Ann Kehoe,
Administration Officer,
Office of Climate, Licensing & Resource Use,
Environmental Protection Agency,
PO Box 3000,
Johnstown Castle,
Co. Wexford

Environmental Protection Agency
11 SEP 2014

10th September 2014

Dear Ms. Kehoe,

Please find enclosed a soft copy of the Soil and Groundwater Baseline Report for WO167-03.

Kind regards,

Jane Hennessy
Project Development & Communications Manager

Indaver Ireland Ltd. Registered in Ireland No. 59667
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VAT Reg. No. IE9F70712T IBAN IE53 AIBK 9334 0630 3250 49 AIBKIE2D
Directors: J. Ahern, C. Jones, J. Keaney, D. McGarry
Belgian Directors: P. De Bruycker, M. Decorte, B. Goethals

John Mc Entagart
Environmental Licensing Programme
Regional Inspectorate
McCumiskeHouse
Richview
Clonskeagh Road
Dublin 14
Ireland

4th July 2014

Re: WO167-03 Notice for the purposes of Section 76A(3) of the Waste Management Act, as amended

Dear Mr. Mc Entagart,

Please find attached a Soil and Groundwater Baseline Report as requested in hard copy and soft copy.

Kind regards,

Jane Hennessy
Communications Manager

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INDAVER IRL LTD.
-
SOIL AND GROUNDWATER BASELINE REPORT (IED)

Technical Report Prepared For

Indaver Irl Ltd.

Technical Report Prepared By

Pat Groves & D Casey, Hydrogeoloist/Hydrologist
Teri Hayes, Director/ Senior Hydrogeologist

Our Reference

TH/14-7108/S/R/01

Date of Issue

30th June 2014

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AWN Consulting Limited
Registered in Ireland No. 319812
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T Donnelly, T Hayes, D Kelly, E Porter

Document History

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Revision Level	Revision Date	Description	Sections Affected

Record of Approval

Details	Written by	Approved by
Signature		
Name	Pat Groves David Casey	Teri Hayes
Title	Hydrogeologist,/Hydrologist	Director (Water)
Date	30/06/2014	30/06/2014

EXECUTIVE SUMMARY

This soil and groundwater quality baseline report has been completed as part of Indaver Irelands IED licence application. The report has been prepared in compliance with *European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions.*

The relevant hazardous substances (substances stored or used onsite and which are classified as hazardous by the EPA under the Groundwater Regulations and/or have risk phrases R50 to R53) are Ammonium Hydroxide (NH_4OH) Solution, Diesel, Flue Gas residues and Boiler Ash. These were identified as hazards present at the site which have the potential to impact soil and groundwater if not adequately mitigated during storage and operation at the plant.

A review of containment and mitigation measures at the facility confirms that the risk of a contamination event resulting in soil or ground water is low. These measures include fire fighting systems, drainage and containment systems and spill management procedures.

A review of the site history confirmed that the only previous use for the site was agriculture (arable/grazing). The plant was constructed over 2008-2011 and commenced operation in 2011.

Much of the site is paved reducing potential for vertical migration to ground. Storage and transport routes have a closed drainage system which ultimately discharges through an interceptor system to an attenuation pond. In addition vertical migration is reduced by the presence of c. 8 metres of generally low permeability glacial till which provides additional protection to the underlying regionally important karstified and fractured aquifer. Receptors include the aquifer, groundwater abstraction wells and drainage ditches which feed tributaries of the Nanny River. Dewatering for Platin Quarry has controls the local groundwater flow direction. A conceptual site model (CSM) has been presented for the site based on the historical baseline data and additional soil data collected downgradient of the ammonical hydroxide and diesel storage bunds.

A review of soil quality from the 2000 and 2007 baseline assessment and additional data collated in 2014 confirm that there is no evidence of significant soil or groundwater contamination at the site. Compliance groundwater monitoring since the plant commenced operation in 2011 has also been reviewed and again there have been no exceedances that suggest soil or groundwater contamination has occurred due to the operation of the site. Chloride levels though not exceeding guidelines are elevated above typical background concentrations suggesting previous impact by the historical use of the site for agricultural grazing.

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1.0 INTRODUCTION

1.1 Instruction

AWN Consulting Ltd. (AWN) was appointed by Indaver Ireland Ltd., to complete a baseline report for their site in Carranstown, Co Meath. This report was completed in accordance with European Commission guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions.

1.2 Background – Soil & Groundwater Compliance

In April 2013 Ireland implemented the requirements of the Industrial Emissions Directive (IED) through SI 137 of 2013 and SI 138 of 2013. The regulations come into operation on 7 January 2014. The requirements of the IED include a soil and groundwater compliance report.

Soil and groundwater compliance is defined in SI 138 in Regulation 13 as:

'Baseline report and permanent cessation of activity'

Section 86B. (1) Where an industrial emissions directive activity involves the use, production or release of relevant hazardous substances, and having regard to the possibility of soil and groundwater contamination at the site of an installation concerned, the Agency shall require an applicant under this Part for a licence or review of a licence or revised licence relating to the activity, including such a review by the Agency of its own volition, to furnish to the Agency a baseline report in accordance with regulations under section 89.

(2) In relation to the installation, a baseline report shall contain information necessary to determine the state of contamination of soil and groundwater at the time that the report is drawn up in order that a quantified comparison may be made to the state of the site upon the permanent cessation (including cessation by abandonment) of the industrial emissions directive activity concerned and the applicant in preparing the baseline report shall include any information prescribed in regulations under section 89.

(3) Notwithstanding the generality of subsection (2), a baseline report shall include at least the following information —

(a) the current use and, where available, the past use of the site; and
(b) any available information on -

(i) Soil or groundwater measurements that reflect the state of the site at the time that the baseline report is drawn up, or

(ii) New soil and groundwater measurements, having regard to the possibility of soil and groundwater contamination by the hazardous substances proposed to be used, produced or released by the installation concerned.

The scope of the baseline report is outlined in *European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions.*

1.3 Objectives & Reporting Format

The Soil and Groundwater report will include items listed in Section 1.2 above and follow the guidance below:

- European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions, and, where relevant:
- Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites, EPA, July 2013;
- Guidance on the Authorisation of Discharges to Groundwater, EPA, December 2011;
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, Draft Guidance, IGI 2013.

1.4 Limitations of Report

The conclusions presented in this report are professional opinions based solely on the tasks outlined herein and the information made available to AWN. They are intended for the purpose outlined herein and for the indicated site and project. Furthermore, this report is produced solely for the benefit of Indaver Ireland Ltd. (located in townland of Carranstown, Co. Meath) to address an EPA requirement for their licence.

This report may not be relied upon by any other party without explicit agreement from AWN. Opinions and recommendations presented herein apply to the site conditions existing at the time of the recently completed field work and subsequent assessment. They cannot apply to changes at the site of which AWN is not aware and has not had the opportunity to evaluate. This report is intended for use in its entirety; no excerpt may be taken to be representative of this baseline assessment. All work carried out in preparing this report has utilised and is based on AWN professional knowledge and understanding of the current relevant Irish and European Community standards, codes and legislation.

2.0 METHODOLOGY

2.1 Methodology Outlined

Table 5 of the Guidance (European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions), outlines the requirements for this report. These requirements form the methodology adopted for this report which is outlined below as Stages 1 to 8.

- Stage 1 Identifying the hazardous substances that are currently used, produced or released at the installation
- Stage 2 Identifying the relevant hazardous substances i.e. those which have the potential to cause soil and groundwater contamination
- Stage 3 Assessment of the site specific pollution risk
- Stage 4 Site History
- Stage 5 Environmental Setting
- Stage 6 Conceptual Site Model
- Stage 7 Site Investigation – Soil & Water Quality Assessment
- Stage 8 Production of the Baseline Report

2.2 Sources of Information

Reference is made in this report to information from a number of existing data sources and reports including the following:

- Geological Survey of Ireland (GSI): On-line mapping resources, available at www.gsi.ie including *inter alia* groundwater well database, Karst feature database, geology, aquifer classification and vulnerability;
- Environmental Protection Agency (EPA): On-line data resources available at http://gis.epa.ie/Envision/
- National Parks & Wildlife Service (NPWS): On-line data resources available at http://webgis.npws.ie/npwsviewer/
- Indaver Ireland Ltd. (AER 2013, EIS 2009 and 2012, ELRA - 2011)

2.3 Scope of Work Undertaken

The scope of the work undertaken for this assessment included the following:

- A desktop review of regional and site geology and hydrogeology, review of chemical storage and operations at the Indaver site.
- Additional site investigation, soil quality sampling down-gradient of chemical storage area and *in situ* permeability testing.
- Review of available soil and groundwater quality data.

3.0 STAGE 1 & 2- IDENTIFYING HAZARDOUS SUBSTANCES

This section summarises the hazardous substances that are currently in significant volumes at Carranstown facility.

Table 3.1 below shows the range of materials used on site including the quantities and hazard phases. In reference to the risk to the soil and geology environment the Risk Phases to note are R50/51/52/53 which are classified as damaging to the environment. The only large scale storage of chemicals on site includes the Ammonium Hydroxide which is used the NOx removal process and diesel which is used for the start-up and shut down processes using the auxiliary burners at the plant and for any periods of time where the calorific value of the waste is too low. These chemicals are classified as potentially damaging to the environment should a release to ground occur.

No.	Chemical Name	Quantity Stored on Site	Risk Phrases
1	Ammonium Hydroxide (NH_4OH) Solution (25%)	Stored in 62m^3 double skinned tank	R34, R37, R50
2	Diesel	Startup and auxiliary burners (40m^3 tank) Firewater pumps (3 x 0.8m3 tanks) Emergency generator (9m3 tank)	R40, R65, R66, R51/53
3	Sodium Hydroxide (NaOH) 30% Solution (Caustic Soda)	Stored in 1m^3 IBC's	R35
4	Nitric Acid (HNO_3) 27% Solution	Stored in 1m^3 IBC's	R35
5	Sodium Chloride (NaCl) (Salt)	Stored in 25kg bags	R36
6	Roclean 2 : Citric Acid Anhydrous ($C_6H_8O_7$)	Stored in 25L drums or 1m^3 IBCs	R36
7	Roclean 12 : Mixture of NaOH, EDTA, and Surfactant	Stored in 25L drums or 1m^3 IBCs	R35
8	Calcium Hydroxide ($Ca(OH)_2$) (Hydrated Lime)	Stored in 150m^3 silo	R37, R38, R41
9	Calcium Oxide (CaO) (Quicklime)	Stored in 115m^3 silo	R37, R38, R41
11	Expanded clay -Dioxorb (Mixture of predominantly calcium hydroxide, and clay minerals, activated carbon)	Stored in 80m^3 silo	R38, R41
12	Ethylene Glycol ($C_2H_4(OH)_2$) 30% solution	6.3m^3 and 3.5m^3 closed circuit loops including vessels	R22
17	Propane Gas (C_3H_8)	3 No. Propane Cylinders	R12
19	Hydrogen Gas (H_2)	1 No. 50 litre cylinder and Hydrogen Cell in CEMS Room	R12
20	Flue Gas Residues	2 No. 238m^3 silos	R52, R53
21	Boiler Ash	122m^3 silo	R36, R37, R38, R52, R53

Table 3.1 List of Chemicals On-site

Figure 3.1 below presents the location of the stored chemicals listed above.

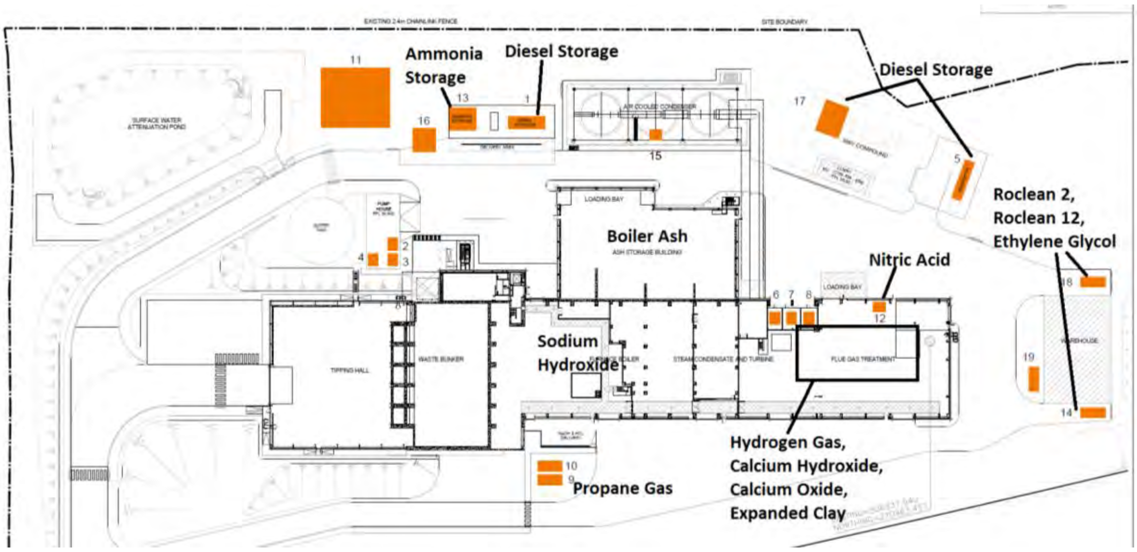

Figure 3.1 *Location of Stored Chemicals*

Each of the storage areas is further summarised in Table 3.2 below.

Number Ref.	Bund Tag	Description
1	EGB10-BB001	Main Diesel Tank
2	SGA01-BB001	Fuel Tanks in Diesel Pump House
3	SGA02-BB001	Fuel Tanks in Diesel Pump House
4	SGA03-BB001	Fuel Tanks in Diesel Pump House
5	XJA99-AG099	Back up Diesel generating Tank
6	ATA99-GT098	Transformer bund 1 under electrical rooms
7	ATA99-GT098	Transformer bund 2 under electrical rooms
8	ATA99-GT098	Transformer bund 3 under electrical rooms
9	GMA93-BB001	Underground recovering water pit
10	GMA95-BB001	Underground Clean Water Pit
11	GUD02-BB001	Underground Fire Water Retention Tank
12	HTS10-BB001	Nitric Acid spill containment
13	HQA01-BB001	Ammonia solution tank spill containment
14	UYA99-AZ096	Chemstore MH001 for Warehouse
15	GUD06-BB001	2.5m^3 Storage tank ACC area
16	GUD07-BB001	2.5m^3 Storage tank Ammonia Slab area
17	ATA99-GT099	38KV Transformer Compound in Sub Station
18	UYA99-AZ096	Chemstore MH002 for Warehouse
19	ATA99-GT098	Transformer at Warehouse
20	TBC	Fuel Oil Storage

Table 3.2 *Bund Descriptions*

Table 3.1 was reviewed to highlight chemicals that are identified as environmentally hazardous to soils and groundwater if a release to ground occurred i.e. without mitigation. The chemicals which are identified as environmentally damaging are summarised in Table 3.3 below.

No.	Chemical Name	Quantity Stored on Site	Risk Phrases
1	Ammonium Hydroxide (NH_4OH) Solution (25%)	Stored in 62m^3 double skinned tank	R34, R37, R50
2	Diesel	Startup and auxiliary burners (40m^3 tank) Firewater pumps (3 x 0.8m3 tanks) Emergency generator (9m3 tank)	R40, R65, R66, R51/53
20	Flue Gas Residues	2 No. 238m^3 silos	R52, R53**
21	Boiler Ash	122m^3 silo	R36, R37, R38, R52, R53**

Table 3.3 *List of Environmentally Damaging Materials*

Table 3.4 below describes the Hazard Risk phrases used to classify the environmental hazard rating.

R-Phrase	Description
R37	Irritating to respiratory system
R34	Causes burns
R38	Irritating to skin
R40	Limited evidence of a carcinogenic effect.
R50	Very toxic to aquatic organism
R51	Toxic to aquatic organisms
R52	Harmful to aquatic organisms
R53	May cause long term adverse effects in the aquatic environment
R65	Harmful: may cause lung damage if swallowed
R66	Repeated exposure may cause skin dryness or cracking

Table 3.4 *Risk Phrase Description*

4.0 STAGE 3 - ASSESSMENT OF THE SITE SPECIFIC POLLUTION RISK

This section includes a review of the containment measures in place for the hazardous substances identified in Stage 2 above.

4.1 Protection Systems and Procedures

The following containment arrangements are in place at the site to prevent any accidental release of hazardous substances, including substances that may be hazardous to the environment:

- The ammonia solution and diesel tanks are double skinned with leak detection systems and have over-fill protection in the form of level switches/ interlocks.
- The ammonia solution and diesel tanks are located on hard standing ground.
- The drainage channel in the delivery area, where diesel and the ammonia solution are unloaded, runs to a 10m^3 forecourt separator where any spills can be contained and the drainage can also be diverted to a 2.5m^3 holding tank for use during deliveries.
- The ammonia solution and diesel pipelines run on over ground tray racks above hardstanding areas to the process building. There are no underground process lines at the facility.
- All containers storing materials that are hazardous to the environment are stored over paved areas and chem store units with spill trays are used for any chemical stores in the contractors' compound (warehouse area).
- All external surface water drainage on the site passes through a Class 1 by-pass petrol interceptor before entering the surface water attenuation pond.
- Drains are painted for high visibility and in accordance with conditions set out in Indaver's Waste Licence.
- The waste bunker which extends below ground is designed with an impermeable liner and 1.2 metres of concrete.
- The firewater retention system has a capacity of 300 m^3 and should this capacity be exceeded the system will overflow to the surface water attenuation pond (capacity 1,600 m^3).

4.2 Risk of Environmental Contamination

The incident scenario with the highest risk rating is an accidental release of diesel from a truck fuel tank (ELRA 2011). The risk prevention measures for storage, transport and operation on site is summarised below.

4.2.1 Stormwater Drainage System

The site is serviced by a stormwater system which is presented in Figure 4.1. All rainfall which falls on the hardstanding area will be captured by the stormwater system with all flows passing through the petrol interceptor before passing through the attenuation pond. The discharge point from the pond is to a drainage ditch located adjacent to the attenuation pond.

As highlighted in Figure 4.1 the attenuation pond is located in the northwest corner of the site. There are four main stormwater systems onsite which services the areas as follows:

- Area 1 - Ammonia and Diesel storage/delivery area
- Area 2 - Forecourt to the north to the Tipping hall and Ash Hall.

- Area 3 - Forecourt to the south of the Tipping hall, Boiler Furnace and Flue gas areas.
- Area 4 - Gully system located along access road and weighbridge areas.

Area 1- An Aco drain is located in the Ammonia/Diesel storage area which collects rainfall and any potential spillages in this area. The flow is channelled through the forecourt separator before joining the area 2 system. The flow is channelled to the attenuation pond via the petrol inceptor

Area 2 services the main yard/forecourt area north of the main building which also included the 38kV sub-station. Aco drains are located around the Sub-station and collects stormwater and potential spillages from around the substation. There is a network of 225mm diameter pipes which connect to the main 375mm pipework which channels stormwater to the attenuation pond via the petrol inceptor.

Area 3 services the hardstanding area south of the main structure which includes the access road in this area. All stormwater and potential spillages will be collected by a system of gullies which are connected to the 225mm diameter pipe system and ultimately channelled to the attenuation pond through the 375mm diameter pipework via the petrol inceptor.

Area 4 services the main access road and the weighbridge located in the southern section of the site. A system of gullies will collect all the stormwater and potential spillages which is channelled to the attenuation pond via the petrol inceptor.

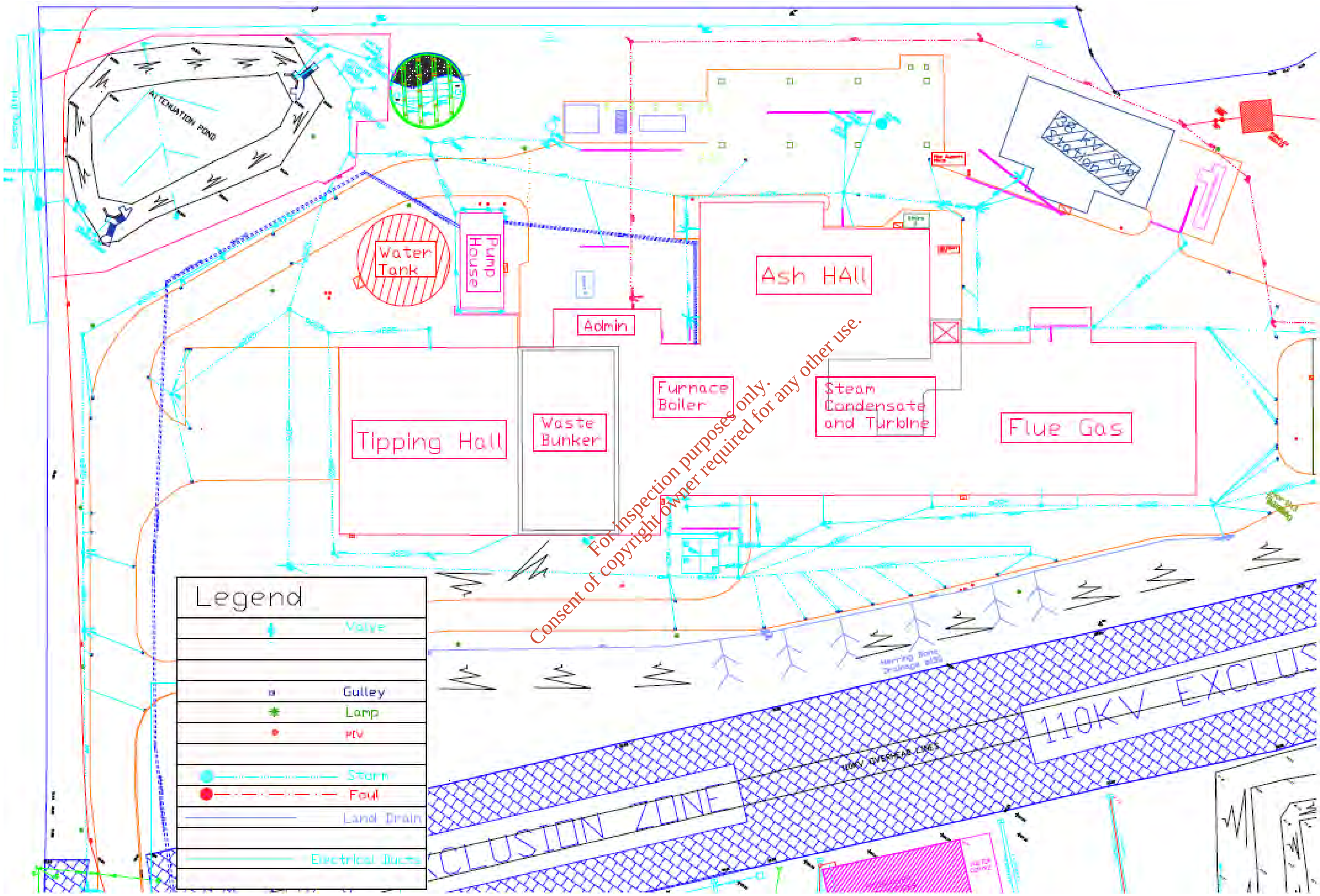

Figure 4.1 *Stormwater system layout*

4.2.2 Chemical Storage

Diesel Fuel

Diesel fuel used in the auxiliary burners is stored in the northern section of the site in the dedicated delivery area, Firewater pumps (3 x 0.8m^3 tanks), and the Emergency generator (9m^3 tank). The main diesel tank has a capacity of 40m^3 and is of double skinned construction comprising an inner (6mm) and outer (4mm) skins.

During unloading operations, a switch can be made to the valve arrangement which will collect any spillages in an underground tank (2.5 m^3).

During normal operations any spillage in the area will be collected by the stormwater system and direct the leak towards the main drainage network. The main drainage network includes a forecourt separator and a Class I petrol interceptor prior to the water being tested, ensuring the results are within the required parameters. TOC, conductivity and pH detectors will activate the shut-off value if any of the results are over the action levels at the attenuation pond inlet and divert the water to an underground storage tank (300m^3) for future treatment. A final analyser is located at the pond outlet, which will cease discharge from the pond if the parameters are not within licenced limits.

See Figure 4.2 below for system layout and Figure 4.3 for construction make-up of bund/ plinth.

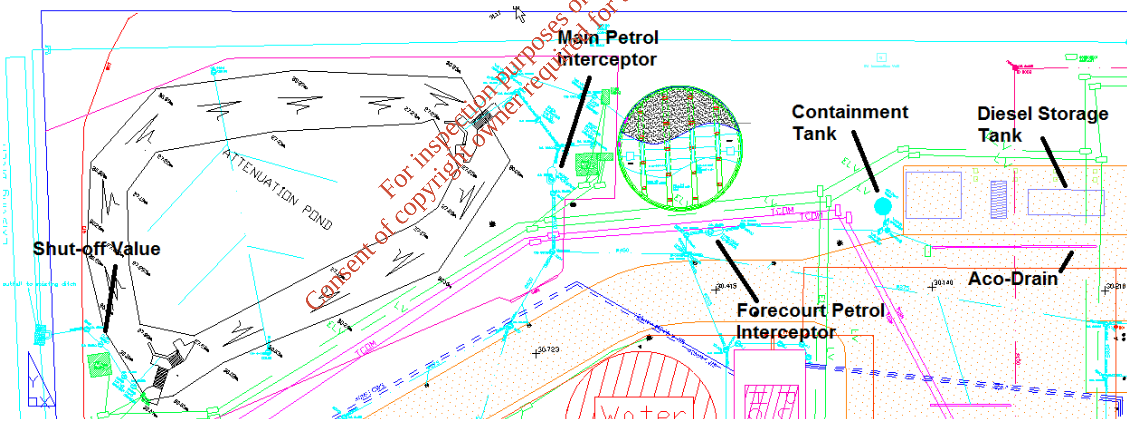

Figure 4.2 *Diesel Tank Stormwater System Layout*

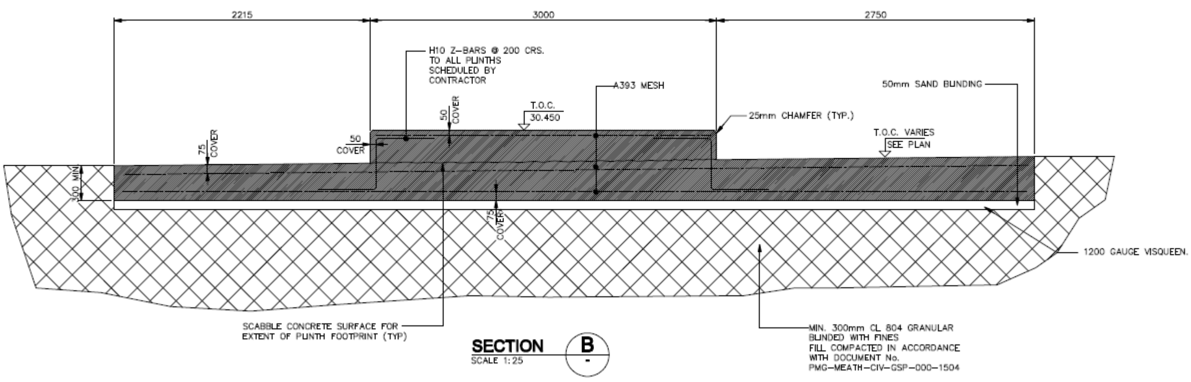

Figure 4.3 *Diesel tank Plinth Construction*

Ammonia

The ammonia utilised on site is classified as Ammonium Hydroxide (NH_4OH) Solution (25%) which has an environmental hazard rating of R50 which is identified as 'Very toxic to aquatic organisms'. Therefore ammonia is identified as the main environmental hazardous substance on-site.

The Ammonia storage tank has a capacity of 62m^3 and is located in the north section of the site as shown in Figure 4.4 in a dedicated delivery area. The tank is a double skinned stainless steel type of construction with leak and overfill protection. Filling of the ammonia tank is a manned event.

As with the Diesel Storage any spillage, during unloading operations a switch is made to the valve arrangement which will collect any spillages in an underground tank (2.5 m^3). Again, during normal operations, any spillages will be diverted into the stormwater system, with the forecourt separator, Class I petrol interceptor, detection and shut off valves and containment tanks as for the diesel tank.

See Figure 4.4 below for system layout and Figure 4.5 for construction make-up of bund/plinth.

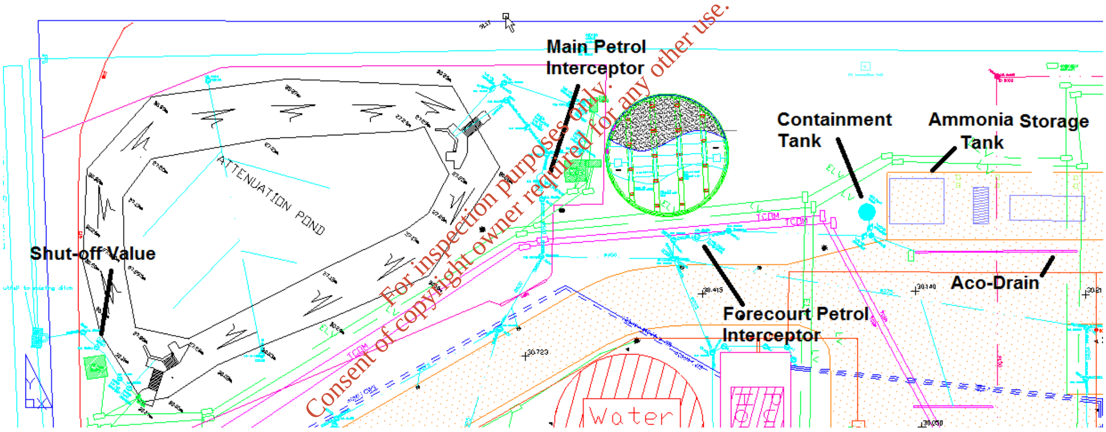

Figure 4.4 *Ammonia Tank Stormwater system layout*

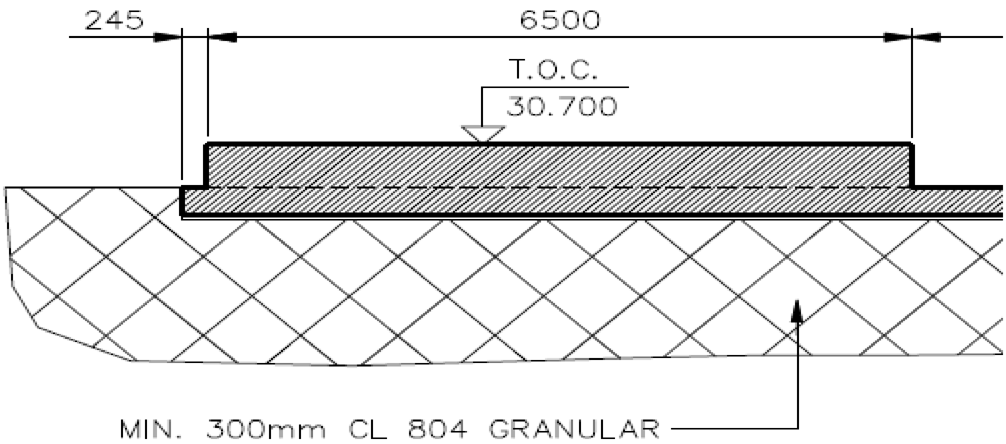

Figure 4.5 *Ammonia Tank Plinth Construction*

Bottom ash, Boiler ash and Flue gas ash

Bottom ash, boiler ash and flue gas ash will be generated from the different process stages at the site. Any ash spills will be contained within the internal structure of the building and will not be discharged to the stormwater system on site.

Additional protection is provided by the following measures; the control room will manage via CCTV or manned loading, all dispensing of ash to collection trucks in coordination with collection truck driver. Spill containment procedures are in place in the event of an ash spill.

In the event of a release of water from the wet bath, spilled material will be contained in the area and any material reaching indoor drains will be contained in the internal drainage recovery tanks where the water can be removed for treatment or reused within the treatment process. The wet bath will be inspected and maintained as part of the site's maintenance programme.

4.2.3 Transport

Deliveries

Due to the large number of vehicle activities, there is the potential for diesel oil spills / leaks from vehicle fuel tanks to occur. The ELRA (2011) highlighted this as the most likely potential environmental incident. Deliveries of waste, collection of ash and supply deliveries will take place daily while additional vehicular activities will include the delivery of materials to the site, including inter alia, diesel, ammonia solution, sodium hydroxide (NaOH), nitric acid, activated carbon, expanded clay and lime for use in the treatment process.

Control measures include the following: The site operates a well-marked one-way traffic system around the main facility. Vehicles enter via the main entrance and traffic operates in a clockwise direction before returning to the main access road/weighbridge area. A wide turning area is provided in the waste tipping area for waste delivery vehicles which can exit the site via the main access road without traversing around the main facility.

As described previously all hardstanding areas are serviced by a stormwater system which contain and divert all potential spillages to the attenuation pond via the main petrol interceptor. In the event of a spill by-passing the interceptor containment systems will activate and close the shut-off valve prior to the attenuation pond where it will be contained in the underground storage tank for future treatment.

5.0 STAGE 4 – SITE HISTORY

This section includes an evaluation of the likelihood of the presence of any contamination on soil/ groundwater at the site and an overview of the site history.

Construction of the facility occurred over 2008/2011. Historically the site was used for agricultural purposes with no previous industrial or commercial activates occurring onsite. Soil and groundwater samples collected as part of the baseline for the EIS study showed no evidence of contamination at the site that indicate anything other than an agricultural use (see section 9).

Aerial Imagery from the Ordnance Survey Ireland (OSi) (see Figure 5.1) and historic maps (refer Figure 5.2) were analysed and do not show any prior land use besides agricultural purposes at the site.

Figure 5.1 *OSi Aerial Image (2005) (source www.osi.ie)*

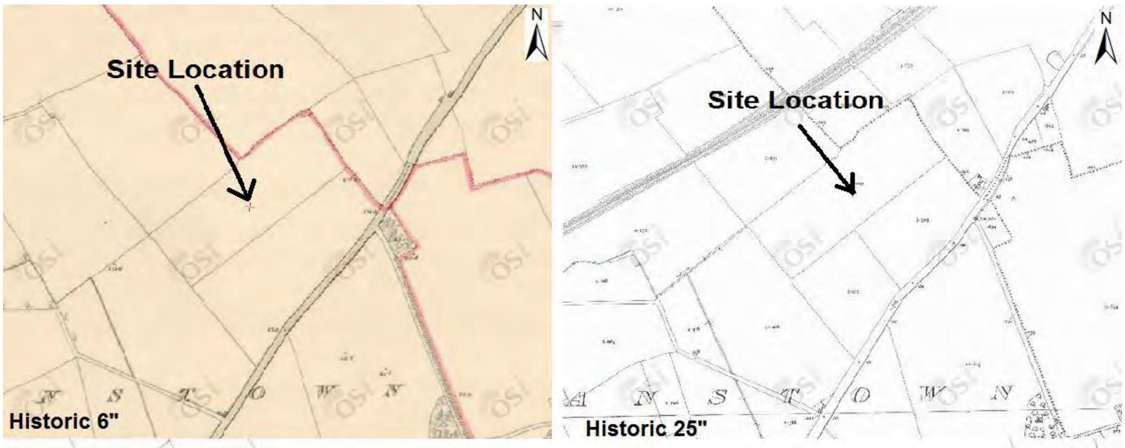

Figure 5.2 *Historical Maps (source www.osi.ie)*

6.0 STAGE 5 – ENVIRONMENTAL SETTING

This section includes an assessment of the likely fate of any spill/leak event based on the topography, soil and groundwater characteristics at the location. Based on the findings of Stages 1 to 4 above, the locations where hazardous substances are stored have also been assessed with regard to confirming source-pathway-receptor linkages i.e. in the unlikely event of a leakage/spillage which is not mitigated on site.

6.1 Topography

The topography around the site is relatively flat with a slight fall from east to west within the boundary however there are embankment/bunds located along the southern and eastern boundary. The overall topography for the study area is relatively shallow with a general fall to the southeast towards the River Nanny. There a number of hills located to the north with a peak of approx. +95mAOD and northwest, +121mAOD of the site. The general elevation of the site is approx. +30mAOD.

6.2 Hydrology

The site is located within the River Nanny catchment which is the main water feature in the study area. The River Nanny is located approximately 2km to the south of the site.

There are two streams located in the vicinity of the site which are the Cruicerath, approximately 200m to the west and the Platin, approximately 500m to the east. There is no direct pathway to the River Nanny however storm water is discharged to a drainage ditch which may ultimately reach the River Nanny via the Cruicerath and Platin. The most recent water quality status for the nearest gauge to the site (Br NE of Bellewstown) is 'Moderate' (3-4) which is located approximately 2km south of the site. Further downstream the gauge located at 'Br at Julianstown' recorded a value of 'Poor' (2-3).

The development is located within the ERBD, as defined under the EU Water Framework Directive (2000/60EC) European Communities Directive 2000/60EC, establishing a framework for community action in the field of water policy, (commonly known as the Water Framework Directive [WFD]).

The WFD requires 'Good Water Status' for all European waters by 2015, to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both 'good ecological status' and 'good chemical status'. The current status for the River Nanny is classified as 'Poor' and is 'at risk of not achieving Good status. The River Nanny (Lower) is not expected to reach 'Good Status' until 2027.

Figure 6.1 below presents the site location and hydrological environment.

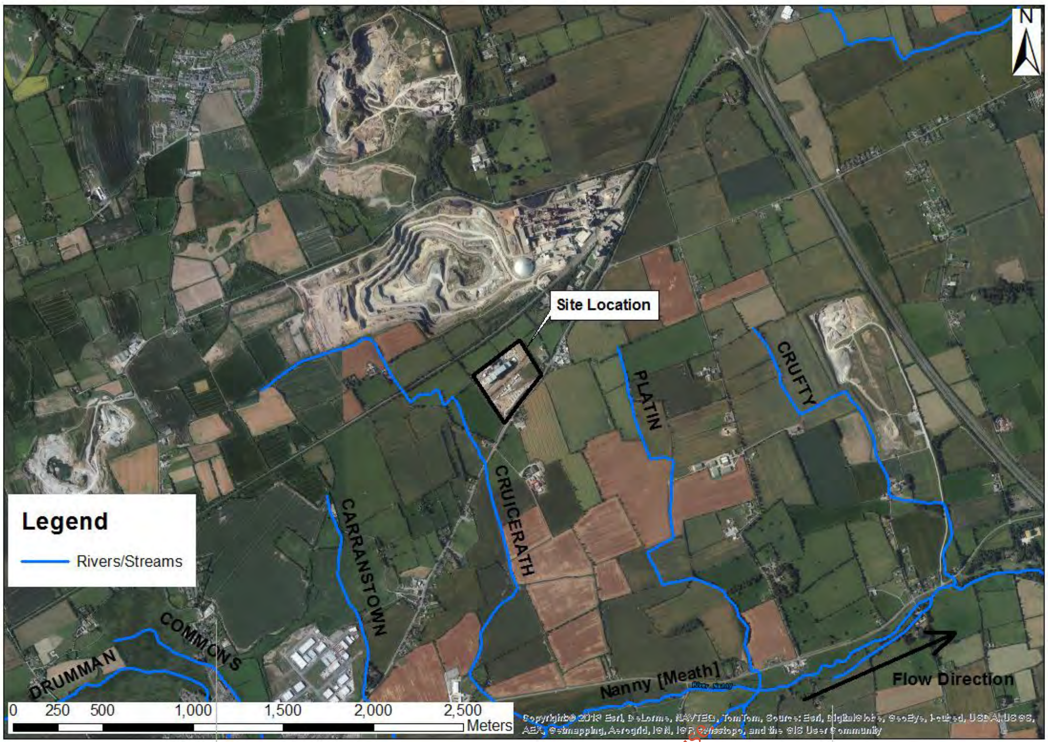

Figure 6.1 *Site Location and Hydrological Environment (source www.epa.ie)*

There is expected to be little overland flow onto the site from the surrounding area due to large quarry to the north and the streams located to the east and west which will capture surface water flow in these areas.

Storm water discharges from the Irish Cement facility will likely flow along drainage ditches to either the Cruicerath and Platin streams including any potential contamination. The site is designed in accordance with Greater Dublin Surface Water Design Standards which stipulates that the runoff from the site should not exceed the greenfield run-off equivalent.

6.3 Geology & Hydrogeology

6.3.1 Regional Geology

The site is underlain by Lower Carboniferous Limestone bedrock which forms part of the Platin Formation (see Figure 6.2 below). The Limestone is typically characterised by pale thick-bedded with minor shale, possibly dolomitised, with paleo-karstic features (GSI Sheet 16 and Meath Groundwater Protection Scheme). A top weathered zone is characteristic of the limestone and has been confirmed by previous borehole drilling.

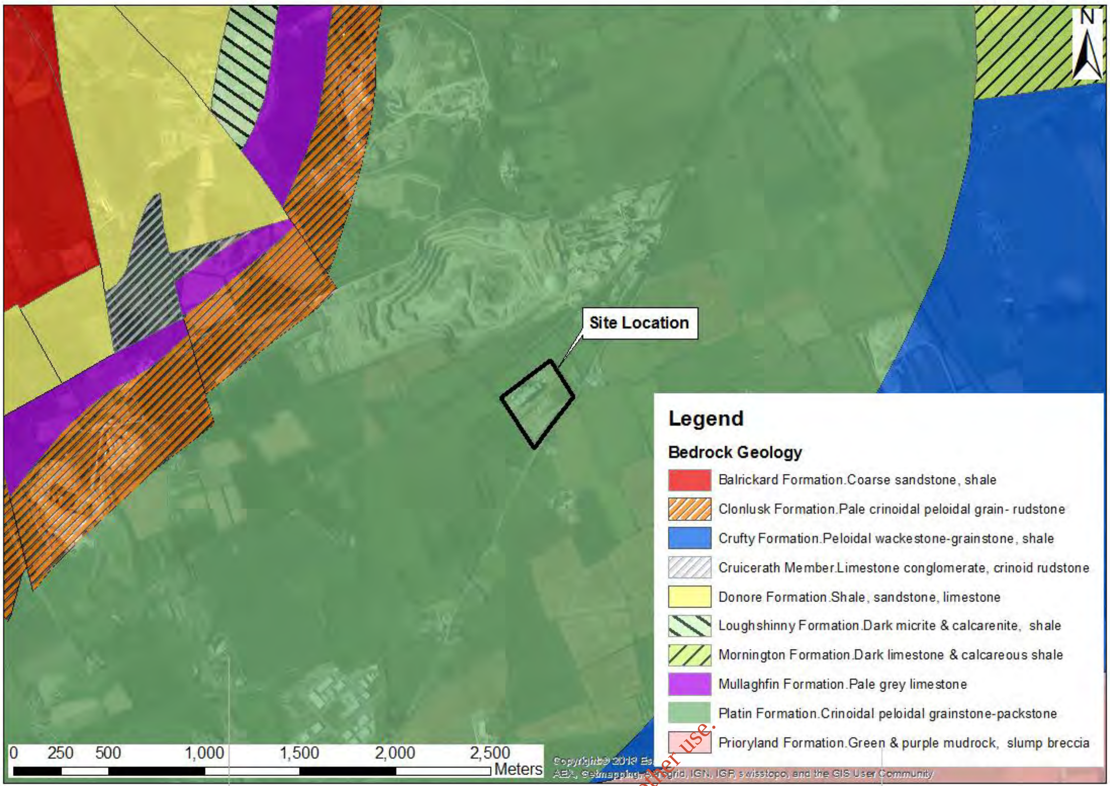

Figure 6.2 Solid Geology Underlying the Site *(source www.gsi.ie)*

The Indaver site at Carranstown is underlain by soils from the Dunboyne-Ashbourne soil complex. The parent material of the soil is drift deposits intermixed with local limestone and shale. This type of soil is generally poorly drained. The soil type for the site comprises AminPD (Surface water Gleys / Groundwater Gleys Acidic), AminDW (Acid Brown Earths/ Brown Podzolics) and AlluvMIN (Mineral alluvium). The soil classification according to the GSI (2014) is presented in Figure 6.3 below.

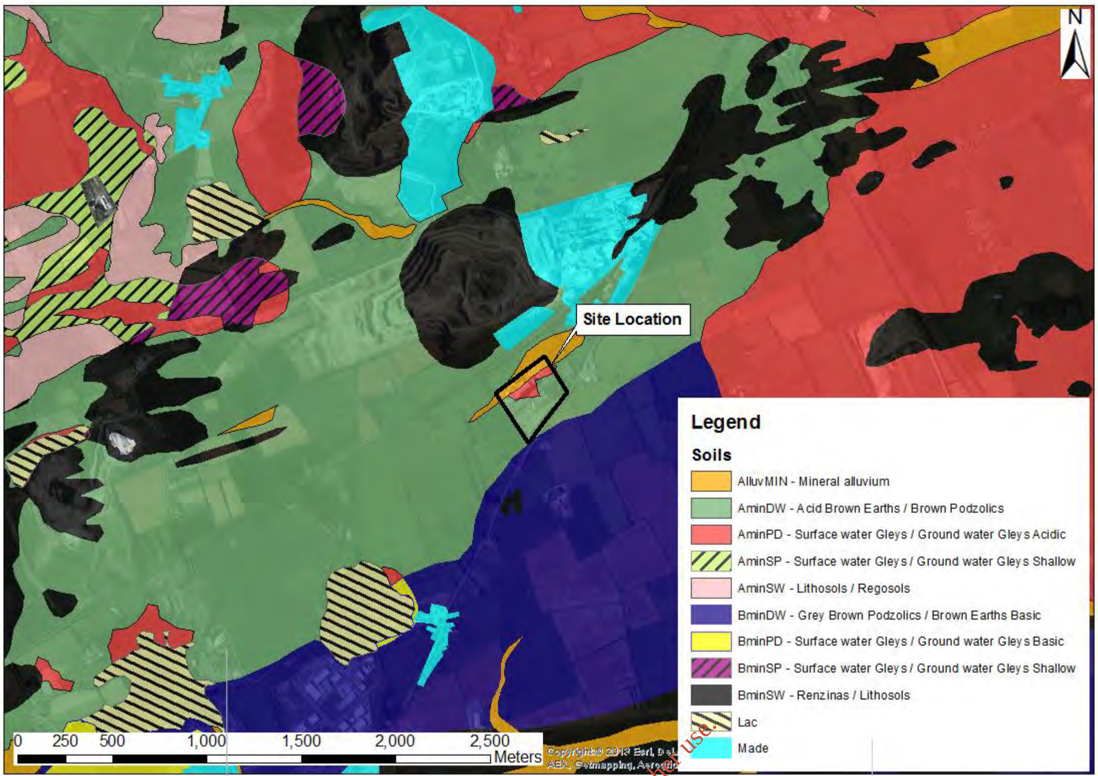

Figure 6.3 *Soils Underlying the Site (source www.gsi.ie)*

The subsoil type in the development comprises Alluvium undifferentiated (A) and Shale and Sandstone till (Namurian) (TNSSs). Subsoil classification according to the GSI (2014) is presented in Figure 6.4 below.

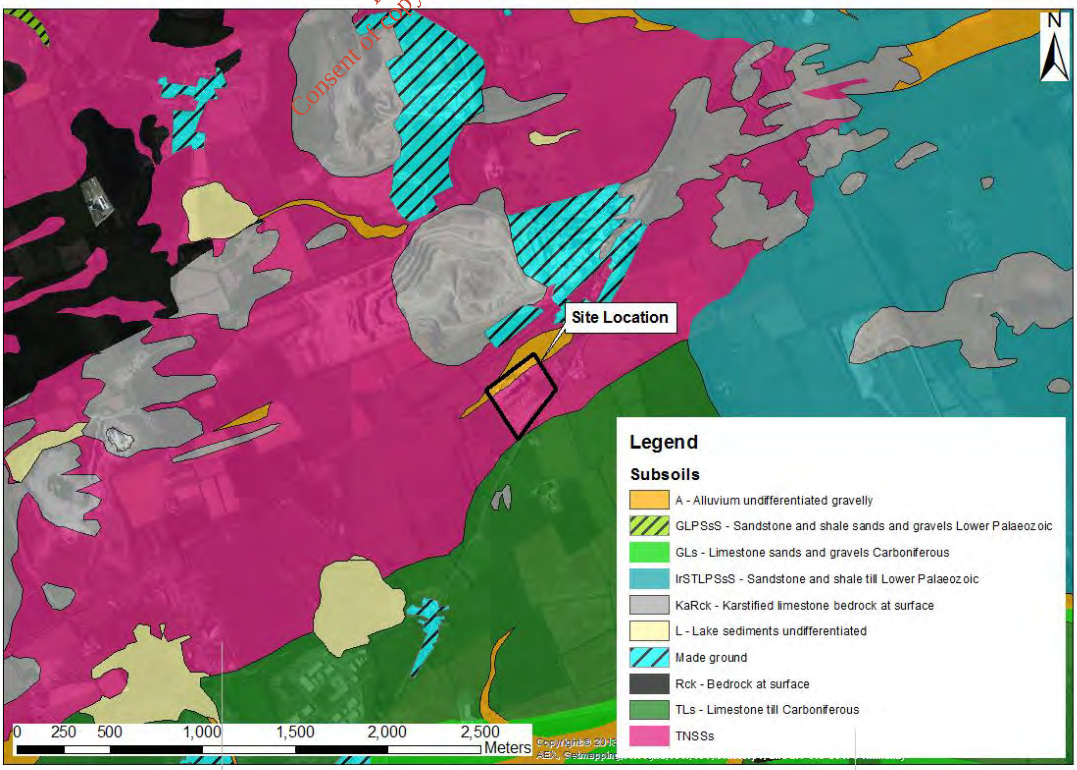

Figure 6.4 *Subsoils Underlying the Site (source www.gsi.ie)*

6.3.2 Superficial Geology – Local Setting

A number of ground investigations were completed at the site, notably in 2000, 2007, and 2009. In January 2000, 15 no. trial pits were excavated at the site (Alpha, 2000) and in May 2000, an additional 7 no. trial pits were excavated. In 2007, three cable percussive and one follow-on rotary borehole were drilled at the site (BLP, 2007). In 2009, a number of additional boreholes were completed at the site consisting of 11 no. rotary boreholes (PM, 2009).

Figure 6.5 below presents exploratory boreholes from the afore-mentioned site investigations together with boreholes drilled in 2014.

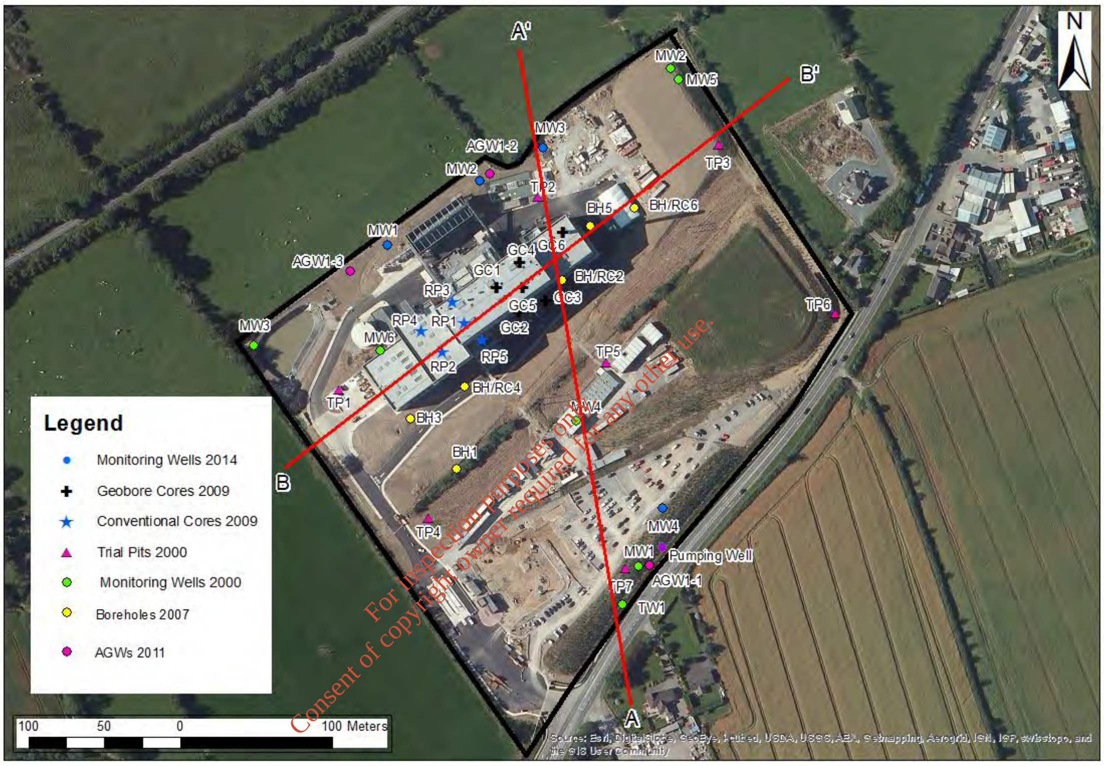

Figure 6.5 Exploratory Hole Locations at Indaver Site

In general, following review of the past site investigation reports, the site stratigraphy is varied across the site but generally consists of TOPSOIL overlying BOULDER CLAY with occasional GRAVEL/SAND lenses, which in turn is underlain by Carboniferous LIMESTONE. A summary of the ground stratigraphy observed in past investigations together with indicative depths encountered is outlined as follows:

- TOPSOIL (0.0-0.4mbgl)
- Soft to firm silty CLAY with cobbles (0.4-1.0mbgl)
- Firm to hard silty CLAY with cobbles/ boulders (0.4-4.0mbgl)
- Medium dense to dense sandy GRAVEL with local sand lenses (0.4-5.0mbgl)
- Hard silty BOULDER CLAY with cobbles/ boulders (2.5-4.0mbgl)

On the basis of previous investigations, BOULDER CLAY, specifically, varies in thickness across the site, ranging from 4m towards the west of the site to approximately 10m towards the centre of the site.

As mentioned above, additional boreholes were completed at the site in May 2014 by AWN and consisted of three boreholes (MW1-MW3) along the northern site boundary and one borehole (MW4) along the southern boundary line. The recorded details of the superficial deposits are presented in Appendix B - these are based on driller descriptions and borehole logging undertaken by AWN supervising personnel. A summary of the general downward geological succession is presented in Table 6.1 below.

Location ID	**MW1 to MW3**	**MW4**
Stratum	**Depth (mbgl)**	
TOPSOIL	0.10 - 0.20	0.20
Slightly sandy gravelly CLAY	0.10 – 4.00	-
sand and/or gravel	Up to 1m in thickness	-
Silty CLAY	-	0.20 – 5.00
Sandy CLAY	-	1.20 - 2.30

Note: mbgl = metres below ground level

Table 6.1 Summary of Monitoring Well Lithology (May 2014)

The soil descriptions are consistent with previous soil investigations for the site, which conclude that the overburden geology consists predominantly of silty clays (BOULDER CLAY - MW1, MW2 and MW3) with cobbles and occasional boulders, with discontinuous lenses of sand or gravel noted. At MW4, located at the southern margin of the site, the superficial geology consists dominantly of stiff to hard brown CLAY.

Figure 6.6 below presents the geological cross section for the site (NW-SE) indicating the predominant superficial deposits of Boulder Clay together with inferred gravel/ sand lenses, overlying weathered limestone which becomes fractured with depth. The section (note: section profile is presented on Figure 6.5 above) also includes the inferred groundwater flow towards the adjacent Irish Cement site to the north under the influence of the dewatering activities at the quarry site.

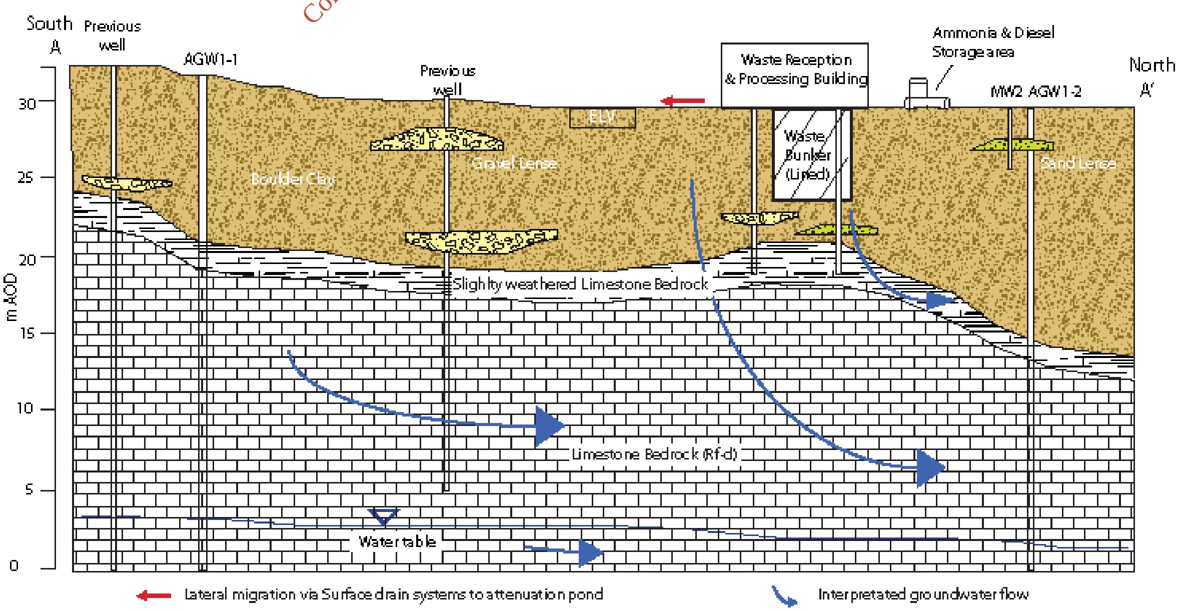

Figure 6.6 *Geological Cross Section (A – A')*

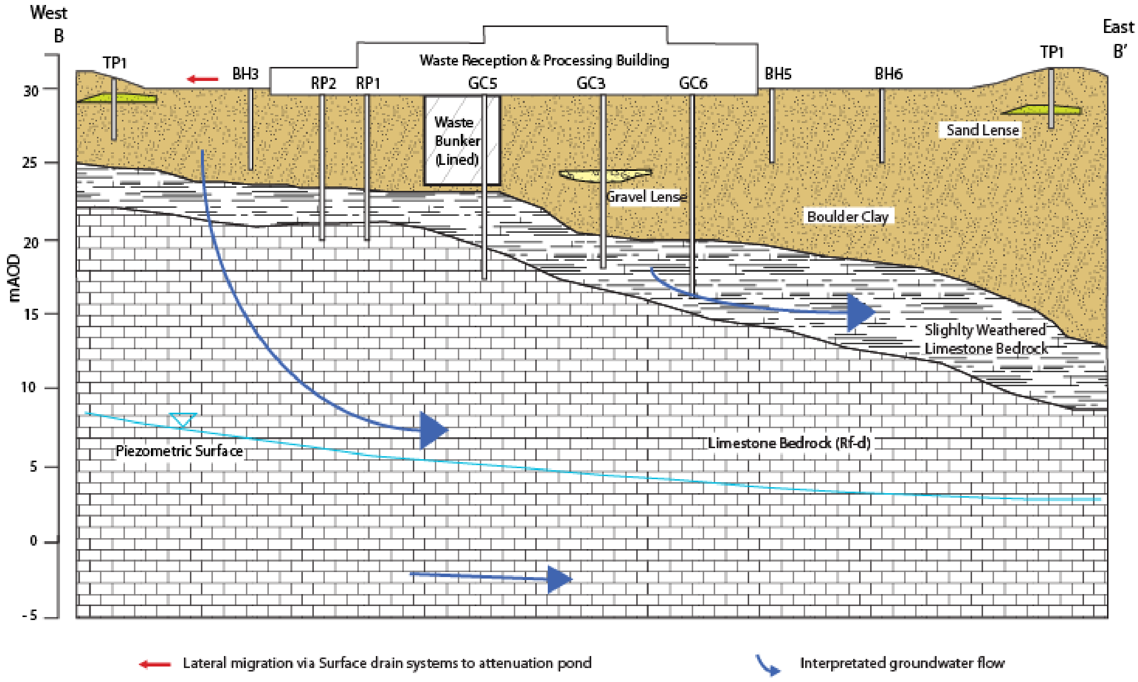

Figure 6.7 *Geological Cross Section (B – B')*

<u>Permeability in subsoils and underlying bedrock</u>
A number of geotechnical and site assessment reports for the site were reviewed in order to better understand the permeability of the subsoils across the site and as a result potential migration rates. The key points are discussed as follows.

1. A variety of clayey subsoils were reported for the site ranging in strength from soft to hard sandy gravelly CLAY (Alpha, 2000). This would initially infer varied permeability coefficients across the site.

2. The Byrne Looby (BLP, 2007) investigatory works show the indigenous soils at this site generally comprise low plasticity, very sandy gravelly CLAY with cobbles (locally grading to SILT). Subordinate horizons or pockets of sandy GRAVEL and gravelly or clayey SAND were also uncovered during the trial pit investigations at the site. The cohesive or fine-grained material is referred to as 'glacial till', while the subordinate coarse or granular dominant materials are typical of fluvio-glacial deposits. The upper glacial till is reported as typically firm/ stiff while the Geobor cores and associated laboratory testing indicates the lower till to be 'stiff- very stiff'. Both classifications would in general indicate cohesively tight clays of low permeability.

3. Groundwater was locally intercepted in the BLP (2007) trial pits (i.e. 1.9 to 3.5 mbgl). These levels are unlikely to reflect long term equilibrium water conditions. With regard to bedrock permeability, packer tests were not carried out to evaluate the permeability or water-tightness of the bedrock. However, on the evidence of the discontinuity spacings and fracture state of the cores, the bedrock would be expected to be of 'medium permeability'. Both the BLP and IGSL geotechnical investigations encountered 'cavities' within the upper limestone bedrock.

6.3.3 Regional Hydrogeology

The Platin formation has been classified as a regionally important karstified (diffuse) aquifer, displaying both karst and fracture flow. The aquifer is classed as having moderate vulnerability, related to the presence of thick boulder clay in the region. The site is located within the Bettystown Groundwater body which status based on overall chemical status and quantities status has been categorised as poor.

Figure 6.8 below presents the aquifer classification for the site according to the GSI (2014), while Figure 6.9 presents the appropriate groundwater vulnerability index.

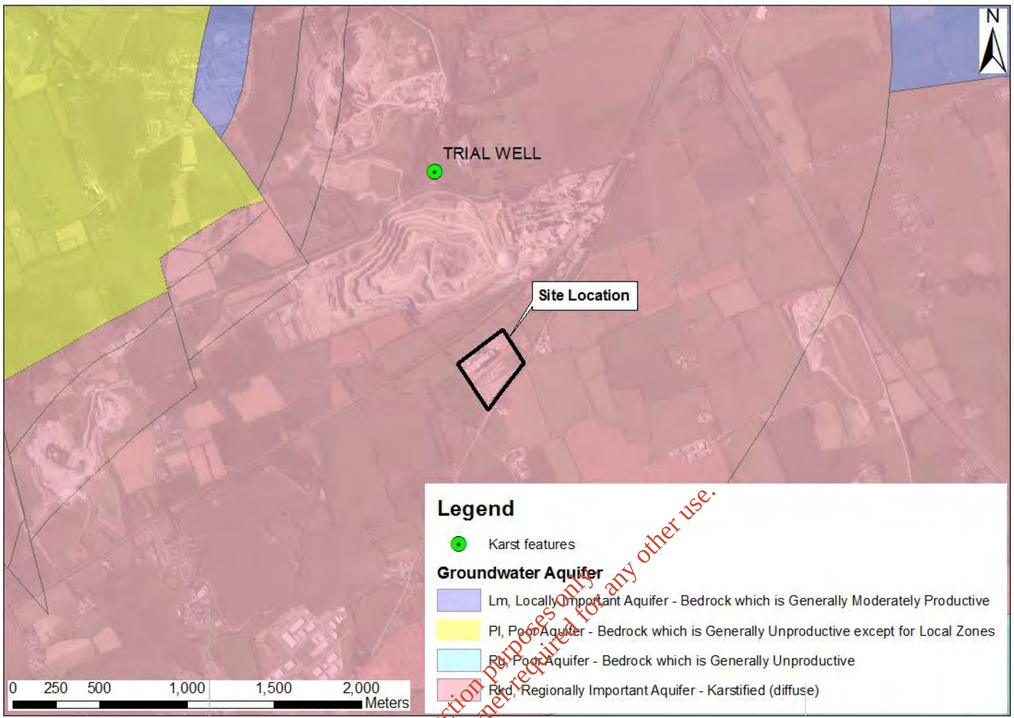

Figure 6.8 *Aquifer Classification & Karst Features (source www.gsi.ie)*

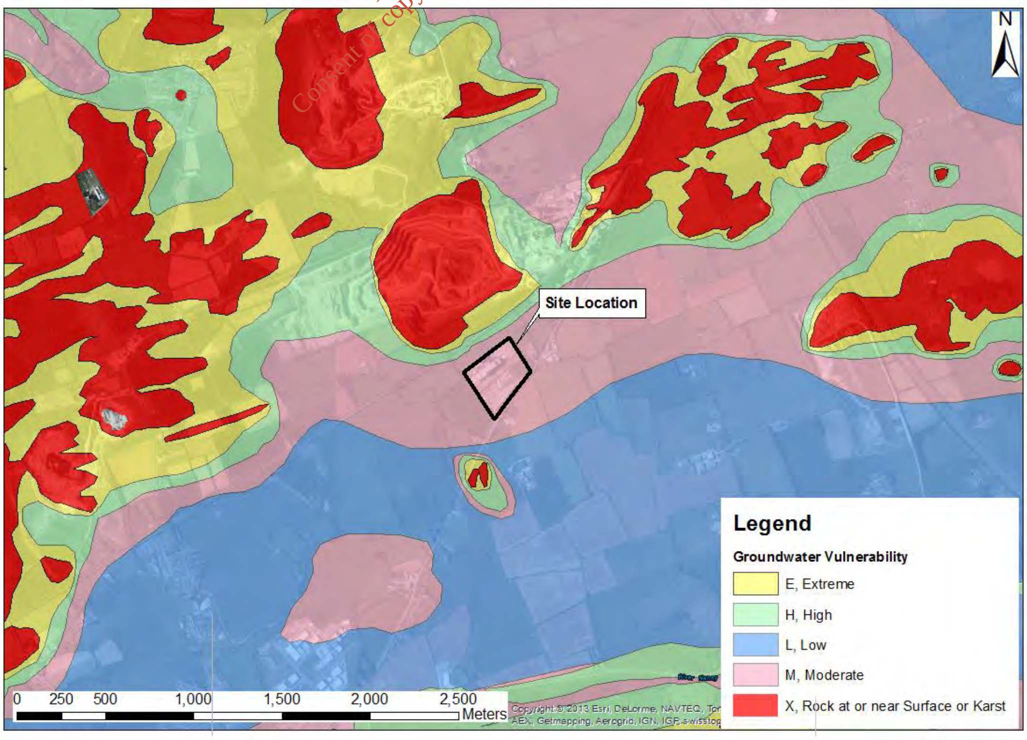

Figure 6.9 Groundwater Vulnerability *(source www.gsi.ie)*

There are two known public water supply wells located in the study area, located approx. 750m to the northeast (2927SEW036 - Moderate 54.5m^3/d) and approx. 2.5km to the southwest (2925NEW058 - Poor yield 3.3m^3/d). The available GSI depth to bedrock data in the study area indicates a depth to bedrock of 9.1-15.2mbgl. Site specific boreholes however indicate depths ranging from 5.0 – 8.25m to rock, which is only slightly shallower that the GSI records.

Review of groundwater contours for the Irish Cement (Platin) site which indicates a groundwater level of between 2-6mAOD (24-28mbgl) in the area of the Indaver site, it is noted that the groundwater level at Indaver is heavily influenced by abstraction wells located to the north of the site within the Irish Cement quarry.

Figure 6.9 below presents the GSI well data. *Note: As boreholes currently do not require licensing in Ireland, this data source may not be representative of a complete record.*

Figure 6.10 GSI Wells within Study Area

Table 6.2 below summarises the GSI well data including available descriptions.

GSI Name	Type	Depth of Borehole	Depth to Bedrock	Source	Yield Class	Yield m^3/d	Water Strike
2927SEW047	Borehole	61	0	Industrial Use	Excellent	3600	41m
2927SEW048	Borehole	30	N/A	Industrial Use	Excellent	3600	
2925NEW058	Dug Well	4.6	N/A	Public supply (Co Co)	Poor	3.3	
2927SEW001	Dug Well	6.1	N/A				
2927SEW037	Borehole	67	0	Industrial Use			33
2827SEW111	Borehole	42.7	0	Agri & domestic use	Excellent	1091	36.5
2927SEW003	Dug Well						
2927SEW110	Borehole	76.2	0	Agri & domestic use	Poor	21.8	
2925NEW070	Borehole	18.9			Moderate	49	
2927SEW035	Borehole						
2927SEW036	Borehole	42.7	9.1	Public supply (Co Co)	Moderate	54.5	
2927SEW038	Borehole	47.2	15.2	Industrial Use	Excellent	872.7	28
2927SEW039	Borehole	34.1	11.3	Industrial Use	Good	164	14.6
2927SEW041	Borehole	21.9			Poor	28	

Table 6.2 GSI Well Descriptions

GSI wells 2927SEW047 and 2927SEW048, as indicated in Table 6.2 above, refer to the current abstraction wells at the ICL Platin Quarry. These production wells are installed on the current quarry floor and are used to dewater the site hence the Excellent Yield Class given in the table.

Groundwater Flow

Regional groundwater flow would be expected to be in the direction of the River Nanny surface watercourse located to the south of the Indaver site. However, it is observed that the static water levels (SWLs) at the Indaver site are directly influenced by the on-going dewatering/ pumping activities at the adjacent quarry site to the north.

Groundwater flow contouring was undertaken by Irish Cement Limited in 2012 which confirms that the groundwater flow direction from the Indaver site is to the north/ north-east towards the production wells (and deepest monitoring well BH16) located within the Irish Cement quarry site. Figure 6.11 below presents the groundwater contouring plots from available SWL data for 2012.

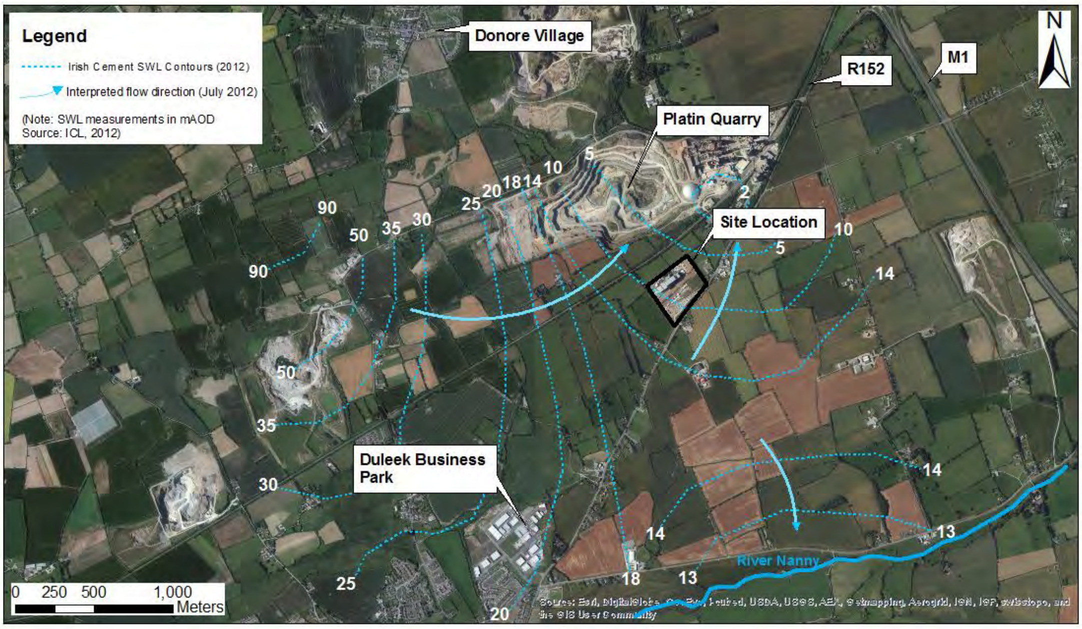

Figure 6.11 *Groundwater Flow in the vicinity of Indaver (2012)*

Figure 6.11 above also presents the flow towards the River Nanny to the south, and beyond the groundwater divide interpreted for the area at 14mAOD in 2012.

In terms of the site specific hydrogeology and bedrock groundwater, no groundwater strikes were recorded on the drilling logs for the 11 no. boreholes completed in 2009, to a maximum depth of 15mbgl (14.90mAOD equivalent). From monitoring of water levels in AGW1-1, AGW1-2 and AGW1-3 the potentiometric surface is presently at approximately 35-40mbgl.

Recent water level data for the bedrock monitoring wells is summarised in Table 6.3 below, and includes static water level elevation using an arbitrary site elevation reference of 30mAOD. This allows some correlation (note: over 1-2 years) to be drawn between the SWLs at Indaver and the groundwater elevation contours for 2012 depicted in Figure 7.4 above.

NOTE: Water level measurements are from depth from top of casing (mtoc) as no elevation is presently available for the monitoring boreholes.

Date	23/01/2014		28/03/2014		23/05/2014	
Well ID	**mbgl**	**mAOD**	**mbgl**	**mAOD**	**mbgl**	**mAOD**
AGW1-1	36.7	**6.7**	34.9	**4.9**	33.5	**3.5**
AGW1-2	33.4	**3.4**	32.8	**2.8**	31.7	**1.7**
AGW1-3	39.2	**9.2**	37.9	**7.9**	36.6	**6.6**

Note: mbgl= metres below ground level; mAOD = metres Above Ordnance Datum

Table 6.3 Groundwater Level Measurements

The local groundwater flow directions at the Indaver site for 2014 are generally consistent with the flow orientation depicted in Figure 6.11 in that the SWLs confirm a general NNE flow direction. Note: the water level readings for monitoring well AGW1-1 located to the south-east of the site boundary, is likely to be affected by the near-by on-site pumping well, which supplies the Indaver site with water (refer also Figure 6.5).

With regard to groundwater within the superficial deposits, a number of waterstrikes were noted during the trial pitting and borehole drilling undertaken at the site to date. Generally, seepages of groundwater in the overburden trial pits were encountered in small quantities only, and more specifically these related to granular (gravel/ sand) horizons. Notwithstanding this, past site investigation reports (Alpha, 2000) have indicated 'significant' seepages in shallow trial pits for example TP8 and TP13 (see also Appendix B). These seepages may therefore relate to the presence of both perched groundwater within the granular lenses in Boulder Clays as well as poorly connected pore-water within the clay itself.

6.4 Surrounding Land use

The Irish Cement factory and quarry is located to the north of the site with the immediate surrounding lands used for agricultural purposes (grazing).

6.5 Man-made Pathways

As identified in Stages 1-4 the main environmental hazards on site are the diesel and ammonium storage and delivery of same by tankers. This relates to the relatively large quantity stored compared to other chemicals on site and the hazard risk phrasing classification. If all mitigation failed, and diesel or ammonia escaped to the environment the consequence would be significant damage to surface water and groundwater bodies.

In the event of a possible containment breach the diesel and ammonia may be discharged to greenfield areas to the north of the site.

Figure 6.12 below shows the potential pathways for the contaminants on site which show both the potential overland and groundwater pathways for a potential leakage on site.

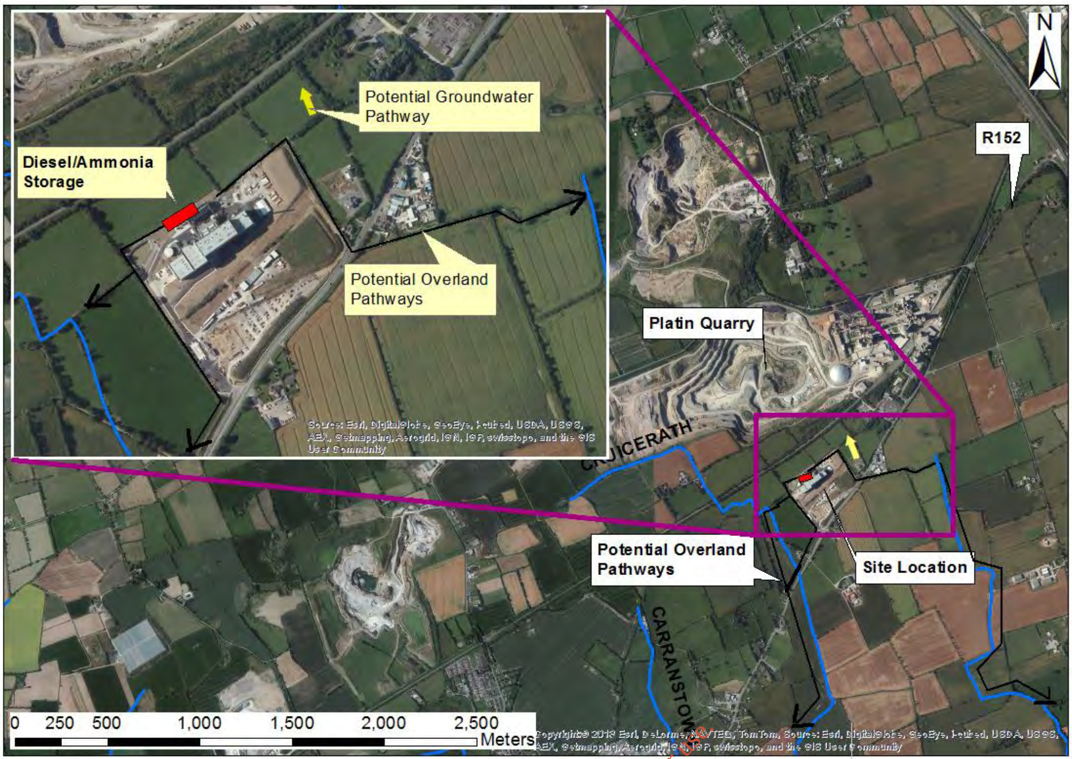

Figure 6.12 Potential Contamination Pathways

Figure 6.12 above indicates that the main pathway for any spillage which reaches the groundwater table is towards the extraction well located in the Irish Cement quarry which is used for dewatering purposes only. There is a local public supply (2927SEW036) well located further to the northwest as shown in figure which has a moderate extraction yield of 54.5m^3/d. Potential groundwater contamination is not expected to encounter this well due to the abstraction rate at Irish Cement. In the event that the abstraction well in Irish Cement is made redundant groundwater flow is expected to follow the natural topography towards the southeast.

Overland contaminate flow will be via drainage ditches located around the site which could potentially channel the flow to the streams, Cruicerath and the Platin which flows directly to the River Nanny.

7.0 STAGE 6 – CONCEPTUAL SITE MODEL

This section presents the Conceptual Site Model (CSM) for the site based on the information obtained above.

The pollutant linkages based on the primary sources of possible contaminants on site are summaries in Table 7.1. Note this CSM is presented on the basis that contamination following a leak/spill is not mitigated by the extensive mitigation measures operating at the site.

Source	Pathways	Receptor
Ammonia and/or Diesel Fuel Spill or leakage impacting lands outside containment area. Tanker leakage impacting area outside of site drainage area.	Vertical and lateral migration via fill and boulder clay to underlying limestone bedrock Lateral migration via groundwater within the bedrock aquifer Lateral migration via drainage system	Limestone Bedrock Aquifer Abstraction Wells at Platin Drainage ditch and Nanny tributaries.

Table 7.1 Pollutant Linkages

The CSM is presented as Figure 7.1 below.

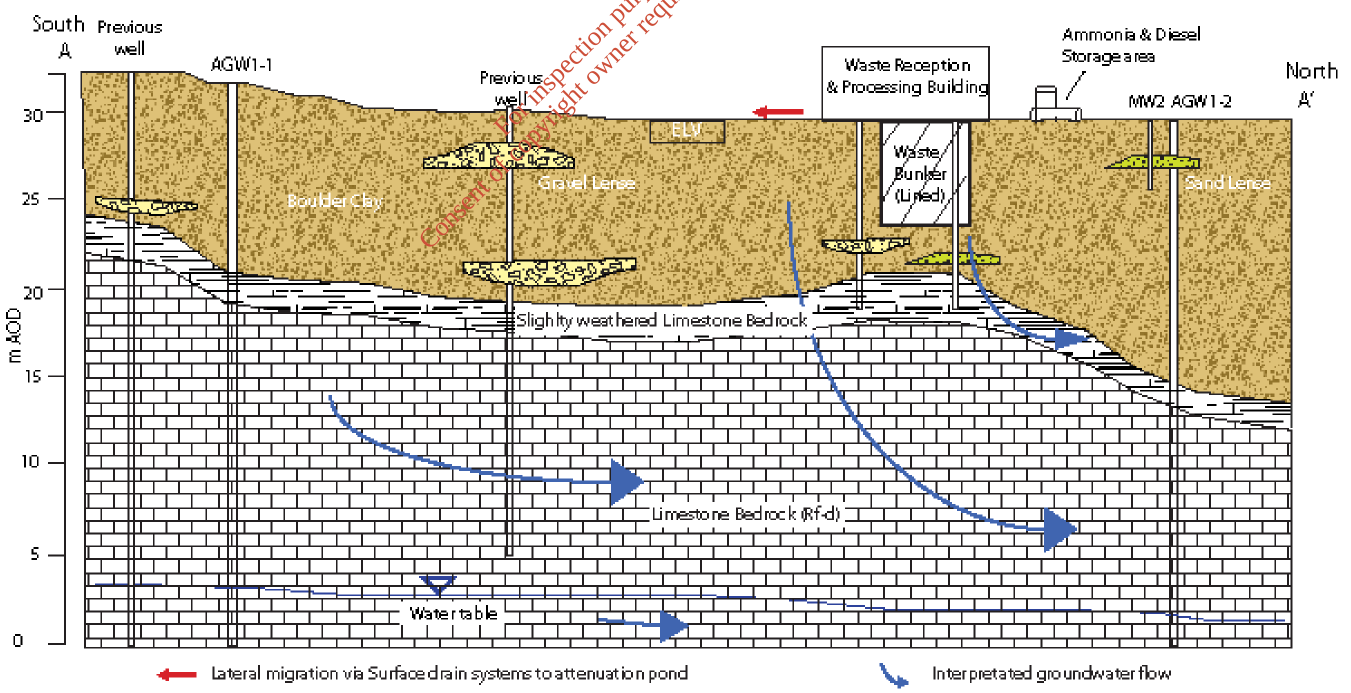

Figure 7.1 *Conceptual Site Model for Indaver (June 2014)*

8.0 STAGE 7 – ADDITIONAL SITE INVESTIGATION & BASELINE SOIL & WATER QUALITY ASSESSMENT

Additional site investigation and soil sampling was undertaken downgradient of the storage tanks to confirm the nature of the geology and soil quality in these areas. Baseline soil and groundwater quality is also presented.

8.1 Additional Site Investigation

Three shallow monitoring wells were drilled and installed to obtain additional soil quality data from down-gradient of potential source areas (i.e. storage tanks) and up-gradient of the site. Borehole logs are presented in Appendix B.

To add to our understanding of shallow permeability data for soils at the Indaver site, falling head tests at each of the newly installed monitoring wells was undertaken to estimate parameters of permeability of the soils.

The additional borings and tests confirm the low permeability nature of the clay which underlies the site. This natural material reduces the potential for vertical migration of contamination to the underlying bedrock aquifer.

8.2 Installation of Groundwater Monitoring Wells

The additional groundwater monitoring wells were drilled and installed on the 29-30th of May 2014. The well construction details are summarised in Table 8.1 below.

Well ID	Date drilled	Depth to bedrock (mbgl)	Depth of pipe (mbgl)	Standpipe diameter (mm)	Well depth (m)	Well diameter (mm)
MW1	29/05/2014	n/a	3.90	50	3.90	150
MW2	29/05/2014	n/a	3.00	50	4.40	150
MW4	30/05/2014	n/a	4.80	50	5.00	150

Note: mbgl = metres below ground level; mbtoc = metres below top of casing (50mm diameter)

Table 8.1 Monitoring Well Construction Details (May 2014)

Each monitoring well was constructed with the following specifications:

- 50mm diameter PVC liner installed from ground surface to base of borehole with machine-slotted sections as indicated on borehole logs;
- The annular space around the well is filled with gravel pack on top of which a bentonite seal (0.3-0.5m) is placed, to prevent vertical migration of any solute down the well.
- Well head construction consisted of steel flush covers secured by simple bolts.

The locations of the newly installed wells on site (and in relation to previous monitoring and the existing pumping well at the site) are highlighted on Figure 6.5 above. The borehole and well construction details for MW1 - MW4 are presented in Appendix B.

8.3 Soil Sampling

Soil samples were collected by AWN from soil cores during drilling of monitoring wells on the 29 to 30th May, 2014. The suite of soil quality parameters tested are listed below:

• Arsenic • Cadmium • Chromium • Copper • Nickel • Lead • Zinc • Mercury • Water Soluble Boron • Beryllium • Vanadium	• Selenium • Barium • Molybdenum • Fluoride • Ammoniacal Nitrogen as NH3 • TPH CWG Aliphatics C5-C35 • TPH CWG Aromatics C5-C35 • PCBs (12 congeners) • VOCs • SVOCs • Free Cyanide

Soil sampling depths are recorded on borehole logs presented in Appendix B.

A site investigation in 2000 for a geotechnical report for the green field site at the current Indaver site was undertaken by Alpha Engineering Services. The work resulted in the excavation of a total of 7 no. trial pits to allow representative soil sample collections for soil quality analysis. The trial pit locations are presented on Figure 6.5- Section 6.3.1. Soil samples were tested for the following parameters:

- Metals and Total Phenols
- Volatile Organic Compounds (VOCs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Polychlorinated Biphenyls (PCBs)
- Pesticides (OPPs, OCPs, ONPs)

The results of all soil quality tests are presented in Appendix C where they are compared with relevant guideline data.

The presence of any contamination present above the laboratory detection limits has been considered. In addition, soil samples were compared to a Generic Assessment Criteria (GAC) derived to be protective of human health and also ecology for a commercial/industrial end use.

Generic Assessment Criteria are soil concentrations that have been derived for a defined set of generic assumptions and are used as trigger values in determining whether further risk management action is required in cases where detailed quantitative risk assessment is not being undertaken. There are no published Generic Assessment Criteria for soils in the Republic of Ireland. Instead reliance is often placed on criteria from the UK and the Netherlands.

Generic Assessment Criteria in the UK has been derived using the Contaminated Land Exposure Assessment (CLEA) model to be protective of human health for a number of different land uses. To date, the UK's Environment Agency has released reports with Soil Guidance Values on a number of organic substances including BTEX and is intending to release further reports for PAHs. In the interim, LQM (Land Quality Management) and the CIEH (Chartered Institute of Environmental Health) developed a document in July 2009 detailing their own research and derivation of their own 'LQM GACs'. A total of 82 substances including many organic substances had LQM GACs derived, for the standard land uses of residential, commercial/industrial and allotments.

The Dutch Guideline values are derived based on a consideration of toxicity to human and ecological receptors. There are two values for each contaminant, an intervention value and a target value. The target value is the value one would expect in un-contaminated soil (from say an agricultural environment). The intervention value is set on the basis of a toxicological assessment of the impact of the contaminant on the health of human receptors and assumes that the human receptor is exposed to the contaminant through ingestion of soil and water, dermal contact with soil and water, eating vegetables grown on soil and inhalation of soil dust and vapour. According to the publication accompanying the Dutch Values, any value above the intervention value is regarded as indicating contamination, which may require further investigation and possible remediation. However, caution was used when applying the Dutch Values as they are not site end use specific and assess for vegetable growing, provision of drinking water and washing and showering in water from the site. Nevertheless, they are a useful screening tool for determining the significance of site contamination.

Neither the Dutch nor the UK values have any legal standing within the Republic of Ireland and no statutory guidance for assessing the significance of soil contamination currently exists. However, the values do provide a means of placing the data within context when considering magnitude of risk and have been used in that capacity for this assessment. The main basis of the assessment remains the conceptual site model and consideration of the pollutant linkages: Source - Pathway – Receptor

A comparison of the soil data against UK and Dutch derived guideline values and highlighting to indicate exceedence of a GAC was made.

The 2000 laboratory results were compared with Dutch Maximum Admissible Concentration thresholds at the time. The Volatile Organics, PAHs, PCBs and Pesticides did not exceed the threshold values for any of the samples. A number of heavy metals did slightly exceed their respective Dutch S-Value for normal uncontaminated soil. Table 8.2 below summaries the metals and those trial pits which showed exceedences of Dutch S levels

Parameter	**Trial pit**
Cadmium	TP-1
Copper	TP-1, TP-2, TP-7
Mercury	TP-1, TP-6
Nickel	TP-2, TP-3, TP-4, TP-5, TP-6, TP-7

Note: Data reference: EIS 2009 Chapter 9 Soils & Geology

Table 8.2 Trial Pits and Metals observed in 2000

The 2000 results concluded that there was no significant soil contamination at the Indaver site. While some traces of heavy metals were identified, these were likely to be attributed to agricultural activity of the area at that time.

The 2014 assessment of soil quality concluded that with the exception of a small number of heavy metals and fluoride, none of the parameters including hydrocarbons exceed the lab detection limit.

Heavy metals which exceed the Dutch S-values are; Cadmium and Copper in MW2 and Nickel in all three borings. The results are consistent with trial pit soil sampling results from 2000. The only exception relates to Mercury concentrations which in the current results are below the lab detection limits. None of the results exceeded the Dutch I levels/ Chromium was present in each of the borings and slightly exceeds the LQM GACs concentrations but not the Dutch I concentrations.

Fluoride soil concentrations exceeded the detection limit (1.9 mg/kg in MW1, 1.4 mg/kg in MW2 and 1.3 mg/kg in MW4). There are no soil guidelines for this parameter.

8.4 Permeability of Soils

Two fallen head tests were undertaken as part of the investigator at MW1 and MW2 under both dry and saturated soil condition.

The results are presented in Appendix B and permeability results are summarised in Table below

	K (m/s)	K/(m/d)
MW1 (dry)	3.96E-07	0.0342
MW1 (saturated)	3.49E-07	0.0302
MW2 (dry)	7.23E-07	0.0625
MW2 (saturated)	7.23E-07	0.0625

Table 8.3 Field Permeability Tests

The values are typical of Glacial till and silt (unconsolidated materials).

8.5 Baseline groundwater quality and trends

Groundwater sampling of monitoring boreholes AGW1-1, AGW1-2 and AGW1-3 are undertaken by Fitz Scientific on behalf of Indaver. Table 8.3 below summarises the groundwater quality parameters for bi-annual and monthly sampling rounds for the monitoring wells at Indaver.

Bi-annual parameters	Monthly parameters
• pH • Nitrate • Nitrate • Chloride • Cadmium • Thallium • Mercury • Lead • Chromium • Copper • Manganese • Nickel • Arsenic • Cobalt • Vanadium • Tin • Organo Halogens • Total Coliforms • Faecal Coliforms	• TOC • Electrical Conductivity at 20 Deg C • Ammonia

Table 8.4 Groundwater Monitoring Parameters (AGW1-1, AGW1-2 & AGW1-3)

The groundwater quality results commencing from November 2011 have been tabulated and are presented in Appendix C.

Results have been compared to Groundwater Quality Threshold Values of SI No 9 of 2010 and EPA Interim Guideline Values. Also presented are site specific warning and action trigger levels agreed with the Agency in July 2011. Trigger levels for a small number of parameters are listed in Table 8.4 below as agreed with the Agency in 2011.

-	Ammonia ug/L	Chloride mg/L	TOC
Warning Level	125ug/L as N	125mg/L as Cl	5mg/l
Action Level	175ug/L as N	187.5mg/L as Cl	10mg/l

Table 8.5 Trigger Warning & Action Levels as agreed with The Agency

In summary the results show that groundwater quality is ‘good’ to ‘moderate’.

Time series graphs are presented below for Chloride, TOC, and Ammonia. Some breaches of the warning trigger Chloride and Total Organic Carbon levels occurred, but did not exceed action levels. The once off exceeding Chloride level corresponds to the down gradient AGW1-2 borehole. The TOC exceeding levels correspond to both up and down gradient wells. Ammonia groundwater concentrations are well below trigger values in both up- and down-gradient monitoring wells. The Chloride concentrations indicate possible historical impact due to agricultural land use as the plant was only commissioned in August 2011.

No metals exceeded the groundwater regulation threshold value or in its absence the EPA interim guideline values for the monitoring data.

Volatile Organic Compounds (VOCs) have not exceeded detection limit (apart from one occasion where the results were later verified as anomalous).

Two soil leachate analysis from samples of MW1 and MW4 monitoring boreholes are presented in Appendix C. The results show that most parameters are below the laboratory detection limits including all heavy metals. Exceptions include Fluoride in MW1, which remains well below EPA interim values for groundwater, and Ammonical Nitrogen as NH_3 (0.08 mg/l in both MW1 and MW4) which also remain below trigger values for the Indaver site.

Trends for Cloride, TOC and Ammonia are presented in Figure 8.1, Figure 8.2 and Figure 8.3 below.

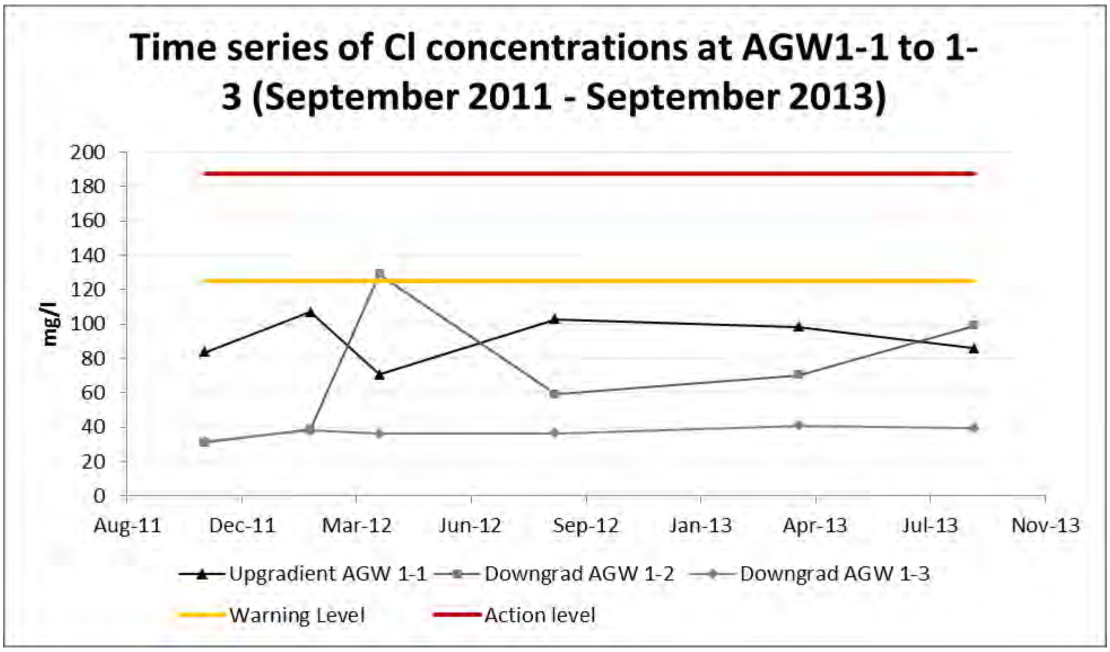

Figure 8.1 Time Series for Chloride (2011 – 2013)

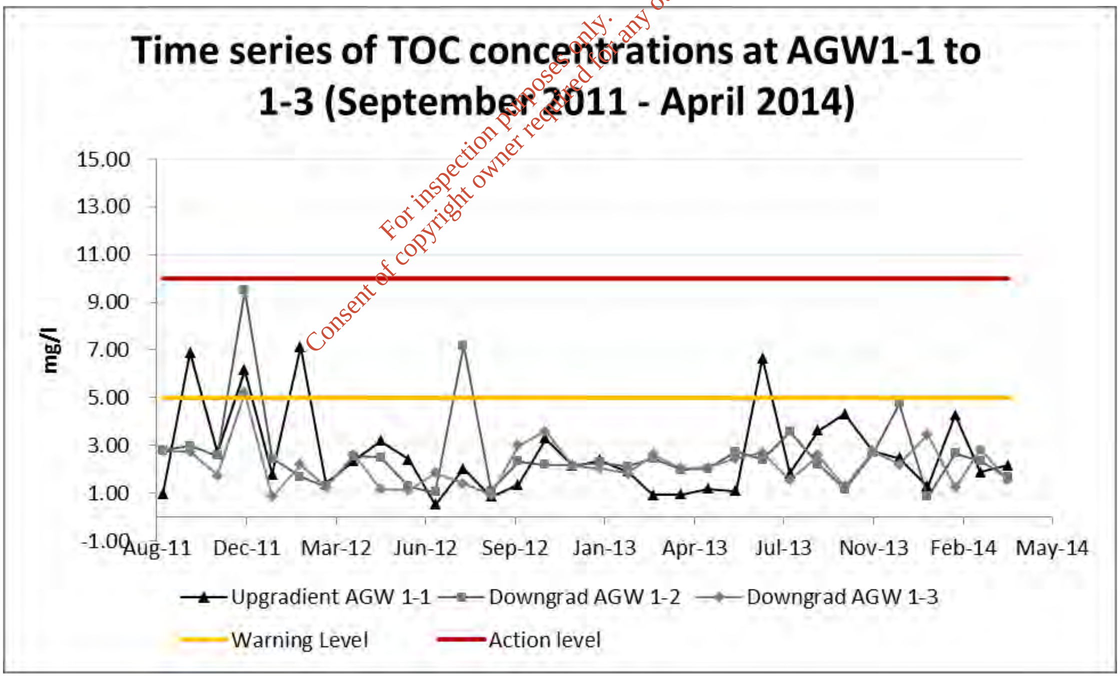

Figure 8.2 Time Series for TOC (2011 – 2014)

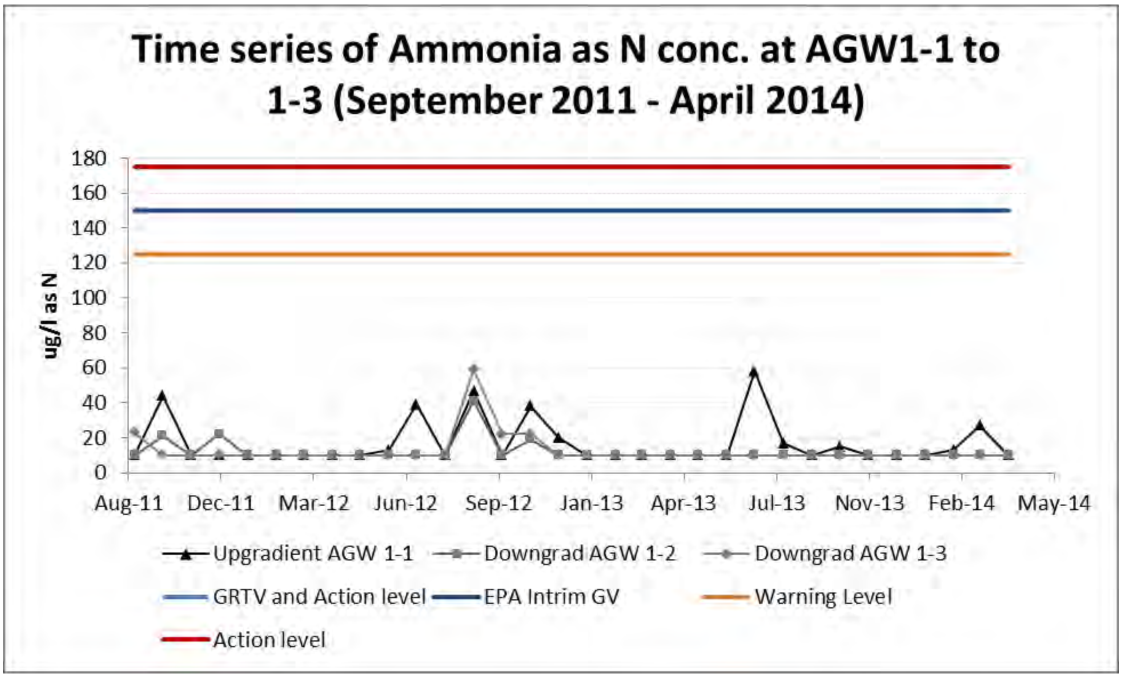

Figure 8.3 Time Series for Ammonia as N (2011 – 2014)

9.0 CONCLUSIONS

On the basis of the soil and groundwater investigations undertaken prior to construction of the Indaver facility and a further assessment of source-pathways and receptors undertaken during 2014, the following conclusions have been made:

- The site is underlain by c. 8 metres of generally low permeability glacial till which provides additional protection to the underlying regionally important karstified and fractured aquifer. Receptors include the aquifer, groundwater abstraction wells and drainage ditches which feed tributaries of the Nanny River. Dewatering for Platin Quarry has controls the local groundwater flow direction.

- A review of soil quality from the 2000 baseline assessment and additional data collated in 2014 confirm that there is no evidence of significant soil or groundwater contamination at the site. Compliance groundwater monitoring since the plant commenced operation in 2011 has also been reviewed and again there have been no exceedences that suggest soil or groundwater contamination has occurred due to the operation of the site. Chloride levels though not exceeding guidelines are elevated above typical background concentrations suggesting previous impact by the historical use of the site for agricultural grazing.

- Ammonium Hydroxide (NH_4OH) Solution , Diesel, Flue Gas residues and Boiler Ash were identified as hazards present at the site which have the potential to impact soil and groundwater if not adequately mitigated during storage and operation at the plant. However, the risk prevention measures present at the Indaver facility significantly reduce the potential for an enviromental impact to soil or water to occur. These measures include fire fighting systems, drainage and containment systems and spill procedures.

10.0 REFERENCES

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GSI, (2013). Geological Survey of Ireland; Available on-line at: http://www.gsi.ie [Accessed: 12-06-2014]

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APPENDICES

Appendix A Material Safety Data Sheets

APPENDICES

Appendix B Exploratory Hole Logs & Associated Site Plans

APPENDICES

Appendix C Laboratory Analytical Results (2000 to 2014)

Appendix A

Ammonium Hydroxide MSDS

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006
Version 5.5 Revision Date 12.05.2014
Print Date 16.06.2014

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Ammonium hydroxide solution
Product Number	:	320145
Brand	:	Sigma-Aldrich
REACH No.	:	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Ireland Ltd. Vale Road ARKLOW Wicklow . IRELAND
Telephone	:	+353 402-20300
Fax	:	+353 402-31147
E-mail address	:	EIRProductStewardship@sial.com

1.4 Emergency telephone number

Emergency Phone #	:	0044(0) 1 865407333 The UK National Chemical Emergency Centre (NCEC)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008
Skin corrosion (Category 1A), H314
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
Acute aquatic toxicity (Category 1), H400

For the full text of the H-Statements mentioned in this Section, see Section 16.

Classification according to EU Directives 67/548/EEC or 1999/45/EC

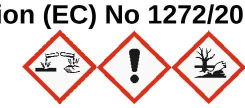
C	Corrosive	R34
N	Dangerous for the environment	R50

For the full text of the R-phrases mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram



Signal word Danger

Hazard statement(s)

H314	Causes severe skin burns and eye damage.
H335	May cause respiratory irritation.
H400	Very toxic to aquatic life.

Precautionary statement(s)

P261	Avoid breathing vapours.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/ physician.

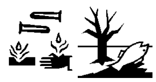
Supplemental Hazard Statements: none

According to European Directive 67/548/EEC as amended.

Hazard symbol(s)

C Corrosive

N Dangerous for the environment



R-phrase(s)

R34	Causes burns.
R50	Very toxic to aquatic organisms.

S-phrase(s)

S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36/37/39	Wear suitable protective clothing, gloves and eye/face protection.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S61	Avoid release to the environment. Refer to special instructions/ Safety data sheets.

2.3 Other hazards

Lachrymator.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Synonyms : Ammonia aqueous
Ammonia water

Formula : H_5NO

Molecular Weight : 35.05 g/mol

Hazardous ingredients according to Regulation (EC) No 1272/2008

Component		Classification	Concentration
Ammonium hydroxide			
CAS-No.	1336-21-6	Skin Corr. 1B; Aquatic Acute 1; H314, H400	50 - 100 %
EC-No.	215-647-6		
Index-No.	007-001-01-2		

Hazardous ingredients according to Directive 1999/45/EC

Component		Classification	Concentration
Ammonium hydroxide			
CAS-No.	1336-21-6	C, N, R34 - R50	50 - 100 %
EC-No.	215-647-6		
Index-No.	007-001-01-2		

For the full text of the H-Statements and R-Phrases mentioned in this Section, see Section 16

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
no data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
nitrogen oxides (NOx)

5.3 Advice for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information
no data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: 480 min
Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 240 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid, clear Colour: colourless
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	11.7 at 20 °C
e)	Melting point/freezing point	-60 °C
f)	Initial boiling point and boiling range	38 - 100 °C at 1,013 hPa
g)	Flash point	not applicable
h)	Evapouration rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 27 %(V) Lower explosion limit: 16 %(V)
k)	Vapour pressure	153 hPa at 20 °C
l)	Vapour density	1.21 - (Air = 1.0)
m)	Relative density	0.9 g/mL at 25 °C
n)	Water solubility	no data available
o)	Partition coefficient: n-octanol/water	no data available
p)	Auto-ignition temperature	no data available
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information

Relative vapour density 1.21 - (Air = 1.0)

SECTION 10: Stability and reactivity

10.1 Reactivity
no data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid
no data available

10.5 Incompatible materials
Copper, Iron, Zinc

10.6 Hazardous decomposition products
Other decomposition products - no data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - rat - 350 mg/kg (Ammonium hydroxide)
Remarks: Gastrointestinal:Other changes. Liver:Other changes. Kidney, Ureter, Bladder:Other changes.

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
Eyes - rabbit (Ammonium hydroxide)
Result: Severe eye irritation

Respiratory or skin sensitisation
no data available (Ammonium hydroxide)

Germ cell mutagenicity
no data available (Ammonium hydroxide)

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity
no data available (Ammonium hydroxide)

Specific target organ toxicity - single exposure
no data available (Ammonium hydroxide)

Specific target organ toxicity - repeated exposure
no data available

Aspiration hazard
no data available (Ammonium hydroxide)

Additional Information
RTECS: Not available

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. (Ammonium hydroxide)

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	mortality NOEC - Oncorhynchus tshawytscha - 3.5 mg/l - 3.0 d (Ammonium hydroxide)

Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 32 mg/l - 50 h (Ammonium hydroxide)

12.2 Persistence and degradability
no data available

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available (Ammonium hydroxide)

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
Very toxic to aquatic life.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 2672	IMDG: 2672	IATA: 2672

14.2 UN proper shipping name

ADR/RID:	AMMONIA SOLUTION
IMDG:	AMMONIA SOLUTION
IATA:	Ammonia solution

14.3 Transport hazard class(es)

ADR/RID: 8	IMDG: 8	IATA: 8

14.4 Packaging group

ADR/RID: III	IMDG: III	IATA: III

14.5 Environmental hazards

ADR/RID: yes	IMDG Marine pollutant: yes	IATA: no

14.6 Special precautions for user
no data available

SECTION 15: Regulatory information

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

no data available

15.2 Chemical Safety Assessment
For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity

H314	Causes severe skin burns and eye damage.
H335	May cause respiratory irritation.
H400	Very toxic to aquatic life.
Skin Corr.	Skin corrosion

Full text of R-phrases referred to under sections 2 and 3

C	Corrosive
N	Dangerous for the environment
R34	Causes burns.
R50	Very toxic to aquatic organisms.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Appendix A

Diesel MSDS

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006
Version 5.0 Revision Date 16.10.2013
Print Date 16.06.2014

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Diesel
Product Number	:	CRMMPGO
Brand	:	Fluka
Index-No.	:	649-224-00-6
REACH No.	:	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	:	68334-30-5

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Ireland Ltd. Vale Road ARKLOW Wicklow . IRELAND
Telephone	:	+353 402-20300
Fax	:	+353 402-31147
E-mail address	:	EIRProductStewardship@sial.com

1.4 Emergency telephone number

Emergency Phone # : 0044(0) 1 865407333 The UK National Chemical Emergency Centre (NCEC)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008
Flammable liquids (Category 3), H226
Acute toxicity, Inhalation (Category 4), H332
Skin irritation (Category 2), H315
Carcinogenicity (Category 2), H351
Specific target organ toxicity - repeated exposure (Category 2), H373
Aspiration hazard (Category 1), H304
Chronic aquatic toxicity (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

Classification according to EU Directives 67/548/EEC or 1999/45/EC

Xn, N	Harmful, Dangerous for the environment	R20, R38, R40, R65, R51/53

For the full text of the R-phrases mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram	
Signal word	Danger

Hazard statement(s)

H226	Flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H332	Harmful if inhaled.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure.
H411	Toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273	Avoid release to the environment.
P281	Use personal protective equipment as required.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P331	Do NOT induce vomiting.
Supplemental Hazard Statements	none

2.3 Other hazards - none

SECTION 3: Composition/information on ingredients

3.1 Substances

CAS-No. : 68334-30-5
EC-No. : 269-822-7
Index-No. : 649-224-00-6

Hazardous ingredients according to Regulation (EC) No 1272/2008

Component		Classification	Concentration
Diesel fuel			
CAS-No. EC-No. Index-No.	68334-30-5 269-822-7 649-224-00-6	Flam. Liq. 3; Acute Tox. 4; Skin Irrit. 2; Carc. 2; STOT RE 2; Asp. Tox. 1; Aquatic Chronic 2; H226, H304, H315, H332, H351, H373, H411	<= 100 %

Hazardous ingredients according to Directive 1999/45/EC

Component		Classification	Concentration
Diesel fuel			
CAS-No. EC-No. Index-No.	68334-30-5 269-822-7 649-224-00-6	Xn, N, Carc.Cat.3, R20 - R38 - R40 - R65 - R51/53	<= 100 %

For the full text of the H-Statements and R-Phrases mentioned in this Section, see Section 16

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
no data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides

5.3 Advice for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Keep away from sources of ignition - No smoking.Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end use(s)
A part from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Body Protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	no data available
f)	Initial boiling point and boiling range	141 - 462 °C at 1,013 hPa
g)	Flash point	>= 56 °C - closed cup57 °C
h)	Evapouration rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	no data available

k)	Vapour pressure	400 hPa at 40 °C
l)	Vapour density	no data available
m)	Relative density	0.8 - 0.91 g/cm3 at 15 °C
n)	Water solubility	no data available
o)	Partition coefficient: n-octanol/water	no data available
p)	Auto-ignition temperature	no data available
q)	Decomposition temperature	no data available
r)	Viscosity	>= 1.5 mm2/s at 40 °C -
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information
no data available

SECTION 10: Stability and reactivity

10.1 Reactivity
no data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - no data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - rat - 17,900 mg/kg
(OECD Test Guideline 401)

LC50 Inhalation - rat - 4 h - 5.6 mg/l
(OECD Test Guideline 403)

LD50 Dermal - rabbit - > 4,300 mg/kg
(OECD Test Guideline 402)

Skin corrosion/irritation
Skin - rabbit
Result: Irritating to skin. - 24 h
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - rabbit
Result: No eye irritation - 24 h
(OECD Test Guideline 405)

Respiratory or skin sensitisation
Maximisation Test - guinea pig
Result: Did not cause sensitisation on laboratory animals.
(OECD Test Guideline 406)

Germ cell mutagenicity
Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity
no data available

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
The substance or mixture is classified as specific target organ toxicant, repeated exposure, category 2.

Aspiration hazard
May be fatal if swallowed and enters airways.

Additional Information
RTECS: Not available

Cough, Difficulty in breathing, chest congestion, Shortness of breath, Fever, defatting, Dermatitis, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Oncorhynchus mykiss (rainbow trout) - 21 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to algae	Growth inhibition EC50 - Pseudokirchneriella subcapitata (green algae) - 10 mg/l - 72 h (OECD Test Guideline 201)

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 28 d Result: 57.5 % - According to the results of tests of biodegradability this product is not readily biodegradable. (OECD Test Guideline 301)

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
Toxic to aquatic life with long lasting effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 1202	IMDG: 1202	IATA: 1202

14.2 UN proper shipping name

ADR/RID:	DIESEL FUEL
IMDG:	DIESEL FUEL
IATA:	Diesel fuel

14.3 Transport hazard class(es)

ADR/RID: 3	IMDG: 3	IATA: 3

14.4 Packaging group

ADR/RID: III	IMDG: III	IATA: III

14.5 Environmental hazards

ADR/RID: no	IMDG Marine pollutant: no	IATA: no

14.6 Special precautions for user
no data available

SECTION 15: Regulatory information

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

no data available

15.2 Chemical Safety Assessment
For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Chronic	Chronic aquatic toxicity
Asp. Tox.	Aspiration hazard
Carc.	Carcinogenicity
Flam. Liq.	Flammable liquids
H226	Flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H332	Harmful if inhaled.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure.
H411	Toxic to aquatic life with long lasting effects.
Skin Irrit.	Skin irritation

Full text of R-phrases referred to under sections 2 and 3

N	Dangerous for the environment
Xn	Harmful
R20	Harmful by inhalation.
R38	Irritating to skin.
R40	Limited evidence of a carcinogenic effect.
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R65	Harmful: may cause lung damage if swallowed.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

APPENDICES

Appendix B Exploratory Hole Logs & Associated Site Plans

Appendix B

Borehole and Trial Pit Locations


N
MW2
MW5
MW3
AGW1-2
MW2
TP2
TP3
BH/RC6
BH5
GC6
MW1
GC4
AGW1-3
GC1
GC5
BH/RC2
GC3
RP3
TP6
RP4
RP1
GC2
MW3
MW6
RP5
TP5
RP2
BH/RC4
TP1
MW4
BH3
BH1
TP4
MW4
MW1
Pumping Well
TP7
AGW1-1
Legend
Monitoring Wells 2014
Geobore Cores 2009
Conventional Cores 2009
Trial Pits 2000
Monitoring Wells 2000
Boreholes 2007
AGWs 2011
100
50
0
100 Meters
AWN Consulting Ltd
The Tecpro Building,
Clonshaugh Business & Technology Park
Dublin 17,
Tel: + 353 1 847 4220
Fax: + 353 1 847 4257
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Appendix B

Alpha Engineering Report

(Trial Pit Logs)

GEOTECHNICAL REPORT

FOR

GREEN FIELD SITE

AT

PLATIN, Co. MEATH

FOR

PROJECT MANAGEMENT LTD.

Alpha Engineering Services
Consulting Engineers, Land Surveyors
March 2000
A228

REPORT ISSUE

Report Title: Draft Geotechnical Report For Green Field Site at Platin, Co. Meath for Project Management.

Issue No.	Date	Checked	Passed
1 (Draft)	February 2000	MAL	
2	March 2000	MAL	

Alpha Engineering Services
Consulting Engineers, Land Surveyors
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CONTENTS

1.0 INTRODUCTION

Alpha Engineering Services (AES) have been requested by Project Management Ltd. to carry out a site investigation at a green field site in Platin, Co. Meath. The total area investigated is approximately 45 acres, which is subdivided into 6 fields.

The site investigation was carried out on the 22nd January 2000 and consisted of excavating fifteen trial pits. This report details the findings of the site investigation along with making a number of geotechnical recommendations.

The trial pits were excavated on the 24th January 2000 using a 13 tonne excavator and were logged by a geotechnical engineer from Alpha Engineering Services.

2.0 SITE INVESTIGATION

2.1 Introduction

15 No. trial pits were excavated on the site at the locations indicated on Drawing No. A228-02. All ground stratas revealed in the trial pits were classified in accordance with BS 5930 "British Standard Code of Practice for Site Investigation". The trial pit logs are represented in Appendix A.

The site is bounded to the north by a railway embankment, to the west by a small side road and the south by the R152 road.

A gas pipe is located through the centre of the site. In order to avoid the pipe, trial pits were not excavated within 25m of the pipeline.

Topographical levels on the site were noted to vary from approximately 34 mOD in the north west corner of the site to 43 mOD in the south east corner of the site. Topographical low points of 32 mOD were noted in the centre and the south east corner of the site.

2.2 Site Stratigraphy

The trial pits were examined by a Geotechnical Engineer from AES. The stratigraphy varied across the site but generally consisted of topsoil overlaying brown boulder clay on a clayey gravel layer which was in turn underlain by a black boulder clay. Bedrock was noted to be carboniferous limestone. In both the gravel and clay layers large boulders up to 600mm in diameter were noted. A summary of the stratigraphy is presented in Table 1 below.

STRATUM	Depth (m bgl)
TOPSOIL	0 – 0.4
Soft to firm brown silty CLAY with cobbles.	0.4 – 1.0
Firm to hard brown silty CLAY with cobbles and large boulders (Brown boulder clay).	0.4 – 4.0
Medium dense to dense sandy GRAVEL approximately 1m in depth with local sand lenses.	0.4 – 5.0
Hard black silty CLAY cobbles and large boulders (Black boulder clay)	2.5 – 4.0

Table1 – Summary of Ground Stratigraphy Revealed by the Site Investigation

2.3 Brown Boulder Clay

In TP No.'s 1, 2, 5, 6, 7, 8, 9 & 12 a soft to firm brown silty clay was noted to a maximum depth of 0.9 m bgl, directly under the topsoil.

The brown boulder clays which underlay the upper soft to firm layer were noted as being firm to stiff silty gravelly low plasticity clays, with a high cobble and boulder content. The undrained shear strength of the clay was estimated to be in the order of 50kPa to 100kPa.

In TP 8 a soft clay layer was noted between 1.5mbgl and 2.6mbgl. The material was of low strength while significant side collapsing of the sides of the pit and ground water seepage were noted. In TP 14 adjacent to TP 8 a similar soft sandy clay was noted to extend from 2.4 to 4.4 mbgl however collapsing was not as significant and ground water ingress was not noted.

In TP 11 a soft clay with large boulder clay was noted to extend from 2.0 to 2.7 mbgl.

2.4 Gravel

Gravel layers were noted to underlay the brown boulder clay layer in all trial pits excluding TP No.'s 1, 2, 4, 10 & 11.

The gravels were generally noted as a competent medium dense to dense sandy clayey gravels with large boulders. Intermittent localised sand lenses typically in the order of 100 – 200mm were also noted. In TP 15 2m of loose sand was noted from 1.5m bgl.

The gravels were generally noted to be dry and stable with only moderate localised seepage occurring in some trial pits (TP 16). However, it is noted that trial pits were generally were not left over for a significant length of time, typically in the order of 15 – 25 minutes.

TP 13 was left open for five hours and significant ground water seepage was noted, localised failure of side slopes had occurred.

2.5 Black Boulder Clay

The black boulder clay stratum was noted in trial pits No.'s 1, 2, 5, 6, 8 & 15.

The black clay layer was noted to be a hard silty gravelly clay with cobbles and large boulders.

As with the brown clay it was described as a low plasticity clay while the undrained strength is estimated to be in the order of 75kPa to 150kPa.

2.6 Bedrock

Refusal was noted at shallow depth in trial pit No. 4 and No. 10 at 2.6 and 2.2m bgl respectively. From a visual inspection the refusal was attributed to the presence of limestone bedrock (rather than large boulders).

3.0 RECOMMENDATIONS

3.1 Excavation

Excavations of subsoils, to the depth investigated by the trial pits, will not require any extraordinary means. Use of conventional excavation plant will be sufficient. However, the presence of large boulders (diameter greater than 0.5m) could make excavation more difficult and slower than would be normally expected in such materials. Also, the preparation of formations may prove more difficult because of the presence of the boulders.

The trial pits were generally noted to be stable. However, when TP 5 was left open for five hours localised collapsing was noted. In TP No.'s 8 and 14 immediate collapsing was noted during excavation. It should be assumed, therefore, that excavations will require temporary support or the side slopes to be graded at a safe angle. Typical side slopes in the clayey subsoils encountered during the excavation would be 1.0 vertical to 1.5 horizontal for temporary slopes and 1.0 vertical to 2.0 horizontal for permanent slopes. Any gravel encountered should be graded tat 1.0 vertical to 2.0 horizontal in the temporary and permanent condition.

It is noted that the depth to bedrock is suspected to be shallow in a number of places across the site (TP 4 and TP 10). Therefore if deep excavations are required (for drainage pipes or localised lift pits etc.) it is recommended that the depth and integrity of the rock is proven by rotary coring.

3.2 Foundations

Given the variation in the upper layers of the brown clays noted in Section 2 the preferable foundation option is pad foundations bearing 1.5 onto the brown boulder clay stratum. It is noted that in some trial pits (TP 9 and TP 15), given the shallow depths of the gravel stratum, foundations will be required to founded on the same. The gravels typically are dense enough to provide adequate bearing capacity for shallow foundations. However, if the site layout means that building will be founded on both strata (gravels and clays), pads should be designed such as to prevent differential settlement occurring.

A net allowable bearing pressure for sizing foundations would be 200kPa based on a steel frame building while for concrete buildings a bearing of 150kPa should be used.

In TP 3 a localised soft spot was noted between 2.0 and 2.7m bgl. It is recommended, therefore, that some contingency is allowed for extending structural pads deeper than such soft spots using leanmix. Foundation formations should be inspected by suitably qualified engineers to detect such layers. It is also recommended that further investigation (Dynamic Loads or similar) are carried out to confirm that such soft spots do not exist in other areas of the site. The probes should also be carried out in the location of Trial Pit 15, to confirm the extent and density of the sand stratum noted, to confirm the above bearing pressure are acceptable in this stratum.

In the area of TP 8 and TP 14 given the presence of low quality clays and sand, a suitable formation level for foundations would be in the order of 4m bgl making pad foundations impracticable. Pile foundations would most likely be the most cost effective and technically suitable solution.

Typically, allowable working of various driven piles are provided below:

Pile size (mm x mm)	Design Load Capacity (kN)
350 sq.	1300
300 sq.	900
250 sq.	600

It is recommended more detail site investigation is carried out in the area to confirm the ground conditions.

The brown and black clay layers would be very susceptible to moisture and will degrade if over exposed to water. Therefore all excavations should be kept as dry as possible and all formations blinded immediately when excavated.

3.3 Slabs

All topsoil and subsoil layers should be removed in the areas of all slabs and carparks.

The upper soft to firm clay layer is most likely not competent enough to support ground bearing slabs and trafficed areas. CBR tests should be carried out to confirm the consistency of these upper clay layers and if a capping layer/geotextile can be employed to avoid removing these layers. A contingency should be allowed for the removal and backfilling of soft spots.

The underlying firm brown boulder clay will be more than competent to support ground bearing slabs and trafficed areas.

It is noted that the upper soft to firm clays would be susceptible to temporary construction traffic and therefore sufficiently deep haul roads should be employed to prevent the permanent formation to be disturbed.

3.4 Groundwater

Groundwater was generally encountered in small quantities. However in TP No. 8 significant seepage was noted. Therefore any excavations in this area will mostly require de-watering methods (pumps etc.) to control groundwater.

3.5 Earthworks

From a visual inspection of the gravels and clays on site, it is estimated that reuse of excavated subsoils as fill under flexibly finished trafficed areas would be acceptable if finished floor/carpark levels result in significant cut and fill volumes.

However given the cost implication of overestimating the strengths of subsoils for reuse, it is recommended that detail classification tests are carried out if this is anticipated.

The upper soft to firm clay would only be suitable for reuse in soft landscape areas.

APPENDIX A – TRIAL PIT LOGS

Alpha	**Alpha Engineering Services** Site Investigation Field Report	Job No:	A228
		Name	DW
Job Title:	Platin S I Client: P M	Date:	24.01.00

Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples Type	Depth	Ref	Ms %
	Topsoil/Subsoil			0.4				
	Soft Brown CLAY			0.9				
	Firm becoming very stiff brown silty CLAY with cobbles and large boulders			2.8				
	Very stiff to hard black CLAY with cobbles and boulders End of Trail Pit			3.8				

Remarks	Trial Pit Stable, Minor Seepage at	Trial Pit No.
Equiptment	1.1m bgl	
Personnel	15 Tonne Excavator	1

Alpha	**Alpha Engineering Services** Site Investigation Field Report	Job No:	A228
		Name	DW
Job Title:	Platin S I Client: P M	Date:	24.01.00

Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples Type	Samples Depth	Samples Ref	Samples Ms %
	Topsoil			0.5				
	Soft Brown CLAY			0.7				
	Firm brown silty CLAY with some cobbles			1.8				
	Stiff brown silty CLAY with some cobbles			2.3				
	Firm to stiff Brown Sandy SILT			4.0				
	Hard black silty CLAY with boulders			4.3				

		Trial Pit No.
Remarks	Pit Stable and No Seepage	
Equiptment		
Personnel		2

Alpha	Alpha Engineering Services Site Investigation Field Report	Job No:	A228
		Name	DW
Job Title:	Platin S I Client: P M	Date:	24.01.00

Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples Type	Samples Depth	Samples Ref	Samples Ms %
	Topsoil			0.3				
	Firm Brown silty CLAY with cobbles			1.0				
	Firm brown silty CLAY with lots of cobbles and boulders			1.6				
	Medium dense clayey GRAVEL with cobbles and boulders			3.0				
	Medium dense silty Sand			3.1				
	Dense clayey GRAVEL with cobbles and boulders							
	Medium dense brown clayey SAND							

Remarks	Pit Dry and Stable	Trial Pit No.
Equiptment	15 Tonne Excavotor	3
Personnel		

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Firm brown silty CLAY with cobbles and boulders			1.0				
Hard Digging	As above but becoming stiff with depth and site of boulders increasing			2.3				
	REFUSAL: PRESUMED BEDROCK							

Remarks	Pit Dry and Stable	Trial Pit No.
Equiptment		4
Personnel		

Alpha	Alpha Engineering Services Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Soft to firm brown CLAY			0.7				
	Firm brown CLAY with cobbles and boulders			0.9				
Hard Digging	Dense clayey GRAVEL with cobbles and large boulders			2.1				
	Very dense clayey GRAVEL with cobbles and large boulders			2.7				
	Very dense GRAVEL with cobbles and boulders			4.0				
	Hard Black Silty CLAY with cobbles and boulders			4.5				
Remarks	TP open for 6 hours, Pit dry with				Trial Pit No.			
Equiptment	Local Collapsing							
Personnel	15 Tonn Excavator				5			

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Soft to firm brown CLAY			0.7				
	Firm brown silty CLAY with cobbles and boulders			1.4				
	Medium Dense brown silty SAND			1.8				
	Stiff brown silty CLAY with cobbles and boulders			2.5				
	As above but "Very Stiff"			3.0				
Hard Digging	Hard black silty CLAY with cobbles and boulders			3.8				

Remarks	Trial Pit Stable, No Seepage	Trial Pit No. 6
Equiptment		
Personnel		

Alpha	**Alpha Engineering Services** Site Investigation Field Report	Job No:	A228
		Name	DW
Job Title:	Platin S I Client: P M	Date:	24.01.00

Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples Type	Samples Depth	Samples Ref	Samples Ms %
	Topsoil			0.4				
	Firm brown CLAY with cobbles			1.3				
	Sandy SILT			1.4				
	Stiff brown CLAY with cobbles and boulders			2.0				
	Clayey Sand Medium Dense			2.4				
Hard Digging	Dense clayey GRAVEL with cobbles and large boulders			3.9				
	Very dense clayey GRAVEL with cobbles and boulders			4.5				

Remarks	Trial Pit Dry and Stable	Trial Pit No.
Equiptment		7
Personnel		

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Soft to firm brown CLAY			0.7				
Pit Collapsing at this depth. A lot of Seepage	Soft brown silty CLAY with cobbles and boulders			2.6				
Moderate Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders			3.8				
Significant Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders - a lot of seepage			4.3				
	Hard black Silty CLAY							

Remarks	Pit Unstable - Collapsing	Trial Pit No. 8
Equiptment		
Personnel		

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Soft to firm brown CLAY			0.7				
Pit Collapsing at this depth. A lot of Seepage	Soft brown silty CLAY with cobbles and boulders			2.6				
Moderate Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders			3.8				
Significant Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders - a lot of seepage			4.3				
	Hard black Silty CLAY							

Remarks	Pit Unstable - Collapsing	Trial Pit No.
Equiptment		
Personnel		8

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Soft Brown CLAY			0.7				
	Sorf to firm brown CLAY with cobbles and boulders			1.4				
Hard Digging	Dense Slightly clayey GRAVEL with cobbles and boulders			2.8				
Hard Digging	Very dense slightly clayey GRAVEL with cobbles and boulders			3.1				
	Very Dense Clean GRAVEL with cobbles and boulders			3.7				
	END							

Remarks	Trial Pit Stable: Local	Trial Pit No.
Equiptment	Collapsing and Dry	
Personnel		9

Alpha	Alpha Engineering Services Site Investigation Field Report			Job No:	A288			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Firm brown CLAY with cobbles			0.8				
Hard Digging	Stiff brown CLAY with lots of boulders and cobbles			2.2				
	REFUSAL: Possibly bedrock							

Remarks	Pit Dry and Stable	Trial Pit No.	
Equiptment			
Personnel		10	

Alpha	**Alpha Engineering Services** Site Investigation Field Report	Job No:	A288
		Name	DW
Job Title:	Platin S I Client: P M	Date:	24.01.00

Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples Type	Samples Depth	Samples Ref	Samples Ms %
	Topsoil			0.3				
	Firm brown CLAY with cobbles and boulders			1.2				
	Hard brown boulder CLAY with cobbles			1.6				
	Loose to medium dense clayey SAND			2.0				
Pit Collapsing	Soft to firm brown CLAY with cobbles			2.7				
Hard Digging	Hard brown boulder CLAY with cobbles and boulders			3.5				

Remarks	Pit Dry	Trial Pit No.
Equiptment		11
Personnel		

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A288			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.4				
	Soft to firm brown CLAY with cobbles			0.8				
	Firm brown sandy CLAY with cobbles and boulders			1.6				
	Firm brown sandy CLAY with cobbles and boulders			2.1				
	Stiff brown silty CLAY with cobbles and boulders			2.7				
Hard Digging	Very dense clayey GRAVEL with cobbles and boulders			4.5				

Remarks	Trial Pit Dry and Stable	Trial Pit No.	
Equiptment			
Personnel		12	

Alpha	Alpha Engineering Services Site Investigation Field Report			Job No:	A288			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.4				
	Soft to firm CLAY			0.8				
	Firm brown CLAY with cobbles and boulders			1.8				
	Stiff brown CLAY with cobbles and boulders			2.6				
	Firm brown CLAY with cobbles and boulders			3.4				
	Dense clayey GRAVEL wth cobbles and boulders			4.4				
	Hard brown silty CLAY							

Remarks		Trial Pit No.	
Equiptment			
Personnel		13	

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A288			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.3				
	Soft to firm CLAY			0.7				
	Firm brown CLAY with cobbles and boulders			1.4				
	Stiff brown CLAY with cobbles and boulders			2.4				
Sides Collapsing	Soft sand CLAY with cobbles			4.4				
	Hard black boulder CLAY							

Remarks	Pit Collapsing - Minor Seepage	Trial Pit No.
Equiptment		
Personnel		14

Alpha	**Alpha Engineering Services** Site Investigation Field Report			Job No:	A288			
				Name	DW			
Job Title:	Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples			
					Type	Depth	Ref	Ms %
	Topsoil			0.45				
	Soft brown CLAY			0.70				
Sides Collapsing	Loose to medium dense grey SAND. No clay content			3.0				
	Medium dense GRAVEL with boulders and cobbles			4.0				
Hard Digging	Hard brown silty CLAY							

Remarks		Trial Pit No. 15
Equiptment		
Personnel		

Alpha	Alpha Engineering Services Site Investigation Field Report	Job No:	A288
		Name	DW
Job Title:	Platin S I Client: P M	Date:	24.01.00

Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples Type	Samples Depth	Samples Ref	Samples Ms %
	Topsoil			0.3				
	Soft to firm brown CLAY with cobbles			0.8				
	Firm brown CLAY with cobbles			1.2				
	Stiff brown CLAY with cobbles			1.4				
Hard Digging	Very stiff sandy gravelly CLAY with cobbles abd large boulders			2.6				
Hard Digging and Sides Collapsing	Dense clayey GRAVELS with cobbles and boulders			3.5				

Remarks	Sides Collapsing - Minor Seepage	Trial Pit No.	
Equiptment	at 24m bgl	16	
Personnel			

Appendix B

Trial Pits 2000

Trial Pit Records

Project No. : 2175	**Location :** Duleek, Co. Meath		**Date :** 28/4/00
Drilling Method : JCB		**Supervisor :** Amy Brennan	

TRIAL PIT NO.1

Geology :

0 - 0.25	Dark brown organic-rich TOPSOIL
0.25 - 0.9	Medium brown silty CLAY with occasional subrounded pebbles.
0.9 - 3.0	Fine grained, homogeneous, brown SAND.
3.0 - 3.2	Brown BOULDER CLAY with occasional large limestone boulders
3.2 - 3.3	Stiff, black BOULDER CLAY

Depth to Rock : >3.3m

Rock Type :

Water Entry : None

Static Water :

Total Depth : 3.3m

Comments : Composite soil samples taken; Dry deposits. No unusual colours o odours noted.

Trial Pit Records

Project No. : 2175 **Location :** Duleek, Co. Meath **Date :** 28/4/00

Drilling Method : JCB **Supervisor :** Amy Brennan

TRIAL PIT NO.2

Geology :

0 - 0.2	Brown organic-rich TOPSOIL
0.2 - 1.1	Medium brown silty CLAY with occasional subangular pebbles.
1.1 - 1.6	Medium brown, silty BOULDER CLAY with large limestone boulders
1.6 - 3.4	Extremely coarse, clayey GRAVEL deposits (boulders up to 40 - 45cm), with water.

Depth to Rock : >3.4m

Rock Type :

Water Entry : 3.2m

Static Water : 3.2

Total Depth : 3.4m

Comments : Water seen to be flowing in through the gravels. Composite soil sample taken. No unusual colours or odours noted.

Trial Pit Records

Project No. : 2175 **Location :** Duleek, Co. Meath **Date :** 28/4/00

Drilling Method : JCB **Supervisor :** Amy Brennan

TRIAL PIT NO.3

Geology :

0 - 0.15	Dark brown organic-rich TOPSOIL
0.15 - 1.9	Dark brown, moderately well-sorted , dry, clayey, sandy GRAVEL.
1.9 - 3.4	Lighter brown, clayey SAND with occasional pebbles up to 3-4cm in size.

Depth to Rock : >3.4m

Rock Type :

Water Entry : Seepage into the excavation from approx. 1.9m

Static Water :

Total Depth : 3.4m

Comments : Water was seen to be seeping in through the clayey SAND layer. Composite soil sample was taken. No unusual colours or odours.

-

Trial Pit Records

Project No. : 2175 **Location :** Duleek, Co. Meath **Date :** 28/4/00

Drilling Method : JCB **Supervisor :** Amy Brennan

TRIAL PIT NO.4

Geology :

0 - 0.15	Brown organic-rich TOPSOIL
0.15 - 0.4	Medium brown subsoil.
0.4 - 1.25	Loose, light brown, silty, sandy, CLAY with occasional rounded pebbles.
1.25 - 3.45	Poorly sorted, subrounded, brown, clayey, sandy, GRAVEL with some black colouration due to presence od shaley fragments.

Depth to Rock : >3.45m

Rock Type :

Water Entry : Gravels moist- Very small amount of seepage.

Static Water :

Total Depth : 3.45m

Comments : Gravel layer collapsing into the hole. No unusual colours or odours noted. Composite soil samples taken.

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Hydrogeological & Environmental Consultants

Trial Pit Records

Project No. : 2175 **Location :** Duleek, Co. Meath **Date :** 28/4/00

Drilling Method : JCB **Supervisor :** Amy Brennan

TRIAL PIT NO.5

Geology :

0 - 0..12	Medium brown organic-rich TOPSOIL
0.12 - 1.3	Loose, light brown, sandy CLAY.
1.3 - 2.7	Loose, fine grained, homogeneous brown SAND.
2.7 - 3.4	Quite stiff, light brown BOULDER CLAY

Depth to Rock : >3.4m

Rock Type :

Water Entry : Water seeping into the hole at approx 2.7m through the bottom of the sands.

Static Water : Not available. Hole filled up with sand.

Total Depth : 3.4m

Comments : Walls of the excavation very unstable and sand collapsing into the hole. No unusual colours or odours noted. Composite soil samples taken.

Trial Pit Records

Project No. : 2175	**Location :** Duleek, Co. Meath	**Date :** 28/4/00
Drilling Method : JCB	**Supervisor :** Amy Brennan	

TRIAL PIT NO.6

Geology :

0 - 0.15 Dark brown organic-rich TOPSOIL

0.15 - 0.6 Medium brown silty CLAY with only occasional subrounded pebbles.

0.6 - 1.85 Grey brown, loose, silty CLAY with boulders up to 25cm in size.

1.85 - 3.15 Moderately well sorted, clayey GRAVEL, with occasional large boulders (up to 30cm).

Depth to Rock : >3.15m

Rock Type :

Water Entry : Spring seen to be flowing into the excavation at approx 1.85m

Static Water : 3.0m and rising

Total Depth : 3.15m

Comments : Spring flowing in from the northern side of the excavation, quite quickly. No unusual colours or odours. Composite soil sample taken.

Trial Pit Records

Project No. : 2175	**Location :** Duleek, Co. Meath	**Date :** 28/4/00
Drilling Method : JCB	**Supervisor :** Amy Brennan	

TRIAL PIT NO.7

Geology :

0 - 0.3	Dark brown organic-rich TOPSOIL & subsoil
0.3 - 0.95	Dark brown, clayey, sandy, SILT with occasional pebbles
0.95 - 3.1	Moderatley well-sorted, dark brown, sandy, clayey, GRAVEL
3.1 - 3.3	Tight, dark brown BOULDER CLAY .

Depth to Rock : >3.3m

Rock Type :

Water Entry : None

Static Water :

Total Depth : 3.3m

Comments : Composite soil samples taken; Dry deposits. No unusual colours or odours noted.

K.T.Cullen & Co. Ltd.
Hydrogeological & Environmental Consultants

Appendix B

Monitoring Wells 2000

(Borehole Logs)

WELL LOG

Well No.	Description	Client
MW1	Overburden well	Project Management
	Location	**Driller**
	Carranstown, Duleek	Tom Briody & Son

Date Drilled: 2/5/00

Water Level (mbtoc):

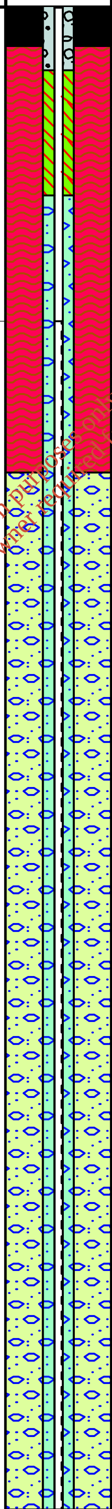
All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
60.0	50.0

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev. [m]
0–0.31		BACKFILL (to 0.5)			Dark brown, organic rich, TOPSOIL (to 0.31)	
0.5–1.5		Bentonite seal (0.5–1.5)				
2					Brown, gravelly CLAY (0.31–3.7)	-2
2.5				2.5		
3.7					3.7	
6	200		50			-6
7		Gravel Pack				-7
8					Dry, Dark brown, well-sorted, clayey GRAVEL (3.7–11.95)	-8
11.95	11.95	11.95	11.95	11.95	11.95	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Elev. scale: -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12



WELL LOG

Well No.	Description	Client
MW2	Overburden well	Project Management
	Location	**Driller**
	Carranstown, Duleek	Tom Briody & Son

Date Drilled
3/5/00

Water Level (mbtoc)

All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
60.0	50.0

Depth [m]	Hole	Annulus	Casing	Screen	Lithology
0–0.4	150	BACKFILL (0.4)	50		Brown organic-rich TOPSOIL (0.4)
0.4–1.4		Bentonite seal (1.4)			
0.4–4.9					Moist, brown, sticky CLAY with occasional pebbles (4.9)
2.4				2.4	
4.9–5.5					Wet, brown, loose gravelly CLAY (5.5)
5.5–6.7					Wet, grey, gravelly CLAY (6.7)
6.7–7.3					Browner CLAY with INFLOW at 7.3m (7.3)
1.4–12.4		Gravel Pack (12.4)			
7.3–12.4					Wet, brown, sticky CLAY with pebbles (12.4)
12.4	12.4	12.4	12.4	12.4	12.4

Depth [m]: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Elev. [m]: -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12

WELL LOG

Well No.	Description	Client
MW3	Overburden well	Project Management
	Location	**Driller**
	Carranstown, Duleek.	Tom Briody & Son

Date Drilled: 3/5/00

Water Level (mbtoc):

All diameters in mm
All depths in metres

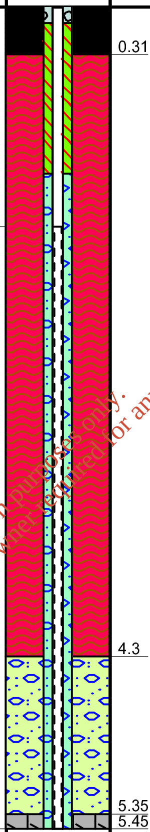
Scale

Vertical	Horizontal
50.0	40.0

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev. [m]
0 – 0.31		Bentonite seal			Dark brown organic rich TOPSOIL	
0.31						
1.1		1.1				
1.45				1.45		
0.31 – 4.3	150	Gravel Pack	50		Medium brown gravelly CLAY ; subangular pebbles	
4.3 – 5.35					Medium well sorted, silty sandy GRAVEL (up to 3cm)	
5.35						
5.45	5.45	5.45	5.45	5.45		

Depth scale: 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10

Elev. scale: -0.5, -1, -1.5, -2, -2.5, -3, -3.5, -4, -4.5, -5, -5.5, -6, -6.5, -7, -7.5, -8, -8.5, -9, -9.5, -10



WELL LOG

Well No.	Description	Client
MW4	Bedrock monitoring Well	Project Management
	Location	**Driller**
	Carranstown, Duleek	Tom Briody & Son

Date Drilled: 5/4/00

Water Level (mbtoc):

All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
150.0	100.0

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev. [m]
0–1	200	Bentonite seal (to 1)	50			
1–21	200 (to 21)	BACKFILL (1–22)	50		0–5.5: Loose, light to medium brown CLAY; some pebbles	
					5.5–9.1: Fine, dark brown clayey GRAVEL	
					9.1–14.6: Loose, dark brown, sandy SILT with pebbles	
					14.6–18.3: Well-sorted, subangular GRAVEL	
					18.3–18.9: Sticky, medium brown CLAY	
					18.9–21: Light grey brown limestone GRAVEL	
21–30.1	150 (to 30.1)	Bentonite seal (22–23)	50 (to 30.1)	23.1–30.1	21–29: Dry, soft brown weathered LIMESTONE	
		Gravel Pack (23–30.1)			29–30.1: Wet, sticky brown CLAY (Possible fracture infilling)	

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30
Elev. scale: -2, -4, -6, -8, -10, -12, -14, -16, -18, -20, -22, -24, -26, -28, -30

WELL LOG

Well No.	Description	Client
TW1	Trial Well	Project Management
	Location	**Driller**
	Carranstown, Duleek	Tom Briody & Son

Date Drilled: 26/4/00

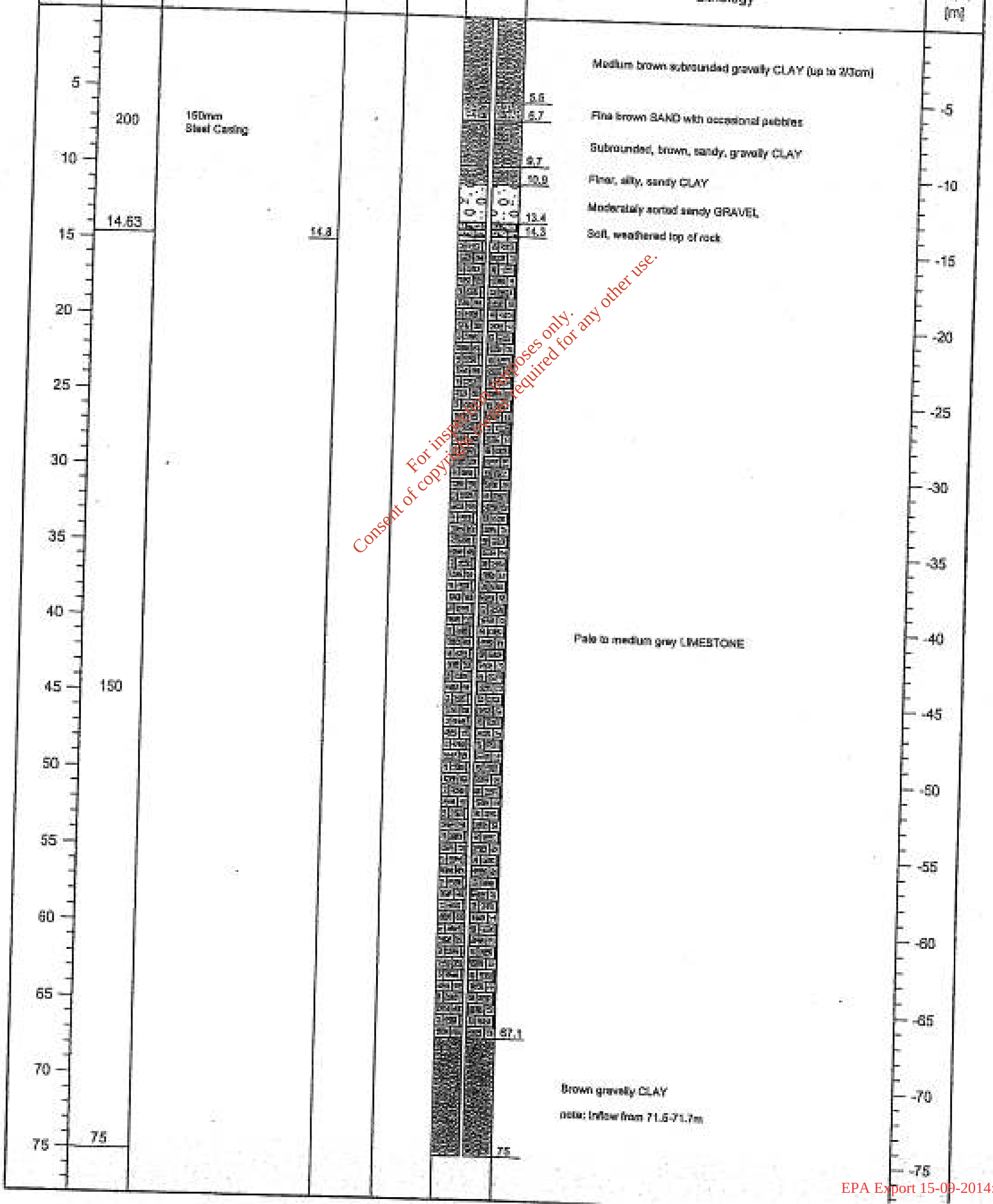
Water Level (mbtoc):

All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
375.0	250.0

Depth [m]	Hole	Annulus	Casing	Screen		Lithology	Elev. [m]
0 – 5.6	200	150mm Steel Casing				Medium brown subrounded gravelly CLAY (up to 2/3cm)	
5.6 – 6.7						Fine brown SAND with occasional pebbles	
6.7 – 9.7						Subrounded, brown, sandy, gravelly CLAY	
9.7 – 10.9						Finer, silty, sandy CLAY	
10.9 – 13.4						Moderately sorted sandy GRAVEL	
13.4 – 14.3	14.63	14.8				Soft, weathered top of rock	
14.3 – 67.1	150					Pale to medium grey LIMESTONE	
67.1 – 75	75					Brown gravelly CLAY note: Inflow from 71.6-71.7m	



Appendix B

Byrne Looby Report 2007

(Borehole and Trial Pit Logs)

Rev	Date	Revision	by	chkd
B	27.02		JP	ML
A	11.10.		KF	ML

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CONSULTING SERVICES IN GEOTECHNICAL ENGINEERING

CLIENT
Mc ELROY ASSOCIATES

PROJECT
INDAVER

DRAWING TITLE
SITE INVESTIGATION LAYOUT

STATUS
FOR CONSTRUCTION

drawn by: KF | date: 24.08.06 | scale: 1:500 | chk: ML
project no B580 | drg.no. 01 | rev. C

Project Name: Carranstown

Hole ID: BH 1

Client:

Consultant: BLP

Location: Co. Meath

Start date: 07/03/2007 End date: 08/03/2007

Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 0.00 0.00

Elevation: 0.000

Project no. 1440-02-07

Drilled by: K.Kolesniak

Logged by: F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
Stiff grey - brown slightly sandy gravelly CLAY/SILT				SPT-C B	0.50 0.50	N=15		
Stiff grey - brown slightly sandy gravelly CLAY with some cobbles		1.00	-1.00	SPT-C B	1.50 1.50	N=17		
				SPT-C B	2.50 2.50	N=18		
				SPT-C B	3.50 3.50	N=21		
OBSTRUCTION - Presumed rock		4.00 4.10	-4.00 -4.10					
End of Borehole at 4.10 m								

Remarks:

Chiselling 4.00-4.10 45mins

KEY

B Bulk disturbed sample.

D Small disturbed sample

U Undisturbed sample

SPT-S Standard Penetration Test, split spoon.

SPT-C Standard Penetration Test, solid cone.

Groundwater strike

Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND

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Project Name: Carranstown

Hole ID: BH 2

Client:		Co-ordinates:	0.00
			0.00
Consultant: BLP		Elevation:	0.000
Location: Co. Meath		Project no.	1440-02-07
Start date: 13/03/2007	End date: 13/03/2007	Drilled by:	K.Kolesniak
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
Stiff grey - brown slightly sandy gravelly CLAY/SILT with occasional cobbles				SPT-C B	0.50 0.50	N=16		
				SPT-C B	1.50 1.50	N=16		
				SPT-C B	2.50 2.50	N=19		
				SPT-C B	3.50 3.50	N=19		
End of Borehole at 4.50 m		4.50	-4.50					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

Remarks:
No groundwater encountered

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
	Groundwater strike
	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Carranstown

Hole ID: BH 3

Client:
Consultant: BLP
Location: Co. Meath
Start date: 08/03/2007 End date: 09/03/2007
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 0.00 / 0.00
Elevation: 0.000
Project no. 1440-02-07
Drilled by: K.Kolesniak
Logged by: F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
Soft CLAY TOPSOIL		0.50	-0.50	SPT-C B	0.50 0.50	N=14		
Stiff grey - brown slightly sandy gravelly CLAY/SILT				SPT-C B	1.50 1.50	N=17		
				SPT-C B	2.50 2.50	N=18		
		3.00	-3.00					
Stiff grey - brown slightly sandy gravelly CLAY/SILT with angular cobbles				SPT-C B	3.50 3.50	N=20		
		4.40	-4.40					
OBSTRUCTION- Presumed rock		4.50	-4.50	SPT-C	4.50	50/5mm		

End of Borehole at 4.50 m

Remarks:
No groundwater encountered
Chiselling 4.40-4.50 45mins,
standpipe installed to 4.50mBGL with pea gravel surround, bentonite seal and cover.

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample
SPT-S Standard Penetration Test, split spoon.
SPT-C Standard Penetration Test, solid cone.
▽ Groundwater strike
▼ Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Carranstown

Hole ID: BH 4

Client:	
Consultant:	BLP
Location:	Co. Meath
Start date:	06/03/2007
End date:	06/03/2007
Type of drilling:	CP
Hole diameter:	200 mm
Co-ordinates:	0.00 / 0.00
Elevation:	0.000
Project no.	1440-02-07
Drilled by:	K.Kolesniak
Logged by:	F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
Stiff grey-brown slightly sandy gravelly CLAY				SPT-C B	0.50 0.50	N=21		
				SPT-C B	1.50 1.50	N=17		
Stiff grey-brown sandy slightly gravelly CLAY/SILT		2.00	-2.00	SPT-C B	2.50 2.50	N=18		
OBSTRUCTION - possible rock		3.00	-3.00					
End of Borehole at 3.10 m		3.10	-3.10					

Remarks:
No groundwater encountered
Chiselling 3.00-3.10 45mins,
move and set up on BH 4A

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
	Groundwater strike
	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Carranstown

Hole ID: BH 4A

Client:		Co-ordinates:	0.00
			0.00
Consultant: BLP		Elevation:	0.000
Location: Co. Meath		Project no.	1440-02-07
Start date: 06/03/2007	End date: 07/03/2007	Drilled by:	K.Kolesniak
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
Stiff grey - brown slightly sandy gravelly CLAY with occasional cobbles				SPT-C B	0.50 0.50	N=23		
				SPT-C B	1.50 1.50	N=18		
				SPT-C B	2.50 2.50	N=19		
				SPT-C B	3.50 3.50	N=21		
		4.40	-4.40					
OBSTRUCTION - presumed rock		4.50	-4.50					
End of Borehole at 4.50 m								

Depth scale: 1 2 3 4 5 6 7 8 9

Remarks:
Chiselling 4.40-4.50 45mins,
Standpipe installed to 4.50mBGL with pea gravel surround, bentonite seal and cover

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Carranstown

Hole ID: BH 5

Client:		Co-ordinates:	0.00 0.00
Consultant: BLP		Elevation:	0.000
Location: Co. Meath		Project no.	1440-02-07
Start date: 02/03/2007	End date: 05/03/2007	Drilled by:	K.Kolesniak
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
Firm grey-brown slightly sandy gravelly CLAY/SILT with occasional cobbles				SPT-C B	0.50 0.50	N=12		
		1.50	-1.50	SPT-C B	1.50 1.50	N=17		
Stiff grey- brown slightly sandy gravelly CLAY with some cobbles				SPT-C B	2.50 2.50	N=19		
				SPT-C B	3.50 3.50	N=18		
				SPT-C	4.50 4.50	N=20		
End of Borehole at 5.00 m		5.00	-5.00					

Remarks:
Chiselling 5.00-5.10 1hr,
No groundwater encountered

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
	Groundwater strike
	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Carranstown

Hole ID: BH 6

Client:
Consultant: BLP
Location: Co. Meath
Start date: 01/03/2007 End date: 01/03/2007
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 0.00 0.00
Elevation: 0.000
Project no. 1440-02-07
Drilled by: K.Kolesniak
Logged by: F.McNamara

Strata Description	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
Soft gravelly TOPSOIL	0.50	-0.50	SPT-C B	0.50 0.50	N=12		
Firm to stiff grey -brown slightly sandy gravelly CLAY/SILT	1.50	-1.50	SPT-C B	1.50 1.50	N=14		
Stiff grey-brown slightly sandy gravelly CLAY with occasional cobbles			SPT-C B	2.50 2.50	N=18		
			SPT-C B	3.50 3.50	N=18		
			SPT-C	4.50 4.50	N=17		
	5.40	-5.40					
OBSTRUCTION -presumed rock	5.50	-5.50	SPT-C	5.50	50/6mm		

End of Borehole at 5.50 m

Remarks:
Chiselling 5.40-5.50 1hr,
No groundwater encountered
Stabdpipe installed to 5.50mBGL with pea gravel surround, bentonite seal and cover

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
	Groundwater strike
	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
www.gii.ie

Project Name: Carranstown

Hole ID: BH 7

Client:	
Consultant: BLP	
Location: Co. Meath	
Start date: 09/03/2007	End date: 12/03/2007
Type of drilling: CP	Hole diameter: 200 mm

Co-ordinates:	0.00
	0.00
Elevation:	0.000
Project no.	1440-02-07
Drilled by:	K.Kolesniak
Logged by:	F.McNamara

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
Soft clay TOPSOIL		0.50	-0.50	SPT-C B	0.50 0.50	N=14		
Stiff grey-brown slightly sandy gravelly CLAY/SILT with occasional cobbles				SPT-C B	1.50 1.50	N=16		
				SPT-C B	2.50 2.50	N=19		
				SPT-C B	3.50 3.50	N=19		
		4.40	-4.40					
OBSTRUCTION - presumed rock		4.50	-4.50					
End of Borehole at 4.50 m								

Depth scale: 1 2 3 4 5 6 7 8 9

Remarks:
Chiselling 4.40-4.50 1hr,
No groundwater encountered

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
	Groundwater strike
	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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CARRANSTOWN

RC 2	0.0 – 10.2	Boulder Clay
	10.2 – 14.2	Strong grey LIMESTONE rock
RC 4	0.0 - 5.1	Boulder Clay
	5.1 - 7.6	Gravel with cobbles and boulders
	7.6 – 12.6	Strong grey LIMESTONE with fractured zones
RC 6	0.0 - 12.2	Boulder Clay
	12.2 -14.2	Strong grey LIMESTONE rock
RC 7	0.0 - 8.2	Boulder Clay
	8.2 - 8.5	Strong grey LIMESTONE rock
	8.5 - 9.9	Cavity
	9.9 - 11.2	Strong grey fractured LIMESTONE rock
	11.2 - 14.0	Strong grey LIMESTONE rock

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TRIAL PIT LOG

Project				TRIAL PIT No
INDAVER				
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	01
Contractor				Sheet 1 of 1

SAMPLES & TESTS Depth	Type	Test Result /REF	Water	STRATA Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument /Backfill
						0.35	TOPSOIL.	
						(0.55) 0.90	Soft to Firm brown slightly gravelly CLAY.	
1.00	B					(1.00) 1.90	Soft to Firm brown silty slightly sandy slightly gravelly CLAY.	
2.50	B					(1.00) 2.90	Firm grey/brown gravelly very sandy CLAY with many cobbles and some boulders.	
						(0.70) 3.60	Firm grey/brown very sandy gravelly CLAY with some cobbles.	
						(0.70) 4.30	Firm light brown silty sandy CLAY.	
							Assumed BEDROCK.	

Water Observations Date	Comments	Depth

GENERAL REMARKS

TP ends @ 4.3m gbl.
TP dry but sides unstable.
Parcial callapse.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	**02**
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						0.30	TOPSOIL.	
						(0.60) 0.90	Firm to Soft brown slightly gravelly CLAY.	
1.00	B					1.20	Firm to Soft light brown silty CLAY.	
						1.40	Firm to Soft light grey silty CLAY.	
2.00	B					(0.70) 2.10	Firm to Soft brown slightly gravelly CLAY.	
						(2.40) 4.50	Firm to Soft slightly gravelly very sandy CLAY becomming very gravelly with some cobbles.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	TP ends @ 4.5m gbl. TP sides unstable. Water ingress @ 3.5m gbl.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	03
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						(0.40) 0.40	TOPSOIL.	
						(0.70) 1.10	Soft to Firm brown slightly gravelly CLAY.	
1.20	B					(0.70) 1.80	Soft to Firm brown gravelly CLAY.	
2.50	B					(1.10) 2.90	Soft to Firm brown/grey mottled light brown in places sandy gravelly CLAY with lots of broken stone and some boulders.	
						(1.00) 3.90	Firm to Stiff brown sandy very gravelly CLAY.	
							TP ends due to continual collapse of sides.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	
			TP ends @ 3.9m bgl. Water ingress @ 2.5m bgl.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project: INDAVER				TRIAL PIT No
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	**04**
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA			Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION
						0.30	TOPSOIL.
						(0.40) 0.70	Soft to Firm brown slightly gravelly CLAY.
1.00	B					(0.80) 1.50	Firm to Stiff brown gravelly CLAY with lots of broken stone and cobbles.
2.00	B					(0.70) 2.20	Firm brown gravelly CLAY with lots of broken stone and cobbles.
						(0.80) 3.00	Firm light brown gravelly sandy silty CLAY with broken stone.
						(1.00) 4.00	Firm light brown gravelly sandy silty CLAY with lots of broken stone.
4.20	B					(0.60) 4.60	Medium Dense light brown/brown /grey clayey slightly gravelly SAND.
							TP Ends.

Water Observations		
Date	Comments	Depth

GENERAL REMARKS

TP ends @ 4.6m bgl. due to hard digging.
Possible bedrock @ 4.7m bgl.
Sides unstable.
Water ingress @ 1.9m bgl.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project				TRIAL PIT No
INDAVER				
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	**05**
Contractor				Sheet 1 of 1

SAMPLES & TESTS: Depth	Type	Test Result /REF	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument /Backfill
						0.35	TOPSOIL.	
						(0.55) 0.90	Firm brown slightly gravelly CLAY.	
						1.10	Soft to Firm grey brown very sandy CLAY.	
1.10	B					(2.50) 3.60	Loose dark brown/grey clayey SAND becaming gravelly @ 2.7m bgl. with cobbles. (Collapse of this layer).	
							Assumed BEDROCK	

Water Observations: Date	Comments	Depth

GENERAL REMARKS

TP ends @ 3.6m bgl.
TP sides unstable.
TP dry.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project: INDAVER				TRIAL PIT No
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	**06**
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						0.30	TOPSOIL.	
						(0.40) 0.70	Soft to Firm brown slightly gravelly silty CLAY.	
1.10	B						Soft to Firm brown slightly gravelly very sandy CLAY.	
2.90	B					(2.40) 3.10		
						(0.40) 3.50	Running SAND.	

Water Observations		
Date	Comments	Depth

GENERAL REMARKS

TP ends @ 3.5m bgl.
Minor water ingress @ 3.1m bgl.
TP sides unstable.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	**07**
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						0.30	TOPSOIL.	
2.00	B					(2.70) 3.00	Firm brown sandy very gravelly CLAY becaming firm to stiff @ 2.0m bgl. with many cobbles and broken stone.	
3.70	B					(0.70) 3.70	Stiff to very Stiff brown sandy very gravelly CLAY with many cobbles and broken stone.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	
			TP ends @ 3.7m bgl. TP dry. TP stable.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	**08**
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						0.30	TOPSOIL.	
0.80	B					(1.20) 1.50	Soft to Firm brown sandy gravelly CLAY.	
						(1.00) 2.50	Firm brown sandy gravelly CLAY.	
						(1.20) 3.70	Firm to Stiff sandy very gravelly CLAY with cobbles becoming Stiff with cobbles and occasional boulders @ 32.4m bgl.	
							TP ends due to hard digging.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	TP ends @ 3.7m bgl. TP dry. TP stable.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	**09**
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						0.30	TOPSOIL.	
						(0.60) 0.90	Soft to Firm brown sandy gravelly CLAY.	
1.00	B					(1.10) 2.00	Firm brown sandy gravelly CLAY.	
						(1.00) 3.00	Firm light brown sandy silty very gravelly CLAY.	
						(0.60) 3.60	Medium Dense slightly clayey very sandy GRAVEL with cobbles.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	TP ends @ 3.6m bgl. TP dry. TP stable.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

AGS3 UK BH B580 TP LOGS.GPJ AGS3_ALL.GDT 29/3/07

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TRIAL PIT LOG

Project: INDAVER				TRIAL PIT No
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	**10**
Contractor				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						0.25	TOPSOIL.	
						(0.75) 1.00	Soft to Firm brown sandy gravelly CLAY.	
1.00	B					(1.20) 2.20	Firm brown grey sandy very gravelly CLAY with some cobbles.	
						(1.30) 3.50	Medium Dense clayey sandy GRAVEL with cobbles and occasional boulders.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	TP ends @ 3.5m bgl. TP dry. TP stable.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project	TRIAL PIT No
INDAVER	11

Job No	Date	Ground Level (m)	Co-Ordinates
B590 INDAVER	27/02/2007		

Contractor:

Sheet 1 of 1

SAMPLES & TESTS Depth	Type	Test Result /REF	Water	Reduced Level	Legend	Depth (Thickness)	STRATA DESCRIPTION	Instrument /Backfill
						0.30	TOPSOIL.	
0.50	B					(0.40) 0.70	Soft to Firm brown sandy gravelly CLAY.	
						(1.50) 2.20	Firm brown sandy very gravelly CLAY with cobbles and occasional boulders.	
						(1.10) 3.30	Firm to Stiff sandy very gravelly CLAY with many cobbles and boulders becoming Stiff @ 2.5m bgl. with large boulders >500mm.	

Water Observations Date	Comments	Depth

GENERAL REMARKS

TP ends @ 3.3m bgl.
TP dry.
TP stable.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project				TRIAL PIT No
INDAVER				
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	12
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						0.25	TOPSOIL.	
						(1.05) 1.30	Firm grey brown sandy gravelly CLAY.	
1.50	B					(2.20) 3.50	Firm brown sandy very gravelly CLAY becomming stiff @ 2.5m bgl. with broken stone and many cobbles.	
3.50	B					3.60	Stiff to very stiff brown sandy very gravelly CLAY.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	
			TP ends @ 3.6m bgl. TP dry. TP stable.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project				TRIAL PIT No
INDAVER				
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	13
Contractor				Sheet 1 of 1

SAMPLES & TESTS / STRATA

Depth	Type	Test Result /REF	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument /Backfill
						0.30	TOPSOIL.	
						(0.60) 0.90	Firm brown slightly gravelly CLAY.	
						(0.90) 1.80	Firm brown very sandy very gravelly CLAY with cobbles and occasional boulders.	
						(2.20) 4.00	Firm to Stiff clayey SILT	

Water Observations

Date	Comments	Depth

GENERAL REMARKS

TP ends @ 4.0m bgl.
TP dry.
TP unstable.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project: INDAVER				TRIAL PIT No
Job No: B590 INDAVER	Date: 27/02/2007	Ground Level (m)	Co-Ordinates	**14**
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						0.25	TOPSOIL.	
						(0.65) 0.90	Firm brown sandy silty CLAY.	
						(0.60) 1.50	Firm dark brown gravelly CLAY.	
						(0.50) 2.00	Loose grey brown slightly clayey sandy GRAVEL with some cobbles.	
						(2.00) 4.00	Medium dense grey brown sandy GRAVEL becomming more course with many cobbles and some boulders.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	TP ends @ 4.0m bgl. TP dry. TP unstable.

All dimensions in metres Scale 1:50	Client: Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By: JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	15
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						(0.40) 0.40	TOPSOIL.	
						(0.80) 1.20	Firm brown sandy gravelly CLAY.	
						(1.80) 3.00	Firm to Stiff brown grey mottled sandy silty CLAY.	
						(0.80) 3.80	Stiff grey clayey sandy SILT.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	
			TP ends @ 3.8m bgl. Minor water ingress @ 2.8m bgl.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

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TRIAL PIT LOG

Project INDAVER				TRIAL PIT No
Job No B590 INDAVER	Date 27/02/2007	Ground Level (m)	Co-Ordinates	16
Contractor				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth	Type	Test Result /REF		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	
						0.30	TOPSOIL.	
0.50	B					(0.50) 0.80	Soft to Firm brown slightly sandy gravelly CLAY.	
						(2.90) 3.70	Medium Dense grey/brown very sandy slightly clayey GRAVEL with some cobbles becomming with many cobbles @ 3.6m bgl.	

Water Observations			GENERAL REMARKS
Date	Comments	Depth	TP ends @ 3.7m bgl. TP dry. TP stable.

All dimensions in metres Scale 1:50	Client Mc ELROY ASSOCIATES	Method/ Plant Used	Logged By JM/LT

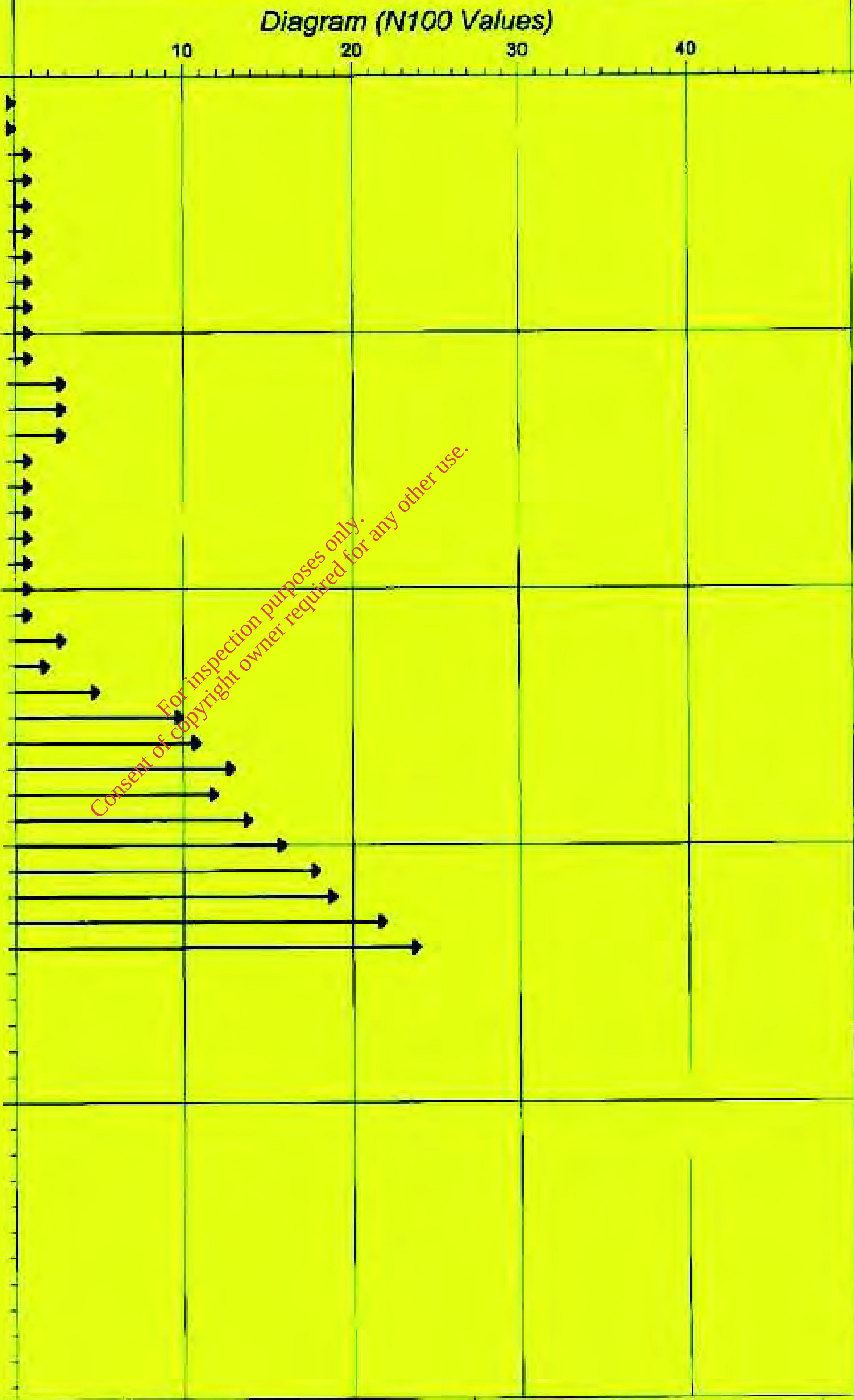
DYNAMIC PROBING LOG

Client	Probe No **DP1**
Consultant **BLP**	Sheet 1 of 1
Site **Carranstown**	Project No **1440-02-07**
E - / N - / Level **0.00 m AOD**	Date **27/02/2007**
	Logged by **John / Mark**

Depth (m) | Readings Blows/100mm | Diagram (N100 Values) | Torque (Nm)

	0	0	1	1	1
	1	1	1	1	1
1.0	1	3	3	3	1
	1	1	1	1	1
2.0	1	3	2	5	10
	11	13	12	14	16
3.0	18	19	22	24	-
	-				
4.0					

Torque (Nm): 0



Remarks:
Refusal at 3.50

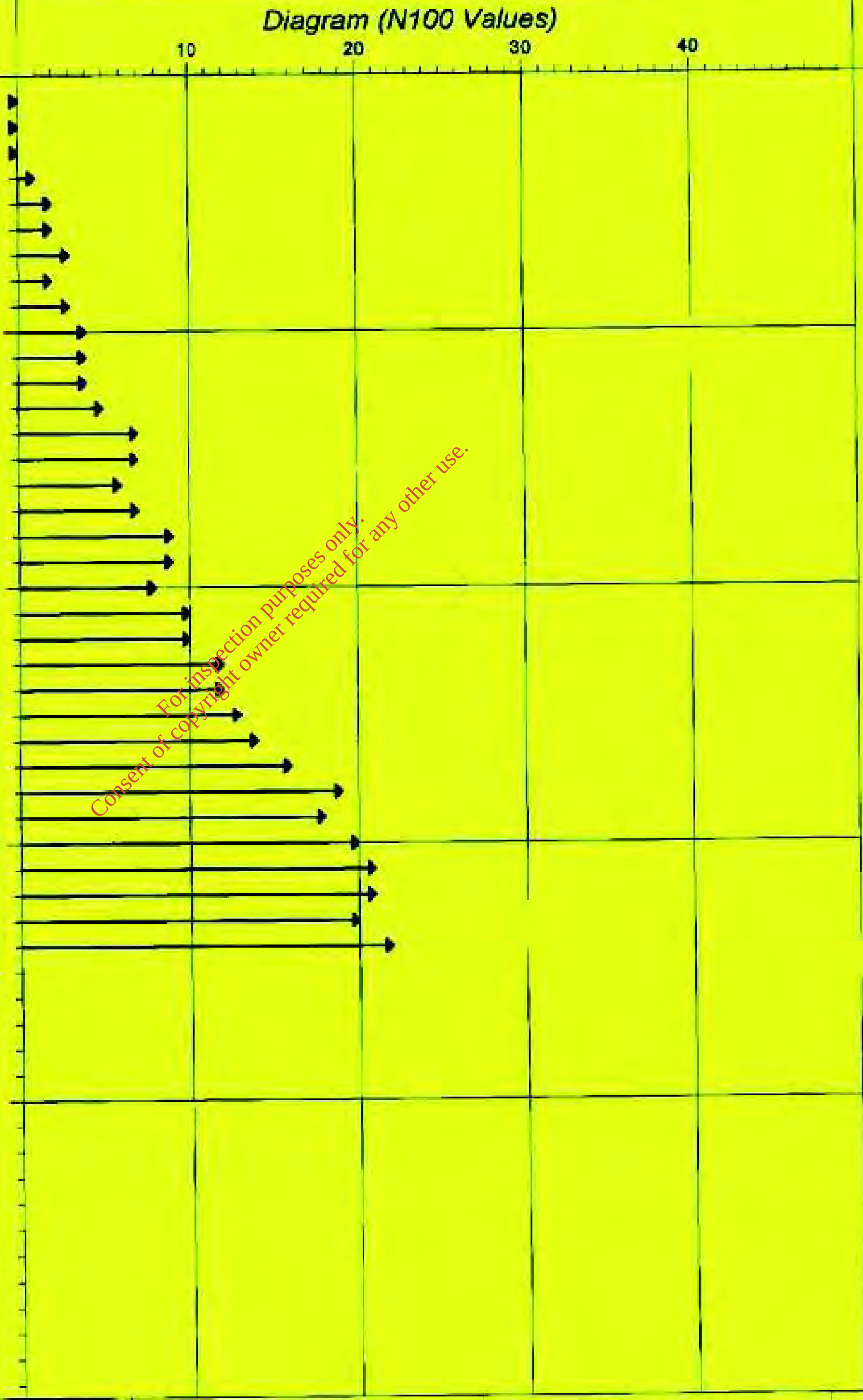
Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	3.50
Probe Type	DPL	Log Scale	1:25

AGS

DYNAMIC PROBING LOG

Client	Probe No **DP2**
Consultant **BLP**	Sheet 1 of 1
Site **Carranstown**	Project No **1440-02-07**
	Date **27/02/2007**
E - / N - / Level -	Logged by **John / Mark**

Depth (m)	Readings Blows/100mm
0.0–0.5	0, 0, 0, 1, 2
0.5–1.0	2, 3, 2, 3, 4
1.0–1.5	4, 4, 5, 7, 7
1.5–2.0	6, 7, 9, 9, 8
2.0–2.5	10, 10, 12, 12, 13
2.5–3.0	14, 16, 19, 18, 20
3.0–3.5	21, 21, 20, 22, -
3.5	-



Remarks:
Refusal at 3.50

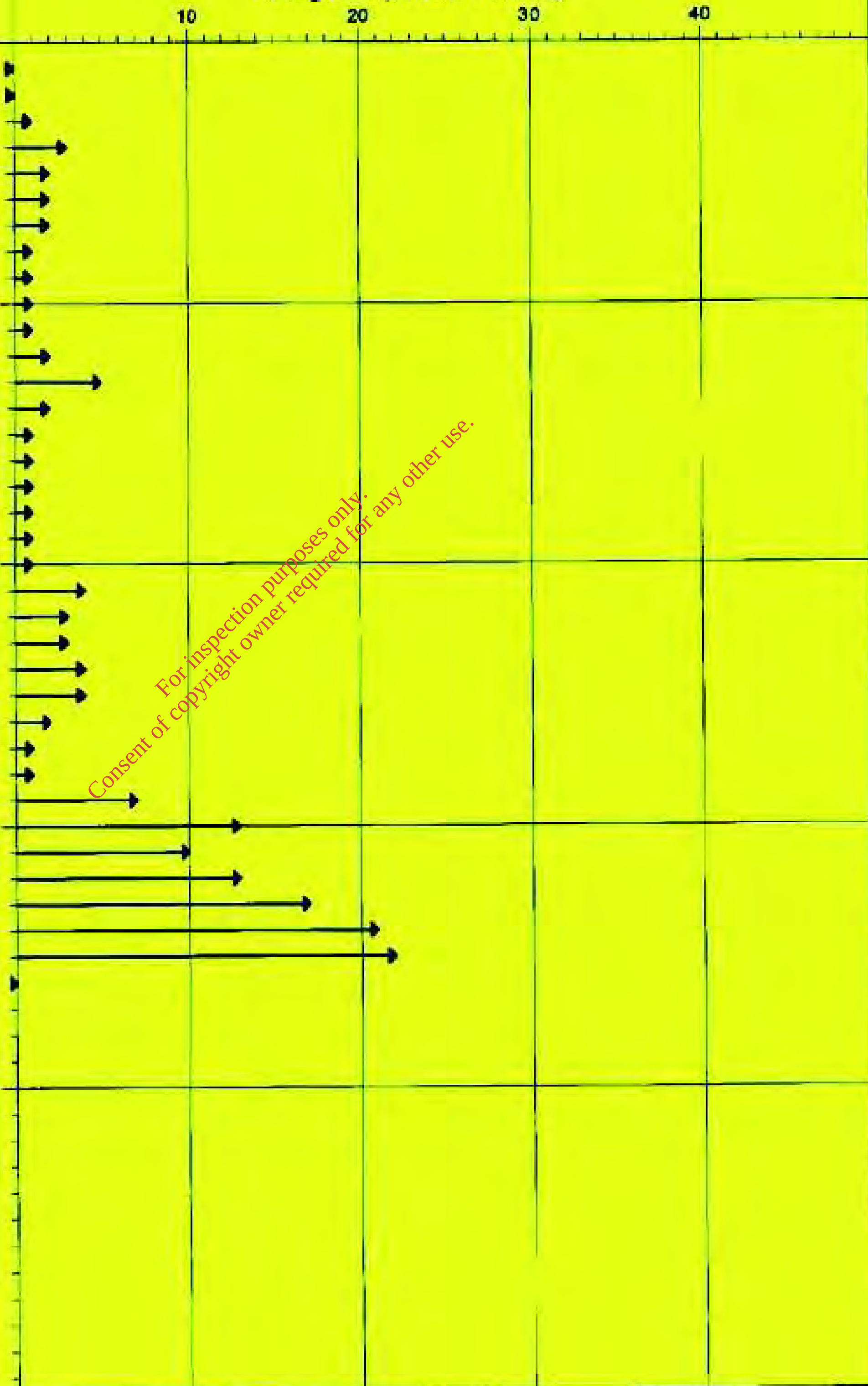
Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	3.50
Probe Type	DPL	Log Scale	1:25

DYNAMIC PROBING LOG

Client	Probe No **DP3**
	Sheet 1 of 1
Consultant **BLP**	Project No **1440-02-07**
Site **Carranstown**	Date **27/02/2007**
E - N - Level -	Logged by **John / Mark**

Depth (m)	Readings Blows/100mm				
	0	0	1	3	2
1.0	2	2	1	1	1
	1	2	5	2	1
2.0	1	1	1	1	1
	4	3	3	4	4
3.0	2	1	1	7	13
	10	13	17	21	22
4.0	0				

Diagram (N100 Values)



Torque (Nm)

0

Remarks:
Refusal at 3.50

Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	3.50
Probe Type	DPL	Log Scale	1:25

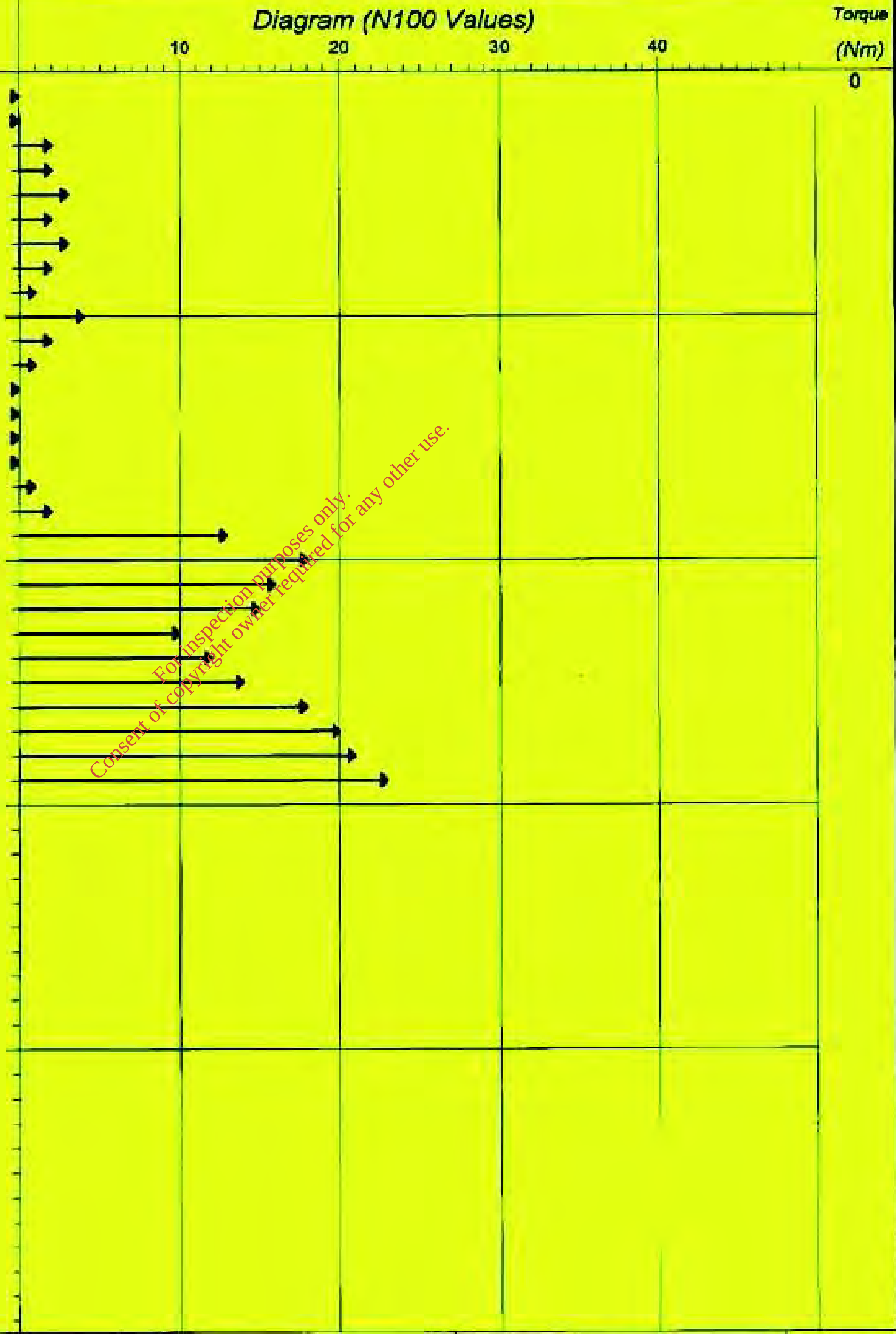
AGS

DYNAMIC PROBING LOG

Client	Probe No **DP4**
Consultant **BLP**	Sheet 1 of 1
Site **Carranstown**	Project No **1440-02-07**
	Date **27/02/2007**
E - N - Level -	Logged by **John / Mark**

Depth (m) | Readings Blows/100mm | Diagram (N100 Values) | Torque (Nm)

Depth (m)	Readings Blows/100mm				
	0	0	2	2	3
1.0	2	3	2	1	4
	2	1	0	0	0
2.0	0	1	2	13	18
	16	15	10	12	14
3.0	18	20	21	23	-
4.0					



Remarks:

Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	2.90
Probe Type	DPL	Log Scale	1:25

AGS

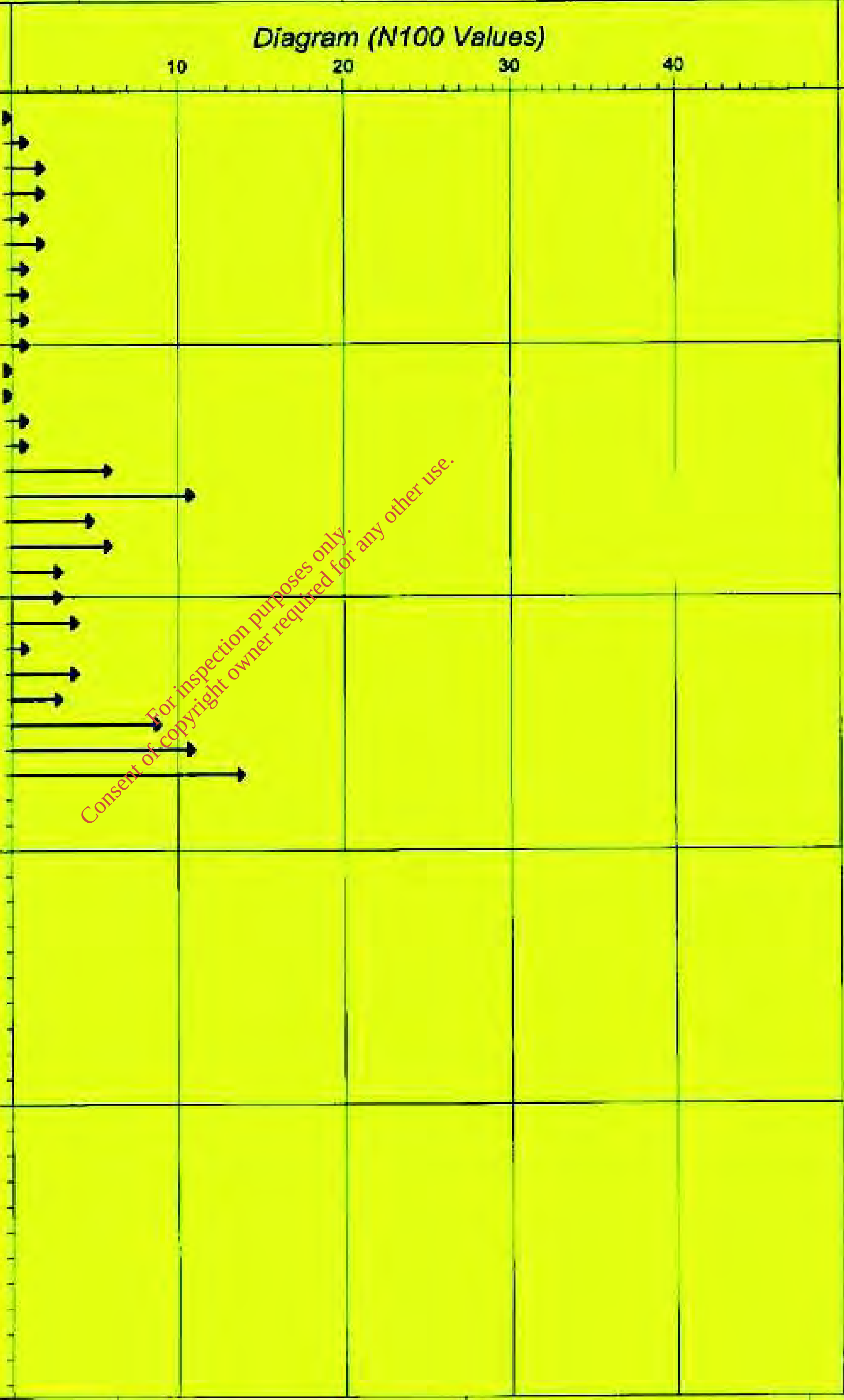
DYNAMIC PROBING LOG

Client	Probe No **DP5**
	Sheet 1 of 1
Consultant **BLP**	Project No **1440-02-07**
Site **Carranstown**	Date **27/02/2007**
E - / N - / Level -	Logged by **John / Mark**

Depth (m)	Readings Blows/100mm
0.0 – 1.0	0, 1, 2, 2, 1, 2, 1, 1, 1, 1
1.0 – 2.0	0, 0, 1, 1, 6, 11, 5, 6, 3, 3
2.0 – 3.0	4, 1, 4, 3, 9, 11, 14, -, -

Depth scale: 1.0, 2.0, 3.0, 4.0

Diagram (N100 Values)



Torque (Nm)
0

Remarks
Refusal at 2.80

Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	2.80
Probe Type	DPL	Log Scale	1:25

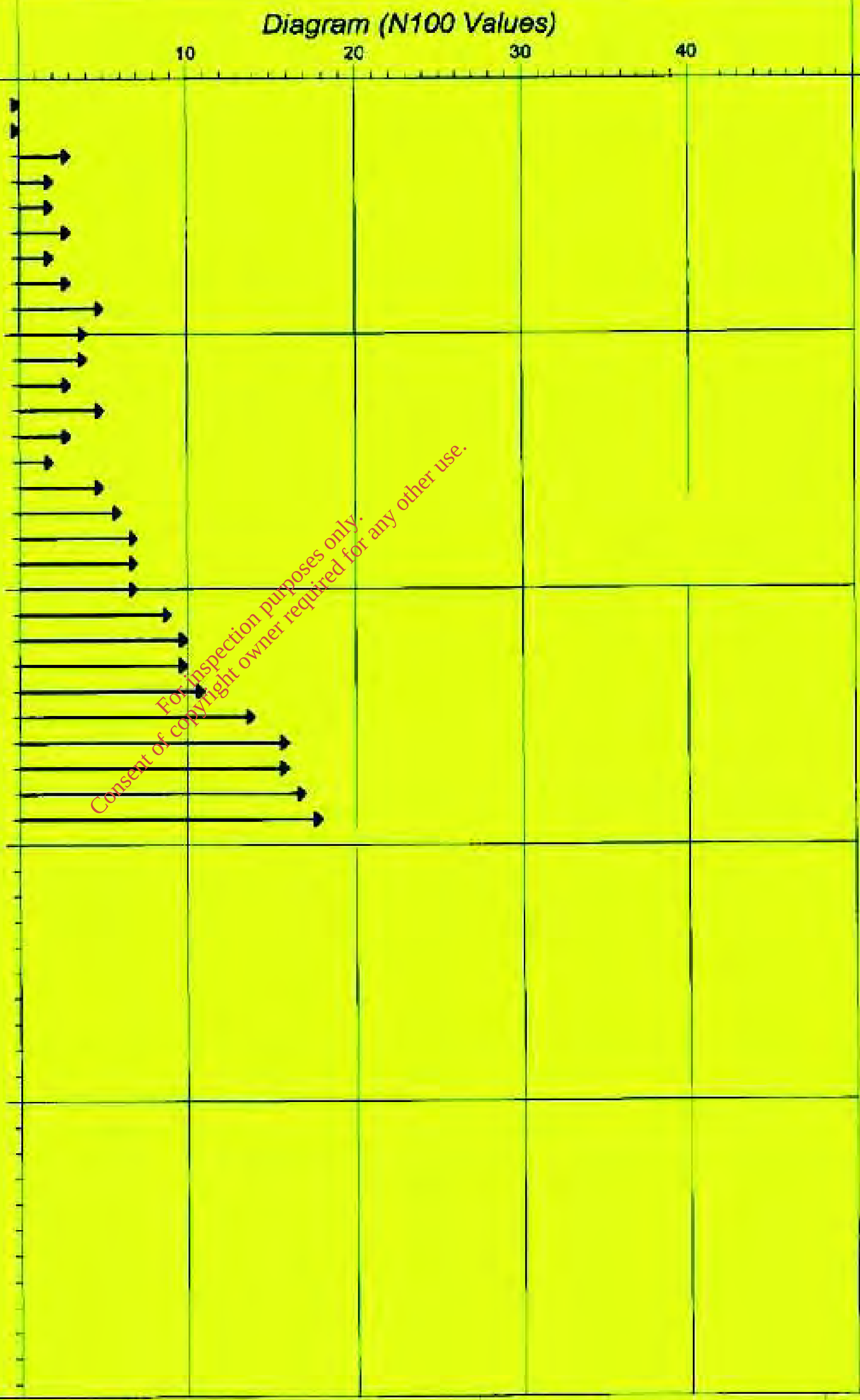
AGS

DYNAMIC PROBING LOG

Client	Probe No **DP6**
Consultant **BLP**	Sheet 1 of 1
Site **Carranstown**	Project No **1440-02-07**
E - N - Level -	Date **27/02/2007**
	Logged by **John / Mark**

Depth (m)	Readings Blows/100mm
0.1	0
0.2	0
0.3	3
0.4	2
0.5	2
0.6	3
0.7	2
0.8	3
0.9	5
1.0	4
1.1	4
1.2	3
1.3	5
1.4	3
1.5	2
1.6	5
1.7	6
1.8	7
1.9	7
2.0	7
2.1	9
2.2	10
2.3	10
2.4	11
2.5	14
2.6	16
2.7	16
2.8	17
2.9	18
3.0	-

Diagram (N100 Values)



Torque (Nm)
0

Remarks:

Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	2.90
Probe Type	DPL	Log Scale	1:25

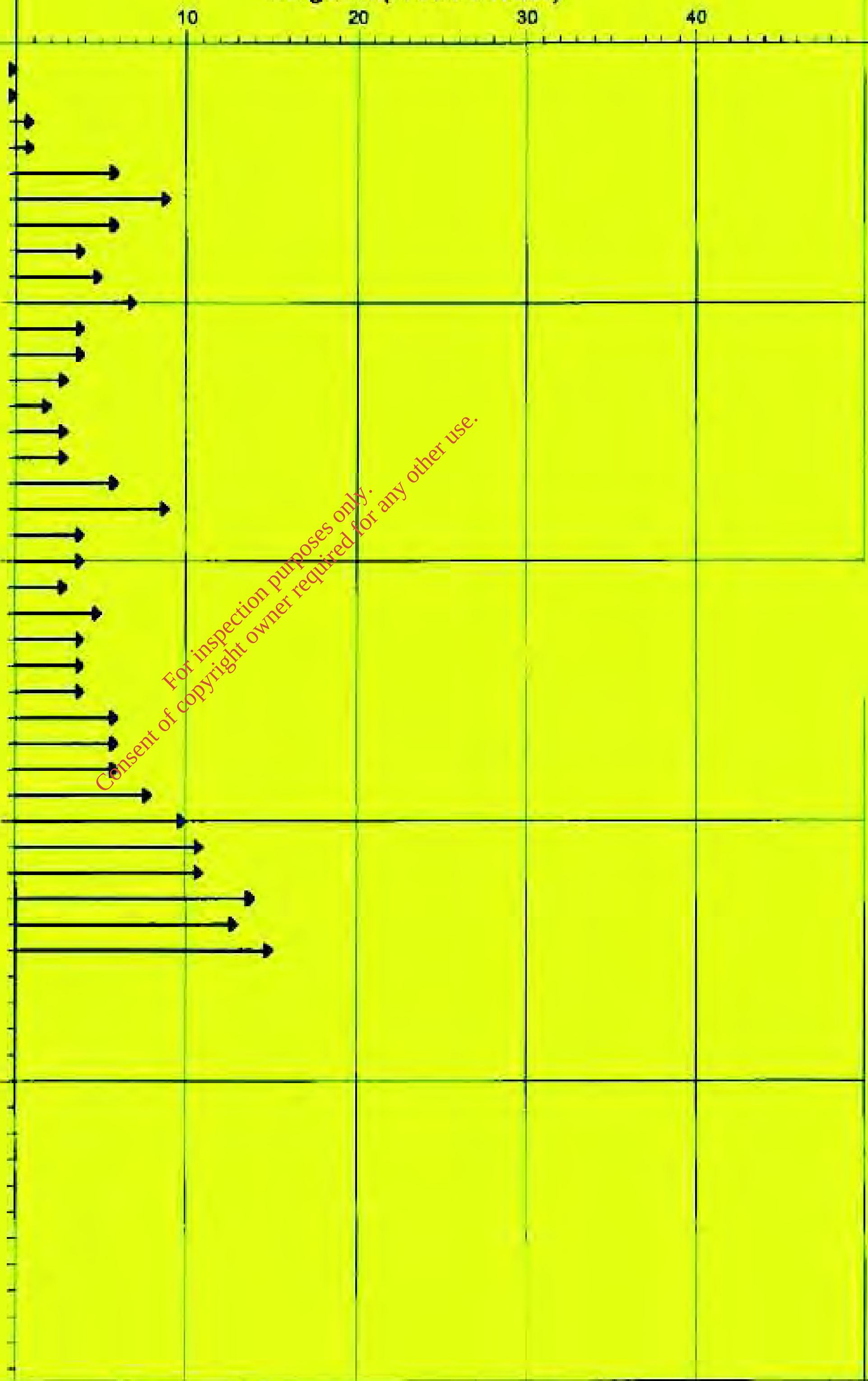
AGS

DYNAMIC PROBING LOG

Client	Probe No **DP 7**
Consultant **BLP**	Sheet 1 of 1
Site **Carranstown**	Project No **1440-02-07**
E - / N - / Level -	Date **27/02/2007**
	Logged by **John / Mark**

Depth (m)	Readings Blows/100mm
0.1	0
0.2	0
0.3	1
0.4	1
0.5	6
0.6	9
0.7	6
0.8	4
0.9	5
1.0	7
1.1	4
1.2	4
1.3	3
1.4	2
1.5	3
1.6	3
1.7	6
1.8	9
1.9	4
2.0	4
2.1	3
2.2	5
2.3	4
2.4	4
2.5	4
2.6	6
2.7	6
2.8	6
2.9	8
3.0	10
3.1	11
3.2	11
3.3	14
3.4	13
3.5	15
	-

Diagram (N100 Values)



Torque (Nm)
0

Remarks:

Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	3.50
Probe Type	DPL	Log Scale	1:25

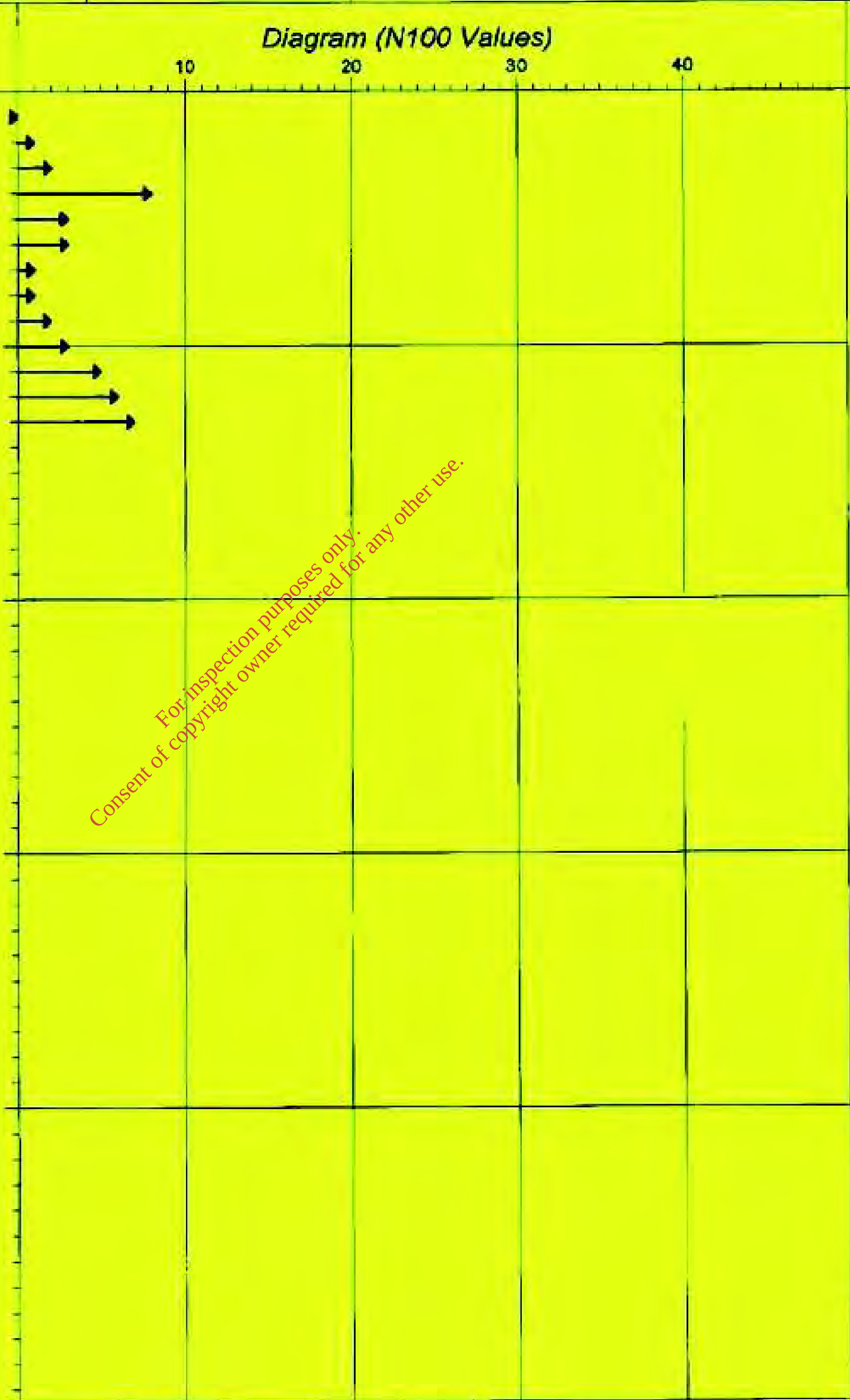
AGS

DYNAMIC PROBING LOG

Client	Probe No **DP8**
	Sheet 1 of 1
Consultant **BLP**	Project No **1440-02-07**
Site **Carranstown**	Date **27/02/2007**
E - N - Level -	Logged by **John / Mark**

Depth (m)	Readings Blows/100mm
0.1	0
0.2	1
0.3	2
0.4	8
0.5	3
0.6	3
0.7	1
0.8	1
0.9	2
1.0	3
1.1	5
1.2	6
1.3	7
1.4	-
1.5	-

Diagram (N100 Values)



Torque (Nm)
0

Depth: 1.0, 2.0, 3.0, 4.0

Remarks:
Refusal at 1.40

Fall Height	0	Cone Base Diameter	0
Hammer Wt	0.00	Final Depth	1.40
Probe Type	DPL	Log Scale	1:25

AGS

Appendix B

PM Group Report 2009

(Borehole Logs)

IGSL Ltd.

Meath Waste Management Facility

Factual Ground Investigation Report
(Project No. 14039)

Indaver Ireland
PM Group

May 2009

Meath Waste Management Facility

Carranstown, Duleek, Co. Meath

Factual Geotechnical Investigation Report

(Report No. 14039)

Client: Indaver Ireland

Engineer: PM Group Ltd

May 2009

IGSL Ltd

DOCUMENT ISSUE REGISTER

Distribution	Copies	Rev.	Date of Issue	Report Prepared By:
PM Dublin	Draft – 1 No hard copy & PDF by email	A	20 March 2009	TD / PQ
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PM Dublin	Final with addendum (stabilization test data)– 1 No hard copy & PDF by email	C	18 May 2009	TD / PQ

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Appendix 2	- Rotary Drillhole Records (Conventional Core Drilholes)
Appendix 3	- Percolation Test Records
Appendix 4	- Geotechnical Soil Laboratory Test Data
Appendix 5	- Geotechnical Rock Laboratory Test Data
Appendix 6	- Core Photographs
Appendix 7	- Exploratory Hole Site Plan
Appendix 8	- Stabilization Test Data

FOREWORD

The following conditions and notes on site investigation procedures should be read in conjunction with this report.

General

The ground investigation works have been carried out in accordance with BS 5930 (1990) and the IEI Specification & Related Documents for Ground Investigation in Ireland (2006). No responsibility can be held for conditions which have not been revealed by exploratory work, or which occur between exploratory hole locations.

Whilst the report may suggest the likely configuration of strata, both between exploratory hole locations, or below the maximum depth of the investigation, this is only indicative, and liability cannot be accepted for its accuracy. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

Boring Procedures

Unless otherwise stated, the 'Shell and Auger' technique of soft ground boring has been employed. All boring operations sampling and/or logging of soils and in-situ testing complies with the recommendations of the British Standard Code of Practice BS 5930 (1981), 'Site Investigation' and BS 1377:1990, 'Methods of test for soils for civil engineering purposes'.

Whilst the technique allows the maximum data to be obtained in soft ground, some disturbance and variation of soft and layered soils is unavoidable. Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

Where peat has been encountered during siteworks, samples have been logged in accordance with the Von Post Classification (ref. Von Post, L. 1992. Sveriges Gologiska Undersoknings torvinventering och nogra av dess hittils vunna resultat (SGU peat inventory and some preliminary results) Svenska Mosskulturforeningens Tidskrift, Jonkoping, Swedden, 36, 1-37 & Hobbs N. B. Mire morphology and the properties of some British and foreign peats. QJEG, Vol. 19, 1986).

Routine Sampling

Undisturbed samples of soils, predominantly cohesive in nature are obtained unless otherwise stated by a 104mm diameter open-drive tube sampler. In granular soils, and where undisturbed sampling is inappropriate, disturbed samples are collected. Smaller disturbed samples are also recovered at intervals to allow a visual examination of the full strata section.

In-Situ Testing

Standard penetration tests, utilising either the standard split spoon sampler or solid cone and automatic trip-hammer are conducted unless otherwise where required by instruction. Subsequent to a seating drive of 150mm, a summation for the number of blows for 300mm penetration is recorded on the boring records together with the blow count for each 75mm penetration. In cases where incomplete penetration is obtained, the number of blows for the depth of penetration are recorded. In coarse granular soils, a cone end is fitted to the sampler and a similar procedure adopted.

Groundwater

The depth of entry of any influx of groundwater is recorded during the course of boring operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level.

Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage condition, tidal variation or other causes.

Retention of Samples
After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material will be discarded. Unless a period of retention of samples is agreed, it is our normal practice to discard all soil samples one month after submission of our final report.

Disclaimer
This report has been prepared for Project Management Group / Indaver Ireland and the information should not be used without prior approval or written permission of either party. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.

1. INTRODUCTION

At the request of Project Management (PM) and Indaver Ireland, IGSL has undertaken a programme of geotechnical investigation works for a waste to energy facility at Carranstown, Duleek, Co. Meath. The works were performed as directed by PM Group, consulting engineers for the project. The site is located at Carranstown, Duleek, Co. Meath and encompasses an area of approximately 25 acres. The site is bounded to the south by the R150 Duleek to Navan Road, to the east by the Platin Cement Works and farmland to the west and north.

It is understood that the proposed development will involve the construction of a waste management facility and include a waste handling area (bunker & furnace), emissions stack, ash bunker, workshop, office and administration buildings and general site infrastructure (i.e. roads, drainage, service utilities, culverts etc). The waste handling area will require a basement type structure (bunker) with a proposed dig depth of the order of 7m below existing ground level (i.e. formation of c23m OD). Site enabling works were completed prior to IGSL commencing the geotechnical investigations and produced a platform level of 30.5m OD. It is noted that a programme of geotechnical investigations were originally carried out in 2007 and details are presented in a report prepared by Byrne Looby Partners (B580 May 2007).

The geophysical and geotechnical fieldworks works for this phase were carried out in accordance with BS 5930, Code of Practice for Site Investigations (1999) and the IEI Specification & Related Documents for Ground Investigation in Ireland (2006). The fieldworks included geophysical surveying, rotary core drillholes and percolation tests. Core drillholes GC 1 to GC 5 were positioned at the footprint of the bunker (note the location of this structure was subsequently altered) while RP 1, 2 and 5 were located at a zone where karst weathering was identified in the original investigations. The geophysical surveying was performed by Apex Geoservices and included seismic refraction spreads and surface wave analysis (MASW) to determine small strain stiffness. Geotechnical soil and rock laboratory testing was performed on selected samples in accordance with BS 1377 and ISRM.

The primary objectives of the investigation were as follows:

- Evaluate rock quality, weathering profile, strength and fracture state of the bedrock at the proposed bunker & emissions stack
- Recover samples for geotechnical laboratory testing (soil & rock)
- Assess percolation characteristics of the upper soils at designated locations

This report presents the factual geotechnical data obtained from the exploratory locations and laboratory testing. A separate geotechnical interpretative report (GIR) has been prepared and includes a discussion of the ground conditions, engineering properties of the soils and bedrock and recommendations developed on the key geotechnical issues impacting on the proposed development. The locations of the exploratory holes are presented on a site plan in Appendix 7. It is noted that sampling of the glacial till from the waste bunker and stockpiles were scheduled by PM in March 2009 and this information is included in Appendix 8 (addendum to the final report issued on 30 March 2009).

2. FIELDWORK

2.1 General

The fieldworks were carried out during the period February 2009 and comprised the following:

- Rotary core drillholes (9 No.)
- Percolation tests (2 No.)
- Geophysical surveying

2.2 Rotary Drillholes

Rotary drilling was undertaken at nine locations using a top drive Knebel rig. Geobor core drilling methods were utilized at six locations (denoted GC 1 to GC 6) with conventional air mist drilling employed at three locations (RP 1, 2 & 5). The Geobor drilling system used polymer gel flush and recirculation tanks, with the emphasis on high quality recovery in the glacial soils and upper bedrock zone.

The Geobor coring produced 102mm diameter cores while the conventional coring produced 80mm diameter cores using air mist flush. Recovery in the Geobor holes was excellent with 100% recovery in the majority of the runs. The Geobor drillholes achieved depths of between 11.80 and 15.10m while each of the conventional holes terminated at depths of 10.50m. Each of the core drillholes were backfilled with cement/bentonite grout (tremmied) as directed by PM.

The rock cores were placed in 3m capacity timber boxes and logged by an IGSL engineering geologist. This included photography of the cores with a digital camera. The core log records are presented in Appendices 1 and 2 and include engineering geological descriptions of the rock cores, details of the bedding / discontinuities and mechanical indices (TCR, SCR and RQD's) for each core run.

Where rock core was recovered, a graphic fracture log is also presented alongside the mechanical indices. This illustrates the fracture state of the rock cores and allows easy identification of highly fractured / non-intact zones and discontinuity spacings. It should be noted that no correction for dip of the joints has been made and that the spacings shown are successive joint / core intersections within the core.

2.3 Percolation Tests

Percolation or soakaway tests were performed at two locations to evaluate the infiltration potential of the upper soils. The tests were conducted in accordance with BRE 365 guidelines and the data sheets are presented in Appendix 3. The infiltration rate values (F Values) were calculated using the field data and are shown on each of the logs.

2.4 Geophysical Surveying

Geophysical surveying was carried out by Apex Geoservices and included resistivity profiling, seismic refraction spreads and multi-channel analysis of surface waves to assess soil stiffness (GMax v depth). Details of the methodologies used, x-sections / profiles and maps are presented in a separate report by Apex Geoservices.

2.5 Trial Pits & Bulk Sampling for Stabilization Testing

Samples of the glacial till were taken from the footprint of the waste bunker and stockpiles to facilitate earthwork and stabilization testing. Two trial pits were excavated at the waste bunker footprint and both extended to a depth of 4m bgl. Large bulk disturbed samples were recovered (c 50 kg) and placed in heavy duty polyethene bags and returned to Naas for testing. The trial pit logs and associated laboratory test data are presented in Appendix 8.

3. LABORATORY TESTING

Geotechnical soil laboratory testing was performed on selected Geobor core samples in accordance with BS 1377 (1990). The soils testing included the following and results are presented in Appendices 4 and 8.

- Moisture content
- Particle size analysis
- Atterberg Limits (Liquid & Plastic Limits)
- Consolidated quick undrained triaxial
- Consolidation (oedometer)
- pH & sulphate
- California Bearing Ratio (CBR)
- Moisture Condition Value (MCV)
- CBR, MCV & sulphates following the addition of lime or cement binders

Rock testing was undertaken on representative core samples and focused on Point Load Strength index (PLSI)) and unconfined compressive strength (UCS) tests in accordance with ISRM. The results of the rock testing are presented in Appendix 5.

References

1. BRE Digest 365 Soakaway Design

2. BS 5930 (1999) Code of Practice for Site Investigation, British Standards Institution (BSI).

3. BS 1377 (1990) Methods of Testing of Soils for Civil Engineering Purposes, BSI.

4. Indaver, Carranstown Geotechnical Assessment Report (B580), May 2007, Byrne Looby Partners

5. Site Investigation Practice: Assessing BS 5930 (1986), Geological Society Special Publication, No. 2.

KEY TO EXPLORATORY RECORDS

Cable Percussion Boreholes

D	Small Disturbed Sample
B	Large Disturbed Sample
T	Tub Sample (for moisture content profiling)
U100	Undisturbed Sample (driven tube sample)
W	Groundwater Sample
C	SPT N-Value (Solid Cone)
S	SPT N-Value (Split Spoon / Open Shoe)
FHT	Falling Head Permeability Test
RHT	Rising Head Permeability Test

Rotary Core Drillholes

TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Designation Value (%)
FS	Fracture Spacing (mm) Presented as Graphic Fracture Log
NI	Non-Intact (where rock core is highly fractured)
ECL	Estimated Core Loss

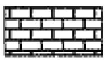
Trial Pits

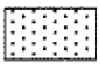
B	Bulk Disturbed Sample
T	Tub Sample
VT	Vane Test (KPa) Using Genor H-70 Hand Vane
HP	Hand Penetrometer Test (KPa)
W	Groundwater Sample

Groundwater Installations

SP	Standpipe (uPVC 50mm diameter with 1mm slots)
Piez	Casagrande Piezometer (19mm diameter)

Strata Legends / Symbolic Logs





Strata legends / symbolic logs are in accordance with BS 5930 (1999). Legend codes are selected from Holebase / GINT to reflect stratum.

Appendix 1

Rotary Core Drillhole Records (Geobor Holes)

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC1
		SHEET	Sheet 1 of 2
CO-ORDINATES	306,263.87 E 270,930.70 N	DATE STARTED	17/02/2009
GROUND LEVEL (m)	30.10	DATE COMPLETED	17/02/2009
CORE DIAMETER (mm)	102		
INCLINATION	-90	DRILLED BY	Petersen
FLUSH	Polymer Gel	LOGGED BY	A. Mahony
CLIENT	Indaver		
ENGINEER	PM Group		

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
0.80–1.50	86	0	0
1.50–3.00	80	0	0
3.00–4.50	100	0	0
4.50–6.00	100	0	0
6.00–7.50	93	27	27
7.50–9.00	100	61	61
9.00–	100	99	94

Fracture Spacing (mm): 0, 250, 500

Strata description	Depth (m)	Elevation
OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	0.80	29.30
Soft brown sandy gravelly CLAY. Gravel is sub-angular and medium grained.	1.50	28.60
Brown clayey gravelly fine SAND. Gravel is rounded to sub-angular and fine to medium grained.	3.16	26.94
Brown SILT	3.40	26.70
Brown slightly silty gravelly fine SAND. Gravel is rounded to angular and fine to coarse grained.	4.25	25.85
Firm to stiff brown sandy gravelly CLAY. Gravel is sub-angular to sub-rounded and fine to coarse grained.	4.95	25.15
Brown silty very gravelly fine SAND with occasional cobbles (5.3m-5.8m. Gravel is sub-angular to sub-rounded and fine to coarse grained.	5.80	24.30
Firm to stiff brown sandy very gravelly CLAY. Gravel is sub-angular to sub-rounded and fine to coarse grained.	6.20	23.90
Firm brown clayey sandy gravelly SILT (sand layer at 6.4m). Gravel is sub-angular to sub-rounded and fine to coarse grained.	6.60	23.50
Strong to very strong, locally moderately strong, medium to	8.55	21.55

Discontinuities: Discontinuities are rough and undulose to irregular. Apertures are open with local clay sand smearing/infill (non intact zones). Dips are commonly sub-45° with variable fractures throughout.

REMARKS

7 Core boxes, 10.7m Core liner used. No groundwater encountered. Grout 0.0m-12.0m. 50% flush loss from 7.5m, 100% flush loss from 11.8m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER
14039

CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC1
		SHEET	Sheet 2 of 2
CO-ORDINATES	306,263.87 E 270,930.70 N	DATE STARTED	17/02/2009
GROUND LEVEL (m)	30.10	DATE COMPLETED	17/02/2009
CORE DIAMETER (mm)	102		
INCLINATION	-90	DRILLED BY	Petersen
CLIENT	Indaver	LOGGED BY	A. Mahony
ENGINEER	PM Group		
FLUSH	Polymer Gel		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
10	10.50	100	79	79				thickly bedded, blue grey, medium grained LIMESTONE (siliceous and fossiliferous). Fresh to slightly weathered.		Discontinuities are rough and undulose. Apertures are open with clay sand smearing surfaces. Dips are sub-10° with sub-vertical fractures (10.0-10.4m, 10.5-10.97m). *(continued)*			
11								Very strong, locally strong, thickly bedded, blue grey, fine to coarse grained LIMESTONE (siliceous and fossiliferous). Fresh to locally slightly weathered. *(continued)*	12.00		18.10		
12	12.00							End of Corehole at 12 (m)					
13													
14													
15													
16													
17													
18													
19													

REMARKS

7 Core boxes, 10.7m Core liner used. No groundwater encountered. Grout 0.0m-12.0m. 50% flush loss from 7.5m, 100% flush loss from 11.8m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC2
		SHEET	Sheet 1 of 2
CO-ORDINATES	306,286.09 E 270,892.72 N	GROUND LEVEL (m)	30.00
		CORE DIAMETER (mm)	102
		INCLINATION	-90
		FLUSH	Polymer Gel
CLIENT	Indaver	DATE STARTED	11/02/2009
ENGINEER	PM Group	DATE COMPLETED	12/02/2009
		DRILLED BY	Petersen
		LOGGED BY	A. Mahony

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm)	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
0 – 1.50								OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	1.50		28.50		
	1.50	100	0	0				Brown very sandy, very gravelly CLAY with occasional cobbles (sandy gravel at 2.95m-3.05m).	3.40		26.60		
	3.00	100	0	0									
	3.50	100	0	0				Brown very clayey, very sandy GRAVEL with occasional cobbles. Gravel is angular to rounded, predominantly fine grained.	5.30		24.70		
	4.50	100	0	0									
	5.30	100	10	0				Strong to very strong, locally moderately strong, medium to thickly bedded, blue grey, fine to medium grained LIMESTONE (siliceous and fossiliferous). Fresh to locally slightly weathered.		Discontinuities are rough and undulose. Apertures are tight to open with local clay sand smearing/infill (5.3m-6.0m6.31-6.33m, 6.73-6.9m, 7.69-7.72m, 8.09-8.1m, 9.22-9.3m, 10.46-10.61m, 11.55-11.75m, 14.13-14.28m), and local slight iron oxide stained surfaces (9.22-9.3m, 14.69m). Dips are sub-0°-20° locally 45° and local sub-vertical fractures (5.3-6.0m, 7.35-7.64m, 9.3-9.67m).			
	6.00	100	96	96									
	6.90	100	58	58									
	7.50	100	80	64									
	8.40	100	100	100									
	9.00	100	61	53									

REMARKS

8 Core boxes, 13.6m Core liner used. No groundwater encountered. Grout 0.0m-15.0m. 50% flush loss from 6.0m, 100% flush loss from 7.5m. Move & Setup 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 14039

CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC2
		SHEET	Sheet 2 of 2
CO-ORDINATES	306,286.09 E 270,892.72 N	GROUND LEVEL (m)	30.00
		CORE DIAMETER (mm)	102
		DATE STARTED	11/02/2009
		DATE COMPLETED	12/02/2009
		INCLINATION	-90
CLIENT	Indaver	DRILLED BY	Petersen
ENGINEER	PM Group	LOGGED BY	A. Mahony
		FLUSH	Polymer Gel

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm)	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
10	10.30							Strong to very strong, locally moderately strong, medium to thickly bedded, blue grey, fine to medium grained LIMESTONE (siliceous and fossiliferous). Fresh to locally slightly weathered. *(continued)*		Discontinuities are rough and undulose. Apertures are tight to open with local clay sand smearing/infill (5.3m-6.0m6.31-6.33m, 6.73-6.9m, 7.69-7.72m, 8.09-8.1m, 9.22-9.3m, 10.46-10.61m, 11.55-11.75m, 14.13-14.28m), and local slight iron oxide stained surfaces (9.22-9.3m, 14.69m). Dips are sub-0°-20° locally 45° and local sub-vertical fractures (5.3-6.0m, 7.35-7.64m, 9.3-9.67m). *(continued)*			
	10.30–10.50	100	80	80									
11	10.50–12.00	100	82	82									
12	12.00–13.50	100	91	91	549, 999999999999								
13					690								
14	13.50–15.10	100	100	100	510, 000000000002				15.10				
15	15.10							End of Corehole at 15.1 (m)			14.90		
16													
17													
18													
19													

REMARKS

8 Core boxes, 13.6m Core liner used. No groundwater encountered. Grout 0.0m-15.0m. 50% flush loss from 6.0m, 100% flush loss from 7.5m. Move & Setup 1hr.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039
CONTRACT	Indaver Waste Management Facility, Duleek
DRILLHOLE NO	RC GC3
SHEET	Sheet 1 of 2
CO-ORDINATES	306,299.12 E 270,902.06 N
GROUND LEVEL (m)	30.14
CORE DIAMETER (mm)	102
INCLINATION	-90
FLUSH	Polymer Gel
DATE STARTED	12/02/2009
DATE COMPLETED	13/02/2009
CLIENT	Indaver
ENGINEER	PM Group
DRILLED BY	Petersen
LOGGED BY	A. Mahony

Columns: Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Fracture Spacing (mm) 0 250 500 | Legend | Non-intact zones | Strata description | Depth (m) | Discontinuities | Elevation | Standpipe Details | SPT (N Value)

Downhole depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
0.70 - 1.50	100	0	0
1.50 - 2.40	100	0	0
2.40 - 3.40	100	0	0
3.40 - 4.10	100	0	0
4.10 - 4.50	100	0	0
4.50 - 6.00	100	10	10
6.00 - 7.50	100	0	0
7.50 - 9.00	100	31	31
9.00 -	100	15	15

Strata description	Depth (m)	Elevation
OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	0.70	29.44
Firm brown (soft 0.7-0.85m) clayey very sandy (occasionally gravelly layers) SILT. Gravel is sub-angular to sub-rounded and fine to coarse grained.	2.00	28.14
Firm brown sandy/gravelly (fine gravel, mostly sand from 2.25m) SILT/CLAY with occasional cobbles	3.65	26.49
Brown silty fine SAND with occasional gravel	3.75	26.39
Firm brown very sandy gravelly SILT with occasional cobbles	4.15	25.99
Firm brown very sandy gravelly SILT/CLAY (local sand layer at 4.28m & 5.02m	5.15	24.99
Brown silty fine SAND	5.40	24.74
COBBLE	5.55	24.59
Brown silty very sandy GRAVEL (predominantly fine to medium) with occasional cobbles.	6.25	23.89
Dark brown, gravelly, silty, fine to medium SAND	6.45	23.69
Brown silty clayey sandy gravelly, COBBLES (possible highly weathered upper bedrock)	8.00	22.14

REMARKS

7 Core boxes, 11.1m Core liner used. No groundwater encountered. Grout 0.0m-11.8m. 100% flush loss from 7.0m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC3
		SHEET	Sheet 2 of 2
CO-ORDINATES	306,299.12 E 270,902.06 N	GROUND LEVEL (m)	30.14
		CORE DIAMETER (mm)	102
		DATE STARTED	12/02/2009
		DATE COMPLETED	13/02/2009
CLIENT	Indaver	INCLINATION	-90
ENGINEER	PM Group	FLUSH	Polymer Gel
		DRILLED BY	Petersen
		LOGGED BY	A. Mahony

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
10	10.30							Strong to moderately strong, medium bedded, blue grey medium grained LIMESTONE (fossiliferous and siliceous). Heavily infilled with clay/sand/gravel (esp. 9.4m-10.03m) (possible variably weathered upper bedrock *(continued)*					
11		100	15	11									
12	11.80								11.80		18.34		
13								End of Corehole at 11.8 (m)					
14													
15													
16													
17													
18													
19													

REMARKS

7 Core boxes, 11.1m Core liner used. No groundwater encountered. Grout 0.0m-11.8m. 100% flush loss from 7.0m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039
CONTRACT	Indaver Waste Management Facility, Duleek
DRILLHOLE NO	RC GC4
SHEET	Sheet 1 of 2
CO-ORDINATES	306,275.13 E 270,938.38 N
GROUND LEVEL (m)	30.02
CORE DIAMETER (mm)	102
INCLINATION	-90
FLUSH	Polymer Gel
DATE STARTED	16/02/2009
DATE COMPLETED	17/02/2009
CLIENT	Indaver
ENGINEER	PM Group
DRILLED BY	Petersen
LOGGED BY	A. Mahony

Core runs

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
0.70			
0.70–1.50	63	0	0
1.50–3.00	97	0	0
3.00–4.50	87	0	0
4.50–5.10	100	0	0
5.10–6.00	100	17	17
6.00–6.90	100	0	0
6.90–7.50	100	60	53
7.50–8.50	100	53	53
8.50–9.00	100	56	40
9.00–	100	15	15

Fracture Spacing (mm): 0, 250, 500

Strata

Strata description	Depth (m)	Elevation
OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	0.70	29.32
Soft brown mottled cream/black/dark brown, very sandy, very gravelly CLAY with occasional cobbles. Gravel is sub-angular to sub-rounded and fine to coarse grained.	1.50	28.52
Firm reddish brown, very sandy, very gravelly CLAY (locally slightly soft 1.5m-2.0m). Gravel is sub-angular and fine to coarse grained.	3.30	26.72
Firm yellow brown, slightly gravelly(fine) /coarse sandy SILT	4.50	25.52
COBBLE	4.60	25.42
Firm dark brown sandy gravelly SILT/CLAY	4.90	25.12
Very gravelly (fine to medium), dark brown fine to coarse SAND	5.10	24.92
COBBLE	5.25	24.77
Brown clayey/silty gravelly, medium SAND with occasional cobbles. Gravel is rounded to sub-angular and fine to medium grained.	6.00	24.02
Firm brown sandy gravelly CLAY with occasional cobbles (becoming sandier towards 6.9m)	6.90	23.12
Dark brown, silty/clayey, gravelly, medium SAND	7.15	22.87
Strong to very strong, locally moderately strong, medium to thickly bedded, blue grey, medium grained	10.00	

Discontinuities: Discontinuities are rough and undulose to irregular. Apertures are open with local clay sand smearing/infill (non intact zones). Dips are commonly sub-45° with variable fractures throughout.

REMARKS

7 Core boxes, 10.85m Core liner used. No groundwater encountered. Grout 0.0m-12.1m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039

CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC4
		SHEET	Sheet 2 of 2
CO-ORDINATES	306,275.13 E 270,938.38 N	GROUND LEVEL (m)	30.02
		CORE DIAMETER (mm)	102
		INCLINATION	-90
		FLUSH	Polymer Gel
DATE STARTED	16/02/2009	DATE COMPLETED	17/02/2009
CLIENT	Indaver	DRILLED BY	Petersen
ENGINEER	PM Group	LOGGED BY	A. Mahony

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
10	10.00	100	100	100	520			LIMESTONE (siliceous and fossiliferous). Fresh to slightly weathered.		Discontinuities are rough and undulose. Apertures are open with clay sand smearing surfaces. Dips are sub-10° with sub-vertical fractures (11.6-12.07m).	20.02		
	10.50	100	98	98	710 0000000000001			Very strong, locally strong, thickly bedded, blue grey, fine to coarse grained LIMESTONE (siliceous and fossiliferous). Fresh to locally slightly weathered.					
11	11.50	100	28	15									
12	12.15							End of Corehole at 12.15 (m)	12.15		17.87		

13 14 15 16 17 18 19

REMARKS

7 Core boxes, 10.85m Core liner used. No groundwater encountered. Grout 0.0m-12.1m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC5
		SHEET	Sheet 1 of 2
CO-ORDINATES	306,280.57 E 270,916.06 N	DATE STARTED	13/02/2009
GROUND LEVEL (m)	30.08	DATE COMPLETED	16/02/2009
CORE DIAMETER (mm)	102		
INCLINATION	-90	DRILLED BY	Petersen
CLIENT	Indaver		
ENGINEER	PM Group		
FLUSH	Polymer Gel	LOGGED BY	A. Mahony

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
0 – 0.70			
0.70 – 1.50	88	0	0
1.50 – 2.50	100	0	0
2.50 – 3.00	100	0	0
3.00 – 4.00	100	0	0
4.00 – 4.50	100	0	0
4.50 – 5.50	100	0	0
5.50 – 6.00	100	58	58
6.00 – 7.50	100	20	20
7.50 – 9.00	100	53	53
9.00 –	100	83	76

Fracture Spacing (mm): 0 250 500

Strata description	Depth (m)	Elevation
OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	0.70	29.38
Brown mottled black/dark brown, sandy gravelly CLAY with occasional cobbles	1.50	28.58
Brown very sandy gravelly SILT/CLAY with occasional cobbles	2.20	27.88
Brown SILT/CLAY	3.20	26.88
Brown mottled yellow/dark brown, slightly sandy gravelly (fine), CLAY with occasional cobbles	3.90	26.18
Dark brown fine SAND with occasional gravel	4.05	26.03
Dark brown gravelly, slightly silty fine SAND	4.30	25.78
Dark brown silty, gravelly SAND.	4.40	25.68
Brown very sandy gravelly SILT/CLAY with occasional cobbles	4.60	25.48
Brown silty, very sandy GRAVEL (very silty/clayey 5.5m-5.8m)	5.80	24.28
Strong to moderately strong and locally very strong where intact, blue grey, medium to coarse grained LIMESTONE (siliceous and fossiliferous). Slightly to moderately weathered.		

Discontinuities (from 5.80 m): Discontinuities are rough and undulose to irregular. Apertures are open with clay/sand/gravel smeared and infilled, slightly iron oxide stained. Dips are sub-0° with sub-vertical fractures common.

Columns: Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Fracture Spacing (mm) | Legend | Non-intact zones | Strata description | Depth (m) | Discontinuities | Elevation | Standpipe Details | SPT (N Value)

REMARKS

7 Core boxes, 11.2m Core liner used. No groundwater encountered. Grout 0.0m-12.2m. 100% flush loss from 6.5m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

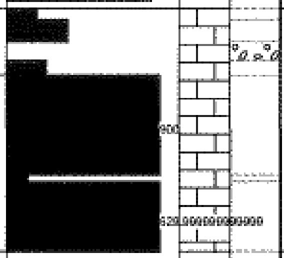
IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER
14039

CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC GC5
		SHEET	Sheet 2 of 2
CO-ORDINATES	306,280.57 E 270,916.06 N	DATE STARTED	13/02/2009
GROUND LEVEL (m)	30.08	DATE COMPLETED	16/02/2009
CORE DIAMETER (mm)	102		
INCLINATION	-90	DRILLED BY	Petersen
CLIENT	Indaver	LOGGED BY	A. Mahony
ENGINEER	PM Group		
FLUSH	Polymer Gel		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
10	10.60	100	90	90				Strong to moderately strong and locally very strong where intact, blue grey, medium to coarse grained LIMESTONE (siliceous and fossiliferous). Slightly to moderately weathered. *(continued)*	12.20	Discontinuities are rough and undulose to irregular. Apertures are open with clay/sand/gravel smeared and infilled, slightly iron oxide stained. Dips are sub-0° with sub-vertical fractures common. *(continued)*	17.88		
11	12.20							End of Corehole at 12.2 (m)					
12													
13													
14													
15													
16													
17													
18													
19													



REMARKS

7 Core boxes, 11.2m Core liner used. No groundwater encountered. Grout 0.0m-12.2m. 100% flush loss from 6.5m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 14039

CONTRACT	Indaver Waste Management Facility, Duleek	**DRILLHOLE NO**	**RC GC6**
		SHEET	Sheet 1 of 2
CO-ORDINATES	306,325.72 E 270,960.26 N	**DATE STARTED**	18/02/2009
GROUND LEVEL (m)	30.27	**DATE COMPLETED**	18/02/2009
CORE DIAMETER (mm)	102		
INCLINATION	-90	**DRILLED BY**	Petersen
CLIENT	Indaver		
ENGINEER	PM Group	**LOGGED BY**	A. Mahony
FLUSH	Polymer Gel		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
0								OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	0.80		29.47		
1	0.80	100	0	0				Brown very sandy, gravelly CLAY/SILT (Gravel is fine to coarse, sub-rounded to angular)	1.50		28.77		
2	1.50	100	0	0				Brown silty fine SAND	2.00		28.27		
	2.50	100	0	0				Brown very silty, gravelly fine to medium grained SAND. (Gravel is fine to coarse, sub-rounded to angular)	2.50		27.77		
3	3.00	100	0	0				Brown silty, sandy, gravelly CLAY. (Gravel is fine to coarse, sub-rounded to sub-angular)					
4	4.00	100	0	0									
5	4.50	100	0	0									
	5.50	100	0	0									
6	6.00	100	9	9									
7	7.40	100	0	0									
8	7.50	100	7	7					8.25	Discontinuities are rough and undulose. Apertures are wide to very wide with sandy/clayey/gravelly smeared surfaces and infilling. Dips appear sub-40° with variably dipping fractues throughout.	22.02		
9	9.00	100	18	18									

REMARKS

8 Core boxes, 12.2m Core liner used. No groundwater encountered. Grout 0.0m-13.5m. 50% flush loss from 9.0m. ½hr dayworks - laid 60m of Geogrid to improve access to location.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	14039
CONTRACT	Indaver Waste Management Facility, Duleek
DRILLHOLE NO	RC GC6
SHEET	Sheet 2 of 2
CO-ORDINATES	306,325.72 E 270,960.26 N
GROUND LEVEL (m)	30.27
CORE DIAMETER (mm)	102
INCLINATION	-90
FLUSH	Polymer Gel
DATE STARTED	18/02/2009
DATE COMPLETED	18/02/2009
CLIENT	Indaver
ENGINEER	PM Group
DRILLED BY	Petersen
LOGGED BY	A. Mahony

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
10	10.50							Strong to moderately strong, medium bedded, grey, medium to coarse grained LIMESTONE (fossiliferous and siliceous). Heavily infilled with clay/sand/gravel. (10.5m-10.9m, 11.17m-11.76m, marly, sandy clayey highly weathered rock - structure locally preserved) *(continued)*		Discontinuities are rough and undulose. Apertures are wide to very wide with sandy/clayey/gravelly smeared surfaces and infilling. Dips appear sub-40° with variably dipping fractues throughout. *(continued)*			
11–12		90	13	13									
13	12.60	100	42	42					13.50				
	13.50							End of Corehole at 13.5 (m)			16.77		
14–19													

REMARKS

8 Core boxes, 12.2m Core liner used. No groundwater encountered. Grout 0.0m-13.5m. 50% flush loss from 9.0m. ½hr dayworks - laid 60m of Geogrid to improve access to location.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 30/3/09

Appendix 2

Rotary Core Drillhole Records (Conventional P Drillholes)

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER
14039

CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC RP1
		SHEET	Sheet 1 of 2
CO-ORDINATES(_)	306,246.51 E 270,914.34 N	DATE STARTED	10/02/2009
GROUND LEVEL (m)	29.94	DATE COMPLETED	10/02/2009
CORE DIAMETER (mm)	80	DRILLED BY	Petersen
INCLINATION	-90	LOGGED BY	A. Mahony
FLUSH	Air/Mist		
CLIENT	Indaver		
ENGINEER	PM Group		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
0 – 6								OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	6.40		23.54		
								OPEN HOLE DRILLING: Observed by driller as angular gravel size returns of	6.90				

REMARKS

1 Core box. No groundwater encountered. 2hrs dayworks - laid 150m of Geogrid to improve access to location.

INSTALLATION REMARKS

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 9/3/09

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	**DRILLHOLE NO**	RC RP1
		SHEET	Sheet 2 of 2
CO-ORDINATES(_)	306,246.51 E 270,914.34 N	**DATE STARTED**	10/02/2009
GROUND LEVEL (m)	29.94	**DATE COMPLETED**	10/02/2009
CORE DIAMETER (mm)	80		
INCLINATION	-90	**DRILLED BY**	Petersen
FLUSH	Air/Mist	**LOGGED BY**	A. Mahony
CLIENT	Indaver		
ENGINEER	PM Group		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
7								limestone (probable variably weathered bedrock)			23.04		
	7.50							OPEN HOLE DRILLING: Observed by driller as angular gravel size returns of limestone (probable bedrock) *(continued)*	7.50		22.44		
8		87	79	79				Strong to very strong, thickly bedded, blue grey, medium grained LIMESTONE (siliceous and fossiliferous). Fresh to locally slightly weathered. Cavity observed by driller at 8.7m-8.9m)		Discontinuities are rough and undulose. Apertures are open with local clay smearing (7.79m-7.88m, 8.84-9.57m, 9.72-9.91m), and local slight iron oxide stained surfaces (8.84m-9.57m). Dips are sub-0°-20° with local sub-vertical fractures (8.84m-9.57m, 9.72-9.91m).			
9	9.00	97	21	21									
10													
	10.50							End of Corehole at 10.5 (m)	10.50		19.44		
11													
12													
13													

REMARKS

1 Core box. No groundwater encountered. 2hrs dayworks - laid 150m of Geogrid to improve access to location.

INSTALLATION REMARKS

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 9/3/09

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	**DRILLHOLE NO**	RC RP2
		SHEET	Sheet 1 of 2
CO-ORDINATES(_)	306,241.74 E 270,906.39 N	**DATE STARTED**	10/02/2009
GROUND LEVEL (m)	30.03	**DATE COMPLETED**	10/02/2009
CORE DIAMETER (mm)	80		
INCLINATION	-90	**DRILLED BY**	Petersen
CLIENT	Indaver		
ENGINEER	PM Group	**LOGGED BY**	A. Mahony
FLUSH	Air/Mist		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
0–5.70								OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	5.70		24.33		
5.70–7.00								OPEN HOLE DRILLING: Observed by driller as angular gravel size returns of limestone (probable variably weathered bedrock)	7.00				

Depth scale: 0, 1, 2, 3, 4, 5, 6

REMARKS

1 Core box. No groundwater encountered.

INSTALLATION REMARKS

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER	14039		
CONTRACT	Indaver Waste Management Facility, Duleek	DRILLHOLE NO	RC RP2
		SHEET	Sheet 2 of 2
CO-ORDINATES(_)	306,241.74 E 270,906.39 N	DATE STARTED	10/02/2009
GROUND LEVEL (m)	30.03	DATE COMPLETED	10/02/2009
CORE DIAMETER (mm)	80		
INCLINATION	-90	DRILLED BY	Petersen
FLUSH	Air/Mist	LOGGED BY	A. Mahony
CLIENT	Indaver		
ENGINEER	PM Group		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
7								OPEN HOLE DRILLING: Observed by driller as angular gravel size returns of limestone (probable bedrock)			23.03		
8	7.50	100	78	72				Strong to very strong, locally moderately strong, medium to thickly bedded, grey, medium grained LIMESTONE (siliceous and fossiliferous). Fresh to slightly weathered.	7.50	Discontinuities are rough and undulose. Apertures are open with local clay smearing (7.84m-8.06m, 8.28m). Dips are sub-0°-10° with local sub-vertical and 45° fractures.	22.53		
9, 10	9.00	97	63	63									
11, 12, 13	10.50							End of Corehole at 10.5 (m)	10.50		19.53		

REMARKS

1 Core box. No groundwater encountered.

INSTALLATION REMARKS

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 9/3/09

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	14039

CONTRACT	Indaver Waste Management Facility, Duleek	**DRILLHOLE NO**	RC RP5
		SHEET	Sheet 1 of 2
CO-ORDINATES(_)	306,255.43 E 270,916.96 N	**GROUND LEVEL (m)**	30.18
		CORE DIAMETER (mm)	80
CLIENT	Indaver	**INCLINATION**	-90
ENGINEER	PM Group	**FLUSH**	Air/Mist
DATE STARTED	19/02/2009	**DATE COMPLETED**	19/02/2009
DRILLED BY	Petersen	**LOGGED BY**	A. Mahony

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
0 – 6								OPEN HOLE DRILLING: Observed by driller as returns of brown silty, very sandy gravelly clay	6.70		23.48		

REMARKS

1 Core box. No groundwater encountered. Grout 0.0m-10.5m.

INSTALLATION REMARKS

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC NEWLOG 10M PER PG 14039.GPJ IGSL.GDT 9/3/09

GEOTECHNICAL CORE LOG RECORD

IGSL

REPORT NUMBER 14039

CONTRACT	Indaver Waste Management Facility, Duleek	**DRILLHOLE NO**	**RC RP5**
		SHEET	Sheet 2 of 2
CO-ORDINATES(_)	306,255.43 E 270,916.96 N	**DATE STARTED**	19/02/2009
GROUND LEVEL (m)	30.18	**DATE COMPLETED**	19/02/2009
CORE DIAMETER (mm)	80		
INCLINATION	-90	**DRILLED BY**	Petersen
FLUSH	Air/Mist	**LOGGED BY**	A. Mahony
CLIENT	Indaver		
ENGINEER	PM Group		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing (mm) 0 250 500	Legend	Non-intact zones	Strata description	Depth (m)	Discontinuities	Elevation	Standpipe Details	SPT (N Value)
7								OPEN HOLE DRILLING: Observed by driller as clayey angular gravel size returns of limestone (probable variably weathered bedrock) *(continued)*					
	7.50	64	0	0					7.50		22.68		
8								Moderately strong to moderately weak, grey, medium to coarse grained LIMESTONE (siliceous and fossiliferous). Moderately weathered. Non intact throughout with clayey (dry) sandy gravel and cobble size returns.					
	8.60	91	63	63					8.65	Discontinuities are rough and undulose. Apertures are wide with sandy surfaces. Variably dipping fractues and locally sub-vertical fractures (8.91m-8.98m, 9.22m-9.41m) and sub-45 planar break at 9.85m.	21.53		
9													
	9.70	100	84	72				Strong to locally moderately strong, medium to thinly bedded, grey, medium to coarse grained LIMESTONE (siliceous and fossiliferous). Fresh to slightly and locally moderately weathered.					
10													
	10.50							End of Corehole at 10.5 (m)	10.50		19.68		
11													
12													
13													

REMARKS

1 Core box. No groundwater encountered. Grout 0.0m-10.5m.

INSTALLATION REMARKS

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

Appendix 3

Percolation Test Records

Soakaway Design f -value from field tests IGSL

Contract:	Indaver Ireland	Contract No.	14039
Test No.	PP2		
Engineer	PM Group		
Date:			

Summary of ground conditions

from	to	Description	Ground water
0.00	0.20	Soft brown SILT/CLAY with some organic matter	None
0.20	1.20	Firm brown sandy gravelly CLAY with sub-angular and angular cobbles	
1.20		Stiff brown sandy gravelly CLAY with pockets of sandy SILT and many	
	2.00	sub-angular and angular cobbles	

Notes:

Field Data

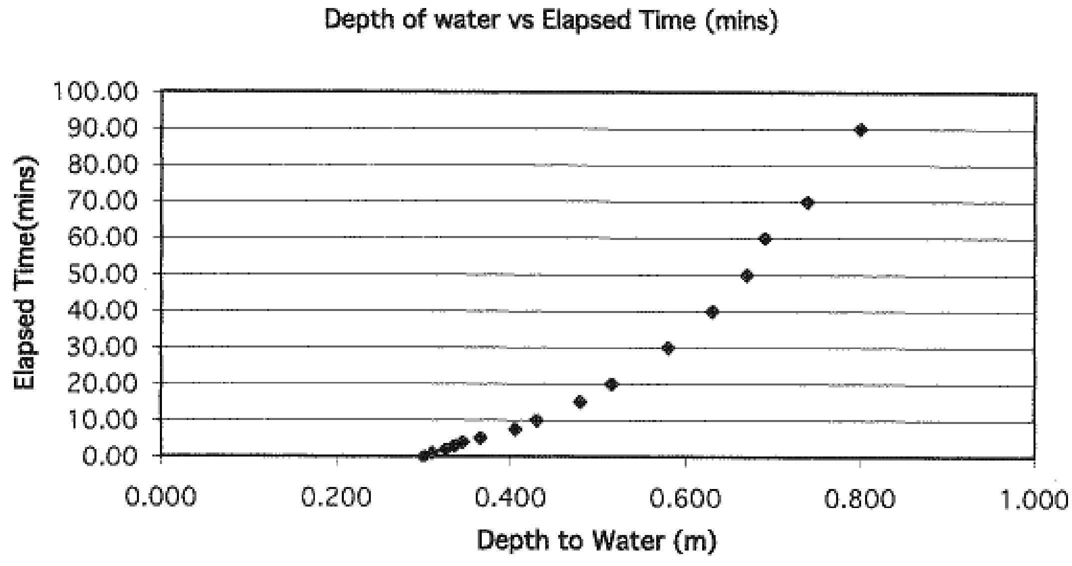
Depth to Water (m)	Elapsed Time (min)
0.300	0.00
0.310	1.00
0.325	2.00
0.335	3.00
0.345	4.00
0.365	5.00
0.405	7.50
0.430	10.00
0.480	15.00
0.515	20.00
0.580	30.00
0.630	40.00
0.670	50.00
0.690	60.00
0.740	70.00
0.800	90.00

Field Test

Depth of Pit (D)	2.00	m
Width of Pit (B)	0.40	m
Length of Pit (L)	1.20	m
Initial depth to Water =	0.30	m
Final depth to water =	0.80	m
Elapsed time (mins)=	90.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.48	m2
*Av. side area of permeable stratum over test period=	4.64	m2
Total Exposed area =	5.12	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00052 m/min or 8.6806E-06 m/sec



Soakaway Design f -value from field tests IGSL

Contract:	Indaver Ireland	Contract No.	14039
Test No.	PP3		
Engineer	PM Group		
Date:			

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	Soft brown slightly sandy CLAY with some organic matter	None
0.30		Soft brown slightly gravelly, sandy CLAY with occasional rounded	
	1.10	cobbles	
1.10		Firm brown slightly gravelly, sandy CLAY with occasional sub-angular	
	1.85	and angular cobbles	

Notes:

Field Data

Depth to Water (m)	Elapsed Time (min)
0.270	0.00
0.270	1.00
0.275	2.00
0.280	3.00
0.285	4.00
0.290	5.00
0.295	7.50
0.305	10.00
0.320	15.00
0.335	20.00
0.360	30.00
0.385	40.00
0.395	50.00
0.410	60.00
0.430	70.00

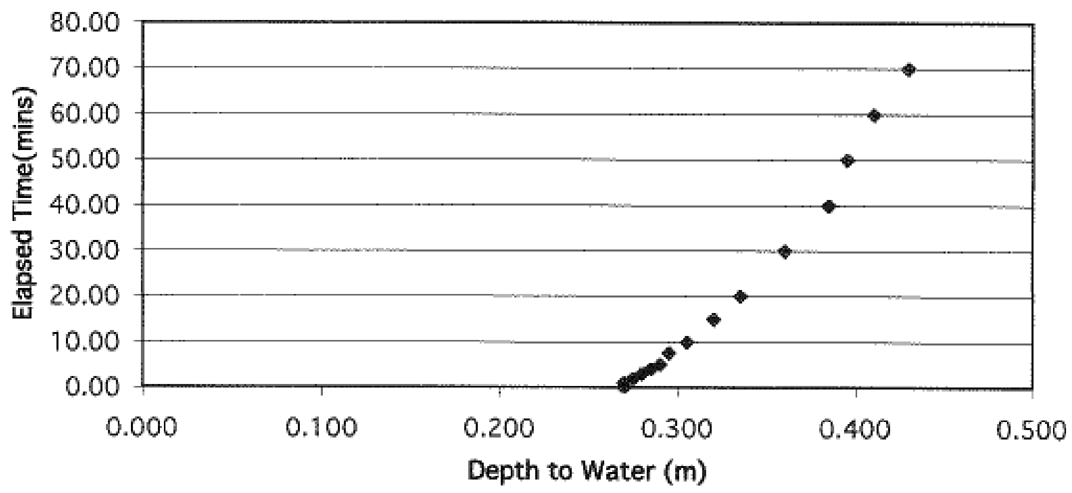
Field Test

Depth of Pit (D)	1.80	m
Width of Pit (B)	0.45	m
Length of Pit (L)	1.10	m
Initial depth to Water =	0.27	m
Final depth to water =	0.43	m
Elapsed time (mins)=	70.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	0.495	m2
*Av. side area of permeable stratum over test period=	4.495	m2
Total Exposed area =	4.99	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00023 m/min or 3.779E-06 m/sec

Depth of water vs Elapsed Time (mins)

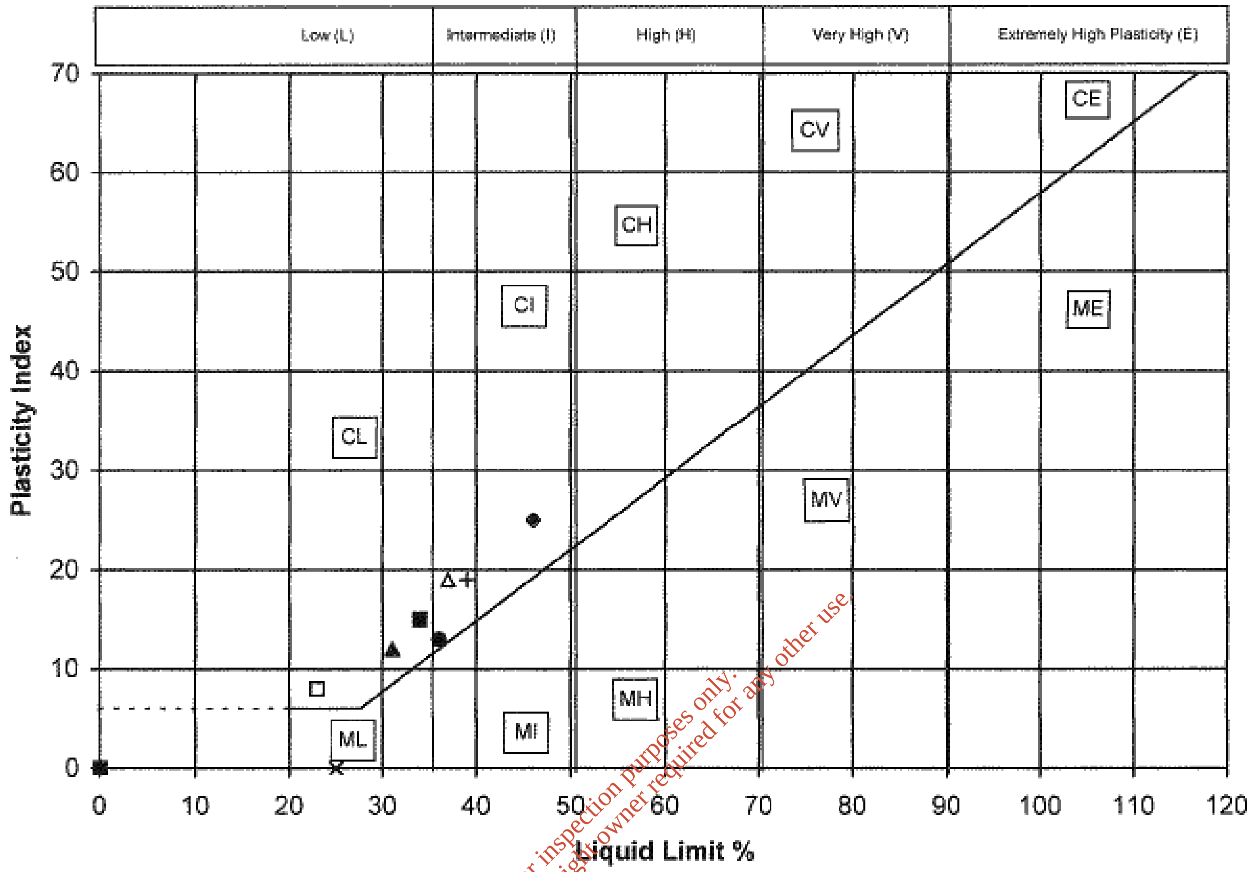


Appendix 4

Geotechnical Soil Laboratory Test Records

Plasticity Chart - Summary of Liquid & Plastic Limit Tests
BS1377:Part 2:1990, clauses 3.2, 4 & 5
Chart in accordance with BS5930:1999, fig.18

Contract No. 14039 Contract: INDAVER WASTE MANAGEMENT FACILITY, DU



Code	BH/TP	Sample	Depth (m)	MC%	LL%	PL%	PI%	%<425µm	Description
▲	GC1	AH2527	2.60	23	31	19	12	88	Orangish brown slightly sandy slightly gravelly CLAY
■	GC2	AH2529	2.50	11.3	34	19	15	28	Grey brown silty very sandy GRAVEL
●	GC2	0	4.50	8.1	36	23	13	13	Grey brown silty sandy GRAVEL
◆	GC3	AH2525	2.00	20	46	21	25	95	Orangish brown slightly sandy slightly gravelly CLAY
×	GC3	0	4.50	13	25	NP	0	69	Light brown slightly sandy slightly gravelly SILT
+	GC4	AH2526	3.20	19.6	39	20	19	98	Light brown slightly sandy slightly gravelly CLAY
△	GC5	AH2528	3.00	18.7	37	18	19	79	Brown slightly sandy slightly gravelly CLAY
□	GC6+	AH2524	2.50	10.9	23	15	8	56	Orangish brown slightly sandy slightly gravelly CLAY
○									
◇									
▲									
■									
●									
◆									
×									
+									
△									

NP denotes specimen is non-plastic.

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		27/03/2009			

Summary of Classification Tests

BS1377:Part 2:1990, clauses 3.2, 4.3, 5.3 & 5.4

BH/TP No.	Sample No.	Depth (m)	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	<425μm %	Preparation	Description	Classification
GC1	AH2527	2.60	GCS	23	31	19	12	88	WS	Orangish brown slightly sandy slightly gravelly CLAY	C L
GC2	AH2529	2.50	GCS	11.3	34	19	15	28	WS	Grey brown silty very sandy GRAVEL	
GC2		4.50	GCS	8.1	36	23	13	13	WS	Grey brown silty sandy GRAVEL	C I
GC3	AH2525	2.00	GCS	20	46	21	25	95	WS	Orangish brown slightly sandy slightly gravelly CLAY	C I
GC3		4.50	GCS	13	25	NP		69	WS	Light brown slightly sandy slightly gravelly SILT	M L
GC4	AH2526	3.20	GCS	19.6	39	20	19	98	WS	Light brown slightly sandy slightly gravelly CLAY	C I
GC5	AH2528	3.00	GCS	18.7	37	18	19	79	WS	Brown slightly sandy slightly gravelly CLAY	C I
GC6+	AH2524	2.50	GCS	10.9	23	15	8	56	WS	Orangish brown slightly sandy slightly gravelly CLAY	C L

Notes: NAT - tested as received WS - Wet sieved (425μm) NP - Non Plastic

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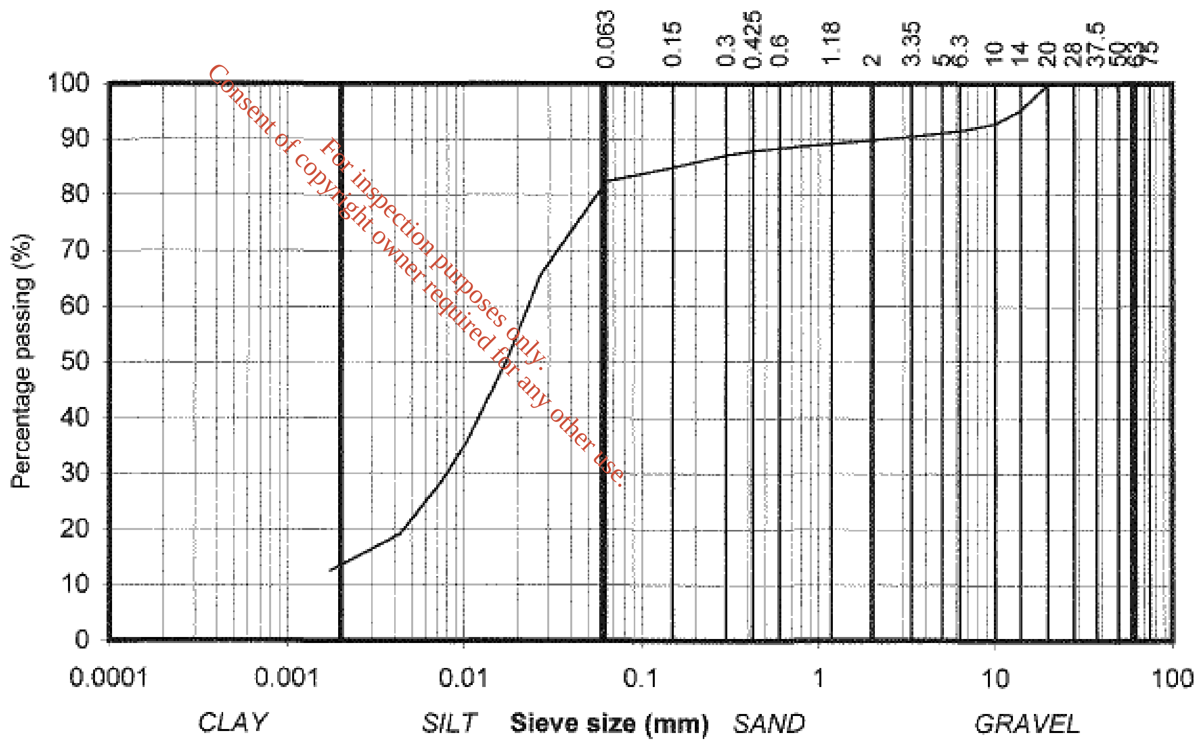
	Issued By	Date 27/03/2009		Page of

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No: 14039
Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
BH/TP No: GC1
SAMPLE No.: AH2527 SAMPLE TYPE: GCS
DEPTH (m): 2.60
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Orangish brown slightly sandy, slightly gravelly, CLAY

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	100	
14	95	
10	93	
6.3	91	
5	91	
3.35	90	
2	90	SAND
1.18	89	
0.6	88	
0.425	88	
0.3	87	
0.15	85	
0.063	82	SILT/CLAY
0.037	72	
0.027	65	
0.017	50	
0.010	36	
0.007	28	
0.004	19	
0.002	13	



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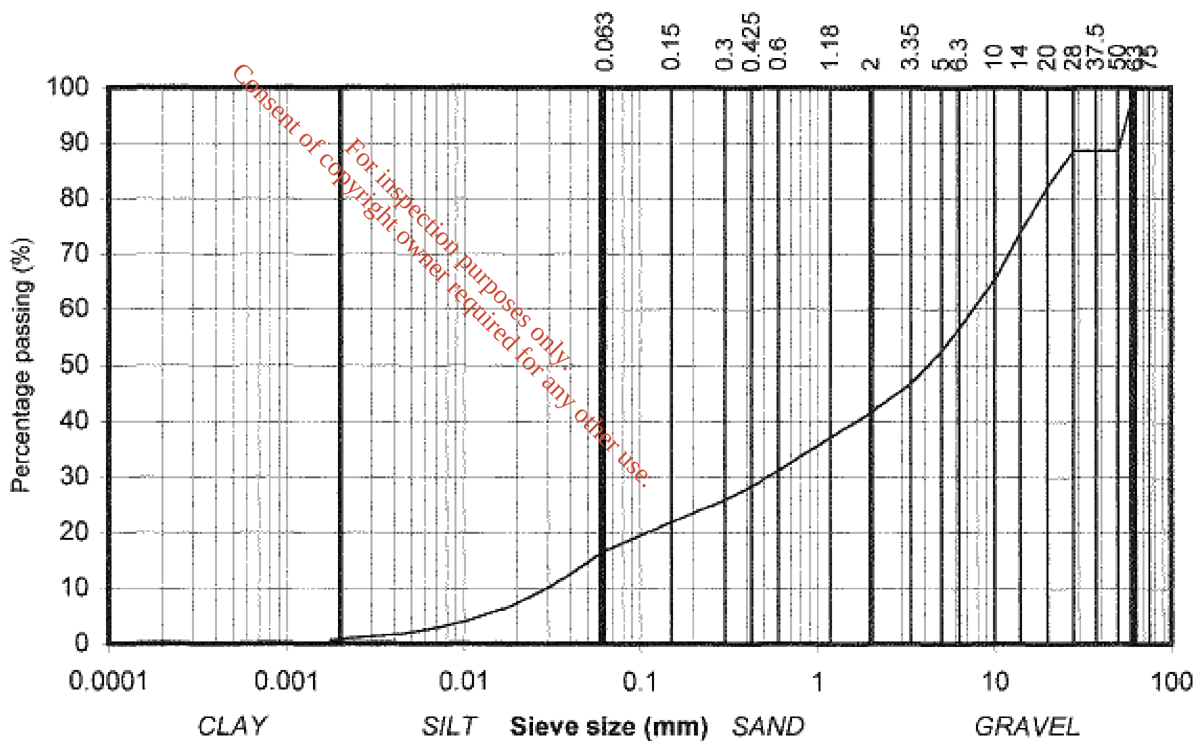
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No: 14039
Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
BH/TP No: GC2
SAMPLE No.: AH2529 SAMPLE TYPE: GCS
DEPTH (m): 2.50
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Grey brown silty, very sandy, GRAVEL

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	89	
37.5	89	
28	89	
20	82	
14	74	
10	65	
6.3	57	
5	52	
3.35	47	
2	42	SAND
1.18	37	
0.6	31	
0.425	28	
0.3	26	
0.15	22	
0.063	17	SILT/CLAY
0.038	12	
0.028	10	
0.018	7	
0.011	4	
0.008	3	
0.004	2	
0.002	1	



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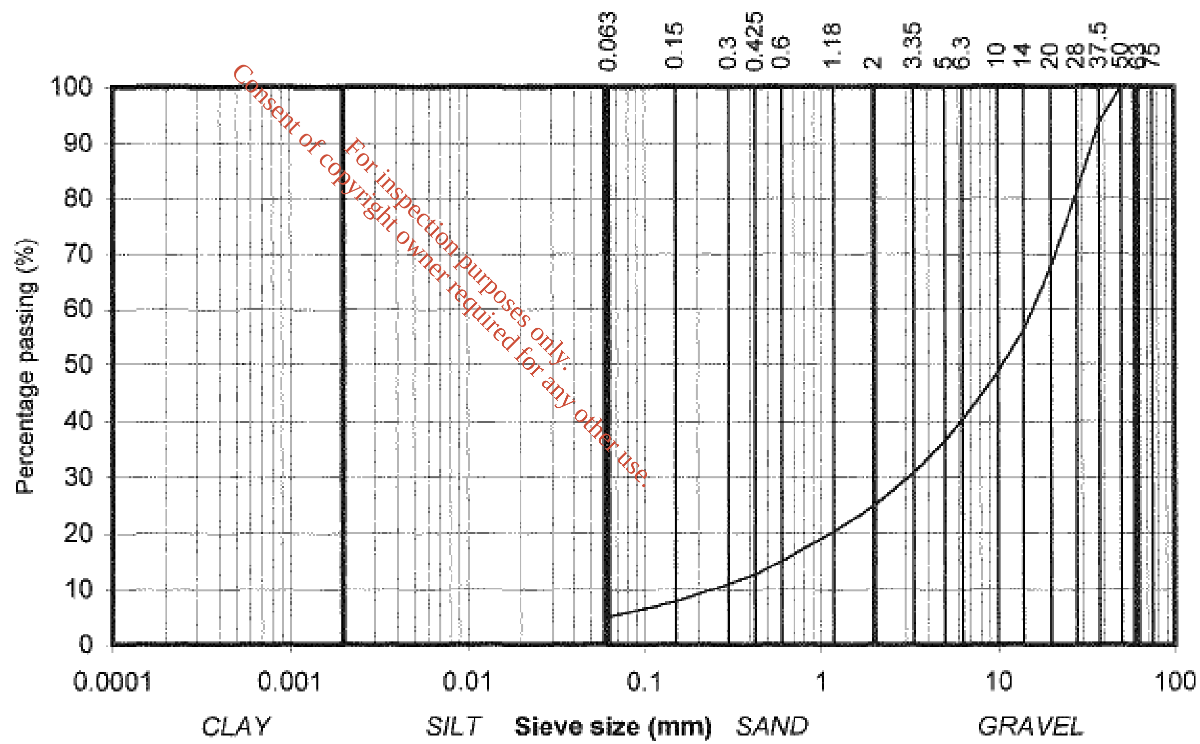
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No:	14039
Contract:	INDAVER WASTE MANAGEMENT FACILITY, DULEEK
BH/TP No:	GC2
SAMPLE No.:	0
SAMPLE TYPE:	GCS
DEPTH (m):	4.50
TEST METHOD:	Wet sieve
DESCRIPTION:	Grey brown silty, sandy, GRAVEL

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	GRAVEL
37.5	94	GRAVEL
28	81	GRAVEL
20	68	GRAVEL
14	56	GRAVEL
10	49	GRAVEL
6.3	40	GRAVEL
5	37	GRAVEL
3.35	31	GRAVEL
2	25	SAND
1.18	20	SAND
0.6	15	SAND
0.425	13	SAND
0.3	11	SAND
0.15	8	SAND
0.063	5	SILT/CLAY
0.043	#N/A	SILT/CLAY
0.030	#N/A	SILT/CLAY
0.019	#N/A	SILT/CLAY
0.011	#N/A	SILT/CLAY
0.008	#N/A	SILT/CLAY
0.005	#N/A	SILT/CLAY
0.002	#N/A	SILT/CLAY



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Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	100	
14	100	
10	100	
6.3	100	
5	99	
3.35	99	
2	99	SAND
1.18	98	
0.6	96	
0.425	95	
0.3	92	
0.15	83	
0.063	75	SILT/CLAY
0.037	66	
0.027	54	
0.017	42	
0.010	32	
0.007	27	
0.004	21	
0.002	16	

Contract No: 14039

Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK

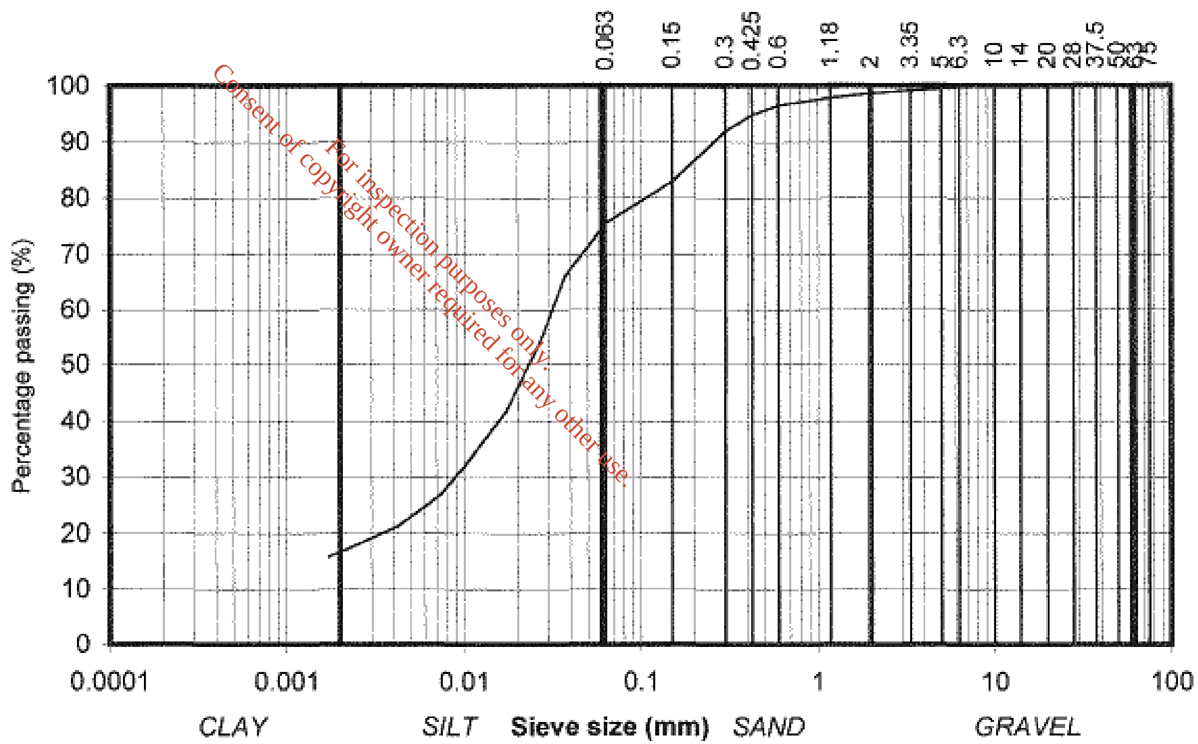
BH/TP No: GC3

SAMPLE No.: AH2525 SAMPLE TYPE: GCS

DEPTH (m): 2.00

TEST METHOD: Wet sieve and hydrometer

DESCRIPTION: Orangish brown slightly sandy, slightly gravelly, SILT



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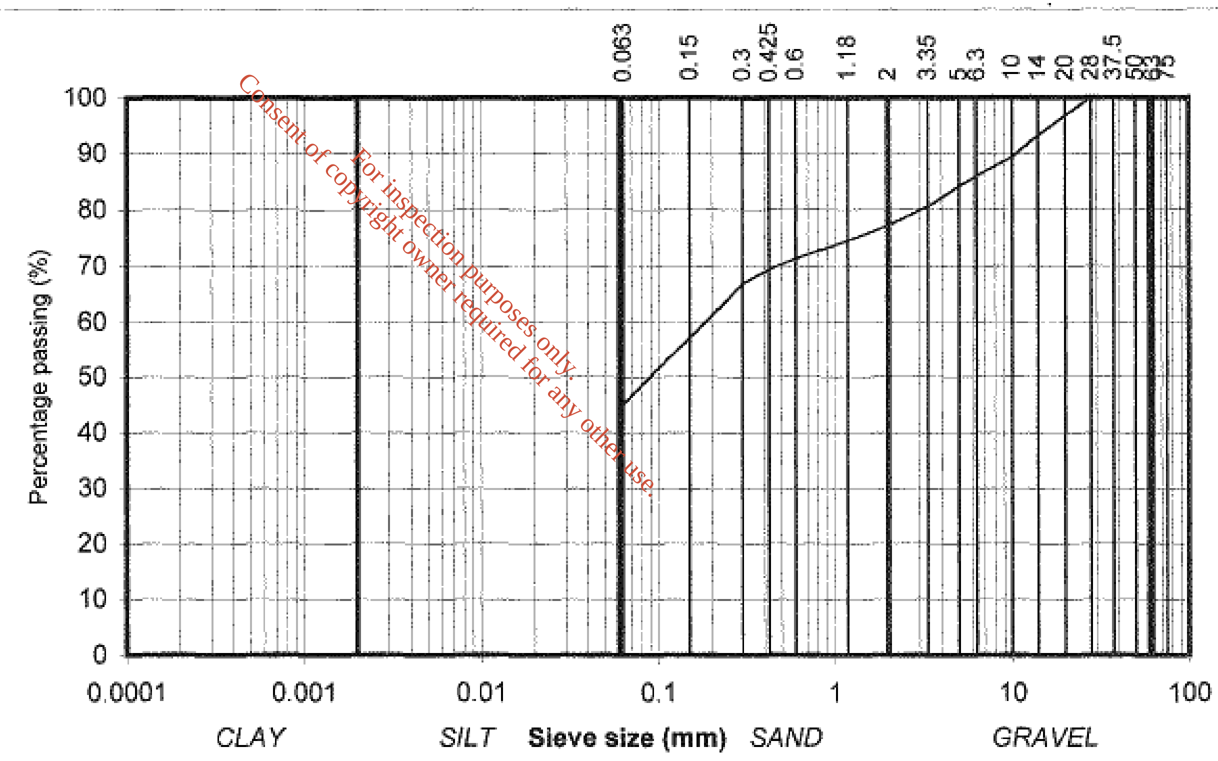
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No: 14039
Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
BH/TP No: GC3
SAMPLE No.: 0   SAMPLE TYPE: GCS
DEPTH (m): 4.50
TEST METHOD: Wet sieve
DESCRIPTION: Light brown slightly sandy, slightly gravelly, SILT

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	97	
14	93	
10	89	
6.3	86	
5	84	
3.35	80	
2	77	SAND
1.18	74	
0.6	71	
0.425	69	
0.3	67	
0.15	57	
0.063	45	SILT/CLAY
0.043	#N/A	
0.030	#N/A	
0.019	#N/A	
0.011	#N/A	
0.008	#N/A	
0.005	#N/A	
0.002	#N/A	



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Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No: 14039

Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK

BH/TP No: GC4

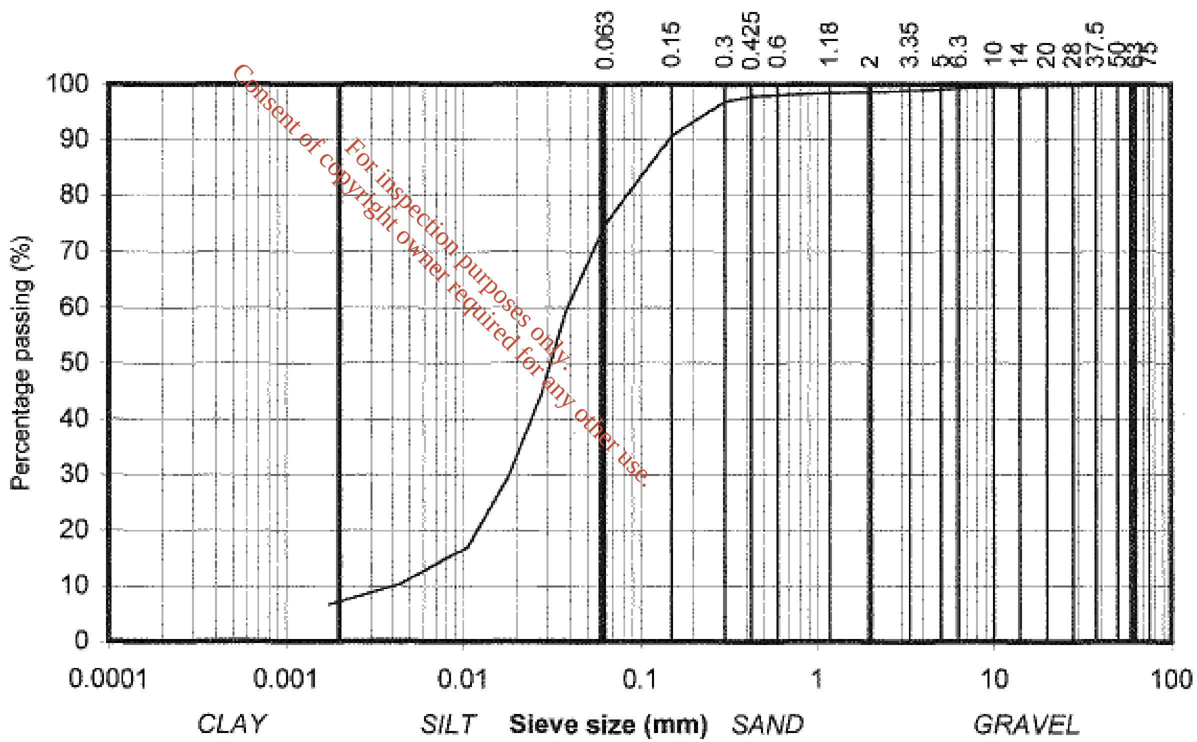
SAMPLE No.: AH2526 SAMPLE TYPE: GCS

DEPTH (m): 3.20

TEST METHOD: Wet sieve and hydrometer

DESCRIPTION: Light brown slightly sandy, slightly gravelly, CLAY

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	100	
14	100	
10	100	
6.3	99	
5	99	
3.35	99	
2	99	SAND
1.18	98	
0.6	98	
0.425	98	
0.3	97	
0.15	91	
0.063	75	SILT/CLAY
0.038	60	
0.028	45	
0.018	29	
0.011	17	
0.007	14	
0.004	10	
0.002	7	



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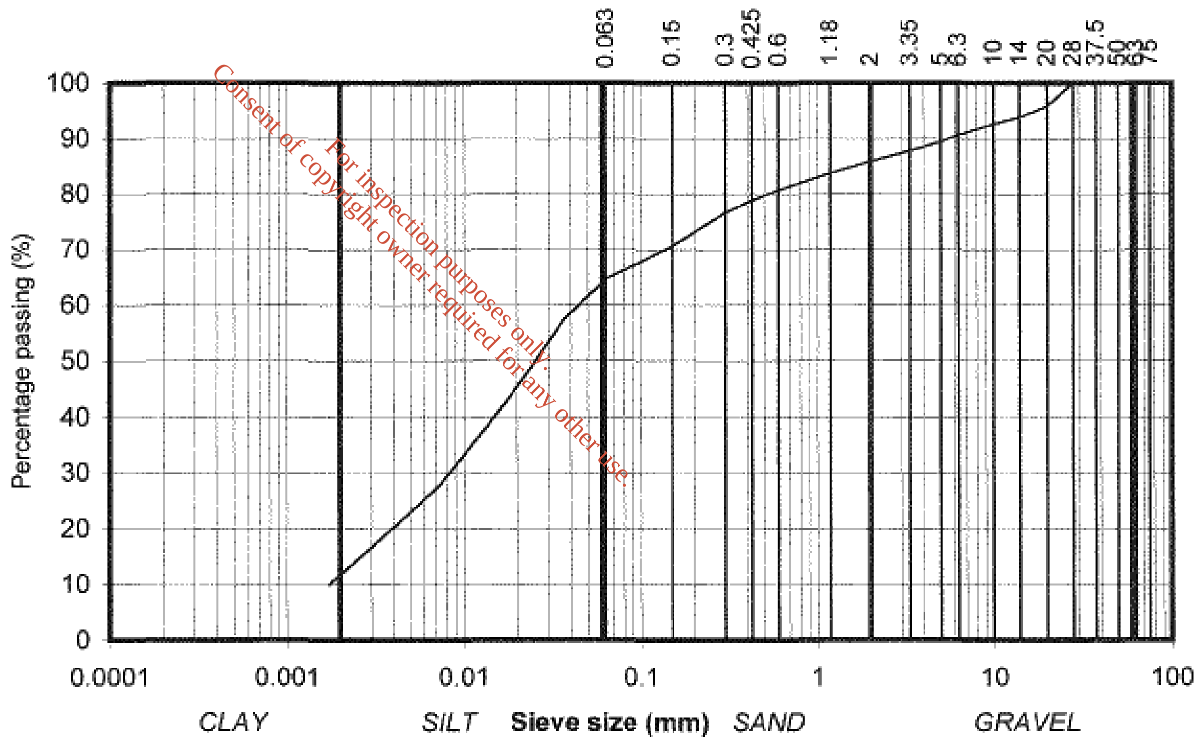
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No: 14039
Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
BH/TP No: GC5
SAMPLE No.: AH2528 SAMPLE TYPE: GCS
DEPTH (m): 3.00
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Brown slightly sandy, slightly gravelly, CLAY

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	100	
20	96	
14	94	
10	93	
6.3	91	
5	89	
3.35	88	
2	86	SAND
1.18	84	
0.6	81	
0.425	79	
0.3	77	
0.15	71	
0.063	65	SILT/CLAY
0.037	58	
0.027	51	
0.017	43	
0.010	33	
0.007	27	
0.004	21	
0.002	10	



IGSL

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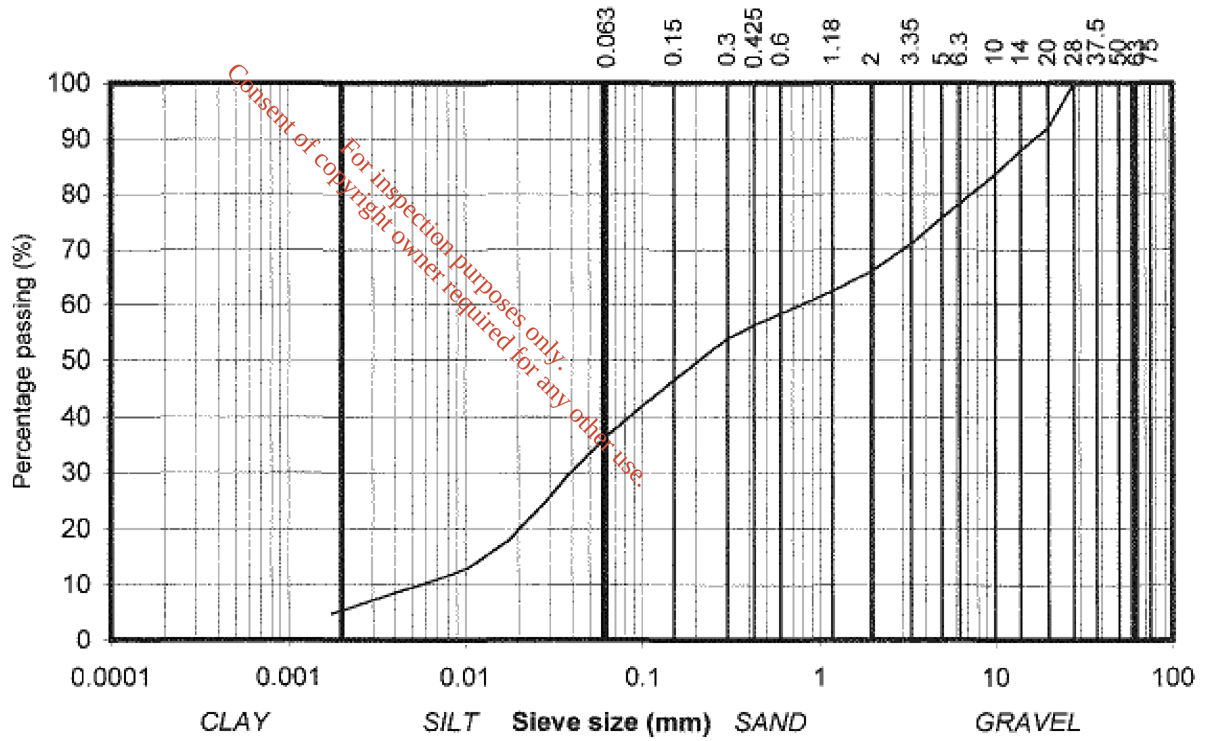
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

Contract No:	14039
Contract:	INDAVER WASTE MANAGEMENT FACILITY, DULEEK
BH/TP No:	GC6+
SAMPLE No.:	AH2524 SAMPLE TYPE: GCS
DEPTH (m):	2.50
TEST METHOD:	Wet sieve and hydrometer
DESCRIPTION:	Orangish brown slightly sandy, slightly gravelly, CLAY

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	GRAVEL
37.5	100	GRAVEL
28	100	GRAVEL
20	92	GRAVEL
14	88	GRAVEL
10	84	GRAVEL
6.3	78	GRAVEL
5	76	GRAVEL
3.35	71	GRAVEL
2	66	SAND
1.18	62	SAND
0.6	58	SAND
0.425	56	SAND
0.3	54	SAND
0.15	47	SAND
0.063	37	SILT/CLAY
0.038	29	SILT/CLAY
0.027	24	SILT/CLAY
0.018	18	SILT/CLAY
0.010	13	SILT/CLAY
0.007	11	SILT/CLAY
0.004	9	SILT/CLAY
0.002	5	SILT/CLAY



IGSL	Issued By	Date:			Page no:
	D Connolly	27/03/2009			1 of 1

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

BH	RC1	Sample	AH2527	Depth (m)	2.6

Condition: Undisturbed

Corrections: 2 membranes and side drains

Description: Orangish brown sandy gravelly CLAY

Initial Conditions

Height (mm)	200	Diameter (mm)	103
Area (mm^2)	8332.29	Volume (cm^3)	1666.46
% Moisture Content	23	Bulk Density (Mg/m^3)	2.06
		Dry Density (Mg/m^3)	1.68

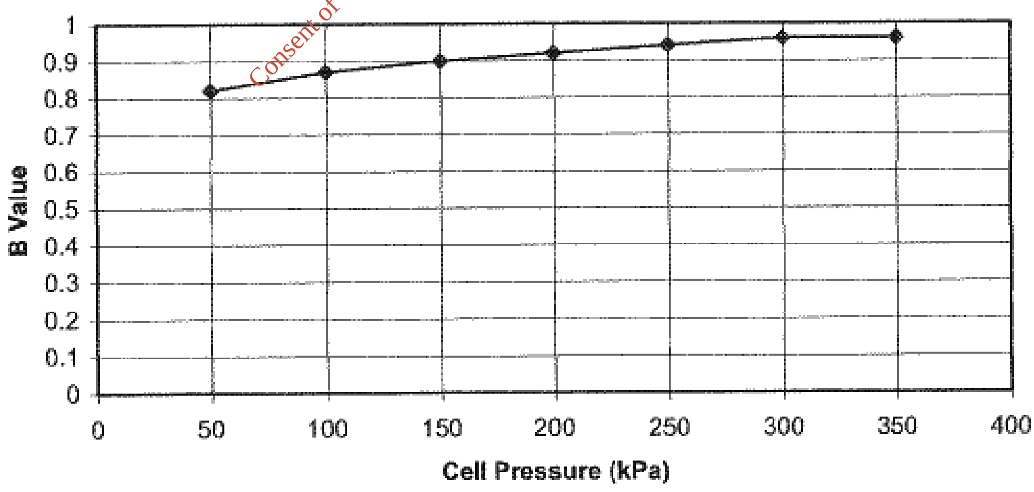
Final Conditions

% Moisture Content	20	Bulk Density (Mg/m^3)	2.02
		Dry Density (Mg/m^3)	1.69

Saturation stage

Effective stress (kPa) 50 Saturation by 50kPa Cell Pressure Increments

Initial B Value 0.82 Final B Value 0.96



IGSL Ltd.

Contract Duleek

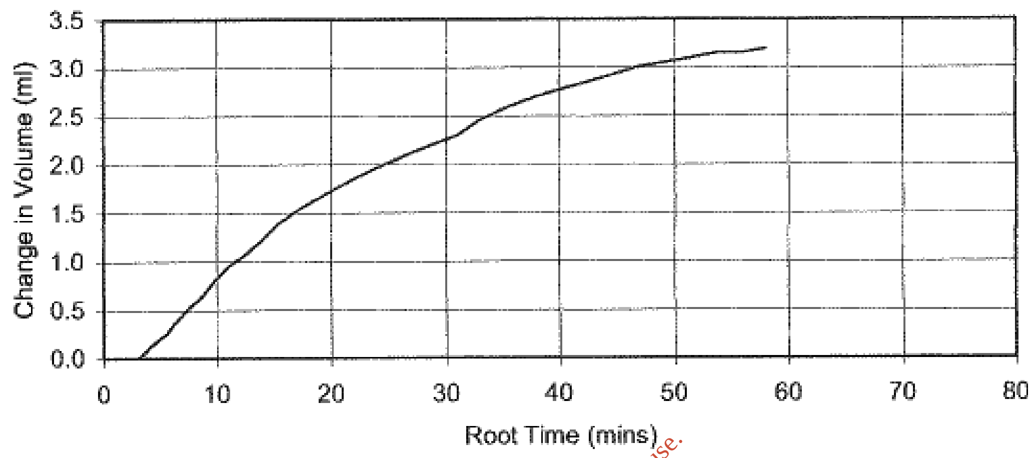
Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

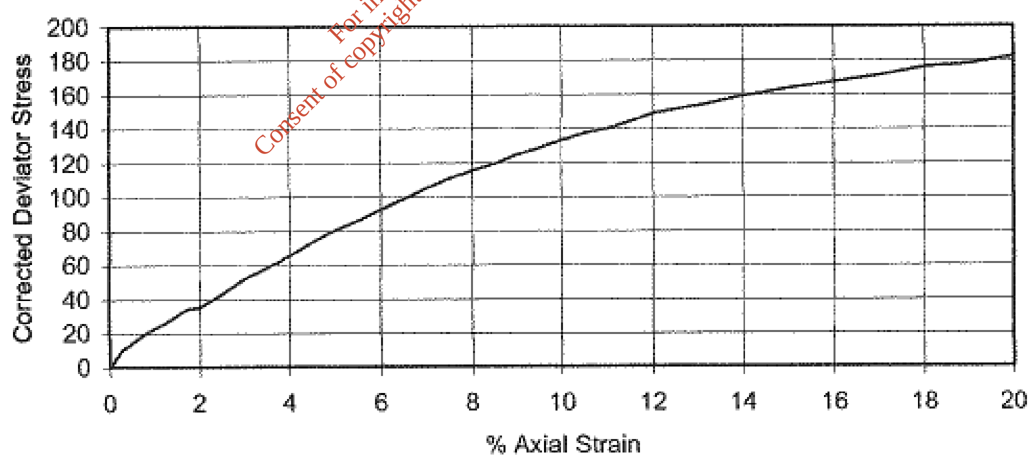
BH	RC1	Sample	AH2527	Depth (m)	2.6

Consolidation stage



Effective stress (kPa)	50	Change in Volume (ml)	3.20

Compression stage



Cell Pressure (kPa)	50	Cohesion	91
Axial strain at failure (%)	20	Failure Type	Compound

IGSL Ltd.

Contract Duleek

Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

BH RC3 Sample AH2525 Depth (m) 2.0

Condition: Undisturbed

Corrections 2 membranes and side drains

Description Orangish brown sandy CLAY

Initial Conditions

Height (mm) 200 Diameter (mm) 101

Area (mm^2) 8011.85 Volume (cm^3) 1602.37

% Moisture Content 14 Bulk Density (Mg/m^3) 2.29

Dry Density (Mg/m^3) 2.01

Final Conditions

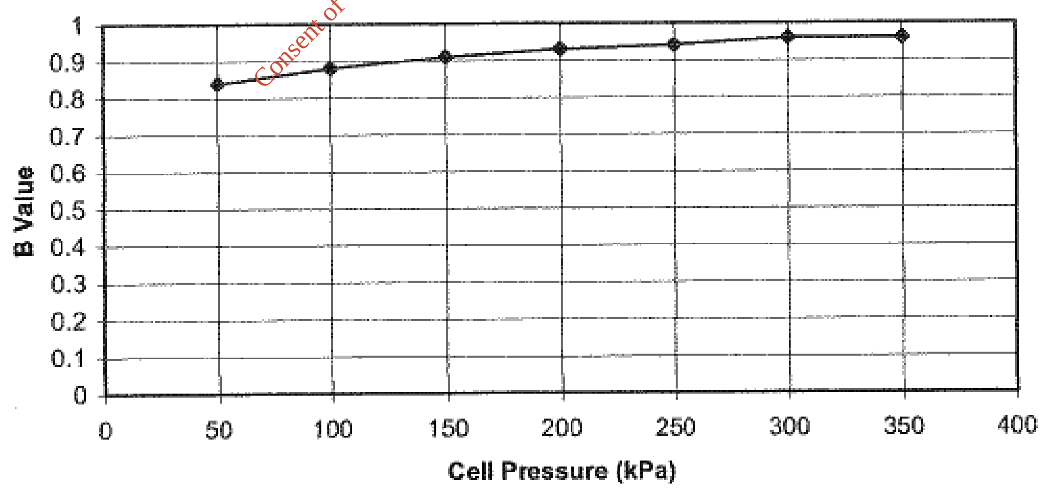
% Moisture Content 14 Bulk Density (Mg/m^3) 2.29

Dry Density (Mg/m^3) 2.01

Saturation stage

Effective stress (kPa) 50 Saturation by 50kPa Cell Pressure Increments

Initial B Value 0.84 Final B Value 0.96



IGSL Ltd.

Contract Duleek

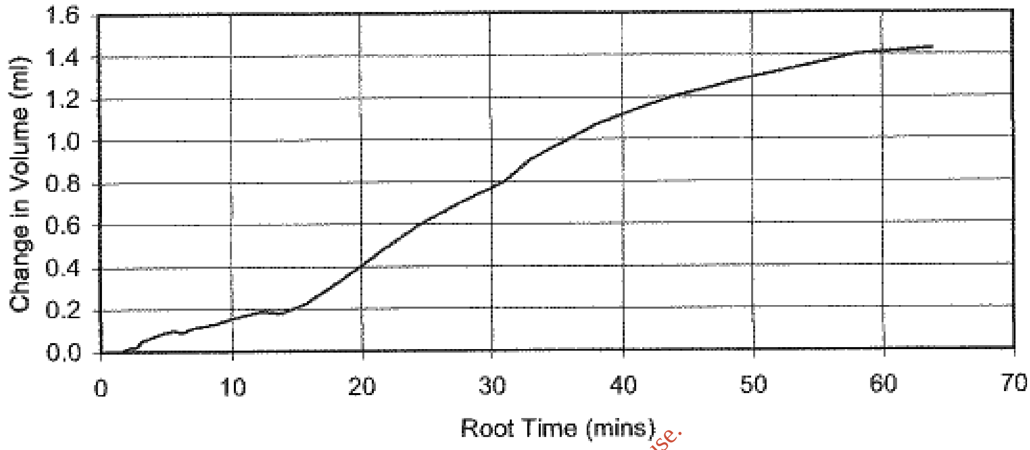
Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

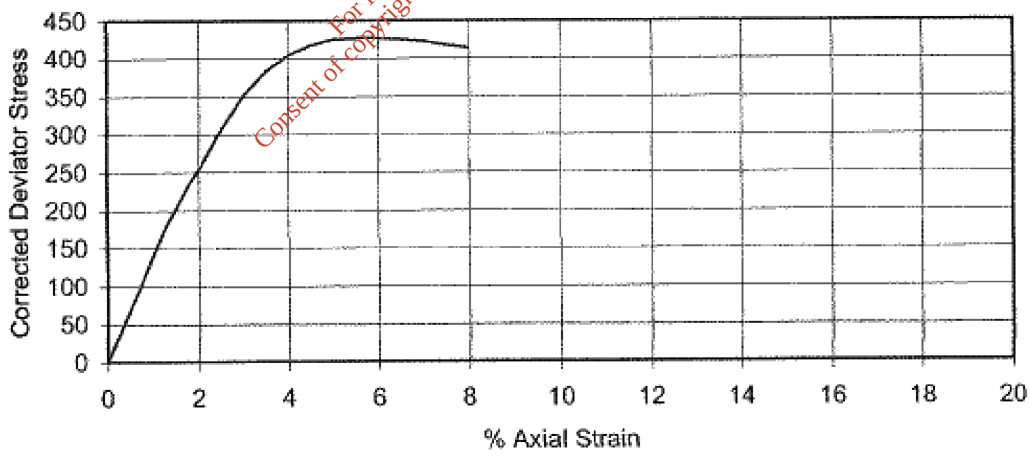
BH	RC3	Sample	AH2525	Depth (m)	2.0

Consolidation stage



Effective stress (kPa)	50	Change in Volume (ml)	1.43

Compression stage



Cell Pressure (kPa)	50	Cohesion	214
Axial strain at failure (%)	6	Failure Type	Compound

IGSL Ltd.

Contract Duleek

Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

BH RC3 Sample Depth (m) 4.5

Condition: Undisturbed

Corrections 2 membranes

Description Yellowish brown sandy gravelly CLAY

Initial Conditions

Height (mm) 201 Diameter (mm) 100

Area (mm^2) 7853.98 Volume (cm^3) 1575.51

% Moisture Content 9.9 Bulk Density (Mg/m^3) 2.36

Dry Density (Mg/m^3) 2.15

Final Conditions

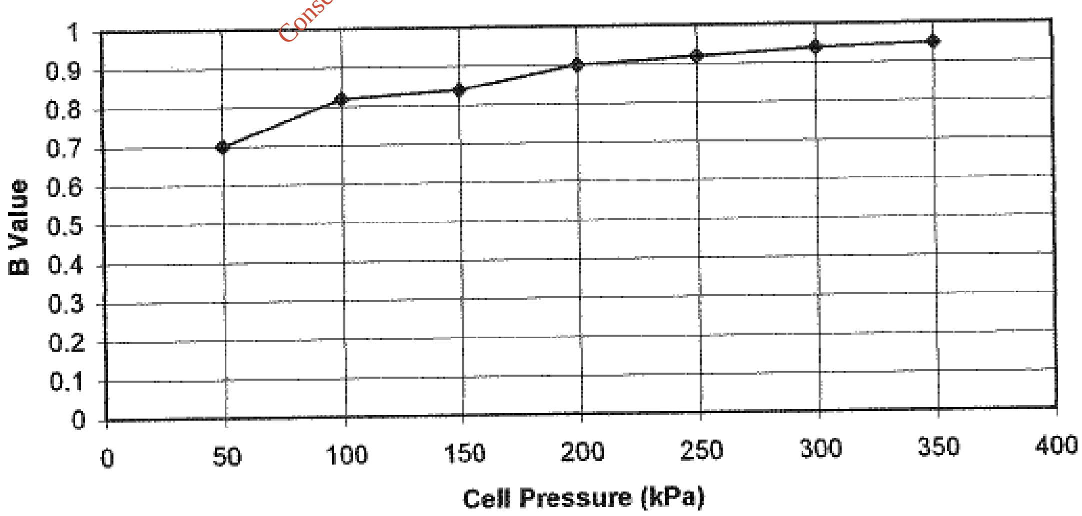
% Moisture Content 9.7 Bulk Density (Mg/m^3) 2.37

Dry Density (Mg/m^3) 2.16

Saturation stage

Effective stress (kPa) 50 Saturation by 50kPa Cell Pressure Increments

Initial B Value 0.7 Final B Value 0.95



IGSL Ltd.

Contract Duleek

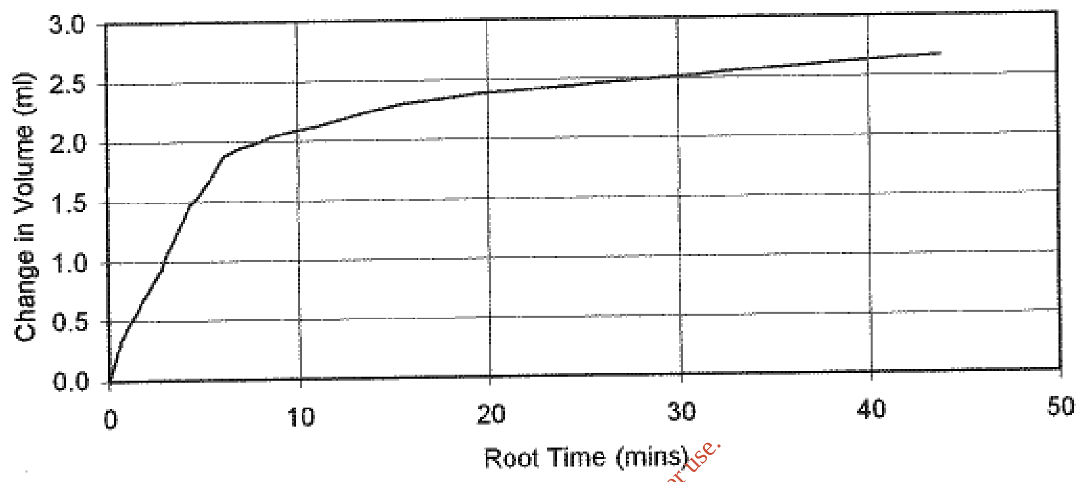
Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

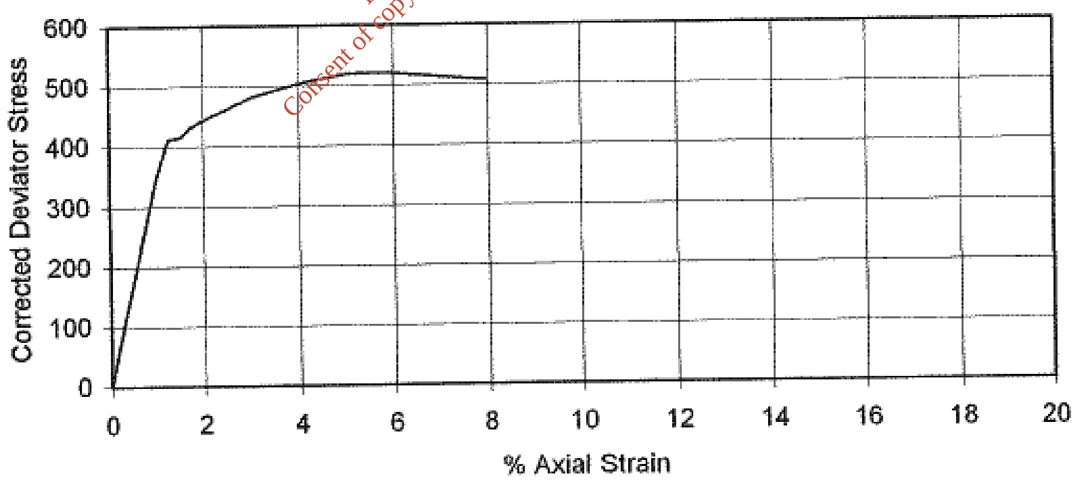
BH RC3 Sample Depth (m) 4.5

Consolidation stage



Effective stress (kPa) 50 Change in Volume (ml) 2.67

Compression stage



Cell Pressure (kPa)	50	Cohesion	260
Axial strain at failure (%)	5.5	Failure Type	Compound

IGSL Ltd.

Contract Duleek

Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

BH RC4 Sample AH2526 Depth (m) 3.2

Condition: Undisturbed

Corrections 2 membranes and side drains

Description Orangish brown sandy gravelly CLAY

Initial Conditions

Height (mm)	200	Diameter (mm)	101
Area (mm^2)	8011.85	Volume (cm^3)	1602.37
% Moisture Content	23	Bulk Density (Mg/m^3)	2.16
		Dry Density (Mg/m^3)	1.76

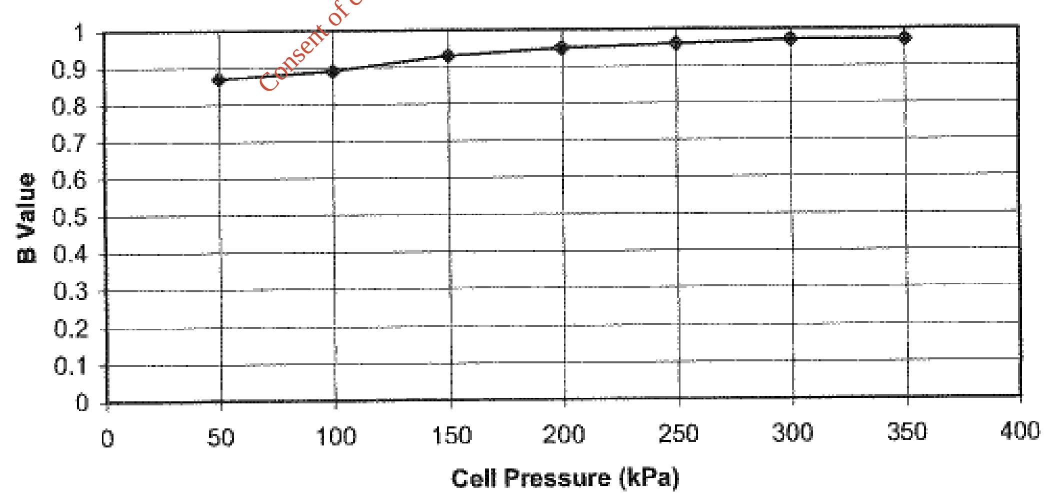
Final Conditions

% Moisture Content	22	Bulk Density (Mg/m^3)	2.15
		Dry Density (Mg/m^3)	1.76

Saturation stage

Effective stress (kPa) 50 Saturation by 50kPa Cell Pressure Increments

Initial B Value 0.87 Final B Value 0.97



IGSL Ltd.

Contract Duleek

Contract No. 14039

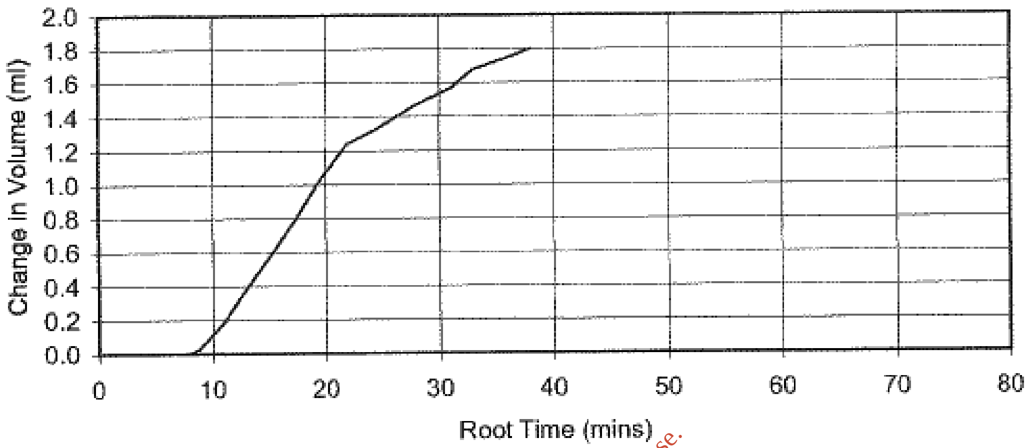
Page 1 of 2

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

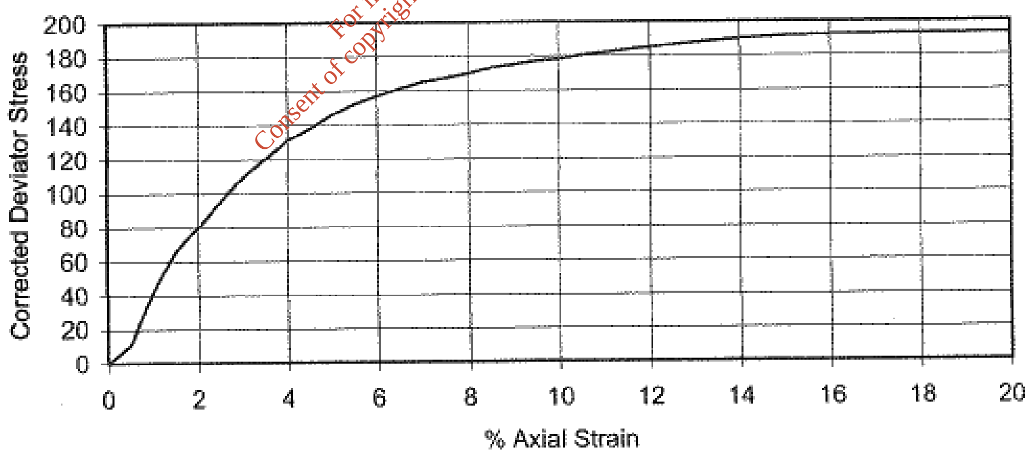
BH RC4 Sample AH2526 Depth (m) 3.2

Consolidation stage



Effective stress (kPa) 50 Change in Volume (ml) 1.80

Compression stage



Cell Pressure (kPa) 50 Cohesion 96

Axial strain at failure (%) 20 Failure Type Plastic

IGSL Ltd.

Contract Duleek

Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

BH RC5 Sample AH2528 Depth (m) 3.0

Condition: Undisturbed

Corrections 2 membranes

Description Orangish brown sandy gravelly CLAY

Initial Conditions

Height (mm)	200	Diameter (mm)	101.5
Area (mm^2)	8091.37	Volume (cm^3)	1618.27
% Moisture Content	11	Bulk Density (Mg/m^3)	2.32
		Dry Density (Mg/m^3)	2.10

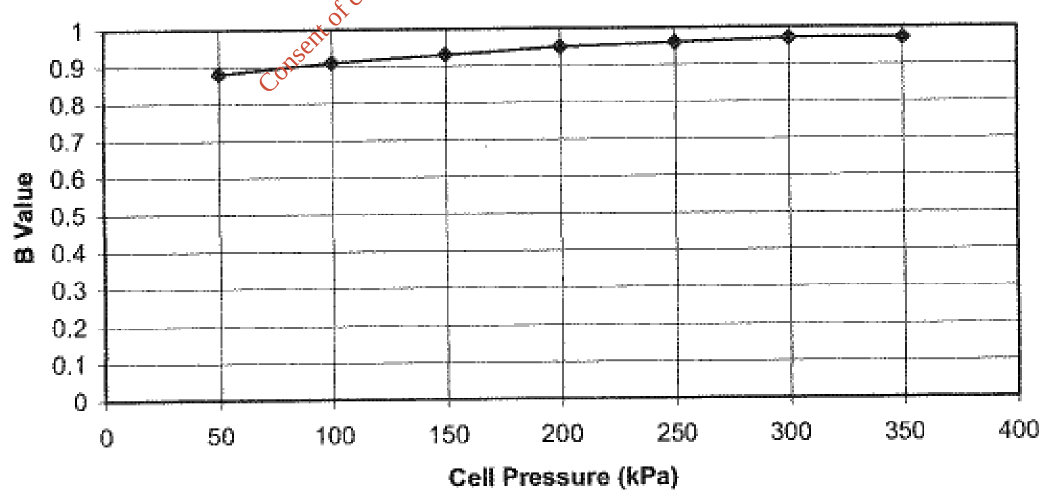
Final Conditions

% Moisture Content	11	Bulk Density (Mg/m^3)	2.35
		Dry Density (Mg/m^3)	2.11

Saturation stage

Effective stress (kPa) 50 Saturation by 50kPa Cell Pressure Increments

Initial B Value 0.88 Final B Value 0.97



Contract Duleek

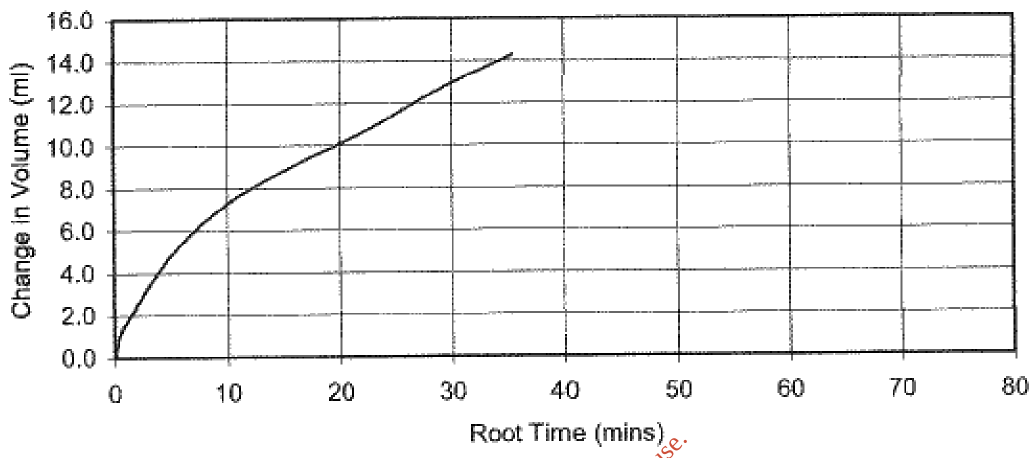
Contract No. 14039

Consolidated Quick-undrained (CQu) Triaxial Test

Manual of Soil Laboratory Testing Volume 3 KH Head Clause 19.3.3

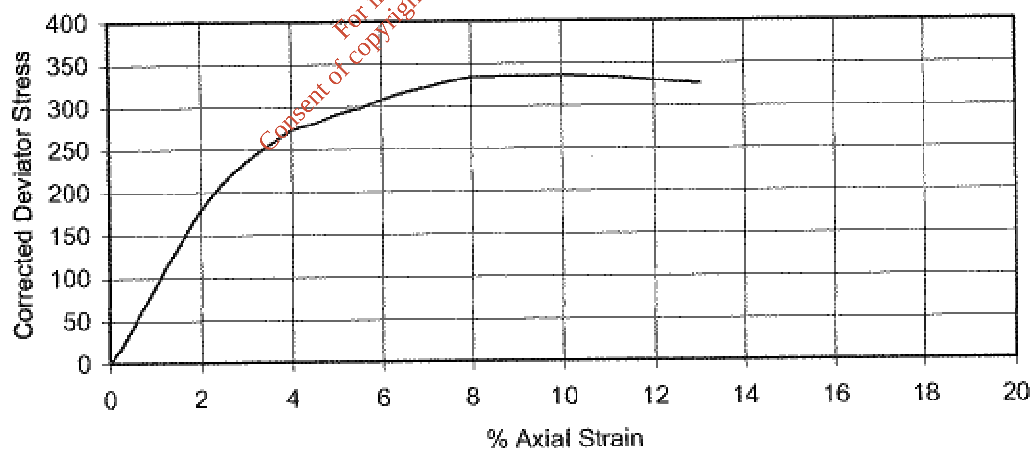
BH RC5 Sample AH2528 Depth (m) 3.0

Consolidation stage



Effective stress (kPa) 50 Change in Volume (ml) 14.28

Compression stage



Cell Pressure (kPa)	50	Cohesion	168
Axial strain at failure (%)	10	Failure Type	Compound

IGSL Ltd.

Contract Duleek

Contract No. 14039

CONSOLIDATION TEST CALCULATIONS IGSL

initial height	18.85	
Wt. soil+ring	278.7	
final wet wt.	280.1	
final dry wt	258.7	
wt. of ring	89.3	
w/c initial	11.8%	
w/c final	12.6%	
S.G.	2.65	Assumed
e final	0.3347698	
change in e	0.0723296	*change in Ht.
Final Height		18.454

Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
Borehole No: GC6
Sample No: AH2524
Sample Type GCS
Depth: 2.50

Pressure range from	to	increment	change in Ht.	change in e	e at end of stage	average e	MV (m2/MN.)	HEIGHT H	AV. HEIGHT
					0.363			18.85	
0	20	20	0.092	0.007	0.357	0.360	0.245	18.758	18.804
20	50	30	0.114	0.008	0.349	0.353	0.203	18.644	18.701
50	100	50	0.13	0.009	0.339	0.344	0.140	18.514	18.579
100	200	100	0.166	0.012	0.327	0.333	0.090	18.348	18.431
200	20	-180	-0.106	-0.008	0.335	0.331	0.032	18.454	18.401
					0.335				
					0.335				
					0.335				
					0.335				
					0.335				

I.G.S.L.

CV calculations

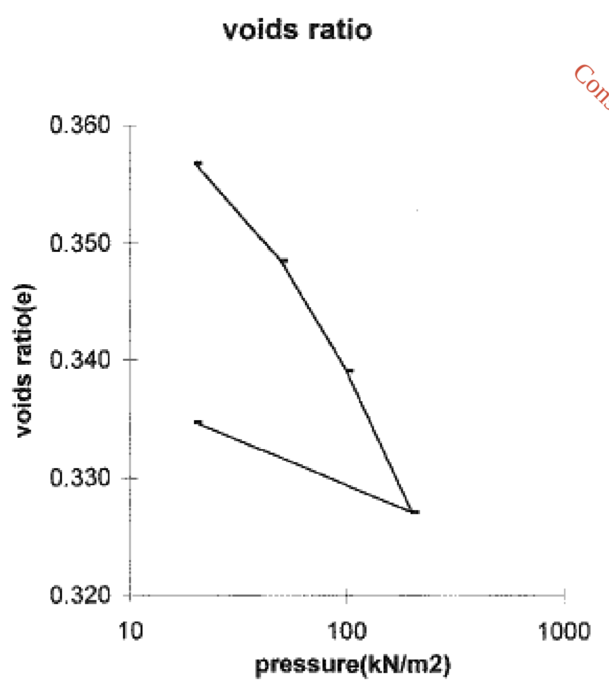
Pressure Range from	to	t 50 mins	t 90 mins	av. Height	Cv =0.026H2 / t50	Cv=0.111H2 / t90
0	20		1.21	18.804		32.44
20	50		0.81	18.701		47.93
50	100		1.69	18.579		22.67
100	200		1	18.431		37.71
200	20					

Contract	INDAVER WASTE MANAGEMENT FACILITY, DULEEK
Borehole No.	GC6
Sample No.	AH2524
Depth	2.5

CONSOLIDATION TEST RESULTS

IGSL

Sample Description: Orangish brown slightly sandy slightly gravelly CLAY



Pressure Range (kN/M2) from	to	Voids Ratio e	MV(m2/MN)	CV(m2/year)
0	20	0.357	0.24	32.44
20	50	0.349	0.20	47.93
50	100	0.339	0.14	22.67
100	200	0.327	0.09	37.71
200	20	0.335		

Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
Borehole No. GC6
Sample No. AH2524
Depth: 2.50

CONSOLIDATION TEST CALCULATIONS IGSL

initial height	18.85	
Wt. soil+ring	278.7	
final wet wt.	280.1	
final dry wt	258.7	
wt. of ring	89.3	
w/c initial	11.8%	
w/c final	12.6%	
S.G.	2.65	Assumed
e final	0.3347698	
change in e	0.0727078	*change in Ht.
Final Height		18.358

Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
Borehole No: GC2
Sample No: AH2529
Sample Type GCS
Depth: 2.50

Pressure range from	to	increment	change in Ht.	change in e	e at end of stage	average e	MV (m2/MN.)	HEIGHT H	AV. HEIGHT
					0.371			18.85	
0	20	20	0.116	0.008	0.362	0.366	0.309	18.734	18.792
20	50	30	0.144	0.010	0.352	0.357	0.257	18.59	18.662
50	100	50	0.156	0.011	0.340	0.346	0.169	18.434	18.512
100	200	100	0.182	0.013	0.327	0.334	0.099	18.252	18.343
200	20	-180	-0.106	-0.008	0.335	0.331	0.032	18.358	18.305
					0.335				
					0.335				
					0.335				
					0.335				
					0.335				

I.G.S.L.

CV calculations

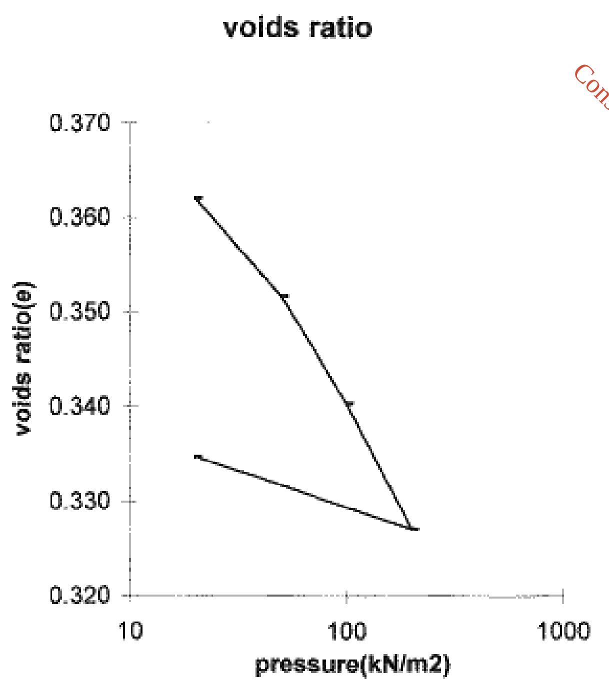
Pressure Range from	to	t 50 mins	t 90 mins	av. Height	Cv =0.026H2 / t50	Cv=0.111H2 / t90
0	20		4.84	18.792		8.10
20	50		1.44	18.662		26.85
50	100		1.21	18.512		31.44
100	200		1	18.343		37.35
200	20					

Contract	INDAVER WASTE MANAGEMENT FACILITY, DULEEK
Borehole No.	GC2
Sample No.	AH2529
Depth	2.5

CONSOLIDATION TEST RESULTS

IGSL

Sample Description: Grey brown silty very sandy GRAVEL



Pressure Range (kN/M2) from	to	Voids Ratio e	MV(m2/MN)	CV(m2/year)
0	20	0.362	0.31	8.10
20	50	0.352	0.26	26.85
50	100	0.340	0.17	31.44
100	200	0.327	0.10	37.35
200	20	0.335		

Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
Borehole No. GC2
Sample No. AH2529
Depth: 2.50

REPORT NO.

SULPHATE ANALYSIS

IGSL

CONTRACT: **INDAVER WASTE MANAGEMENT FACILITY, DULEEK** CONTRACT NO 14039

BH/TP NO.	DEPTH (M)	SAMPLE NO.	SAMPLE TYPE	TEST CODE	% Passing 2mm	SULPHUR TRIOXIDE 2:1WATER SOIL EXTRACT So3 g/L	SULPHUR TRIOXIDE TOTAL SOIL so3 %	(so3 X 1.2) 2:1WATER SOIL EXTRACT So4 g/L	pH VALUE
GC1	2.60	AH2527	GCS	A	67	0.01		0.012	7.2
GC2	2.50	AH2529	GCS	A	53	0.02		0.029	7.5
GC3	2.00	AH2525	GCS	A	96	0.01		0.007	7.0
GC4	3.20	AH2526	GCS	A	99	0.03		0.032	7.1
GC5	3.00	AH2528	GCS	A	84	0.01		0.012	7.2
GC6+	2.50	AH2524	GCS	A	71	0.02		0.024	7.7

TEST CODE W = WATER S = SOIL A = AQUEOUS SOIL EXTRACT(2:1)

Appendix 5

Geotechnical Rock Laboratory Test Records

POINT LOAD TEST RESULTS

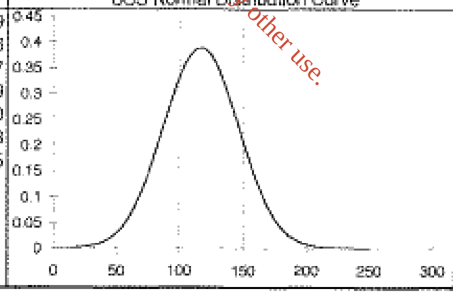
Contract: Indaver Duleek
Contract no. 14039
Date of test: 12/03/2009 Tested by: A. Mahony

Sample Type: LIMESTONE

Sample No.	Depth m	Width1 mm	Width2 mm	Diameter mm	*P kN	=	*Is Mpa	*Is(50) Mpa	*UCS MPa	Type
GC1	11.50			102	48.0	1.378	4.61	6.36	127	d
GC1	6.90			102	50.0	1.378	4.81	6.62	132	d
GC1	9.90			102	44.0	1.378	4.23	5.83	117	d
GC1	8.35			102	45.0	1.378	4.33	5.96	119	d
GC2	6.20			102	43.0	1.378	4.13	5.70	114	d
GC2	9.10			102	45.0	1.378	4.33	5.96	119	d
GC2	13.00			102	38.0	1.378	3.65	5.03	101	d
GC2	8.60			102	47.0	1.378	4.52	6.23	125	d
GC2	8.00			102	21.0	1.378	2.02	2.78	56	d
GC2	11.80			102	29.0	1.378	2.79	3.84	77	d
GC3	8.70			102	51.0	1.378	4.90	6.76	135	d
GC3	7.00			102	53.0	1.378	5.09	7.02	140	d
GC3	9.10			102	55.0	1.378	5.29	7.29	146	d
GC3	11.65			102	42.0	1.378	4.04	5.56	111	d
GC3	10.10	99.00	67.00	60	28.0	1.086	7.78	8.44	169	d
GC4	11.40			102	57.0	1.378	5.48	7.55	151	d
GC4	8.40			102	45.0	1.378	4.33	5.96	119	d
GC4	8.60			102	48.0	1.378	4.61	6.36	127	d
GC4	7.40			102	32.0	1.378	3.08	4.24	85	d
GC4	10.60			102	53.0	1.378	5.09	7.02	140	d
GC5	5.80			102	57.0	1.378	5.48	7.55	151	d
GC5	8.60			102	21.0	1.378	2.02	2.78	56	d
GC5	11.40			102	52.0	1.378	5.00	6.89	138	d
GC5	10.30			102	46.0	1.378	4.42	6.09	122	d
GC6	10.05			102	32.0	1.378	3.08	4.24	85	d
GC6	11.10			102	37.0	1.378	3.56	4.90	98	d
GC6	13.20			102	22.0	1.378	2.11	2.91	58	d
GC6	6.80			102	46.0	1.378	4.42	6.09	122	d
GC6	9.70			102	57.0	1.378	5.48	7.55	151	d

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	29	29
Minimum	2.78	56
Average	5.85	117
Maximum	8.44	169
Standard Dev.	1.49	30
Upper 95% Confidence Limit	8.76	175.18
Lower 95% Confidence Limit	2.93	58.65

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

Comments:
*UCS (Uniaxial Compressive Strength) taken as k x Point Load Is(50): k= 20
*Is = Index Strength. *Is(50) = Corrected Index Strength
*P = Failure Load

POINT LOAD TEST RESULTS

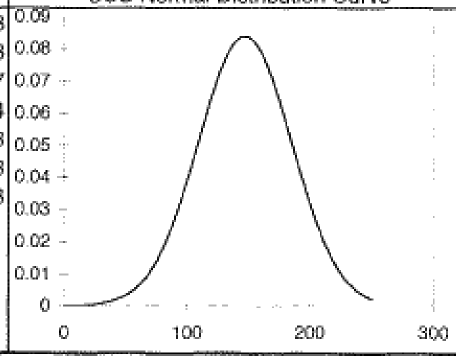
Contract: Indaver Duleek
Contract no. 14039
Date of test: 12/03/2009 Tested by: A. Mahony

Sample Type: LIMESTONE

Sample No.	Depth m	Width1 mm	Width2 mm	Diameter mm	*P kN	F	*Is Mpa	*Is(50) Mpa	*UCS MPa	Type
RP1	8.95			80	31.0	1.236	4.84	5.98	120	d
RP1	10.1			80	35.0	1.236	5.47	6.76	135	d
RP1	7.7			80	58.0	1.236	9.06	11.20	224	d
RP2	9.30			80	24.0	1.236	3.75	4.63	93	d
RP2	8.10			80	36.0	1.236	5.63	6.95	139	d
RP5	10			80	39.0	1.236	6.09	7.53	151	d
RP5	9.6			80	40.0	1.236	6.25	7.72	154	d
RP5	8.80			80	42.0	1.236	6.56	8.11	162	d

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	8	8
Minimum	4.63	93
Average	7.36	147
Maximum	11.20	224
Standard Dev.	1.90	38
Upper 95% Confidence Limit	11.09	221.73
Lower 95% Confidence Limit	3.63	72.68

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

Comments:
*UCS (Uniaxial Compressive Strength) taken as k x Point Load Is(50): k= 20
*Is = Index Strength. *Is(50) = Corrected Index Strength
*P = Failure Load

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RC GC1
Depth (m):	8.80

Sample Description

Colour:	Blue grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

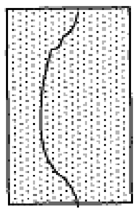
Sample Measurements

Length	251.5	
Diameter (Ø)	102	mm

Testing

Load Rate	42	kN/min
Load at Failure (P)	217.9	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{217900}{8167.14}$

$= \dfrac{1000 \times P}{\pi \times (Ø/2)^2}$

$=$ 26.67 (Mpa)

Bulk Density $=$ 2.66 (Mg/m^3)

Notes:

IGSL Ltd.

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RC GC2
Depth (m):	6.50

Sample Description

Colour:	Blue grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

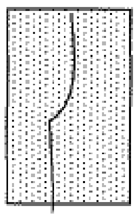
Sample Measurements

Length	253	
Diameter (Ø)	102	mm

Testing

Load Rate	88	kN/min
Load at Failure (P)	589.8	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{589800}{8167.14}$

$$= \frac{1000 \times P}{\pi \times (Ø/2)^2}$$

= 72.18 (Mpa)

Bulk Density = 2.68 (Mg/m^3)

Notes:

IGSL Ltd.

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RC GC4
Depth (m):	10.30

Sample Description

Colour:	Blue grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

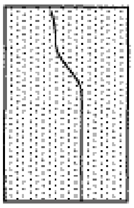
Sample Measurements

Length	251.5	
Diameter (Ø)	102	mm

Testing

Load Rate	52.5	kN/min
Load at Failure (P)	293.6	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{293600}{8167.14}$

$= \dfrac{1000 \times P}{\Pi \times (Ø/2)^2}$

$=$ 35.93 (Mpa)

Bulk Density $=$ 2.69 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RC GC5
Depth (m):	7.90

Sample Description

Colour:	Blue grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

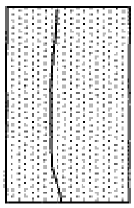
Sample Measurements

Length	250	mm
Diameter (Ø)	102	mm

Testing

Load Rate	46.5	kN/min
Load at Failure (P)	310.8	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{310800}{8167.14}$

$= \dfrac{1000 \times P}{\Pi \times (Ø/2)^2}$

$=$ 38.04 (Mpa)

Bulk Density $=$ 2.68 (Mg/m^3)

Notes:

IGSL Ltd.

Uniaxial Compression Test Report Sheet | I.G.S.L.

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RC GC6
Depth (m):	9.20

Sample Description

Colour:	Blue grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

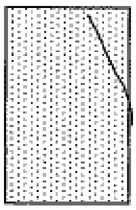
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	251	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	53	kN/min
Load at Failure (P)	321.7	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{321700}{8167.14}$

$= \dfrac{1000 \times P}{\pi \times (Ø/2)^2}$

$=$ 39.37 (Mpa)

Bulk Density $=$ 2.66 (Mg/m^3)

Notes:

IGSL Ltd.

# Uniaxial Compression Test Report Sheet	*I.G.S.L.*

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RP1
Depth (m):	8.10

Sample Description

Colour:	Blue grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

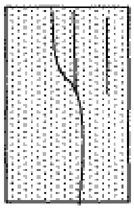
Sample Measurements

Length	202	
Diameter (Ø)	80	mm

Testing

Load Rate	34.5	kN/min
Load at Failure (P)	185.2	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{185200}{5024}$

$$= \frac{1000 \times P}{\pi \times (Ø/2)^2}$$

= 36.84 (Mpa)

Bulk Density = 2.68 (Mg/m^3)

Notes:

IGSL Ltd.

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RP2
Depth (m):	7.70

Sample Description

Colour:	Grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

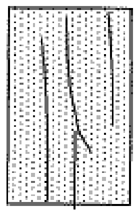
Sample Measurements

Length	112	
Diameter (Ø)	80	mm

Testing

Load Rate	46.5	kN/min
Load at Failure (P)	274	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength $= \dfrac{274000}{5024}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 54.51 (Mpa)

Bulk Density $=$ 2.68 (Mg/m^3)

Notes:

IGSL Ltd.

Uniaxial Compression Test Report Sheet | *I.G.S.L.*

Sample Identification

Contract Name:	Indaver Duleek
Job Number:	14039
Hole No:	RP5
Depth (m):	10.20

Sample Description

Colour:	Grey
Grain size:	Medium
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

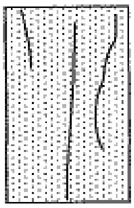
Sample Measurements

Length	200	
Diameter (Ø)	80	mm

Testing

Load Rate	48.5	kN/min
Load at Failure (P)	299.7	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\dfrac{299700}{5024}$

= $\dfrac{1000 \times P}{\pi \times (Ø/2)^2}$

= 59.62 (Mpa)

Bulk Density = 2.68 (Mg/m^3)

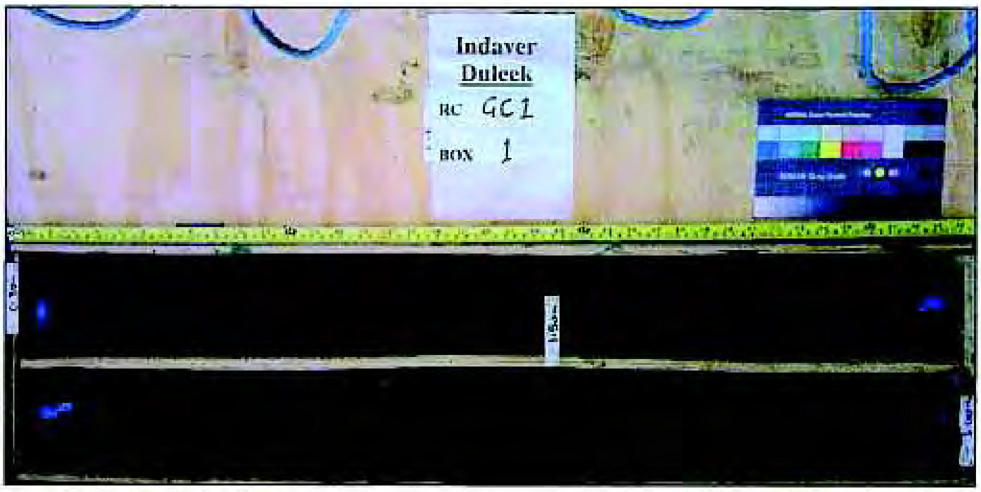
Notes:

Appendix 6

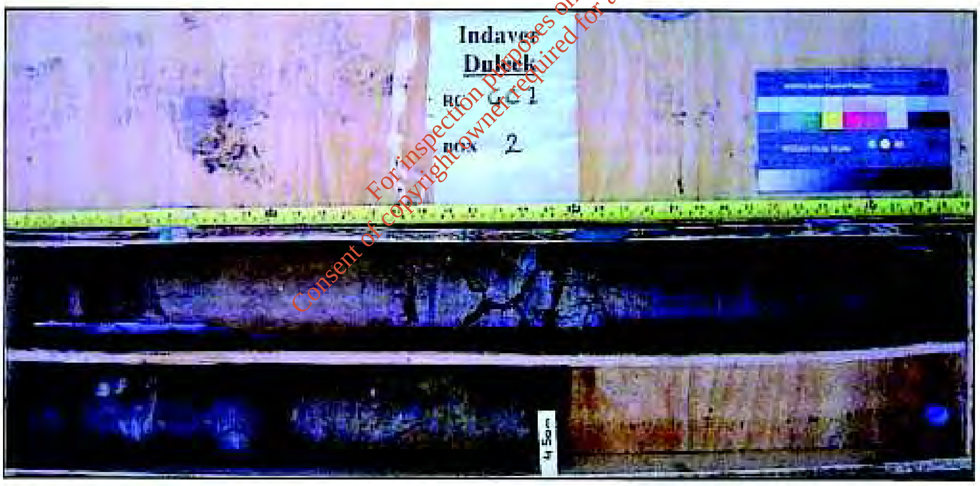
Core Photographs

Core Photography – Indaver Duleek (14039)

RC GC1 BOX 1 OF 7



RC GC1 BOX 2 OF 7



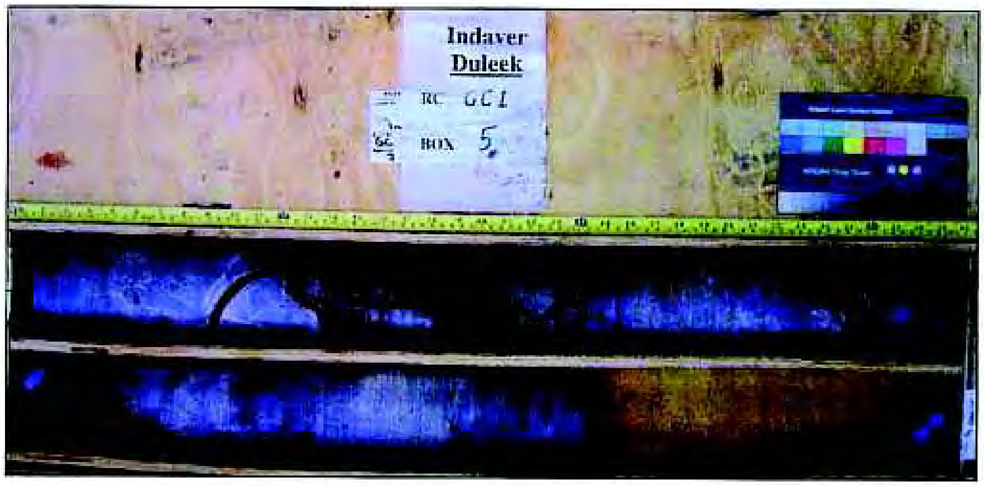
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC1 BOX 3 OF 7

RC GC1 BOX 4 OF 7

RC GC1 BOX 5 OF 7



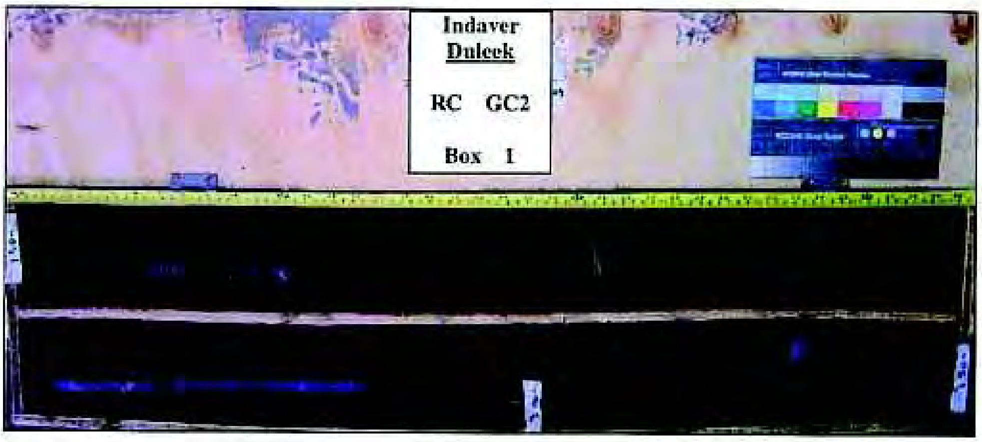
RC GC1 BOX 6 OF 7

Core Photography – Indaver Duleek (14039)

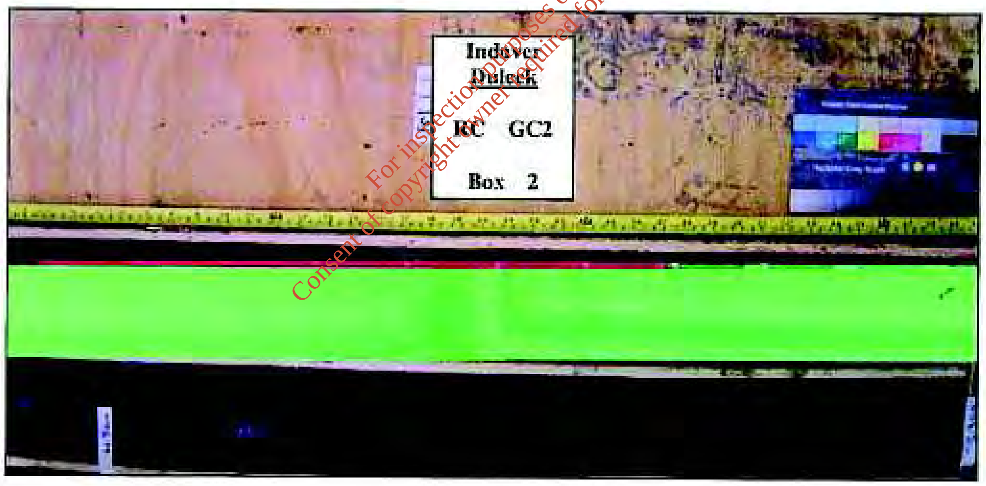
RC GC1 BOX 7 OF 7

Core Photography – Indaver Duleek (14039)

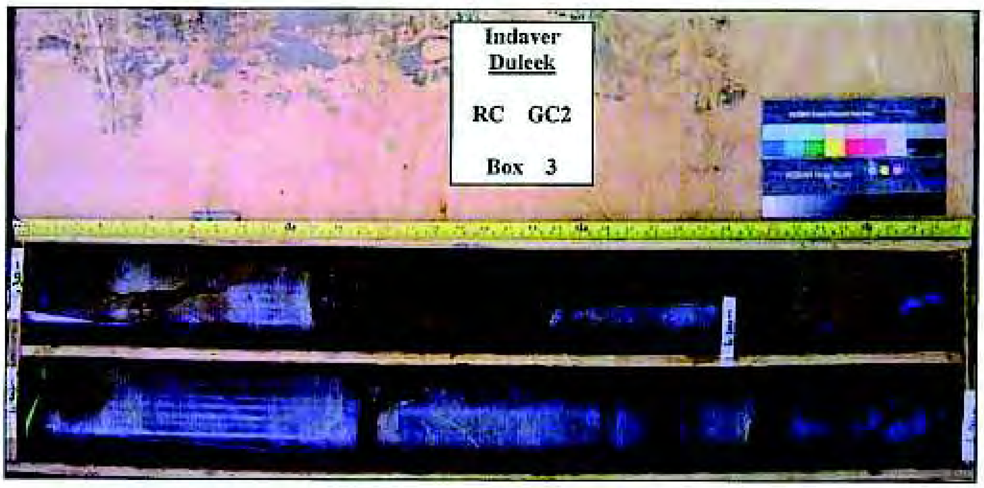
RC GC2 BOX 1 OF 8



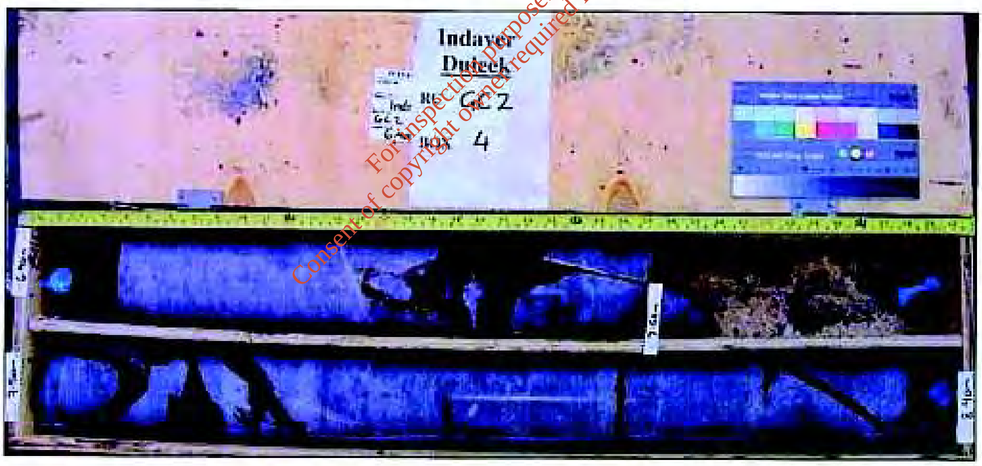
RC GC2 BOX 2 OF 8



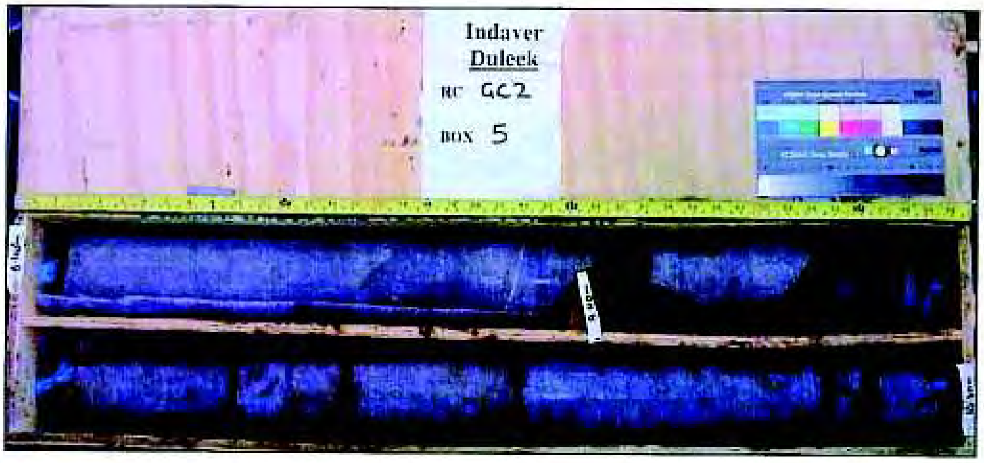
RC GC2 BOX 3 OF 8



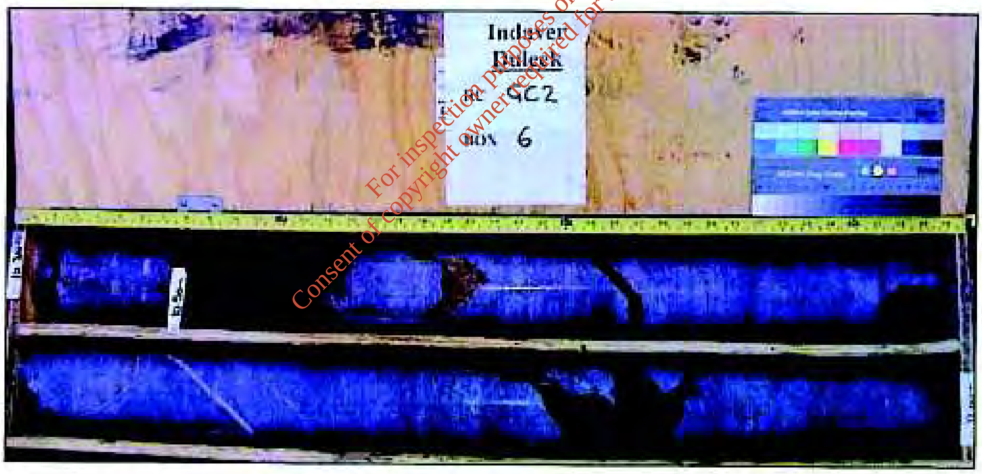
RC GC1 BOX 4 OF 8



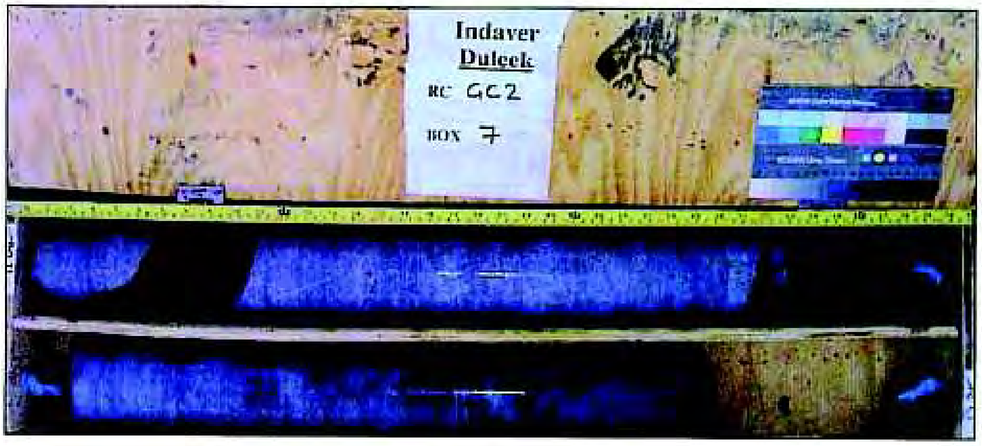
RC GC2 BOX 5 OF 8



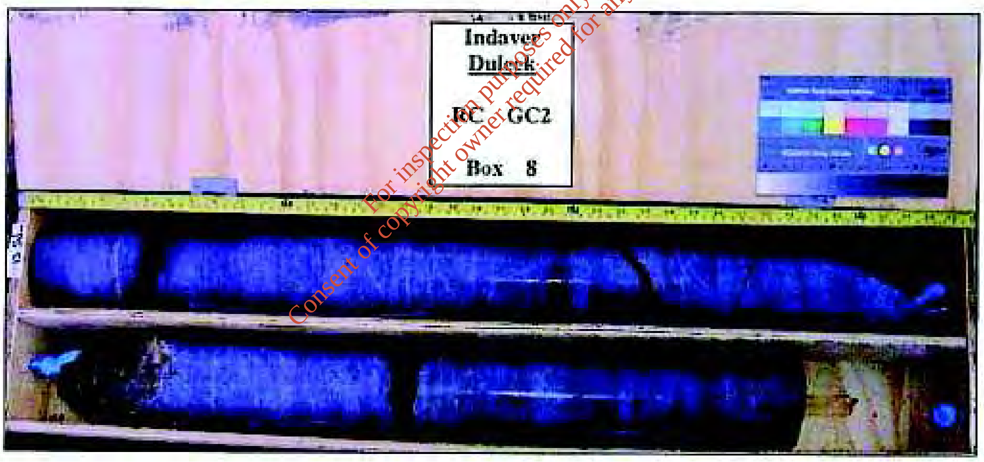
RC GC2 BOX 6 OF 8



RC GC2 BOX 7 OF 8



RC GC2 BOX 8 OF 8



Core Photography – Indaver Duleek (14039)

RC GC3 BOX 1 OF 7

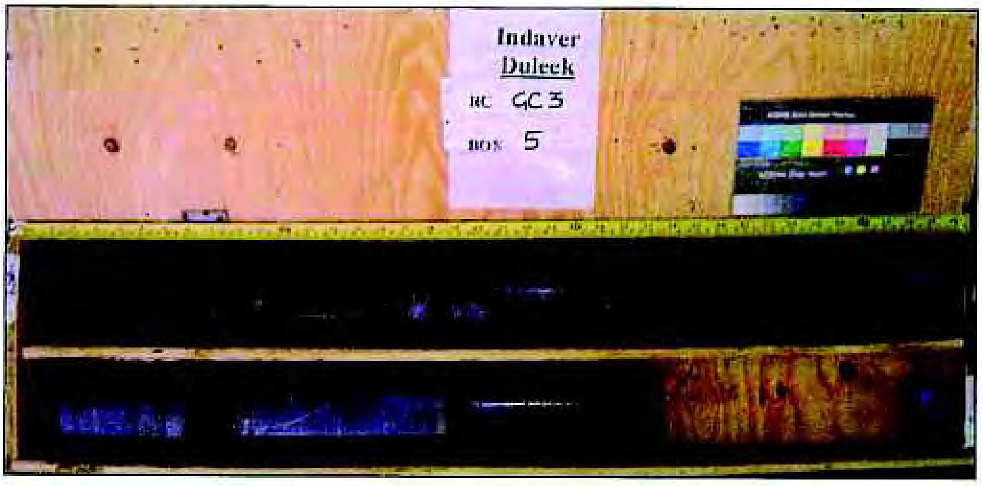
RC GC3 BOX 2 OF 7

Core Photography – Indaver Duleek (14039)

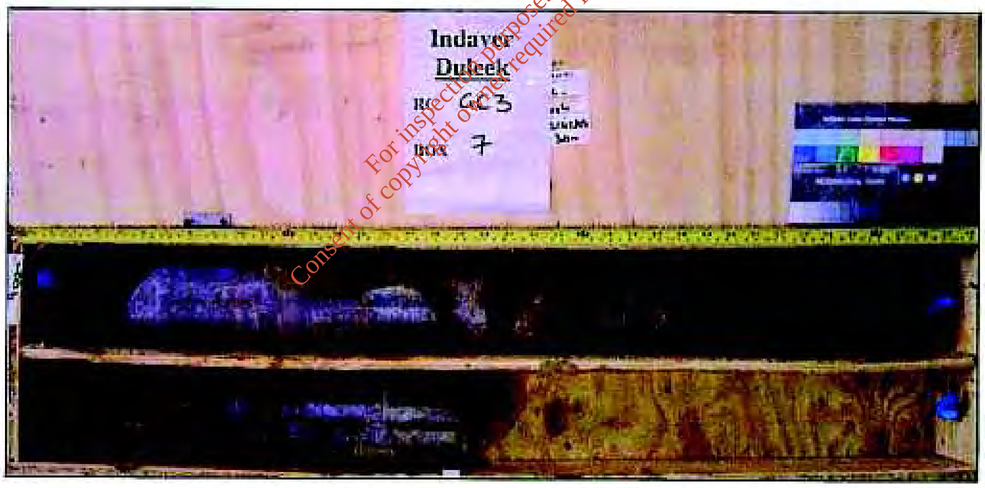
RC GC3 BOX 3 OF 7

RC GC3 BOX 4 OF 7

RC 3 BOX 5 OF 7

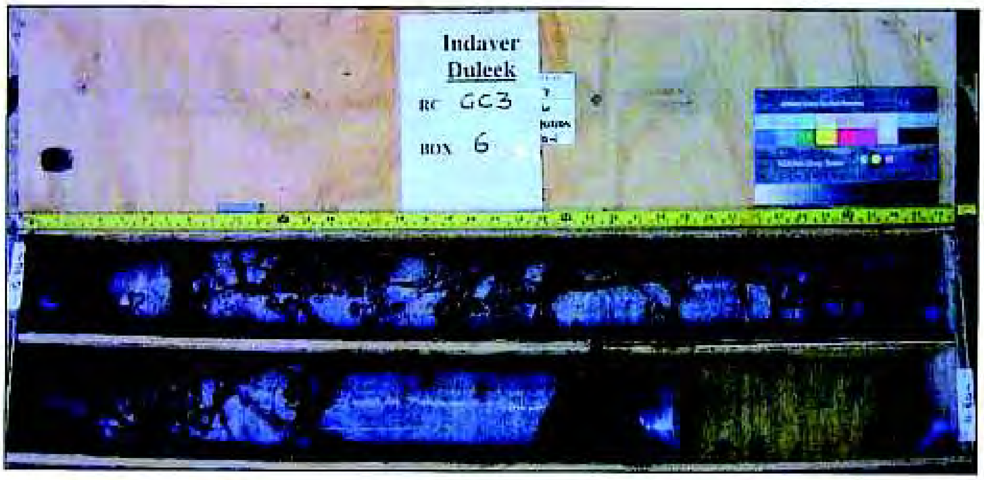


RC GC3 BOX 6 OF 7



Core Photography – Indaver Duleek (14039)

RC GC3 BOX 7 OF 7



IGSL Ltd.

Core Photography – Indaver Duleek (14039)

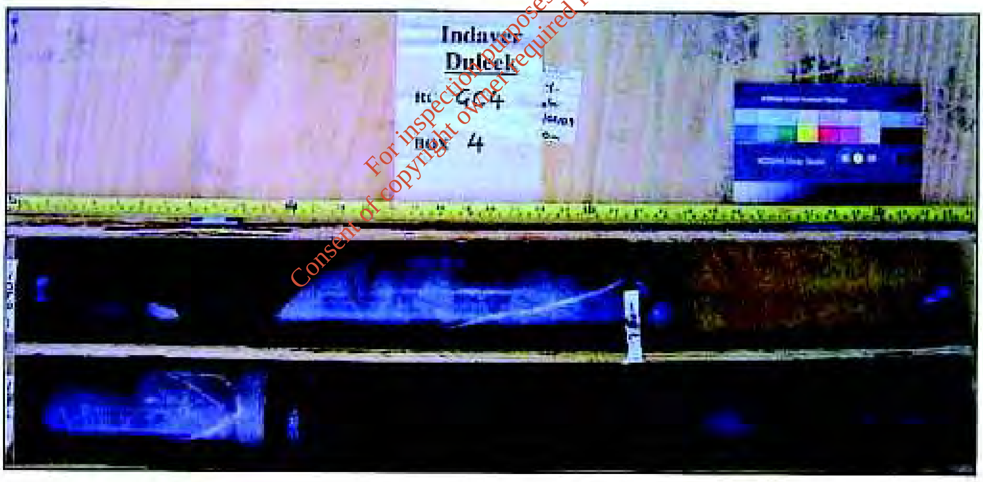
RC GC4 BOX 1 OF 7

RC GC4 BOX 2 OF 7

Core Photography – Indaver Duleek (14039)

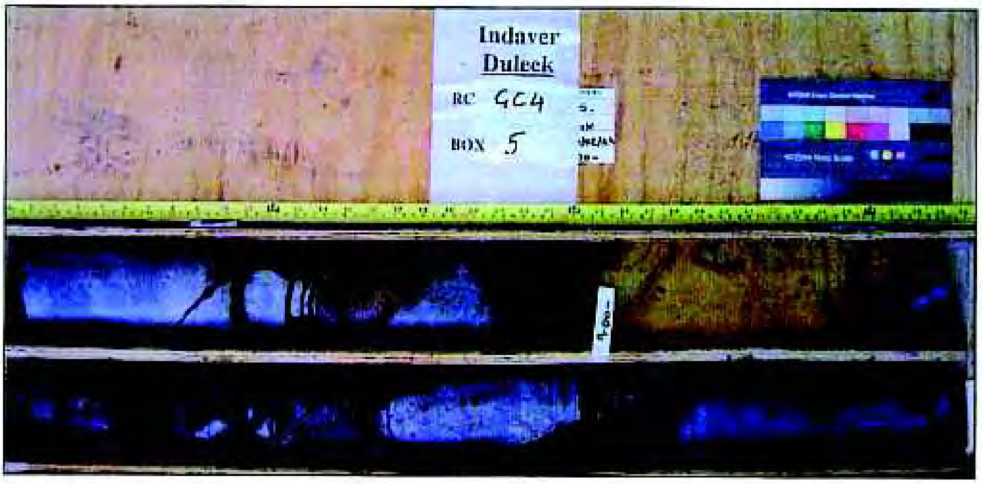
RC GC4 BOX 3 OF 7

RC GC4 BOX 4 OF 7

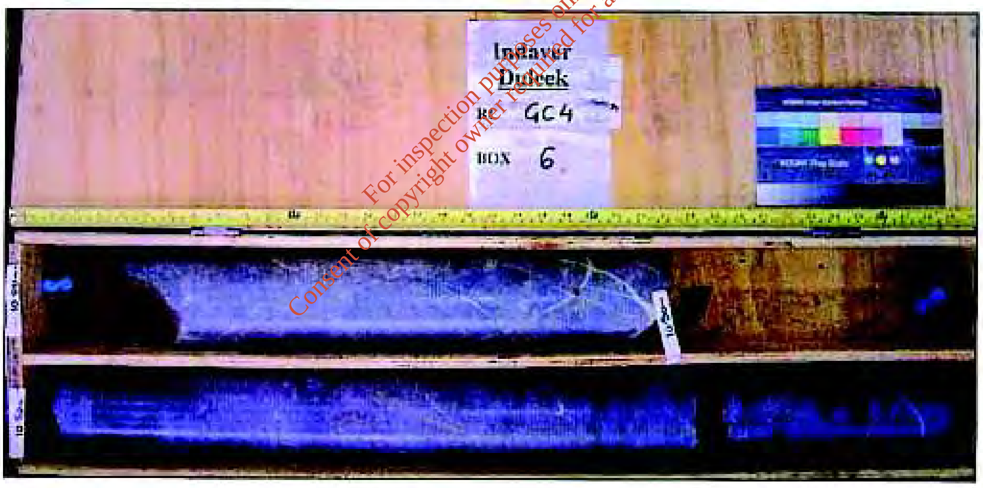


Core Photography – Indaver Duleek (14039)

RC GC4 BOX 5 OF 7



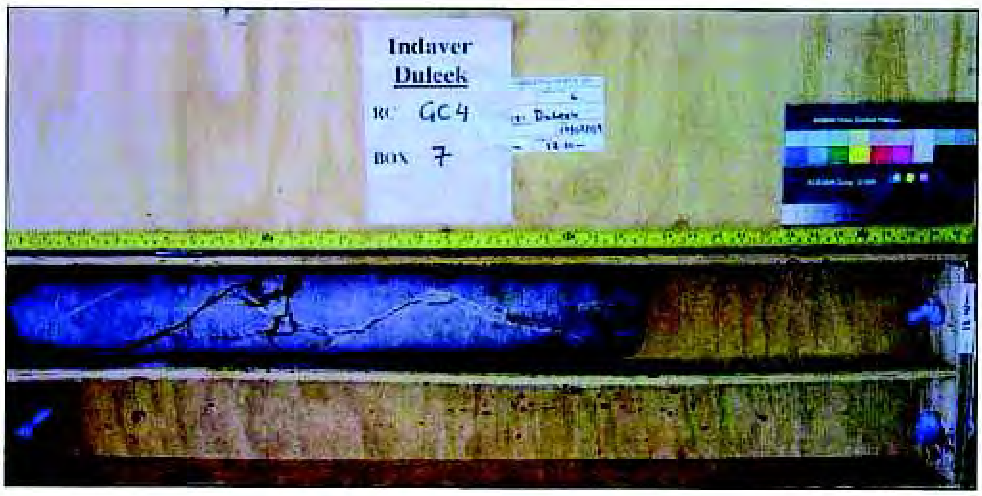
RC GC4 BOX 6 OF 7



IGSL Ltd.

Core Photography – Indaver Duleek (14039)

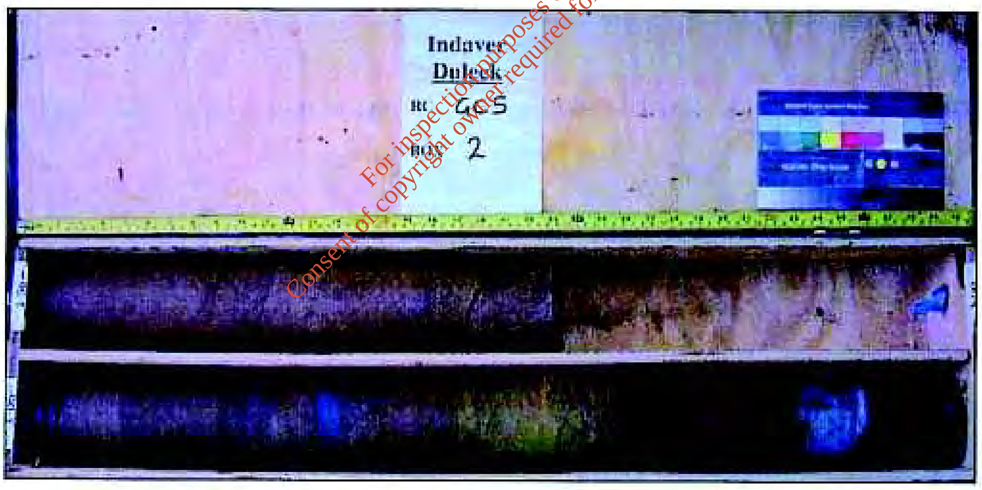
RC GC4 BOX 7 OF 7



Core Photography – Indaver Duleek (14039)

RC GC5 BOX 1 OF 7

RC GC5 BOX 2 OF 7



RC GC5 BOX 3 OF 7

RC GC5 BOX 4 OF 7

RC GC5 BOX 5 OF 7

RC GC5 BOX 6 OF 7

RC GC5 BOX 7 OF 7

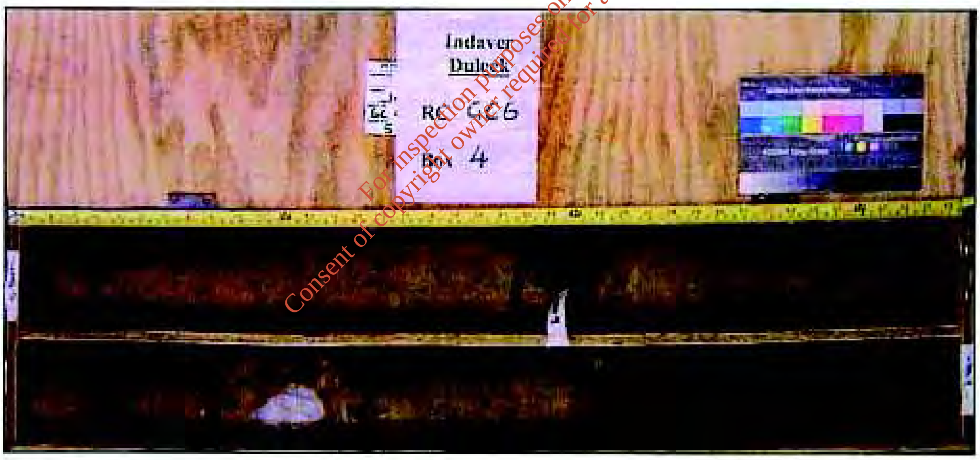
Core Photography – Indaver Duleek (14039)

RC GC6 BOX 1 OF 8

RC GC6 BOX 2 OF 8

RC GC6 BOX 3 OF 8

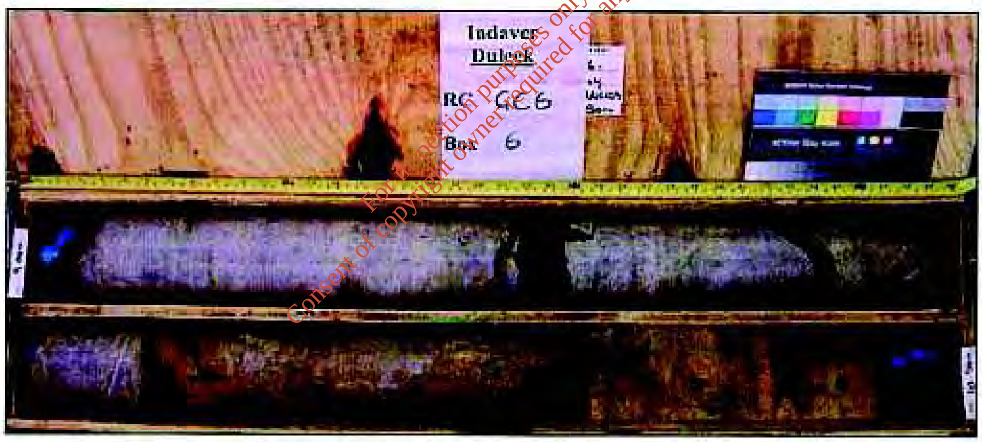
RC GC6 BOX 4 OF 8



Core Photography – Indaver Duleek (14039)

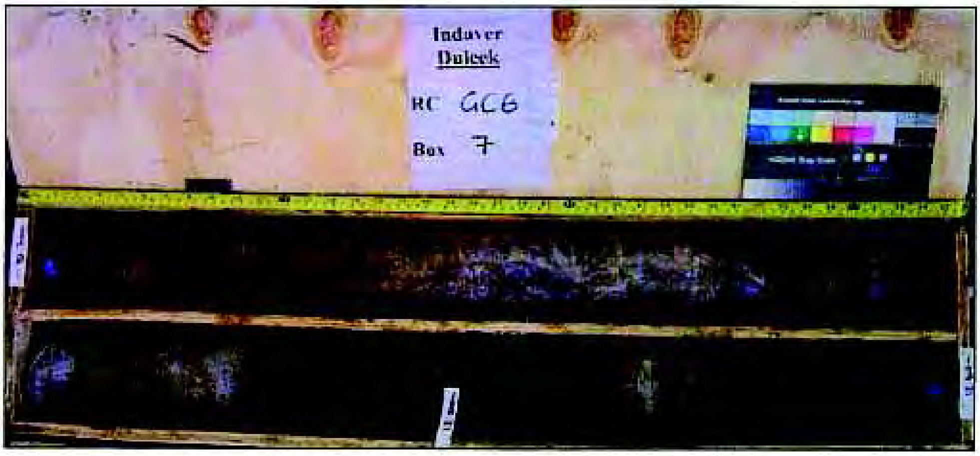
RC GC6 BOX 5 OF 8

RC GC6 BOX 6 OF 8



Core Photography – Indaver Duleek (14039)

RC GC6 BOX 7 OF 8



RC GC6 BOX 8 OF 8

Core Photography – Indaver Duleek (14039)

RC RP1 BOX 1 OF 1

RC RP2 BOX 1 OF 1

IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC RP5 box 1 of 1

Appendix 7

Exploratory Site Plan

GPS SURVEY - INDAVER PROJECT

EXPLORATORY NO.	EASTING (m)	NORTHING (m)	HEIGHT (m)
GC1	306263.874	270930.70	30.096
GC2	306286.093	270892.715	30.003
GC3	306299.117	270902.057	30.144
GC4	306275.131	270938.384	30.019
GC5	306280.567	270916.062	30.081
GC6	306325.715	270960.256	30.269
PP2	306334.870	271034.982	30.788
PP3	306229.147	270963.299	29.350
RP1	306246.509	270914.342	29.943
RP2	306241.735	270906.390	30.026
RP5	306255.430	270916.960	30.175


AIR CONDENSER
LOADING BAY
SLAG STORAGE BUILDING
TURBINE AND AUXILIARIES
FURNACE BOILER
WASTE BUNKER
RECEPTION HALL
PUMP HOUSE
TRANSFORMER COMPOUND
TRANSFORMER COMPOUND
ESB
BUS PARKING
WAREHOUSE AND EDUCATION CENTRE
DITCH

Appendix 8

Stabilization Test Data

TRIAL PIT RECORD

REPORT NUMBER	14039
CONTRACT	Indaver Waste Management Facility
TRIAL PIT NO.	TP1
SHEET	Sheet 1 of 1
LOGGED BY	D Tallon
CO-ORDINATES(_)	
GROUND LEVEL (m)	
DATE STARTED	30/03/200930/03/2009
DATE COMPLETED	
CLIENT	Indaver
ENGINEER	PM Group
EXCAVATION METHOD	13T Tracked

Scale (m)	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	Very firm brown very sandy gravelly CLAY									
						AD1376 AD1377	LB LB	1.50-1.50 1.50-1.50		
2.0	Dense brown clayey gravelly fie to coarse SAND		1.90							
3.0						AD1378 AD1379	LB LB	3.00-3.00 3.00-3.00		
	Dense brown clayey sandy GRAVEL with occasional cobbles		3.30							
4.0	End of Trial Pit at 4.00m		4.00			AD1380 AD1381	LB LB	4.00-4.00 4.00-4.00		

Groundwater Conditions
Pit dry

Stability
Pit Stable

General Remarks

IGSL	**TRIAL PIT RECORD**	REPORT NUMBER 14039

CONTRACT Indaver Waste Management Facility		TRIAL PIT NO.	TP2
		SHEET	Sheet 1 of 1
LOGGED BY D Tallon	CO-ORDINATES(_)	DATE STARTED	30/03/2009
	GROUND LEVEL (m)	DATE COMPLETED	30/03/2009
CLIENT Indaver ENGINEER PM Group		EXCAVATION METHOD	13T Tracked

Scale	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	Loose grey slightly clayey very sandy GRAVEL									
1.0										
						AD1382 AD1383	LB LB	1.50-1.50 1.50-1.50		
2.0										
3.0	Medium dense grey/brown very sandy clayey GRAVEL with occasional cobbles		3.00			AD1384 AD1385	LB LB	2.90-3.00 2.90-3.00		
4.0	End of Trial Pit at 4.00m		4.00			AD1386 AD1387	LB LB	3.90-4.00 3.90-4.00		

Groundwater Conditions
Pit dry

Stability
Pit Unstable from 1.0m

General Remarks

IGSL TP LOG 14039.GPJ IGSL.GDT 30/3/09

REPORT NO.

SULPHATE ANALYSIS

IGSL

CONTRACT: **Indaver Waste Management Facility** CONTRACT NO 14039

BH/TP NO.	DEPTH (M)	SAMPLE NO.	SAMPLE TYPE	TEST CODE	% Passing 2mm	SULPHUR TRIOXIDE 2:1WATER SOIL EXTRACT So3 g/L	SULPHUR TRIOXIDE TOTAL SOIL so3 %	(so3 X 1.2) 2:1WATER SOIL EXTRACT So4 g/L	pH VALUE
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	TREATED WITH 1%LIME TESTED AFTER 14	SP1A	S	A	N/A	0.41		0.492	11.9
	TREATED WITH 2%LIME TESTED AFTER 14	SP1B	S	A	N/A	0.007		0.008	12.8
	TREATED WITH 1%LIME & 1% CEMENT TESTED	SP1C	S	A	N/A	0.014		0.017	12.6
COMBINED SAMPLES FROM STOCKPILE 3	TREATED WITH2% LIME TESTED AFTER 14 DAYS	SP2A	S	A	N/A	0.017		0.020	12.4
COMBINED SAMPLES FROM TRIAL PIT 1	TREATED WITH 1%LIME TESTED AFTER 14 DAYS	TP1A	S	A	N/A	0.031		0.037	11.7
COMBINED SAMPLES FROM TRIAL PIT 2	TREATED WITH 1%CEMENT TESTED AFTER 14 DAYS	TP2A	S	A	N/A	0.141		0.169	11.0

TEST CODE W = WATER S = SOIL A = AQUEOUS SOIL EXTRACT(2:1)

Report No.

MCV SUMMARY

I.G.S.L.

Contract: **Indaver Waste Management Facility**

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM TRIAL PIT 1	TP1A		NATURAL	10.5	12.1	93.9	
			NATURAL	9.8	11.7	93.9	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	13.6	11.5	93.9	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	12.9	11.6	93.9	

Test Code:

Report No.

MCV SUMMARY

I.G.S.L.

Contract: **Indaver Waste Management Facility** CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
	TP2A		NATURAL	9.0	12.0	81.7	
			NATURAL	8.9	12.6	81.7	
COMBINED SAMPLES FROM TRIAL PIT 2							
			TREATED WITH 1%CEMENT TESTED AFTER 3 HRS	9.7	13.3	81.7	
			TREATED WITH 1%CEMENT TESTED AFTER 3 HRS	10.1	13.2	81.7	

Test Code:

Report No.

MCV SUMMARY

I.G.S.L.

Contract: Indaver Waste Management Facility

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM STOCKPILE 3	SP2A		NATURAL	2.9	23.2	92.8	
			NATURAL	3.2	23.9	92.8	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	5.6	25.9	92.8	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	5.5	26.5	92.8	

Test Code:

Report No.

MCV SUMMARY

I.G.S.L.

Contract: **Indaver Waste Management Facility**

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1A		NATURAL	3.0	16.6	91.5	
			NATURAL	2.7	16.8	91.5	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	6.3	18.3	91.5	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	7.6	18.6	91.5	

Test Code:

Report No.

MCV SUMMARY

I.G.S.L.

Contract: **Indaver Waste Management Facility**

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1B		NATURAL	3.0	16.6	91.5	
			NATURAL	2.7	16.8	91.5	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	7.9	17.8	91.5	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	8.4	17.3	91.5	

Test Code:

Report No.

MCV SUMMARY

I.G.S.L.

Contract: **Indaver Waste Management Facility**

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
	SP1C		NATURAL	3.0	16.6	91.5	
			NATURAL	2.7	16.8	91.5	
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4			TREATED WITH 1%LIME & 1% CEMENT TESTED AFTER 3 HR	7.5	17.6	91.5	
			TREATED WITH 1%LIME & 1% CEMENT TESTED AFTER 3 HR	7.5	18.0	91.5	

Test Code:

Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: **Indaver Waste Management Facility** **DATE: 12/05/2009** CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
	TP1A		NATURAL	11.9	NAT	L/St	12.0	11.8	2.25	93.9	16.5	18.2	17.4
			NATURAL	11.8	NAT	L/St	11.9	11.7	2.25	93.9	18.5	18.2	18.3
COMBINED SAMPLES FROM TRIAL PIT 1			TREATED WITH 1%LIME	11.4	1 DAY	L/St	11.3	11.4	2.20	93.9	38.9	36.4	37.6
			TREATED WITH 1%LIME	11.5	1 DAY	L/St	11.5	11.5	2.20	93.9	33.9	38.1	36.0
			TREATED WITH 1%LIME	11.4	3 DAY	L/St	11.5	11.3	2.20	93.9	33.5	30.5	32.0
			TREATED WITH 1%LIME	11.7	3 DAY	L/St	11.8	11.5	2.20	93.9	38.2	38.4	38.3
			TREATED WITH 1%LIME	11.2	14 DAY	L/St	11.3	11.1	2.20	93.9	44.4	54.7	49.6
			TREATED WITH 1%LIME	11.4	14 DAY	L/St	11.6	11.2	2.20	93.9	48.3	53.4	50.9

Test Code U.-Undisturbed Sample L.-2.5Kg. Rammer A/5.-5% Air Voids Ratio V.- Vibrating Hammer
D.-Dynamic Compaction H.-4.5Kg. Rammer A10.-10% Air Voids Ratio M.- Method Number
St.-Static compaction RN29.- Road Note 29 (St. 95% H.)

Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: **Indaver Waste Management Facility** **DATE: 12/05/2009** CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
COMBINED SAMPLES FROM TRIAL PIT2	TP2A		NATURAL	13.2	NAT	L/St	13.2	13.1	2.24	81.7	23.3	17.6	20.5
			NATURAL	13.3	NAT	L/St	13.0	13.5	2.24	81.7	16.4	17.4	16.9
			TREATED WITH 1% CEMENT	13.4	1 DAY	L/St	13.3	13.5	2.23	81.7	55.5	55.6	55.6
			TREATED WITH 1% CEMENT	13.4	1 DAY	L/St	13.3	13.4	2.23	81.7	58.7	49.6	54.1
			TREATED WITH 1% CEMENT	13.5	3 DAY	L/St	13.3	13.6	2.23	81.7	58.1	43.3	50.7
			TREATED WITH 1% CEMENT	13.1	3 DAY	L/St	13.1	13.0	2.23	81.7	69.2	67.4	68.3
			TREATED WITH 1% CEMENT	12.4	14 DAY	L/St	12.4	12.4	2.23	81.7	69.0	78.4	73.7
			TREATED WITH 1% CEMENT	12.9	14 DAY	L/St	12.9	12.8	2.23	81.7	74.1	65.0	69.6

Test Code U.-Undisturbed Sample; D.-Dynamic Compaction; St.-Static compaction
L.-2.5Kg. Rammer; H.-4.5Kg. Rammer
A/5.-5% Air Voids Ratio; A10.-10% Air Voids Ratio; RN29.- Road Note 29 (St. 95% H.)
V.- Vibrating Hammer; M.- Method Number

Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: **Indaver Waste Management Facility** **DATE: 12/05/2009** CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1A		NATURAL	19.5	NAT	L/St	19.5	19.5	2.07	91.5	1.0	0.8	0.9
			NATURAL	19.7	NAT	L/St	19.2	20.1	2.07	91.5	1.1	0.6	0.9
			TREATED WITH 1%LIME & 1% CEMENT	18.1	1 DAY	L/St	18.1	18.1	2.10	91.5	10.3	10.1	10.2
			TREATED WITH 1%LIME & 1% CEMENT	18.7	1 DAY	L/St	18.4	19.0	2.10	91.5	10.1	10.2	10.1
			TREATED WITH 1%LIME & 1% CEMENT	18.4	3 DAY	L/St	18.4	18.4	2.10	91.5	10.6	10.5	10.6
			TREATED WITH 1%LIME & 1% CEMENT	18.8	3 DAY	L/St	18.8	18.7	2.10	91.5	13.9	14.5	14.2
			TREATED WITH 1%LIME & 1% CEMENT	18.6	14 DAY	L/St	18.7	18.4	2.09	91.5	19.1	12.8	16.0
			TREATED WITH 1%LIME & 1% CEMENT	18.1	14 DAY	L/St	17.8	18.4	2.09	91.5	15.7	16.2	16.0

Test Code U.-Undisturbed Sample
D.-Dynamic Compaction
St.-Static compaction

L.-2.5Kg. Rammer
H.-4.5Kg. Rammer

A/5.-5% Air Voids Ratio
A10.-10% Air Voids Ratio
RN29.- Road Note 29 (St. 95% H.)

V.- Vibrating Hammer
M.- Method Number

Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: **Indaver Waste Management Facility** **DATE: 12/05/2009** CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
COMBINED SAMPLES FROM STOCKPILE 3	SP2A		NATURAL	27.8	NAT	L/St	27.0	28.6	1.89	92.8	0.3	0.2	0.3
			NATURAL	26.7	NAT	L/St	26.2	27.2	1.89	92.8	0.4	0.3	0.3
			TREATED WITH 2%LIME	26.2	1 DAY	L/St	26.3	26.1	1.95	92.8	4.2	4.2	4.2
			TREATED WITH 2%LIME	26.1	1 DAY	L/St	26.8	25.4	1.95	92.8	3.7	4.8	4.2
			TREATED WITH 2%LIME	26.4	3 DAY	L/St	26.3	26.4	1.95	92.8	2.8	2.7	2.7
			TREATED WITH 2%LIME	26.6	3 DAY	L/St	26.5	26.6	1.95	92.8	3.4	3.1	3.3
			TREATED WITH 2%LIME	25.3	14 DAY	L/St	25.0	25.6	1.95	92.8	5.6	5.6	5.6
			TREATED WITH 2%LIME	25.8	14 DAY	L/St	25.2	26.3	1.95	92.8	6.1	6.2	6.1

Test Code U.-Undisturbed Sample, D.-Dynamic Compaction, St.-Static compaction
L.-2.5Kg. Rammer, H.-4.5Kg. Rammer
A/5.-5% Air Voids Ratio, A10.-10% Air Voids Ratio, RN29.- Road Note 29 (St. 95% H.)
V.- Vibrating Hammer, M.- Method Number

Report No.

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I.G.S.L.

Contract: **Indaver Waste Management Facility** **DATE: 12/05/2009** CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1A		NATURAL	19.5	NAT	L/St	19.5	19.5	2.07	91.5	1.0	0.8	0.9
			NATURAL	19.7	NAT	L/St	19.2	20.1	2.07	91.5	1.1	0.6	0.9
			TREATED WITH 2%LIME	18.9	1 DAY	L/St	18.7	19.0	2.11	91.5	11.1	5.9	8.5
			TREATED WITH 2%LIME	19.0	1 DAY	L/St	19.0	19.0	2.11	91.5	12.7	11.9	12.3
			TREATED WITH 2%LIME	18.1	3 DAY	L/St	18.3	17.8	2.11	91.5	15.1	11.2	13.1
			TREATED WITH 2%LIME	18.5	3 DAY	L/St	18.5	18.5	2.11	91.5	16.9	16.4	16.6
			TREATED WITH 2%LIME	18.0	14 DAY	L/St	18.0	18.0	2.11	91.5	17.3	19.2	18.2
			TREATED WITH 2%LIME	17.6	14 DAY	L/St	17.1	18.0	2.11	91.5	16.5	17.4	16.9

Test Code U.-Undisturbed Sample; D.-Dynamic Compaction; St.-Static compaction
L.-2.5Kg. Rammer; H.-4.5Kg. Rammer
A/5.-5% Air Voids Ratio; A10.-10% Air Voids Ratio; RN29.- Road Note 29 (St. 95% H.)
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Contract: **Indaver Waste Management Facility** **DATE:** **12/05/2009** CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
	SP1A		NATURAL	19.5	NAT	L/St	19.5	19.5	2.07	91.5	1.0	0.8	0.9
			NATURAL	19.7	NAT	L/St	19.2	20.1	2.07	91.5	1.1	0.6	0.9
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4			TREATED WITH 1%LIME	19.3	1 DAY	L/St	19.8	18.7	2.09	91.5	5.4	5.5	5.4
			TREATED WITH 1%LIME	19.4	1 DAY	L/St	19.0	19.7	2.09	91.5	4.6	6.3	5.4
			TREATED WITH 1%LIME	19.3	3 DAY	L/St	19.4	19.1	2.09	91.5	5.4	5.8	5.6
			TREATED WITH 1%LIME	18.8	3 DAY	L/St	18.8	18.7	2.09	91.5	3.4	5.9	4.7
			TREATED WITH 1%LIME	18.9	14 DAY	L/St	19.1	18.6	2.09	91.5	8.0	6.5	7.2
			TREATED WITH 1%LIME	17.9	14 DAY	L/St	18.1	17.6	2.09	91.5	8.6	9.7	9.2

Test Code U.-Undisturbed Sample, D.-Dynamic Compaction, St.-Static compaction
L.-2.5Kg. Rammer, H.-4.5Kg. Rammer
A/5.-5% Air Voids Ratio, A10.-10% Air Voids Ratio, RN29.- Road Note 29 (St. 95% H.)
V.- Vibrating Hammer, M.- Method Number

Meath Waste Management Facility

Carranstown, Co. Meath

Geotechnical Interpretative Report

(Report No. 14039)

Client: Indaver Ireland

Engineer: PM Group Ltd

May 2009

IGSL Ltd

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FOREWORD

The following conditions and notes on site investigation procedures should be read in conjunction with this geotechnical report.

General

The ground investigation works for the Meath Waste Management Facility, Duleek have been carried out in accordance with BS 5930 (1990) and the IEI Specification & Related Documents for Ground Investigation in Ireland (2006).

Recommendations made and opinions expressed in this report are based on the strata observed in the exploratory holes, together with the results of in-situ and laboratory test data. No responsibility can be held for conditions which have not been revealed by exploratory work, or which occur between exploratory hole locations.

Whilst the report may suggest the likely configuration of strata, both between exploratory hole locations, or below the maximum depth of the investigation, this is only indicative, and liability cannot be accepted for its accuracy. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

Disclaimer

The geotechnical interpretative report has been prepared for Project Management Group / Indaver Ireland and the information should not be used without prior approval or written permission of either party. The recommendations developed in this report are based on the IGSL factual ground investigation data (IGSL Project No. 14039), Byrne Looby Geotechnical Assessment Report (B580) and Apex Geophysical Report. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.

1. INTRODUCTION

At the request of Project Management (PM) and Indaver Ireland, IGSL has undertaken a programme of geotechnical investigation works for a waste to energy facility at Carranstown, Duleek, Co. Meath. The works were performed as directed by PM Group, consulting engineers for the project. The site is located at Carranstown, Duleek, Co. Meath and encompasses an area of approximately 25 acres. The site is bounded to the south by the R150 Duleek to Navan Road, to the east by the Platin Cement Works and farmland to the west and north.

It is understood that the proposed development will involve the construction of a waste management facility and include a waste handling area (bunker & furnace), emissions stack, ash bunker, workshop, office and administration buildings and general site infrastructure (i.e. roads, drainage, service utilities, culverts etc). The waste handling area will require a basement type structure (bunker) with a proposed dig depth of the order of 7m below existing ground level (i.e. formation of c23m OD). Site enabling works were completed prior to IGSL commencing the geotechnical investigations and produced a platform level of 30.5m OD. It is noted that a programme of geotechnical investigations were originally carried out in 2007 and details are presented in a report prepared by Byrne Looby Partners (B580 May 2007).

The geophysical and geotechnical fieldworks works for this phase were carried out in accordance with BS 5930, Code of Practice for Site Investigations (1999) and the IEI Specification & Related Documents for Ground Investigation in Ireland (2006). The fieldworks included geophysical surveying, rotary core drillholes and percolation tests. Core drillholes GC 1 to GC 5 were positioned at the footprint of the bunker (note the location of this structure was subsequently altered) while RP 1, 2 and 5 were located at a zone where karst weathering was identified in the original investigations. The geophysical surveying was performed by Apex Geoservices and included seismic refraction spreads and surface wave analysis (MASW) to determine small strain stiffness.

Geotechnical soil and rock laboratory testing was performed on selected samples in accordance with BS 1377 and ISRM. In addition, modification / stabilization trial testing was performed in the laboratory to evaluate the behaviour of the glacial till, following the addition of lime (calcium oxide) and ordinary portland cement. This element of the testing focused on MCV, CBR and sulphates.

The primary objectives of the investigation were as follows:

- Evaluate rock quality, weathering profile, strength and fracture state of the bedrock at the proposed bunker & emissions stack
- Recover samples for geotechnical laboratory testing (soil & rock)
- Assess percolation characteristics of the upper soils at designated locations

This report presents an interpretation of the ground conditions and engineering properties of the soils and bedrock. Recommendations are developed and provided on the key geotechnical issues impacting on the proposed development. A separate factual report has been prepared and this includes the rotary drillhole records, percolation test data and laboratory test results.

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2. FIELDWORK

2.1 General

The fieldworks were carried out during the period February 2009 and comprised the following:

- Rotary core drillholes (9 No.)
- Percolation tests (2 No.)
- Geophysical surveying

2.2 Rotary Drillholes

Rotary drilling was undertaken at nine locations using a top drive Knebel rig. Geobor core drilling methods were utilized at six locations (denoted GC 1 to GC 6) with conventional air mist drilling employed at three locations (RP 1, 2 & 5). The Geobor drilling system used polymer gel flush and recirculation tanks, with the emphasis on high quality recovery in the glacial soils and upper bedrock zone.

The Geobor coring produced 102mm diameter cores while the conventional coring produced 80mm diameter cores using air mist flush. Recovery in the Geobor holes was excellent with 100% recovery in the majority of the runs. The Geobor drillholes achieved depths of between 11.80 and 15.10m while each of the conventional holes terminated at depths of 10.50m. Each of the core drillholes were backfilled with cement/bentonite grout (tremmied) as directed by PM.

The rock cores were placed in 3m capacity timber boxes and logged by an IGSL engineering geologist. This included photography of the cores with a digital camera. The core log records are presented in Appendices 1 and 2 of the factual report and include engineering geological descriptions of the rock cores, details of the bedding / discontinuities and mechanical indices (TCR, SCR and RQD's) for each core run.

Where rock core was recovered, a graphic fracture log is also presented alongside the mechanical indices. This illustrates the fracture state of the rock cores and allows easy identification of highly fractured / non-intact zones and discontinuity spacings. It should be noted that no correction for dip of the joints has been made and that the spacings shown are successive joint / core intersections within the core.

2.3 Percolation Tests

Percolation or soakaway tests were performed at two locations to evaluate the infiltration potential of the upper soils. The tests were conducted in accordance with BRE 365 guidelines and the data sheets are presented in Appendix 3 of the factual report. The infiltration rate values (F Values) were calculated using the field data and are shown on each of the logs.

2.4 Geophysical Surveying

Geophysical surveying was carried out by Apex Geoservices and included resistivity profiling, seismic refraction spreads and multi-channel analysis of surface waves to assess soil stiffness (GMax v depth). Details of the methodologies used, x-sections / profiles and maps are presented in a separate report by Apex Geoservices.

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3. LABORATORY TESTING

Geotechnical soil laboratory testing was performed on selected Geobor core samples in accordance with BS 1377 (1990). The soils testing included the following and results are presented in Appendix 4 of the factual report.

- Moisture contents
- Particle size analysis
- Atterberg Limits (Liquid & Plastic Limits)
- Consolidated quick undrained triaxial tests
- Consolidation (oedometer) tests
- pH & sulphates

Soil modification / stabilization testing was carried out on samples of the glacial till recovered from stockpiles and at the bunker footprint. The results of these tests are presented in Appendix 6 of the factual report. Rock testing was undertaken on representative core samples and focused on Point Load Strength Index (PLSI)) and unconfined compressive strength (UCS) tests in accordance with ISRM. The results of the rock testing are presented in Appendix 5 of the factual report.

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4. GROUND CONDITIONS & ENGINEERING PROPERTIES

4.1 Ground Profile

The exploratory holes have revealed the ground conditions at this site to comprise:

- Glacial deposits
- Limestone Bedrock

4.2 Glacial Deposits

The Byrne Looby (BLP) investigatory works show the indigenous soils at this site comprise low plasticity, brown very sandy gravelly CLAY with cobbles (locally grading to SILT). Subordinate horizons or pockets of sandy GRAVEL and gravelly or clayey SAND were also uncovered during the aforementioned investigations (trial pits). The cohesive or fine grained material is referred to as 'glacial till', while the subordinate coarse or granular dominant materials are typical of fluvio-glacial deposits. Ground levels (mOD) were not reported on the BLP records, however it appears that the cable percussion boreholes refused on cobble / boulder obstructions.

The soils are thought to represent over-consolidated lodgement till and examination of the BLP borehole and trial pit descriptions show changes in colour and grading with depth. The gravel constituents or clasts range from fine to coarse, are subrounded to subangular and predominantly limestone in origin. Recovery of the glacial till in the Geobor drillholes was good to excellent and the cores show a complex and variable stratigraphy. An example of the core recovery in the glacial till is presented in Plate 1.

Plate 1 – Geobor Recovery in Glacial Till (GC 3)

No undisturbed samples (U100's) were recovered by BLP/GII for laboratory strength testing. However, the SPT test is widely used in establishing the strength or relative density of glacial till deposits and relationships exist between SPT N-Value (blows for 300mm penetration) and undrained shear strength (C_u). The most widely used correlation between N-Value and C_u for glacial till soils is that proposed by Stroud & Butler where $C_u \approx 4$ to 6N. An SPT data plot has been prepared using the relevant BLP/GII borehole data and this is presented in Figure 1. The N-Values show the upper glacial till to be principally firm in consistency, becoming firm / stiff with depth.

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Consolidated quick undrained (CQu) triaxial compression and odeometer consolidation tests were performed by IGSL on selected Geobor samples. The CQu tests produced cohesion values of between 91 and 241 kN/m^2 (mean value of 166 kN/m^2) and these indicate stiff and very stiff glacial soils. Bulk densities range from 2.06 to 2.36 Mg/m^3 and these are characteristic of over-consolidated gravel or cobble dominant glacial till.

Inspection of the oedometer test data shows Modulus of Volume compressibility (Mv) values typically around 0.3 m^2/MN in the 100 to 200 kN/m^2 pressure range. Coefficients of consolidation (Cv) were also calculated and appear to be quite consistent, with values typically of the order of 20 to 30 m^2/yr. It is highlighted that the oedometer test is performed on a 76mm diameter sample and in glacial till materials, this can produce higher Mv's as the gravel and cobble constituents are excluded in the laboratory test.

On a field scale, the gravel / cobble constituents tend to enhance the stiffness of a glacial till deposit. The oedometer consolidation tests produced higher Mv's than expected and the values suggest the till is of medium compressibility (Mv of 0.1 to 0.30 m^2/MN). For settlement calculations, a Modulus of Volume Compressibility value of 0.2 to 0.25 m^2/MN for the firm glacial till is deemed reasonable.

Table 1 - Summary Details of Consolidated Quick Undrained (CQu) Tests

Geobor Drillhole	Sample Depth (m bgl)	Dry Density (Mg/m^3)	Bulk Density (Mg/m^3)	NMC (%)	Cohesion (kN/m^2)
RC 1	2.60	1.68	2.06	20	91
RC 3	2.00	2.01	2.29	14	214
RC 3	4.50	2.10	2.36	9.7	260
RC 4	3.20	1.76	2.16	22	96
RC 5	3.00	2.10	2.32	11	168

Natural moisture contents were determined on representative Geobor core samples and produced values mostly in the range 11 to 19%. Liquid and Plastic Limit tests (consistency indices) were also performed on selected samples and these show the till to be predominantly of low plasticity (CL). With the exception of one sample (GC 3 at 4.50m) the remainder of the tests plot above the A-Line on the Casagrande Chart. The majority of the plasticity Indices are in the 12 to 19% range. Fines contents (i.e. silt & clay) vary considerably in the Geobor drillholes, with the till having between and 30 and 70% fines. Applying the Hazen or Sherard equations, the boulder clay is classed as being of low permeability, with coefficients of permeability (K) of the order of 10^{-8}to 10^{-9}m/s.

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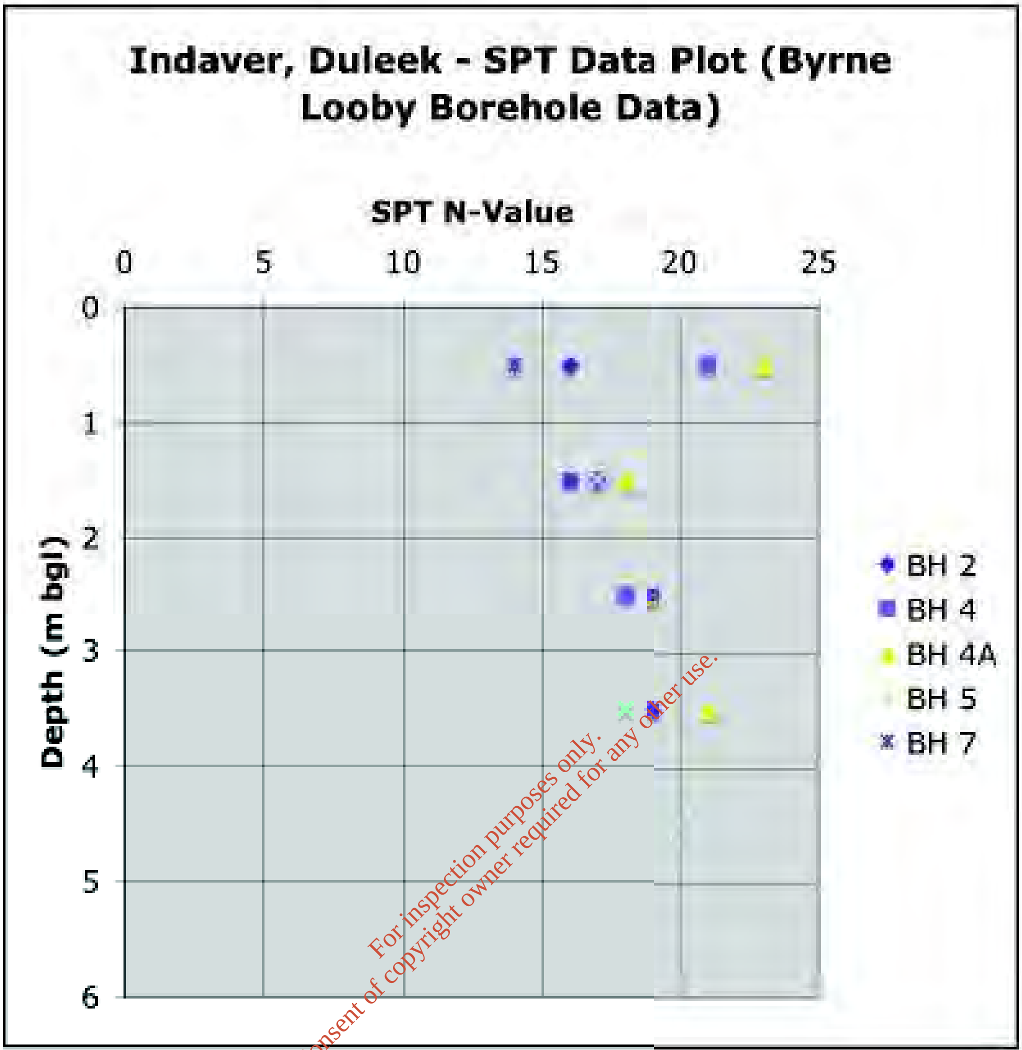
Figure 2 - SPT Data Plot



Surface wave velocities (Rayleigh waves) were measured by Apex Geoservices at five spread locations using an array of geophones at designated spacings. The shear wave velocity data (Vs) was used to derive small strain shear modulus or stiffness values (G_{max}) with depth. The shear wave velocity and small strain stiffness plots have been combined and are presented in Figures 2 and 3 respectively. The shear wave velocities increase with depth and this data can be used to derive Bulk Modulus, Youngs Modulus, Poisson's Ratio and G_{max}. Values of dynamic moduli (G_{max}) are typically an order of magnitude *greater* than static values, established by routine in-situ testing. Ground strains are generally accepted to be < 0.1% and therefore small strain stiffness values can be used to make reasonable predictions of deformations (Jardine et al. 1986). The Apex geophysical report presents values of Vs, Vp, Density, Poissons Ratio, Youngs Modulus (dynamic & static)) and Bulk Modulus.

The data shows of G_{Max} values in the upper glacial soils typically ranging from around 50 MPa to 150 MPa (firm / stiff boulder clay), increasing to 500 MPa in the very stiff till /upper variably weathered bedrock. The variations in the small strain stiffness values correlate well with the variations in soil composition as indicated by the Geobor core recovery. There is a noticeable 'kick' at a depth of approximately 5 to 6m, this correlates with the core drillhole data (GC 1 to 5) where rockhead was confirmed at depths of 5.30 to 8.00m.

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Figure 2 – Shear Wave Velocities v Depth

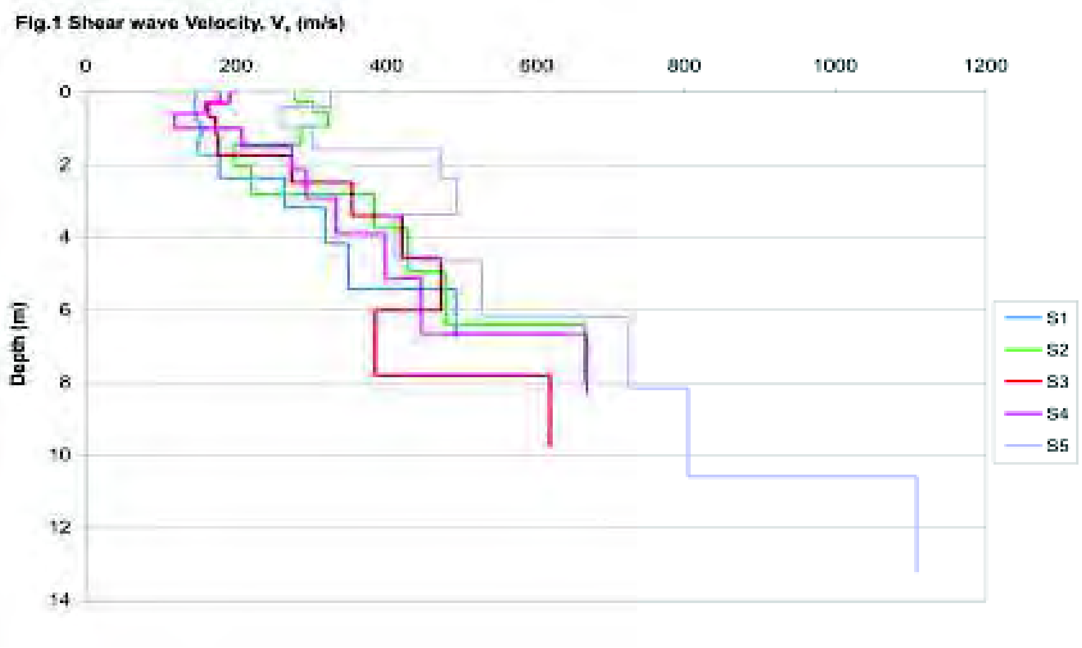
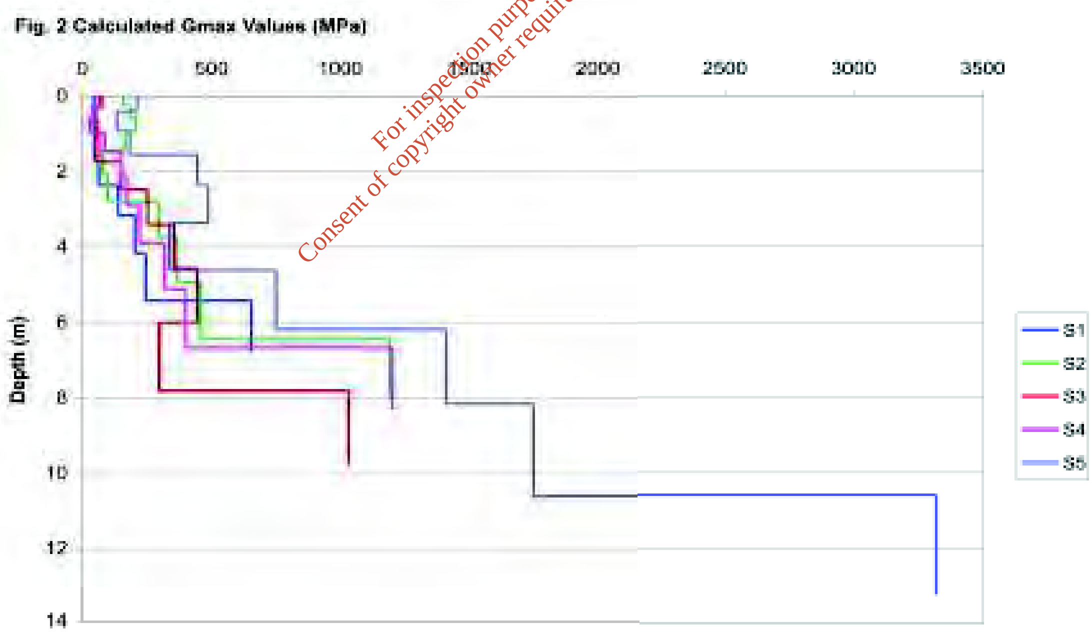


Figure 3 – Small Strain Stiffness (GMax) v Depth



4.3 Bedrock

The core drillholes show that bedrock consists of mid grey and grey blue, fine to medium grained silileous and fossiliferous LIMESTONE belonging to the Platin Formation (GSI Sheet 13, Geology of Meath). The limestone appears to be have been silicified, and is classed as being predominantly slightly weathered to fresh, though zones of moderately weathered and heavily fractured (non-intact) limestone were also uncovered. Table 1 presents summary details of the rotary drillholes, and includes rockhead depths and an overview of rock quality at each exploratory location. Not

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unexpectedly, rockhead elevation appears to be irregular at the site and appears to be deepest in GC 3 and GC 6 (east of the turbine and auxillaries).

Plate 2 – Example of Limestone Bedrock at Waste Bunker (RP 2)

The Geobor drillholes produced high quality core recovery in the variably weathered upper bedrock. Prominent clay, sand and gravel infill was noted in a number of the drillholes and there is clear evidence that the bedrock has been subjected to karst weathering / alteration. It should be noted that the siliceous limestone is more resistant to solution weathering (as opposed to the more calcareous fine grained limestone which is much more susceptible) and this may 'mask' the true rock mass quality. There is good reason to suspect that a paleokarst system could be present at the site and this will be discussed further in Section 5.

Discontinuities are generally rough and undulose while apertures appear to have widths of around 1 to 2mm. Dips mostly vary between sub-horizontal and 45° and surfaces show iron staining or discolouration. There is also evidence of clay smearing or infill along discontinuity surfaces. Discontinuity spacings are principally close (60 to 200mm) and medium (200 to 600mm) spaced though GC 3 shows very closely spaced (20 to 60mm) discontinuities, with much of the core more akin to a coarse angular gravel.

Point load strength index (PLSI) tests were carried out on a number of core samples and results are presented in Appendix 5 of the factual report. Inspection of the data sheets shows Is_{50} values of between 2.78 and 11.2 MPa with a mean value of 6.6 MPa. The compressive strength of the rock (q_c) can be established using a correlation suggested by Goodman where $q_c \approx 18$ to $24 \times Is_{50}$. Using a correlation value of 20, the point load test data shows the limestone to be predominantly strong (i.e. 50 to 100 MPa) to locally very strong (100 to 200 MPa).

Unconfined compressive strength (UCS) tests were also undertaken on selected rock cores and produced values of 27, 72, 35, 38, 39, 36, 54 and 59 MPa respectively. The UCS test data classes the limestone as moderately strong to locally strong and this is clearly at variance with the PLSI data. It is thought that the core samples failed prematurely during UCS testing (failure along

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incipient discontinuities as the principal stress was applied) and hence does not truly reflect the inherent strength of the limestone bedrock.

Table 2 - Summary Details of Rotary Drillholes

Rotary Hole	Total Depth (m bgl)	Rockhead (m bgl)	Rock Quality Characteristics
GC 1	12.00	6.60m (23.5m OD)	Strong to very strong (where intact) and locally moderately strong, fresh to slightly weathered LIMESTONE. Very closely fractured from 6.60 to c8.7m. Dry.
GC 2	15.10	5.30 (24.70m OD)	Strong to very strong (where intact) and locally moderately strong, fresh to locally slightly weathered LIMESTONE. Dry.
GC 3	11.80	8.00 (22.14m OD)	Strong to moderately strong, slightly to locally moderately weathered LIMESTONE. Dry. Prominent infill with sand, gravel & clay throughout, indicative of karst weathering / alteration.
GC 4	12.15	7.15 (23.12m OD)	Strong to very strong (where intact) and locally moderately strong, fresh to locally slightly weathered LIMESTONE. Locally highly fractured (8.60 to 9.80m). Dry.
GC 5	12.20	5.80 (24.28m OD)	Strong to moderately strong, fresh to slightly weathered LIMESTONE. Dry.
GC 6	13.50	8.25 (22.02m OD)	Strong to moderately strong, fresh to locally slightly weathered LIMESTONE. Highly fractured with very prominent clay, sand, gravel infill, indicative of karst weathering / alteration. Dry.
RP 1	10.50	6.40 (23.54m OD)	Strong to very strong (where intact), fresh to locally slightly weathered LIMESTONE. <u>*Cavity*</u> noted by driller from 8.70 to 8.90m, indicative of karst weathering / alteration. Dry.
RP 2	10.50	5.70 (24.33m OD)	Strong to very strong (where intact) and locally moderately strong, fresh to locally slightly weathered LIMESTONE. Dry.
RP 5	10.50	6.70 (23.48m OD)	Moderately strong (where intact) to moderately weak, moderately to locally highly weathered LIMESTONE. Becoming strong to moderately strong from c8.60m,

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			upper bedrock zone highly weathered / non-intact (6.70 to c8.60m). Dry.

4.4 Groundwater

Groundwater was not encountered in any of the nine IGSL rotary core drilholes. It is highlighted that loss of water flush was observed during drilling and this is characteristic of karst bedrock. It is noted that standpipes were not installed in the rotary drillholes to establish equilibrium groundwater levels.

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5. DISCUSSION & RECOMMENDATIONS

5.1 General

It is understood that a waste to energy facility will be constructed at this site. In light of this and the geotechnical / geophysical findings, the following ground engineering issues are developed and discussed:

- Bearing capacity
- Foundations & floor slabs
- Excavatability
- Earthworks & modification of glacial soils
- Groundwater
- Slopes & ground retention
- Karst weathering & geotechnical risk management

5.2 Bearing Capacity

The strength and relative density of the soils has been discussed previously in Section 4.2. The upper glacial till is principally firm and firm / stiff in consistency, while the lower till is typically stiff to locally very stiff. The weathering and strength of the limestone bedrock has been discussed in Section 4.3 and on foot of the strengths established by the laboratory testing, safe bearing and recommended allowable capacities (as defined in Section 2.2.8 of Tomlinson, 7th Ed) are presented in Table 2.

Table 2 - Summary Details of Safe Bearing Capacities

Stratum	Characteristic Strength or Relative Density Range	Assumed Safe Bearing Capacity (kN/m^2)	Recommended Allowable Bearing Capacity* (kN/m^2)
Upper till - firm and firm / stiff brown and grey brown sandy gravelly CLAY / SILT (N-Values of 15 to 20)	75 to 100 kN/m^2	175 to 225	200
Lower till – stiff and very stiff sandy very gravelly CLAY / SILT with cobbles (N-Values of 20 or greater)	125 to 150 kN/m^2	250 to 300	275
Variably weathered (slightly to moderately weathered) upper LIMESTONE	Moderately strong to strong	1250 to 1500	1250

** Recommended allowable bearing pressures presented are proposed to limit differential settlement*

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The upper glacial till is typically firm / stiff and should provide an allowable bearing capacity of 200 kN/m². The Geobor cores and associated laboratory testing indicates the lower till to be stiff / very stiff and this should safely support loads of the order of 250 kN/m². It is highlighted that the low plasticity glacial till will be particularly susceptible or sensitive to small increases in moisture content and should be protected without delay to avoid degradation.

An allowable bearing capacity of 1250 kN/m² is suggested for pad or spread foundations located on the upper variably weathered limestone bedrock. Should foundations be located on the slightly weathered / fresh strong or very strong limestone, then an allowable bearing capacity of 1750 to 2000 kN/m² could be adopted.

5.3 Foundations

It is understood that the waste to energy facility building will be on two levels (34.00 & 30.50m OD) while the bunker will have a formation level of 22.60m OD. Building column loads are typically of the order of 500 KN, though equipment loads vary greatly, with the heavier structures having loads of 2000 kN and in some areas up to 3900 kN (furnace boiler). The reception hall building is expected to have column loads of approximately 350 kN while the ash (slag) storage building will have column loads of c500 kN.

In light of these loads and the geotechnical findings, foundation solutions for the principal structures are suggested in Table 3. This is to provide guidance to the designer and he must consider all of the relevant geotechnical data and impact of differential settlement with regard to the foundation design for the structure.

Table 3 - Suggested Foundation Solutions

Structure	Column Loads	Floor Slab Loads	Proposed Foundation Solution
Reception Hall	350 kN	Axle loads 13t Truck load 30t	Pads / strip footings founded on stabilized fill or imported granular fill with ground bearing floor slabs
Waste / Ash Bunker	1600 kN/m along retaining wall	100kN/m² on bunker slab	Raft founded on upper limestone bedrock (remove glacial till & replace with lean mix concrete)
Furnace Boiler	+ 500kN along building perimeter Equipment 1500 to 3900 kN	20 kN/m²	Piles
Turbine Area	+ 500 kN along building perimeter Equipment loads 2000 to 3500 kN	20 kN/m²	Piles

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Slag Storage	+ 500 kN building loads	20 kN/m^2	Pads & strip footings*
Lab Area	+500 kN building loads Equipment 800 to 3500 kN	20 kN/m^2	Piles

** refer to text

Reception Hall / Building

It is understood that the reception hall / building will have a floor level of 34.00m and with ground levels at c30.0m, this will entail approximately 3.5 to 4m of engineering fill. Either modified glacial till (use of lime or cement to increase strength / stiffness) or imported granular fill (6F1 / 6F2 capping or 6N) could be used to achieve the platform level. If modified glacial till is selected, it should be placed in layers not exceeding 300mm and high quality compaction should be attained using either smooth drum or sheepsfoot rollers having a minimum mass per metre width of roll of not less than 5400kg. Modified / stabilized glacial till should be compacted to achieve a minimum of 95% of Proctor optimum (as determined by the 2.5kg rammer method) or air voids not exceeding 5%. Geotechnical testing should form an integral part of the modification works, with plate tests to derive CBR values and modulus of sub-grade reaction (Ks) values.

Waste Ash Bunker

Formation level for the waste ash bunker will be 22.60m OD and this will involve removing approximately 8m of glacial till and limestone. The rotary core drillholes (BLP/IGSL) have established rockhead at elevations of 23 to 24.3m OD at the northern section and 24.9m OD at the south / southeast corner. Based on this, it is expected that the waste bunker foundations will be located on the upper limestone bedrock (Bedrock topography map will be produced by Apex Geoservices afer completion of the additional site works on 31/3/09). Given the variability in weathering and irregular rockhead profile, provision should be made for excavating pockets or zones of moderately to highly weathered limestone and replacing with lean mix concrete. It appears from the two phases of geotechnical investigations that cavities are present in the limestone at Carranstown (note adjacent Irish Cement Platin Works site is known to contain prominent karst features) and these should be a key consideration during the construction works at Indaver.

Both the BLP and IGSL geotechnical investigations encountered cavities within the upper limestone bedrock. RP 1 identified a cavity between 8.70 and 8.90m while RC 7 encountered a cavity between 8.50 and 9.90m. It is strongly advised that the bedrock formation material at the waste bunker be closely inspected by an experienced geotechnical engineer. In addition, provision shoud be made for geophysical surveying (ground probing radar & resistivity profiling methods) to be carried out when excavation works are complete. A reinforced concrete raft foundation is advised for the bunker, and should be designed to deal with a potential open void or cavity span of at least 1m.

Furnace Boiler

With equipment loads of 1500 to 3900 kN at the furnace boiler, it is advised that piles are utilized. The expectation is that bored piles would be used and formed by odex / symmetrix methods, extending through the superficial deposits and into the limestone bedrock. The rotary core drillholes undertaken at this area (GC 1, GC 5 & RP 5) encountered rockhead at elevations of 23.5 to 24.3m OD. The aforementioned drillholes showed significant variations in rock mass quality (i.e. weathering and strength) and this has to be considered in pile design. RP 5 showed a distinctive highly weathered profile from 23.5 to 21.5m OD. On the evidence of the rotary holes (particularly RP 5) pile lengths are expected to vary considerably, with load capacity dependant on variation in strengths and alteration due to karst weathering.

For preliminary foundation design purposes, it would be reasonable to assume that 600mm diameter piles, founded in the limestone bedrock, would provide a safe working load of the order of 1500kN. Therefore, pile groups of 3 or 4 could be designed to accommodate equipment loads of 4000 to 5000 kN. The piles should achieve adequate socket depths and rely largely on skin friction developed within the glacial till and limestone bedrock. If end bearing is to be relied upon, then core drilling should be carried out to validate rock quality below the pile toe. In view of the variably weathered nature of the karst altered limestone bedrock, the emphasis should be on reducing pile capacity and ensuring that the pile group can safely accommodate the column loads. It is expected that bored piles would have a minimum socket depth of 2.5 to 3m but this will be governed by the actual weathering profile and degree of intactness of the limestone bedrock at each pile group location.

Turbine Area

The ground conditions at the turbine area comprise stiff glacial till underlain by strong and very strong limestone bedrock (at an elevation of approximately 21.3m OD based on RC 2 BLP/GII Report). Again, equipment loads are considerable at the turbine area (up to 3500 kN), hence piles are recommended. It is expected that the piles for this structure will extend into the limestone bedrock (to provide an adequate socket). There was no evidence of cavities or voids in RC 2 and total core recovery (TCR) was fair to good. The limestone appears to be largely intact (though non-intact zone was present from 19 to 18.2m OD) and should provide a competent founding medium. Again, 600 or 900mm diameter bored piles are expected to be used and extend sufficiently into the intact or competent limestone.

Slag Storage Building

Building column loads at the slag storage building are estimated at +500 kN. GC 1 and GC 4 are most relevant to this area (note an absence of geotechnical information at the northern portion) and showed the glacial till materials to be generally stiff or upperbound medium dense. It is expected that pad and strip footing foundations will be utilized at this area and should be sized using an allowable bearing capacity of 200 kN/m^2. The real concern with utilizing pads at this building is the potential for differential settlement and the impact this would have on the structure.

In karst altered terrain, the strength / stiffness of glacial till soils can be highly variable (due to migration into voided zones) and this should be considered. Before foundations are finalized for the slag storage building, a programme of dynamic probing should be considered (grid of 5 x 5m) to evaluate the strength of the upper soils (i.e. within 3 to 4m of existing ground level). This data should be subsequently reviewed with the small strain stiffness geophysical data (Gmax profiles).

5.4 Floor Slabs

Anticipated floor slab loadings are presented in Table 2 and are generally of the order of 20 kN/m^2. Ground bearing floor slabs are expected to be suitable for the reception hall, slag storage, administration and laboratory buildings. Ground bearing floor slabs should not be located on made ground / fill material. This is due to its inherent variability and likely poor compaction (or no compaction), hence total and differential settlement would be a real concern. Made ground / fill materials should be removed and replaced with suitable approved engineering fill (i.e. imported granular fill or stabilized glacial till).

Given the silt dominant nature of the glacial till and proposed floor slabs loadings of 20 kN/m^2 a minimum granular layer thickness (6F1 / 6F2) of 500 mm is recommended. However, where floor slab loading are > 20 kN/m^2 an enhanced modulus granular layer should be considered. A granular

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layer thickness of 600 to 800mm should be considered where modulus of sub-grade reaction values (Ks) are < 20 MPa/m or CBR < 1%.
If imported limestone / mudstone derived granular fill is used under floor slabs or structures, then it should have a minimum Ten Per Cent Fines Value of 130 kN and minimum CBR value of 15% (derived using plate bearing plate method). From a chemical and pyrite degradation aspect, granular fill material should have a maximum equivalent pyrite content of < 1% (i.e. low to medium swelling potential in accordance with CTQ-M200), maximum total sulphur content of 1.0% (or < 0.4% if pyrrhotite is suspected) and maximum acid soluble sulphate of 0.2% in accordance with IS EN 13242:2002.

If pyrite is present in granular fill, this may lead to problems with oxidation, weathering and adverse reaction with carbonate minerals. Potentially expansive fill materials should not be used under structures. Imported granular fill material (e.g. capping or sub-base) should be thoroughly checked for total sulphur and soluble sulphates (SO_4). Thin section petrographic analysis should also be carried out to determine mineralogical composition, particularly for the presence of pyrite in the rock matrix (especially more reactive fine grained or framboidal pyrite).

5.5 Excavatability
The key factors which govern or control excavation methods in glacial till / boulder clay and hence production rates are the strength of the matrix and frequency or predominance of boulders. On the basis of the SPT Values and strength descriptors on the logs, excavation of the glacial till is expected to be efficiently carried out using 20t tracked excavators.

The three key factors, which govern or control excavation methods and hence production rates in bedrock are:

- compressive strength of the rock
- discontinuity / bed spacings
- orientation and tightness of the discontinuities or bedding

A number of methods are available to assess the excavatability characteristics of the limestone bedrock, including the Pettifer & Fookes chart, Weaver rating chart etc. On the basis of the mechanical indices (SCR/RQD), discontinuity characteristics and strengths established by the point load tests, heavy digging and hydraulic breaking (6 or 8t breakers mounted on 50t excavators) is anticipated to efficiently loosen or fracture the upper bedrock. The strong / very strong siliceous or fossiliferous limestone bedrock will be more onerous to loosen and this should be considered by civil engineering contractors.

Trench excavations in the strong / very strong limestone bedrock will be very onerous (due to the lack of a free face) and the siliceous limestone will tend to reduce to a powder. It is highlighted that the Pettifer & Fookes excavatability chart (nomogram) tends to be very optimistic for indurated Irish bedrock deposits, particularly strong / very strong materials. It provides no information on production rates and serves only as a guide in assessing possible excavation methods digging/ripping/hydraulic breaking/blasting).

5.6 Earthworks & Modification of Glacial Soils
In view of the variability of the glacial till soils and concerns regarding their re-use potential, a programme of laboratory modification / stabilization testing was carried out by IGSL. Moisture Condition Value (MCV) and California Bearing Ratio (CBR) tests were undertaken on samples of the glacial till recovered from the bunker footprint and stockpiles constructed by Sisk. This focused on two modes of testing following the addition of calcium oxide (supplied by White Rhino, Clogrennane) or OPC to the glacial till. MCV's were carried out after a period of circa 3 hours and

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CBR tests following curing for periods of 1, 3 and 14 days respectively. The CBR and MCV tests were performed on unsoaked samples, where the material was allowed to cure at a laboratory temperature of 16 to 18°C.

Inspection of the laboratory test data in the factual report shows MCV's increased significantly after lime or cement binder was added. The MCV's were undertaken after mixing and curing for 3 hours. In the majority of cases, the MCV's increased to +7 with the material from the bunker footprint (TP 1A & 1B) performing best. The samples from the stockpiles were considerably wetter and the MCV's on these samples increased modestly after adding 1 or 2% calcium oxide. With regard to the CBR test data, the glacial till material showed a good exothermic reaction with calcium oxide, particularly the samples from the bunker (TP 1A & 1B), which produced high CBR values. The CBR values from the stockpile samples were considerably lower and more erratic, even with 2% binder.

It is concluded from the modification / stabilization laboratory trial testing that the glacial till has the capacity to produce a good quality engineering fill, following the addition of 1 to 2% calcium oxide or OPC. It is expected that a minimum CBR value of 5% will be required for bulk engineering fill (after curing for a period of 7 days) under structures and floor slabs. In view of the laboratory CBR values obtained from the stockpiles, provision should be made for at least 2% binder. Given the composition and variability of the glacial till, a combination of lime and cement (e.g. 2% lime with 1% cement) should be considered for the variable stockpiled material. Field trials are advised during the early stages of the modification / stabilization works to determine dosage or consumption quantities to achieve an MCV of 8 to 14 and minimum CBR value of 5% or modulus of sub-grade reaction (Ks) value of 40 MPa/m.

5.7 Pavement

Capping material (6F1 / 6F2) is used to protect the sub-grade and the sub-base material and increase the stiffness modulus and strength of the formation. In accordance with DMRB Design Guidance for Road Pavement (HD 25) the lower-end equilibrium CBR values should be used to determine appropriate capping layer thickness. Remoulded CBR values were carried out by BLP/GII on the soils at depths from 0.5 to 3.50m and values range from 1.0 to 18%. Taking a characteristic lower end CBR value of around 2%, a capping layer thickness of the order of 400 to 450mm is recommended.

Provision should be made for additional CBR tests to be carried out during the earthworks phase at the principal access roads and pavement formations (i.e. preferably plate bearing tests to derive CBR values). It is expected that this would be undertaken during the early earthworks phase to confirm design CBR value and validate appropriate capping layer thickness. A geotextile fabric (PB 120 or similar) should be used for separation at roads, car park and general pavement areas.

5.8 Groundwater

As set out in Section 4.4, groundwater was not encountered in any of the IGSL rotary drillholes. Groundwater was locally intercepted in the BLP/GII trial pits (i.e. 1.9 to 3.5m bgl). These levels are unlikely to reflect long term equilibrium water conditions but should be considered in terms of ingress during excavation works. Packer tests were not carried out to evaluate the permeability or water-tightnes of the bedrock. However, on the evidence of the discontinuity spacings and fracture state of the cores, the bedrock would be expected to be of medium permeability (i.e. Lugeon Values of 5 to 20).

In light of the BLP/GII borehole and trial pit findings, provision should be made for sump pumping in excavations. It is possible that some groundwater pumping may be required at the bunker and other deeper foundations areas (chambers or waste sump tanks etc). Perimeter drains and sumps should be carefully located and constructed, to ensure that groundwater is efficiently removed from excavations and trenches.

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5.9 Slopes

On the basis of the strength of the material from the SPT's,and Gebor cores and groundwater conditions, a slope batter of 33° (1V:1.5H) is suggested for temporary excacations in the firm / stiff glacial till. Temporary slope protection measures should be installed to prevent the risk of spalling. To mitigate against cobbles, boulders or loose blocks / clods spalling, either galvanised mesh or a geogrid (Tensar SS 30 or similar) should be fixed against the crest, mid-point and toe of the batter. This is normally carried out with upturned reinforcing bars or a bulb of concrete at the toe.

Temporary slopes should be regularly inspected during the course of any excavation works by an experienced geotechnical engineer. The purpose of this is to evaluate unfavourable or potentially unstable ground conditions, general slope behaviour and groundwater. The slope batters should be inspected daily by an experienced site engineer. If there are concerns with instability, then advice should be sought from a suitably experienced geotechnical engineer.

5.10 Ground Retention

With an excavation depth of the order of 7m required for the bunker, ground retention is expected to be used. Considering the prevailing ground and groundwater conditions at the bunker footprint, it is believed that either a contiguous bored piled wall or king post wall is most appropriate, Given the space constraints within the excavation (19m wide), a cantilever contiguous bored piled (600mm diameter) wall or unpropped king post wall would be preferred. With groundwater largely absent in the boreholes / drillholes, king posts could be constructed with universal columns at 5m centres and utilizing precast concrete panels.

To progress through the strong limestone bedrock and attain the required embedment depths for either solution, robust bored piling methods will be necessary. The use of CFA piling techniques is not recommended, as this system is not expected to penetrate through strong limestone bedrock. Odex / symmetrix or down the hole hammer methods are considered most suitable.

Geotechnical instrumentation should form a key part of the ground retention works. Inclinometers (minimum of 2 No.) should be installed to measure lateral wall deflections. The actual deflections should be compared with the predicted values and ensure that they do not exceed threshold limits agreed with the Engineer.

5.11 Karst Weathering

Karst subsidence is a function of groundwater movement and hydrogeological changes in surface water. Groundwater play a key role in the formation of subsidence sinkholes. A subsidence sinkhole was defined by Waltham (1989) as a 'failure of soil or weak rock into underlying cavernous limestone'. Newton & Waltham (1989) identified sinkholes into two types: firstly those resulting from water level decline and secondly, those resulting from diversion or impoundment of surface drainage.

Temporary lowering of the water table down to bedrock level is known to be a significant contributory factor in sinkhole development. It is also well established, that periods of dry weather followed by very heavy prolonged rainfall can trigger subsidence. Similarly, stripping of topsoil or vegetation increases the rate of infiltration of surface water and redirection of run-off can cause preferential flow and initiate subsidence. Subsidence sinkholes can develop very quickly following heavy rainfall and earthworks stripping.

As noted in Section 4.3, there is evidence of solution weathering or karstification in the limestone bedrock at this site. Karstification is known to occur in the Duleek / Carranstown area and the Platin Formation is known to be very susceptible to karst weathering. Considering all of this, the potential or likelihood for karst subsidence features to occur should be strongly considered in both foundation and drainage design. The site development earthworks (completed in January 2009)

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have produced a platform level of 30m OD. Surface water was present during the course of the rotary drilling works (early to mid February) but there was no evidence of sinkholes or depressions. It is noted that significant water flush loss during drilling was recorded by the driller and this suggests fissures or voids in the limestone bedrock.

A number of measures can be taken to minimise the risk associated with excavation works and foundations. Surface water should be carefully managed and controlled, so as to avoid indiscriminate run-off or dissipation into the formation soils. The civil engineering contractor should be aware of the risks associated with this particular site and provide tool box talks to engineering staff and site operatives. Bunds or swales should be constructed to control surface water run-off and discharge to attenuation ponds.

The groundwater levels in the BLP/GII standpipes should be monitored during the course of the excavation works for the bunker and should groundwater levels drop below equilibrium levels, this should be a cause for concern, as significant lowering of the groundwater table (as noted previously) can trigger or initiate subsidence sinkholes. Piling contractors should also be made aware of the potential issues with ground engineering works in karst altered limestone. Earthwork and piling contractors should evaluate the risk of ground hazards and address in method statements. As regards foundations located on the limestone bedrock (i.e. waste bunker), the recommendations outlined in Section 5.3 should be considered and implemented.

5.12 Geotechnical Risk Management

Reference should be made to the ICE / DETR 'Managing Geotechnical Risk' report which addresses the principles of managing geotechnical risk, steps in risk management, undertaking risk analysis and setting up a risk register with designers, contractors and of course the client. Given the scale of the main structures and the fact that karst limestone is present, a risk assessment is suggested. Geotechnical risk management provides a means of:

- Identifying potential geotechnical or ground related hazards
- Reducing the uncertainty of geotechnical or ground related hazards
- Evaluating the vulnerability of construction activities (particularly foundations & earthworks) to the geotechnical risks
- Producing robust geotechnical designs with back-up plans in the event that unforeseen conditions arise

A key part of geotechnical risk management is the setting up of a risk register or risk management log. The risk register provides a means of recording potential uncertainties or hazards before and during construction. The type of risk can be identified, consequences established and the risk classed accordingly (low, medium, high or very high). A risk management register is strongly recommended for this project and both the designer and contractor should identify particular geotechnical risks or hazards pertaining to the main structures.

Examples of a risk register are presented in Appendix A of the aforementioned ICE / DETR report and a sample version is presented in Table 5. This presents an outline of the <u>key geotechnical risks</u> for four key areas at the site. The design strategy or risk control measures (RCM) must be adequately robust to deal with uncertainties identified by the geotechnical investigations and requirements of the client.

The risk register should be reviewed and updated as design and construction progresses. This can be used to re-assess risk and re-rank the key risks accordingly. On-going assessment is

.

particularly important in karst affected sites, where subsidence features can develop randomly and without warning.

Table 5 - Sample of Geotechnical Risk Register / Log for Indaver Carranstown Project

Structure	Key Risks	Probability (1,2,3)	Impact (1,2,3)	Risk Class (L,M,H.C)	Design Strategy
Reception Hall	Ability of modification / stabilization works to achieve target strength / stiffness. Differential settlement of pad or strip footing foundations. Elevated sulphates in modified glacial till.				
Waste Bunker	Rock excavatibility. Ability of contiguous bored piles or king posts to attain design embedment depth. Potential for subsidence (voids / cavities) to develop under foundations or void migration.				
Turbine & Auxillaries	Differential settlement between pads. Piles failing to achieve adequate embedment or socket depth in limestone bedrock. Possibility of void migration under turbine and auxillary structures.				
Slag Storage	Differential settlement between pads. Stiffness of formation soils to accommodate floor slab loads. Possibility of void migration under slag storage.				

Probability (1=Low, 2=Medium, 3= High)
Risk Class (Low, Medium, High, Critical)

.

References

1. BS 5930 (1999) Code of Practice for Site Investigation, British Standards Institution (BSI) incorporating Amendment No. 1 (December 2007)

2. BS 1377 (1990) Methods of Testing of Soils for Civil Engineering Purposes, BSI

3. BS 8004 (1986) Code of Practice for Foundations, BSI

4. Indaver, Carranstown Geotechnical Assessment Report (B580), May 207, Byrne Looby Partners

5. IS EN 13242:2002, Aggregates For Unbound and Hydraulically Bound Materials for use in Civil Engineering and Road Construction, January 2003

6. Managing Geotechnical Risk, DETR / ICE, Thomas Telford, 2001

7. NRA Specification for Road Works, March 2000

8. Site Investigation Practice: Assessing BS 5930 (1986), Geological Society Special Publication, No. 2

9. Tomlinson, M.J. Foundation Design & Construction, 7th Edition

10. Waltham, A.C. (1989). Sinkholes on Limestone. Ground Subsidence, Blackie, Glasgow, 17-40

.

Appendix B

AWN Borehole Logs 2014

awnconsulting

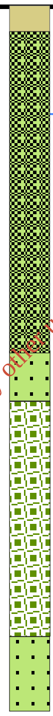
Monitoring Well Log | **MW1**

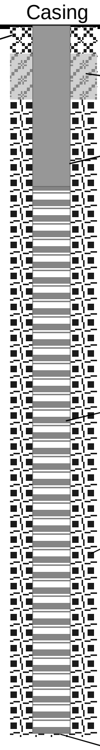
Sheet 1 / 1

AWN Project Ref: **14/1708**	Client: Indaver	Drill date: 29/05/2014
Ground Level (mAOD):		
Grid Reference:	Location: Carranstown, Co. Meath	Logged/ Checked By: JN/ PG

Field check: Site drawings √ **U/G services** √ **O/H cables** √ **CAT scan** √ **Contamination** √ (N/A)

SUBSURFACE PROFILE	Depth (mbgl)	Lithology summary	Fracture Index/ Water ingress/ Casing
Ground surface	0.00		Depth/ details — Casing — Notes
Topsoil	0.10		
(Firm) Light grey brown mottled orange gravelly CLAY with occasional sub-angular cobbles Detail: 0.60m (Damp) slight water ingress	1.90	0.60 spl 1.5	Concrete 0.90
(Firm) Grey brown sandy CLAY with occasional sub-angular	2.20		
Dark brown sandy GRAVEL with occasional sub-angular cobbles	3.50	spl 3.2	
(Hard) Brown slightly gravelly sandy SILT/ CLAY with occasional angular cobbles	**3.90**	Driller spl 3.5-3.9	3.90
End of Borehole 3.90mbgl			





Drill Method: Percussive (Dando Terrier Rig)	Hole Diameter:	From: 0.00 to: 3.90 150 mm
	Hole Diameter:	-
	Top of Casing (mAOD):	
Casing Length (m): 3.90	Water Strikes (mbgl):	0.60
Driller: Causeway Drilling Geotech Ltd.	Static Water Level (mbgl):	

awnconsulting

Monitoring Well Log	MW2
	Sheet 1 / 1

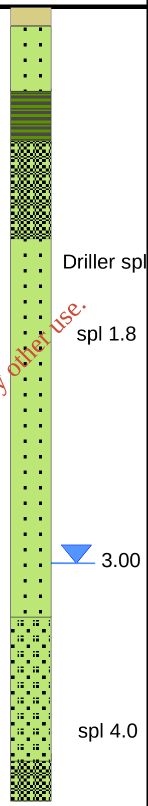
AWN Project Ref: **14/1708** Ground Level (mAOD): Grid Reference:	Client: **Indaver** Location: Carranstown, Co. Meath	Drill date: 29/05/2014 Logged/ Checked By: JN/ PG

Field check: Site drawings √ U/G services √ O/H cables √ CAT scan √ Contamination √ (N/A)

SUBSURFACE PROFILE	Depth (mbgl)
Ground surface	0.00
Topsoil	0.10
Brown slightly sandy gravelly SILT with occasional to some angular cobbles	0.50
(Firm) Dark grey gravelly CLAY	0.70
(Firm) Brown silty slightly gravelly CLAY. Gravel is sub-angular.	1.30
(Soft - firm) Grey brown slightly sandy gravelly SILT/ CLAY with occasional sub-angular cobbles and boulders	3.40
Brown red silty SAND (damp) Detail: 4.20m borehole collapsing	4.20
(Stiff) Grey sandy gravelly CLAY	**4.40**

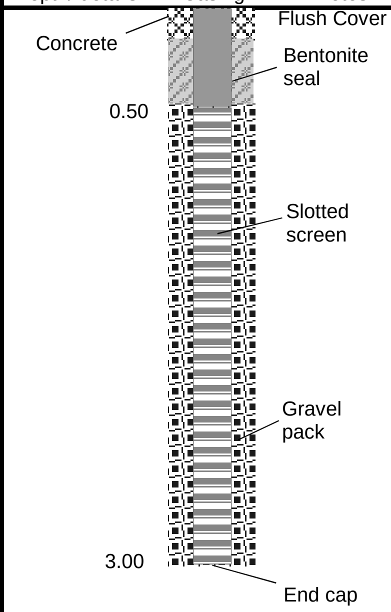
End of Borehole 4.40mbgl

Lithology summary



Fracture Index/ Water ingress/ Casing

Depth/ details | Casing | Notes



Drill Method: Percussive (Dando Terrier Rig)	Hole Diameter:	From: 0.00 to: 4.40 150 mm	
	Hole Diameter:	-	
	Top of Casing (mAOD):		
Casing Length (m): 4.20	Water Strikes (mbgl):	3.00	
Driller: Causeway Drilling Geotech Ltd.	Static Water Level (mbgl):		

awnconsulting	Monitoring Well Log	MW3 (A)
	Sheet 1 / 1	

AWN Project Ref: **14/1708** Ground Level (mAOD): Grid Reference:	Client: **Indaver** Location: Carranstown, Co. Meath	Drill date: 29/05/2014 Logged/ Checked By: JN/ PG

Field check: Site drawings √ U/G services √ O/H cables √ CAT scan √ Contamination √ (N/A)

SUBSURFACE PROFILE	Depth (mbgl)	Lithology summary	Fracture Index/ Water ingress/ Casing		
Ground surface	0.00		Depth/ details	Casing	Notes
Grey brown slightly sandy gravelly CLAY occasional angular cobbles Detail: occasional pockets of black CLAY (no odour)	1.20			No Installation; Borehole backfilled with arisings	
(Firm) Brown sandy CLAY with rare sub-angular gravel	2.00	spl 1.8			
(Soft - firm) Grey brown gravelly CLAY with occasional sub-angular cobbles and occasional boulders Detail: Obstruction on boulder at 2.20 mbgl (20% core recovery from 2.0 - 2.6)	2.60				
End of Borehole 2.60mbgl					

Drill Method: Percussive (Dando Terrier Rig)	Hole Diameter:	From: 0.00 to: 2.60 150 mm
	Hole Diameter:	-
	Top of Casing (mAOD):	
Casing Length (m): -	Water Strikes (mbgl):	
Driller: Causeway Drilling Geotech Ltd.	Static Water Level (mbgl):	

Monitoring Well Log	MW3 (B)
	Sheet 1 / 1

AWN Project Ref: **14/1708** Ground Level (mAOD): Grid Reference:	Client: **Indaver** Location: Carranstown, Co. Meath	Drill date: 30/05/2014 Logged/ Checked By: JN/ PG

Field check: Site drawings √ U/G services √ O/H cables √ CAT scan √ Contamination √ (N/A)

SUBSURFACE PROFILE	Depth (mbgl)	Lithology summary	Fracture Index/ Water ingress/ Casing		
Ground surface	0.00		Depth/ details	Casing	Notes
Grey brown slightly sandy gravelly CLAY some angular cobbles	1.20	spl 1.0		No Installation; Borehole backfilled with arisings	
(Firm) Brown sandy CLAY with occasional sub-angular gravel Detail: Obstruction on boulder at 1.7 mbgl	**1.70**				
End of Borehole 1.70mbgl					

Drill Method: Percussive (Dando Terrier Rig)	Hole Diameter:	From: 0.00 to: 1.70 150 mm
	Hole Diameter:	-
	Top of Casing (mAOD):	
Casing Length (m): -	Water Strikes (mbgl):	
Driller: Causeway Drilling Geotech Ltd.	Static Water Level (mbgl):	

Monitoring Well Log — MW4

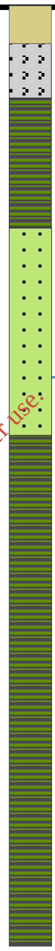
Sheet 1 / 1

AWN Project Ref: **14/1708**	Client: **Indaver**	Drill date: 30/05/2014
Ground Level (mAOD):		
Grid Reference:	Location: Carranstown, Co. Meath	Logged/ Checked By: JN/ PG

Field check: Site drawings √ U/G services √ O/H cables √ CAT scan √ Contamination √ (N/A)

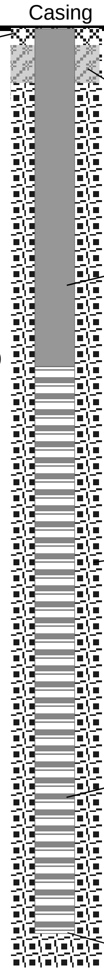
SUBSURFACE PROFILE	Depth (mbgl)
Ground surface	0.00
Topsoil	0.20
MADE GROUND (gravel subbase)	0.50
(Stiff) Orange brown silty CLAY with pockets of black clay (no odour)	1.20
(Soft) Orange brown sandy CLAY occasional sub-angular gravel Detail: 2.00m (Damp) slight water ingress	2.30
(Very stiff) Brown grey SILT/ CLAY with rare fine sand	5.00
End of Borehole 5.00mbgl	

Lithology summary



Fracture Index/ Water ingress/ Casing

Depth/ details | Casing | Notes



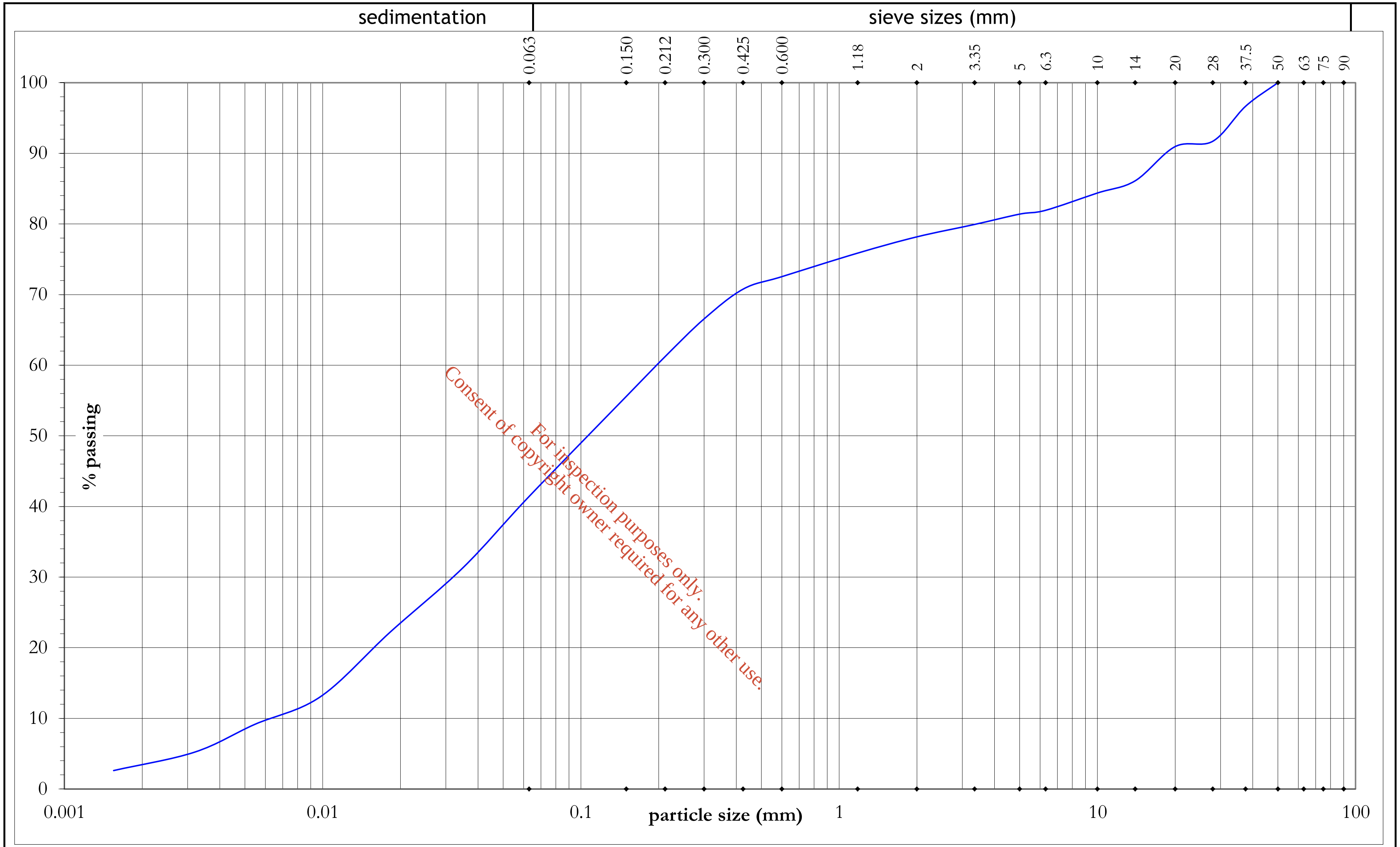
Drill Method: Percussive (Dando Terrier Rig)	Hole Diameter:	From: 0.00 to: 5.00 150 mm		
	Hole Diameter:	-		
	Top of Casing (mAOD):			
Casing Length (m): 5.00	Water Strikes (mbgl):	2.00		
Driller: Causeway Drilling Geotech Ltd	Static Water Level (mbgl):			

Causeway Geotech Ltd

Particle Size Distribution

BS1377:1990 Part 2 Clause 9.2 and 9.5

Particle size (mm)	% passing
125	100
90	100
75	100
63	100
50	100
37.5	97
28	92
20	91
14	86
10	84
6.3	82
5	81
3.35	80
2	78
1.18	76
0.6	73
0.425	71
0.3	67
0.212	61
0.15	56
0.063	41
0.0350	31.3
0.0182	22.2
0.0098	13.1
0.0055	9.1
0.0032	5.2
0.0016	2.6



Clay 3%	Silt 38%	Sand 37% fine	Sand 37% medium	Sand 37% coarse	Gravel 22% fine	Gravel 22% medium	Gravel 22% coarse	Cobbles 0%

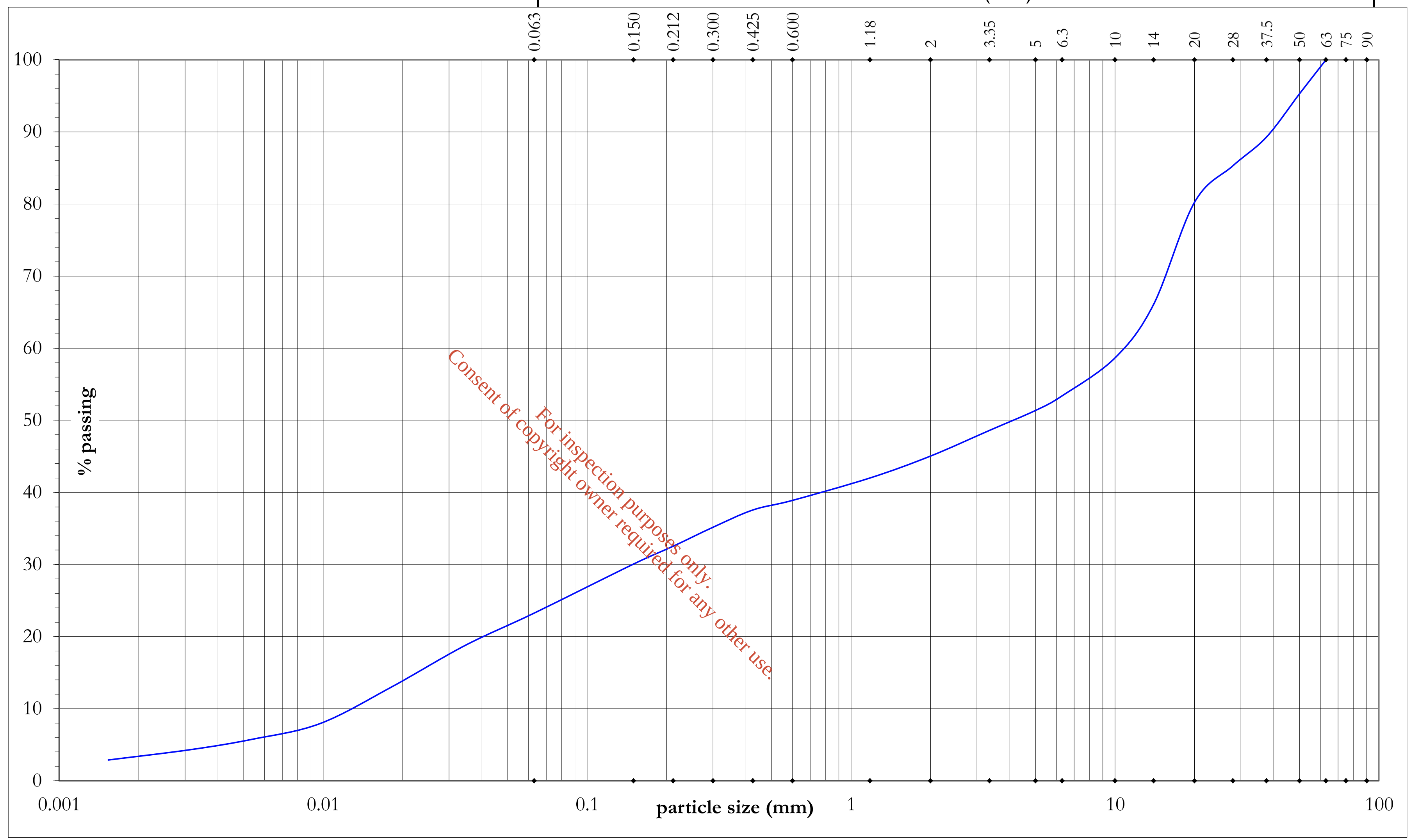
Project:	Indaver Waste - Energy Carranstown	Exploratory Hole No.:	MW01	Sample Type	Sample No.	Sample at (m)	Sample to (m)	Soil description: slightly gravelly, sandy SILT/CLAY
Job No.:	14-388			B		3.50	3.90	

Causeway Geotech Ltd

Particle Size Distribution

BS1377:1990 Part 2 Clause 9.2 and 9.5

Particle size (mm)	% passing
125	100
90	100
75	100
63	100
50	95
37.5	89
28	85
20	80
14	66
10	59
6.3	53
5	51
3.35	49
2	45
1.18	42
0.6	39
0.425	38
0.3	35
0.212	33
0.15	30
0.063	23
0.0345	18.8
0.0181	13.0
0.0097	7.9
0.0054	5.8
0.0032	4.3
0.0015	2.9



Clay 3%	Silt 20%	Sand 22%			Gravel 55%			Cobbles 0%
		fine	medium	coarse	fine	medium	coarse	

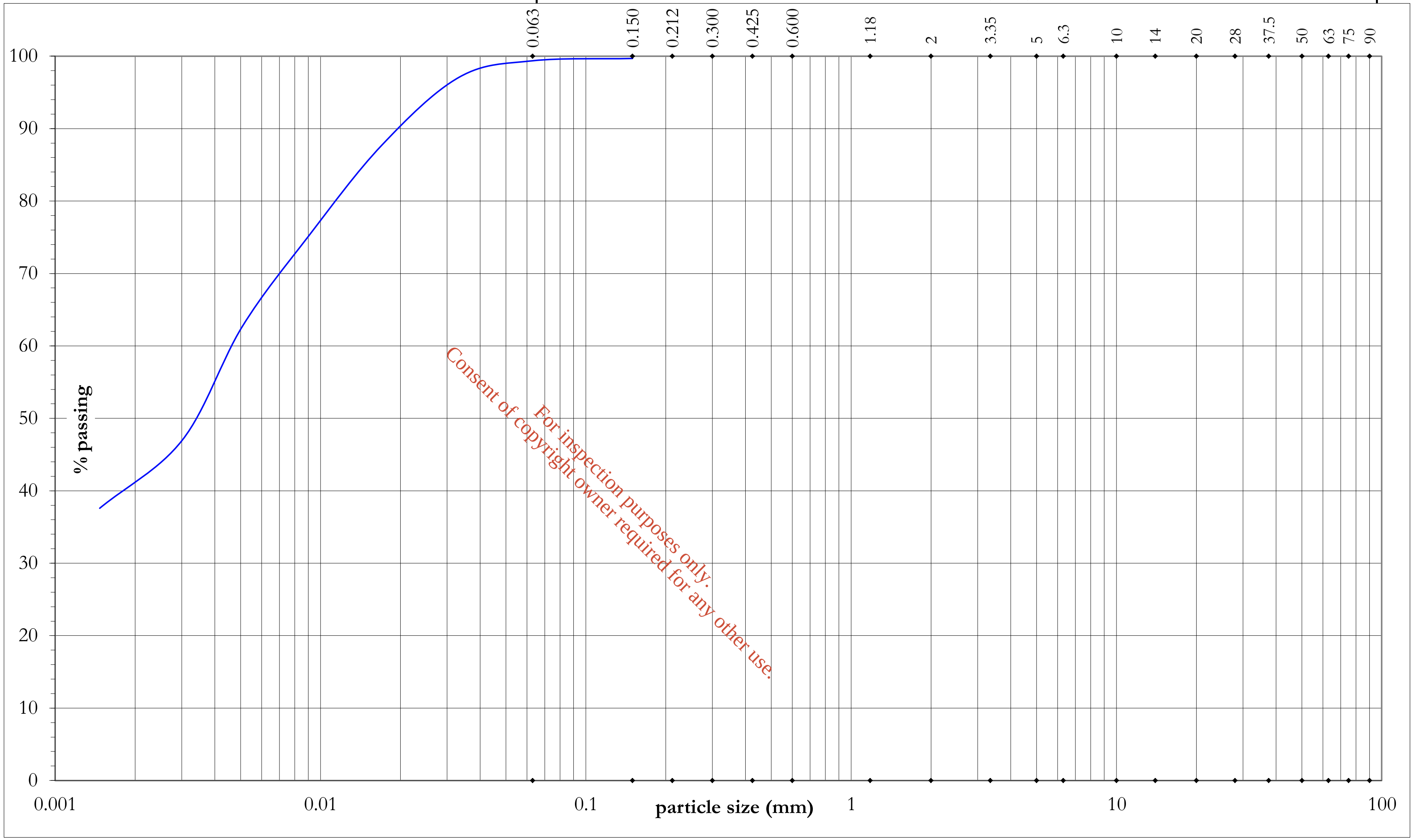
Project:	Indaver Waste - Energy Carranstown	Exploratory Hole No.:	MW02	Sample Type	Sample No.	Sample at (m)	Sample to (m)	Sample description: slightly sandy, gravelly SILT/CLAY
Job No.:	14-388			B		1.30	1.80	

Causeway Geotech Ltd

Particle Size Distribution

BS1377:1990 Part 2 Clause 9.2 and 9.5

Particle size (mm)	% passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	100
1.18	100
0.6	100
0.425	100
0.3	100
0.212	100
0.15	100
0.063	99
0.0334	97.1
0.0170	87.7
0.0090	75.2
0.0051	62.6
0.0030	47.0
0.0015	37.6



Clay 38%	Silt 61%	Sand 1% fine	Sand 1% medium	Sand 1% coarse	Gravel 0% fine	Gravel 0% medium	Gravel 0% coarse	Cobbles 0%

Project:	Indaver Waste - Energy Carranstown	Exploratory Hole No.:	MW04	Sample Type	Sample No.	at (m)	to (m)	Soil description : slightly sandy SILT/CLAY
Job No.:	14-388			B		4.00	4.50	

Appendix B

Permeability Tests

Groundwater Level 3.79 mbtoc Dry

secs	Elapsed time, t (minutes)	Depth to water from datum (m)	Head, H_t (m)	Head Ratio H_t/H_0
0	0	2.88	0.91	1
30	0.5	3.01	0.78	0.857143
60	1	3.11	0.68	0.747253
90	1.5	3.17	0.62	0.681319
120	2	3.21	0.58	0.637363
150	2.5	3.24	0.55	0.604396
180	3	3.27	0.52	0.571429
210	3.5	3.28	0.51	0.56044
240	4	3.285	0.505	0.554945
270	4.5	3.295	0.495	0.543956
300	5	3.31	0.48	0.527473
330	5.5	3.32	0.47	0.516484
360	6	3.325	0.465	0.510989
390	6.5	3.33	0.46	0.505495
420	7	3.335	0.455	0.5
450	7.5	3.34	0.45	0.494505
480	8	3.345	0.445	0.489011
510	8.5	3.345	0.445	0.489011
540	9	3.35	0.44	0.483516
570	9.5	3.36	0.43	0.472527
600	10	3.36	0.43	0.472527
630	10.5	3.365	0.425	0.467033
660	11	3.37	0.42	0.461538
690	11.5	3.37	0.42	0.461538
720	12	3.375	0.415	0.456044
750	12.5	3.375	0.415	0.456044
780	13	3.38	0.41	0.450549
810	13.5	3.38	0.41	0.450549
840	14	3.385	0.405	0.445055
870	14.5	3.385	0.405	0.445055
900	15	3.385	0.405	0.445055
960	16	3.395	0.395	0.434066
1020	17	3.395	0.395	0.434066
1080	18	3.4	0.39	0.428571
1140	19	3.405	0.385	0.423077
1200	20	3.41	0.38	0.417582
1500	25	3.43	0.36	0.395604
1800	30	3.44	0.35	0.384615
2100	35	3.45	0.34	0.373626
2400	40	3.46	0.33	0.362637
2700	45	3.47	0.32	0.351648
3000	50	3.48	0.31	0.340659
3300	55	3.485	0.305	0.335165
3600	60	3.49	0.3	0.32967
5400	90	3.79	0	0

Location:	MW1 (Test 1)	Type: Falling Head
		18/06/2014
		Dry spell, BH dry

Key	
(yellow)	Input Required
(red)	Active Cell
(green)	Permeability result

Area (A)

Borehole Diameter=	0.15	meters	squared =	0.005625
Pi=	3.141593			
Then Area A=	0.017671	m^2		

Intake Factor (F)

L (Response Zone)=	3.0	m
D=	0.15	m
F/D=	38.75622	
F=	5.813433	

MW1 0.70 to 3.70mbgl | 50mm standpipe

Time (T)

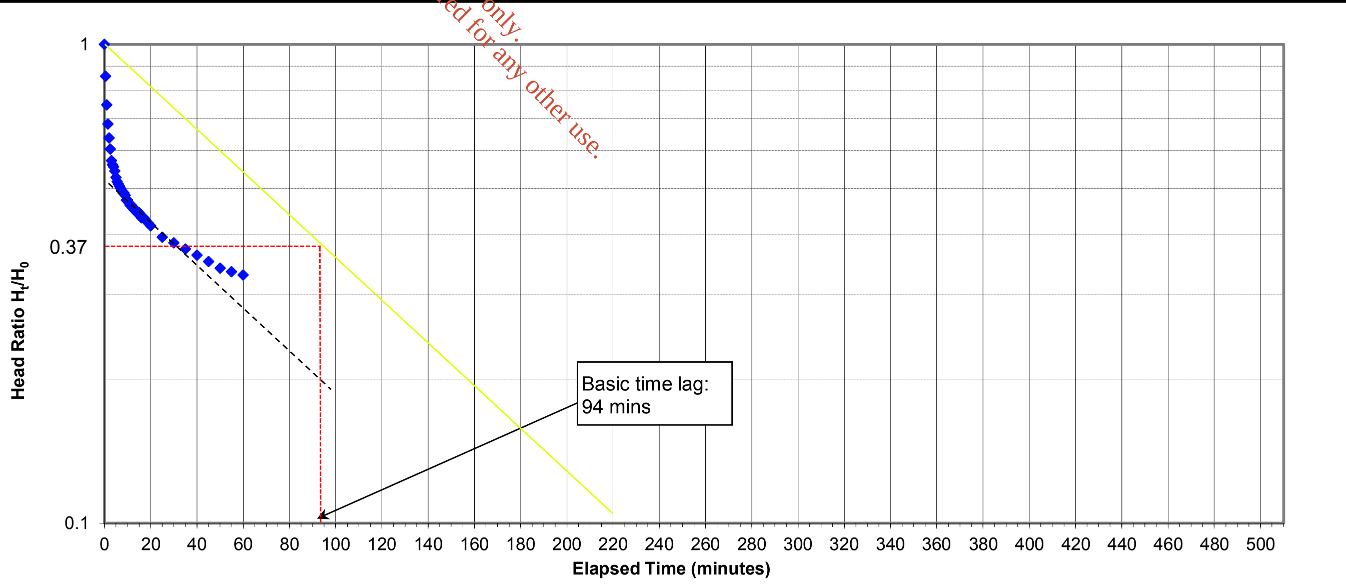
T (taken from graph) =	94	min
	5640	seconds

Variable Head Test (after *Hvorslev*, 1951)

k = A/FT

Permeability (k)

k=	5.38965E-07	m/s	k=	0.046567	m/d



Groundwater Level 3.79 mbtoc Dry

secs	Elapsed time, t (minutes)	Depth to water from datum (m)	Head, H_t (m)	Head Ratio H_t/H_0
0	0.0	2.65	1.14	1
30	0.5	2.87	0.92	0.807018
60	1.0	3.01	0.78	0.684211
90	1.5	3.08	0.71	0.622807
120	2.0	3.11	0.68	0.596491
150	2.5	3.16	0.63	0.552632
180	3.0	3.18	0.61	0.535088
210	3.5	3.2	0.59	0.517544
240	4.0	3.22	0.57	0.5
270	4.5	3.23	0.56	0.491228
300	5.0	3.24	0.55	0.482456
330	5.5	3.25	0.54	0.473684
360	6.0	3.26	0.53	0.464912
390	6.5	3.27	0.52	0.45614
420	7.0	3.28	0.51	0.447368
450	7.5	3.285	0.505	0.442982
480	8.0	3.29	0.5	0.438596
510	8.5	3.29	0.5	0.438596
540	9.0	3.295	0.495	0.434211
570	9.5	3.3	0.49	0.429825
600	10.0	3.305	0.485	0.425439
630	10.5	3.31	0.48	0.421053
660	11.0	3.315	0.475	0.416667
690	11.5	3.32	0.47	0.412281
720	12.0	3.32	0.47	0.412281
750	12.5	3.325	0.465	0.407895
780	13.0	3.325	0.465	0.407895
810	13.5	3.325	0.465	0.407895
840	14.0	3.325	0.465	0.407895
870	14.5	3.325	0.465	0.407895
900	15.0	3.33	0.46	0.403509
1200	20	3.36	0.43	0.377193
1500	25	3.38	0.41	0.359649
1800	30	3.39	0.4	0.350877
2100	35	3.4	0.39	0.342105
2400	40	3.41	0.38	0.333333
2700	45	3.42	0.37	0.324561
3000	50	3.43	0.36	0.315789
3300	55	3.44	0.35	0.307018
3600	60	3.445	0.345	0.302632
5400	90	3.475	0.315	0.276316
6300	105	3.49	0.3	0.263158

Location: **MW1** (Test 2) Type: Falling Head
18/06/2014
Dry spell, BH dry

Key	
	Input Required
	Active Cell
	Permeability result

Area (A)
Borehole Diameter= 0.15 meters squared = 0.005625
Pi= 3.141593
Then Area A= 0.017671 m^2

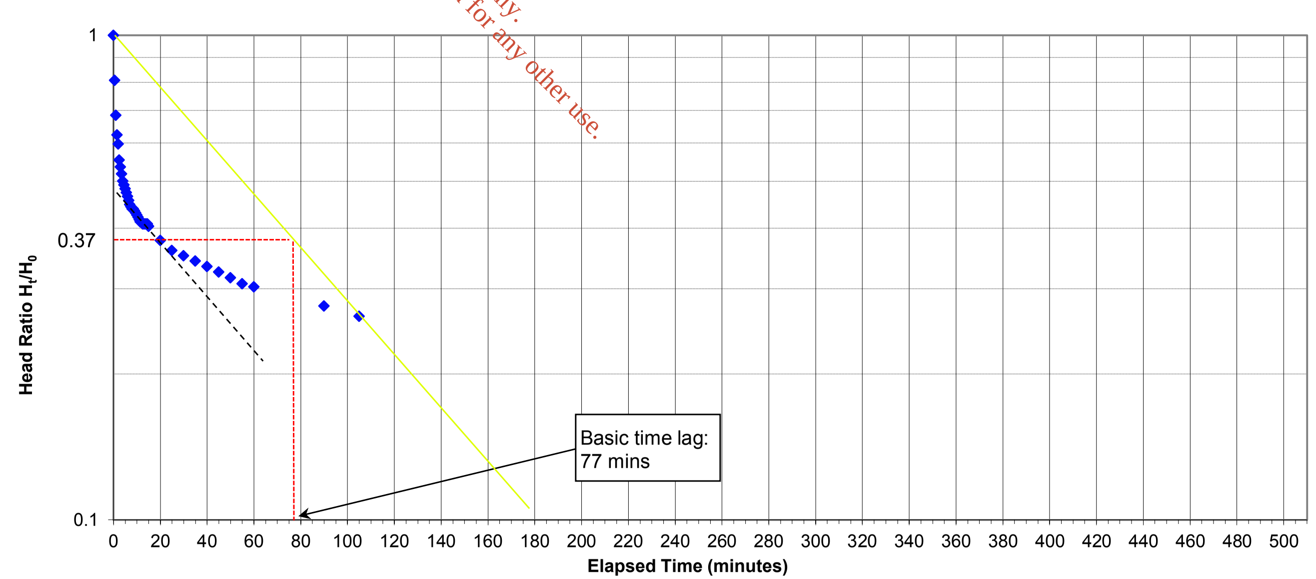
Intake Factor (F)
L (Response Zone)= 3.0 m
D= 0.15 m
F/D= 38.75622
F= 5.813433

MW1 0.70 to 3.70mbgl | 50mm standpipe

Time (T)
T (taken from graph) = 77 min
4620 seconds

Variable Head Test (after *Hvorslev* , 1951)
k = A/FT

Permeability (k)
k= 6.57957E-07 m/s k= 0.056848 m/d



Groundwater Level 2.80 mbtoc Dry

secs	Elapsed time, t (minutes)	Depth to water from datum (m)	Head, H_t (m)	Head Ratio H_t/H_0
0	0.0	1.79	1.01	1
30	0.5	1.92	0.88	0.871287
60	1.0	2.10	0.7	0.693069
90	1.5	2.24	0.56	0.554455
120	2.0	2.32	0.48	0.475248
150	2.5	2.37	0.43	0.425743
180	3.0	2.41	0.39	0.386139
210	3.5	2.45	0.35	0.346535
240	4.0	2.49	0.31	0.306931
270	4.5	2.5	0.3	0.29703
300	5.0	2.52	0.28	0.277228
330	5.5	2.535	0.265	0.262376
360	6.0	2.55	0.25	0.247525
390	6.5	2.55	0.25	0.247525
420	7.0	2.57	0.23	0.227723
450	7.5	2.58	0.22	0.217822
480	8.0	2.585	0.215	0.212871
510	8.5	2.59	0.21	0.207921
540	9.0	2.6	0.2	0.19802
570	9.5	2.61	0.19	0.188119
600	10.0	2.62	0.18	0.178218
630	10.5	2.625	0.175	0.173267
660	11.0	2.635	0.165	0.163366
690	11.5	2.64	0.16	0.158416
720	12.0	2.65	0.15	0.148515
750	12.5	2.655	0.145	0.143564
780	13.0	2.66	0.14	0.138614
810	13.5	2.66	0.14	0.138614
840	14.0	2.665	0.135	0.133663
870	14.5	2.67	0.13	0.128713
900	15.0	2.675	0.125	0.123762
960	16	2.68	0.12	0.118812
1020	17	2.68	0.12	0.118812
1080	18	2.685	0.115	0.113861
1140	19	2.685	0.115	0.113861
1200	20	2.69	0.11	0.108911
1500	25	2.695	0.105	0.10396
1800	30	2.71	0.09	0.089109
2100	35	2.72	0.08	0.079208
2400	40	2.73	0.07	0.069307
2700	45	2.74	0.06	0.059406
3000	50	2.75	0.05	0.049505
3600	60	2.75	0.05	0.049505

Location: **MW2** (Test 1) Type: Falling Head

18/06/2014

Dry spell, BH dry

Key	
	Input Required
	Active Cell
	Permeability result

Area (A)

Borehole Diameter= 0.15 meters squared = 0.005625

Pi= 3.141593

Then Area A= 0.017671 m^2

Intake Factor (F)

L (Response Zone)= 2.3 m

D= 0.15 m

F/D= 31.96813

F= 4.79522

MW1 0.50 to 2.80mbgl | 50mm standpipe

Time (T)

T (taken from graph) = 42 min

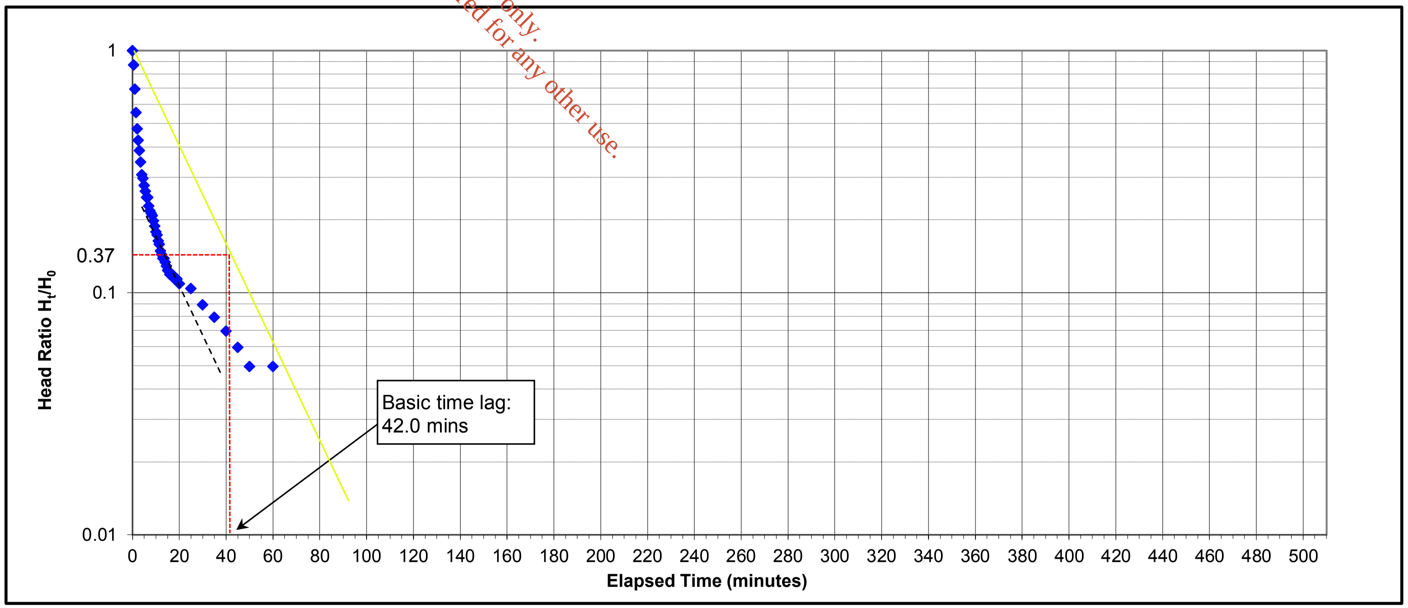
2520 seconds

Variable Head Test (after *Hvorslev* , 1951)

k = A/FT

Permeability (k)

k= 1.46239E-06 m/s k= 0.126351 m/d



Groundwater Level 2.80 mbtoc Dry

secs	Elapsed time, t (minutes)	Depth to water from datum (m)	Head, H_t (m)	Head Ratio H_t/H_0
0	0.0	1.35	1.45	1
30	0.5	1.82	0.98	0.675862
60	1.0	2.00	0.8	0.551724
90	1.5	2.15	0.65	0.448276
120	2.0	2.25	0.55	0.37931
150	2.5	2.32	0.48	0.331034
180	3.0	2.37	0.43	0.296552
210	3.5	2.41	0.39	0.268966
240	4.0	2.44	0.36	0.248276
270	4.5	2.47	0.33	0.227586
300	5.0	2.495	0.305	0.210345
330	5.5	2.52	0.28	0.193103
360	6.0	2.53	0.27	0.186207
390	6.5	2.535	0.265	0.182759
420	7.0	2.545	0.255	0.175862
450	7.5	2.56	0.24	0.165517
480	8.0	2.575	0.225	0.155172
510	8.5	2.585	0.215	0.148276
540	9.0	2.595	0.205	0.141379
570	9.5	2.6	0.2	0.137931
600	10.0	2.61	0.19	0.131034
630	10.5	2.62	0.18	0.124138
660	11.0	2.625	0.175	0.12069
690	11.5	2.63	0.17	0.117241
720	12.0	2.635	0.165	0.113793
750	12.5	2.64	0.16	0.110345
780	13.0	2.645	0.155	0.106897
810	13.5	2.65	0.15	0.103448
840	14.0	2.655	0.145	0.100000
870	14.5	2.655	0.145	0.100000
900	15.0	2.66	0.14	0.096552
960	16	2.67	0.13	0.089655
1020	17	2.675	0.125	0.086207
1080	18	2.675	0.125	0.086207
1140	19	2.675	0.125	0.086207
1200	20	2.68	0.12	0.082759
1500	25	2.7	0.1	0.068966
1800	30	2.71	0.09	0.062069
2100	35	2.715	0.085	0.058621
2400	40	2.72	0.08	0.055172
2700	45	2.735	0.065	0.044828
3000	50	2.74	0.06	0.041379

Location: **MW2** (Test 2) Type: Falling Head

18/06/2014

Dry spell, BH dry

Key	
	Input Required
	Active Cell
	Permeability result

Area (A)

Borehole Diameter= 0.15 meters squared = 0.005625

Pi= 3.141593

Then Area A= 0.017671 m^2

Intake Factor (F)

L (Response Zone)= 2.3 m

D= 0.15 m

F/D= 31.96813

F= 4.79522

MW1 0.50 to 2.80mbgl | 50mm standpipe

Time (T)

T (taken from graph) = 54 min

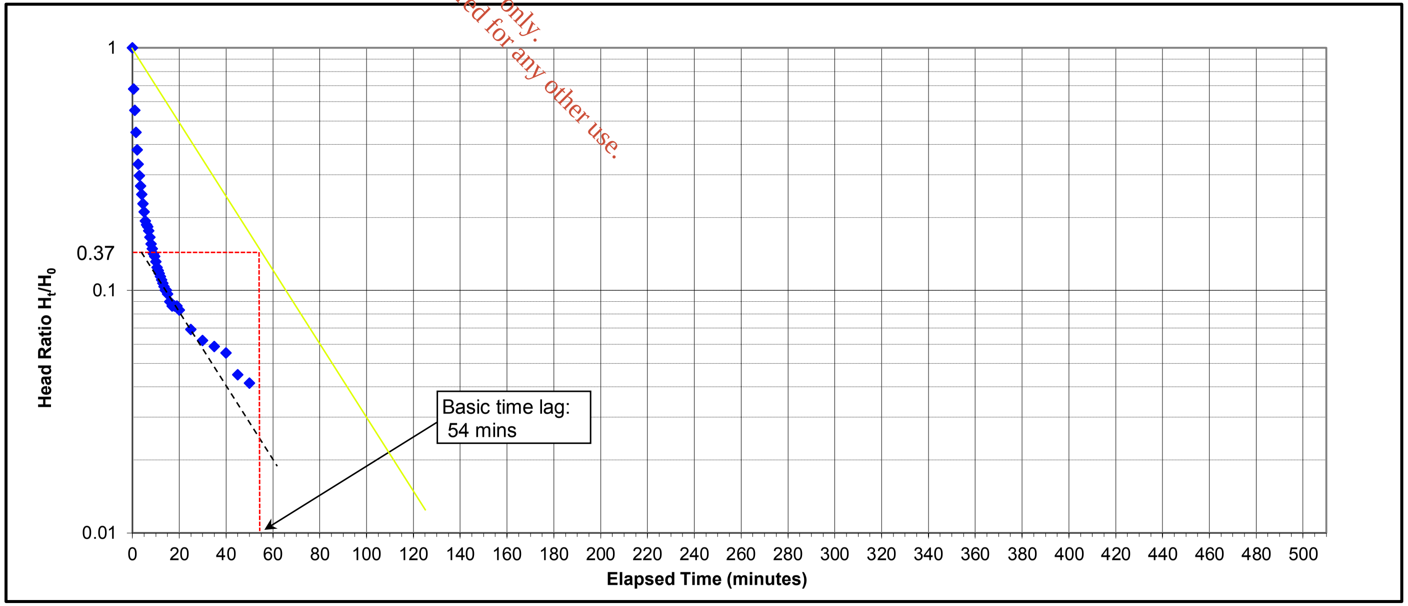
3240 seconds

Variable Head Test (after *Hvorslev* , 1951)

k = A/FT

Permeability (k)

k= 1.13741E-06 m/s | k= 0.098273 m/d



Appendix C

Soil Trial Pit Sampling Results 2000

Table 9.1: Soil Analytical Results - Metals Phenols (28/4/00)

Sample Identity	Depth (m)	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Mercury mg/kg	Nickel mg/kg	Lead mg/kg	Selenium mg/kg	Zinc mg/kg	Total Phenols mg/kg
TP1	0 - 3.3	<1	2	16	37	2	33	10	<1	54	0.01
TP2	0 - 3.4	1	<1	44	48	<1	58	13	<1	72	<0.01
TP3	0 - 3.4	<1	<1	46	26	1	46	9	<1	54	<0.01
TP4	0 - 3.5	<1	<1	49	30	<1	54	12	<1	66	<0.01
TP5	0 - 3.4	19	<1	43	25	<1	43	11	<1	51	<0.01
TP6	0 - 3.1	<1	<1	36	29	3	47	11	<1	59	<0.01
TP7	0 - 3.3	23	<1	39	37	<1	55	13	<1	60	<0.01
TP-7 Duplicate	0 - 3.3	3	<1	42	38	<1	39	9	<1	46	n.a.
Dutch MAC S Values		29	0.8	100	36	0.3	35	85	-	140	-
Dutch MAC I Values		55	12	380	190	10	210	530	-	720	-

Legend

mg/kg: milligrams per kilogram

MAC: Dutch Standard Maximum Admissible Concentration

S Value: Dutch Guidline for normal uncontaminated soil

I Value: Dutch Guideline for Intervention

"-": MAC Guideline not available

n.a. = not analysed

"<" = below detection limit

Table 9.2: Soil Analytical Results - VOCs (28/4/00)

Trace Organics (VOCs)		TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MACs S-Value	Dutch MACs I-Value
Dichlorofluoromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Vinylchloride	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	100
Bromomethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Trichlorofluoromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
trans-1,2-Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dichloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	20,000
1,1 Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1 Dichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
cis-1,2-Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromochloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloroform	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
2,2-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	4,000
1,1,1-Trichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Benzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	1,000
Carbontetrachloride	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dibromomethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromodichloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Trichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	60,000
cis-1,3-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
trans-1,3-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1,2-Trichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Toluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	130,000
1,3-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dibromochloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dibromoethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Tetrachloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	4,000
1,1,1,2 -Tetrachloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1		
Chlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Ethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	50,000
p/m Xylenes	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	25,000
Bromoform	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Styrene	µg/kg	<1	<1	<1	<1	<1	<1	<1	100	100,000
1,1,2,2-Tetrachloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
o - Xylene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,3-Trichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Isopropylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
2-Chlorotoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Propylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4-Chlorotoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,4-Trimethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4-Isopropyltoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,3,5-Trimethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
1,4-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
sec-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
tert-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,3-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
n-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dibromo-3-Chloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,4-Trichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
Naphthalene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,3-trichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Hexachlorobutadiene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-

LEGEND
µg/kg: micrograms per kilogram
MAC: Maximum Admissible Concentration
Dutch S-Value: Target Value
Dutch I-Value: Intervention Value
-': MAC Guideline Not Available
< = Below current laboratory detection limit

Table 9.3: Soil Analytical Results - Polynuclear Aromatic Hydrocarbons (28/4/00)

Parameters	Depth (m)	TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MAC Values	
		-	-	-	-	-	-	-		
	Units								S-Value	I-Value
Acenaphthene	µg/kg	<1	12	<1	<1	<1	<1	5	-	-
Acenaphthylene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Benzo(B)fluoranthene	µg/kg	38	25	5	9	5	11	9	-	-
Dibenz(AH)anthracene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Fluorene	µg/kg	5	25	3	12	4	3	3	-	-
Pyrene	µg/kg	12	25	6	7	9	16	4	-	-
PAHs included in 'PAH (Sum of 10)' Dutch S and I MAC values for PAHs in soil										
Anthracene	µg/kg	28	13	9	7	4	9	5	-	-
Benzo(a)anthracene	µg/kg	65	18	5	<1	6	4	10	-	-
Benzo(a)pyrene	µg/kg	21	21	<1	<1	<1	<1	<1	-	-
Benzo(ghi)perylene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Benzo(k)flouranthene	µg/kg	22	15	4	4	2	6	4	-	-
Chrysene	µg/kg	51	28	7	<1	2	10	7	-	-
Fluoranthene	µg/kg	17	28	8	9	12	14	5	-	-
Indeno(123-cd)pyrene	µg/kg	4	10	<1	<1	<1	<1	3	-	-
Naphthalene	µg/kg	67	148	59	94	40	54	34	-	-
Phenanthrene	µg/kg	120	63	13	21	16	18	12	-	-
PAH (Sum of 10)	µg/kg	395	344	105	135	82	115	80	1000	40000
PAH (Total)	µg/kg	449	432	118	162	100	146	100	-	-

Legend

µg/kg: micrograms per kilogram

MAC: Maximum admissable concentration

S-level: Dutch guideline for normal uncontaminated soil

I-Level: Dutch guideline for Intervention

Results awaiting confirmation

"-": MAC not available

< = below laboratory detection limit

Table 9.4: Soil Analytical Results - Polychlorinated Biphenyls (28/4/00)

Parameters		TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MAC Values	
	Depth								S	I
	Units									
PCB Aroclor 1016	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1221	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1232	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1242	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1248	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1254	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1260	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB total	µg/kg	<1	<1	<1	<1	<1	<1	<1	20	1000

Legend

µg/kg: micrograms per kilogram

MAC: Maximum admissable concentration

S-level: Dutch guideline for normal uncontaminated soil

I-Level: Dutch guideline for Intervention

-: MAC not available

< = below laboratory detection limit

Table 9.5: Soil Analytical Results - Pesticide Analysis (28/4/00)

Pesticide	Units	TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	Dutch Values S- Value	Dutch Values I Value
Dichlorvos	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Mevinphos	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Phorate	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Alpha-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	-
Beta-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	-
Gamma-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	0.05	-
Diazinon	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Disulfoton	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Delta-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Methyl Parathion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Heptachlor	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Fenitrothion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Aldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	-
Malathion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Parathion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Heptachlor Epoxide	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Endosulfan I	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dieldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	0.5	-
4,4-DDE	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	4000
Endrin Ketone	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Endosulfan II	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4,4-DDD	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	4000
Ethion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Endrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	-
Endosulfan Sulphate	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4,4-DDT	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	4000
Methoxychlor	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Azinphos Methyl	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-

Legend
µg/kg: micrograms per kilogram
MAC: Maximum Admissable Concentration
S-level: Dutch guideline for normal uncontaminated soil
I-Level: Dutch guideline for Intervention
-: MAC not available
< = below laboratory detection limit

Appendix C

Soil Sampling Lab Results 2014

Jones Environmental Laboratory

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

Unit 3 Deeside Point
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AWN Consulting
Tecpro Building
Clonshaugh Business & Technology Park
Dublin
Dublin 17
Ireland

Attention :	Janka Nitsche
Date :	13th June, 2014
Your reference :	14-1708
Our reference :	Test Report 14/6422 Batch 1
Location :	Indaver
Date samples received :	2nd June, 2014
Status :	Final report
Issue :	1

Eight samples were received for analysis on 2nd June, 2014. 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:

Phil Sommerton BSc
Project Manager

Bob Millward BSc FRSC
Principal Chemist

Client Name:	AWN Consulting	**Report :**	**Solid**
Reference:	14-1708		
Location:	Indaver	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Janka Nitsche		
JE Job No.:	14/6422		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	4-6	7-9	19-21	LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	MW4			
Depth	3.2	1.8	1.8			
COC No / misc						
Containers	V J	V J	V J			
Sample Date	29/05/2014	29/05/2014	30/05/2014			
Sample Type	Soil	Soil	Soil			
Batch Number	1	1	1			
Date of Receipt	02/06/2014	02/06/2014	02/06/2014			
Arsenic #	9.6	15.3	6.5	<0.5	mg/kg	TM30/PM15
Barium #	55	96	81	<1	mg/kg	TM30/PM15
Beryllium	0.9	1.2	0.7	<0.5	mg/kg	TM30/PM15
Cadmium #	0.7	1.3	0.3	<0.1	mg/kg	TM30/PM15
Chromium #	45.5	45.4	42.4	<0.5	mg/kg	TM30/PM15
Copper #	27	42	21	<1	mg/kg	TM30/PM15
Lead #	11	21	10	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum #	2.8	4.4	1.2	<0.1	mg/kg	TM30/PM15
Nickel #	44.8	51.5	40.4	<0.7	mg/kg	TM30/PM15
Selenium #	1	2	<1	<1	mg/kg	TM30/PM15
Vanadium	31	35	39	<1	mg/kg	TM30/PM15
Water Soluble Boron #	0.2	0.3	<0.1	<0.1	mg/kg	TM74/PM32
Zinc #	68	85	57	<5	mg/kg	TM30/PM15
VOC TICs	ND	ND	ND		None	TM15/PM10
Hexane	<100	<100	<100	<100	ug/kg	TM15/PM10
Heptane	<100	<100	<100	<100	ug/kg	TM15/PM10
Octane	<100	<100	<100	<100	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
p/m-Xylene #	<6	<6	<6	<6	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	109	53	94	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	120	126	130	<0	%	TM15/PM10
TPH CWG						
Aliphatics						
>C5-C6 #	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4	<4	<4	mg/kg	TM5/PM16
>C16-C21 #	<7	<7	<7	<7	mg/kg	TM5/PM16
>C21-C35 #	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aliphatics C5-35	<19	<19	<19	<19	mg/kg	TM5/TM36/PM12/PM16

Jones Environmental Laboratory

Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche
JE Job No.: 14/6422

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	4-6	7-9	19-21			
Sample ID	MW1	MW2	MW4			
Depth	3.2	1.8	1.8			
COC No / misc						
Containers	V J	V J	V J			
Sample Date	29/05/2014	29/05/2014	30/05/2014			
Sample Type	Soil	Soil	Soil			
Batch Number	1	1	1			
Date of Receipt	02/06/2014	02/06/2014	02/06/2014	LOD/LOR	Units	Method No.
TPH CWG						
Aromatics						
>C5-EC7	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>EC12-EC16	<4	<4	<4	<4	mg/kg	TM5/PM16
>EC16-EC21	<7	<7	<7	<7	mg/kg	TM5/PM16
>EC21-EC35	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aromatics C5-35	<19	<19	<19	<19	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-35)	<38	<38	<38	<38	mg/kg	TM5/TM36/PM12/PM16
PCB 77	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 81	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 105	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 114	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 118	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 123	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 126	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 156	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 157	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 167	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 169	<5	<5	<5	<5	ug/kg	TM16/PM8
PCB 189	<5	<5	<5	<5	ug/kg	TM16/PM8
Total 12 PCBs	<60	<60	<60	<60	ug/kg	TM16/PM8
Natural Moisture Content	7.0	17.5	12.6	<0.1	%	PM4/PM0
Ammoniacal Nitrogen as NH3	<0.6	<0.6	<0.6	<0.6	mg/kg	TM38/PM20
Fluoride	1.9	1.4	1.3	<0.3	mg/kg	TM27/PM20
Free Cyanide	<0.5	<0.5	<0.5	<0.5	mg/kg	TM89/PM45

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All solid results are expressed on a dry weight basis unless stated otherwise.

Jones Environmental Laboratory

Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche
JE Job No.: 14/6422

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-3	19-21											
Sample ID	MW1	MW4											
Depth	1.5	1.8											
COC No / misc													
Containers	V J	V J											
Sample Date	29/05/2014	30/05/2014											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	02/06/2014	02/06/2014									LOD/LOR	Units	Method No.
Dissolved Arsenic #	<2.5	2.6									<2.5	ug/l	TM30/PM14
Dissolved Barium #	4	4									<3	ug/l	TM30/PM14
Dissolved Beryllium #	<0.5	<0.5									<0.5	ug/l	TM30/PM14
Dissolved Boron #	<12	<12									<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5									<0.5	ug/l	TM30/PM14
Dissolved Chromium #	<1.5	<1.5									<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7									<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5									<5	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1									<1	ug/l	TM30/PM14
Dissolved Molybdenum #	3	2									<2	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2									<2	ug/l	TM30/PM14
Dissolved Selenium #	<3	<3									<3	ug/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5									<1.5	ug/l	TM30/PM14
Dissolved Zinc #	3	<3									<3	ug/l	TM30/PM14
Methyl Tertiary Butyl Ether	<1	<1									<1	ug/l	TM15/PM69
Benzene	<1	<1									<1	ug/l	TM15/PM69
Toluene	<2	<2									<2	ug/l	TM15/PM69
Ethylbenzene	<2	<2									<2	ug/l	TM15/PM69
p/m-Xylene	<3	<3									<3	ug/l	TM15/PM69
o-Xylene	<2	<2									<2	ug/l	TM15/PM69
Surrogate Recovery Toluene D8	83	85									<0	%	TM15/PM69
Surrogate Recovery 4-Bromofluorobenzene	93	94									<0	%	TM15/PM69
TPH CWG													
Aliphatics													
>C5-C6	<5	<5									<5	ug/l	TM36/PM69
>C6-C8	<5	<5									<5	ug/l	TM36/PM69
>C8-C10	<5	<5									<5	ug/l	TM36/PM69
>C10-C12	<5	<5									<5	ug/l	TM5/PM30
>C12-C16	<10	<10									<10	ug/l	TM5/PM30
>C16-C21	<10	<10									<10	ug/l	TM5/PM30
>C21-C35	<10	<10									<10	ug/l	TM5/PM30
Total aliphatics C5-35	<10	<10									<10	ug/l	TM5/TM36/PM30/PM69

Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche
JE Job No.: 14/6422

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-3	19-21											
Sample ID	MW1	MW4											
Depth	1.5	1.8											
COC No / misc													
Containers	V J	V J											
Sample Date	29/05/2014	30/05/2014											
Sample Type	Soil	Soil											
Batch Number	1	1									LOD/LOR	Units	Method No.
Date of Receipt	02/06/2014	02/06/2014											
TPH CWG													
Aromatics													
>C5-EC7	<5	<5									<5	ug/l	TM36/PM69
>EC7-EC8	<5	<5									<5	ug/l	TM36/PM69
>EC8-EC10	<5	<5									<5	ug/l	TM36/PM69
>EC10-EC12	<5	<5									<5	ug/l	TM5/PM30
>EC12-EC16	<10	<10									<10	ug/l	TM5/PM30
>EC16-EC21	<10	<10									<10	ug/l	TM5/PM30
>EC21-EC35	<10	<10									<10	ug/l	TM5/PM30
Total aromatics C5-35	<10	<10									<10	ug/l	TM5/TM36/PM30/PM69
Total aliphatics and aromatics(C5-35)	<10	<10									<10	ug/l	TM5/TM36/PM30/PM69
PCB 77	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 81	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 105	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 114	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 118	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 123	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 126	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 156	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 157	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 167	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 169	<0.1	<0.1									<0.1	ug/l	TM17/PM30
PCB 189	<0.1	<0.1									<0.1	ug/l	TM17/PM30
Total 12 PCBs	<1.2	<1.2									<1.2	ug/l	TM17/PM30
Fluoride	0.6	<0.3									<0.3	mg/l	TM27/PM0
Ammoniacal Nitrogen as NH3 #	0.08	0.08									<0.03	mg/l	TM38/PM0
Mass of raw test portion	0.1006	0.1058										kg	NONE/PM17
Leachant Volume	0.89	0.885										l	NONE/PM17

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Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche
JE Job No.: 14/6422

SVOC Report : **CEN 10:1 1 Batch**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-3	19-21	LOD/LOR	Units	Method No.
Sample ID	MW1	MW4			
Depth	1.5	1.8			
COC No / misc					
Containers	V J	V J			
Sample Date	29/05/2014	30/05/2014			
Sample Type	Soil	Soil			
Batch Number	1	1			
Date of Receipt	02/06/2014	02/06/2014			
SVOC MS					
Phenols					
2-Chlorophenol	<10	<10	<10	ug/l	TM16/PM30
2-Methylphenol	<10	<10	<10	ug/l	TM16/PM30
2-Nitrophenol	<10	<10	<10	ug/l	TM16/PM30
2,4-Dichlorophenol	<10	<10	<10	ug/l	TM16/PM30
2,4-Dimethylphenol	<10	<10	<10	ug/l	TM16/PM30
2,4,5-Trichlorophenol	<10	<10	<10	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<10	<10	<10	ug/l	TM16/PM30
4-Chloro-3-methylphenol	<10	<10	<10	ug/l	TM16/PM30
4-Methylphenol	<10	<10	<10	ug/l	TM16/PM30
4-Nitrophenol	<10	<10	<10	ug/l	TM16/PM30
Pentachlorophenol	<10	<10	<10	ug/l	TM16/PM30
Phenol	<10	<10	<10	ug/l	TM16/PM30
PAHs					
2-Chloronaphthalene	<10	<10	<10	ug/l	TM16/PM30
2-Methylnaphthalene	<10	<10	<10	ug/l	TM16/PM30
Naphthalene	<10	<10	<10	ug/l	TM16/PM30
Acenaphthylene	<10	<10	<10	ug/l	TM16/PM30
Acenaphthene	<10	<10	<10	ug/l	TM16/PM30
Fluorene	<10	<10	<10	ug/l	TM16/PM30
Phenanthrene	<10	<10	<10	ug/l	TM16/PM30
Anthracene	<10	<10	<10	ug/l	TM16/PM30
Fluoranthene	<10	<10	<10	ug/l	TM16/PM30
Pyrene	<10	<10	<10	ug/l	TM16/PM30
Benzo(a)anthracene	<10	<10	<10	ug/l	TM16/PM30
Chrysene	<10	<10	<10	ug/l	TM16/PM30
Benzo(bk)fluoranthene	<10	<10	<10	ug/l	TM16/PM30
Benzo(a)pyrene	<10	<10	<10	ug/l	TM16/PM30
Indeno(123cd)pyrene	<10	<10	<10	ug/l	TM16/PM30
Dibenzo(ah)anthracene	<10	<10	<10	ug/l	TM16/PM30
Benzo(ghi)perylene	<10	<10	<10	ug/l	TM16/PM30
Phthalates					
Bis(2-ethylhexyl) phthalate	<10	<10	<10	ug/l	TM16/PM30
Butylbenzyl phthalate	<10	<10	<10	ug/l	TM16/PM30
Di-n-butyl phthalate	<10	<10	<10	ug/l	TM16/PM30
Di-n-Octyl phthalate	<10	<10	<10	ug/l	TM16/PM30
Diethyl phthalate	<10	<10	<10	ug/l	TM16/PM30
Dimethyl phthalate	<10	<10	<10	ug/l	TM16/PM30

Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche
JE Job No.: 14/6422

SVOC Report : **CEN 10:1 1 Batch**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-3	19-21									LOD/LOR	Units	Method No.
Sample ID	MW1	MW4											
Depth	1.5	1.8											
COC No / misc													
Containers	V J	V J											
Sample Date	29/05/2014	30/05/2014											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	02/06/2014	02/06/2014											
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	<10	<10									<10	ug/l	TM16/PM30
1,2,4-Trichlorobenzene	<10	<10									<10	ug/l	TM16/PM30
1,3-Dichlorobenzene	<10	<10									<10	ug/l	TM16/PM30
1,4-Dichlorobenzene	<10	<10									<10	ug/l	TM16/PM30
2-Nitroaniline	<10	<10									<10	ug/l	TM16/PM30
2,4-Dinitrotoluene	<10	<10									<10	ug/l	TM16/PM30
2,6-Dinitrotoluene	<10	<10									<10	ug/l	TM16/PM30
3-Nitroaniline	<10	<10									<10	ug/l	TM16/PM30
4-Bromophenylphenylether	<10	<10									<10	ug/l	TM16/PM30
4-Chloroaniline	<10	<10									<10	ug/l	TM16/PM30
4-Chlorophenylphenylether	<10	<10									<10	ug/l	TM16/PM30
4-Nitroaniline	<10	<10									<10	ug/l	TM16/PM30
Azobenzene	<10	<10									<10	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane	<10	<10									<10	ug/l	TM16/PM30
Bis(2-chloroethyl)ether	<10	<10									<10	ug/l	TM16/PM30
Carbazole	<10	<10									<10	ug/l	TM16/PM30
Dibenzofuran	<10	<10									<10	ug/l	TM16/PM30
Hexachlorobenzene	<10	<10									<10	ug/l	TM16/PM30
Hexachlorobutadiene	<10	<10									<10	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<10	<10									<10	ug/l	TM16/PM30
Hexachloroethane	<10	<10									<10	ug/l	TM16/PM30
Isophorone	<10	<10									<10	ug/l	TM16/PM30
N-nitrosodi-n-propylamine	<10	<10									<10	ug/l	TM16/PM30
Nitrobenzene	<10	<10									<10	ug/l	TM16/PM30

Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche
JE Job No.: 14/6422

VOC Report : **Solid**

Please see attached notes for all abbreviations and acronyms

J E Sample No.	4-6	7-9	19-21	LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	MW4			
Depth	3.2	1.8	1.8			
COC No / misc						
Containers	V J	V J	V J			
Sample Date	29/05/2014	29/05/2014	30/05/2014			
Sample Type	Soil	Soil	Soil			
Batch Number	1	1	1			
Date of Receipt	02/06/2014	02/06/2014	02/06/2014			
VOC MS						
Dichlorodifluoromethane	<2	<2	<2	<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	<2	ug/kg	TM15/PM10
Bromomethane	<1	<1	<1	<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<7	<7	<7	<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3	<3	<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
p/m-Xylene #	<6	<6	<6	<6	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	ug/kg	TM15/PM10
Styrene	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromoform	<3	<3	<3	<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	109	53	94	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	120	126	130	<0	%	TM15/PM10

Jones Environmental Laboratory

Client Name:	AWN Consulting	**VOC Report :**	**CEN 10:1 1 Batch**
Reference:	14-1708		
Location:	Indaver		
Contact:	Janka Nitsche		
JE Job No.:	14/6422		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-3	19-21	LOD/LOR	Units	Method No.
Sample ID	MW1	MW4			
Depth	1.5	1.8			
COC No / misc					
Containers	V J	V J			
Sample Date	29/05/2014	30/05/2014			
Sample Type	Soil	Soil			
Batch Number	1	1			
Date of Receipt	02/06/2014	02/06/2014			
VOC MS					
Dichlorodifluoromethane	<2	<2	<2	ug/l	TM15/PM69
Methyl Tertiary Butyl Ether	<1	<1	<1	ug/l	TM15/PM69
Chloromethane	<3	<3	<3	ug/l	TM15/PM69
Vinyl Chloride	<0.1	<0.1	<0.1	ug/l	TM15/PM69
Bromomethane	<1	<1	<1	ug/l	TM15/PM69
Chloroethane	<3	<3	<3	ug/l	TM15/PM69
Trichlorofluoromethane	<3	<3	<3	ug/l	TM15/PM69
1,1-Dichloroethene (1,1 DCE)	<3	<3	<3	ug/l	TM15/PM69
Dichloromethane (DCM)	<3	<3	<3	ug/l	TM15/PM69
trans-1-2-Dichloroethene	<3	<3	<3	ug/l	TM15/PM69
1,1-Dichloroethane	<3	<3	<3	ug/l	TM15/PM69
cis-1-2-Dichloroethene	<3	<3	<3	ug/l	TM15/PM69
2,2-Dichloropropane	<1	<1	<1	ug/l	TM15/PM69
Bromochloromethane	<2	<2	<2	ug/l	TM15/PM69
Chloroform	<2	<2	<2	ug/l	TM15/PM69
1,1,1-Trichloroethane	<2	<2	<2	ug/l	TM15/PM69
1,1-Dichloropropene	<3	<3	<3	ug/l	TM15/PM69
Carbon tetrachloride	<2	<2	<2	ug/l	TM15/PM69
1,2-Dichloroethane	<2	<2	<2	ug/l	TM15/PM69
Benzene	<1	<1	<1	ug/l	TM15/PM69
Trichloroethene (TCE)	<3	<3	<3	ug/l	TM15/PM69
1,2-Dichloropropane	<2	<2	<2	ug/l	TM15/PM69
Dibromomethane	<3	<3	<3	ug/l	TM15/PM69
Bromodichloromethane	<2	<2	<2	ug/l	TM15/PM69
cis-1-3-Dichloropropene	<2	<2	<2	ug/l	TM15/PM69
Toluene	<2	<2	<2	ug/l	TM15/PM69
trans-1-3-Dichloropropene	<2	<2	<2	ug/l	TM15/PM69
1,1,2-Trichloroethane	<2	<2	<2	ug/l	TM15/PM69
Tetrachloroethene (PCE)	<3	<3	<3	ug/l	TM15/PM69
1,3-Dichloropropane	<2	<2	<2	ug/l	TM15/PM69
Dibromochloromethane	<2	<2	<2	ug/l	TM15/PM69
1,2-Dibromoethane	<2	<2	<2	ug/l	TM15/PM69
Chlorobenzene	<2	<2	<2	ug/l	TM15/PM69
1,1,1,2-Tetrachloroethane	<2	<2	<2	ug/l	TM15/PM69
Ethylbenzene	<2	<2	<2	ug/l	TM15/PM69
p/m-Xylene	<3	<3	<3	ug/l	TM15/PM69
o-Xylene	<2	<2	<2	ug/l	TM15/PM69
Styrene	<2	<2	<2	ug/l	TM15/PM69
Bromoform	<2	<2	<2	ug/l	TM15/PM69
Isopropylbenzene	<3	<3	<3	ug/l	TM15/PM69
1,1,2,2-Tetrachloroethane	<4	<4	<4	ug/l	TM15/PM69
Bromobenzene	<2	<2	<2	ug/l	TM15/PM69
1,2,3-Trichloropropane	<3	<3	<3	ug/l	TM15/PM69
Propylbenzene	<3	<3	<3	ug/l	TM15/PM69
2-Chlorotoluene	<3	<3	<3	ug/l	TM15/PM69
1,3,5-Trimethylbenzene	<3	<3	<3	ug/l	TM15/PM69
4-Chlorotoluene	<3	<3	<3	ug/l	TM15/PM69
tert-Butylbenzene	<3	<3	<3	ug/l	TM15/PM69
1,2,4-Trimethylbenzene	<3	<3	<3	ug/l	TM15/PM69
sec-Butylbenzene	<3	<3	<3	ug/l	TM15/PM69
4-Isopropyltoluene	<3	<3	<3	ug/l	TM15/PM69
1,3-Dichlorobenzene	<3	<3	<3	ug/l	TM15/PM69
1,4-Dichlorobenzene	<3	<3	<3	ug/l	TM15/PM69
n-Butylbenzene	<3	<3	<3	ug/l	TM15/PM69
1,2-Dichlorobenzene	<3	<3	<3	ug/l	TM15/PM69
1,2-Dibromo-3-chloropropane	<2	<2	<2	ug/l	TM15/PM69
1,2,4-Trichlorobenzene	<3	<3	<3	ug/l	TM15/PM69
Hexachlorobutadiene	<3	<3	<3	ug/l	TM15/PM69
1,2,3-Trichlorobenzene	<3	<3	<3	ug/l	TM15/PM69
Surrogate Recovery Toluene D8	83	85	<0	%	TM15/PM69
Surrogate Recovery 4-Bromofluorobenzene	93	94	<0	%	TM15/PM69

Jones Environmental Laboratory **Notification of Deviating Samples**

Client Name: AWN Consulting
Reference: 14-1708
Location: Indaver
Contact: Janka Nitsche

Matrix : CEN 10:1 1 Batch

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason

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.: 14/6422

SOILS

Please note we are only MCERTS accredited 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 we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

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.

WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

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.

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.

ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
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.
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
OC	Outside Calibration Range

JE Job No: 14/6422

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM5	In-House method based on USEPA 8015B. Determination of Extractable Petroleum Hydrocarbons (EPH) in the carbon chain length range of C8-40 by GC-FID. Accredited to ISO 17025 on soil and water samples and MCERTS (carbon banding only) on soils. All accreditation is matrix specific.	PM16	Aliphatic/Aromatic fractionation			AR	Yes
TM5	In-House method based on USEPA 8015B. Determination of Extractable Petroleum Hydrocarbons (EPH) in the carbon chain length range of C8-40 by GC-FID. Accredited to ISO 17025 on soil and water samples and MCERTS (carbon banding only) on soils. All accreditation is matrix specific.	PM16	Aliphatic/Aromatic fractionation	Yes		AR	Yes
TM5	In-House method based on USEPA 8015B. Determination of Extractable Petroleum Hydrocarbons (EPH) in the carbon chain length range of C8-40 by GC-FID. Accredited to ISO 17025 on soil and water samples and MCERTS (carbon banding only) on soils. All accreditation is matrix specific.	PM30	In-house method based on USEPA 3510. Liquid samples are mixed with solvent and agitated with an automatic magnetic stirrer with a stir bar for 15 minutes to extract organic molecules. ISO 17025 accredited extraction method. All accreditation is matrix specific			AR	Yes
TM5/TM36	TPH CWG by GC-FID	PM12/PM16	CWG GC-FID			AR	Yes
TM5/TM36	TPH CWG by GC-FID	PM30/PM69	CWG GC-FID			AR	Yes
TM15	In-House method based on USEPA 8260. Determination of Volatile Organic compounds (VOCs) by Headspace GC-MS. Accredited to ISO 17025 for soils and waters and MCERTS for Soils. All accreditation is matrix specific. Quantification by Internal Standard method.	PM10	In-house method based on USEPA 5021. Preparation of solid and liquid samples for headspace analysis. Samples are spiked with surrogates to facilitate quantification. ISO 17025 accredited extraction method. All accreditation is matrix specific			AR	Yes
TM15	In-House method based on USEPA 8260. Determination of Volatile Organic compounds (VOCs) by Headspace GC-MS. Accredited to ISO 17025 for soils and waters and MCERTS for Soils. All accreditation is matrix specific. Quantification by Internal Standard method.	PM10	In-house method based on USEPA 5021. Preparation of solid and liquid samples for headspace analysis. Samples are spiked with surrogates to facilitate quantification. ISO 17025 accredited extraction method. All accreditation is matrix specific	Yes		AR	Yes
TM15	In-House method based on USEPA 8260. Determination of Volatile Organic compounds (VOCs) by Headspace GC-MS. Accredited to ISO 17025 for soils and waters and MCERTS for Soils. All accreditation is matrix specific. Quantification by Internal Standard method.	PM69	CEN 10:1 Leachate preparation with zero headspace			AR	Yes
TM15	In-House method based on USEPA 8260. Determination of Volatile Organic compounds (VOCs) by Headspace GC-MS. Accredited to ISO 17025 for soils and waters and MCERTS for Soils. All accreditation is matrix specific. Quantification by Internal Standard method.	PM69	CEN 10:1 Leachate preparation with zero headspace			AR	

JE Job No: 14/6422

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Reported on dry weight basis
TM16	In-House method based on USEPA 8270. Determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS. Accredited to ISO 17025 for waters. All accreditation is matrix specific. Quantification by Internal Standard method.	PM30	In-house method based on USEPA 3510. Liquid samples are mixed with solvent and agitated with an automatic magnetic stirrer with a stir bar for 15 minutes to extract organic molecules. ISO 17025 accredited extraction method. All accreditation is matrix specific			AR	Yes
TM16	In-House method based on USEPA 8270. Determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS. Accredited to ISO 17025 for waters. All accreditation is matrix specific. Quantification by Internal Standard method.	PM8	In-house method based on USEPA 3510. ISO 17025 accredited extraction method for organic extraction from solid samples using an end over end agitator.			AR	Yes
TM17	PCB 7 Congeners and WHO 12 PCBs by GC-MS	PM30	In-house method based on USEPA 3510. Liquid samples are mixed with solvent and agitated with an automatic magnetic stirrer with a stir bar for 15 minutes to extract organic molecules. ISO 17025 accredited extraction method. All accreditation is matrix specific			AR	Yes
TM27	In-House method based on USEPA 9056. Analysis of samples using a Dionex Ion-Chromatograph instrument.	PM0	No preparation is required.			AR	Yes
TM27	In-House method based on USEPA 9056. Analysis of samples using a Dionex Ion-Chromatograph instrument.	PM20	In-house method based on USEPA 1311 (TCLP). Solid samples are extracted with two parts de-ionised water to one part solid material for analysis of the extract for various parameters.			AD	Yes
TM30	Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry) using Thermo iCAP 6000 series instrument. Accredited to ISO 17025 for soils and waters and MCERTS accredited for Soils. All accreditation is matrix specific.	PM14	In-house method based on USEPA 3005A. Acid digestion of water samples and analsyis by ICP-OES as per method TM030W.ISO 17025 accredited extraction method. All accreditation is matrix specific	Yes		AR	Yes
TM30	Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry) using Thermo iCAP 6000 series instrument. Accredited to ISO 17025 for soils and waters and MCERTS accredited for Soils. All accreditation is matrix specific.	PM15	In-house method based on USEPA 3010A. Acid digestion of dried and crushed solid samples using Aqua Regia reflux.			AD	Yes
TM30	Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry) using Thermo iCAP 6000 series instrument. Accredited to ISO 17025 for soils and waters and MCERTS accredited for Soils. All accreditation is matrix specific.	PM15	In-house method based on USEPA 3010A. Acid digestion of dried and crushed solid samples using Aqua Regia reflux.	Yes		AD	Yes
TM36	In-House method based on USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-12 by headspace GC-FID. Accredited to ISO 17025 on soil and water samples and MCERTS accredited (carbon banding only) on soils. All accreditation is matrix specific.	PM12	In-house method based on USEPA 5021. Preparation of solid and liquid samples for headspace analysis. Samples are spiked with surrogates to facilitate quantification. ISO 17025 accredited extraction method. All accreditation is matrix specific			AR	Yes
TM36	In-House method based on USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-12 by headspace GC-FID. Accredited to ISO 17025 on soil and water samples and MCERTS accredited (carbon banding only) on soils. All accreditation is matrix specific.	PM12	In-house method based on USEPA 5021. Preparation of solid and liquid samples for headspace analysis. Samples are spiked with surrogates to facilitate quantification. ISO 17025 accredited extraction method. All accreditation is matrix specific	Yes		AR	Yes

JE Job No: 14/6422

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Reported on dry weight basis
TM36	In-House method based on USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-12 by headspace GC-FID. Accredited to ISO 17025 on soil and water samples and MCERTS accredited (carbon banding only) on soils. All accreditation is matrix specific.	PM69	CEN 10:1 Leachate preparation with zero headspace			AR	Yes
TM38	Ionic analysis using the Thermo Aquakem Photometric Automatic Analyser. Accredited to ISO17025 and MCERTS for most analytes. All accreditation is matrix specific.	PM0	No preparation is required.	Yes		AR	Yes
TM38	Ionic analysis using the Thermo Aquakem Photometric Automatic Analyser. Accredited to ISO17025 and MCERTS for most analytes. All accreditation is matrix specific.	PM20	in-house method based on USEPA 1311 (TCLP). Solid samples are extracted with two parts de-ionised water to one part solid material for analysis of the extract for various parameters.			AR	Yes
TM74	Water Soluble Boron by ICP-OES	PM32	Preparation of soils for WSB	Yes		AD	Yes
TM89	In-house method based on USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. ISO17025 accredited method for soils and waters and MCERTS on soils. Accreditation is matrix specific.	PM45	Cyanide & Thiocyanate prep for soils			AR	Yes
NONE	No Method Code	PM17	CEN PR12457-2 10:1 1 batch leach				
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

Appendix C

Soil Summary Results 2014

Soil Sampling Summary Results 2014

Parameter	Units	COMMERCIAL/ INDUSTRIAL HHRA	Reference	Dutch S-Value	Dutch I-Value	LOD	MW1	MW2	MW4
Arsenic #	mg/kg	640	SGV	29	55	<0.5	9.6	15.3	6.5
Barium #	mg/kg					<1	55	96	81
Beryllium	mg/kg					<0.5	0.9	1.2	0.7
Cadmium #	mg/kg	230	SGV	0.8	12	<0.1	0.7	**1.3**	0.3
Chromium #	mg/kg	35	LQM GAC	100	380	<0.5	45.5	45.4	42.4
Copper #	mg/kg	71700	LQM GAC	39	190	<1	27	**42**	21
Lead #	mg/kg			85	530	<5	11	21	10
Mercury #	mg/kg	3600	SGV	0.3	10	<0.1	<0.1	<0.1	<0.1
Molybdenum #	mg/kg					<0.1	2.8	4.4	1.2
Nickel #	mg/kg	1800	SGV	35	210	<0.7	**44.8**	**51.5**	**40.4**
Selenium #	mg/kg	13000	SGV	-	-	<1	1	2	<1
Vanadium	mg/kg					<1	31	35	39
Water Soluble Boron #	mg/kg					<0.1	0.2	0.3	<0.1
Zinc #	mg/kg	665000	LQM GAC	140	720	<5	68	85	57
VOC MS									
Dichlorodifluoromethane	ug/kg					<2	<2	<2	<2
Methyl Tertiary Butyl Ether #	ug/kg					<2	<2	<2	<2
Chloromethane #	ug/kg					<3	<3	<3	<3
Vinyl Chloride	ug/kg					<2	<2	<2	<2
Bromomethane	ug/kg					<1	<1	<1	<1
Chloroethane #	ug/kg					<2	<2	<2	<2
Trichlorofluoromethane #	ug/kg					<2	<2	<2	<2
1,1-Dichloroethene (1,1 DCE) #	ug/kg					<6	<6	<6	<6
Dichloromethane (DCM) #	ug/kg					<7	<7	<7	<7
trans-1-2-Dichloroethene #	ug/kg					<3	<3	<3	<3
1,1-Dichloroethane #	ug/kg					<3	<3	<3	<3
cis-1-2-Dichloroethene #	ug/kg					<3	<3	<3	<3
2,2-Dichloropropane	ug/kg					<4	<4	<4	<4
Bromochloromethane #	ug/kg					<3	<3	<3	<3
Chloroform #	ug/kg					<3	<3	<3	<3
1,1,1-Trichloroethane #	ug/kg					<3	<3	<3	<3
1,1-Dichloropropene #	ug/kg					<3	<3	<3	<3
Carbon tetrachloride #	ug/kg					<4	<4	<4	<4
1,2-Dichloroethane #	ug/kg					<4	<4	<4	<4
Benzene #	ug/kg			50		<3	<3	<3	<3
Trichloroethene (TCE) #	ug/kg			1		<3	<3	<3	<3
1,2-Dichloropropane #	ug/kg					<6	<6	<6	<6
Dibromomethane #	ug/kg					<3	<3	<3	<3
Bromodichloromethane #	ug/kg					<3	<3	<3	<3

Soil Sampling Summary Results 2014

Parameter	Units	COMMERCIAL/ INDUSTRIAL HHRA	Reference	Dutch S-Value	Dutch I-Value	LOD	MW1	MW2	MW4
cis-1-3-Dichloropropene	ug/kg					<4	<4	<4	<4
Toluene #	ug/kg					<3	<3	<3	<3
trans-1-3-Dichloropropene	ug/kg					<3	<3	<3	<3
1,1,2-Trichloroethane #	ug/kg					<3	<3	<3	<3
Tetrachloroethene (PCE) #	ug/kg			10		<3	<3	<3	<3
1,3-Dichloropropane #	ug/kg					<3	<3	<3	<3
Dibromochloromethane #	ug/kg					<3	<3	<3	<3
1,2-Dibromoethane #	ug/kg					<3	<3	<3	<3
Chlorobenzene #	ug/kg					<3	<3	<3	<3
1,1,1,2-Tetrachloroethane	ug/kg					<3	<3	<3	<3
Ethylbenzene #	ug/kg			50		<3	<3	<3	<3
p/m-Xylene #	ug/kg			50		<6	<6	<6	<6
o-Xylene #	ug/kg					<3	<3	<3	<3
Styrene	ug/kg			100		<3	<3	<3	<3
Bromoform	ug/kg					<3	<3	<3	<3
Isopropylbenzene #	ug/kg					<3	<3	<3	<3
1,1,2,2-Tetrachloroethane #	ug/kg					<3	<3	<3	<3
Bromobenzene	ug/kg					<2	<2	<2	<2
1,2,3-Trichloropropane #	ug/kg					<4	<4	<4	<4
Propylbenzene #	ug/kg					<4	<4	<4	<4
2-Chlorotoluene	ug/kg					<3	<3	<3	<3
1,3,5-Trimethylbenzene #	ug/kg					<3	<3	<3	<3
4-Chlorotoluene	ug/kg					<3	<3	<3	<3
tert-Butylbenzene #	ug/kg					<5	<5	<5	<5
1,2,4-Trimethylbenzene #	ug/kg					<6	<6	<6	<6
sec-Butylbenzene #	ug/kg					<4	<4	<4	<4
4-Isopropyltoluene #	ug/kg					<4	<4	<4	<4
1,3-Dichlorobenzene #	ug/kg			10		<4	<4	<4	<4
1,4-Dichlorobenzene #	ug/kg			10		<4	<4	<4	<4
n-Butylbenzene #	ug/kg					<4	<4	<4	<4
1,2-Dichlorobenzene #	ug/kg			10		<4	<4	<4	<4
1,2-Dibromo-3-chloropropane #	ug/kg					<4	<4	<4	<4
1,2,4-Trichlorobenzene #	ug/kg			10		<7	<7	<7	<7
Hexachlorobutadiene	ug/kg					<4	<4	<4	<4
Naphthalene	ug/kg					<27	<27	<27	<27
1,2,3-Trichlorobenzene #	ug/kg					<7	<7	<7	<7
Surrogate Recovery Toluene D8	%					<0	109	53	94
Surrogate Recovery 4-Bromofluorobenzene	%					<0	120	126	130
VOC TICs	None						ND	ND	ND

Soil Sampling Summary Results 2014

Parameter	Units	COMMERCIAL/ INDUSTRIAL HHRA	Reference	Dutch S-Value	Dutch I-Value	LOD	MW1	MW2	MW4
Hexane	ug/kg					<100	<100	<100	<100
Heptane	ug/kg					<100	<100	<100	<100
Octane	ug/kg					<100	<100	<100	<100
Methyl Tertiary Butyl Ether #	ug/kg					<2	<2	<2	<2
Benzene #	ug/kg			50		<3	<3	<3	<3
Toluene #	ug/kg			50		<3	<3	<3	<3
Ethylbenzene #	ug/kg			50		<3	<3	<3	<3
p/m-Xylene #	ug/kg					<6	<6	<6	<6
o-Xylene #	ug/kg					<3	<3	<3	<3
Surrogate Recovery Toluene D8	%					<0	109	53	94
Surrogate Recovery 4-Bromofluorobenzene	%					<0	120	126	130
TPH CWG									
Aliphatics									
>C5-C6 #	mg/kg	304	LQM GAC			<0.1	<0.1	<0.1	<0.1
>C6-C8 #	mg/kg	144	LQM GAC			<0.1	<0.1	<0.1	<0.1
>C8-C10	mg/kg	78	LQM GAC			<0.1	<0.1	<0.1	<0.1
>C10-C12 #	mg/kg	48	LQM GAC			<0.2	<0.2	<0.2	<0.2
>C12-C16 #	mg/kg	24	LQM GAC			<4	<4	<4	<4
>C16-C21 #	mg/kg	1600000	LQM GAC			<7	<7	<7	<7
>C21-C35 #	mg/kg					<7	<7	<7	<7
Total aliphatics C5-35	mg/kg	1600000	LQM GAC			<19	<19	<19	<19
Aromatics									
>C5-EC7	mg/kg	1220	LQM GAC			<0.1	<0.1	<0.1	<0.1
>EC7-EC8	mg/kg	869	LQM GAC			<0.1	<0.1	<0.1	<0.1
>EC8-EC10 #	mg/kg	613	LQM GAC			<0.1	<0.1	<0.1	<0.1
>EC10-EC12	mg/kg	364	LQM GAC			<0.2	<0.2	<0.2	<0.2
>EC12-EC16	mg/kg	169	LQM GAC			<4	<4	<4	<4
>EC16-EC21	mg/kg	28000	LQM GAC			<7	<7	<7	<7
>EC21-EC35	mg/kg					<7	<7	<7	<7
Total aromatics C5-35	mg/kg	28000	LQM GAC			<19	<19	<19	<19
Total aliphatics and aromatics(C5-35)	mg/kg					<38	<38	<38	<38
PCB 77	ug/kg					<5	<5	<5	<5
PCB 81	ug/kg					<5	<5	<5	<5
PCB 105	ug/kg					<5	<5	<5	<5
PCB 114	ug/kg					<5	<5	<5	<5
PCB 118	ug/kg					<5	<5	<5	<5
PCB 123	ug/kg					<5	<5	<5	<5
PCB 126	ug/kg					<5	<5	<5	<5

Soil Sampling Summary Results 2014

Parameter	Units	COMMERCIAL/ INDUSTRIAL HHRA	Reference	Dutch S-Value	Dutch I-Value	LOD	MW1	MW2	MW4
PCB 156	ug/kg					<5	<5	<5	<5
PCB 157	ug/kg					<5	<5	<5	<5
PCB 167	ug/kg					<5	<5	<5	<5
PCB 169	ug/kg					<5	<5	<5	<5
PCB 189	ug/kg					<5	<5	<5	<5
Total 12 PCBs	ug/kg					<60	<60	<60	<60
Natural Moisture Content	%					<0.1	<u>7</u>	<u>17.5</u>	<u>12.6</u>
Moisture Content 105C (% Dry Weight)	%					<0.1	NA	NA	<u>17</u>
Dry Matter Content Ratio 105°C	%					<0.1	NA	NA	<u>85.5</u>
Ammoniacal Nitrogen as NH3	mg/kg					<0.6	<0.6	<0.6	<0.6
Fluoride	mg/kg					<0.3	<u>1.9</u>	<u>1.4</u>	<u>1.3</u>
Free Cyanide	mg/kg					<0.5	<0.5	<0.5	<0.5

Notes:

Durch S-values for normal uncontaminated soil

<u>100</u> above lab detection limit

above guideline values where

22 (bold) above Dutch S-values

Appendix C

Groundwater Summary Results 2011-2013

(AGW1 Wells)

Groundwater Bi Annual data (October 2013) -Table 1 Metals, Inorganics, Other

	Sample ID	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	Groundwater Regulations S.I. 9	EPA IGVs 2003
	Date sampled		30/11/2011			16/02/2012			27/04/2012			18/09/2012			22/04/2013			13/05/2013			24/09/2013			
Parameter	Units																							
pH	pH units	7.1	7.4	7.2	7.2	7.3	7.2	7.2	7.3	7.2	7	7.3	7.2	7.1	7.3	7.2				7.2	7.3	7.3	-	≥6.5 and ≤9.5
Nitrate	mg/L as N	3.97	10.02	12.61				3.42	14.07	8.87	3.58	11.07	10.87	3.25	10.38	8.4				3.41	9.17	7.73	37.5	25
Nitrite	mg/L as N	<0.002	<0.002	<0.002				0.009	0.007	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	<0.002	0.375	0.1
Chloride	mg/l	83.52	30.9	31.56	106.76	38.77	37.96	70.58	<u>129.09</u>	35.99	102.64	59	36.38	98.2	70.29	40.91				85.92	98.79	39.29	187.5	30
Fluoride	mg/l	0.14	0.12	0.14	0.15	0.11	0.13	0.13	0.11	0.13	<0.02	<0.02	<0.02	0.11	0.15	0.14				0.13	0.1	0.11	187.5	30
Metals-Cd	ug/l	<0.09	<0.09	<0.09	<0.09	<0.09	0.095	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09				<0.09	<0.09	<0.09	3.75	5
Metals Tl	ug/l	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06				<0.06	<0.06	<0.06	-	-
Metals Hg	ug/l	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04				<0.04	<0.04	<0.04	0.75	1
Metals Pb	ug/l	<0.02	<0.02	<0.02	6.923	2.315	2.568	1.749	6.211	4.547	0.05	0.053	0.071	<0.02	<0.02	<0.02				0.197	0.605	<0.02	18.75	10
Metals Cr	ug/l	<2.14	<2.14	<2.14	4.788	4.106	<2.14	<2.14	<2.14	<2.14	<2.14	<2.14	<2.14	<2.14	<2.14	2.65				2.249	5.08	<2.14	37.5	30
Metals Cu	ug/l	<0.11	<0.11	<0.11	8.841	4.148	3.079	0.183	<0.11	<0.11	0.251	0.249	0.306	<0.11	2.209	1.248				5.309	5.107	2.767	1500	30
Metals Mn	ug/l	<0.04	<0.04	<0.04	44.67	40.7	25.57	0.435	0.293	2.913	2.828	1.504	2.153	0.446	0.363	1.983				3.165	5.725	1.371	-	50
Metals Ni	ug/l	<0.14	<0.14	<0.14	4.801	1.169	2.565	0.447	0.259	2.412	0.441	0.3	0.811	0.177	4.227	3.558				0.687	0.426	0.825	15	20
Metals As	ug/l	<0.1	<0.1	<0.1	2.101	0.131	0.128	0.271	0.241	0.234	0.365	0.28	0.211	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	7.5	10
Metals CO	ug/l	<0.02	<0.02	<0.02	0.763	0.315	0.417	0.03	0.143	0.172	0.066	0.171	0.153	<0.02	0.091	0.136				0.069	0.108	0.132	-	-
Metals V	ug/l	<0.16	<0.16	<0.16	4.882	2.817	1.442	0.295	0.266	0.575	0.693	0.466	0.898	<0.16	0.166	0.655				0.341	0.349	0.61	-	-
Metals Sn	ug/l	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8				<2.8	<2.8	<2.8	-	-
Organohalogens	ug/l	<1	<1	<1				<1	<1	<1	<1	<1	<1	18.743	16.386	22.16	<1	<1	<1	<1	<1	<1		
Total coliforms	no/100ml	0	0	0				20	0	0	66	1	6	21	0	0				13	0	0		0
Faecal Coliforms	no/100ml	0	0	0				0	0	0	0	0	0	0	0	0				0	0	0		0

Note VOC test only on 13/05//2013 as last month had elevated values
* lower EC Directive value for Cl taken as worst case comparison
µg/l = micrograms per litre
mg/l = milligrams per litre
< = Less Than

Results are **Bold** and shaded where they exceed the 2010 Regulations
<u>Results are underlined where they exceed the EPA Interim Guideline</u>

EPA Interim Guideline Values (IGVs) 2003
SI No. 9 of 2010 Groundwater Regulations

Appendix C

Soil Leachate Summary Results 2014

Soil Leachate Summary Results 2014

Test	Units	EPA Interim Groundwater Values (IGV)	EC Env. Objectives (Groundwater) Regs.	LOD	MW1	MW4
Dissolved Arsenic[#]	ug/l	10	7.5	<2.5	<2.5	2.6
Dissolved Barium[#]	ug/l			<3	4	4
Dissolved Beryllium[#]	ug/l			<0.5	<0.5	<0.5
Dissolved Boron[#]	ug/l	1000	750	<12	<12	<12
Dissolved Cadmium[#]	ug/l	5	3.75	<0.5	<0.5	<0.5
Dissolved Chromium[#]	ug/l	30	37.5	<1.5	<1.5	<1.5
Dissolved Copper[#]	ug/l	30	1500	<7	<7	<7
Dissolved Lead[#]	ug/l			<5	<5	<5
Dissolved Mercury[#]	ug/l	1	0.75	<1	<1	<1
Dissolved Molybdenum[#]	ug/l			<2	3	2
Dissolved Nickel[#]	ug/l	20	15	<2	<2	<2
Dissolved Selenium[#]	ug/l	-	-	<3	<3	<3
Dissolved Vanadium[#]	ug/l			<1.5	<1.5	<1.5
Dissolved Zinc[#]	ug/l	100	-	<3	<3	<3
VOC MS						
Dichlorodifluoromethane	ug/l			<2	<2	<2
Methyl Tertiary Butyl Ether	ug/l			<1	<1	<1
Chloromethane	ug/l			<3	<3	<3
Vinyl Chloride	ug/l	-	0.375	<0.1	<0.1	<0.1
Bromomethane	ug/l			<1	<1	<1
Chloroethane	ug/l			<3	<3	<3
Trichlorofluoromethane	ug/l			<3	<3	<3
1,1-Dichloroethene (1,1 DCE)	ug/l			<3	<3	<3
Dichloromethane (DCM)	ug/l	10	-	<3	<3	<3
trans-1-2-Dichloroethene	ug/l			<3	<3	<3
1,1-Dichloroethane	ug/l			<3	<3	<3
cis-1-2-Dichloroethene	ug/l			<3	<3	<3
2,2-Dichloropropane	ug/l			<1	<1	<1
Bromochloromethane	ug/l			<2	<2	<2
Chloroform	ug/l			<2	<2	<2
1,1,1-Trichloroethane	ug/l			<2	<2	<2
1,1-Dichloropropene	ug/l			<3	<3	<3
Carbon tetrachloride	ug/l			<2	<2	<2
1,2-Dichloroethane	ug/l			<2	<2	<2
Benzene	ug/l	1	0.75	<1	<1	<1
Trichloroethene (TCE)	ug/l	70	0	<3	<3	<3

Soil Leachate Summary Results 2014

Test	Units	EPA Interim Groundwater Values (IGV)	EC Env. Objectives (Groundwater) Regs.	LOD	MW1	MW4
1,2-Dichloropropane	ug/l			<2	<2	<2
Dibromomethane	ug/l			<3	<3	<3
Bromodichloromethane	ug/l			<2	<2	<2
cis-1-3-Dichloropropene	ug/l			<2	<2	<2
Toluene	ug/l	10	-	<2	<2	<2
trans-1-3-Dichloropropene	ug/l			<2	<2	<2
1,1,2-Trichloroethane	ug/l			<2	<2	<2
Tetrachloroethene (PCE)	ug/l	40	-	<3	<3	<3
1,3-Dichloropropane	ug/l			<2	<2	<2
Dibromochloromethane	ug/l			<2	<2	<2
1,2-Dibromoethane	ug/l			<2	<2	<2
Chlorobenzene	ug/l			<2	<2	<2
1,1,1,2-Tetrachloroethane	ug/l			<2	<2	<2
Ethylbenzene	ug/l	10	-	<2	<2	<2
p/m-Xylene	ug/l			<3	<3	<3
o-Xylene	ug/l			<2	<2	<2
Styrene	ug/l	-	-	<2	<2	<2
Bromoform	ug/l			<2	<2	<2
Isopropylbenzene	ug/l			<3	<3	<3
1,1,2,2-Tetrachloroethane	ug/l			<4	<4	<4
Bromobenzene	ug/l			<2	<2	<2
1,2,3-Trichloropropane	ug/l			<3	<3	<3
Propylbenzene	ug/l			<3	<3	<3
2-Chlorotoluene	ug/l			<3	<3	<3
1,3,5-Trimethylbenzene	ug/l			<3	<3	<3
4-Chlorotoluene	ug/l			<3	<3	<3
tert-Butylbenzene	ug/l			<3	<3	<3
1,2,4-Trimethylbenzene	ug/l			<3	<3	<3
sec-Butylbenzene	ug/l			<3	<3	<3
4-Isopropyltoluene	ug/l			<3	<3	<3
1,3-Dichlorobenzene	ug/l			<3	<3	<3
1,4-Dichlorobenzene	ug/l			<3	<3	<3
n-Butylbenzene	ug/l			<3	<3	<3
1,2-Dichlorobenzene	ug/l			<3	<3	<3
1,2-Dibromo-3-chloropropane	ug/l			<2	<2	<2
1,2,4-Trichlorobenzene	ug/l			<3	<3	<3
Hexachlorobutadiene	ug/l			<3	<3	<3
1,2,3-Trichlorobenzene	ug/l			<3	<3	<3
Surrogate Recovery Toluene D8	%			<0	83	85
Surrogate Recovery 4-Bromofluorobenzene	%			<0	93	94

Soil Leachate Summary Results 2014

Test	Units	EPA Interim Groundwater Values (IGV)	EC Env. Objectives (Groundwater) Regs.	LOD	MW1	MW4
Methyl Tertiary Butyl Ether	ug/l			<1	<1	<1
Benzene	ug/l	1	0.75	<1	<1	<1
Toluene	ug/l			<2	<2	<2
Ethylbenzene	ug/l	10	-	<2	<2	<2
p/m-Xylene	ug/l			<3	<3	<3
o-Xylene	ug/l			<2	<2	<2
Surrogate Recovery Toluene D8	%			<0	83	85
Surrogate Recovery 4-Bromofluorobenzene	%			<0	93	94
SVOC MS						
Phenols						
2-Chlorophenol	ug/l			<10	<10	<10
2-Methylphenol	ug/l			<10	<10	<10
2-Nitrophenol	ug/l			<10	<10	<10
2,4-Dichlorophenol	ug/l			<10	<10	<10
2,4-Dimethylphenol	ug/l			<10	<10	<10
2,4,5-Trichlorophenol	ug/l			<10	<10	<10
2,4,6-Trichlorophenol	ug/l			<10	<10	<10
4-Chloro-3-methylphenol	ug/l			<10	<10	<10
4-Methylphenol	ug/l			<10	<10	<10
4-Nitrophenol	ug/l			<10	<10	<10
Pentachlorophenol	ug/l			<10	<10	<10
Phenol	ug/l			<10	<10	<10
PAHs						
2-Chloronaphthalene	ug/l			<10	<10	<10
2-Methylnaphthalene	ug/l			<10	<10	<10
Naphthalene	ug/l	1	-	<10	<10	<10
Acenaphthylene	ug/l			<10	<10	<10
Acenaphthene	ug/l			<10	<10	<10
Fluorene	ug/l			<10	<10	<10
Phenanthrene	ug/l	-	-	<10	<10	<10
Anthracene	ug/l			<10	<10	<10
Fluoranthene	ug/l			<10	<10	<10
Pyrene	ug/l			<10	<10	<10
Benzo(a)anthracene	ug/l	-	-	<10	<10	<10
Chrysene	ug/l	-	-	<10	<10	<10
Benzo(bk)fluoranthene	ug/l			<10	<10	<10
Benzo(a)pyrene	ug/l	0.01	-	<10	<10	<10
Indeno(123cd)pyrene	ug/l			<10	<10	<10

Soil Leachate Summary Results 2014

Test	Units	EPA Interim Groundwater Values (IGV)	EC Env. Objectives (Groundwater) Regs.	LOD	MW1	MW4
Dibenzo(ah)anthracene	ug/l			<10	<10	<10
Benzo(ghi)perylene	ug/l			<10	<10	<10
Phthalates						
Bis(2-ethylhexyl) phthalate	ug/l			<10	<10	<10
Butylbenzyl phthalate	ug/l			<10	<10	<10
Di-n-butyl phthalate	ug/l			<10	<10	<10
Di-n-Octyl phthalate	ug/l			<10	<10	<10
Diethyl phthalate	ug/l			<10	<10	<10
Dimethyl phthalate	ug/l			<10	<10	<10
Other SVOCs						
1,2-Dichlorobenzene	ug/l			<10	<10	<10
1,2,4-Trichlorobenzene	ug/l			<10	<10	<10
1,3-Dichlorobenzene	ug/l			<10	<10	<10
1,4-Dichlorobenzene	ug/l			<10	<10	<10
2-Nitroaniline	ug/l			<10	<10	<10
2,4-Dinitrotoluene	ug/l			<10	<10	<10
2,6-Dinitrotoluene	ug/l			<10	<10	<10
3-Nitroaniline	ug/l			<10	<10	<10
4-Bromophenylphenylether	ug/l			<10	<10	<10
4-Chloroaniline	ug/l			<10	<10	<10
4-Chlorophenylphenylether	ug/l			<10	<10	<10
4-Nitroaniline	ug/l			<10	<10	<10
Azobenzene	ug/l			<10	<10	<10
Bis(2-chloroethoxy)methane	ug/l			<10	<10	<10
Bis(2-chloroethyl)ether	ug/l			<10	<10	<10
Carbazole	ug/l			<10	<10	<10
Dibenzofuran	ug/l			<10	<10	<10
Hexachlorobenzene	ug/l			<10	<10	<10
Hexachlorobutadiene	ug/l			<10	<10	<10
Hexachlorocyclopentadiene	ug/l			<10	<10	<10
Hexachloroethane	ug/l			<10	<10	<10
Isophorone	ug/l			<10	<10	<10
N-nitrosodi-n-propylamine	ug/l			<10	<10	<10
Nitrobenzene	ug/l			<10	<10	<10
TPH CWG						
Aliphatics						
>C5-C6	ug/l			<5	<5	<5
>C6-C8	ug/l			<5	<5	<5
>C8-C10	ug/l			<5	<5	<5

Soil Leachate Summary Results 2014

Test	Units	EPA Interim Groundwater Values (IGV)	EC Env. Objectives (Groundwater) Regs.	LOD	MW1	MW4
>C10-C12	ug/l			<5	<5	<5
>C12-C16	ug/l			<10	<10	<10
>C16-C21	ug/l			<10	<10	<10
>C21-C35	ug/l			<10	<10	<10
Total aliphatics C5-35	ug/l			<10	<10	<10
Aromatics						
>C5-EC7	ug/l			<5	<5	<5
>EC7-EC8	ug/l			<5	<5	<5
>EC8-EC10	ug/l			<5	<5	<5
>EC10-EC12	ug/l			<5	<5	<5
>EC12-EC16	ug/l			<10	<10	<10
>EC16-EC21	ug/l			<10	<10	<10
>EC21-EC35	ug/l			<10	<10	<10
Total aromatics C5-35	ug/l			<10	<10	<10
Total aliphatics and aromatics(C5-35)	ug/l			<10	<10	<10
PCB 77	ug/l			<0.1	<0.1	<0.1
PCB 81	ug/l			<0.1	<0.1	<0.1
PCB 105	ug/l			<0.1	<0.1	<0.1
PCB 114	ug/l			<0.1	<0.1	<0.1
PCB 118	ug/l			<0.1	<0.1	<0.1
PCB 123	ug/l			<0.1	<0.1	<0.1
PCB 126	ug/l			<0.1	<0.1	<0.1
PCB 156	ug/l			<0.1	<0.1	<0.1
PCB 157	ug/l			<0.1	<0.1	<0.1
PCB 167	ug/l			<0.1	<0.1	<0.1
PCB 169	ug/l			<0.1	<0.1	<0.1
PCB 189	ug/l			<0.1	<0.1	<0.1
Total 12 PCBs	ug/l			<1.2	<1.2	<1.2
Fluoride	mg/l	30	187.5	<0.3	0.6	<0.3
Ammoniacal Nitrogen as NH_3 #	mg/l			<0.03	0.08	0.08
Mass of raw test portion	kg				0.1006	0.1058
Leachant Volume	l				0.89	0.885

Values for the general quality of groundwater in a groundwater body in terms of whether its ability to support humar

100 above lab detection limit

above guideline values where