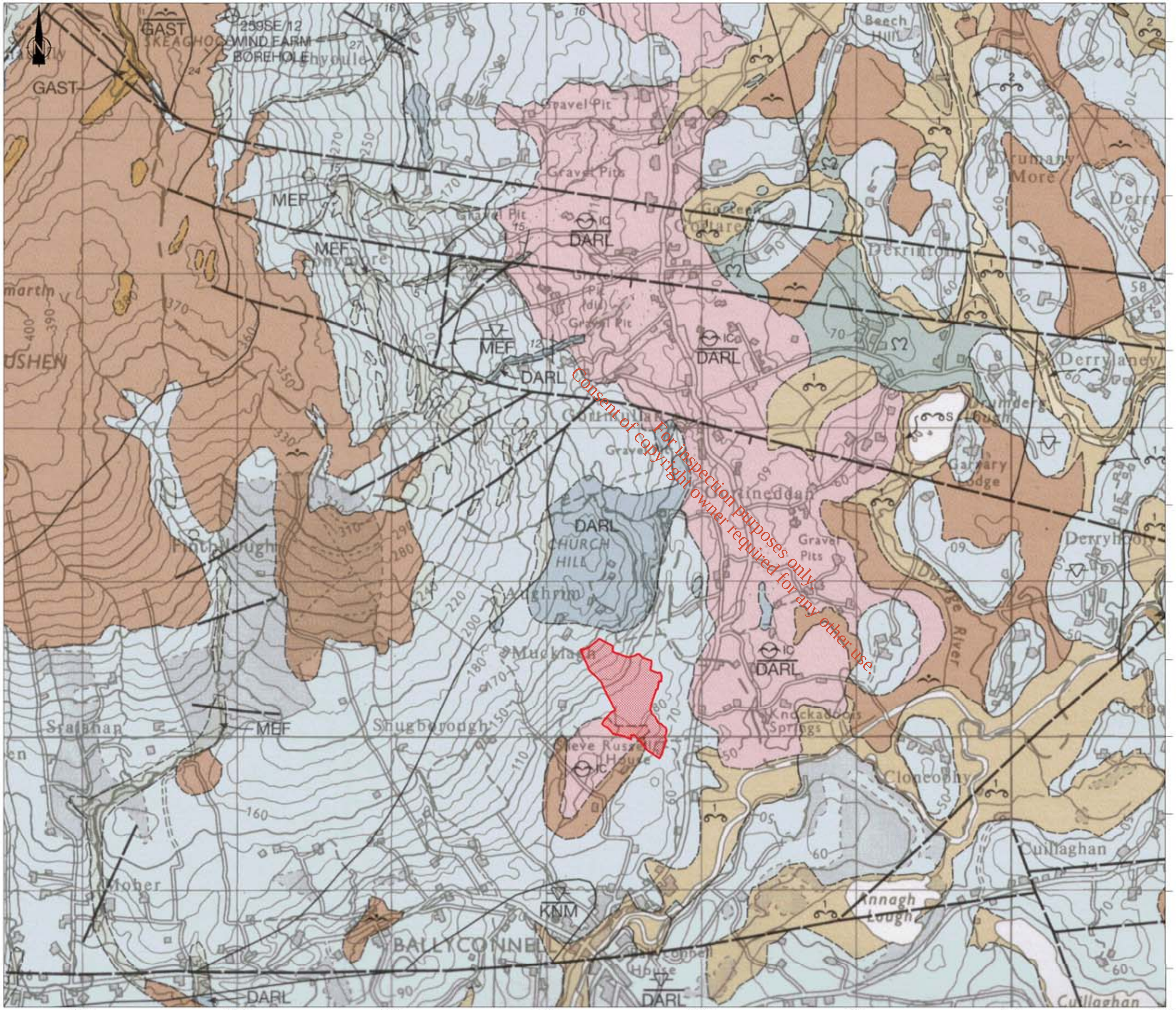


BCL Technology Centre, Wolverhampton Science Park Wolverhampton, WV10 9RU
tel: 01902 824111 fax: 01902 824112
email: info@bclhydro.co.uk
www: http://www.bclhydro.co.uk

Quinn Cement Limited : New Cement Works, Ballyconnell, County Cavan

Published Geological Mapping: Solid Geology

Drawn By:	HL	Scale:	1:25,000
Date:	Mar 2016	Figure No:	2a



SUPERFICIAL DEPOSITS

QUATERNARY

- Alluvium
- Peat
- Lacustrine Shoreface and Beach Deposits
- Lacustrine Delta Deposits
- Lacustrine Alluvium, first level
- Lacustrine Alluvium, second level
- Lacustrine Alluvium, third level
- Lacustrine Alluvium, fourth level
- Lacustrine Alluvium, fifth level
- Lacustrine Alluvium, high level
- Glaciofluvial, Ice-contact Deposits
- Glaciofluvial, Sheet Deposits
- Hummocky (moundy) Glacial Deposits
- Till

See also Generalized Vertical Section

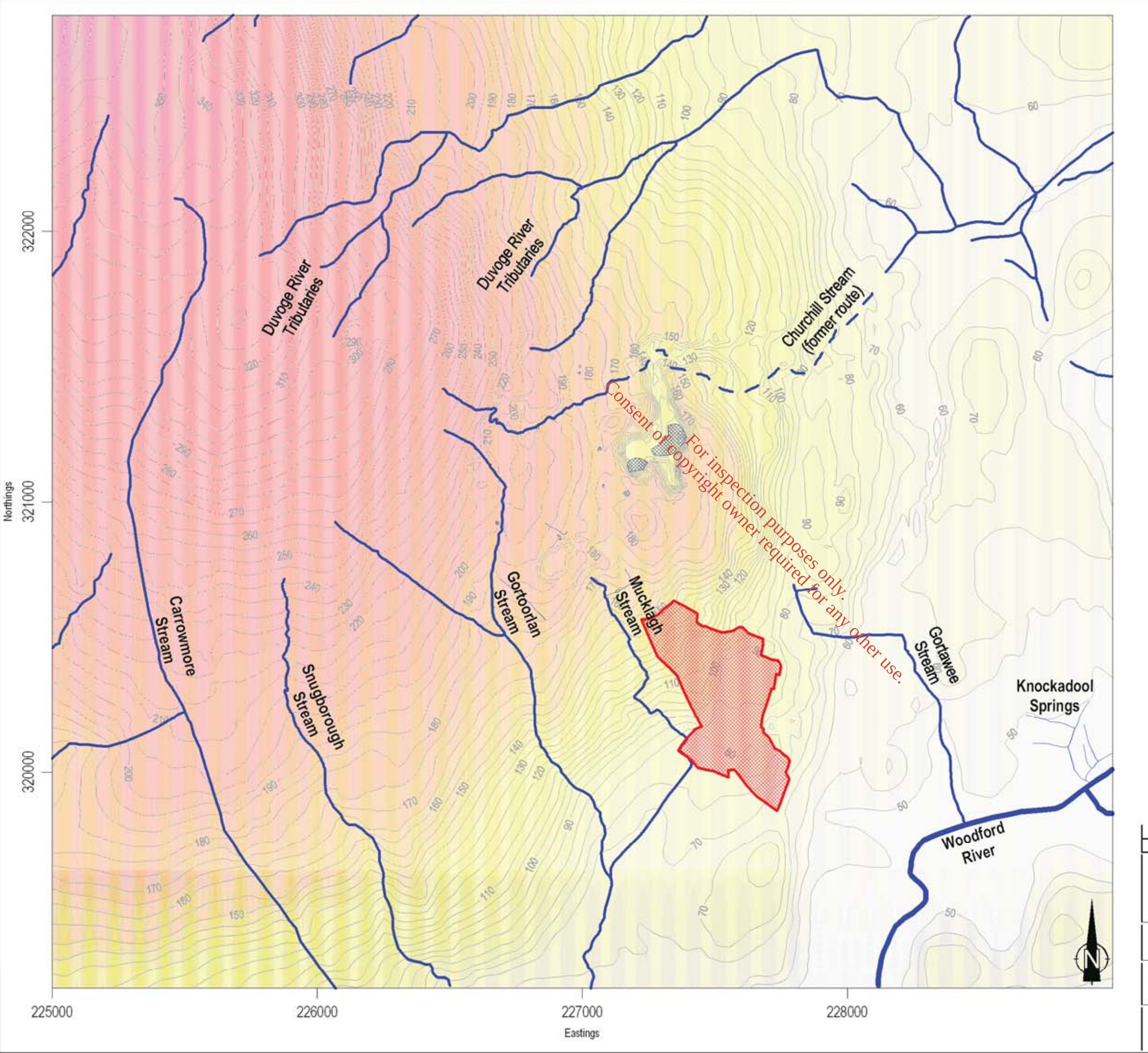
- Inclined strata, dip in degrees
- Geological boundary, Superficial
- Geological boundary, Bedrock
- Fault at bedrock surface, crossmark on downthrow side

BCL Technology Centre, Wolverhampton Science Park, Wolverhampton, WV10 9RU
tel: 01902 824111 fax: 01902 824112
email: info@bclhydro.co.uk
www: http://www.bclhydro.co.uk

Quinn Cement Limited : New Cement Works, Ballyconnell, County Cavan

Published Geological Mapping: Solid & Drift Geology

Drawn By:	HL	Scale:	1:25,000
Date:	Mar 2016	Figure No:	2b

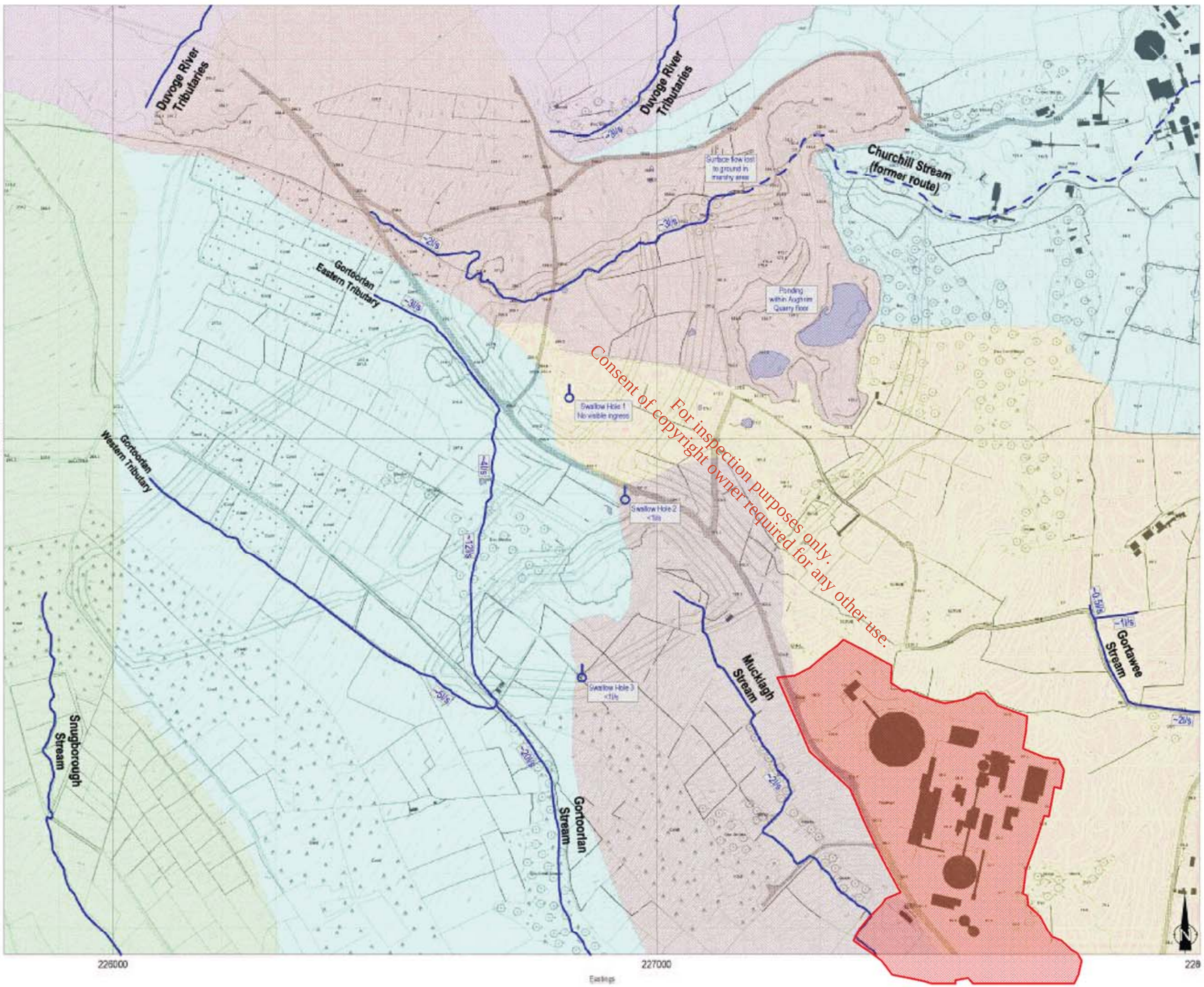


Technology Centre, Wolverhampton Science Park Wolverhampton, WV10 9RU
tel: 01902 824111 fax: 01902 824112
email: info@bclhydro.co.uk
web: http://www.bclhydro.co.uk

Quinn Cement Limited: New Cement Works, Ballyconnell, County Cavan

Water Features (1:20,000)

Drawn By:	HL	Scale:	N/A
Date:	March 2016	Figure No.	3



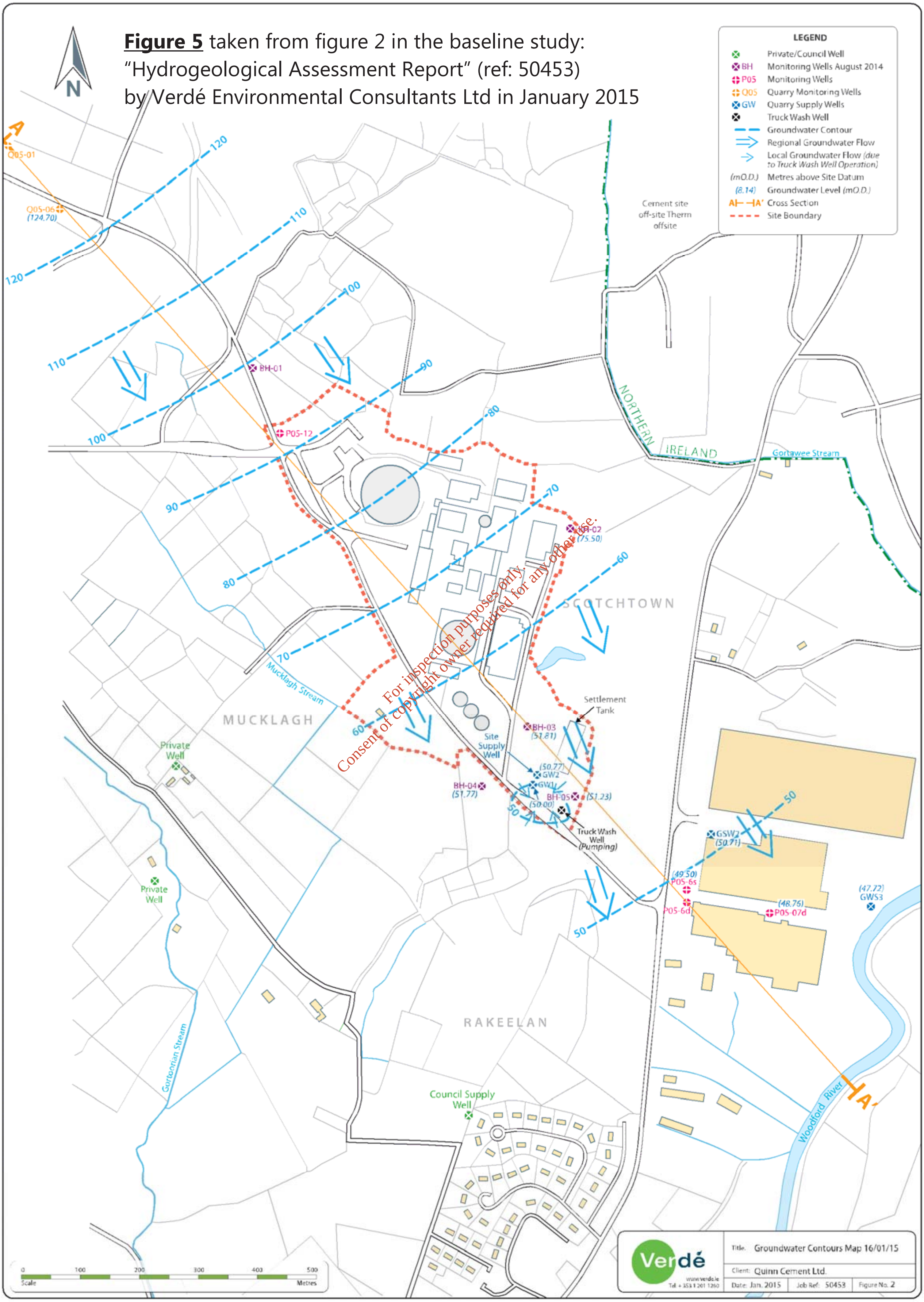
BCL Technology Centre, Wolverhampton Science Park Wolverhampton, WV10 9RU
tel: 01902 824111 fax: 01902 824112
email: info@bclhydro.co.uk
www: http://www.bclhydro.co.uk

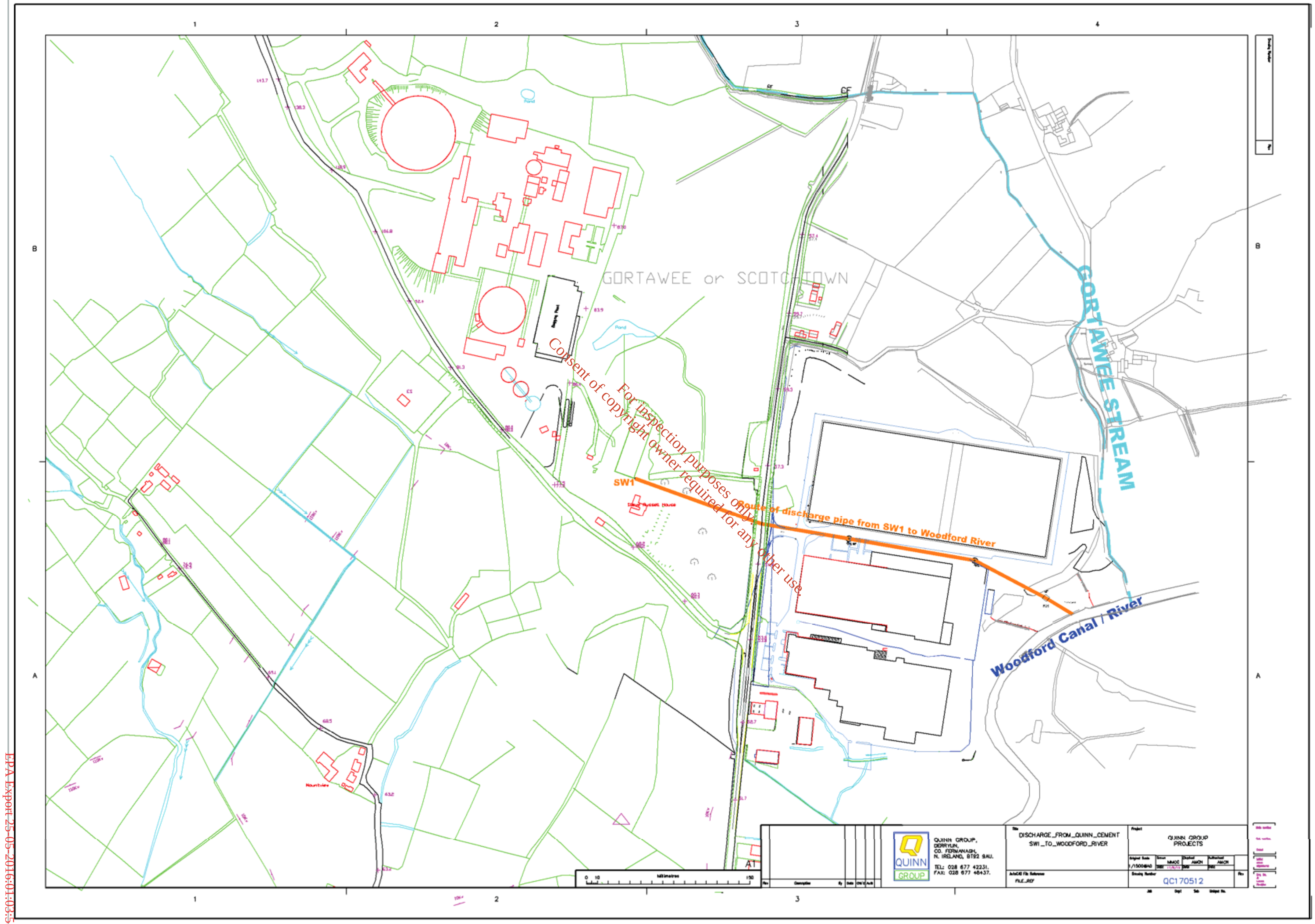
Quinn Cement Limited: New Cement Works, Ballyconnell, County Cavan

Water Features & Sub Catchment Boundaries

Drawn By:	HL	Scale:	1:7,000
Date:	March 2016	Figure No:	4

Figure 5 taken from figure 2 in the baseline study: "Hydrogeological Assessment Report" (ref: 50453) by Verdé Environmental Consultants Ltd in January 2015




GORTAWEE STREAM
GORTAWEE or SCOTCHTOWN
Woodford Canal / River
SW1
Route of discharge pipe from SW1 to Woodford River
QUINN GROUP
QUINN GROUP,
DERRYLIN,
CO. FERMANAGH,
N. IRELAND, BT92 9AU.
TEL: 028 677 42231.
FAX: 028 677 48437.
DISCHARGE_FROM_QUINN_CEMENT
SW1_TO_WOODFORD_RIVER
QUINN GROUP PROJECTS
QC170512

Quinn Cement Limited

BALLYCONNELL CEMENT PLANT

Ballyconnell, County Cavan

Proposal to use alternative fuels / raw materials at the Cement Plant

Hydrogeological and Hydrological Assessment

March 2016

APPENDIX II

Water Quality Data

Consultant Hydrogeologists

Technology Centre
Wolverhampton Science Park, Wolverhampton, WV10 9RU
Tel: 01902 824111, Fax: 01902 824112
email: info@bclhydro.co.uk www: http://www.bclhydro.co.uk

Company Registration Number: 4043373
Registered in England & Wales. Registered Office: 33 Wolverhampton Road, Cannock.

Jones Environmental Laboratory

Registered Address : Unit 3 Deeside Point, Zone 3, Deeside Industrial Park, Deeside, CH5 2UA. UK

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Quinn Cement Ltd
Scotstown
Ballyconnell
Co Cavan
Ireland

4225

Attention :	Colin Lunney
Date :	8th March, 2016
Your reference :	31705
Our reference :	Test Report 16/5506 Batch 1
Location :	
Date samples received :	26th February, 2016
Status :	Final report
Issue :	1

Nine samples were received for analysis on 26th February, 2016 of which nine 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.

Compiled By:

Bruce Leslie
Project Co-ordinator

Jones Environmental Laboratory

Client Name:	Quinn Cement Ltd	**Report :**	**Liquid**
Reference:	31705		
Location:			
Contact:	Colin Lunney	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
JE Job No.:	16/5506		H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72				
Sample ID	SW-1	SW-D	SW-U	GW-1	BH-02	BH-03	BH-04	BH-05	BH-05-06				
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	V H HN P G				
Sample Date	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016				
Sample Type	Surface Water	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1		LOD/LOR	Units	Method No.
Date of Receipt	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016				
Dissolved Aluminium #	27	45	44	<20	<20	<20	<20	<20	<20		<20	ug/l	TM30/PM14
Dissolved Arsenic #	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5		<2.5	ug/l	TM30/PM14
Dissolved Boron	62	<12	<12	<12	27	<12	<12	25	<12		<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		<0.5	ug/l	TM30/PM14
Dissolved Calcium #	45.1	22.0	22.3	65.8	80.1	9.0	52.7	64.9	94.1		<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	25.3	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	2.4	5.0		<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	ug/l	TM30/PM14
Total Dissolved Iron #	<20	344	340	52	<20	<20	<20	<20	<20		<20	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Magnesium #	3.2	2.7	2.7	6.8	13.0	1.9	3.2	5.5	8.1		<0.1	mg/l	TM30/PM14
Dissolved Manganese #	<2	31	30	<2	4017	9	<2	34	<2		<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2	6	3	<2	23	<2		<2	ug/l	TM30/PM14
Dissolved Potassium #	26.1	1.3	1.3	0.8	18.1	1.6	0.4	37.9	0.6		<0.1	mg/l	TM30/PM14
Dissolved Sodium #	106.9	7.1	7.2	8.1	18.0	9.1	6.3	25.0	7.5		<0.1	mg/l	TM30/PM14
Dissolved Zinc #	<3	<3	<3	14	<3	11	5	49	<3		<3	ug/l	TM30/PM14
VOC TICs	ND	ND	ND	ND	ND	ND	ND	ND	ND			None	TM15/PM10
Dimethylformamide (DMF)	<100	<100	<100	<100	<100	<100	<100	<100	<100			<100	TM15/PM10
Isopropyl acetate	<100	<100	<100	<100	<100	<100	<100	<100	<100			<100	TM15/PM10
Acetonitrile	<100	<100	<100	<100	<100	<100	<100	<100	<100			<100	TM15/PM10
SVOC TICs	ND	ND	ND	ND	ND	ND	ND	ND	ND			None	TM16/PM30
Pentylphenols	<100	<100	<100	<100	<100	<100	<100	<100	<100			<100	TM16/PM30
Octylphenols	<100	<100	<100	<100	<100	<100	<100	<100	<100			<100	TM16/PM30
Nonylphenols	<100	<100	<100	<100	<100	<100	<100	<100	<100			<100	TM16/PM30
EPH (C8-C40) #	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM5/PM30
GRO (>C4-C8) #	<10	<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		<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM36/PM12

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

Jones Environmental Laboratory

Client Name: Quinn Cement Ltd
Reference: 31705
Location:
Contact: Colin Lunney
JE Job No.: 16/5506

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HNO_3$

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72		LOD/LOR	Units	Method No.
Sample ID	SW-1	SW-D	SW-U	GW-1	BH-02	BH-03	BH-04	BH-05	BH-05-06				
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	V H HN P G				
Sample Date	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016				
Sample Type	Surface Water	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016				
Alcohols/Acetates													
Methyl Alcohol (Methanol)	<500	<500	<500	<500	<500	<500	<500	<500	<500		<500	ug/l	TM83/PM10
Ethyl Alcohol (Ethanol)	<500	<500	<500	<500	<500	<500	<500	<500	<500		<500	ug/l	TM83/PM10
i-Propyl Alcohol (Isopropanol)	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Propyl Alcohol	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Butyl Alcohol	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Pentyl Alcohol	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Hexyl Alcohol	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Heptyl Alcohol	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
Methyl Acetate	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
Ethyl Acetate	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
i-Propyl Acetate	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Propyl Acetate	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
n-Butyl Acetate	<100	<100	<100	<100	<100	<100	<100	<100	<100		<100	ug/l	TM83/PM10
Acetone	<50	<50	<50	<50	<50	<50	<50	<50	<50		<50	ug/l	TM83/PM10
Cyclohexane	<50	<50	<50	<50	<50	<50	<50	<50	<50		<50	ug/l	TM83/PM10
Methyl Ethyl Ketone (MEK)	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM83/PM10
Tetrahydrofuran	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM83/PM10
Sulphate #	95.09	3.86	1.94	21.58	91.49	2.77	2.62	72.85	19.93		<0.05	mg/l	TM38/PM0
Chloride #	207.2	13.9	13.6	14.5	29.6	24.3	13.5	68.4	12.5		<0.3	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.06	0.06	0.06	<0.03	0.09	<0.03	<0.03	0.08	0.03		<0.03	mg/l	TM38/PM0
Hexavalent Chromium #	0.025	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006		<0.006	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	64	82	82	180	232	38	166	168	262		<1	mg/l	TM75/PM0
Acetonitrile	<500	<500	<500	<500	<500	<500	<500	<500	<500		<500	ug/l	TM83/PM10
COD (Settled) #	123	31	25	8	8	37	67	15	18		<7	mg/l	TM57/PM0
Electrical Conductivity @25C #	942	181	169	405	625	140	331	643	541		<2	uS/cm	TM76/PM0
pH #	7.75	7.13	7.13	7.29	7.63	5.88	6.60	6.85	7.48		<0.01	pH units	TM73/PM0

Jones Environmental Laboratory

Client Name: Quinn Cement Ltd
Reference: 31705
Location:
Contact: Colin Lunney
JE Job No.: 16/5506

SVOC Report : Liquid

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72				
Sample ID	SW-1	SW-D	SW-U	GW-1	BH-02	BH-03	BH-04	BH-05	BH-05-06				
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	V H HN P G				
Sample Date	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016				
Sample Type	Surface Water	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016		LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
2-Methylphenol #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
4-Methylphenol	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
4-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM16/PM30
Pentachlorophenol	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Phenol	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
2-Methylnaphthalene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Naphthalene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Acenaphthylene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Acenaphthene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Fluorene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Phenanthrene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Anthracene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Fluoranthene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Pyrene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Benzo(a)anthracene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Chrysene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Benzo(bk)fluoranthene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Benzo(a)pyrene	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Indeno(123cd)pyrene	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Dibenzo(ah)anthracene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Benzo(ghi)perylene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Di-n-butyl phthalate #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5		<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Diethyl phthalate #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Dimethyl phthalate	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30

Jones Environmental Laboratory

Client Name: Quinn Cement Ltd
Reference: 31705
Location:
Contact: Colin Lunney
JE Job No.: 16/5506

SVOC Report : **Liquid**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72				
Sample ID	SW-1	SW-D	SW-U	GW-1	BH-02	BH-03	BH-04	BH-05	BH-05-06				
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	V H HN P G				
Sample Date	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016				
Sample Type	Surface Water	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1		LOD/LOR	Units	Method No.
Date of Receipt	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016				
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
1,3-Dichlorobenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
1,4-Dichlorobenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
2-Nitroaniline	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
2,4-Dinitrotoluene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
2,6-Dinitrotoluene	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
3-Nitroaniline	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
4-Bromophenylphenylether #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
4-Chloroaniline	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
4-Chlorophenylphenylether #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
4-Nitroaniline	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Azobenzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Bis(2-chloroethyl)ether #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Carbazole #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Dibenzofuran #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Hexachlorobenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Hexachlorobutadiene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Hexachloroethane #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Isophorone #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM16/PM30
Nitrobenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	82	78	82	78	82	83	74	88	72		<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	90	84	87	85	86	83	80	92	80		<0	%	TM16/PM30

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: Quinn Cement Ltd
Reference: 31705
Location:
Contact: Colin Lunney
JE Job No.: 16/5506

VOC Report : **Liquid**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72				
Sample ID	SW-1	SW-D	SW-U	GW-1	BH-02	BH-03	BH-04	BH-05	BH-05-06				
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	V H HN P G				
Sample Date	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016	20/02/2016				
Sample Type	Surface Water	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1		LOD/LOR	Units	Method No.
Date of Receipt	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016	26/02/2016				
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Chloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Dichloromethane (DCM) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Bromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Chloroform #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Ethylbenzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
p/m-Xylene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
o-Xylene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Bromoform #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/l	TM15/PM10
Bromobenzene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	105	104	105	103	103	102	103	102	101		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	100	98	100	99	99	99	99	98	98		<0	%	TM15/PM10

Client Name: Quinn Cement Ltd
Reference: 31705
Location:
Contact: Colin Lunney

Matrix : Liquid

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
16/5506	1					Liquid Samples were received at a temperature above 9°C.

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

JE Job No.: 16/5506

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. 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.

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.

WATERS

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

ISO17025 (UKAS) accreditation applies to surface water and groundwater and 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

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

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.

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.

JE Job No.: 16/5506

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
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.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental 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

JE Job No: 16/5506

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM14	Analysis of waters and leachates for metals by ICP OES. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM14	Analysis of waters and leachates for metals by ICP OES. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			

JE Job No: 16/5506

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM83	Modified USEPA method 8260. Determination of Alcohols, Acetates, Acetone, Fuel Oxygenates, THF and Cyclohexane by Headspace GC-MS	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				

BCL Document Reference: BCL/htl/BCNL/009.doc

Quinn Cement Limited

BALLYCONNELL CEMENT PLANT

Ballyconnell, County Cavan

Proposal to use alternative fuels / raw materials at the Cement Plant

Hydrogeological and Hydrological Assessment

March 2016

APPENDIX III

Fluids Handling Protocol

Consultant Hydrogeologists Limited

Technology Centre
Wolverhampton Science Park, Wolverhampton, WV10 9RU
Tel: 01902 824111, Fax: 01902 824112
email: info@bclhydro.co.uk www: http://www.bclhydro.co.uk

Company Registration Number: 4043373
Registered in England & Wales. Registered Office: 33 Wolverhampton Road, Cannock.

Introduction
Inappropriate storage and handling of fuels and oils can result in contamination of ground, groundwater and surface water.

This procedure covers:
Bulk storage of fuels and oils, including waste oil
Filling of bulk storage tanks
Storage and handling of drums
Refuelling operations
Procedure for emptying bunded areas
Fuel and oil spills

Bulk storage of fuels and oils, including waste oil
1. All fuels and oils in bulk shall be kept in bunded storage, the location of which shall be identified on a site plan.
2. The walls and floor of storage bunds must be impervious to oil.
3. Tank filling points shall be inside the bunded area.
4. Delivery lines shall be overhead or, if underground, sleeved.
5. Delivery nozzles shall be stored inside the bund and locked when not in use.
6. Bund drain valves, where fitted, shall be designed so that they can only be removed by key or hand held tool, except when emptying the bund under controlled conditions.
7. All bulk storage tanks shall be appropriately labelled with contents and capacity.
8. Spill kits shall be provided close to hand.
9. Bunded areas shall be checked weekly for build up of oil residues, rainwater or debris.
10. The inside of the bund shall have a line painted to identify when 10% of the capacity has been filled by rainwater etc.

Filling of bulk storage tanks
1. A member of site staff must supervise all tank filling operations.
2. Storage tank levels must be checked to gauge spare capacity before starting filling operations.
3. Check delivery hoses and hose connections for leaks.
4. Report spillages and leaks and clean them up promptly, disposing of waste correctly according to the requirements of prevailing regulation(s).

Storage and handling of drums
1. All drums and containers used for the storage of fuels and oils, including waste oil, shall be appropriately labelled and kept in designated areas identified on a site plan. This will include temporary storage areas.
2. All drums or containers will be kept in bunded storage or on bund trays. This will include temporary storage.
3. Where drum taps are fitted these should be secure. The tap should be positioned over a bund tray to collect drips and spillage.
4. No drum shall be stored in the open without a drum cap fitted.
5. Drums shall be secured when moving them about the site.
6. Report spillages and leaks and clean them up promptly.
7. Spill kits shall be provided.
8. Drum storage areas shall be checked weekly for evidence of poor practice.

Refuelling operations

1. The person refuelling the vehicle must be present throughout the entire refuelling operation.
2. Check vehicle fuel tank level before starting refuelling operations to gauge how much fuel is required.
3. Check delivery hose from the pump / tank to the nozzle for leaks.
4. All delivery nozzles shall be fitted with an automatic cut-out to prevent over-filling.
5. Ensure delivery nozzle is held upright when moving between storage tank and vehicle.
6. Operatives should be prepared to react to any gas oil splashing out whilst re-fuelling.
7. Fuel delivery nozzles shall be locked or similarly disabled when not in use.
8. Report spillages and leaks and clean them up promptly.

Procedure for emptying bunded areas

1. Authority of site management is required before emptying a bund.
2. Details of bund emptying shall be recorded and maintained on site.
3. If the contents of the bund include floating oil then the water underneath this oil should be carefully pumped out. The remaining oil coated water should be collected and disposed of through a licensed contractor.
4. The reason for bund contamination shall be investigated.

Fuel and oil spills

1. Any spillage that cannot be cleaned up promptly with a rag or use of a shovel-full of absorbent material must be reported to the site manager or his designated deputy who will co-ordinate the response and investigate the cause.
2. Spills to ground shall be absorbed and prevented from spreading by using absorbent materials such as sand, fines, absorbent mats, paper or cloth.
3. Halt the movement of fuel or oil towards a watercourse by creating a barrier in front of it by sand bagging, deployment of absorbent boom or use of 3mm or finer dust.
4. If oil enters a watercourse, prevent it spreading by deploying an absorbent boom.
5. If spilt oil or fuel leaves the site the Site Manager must inform the regulatory authorities.
6. Contaminated materials from clean-up should be put in an appropriately labelled container and disposed of through a licensed contractor in line with regulatory requirements.