Volume 3 of 3
Appendices to EIS

DUBLIN WASTE TO ENERGY PROJECT
ENVIRONMENTAL IMPACT STATEMENT

June 2006

60 mm

Environmental Impact Statement

Volume 3 of 3
Appendices to EIS

11	Appendices to chapter 11
12	Appendices to chapter 12
13	Appendices to chapter 13
14	Appendices to chapter 14
15	Appendices to chapter 15
16	Appendices to chapter 16
17	Appendices to chapter 17
18	Chapter 18 – N/A
19	Chapter 19 – N/A
20	Chapter 20 – N/A
21	Chapter 21 – N/A

Elsam Engineering A/S
Kraftværksvej 53
DK-7000 Fredericia
Phone: +45 79 23 33 33
Fax: + 45 75 56 44 77

www. elsam-eng.com

Reg. no. 10650798

Chapter	Appendix	Title
11	Appendix 11.1	Geo-environmental Engineering Assessment

Arup Consulting Engineers

Elsam

Dublin Waste to Energy Project, Ringsend, Dublin

Geo-Environmental Engineering Assessment

ISSUE

Arup Consulting Engineers

Elsam

Dublin Waste to Energy Project, Ringsend, Dublin

Geo-Environmental Engineering Assessment

June 2006

This report takes into account the particular instructions and requirements of our client.
It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

Job number D5072/30

Arup Consulting Engineers
10 Wellington Road, Dublin 4 Ireland
Tel +353 1 614 4200 Fax +353 1 668 3169
www.arup.ie

Job title	Dublin Waste to Energy Project, Ringsend, Dublin		Job number D5072/30
Document title	Geo-Environmental Engineering Assessment		File reference
Document ref			

Revision	Date				
Draft 1	31/05/06	Filename			
		Description	First draft		
			Prepared by	Checked by	Approved by
		Name	Malcolm Fitzell/ Craig O'Connor	Michael McGowan	Sean Mason
		Signature			
Issue	07/06/06	Filename	Geo-Environmental Engineering Assessment_07-06-06_D5072-30.doc		
		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	Malcolm Fitzell/ Craig O'Connor	Michael McGowan	Sean Mason
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

CONTENTS

REFERENCES

Tables

Figures

1. INTRODUCTION

Dublin Waste to Energy Limited are the preferred bidder for the Dublin Waste to Energy Project, in association with Dublin City Council (DCC) as a public private partnership arrangement.

The site for the proposed facility is situated on the Poolbeg Penninsula, Ringsend, Dublin (See Figure 1). A number of previous site investigations had taken place on the site between 2001 and 2005 and these investigations identified a considerable thickness of made ground beneath the site and also noted observations of hydrocarbon contamination.

Arup Consulting Engineers have been appointed by Elsam A/S to complete a desk study of the site including a review of previous intrusive geotechnical and environmental ground investigations in order to produce a geo-environmental engineering assessment of the site as a response to concerns regarding the precise extent of the made ground/ fill material, its depth and the levels of contamination present. No additional site investigation or chemical testing of soil or groundwater from the site was undertaken to complete this assessment.

Section 2 of the report describes the proposed development in relation to the site. A desk study of the site is presented in Section 3. Section 4 describes the site investigations previously carried out on the site. Section 5 presents the ground conditions specific to the site. An appraisal of the available environmental data is presented in Section 6 followed by an appraisal of the geotechnical data in Section 7. Engineering studies undertaken are presented in Section 8 and conclusions and recommendations in Section 9 of the report.

2. PROPOSED DEVELOPMENT

2.1 General Site Description

The proposed facility will comprise a waste to energy facility which will be constructed on a reclaimed site at Pigeon House Road, Ringsend, Dublin (See Figure 1).

2.2 Concept Design

The proposed layout and elevations of the facility are contained on the following drawings produced by Elsam A/S. Relevant drawings include:

Drawing BE002	Layout Permanent Waste Facility
Drawing BE101	Layout Elevation and Distances
Drawing BH001	Layout Longitudinal Section
Drawing BH002	Layout Elevation East
Drawing BH003	Layout Elevation West
Drawing BH004	Layout Elevation North
Drawing BH005	Layout Elevation South

These drawings show the main elements to the facility including the waste bunker, waste reception hall, plant and turbine rooms and flues. External areas comprising roads / parking and landscaped areas are also indicated. A full description of the proposed facility is provided in the EIS.

2.3 Site Formation and Landscaping

The principal areas of cut and fill and land-uses within the site are shown on Figure 2. In the course of construction an amount of material will need to be excavated from portions of the site whilst fill material will be required in other parts of the site. Estimates of the main quantities are given below:

Table 2.1: Approximate Earthworks Quantities

Cut areas	**Un-bulked Volume (m^3)**
Main Building (including Waste Bunker)	16,000
Cooling water pipes	2,000
External Areas	2,000
Fill areas	**Un-bulked Volume (m^3)**
Main Building (incl. Ramp)	6,500
Roads / Hardstanding	7,000
Soft Landscaped Areas	6,000

The principal options of using excavated material onsite will be:

- Filling of soft landscaped area in the northern part of the site;
- Filling beneath the access ramp to the main building.

The implications and viability of retaining the excavated material on site or whether excavated material will be unsuitable for reuse onsite and will require disposal off site are discussed in Section 8 of this report.

3. DESK STUDY

3.1 Site Location

The site is located in an area known as the Poolbeg Penninsula which forms the southern boundary to the entrance to Dublin Port. The principal part of the site itself is situated to the south of Pigeon House Road, east of the Synergen Dublin Bay Power Plant. The Ringsend Wastewater Treatment Plant is located immediately to the west. The auxiliary part of the site which will house the cooling water pipes is located to the north of Pigeon House Road.

3.2 Site Description

The site is rectangular in outline and extends for a distance of approximately 335 metres SSW from Pigeon House Road and is approximately 160 metres from WNW to ESE. The area of the site is approximately 5.5 Ha.

The northern portion of the site, adjoining Pigeon House Road, is currently used as a scrap metal storage and processing yard by the Clearway Disposal. Much of this area is covered by piles of scrap metal. A number of loading bays are present in the west-centre of this area.

A small office building and substantial sheet metal shed are situated in the south-western part of this area. An unbunded fuel oil tank is situated close to the east of this shed; there is evidence of recent fuel oil spillage beside this tank. The ground surface throughout this portion of the site appears to be rubble/gravel/soil with no hard standing evident.

The west-central portion of the site is occupied by Hibernian Molasses Limited and is dominated by one large and three smaller, circular above ground steel storage tanks which contain molasses. These tanks are bunded and there is a concrete surface inside the bunds. Two unbunded rectangular cylindrical steel tanks are present immediately to the northeast, located on a gravel surface – this area is used for loading/unloading. It is understood that these tanks contain blended molasses. Tanker trucks were also seen to be parked in this area. A light fuel oil tank is situated close to the site entrance on a gravel surface.

The east-central portion of the site, separated from the Hibernian Molasses premises by a high steel fence, is understood to be vacant and in the ownership of Dublin City Council and forms part of their waste water treatment facility.

A pipeline runs along the eastern boundary of the scrap yard premises, then along the northern boundary of the east-central portion of the site and continues into the Hibernian Molasses premises. We understand that this is a supply pipeline taking molasses material from ship into the molasses plant (Hibernian Molasses Limited).

The southern part of the site is largely surfaced in tarmac except for portions of the periphery which appear to be gravelled. A number of truck trailers are parked and there are also a considerable number of portable plastic storage tanks in the northern part. There is a substantial prefabricated office/storage building situated near the eastern perimeter and a smaller, similar building in the north-centre.

Pigeon House Road is at an elevation of between about +3.8 and +4.8mOD at the northern margin of the site. In general ground levels on the site itself are between approximately +3.6 and +4.7 mOD, with the scrap metal yard in the northern part of the site being slightly higher than the remainder of the site (see Figure 3). There is no appreciable sloping ground on the site.

3.3 Surrounding Land Use

The surrounding area is currently dominated by industrial utilities and fuel storage facilities including some derelict and disused industrial sites. There is also some public amenity/open space south of the site.

The Synergen Dublin Bay Power Plant is situated to the west of Shellybanks Road which runs along the western boundary of the site. The northern portion of this road is currently used by vehicles accessing Hibernian Molasses' plant.

The Ringsend Wastewater Treatment Plant is situated to the east of the site.

To the north of the site, immediately to the north of Pigeon House Road, there is an open channel which carries cooling water from the power plant into the Liffey Estuary.

The Irishtown Nature Park is situated to the southeast of the site whilst Sean Moore Park, Irishtown Stadium and Ringsend Park are situated to the east.

3.4 Site History

An historical review of the site and surrounding area has been undertaken for Dublin City Council by the RPS Group (ref. RPS 2005) and reported on under a separate cover (See EIS Chapter 16 – Archaeology). This assessment of the site was based on a review of historical maps and aerial photographs.

The study showed the site was largely underwater up to the 1970s except for a small amount of beach shingle in the northern portion of the site adjoining Pigeon House Road. In the late 1930's the old Poolbeg power station was built to the west of the site and was enlarged by subsequent land reclamation towards the east where a number of oil tanks were installed. An outfall from the power station discharged onto the existing site which was described as a lagoon contained by a sand and gravel bund situated to the south.

A sewage works and outfall is described as situated to the north of Pigeon House Road from the 1930s and possibly earlier. The Ringsend Wastewater Treatment Plant east of the site dates from c.1976-78.

The RPS report records that the site was infilled between 1970 and 1976 with a mixture of glass, rubble, concrete, ash waste, bricks, gravel and clay. A Dublin Port and Docks Board map shows the northern and central portions of the site as infilled in September 1972 (Figure 4). A handwritten addition to this drawing notes that this infilled material may possibly have consisted of hydraulic fill.

The RPS report noted that Hibernian Molasses established a plant on the site in 1979 and that the five above ground storage tanks which currently exist were recorded on the 1988 Ordnance Survey 1:1000 scale map for the area. The tanks were described in the RPS report as currently containing molasses except in the case of one smaller tank which contained light fuel oil.

The northern and southern portions of the site were reported to be coal storage sites in 1982. The northern portion of the site is mentioned as having been leased to Coal Distributors Limited prior to 1995 and since then it has been operated as a scrap metal yard.

3.5 Ground Conditions and Geology

General geological information on the study area was obtained from the following sources:

- GSI 1:100,000 scale Bedrock Geology map, Sheet 16 (Kildare-Wicklow)
- The GSI 1:50,000 scale Quaternary map of Dublin
- Nolan, S.C. 1986 *The Carboniferous Geology of the Dublin Area.* Unpubl. PhD thesis, Univ.Dub.
- Naylor, D. 1965 Pleistocene and post-Pleistocene sediments in Dublin Bay, *Sci. Proc. Roy.Dub. Soc.,* Series A, Vol. 2, 175-188
- Farrell, E. R., and Wall D., 1990 The soils of Dublin, *Trans. Instn. Engrs. Ireland*, 115, 78-97

Detailed geological information, data on ground conditions and environmental information was inferred from available ground investigation data for the site and adjoining areas, see Section 4.

4. PREVIOUS GROUND INVESTIGATIONS ON SITE

4.1 General

Previous geotechnical and environmental investigations have been carried out by others to provide data on the ground conditions, the contamination levels of the soil and the hydrogeological conditions relating to the site. These investigations fall into two categories:

- Previous ground investigations on site, see Table 4.1 below and Figure 5;
- Archival ground investigations undertaken in the surrounding areas, see Table 4.2 below. Unless specifically stated otherwise these investigations have not been considered in this appraisal.

Table 4.1: Previous ground investigations on site

Contractor	Description of Investigation	Number of Explorations	Date work carried out
Geotech Specialists Limited	Factual Report on Ground Investigation, Dublin Waste to Energy Project	5 shell & auger 5 rotary core 9 trial pits 5 slit trenches	May-June 2003
RPS	Soil and Groundwater Investigation at Dublin Waste to Energy Site, Ringsend, Dublin	7 shell & auger 18 trial pits	March 2005
IGSL	Site Investigation at Waste to Energy Project, Ringsend, Dublin City	4 shell & auger 2 rotary core 2 CPT	October 2005

Table 4.2: Archival ground investigations in the surrounding area

Contractor	Description of Investigation	Number of Explorations	Issue date
IGSL	Poolbeg Generating Station Site Investigation (Report available but no borehole logs or maps included)	14 shell & auger with rotary coring 4 trial pits	1992
Norwest Holst	Ringsend Wastewater Treatment Works Investigation	125 trial pits, 114 percussive boreholes, 35 rotary cored holes, 59 dynamic and 36 static cone probe holes	1997

4.2 Fieldworks

4.2.1 Cable Percussive Boreholes

In total, 16 no. cable percussive boreholes were undertaken at the site (Figure 5). They typically extended to a depth of up to 34m bgl. Disturbed samples were taken at typically 1-2m intervals from the drill holes undertaken. Standard Penetration Tests (SPT's) were typically undertaken at 1.5-2m intervals from ground level in all of the cable percussive boreholes, except in the RPS 2005 investigations.

4.2.2 Rotary Core Drill-Holes

A total of 7 no. rotary core drill-holes were completed at the site (Figure 5). They generally were drilled to depths of 40-52m bgl. The holes undertaken during the 2003 Geotech investigation were open hole drilled to bedrock; Standard Penetration Tests (SPT's) were typically carried out at 1.5 m intervals between ground level and bedrock in the 2003 drill-holes.

4.2.3 Trial Pits

27 no. trial pits were completed within the site, see Figure 5. Disturbed bulk samples were taken from each pit.

4.2.4 Slit Trenches

5 no. slit trenches were excavated during the Geotech investigation in 2003 (Figure 5). The slit trenches were situated along the perimeter in the western and south-western portions of the site. The trenches were dug to a depth of 1.2m bgl and were 10.0 – 10.5 m in length. The slit trenches where undertaken primarily to locate services.

4.2.5 Cone Penetration Testing

Cone penetrometer (CPT) tests were carried out at two locations in the southern portion of the site during the 2005 IGSL investigation. The tests were subcontracted to the Civil Engineering Department of Trinity College, Dublin.

4.2.6 Groundwater Monitoring

Standpipes were installed in 15 no. of the drillholes, as follows (see Figure 5):

- BH1, BH4, BH5, BR6, BR8, BR9 (2003);
- BH3, BH4 (2005)
- MW01, MW02, MW03, MW04a, MW05, MW06A and MW07 (2005).

Water level monitoring was carried out in 2003 in all of the 2003 installations, and in 2005 for 4 of the 2003 installations (BH1, BH4, BR6 and BR8) and all of the 2005 installations (MW01 - MW07).

4.2.7 Gas Monitoring

Gas barrel headworks were installed on the following drill holes: BH1, BH4, BH5, BR6, BR8 and BR9 (Figure 5). Gases measured included O_2, CO_2 and CH_4 and barometric pressure on one occasion only.

4.3 Environmental Laboratory Testing

Laboratory testing of selected soil and groundwater samples recovered was undertaken as follows:

4.3.1 2003 Geotech Investigations (Environmental Testing)

6 no. soil samples were tested for metals (As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn), free/total cyanide, thiocyanate, elemental sulphur, sulphate, sulphide, hexavalent chromium, pH, TPH, PAHs and phenol index. 2 no. samples were tested for dioxins and 28 no. samples for pH/sulphates.

It should be noted that no groundwater samples were tested as part of this investigation.

4.3.2 2005 RPS Investigations (Environmental Testing)

64 no. soil samples were tested for TPH, PAHs, VOCs, metals, asbestos, pH, ammonia, total/faecal coliforms and phenols.

11 No. groundwater samples (7 from new installations /4 from 2003 installations) were tested for TPH, PAHs, VOCs, metals, pH, total/faecal coliforms and phenols.

4.4 Geotechnical Laboratory Testing

Particle size distribution and classification tests were carried out on selected disturbed samples of soil recovered from the cable percussive drill holes. Unconsolidated undrained triaxial tests and 1-D consolidation tests were carried out on selected samples recovered. Point load index tests and uniaxial compressive strength tests were carried out on rock cores recovered during rotary coring.

5. GROUND CONDITIONS

5.1 Overview

5.1.1 Geotechnical setting

A detailed geological cross section and layout of the existing boreholes at the site are presented in Figures 5 and 6. The general stratigraphy is summarised in tabular form below:

Table 5.1: Summary of General Stratigraphy

Stratigraphic Divisions		Lithostratigraphy and Genetic Classification	Principal Materials
Quaternary	Recent	Made ground (fill)	Natural earth and man made waste / made ground.
	Recent	Marine (beach, estuarine and seabed) deposits	Generally mixed silts/clays and fine sands with shell fragments
	Pleistocene-Recent	Glacial and Fluvioglacial deposits	Generally well sorted sand and gravels, typically with some cobbles, and boulders in places. Some boulder clay layers reported in places
	Pleistocene	Outwash/ glacio-marine clay deposit	Slightly sandy clays with some silt and sand layers. Thicker sandy silt/clay at top in places
		Lodgement till/ weathered rock	Boulders, cobbles, gravel, clay, silt
Lower Carboniferous		Calp Formation	Dark grey, fine grained limestone with interbedded black shale, and locally common chert

Reviews of site investigation data in the Dublin port area (Naylor, 1965; Farrell and Wall, 1990) indicate local thickening of the Quaternary deposits in a deep channel in the bedrock surface, from -20mOD in the Ringsend/Irishtown area to -40mOD in the in the area of the site. This channel extends north-westwards through the Alexandra Basin on the northern side of the Liffey.

5.2 Geotechnical Materials

5.2.1 Made Ground

During site investigations undertaken on the site the made ground was logged as being between 1.6 m and 5.6 m in thickness across the site. It consists of a mixture of gravels, sands, silts and clays and includes rubble, bricks, concrete, glass, timber and cinder. By its nature the composition of the material is variable as can be seen from the drill-hole logs and photographs taken.

The inferred extent and thickness of the fill material at the site is shown graphically on Figure 6.

5.2.2 Recent Marine Deposits

This material generally consists of loose to medium dense sandy silt and slightly clayey/silty fine sand with shells and, where logged, ranged in thickness from 0.3m to 2.5m in thickness.

5.2.3 Glacial and Fluvioglacial Deposits

This material consists of sands and gravels (generally medium dense to dense sandy gravel with shell fragments and occasional cobbles and boulders). Occasionally the material is silty in nature. Where proven, thicknesses logged varied between 10.5m and 13.3m.

5.2.4 Outwash/Glacio-Marine Clay Deposits

The upper layer of this stratum has been described as a silt with sand laminations. Where logged this material varied between 5.5 m and 6.4 m in thickness. The sand laminations of this material make it susceptible to blowing without good control of groundwater during drilling, as is evident from the low SPT values reported for the IGSL 2005 investigations. This material may be a glacial outwash deposit.

Below this layer a thick, possibly glacio-marine deposit is encountered. This is generally described as stiff to very stiff dark grey or black slightly sandy clay with layers and laminations of silt and silty sand. Where proven, thicknesses ranged between 15.4 m and 16.5m.

5.2.5 Limestone Bedrock

The bedrock underlying the site is described as strong, mostly thinly bedded, fine grained Limestone. Rockhead was confirmed at a number of locations within the site. Depths to rockhead varied between 36 and 45mbgl (-32mOD and –40mOD).

Closely to medium spaced fractures were described as occurring in this limestone. Some weathering of the limestone was recorded, with localised zones of brown clay, and infill along fracture planes.

5.3 Groundwater

The main aquifer beneath the site is the sand/gravel unit below the made ground (i.e. fluvioglacial sands/gravels). The made ground and underlying sands/gravels are expected to be in hydraulic continuity. The clays underlying the sands/gravels act as aquitards, restricting the downward movement of groundwater.

The water table was monitored at a depth of approximately 3-4 m bgl towards the base of the fill material across the site, close to mean sea level. The elevation of the water table at the site is expected to be heavily influenced by tidal effects given the close proximity to Dublin Bay.

7 no. monitoring wells were installed across the site during the RPS site investigation in 2005. The monitoring wells were installed to shallow depths, mostly screened across the fill material/natural ground boundary. Groundwater levels reported by RPS in March 2005 indicate a hydraulic gradient to the east towards Dublin Bay. Deeper groundwater in the limestone bedrock has not been monitored however it would be expected to be brackish to saline, discharging to Dublin Bay.

The sands/gravels although permeable do not represent a potable supply of groundwater given the close proximity to the sea and the recent history of landfilling in the area. The Ringsend area is served by a mains water supply and it is unlikely that there are any private groundwater abstractions in the area. The limestone bedrock (Calp) is classified regionally as a Locally Important Aquifer, moderately productive only in local zones (Ll).

6. APPRAISAL OF ENVIRONMENTAL DATA

6.1 Overview of Legislative Context

6.1.1 Soils

Ireland lacks specific legislation for dealing with contaminated land, however current legislation provides certain powers for dealing with contaminated land such as the Waste Management Acts 1996 – 2003 (and arising Regulations), the Local Government (Water Pollution) Acts 1977-1990, the Building Control Act 1990 (and arising 'Building Regulations'), and the Protection of Environment Act 2003.

In the absence of any national guidelines regulating levels of contamination in soils and groundwater in Ireland, it has been common industry practice to compare contaminant levels with the Dutch guideline values for soil remediation (RIVM 2000). The Dutch guidelines do not have any statutory basis in Ireland however they are widely accepted by the Irish environmental industry and by Irish regulatory authorities. This approach was applied to the sample results to initially assess the levels of possible contamination within the site. This is considered a qualitative assessment as it involves screening the results against guideline values such as the Dutch guideline values.

The Dutch soil remediation guidelines provide "Target" and "Intervention" values for a wide range of soil and groundwater contaminants. "Target" values generally represent clean up levels for soil remediation and are based on the principal of multi-functionality, where remediation must fully recover the functional properties of the soil for humans, plant and animal life. "Intervention" values represent the level of contamination above which there is a serious case of soil contamination. If the Intervention values are exceeded, clean up should be considered (unless a subsequent site specific risk assessment proves otherwise). In Ireland the "suitable for use" principle is adopted for soil remediation, where remedial action is only necessary if there are unacceptable risks to human health or the environment.

If material were to be reused or stored on site, or left in situ, a site-specific risk assessment may be required depending on the level of contamination. Site-specific risk assessment is quantitative, in that a given site (with unique characteristics) is quantitatively assessed as to the potential for hazards to impact on specific receptors, either human or environmental.

However, if soil is excavated and taken offsite it becomes a waste and there are regulations determining the levels of contamination in waste materials. The EU Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills, which formed an annex to the Landfill Directive (1999/31/EC), took effect in Ireland on 12 July 2005. This Council Decision sets limit values on waste for each landfill type based on total pollutant contents and leachate concentrations.

The transport of contaminated soils of a hazardous nature for onward disposal/recovery requires compliance with the 'C1' Waste Management (Movement of Hazardous Waste) Regulations 1998 for movement between counties, or the 'TFS' Waste Management (Transfrontier Shipment of Waste) Regulations 1998 for movement between countries in the EU. Where soil has non-hazardous concentrations of contaminants, its movement off-site is subject to the Waste Management (Collection Permit) Regulations 2001, which require the haulier to hold a waste collection permit issued by a Local Authority. The waste collection permit specifies which facilities a haulier is permitted to transport waste to and lists the registration numbers of the vehicles to be used. Hauliers are liable to prosecution if they transfer waste to a site not listed on their waste collection permit.

It is our experience that the Environmental Protection Authority (EPA) will prefer an approach whereby the excavated materials are not moved off site and the material is kept in the proximity of where it is currently situated (i.e. material is retained with the site boundary), unless the level of contamination dictates that the material is causing a significant environmental risk.

6.1.2 Groundwater

The discharge of groundwater off site to sewer or to surface water requires a trade effluent discharge license from Dublin City Council, as per Section 4 of the Water Pollution Act 1977.

Recirculating groundwater within the site is subject to prior investigation and permitting by Dublin City Council under the Protection of Groundwater Regulations, 1999 (S.I. 41 of 1999) which give effect to the Groundwater Directive 80/68/EEC. The purpose of the Regulations is to prevent pollution of groundwater by substances in List I and List II in the Annex to the Directive. The substances listed as either List I or List II are harmful to the environment because of their properties, i.e. toxic, persistent or bioaccumulable. Hydrocarbon compounds are considered List I substances under the Directive.

6.2 Site History – Potential Contaminants

The history of the site has been discussed in detail in Section 3.4 and is summarised below in relation to potential contaminants that may be present in soils and groundwater.

The site was reclaimed in the 1970's possibly with hydraulic fill. Depending on where this hydraulic fill was sourced potential contaminants present in these soils could include heavy metals and hydrocarbon compounds, as well as increased organic matter content.

The northern and southern portions of the site were historically used as a coal storage yards. The principle releases to the environment from coal storage are dust to air/soils and leachate to groundwater. Coal particles in shallow soils may give rise to elevated PAHs and TOC. Leachate from coal is governed by coal composition, in particular the presence of pyrite, and can be acidic containing PAHs and heavy metals.

The northern portion of the site is currently used as a scrap metal storage yard which may lead to elevated metals in shallow soils due to weathering of stockpiled waste metals.

The middle portion of the site is used as a storage facility for Molasses. Spillages during loading operations may lead to shallow soil and groundwater contamination with molasses. Molasses is not hazardous to human health and is naturally biodegradable, therefore is not of concern if present in shallow soils on site. Molasses may lead to reduced groundwater conditions (low dissolved oxygen) if present in groundwater.

The containment of fuels for vehicles and on site machinery across the site may give rise to additional hydrocarbon contamination of shallow soils and groundwater.

6.3 Screening of Data

In the absence of any Irish soil quality standards, the analytical results for soils have been screened against the Dutch Intervention values (RIVM 2000). Dutch Intervention values are only used for guideline purpose in Ireland as they have no statutory basis outside the Netherlands however they are widely accepted by the environmental industry and by Irish regulatory authorities. Therefore it provides an opportunity to assess the levels of possible contamination onsite against an internationally accepted set of assessment criteria. Sulphate concentrations in soil are compared to the Irish concrete standard I.S.EN 206-1:2002.

Groundwater results have been screened against the Environmental Protection Agency (EPA) Interim Guideline Values for groundwater ("Towards Setting Guideline Values for the Protection of Groundwater in Ireland", 2002). Groundwater beneath the site does not represent a drinking water source, given the history of the area and the close proximity to the sea.

Landfill gas results have been screened against guidelines published by the Department of the Environment, "Protection of New Buildings and Occupants from Landfill Gas", 1994.

6.4 Environmental Laboratory Testing

6.4.1 Soils

2003 Geotech Investigations

All soil samples were collected from the fill material and show elevated Polycyclic Aromatic Hydrocarbons (PAHs), ranging from 20-5020mg/kg.

Elevated concentrations of sulphate were detected in the fill material (811-8350mg/kg). A single high concentration (13100mg/kg) was detected in one sample of estuarine sand below the fill material (borehole BH2 at 4m depth). The lowest protective threshold for sulphate for ordinary concrete is 2000mg/kg (Irish Concrete Standard I.S.EN 206-1:2002).

Total concentrations of certain metals in the fill (lead, zinc and copper) are slightly elevated but are below Dutch Intervention Values.

2005 RPS Investigations

Total Petroleum Hydrocarbons (TPH) was elevated in most soil samples analysed, ranging from 0.721-44,374mg/kg, concentrated in the fill material. There is no Dutch Intervention value for TPH however 2 no. of these samples exceed the Dutch Intervention value for Mineral Oil (5000mg/kg) – MW2 at depths of 1 m and 7 m. Speciated TPH analyses show that the elevated TPH results in the soils are predominantly concentrated within the heavier, less mobile C16-C35 carbon ranges. TPH generally decreases with depth through the fill in most locations sampled.

Elevated concentrations of PAHs (Sum of 16 compounds) were detected in the majority of samples, ranging from 0.042-120.6mg/kg. The Dutch Intervention value for PAHs (40mg/kg, based on 10 compounds) is exceeded in 8 no. samples of the fill material, probably representing local hotspots.

Trace concentrations of Benzene, Toluene, Ethylbenzene and Xylene (BTEX compounds) were detected at various depths in the fill material, the concentrations of which are well below Dutch Intervention values. Trace concentrations of Trichloroethene (TCE) up to 0.067mg/kg and Tetrachloroethene (PCE) up to 3.2mg/kg were detected in the fill material at various depths, below the Dutch Intervention values.

Total concentrations of certain metals (lead, zinc and copper) were elevated above Dutch Intervention values in the fill material in a number of samples.

No asbestos fibres were detected in the soil samples analysed.

6.4.2 Groundwater Monitoring

2005 RPS Investigations

Physical evidence of hydrocarbon contamination was noted in the soils across the water table in all 7 No. monitoring wells installed by GES in 2005, suggesting historic free-phase product. No free-phase product was detected floating on the water surface in the monitoring wells, however some hydrocarbon product was observed in purged groundwater from 3 No. monitoring wells (MW01, MW04A, MW06A). In addition, a deep orange odourless liquid was recovered from one monitoring well during purging within the Hibernian Molasses site (BH4).

Groundwater conductivity is elevated, ranging from 2.3-34.6mS/cm indicating a high dissolved load and probable brackish-saline conditions. Groundwater temperatures were elevated up to 17.4 degrees which would suggest that degradation of waste in the fill material is still continuing.

Trace concentrations of hydrocarbons were detected in shallow groundwater from monitoring wells MW1 (TPH 14ug/l), MW2 (TPH 269ug/l), MW6a (TPH 15ug/l) and MW7 (TPH 14ug/l), as well as the deep monitoring well BR8 installed in 2003 (TPH 147ug/l). These concentrations exceed the EPA's interim guideline value for TPH in groundwater of 10ug/l.

PAHs (Sum of 16 compounds) were only detected in 2 no. wells, MW3 (0.89ug/l – lighter, more soluble PAHs) and BH1 (32.4ug/l). These concentrations exceed the EPA's interim guideline value of 0.1ug/l for total PAHs in groundwater.

Boron was the only dissolved metal in groundwater that was significantly elevated above the EPA's interim guideline value of 1mg/l (maximum concentration 3.1mg/l), probably as a result of mixing with seawater, the highest concentrations are found in the samples with the highest electrical conductivities. Detected concentrations of arsenic, lead, nickel and zinc in groundwater are also slightly elevated above their respective interim guideline values, probably as a result of mixing with seawater.

No VOCs/phenols were detected in groundwater, apart from a trace concentration of Toluene (3ug/l) detected in one of the deeper wells (BH1) installed in 2003. This is below the EPA's interim guideline value for Toluene of 10ug/l.

6.4.3 Gas Monitoring

Landfill gases were measured on one occasion only (5 July 2003) for the 6 no. shallow monitoring wells fitted with gas heads. Oxygen was lower than typical atmospheric concentrations in one well (BH1 – 4.1%), suggesting ongoing degradation of organic matter. Carbon dioxide was above the 0.5% long-term exposure limit in 4 no. of the monitoring wells, indicating some continuing gas production within the fill. Methane was not detected. Note: the gas measurements were taken on a day of relatively high barometric pressure (1021mb), therefore higher concentrations/flow rates may be detected on days of lower atmospheric pressure.

Landfill gases were measured in a number of monitoring wells as part of the site investigation of the adjacent Ringsend Wastewater Treatment Plant site in 1997. Three monitoring wells were monitored adjacent to the Waste to Energy Project site: BH63, BH64 and BH67. These wells were monitored for CH_4, CO_2, O_2, and barometric pressure on 8 no. occasions in July 1997.

Carbon dioxide was detected at concentrations above the 0.5% long-term exposure limit in all three wells (maximum 13.2%). Methane was occasionally detected at trace concentrations (0.1%), below the Lower Explosive Limit of 5%. The range of variation in the concentrations detected would suggest that concentrations/flow rates vary with the tidal response of the water table. Higher concentrations of carbon dioxide and methane were detected to the southeast of the waste water treatment plant site (maximum CO_2 21%, maximum CH_4 19%).

Elevated landfill gases were detected to the south/southwest of the Waste to Energy Project site as part of the Ringsend Wastewater Treatment Plant site investigation in 1997. Three monitoring wells were monitored: BH72 (200m southwest of site), BH73 (100m southwest of site), and BH74 (50m south of site). These wells were monitored for CH_4, CO_2, O_2, and barometric pressure on 5 no. occasions in July 1997, and 2 no. occasions in September 1997. Methane was detected at elevated concentrations of between 27-59%, carbon dioxide was detected at concentrations between 22-32% and oxygen was either absent or detected at trace concentrations. A reclamation map by Dublin Port and Docks Board indicates that the area to the south of the site was infilled at an earlier date from 1969-1970 (see Figure 4), and a handwritten addition to this drawing notes that the infilled material consisted predominantly of domestic waste.

6.5 Summary of Results

The fill material across the site generally shows evidence of hydrocarbon contamination however concentrations of TPH and PAHs are mostly below the Dutch Intervention values. Concentrations that exceed Dutch Intervention values are likely to be associated with localised hotspots of contaminated soils. Trace concentrations of BTEX, PCE, and TCE were also detected in the fill material at concentrations below the Dutch Intervention values.

Elevated concentrations of metals (lead, copper and zinc) were detected within the fill material in a number of locations above the Dutch Intervention values, possibly related to the waste included in the fill (waste metals, etc.). Some high sulphate concentrations have also been measured in the fill material above the threshold for the protection of ordinary concrete.

There was evidence of free-product in groundwater during sampling of the monitoring wells in March 2005 (i.e. an oily film), as well as a deep orange liquid in one well within the Hibernian Molasses site. Groundwater results show trace concentrations of TPH and PAHs, which slightly exceed the EPA's interim guideline values for groundwater, as well as elevated Boron probably as a result of mixing with seawater.

Limited landfill gas data for the site shows elevated concentrations of Carbon Dioxide within the fill material above the long-term exposure limit, indicating some continuing gas production. More comprehensive gas monitoring on the adjacent Ringsend Wastewater Treatment Plant site indicates highly variable concentrations of carbon dioxide, probably as a result of tidal variation of the water table. Significantly elevated concentrations of methane and carbon dioxide have been detected further to the southeast of the Ringsend Wastewater Treatment Plant site, as well as 50-100 m south/southwest of the Waste to Energy Project site.

6.6 Conclusions

6.6.1 Option: Disposal of Excavated Soils off site

6.6.1.1 Excavation Areas

For the proposed Plant Area the ground level will be reduced to a formation level of about +3mOD therefore the top 0.5-1 m of the existing ground will be excavated. This area includes the gravel-covered Hibernian Molasses yard, part of a bunded molasses tank, a fuel oil tank in the Clearway site with obvious surface oil contamination, and a storage area to the east of the Hibernian Molasses site.

Therefore the potential for hotspots of soil contamination within this area is high. The existing shallow soil results for this area (<1m) indicate TPH concentrations ranging from 3-386mg/kg and PAHs ranging from 14-100mg/kg (Sum of 16 compounds).

The proposed Waste Bunker location will be reduced to a formation level of approximately -1.5mOD which will involve an excavation of approximately 5.5m. The present ground surface in this area is mostly tarmac-covered and currently used for storage. The fill material is approximately 3.5-4 m thick in this area therefore most of the excavated spoil will be fill material. The existing soil results for this area (<5.5m) indicate TPH concentrations ranging from 4-572mg/kg and PAHs ranging from 0.1-147mg/kg (Sum of 16 compounds).

The proposed route for the cooling pipes will be reduced to a formation level of approximately 2mOD therefore the top 2.5-3m will be excavated. The route of the proposed cooling pipes lies within the Clearway site. The existing soil results for this area (<3m) indicate TPH concentrations ranging from 2-21051mg/kg and PAHs ranging from 0-27mg/kg Sum of 16 compounds).

6.6.1.2 Classification of Excavated Soils

It is not possible to determine the exact classification of the soils for disposal to landfill without carrying out a detailed targeted environmental investigation.

However, based on the existing results the soils in the proposed Plant Area and Waste Bunker area would be considered non-hazardous waste for disposal. The concentrations of metals in these soils are not elevated to hazardous concentrations. Hydrocarbon (TPH) concentrations are below the generic hazardous threshold for oil (0.1% by weight – 1000mg/kg) where the specific nature of the oil contaminating the soil is unknown. Shallow hydrocarbon contamination in the vicinity of the proposed cooling pipes route exceeds this generic threshold and may be considered hazardous for disposal, depending on the nature of the contaminating oil. Note: the probability of local hotspots of contamination within the excavation areas is high based on the nature of the fill and current site usage.

6.6.2 Option: Retention of Excavated Soils on site

6.6.2.1 Retention as Landscaping

It would be possible to retain the excavated soils on site as landscaping, however to do this a detailed quantitative risk assessment will be required for the final retention design to prove that the retention does not pose a risk to human health or the environment.

A detailed quantitative risk assessment would consider all source-pathway-receptor linkages (i.e. pollutant linkages) associated with the retained soils, and estimate the risk associated with each pollutant linkage. Site-specific target levels (SSTLs) could then be calculated for the final retention design which would be protective of all identified human and environmental receptors.

Only soils with contaminant concentrations below the SSTLs would be retained on site; soils that exceed the SSTLs would be disposed off site to an appropriately licenced facility. Hotspots of contaminated soils encountered during excavation would be segregated and sampled; if the concentrations detected were above the SSTLs the soils would be disposed off site.

A key consideration if the soils are re-used as landscaping would be the effect of leaching rainwater on groundwater quality. The landscaped feature could be capped with a low permeability soil cap beneath the topsoil to limit infiltration of rainwater and minimize leaching of the soils to groundwater. Consideration would have to be given in the design to venting any landfill gases that may be produced.

The potential leaching to groundwater would depend on the size, shape and slope of the designed landscaping, as well as the permeability of the soil cap. At the detailed design phase a representative number of soil samples will be collected from the areas to be excavated in order to assess the potential leaching from these soils in a landscaped feature.

There are several precedents in the Dublin area of old local authority landfills being excavated/re-deposited within a development site as landscaping without the need for waste permitting by the local authority or waste licencing by the EPA (e.g. Dublin Port Tunnel, Pfizer Deansgrange, etc.). In these cases, it had to be shown that the proposed re-use would not create a risk to human health or the environment either during construction or in the final development. Hotspots encountered during these excavations were isolated and assessed separately.

6.6.2.2 Retention beneath Main Building

The excavated soils could be re-used as an engineering fill beneath the main building.

The geotechnical properties of the excavated soils would have to be shown to be suitable as a fill material for use beneath the main building (e.g. beneath the access ramp). Such a design would need to incorporate venting for any landfill gases generated by the retained fill material. It is unlikely however that the fill material could be used as an engineering fill without treatment to improve its geotechnical properties.

6.6.3 Disposal of Groundwater off site

6.6.3.1 Option: Discharge directly into Dublin Bay

Laboratory analyses of groundwater carried out to date have only shown trace concentrations of hydrocarbons in the shallow groundwater below levels protective of seawater aquatic life (e.g. UK Saltwater EQSs). The number of parameters analysed are limited however and a number of other parameters would be required to fully assess the potential impact of abstracted groundwater on seawater quality (e.g. BOD, ammonical nitrogen, suspended solids, etc.).

Evidence of free-product was noted during groundwater sampling in March 2005 but is not apparent from the laboratory analyses. If free-product is present on site then Dublin City Council would require groundwater to be treated prior to discharge to Dublin Bay.

An example of such treatment would be an oil/water separator to remove any free-product, a bunded fuel tank for the storage of recovered product, followed by passage through an activated carbon filter to remove any dissolved hydrocarbons. For a flow rate of 80m3/hour 3 no. oil/water separators would be needed in parallel (each handling approximately 30m3/hr.) followed by 4 no. carbon filter units (each handling approximately 20m3/hr.). If there are high suspended solids in groundwater then either sand filters or a settlement unit would be required dependent on loading.

It is unlikely that Dublin City Council would grant a discharge licence to discharge directly to Dublin Bay without treatment based on the existing groundwater information.

6.6.3.2 Option: Discharge into Dublin City Council Sewerage System

Abstracted groundwater from the construction dewatering could be discharged directly to the foul sewer, subject to a trade effluent discharge licence from Dublin City Council. Dublin City Council may accept the existing groundwater results as sufficient for a discharge licence however it is likely that further analyses would be required.

Prior to applying for a discharge licence, it would need to be confirmed with Dublin City Council that the existing foul sewer/treatment facility has the capacity to take the estimated 80m3/hour of water for 6 months and whether or not pre-treatment is required (i.e. removal of any free-product prior to discharge to sewer).

This option is the preferred option and may prove to be the simplest, most cost effective solution if the existing foul sewer/treatment facility has the capacity.

6.6.4 Option: Recirculation of Groundwater within the site

The legislative context of re-circulating groundwater within the site is discussed in Section 6.1.2.

The fact that evidence of free-product was detected during sampling would mean that Dublin City Council may require groundwater to be treated prior to recirculation on site so as not to pollute groundwater in previously uncontaminated areas. The level of treatment required would similar to that required to discharge directly to Dublin Bay. In addition, this option would require an assessment as to how best to recharge 80m3/hour of water to ground and would require the installation of injection wells or infiltration trenches on site prior to excavation.

Recharging the abstracted groundwater within the site would not be as simple as discharging to sewer, or treating groundwater and discharging directly to Dublin Bay. We do not favour this option at this stage.

7. APPRAISAL OF GEOTECHNICAL DATA

7.1 General

This section presents geotechnical information obtained during the site investigations relating to the soil and rock encountered on the site.

7.2 In-situ testing

Standard Penetration tests were typically undertaken at 1.5-2 m intervals from ground level in all of the cable percussive drillholes. The SPT 'N' values obtained in made ground, sands and gravels and glacial tills are shown plotted against depth in Figures 7 to 9 respectively.

7.2.1 Made Ground

Figure 7 shows the SPT values within this material vary between 2 and 50. Values are variable reflecting the uncontrolled nature of the filling.

7.2.2 Marine/Fluvio-Glacial Sands and Gravels

Figure 8 shows the SPT values within these materials vary between 3 and 60, most of the values being between 11 and 50. SPT values of less than 15 occur above 6m bgl indicating that the upper parts may be recent marine deposits.

7.2.3 Glacio-Marine/Glacial Tills

Figure 9 shows the SPT values within this material vary between 1and 57; however most of the values are between 17 and 50. As referred to in Section 5.2.4, low SPT values recorded during the 2005 IGSL investigation for the upper laminated silts have been interpreted as relating to blowing in the sand laminations in this unit.

7.3 Geotechnical Laboratory Soil Testing

Geotechnical testing was carried out on selected samples taken from drillholes and trail pits in all soils. The following tests were performed:

- Atterberg limits;
- Particle Size Distribution testing;
- Undrained unconsolidated triaxial testing;
- Consolidation testing.

7.3.1 Made Ground

Classification testing carried out on the made ground is summarised below.

Material	Moisture Content (%)	Plastic Limit	Liquid Limit	Plasticity Index
Made Ground	13% - 28%	18% - 30%	30% - 39%	7% - 13%

Using Casagrande's Plasticity charts the fill material sampled can be classified as inorganic silts and clays of low to intermediate plasticity.

Bulk densities and dry densities were not measured.

MCV values on selected clayey samples ranged between 5.6 and 14.1.

7.3.2 Fluvio-Glacial Sands and Gravels

No laboratory testing of this material was undertaken.

7.3.3 Glacio-Marine/Glacial Tills

Classification testing carried out on these materials are summarised below.

Material	Moisture Content (%)	Plastic Limit	Liquid Limit	Plasticity Index
Laminated Silts	21% - 30%	NP	22% - 25%	NP
Glacial Tills	16% - 23%	16%- 18%	28% - 36%	12% - 18%

Using Casagrande's Plasticity charts the glacial tills can be classified as inorganic clays of low plasticity.

Bulk densities and dry densities were not measured.

6 no. unconsolidated undrained triaxial tests were undertaken on glacial till samples recovered. The shear strengths recorded in these tests were all less than 100kPa. These results are considered unrealistically low given the SPT's values recorded and information known about this material from elsewhere in Dublin. Sample disturbance and inappropriate test method are considered to be the reasons for the low results recorded.

Consolidation testing was carried out on 6 no. of the glacial till samples recovered. Over the highest stress ranges applied (400kPa) c_v values recorded varied between 6.5m^2/year and 50m^2/year. Published information on tills in Dublin quote c_v values in the range of 20m^2/year and 60m^2/year. Sample disturbance and low stresses applied to the samples could account for the low values recorded.

7.4 Laboratory Rock Testing

The site is underlain by Limestone. The strength of intact bedrock was obtained using two conventional test methods, the unconfined compressive strength (UCS) test; and the point load index test (PLI) expressed in Is50. UCS and PLI tests were carried out on samples recovered. The factor adopted between UCS/Is50 has been assumed to be 20 (IGSL, unpublished).

The adjusted UCS of intact rock samples tested varied from 66MPa to 172MPa.

8. ENGINEERING STUDIES

8.1 General

This section describes some of the key design issues and preliminary engineering studies, undertaken for the substructure works for the proposed facility. Brief descriptions of works are included along with envisaged construction methods. The subsurface profiles used have been based on the ground conditions and groundwater regime inferred from the ground investigations. Geotechnical design parameters have not been selected at this stage.

8.2 Substructure works and envisaged construction methods

8.2.1 Main Building

Within the main building a subsurface waste storage bunker is proposed which will require an excavation to a level of approximately – 1.5mOD (~5mbgl). As this excavation will be carried out to a depth of about 2m below groundwater level it is envisaged that the bunker will be constructed within a sheetpile cofferdam. The sheetpiles will be founded at a depth to ensure stability. Lateral support in the form of internal bracing or possibly anchors will be provided. Spoil and groundwater will be generated during the excavation.

It is proposed to support the main building and venting flues on deep foundations. Where possible it is proposed to support the structure on driven piles founded in soils above bedrock. For heavily loaded areas or areas with sensitive equipment bored piles end bearing on bedrock may be necessary. Spoil will be generated from bored piling works.

8.2.2 Cooling water facilities

The laying of part of the cooling water inlet and outlet pipes will require an excavation to a level of approximately +0.5mOD (~3mbgl).

The excavation will be carried out in open cut where possible although sheet piled support may be necessary close to existing structures or if groundwater levels are higher than expected. Spoil and possibly groundwater will be generated during the excavation.

8.2.3 External areas

External areas will comprise roadways, parking and areas of soft landscaping.

Conventional materials used in road construction will be imported for the construction of the roads and parking areas.

The main area of soft landscaping is in the northern part of the site. Where possible it is intended to re-deposit excavated material from within the site to make up levels for the landscaped areas. Refer to Section 8.3 below.

8.3 Disposal off site/ Retention of excavated soil material

8.3.1 Appraisal of Contamination

The soil results have been discussed in Section 6.4 and summarised in Section 6.5. Conclusions regarding disposal off site/retention on site have been made in Sections 6.6.1 and 6.6.2 respectively.

8.3.2 Engineering Options

Refer to Section 2.3 for approximate un-bulked quantities of excavated material that will be generated. Engineering options for using this material are as follows:

8.3.2.1 Option 1 – Dispose of Material off site

Based on the existing results the soils in the proposed Plant Area and Waste Bunker area would generally be considered non-hazardous waste for disposal. Shallow hydrocarbon contaminated soils in the vicinity of the proposed cooling pipes route may possibly be considered hazardous for disposal. Note: the probability of local hotspots of contamination within the excavation areas is high (See Section 6.6.1).

8.3.2.2 Option 2 – Retain material on site in Landscaped Area

It would be possible to retain the excavated soils on site as landscaping, subject to the findings of a detailed quantitative risk assessment which would be required for the retention design to ensure that the excavated soils do not pose a risk to human health or the environment (See Section 6.6.2.1).

8.3.2.3 Option 3 – Retain material on site beneath Main Building

Excavated soils could only be re-used as an engineering fill beneath the main building (See Section 6.6.2.2), subject to the findings of a risk assessment and the improvement of the soil.

8.3.3 Construction Issues

Not withstanding the above options, procedures will need to be implemented / considered when undertaking the works:

1. Establishment of a materials handling protocol: This should ensure that excavated material is moved around the site in a controlled manner. Excavations would proceed according to a grid system to allow for traceability of all materials. The protocol should also ensure that all health and safety requirements are adhered to. This will include occupational exposure monitoring of site workers and at the perimeter of the site.

2. Since elevated levels of hydrocarbons were found in most soil samples and the potential for finding hotspots of contaminated soils is considered high, any excavation work should be supervised by an environmental engineer to observe for hydrocarbon hot spots within the fill material. If encountered, hotspots of hydrocarbon contamination would have to be segregated and stockpiled in a controlled manner temporarily. Analysis of the materials stockpiled would be required and depending on the results these materials may have to be removed from site for disposal, with the landfill acceptance criteria determining where the material could be disposed.

8.4 Disposal off site/ Retention of groundwater

8.4.1 Appraisal of Groundwater Contamination

The groundwater results have been discussed in Section 6.4 and summarised in Section 6.5. Conclusions regarding disposal off site/recirculation of groundwater on site have been made in Sections 6.6.3 and 6.6.4 respectively.

8.4.2 Engineering Options

During the construction phase the water table will have to be lowered during the construction of the waste bunker and possibly during the laying of the cooling pipelines below ground. For the excavation for the waste bunker we have carried out a seepage analysis and estimated the maximum unfactored steady state seepage generated during this excavation would be approximately 80m3 / hour. Approximate duration of construction has been assumed to be six months.

8.4.2.1 Option 1 – Discharge directly into Dublin Bay

It is unlikely that Dublin City Council would grant a discharge licence to discharge directly to Dublin Bay without treatment based on the existing groundwater information (See Section 6.6.3.1).

8.4.2.2 Option 2 – Discharge into Dublin City Council Sewerage System

Abstracted groundwater from the construction dewatering could be discharged directly to the foul sewer, subject to a trade effluent discharge licence from Dublin City Council. This option is the preferred option and may prove to be the simplest, most cost effective solution (See Section 6.6.3.2).

8.4.2.3 Option 3 – Recharge back into the ground within the site

Abstracted groundwater could be recirculated within the site however this option would not be as simple as discharging to sewer, or treating groundwater and discharging directly to Dublin Bay (See Section 6.6.4).

8.5 Bearing capacity of shallow footings

The bearing capacity for a soil is not a unique value. It depends on the following:

- foundation depth below ground;
- foundation dimensions;
- proximity to the crest of sloping ground;
- presence of groundwater above the foundation base

Ignoring the site topography issues, we have estimated minimum allowable bearing capacity as follows:

Soil Type	Allowable Bearing Capacity (kPa)
Cohesionless Fluvio-Glacial Soils	175
Cohesive Glacial Till	250

Note that the values given above are presumed values. The capacity for each foundation type will need to be reviewed in the content of its depth, dimensions etc. to establish a specific capacity for individual foundation.

8.6 Deep Foundation Design

The design methodology is highly dependent on the pile type adopted and the founding levels of the foundations. This will covered in detail during detailed design.

9. CONCLUSIONS AND RECOMMENDATIONS

The ground investigations carried out at the site indicate the site is covered by up to 5 m of fill below which are extensive deposits of sand and gravels and glacial soils overlying limestone bedrock. Groundwater levels are typically 3m below ground level.

Geotechnical

1. Excavations required to construct the waste bunker within the waste building will extend into the water bearing sands and gravels. It is envisaged that the excavation will be carried out within braced retaining walls founded sufficiently deep to ensure stability of the excavation and groundwater control.
2. Excavated material generated from within the site would not be suitable for use as engineering fill without treatment to improve its geotechnical properties (beneath the main building / ramp).
3. Deep foundations required to support the main facility building will have to be installed through the water bearing sands and gravels and potentially through the underlying laminated silts which can become unstable without control of water pressures.
4. In external areas where roads / parking are proposed the constituents of the hard surfacing and the formation material provided will need to account for the variable composition of the existing fill material beneath.

Environmental

1. Elevated hydrocarbons are the main contaminants detected within the fill material on site. These soils would mostly be considered non-hazardous for disposal purposes however hotspots of contaminated soils are likely given the history of infilling and current site use.

2. The cost of disposing of the excavated soils off-site would be considerable and is the least attractive option. The preferred option would be to retain the excavated soils on site as beneath the soft landscaped areas. This will only be carried out if proven safe to both human health and the environmental through a site specific risk assessment. If the landscaping option is considered we recommend further sampling of the soils to be excavated in order to assess the potential for leaching and associated risk to the receiving environment.
3. Elevated sulphate concentrations were detected within the fill material at a number of locations above the threshold for the protection of ordinary concrete. We recommend that further soil sampling for sulphate is carried out during detailed design to better characterise sulphates in areas where concrete will be placed. The results of these analyses would determine whether a more chemically resistant concrete would need to be specified.
4. Elevated carbon dioxide was detected within the fill material above the long-term exposure limit, indicating some continuing gas production. We recommend that further gas monitoring is carried out on the existing monitoring wells at different atmospheric pressures to determine the range of gas concentrations and flow rates on site. The range of gas concentrations/flow rates with the tidal response of the water table should also be investigated. This information will be necessary to determine if any gas protection measures will be required beneath the buildings and in service trenches.
5. It is unlikely that Dublin City Council would grant a discharge licence to discharge groundwater directly to Dublin Bay without treatment based on the existing groundwater results. Confirmatory groundwater samples should be collected and analysed for the full suite of parameters required to support an application for a discharge licence to discharge groundwater off-site. The preferred option would be to discharge the abstracted groundwater directly to the foul sewer, otherwise costly treatment will most likely be required prior to discharge to Dublin Bay or recirculation within the site.

REFERENCES

GSI 1:100,000 scale Bedrock Geology map, Sheet 16 (Kildare-Wicklow)

GSI 1:50,000 scale Quaternary map of Dublin

Nolan, S.C. 1986 *The Carboniferous Geology of the Dublin Area.* Unpubl. PhD thesis, Univ.Dub.

Naylor, D. 1965 Pleistocene and post-Pleistocene sediments in Dublin Bay, *Sci. Proc. Roy.Dub. Soc., Series A, Vol. 2,* 175-188

Farrell, E. R., and Wall D., 1990 The soils of Dublin, *Trans. Instn. Engrs. Ireland, 115*, 78-9.

GLOSSARY OF TERMS

As	Arsenic
Ba	Barium
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
Cd	Cadmium
Cr	Chromium
Cu	Copper
Hg	Mercury
mb	millibars
mbgl	meters below ground level
Mo	Molybdenum
mOD	meters Ordinance Datum
Ni	Nickel
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCE	Perchloroethylene
pH	hydrogen ion concentration (i.e. acidity)
Sb	Antimony
Se	Selenium
TCE	Trichloroethylene
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compounds
Zn	Zinc

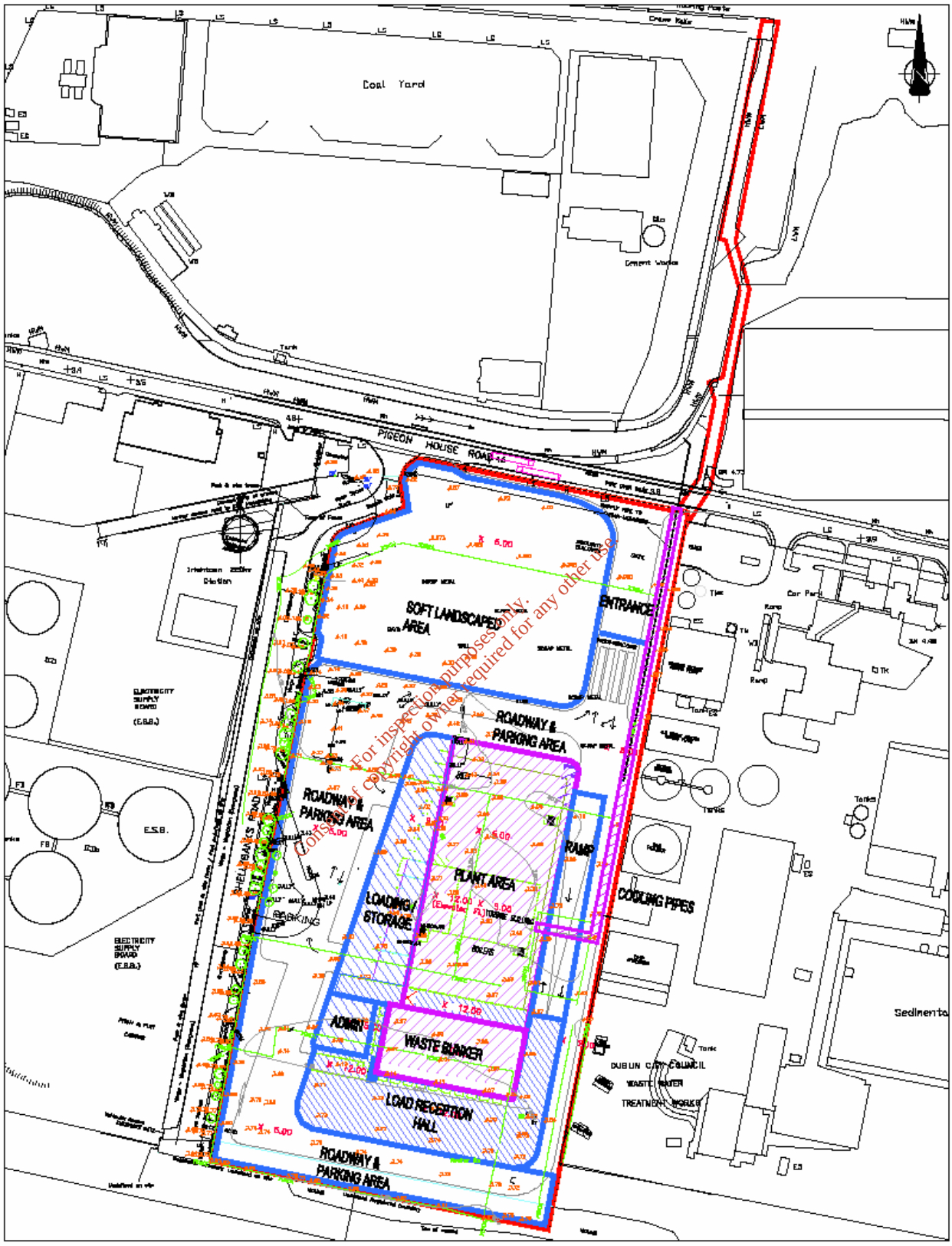
FIGURES

ARUP

Site Location

Dublin Waste to Energy Project

D5072.30 | April 2006 | **Figure 1.0**

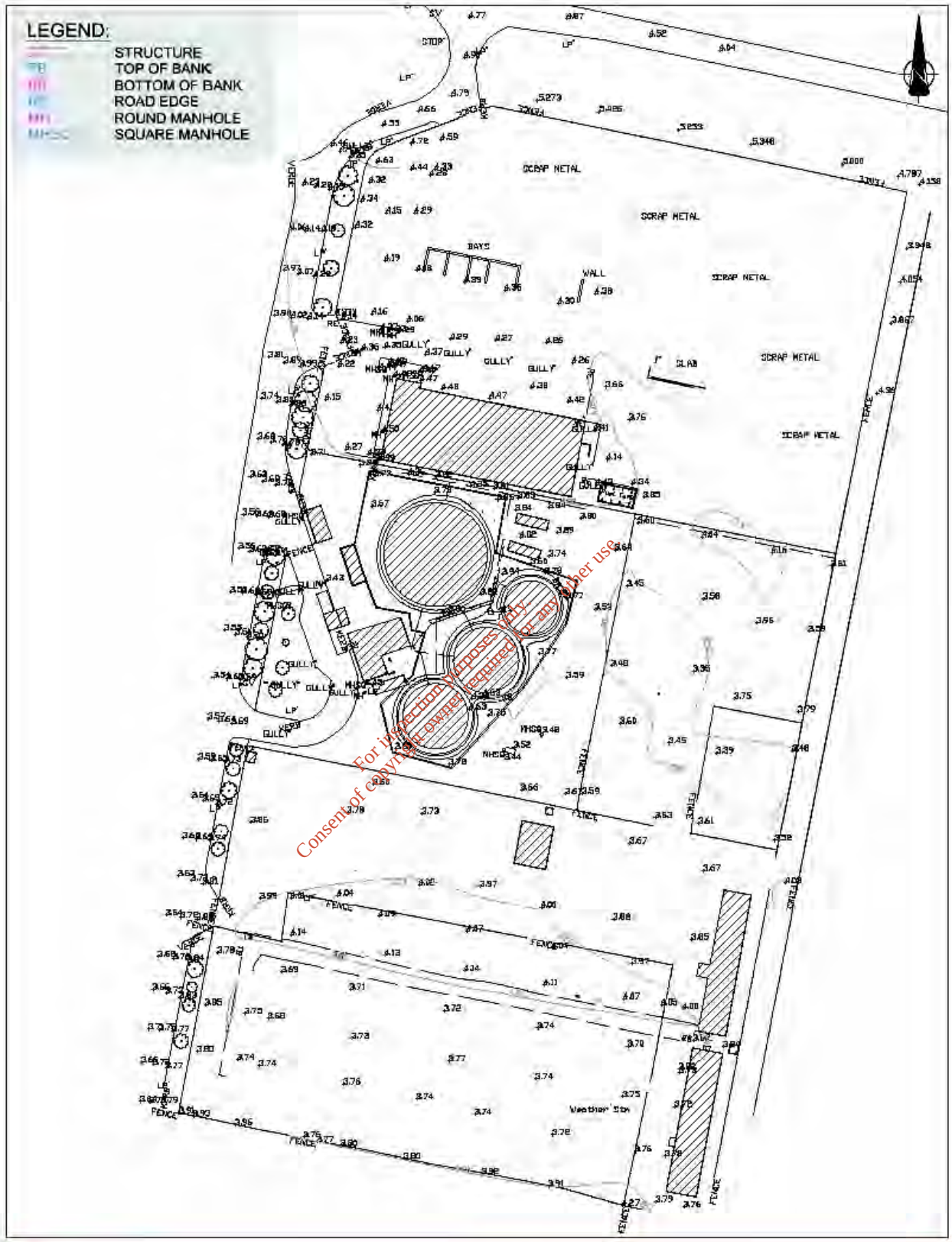


ARUP

Cut & Fill Areas - Landuse

Dublin Waste to Energy Project

D5072.30 | April 2006 | **Figure 2.0**

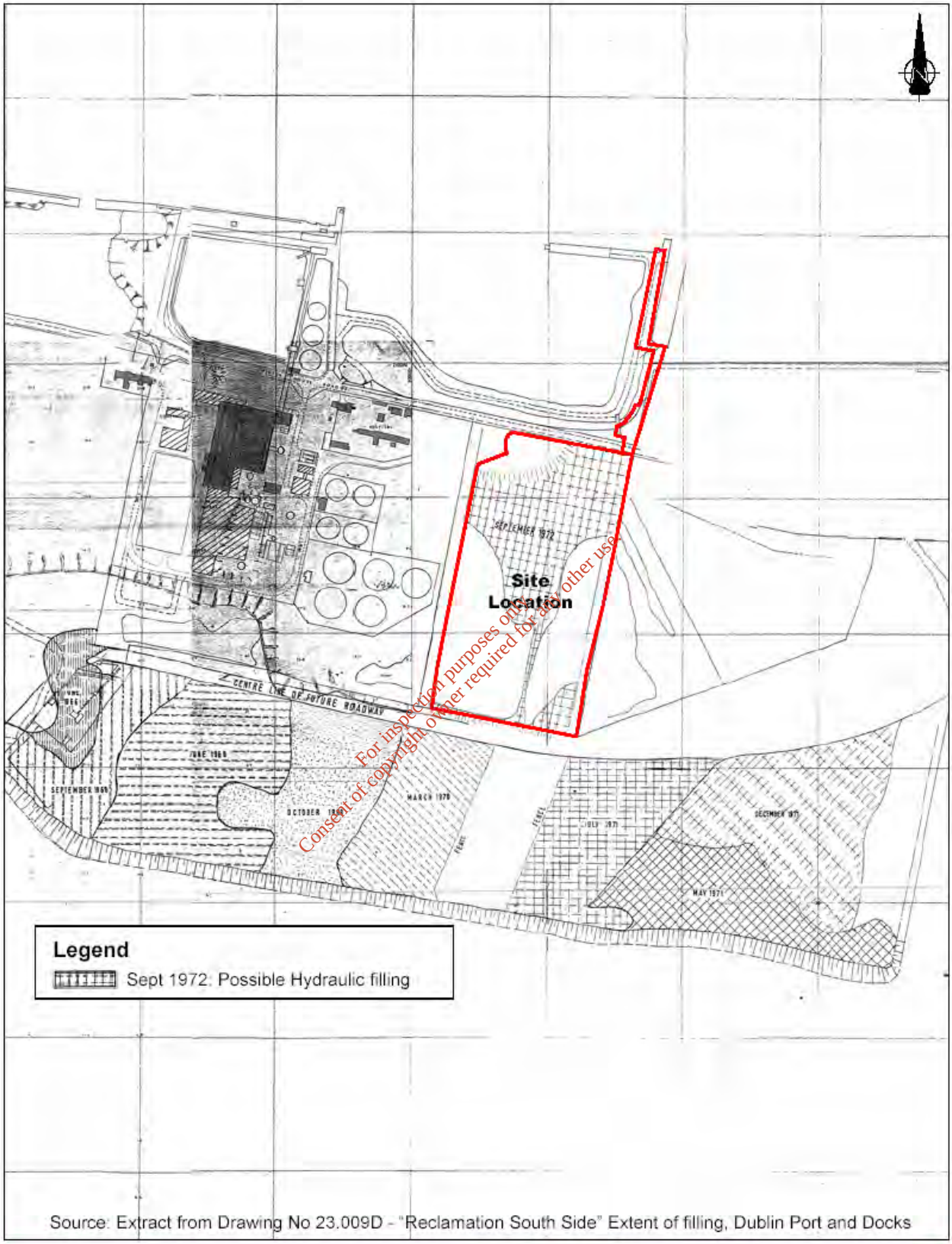


ARUP

Site Topography

Dublin Waste to Energy Project

D5072.30 | April 2006 | Figure 3.0



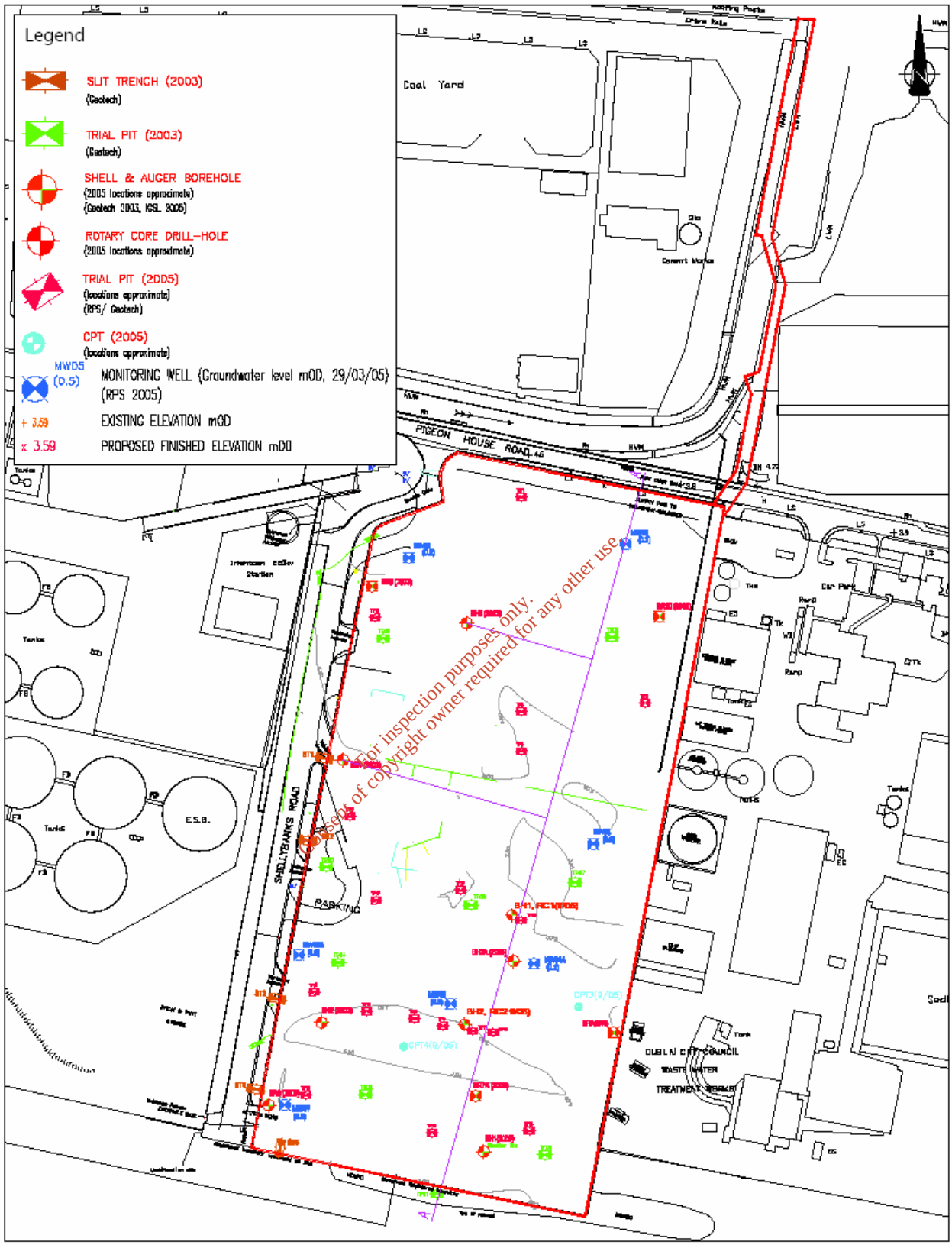
Source: Extract from Drawing No 23.009D - "Reclamation South Side" Extent of filling, Dublin Port and Docks

ARUP

Landfill History

Dublin Waste to Energy Project

D5072.30 | April 2006 | **Figure 4.0**

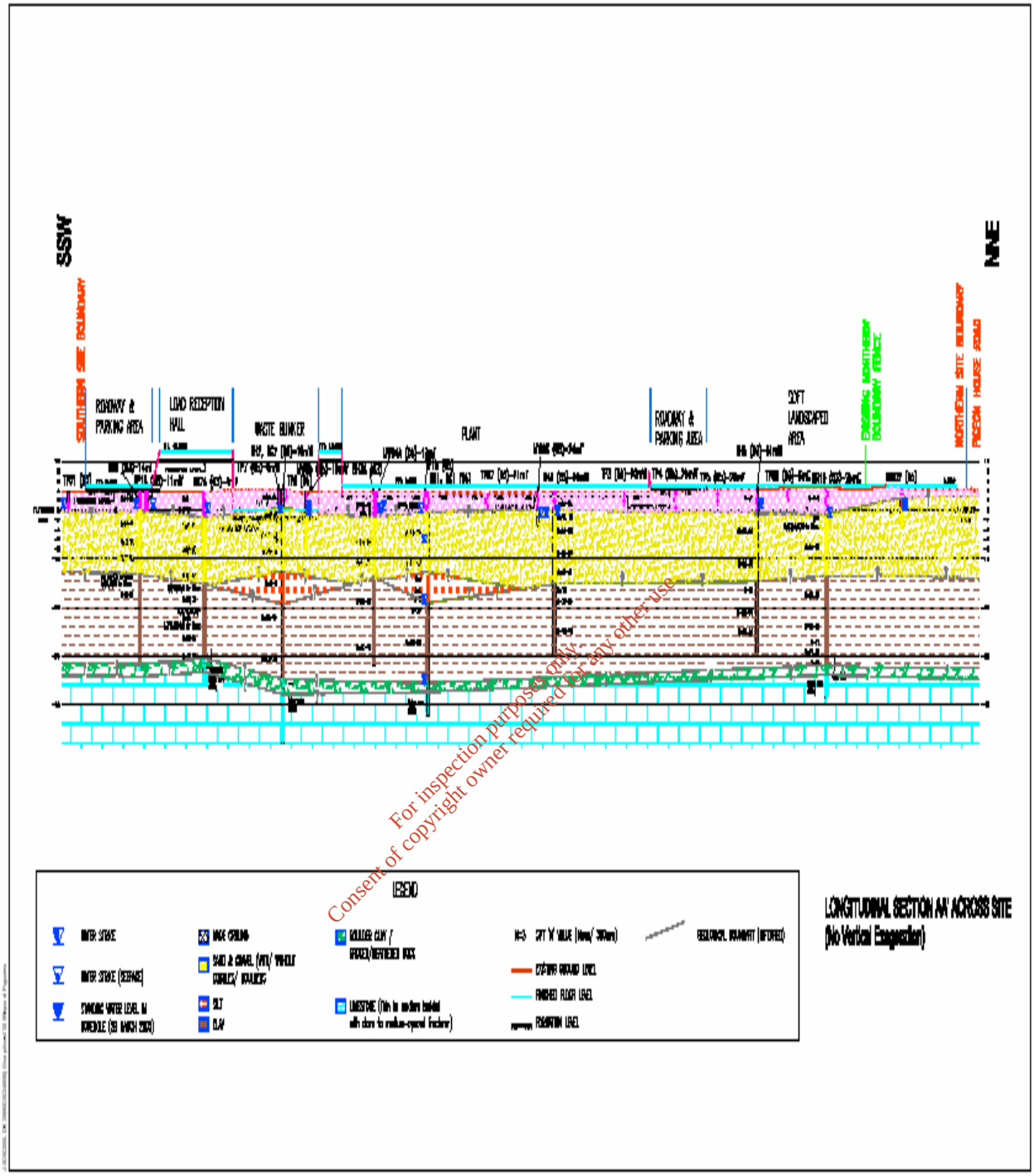


ARUP

Ground Investigation Location Plan

Dublin Waste to Energy Project

D5072.30 | April 2006 | **Figure 5.0**

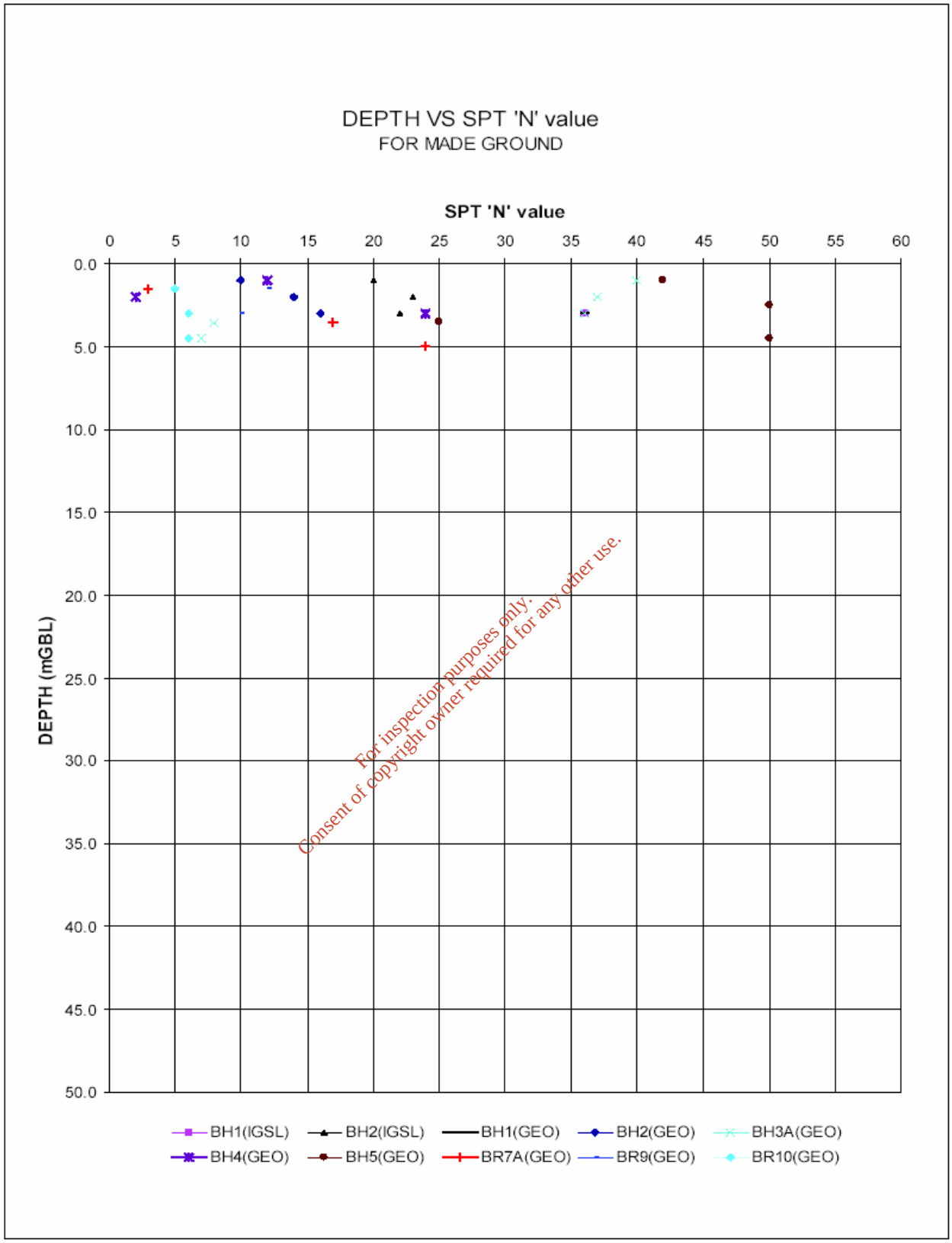


ARUP

Geotechnical Cross Section

Dublin Waste Energy Project

D5072.30 | April 2006 | Figure 6.0

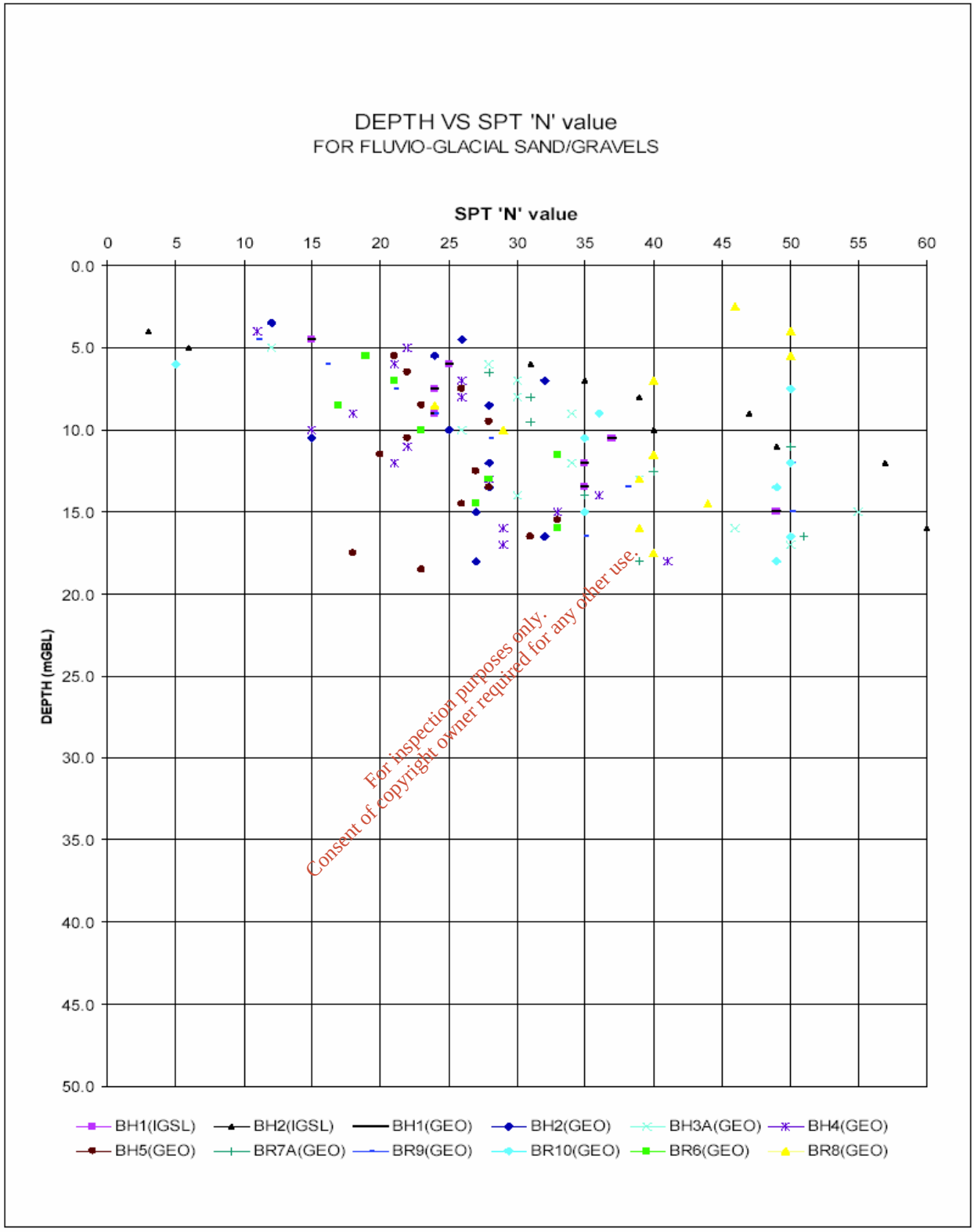


ARUP

SPT | Fill

Dublin Waste to Energy Project

D5072.30 | April 2006 | Figure 7.0

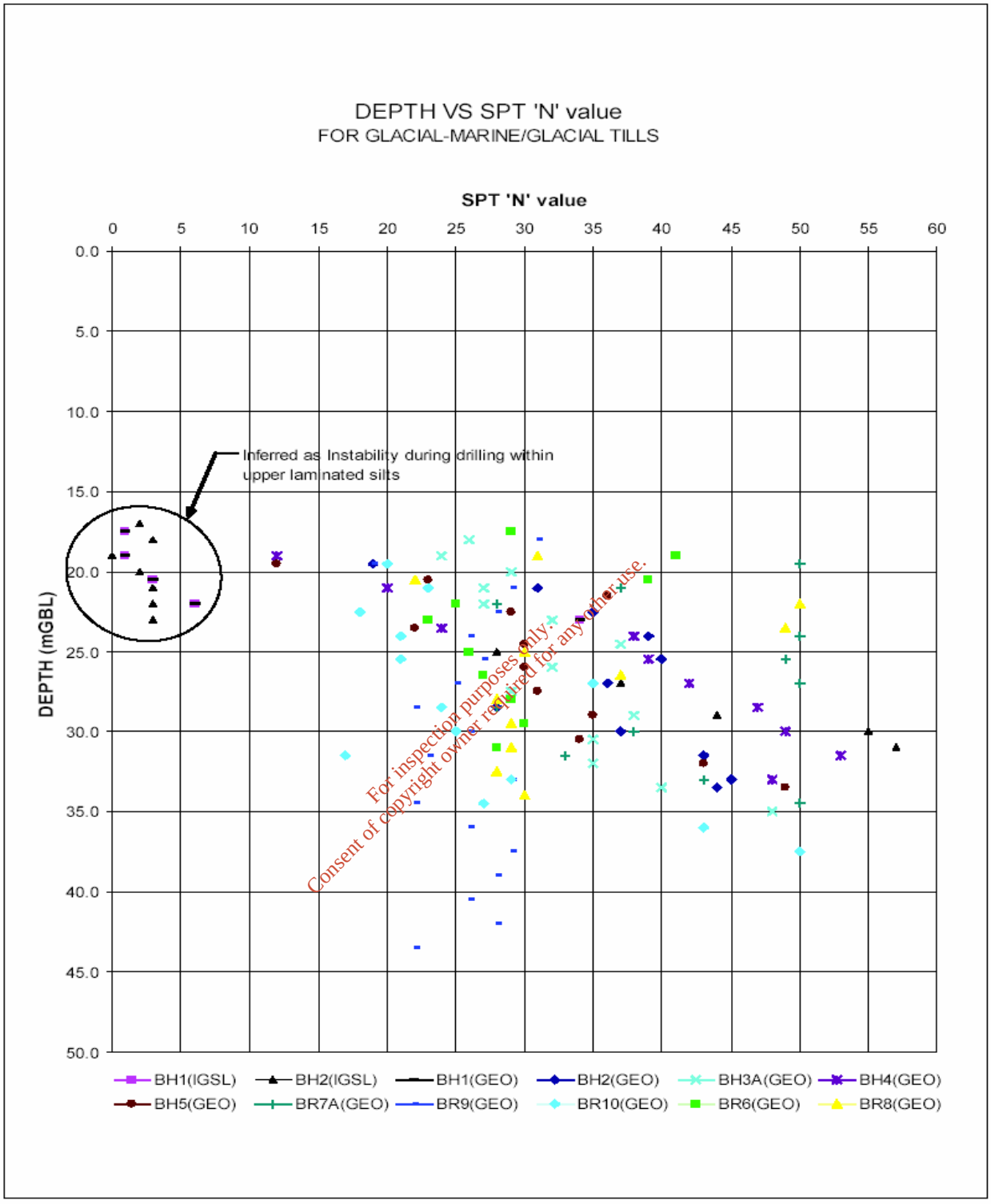


ARUP

SPT | Soils / Gravels

Dublin Waste to Energy Project

D5072.30 | April 2006 | Figure 8.0



ARUP

SPT | Tills

Dublin Waste to Energy Project

D5072.30 | April 2006 | Figure 9.0

GEOTECH

Geotech Specialists Limited

Dublin Waste to Energy

REPORT ON GROUND INVESTIGATION

Factual Report No. KD3116

Engineer: M.C. O'Sullivan & Co. Ltd.

Client: Dublin City Council

Carewswood
Castlemartyr
Co. Cork
Ireland

Tel: (021) 4667164
Fax: (021) 4667630

Our Ref: EFS/034319
Your Ref:
7 November, 2003

Mr M Kelly
Geotech Specialists Ltd
Hartwell Upper
Kill
County Kildare
Eire

TES Bretby

PO Box 100
Ashby Road
Burton-upon-Trent
Staffordshire
DE15 0XD

Telephone: 01283 554400
Facsimile: 01283 554422
E-mail: enquiries@tes-bretby.co.uk

Dear Mr Kelly

Soil Sample Analysis – Dublin Waste

Please find attached an amended Table 1 for the samples from the above site with the Elemental Sulphur results that were missing from the original report.

The work was carried out in accordance with Mowlem Environmental Sciences Group Standard Terms and Conditions of Contract.

Please contact me if you require any further information.

Yours sincerely

J Hannah

J Hannah
Project Co-ordinator
01283 554403

TEST REPORT
SOIL SAMPLE ANALYSIS

UKAS TESTING
1252

Amended Report
TES Report No. EFS/034319

Site: Dublin Waste

Geotech Specialists Ltd
Hartwell Upper
Kill
County Kildare
Eire

The 2 samples described in this report were scheduled for analysis by TES Bretby on Friday, 17 October 2003. This is an amended report that replaces the report issued on 31 October 2003. The analysis was completed by Friday, 7 November 2003.

Tests marked as 'not UKAS accredited' and any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by TES Bretby laboratories.

The following tables are contained in this report:

Table 1 Main Analysis Results
Table of Report Notes (1 Page)

behalf of
Bretby :
annah

Project Co-ordinator

Date of Issue: 07/11/03

rked 'not UKAS accredited' in this report are not included in the UKAS Accreditation Schedule for our laboratory.

Bretby accepts no responsibility for the sampling related to the above results

Units :		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Method Codes :		BGCN22	ELESULP	ICPACIDS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICTSCN28	ICTSCN28	PAHSCUV	SCNCRI
Detection Limits :		1	20	10	0.5	0.1	0.5	0.5	0.5	0.10	0.5	0.5	3.0	1	5	10	0.1
UKAS Accredited :		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
TES ID Number CL/	Client Sample Description	Cyanide (Free)	Elemental Sulphur	SO4-- (acid sol)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Zinc (MS)	CN- (total)	Sulphide	PAH (screening)	Chromium VI.
0330243	BH001 3.6																
0330244	BH002 4.0	<1	29	13100	12.80	0.97	19.2	27.5	178.6	0.34	24.9	1.10	320.9	<1	14	68	<0.1

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name: Geotech Specialists

Contact: Mr M Kelley

Dublin Waste

Soils Sample Analysis

Amended Report

Date Printed	7 November 2003
Report Number	EFS/034319
Table Number	1
Page Number	1 of 2

UKAS TESTING 1252

GEOTECH SPECIALISTS LIMITED
Hartwell Upper, Kill, Co. Kildare, Ireland
Tel: (045) 877201 Fax (045) 877510
Email: geotech.dublin@mesg.co.uk

Dublin Waste to Energy

REPORT ON GROUND INVESTIGATION

Factual Report No. KD3116

Engineer: M.C. O'Sullivan & Co. Ltd.

Client: Dublin City Council

Client:

Dublin City Council
Waste Management Services Dept.
68/70 Marrowbone Lane
Dublin 8

Engineer:

M.C. O'Sullivan & Co. Ltd.
Consulting Engineers
Ashurst
Mount Merrion Avenue
Blackrock
Co. Dublin

GEOTECH

CONTENTS

1 INTRODUCTION

In May 2003 Geotech Specialists Limited (GSL) were commissioned by M.C. O'Sullivan & Co. Ltd., (MCOS), on behalf of Dublin City Council (DCC), to carry out a ground investigation at a site in the Ringsend area of Dublin. The investigation was required to obtain geotechnical and geoenvironmental information for the proposed Waste to Energy plant.

The scope of the investigation, which was specified by MCOS, comprised cable percussion and rotary drilled boreholes, excavation of trial pits and slit trenches, and laboratory testing. The investigation was carried out in accordance with the contract specification and relevant standards (see References). The fieldwork was carried out between 14 May and 27 June 2003. This report presents the factual records of the fieldwork and laboratory testing.

2 THE SITE AND GEOLOGY

2.1 The Site

The proposed site is situated to the south of Dublin Harbour and to the west of the of the existing Poolbeg Power Station. The site is at Irish National Grid reference O 196 335, see Site Location Plan in Enclosure F.

The proposed site covers approximately 7 hectares and is generally rectangular in shape with hardstanding surfaces. The site comprises three relatively flat sections including a scrap yard, an area with above ground storage tanks and a car park. The site is bounded by Pigeon House Road to the north, Shellybanks Road and an electrical station to the west and the Ringsend Sewage Treatment Plant to the east. As indicated in the tender documents, the site may have been used as a municipal waste disposal site in the past.

2.2 Published Geology

The published geological map covering the site, GSI Sheet 16 (1995), shows the solid geology in the areas comprises dark grey to black limestone and shale of the Calp Formation (Carboniferous Age)

As reported in the project tender documents (Dublin Waste to Energy, Ground Investigation Contract, October 2002) previous investigations in the vicinity of the site indicate that the area is underlain by made ground overlying a sequence of sands and gravels, soft estuarine clays and silts, laminated clays, glacial till and dense coarse to very coarse granular soils, overlying Lower Carboniferous deposits of limestone.

3 FIELDWORK

3.1 General

The fieldwork was carried out in general accordance with BS 5930 (1999) and Part 9 of BS 1377 (1990). The exploratory hole locations were selected by MCOS as shown on the Exploratory Hole Location Plan in Enclosure F. The locations were set out by taping from local features. The final co-ordinates and reduced levels were surveyed by GSL to Irish National Grid and Ordnance Datum (Malin Head) and are shown on the logs in Enclosure A.

3.2 Exploratory Holes

The exploratory holes are listed in the following table.

SUMMARY OF EXPLORATORY HOLES

Type	Quantity	Maximum Depth (m)	Remarks
Cable Percussion Boring	5	36.50	BH1, 2, 3A, 4 & 5
Rotary Open Hole / Core Drilling	4	49.50	BR6, 7A, 8, 9 & 10
Trial Pits	9	4.40	machine dug, TP1 to TP9
Slit Trenches	5	1.20	machine and hand dug, ST1 to ST5

The exploratory hole records are presented in Enclosure A and should be read in conjunction with the Key included therein. The records provide descriptions, in accordance with BS 5930 (1999), of the materials encountered and details of the samples taken, together with observations made during boring, drilling, pitting and trenching. Slit trench sketches and logs are shown in Enclosure C. Photographs of the trial pits and recovered cores are presented separately.

3.3 Instrumentation and Monitoring

Standpipe piezometers were installed in borings BH1, BH4, BH5, BR6, BR8 and BR9 as shown on the logs in Enclosure A and detailed in Enclosure B. Records of groundwater and gas monitoring carried out by GSL during and after the fieldwork period are also presented in Enclosure B.

3.4 In-Situ Testing

In-situ testing was carried in accordance with BS5930 (1999) and Part 9 of BS1377 (1990) unless otherwise stated. The testing is summarised below and the results are presented on the logs in Enclosure A.

SUMMARY OF IN-SITU TESTING

Type	Quantity	Remarks
Standard Penetration Tests	269	conducted during boring and drilling

Standard Penetration Test (SPT) N-values ranged from less than 10 to greater than 50 (blows per 0.30 m). Tests conducted in made ground where the N-values are greater than approximately 35 is likely due to the presence of cobbles, boulders and obstructions. These values are not regarded as representative of the relative density, consistency or strength of the soil at that depth. The visual description of the consistency or density of the recovered soil samples in these layers is reported on the logs.

4 LABORATORY TESTING

4.1 Geotechnical Testing

On completion of the fieldwork all samples were transported to the Castlemartyr, Co. Cork laboratory of GSL for temporary retention and testing. The laboratory testing was scheduled by MCOS. The geotechnical testing was carried out in accordance with BS 1377 (1990) and ISRM (1981) and ISRM (1985). The testing is summarised below and the results are presented in Enclosure D.

SUMMARY OF GEOTECHNICAL LABORATORY TESTING

Type	Remarks
Moisture Content Determination	20no., conducted on sealed jar (D) samples
Atterberg Limit Determination	18no.
Particle Size Distribution Analysis	32no. including 5no. hydrometer tests
pH Level and Sulphate Content of Soils	28no.
Moisture Condition Value (MCV) Tests	12no. conducted on bulk (B) samples
California Bearing Ratio (CBR) Tests	3no. conducted on bulk (B) samples
Determination of Point Load Index Values	10no., conducted on selected rock core samples
Unconfined Compressive Strength (UCS) Tests	1no., conducted on a selected rock core sample from BR8

4.2 Geoenvironmental Testing

On completion of the fieldwork, samples for geoenvironmental testing were transported to the TES Bretby laboratory in Burton-on-Trent, UK and the ALControl Geochem laboratory in Dublin. The laboratory testing was scheduled by MCOS. The testing is summarised below and the results are presented in Enclosure E.

SUMMARY OF GEOTECHNICAL LABORATORY TESTING

Type	Remarks
ICRCL Full Suite (common contaminants)	6no., conducted on samples from BH2, BH5 & BH8 and TP1, TP4 & TP7.
Total Petroleum Hydrocarbons (by GCFID)	6no., conducted on samples from BH1, BH3A, & BH5 and TP8
Dioxins	2no., conducted on samples from TP2 & TP9

REFERENCES

British Standards and Codes of Practice

BS 1377 : 1990 : Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930 : 1999 : Code of practice for site investigations. British Standards Institution.

Maps

GSI Sheet 16 : 1995 : "Kildare-Wicklow". 1:100000 geological map (solid). Geological Survey of Ireland.

Ordnance Survey Landranger Series. Sheet 50 : 2001 : Dublin Kildare Meath Wicklow. 1:50000. Ordnance Survey of Ireland.

Publications and Reports

Dublin Waste to Energy Project, Ground Investigation Contract, October 2002.

ISRM : 1981 : Rock Characterisation, Testing and Monitoring - ISRM Suggested Methods (Ed E T Brown). Commission on Testing Methods, International Society for Rock Mechanics, Pergamon Press.

ISRM : 1985 : Suggested method for determining point load strength. Commission on Testing Methods, International Society for Rock Mechanics, International Journal of Rock Mechanics, Mining Sciences and Geomechanics Abstracts, Vol 22.

ICRCL 59/83 : 1987: Guidance on the assessment and redevelopment of contaminated land, Department of Environment.

Prepared By	**Mike Kelley, B.Sc., M.Sc.**
Approved for Issue By	**Mike Kelley, B.Sc., M.Sc.**

ENCLOSURE A
EXPLORATORY HOLE RECORDS

	Key
Key to Exploratory Hole Records	
Borehole Logs	BH1, 2, 3A, 4 & 5, BR6, 7A, 8, 9, & 10
Trial Pit Logs	TP1 to TP9

Key to Exploratory Hole Records

GEOTECH

SAMPLES

Undisturbed

U	Driven tube sample
TW	Pushed thin wall tube sample } nominally 100 mm diameter and full recovery unless otherwise stated
P	Pushed piston sample
L	Liner sample (from Windowless or similar sampler), full recovery unless otherwise stated
CBR	CBR mould sample
BLK	Block sample
CS	Core sample (from rotary core) taken for laboratory testing

Disturbed

D	Small sample
B	Bulk sample

Other

W	Water sample
G	Gas sample
	Environmental chemistry samples (in more than one container where appropriate)
ES	Soil sample
EW	Water sample

Comments Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that attempt was made to take a tube sample, however, there was no recovery.

Monitoring samples taken after completion of hole construction are not shown on the exploratory hole logs.

TESTS

SPT S or SPT C — Standard Penetration Test, open shoe (S) or solid cone (C)

The Standard Penetration Test is defined in BS 1377 : Part 9 (1990). The incremental blow counts are given in the Field Records column; each increment is 75 mm unless stated otherwise and any penetration under self weight in mm (SW) is noted. Where the full 300 mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Test column. Where the test drive blows reach 50 (either in total or for a single increment) the total blow count beyond the seating drive is given (without the N = prefix).

IV	In situ vane test, peak (p) and remoulded (r)
HV	Hand vane test, peak (p) and remoulded (r)
PP	Pocket penetrometer test, strength value
KFH, KRH, KPI	Variable head permeability tests (KFH = falling head test, KRH = rising head test, KPI = packer test), permeability value
	Test results provided in Field Records column

DRILLING RECORDS

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930 (1999)

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation, %
If	Fracture spacing, mm. Minimum, typical and maximum spacings are presented. The term non-intact (NI) is used where the core is fragmented.

Flush returns, estimated percentage with colour where relevant, are given in the Records column

CRF	Core recovered (length in m) in the following run
AZCL	Assessed zone of core loss
N/A	Not applicable

GROUNDWATER

▼	Groundwater strike
▽	Groundwater level after standing period

Notes:	Project: Dublin Waste to Energy Project Project No.: KD3116 Carried out for: Dublin City Council	Key Sheet 1

Key to Exploratory Hole Records

GEOTECH

INSTALLATION

Standpipe/ piezometer

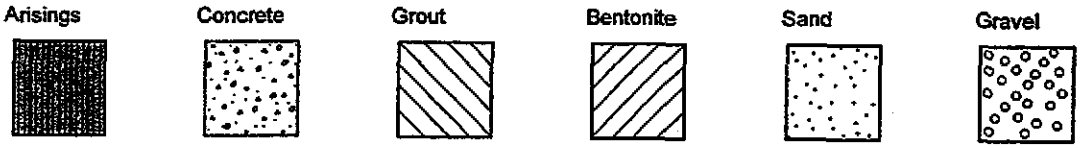
Details of standpipe/piezometer installations are given on the Record. Legend column shows installed instrument depths including slotted pipe section or tip depth, response zone filter material type and layers of backfill.

The types of instrument installed is indicated by a code in the Legend column at the depth of the response zone:

SP	Standpipe
SPIE	Standpipe piezometer
PPIE	Pneumatic piezometer
EPIE	Electronic piezometer

INSTALLATION LEGENDS

A legend describing the installation is shown in the rightmost column. Legends additional to BS5930 are used to describe the backfill materials as indicated below.



NOTES

1 Strata legends are in accordance with BS 5930 (1999).

2 Water level observations of discernible entries during the advancing of the exploratory hole are given at the foot of the log and in the Legend column. The term "none observed" is used where no discrete entries are identified although this does not necessarily indicate that the hole has not been advanced below groundwater level. Under certain conditions groundwater cannot be observed, for instance, drilling with water flush or overwater, or boring at a rate much faster than water can make its way into the borehole (ref BS5930 : 1999, Clause 47.2.7). In addition, where appropriate, water levels in the hole at the time of recovering individual samples or carrying out in situ tests and at shift changes are given in the Records column.

3 Evidence of the occurrence of very coarse particles (cobbles and boulders) is presented on the logs, however, because of their size in relation to the exploratory hole these records may not be fully representative of their size and frequency *in the ground mass*.

4 The borehole logs present the results of Standard Penetration Tests recorded in the field without correction or interpretation. However, in certain ground conditions (eg high hydraulic head or where very coarse particles are present) some judgement may be necessary in considering whether the results are representative of in situ mass conditions.

5 The declination of bedding and joints is given with respect to the normal to the core axis. Thus in a vertical borehole this will be the dip.

6 The assessment of SCR, RQD and Fracture Spacing excludes artificial fractures

REFERENCES

BS 1377 : 1990 : British Standard Methods of test for soils for civil engineering purposes. British Standards Institution
BS 5930 : 1999 : Code of Practice for site investigations. British Standards Institution

Notes:	Project	Dublin Waste to Energy Project	Key
	Project No.	KD3116	
	Carried out for	Dublin City Council	Sheet 2 of 2

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 20/05/2003 End 26/05/2003	Equipment, Methods and Remarks Dando 175 cable tool drill rig Hand dug inspection pit to 1.20m Cable percussive boring to 36.50m Installed 50mm dia. standpipe	Depth from / to / Diameter / Casing Depth 0.00m / 13.50m / 250mm / 13.50m 13.50m / 36.50m / 200mm / 36.50m	Ground Level +3.64 mOD Coordinates E 319923.03 National Grid N 233437.37	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00-0.50	B 1			
0.50-1.00	B 2			
1.00-1.50	B 3			
1.20-1.65	SPT C	N=48 (4,4/6,10,14,18)	1.20	dry
2.00-2.50	B 4			
3.00-3.45	SPT C	N=16 (2,3/3,4,4,5)	3.00	dry
3.00-3.50	B 5			
3.00	W 9			
3.50	D 6			
3.60-4.05	SPT S	N=11 (1,2/2,3,2,4)	3.60	dry
3.60-4.00	B 7			
4.00-4.45	SPT C	N=23 (3,4/4,5,6,8)	4.00	dry
4.00-4.50	B 8			
4.50	W 48			
5.00-5.45	SPT C	N=41 (6,8/9,10,11,11)	5.00	3.00
5.00-5.50	B 10		20/05/2003 5.00	3.00
6.00-6.45	SPT C	N=33 (4,6/6,8,8,11)	6.00	3.00
6.00-6.50	B 11			
7.00-7.45	SPT C	N=35 (4,4/7,8,10,10)	7.00	3.00
7.00-7.50	B 12			
8.00-8.45	SPT C	N=[illegible]	[illegible]	3.00
8.00-8.50	B 13			
9.00-9.45	SPT C	N=46 (6,8/9,11,12,14)	9.00	3.00
9.00-9.50	B 14			

Strata

Description	Depth, Level (Thickness)	Legend	Backfill / Instrumentation
Soft brown to black sandy gravelly CLAY and sandy GRAVEL FILL with subangular cobbles and fragments of brick, concrete, wood and plastic. Gravel is subangular to subrounded fine to coarse. (MADE GROUND)			
1.00-2.50 m Occasional boulder-sized concrete fragment.	(4.00)		
Medium dense to dense grey sandy GRAVEL with shell fragments and occasional subrounded cobbles. Sand is fine to medium, gravel is subangular to rounded fine to coarse. (ESTUARINE DEPOSIT).	4.00 -0.37		
4.00-4.50 m some brown cemented sand clods			
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.50	Rose to 3.00 m after 20 minutes. Strong inflow	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m)	Time	Tools used
1.50 -2.50	330 mins	Chisel
7.60 -7.80	30 mins	Chisel
9.85 -10.00	45 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG NBR (281), 30/10/2003 12:44:51

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole

BH1

Sheet 1 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 20/05/2003 End 26/05/2003	Equipment, Methods and Remarks	Depth from 0.00m / 13.50m; to 13.50m / 36.50m; Diameter 250mm / 200mm; Casing Depth 13.50m / 36.50m	Ground Level +3.64 mOD Coordinates E 319923.03 National Grid N 233437.37

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water
10.00-10.29 10.00-10.50	SPT C B 15	50 (6,11/25,25 for 65mm)	10.00	3.00
11.00-11.45 11.00-11.50	SPT C B 16	N=42 (7,7/8,8,14,12)	11.00	3.00
			22/05/2003 11.00	3.00
12.00-12.45 12.00-12.50	SPT C B 17	N=17 (1,2/4,4,4,5)	12.00	3.20
13.00-13.45 13.00-13.50	SPT C B 18	N=28 (4,4/6,6,7,9)	13.00	3.20
14.00-14.45 14.00-14.50	SPT C B 19	N=27 (5,5/6,7,6,8)	14.00	3.20
15.00-15.45 15.00-15.50	SPT C B 20	N=32 (4,4/6,6,9,11)	15.00	3.20
16.00-16.45 16.00-16.50	SPT C B 21	N=35 (5,5/5,8,10,12)	16.00	3.20
17.00-17.10 17.10-17.53 17.10-17.60	D 22 SPT S B 23	50 (3,8/10,14,11 for 55mm)	17.10	3.20
18.00-18.44 18.00-18.50	SPT S B 24	55 (5,9/9,13,12 for 60mm)	18.00	3.20
			23/05/2003 18.00	3.20
19.50-19.95 19.50-19.95	SPT S D 25	N=30 (4,4/5,7,9,9)	19.50	3.20

Description	Depth, Level (Thickness)	Legend	Backfill/Instruments
Medium dense to dense grey sandy GRAVEL with shell fragments and occasional subrounded cobbles. Sand is fine to medium, gravel is subangular to rounded fine to coarse. (ESTUARINE DEPOSIT). 14.00 m becoming clayey	(13.00)		SP
Stiff to very stiff dark grey brown slightly sandy CLAY with rare fine sand lenses. (ESTUARINE DEPOSIT).	17.00 -13.36		

Stratum continued next sheet

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.50	Rose to 3.00 m after 20 minutes. Strong inflow	-

Depth Related Remarks
From to (m)

Chiselling

Depths (m)	Time	Tools used
10.80 - 10.95	45 mins	Chisel
12.80 - 12.90	30 mins	Chisel
13.70 - 13.95	45 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(4) MESG HBIII (281), 30/10/2003 12:44:56 AGS

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole **BH1**

Borehole Log

GEOTECH

Drilled by	MD
Logged by	PG
Checked by	MK

Start 20/05/2003
End 26/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	13.50m	250mm	13.50m
13.50m	36.50m	200mm	36.50m

Ground Level +3.64 mOD
Coordinates E 319923.03
National Grid N 233437.37

Samples and Tests

Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)	Legend	Backfill Instrumen
20.00-20.50	B 26				Stiff to very stiff dark grey brown slightly sandy CLAY with rare fine sand lenses. (ESTUARINE DEPOSIT).			
21.00-21.45	SPT S	N=29 (3,4/4,8,8,9)	21.00	3.20				
21.00-21.45	D 27							
22.00-22.50	B 28							
22.50-22.95	SPT S	N=30 (4,4/6,8,8,10)	22.50	3.20				
22.50-22.95	D 29							
23.00-23.50	B 30							
24.00-24.45	SPT S	N=28 (5,5/5,7,7,9)	24.00	3.20				
24.00-24.45	D 31							
24.50-25.00	B 32							
25.50-25.95	SPT S	N=31 (4,4/6,8,8,9)	25.50	3.20				
25.50-25.95	D 33							
			24/05/2003					
			25.50	3.20				
26.00-26.50	B 34					(18.50)		
27.00-27.45	SPT S	N=29 (3,4/4,8,8,9)	27.00	3.20				
27.00-27.45	D 35							
28.00-28.50	B 36							
28.50-28.95	SPT S	N=28 (5,5/6,8,8,6)	28.50	3.20				
28.50-28.95	D 37							
29.00-29.50	B 38							
					Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.50	Rose to 3.00 m after 20 minutes. Strong inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BH1
Sheet 3 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 20/05/2003 End 26/05/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level +3.64 mOD Coordinates E 319923.03 National Grid N 233437.37
			0.00m	13.50m	250mm	13.50m	
			13.50m	36.50m	200mm	36.50m	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.00-30.45 30.00-30.45	SPT S D 39	N=24 (3,3/5,5,6,8)	30.00	3.20
31.00-31.50	B 40			
31.50-31.95 31.50-31.95	SPT S D 41	N=27 (3,4/5,6,8,8)	31.50	3.20
			25/05/2003 33.50	3.20
33.00-33.45 33.00-33.50	SPT S B 42	N=29 (4,4/6,6,8,9)	33.00	3.20
34.00-34.50	B 43			
34.50-34.95 34.50-34.95	SPT S D 44	N=27 (3,4/5,6,8,8)	34.50	3.20
35.00-35.50	B 45			
35.50-35.95 35.50-35.95	SPT S D 46	N=31 (3,5/5,6,9,11)	35.50	3.20
36.00-36.39 36.00-36.50	SPT C B 47	47 (4,6/10,12,18,7 for 10mm)	36.00	3.20
			26/05/2003 36.00	3.20

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Stiff to very stiff dark grey brown slightly sandy CLAY with rare fine sand lenses. (ESTUARINE DEPOSIT).	35.50 -31.86		
Recovered as brown slightly silty GRAVEL with occasional subangular to subrounded cobbles. Gravel is angular to subrounded fine to coarse. (possible weathered rockhead)	(1.00) 36.50 -32.86		
EXPLORATORY HOLE ENDS AT 36.50 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.50	Rose to 3.00 m after 20 minutes. Strong inflow	-

Depth Related Remarks
From to (m)

Chiselling

Depths (m)	Time	Tools used
36.40 -36.50	45 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG HBM (OR1), 30/10/2003 12:45:01 AGS

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole BH1
Sheet 4 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 27/05/2003 End 06/06/2003	Equipment, Methods and Remarks Dando 175 cable tool drill rig Hand dug inspection pit to 1.20m Cable percussive boring to 34.00m. Borehole backfilled with grout.	Depth from / to / Diameter / Casing Depth 0.00m 13.60m 250mm 13.60m 13.60m 34.00m 200mm 34.00m	Ground Level +3.99 mOD Coordinates E 319847.27 National Grid N 233497.54

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00-0.50	B 1			
0.50-1.00	B 2			
1.00-1.45 1.00-1.50	SPT C B 3	N=10 (2,3/3,2,3,2)	1.00	dry
1.50-2.00	B 4			
2.00-2.45 2.00-2.50	SPT C B 5	N=14 (2,3/3,4,4,3)	2.00	dry
2.50-3.00	B 6			
3.00-3.45 3.00-3.50	SPT C B 7	N=16 (2,2/4,3,4,5)	3.00	dry
3.60-3.70 3.70-4.15 3.70-4.15	D 8 SPT S D 9	N=12 (1,1/2,2,3,5)	3.70	dry
4.00-4.50	B 10			
4.50-4.95 4.50 4.50-5.00	SPT C W 11 B 12	N=26 (3,4/4,6,7,9)	4.50	3.20
5.00-5.50	B 13			
5.50-5.95 5.50-6.00	SPT C B 14	N=24 (4,4/4,6,6,8)	5.50	3.20
6.50-7.00	B 15			
7.00-7.45 7.00-7.50	SPT C B 16	N=32 (3,6/8,8,7,9)	7.00	3.20
8.50-8.95 8.50-9.00	SPT C B 17	N=28 (4,4/6,7,7,8)	8.50	3.20
			27/05/2003 10.00	3.20

Strata

Description	Depth, Level (Thickness)
TARMAC pavement overlying grey angular to subangular cobbles (MADE GROUND).	(0.50) 0.50 +3.49
Soft grey brown to black slightly sandy CLAY and GRAVEL FILL with concrete, wood, ceramics and brick fragments. Gravel is angular to subrounded fine to coarse. (MADE GROUND)	(3.10) 3.60 +0.39
Medium dense grey slightly clayey fine SAND with rare shell fragments. Gravel is subangular to subrounded fine to medium. (ESTUARINE DEPOSIT).	(2.00) 5.60 -1.62
Medium dense dark grey to multi-coloured sandy GRAVEL with shell fragments. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse. (ESTUARINE DEPOSIT).	

Stratum continued next sheet

Legend | Backfill/Instrument

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.70	Rose to 4.50 m after 20 minutes. Slow ingress	-

Depth Related Remarks
From to (m)

Chiselling

Depths (m)	Time	Tools used
1.80 -1.95	45 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG HBM (291), 30/10/2003 12:45:16 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BH2**
Sheet 1 of 4

Borehole Log

GEOTECH

Drilled by MD	Start 27/05/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	+3.99 mOD
Logged by PG	End 06/06/2003		0.00m	13.60m	250mm	13.60m	Coordinates	E 319847.27
Checked by MK			13.60m	34.00m	200mm	34.00m	National Grid	N 233497.54

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00-10.45 10.00-10.50	SPT C B 18	N=25 (3,4/4,7,7,7)	10.00	3.20
10.50-10.95 10.50-11.00	SPT C B 19	N=15 (2,3/2,3,3,7)	10.50	3.00
12.00-12.45 12.00-12.50	SPT C B 20	N=26 (3,4/4,7,7,10)	12.00	3.00
13.50-13.95 13.50-14.00	SPT C B 21	N=28 (4,4/4,6,6,12)	13.50	3.00
15.00-15.45 15.00-15.50	SPT C B 22	N=27 (3,5/5,6,8,8)	15.00	3.00
16.50-16.95 16.50-17.00	SPT C B 23	N=32 (4,4/7,7,8,10)	16.50	3.00
18.00-18.45 18.00-18.50	SPT C B 24	N=27 (6,6/4,8,8,7)	18.00	3.00
19.50-19.95 19.50-19.95	SPT S D 25	N=19 (3,3/4,4,4,7)	19.50	3.00
			28/05/2003 19.50	3.00
Depth	Type & No	Records	Date Casing	Time Water

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Medium dense dark grey to multi-coloured sandy GRAVEL with shell fragments. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse. (ESTUARINE DEPOSIT).	(12.90)		
18.00-18.50 m becoming clayey			
Stiff to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	18.50 -14.51		
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.70	Rose to 4.50 m after 20 minutes. Slow ingress	-

Depth Related Remarks
From to (m)

Chiselling

Depths (m)	Time	Tools used
14.30 -14.45	30 mins	Chisel
17.50 -17.80	45 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH2
Sheet 2 of 4

Borehole Log

GEOTECH

Drilled by MD	Start 27/05/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	+3.99 mOD
Logged by PG	End 06/06/2003		0.00m	13.60m	250mm	13.60m	Coordinates	E 319847.27
Checked by MK			13.60m	34.00m	200mm	34.00m	National Grid	N 233497.54

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00-20.50	B 26			
21.00-21.45 21.00-21.45	SPT S D 27	N=31 (3,5/5,8,8,10)	21.00	3.80
22.00-22.50	B 28			
22.50-22.95 22.50-22.95	SPT S D 29	N=35 (4,4/6,9,10,10)	22.50	3.80
23.50-24.00	B 30			
24.00-24.45 24.00-24.45	SPT S D 31	N=39 (3,5/7,10,10,12)	24.00	3.80
25.00-25.50	B 32			
25.50-25.95 25.50-25.95	SPT S D 33	N=40 (4,4/8,11,10,11)	25.50	3.80
26.00-26.50	B 34			
			04/06/2003 26.00	3.60
27.00-27.45 27.00-27.45	SPT S D 35	N=36 (4,6/6,8,10,12)	27.00	3.60
28.00-28.50	B 36			
28.50-28.95 28.50-28.95	SPT S D 37	N=28 (3,4/4,7,7,10)	28.50	3.60
29.50-30.00	B 38			

Strata

Description	Depth,Level/ (Thickness)	Legend	Backfill Instrumen
Stiff to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	(15.50)		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.70	Rose to 4.50 m after 20 minutes. Slow ingress	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH2
Sheet 3 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 27/05/2003 End 06/06/2003	Equipment, Methods and Remarks	Depth from 0.00m 13.60m	to 13.60m 34.00m	Diameter 250mm 200mm	Casing Depth 13.60m 34.00m	Ground Level +3.99 mOD Coordinates E 319847.27 National Grid N 233497.54

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.00-30.45 30.00-30.45	SPT S D 39	N=37 (4,4/7,8,11,11)	30.00	3.60
31.00-31.50	B 40			
31.50-31.95 31.50-31.95	SPT S D 41	N=43 (5,7/8,10,11,14)	31.50	3.60
32.50-33.00	B 42			
33.00-33.44 33.00-33.45	SPT S D 43	45 (6,7/10,10,13,12 for 65mm)	33.00	3.60
			05/06/2003 33.00	3.60
33.50-33.95 33.50-33.95	SPT S D 44	N=42 (5,5/8,8,10,16)		
			06/06/2003 33.50	3.40

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Stiff to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	34.00 -30.01		
EXPLORATORY HOLE ENDS AT 34.00 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.70	Rose to 4.50 m after 20 minutes. Slow ingress	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole **BH2**
Sheet 4 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by JL Checked by MK	Start 07/06/2003 End 13/06/2003	Equipment, Methods and Remarks Dando 175 cable tool drill rig Relocated from BH3 due to obstruction. Hand dug inspection pit to 1.20m. Cable percussive boring to 35.50m. Borehole backfilled with grout	Depth from / to / Diameter / Casing Depth 0.00m 16.00m 250mm 16.00m 16.00m 35.50m 200mm 35.50m	Ground Level +3.59 mOD Coordinates E 319936.91 National Grid N 233526.20

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)
0.00 0.00-0.50	B 1				TARMAC pavement over roadstone (MADE GROUND)	0.30 +3.29
0.50-1.00	B 2				Soft dark brown sandy gravelly CLAY and ASH FILL with occasional subrounded cobbles and fragments of brick, concrete and plastic. (MADE GROUND)	
1.20-1.65 1.20-1.70	SPT C B 3	N=40 (3,4/4,8,10,18)	1.20		1.20-1.70 m concrete cobbles and boulders	
2.00-2.45 2.00-2.50	SPT C B 4	N=37 (6,6/7,8,12,10)	2.00			(3.30)
3.00-3.45 3.00-3.50	SPT C B 5	N=36 (5,7/7,8,9,12)	3.00			
3.60-4.05 3.60-4.00	SPT S B 6	N=8 (2,1/1,2,3,2)	3.60 07/06/2003 4.00	1800 3.30	Soft black sandy slightly gravelly CLAY FILL with fragments of concrete and ceramics and rare pockets of silty sand. (MADE GROUND).	3.60 -0.01
4.00-4.50	B 7		08/06/2003 35.00	0800 3.20		
4.50-4.95 4.50-5.00	SPT S D 8	N=7 (2,2/2,2,1,2)	4.50			(1.60)
5.20-5.65 5.20-5.70	SPT C B 9	N=12 (2,3/3,2,3,4)	5.20		Medium dense to dense dark grey sandy GRAVEL with occasional subrounded cobbles and shell fragments. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse. (ESTUARINE DEPOSIT).	5.20 -1.61
6.00-6.45 6.00-6.50	SPT C B 10	N=26 (4,4/7,7,6,8)	6.00			
7.00-7.45 7.00-7.50	SPT C B 11	N=30 (3,3/6,6,8,10)	7.00			
8.00-8.45 8.00-8.50	SPT C B 12	N=30 (4,4/7,7,7,9)	8.00			
9.00-9.45 9.00-9.50	SPT C B 13	N=34 (6,6/7,8,8,11)	9.00			

Stratum continued next sheet

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.30 m after 20 minutes. Slow ingress	-

Depth Related Remarks
From to (m)

Chiselling

Depths (m)	Time	Tools used
1.80 -2.10	90 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG HBM (Q81), 30/10/2003 12:45:44 AGS

Project: Dublin Waste to Energy
Project No. K03116
Carried out for: Dublin City Council

Borehole **BH3A**

Borehole Log

GEOTECH

Drilled by	MD
Logged by	JL
Checked by	MK

Start 07/06/2003
End 13/06/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	16.00m	250mm	16.00m
16.00m	35.50m	200mm	35.50m

Ground Level +3.59 mOD
Coordinates E 319936.91
National Grid N 233526.20

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00-10.45 10.00-10.50	SPT C B 14	N=26 (4,4/8,5,5,8)	10.00	
11.00-11.45 11.00-11.50	SPT C B 15	N=22 (3,4/4,7,2,9)	11.00	
12.00-12.45 12.00-12.50	SPT C B 16	N=34 (4,4/4,8,8,14)	12.00	
			08/06/2003 13.00	1600 3.30
13.00-13.45 13.00-13.50	SPT C B 17	N=39 (6,6/8,8,10,13)	09/06/2003 13.00	0800 3.20
14.00-14.45 14.00-14.50	SPT C B 18	N=30 (5,4/5,6,8,11)	14.00	
			09/06/2003 14.00	1600 3.20
			10/06/2003 14.00	0800 3.20
15.00-15.33 15.00-15.50	SPT C B 19	55 (4,8/10,20,25 for 25mm)	15.00	
15.50-16.00	B 20			
16.00-16.40	SPT S	45 (5,6/9,12,17,8 for 25mm)	16.00	
			10/06/2003 17.00	1600 3.20
17.00-17.45 17.00-17.50	SPT S B 21	N=50 (6,8/8,10,14,18)	11/06/2003 17.00	0800 3.30
17.60-18.00	D 22			
18.00-18.45 18.00-18.50	SPT S B 23	N=28 (4,4/4,6,8,8)	18.00	
19.00-19.45 19.00-19.45	SPT S D 24	N=24 (3,3/4,6,7,7)	19.00	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Medium dense to dense dark grey sandy GRAVEL with occasional subrounded cobbles and shell fragments. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse. (ESTUARINE DEPOSIT).	(12.40)		
Stiff to very stiff grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	17.60 -14.01		
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.30 m after 20 minutes. Slow ingress	-

Depth Related Remarks
From to (m)

Chiselling

Depths (m)	Time	Tools used
11.80 -11.95	30 mins	Chisel
12.60 -12.85	45 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BH3A
Sheet 2 of 4

Borehole Log

GEOTECH

Drilled by MD	Start 07/06/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	+3.59 mOD
Logged by JL	End 13/06/2003		0.00m	16.00m	250mm	16.00m	Coordinates	E 319936.91
Checked by MK			16.00m	35.50m	200mm	35.50m	National Grid	N 233526.20

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00-20.45	SPT S	N=29 (2,3/8,8,7,8)	20.00	
20.00-20.45	D 25			
20.50-21.00	B 26			
21.00-21.45	SPT S	N=27 (4,4/6,6,7,8)	21.00	
21.00-21.45	D 27			
21.50-22.00	B 28			
22.00-22.45	SPT S	N=27 (3,4/4,7,7,9)	22.00	
22.00-22.45	D 29			
22.50-23.00	B 30			
23.00-23.45	SPT S	N=32 (4,4/4,8,9,11)	23.00	
23.00-23.45	D 31			
24.00-24.50	B 32			
24.50-24.95	SPT S	N=37 (4,3/7,9,9,12)	24.50	
24.50-24.95	D 33			
			11/06/2003	1800
			25.00	3.30
			12/06/2003	0800
			25.00	3.30
25.50-26.00	B 34			
26.00-26.45	SPT S	N=32 (3,4/4,8,8,12)	26.00	
26.00-26.45	D 35			
27.00-27.50	B 36			
27.50-27.95	SPT S	N=29 (4,4/6,6,7,10)	27.50	
27.50-27.95	D 37			
28.00-28.50	B 38			
29.00-29.45	SPT S	N=38 (3,7/7,8,10,13)	29.00	
29.00-29.45	D 39			

Strata

Description	Depth, Level (Thickness)	Legend	Backfill / Instrumentation
Stiff to very stiff grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	(17.90)		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.30 m after 20 minutes. Slow ingress	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole

BH3A

Sheet 3 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by JL Checked by MK	Start 07/06/2003 End 13/06/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth 0.00m / 16.00m / 250mm / 16.00m 16.00m / 35.50m / 200mm / 35.50m	Ground Level +3.59 mOD Coordinates E 319936.91 National Grid N 233526.20

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.00-30.50	B 40			
30.50-30.95 30.50-30.95	SPT S D 41	N=35 (4,4/6,8,11,12)	30.50	
32.00-32.45 32.00-32.45	SPT S D 42	N=35 (4,5/5,8,10,14)	32.00	
33.50-33.95 33.50-33.95	SPT S D 43	N=40 (3,6/6,10,12,12)	33.50	
34.50-35.00	B 44			
			12/06/2003 35.00	1800 3.30
35.00-35.45 35.00-35.45	SPT S D 45	N=48 (4,8/8,12,14,14)	13/06/2003 35.00 13/06/2003 35.50	0800 3.30 1200 3.30

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Stiff to very stiff grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).			
EXPLORATORY HOLE ENDS AT 35.50 m	35.50 -31.91		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.30 m after 20 minutes. Slow ingress	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BH3A
Sheet 4 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 13/06/2003 End 17/06/2003	Equipment, Methods and Remarks Dando 175 cable tool drill rig. Hand dug inspection pit to 1.20m. Cable percussive drilling to 33.50m Installed 50mm diameter standpipe.	Depth from / to / Diameter / Casing Depth 0.00m / 14.50m / 250mm / 14.50m 14.50m / 33.50m / 200mm / 33.50m	Ground Level +3.49 mOD Coordinates E 319857.30 National Grid N 233620.06

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00-0.50	B 1			
0.50-1.00	B 2			
1.00-1.45 1.00-1.50	SPT C B 3	N=12 (3,2/4,3,2,3)	1.00	
1.50-2.00	B 4			
2.00-2.45 2.00-2.50	SPT C B 5	N=26 (4,4/6,4,9,7)	2.00	
2.50-3.00	B 6			
3.00-3.45 3.00-3.50	SPT C B 7	N=24 (3,4/4,6,6,8)	3.00	
3.30	W 42			
4.00-4.45 4.00-4.50	SPT C B 8	N=11 (3,3/2,3,3,3)	4.00	
5.00-5.45 5.00-5.50	SPT C B 9	N=22 (4,4/4,5,5,8)	5.00	
6.00-6.45 6.00-6.50	SPT C B 10	N=21 (4,3/3,4,7,7)	6.00	
7.00-7.45 7.00-7.50	SPT C B 11	N=26 (3,4/4,6,8,8)	7.00	
8.00-8.45 8.00-8.50	SPT C B 12	N=26 (3,5/5,5,7,9)	8.00	
9.00-9.45 9.00-9.50	SPT C B 13	N=16 (3,3/4,4,4,5)	9.00	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill Instrument
Hard standing GRAVEL (MADE GROUND)	0.10 +3.39		
Soft brown slightly sandy CLAY and GRAVEL FILL with fragments of brick, concrete and wood.(MADE GROUND)	(3.50)		
Medium to dense grey brown clayey sandy GRAVEL with abundant shell fragments. Gravel is angular to subrounded fine to coarse. (ESTUARINE DEPOSIT). 3.60-3.90 m Driller reports pushing boulder. 5.00-5.50 m Occassional tabular cobbles.	3.60 -0.12 (1.90)		
Medium dense grey sandy GRAVEL with some shell fragments. Sand is fine to medium. Gravel is subangular fine to medium. (ESTUARINE DEPOSIT).	5.50 -2.02		

Stratum continued next sheet

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.60	Rose to 3.30 m after 20 minutes. Slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG HBM (Pt D, 30/10/2003 12:46:08 AGS

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole **BH4**
Sheet 1 of 4

Borehole Log

GEOTECH

Drilled by MD	Start 13/06/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	+3.49 mOD
Logged by PG	End 17/06/2003		0.00m	14.50m	250mm	14.50m	Coordinates	E 319857.30
Checked by MK			14.50m	33.50m	200mm	33.50m	National Grid	N 233620.06

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00-10.38 10.00-10.50	SPT C B 14	N=15 (3 for 80mm/3,3,4,5)	10.00	
			14/06/2003	1800
			11.00	3.30
11.00-11.45 11.00-11.50	SPT C B 15	N=22 (3,4/4,6,5,7)		
			15/06/2003	0800
			11.00	3.30
12.00-12.45 12.00-12.50	SPT C B 16	N=21 (4,4/4,6,5,6)	12.00	
13.00-13.45 13.00-13.50	SPT C B 17	N=28 (3,5/5,7,7,9)	13.00	
14.00-14.45 14.00-14.50	SPT C B 18	N=36 (4,4/6,8,10,12)	14.00	
15.00-15.45 15.00-15.50	SPT C B 19	N=33 (4,6/6,8,8,11)	15.00	
16.00-16.45 16.00-16.50	SPT C B 20	N=29 (5,5/6,7,7,9)	16.00	
17.00-17.45 17.00-17.50	SPT C B 21	N=29 (6,6/5,4,8,12)	17.00	
18.00-18.45 18.00-18.50	SPT C B 22	N=41 (4,4/8,9,10,14)	18.00	
18.85-18.90	D 23			
19.00-19.45	*SPT S*	*N=12 (2,3/3,2,3,4)*	19.00	
19.50-20.00	*B 24*			
			15/06/2003	1800
			20.00	3.30

Strata

Description	Depth,Level/ (Thickness)	Legend	Backfill/ Instrument
Medium dense grey sandy GRAVEL with some shell fragments. Sand is fine to medium. Gravel is subangular fine to medium. (ESTUARINE DEPOSIT).	(13.35)		
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	18.85 -15.36		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.60	Rose to 3.30 m after 20 minutes. Slow inflow	- -

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole

BH4

Sheet 2 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 13/06/2003 End 17/06/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth 0.00m / 14.50m / 250mm / 14.50m 14.50m / 33.50m / 200mm / 33.50m	Ground Level +3.49 mOD Coordinates E 319857.30 National Grid N 233620.06

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00-20.20 20.00-20.50	SPT S B 25	25 (12,25/25 for 50mm)	16/06/2003 20.00	0800 3.00
21.00-21.45 21.00-21.45	SPT S D 26	N=20 (3,3/4,4,6,6)	21.00	
22.00-22.50	B 27			
23.50-23.95 23.50-23.95 23.50-24.00	SPT S D 28 B 29	N=24 (4,4/4,6,8,6)	23.50	
24.00-24.45 24.00-24.45	SPT S D 30	N=38 (5,7/7,9,10,12)	24.00	
25.00-25.50	B 31			
25.50-25.95 25.50-25.95	SPT S D 32	N=39 (6,8/8,8,10,13)	25.50	
26.50-27.00	B 33			
27.00-27.45 27.00-27.45	SPT S D 34	N=42 (5,7/7,10,11,14)	27.00	
28.00-28.50	B 35			
28.50-28.95 28.50-28.95	SPT S D 36	N=47 (6,8/9,9,14,15)	28.50	
			16/06/2003 30.00	1800 3.00

Strata

Description	Depth, Level (Thickness)	Legend	Backfill / Instrumen
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	(14.62)		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.60	Rose to 3.30 m after 20 minutes. Slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH4
Sheet 3 of 4

Borehole Log

GEOTECH

Drilled by	MD
Logged by	PG
Checked by	MK

Start 13/06/2003
End 17/06/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	14.50m	250mm	14.50m
14.50m	33.50m	200mm	33.50m

Ground Level	+3.49 mOD
Coordinates	E 319857.30
National Grid	N 239620.06

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.00-30.45	SPT S	N=49 (5,8/10,10,13,15)	17/06/2003	0800
30.00-30.45	D 37		30.00	3.00
31.00-31.50	B 38			
31.50-31.95	SPT S	N=53 (6,8/11,13,14,15)	31.50	
31.50-31.95	D 39			
32.50-33.00	B 40			
33.00-33.45	SPT S	N=48 (7,7/10,12,12,14)	33.00	
33.00-33.45	D 41			
			17/06/2003	1800
			33.50	3.00

Strata

Description	Depth,Level/ (Thickness)	Legend	Backfill/ Instrument
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).			
EXPLORATORY HOLE ENDS AT 33.50 m	33.50 -30.01		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.60	Rose to 3.30 m after 20 minutes. Slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH4
Sheet 4 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 18/06/2003 End 27/06/2003	Equipment, Methods and Remarks Dando 175 cable tool drill rig. Hand dug inspection pit to 1.20m Cable percussive boring to 34.50m Installed 50mm standpipe	Depth from / to / Diameter / Casing Depth 0.00m 14.50m 250mm 14.50m 14.50m 34.50m 200mm 34.50m	Ground Level Coordinates National Grid	+4.38 mOD E 319914.98 N 233683.89

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00 0.00-0.50	B 1			
0.50-1.00	B 2			
1.20-1.65 1.20-1.70	SPT C B 3	N=42 (3,6/6,8,10,18)	1.20	
2.00-2.50	B 4			
2.50-2.78 2.50-3.00	SPT C B 5	50 (6,18/25,25 for 55mm)	2.50	
3.50-3.71 3.50-4.00	SPT C B 6	25 (10,25/25 for 60mm)	3.50	
			18/06/2003 4.00	1800
3.90 4.00-4.50	W 39 B 7			
			24/06/2003 4.00	0800 3.90
4.50-4.75 4.50-5.00	SPT C B 8	50 (3,20/25,25 for 20mm)	4.50	
5.00-5.50	B 9			
5.50-5.95 5.50-6.00	SPT C B 10	N=21 (4,4/4,6,5,6)	5.50	
6.00-6.50	B 11			
6.50-6.95 6.50-7.00	SPT C B 12	N=22 (3,4/4,4,7,7)	6.50	
7.50-7.95 7.50-8.00	SPT C B 13	N=26 (3,4/4,7,7,8)	7.50	
8.50-8.95 8.50-9.00	SPT C B 14	N=23 (3,4/5,5,5,8)	8.50	
9.50-9.95 9.50-10.00	SPT C B 15	N=28 (4,4/6,6,6,10)	9.50	
			24/06/2003 10.00	1800 5.60

Strata

Description	Depth,Level/ (Thickness)
Soft brown sandy CLAY and GRAVEL FILL with occasional cobbles and abundant fragments of metal, brick, wood, concrete. Slight hydrocarbon odour detected. (MADE GROUND)	(5.00)
Medium dense grey sandy GRAVEL with abundant shell fragments and occasional subrounded cobbles. Sand is fine to medium. Gravel is angular to rounded fine to coarse. (ESTUARINE DEPOSIT).	5.00 -0.62
Stratum continued next sheet	

Legend / Backfill / Instrumentation

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.90 m after 15 minutes. slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESC HBM (281), 30/10/2003 12:46:32 AGS

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH5
Sheet 1 of 4

Borehole Log

GEOTECH

Drilled by MD	Start 18/06/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	+4.38 mOD
Logged by PG	End 27/06/2003		0.00m	14.50m	250mm	14.50m	Coordinates	E 319914.98
Checked by MK			14.50m	34.50m	200mm	34.50m	National Grid	N 233683.89

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			25/06/2003	0800
			10.00	3.90
10.50-10.95	SPT C	N=22 (2,3/4,4,7,7)	10.50	
10.50-11.00	B 16			
11.50-11.95	SPT C	N=20 (1,2/4,4,6,6)	11.50	
11.50-12.00	B 17			
12.50-12.95	SPT C	N=27 (3,3/4,7,8,8)	12.50	
12.50-13.00	B 18			
13.50-13.95	SPT C	N=26 (4,4/4,7,7,10)	13.50	
13.50-14.00	B 19			
14.50-14.95	SPT C	N=26 (4,5/5,6,6,9)	14.50	
14.50-15.00	B 20			
15.50-15.95	SPT C	N=33 (4,4/8,7,8,10)	15.50	
15.50-16.00	B 21			
16.50-16.95	SPT C	N=31 (5,4/4,8,8,11)	16.50	
16.50-17.00	B 22			
			25/06/2003	1800
			17.00	3.90
			26/06/2003	0800
			17.00	4.00
17.50-17.95	SPT C	N=18 (3,4/4,4,5,5)	17.50	
17.50-18.00	B 23			
18.50-18.95	SPT C	N=23 (4,4/5,6,6,6)	18.50	
18.50-19.00	B 24			
19.10	D 25			
19.50-19.95	SPT S	N=12 (1,2/2,3,3,4)	19.50	
19.50-20.00	B 26			

Strata

Description	Depth,Level/ (Thickness)	Legend	Backfill/ Instruments
Medium dense grey sandy GRAVEL with abundant shell fragments and occasional subrounded cobbles. Sand is fine to medium. Gravel is angular to rounded fine to coarse. (ESTUARINE DEPOSIT).	(14.10)		SP
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT). 19.10-20.00 m slightly gravelly	19.10 -14.72		
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.90 m after 15 minutes. slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH5
Sheet 2 of 4

Borehole Log

GEOTECH

Drilled by MD Logged by PG Checked by MK	Start 18/06/2003 End 27/06/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth 0.00m / 14.50m / 250mm / 14.50m 14.50m / 34.50m / 200mm / 34.50m	Ground Level +4.38 mOD Coordinates E 319914.96 National Grid N 233683.89

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.00	D 27			
20.50-20.95 20.50-20.95	SPT S D 28	N=23 (3,4/4,6,6,7)	20.50	
21.50-21.95 21.50-22.00	SPT S B 29	N=36 (4,5/8,8,10,10)	21.50	
22.50-22.95 22.50-23.00	SPT S B 30	N=29 (4,4/6,7,7,9)	22.50	
23.50-23.95 23.50-24.00	SPT S B 31	N=22 (3,3/4,4,6,8)	23.50	
24.50-24.95 24.50-25.00	SPT S B 32	N=30 (4,4/7,7,7,9)	24.50	
			26/06/2003 25.00	1600 8.00
			27/06/2003 25.00	0600 3.90
26.00-26.45 26.00-26.50	SPT S B 33	N=30 (3,4/5,7,7,11)	26.00	
27.50-27.95 27.50-28.00	SPT S B 34	N=31 (3,4/4,8,7,12)	27.50	
29.00-29.45 29.00-29.50	SPT S B 35	N=35 (4,4/7,7,10,11)	29.50	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill / Instrumer
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).	(14.90)		
22.10-23.00 m slightly gravelly			
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.90 m after 15 minutes. slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH5
Sheet 3 of 4

Borehole Log

GEOTECH

Drilled by MD	Start 18/06/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	+4.38 mOD
Logged by PG	End 27/06/2003		0.00m	14.50m	250mm	14.50m	Coordinates	E 319914.98
Checked by MK			14.50m	34.50m	200mm	34.50m	National Grid	N 233683.89

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.50-30.95 30.50-31.00	SPT S B 36	N=34 (4,5/6,8,8,12)	30.50	
32.00-32.45 32.00-32.50	SPT S B 37	N=43 (6,6/8,9,12,14)	32.00	
33.50-33.95 33.50-34.00	SPT S B 38	N=49 (7,8/8,13,14,14)	33.50	
			27/06/2003	1800
			34.00	3.90

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine. (ESTUARINE DEPOSIT).			
EXPLORATORY HOLE ENDS AT 34.00 m	34.00 -29.62		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	Rose to 3.90 m after 15 minutes. slow inflow	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESC HBB (2011), 30/10/2003 12:48:42

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole
BH5
Sheet 4 of 4

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 16/05/2003 End 20/05/2003	**Equipment, Methods and Remarks** Casagrande C6 rotary drill rig Hand dug inspection pit to 1.20m. Rotary open hole drilling to 33.00m Rotary coring to 40.20m. Installed 50mm standpipe.	Ground Level +3.91 mOD Coordinates E 319822.62 National Grid N 233458.92

Depth from	to	Diameter	Casing Depth
0.00m	26.70m	131mm	26.70m
26.70m	33.00m	120mm	33.00m
33.00m	40.20m	76mm	35.90m

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)
					Driller reports black waste FILL with strong hydrocarbon (oily) odour.	(5.60)
						5.60 -1.70
5.70-6.15	SPT C	N=19 (2,3/5,4,4,6)	5.70		Driller reports SAND and GRAVEL.	
7.20-7.65	SPT C	N=21 (4,3/4,5,5,7)	7.20			
8.70-9.15	SPT C	N=17 (2,2/3,2,5,7)	8.70			

Stratum continued next sheet

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.20	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG HBM (2R1), 30/10/2003 12:47:24 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR6**
Sheet 1 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 16/05/2003
End 20/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	26.70m	131mm	26.70m
26.70m	33.00m	120mm	33.00m
33.00m	40.20m	76mm	35.90m

Ground Level +3.91 mOD
Coordinates E 319822.62
National Grid N 233458.92

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.20-10.65	SPT C	N=23 (3,4/5,5,7,6)	10.20	
11.70-12.15	SPT C	N=33 (5,7/7,8,9,9)	11.70	
13.20-13.59	SPT C	28 (4,5/6,7,8,7 for 13mm) Flush: 0.00-26.70 Air foam, 100 %	13.20	
14.70-15.15	SPT C	N=27 (2,2/3,7,7,10)	14.70	
16.20-16.65	SPT C	N=33 (6,7/7,8,9,9)	16.20	
			16/05/2003	1815
17.70-18.15	SPT C	N=29 (9,9/8,7,7,7)	17.70	7.80
			17/05/2003	0800
			17.70	4.70
19.20-19.65	SPT C	N=41 (6,7/9,10,11,11)	19.20	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Driller reports SAND and GRAVEL.	(10.70)		
Driller reports sandy SILT	16.30 -12.39		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.20	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR6
Sheet 2 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 16/05/2003 End 20/05/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level +3.91 mOD Coordinates E 319822.62 National Grid N 233458.92
			0.00m	26.70m	131mm	26.70m	
			26.70m	33.00m	120mm	33.00m	
			33.00m	40.20m	76mm	35.90m	

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth,Level (Thickness)	Legend	Backfill/ Instruments
					Driller reports sandy SILT			
20.70-21.15	SPT C	N=39 (10,7/9,9,10,11)	20.70					
						(10.40)		
22.20-22.65	SPT S	N=25 (4,4/5,6,7,7)	22.20					
23.70-24.15	SPT S	N=23 (4,5/5,6,5,7)	23.70					
25.20-25.65	SPT S	N=26 (5,5/6,6,7,7)	25.20					
			17/05/2003 26.70	1800 22.00				
26.70-27.15	SPT S	N=27 (4,5/7,7,6,7)	18/05/2003 26.70	0800 4.75	Driller reports SILT/CLAY	26.70 -22.79		
28.20-28.65	SPT S	N=29 (4,6/7,7,8,7)	26.70					
29.70-30.15	SPT S	N=30 (4,7/7,7,8,8)	26.70			(6.00)		
					Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.20	-	-

Depth Related Remarks

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG NBW (2R1), 30/10/2003 12:47:30 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR6**

Sheet 3 of 5

Units :		mg/kg	mg/kg	pH Units	mg/kg	mg/kg												
Method Codes :		SCNCR8	TPHFID	WSLM3	WSLM4	ICPBOR												
Detection Limits :		0.5	10.0		0.5	0.5												
UKAS Accredited :		yes	yes	yes	yes	no												
TES ID Number CU	Client Sample Description	Thiocyanate.	TPH GCFID (AR)	pH units	Phenol Index	Boron.												
0330243	BH001 3.6		72															
0330244	BH002 4.0	<0.5		9.6	<0.5	1.3												

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name	Geotech Specialists
Contact	Mr M Kelley

Dublin Waste

Soils Sample Analysis

Amended Report

Date Printed	7 November 2003
Report Number	EFS/034319
Table Number	1
Page Number	2 of 2

UKAS TESTING
1252

Report Notes

Soil/Solid analysis specific:
Results expressed as mg/kg unless stated otherwise
S04 analysis not conducted in accordance with BS1377
Water Soluble Sulphate on 2:1 water:soil extract
AR denotes analysis conducted on the As Received sample
co-eluted with benzo(b)fluoranthene
co-eluted with Indeno(123-cd)pyrene
BTEX analysis expressed as ug/kg As Received
Phenol HPLC results expressed as mg/kg As Received

Water analysis specific:
Results expressed as mg/l unless stated otherwise

Oil analysis specific:
Results expressed as mg/kg unless stated otherwise
S.G. expressed as g/cm^3@ 15°C

Filter analysis specific:
Results expressed as mg on filter unless stated otherwise

VOC analysis specific:
Explanatory notes for data flagging
U = undetected above reporting limit
J = concentration at instrument was below lowest calibration standard
E = concentration at instrument was above top calibration standard
B = compound was detected in method blank

Gas (Tedlar bag) analysis specific:
Results expressed as ug/l unless stated otherwise

Air (Carbon tube) analysis specific:
Results expressed as ug on tube unless stated otherwise

Asbestos analysis specific:
CH denotes Chrysotile
CR denotes Crocidolite
AM denotes Amosite
NADIS denotes No Asbestos Detected in Sample
NBFO denotes No Bulk fibres Observed
T Trace
L Low (2-15%)
M Medium (15-50%)
H High (>50%)

General notes:
^ this analysis was subcontracted to another laboratory
$ Within laboratory tolerances
$$ unable to analyse due to nature of sample
¥ Results for guidance only, possible interference
& Blank corrected
I.S insufficient sample for analysis
Intf Unable to analyse due to interferences
N.D Not determined
N.R Not recorded
N.Det Not detected
Req Analysis Requested, see attached sheets for results
***** denotes this result not UKAS accredited on this sample
Þ Raised detection limit due to nature of sample

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 16/05/2003 End 20/05/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth 0.00m 26.70m 131mm 26.70m 26.70m 33.00m 120mm 33.00m 33.00m 40.20m 76mm 35.90m	Ground Level +3.91 mOD Coordinates E 319822.62 National Grid N 233458.92

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
31.20-31.65	SPT C	N=28 (5,6/6,7,7,8)	26.70	
32.70-32.88	SPT C	50 (20,5 for 0mm/ 28,22 for 25mm)	32.70 18/05/2003 33.00	1730 0.00
			19/05/2003 33.00	0740 4.90
33.00-33.75 m	67 / 0 / 0	Flush: 26.70-40.20 Water, 100 % TCR 60, SCR 0, RQD 0		
33.75-34.05 m				
34.05-34.60 m	64 / 0 / 0			
34.60-34.70 m	NI	TCR 100, SCR 0, RQD 0		
34.70-34.74 m	NI / NI	TCR 100, SCR 0, RQD 0		
34.74-35.40 m	100 / 0 / 0			
35.40-35.90 m	26 / 0 / 0			
35.90-36.34 m	136 / 0 / 0			
36.34-37.40 m	100 / 69 / 63; NI 110 340			
37.40-37.88 m	100 / 65 / 0; NI 95 120			
37.88-38.70 m	100 / 65 / 50; NI 85 320			
38.70-39.63 m	100 / 59 / 32	If NI/100/100	19/05/2003 35.90	1830 8.60
39.63-40.20 m	100 / 75 / 40; NI 50 250		20/05/2003 35.90	0730 4.35
Depth	TCR SCR RQD / If	Records/Samples	Date Casing	Time Water

Strata

Description		Depth, Level (Thickness)
Driller reports SILT/CLAY		
Driller reports clayey GRAVEL (possible weathered rockhead) Core recovered as dark grey angular to subrounded GRAVEL and COBBLES of limestone with some dark brown silt/clay.	35.40-35.77 m AZCL	32.70 -28.79 (3.34)
Core recovered as very stiff dark grey to black slightly sandy gravelly CLAY. Gravel is angular to subangular, fine to medium.		36.04 -32.13 (0.30)
Strong to very strong grey fine-grained LIMESTONE with rare calcite veins. Joints are closely spaced, 20 to 45° dip, and planar rough. Weathering includes slight clay infill along fracture planes and zones of non-intact core reduced to angular to subangular gravel.	37.24-37.34 m non-intact	36.34 -32.43 (1.16)
Moderately strong to strong dark grey to black fine-grained MUDSTONE. Joints are closely spaced, 45 to 60° dip, and planar rough. Weathering includes zones of weak core.	38.00-38.15 m very weak core	37.50 -33.59 (0.38) 37.88 -33.97
Strong grey fine-grained LIMESTONE. Joints are closely to very closely spaced, 30 to 45° dip, and planar rough. Weathering includes zones of weak core and slight orange discoloration along fracture planes.	39.05-39.30 m very weak core 39.30-39.43 m non-intact 39.63-39.73 m non-intact	(1.42) 39.30 -35.39 39.53 -35.62 (0.67)
Stratum continued next sheet		

Legend | Backfill/ Instruments

Groundwater Entries No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.20	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG HBB (281). 30/10/2003 12:47:33 AGS

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole **BR6**
Sheet 4 of 5

Borehole Log

Drilled by MN Logged by PG Checked by MK	Start 16/05/2003 End 20/05/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth 0.00m 26.70m 131mm 26.70m 26.70m 33.00m 120mm 33.00m 33.00m 40.20m 76mm 35.90m	Ground Level +3.91 mOD Coordinates E 319622.62 National Grid N 233458.92

Samples and Tests / Strata

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill Instrument
				20/05/2003 35.90		39.30m - 39.53m : Moderately weak to moderatley strong dark grey to black fine-grained MUDSTONE. Joints are subhorizontal. Weathering includes core reduced to gravel and core wall and fracture planes coated in stiff black slightly gravelly clay. 39.53m - 40.20m : Strong to very strong grey fine-grained LIMESTONE. Joints are very closely to closely spaced, 20 to 30° dip, and undulating rough. No visible weathering. EXPLORATORY HOLE ENDS AT 40.20 m	40.20 -36.29		SP

Groundwater Entries No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.20	-	-

Depth Related Remarks: From / to (m)

Chiselling: Depths (m) / Time / Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG HBM (261), 30/10/2003 12:47:39 AGS

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole **BR6**
Sheet 5 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 20/05/2003 End 23/05/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level +3.66 mOD Coordinates E 319919.19 National Grid N 233463.25
		Casagrande C6 rotary rig Relocated 1.00m from BH7 due to mechanical failure. Hand dug inspection pit to 1.20m. Rotary open hole drilling to 36.40m. Rotary coring to 40.20m	0.00m 22.00m 36.40m	22.20m 36.40m 40.20m	131mm 120mm 76mm	22.20m 36.40m	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
1.50-1.95	SPT S	N=3 (1,1/0,1,1,1)	1.50	dry
3.60-4.05	SPT C	N=17 (2,3/3,4,5,5)	1.80	dry
5.10-5.55	SPT C	N=24 (3,6/6,5,6,7)	3.60	
6.60-7.05	SPT C	N=28 (4,4/7,7,6,8)	5.10	
8.10-8.55	SPT C	N=31 (7,7/6,8,8,9)	7.00	
9.60-10.05	SPT C	N=31 (7,7/6,8,8,9)	7.00	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
TARMAC pavement over GRAVEL FILL (MADE GROUND)	(1.20) 1.20 +2.46		
Driller reports black CLAY FILL and waste material with hydrocarbon (oil) odors. (MADE GROUND)	(4.10) 5.30 -1.64		
Driller reports silty sandy GRAVEL.			

Stratum continued next sheet

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.30	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG HBM (281), 30/10/2003 12:47:58 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR7A**

Sheet 1 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 20/05/2003
End 23/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	22.20m	131mm	22.20m
22.00m	36.40m	120mm	36.40m
36.40m	40.20m	76mm	

Ground Level +3.65 mOD
Coordinates E 319919.19
National Grid N 233463.25

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
11.10-11.55	SPT C	N=50 (12,11/15,10,11,14)		10.00
12.60-13.05	SPT C	N=40 (6,9/9,10,10,11)		12.60
14.10-14.55	SPT C	N=35 (7,8/7,8,10,10)		14.10
16.60-17.05	SPT C	N=51 (4,8/11,12,14,14)	20/05/2003 16.60	1840 3.20
			21/05/0200 16.60	0730 4.00
18.20-18.65 18.20	SPT S D 1	N=39 (7,6/8,10,10,11)		18.20
19.60-19.91 19.60	SPT S D 2	50 (3,9/14,21,15 for 10mm)		19.60

Depth	Type & No	Records	Date Casing	Time Water

Strata

Description	Depth,Level (Thickness)	Legend	Backfill Instrume
Driller reports silty sandy GRAVEL.	(11.30)		
Dense grey fine SAND. Driller reports SAND and GRAVEL	16.60 -12.94 (2.60)		
Very stiff dark grey brown slightly sandy CLAY.	19.20 -15.54		
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.30	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR7A
Sheet 2 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 20/05/2003
End 23/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	22.20m	131mm	22.20m
22.00m	36.40m	120mm	36.40m
36.40m	40.20m	76mm	

Ground Level +3.66 mOD
Coordinates E 319919.19
National Grid N 233463.25

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
21.20-21.65	SPT C	N=37 (4,7/8,8,9,12)	21.20	
22.60-23.05 22.60	SPT S D 3	N=28 (9,8/6,7,7,8)	22.20	
24.20-24.58 24.20	SPT S D 4	50 (14,11/14,18,18,- for 0mm)	24.20	
25.60-26.05 25.60	SPT S D 5	N=49 (7,8/11,12,13,13)	25.60	
27.20-27.60 27.20	SPT S D 6	50 (5,7/11,12,16,11 for 20mm)	27.20	
		Flush: 22.20-33.20 Water, 100 %		
28.60-29.05 28.60	SPT S D 7	N=28 (5,5/7,8,7,8)	28.60	

Strata

Description	Depth,Level/ (Thickness)	Legend	Backfill/ Instrument
Very stiff dark grey brown slightly sandy CLAY.	(15.20)		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.30	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR7A
Sheet 3 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 20/05/2003
End 23/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	22.20m	131mm	22.20m
22.00m	36.40m	120mm	36.40m
36.40m	40.20m	76mm	

Ground Level +3.66 mOD
Coordinates E 319919.19
National Grid N 233463.25

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.20-30.65	SPT S	N=38 (5,6/8,8,11,11)	30.20	
31.60-32.05 31.60	SPT C D 8	N=33 (5,6/7,8,9,9)	31.60	
33.20-33.65	SPT C	N=43 (7,8/10,10,11,12)	21/05/2003 33.20 ~~33.20~~ 22/05/2003 33.20	1600 6.25 0730 3.85
34.60-34.78	SPT C	50 (18,7/50 for 25mm)	34.60	
36.40-36.66 m		TCR 100, SCR 35, RQD 0		
36.66-36.76 m	NI 70 112	TCR 100, SCR 0, RQD 0		
36.76-37.04 m		TCR 100, SCR 68, RQD 39	22/05/2003 36.40	1800 1.60
37.04-37.08 m		TCR 100, SCR 0, RQD 0		
37.08-37.25 m		TCR 100, SCR 47, RQD 9	23/05/2003 36.40	0745 4.00
37.25-37.35 m		TCR 100, SCR 40, RQD 0		
37.35-38.10 m	100 71 59			
38.10-38.90 m	100 81 56	NI 130 250		
38.90-40.20 m	100 92 82			

Strata

Very stiff dark grey brown slightly sandy CLAY.

Driller reports gravel, boulders and clay bands. (possible weathered rockhead).

Recovered core is predominantly non-intact: strong to very strong gravel and cobbles of LIMESTONE. Weathering includes rock mass reduced to subangular medium gravel with soft brown binding clay at NI zones. Clay coating rock surfaces 0 to 45° and sub-horizontal 30° dip; undulating and rough.

36.40-36.45 m Stiff brown slightly gravelly clay bands

Strong to very strong grey to dark grey LIMESTONE with occasional calcite veins (thickness varying from 1mm to 15mm).

37.75-37.90 m NI

Joints are closely to medium spaced, 30 to 40° dip, planar and rough. Weathering includes zones of rock mass reduced to soft to firm brown clay, with stiff brown slightly gravelly clay infill along fracture planes at 37.80m to 37.90m. Rare subvertical fractures at calcite veins between 38.39 to 38.49m.

38.46-38.56 m non-intact

39.04-40.04 m very weak rock with calcite veins

Stratum continued next sheet

Depth,Level (Thickness)	Legend	Backfill / Instrumentation
34.40 -30.74		
(2.00)		
36.40 -32.74		
(0.85)		
37.25 -33.59		
(2.95)		

Depth | TCR SCR RQD | If | Records/Samples | Date Casing | Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.30	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESO HSW (361), 30/10/2003 12:48:04

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR7A
Sheet 4 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 20/05/2003 End 23/05/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level +3.66 mOD Coordinates E 319919.19 National Grid N 233463.25
			0.00m	22.20m	131mm	22.20m	
			22.00m	36.40m	120mm	36.40m	
			36.40m	40.20m	76mm		

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
				23/05/2003 36.40	1800 8.36

Strata

Description	Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
Strong to very strong grey to dark grey LIMESTONE with occasional calcite veins (thickness varying from 1mm to 15mm). Joints are closely to medium spaced, 30 to 40° dip, planar and rough. Weathering includes zones of rock mass reduced to soft to firm brown clay, with stiff brown slightly gravelly clay infill along fracture planes at 37.80m to 37.90m. Rare subvertical fractures at calcite veins between 38.39 to 38.49m.	40.20 *-36.54*		

EXPLORATORY HOLE ENDS AT 40.20 m

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.30	-	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG HBG (281), 30/10/2003 12:45:08 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole

BR7A

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 24/05/2003 End 28/05/2003	Equipment, Methods and Remarks Casagrande C8 rotary drill rig Hand dug inspection pit to 1.20m Rotary open hole drilling to 39.0m Rotary coring to 46.50m Installed 50mm diameter standpipe with stand up cover	Depth from / to / Diameter / Casing Depth 0.00m – 20.70m / 131mm / 20.70m 20.70m – 39.80m / 120mm / 39.80m 39.80m – 46.50m / 76mm / 41.20m

Ground Level +3.95 mOD
Coordinates E 319963.53
National Grid N 233492.81

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
1.50-1.61	SPT C	(25,50 for 35mm)	1.50	dry
2.60-3.05	SPT C	N=46 (5,1/1,4,2,39)	2.60	dry
4.20-4.60	SPT C	50 (7,7/14,13,13,10 for 20mm)	4.20	3.80
5.70-5.99	SPT C	50 (5,7/25,25 for 65mm)	5.70	
7.20-7.65	SPT C	N=40 (5,6/9,10,10,11)	7.20	
8.70-9.15	SPT C	N=24 (2,3/4,5,5,9)	8.70	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill / Instrumentation
Driller reports FILL material with concrete, rubble and bricks. (MADE GROUND)	(2.30)		
Driller reports clayey GRAVEL.	2.30 +1.65 (1.40)		
Driller reports light grey SAND and GRAVEL.	3.70 +0.25 (0.50)		1
Driller reports grey blue CLAY/SILT	4.20 -0.25 (2.50)		
Driller reports grey SAND.	6.70 -2.75 (0.50)		
Driller reports coarse GRAVEL.	7.20 -3.25 (1.50)		
Driller reports GRAVEL with clay bands.	8.70 -4.75		
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR8
Sheet 1 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 24/05/2003
End 28/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	20.70m	131mm	20.70m
20.70m	39.80m	120mm	39.80m
39.80m	46.50m	76mm	41.20m

Ground Level +3.95 mOD
Coordinates E 319983.53
National Grid N 233492.81

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.20-10.65	SPT C	N=29 (4,5/7,7,7,8) Flush: 0.00-20.70 Air, 100 %	10.20	
11.70-12.15	SPT C	N=40 (6,9/9,10,10,11)	11.70	
13.20-13.65	SPT C	N=39 (6,7/10,10,9,10)	13.20	
14.70-15.15	SPT C	N=44 (9,7/11,11,10,12)	24/05/2003 14.70	1845 4.30
			25/05/2003 14.70	0730 9.83
16.20-16.65	SPT C	N=39 (5,7/8,9,11,11)	16.20	
17.70-18.15	SPT C	N=40 (6,8/9,10,10,11)	17.70	
19.20-19.65	SPT C	N=31 (4,6/6,7,9,9)	19.20	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller reports GRAVEL with clay bands.	(4.50)		
Driller reports brown clayey GRAVEL.	13.20 -9.25		
	(3.00)		
Driller reports black sandy SILT with gravel bands.	16.20 -12.25		
	(2.90)		
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine.	19.10 -15.15		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG Hdbk (281), 30/10/2003 12:48:28

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR8
Sheet 2 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start	24/05/2003
End	28/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	20.70m	131mm	20.70m
20.70m	39.80m	120mm	39.80m
39.80m	46.50m	76mm	41.20m

Ground Level	+3.95 mOD
Coordinates	E 319983.53
National Grid	N 233492.81

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.70-21.15 20.70	SPT S D 1	N=22 (2,3/3,5,8,8)	20.70	
22.20-23.15 22.20	SPT S D 2	N=50 (11,12/10,12,15,13)	22.20	
23.70-24.15 23.70	SPT S D 3	49 (9,11/12,13,14,10 for 70mm)	23.70	
25.20-25.65 25.20	SPT S D 4	N=30 (4,6/6,7,8,9)	25.20	
26.70-27.15 26.70	SPT S D 5	N=37 (5,10/5,10,10,12)	26.70	
28.20-28.65 28.20	SPT S D 6	N=28 (6,7/7,8,6,7)	28.20	
29.70-30.15 29.70	SPT S D 7	N=29 (7,7/7,8,6,8)	29.70	

Strata

Description	Depth/Level/ (Thickness)	Legend	Backfill/ Instrument
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine.	(17.10)		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole
BR8
Sheet 3 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start	24/05/2003
End	28/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	20.70m	131mm	20.70m
20.70m	39.80m	120mm	39.80m
39.80m	46.50m	76mm	41.20m

Ground Level	+3.95 mOD
Coordinates	E 319983.53
National Grid	N 233492.81

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
31.20-31.65 31.20	SPT S D 8	N=29 (5,6/7,7,8,7)	25/05/2003 20.70	1730 3.60
			26/05/2003 20.70	0730 3.80
32.70-33.15 32.70	SPT S D 9	N=28 (5,6/6,6,6,10)	32.70	
		Flush: 20.70-46.50 Mud drilling, 100 %		
34.20-34.65	SPT C	N=30 (6,7/7,8,8,7)	34.20	
35.70-35.74	SPT C	(75 for 35mm)	35.70	
37.20	SPT C	(50 for 0mm)	37.20	
39.00-39.10 m		TCR 100, SCR 60, RQD 0		
39.10-39.30 m		TCR 50, SCR 0, RQD 0		
39.30-39.70 m	50 0 0			
39.70-39.80 m		TCR 0, SCR 0, RQD 0	26/05/2003 39.80	1800 5.20
39.80-40.00 m		TCR 25, SCR 0, RQD 0	27/05/2003	0730

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Firm to very stiff dark grey brown slightly sandy CLAY. Sand is fine.			
Drillers reports gravel, boulders and clay bands.	36.20 -32.25		
Recovered as grey sandy GRAVEL with compact dark brown clay bands. Gravel is subangular to subrounded fine to coarse, sand is fine to coarse. (possible weathered rockhead). 39.00-39.10 m clay bands	(2.80)		
Stratum continued next sheet	39.00 -35.05		

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	-	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole

BR8

Sheet 4 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 24/05/2003
End 28/05/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	20.70m	131mm	20.70m
20.70m	39.80m	120mm	39.80m
39.80m	46.50m	76mm	41.20m

Ground Level +3.95 mOD
Coordinates E 319963.53
National Grid N 233492.81

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
40.00-40.30 m		NI	TCR 17, SCR 0, RQD 0	39.80	8.25
		NI			
	29	70			
40.30-40.65 m	0				
	0				
	18				
40.65-41.20 m	0				
	0				
41.20-41.30 m			TCR 100, SCR 0, RQD 0		
	100				
41.30-42.00 m	80				
	70				
	100				
42.00-43.50 m	77				
	61				
		NI			
	100	200			
43.50-45.00 m	91	800			
	85				
	100				
45.00-46.50 m	99				
	99				
				27/05/2003	1800
				41.20	6.35

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Recovered as grey sandy GRAVEL with compact dark brown clay bands. Gravel is subangular to subrounded fine to coarse, sand is fine to coarse. (possible weathered rockhead).	(2.30)		
Moderately weak to strong fine to coarse grained LIMESTONE with high calcite content (irregular matrix).	41.30 -37.35		
Joints are closely spaced, 10 to 30° dip, smooth and stepped. Weathering includes slight weakening of rock strength at joints; moderately weak crystalline calcite - platy habit (80 to 90% calcite content)			
42.00-42.30 m zone of weak rock			
43.85-44.20 m zone of weak rock	(5.20)		
44.55-44.70 m subvertical fracture, undulating and rough			
45.45-45.60 m subvertical fracture, undulating and rough			
45.50-45.55 m Pyrite veins			
46.15-46.50 m subvertical fracture, undulating and rough			
EXPLORATORY HOLE ENDS AT 46.50 m	46.50 -42.55		SP

Depth | TCR SCR RQD | If | Records/Samples | Date Casing | Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	-	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR8
Sheet 5 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 09/06/2003 End 12/06/2003	Equipment, Methods and Remarks Casagrande C8 rotary rig Hand dug inspection pit to 1.20m Rotary open hole drilling to 44.70m Rotary coring to 49.50m Installed 50mm standpipe with stand up cover

Depth from	to	Diameter	Casing Depth
0.00m	39.00m	131mm	39.00m
39.00m	44.70m	120mm	44.70m
44.70m	49.50m	76mm	

Ground Level +4.29 mOD
Coordinates E 319870.84
National Grid N 233701.08

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
1.50-1.95	SPT C	N=12 (3,2/3,3,2,4)	1.50	dry
3.00-3.45	SPT C	N=10 (1,1/2,2,3,3)	3.00	dry
4.50-4.95	SPT C	N=11 (2,2/2,3,3,3)	4.50	4.10
6.00-6.45	SPT C	N=16 (1,1/3,4,4,5)	6.00	
7.50-7.95	SPT C	N=21 (3,4/5,6,5,5)	7.50	
9.00-9.45	SPT C	N=24 (4,5/6,6,5,7)	9.00	

Strata

Description	Depth, Level (Thickness)
Driller reports soft light grey gravelly CLAY.	(3.00) 3.00 +1.29
Driller reports soft sandy CLAY.	(1.20) 4.20 +0.09
Driller reports black shale GRAVEL.	(1.80) 6.00 -1.72
Driller reports sandy GRAVEL with shells.	(2.70) 8.70 -4.42
Driller reports GRAVEL with silt and sand bands.	

Stratum continued next sheet

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	-	-

Depth Related Remarks

From	to (m)	
0.00	1.20	Inspection pit

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG KBM (261), 20/10/2003 12:45:55 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR9**
Sheet 1 of 5

Borehole Log

GEOTECH

Drilled by MN	Start 09/06/2003	Equipment, Methods and Remarks
Logged by PG	End 12/06/2003	
Checked by MK		

Depth from	to	Diameter	Casing Depth
0.00m	39.00m	131mm	39.00m
39.00m	44.70m	120mm	44.70m
44.70m	49.50m	76mm	

Ground Level +4.29 mOD
Coordinates E 319870.84
National Grid N 233701.08

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT C	N=28 (6,6/7,6,7,8)	10.50	
12.00-12.40	SPT C	50 (8,10/10,11,12,17 for 20mm)	12.00	
13.50-13.95	SPT C	N=38 (8,8/7,9,11,11)	13.50	
15.00-15.38	SPT C	50 (10,10/12,14,17,7 for 0mm)	15.00	
16.50-16.95	SPT C	N=35 (8,8/7,8,9,11)	16.50	
18.00-18.45 18.00	SPT S D 1	N=31 (4,6/8,7,9,7)	18.00	
19.50-19.95 19.50	SPT S D 2	N=19 (4,5/4,4,5,6)	19.50	

Strata

Description	Depth,Level/ (Thickness)	Legend	Backfill Instrumen
Driller reports GRAVEL with silt and sand bands.	(8.10)		
Firm to stiff grey brown slightly sandy CLAY..Sand is fine.	16.80 -12.51		
Stratum continued next sheet			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR9
Sheet 2 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 09/06/2003 End 12/06/2003	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level +4.29 mOD Coordinates E 319870.84 National Grid N 233701.08
			0.00m	39.00m	131mm	39.00m	
			39.00m	44.70m	120mm	44.70m	
			44.70m	49.50m	76mm		

Samples and Tests / Strata

Depth	Type & No	Records	Date / Casing	Time / Water	Description	Depth, Level (Thickness)
					Firm to stiff grey brown slightly sandy CLAY. Sand is fine.	
			09/06/2003 21.00	1830 12.47		
21.00-21.45 21.00	SPT S D 3	N=29 (4,4/6,7,8,8)	10/06/2003 21.00	0730 6.30		
22.50-22.95 22.50	SPT S D 4	N=28 (5,4/5,7,7,9)	22.50			
24.00-24.45 24.00	SPT S D 5	N=26 (5,5/6,5,7,8)	24.00			
25.50-25.95 25.50	SPT S D 6	N=27 (5,6/6,7,7,7)	25.50			
27.00-27.45 27.00	SPT S D 7	N=25 (4,4/6,5,6,8)	27.00			
						(22.20)
28.50-28.95 28.50	SPT S D 8	N=22 (5,4/6,5,5,6)	28.50			
					Stratum continued next sheet	

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG HBM (281), 30/10/2003 12:48:01 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR9**

Borehole Log

GEOTECH

Drilled by	MN
Logged by	PG
Checked by	MK

Start 09/06/2003
End 12/06/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	39.00m	131mm	39.00m
39.00m	44.70m	120mm	44.70m
44.70m	49.50m	76mm	

Ground Level +4.29 mOD
Coordinates E 319870.84
National Grid N 233701.08

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.00-30.45 30.00	SPT S D 9	N=26 (4,4/6,7,7,6)	30.00	
31.50-31.95 31.50	SPT S D 10	N=23 (4,5/4,5,6,7)	31.50	
33.00-33.45 33.00	SPT S D 11	N=29 (4,6/7,7,7,8)	33.00	
		Flush: 21.00-46.30 Water, 95 %		
34.50-34.95 34.50	SPT S D 12	N=22 (5,7/6,5,5,5)	34.50	
36.00-36.45 36.00	SPT S D 13	N=26 (4,5/5,6,7,8)	36.00	
37.50-37.95 37.50	SPT S D 14	N=29 (5,6/6,7,8,8)	37.50	
39.00-39.45 39.00	SPT S D 15	N=28 (6,7/6,7,7,8)	10/06/2003 1745 39.00 8.65 ~~39.00~~ 11/06/2003 0730 39.00 5.86	

Strata

Description	Depth,Level (Thickness)	Legend	Backfill Instrumen
Firm to stiff grey brown slightly sandy CLAY. Sand is fine.			
Driller reports gravelly SILT.	39.00 -34.71		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR9
Sheet 4 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by PG Checked by MK	Start 03/06/2003 End 12/06/2003	Equipment, Methods and Remarks	Ground Level +4.29 mOD Coordinates E 319870.84 National Grid N 233701.08

Depth from	to	Diameter	Casing Depth
0.00m	39.00m	131mm	39.00m
39.00m	44.70m	120mm	44.70m
44.70m	49.50m	76mm	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
40.50-40.95	SPT C	N=26 (6,7/7,7,6,6)	40.50	
42.00-42.45	SPT C	N=28 (5,5/6,7,7,8)	42.00	
43.50-43.67	SPT C	22 (25,28/22 for 15mm)	43.50	
44.70-44.80 m		TCR 100, SCR 50, RQD 0		
44.80-46.30 m	100 91 85 / NI 70 290		11/06/2003 44.70	1630 18.60
46.30-47.00 m	100 86 86			
47.00-48.15 m	100 89 59 / NI 150 350	Flush: 46.30-49.50 Water, 0 %		
48.15-49.50 m	100 96 79		12/06/2003 44.70	0730 16.30

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description	Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
Driller reports gravelly SILT.	(4.50) 43.50 *-39.21*		
Driller reports gravel, boulders and clay bands.	(1.20) 44.70 *-40.41*		
Strong to very strong dark grey fine to coarse-grained LIMESTONE with occasional calcite veins. Joints are closely to medium spaced, 30 to 40° dip, undulating and smooth. Weathering includes uncompact grey brown silt infill along fracture planes. 44.70-44.80 m NI 45.60 m 50° fracture along 10mm thick calcite vein 46.30-46.45 m NI 46.70 m 20° fracture along 5mm thick calcite vein 46.85-46.90 m occasional vugs in calcite veins 47.00-47.05 m NI 47.40-49.05 m silt coating at joint surfaces 48.20-48.50 m subvertical fracture along pre-existing calcite vein, smooth and planar	(4.80) 49.50 *-45.21*		SP
EXPLORATORY HOLE ENDS AT 49.50 m			

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	4.10	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR9**

Borehole Log

GEOTECH

Drilled by MN Logged by JL Checked by MK	Start 03/06/2003 End 06/06/2003	Equipment, Methods and Remarks Casagrande C6 rotary drill rig Hand dug inspection pit to 1.20m. Rotary open hole drilling to 38.55m. Rotary coring to 43.17m. Borehole backfilled with grout	Depth from / to / Diameter / Casing Depth 0.00m / 20.70m / 131mm / 20.70m 20.70m / 38.55m / 120mm / 38.55m 38.55m / 43.17m / 76mm	Ground Level +4.30 mOD Coordinates E 320004.82 National Grid N 233686.92	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
1.50-1.95	SPT C	N=5 (2,1/1,2,1,1)	1.50	dry
3.00-3.45	SPT C	N=6 (1,2/1,1,2,2)	3.00	dry
4.50-4.95	SPT C	N=6 (2,1/1,2,2,1)	4.50	dry
6.00-6.45	SPT C	N=5 (2,1/1,1,1,2)	6.00	5.80
7.50-7.91	SPT C	50 (2,4/7,14,17,12 for 35mm)	7.50	
9.00-9.45	SPT C	Flush: 0.00-17.70 Air, 100 % N=36 (2,3/5,9,10,12)	9.00	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill / Instrumen
Driller reports ASH and GRAVEL FILL with metal fragments (MADE GROUND)	(5.40)		
Driller reports SAND and GRAVEL with shells.	5.40 -1.10		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR10
Sheet 1 of 5

Borehole Log

GEOTECH

Drilled by MN	Start 03/06/2003	Equipment, Methods and Remarks
Logged by JL	End 06/06/2003	
Checked by MK		

Depth from	to	Diameter	Casing Depth
0.00m	20.70m	131mm	20.70m
20.70m	38.55m	120mm	38.55m
38.55m	43.17m	76mm	

Ground Level	+4.30 mOD
Coordinates	E 320004.82
National Grid	N 233686.92

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT C	N=35 (3,6/7,8,9,11)	10.50	
12.00-12.33	SPT C	50 (8,10/12,24,14 for 25mm)	12.00	
13.50-13.95	SPT C	N=49 (9,10/9,9,11,20)	13.50	
15.00-15.45	SPT C	N=35 (6,5/6,7,10,12)	15.00	
16.50-16.90	SPT C	50 (7,6/8,9,9,24 for 20mm)	16.50	
			03/06/2003	1630
			17.70	14.10
			04/06/2003	0730
			17.70	6.20
18.00-18.40	SPT C	49 (8,8/11,10,11,17 for 25mm)	18.00	
19.50-19.95	SPT S	N=20 (3,2/4,5,5,6)	19.50	
19.50	D 1			

Strata

Description	Depth,Level (Thickness)	Legend	Backfill/ Instrument
Driller reports SAND and GRAVEL with shells.	(12.80)		
Firm to stiff grey brown slightly sandy CLAY. Sand is fine to medium.	18.20 -13.90		
Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR10
Sheet 2 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by JL Checked by MK	Start 03/06/2003 End 06/06/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth	Ground Level / Coordinates / National Grid
			0.00m 20.70m 131mm 20.70m 20.70m 38.55m 120mm 38.55m 38.55m 43.17m 76mm	Ground Level +4.30 mOD Coordinates E 320004.82 National Grid N 233686.92

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
					Firm to stiff grey brown slightly sandy CLAY. Sand is fine to medium.			
21.00-21.45 21.00	SPT S D 2	N=23 (2,3/4,4,7,8)	21.00					
22.50-22.95 22.50	SPT S D 3	N=18 (2,3/5,4,4,5)	22.50					
24.00-24.45 24.00	SPT S D 4	N=21 (3,2/4,6,5,6)	24.00					
25.50-25.95 25.50	SPT S D 5	N=21 (3,3/5,4,6,6)	25.50					
27.00-27.45 27.00	SPT S D 6	N=35 (3,6/7,8,10,10)	27.00			(18.30)		
28.50-28.95 28.50	SPT S D 7	Flush: 20.70-36.00 Water, 100 % N=24 (4,4/6,6,7,5)	28.50					
					Stratum continued next sheet			

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

(c) MESG H800 (287), 30/10/2003 12:47:01 AGS

Project	Dublin Waste to Energy
Project No.	KD3116
Carried out for	Dublin City Council

Borehole **BR10**
Sheet 3 of 5

Borehole Log

GEOTECH

Drilled by	MN
Logged by	JL
Checked by	MK

Start 03/06/2003
End 06/06/2003

Equipment, Methods and Remarks

Depth from	to	Diameter	Casing Depth
0.00m	20.70m	131mm	20.70m
20.70m	38.55m	120mm	38.55m
38.55m	43.17m	76mm	

Ground Level +4.30 mOD
Coordinates E 320004.82
National Grid N 233686.92

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
30.00-30.45 30.00	SPT S D 8	N=25 (5,5/5,7,7,6)	30.00	
31.50-31.95 31.50	SPT S D 9	N=17 (3,3/4,3,5,5)	31.50	
33.00-33.45 33.00	SPT S D 10	N=29 (7,6/6,8,7,8)	33.00	
34.50-34.95 34.50	SPT S D 11	N=27 (6,5/6,7,8,6)	34.50	
36.00-36.45 36.00	SPT S D 12	N=43 (9,11/8,11,9,15)	04/06/2003 1630 36.00 1.20 ~~36.96~~ 05/06/2003 0730 36.00 4.35	
37.50-37.56	SPT C	50 (25 for 35mm/50 for 20mm)	37.50	
38.55	~~SPT C~~	(25 for 0mm/50 for 0mm)	38.50	
38.55-39.15 m	100 42 42	NI NI 150		
39.15-39.66 m	100 71 53		Flush: 36.00-43.17 Mud, 100 %	
39.66-40.17 m	100 88 78			

Depth	Type & No	If	Records/Samples	Date Casing	Time Water

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
Firm to stiff grey brown slightly sandy CLAY. Sand is fine to medium.			
Driller reports clayey SAND and GRAVEL and boulders with clay.	36.50 -32.20 (2.05)		
Moderately strong to strong dark and light grey slightly fossiliferous medium to coarse-grained LIMESTONE with rare calcite veins. 38.55-38.70 m non-intact, recoved as gravel Joints are closely to medium spaced, 45 to 60° dip, and rough undulating. Weathering includes soft grey sandy clay infill along fracture planes. 39.40-39.60 m subvertical fracture along calcite vein Stratum continued next sheet	38.55 -34.25 (2.45)		

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1:50

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Borehole
BR10
Sheet 4 of 5

Borehole Log

GEOTECH

Drilled by MN Logged by JL Checked by MK	Start 03/06/2003 End 06/06/2003	Equipment, Methods and Remarks	Depth from / to / Diameter / Casing Depth 0.00m 20.70m 131mm 20.70m 20.70m 38.55m 120mm 38.55m 38.55m 43.17m 76mm	Ground Level +4.30 mOD Coordinates E 320004.82 National Grid N 233686.92

Samples and Tests / Strata

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
		NI 70 270				Moderately strong to strong dark and light grey slightly fossiliferous medium to coarse-grained LIMESTONE with rare calcite veins. Joints are closely to medium spaced, 45 to 60° dip, and rough undulating. Weathering includes soft grey sandy clay infill along fracture planes.			
40.17-41.67 m	105 93 71						41.00 -36.70		
				05/06/2003 38.55	1630 11.30	Strong dark to light grey medium to coarse-grained thickly laminated to thinly bedded LIMESTONE. Joints are medium spaced, 35 to 45° dip, smooth and planar, predominantly along bedding planes. No visible weathering, slight discolouration along fracture planes. 41.30 m 40° fracture along calcite vein. 42.50-42.58 m subvertical rough fracture	(2.17)		
		40 150 300		06/06/2003 38.55	0730 6.25				
41.67-43.17 m	93 93 90								
				06/06/2003 38.55	1500		43.17 -38.87		
						EXPLORATORY HOLE ENDS AT 43.17 m			

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.80	-	-

Depth Related Remarks
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50 (c) MESG NBR (2R1), 30/10/2003 12:47:06 AGS

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Borehole **BR10**

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB 3CX Trial pit terminated at required depth. Pit backfilled with arisings.	Dimensions and Orientation Width 0.75 m Length 3.20 m 110 (Deg)	Ground Level +3.81 mOD Coordinates E 319901.10 National Grid N 233417.70

Samples and Tests

Depth	Type & No.	Date Records
0.50-0.60	B 1	
0.50-0.60	D 2	
1.20-1.60	B 3	
1.20-1.60	D 4	
2.40-2.60	B 5	
2.40-2.60	D 6	
3.40	W 7	
3.40	W 8	
3.50-3.70	D 10	
3.50-3.70	B 9	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
1 Soft, brown slightly sandy slightly gravelly CLAY FILL with rare brick fragments metal and plastic. Gravel is subangular to subrounded fine to medium (MADE GROUND)	(0.50)		
2 Grey slightly clayey gravelly SAND with ASH FILL. Gravel is subangular to subrounded fine to medium (MADE GROUND)	0.50 +3.31		
3 Soft dark brown sandy slightly gravelly CLAY and ASH FILL with occasional brick fragments. Gravel is subangular to subrounded fine to medium. (MADE GROUND).	0.70 +3.11		
2.00 m Rare shells and some ceramic fragments	(3.30)		
EXPLORATORY HOLE ENDS AT 4.00 m	4.00 -0.19		

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck (m)	Post Strike (m)	Behaviour
140	3.40		Very Fast Inflow

Depth Related Remarks
From to (m)

Stability Moderate
Shoring None
Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
TP01
Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB3CX Trial pit terminated at required depth. Pit backfilled with arisings.	Dimensions and Orientation Width 0.75 m Length 3.42 m 285 (Deg)	Ground Level +3.72 mOD Coordinates E 319867.74 National Grid N 233463.92

Samples and Tests

Depth	Type & No.	Date Records
1.00-1.10	B 1	
1.00-1.10	D 2	
2.00-2.20	B 3	
2.00-2.20	D 4	
3.20-3.40	B 5	
3.20-3.40	D 6	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrumen
1 TARMAC pavement (MADE GROUND)	0.08 +3.64		
2 Grey slightly clayey sandy GRAVEL (subbase) with frequent angular to subangular cobbles. Sand is fine to coarse gravel is angular fine to coarse (MADE GROUND)	(0.30)		
3 Soft dark brown slightly sandy gravelly CLAY and ASH FILL with many pockets of gravel and occasional cobble and boulder-sized fragments of red brick, glass concrete, wood, slate and plastic (MADE GROUND)	0.38 +3.34		
3.10 m becoming damp	(3.22)		
4 Dark grey fine to medium SAND with some medium spaced dark grey laminae of SILT. (ESTUARINE DEPOSIT)	3.60 +0.12		
	(0.80)		
EXPLORATORY HOLE ENDS AT 4.40 m	4.40 -0.68		

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck (m)	Post Strike (m)	Behaviour
1	3.45		Strong Inflow

Depth Related Remarks
From to (m)

Stability Moderate
Shoring None
Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
TP02
Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 15/05/2003 End 15/05/2003	Equipment, Methods and Remarks Excavated by JCB 3CX Trial Pit terminated due to poor stability. Pit backfilled with arisings.	Dimensions and Orientation Width 0.60 m Length 3.00 m 20 (Deg)	Ground Level +3.67 mOD Coordinates E 319951.50 National Grid N 233435.75

Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
			1 TARMAC pavement overlying crushed stone subbase (MADE GROUND).	(0.30)		
			2 Soft brown sandy CLAY and GRAVEL FILL with many pockets of coarse gravel and occasional boulder-sized (50 x 25 x 20cms) fragments of red/yellow brick, plastic metal, concrete. Sand is fine to coarse, gravel is subangular to subrounded fine to coarse. (MADE GROUND)	0.30 +3.37		
0.60-0.80 0.60-0.80	B 1 D 2					
1.80-2.00 1.80-2.00	B 3 D 4			(3.10)		
2.80-3.20 2.80-3.20	B 5 D 6		3.20-3.40 m sidewall collapse			
			EXPLORATORY HOLE ENDS AT 3.40 m	3.40 +0.27		
Depth	Type & No.	Records Date				

Groundwater Entries			Depth Related Remarks	Stability poor below 3.20 m.
No.	Struck (m)	Post Strike Behaviour	From to (m)	Shoring None
1	3.20	Moderate Inflow		Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
TP03
Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB3CX Trial Pit terminated at required depth. Pit backfilled with arisings.	Dimensions and Orientation Width 0.75 m Length 3.10 m 286 (Deg)	Ground Level +3.70 mOD Coordinates E 319855.15 National Grid N 233525.52

Samples and Tests

Depth	Type & No.	Date Records
0.50-0.60	B 1	
0.50-0.60	D 2	
1.20-1.40	B 3	
1.20-1.40	D 4	
2.40-2.50	B 5	
2.40-2.50	D 6	
2.80-3.00	B 7	
2.80-3.00	D 8	
3.90-4.10	D 10	
3.90-4.10	B 9	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrume
1 TARMAC pavement over dark grey gravel subbase. (MADE GROUND).	(0.47)		
3 Dark brown sandy CLAY and GRAVEL FILL with pockets of ash and coarse gravel to cobble-sized fragments of red/yellow bricks, concrete, slate , wood, steel bars and plastics (MADE GROUND)	0.47 +3.23 (2.33)		
4 Grey clayey gravelly SAND. Gravel is subangular to subrounded fine to medium (ESTUARINE DEPOSIT)	2.80 +0.90 (1.40)		
EXPLORATORY HOLE ENDS AT 4.20 m	4.20 -0.50		

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck	Post Strike	Behaviour
	(m)		

None observed (see Key Sheet)

Depth Related Remarks

From to (m)

Stability poor

Shoring none

Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25 (c) MEDG HBM (.287), 30/10/2003 12:51:01 AGS

Project Dublin Waste to Energy

Project No. KD3116

Carried out for Dublin City Council

Trial Pit

TP04

Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 15/05/2003 End 15/05/2003	Equipment, Methods and Remarks Excavated by JCB 3CX Trial pit terminated at 3.10 m due to obstruction. Pit backfilled with arisings.	Dimensions and Orientation Width 0.90 m Length 2.90 m 270 (Deg)	Ground Level +3.35 mOD Coordinates E 319849.51 National Grid N 233570.09

Samples and Tests

Depth	Type & No.	Date Records
0.70-0.80	B 1	
0.70-0.80	D 2	
1.80-2.00	B 3	
1.80-2.00	D 4	
2.80-3.00	B 5	
2.80-3.00	D 6	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
1 TOPSOIL: soft sandy gravelly CLAY with roots. Sand is fine to medium. Gravel is subangular to subrounded fine to medium	0.15 +3.20		
2 Soft dark brown sandy CLAY and GRAVEL FILL with abundant pockets of coarse gravel and occasional boulder-sized (up to 160cm) fragments of brick and concrete, some wood, glass, wire and slate. (MADE GROUND)	(2.95)		
2.80 m concrete blocks			
EXPLORATORY HOLE ENDS AT 3.10 m	3.10 +0.25		

Depth	Type & No.	Records Date

Groundwater Entries
No. Struck Post Strike Behaviour (m)
None observed (see Key Sheet)

Depth Related Remarks
From to (m)

Stability poor
Shoring none
Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
TP05
Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 15/05/2003 End 15/05/2003	Equipment, Methods and Remarks Excavated by JCB3CX Trial pit terminated due to poor stability. Pit backfilled with arisings.	Dimensions and Orientation Width 0.90 m Length 3.10 m 15 (Deg)	Ground Level +3.45 mOD Coordinates E 319916.98 National Grid N 233552.27

Samples and Tests

Depth	Type & No.	Date Records
0.80-1.00	B 1	
0.80-1.00	D 2	
1.80-2.00	B 3	
1.80-2.00	D 4	
2.80-3.00	B 5	
2.80-3.00	D 6	
3.20	W 7	
3.20	W 8	
3.50-3.70	D 10	
3.50-3.70	B 9	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
1 Gravel - Hard Standing (MADE GROUND).	(0.40)		
2 Soft brown slightly sandy CLAY and GRAVEL FILL with many pockets of coarse gravel to boulder-sized fragments of yellow/red brick, concrete, concrete blocks, limestone and granite, abundant glass, cloth and wood fragments. Sand is fine to coarse, gravel is subangular to subrounded fine to coarse. (MADE GROUND)	0.40 +3.05 (3.00)		
2.50 m limestone boulder			
3 Dark grey to black fine to medium SAND (ESTUARINE DEPOSIT)	3.40 +0.05 (0.30)		
EXPLORATORY HOLE ENDS AT 3.70 m	3.70 -0.25		

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck	Post Strike	Behaviour
	(m)	(m)	
1	3.20		Very fast inflow

Depth Related Remarks
From to (m)

Stability poor
Shoring none
Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
TP06
Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG	Start 15/05/2003	Equipment, Methods and Remarks	Dimensions and Orientation	Ground Level +3.77 mOD
Checked by MK	End 15/05/2003	Excavated by JCB3CX Trial pit terminated due to poor stability. Pit backfilled with arisings.	Width 0.80 m Length 3.20 m 197 (Deg)	Coordinates E 319965.50 National Grid N 233562.82

Samples and Tests

Depth	Type & No.	Date Records
0.70-0.80	B 1	
0.70-0.80	D 2	
1.80-2.00	B 3	
1.80-2.00	D 4	
2.80-3.00	B 5	
2.80-3.00	D 6	
3.40	W 7	
3.40	B 8	

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
1 GRAVEL - Hard Standing (MADE GROUND)			
2 Soft brown slightly sandy CLAY and GRAVEL FILL with many cobbles and boulders, abundant fragments of red brick, wood, plastic, metal, glass, concrete blocks and rubble. (MADE GROUND).	0.10 +3.67		
2.00 m boulder sized fragments of concrete (40cm wide) slow progress.	(3.40)		
EXPLORATORY HOLE ENDS AT 3.50 m	3.50 +0.27		

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck (m)	Post Strike	Behaviour
1	3.40		Slow inflow

Depth Related Remarks
From to (m)

Stability poor below 2.00 m.
Shoring none
Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
TP07
Sheet 1 of 1

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 27/06/2003 End 27/06/2003	Equipment, Methods and Remarks Excavated by JCB 3CX Trial pit terminated due to poor stability. Pit backfilled with arisings	Dimensions and Orientation Width 0.60 m Length 3.20 m 230 (Deg)	Ground Level +4.26 mOD Coordinates E 319982.73 National Grid N 233677.34

Samples and Tests			Strata				
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)		Legend	Backfill/ Instrumer
			1 Soft brown sandy gravelly CLAY FILL with rare cobbles and fragments of brick, metal and plastic.	(0.70)			
0.80-1.00 0.80-1.00	B 1 D 2		2 Loose orange grey clayey sandy GRAVEL and ASH FILL with fragments of charcoal and burnt wood. Gravel is subangular to subrounded fine to medium.	0.70	+3.56		
1.80-2.00 1.80-2.00	B 3 D 4			(3.30)			
2.80-3.10 2.80-3.10	B 5 D 6		3.60 m rare subangular boulders				
~~4.00~~ 4.00	~~B 7~~ D 8		EXPLORATORY HOLE ENDS AT 4.00 m	4.00	+0.26		
Depth	Type & No.	Records Date					

Groundwater Entries	Depth Related Remarks	
No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)	From to (m)	Stability poor Shoring none Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.	Project Dublin Waste to Energy Project No. KD3116 Carried out for Dublin City Council	Trial Pit TP08 Sheet 1 of 1
Scale 1:25 (c) MESC HBR (28n), 30/10/2003 12:51:22 AGS		

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 27/06/2003 End 27/06/2003	Equipment, Methods and Remarks Excavated by JCB 3CX Trial pit terminated due to poor stability. Pit backfilled with arisings	Dimensions and Orientation Width 0.70 m Length 3.20 m 195 (Deg)	Ground Level +4.36 mOD Coordinates E 319876.08 National Grid N 233676.72

Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
0.70-0.90 0.70-0.90	B 1 D 2		1 Soft brown sandy CLAY and GRAVEL FILL with occasional subangular cobbles and fragments of brick, concrete, wood, plastic, metal etc. (MADE GROUND).			
1.70-1.80 1.70-1.80	B 3 D 4		1.80 m many subangular boulders 2.00-3.40 m concrete blocks	(3.50)		
2.80-3.10 2.80-3.10	B 5 D 6					
3.50	B 7		EXPLORATORY HOLE ENDS AT 3.50 m	3.50 +0.86		
Depth	Type & No.	Records Date				

Groundwater Entries	Depth Related Remarks	
No. Struck Post Strike Behaviour (m) None observed (see Key Sheet)	From to (m)	Stability poor Shoring none Weather

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25	Project Dublin Waste to Energy Project No. KD3116 Carried out for Dublin City Council	Trial Pit **TP09** Sheet 1 of 1

ENCLOSURE B

INSTRUMENTATION MONITORING

Installation Details

GEOTECH

Hole No	Installation Type	Date of Installation	Tip depth, (m)	Piezometer Diameter (mm)	Top of response zone, (m)	Base of response zone, (m)	Tubing Completion Details	Headworks	Remarks
BH1	SP	26/05/2003	12.00	50	2.00	12.00	Open	Gas barrel	
BH4	SP	17/06/2003	20.00	50	2.00	20.00	Open	Gas barrel	
BH5	SP	28/06/2003	12.00	50	2.50	12.00	Open	Gas barrel	
BR6	SP	20/05/2003	40.20	50	34.20	40.20	Open	Gas barrel	
BR8	SP	25/05/2003	46.50	50	40.50	46.50	Open	Lockable top cover	
BR9	SP	12/06/2003	49.50	50	44.70	49.50	Open	Lockable top cover	

Notes: Type: SP - Standpipe, SPIE - Standpipe Piezometer, HPIE - Hydraulic Piezometer, PPIE - Pneumatic Piezometer, EPIE - Vibrating Wire Piezometer, PWEL - Pumping Well

Project: Dublin Waste to Energy
Project No.: KD3116
Carried out for: Dublin City Council

Table B1
Sheet 1 of 1

Mowlem Environmental Sciences Group

Gas Monitoring Record

Project No	KD3116	Project	Dublin Waste to Energy
Date	05/07/2003	State of Ground	dry
Operator	P. Groves	Wind	Light
Equipment Used	GMI CO2 Portable	Wind Direction	Easterly
		Cloud Cover	Slight
		Precipitation	None

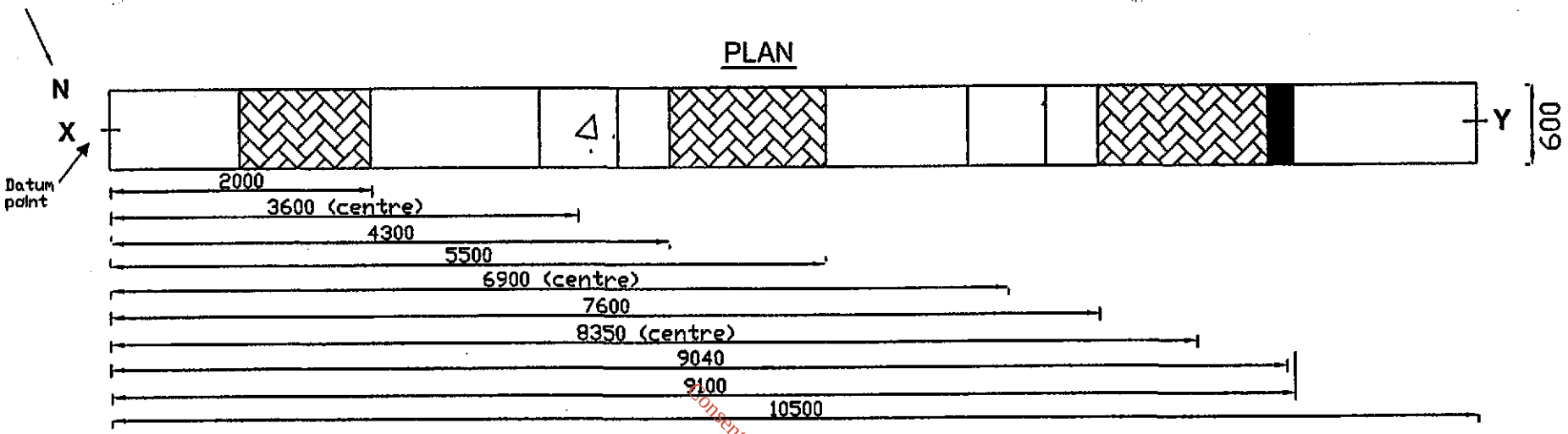
Sheet No

Borehole/ Instrument	Barometric Pressure (mbars)	Air temp (°C)	Depth of Installation (m BGL)	Time of Reading hh:mm:ss	Depth to Groundwater (m BGL)	Reading Depth (mBGL)	Differential Pressure (Pa)	FlowRate (l/hr)	CH_4 (% vol)	CH4 (% LEL)	O_2 (% vol)	CO_2 (% vol)	CO (% vol)	H_2S (ppm)	Ammonia (ppm)	Remarks
Detection Limits																
BH1	1021	18			3.17				0.0		4.1	5.1				
BH5	1021	18			3.87				0.0		19.9	1.3				
BR6	1021	18			3.57				0.0		20.1	0.4				
BR8	1021	18			3.61				0.0		20.8	0.0				
BR9	1021	18			3.75				0.0		19.4	2.2				
BH4	1021	18			2.97				0.0		19.9	4.0				

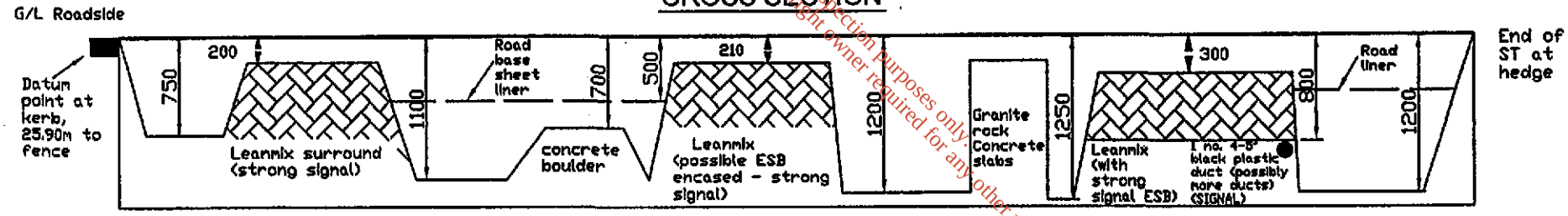
ENCLOSURE C
SLIT TRENCH RECORDS

Slit Trench Sketches and Logs	ST1 to ST5

PLAN



CROSS SECTION



KEY

- Dimensions (in millimetres)
- Pipes
- Ground level

LOG OF TRENCH (m)

0.00 - 0.14	DENSE BITUMEN MACADAM
0.14 - 0.43	Roadstone
0.43 - 1.20	MADE GROUND - sandy gravelly CLAY

CO-ORDINATES **ELEVATION**

X: E 319845 N 233634 3.83m
Y: E 319835 N 233636 3.65m

Orientation - 290°

SLIT TRENCH DETAILS

Date	14.5.03
Depth	1.20m
Width	0.60m
Length	10.50m

Dublin Waste to Energy
M. C. O'Sullivan & Co. Ltd.
Ground Investigation Slit Trench Details

DRAWN BY	DATE	SCALE
TL	18/6/03	1:50
CHECKED	APPRD	STATUS
PG	MK	
SLIT TRENCH NO.		REV:
ST01		

GEOTECH

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB and Komatsu Mini-digger ESB representative on site for dig. Backfilled with gravel, reinstated surface.	Dimensions and Orientation Width 0.60 m Length 10.50 m 290 (Deg)	Ground Level - Coordinates - National Grid -

Samples and Tests / Strata

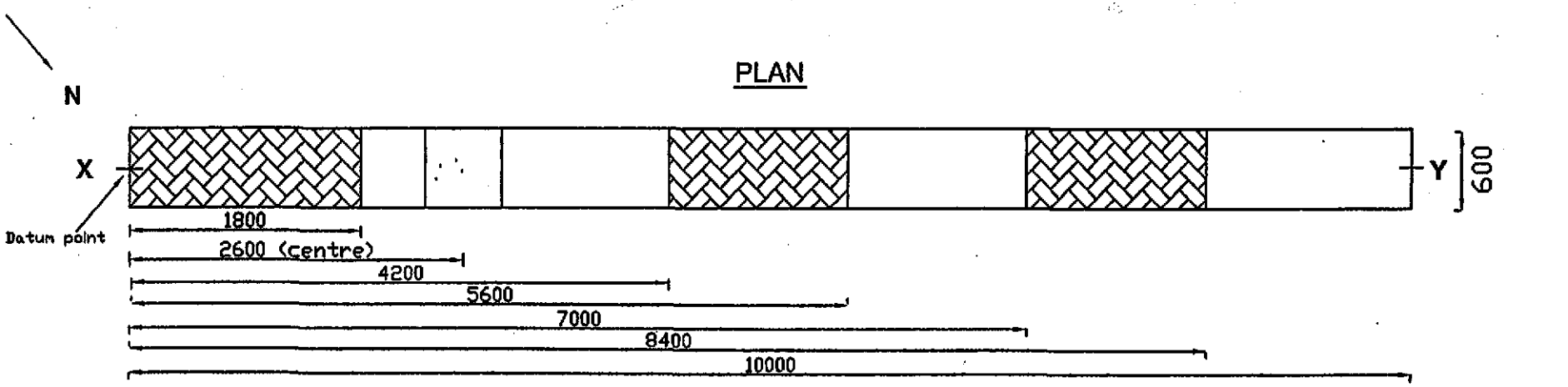
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
			1 Dense Bitumen Macadam	0.14		
			2 Compacted black ROADSTONE subbase (Leanmix over ducts)	(0.29) 0.43		
			3 Firm brown fine to coarse sandy gravelly CLAY FILL with brick and block fragments. Gravel is subangular to subrounded fine to coarse. (MADE GROUND). 0.80-1.20 m Rare stiff dark brown slightly gravelly clay clods. Irregular	(0.77) 1.20		
			EXPLORATORY HOLE ENDS AT 1.20 m			

Depth	Type & No.	Records Date

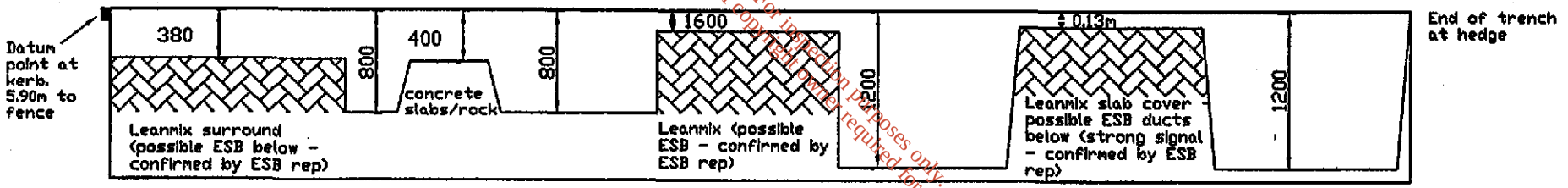
Groundwater Entries No. Struck (m) Post Strike Behaviour None observed (see Key Sheet)	Depth Related Remarks From to (m)	Stability Poor from 0.43m bgl Shoring N/A Weather -

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column. Scale 1:25 (c) MESG HBM (281), 30/10/2003 12:50:21 AGS	Project Dublin Waste to Energy Project No. KD3116 Carried out for Dublin City Council	Trial Pit ST01 Sheet 1 of 1

PLAN



CROSS SECTION



KEY

- Dimensions (in millimetres)
- Pipes
- Ground level

LOG OF TRENCH (m)

0.00 - 0.31 DENSE BITUMEN MACADAM
0.31 - 1.20 MADE GROUND - sandy CLAY

CO-ORDINATES		ELEVATION
X: E 319835	N 233582	3.64m
Y: E 319826	N 233584	3.45m

Orientation - 287°

SLIT TRENCH DETAILS

Date	14.5.03
Depth	1.20m
Width	0.60m
Length	10.00m

Dublin Waste to Energy
M. C. O'Sullivan & Co. Ltd.
Ground Investigation Slit Trench Details

DRAWN BY	DATE	SCALE
TL	18.6.03	1:50
CHECKED	APPRD	STATUS
MK	MK	
SLIT TRENCH NO.		REV.
ST02		

GEOTECH

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB and Komatsu Mini-digger ESB representative on site for dig. Backfilled with gravel, reinstated surface.	Dimensions and Orientation Width 0.60 m Length 10.00 m 287 (Deg)	Ground Level - Coordinates - National Grid -

Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level/ (Thickness)	Legend	Backfill/ Instrument
			1 Dense bitumen macadam	(0.31)		
			2 Soft brown fine to medium sandy gravelly CLAY FILL with many granite boulders, brick and metal fragments, rare copper pipe, plastic, rubber and iron strips. Gravel is subangular to subrounded, fine to coarse. (MADE GROUND).	0.31 (0.89)		
			EXPLORATORY HOLE ENDS AT 1.20 m	1.20		
Depth	Type & No.	Records Date				

Groundwater Entries
No. Struck Post Strike Behaviour (m)
None observed (see Key Sheet)

Depth Related Remarks
From to (m)

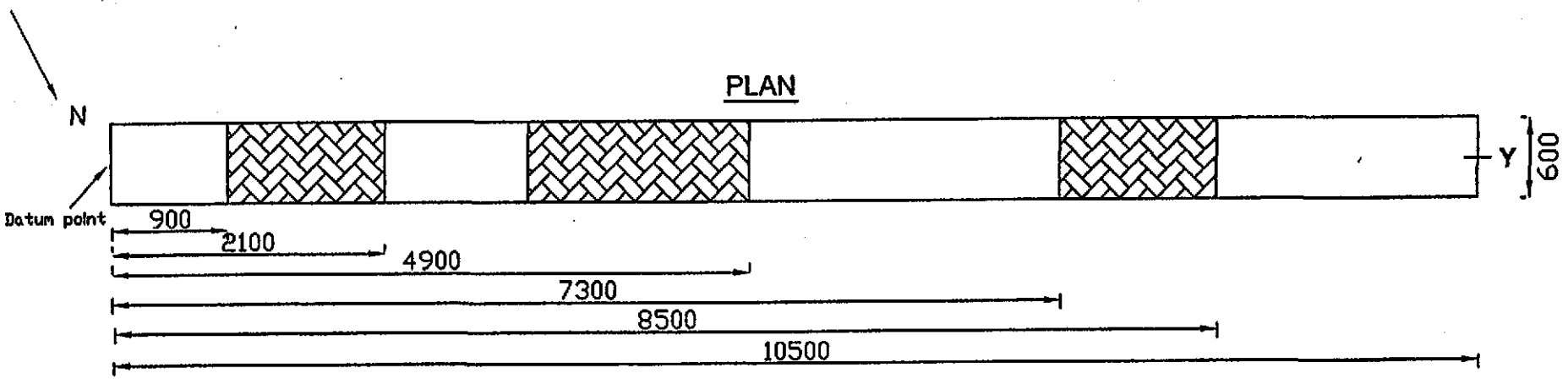
Stability Poor at hedge side
Shoring N/A
Weather -

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.
Scale 1:25 (c) MESG HBM (201), 30/10/2003 12:50:28

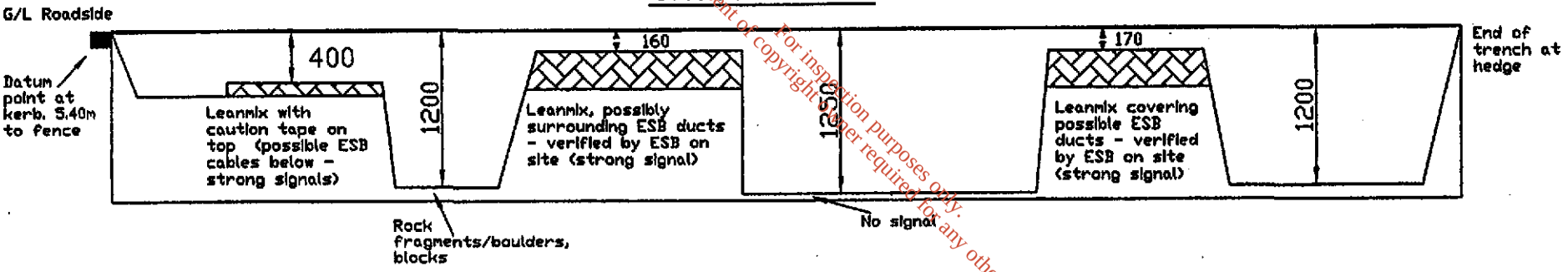
Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
ST02
Sheet 1 of 1

PLAN



CROSS SECTION



KEY

- Dimensions (in millimetres)
- Pipes
- Ground level

LOG OF TRENCH (m)

0.00 - 0.10	DENSE BITUMEN MACADAM
0.10 - 0.41	Roadstone
0.41 - 1.20	MADE GROUND - sandy gravelly CLAY

CO-ORDINATES **ELEVATION**

X: E 319824 N 233525 3.66m
Y: E 319815 N 233527 3.56m

Orientation - 287°

SLIT TRENCH DETAILS

Date 14.5.03
Depth 1.20m
Width 0.60m
Length 10.50m

Dublin Waste to Energy
M. C. O'Sullivan & Co. Ltd.
Ground Investigation Slit Trench Details

DRAWN BY TL	DATE 18.6.03	SCALE 1:50
CHECKED PG	APPRD MK	STATUS
SLIT TRENCH NO. ST03		REV.

GEOTECH

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB and Komatsu mini-digger ESB representative on site for dig. Backfilled with gravel, reinstated surface.	Dimensions and Orientation Width 0.60 m Length 10.50 m 287 (Deg)	Ground Level - Coordinates - National Grid -

Samples and Tests

Depth	Type & No.	Date Records

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
1 Dense bitumen macadam	0.10		
2 Grey slightly clayey ROADSTONE subbase.	(0.31)		
	0.41		
3 Soft mottled grey brown fine to medium sandy gravelly CLAY FILL with many concrete, granite and brick fragments, wiring, cables, metal and wood fragments, rare re-inforcing bars (not local to trench) and plastic. Rare yellow sandstone blocks. Gravel is angular to subrounded fine to coarse. (MADE GROUND).	(0.79)		
	1.20		
EXPLORATORY HOLE ENDS AT 1.20 m			

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck (m)	Post Strike	Behaviour
None observed (see Key Sheet)			

Depth Related Remarks

From to (m)

Stability poor from 0.41m bgl.

Shoring N/A

Weather -

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25 (c) MESC HBR (281), 30/10/2003 12:50:30

Project Dublin Waste to Energy

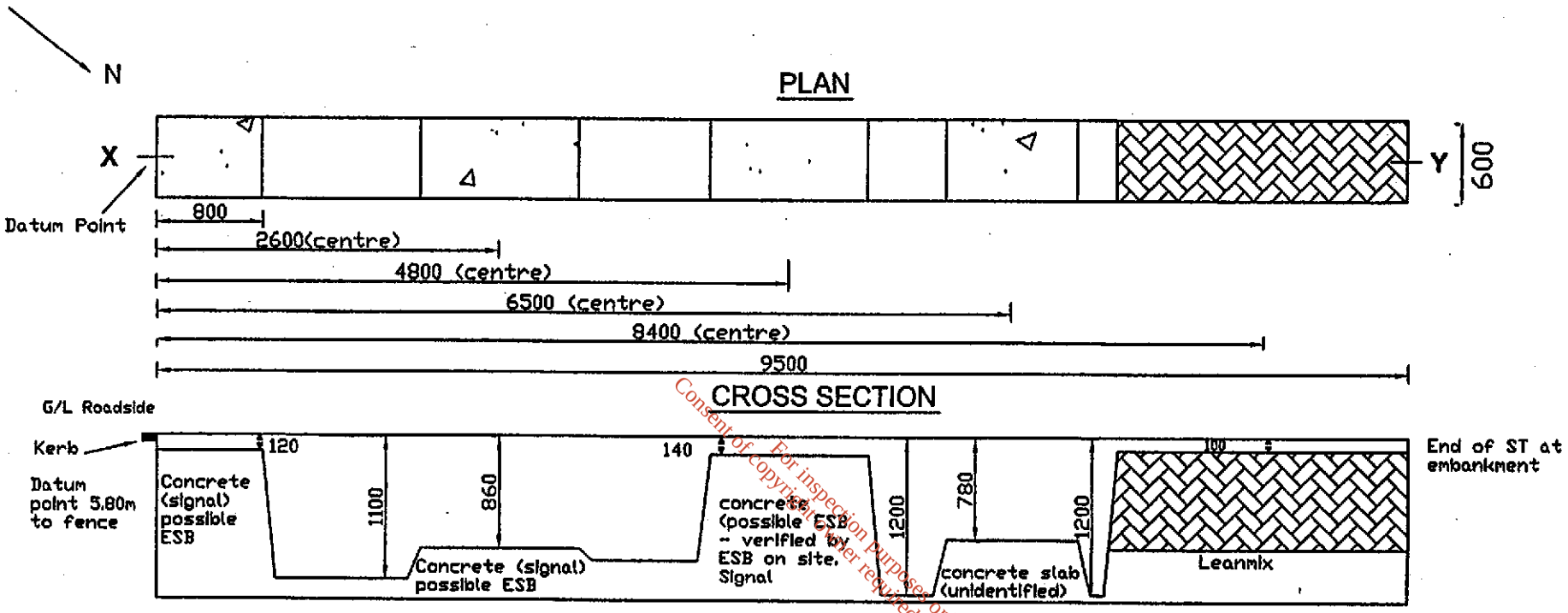
Project No. KD3116

Carried out for Dublin City Council

Trial Pit

ST03

Sheet 1 of 1



KEY

- Dimensions (in millimetres)
- Pipes
- Ground level

LOG OF TRENCH

0.00 - 0.10	DENSE BITUMEN MACADAM
0.10 - 0.33	ROADSTONE sub base
0.33 - 1.20	MADE GROUND - sandy gravelly CLAY

CO-ORDINATES **ELEVATION**

X: E 319810 N 233452 3.74m
Y: E 319801 N 233454 3.56m

Orientation - 277°

SLIT TRENCH DETAILS

Date	14.5.03
Depth	1.20m
Width	0.60m
Length	9.50m

Dublin Waste to Energy
M. C. O'Sullivan & Co. Ltd.
Ground Investigation Slit Trench Details

DRAWN BY: TL	DATE: 26.6.03	SCALE: 1:50
CHECKED: PG	APPRD: MK	STATUS:
SLIT TRENCH NO.: **ST04**		REV.

GEOTECH

Trial Pit Log

PRELIMINARY

GEOTECH

Logged by PG	Start 14/05/2003	Equipment, Methods and Remarks	Dimensions and Orientation	Ground Level -
Checked by	End 14/05/2003	Excavated by JCB and Komatsu mini-digger ESB representative on site for dig. Backfilled with gravel, reinstated surface.	Width 0.60 m Length 9.50 m 277 (Deg)	Coordinates - National Grid -

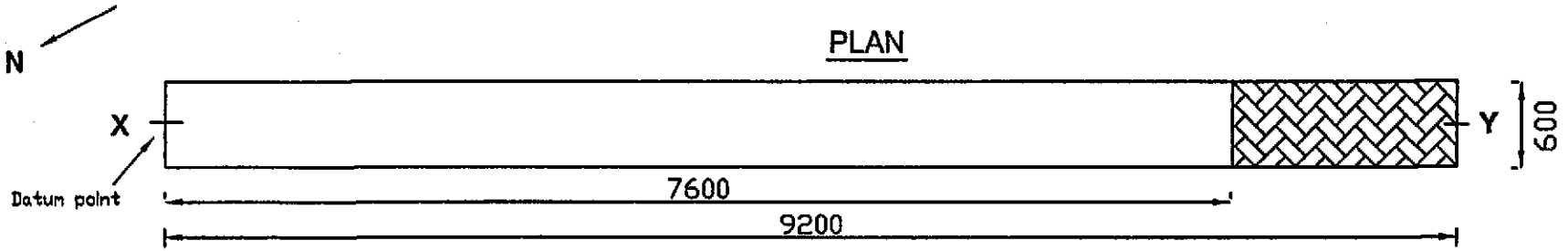
Samples and Tests			Strata			
Depth	Type & No.	Date Records	Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
			1 Dense bitumen macadam	0.10		
			2 Grey ROADSTONE subbase.	0.33		
			3 Soft to firm dark brown fine to coarse sandy gravelly CLAY FILL with many red brick and concrete fragments, wood chips, metal bars and plastic. Gravel is subangular to subrounded fine to coarse. (MADE GROUND).	(0.87)		
			EXPLORATORY HOLE ENDS AT 1.20 m	1.20		

Depth	Type & No.	Records Date

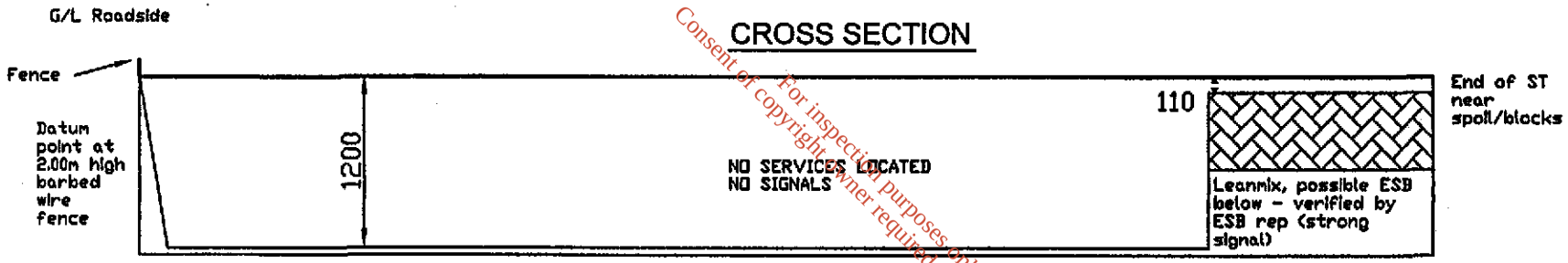
Groundwater Entries	Depth Related Remarks	Stability Poor from 0.33m bgl.
No. Struck Post Strike Behaviour (m)	From to (m)	Shoring N/A
None observed (see Key Sheet)		Weather -

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.	Project Dublin Waste to Energy	Trial Pit
Scale 1:25	Project No. KD3116	ST04
	Carried out for Dublin City Council	Sheet 1 of 1

PLAN



CROSS SECTION



KEY

- Dimensions (in millimetres)
- Pipes
- Ground level

LOG OF TRENCH

0.00 - 0.10	DENSE BITUMEN MACADAM
0.10 - 0.40	Gravelly CLAY
0.40 - 1.20	MADE GROUND - sandy gravelly CLAY

CO-ORDINATES **ELEVATION**

Xı	E 319827	N 233436	3.88m
Yı	E 319825	N 233428	3.89m

ORIENTATION - 200°

SLIT TRENCH DETAILS

Date	14.5.03
Depth	1.20m
Width	0.60m
Length	9.20m

Dublin Waste to Energy
M. C. O'Sullivan & Co. Ltd.
Ground Investigation Slit Trench Details

DRAWN BY: TL	DATE: 16.5.03	SCALE: 1:50
CHECKED: PG	APPRD: MK	STATUS:
SLIT TRENCH NO.: ST05		REV.:

GEOTECH

Trial Pit Log

GEOTECH

Logged by PG Checked by MK	Start 14/05/2003 End 14/05/2003	Equipment, Methods and Remarks Excavated by JCB and Komatsu mini-digger ESB representative on site for dig. Backfilled with gravel, reinstated surface.	Dimensions and Orientation Width 0.60 m Length 9.20 m 200 (Deg)	Ground Level - Coordinates - National Grid -

Samples and Tests

Depth	Type & No.	Date Records

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instrument
1 Dense bitumen macadam	0.10		
2 Stiff brown gravelly CLAY (possible subbase). Gravel is subangular to subrounded fine to coarse.	(0.30)		
3 Soft brown slightly fine to coarse sandy gravelly CLAY FILL with many red and yellow brick fragments, blocks, wood chips, plastic, cloth, glass, metal strips and re-inforcing bars (not local to trench). Gravel is subangular to subrounded fine to coarse. (MADE GROUND).	0.40 (0.80)		
EXPLORATORY HOLE ENDS AT 1.20 m	1.20		

Depth	Type & No.	Records Date

Groundwater Entries

No.	Struck	Post Strike	Behaviour (m)
None observed (see Key Sheet)			

Depth Related Remarks

From to (m)

Stability Poor along entire length of trench to 1.20m bgl.
Shoring N/A
Weather -

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Dublin Waste to Energy
Project No. KD3116
Carried out for Dublin City Council

Trial Pit
ST05
Sheet 1 of 1

ENCLOSURE D
GEOTECHNICAL LABORATORY TEST RESULTS

KEY TO SYMBOLS ON LABORATORY TEST RESULTS SHEETS

U	Undisturbed Sample	
P	Piston Sample	
TWS	Thin Wall Sample	
B	Bulk Sample - Disturbed	
D	Jar Sample - Disturbed	
W	Water Sample	
pH	Acidity/Alkalinity Index	
SO_3	% - Total Sulphate Content (acid soluble)	
SO_3	g/ltr - Water Soluble Sulphate (Water or 2:1 Aqueous Soil Extract)	
+	Calcareous Reaction	
Cl	Chloride Content	
I_p	Plasticity Index	
<425	% of material in sample passing 425 micron sieve	
w_L	Liquid Limit	
w_p	Plastic Limit	
w	Water Content	
NP	Non Plastic	
γ_b	Bulk Density	
γ_d	Dry Density	
Ps	Particle Density	
U/D	Undrained/Drained Triaxial	
U/C	Unconsolidated/Consolidated Triaxial	
T/M	Single Stage/Multistage Triaxial	
100/38	Sample Diameter (mm)	
REM	Remoulded Triaxial Test Specimen	
TST	Triaxial Suction Test	
V	Vane Test	
DSB	Drained Shear Box	
RSB	Residual Shear Box	
RS	Ring Shear	
σ_3	Cell Pressure	
$\sigma_1-\sigma_3$	Deviator Stress	
c	Cohesion	
c_	Effective Cohesion Intercept	
ϕ	Angle of Shearing Resistance - Degrees	
ϕ_	Effective Angle of Shearing Resistance	
εf	Strain at Failure	
*	Failed under 1st Load	
**	Failed under 2nd Load	
#	Untestable	
##	Excessive Strain	
p_o	Effective Overburden Pressure	
m_v	Coefficient of Volume Decrease	
c_v	Coefficient of Consolidation	
Opt	Optimum	
Nat	Natural	
Std	Standard Compaction - 2.5kg Rammer	(¶ CBR)
Hvy	Heavy Compaction - 4.5kg Rammer	(§ CBR)
Vib	Vibratory Compaction	
CBR	California Bearing Ratio	
Sat m.c.	Saturation Moisture Content	
MCV	Moisture Condition Value	

Laboratory Symbols	**Project** Dublin Waste to Energy Project Dublin City Council	Contract KD3116
GEOTECH		Figure KEY

Samples				Classification					Strength			Other Tests
Hole	Depth	Type	Description	<425 I_P	Prep w_L	w_P	Water %	$\gamma_{b\,3}$ Mg/m	Test	σ_3 kPa	C kPa	
BH1	0.50 - 1.00	B	Slightly silty very sandy GRAVEL	42	425µ 25	Sieve NP	11					MCV pH = 8.4 Particle Size analysis SO3 (2:1) = 0.17g/l Passing 2mm = 46%
BH1	3.00	W										pH = 8.1 SO3 Water = 0.57g/l
BH1	3.00 - 3.50	B	Sandy GRAVEL									pH = 8.5 SO3 (2:1) = 0.71g/l Passing 2mm = 99%
BH1	3.60 - 4.00	B	Sandy GRAVEL									Particle Size analysis Sample unsuitable for P
BH1	3.60 - 4.00	D	Sandy GRAVEL				2.7					
BH1	6.00 - 6.50	B	Slightly clayey sandy GRAVEL									pH = 8.6 Particle Size analysis SO3 (2:1) = 1.15g/l Passing 2mm = 22%
BH1	18.00- 18.44	B	Slightly sandy CLAY	95 11	425µ 26	Sieve 15						pH = 8.4 Particle Size analysis SO3 (2:1) = 1.02g/l Passing 2mm = 65%
BH2	0.50 - 1.00	B	GRAVEL									MCV pH = 7.8 Particle Size analysis SO3 (2:1) = 0.11g/l Passing 2mm = 21% sample insufficient to carry out plastic limit
BH2	0.50 - 1.00	D	GRAVEL				0.9					
BH2	1.50 - 2.00	B	Slightly sandy gravelly CLAY	53 11	425µ 35	Sieve 24						Particle Size analysis
BH2	4.00 - 4.50	B	Slightly clayey gravelly SAND									pH = 8.3 Particle Size analysis SO3 (2:1) = 0.59g/l Passing 2mm = 96%
BH3A	0.50 - 1.00	B	Clayey very sandy GRAVEL	43 10	425µ 34	Sieve 24						MCV pH = 8.4 Particle Size analysis SO3 (2:1) = 0.17g/l Passing 2mm = 42%

Remarks

Form 10

Laboratory - Results Summary

Project dublin waste to energy

Contract KD3116x

GEOTECH

Sheet

Samples				Classification					Strength			Other Tests
Hole	Depth	Type	Description	<425 I_P	Prep w_L	w_P	Water %	γ_{b_3} Mg/m	Test	σ_3 kPa	C kPa	
BH3A	0.50 - 1.00	D	Clayey very sandy GRAVEL				17					
BH3A	3.60 - 4.00	B	Slightly sandy slightly gravelly SILT									Particle Size analysis
BH3A	4.00 - 4.50	B	Slightly sandy slightly gravelly SILT									Org = 8.0% Passing 2mm = 86% pH = 8.1 SO3 (2:1) = 0.95g/l Passing 2mm = 86%
BH3A	6.00 - 6.45	B	Very sandy GRAVEL									Particle Size analysis
BH4	0.50 - 1.00	B	Clayey sandy GRAVEL	68 12	425µ 30	Sieve 18						CBR MCV pH = 7.6 Particle Size analysis SO3 (2:1) = 2.19g/l Passing 2mm = 43%
BH4	0.50 - 1.00	D	Slightly sandy gravelly CLAY				16					
BH4	4.00 - 4.50	B	Clayey very sandy GRAVEL									pH = 8.6 Particle Size analysis SO3 (2:1) = 0.11g/l Passing 2mm = 32%
BH5	0.00 - 0.50	B	Clayey sandy GRAVEL	24 12	425µ 39	Sieve 27	15					MCV pH = 9.0 Particle Size analysis SO3 (2:1) = 0.90g/l Passing 2mm = 36%
BH5	0.50 - 1.00	B	Clayey sandy GRAVEL									Particle Size analysis
BH5	1.20 - 1.65	B	Clayey sandy GRAVEL									pH = 8.5 SO3 (2:1) = 1.38g/l Passing 2mm = 20%
BH5	3.90	W										pH = 8.4 SO3 Water = 0.72g/l
BH5	5.50 - 5.95	B	Sandy GRAVEL	26	425µ 30	Sieve NP	11					pH = 8.3 Particle Size analysis SO3 (2:1) = 0.32g/l Passing 2mm = 38%

Remarks

Form 10/2

Laboratory - Results Summary

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

Samples				Classification					Strength			Other Tests
Hole	Depth	Type	Description	<425 I_P	Prep w_L	w_P	Water %	$\gamma_{b\,3}$ Mg/m	Test	σ_3 kPa	C kPa	
TP01	0.50 - 0.60	B	Silty gravelly SAND	80	425µ 33	Sieve NP						pH = 8.0 Particle Size analysis SO3 (2:1) = 0.15g/l Passing 2mm = 88%
TP01	0.50 - 0.60	D	Silty gravelly SAND				15					
TP01	1.20 - 1.60	D	Sandy slightly gravelly CLAY				18					
TP01	3.40	W										pH = 8.5 SO3 Water = 0.25g/l
TP02	1.00 - 1.10	B	SAND and GRAVEL	58 10	425µ 33	Sieve 23						MCV Particle Size analysis
TP02	1.00		SAND and GRAVEL				29					
TP2	2.00 - 2.20	B	SAND and GRAVEL									MCV
TP02	3.20 - 3.40	B	Sandy GRAVEL	43	425µ 39	Sieve NP						pH = 8.2 Particle Size analysis SO3 (2:1) = 0.85g/l Passing 2mm = 44%
TP03	0.60 - 0.80	B	Very gravelly SAND	64	425µ 29	Sieve NP						MCV Particle Size analysis
TP03	0.60 - 0.80	D	Very gravelly SAND				12					
TP03	1.80 - 2.00	B	Silty sandy GRAVEL	56	425µ 31	Sieve NP						MCV pH = 7.7 Particle Size analysis SO3 (2:1) = 0.29g/l Passing 2mm = 33%
TP04	0.50 - 0.60	B	Silty sandy GRAVEL	45	425µ 26	Sieve NP						MCV Particle Size analysis
TP04	0.50 - 0.60	D	Silty sandy GRAVEL				9.8					
TP04	3.90 - 4.10	B	Clayey very gravelly SAND	86 10	425µ 22	Sieve 12						pH = 8.3 Particle Size analysis SO3 (2:1) = 0.34g/l Passing 2mm = 83%
TP04	3.90 - 4.10	D	Clayey very gravelly SAND				29					

Remarks

Form 10/

Laboratory - Results Summary

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

Samples				Classification					Strength			Other Tests
Hole	Depth	Type	Description	<425 I_P	Prep w_L	w_P	Water %	$\gamma_{b\,3}$ Mg/m	Test	σ_3 kPa	C kPa	
TP05	0.70 - 0.80	B	Black mottled grey sandy gravelly CLAY	60 13	425µ 34	Sieve 21						pH = 8.2 Particle Size analysis SO3 (2:1) = 0.42g/l Passing 2mm = 50%
TP05	0.70 - 0.80	D	Black mottled grey sandy gravelly CLAY				21					
TP05	2.80 - 3.00	B	Clayey sandy GRAVEL									Particle Size analysis
TP06	0.80 - 1.00	B	Clayey sandy GRAVEL	41 7	425µ 33	Sieve 26						MCV pH = 7.7 Particle Size analysis SO3 (2:1) = 7414.88g/l Passing 2mm = 31%
TP06	0.80 - 1.00	D	Clayey sandy GRAVEL				17					
TP06	3.50 - 3.70	B	Sandy slightly gravelly CLAY									pH = 8.4 Particle Size analysis SO3 (2:1) = 0.28g/l Passing 2mm = 96%
TP07	0.70 - 0.80	D	Slightly sandy gravelly CLAY				22					
TP07	2.80 - 3.00	D	Clayey sandy GRAVEL				24					
TP07	2.80 - 3.00	B	Clayey sandy GRAVEL									pH = 7.8 Particle Size analysis SO3 (2:1) = 1.74g/l Passing 2mm = 37%
TP07	3.40 - 4.00	B	Slightly clayey sandy GRAVEL	27 7	425µ 37	Sieve 30						Particle Size analysis
TP8	0.80 - 1.00	B	Slightly clayey sandy GRAVEL									CBR
TP8	1.80 - 2.00	B	Slightly clayey sandy GRAVEL									pH = 8.0 Particle Size analysis SO3 (2:1) = 0.35g/l Passing 2mm = 463% Sample unsuitable for PI
TP8	1.80 - 2.00	D	Slightly clayey sandy GRAVEL				20					

Remarks

Form 10/2

Laboratory - Results Summary

Project dublin waste to energy

Contract KD3116x

GEOTECH

Sheet

Samples				Classification					Strength			Other Tests
Hole	Depth	Type	Description	<425 I_P	Prep w_L	w_P	Water %	γ_b Mg/m^3	Test	σ_3 kPa	C kPa	
TP8	4.00	B	Slightly clayey sandy GRAVEL									pH = 7.8 Particle Size analysis SO3 (2:1) = 0.39g/l Passing 2mm = 53%
TP8	4.00	D	Slightly clayey sandy GRAVEL				22					
TP9	0.70 - 0.90	D	Slightly clayey sandy GRAVEL				10					
TP9	1.70 - 1.80	B	Slightly clayey sandy GRAVEL	44 11	425µ 33	Sieve 22						MCV pH = 8.0 Particle Size analysis SO3 (2:1) = 0.46g/l Passing 2mm = 52%
TP9	2.80 - 3.10	B	Slightly sandy gravelly CLAY									pH = 8.2 Particle Size analysis SO3 (2:1) = 0.30g/l Passing 2mm = 60%

Remarks

Form 10/

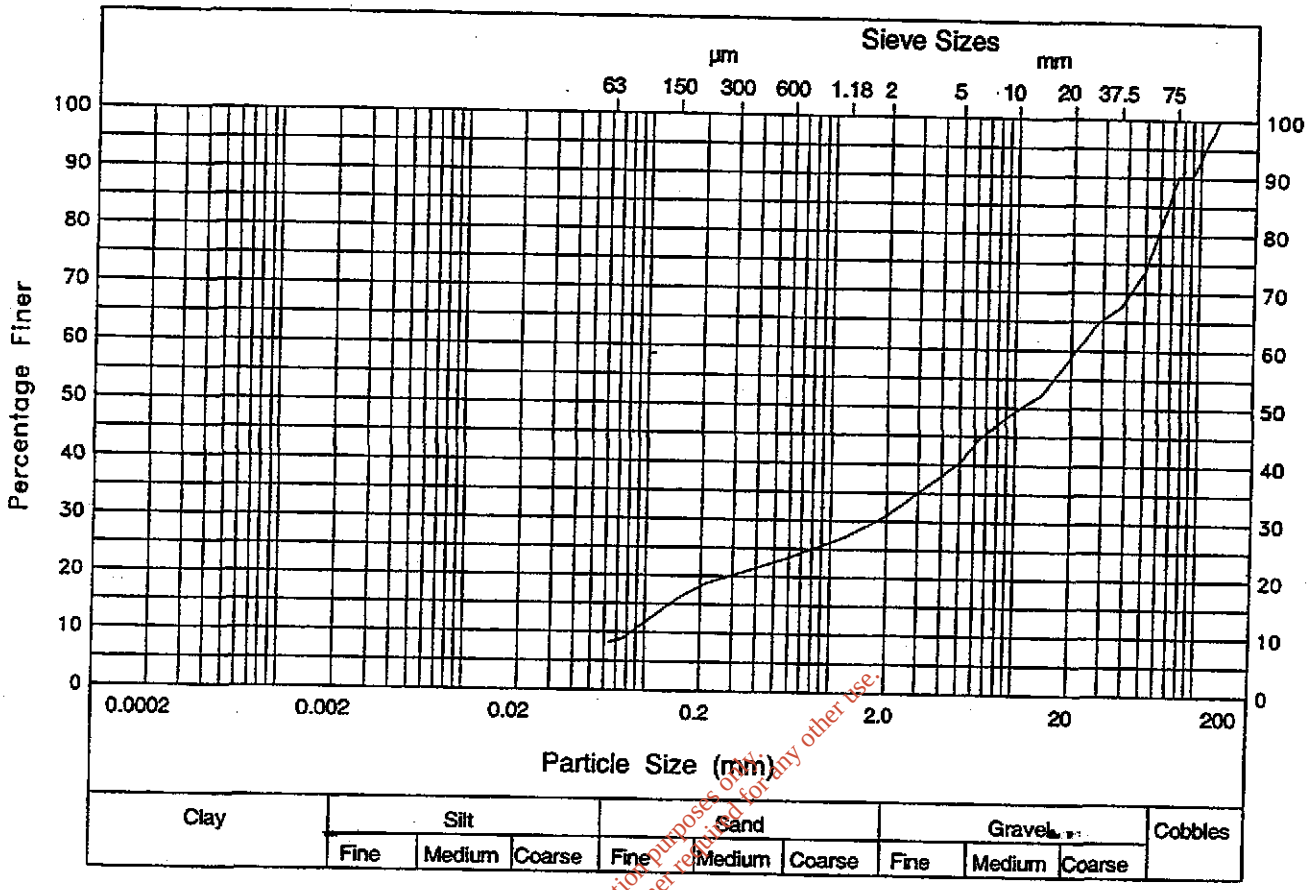
Laboratory - Results Summary

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

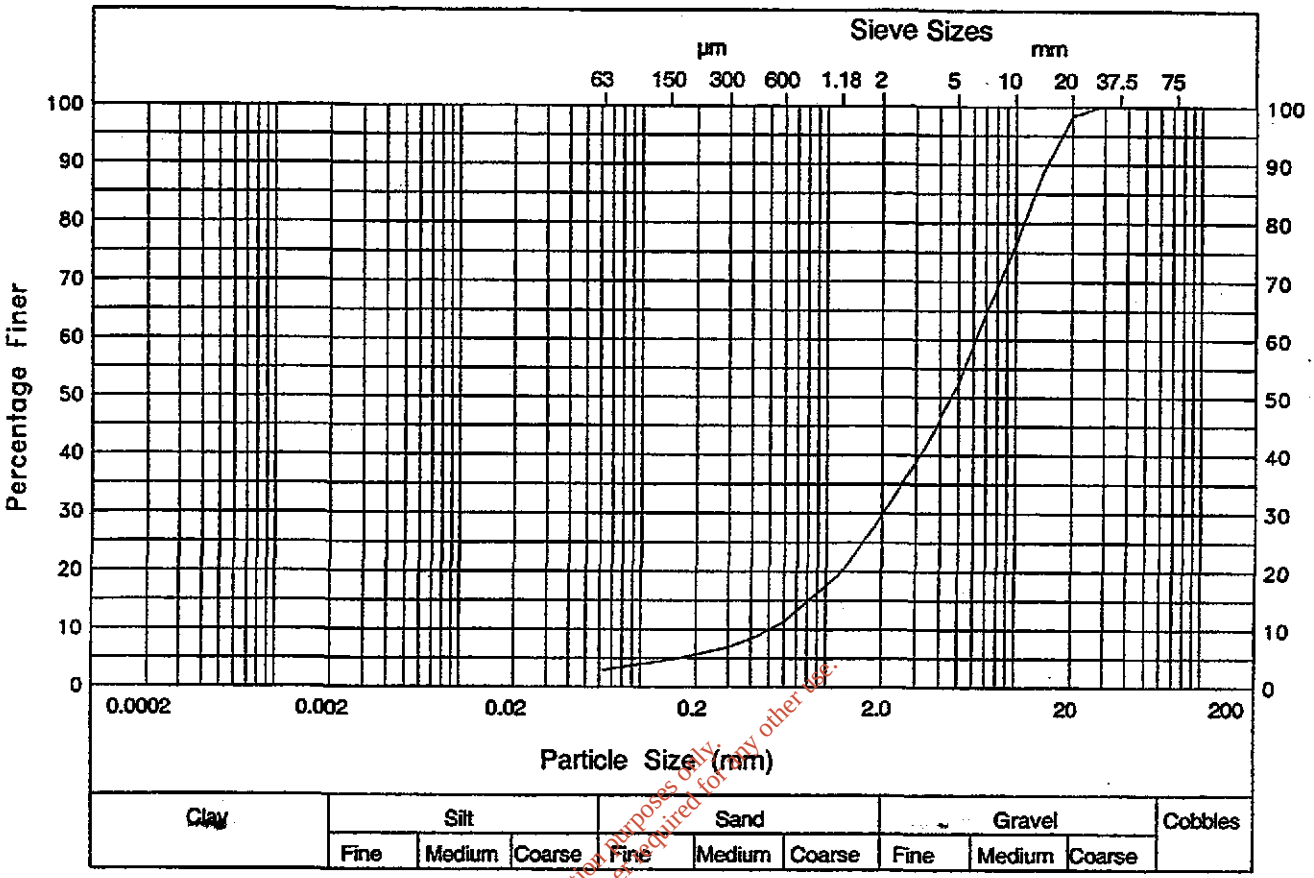


Particle Size	% Passing	Particle Size	% Passing
90 mm	90	2 mm	31
75 mm	90	1.18 mm	27
63 mm	83	600 µm	23
50 mm	74	425 µm	22
37.5 mm	68	300 µm	20
28 mm	65	212 µm	19
20 mm	59	150 µm	16
14 mm	52	75 µm	9
10 mm	49	63 µm	8
6.3 mm	44		
5 mm	40		
3.35 mm	36		

Hole BH1	Description: Slightly silty very sandy GRAVEL
Depth 0.50 -1.00	
Type B	
Test Performed Wet	Uniformity Coefficient = 256

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

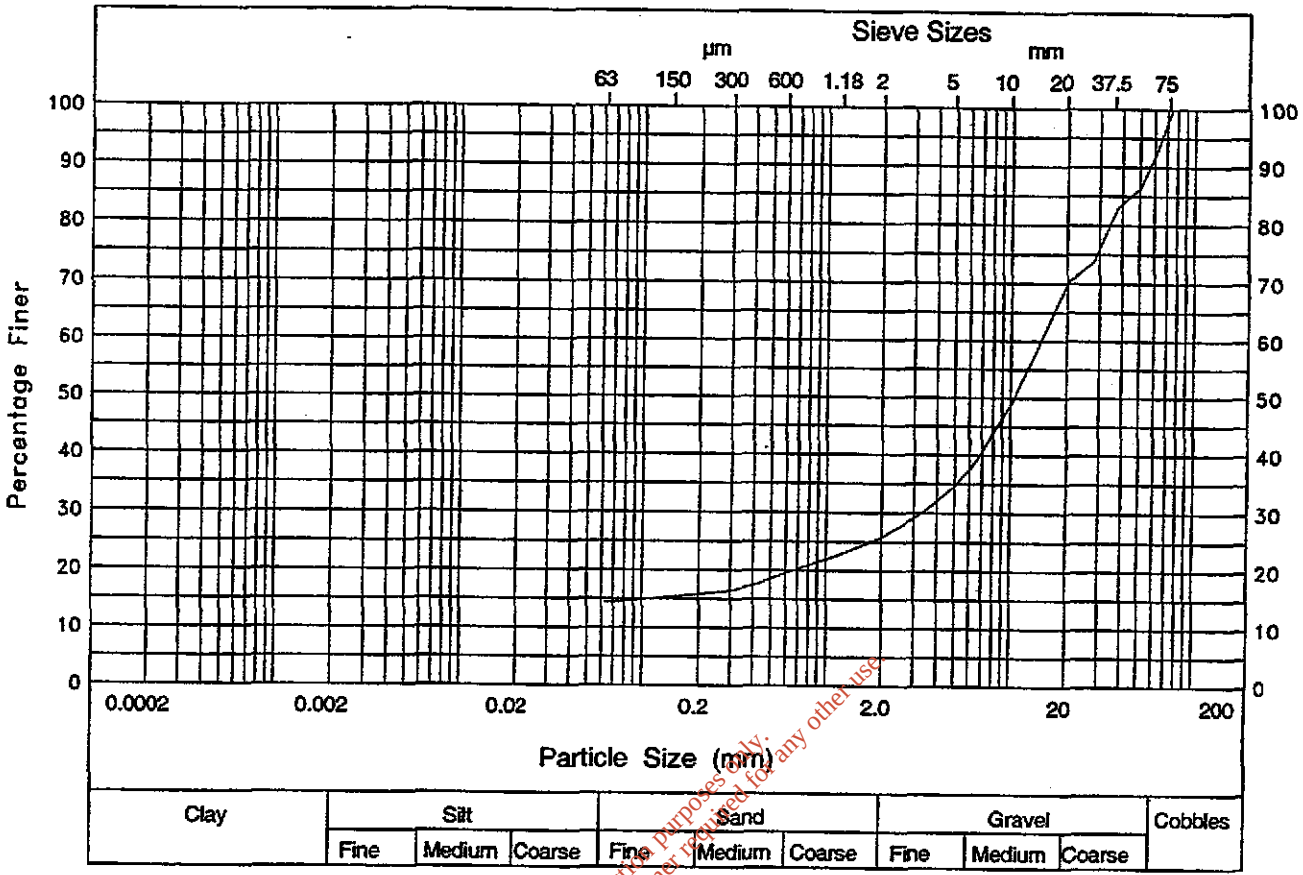


Particle Size	% Passing	Particle Size	% Passing
28 mm	100	212 µm	6
20 mm	98	150 µm	5
14 mm	89	75 µm	3
10 mm	76	63 µm	3
6.3 mm	61		
5 mm	52		
3.35 mm	41		
2 mm	30		
1.18 mm	20		
600 µm	11		
425 µm	9		
300 µm	7		

Hole BH1	Description: Sandy GRAVEL
Depth 3.60 -4.00	
Type B	
Test Performed Wet	Uniformity Coefficient = 13

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



Particle Size	% Passing	Particle Size	% Passing
75 mm	100	1.18 mm	23
63 mm	93	600 µm	20
50 mm	86	425 µm	18
37.5 mm	83	300 µm	16
28 mm	74	212 µm	16
20 mm	70	150 µm	15
14 mm	59	75 µm	15
10 mm	49	63 µm	14
6.3 mm	38		
5 mm	35		
3.35 mm	30		
2 mm	26		

Hole BH1	Description: Slightly clayey sandy GRAVEL
Depth 6.00 -6.50	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

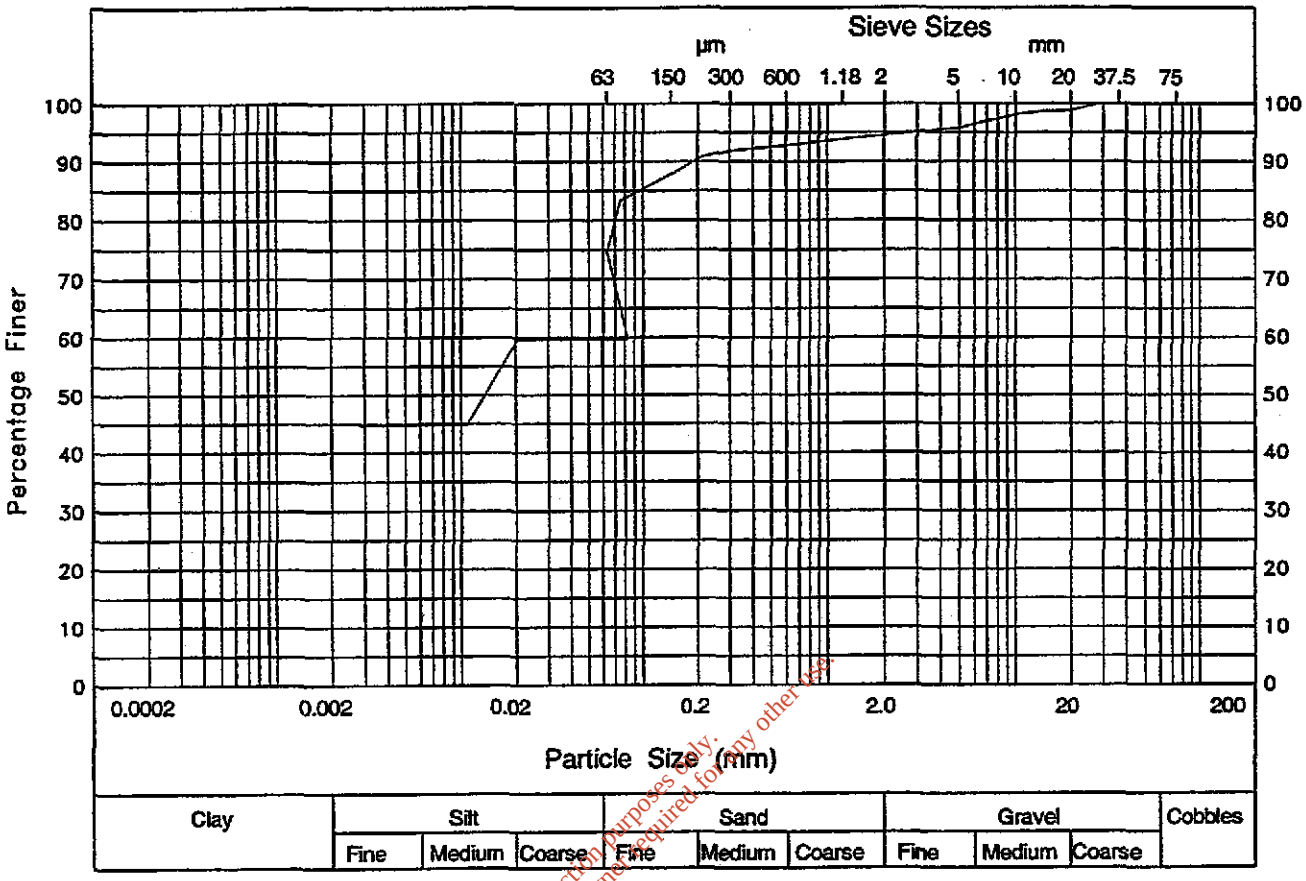
Laboratory - Particle Size Plot

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

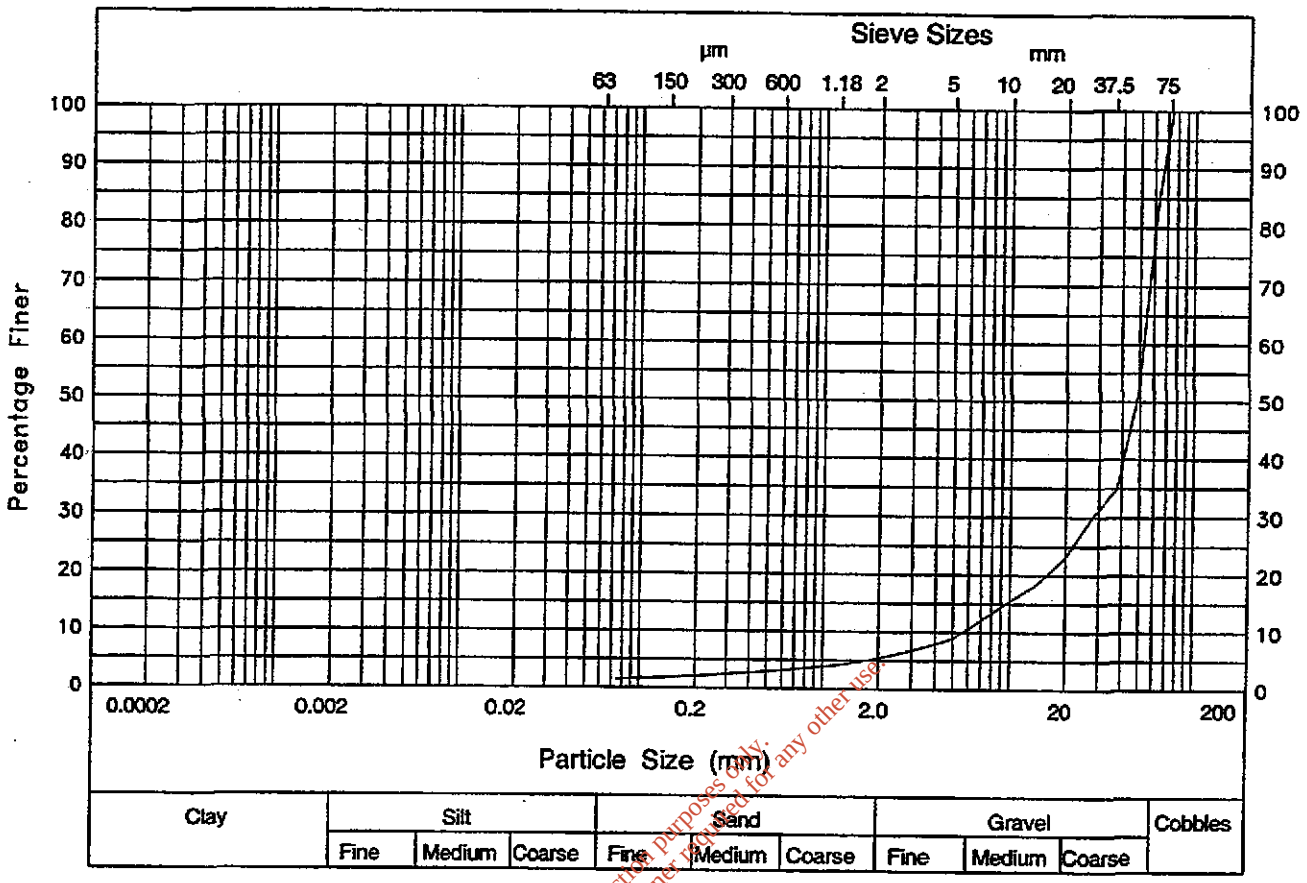


Particle Size	% Passing	Particle Size	% Passing
28 mm	100	212 µm	91
20 mm	99	150 µm	88
14 mm	99	75 µm	83
10 mm	98	63 µm	75
6.3 mm	97		
5 mm	96		
3.35 mm	95		
2 mm	94		
1.18 mm	94		
600 µm	93		
425 µm	92		
300 µm	92		

Hole BH1	Description Slightly sandy CLAY
Depth 18.00-18.44	
Type B	
Test Performed Wet	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

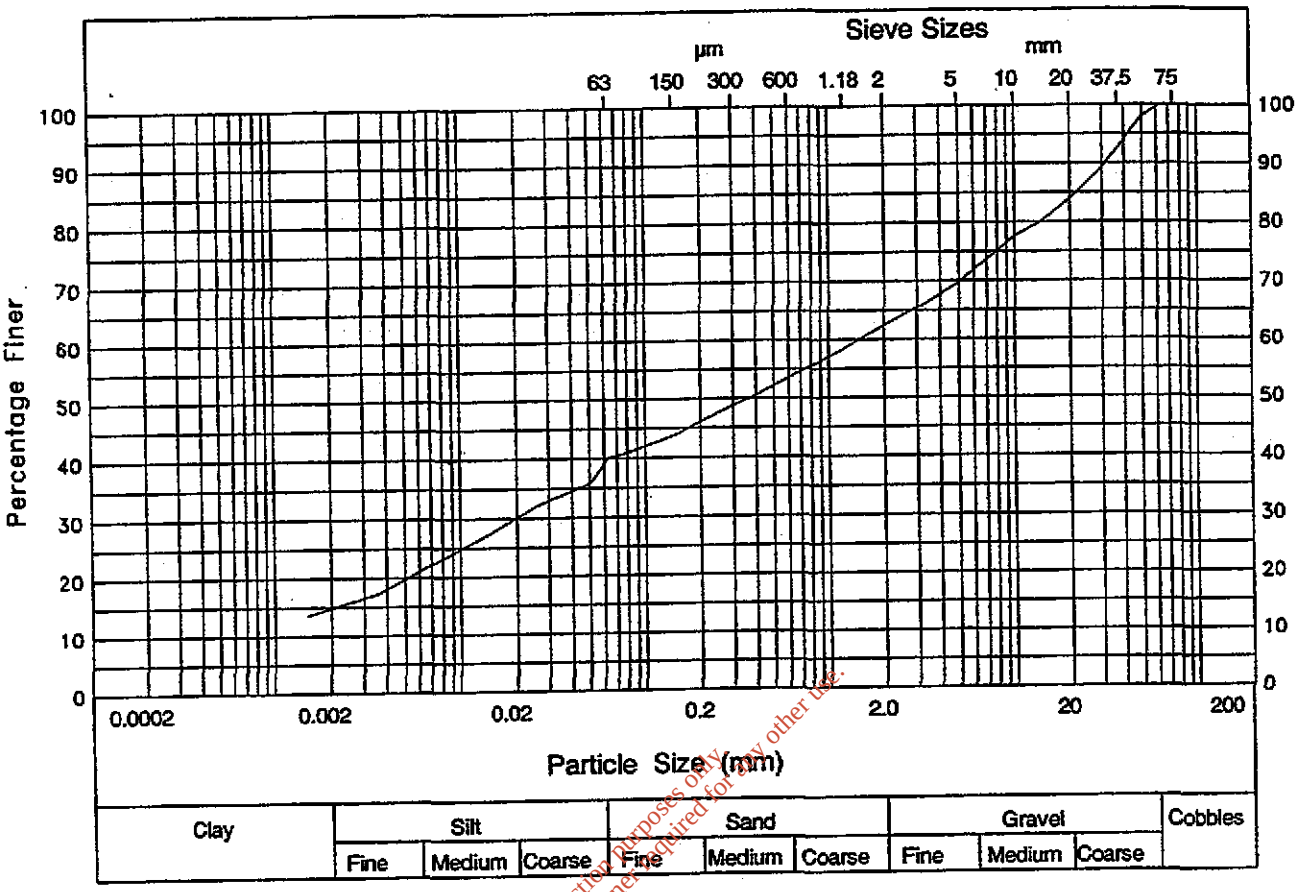


Particle Size	% Passing	Particle Size	% Passing
75 mm	100	1.18 mm	4
63 mm	85	600 µm	3
50 mm	53	425 µm	3
37.5 mm	35	300 µm	2
28 mm	30	212 µm	2
20 mm	23	150 µm	2
14 mm	18	75 µm	1
10 mm	15		
6.3 mm	11		
5 mm	9		
3.35 mm	7		
2 mm	5		

Hole BH2	Description GRAVEL
Depth 0.50 -1.00	
Type B	
Test Performed Dry	Uniformity Coefficient = 9.4

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

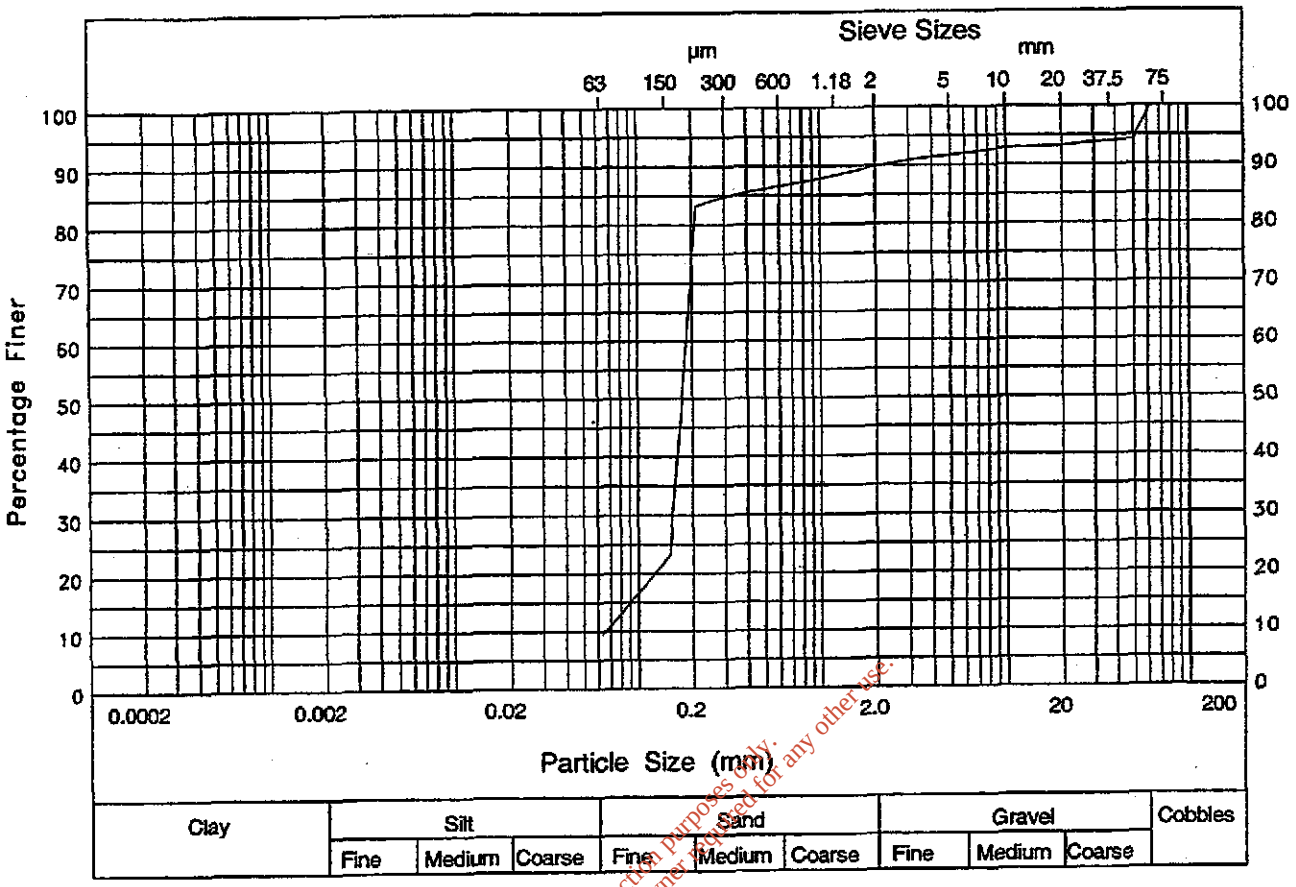


Particle Size	% Passing	Particle Size	% Passing
63 mm	100	600 µm	54
50 mm	98	425 µm	51
37.5 mm	93	300 µm	49
28 mm	88	212 µm	46
20 mm	84	150 µm	44
14 mm	80	75 µm	41
10 mm	78	63 µm	40
6.3 mm	72	51 µm	36
5 mm	70	26 µm	32
3.35 mm	66	14 µm	27
2 mm	62		
1.18 mm	58		

Hole BH2	*Description* Slightly sandy gravelly CLAY
Depth 1.50 -2.00	
Type B	
Test Performed Wet	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

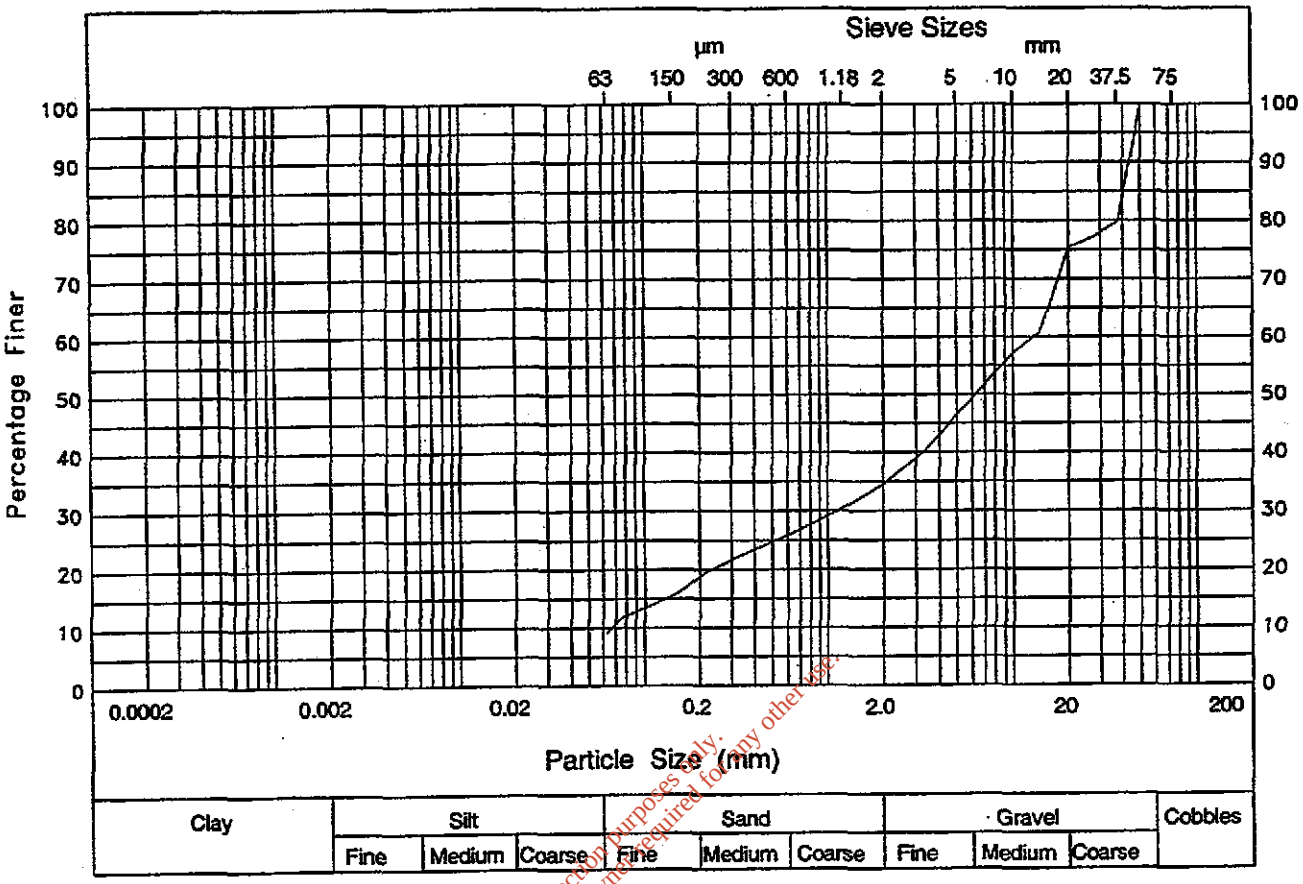


Particle Size	% Passing	Particle Size	% Passing
63 mm	100	300 µm	85
50 mm	94	212 µm	83
28 mm	94	150 µm	23
20 mm	93	75 µm	12
10 mm	93	63 µm	9
6.3 mm	92		
5 mm	92		
3.35 mm	91		
2 mm	90		
1.18 mm	88		
600 µm	87		
425 µm	86		

Hole BH2	Description Slightly clayey gravelly SAND
Depth 4.00 -4.50	
Type B	
Test Performed Wet	Uniformity Coefficient = 2.8

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

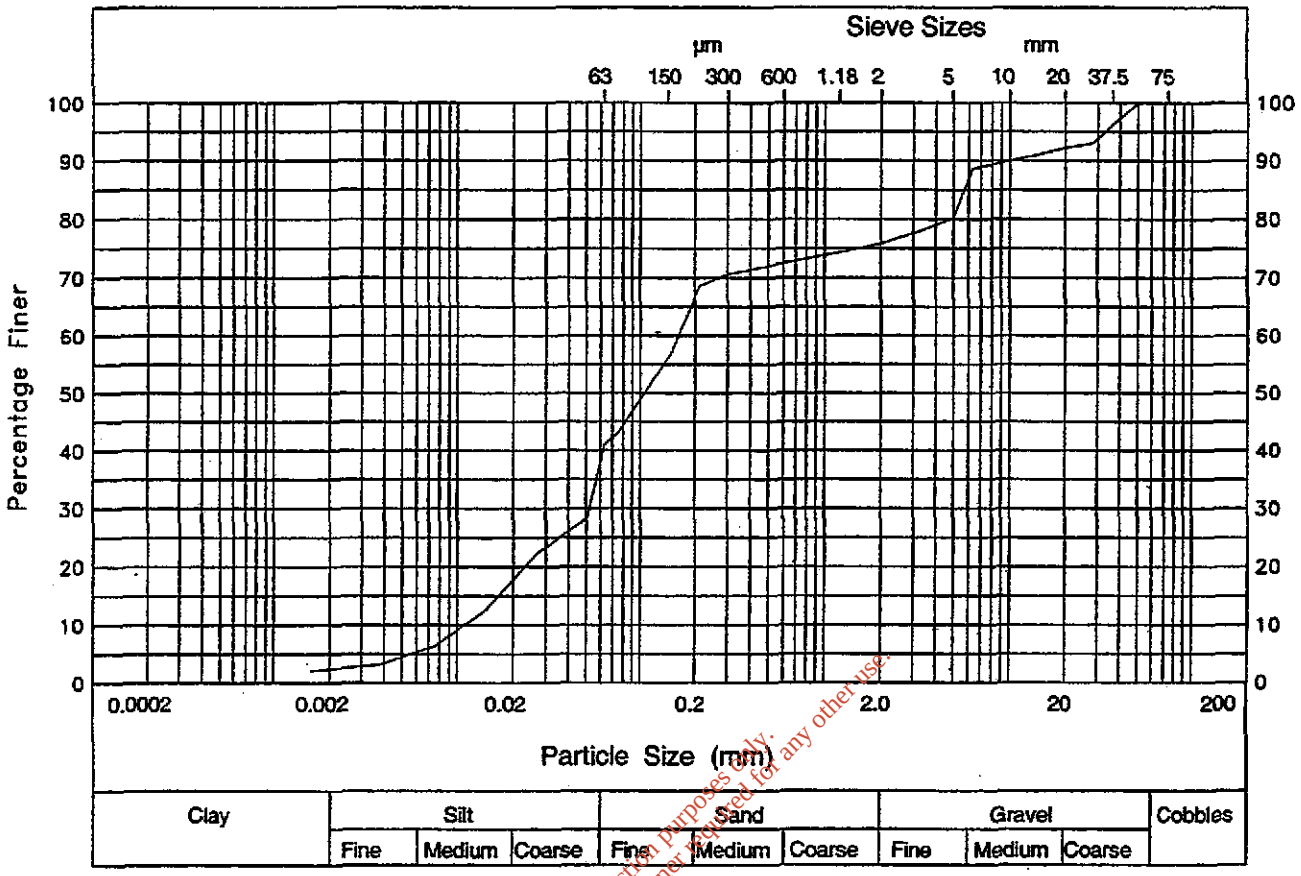


Particle Size	% Passing	Particle Size	% Passing
50 mm	100	425 µm	24
37.5 mm	80	300 µm	22
28 mm	77	212 µm	19
20 mm	75	150 µm	16
14 mm	61	75 µm	12
10 mm	57	63 µm	9
6.3 mm	50		
5 mm	47		
3.35 mm	40		
2 mm	34		
1.18 mm	30		
600 µm	26		

Hole BH3A	Description: Clayey very sandy GRAVEL
Depth 0.50 -1.00	
Type B	
Test Performed Dry	Uniformity Coefficient = 195

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

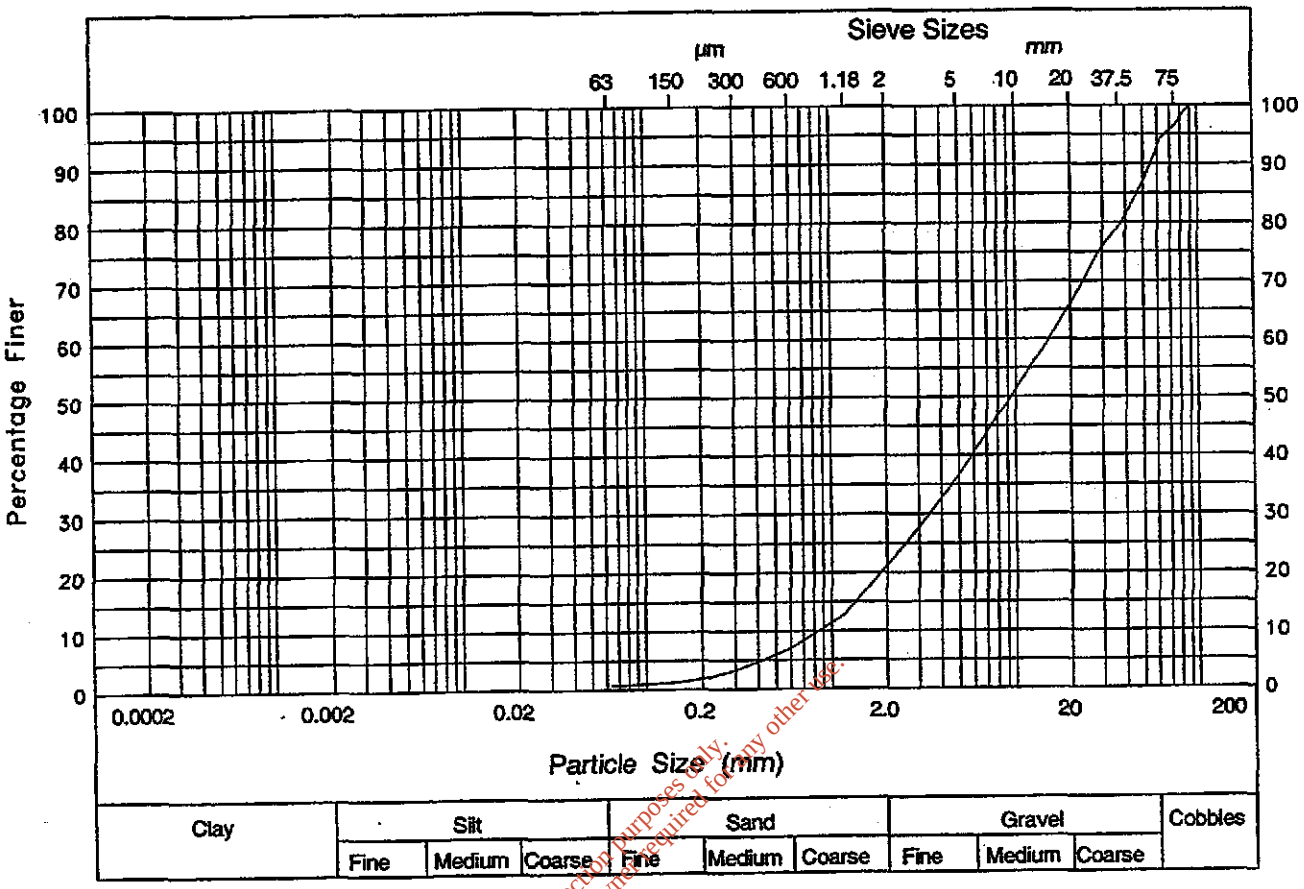


Particle Size	% Passing	Particle Size	% Passing
50 mm	100	425 µm	72
37.5 mm	97	300 µm	71
28 mm	93	212 µm	69
20 mm	92	150 µm	57
14 mm	91	75 µm	43
10 mm	90	63 µm	41
6.3 mm	89	51 µm	28
5 mm	80	27 µm	22
3.35 mm	78	14 µm	13
2 mm	76		
1.18 mm	74		
600 µm	73		

Hole BH3A	Description: Slightly sandy slightly gravelly SILT
Depth 3.60 -4.00	
Type B	
Test Performed Wet	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

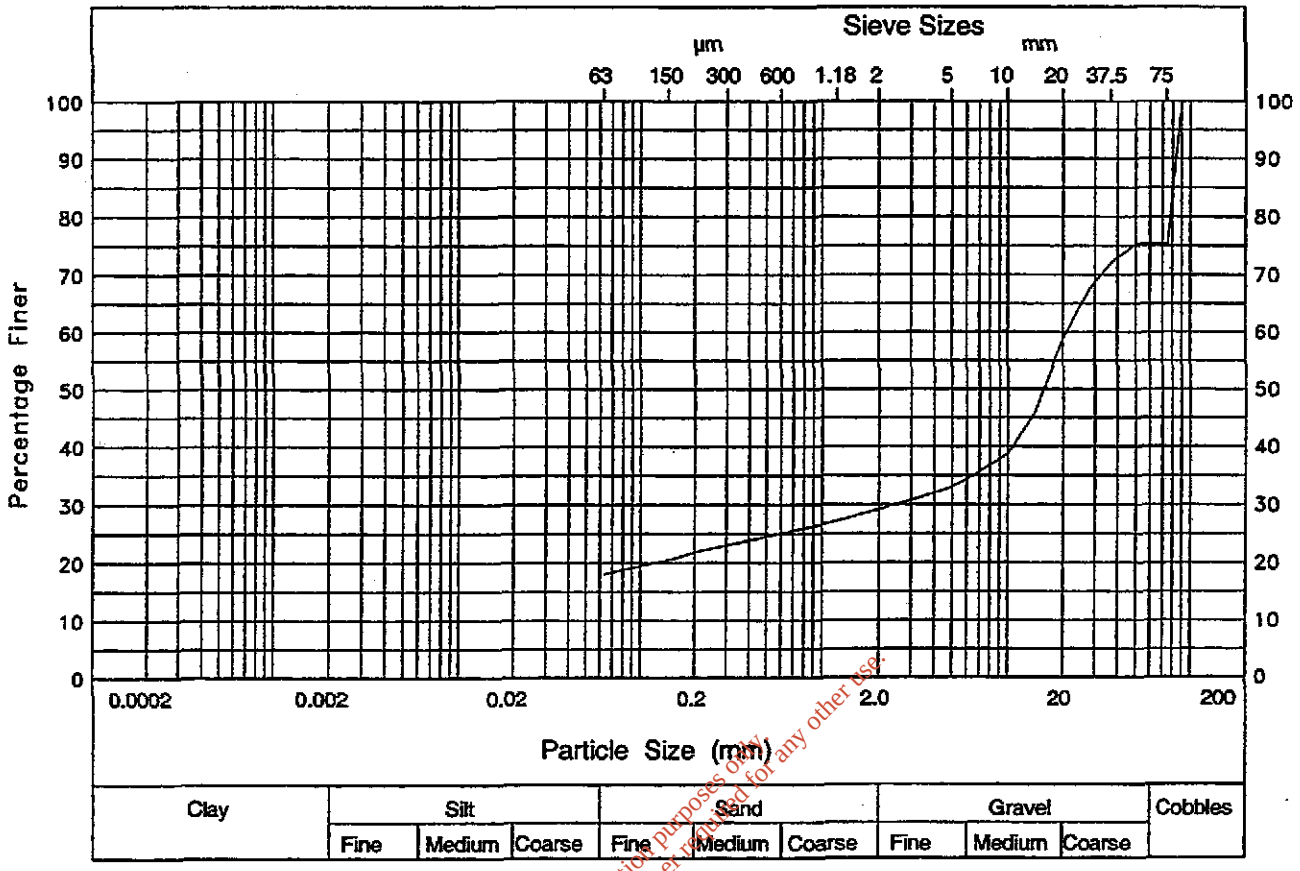


Particle Size	% Passing	Particle Size	% Passing
90 mm	100	2 mm	21
75 mm	96	1.18 mm	13
63 mm	94	600 µm	7
50 mm	87	425 µm	5
37.5 mm	80	300 µm	3
28 mm	75	212 µm	2
20 mm	66	150 µm	1
14 mm	58	75 µm	1
10 mm	51	63 µm	1
6.3 mm	42		
5 mm	37		
3.35 mm	30		

Hole BH3A	Description: Very sandy GRAVEL
Depth 6.00 -6.45	
Type B	
Test Performed Wet	Uniformity Coefficient = 18

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



Particle Size	% Passing	Particle Size	% Passing
90 mm	100	2 mm	29
75 mm	75	1.18 mm	27
63 mm	75	600 µm	25
50 mm	75	425 µm	24
37.5 mm	72	300 µm	23
28 mm	68	212 µm	22
20 mm	59	150 µm	21
14 mm	46	75 µm	19
10 mm	39	63 µm	18
6.3 mm	35		
5 mm	33		
3.35 mm	31		

Hole BH4	Description: Clayey sandy GRAVEL
Depth 0.50 -1.00	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

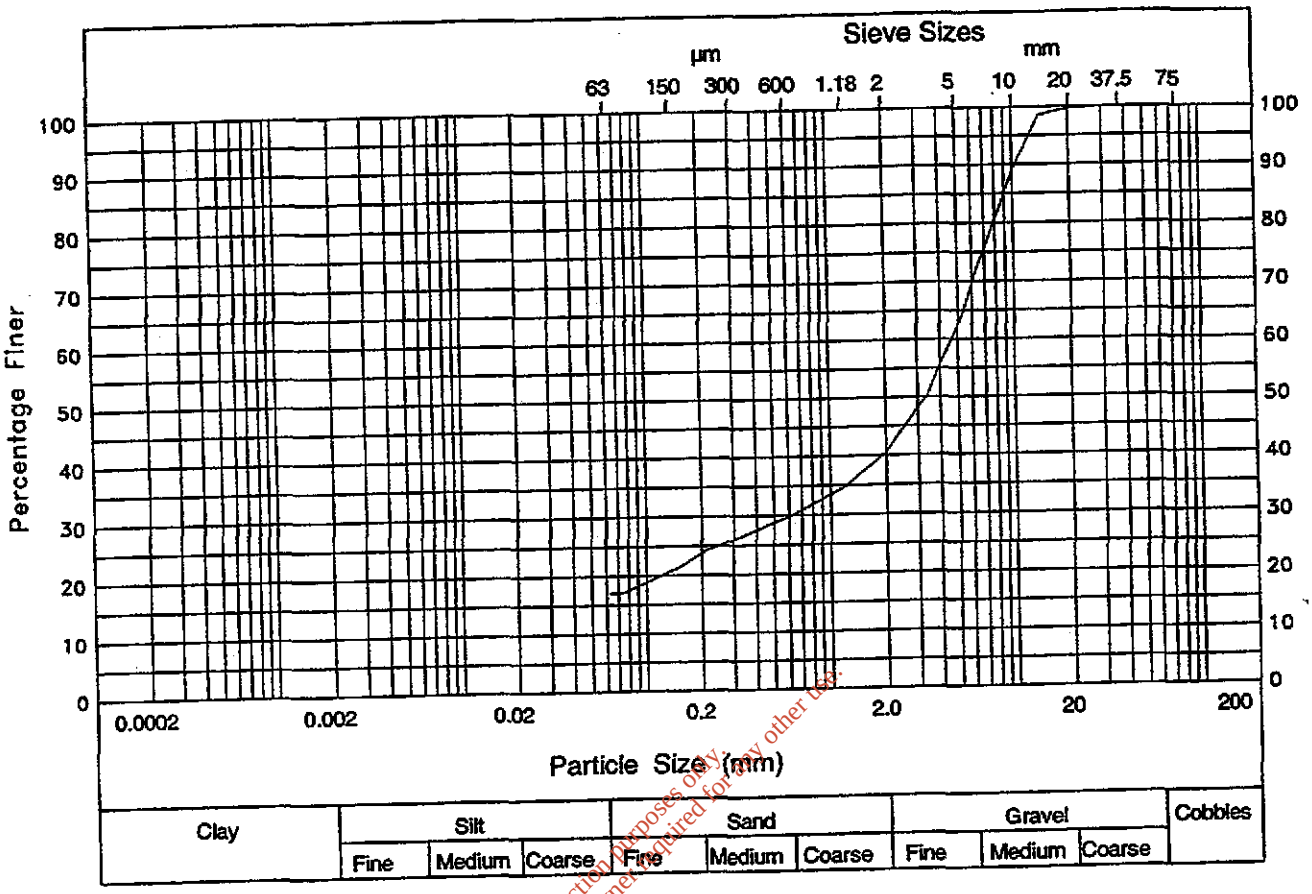
Laboratory - Particle Size Plot

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

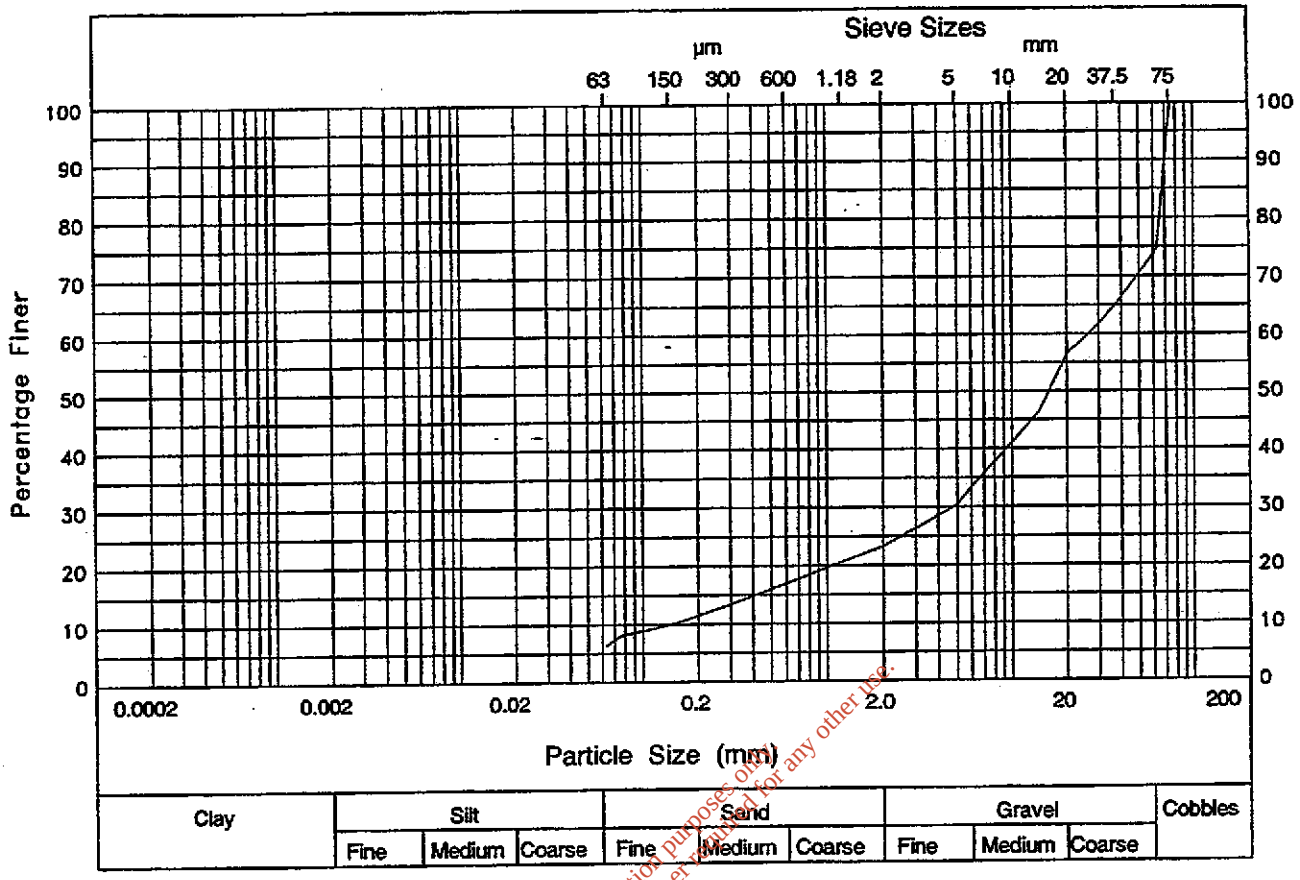


Particle Size	% Passing	Particle Size	% Passing
28 mm	100	212 µm	24
20 mm	100	150 µm	21
14 mm	99	75 µm	17
10 mm	89	63 µm	17
6.3 mm	72		
5 mm	62		
3.35 mm	50		
2 mm	40		
1.18 mm	35		
600 µm	30		
425 µm	28		
300 µm	26		

Hole BH4	Description: Clayey very sandy GRAVEL
Depth 4.00 -4.50	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

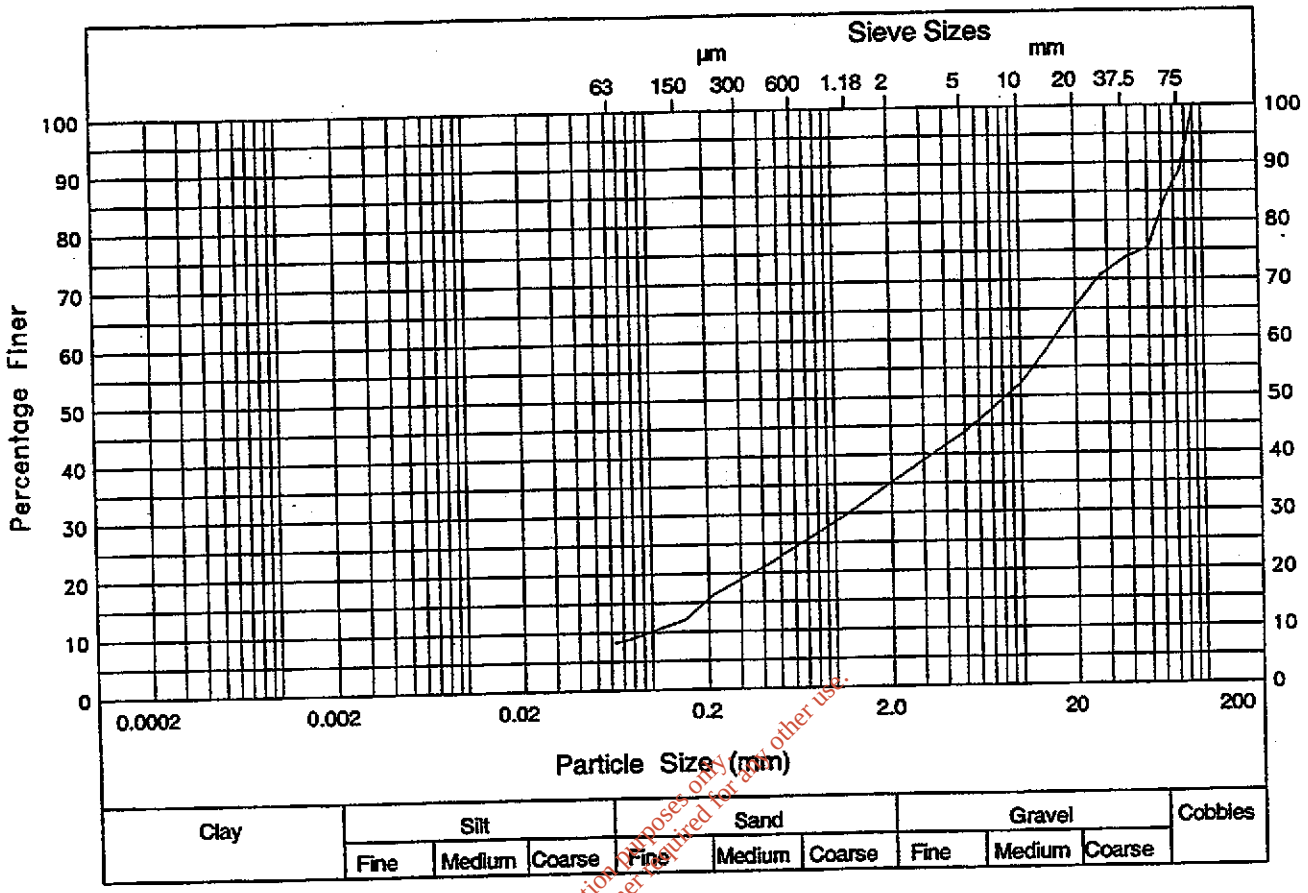


Particle Size	% Passing	Particle Size	% Passing
75 mm	100	600 µm	17
63 mm	75	425 µm	15
37.5 mm	65	300 µm	13
28 mm	61	212 µm	12
20 mm	56	150 µm	10
14 mm	46	75 µm	8
10 mm	41	63 µm	6
6.3 mm	34		
5 mm	30		
3.35 mm	27		
2 mm	23		
1.18 mm	21		

Hole BH5	Description: Clayey sandy GRAVEL
Depth 0.00 -0.50	
Type B	
Test Performed Dry	Uniformity Coefficient = 187

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

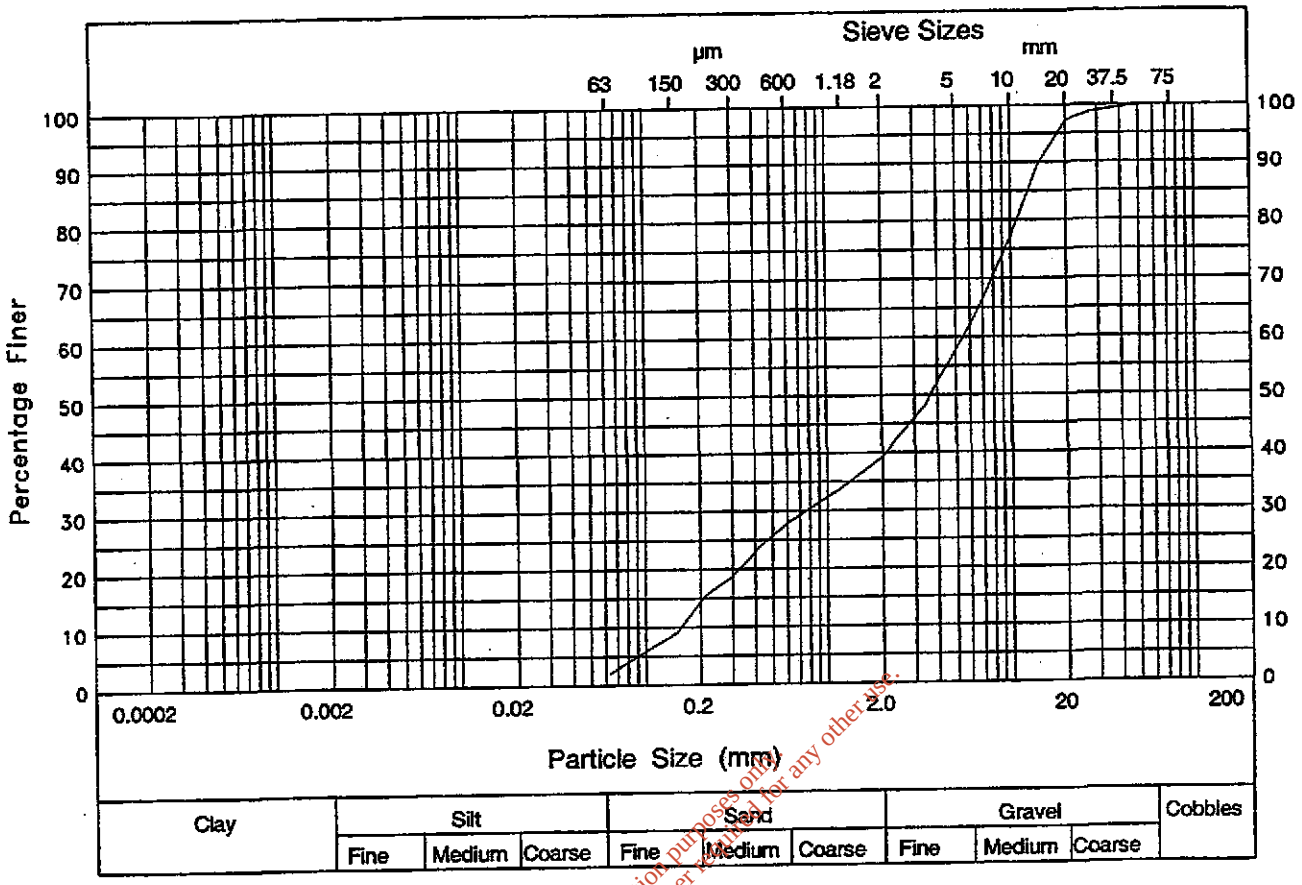


Particle Size	% Passing	Particle Size	% Passing
90 mm	100	2 mm	35
75 mm	88	1.18 mm	30
63 mm	84	600 µm	24
50 mm	75	425 µm	21
37.5 mm	74	300 µm	19
28 mm	71	212 µm	16
20 mm	65	150 µm	12
14 mm	58	75 µm	9
10 mm	52	63 µm	8
6.3 mm	46		
5 mm	44		
3.35 mm	40		

Hole BH5	Description: Clayey sandy GRAVEL
Depth 0.50 -1.00	
Type B	
Test Performed Wet	Uniformity Coefficient = 164

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

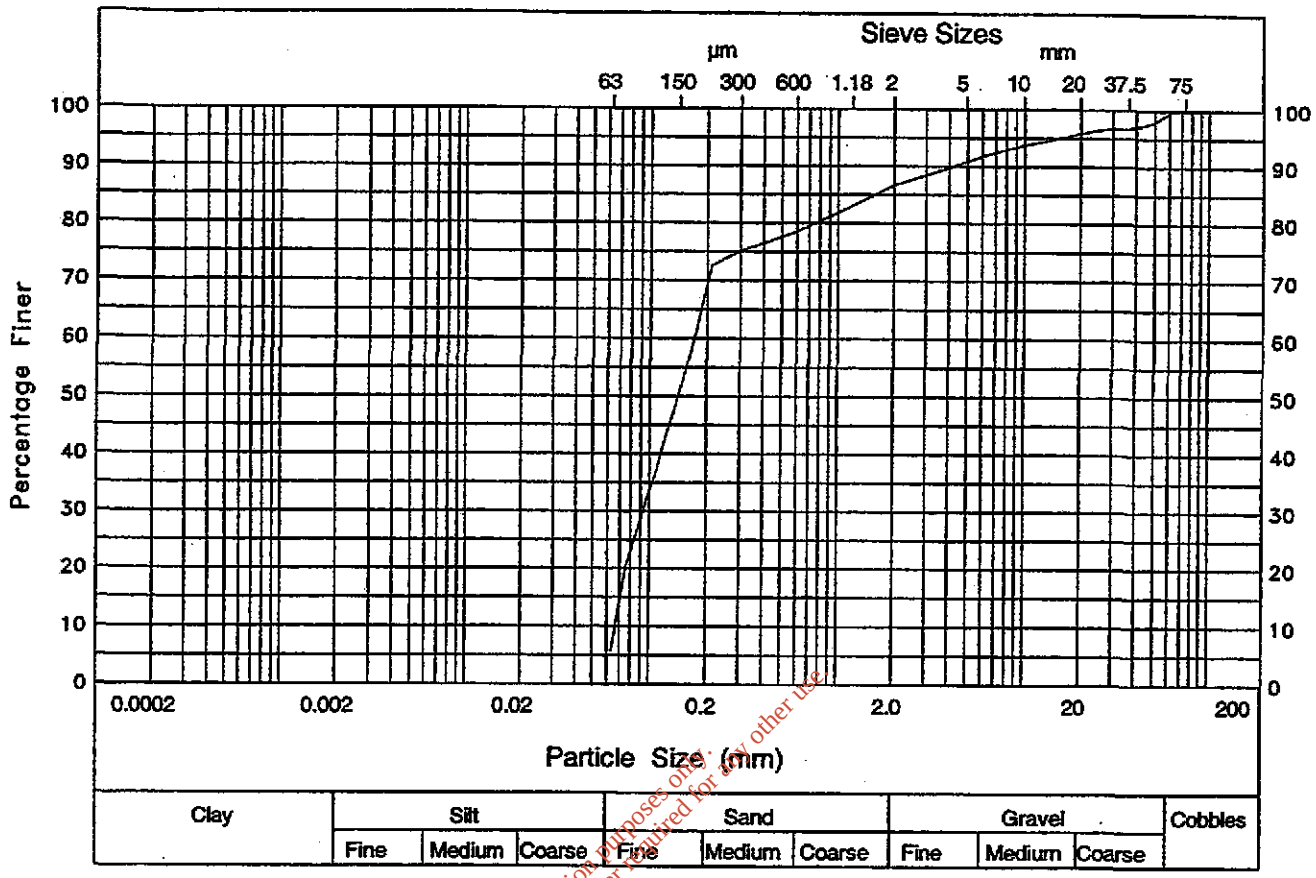


Particle Size	% Passing	Particle Size	% Passing
50 mm	100	425 µm	24
37.5 mm	99	300 µm	19
28 mm	99	212 µm	15
20 mm	97	150 µm	9
14 mm	89	75 µm	4
10 mm	77	63 µm	2
6.3 mm	63		
5 mm	58		
3.35 mm	48		
2 mm	39		
1.18 mm	34		
600 µm	28		

Hole BH5	Description Sandy GRAVEL
Depth 5.50 -5.95	
Type B	
Test Performed Wet	Uniformity Coefficient = 35

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

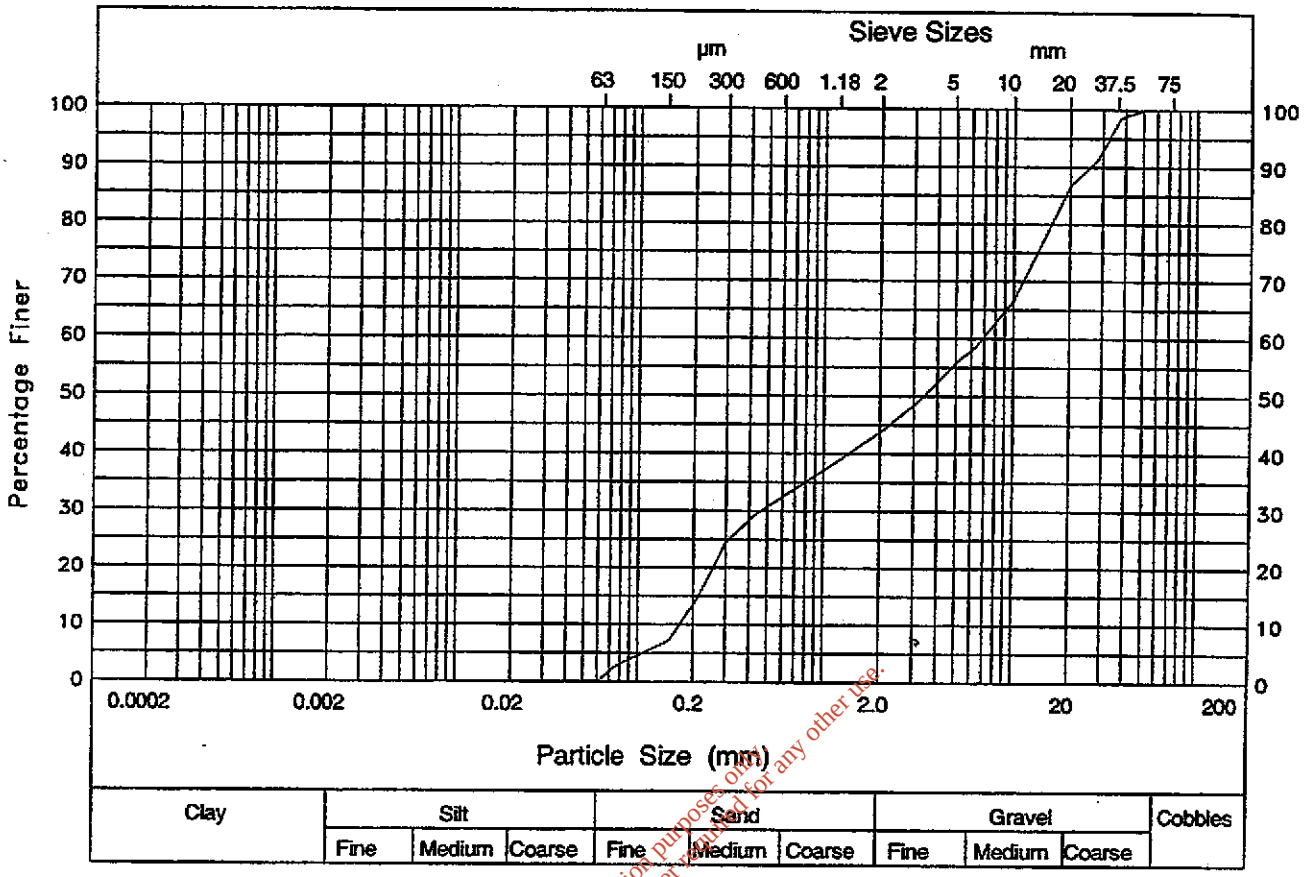


Particle Size	% Passing	Particle Size	% Passing
63 mm	100	600 µm	79
50 mm	98	425 µm	77
37.5 mm	97	300 µm	75
28 mm	97	212 µm	73
20 mm	96	150 µm	53
14 mm	95	75 µm	20
10 mm	94	63 µm	6
6.3 mm	92		
5 mm	91		
3.35 mm	89		
2 mm	87		
1.18 mm	83		

Hole TP01	Description Silty gravelly SAND
Depth 0.50 -0.60	
Type B	
Test Performed Wet	Uniformity Coefficient = 2.6

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

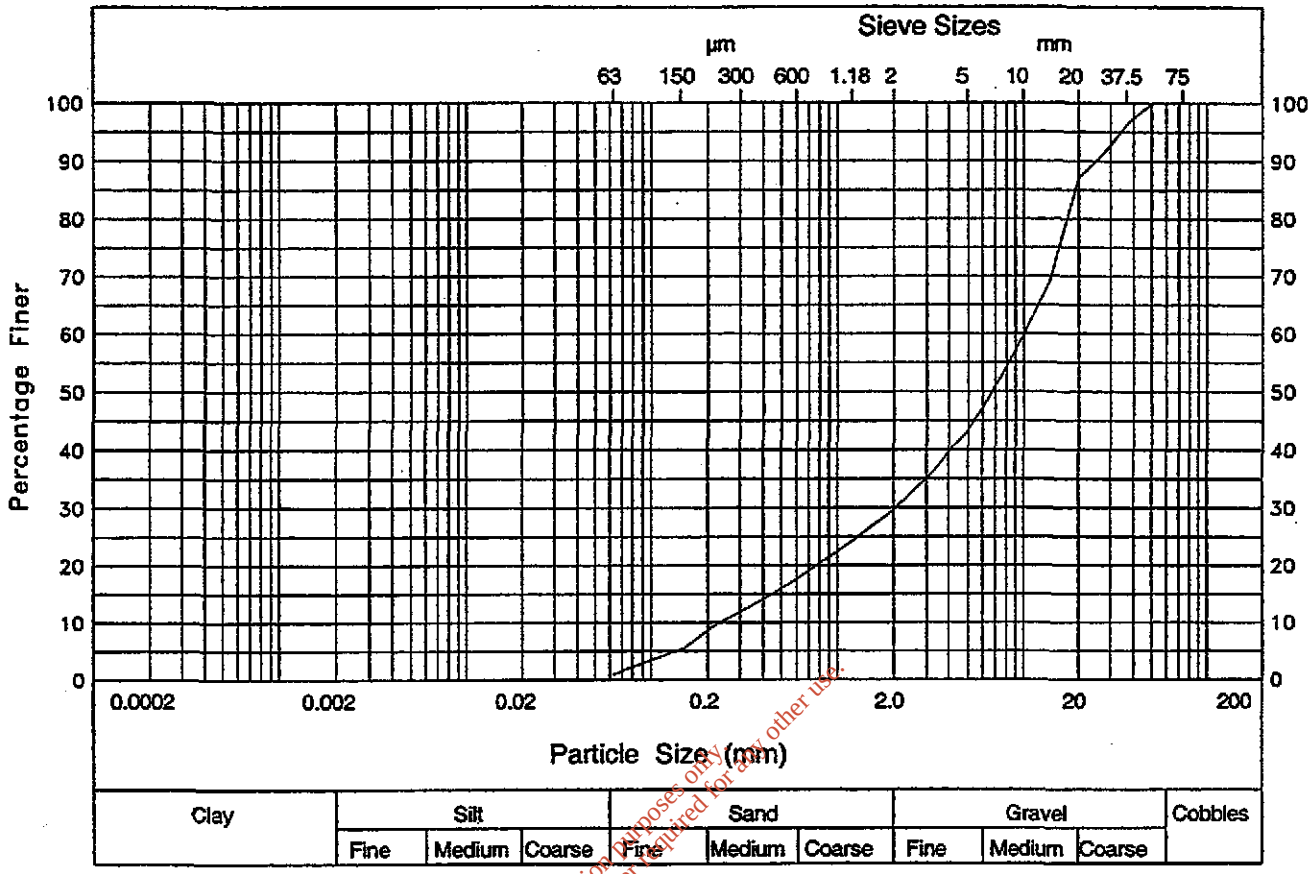


Particle Size	% Passing	Particle Size	% Passing
50 mm	100	425 µm	29
37.5 mm	99	300 µm	24
28 mm	91	212 µm	15
20 mm	87	150 µm	7
14 mm	76	75 µm	3
10 mm	67	63 µm	1
6.3 mm	58		
5 mm	56		
3.35 mm	50		
2 mm	44		
1.18 mm	39		
600 µm	32		

Hole TP02	Description SAND and GRAVEL
Depth 1.00 -1.10	
Type B	
Test Performed Dry	Uniformity Coefficient = 41

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

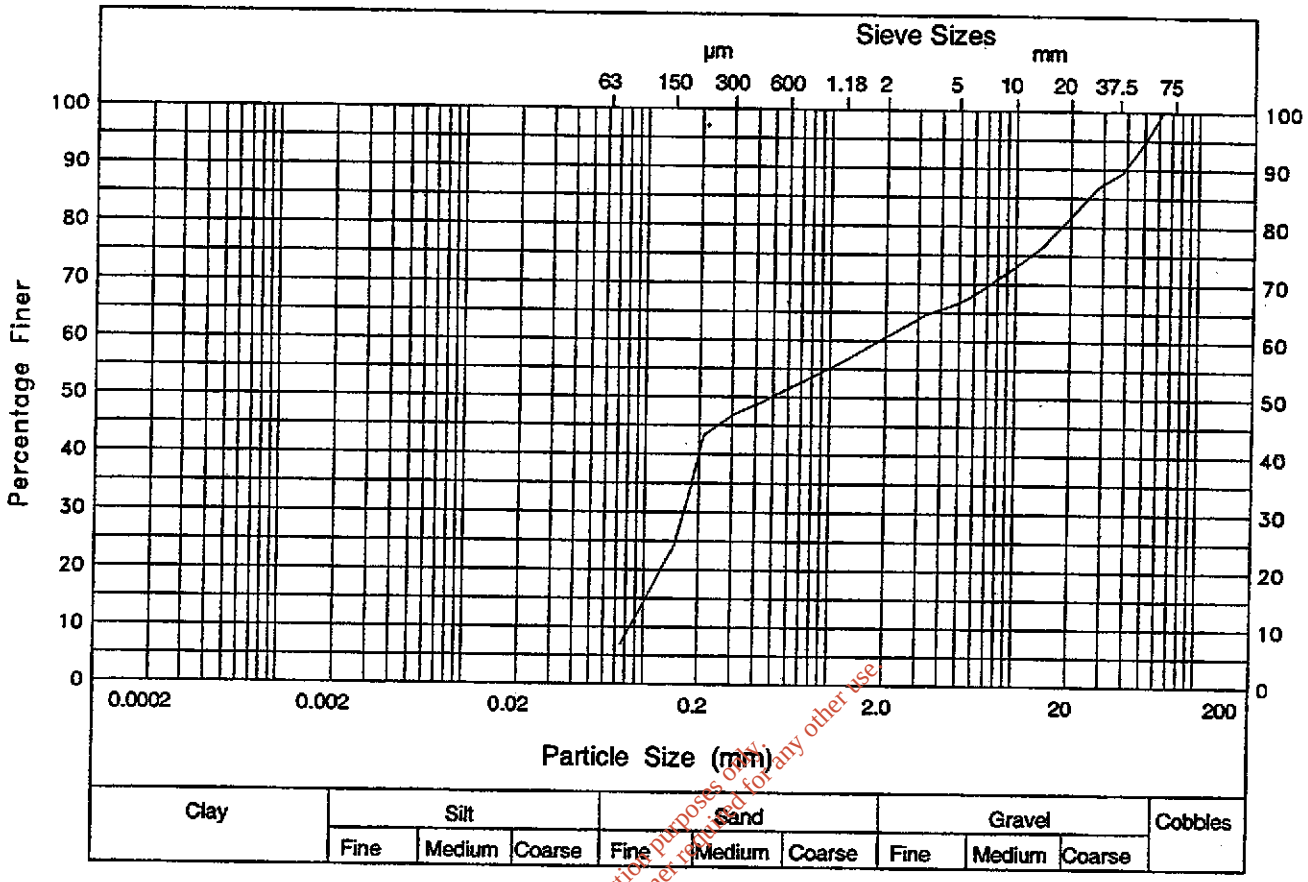


Particle Size	% Passing	Particle Size	% Passing
50 mm	100	425 µm	15
37.5 mm	97	300 µm	12
28 mm	92	212 µm	9
20 mm	87	150 µm	5
14 mm	69	75 µm	2
10 mm	60	63 µm	1
6.3 mm	48		
5 mm	43		
3.35 mm	37		
2 mm	30		
1.18 mm	24		
600 µm	18		

Hole TP02	Description Sandy GRAVEL
Depth 3.20 -3.40	
Type B	
Test Performed Dry	Uniformity Coefficient = 42

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

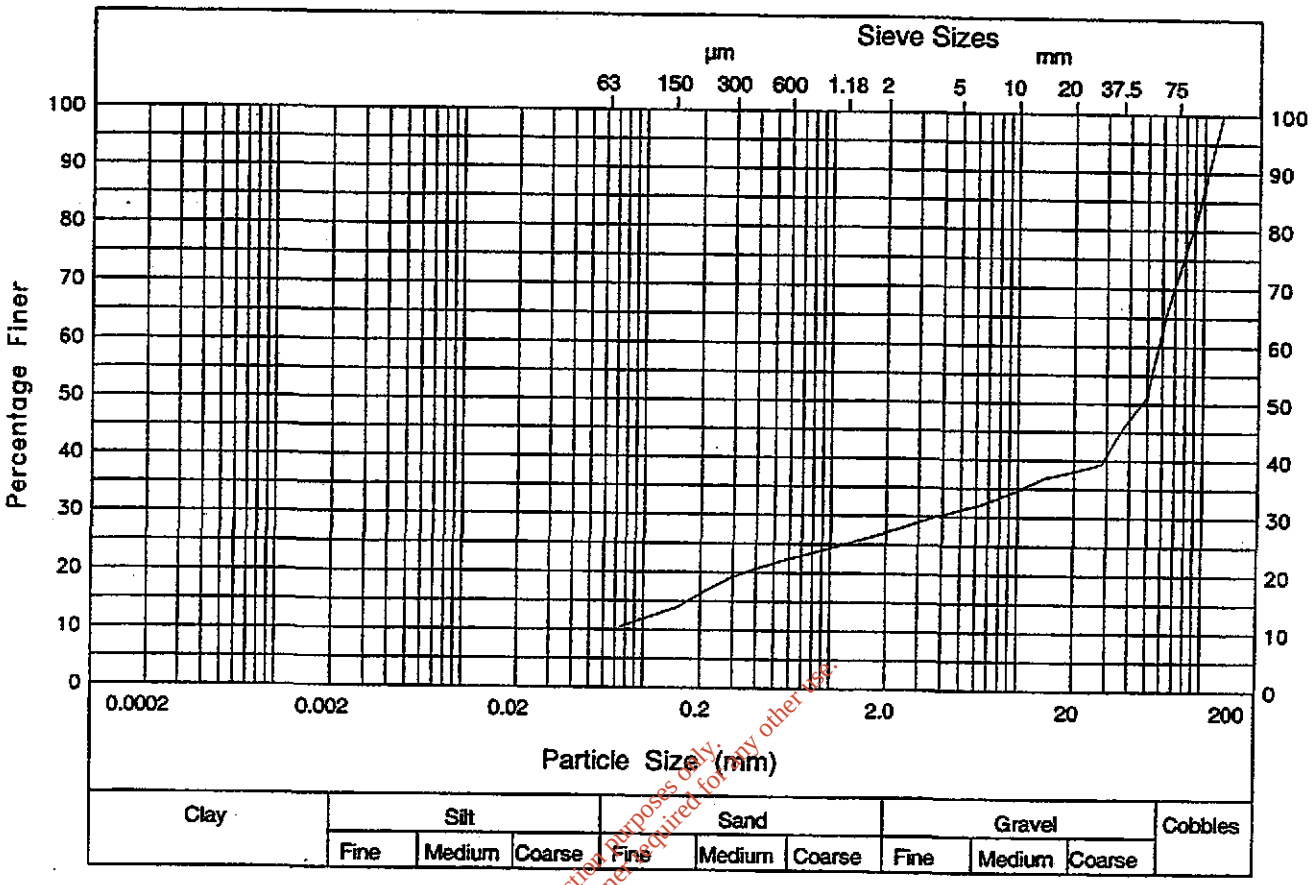


Particle Size	% Passing	Particle Size	% Passing
63 mm	100	600 µm	52
50 mm	95	425 µm	49
37.5 mm	89	300 µm	47
28 mm	87	212 µm	43
20 mm	82	150 µm	25
14 mm	76	75 µm	7
10 mm	73		
6.3 mm	69		
5 mm	67		
3.35 mm	65		
2 mm	61		
1.18 mm	56		

Hole TP03	Description Very gravelly SAND
Depth 0.60 -0.80	
Type B	
Test Performed Dry	Uniformity Coefficient = 22

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

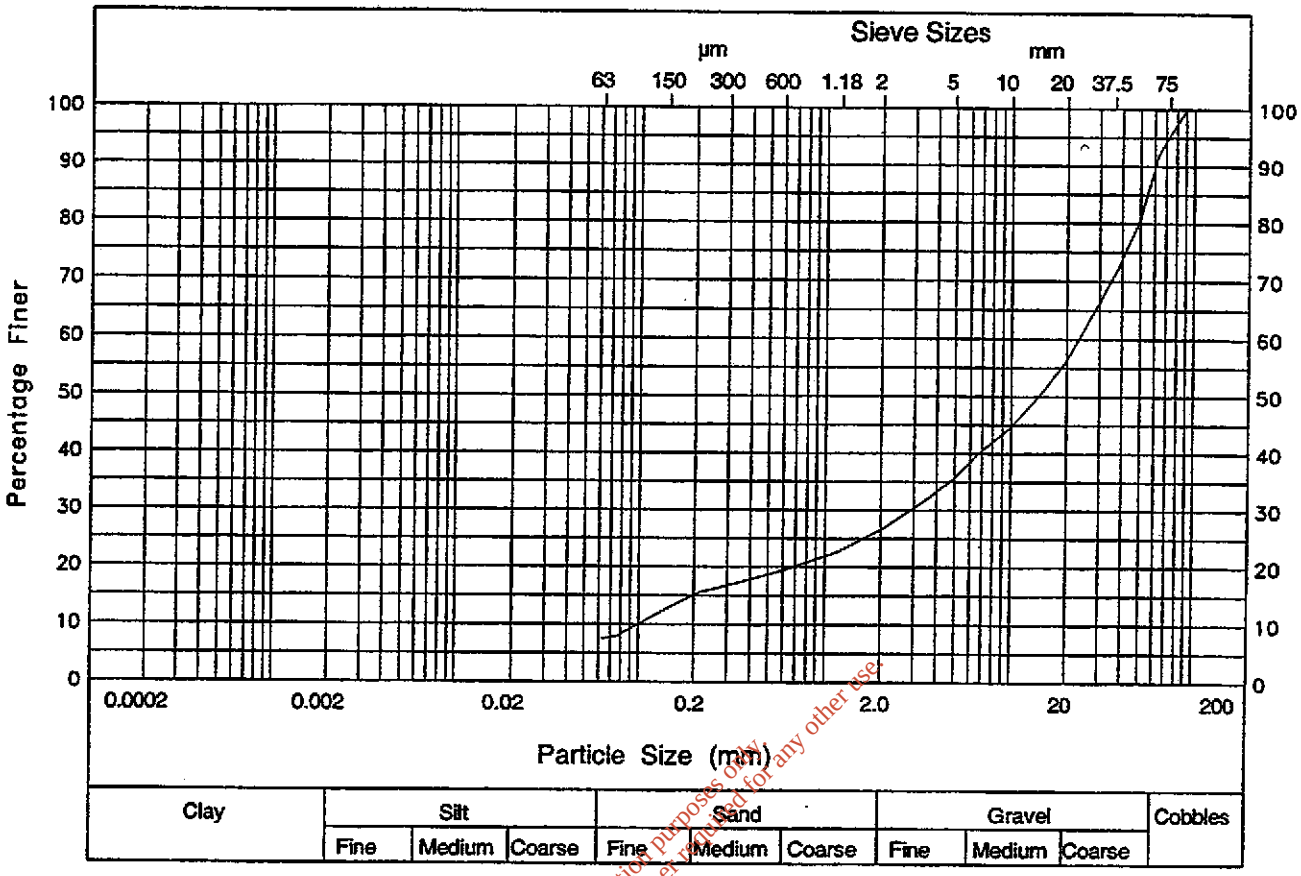


Particle Size	% Passing	Particle Size	% Passing
90 mm	81	1.18 mm	25
63 mm	66	600 µm	22
50 mm	51	425 µm	21
37.5 mm	46	300 µm	19
28 mm	39	212 µm	17
20 mm	38	150 µm	14
14 mm	37	75 µm	11
10 mm	35		
6.3 mm	32		
5 mm	31		
3.35 mm	29		
2 mm	27		

Hole TP03	Description: Silty sandy GRAVEL
Depth 1.80 -2.00	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy .	**Contract** KD3116x
GEOTECH		**Sheet**

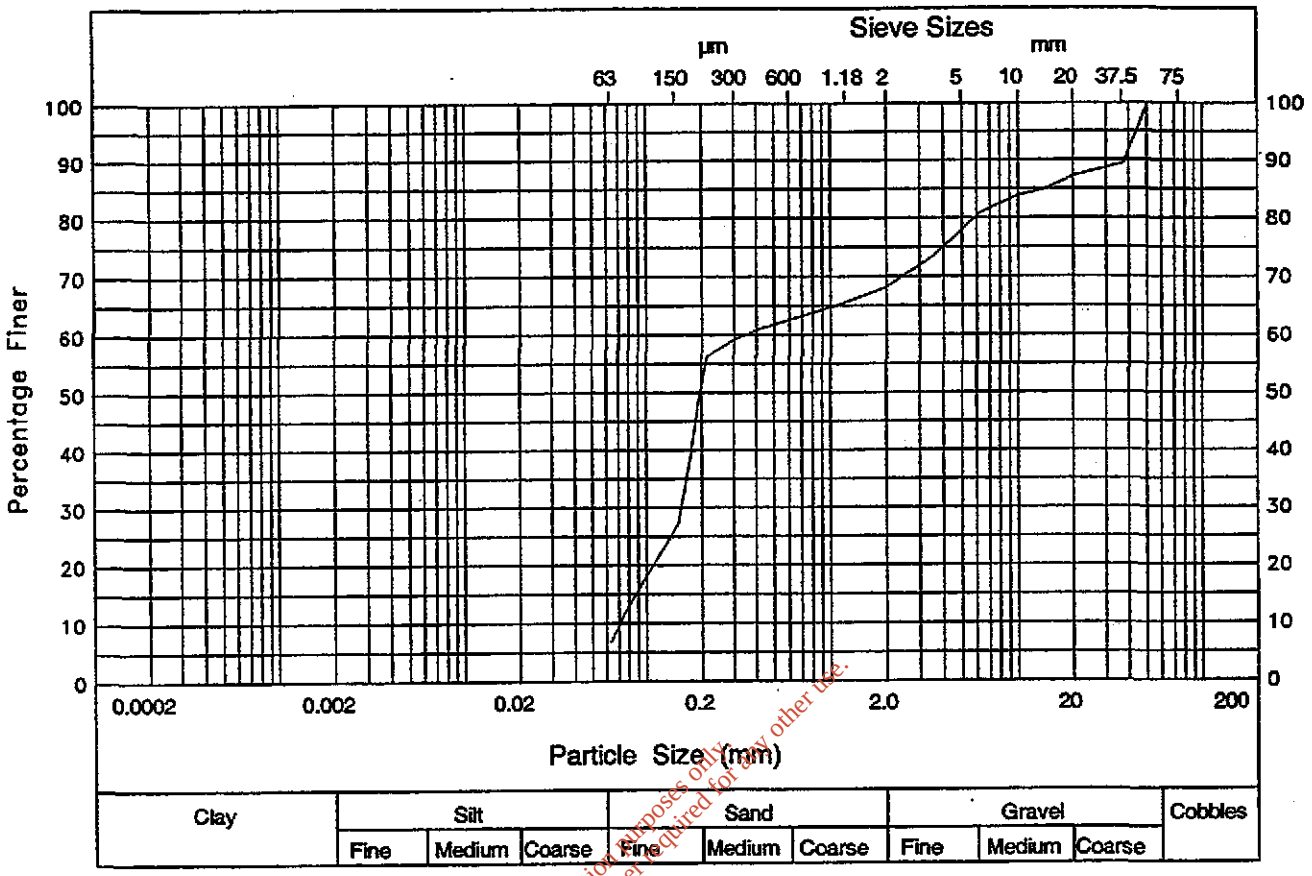


Particle Size	% Passing	Particle Size	% Passing
90 mm	100	2 mm	27
75 mm	96	1.18 mm	23
63 mm	92	600 µm	19
50 mm	81	425 µm	18
37.5 mm	72	300 µm	17
28 mm	65	212 µm	15
20 mm	56	150 µm	13
14 mm	50	75 µm	8
10 mm	45	63 µm	8
6.3 mm	39		
5 mm	36		
3.35 mm	31		

Hole TP04	Description: Silty sandy GRAVEL
Depth 0.50 -0.60	
Type B	
Test Performed Wet	Uniformity Coefficient = 237

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



Particle Size	% Passing	Particle Size	% Passing
50 mm	100	300 µm	59
37.5 mm	89	212 µm	56
20 mm	87	150 µm	27
14 mm	85	75 µm	12
10 mm	84	63 µm	7
6.3 mm	81		
5 mm	78		
3.35 mm	73		
2 mm	68		
1.18 mm	65		
600 µm	63		
425 µm	61		

Hole TP04	Description: Clayey very gravelly SAND
Depth 3.90 -4.10	
Type B	
Test Performed Dry	Uniformity Coefficient = 5.0

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

Our Ref : EFS/033223
Your Ref:
18 August 2003

TES Bretby

PO Box 100
Ashby Road
Burton-upon-Trent
Staffordshire
DE15 0XD

Telephone: 01283 554400
Facsimile: 01283 554422
E-mail: enquiries@tes-bretby.co.uk

Mr A Garne
Geotech Specialists Ltd
Carewswood
Castlemartyr
County Cork
Ireland

Dear Mr Garne

SOILS ANALYSIS - Dublin Waste

Please find attached analytical results for the samples from the above site.

An invoice for this work will follow under separate cover.

If appropriate, samples covered by this report will be saved until approximately 17/09/03 when they will be discarded. Please call 01283 554403 for an extension of this date.
Please be aware that from 1 January 2003 our policy for the retention of paper based laboratory records and analysis reports will be 3 year

The work was carried out in accordance with Mowlem Environmental Sciences Group Standard Terms and Conditions of Contract.

Please contact me if you require any further information.

Yours sincerely

J Hannah

J Hannah
Project Co-ordinator
01283-554403

ENCLOSURE E

GEOENVIRONMENTAL LABORATORY TEST RESULTS

TES Report	EFS/033223
TES Report	EFS/032527
TES Report	EFS/034319
ALControl Geochem Report	03-B02557

Point Load Test Data
Project: Dublin Waste to Energy
Project No.: KD3116
Test Date: 25-Jul-03

GEOTECH

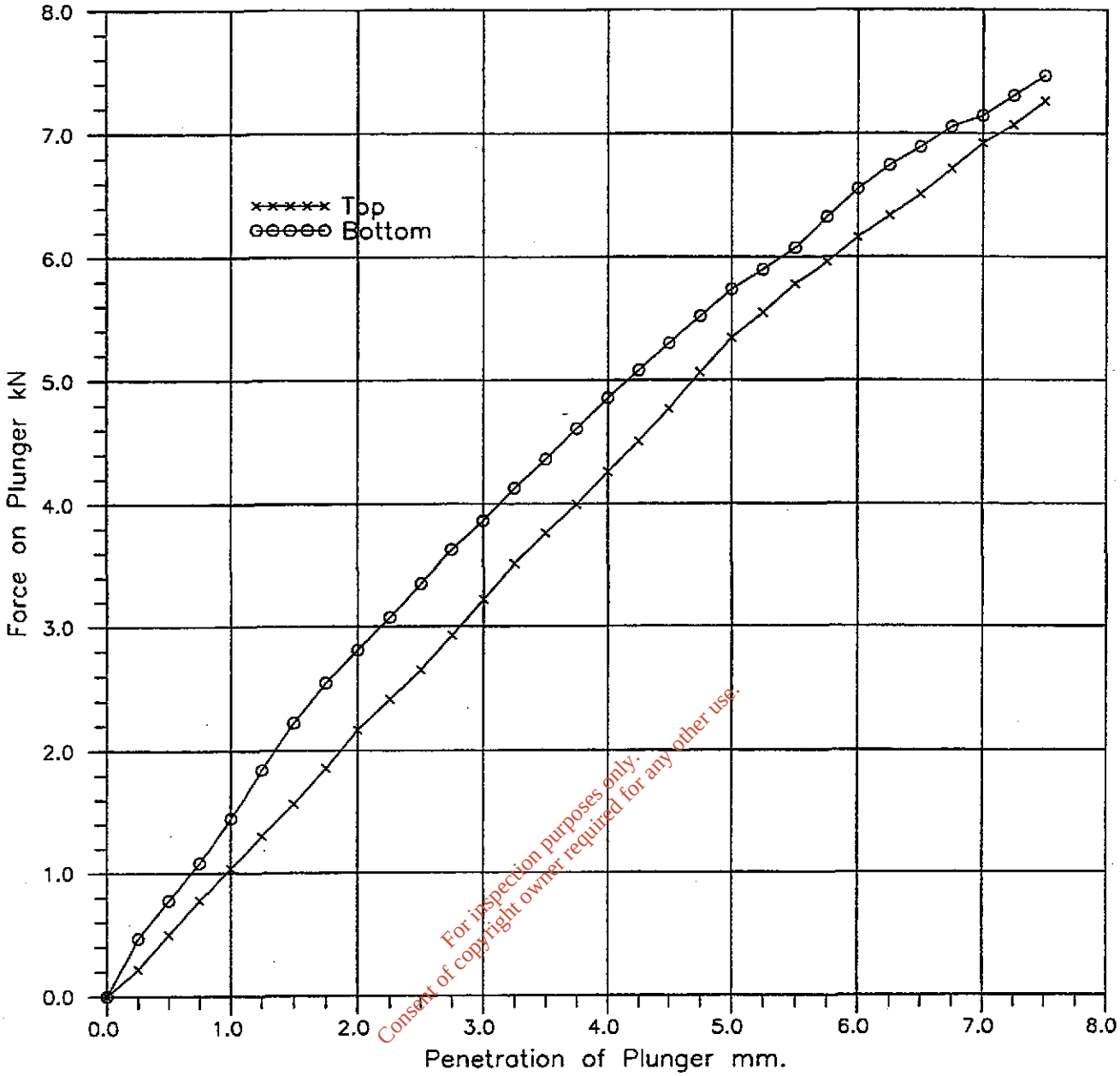
Borehole	Top Depth (mBGL)	Bottom Depth (mBGL)	Rock Description	Test Direction (PL/PD/R)	Core/Lump Diam/Width (mm)	Platen Separation D (initial) (mm)	D (failure) (mm)	Equiv Diam (mm)	Failure Loa (kN)	Is P/De^2 Mpa	Correction Factor $(De/50)^{0.45}$	Is50 Is x F Mpa	Remarks
Diametric Tests													
BR6	36.34		Grey limestone	R	78	78	71	71	35.5	7.0	1.2	8.6	
BR6	36.44		Grey limestone	R	78	78	75	75	22.0	3.9	1.2	4.8	
BR7A	37.35		Grey Limestone	R	78	78	73	73	35.0	6.6	1.2	8.0	
BR8	41.60		Grey limestone	R	78	78	73	73	0.5	0.1	1.2	0.1	fracture along calcite vein
BR9	44.95		Grey Limestone	R	78	78	73	73	24.5	4.6	1.2	5.6	
BR10	38.70		Grey Limestone	R	78	78	75	75	15.5	2.8	1.2	3.4	
Axial Tests													
BR6	36.44		Grey Limestone	R	78	58	53	72.5	31.5	6.0	1.1	6.4	
BR7A	37.45		Grey limestone	R	78	55	47	68.3	28.0	6.0	1.0	6.3	
BR8	41.60		Grey limestone	R	78	51	47	68.3	0.4	0.1	1.0	0.1	fracture along calcite vein
BR10	38.70		Grey Limestone	R	78	58	53	72.5	16.5	3.1	1.1	3.3	

Sample Details				Test Data							
Hole	Depth	Description	Length Dia. mm	Test Date	W %	γ_b Mg/m^3	Strain at Failure	Test Time secs	At 50% Stress: Secant Mod. E MN/m^2	At 50% Stress: Poiss. Ratio	UCS Value MPa	NOTES (Failure Mode, Orientation etc.)
BR8	42.7-43.00		155.2 75.5	14/08/03	0.3 Nat	2.67		295			37.5	

Remarks Tests performed and reported in accordance with ISRM (1981). Applied stress Rate 0.5 to 1 MPa/sec.
All testing performed along core axis unless otherwise stated in the notes.
Moisture condition (w%) - A-air dry, S-saturated, N-natural moisture content

Form 44/2

Laboratory - Uniaxial Compression Test Summary	**Project** Dublin Waste to Energy	**Contract** KD3116
Soil Mechanics		**Sheet**



Hole : TP8
Depth : 0.80 -1.00
Type : B

Method : Remoulded 2.5kg

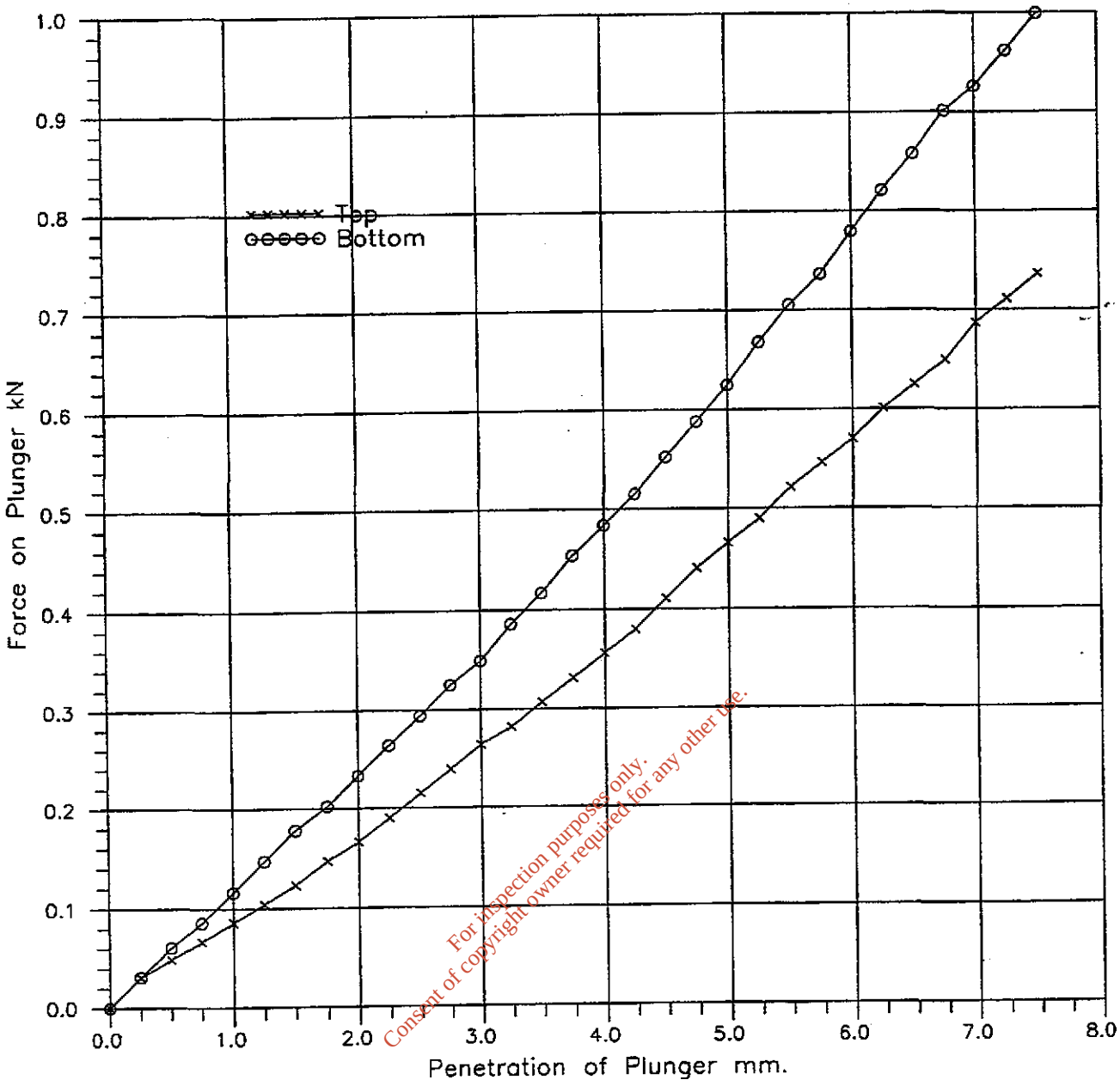
Test Type :Unsoaked
Material Ret 20mm:9.1 %
Surcharge :13.6Kg
Bulk Density :1.36 Mg/m3
Moisture Content :30 %
Dry Density :1.05 Mg/m3

Description
Slightly clayey sandy GRAVEL

CBR Value at Penetration %

	2.5mm	5.0mm
Top	20	27
Btm	25	29

CBR Penetration/Force Plot	Project dublin waste to energy	Contract KD3116x
GEOTECH		Figure -



Hole : TP06
Depth : 0.80 -1.00
Type : B

Method : Undisturbed 2.5kg

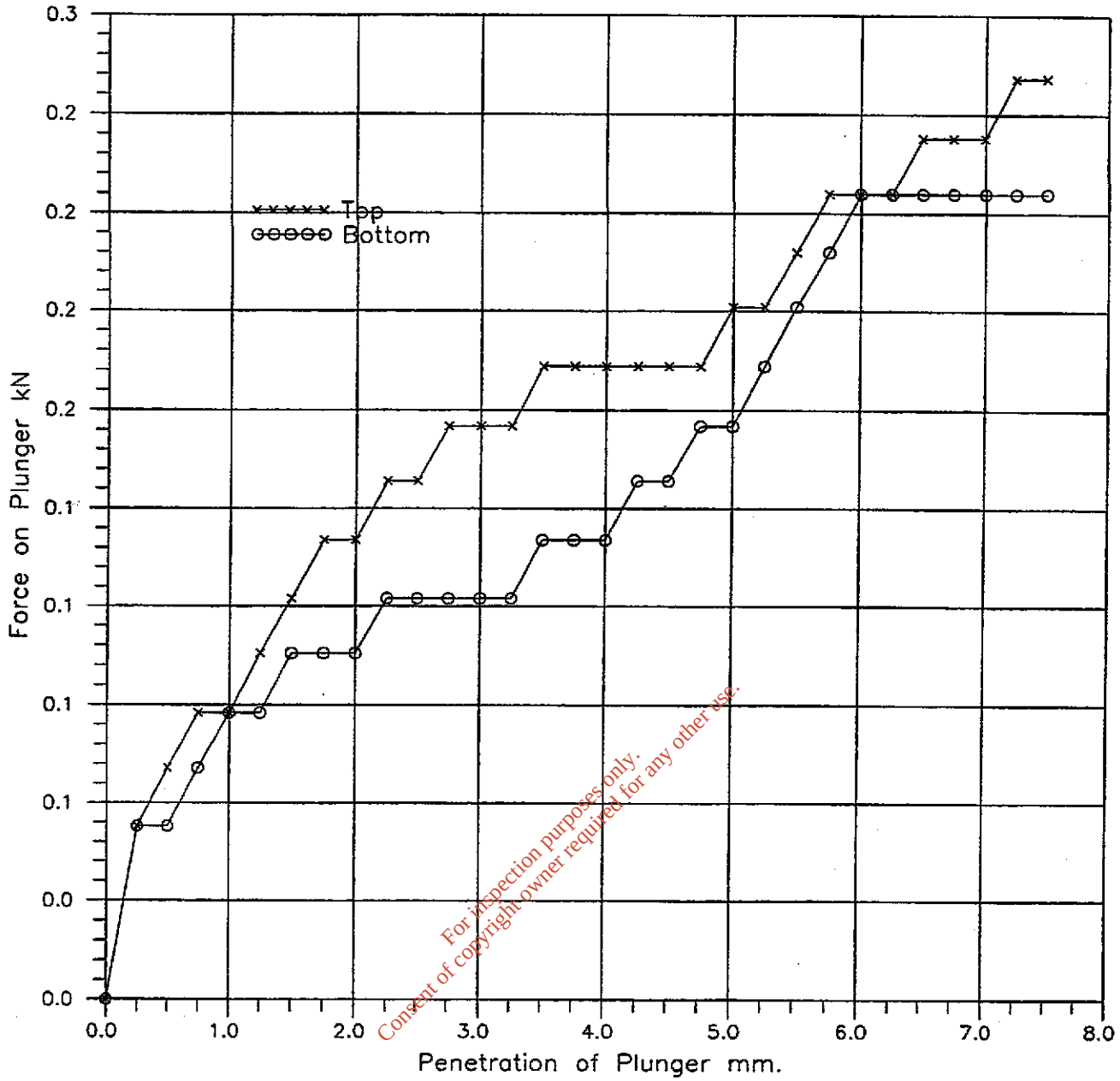
Test Type :Unsoaked
Material Ret 20mm:19 %
Surcharge :13.6Kg
Bulk Density :1.98 Mg/m3
Moisture Content :21 %
Dry Density :1.64 Mg/m3

Description
Clayey sandy GRAVEL

CBR Value at Penetration %

	2.5mm	5.0mm
Top	1.6	2.3
Btm	2.2	3.1

CBR Penetration/Force Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Figure**



Hole : BH4
Depth : 0.50 -1.00
Type : B

Method : Remoulded 2.5kg

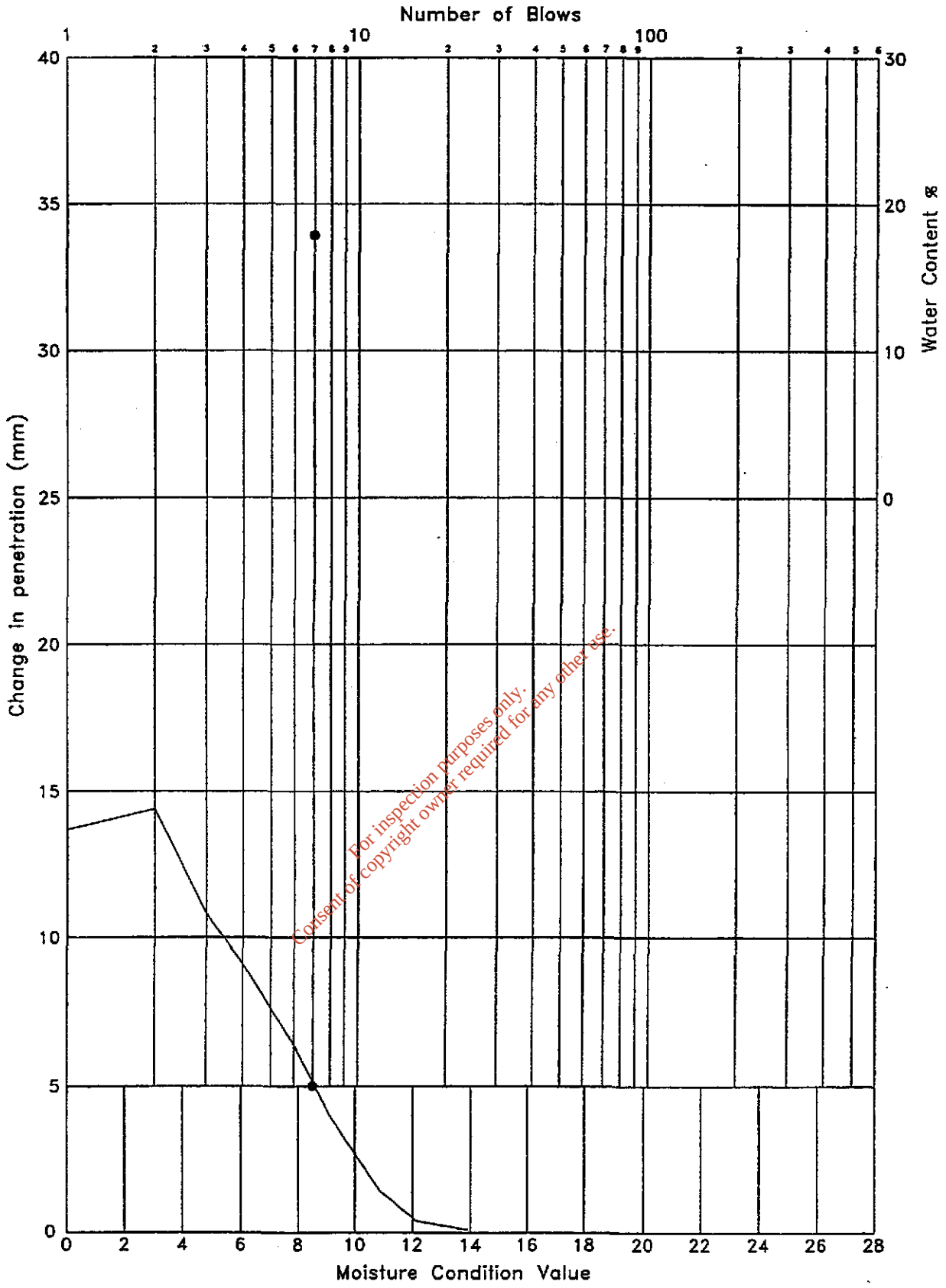
Test Type :Unsoaked
Material Ret 20mm:4.9 %
Surcharge :13.6Kg
Bulk Density :2.22 Mg/m3
Moisture Content :14 %
Dry Density :1.95 Mg/m3

Description
Clayey sandy GRAVEL

CBR Value at Penetration %

	2.5mm	5.0mm
Top	1.0	0.9
Btm	0.8	0.7

CBR Penetration/Force Plot	Project dublin waste to energy	Contract KD3116x
GEOTECH		Figure

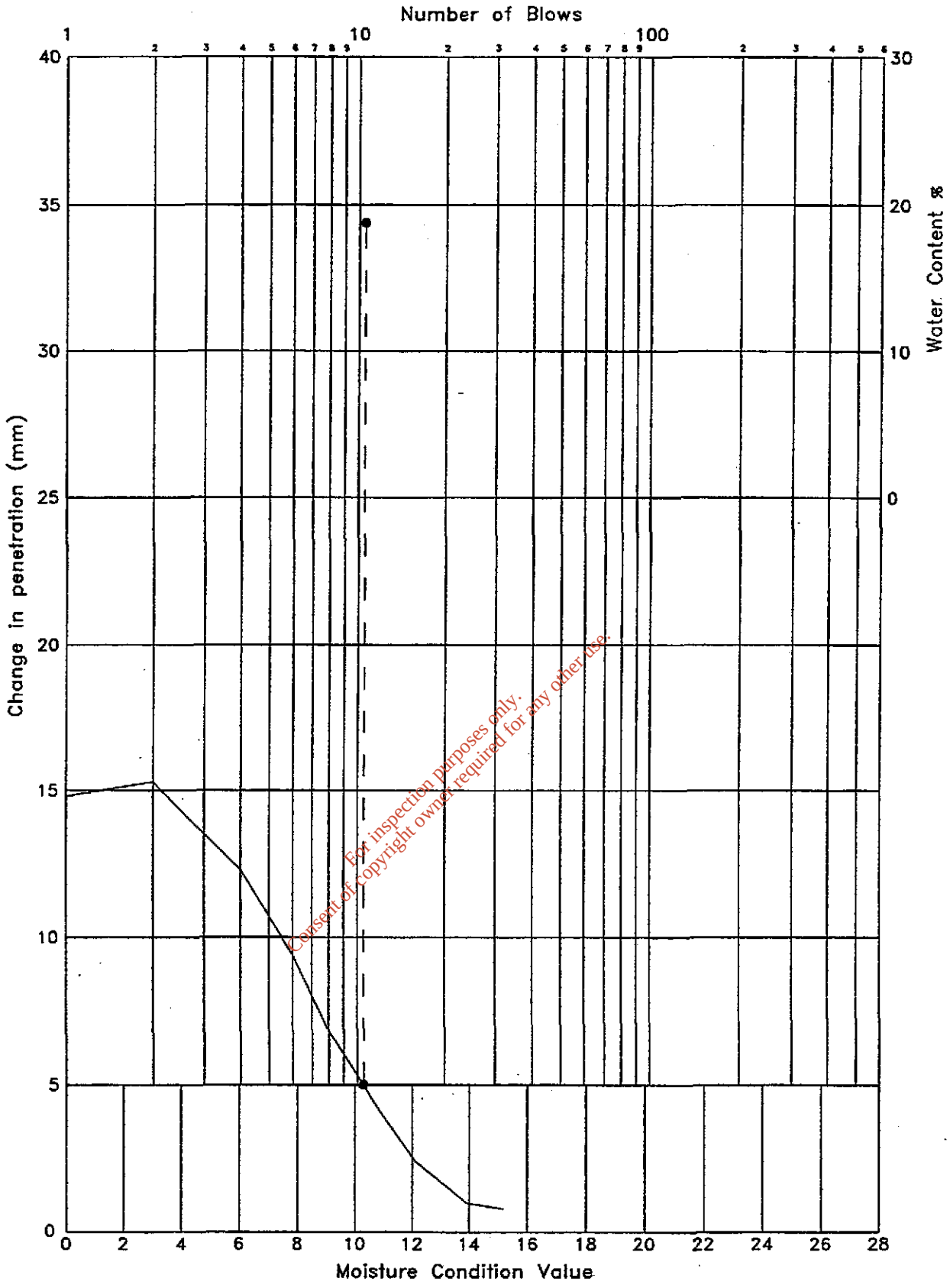


% retained on 20mm sieve 13	Description: Slightly clayey sandy GRAVEL	Hole TP9 Depth 1.70 -1.80 Type B

Remarks

Form 52/1

Laboratory - MCV	**Project**: dublin waste to energy	**Contract**: KD3116x
GEOTECH		

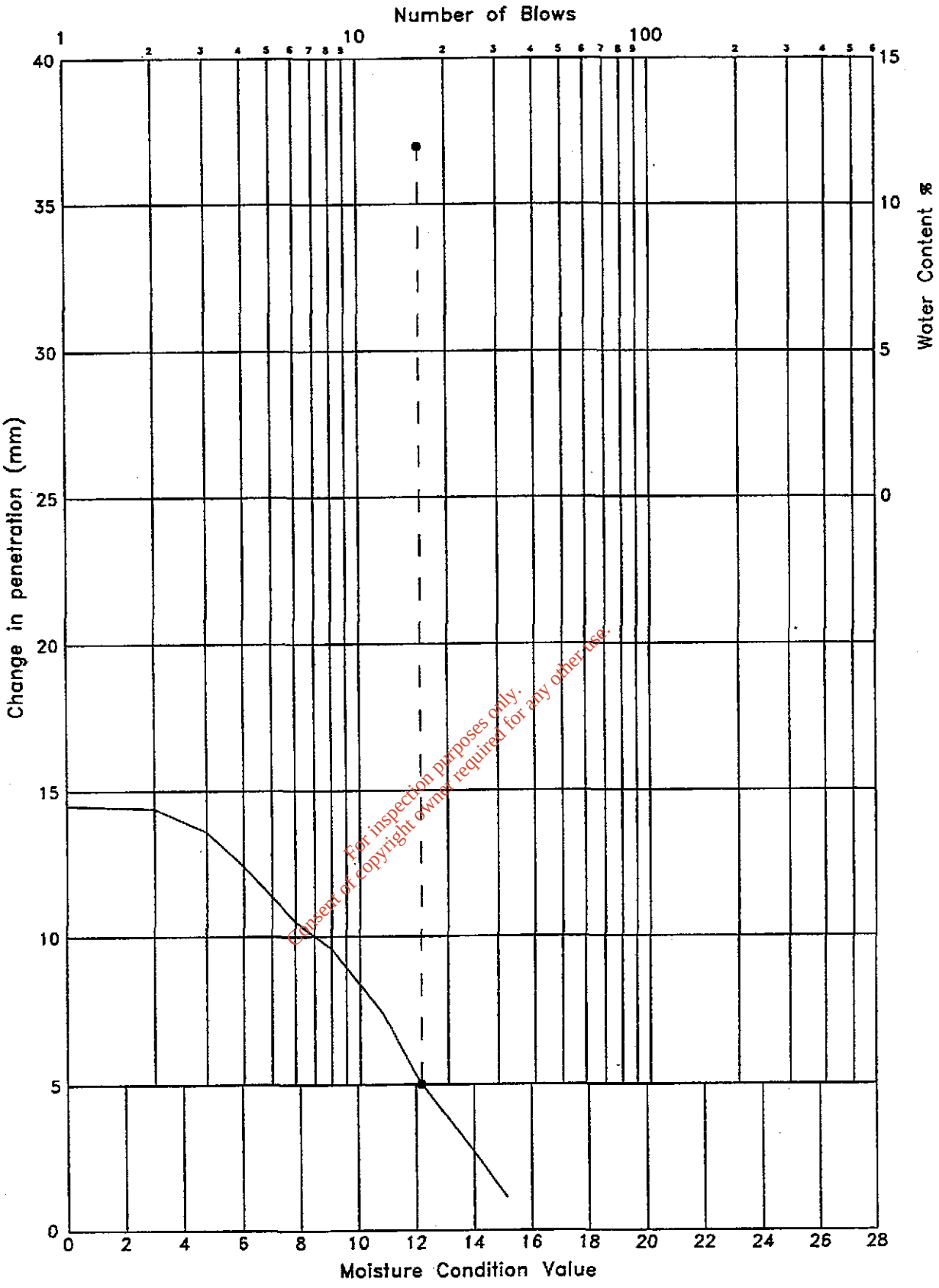


% retained on 20mm sieve 22	Description Clayey sandy GRAVEL	Hole TP06 Depth 0.80 -1.00 Type B

Remarks

Form 52/1

Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		

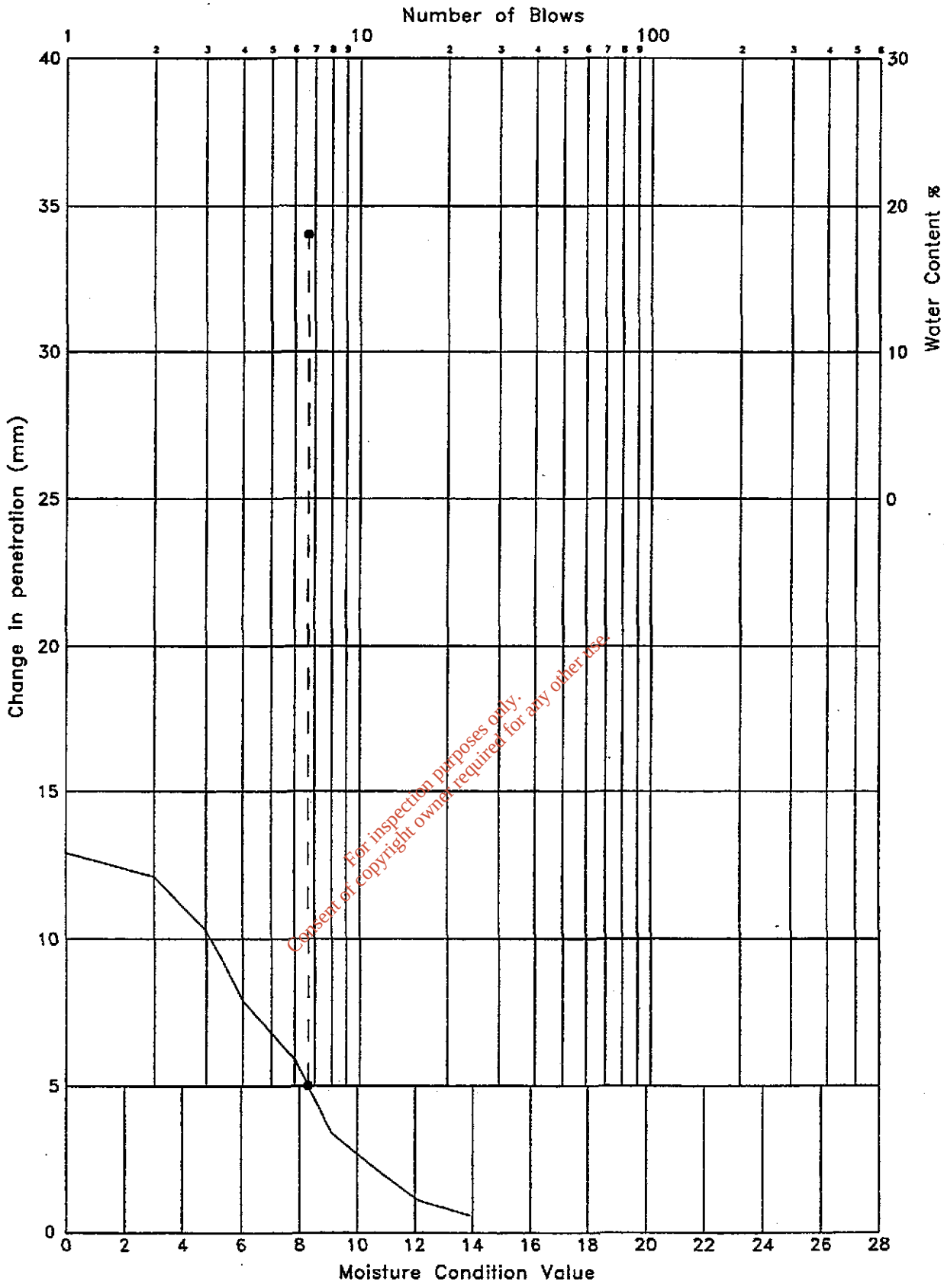


% retained on 20mm sieve 53	Description: Silty sandy GRAVEL	Hole TP04 Depth 0.50 -0.60 Type B

Remarks

Form 52/1

Laboratory - MCV	**Project**: dublin waste to energy	**Contract**: KD3116x
GEOTECH		

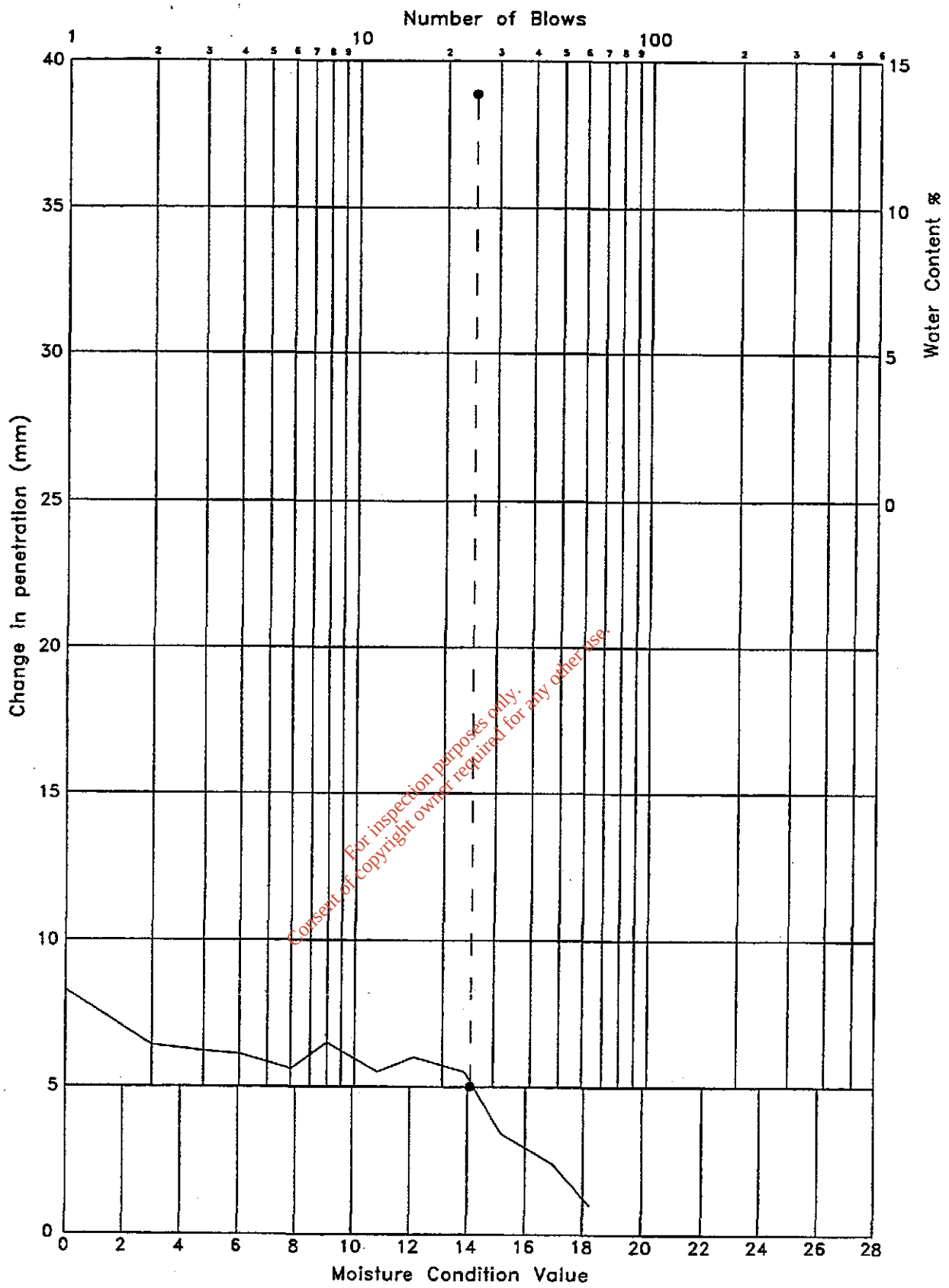


% retained on 20mm sieve 27	Description Silty sandy GRAVEL	Hole TP03 Depth 1.80 -2.00 Type B

Remarks

Form 52/1

Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		

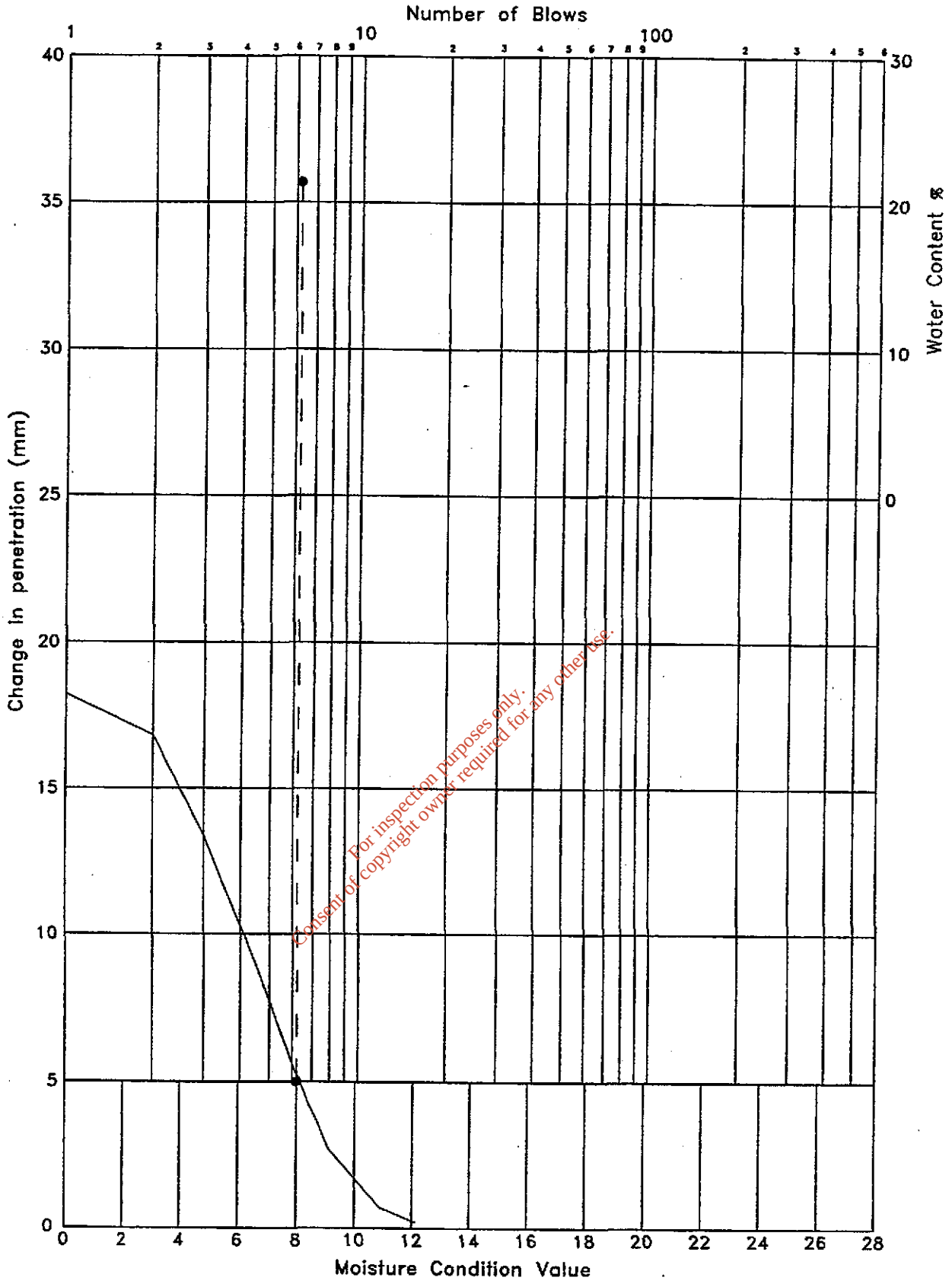


% retained on 20mm sieve 7	Description Very gravelly SAND	Hole TP03 Depth 0.60 -0.80 Type B

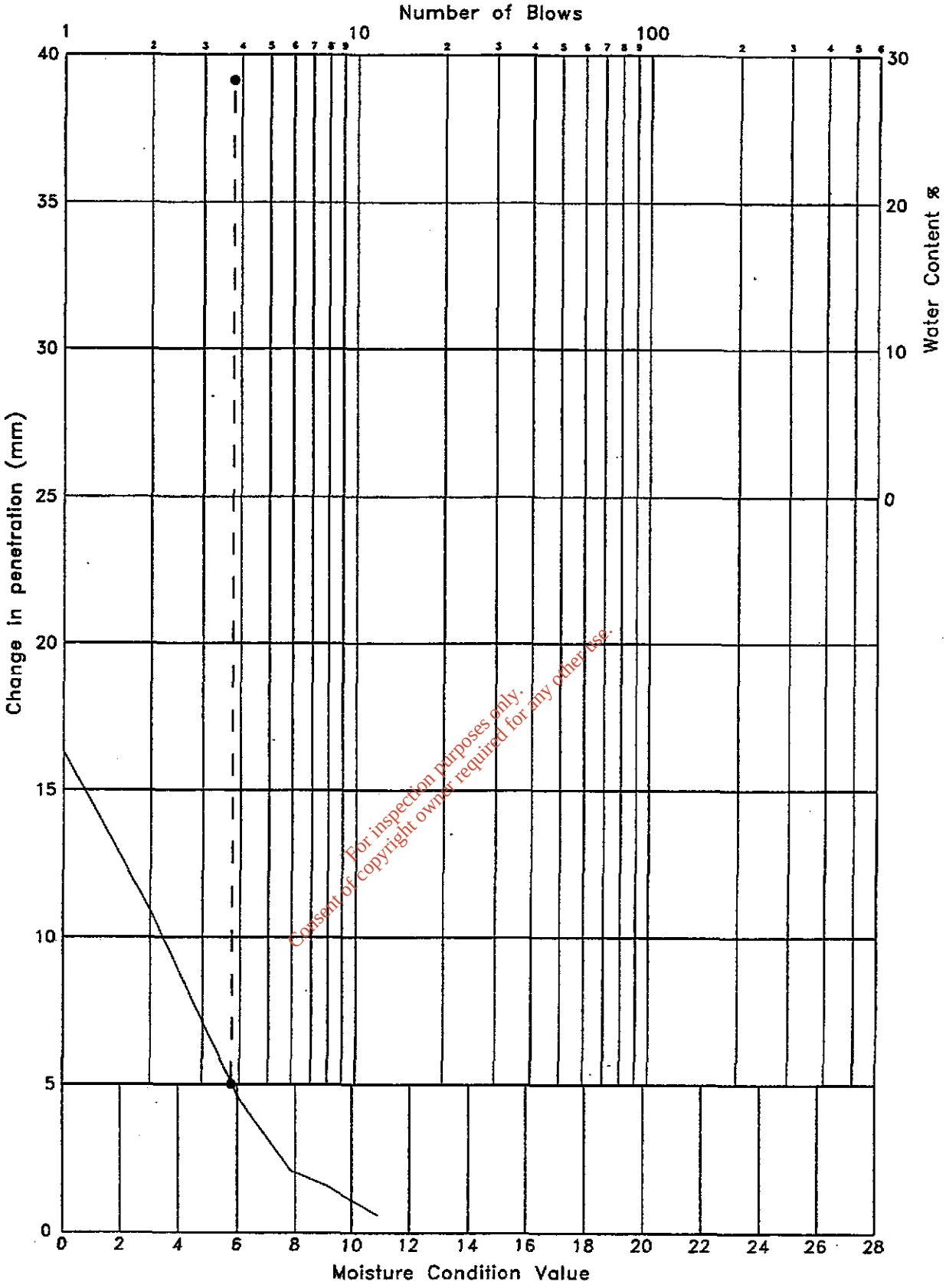
Remarks

Form 52/1

Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		



% retained on 20mm sieve 32	Description SAND and GRAVEL	Hole TP2 Depth 2.00 -2.20 Type B
Remarks		
		Form 52/1
Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		

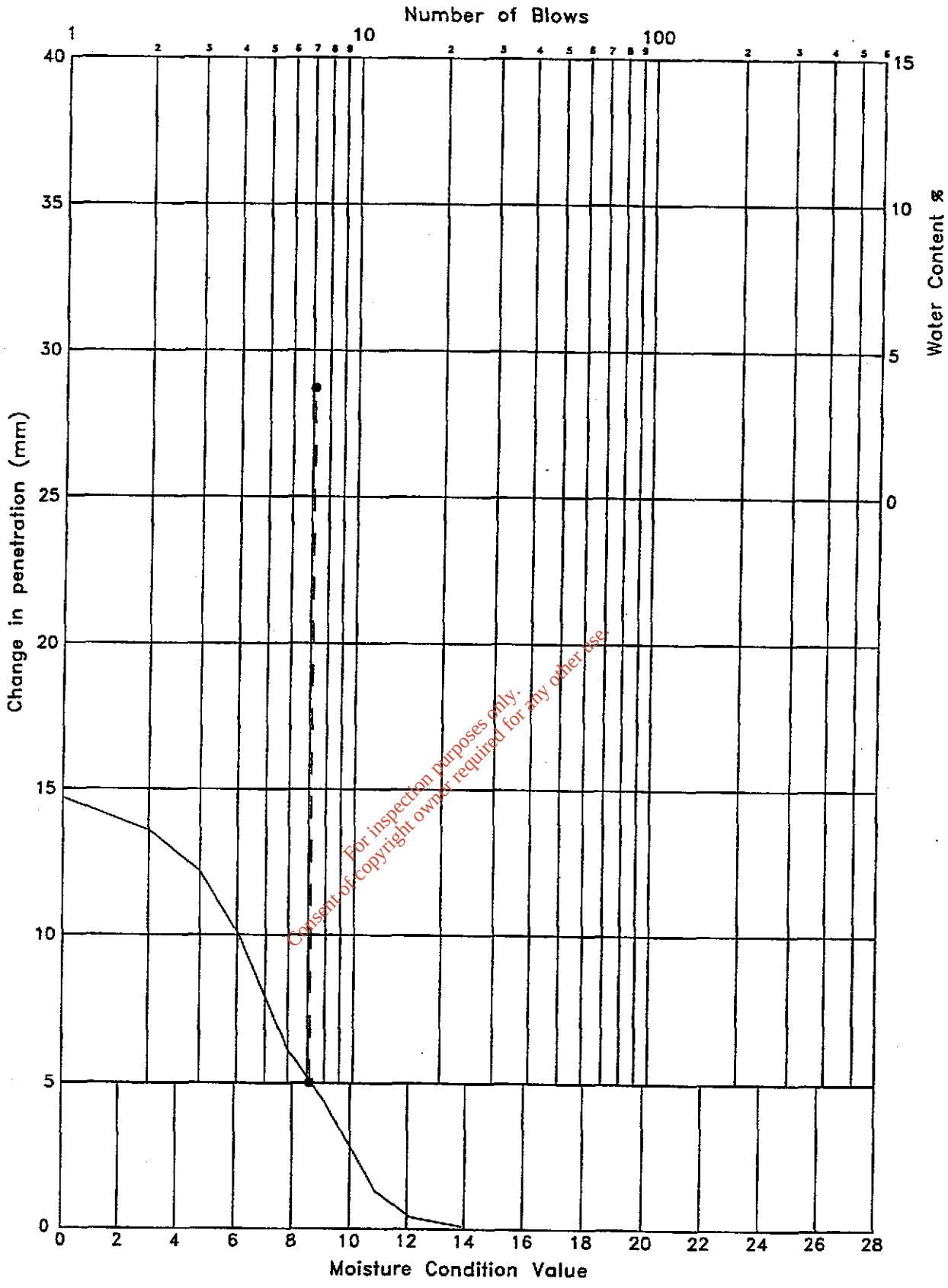


% retained on 20mm sieve 22	Description SAND and GRAVEL	Hole TP02 Depth 1.00 -1.10 Type B

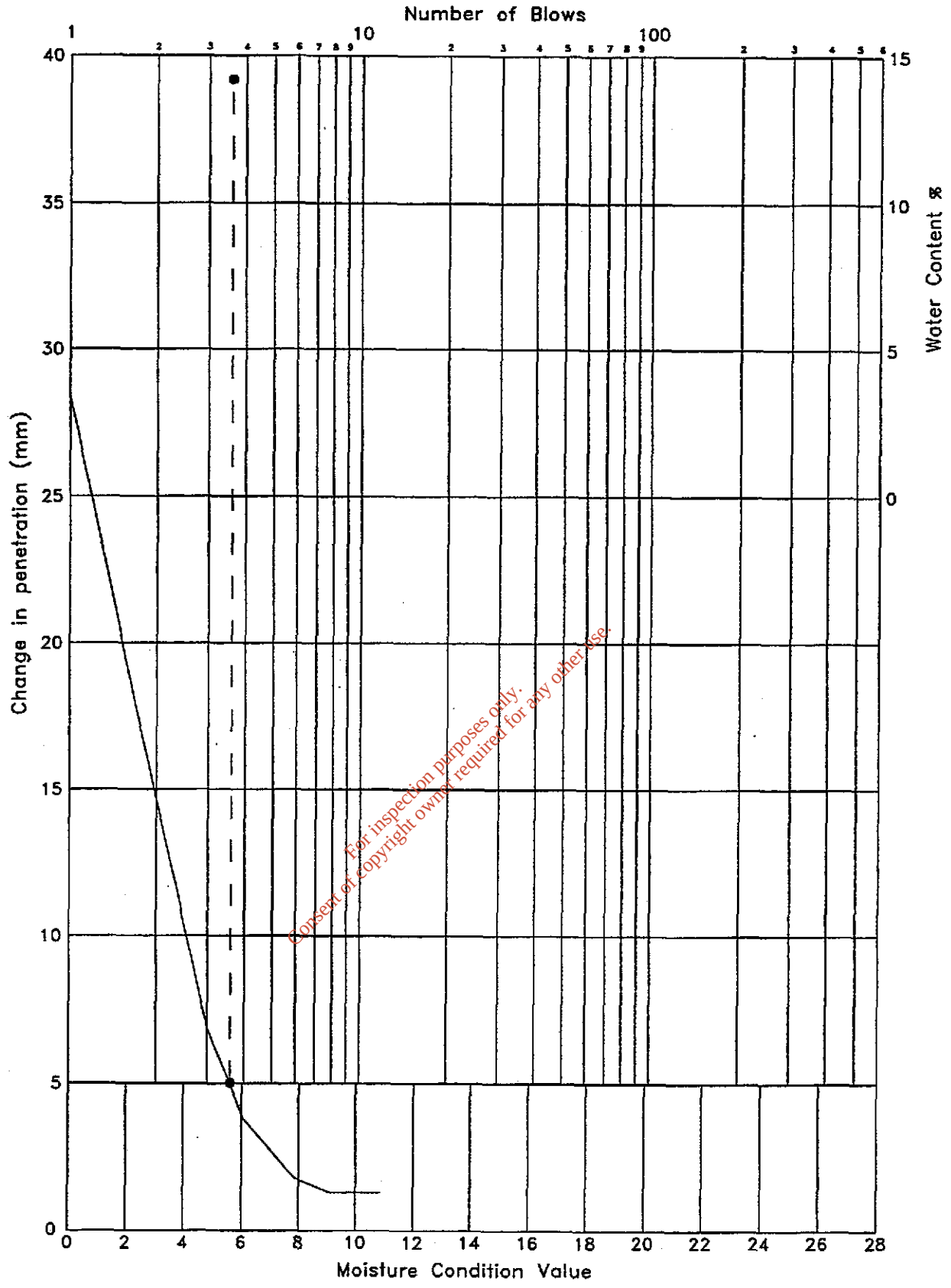
Remarks

Form 52/1

Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		



% retained on 20mm sieve 24	Description Clayey sandy GRAVEL	Hole BH5 Depth 0.00 -0.50 Type B
Remarks		
		Form 52/1
Laboratory - MCV GEOTECH	**Project** dublin waste to energy	**Contract** KD3116x

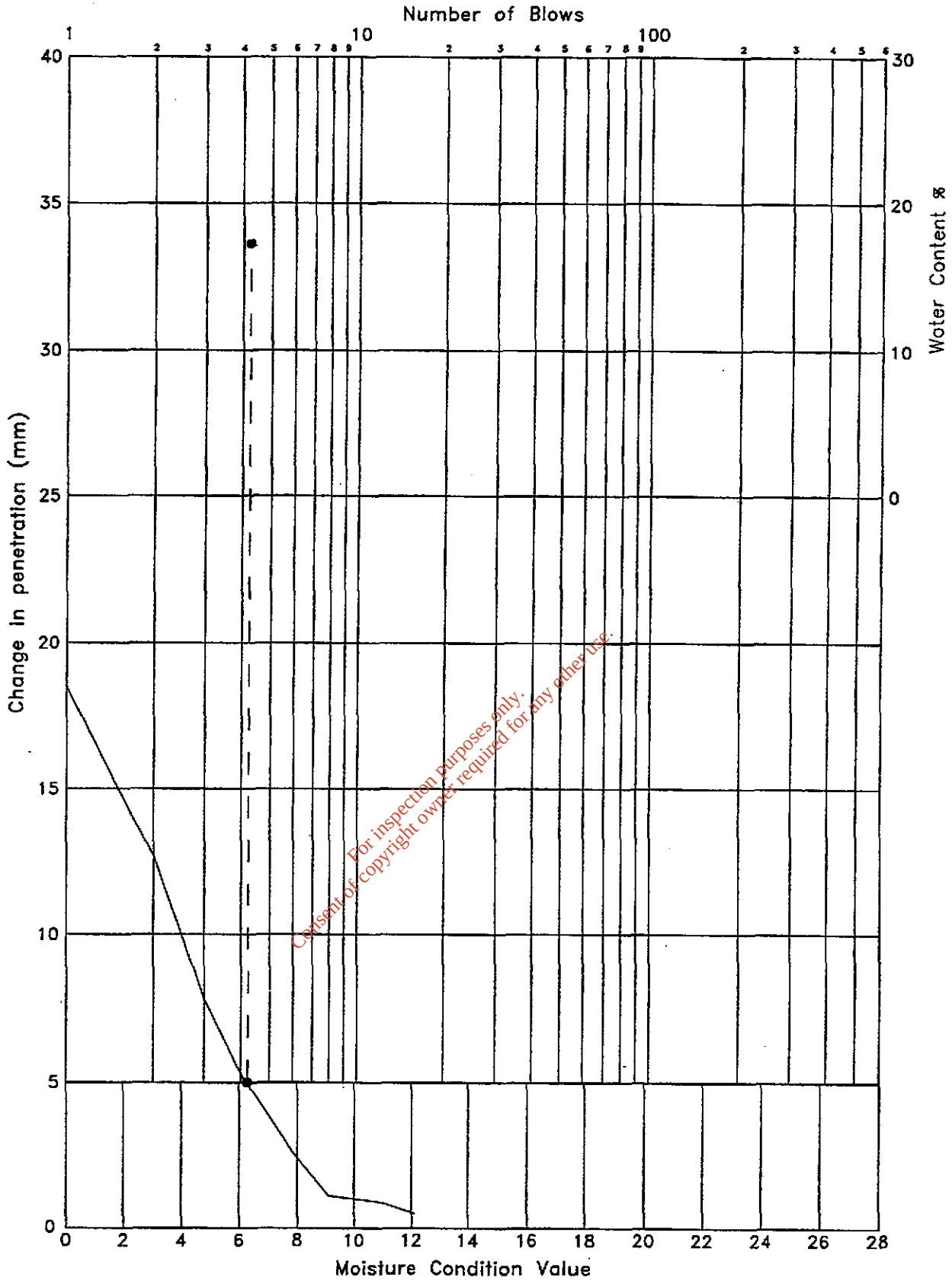


% retained on 20mm sieve 1	Description Clayey sandy GRAVEL	Hole BH4 Depth 0.50 -1.00 Type B

Remarks

Form 52/1

Laboratory - MCV GEOTECH	**Project** dublin waste to energy	**Contract** KD3116x

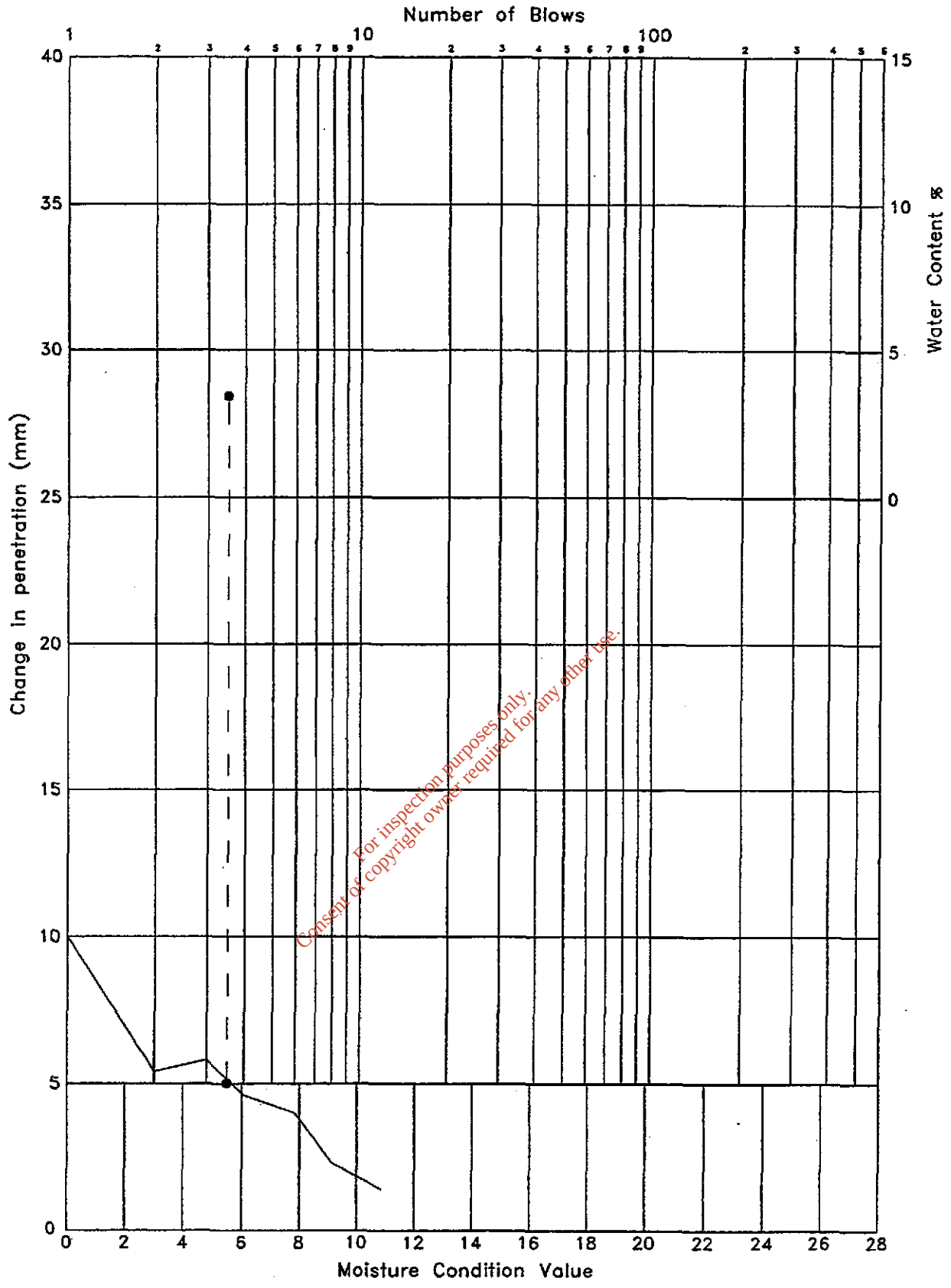


% retained on 20mm sieve 35	Description Clayey very sandy GRAVEL	Hole BH3A Depth 0.50 -1.00 Type B

Remarks

Form 52/1

Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		

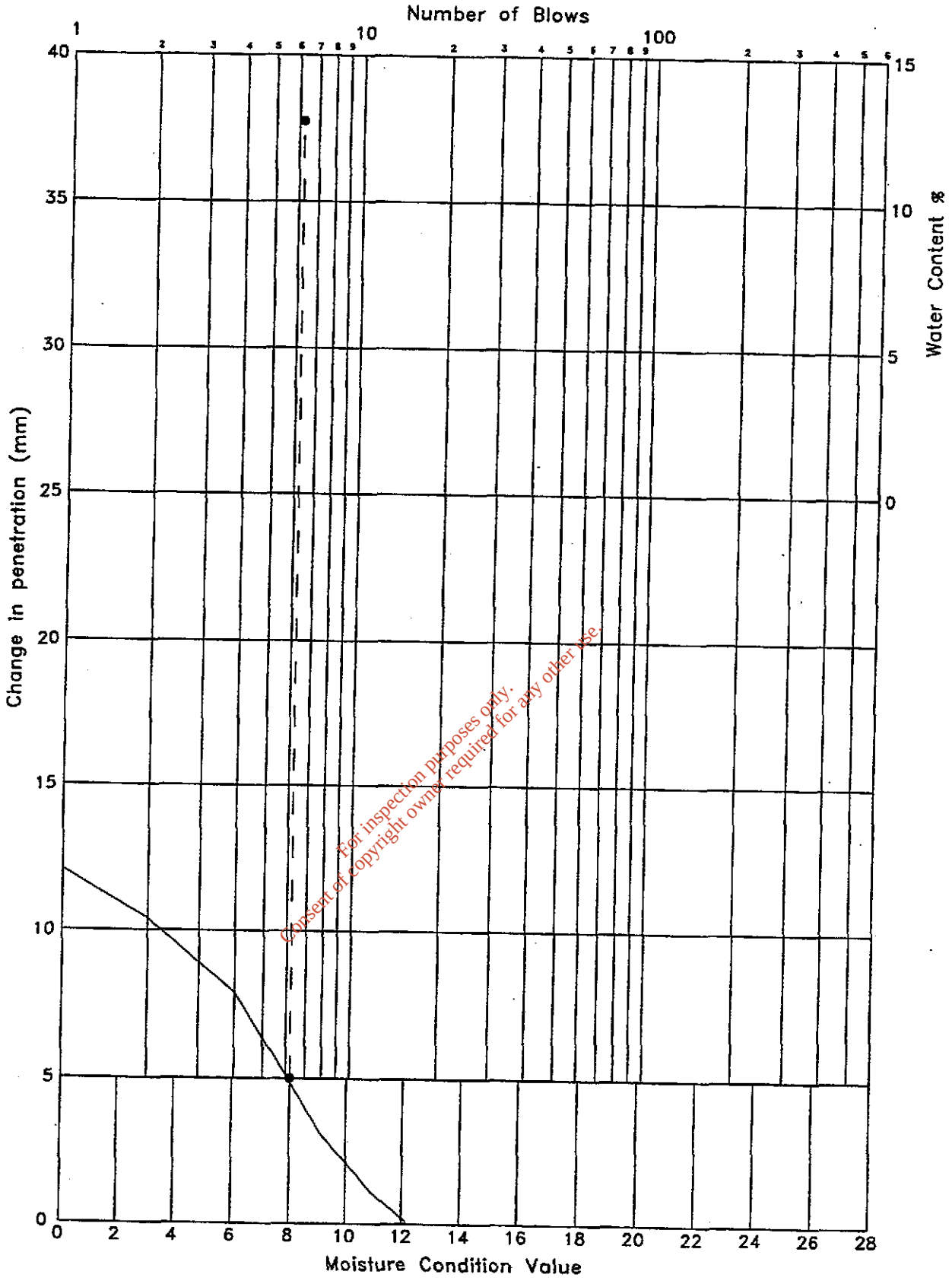


% retained on 20mm sieve 78	Description GRAVEL	Hole BH2 Depth 0.50 -1.00 Type B

Remarks

Form 52/1

Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		



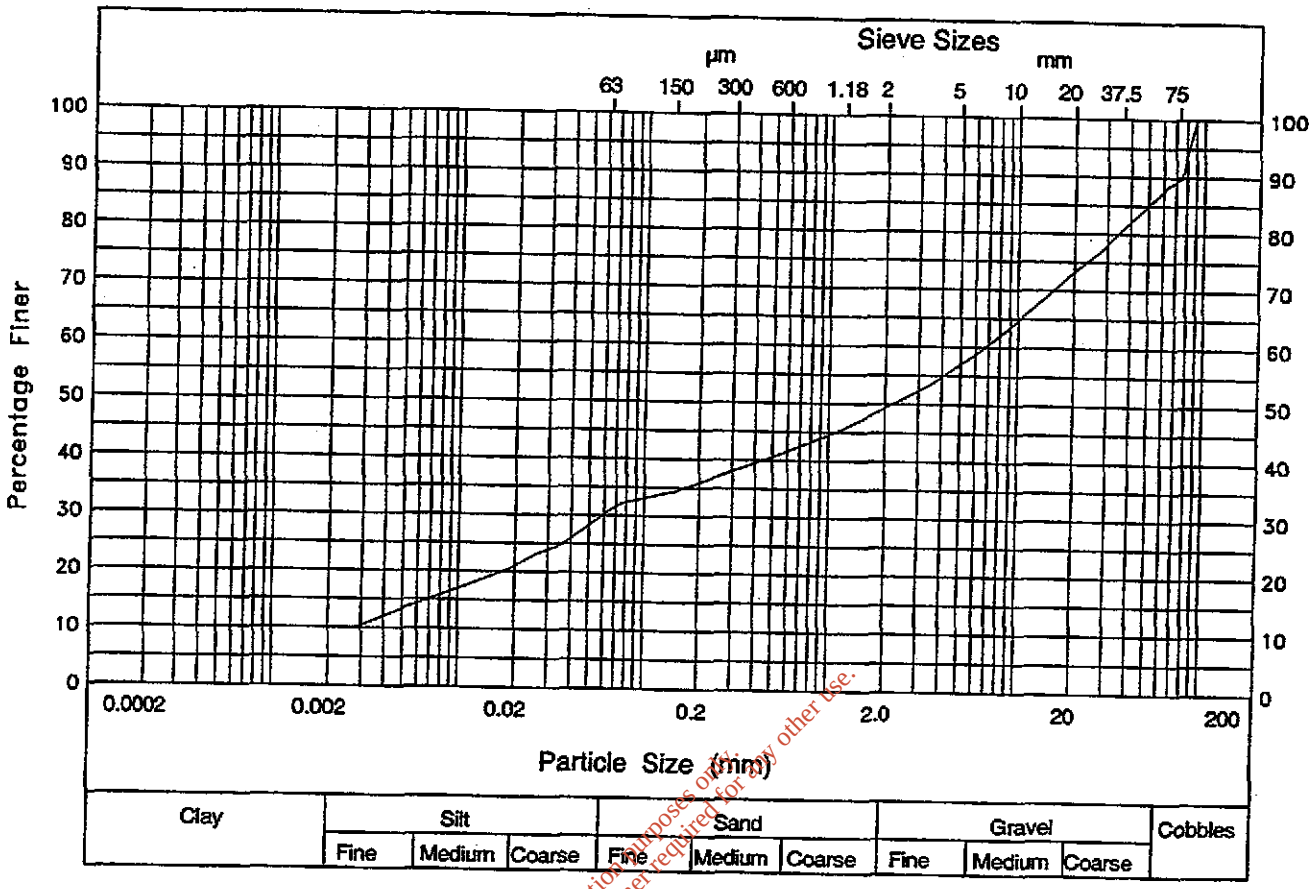
% retained on 20mm sieve 41	Description Slightly silty very sandy GRAVEL	Hole BH1 Depth 0.50 -1.00 Type B
Remarks		
		Form 52/1
Laboratory - MCV	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		

Samples				Earthworks												
Hole	Depth	Type	Description	CBR Top	CBR Base	CBR Top w%	CBR Base w%	CBR Surch kg.	γ_b Mg/m^3	Comp Type	w% (Opt) <Nat>	γ_d (max) Mg/m^3	ρ_s Mg/m^3	% ret 20/ 37.5 mm	MCV
BH1	0.50-1.00	B	Slightly silty very sandy GRAVEL						2.12	MCV	13	1.88		41	8.0
BH2	0.50-1.00	B	GRAVEL						2.33	MCV	3.4	2.25		78	5.5
BH3A	0.50-1.00	B	Clayey very sandy GRAVEL						2.07	MCV	17	1.77		35	6.3
BH4	0.50-1.00	B	Clayey sandy GRAVEL	1.0	0.8	13	14	13.6	2.22	2.5kg		1.95		5	
									2.22	MCV	14	1.94		1	5.6
BH5	0.00-0.50	B	Clayey sandy GRAVEL						2.27	MCV	3.7	2.19		24	8.6
TP02	1.00-1.10	B	SAND and GRAVEL						1.94	MCV	28	1.52		22	5.8
TP2	2.00-2.20	B	SAND and GRAVEL						1.96	MCV	21	1.61		32	8.0
TP03	0.60-0.80	B	Very gravelly SAND						2.11	MCV	14	1.86		7	14.1
TP03	1.80-2.00	B	Silty sandy GRAVEL						2.11	MCV	18	1.79		27	8.3
TP04	0.50-0.60	B	Silty sandy GRAVEL						2.05	MCV	12	1.83		53	12.2
TP06	0.80-1.00	B	Clayey sandy GRAVEL						2.02	MCV	19	1.70		22	10.3
TP8	0.80-1.00	B	Slightly clayey sandy GRAVEL	27	29	31	30	13.6	1.36	2.5kg		1.05		9	
TP9	1.70-1.80	B	Slightly clayey sandy GRAVEL						2.03	MCV	18	1.72		13	8.5

Remarks

Form 6/2

Laboratory - Compaction, CBR & MCV Summary	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



Particle Size	% Passing	Particle Size	% Passing
90 mm	100	2 mm	49
75 mm	90	1.18 mm	46
63 mm	88	600 µm	42
50 mm	85	425 µm	40
37.5 mm	81	300 µm	38
28 mm	77	212 µm	36
20 mm	73	150 µm	34
14 mm	69	75 µm	32
10 mm	65	63 µm	31
6.3 mm	59	36 µm	25
5 mm	57	26 µm	23
3.35 mm	53	19 µm	20

Hole TP9	Description: Slightly sandy gravelly CLAY
Depth 2.80 -3.10	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

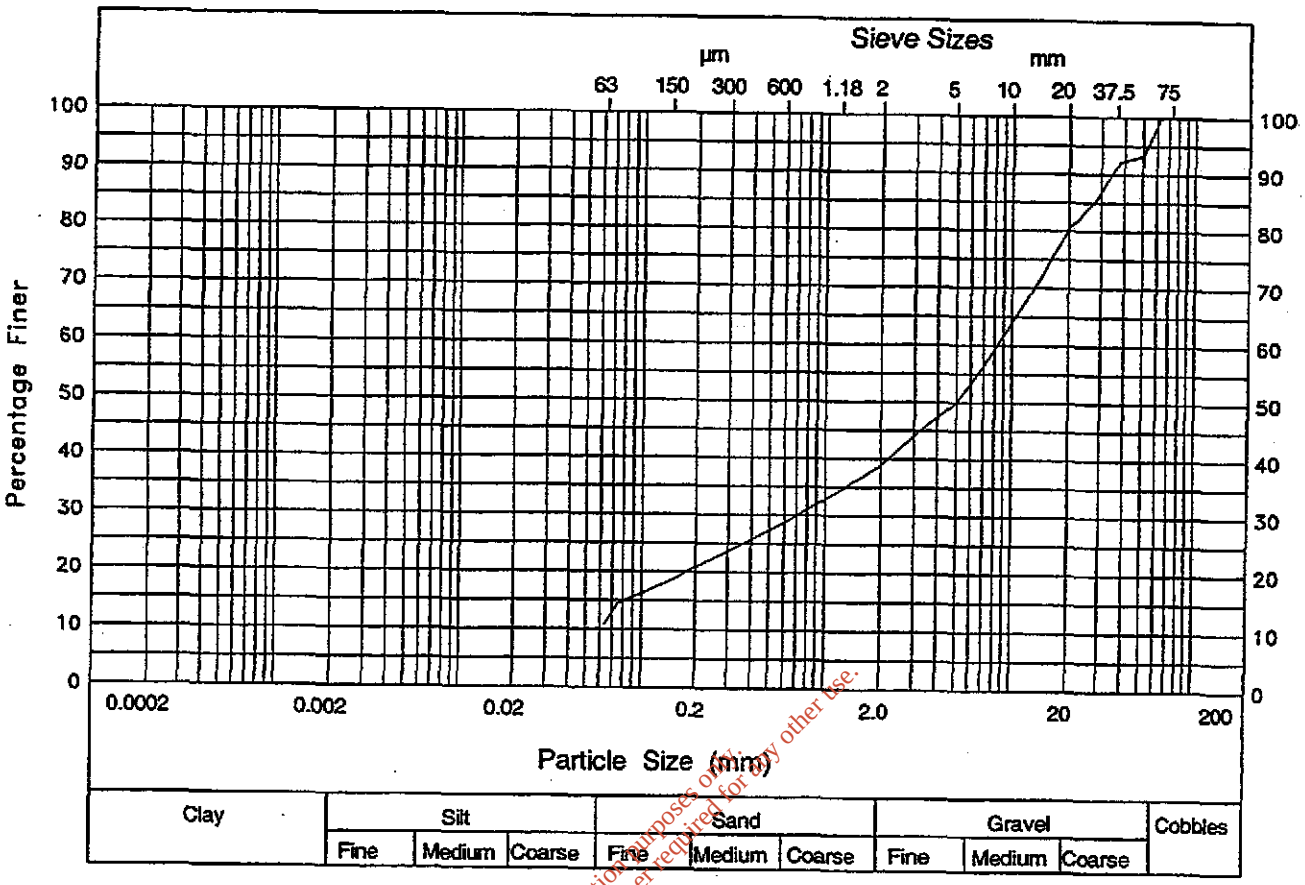
Laboratory - Particle Size Plot

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

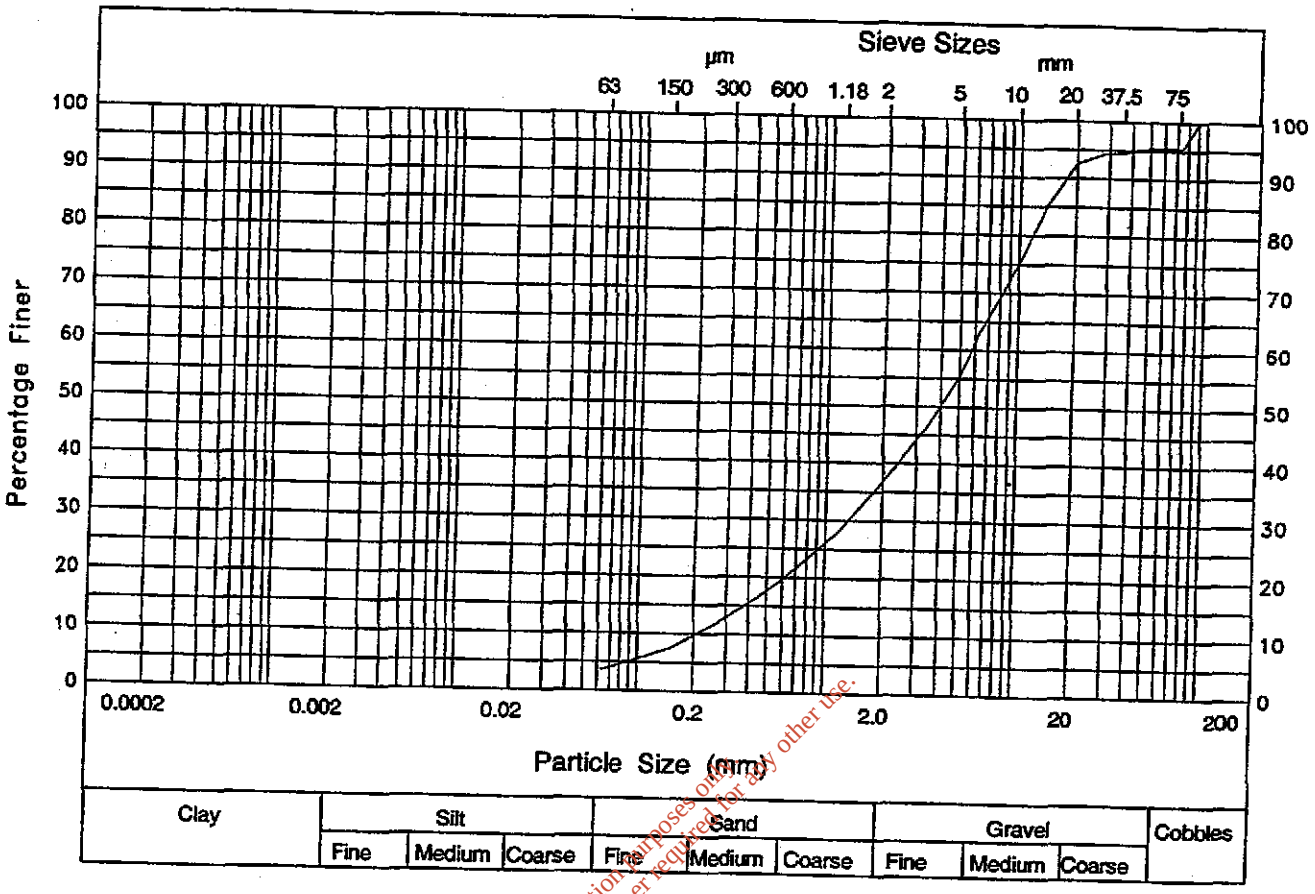


Particle Size	% Passing	Particle Size	% Passing
63 mm	100	600 µm	29
50 mm	93	425 µm	26
37.5 mm	92	300 µm	24
28 mm	85	212 µm	21
20 mm	80	150 µm	19
14 mm	72	75 µm	14
10 mm	64	63 µm	11
6.3 mm	54		
5 mm	50		
3.35 mm	45		
2 mm	39		
1.18 mm	34		

Hole TP9	Description: Slightly clayey sandy GRAVEL
Depth 1.70 -1.80	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



Particle Size	% Passing	Particle Size	% Passing
90 mm	100	2 mm	37
75 mm	95	1.18 mm	28
63 mm	95	600 µm	20
50 mm	95	425 µm	16
37.5 mm	95	300 µm	13
28 mm	94	212 µm	10
20 mm	93	150 µm	7
14 mm	85	75 µm	4
10 mm	75	63 µm	4
6.3 mm	63		
5 mm	55		
3.35 mm	46		

Hole TP8	Description: Slightly clayey sandy GRAVEL
Depth 4.00	
Type B	
Test Performed Dry	Uniformity Coefficient = 28

Form 25/4

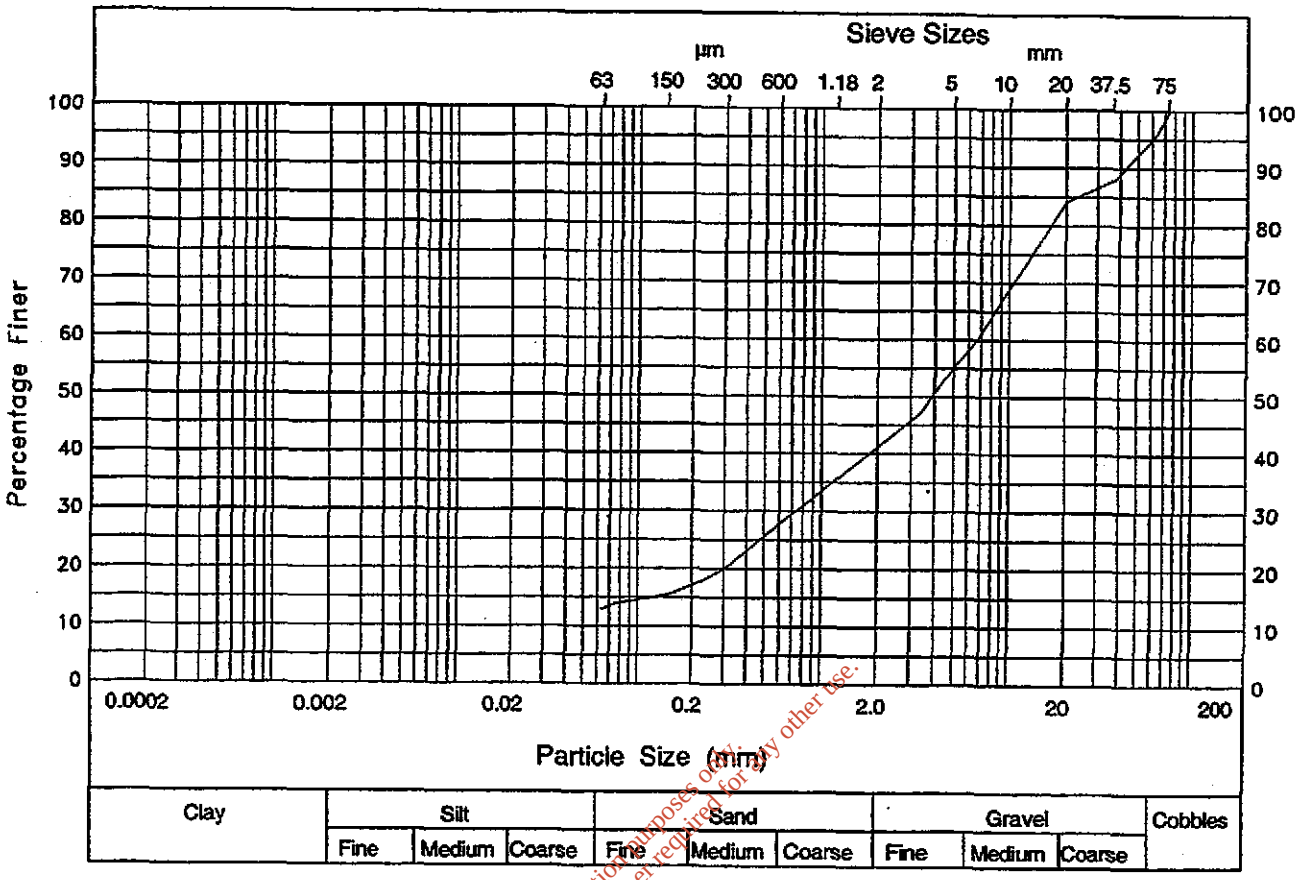
Laboratory - Particle Size Plot

GEOTECH

Project dublin waste to energy

Contract KD3116x

Sheet

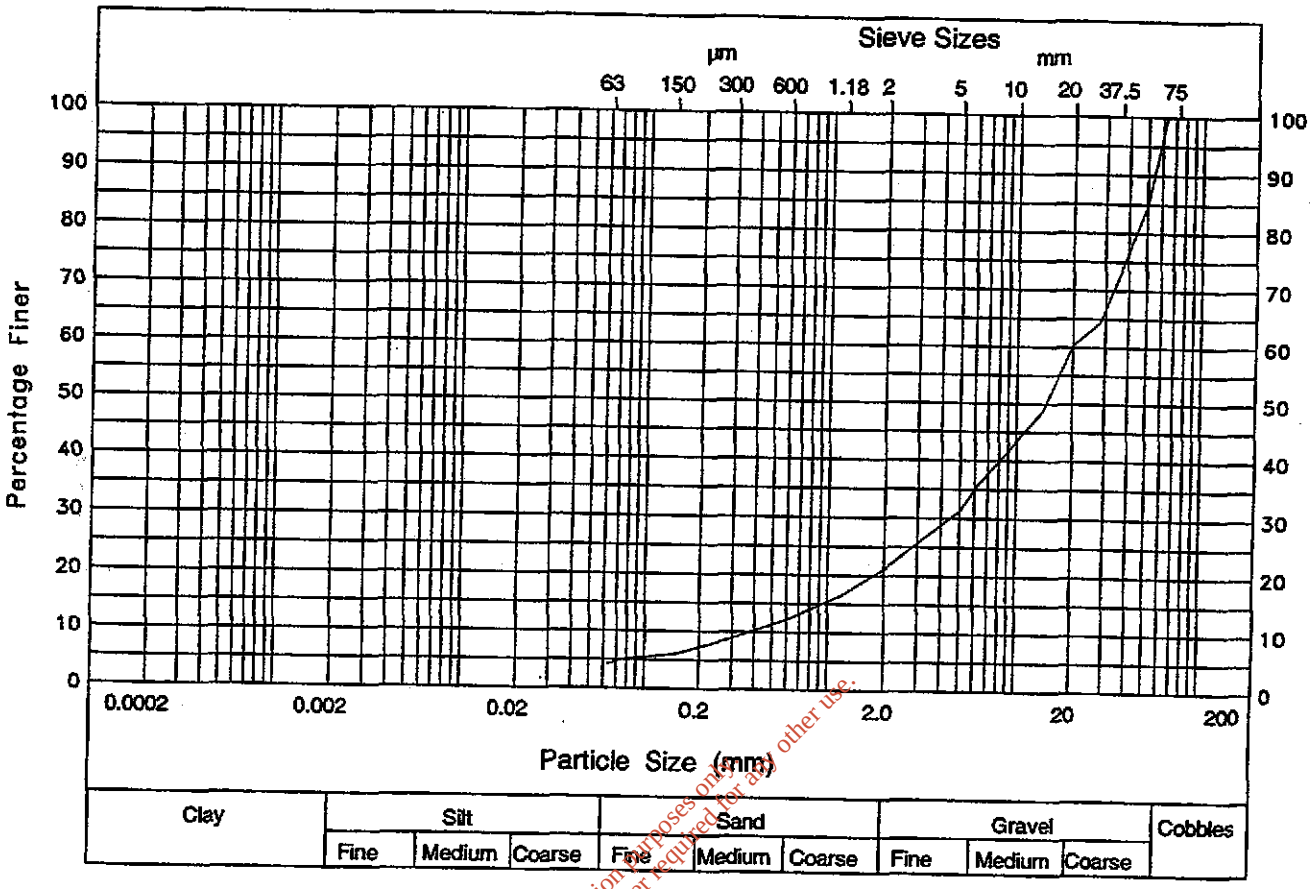


Particle Size	% Passing	Particle Size	% Passing
75 mm	100	600 µm	28
63 mm	96	425 µm	24
37.5 mm	88	300 µm	20
28 mm	86	212 µm	17
20 mm	84	150 µm	15
14 mm	76	75 µm	14
10 mm	69	63 µm	13
6.3 mm	59		
5 mm	55		
3.35 mm	47		
2 mm	41		
1.18 mm	35		

Hole TP8	Description: Slightly clayey sandy GRAVEL
Depth 1.80 -2.00	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



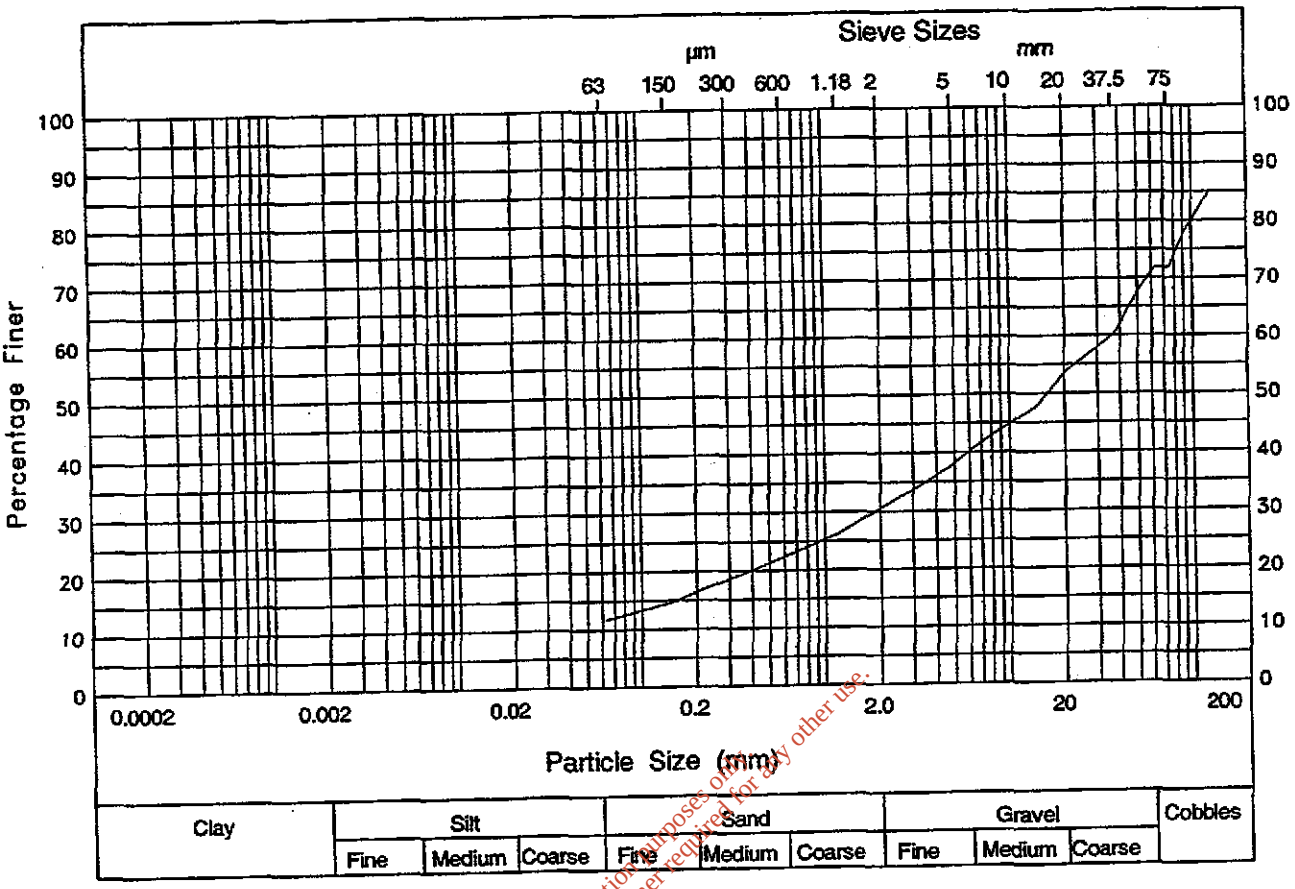
Clay	Silt			Sand			Gravel			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Particle Size	% Passing	Particle Size	% Passing
63 mm	100	600 µm	12
50 mm	85	425 µm	11
37.5 mm	74	300 µm	9
28 mm	64	212 µm	8
20 mm	60	150 µm	6
14 mm	49	75 µm	5
10 mm	43	63 µm	4
6.3 mm	36		
5 mm	31		
3.35 mm	27		
2 mm	21		
1.18 mm	16		

Hole TP07	Description: Slightly clayey sandy GRAVEL
Depth 3.40 -4.00	
Type B	
Test Performed Dry	Uniformity Coefficient = 53

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

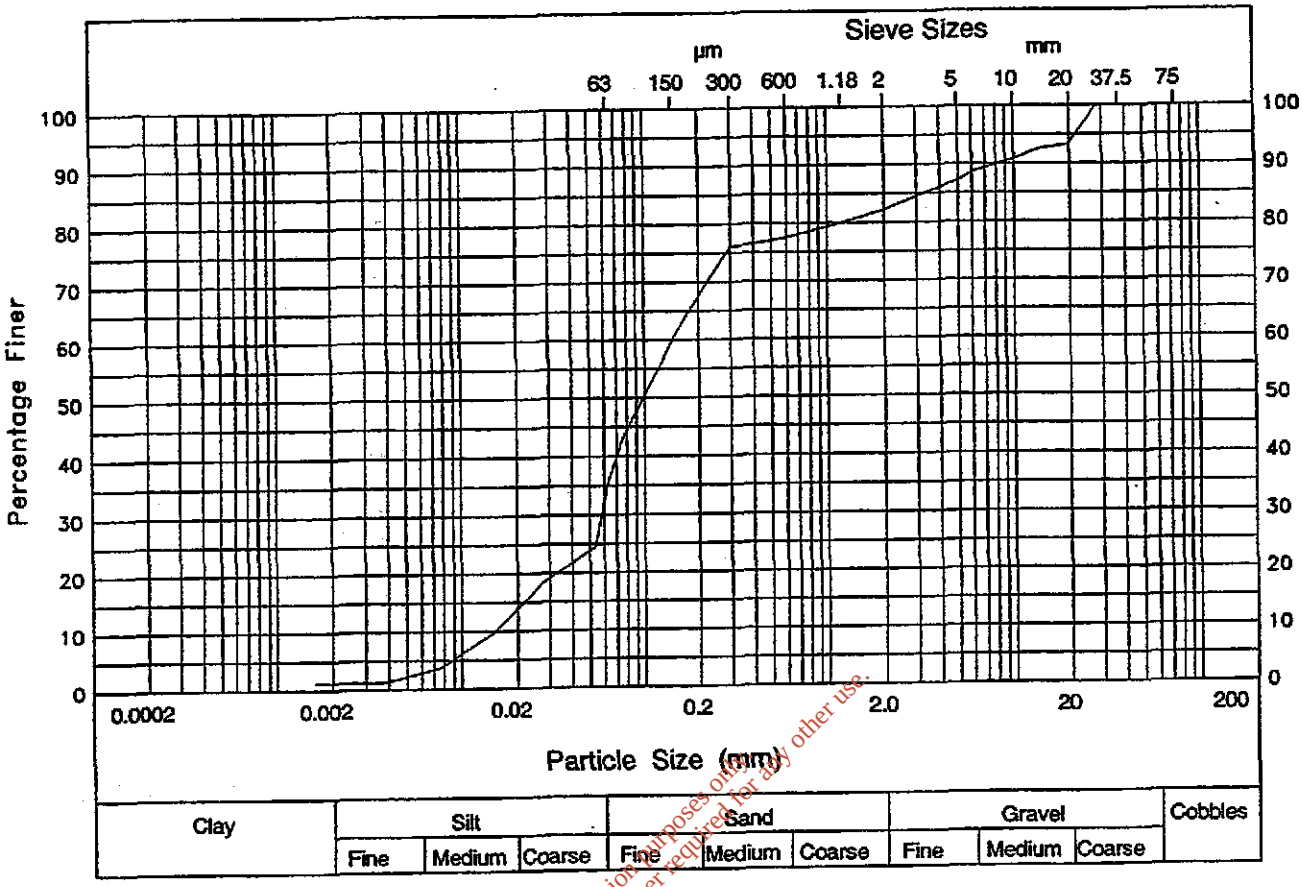


Particle Size	% Passing	Particle Size	% Passing
90 mm	78	2 mm	30
75 mm	72	1.18 mm	26
63 mm	72	600 µm	22
50 mm	68	425 µm	20
37.5 mm	60	300 µm	19
28 mm	57	212 µm	17
20 mm	54	150 µm	15
14 mm	48	75 µm	12
10 mm	45	63 µm	12
6.3 mm	41		
5 mm	38		
3.35 mm	35		

Hole TP07	Description: Clayey sandy GRAVEL
Depth 2.80 -3.00	
Type B	
Test Performed Wet	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet** .

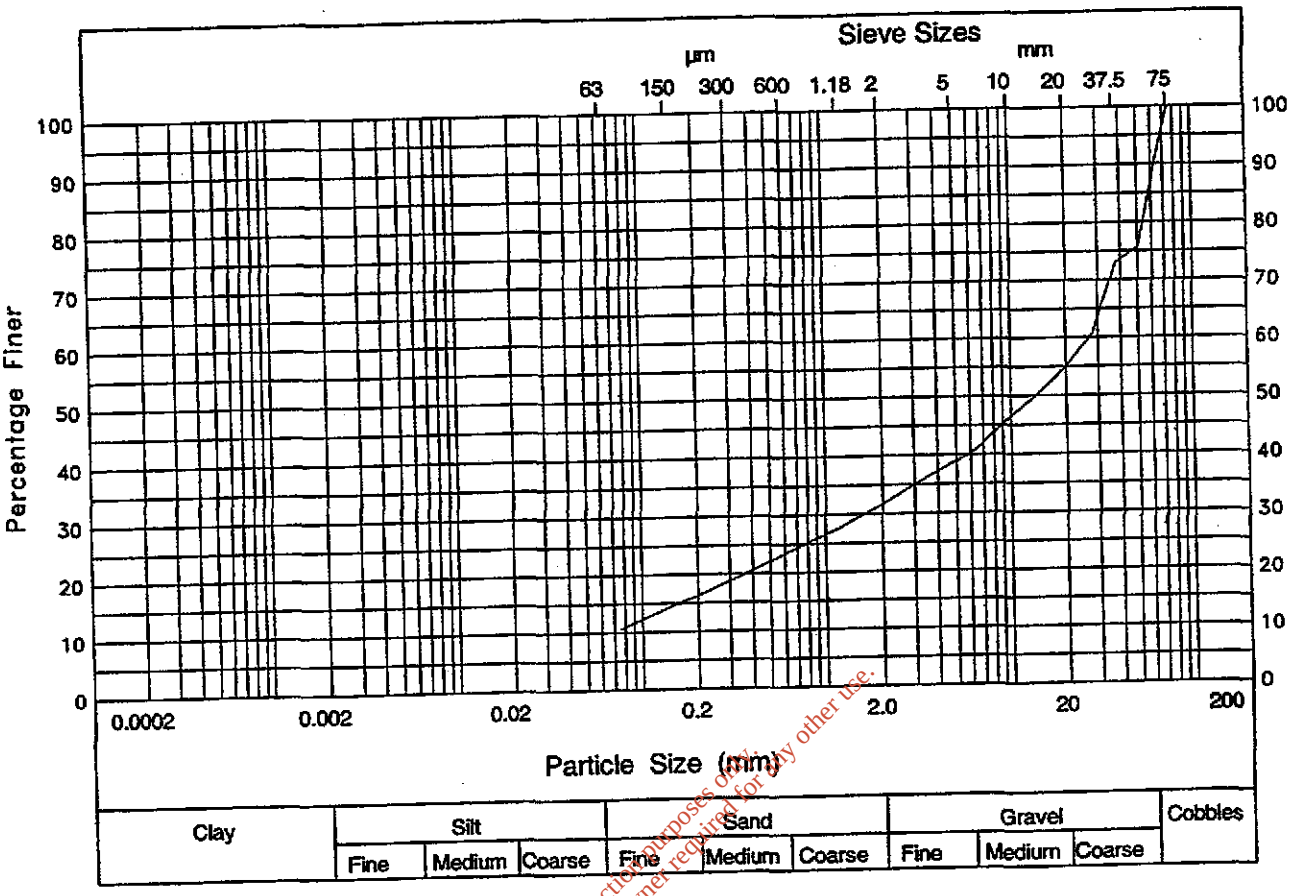


Particle Size	% Passing	Particle Size	% Passing
28 mm	100	212 µm	69
20 mm	93	150 µm	61
14 mm	93	75 µm	43
10 mm	91	63 µm	36
6.3 mm	89	54 µm	24
5 mm	87	28 µm	18
3.35 mm	85	15 µm	10
2 mm	82		
1.18 mm	80		
600 µm	78		
425 µm	77		
300 µm	76		

Hole TP06	Description: Sandy slightly gravelly CLAY
Depth 3.50 -3.70	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

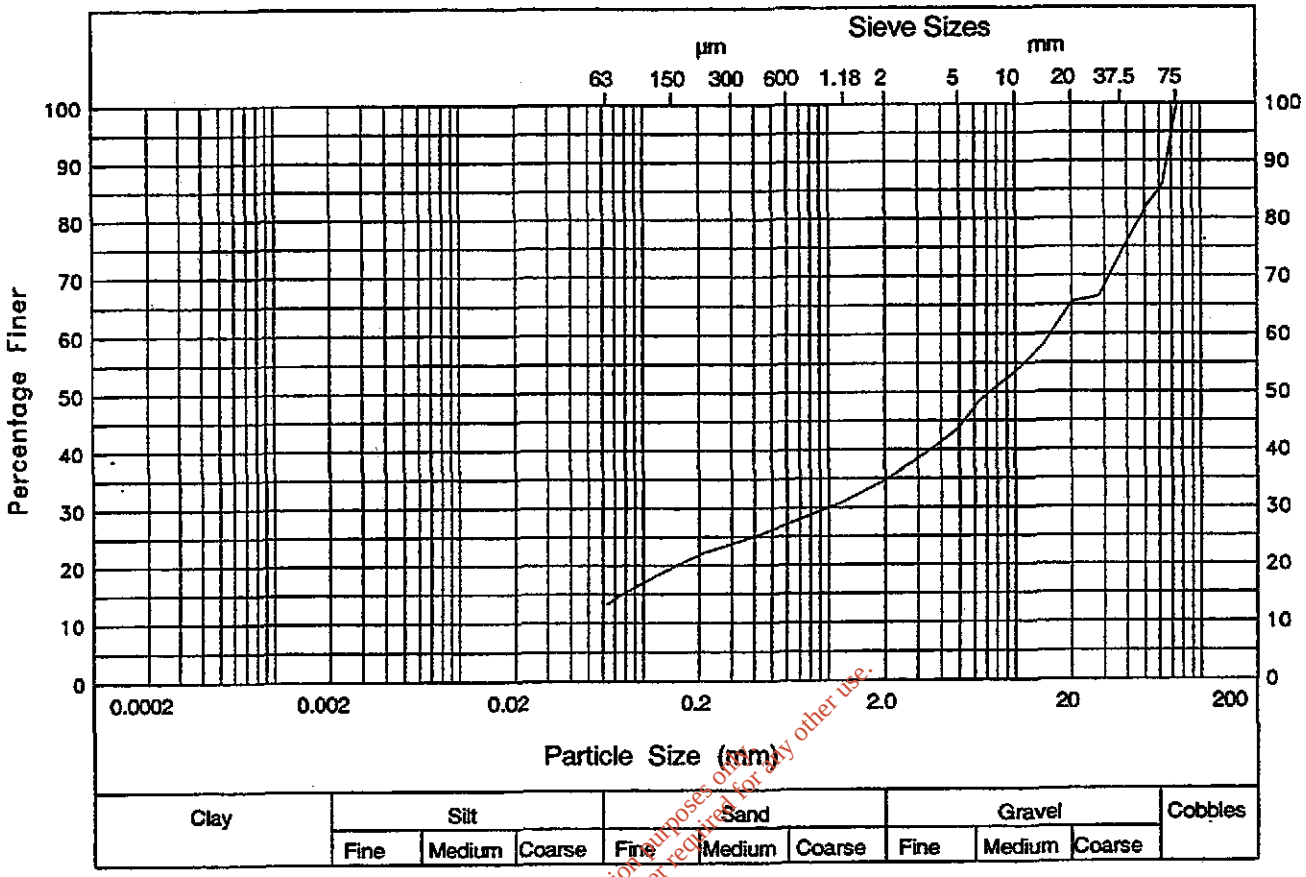


Particle Size	% Passing	Particle Size	% Passing
75 mm	100	1.18 mm	28
63 mm	90	600 µm	23
50 mm	76	425 µm	21
37.5 mm	73	300 µm	19
28 mm	61	212 µm	17
20 mm	55	150 µm	15
14 mm	50	75 µm	11
10 mm	47		
6.3 mm	41		
5 mm	39		
3.35 mm	36		
2 mm	32		

Hole TP06	Description: Clayey sandy GRAVEL
Depth 0.80 -1.00	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

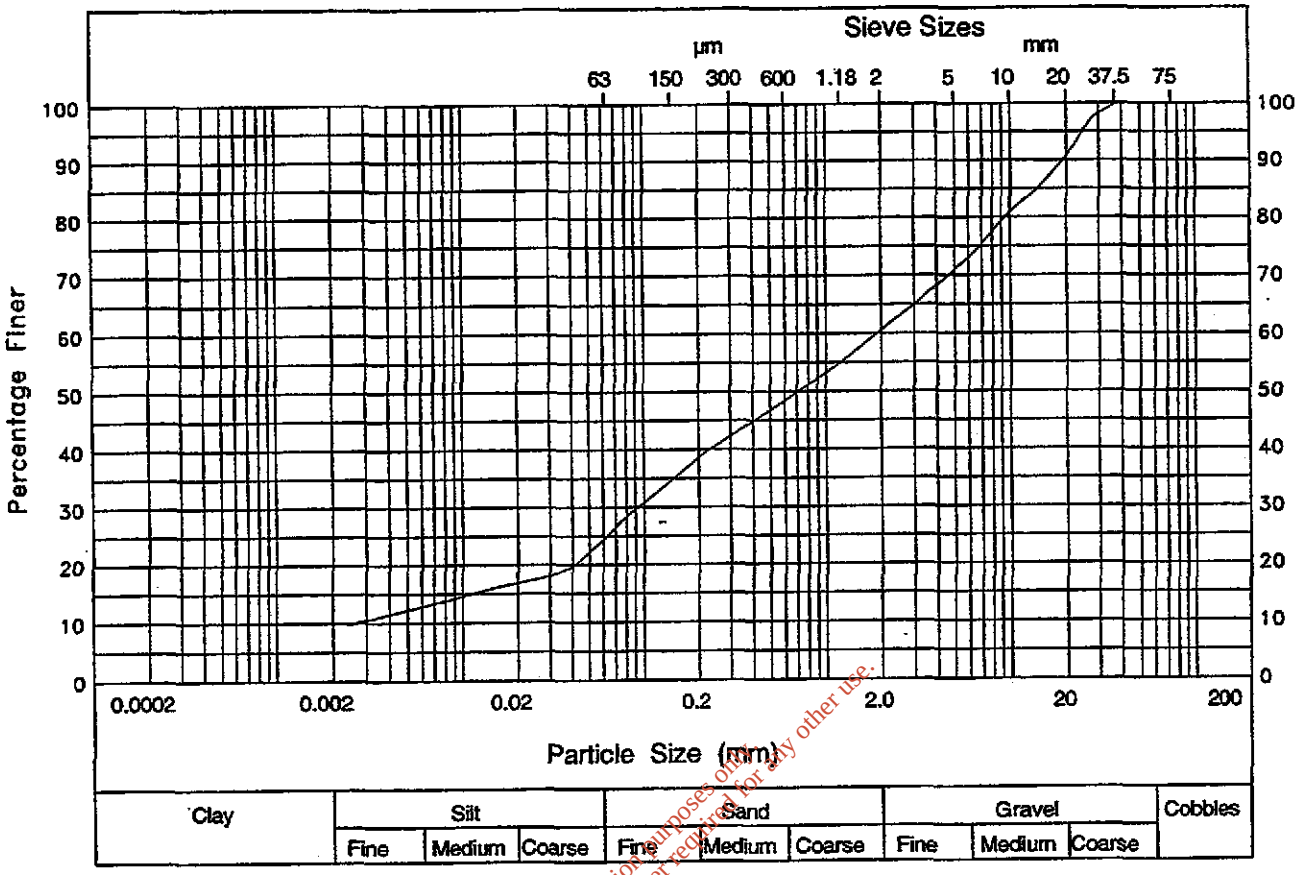


Particle Size	% Passing	Particle Size	% Passing
75 mm	100	1.18 mm	31
63 mm	86	600 µm	27
50 mm	82	425 µm	25
37.5 mm	74	300 µm	24
28 mm	66	212 µm	22
20 mm	65	150 µm	20
14 mm	58	75 µm	15
10 mm	53	63 µm	13
6.3 mm	48		
5 mm	44		
3.35 mm	39		
2 mm	35		

Hole TP05	Description Clayey sandy GRAVEL
Depth 2.80 -3.00	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**



Particle Size	% Passing	Particle Size	% Passing
37.5 mm	100	300 µm	42
28 mm	98	212 µm	39
20 mm	91	150 µm	35
14 mm	85	75 µm	28
10 mm	81	63 µm	25
6.3 mm	74	41 µm	20
5 mm	71	30 µm	18
3.35 mm	66	16 µm	16
2 mm	61		
1.18 mm	55		
600 µm	48		
425 µm	45		

Hole TP05	Description: Black mottled grey sandy gravelly CLAY
Depth 0.70 -0.80	
Type B	
Test Performed Dry	Uniformity Coefficient not applicable.

Form 25/4

Laboratory - Particle Size Plot	**Project** dublin waste to energy	**Contract** KD3116x
GEOTECH		**Sheet**

TES Bretby

TEST REPORT
SOIL SAMPLE ANALYSIS

UKAS TESTING

1252

TES Report No. EFS/033223

Site: Dublin Waste

Geotech Specialists Ltd
Carewswood
Castlemartyr
County Cork
Ireland

The 7 samples described in this report were scheduled for analysis by TES Bretby on Wednesday, 6 August 2003. The analysis was completed by Monday, 18 August 2003.

Tests marked as 'not UKAS accredited' and any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by TES Bretby laboratories.

The following tables are contained in this report:

Table 1 Main Analysis Results
Tables of TPH Chromatograms (5 Pages)
Table of Report Notes (1 Page)

On behalf of
TES Bretby : J Hannah
J Hannah Project Co-ordinator

Date of Issue: 18/08/03

Tests marked 'not UKAS accredited' in this report are not included in the UKAS Accreditation Schedule for our laboratory.

TES Bretby accepts no responsibility for the sampling related to the above results

Units :		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Method Codes :		BGCN22	ELESULP	ICPACIDS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICTSCN28	ICTSCN28	PAHSCUV	SCNCR6
Detection Limits :		1	20	10	0.5	0.1	0.5	0.5	0.5	0.10	0.5	0.5	3.0	1	5	10	0.1
UKAS Accredited :		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
TES ID Number CU	Client Sample Description	Cyanide (Free)	Elemental Sulphur	SO4– (acid sol)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Zinc (MS)	CN- (total)	Sulphide	PAH (screening)	Chromium vi.
0322922	BH003A 4.0																
0322923	BH003A 6.0																
0322924	BH005 0.5																
0322925	BH005 1.2	<1	<20	1850	10.40	0.44	23.6	32.6	104.2	0.12	18.6	1.34	107.4	<1	6	5020	0.3
0322926	BH005 5.5																
0322920	TP008 0.8	<1	69	811	13.60	0.24	15.8	99.0	51.5	0.26	41.6	1.23	448.8	<1	<5	29	<0.1

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name: Geotech Specialists

Contact: Mr A Game

Dublin Waste

Soils Sample Analysis

Date Printed	18 August 2003
Report Number	EFS/033223
Table Number	1
Page Number	1 of 2

UKAS TESTING 1252

Units :		mg/kg	mg/kg	pH Units	mg/kg	mg/kg												
Method Codes :		SCNCR6	TPHFID	WSLM3	WSLM4	ICPBOR												
Detection Limits :		0.5	10.0		0.5	0.5												
UKAS Accredited :		yes	yes	yes	yes	no												
TES ID Number CL/	Client Sample Description	Thiocyanate.	TPH GCFID (AR)	pH units	Phenol Index	Boron.												
0322922	BH003A 4.0		47															
0322923	BH003A 6.0		<10.0															
0322924	BH005 0.5		815															
0322925	BH005 1.2	1.0		10.6	7.6	0.8												
0322926	BH005 5.5		132															
0322920	TP008 0.8	<0.5		8.5	<0.5	1.7												
0322921	TP008 1.8		149															

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name	Geotech Specialists
Contact	Mr A Garne

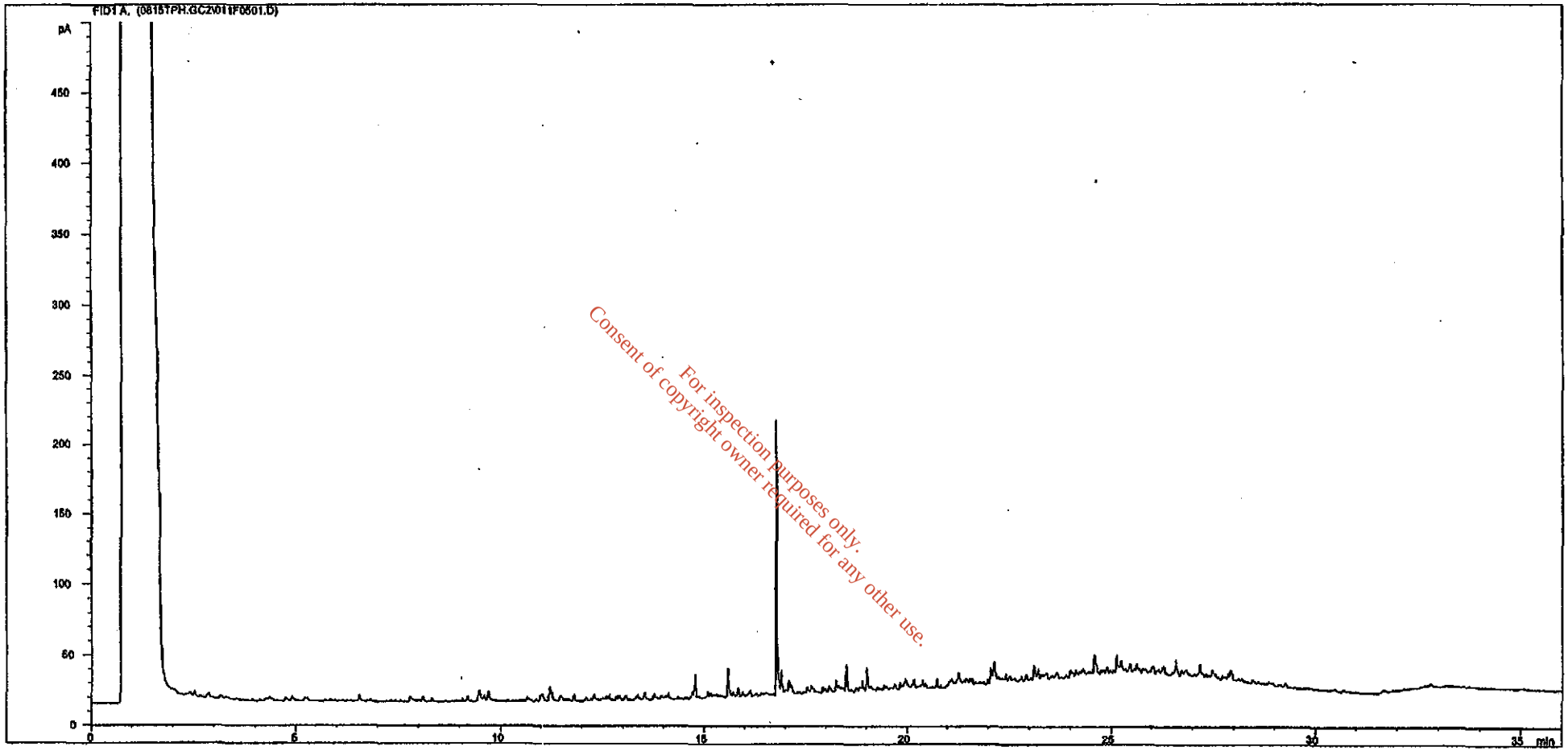
Dublin Waste

Soils Sample Analysis

Date Printed	18 August 2003
Report Number	EFS/033223
Table Number	1
Page Number	2 of 2

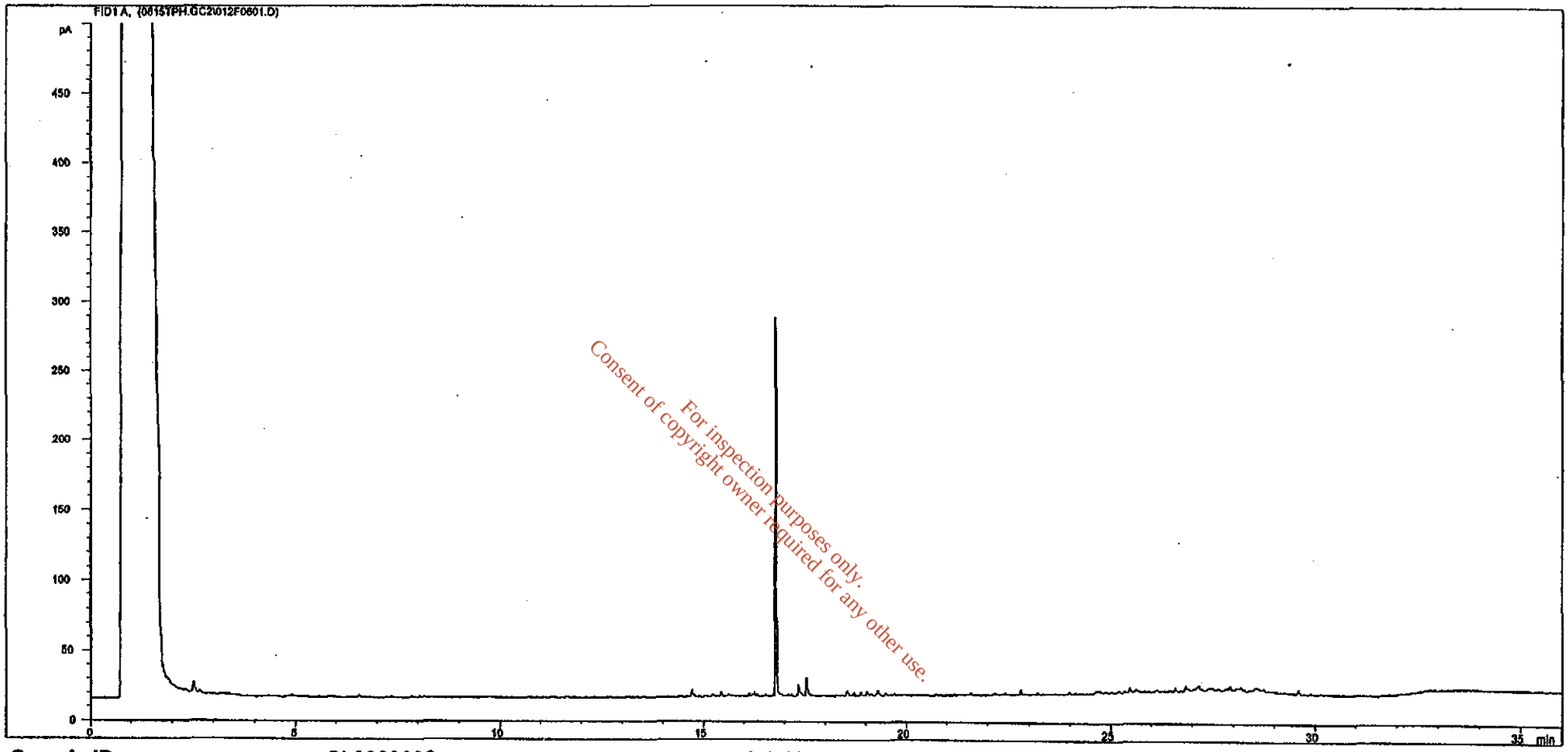
UKAS TESTING
1252

Petroleum Hydrocarbons (C8 to C37) by GC/FID



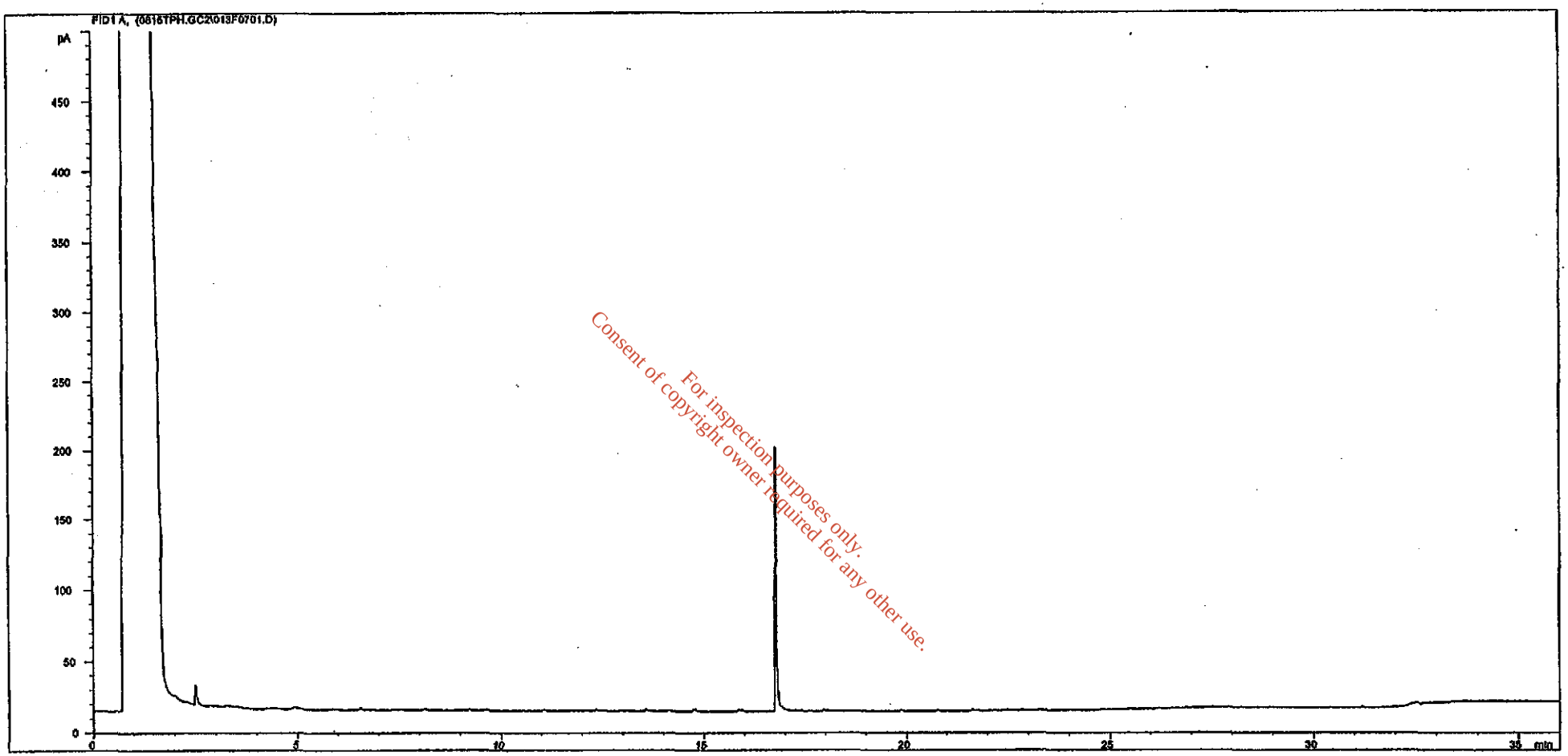
Sample ID:	CL0322921	**Job Number:**	S03_3223
Multiplier:	0.1	**Client:**	Geotech Specialists
Dilution:	1	**Site:**	Dublin Waste
Acquisition Method:	WMF_RUNF.M	**Client Sample Ref:**	TP008 1.8
Acquisition Date/Time:	15/08/2003 19:02		
Datafile:	L:\DATA\0815TPH.GC2\011F0501.D		

Petroleum Hydrocarbons (C8 to C37) by GC/FID



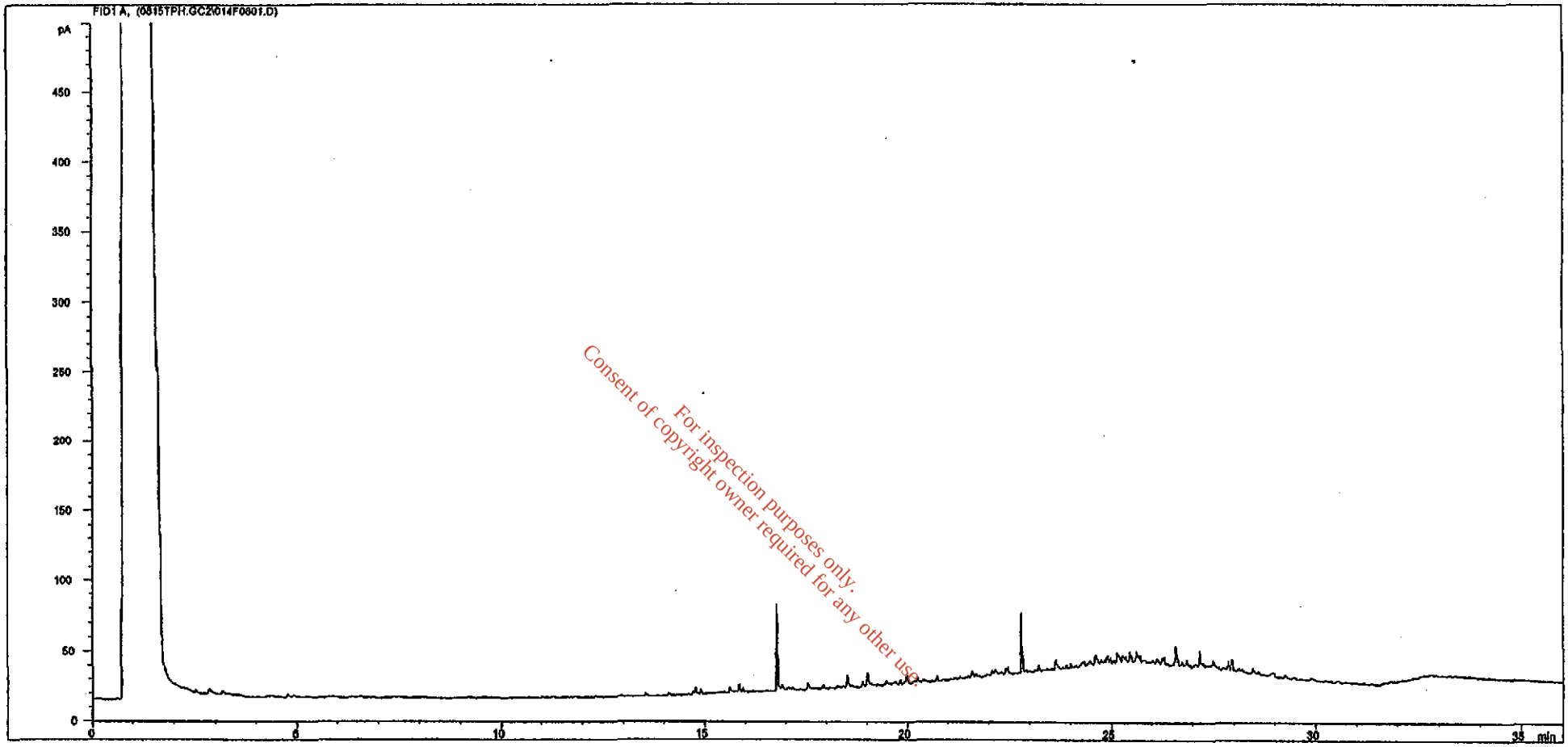
Sample ID:	CL0322922	**Job Number:**	S03_3223
Multiplier:	0.1	**Client:**	Geotech Specialists
Dilution:	1	**Site:**	Dublin Waste
Acquisition Method:	WMF_RUNF.M	**Client Sample Ref:**	BH003A 4.0
Acquisition Date/Time:	15/08/2003 19:49		
Datafile:	L:\DATA\0815TPH.GC2\012F0601.D		

Petroleum Hydrocarbons (C8 to C37) by GC/FID



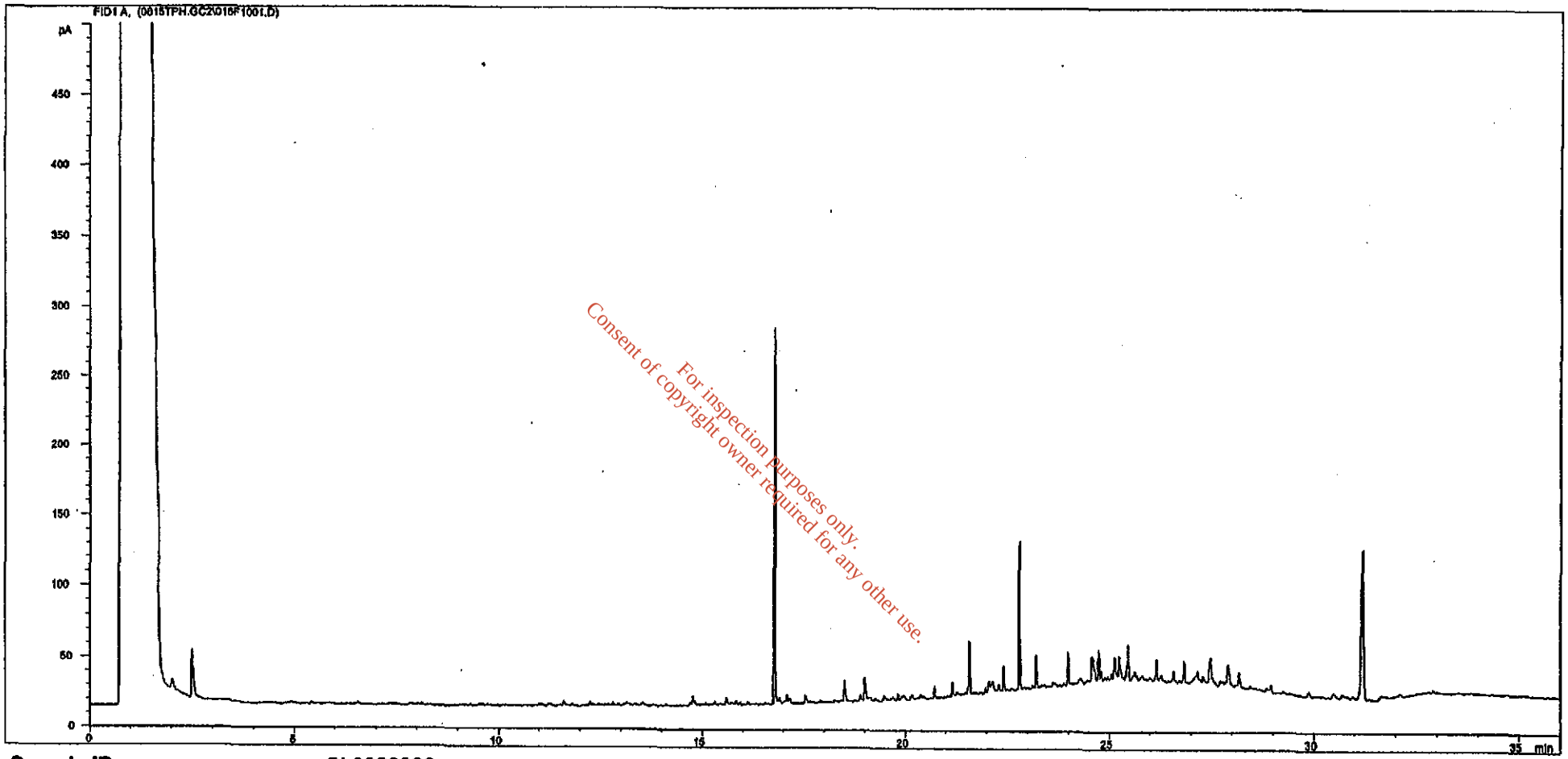
Sample ID:	CL0322923	**Job Number:**	S03_3223
Multiplier:	0.1	**Client:**	Geotech Specialists
Dilution:	1	**Site:**	Dublin Waste
Acquisition Method:	WMF_RUNF.M	**Client Sample Ref:**	BH003A 6.0
Acquisition Date/Time:	15/08/2003 20:36		
Datafile:	L:\DATA\0815TPH.GC2\013F0701.D		

Petroleum Hydrocarbons (C8 to C37) by GC/FID



Sample ID:	CL0322924	**Job Number:**	S03_3223
Multiplier:	0.1	**Client:**	Geotech Specialists
Dilution:	5	**Site:**	Dublin Waste
Acquisition Method:	WMF_RUNF.M	**Client Sample Ref:**	BH005 0.5
Acquisition Date/Time:	15/08/2003 21:23		
Datafile:	L:\DATA\0815TPH.GC2\014F0801.D		

Petroleum Hydrocarbons (C8 to C37) by GC/FID



Sample ID:	CL0322926	**Job Number:**	S03_3223
Multiplier:	0.1	**Client:**	Geotech Specialists
Dilution:	1	**Site:**	Dublin Waste
Acquisition Method:	WMF_RUNF.M	**Client Sample Ref:**	BH005 5.5
Acquisition Date/Time:	15/08/2003 22:56		
Datafile:	L:\DATA\0815TPH.GC2\016F1001.D		

Report Notes

Soil/Solid analysis specific:
Results expressed as mg/kg unless stated otherwise
S04 analysis not conducted in accordance with BS1377
Water Soluble Sulphate on 2:1 water:soil extract
AR denotes analysis conducted on the As Received sample
co-eluted with benzo(b)fluoranthene
co-eluted with Indeno(123-cd)pyrene
BTEX analysis expressed as ug/kg As Received
Phenol HPLC results expressed as mg/kg As Received

Water analysis specific:
Results expressed as mg/l unless stated otherwise

Oil analysis specific:
Results expressed as mg/kg unless stated otherwise
S.G. expressed as g/cm^3@ 15°C

Filter analysis specific:
Results expressed as mg on filter unless stated otherwise

VOC analysis specific:
Explanatory notes for data flagging
U = undetected above reporting limit
J = concentration at instrument was below lowest calibration standard
E = concentration at instrument was above top calibration standard
B = compound was detected in method blank

Gas (Tedlar bag) analysis specific:
Results expressed as ug/l unless stated otherwise

Air (Carbon tube) analysis specific:
Results expressed as ug on tube unless stated otherwise

Asbestos analysis specific:
CH denotes Chrysotile
CR denotes Crocidolite
AM denotes Amosite
NADIS denotes No Asbestos Detected in Sample
NBFO denotes No Bulk fibres Observed
T Trace
L Low (2-15%)
M Medium (15-50%)
H High (>50%)

General notes:
^ this analysis was subcontracted to another laboratory
$ Within laboratory tolerances
$$ unable to analyse due to nature of sample
¥ Results for guidance only, possible interference
& Blank corrected
I.S insufficient sample for analysis
Intf Unable to analyse due to interferences
N.D Not determined
N.R Not recorded
N.Det Not detected
Req Analysis Requested, see attached sheets for results
***** denotes this result not UKAS accredited on this sample
Þ Raised detection limit due to nature of sample

TES
Bretby

TES Bretby

PO Box 100
Ashby Road
Burton-upon-Trent
Staffordshire
DE15 0XD

Telephone: 01283 554400
Facsimile: 01283 554422
E-mail: enquiries@tes-bretby.co.uk

Our Ref : EFS/032527
Your Ref:
9 July 2003

Mr A Garne
Geotech Specialists Ltd
Carewswood
Castlemartyr
County Cork
Ireland

Dear Mr Garne

SOILS ANALYSIS - Dublin Waste

Please find attached analytical results for the samples from the above site.

An invoice for this work will follow under separate cover.

If appropriate, samples covered by this report will be saved until approximately 06/08/03 when they will be discarded. Please call 01283 554403 for an extension of this date.
Please be aware that from 1 January 2003 our policy for the retention of paper based laboratory records and analysis reports will be 3 year

The work was carried out in accordance with Mowlem Environmental Sciences Group Standard Terms and Conditions of Contract.

Please contact me if you require any further information.

Yours sincerely

J Hannah

J Hannah
Project Co-ordinator
01283-554403

TES Bretby

TEST REPORT
SOIL SAMPLE ANALYSIS

UKAS TESTING

1252

TES Report No. EFS/032527

Site: Dublin Waste

Geotech Specialists Ltd
Carewswood
Castlemartyr
County Cork
Ireland

The 3 samples described in this report were scheduled for analysis by TES Bretby on Wednesday, 25 June 2003. The analysis was completed by Wednesday, 9 July 2003.

Tests marked as 'not UKAS accredited' and any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by TES Bretby laboratories.

The following tables are contained in this report:

Table 1 Main Analysis Results
Table of Report Notes (1 Page)

On behalf of
TES Bretby : J Hannah
J Hannah Project Co-ordinator

Date of Issue: 09/07/03

Tests marked 'not UKAS accredited' in this report are not included in the UKAS Accreditation Schedule for our laboratory.

TES Bretby accepts no responsibility for the sampling related to the above results

Units :	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Method Codes :	BGCN22	ELESULP	ICPACIDS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICTSCN28	ICTSCN28	PAHSCUV	SCNCR6
Detection Limits :	1	20	10	0.5	0.1	0.5	0.5	0.5	0.10	0.5	0.5	3.0	1	5	10	0.1
UKAS Accredited :	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

TES ID Number CU	Client Sample Description	Cyanide (Free)	Elemental Sulphur	SO4-- (acid sol)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Zinc (MS)	CN- (total)	Sulphide	PAH (screening)	Chromium vi.
0318336	TP001 1.2-1.6	<1	48	839	12.10	0.13	20.5	65.3	30.6	0.21	29	1.04	66.1	<1	16	20	<0.1
0318337	TP004 1.2-1.4	<1	21	8350	13.50	1.25	17.5	42.4	479.2	0.69	23.8	1.82	292.6	<1	<5	108	<0.1
0318338	TP007 0.7-0.8	<1	<20	7180	23.2	1.57	58.3	189.5	822.6	0.49	52.4	1.70	381.4	<1	16	125	<0.1

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name: Geotech Specialists
Contact: Mr A Game

Dublin Waste

Soils Sample Analysis

Date Printed	9 July 2003
Report Number	EFS/032527
Table Number	1
Page Number	1 of 2

UKAS TESTING
1252

Units :		mg/kg	pH Units	mg/kg	mg/kg													
Method Codes :		SCNCR6	WSLM3	WSLM4	ICPBOR													
Detection Limits :		0.5		0.5	0.5													
UKAS Accredited :		yes	yes	yes	no													
TES ID Number CU	Client Sample Description	Thiocyanate.	pH units	Phenol Index	Boron.													
0318336	TP001 1.2-1.6	<0.5	9.5	<0.5	0.9													
0318337	TP004 1.2-1.4	<0.5	8.4	<0.5	1.1													
0318338	TP007 0.7-0.8	<0.5	9.0	<0.5	1.1													

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name: Geotech Specialists

Contact: Mr A Garne

Dublin Waste

Soils Sample Analysis

Date Printed	9 July 2003
Report Number	EFS/032527
Table Number	1
Page Number	2 of 2

UKAS TESTING 1252

Report Notes

Soil/Solid analysis specific:
Results expressed as mg/kg unless stated otherwise
S04 analysis not conducted in accordance with BS1377
Water Soluble Sulphate on 2:1 water:soil extract
AR denotes analysis conducted on the As Received sample
co-eluted with benzo(b)fluoranthene
co-eluted with Indeno(123-cd)pyrene
BTEX analysis expressed as ug/kg As Received
Phenol HPLC results expressed as mg/kg As Received

Water analysis specific:
Results expressed as mg/l unless stated otherwise

Oil analysis specific:
Results expressed as mg/kg unless stated otherwise
S.G. expressed as g/cm³ @ 15°C

Filter analysis specific:
Results expressed as mg on filter unless stated otherwise

VOC analysis specific:
Explanatory notes for data flagging
U = undetected above reporting limit
J = concentration at instrument was below lowest calibration standard
E = concentration at instrument was above top calibration standard
B = compound was detected in method blank

Gas (Tedlar bag) analysis specific:
Results expressed as ug/l unless stated otherwise

Air (Carbon tube) analysis specific:
Results expressed as ug on tube unless stated otherwise

Asbestos analysis specific:
CH denotes Chrysotile
CR denotes Crocidolite
AM denotes Amosite
NADIS denotes No Asbestos Detected in Sample
NBFO denotes No Bulk fibres Observed
T Trace
L Low (2-15%)
M Medium (15-50%)
H High (>50%)

General notes:
^ this analysis was subcontracted to another laboratory
$ Within laboratory tolerances
$$ unable to analyse due to nature of sample
¥ Results for guidance only, possible interference
& Blank corrected
LS insufficient sample for analysis
Intf Unable to analyse due to interferences
N.D Not determined
N.R Not recorded
N.Det Not detected
Req Analysis Requested, see attached sheets for results
* denotes this result not UKAS accredited on this sample
Þ Raised detection limit due to nature of sample

TES Bretby

TES Bretby

PO Box 100
Ashby Road
Burton-upon-Trent
Staffordshire
DE15 0XD

Telephone: 01283 554400
Facsimile: 01283 554422
E-mail: enquiries@tes-bretby.co.uk

Our Ref : EFS/034319
Your Ref: 21964
31 October 2003

Mr M Kelley
Geotech Specialists Ltd
Hartwell Upper
Kill
County Kildare
Eire

Dear Mr Kelley

SOILS ANALYSIS - Dublin Waste

Please find attached analytical results for the samples from the above site.

An invoice for this work will follow under separate cover.

If appropriate, samples covered by this report will be saved until approximately 28/11/03 when they will be discarded. Please call 01283 554403 for an extension of this date.
Please be aware that from 1 January 2003 our policy for the retention of paper based laboratory records and analysis reports will be 3 years

The work was carried out in accordance with Mowlem Environmental Sciences Group Standard Terms and Conditions of Contract.

Please contact me if you require any further information.

Yours sincerely

J Elstub
Project Co-ordinator
01283-554403

TEST REPORT
SOIL SAMPLE ANALYSIS

1252

TES Report No. EFS/034319

Site: Dublin Waste

Geotech Specialists Ltd
Hartwell Upper
Kill
County Kildare
Eire

The 2 samples described in this report were scheduled for analysis by TES Bretby on Friday, 17 October 2003. The analysis was completed by Friday, 31 October 2003.

Tests marked as 'not UKAS accredited' and any opinions or interpretations expressed herein are outside the scope of any UKAS accreditation held by TES Bretby laboratories.

The following tables are contained in this report:

Table 1 Main Analysis Results
Table of TPH Chromatogram (1 Page)
Table of Report Notes (1 Page)

On behalf of
TES Bretby :
J Elstub Project Co-ordinator

Date of Issue: 31/10/03

Tests marked 'not UKAS accredited' in this report are not included in the UKAS Accreditation Schedule for our laboratory.

TES Bretby accepts no responsibility for the sampling related to the above results

TES Bretby, P.O. Box 100, Burton-on-trent, DE15 0XD Tel: 01283 554400 Fax: 01283 554422

Units :		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Method Codes :		BGCN22	ICPACIDS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICTSCN28	ICTSCN28	PAHSCUV	SCNCR6	SCNCR6
Detection Limits :		1	10	0.5	0.1	0.5	0.5	0.5	0.10	0.5	0.5	3.0	1	5	10	0.1	0.5
UKAS Accredited :		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
TES ID Number CU	Client Sample Description	Cyanide (Free)	SO4-- (acid sol)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Zinc (MS)	CN- (total)	Sulphide	PAH (screening)	Chromium vi.	Thiocyanate.
0330243	BH001 3.6																
0330244	BH002 4.0	<1	13100	12.80	0.91	19.2	27.5	178.6	0.34	24.9	1.10	320.9	<1	14	68	<0.1	<0.5

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name: Geotech Specialists

Contact: Mr M Kelley

Dublin Waste

Soils Sample Analysis

Date Printed	31 October 2003
Report Number	EFS/034319
Table Number	1
Page Number	1 of 2

UKAS TESTING 1252

Units :		mg/kg	pH Units	mg/kg	mg/kg													
Method Codes :		TPHFID	WSLM3	WSLM4	ICPBOR													
Detection Limits :		10.0		0.5	0.5													
UKAS Accredited :		yes	yes	yes	no													
TES ID Number CU	Client Sample Description	TPH GCFID (AR)	pH units	Phenol Index	Boron.													
0330243	BH001 3.6	72																
0330244	BH002 4.0		9.6	<0.5	1.3													

TES Bretby
PO Box 100, Bretby Business Park,
Burton-on-Trent, Staffordshire, DE15 0XD
Tel +44 (0) 1283 554400
Fax +44 (0) 1283 554422

Client Name	Geotech Specialists
Contact	Mr M Kelley

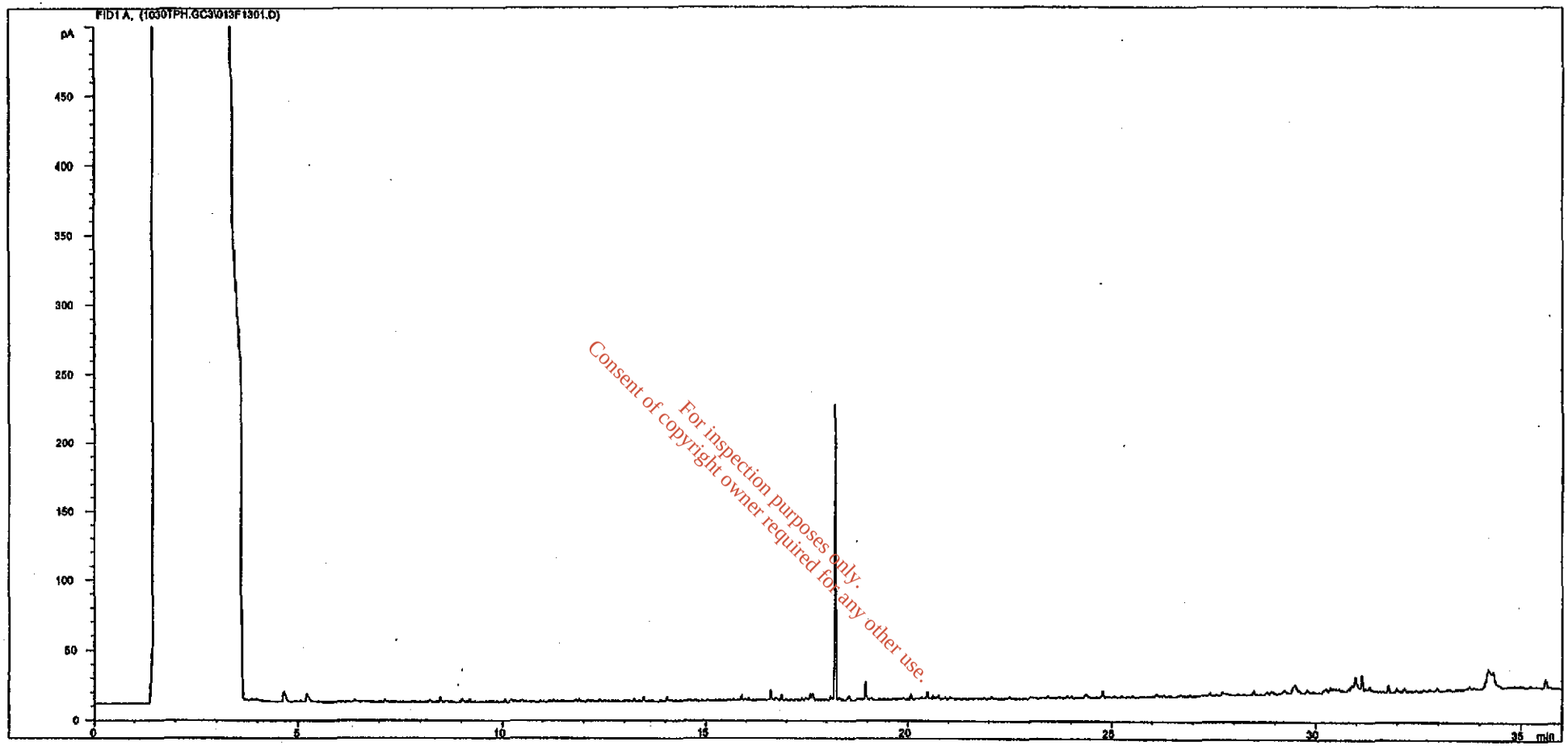
Dublin Waste

Soils Sample Analysis

Date Printed	31 October 2003
Report Number	EFS/034319
Table Number	1
Page Number	2 of 2

UKAS TESTING 1252

Petroleum Hydrocarbons (C8 to C37) by GC/FID



Sample ID:	CL0330243	**Job Number:**	S03_4319
Multiplier:	0.1	**Client:**	Geotech Specialists
Dilution:	1	**Site:**	Dublin Waste
Acquisition Method:	WMF_RUNF.M	**Client Sample Ref:**	BH001 3.6
Acquisition Date/Time:	31/10/03 02:30:17		
Datafile:	C:\TES\DATA\1030TPH.GC3\013F1301.D		

Report Notes

Soil/Solid analysis specific:

Results expressed as mg/kg unless stated otherwise
S04 analysis not conducted in accordance with BS1377
Water Soluble Sulphate on 2:1 water:soil extract
AR denotes analysis conducted on the As Received sample
co-eluted with benzo(b)fluoranthene
co-eluted with Indeno(123-cd)pyrene
BTEX analysis expressed as ug/kg As Received
Phenol HPLC results expressed as mg/kg As Received

Water analysis specific:

Results expressed as mg/l unless stated otherwise

Oil analysis specific:

Results expressed as mg/kg unless stated otherwise
S.G. expressed as g/cm^3 @ 15°C

Filter analysis specific:

Results expressed as mg on-filter unless stated otherwise

VOC analysis specific:

Explanatory notes for data flagging
U = undetected above reporting limit
J = concentration at instrument was below lowest calibration standard
E = concentration at instrument was above top calibration standard
B = compound was detected in method blank

Gas (Tedlar bag) analysis specific:

Results expressed as ug/l unless stated otherwise

Air (Carbon tube) analysis specific:

Results expressed as ug on tube unless stated otherwise

Asbestos analysis specific:

CH denotes Chrysotile
CR denotes Crocidolite
AM denotes Amosite
NADIS denotes No Asbestos Detected in Sample
NBFO denotes No Bulk fibres Observed
T Trace
L Low (2-15%)
M Medium (15-50%)
H High (>50%)

General notes:

^ this analysis was subcontracted to another laboratory
$ Within laboratory tolerances
$$ unable to analyse due to nature of sample
¥ Results for guidance only, possible interference
& Blank corrected
I.S insufficient sample for analysis
Intf Unable to analyse due to interferences
N.D Not determined
N.R Not recorded
N.Det Not detected
Req Analysis Requested, see attached sheets for results
* denotes this result not UKAS accredited on this sample
Þ Raised detection limit due to nature of sample

ALcontrol Laboratories (Dublin)

18a Rosemount Business Park,
Ballycoolin,
Dublin 11
Ireland
Tel: + 353 (0) 1 8829893
Fax: + 353 (0) 1 8829895

CERTIFICATE OF ANALYSIS

Client: Geotech Specialists Ltd

Carewswood
Castlemartyr
Co. Cork

Attention: Ronan Lynam

Date: 15 August, 2003

Our Reference: 03-B02557

Your Reference: DUBLIN WASTE KD3116

Location:

A total of 2 samples was received for analysis on Wednesday, 30 July 2003. We are pleased to enclose our final report, it was a pleasure to be of service to you, and we look forward to our continuing association.

Signed

Ken Scally
Site Manager

Compiled By

Natalie Duncan

ALcontrol Laboratories Ireland

Test Schedule

Ref Number: 03-B02557

Client: Geotech Specialists Ltd

Date of Receipt: 30/07/2003

Turnaround: 7 days

Sample Type: SOIL

Location:

Client Contact: Ronan Lynam

Client Ref: DUBLIN WASTE KD3116

Detection Method				GCMS	GRAVIMETRIC													
UKAS Accredited																		
ALcontrol Reference	Sample Identity	Other ID	P / V	Dioxins*	Natural Moisture Content													
03-B02557-S0004-A01	TP9 (0.7-0.9m)	UNKNOWN	Plastic tub	X	X													
03-B02557-S0005-A01	TP2 (1.0-1.1m)	UNKNOWN	Plastic tub	X	X													

Notes : NUMERIC VALUES INDICATE ADDITIONAL SCHEDULING

Checked By _____

☐ Interim

☑ Validated

ALcontrol Laboratories Ireland

Table Of Results

Ref Number: 03-B02557

Client: Geotech Specialists Ltd

Date of Receipt: 30/07/03

(of first sample)

Sample Type: SOIL

Location:

Client Contact: Ronan Lynam

Client Ref: DUBLIN WASTE KD3116

	Detection Method		GCMS	GRAVIMETRIC
	Method Detection Limit		n/a	<0.1%
	UKAS Accredited			
ALcontrol Reference	Sample Identity	Other ID	Dioxins*	Natural Moisture Content
				%
03-B02557-S0004	TP9 (0.7-0.9m)	UNKNOWN	Done	14.6
03-B02557-S0005	TP2 (1.0-1.1m)	UNKNOWN	Done	23.4

Notes : METHOD DETECTION LIMITS ARE NOT ALWAYS ACHIEVABLE DUE TO VARIOUS CIRCUMSTANCES BEYOND OUR CONTROL.

NDP = NO DETERMINATION POSSIBLE

NFP = NO FIBRES PRESENT

Checked By Natalie Duncan

Printed at 16:32 on 18/08/03

* SUBCONTRACTED TO OTHER LABORATORY / ** SAMPLES ANALYSED AT THE CHESTER LABORATORY

Appendix

APPENDIX

1. Results are expressed as mg/kg dry weight unless otherwise stated, excluding analyses in (2) below .

2. Leach tests, cyanide, phenols by MS, hexavalent chrome, flash point, acid soluble sulphides, TPH by IR and volatiles are performed on wet soil as received, and results are expressed as mg/kg of wet soil or mg/I of Leachate of specified leach test . Ammoniacal nitrogen and total phenols by HPLC are performed on wet sample but are then re-calculated and expressed as mg/kg of dry soil .

3. ICP metals results are analysed using a screening program and the data is accurate to within 20%

4. The Majority of analyses are run to an accuracy of 10%, but this may be improved upon if legally defensible data is required .

5. A sub sample of all samples received will be retained free of charge for two months for soils and one month for waters (sample size permitting), but may then be discarded unless we are instructed to the contrary . Once the initial period has expired, a storage charge will be applied for each month or thereof until the client cancels the request for sample storage.

6. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but the turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

7. Please note that we take no responsibility for any test performed by sub-contractor's (marked with an asterisk) .

8. Asbestos screen is done in-house on soils and if no fibres are found will be reported as NFD-no fibres present . If asbestos is detected then identification & quantifications is carried out by sub-contractor . If a sample is suspected of containing asbestos then drying & crushing will be suspended on the sample until the asbestos result is known . If asbestos is present then no analysis requiring dry sampling will be undertaken .

9. NDP-No determination possible due to insufficient / unsuitable sample.

SCIENTIFIC ANALYSIS LABORATORIES LTD.
Medlock House,
New Elm Road,
Manchester M3 4JH
Telephone: 0161-827 1400
Fax: 0161-827 1414

Job 37310E/Dioxins

Dioxin and Furan Analysis

For

ALcontrol Geochem Ireland

Unit 18a

Rosemount Business Park,

Ballycoolin, Dublin 11

Ireland

Date of Sample Receipt: 31/07/03

Date(s) of Sample Testing: 31/07/03 - 11/08/03

Date of Issue of Report: 11/08/03

UKAS TESTING
1549

Scientific Analysis Laboratories Ltd.

Certificate of Analysis

All analytical results contained within have been obtained in accordance with the Laboratory's standard operating procedures contained in SAL SOP #1

Any deviations from these standard operating procedures are described in the following text.

Report written by D. Hood Signature/date 11/08/03
Laboratory Director

Report checked by V.C. Pam Signature/date 11/8/03
Director

Scientific Analysis Laboratories Ltd.

Report Checking Form

CHECK	SIGNED/DATE
CLIENT ID vs LAB ID CHECKED	11/8/07
DETECTION LIMITS CHECKED	11/8/07
QUALITY CONTROL DATA CHECKED	11/8/07
SAMPLE TEQs TRANSPOSED TO SUMMARY CORRECTLY	11/8/07
SAMPLE NARRATIVES CHECKED	11/8/07
ID OF TARGET COMPOUNDS	11/8/07
SELECTED ANALYTE CONCNS. CHECKED FROM RAW DATA	11/8/07
TRACKING FORMS CHECKED	11/8/07

Sample Data Pack, JOB # 37310E

Table of Contents

1.5 Summary of Objectives

Two soil samples were analysed for the seventeen 2,3,7,8 containing chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans. The concentrations of total tetra- through heptachlorinated dioxin and furan homologues were also determined.

Please note that the data reported here are based on the samples on a 'dried and ground' basis. Analysis and quantitation was performed at SAL via isotope dilution high resolution gas chromatography/ high resolution mass spectrometry according to SAL SOP #1. Tests covered by this report are within the scope of our UKAS accreditation.

The detection limits for these samples were between 0.2 and 0.4 ng/kg per congener, depending upon the specific sample and congeners involved.

Raw data from calibration and sample analyses are archived indefinitely on magnetic tape.

2.5 Sample data and results presentation

This is a brief explanation of the way in which the results are presented for this sample. The sample data pack commences with a sample narrative, this contains any comments upon the data, or any peculiarities observed in the sample's pathway through the laboratory.

Following this is a data summary sheet, this contains the results obtained for the targeted 2378 containing congeners and the "totals" for other chlorinated dioxin and furan isomers present in the sample.

The next page consists of the recovery information for the isotope labelled standards relative to the $^{13}C_6$-1,2,3,4-TCDD standard added prior to injection. Any comments thought appropriate will appear in the sample narrative.

Finally the sample tracking sheet is included.

"Totals" Determinations

In the case of quantitation of isomers other than the 2378 containing ones the RRFs of the first eluting 2378 isomer of the same degree of chlorination (or homologue group) are used.

Note that the current Toxic Equivalent Factors (TEFs) for the German BGA/UBA, US EPA and European Community/NATO (also known as i-TEF) are listed on the next page and are used to produce a total Dioxin and Furan equivalent amount for all congeners.

3.6 Toxic Equivalent Factors

Dioxin 2,3,7,8-Isomer	TEF		
	BGA/UBA	USEPA	EC
2,3,7,8-TCDD	1.0	1.0	1.0
1,2,3,7,8-PeCDD	0.1	0.5	0.5
1,2,3,4,7,8-HxCDD	0.1	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.01	0.01
OCDD	0.001	0.001	0.001

Total Dioxin Non-2,3,7,8-Isomer	
Summed TCDD	0.01
Summed PeCDD	0.01
Summed HxCDD	0.01
Summed HpCDD	0.001

Furan 2,3,7,8-Isomer			
2,3,7,8-TCDF	0.1	0.1	0.1
1,2,3,7,8-PeCDF	0.1	0.05	0.05
2,3,4,7,8-PeCDF	0.1	0.5	0.5
1,2,3,4,7,8-HxCDF	0.1	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01	0.01
OCDF	0.001	0.001	0.001

Total Furan Non-2,3,7,8-Isomer	
Summed TCDF	0.01
Summed PeCDF	0.01
Summed HxCDF	0.01
Summed HpCDF	0.001

Please note that the USEPA TEFs now employed correspond exactly with those promulgated by NATO/CCMS and the EC.

4.7 Data Summary

The EC/NATO/CCMS/i-TE total toxic equivalent amounts for each of the samples are given in the table below. Note that the results are reported in ng/kg for the soil samples.

SAL Reference	Your Reference	Amount ng/kg I-TE
37310E001	03-B02557-50004-AD1 TP9 (0.7-0.9m)	2.2
37310E002	03-B02557-50005-AD1 TP2 (1.0-1.1m)	19
37310EBL	Method Blank	<0.5

5.8 Sample Narrative, Sample Number 37310E001

Extraction/ Clean up :- No Comments.

Data Acquisition :- No Comments.

Data Analysis :- A number of the toxic PCDD/Fs were detected in this sample together with some non-toxic ones.

The internal standard recoveries are acceptable.

RESULTS SUMMARY REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310E001 Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.005\D0808.DAT
File Text : 03-B02557-50004-AD1 TP9 (0.7-0.9m)
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	1.6	0.16	0.16	0.16
1,2,3,4,7,8-HxCDD	N.D.			
1,2,3,7,8,9-HxCDD	0.72	0.072	0.072	0.072
1,2,3,4,6,7,8-HpCDD	58	0.58	0.58	0.58
OCDD	440	0.44	0.44	0.44
Total non-targeted isomers				
TCDD	4.9	0.049	0.0	0.0
PeCDD	1.7	0.017	0.0	0.0
HxCDD	9.4	0.094	0.0	0.0
HpCDD	71	0.071	0.0	0.0
Total Dioxins TEQ		1.5	1.3	1.3
Furans				
2,3,7,8-TCDF	0.76	0.076	0.076	0.076
1,2,3,7,8-PeCDF	0.82	0.082	0.041	0.041
2,3,4,7,8-PeCDF	0.64	0.064	0.32	0.32
1,2,3,4,7,8-HxCDF	1.1	0.11	0.11	0.11
1,2,3,6,7,8-HxCDF	0.73	0.073	0.073	0.073
2,3,4,6,7,8-HxCDF	0.75	0.075	0.075	0.075
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	16	0.16	0.16	0.16
1,2,3,4,7,8,9-HpCDF	0.94	0.0094	0.0094	0.0094
OCDF	45	0.045	0.045	0.045
Total non-targeted isomers				
TCDF	2.6	0.026	0.0	0.0
PeCDF	3.7	0.037	0.0	0.0
HxCDF	12	0.12	0.0	0.0
HpCDF	27	0.027	0.0	0.0
Total Furans TEQ		0.90	0.91	0.91
Grand Total TEQ		2.4	2.2	2.2

TARGETING REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310E001 Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.005\D0808.DAT
File Text : 03-B02557-50004-AD1 TP4 (0.7-0.9m)
Sample Employed : 10.0 g

Compound Name	M1	M2	M1/M2 thry	M1/M2 actl	Ok	Retention Time theory	Retention Time found	Area	RRF	Amount
Dioxins										
13C 1,2,3,4-TCDD	326	328	0.78	0.83	Y	00:30:06	00:29:37	111369	1.00	300.0
13C 2,3,7,8-TCDD	332	334	0.78	0.80	Y	00:30:38	00:30:09	25508	1.00	69.0
13C 1,2,3,7,8-PeCDD	368	370	1.55	1.56	Y	00:35:52	00:35:26	25205	0.94	72.4
13C 1,2,3,6,7,8-HxCDD	402	404	1.24	1.19	Y	00:40:20	00:40:01	17345	0.63	74.0
1,2,3,6,7,8-HxCDD	390	392	1.24	1.31	Y	00:40:21	00:40:01	288	1.03	1.6
1,2,3,7,8,9-HxCDD	390	392	1.24	1.28	Y	00:40:44	00:40:26	114	0.91	0.7
13C 1,2,3,4,6,7,8-HpCDD	436	438	1.05	1.08	Y	00:44:34	00:44:10	12982	0.56	63.0
1,2,3,4,6,7,8-HpCDD	424	426	1.05	1.03	Y	00:44:35	00:44:11	7007	0.93	57.8
13C OCDD	470	472	0.89	0.87	Y	00:49:16	00:48:50	6939	0.33	56.3
OCDD	458	460	0.89	0.91	Y	00:49:17	00:48:52	31458	1.03	439.5
Furans										
13C 1,2,3,4-TCDD	326	328	0.78	0.83	Y	00:30:06	00:29:37	111369	1.00	300.0
13C 2,3,7,8-TCDF	316	318	0.78	0.77	Y	00:29:56	00:29:26	35363	1.36	70.1
2,3,7,8-TCDF	304	306	0.78	0.75	Y	00:29:57	00:29:27	283	1.06	0.8
13C 1,2,3,7,8-PeCDF	352	354	1.55	1.52	Y	00:34:27	00:34:00	31982	1.19	72.7
1,2,3,7,8-PeCDF	340	342	1.55	1.53	Y	00:34:28	00:33:58	249	0.95	0.8
2,3,4,7,8-PeCDF	340	342	1.55	1.60	Y	00:35:34	00:35:08	188	0.92	0.6
13C 1,2,3,4,7,8-HxCDF	384	386	0.51	0.50	Y	00:39:12	00:38:48	24763	0.84	79.3
1,2,3,4,7,8-HxCDF	374	376	1.24	1.35	Y	00:39:12	00:38:48	283	1.07	1.1
1,2,3,6,7,8-HxCDF	374	376	1.24	1.26	Y	00:39:21	00:38:59	204	1.13	0.7
2,3,4,6,7,8-HxCDF	374	376	1.24	1.29	Y	00:40:04	00:39:44	170	0.91	0.8
13C 1,2,3,4,6,7,8-HpCDF	418	420	0.46	0.42	Y	00:43:06	00:42:45	10222	0.57	47.9
1,2,3,4,6,7,8-HpCDF	408	410	1.05	1.00	Y	00:43:07	00:42:46	2029	1.27	15.7
1,2,3,4,7,8,9-HpCDF	408	410	1.05	1.00	Y	00:45:28	00:45:02	70	0.73	0.9
13C OCDD	470	472	0.89	0.87	Y	00:49:16	00:48:50	6939	0.33	56.3
OCDF	442	444	0.89	0.90	Y	00:49:42	00:49:15	2926	0.93	45.4

RECOVERY REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310E001 Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.005\D0808.DAT
File Text : 03-B02557-50004-AD1 TP9 (0.7-0.9m)
Sample Employed : 10.0 g

Compound Name	Recovery %	Standard Addition / ng
Dioxins		
13C 1,2,3,4-TCDD		
13C 2,3,7,8-TCDD	69	1.00
13C 1,2,3,7,8-PeCDD	72	1.00
13C 1,2,3,6,7,8-HxCDD	74	1.00
13C 1,2,3,4,6,7,8-HpCDD	63	1.00
13C OCDD	56	1.00
Furans		
13C 1,2,3,4-TCDD		
13C 2,3,7,8-TCDF	70	1.00
13C 1,2,3,7,8-PeCDF	73	1.00
13C 1,2,3,4,7,8-HxCDF	79	1.00
13C 1,2,3,4,6,7,8-HpCDF	48	1.00
13C OCDD	56	1.00

SAL Sample Tracking Form : Issue 6

PLEASE INITIAL AND DATE ALL ENTRIES

Job Number 37310 **Sample Number** 001 **Analysis** PCDD/F

Sample Extraction

Weight/Volume Extracted 10.00g — 05.08.03 PSM

PCCD/F Internal Standard id/Lot #/Volume EDF957/32461-83/ 46 3µl — 05.08.03 PSM

PCB Internal Standard id/Lot #/Volume

Extraction Method/Solvent/Volume SOXHLET TOLUENE 300ml — 05.08.03 PSM

Extraction Start 16:00 05.08.03 PSM **End** 09:00 — 06.08.03 PSM

Additional Comments

Extract Clean-up

Clean-up 1 COMBINATION COLUMN — 06.08.03 PSM

Clean-up 2 FLORISIL COLUMN — 06.08.03 PSM

Clean-up 3

Additional Comments

GC/MS Analysis

Instrument ULTIMA **Analyte** PCDD/F **Injection** 47585 — 08/08/03 PSM

Instrument **Analyte** **Injection**

Instrument **Analyte** **Injection**

Quantitation

Method SALLY (DIOXIN) — 10/08/03 PSM

Additional Comments

6.13 Sample Narrative, Sample Number 37310E002

Extraction/ Clean up :- No Comments.

Data Acquisition :- No Comments.

Data Analysis :- All bar one of the toxic PCDD/Fs were detected in this sample together with some non-toxic ones.

The internal standard recoveries are acceptable.

RESULTS SUMMARY REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310E002 Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.006\D0808.DAT
File Text : 03-B02557-50005-AD1 TP2 (1.0-1.1m)
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	1.3	0.13	0.64	0.64
1,2,3,6,7,8-HxCDD	13	1.3	1.3	1.3
1,2,3,4,7,8-HxCDD	3.3	0.33	0.33	0.33
1,2,3,7,8,9-HxCDD	5.3	0.53	0.53	0.53
1,2,3,4,6,7,8-HpCDD	380	3.8	3.8	3.8
OCDD	3600	3.6	3.6	3.6
Total non-targeted isomers				
TCDD	23	0.23	0.0	0.0
PeCDD	28	0.28	0.0	0.0
HxCDD	190	1.9	0.0	0.0
HpCDD	450	0.45	0.0	0.0
Total Dioxins TEQ		13	10	10
Furans				
2,3,7,8-TCDF	5.9	0.59	0.59	0.59
1,2,3,7,8-PeCDF	17	1.7	0.86	0.86
2,3,4,7,8-PeCDF	6.9	0.69	3.5	3.5
1,2,3,4,7,8-HxCDF	13	1.3	1.3	1.3
1,2,3,6,7,8-HxCDF	6.6	0.66	0.66	0.66
2,3,4,6,7,8-HxCDF	7.6	0.76	0.76	0.76
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	89	0.89	0.89	0.89
1,2,3,4,7,8,9-HpCDF	16	0.16	0.16	0.16
OCDF	330	0.33	0.33	0.33
Total non-targeted isomers				
TCDF	58	0.58	0.0	0.0
PeCDF	53	0.53	0.0	0.0
HxCDF	110	1.1	0.0	0.0
HpCDF	13	0.013	0.0	0.0
Total Furans TEQ		9.2	9.0	9.0
Grand Total TEQ		22	19	19

TARGETING REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310E002 Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.006\D0808.DAT
File Text : 03-B02557-50005-AD1 TP2 (1.0-1.1m)
Sample Employed : 10.0 g

Compound Name	M1	M2	M1/M2 thry	M1/M2 actl	Ok	Retention Time theory	Retention Time found	Area	RRF	Amount
Dioxins										
13C 1,2,3,4-TCDD	326	328	0.78	0.86	Y	00:30:06	00:29:43	35168	1.00	300.0
13C 2,3,7,8-TCDD	332	334	0.78	0.83	Y	00:30:38	00:30:12	8670	1.00	74.3
13C 1,2,3,7,8-PeCDD	368	370	1.55	1.57	Y	00:35:52	00:35:30	8016	0.94	72.9
1,2,3,7,8-PeCDD	356	358	1.55	1.40	Y	00:35:53	00:35:31	90	0.88	1.3
13C 1,2,3,6,7,8-HxCDD	402	404	1.24	1.28	Y	00:40:20	00:40:04	4289	0.63	58.0
1,2,3,6,7,8-HxCDD	390	392	1.24	1.23	Y	00:40:21	00:40:05	586	1.03	13.2
1,2,3,4,7,8-HxCDD	390	392	1.24	1.39	Y	00:40:13	00:39:58	124	0.88	3.3
1,2,3,7,8,9-HxCDD	390	392	1.24	1.29	Y	00:40:44	00:40:30	206	0.91	5.3
13C 1,2,3,4,6,7,8-HpCDD	436	438	1.05	1.10	Y	00:44:34	00:44:14	2551	0.56	39.2
1,2,3,4,6,7,8-HpCDD	424	426	1.05	1.04	Y	00:44:35	00:44:15	8988	0.93	377.3
13C OCDD	470	472	0.89	0.85	Y	00:49:16	00:48:54	1092	0.33	28.1
OCDD	458	460	0.89	0.91	Y	00:49:17	00:48:55	40980	1.03	3636.6
Furans										
13C 1,2,3,4-TCDD	326	328	0.78	0.86	Y	00:30:06	00:29:43	35168	1.00	300.0
13C 2,3,7,8-TCDF	316	318	0.78	0.69	Y	00:29:56	00:29:32	12655	1.36	79.5
2,3,7,8-TCDF	304	306	0.78	0.67	Y	00:29:57	00:29:33	791	1.06	5.9
13C 1,2,3,7,8-PeCDF	352	354	1.55	1.44	Y	00:34:27	00:34:04	11402	1.19	82.1
1,2,3,7,8-PeCDF	340	342	1.55	1.51	Y	00:34:28	00:34:02	1851	0.95	17.2
2,3,4,7,8-PeCDF	340	342	1.55	1.58	Y	00:35:34	00:35:12	725	0.92	6.9
13C 1,2,3,4,7,8-HxCDF	384	386	0.51	0.55	Y	00:39:12	00:38:52	6859	0.84	69.6
1,2,3,4,7,8-HxCDF	374	376	1.24	1.28	Y	00:39:12	00:38:53	920	1.07	12.5
1,2,3,6,7,8-HxCDF	374	376	1.24	1.32	Y	00:39:21	00:39:03	509	1.13	6.6
2,3,4,6,7,8-HxCDF	374	376	1.24	1.22	Y	00:40:04	00:39:48	475	0.91	7.6
13C 1,2,3,4,6,7,8-HpCDF	418	420	0.46	0.45	Y	00:43:06	00:42:50	2328	0.57	34.5
1,2,3,4,6,7,8-HpCDF	408	410	1.05	1.03	Y	00:43:07	00:42:51	2636	1.27	89.4
1,2,3,4,7,8,9-HpCDF	408	410	1.05	1.08	Y	00:45:28	00:45:06	267	0.73	15.8
13C OCDD	470	472	0.89	0.85	Y	00:49:16	00:48:54	1092	0.33	28.1
OCDF	442	444	0.89	0.87	Y	00:49:42	00:49:20	3378	0.93	333.1

RECOVERY REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310E002 Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.006\D0808.DAT
File Text : 03-B02557-50005-AD1 TP2 (1.0-1.1m)
Sample Employed : 10.0 g

Compound Name	Recovery %	Standard Addition / ng
Dioxins		
13C 1,2,3,4-TCDD		
13C 2,3,7,8-TCDD	74	1.00
13C 1,2,3,7,8-PeCDD	73	1.00
13C 1,2,3,6,7,8-HxCDD	58	1.00
13C 1,2,3,4,6,7,8-HpCDD	39	1.00
13C OCDD	28	1.00
Furans		
13C 1,2,3,4-TCDD		
13C 2,3,7,8-TCDF	79	1.00
13C 1,2,3,7,8-PeCDF	82	1.00
13C 1,2,3,4,7,8-HxCDF	70	1.00
13C 1,2,3,4,6,7,8-HpCDF	35	1.00
13C OCDD	28	1.00

SAL Sample Tracking Form : Issue 6

PLEASE INITIAL AND DATE ALL ENTRIES

Job Number 37310 **Sample Number** 002 **Analysis** PCDDF

Sample Extraction

Weight/Volume Extracted 10.00g — 05.08.03 PSH

PCCD/F Internal Standard id/Lot #/Volume EDF957/32461-83/46 3mL — 05.08.03 PSH

PCB Internal Standard id/Lot #/Volume — 05.08.03 PSH

Extraction Method/Solvent/Volume SOXHLET TOLUENE 300mL — 05.08.03 PSH

Extraction Start 16:00 05.08.03 PSH **End** 09:00 — 06.08.03 PSH

Additional Comments

Extract Clean-up

Clean-up 1 COMBINATION COLUMN — 06.08.03 PSH

Clean-up 2 FLORISIL COLUMN — 06.08.03 PSH

Clean-up 3

Additional Comments

GC/MS Analysis

Instrument ULTIMA **Analyte** DIOXINS **Injection** 4758 — 08/08/0330

Instrument **Analyte** **Injection**

Instrument **Analyte** **Injection**

Quantitation

Method — 10/8/3 1005

Additional Comments

7.18 Reagent Blank Narrative

Extraction/ Clean up :- No Comments.

Data Acquisition :- No Comments.

Data Analysis :- This reagent blank contains a limited number of the target congeners. It is reported as <0.5 ng/kg I-TEQ in the data summary.

The internal standard recoveries are acceptable.

RESULTS SUMMARY REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310EBL Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.004\D0808.DAT
File Text : Method Blank
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	0.16	0.016	0.016	0.016
1,2,3,4,7,8-HxCDD	N.D.			
1,2,3,7,8,9-HxCDD	N.D.			
1,2,3,4,6,7,8-HpCDD	1.6	0.016	0.016	0.016
OCDD	4.2	0.0042	0.0042	0.0042
Total non-targeted isomers				
TCDD	N.D.			
PeCDD	1.2	0.012	0.0	0.0
HxCDD	0.56	0.0056	0.0	0.0
HpCDD	N.D.			
Total Dioxins TEQ		0.054	0.036	0.036
Furans				
2,3,7,8-TCDF	N.D.			
1,2,3,7,8-PeCDF	N.D.			
2,3,4,7,8-PeCDF	N.D.			
1,2,3,4,7,8-HxCDF	N.D.			
1,2,3,6,7,8-HxCDF	N.D.			
2,3,4,6,7,8-HxCDF	N.D.			
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	1.3	0.013	0.013	0.013
1,2,3,4,7,8,9-HpCDF	N.D.			
OCDF	1.9	0.0019	0.0019	0.0019
Total non-targeted isomers				
TCDF	1.6	0.016	0.0	0.0
PeCDF	0.62	0.0062	0.0	0.0
HxCDF	2.5	0.025	0.0	0.0
HpCDF	N.D.			
Total Furans TEQ		0.062	0.015	0.015
Grand Total TEQ		0.12	0.051	0.051

TARGETING REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310EBL Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.004\D0808.DAT
File Text : Method Blank
Sample Employed : 10.0 g

Compound Name	M1	M2	M1/M2 thry	M1/M2 actl	Ok	Retention Time theory	Retention Time found	Area	RRF	Amount
Dioxins										
13C 1,2,3,4-TCDD	326	328	0.78	0.85	Y	00:30:06	00:29:34	148320	1.00	300.0
13C 2,3,7,8-TCDD	332	334	0.78	0.84	Y	00:30:38	00:30:04	34908	1.00	70.9
13C 1,2,3,7,8-PeCDD	368	370	1.55	1.50	Y	00:35:52	00:35:23	34363	0.94	74.1
13C 1,2,3,6,7,8-HxCDD	402	404	1.24	1.21	Y	00:40:20	00:39:51	24700	0.63	79.2
1,2,3,6,7,8-HxCDD	390	392	1.24	1.07	Y	00:40:21	00:39:52	40	1.03	0.2
13C 1,2,3,4,6,7,8-HpCDD	436	438	1.05	1.11	Y	00:44:34	00:44:04	17824	0.56	65.0
1,2,3,4,6,7,8-HpCDD	424	426	1.05	1.11	Y	00:44:35	00:44:06	270	0.93	1.6
13C OCDD	470	472	0.89	0.88	Y	00:49:16	00:48:40	11071	0.33	67.4
OCDD	458	460	0.89	0.80	Y	00:49:17	00:48:43	479	1.03	4.2
Furans										
13C 1,2,3,4-TCDD	326	328	0.78	0.85	Y	00:30:06	00:29:34	148320	1.00	300.0
13C 2,3,7,8-TCDF	316	318	0.78	0.68	Y	00:29:56	00:29:23	49340	1.36	73.5
13C 1,2,3,7,8-PeCDF	352	354	1.55	1.54	Y	00:34:27	00:33:57	31591	1.19	53.9
13C 1,2,3,4,7,8-HxCDF	384	386	0.51	0.51	Y	00:39:12	00:38:42	34139	0.84	82.1
13C 1,2,3,4,6,7,8-HpCDF	418	420	0.46	0.45	Y	00:43:06	00:42:37	22390	0.57	78.8
1,2,3,4,6,7,8-HpCDF	408	410	1.05	0.90	Y	00:43:07	00:42:38	359	1.27	1.3
13C OCDD	470	472	0.89	0.88	Y	00:49:16	00:48:40	11071	0.33	67.4
OCDF	442	444	0.89	0.89	Y	00:49:42	00:49:05	199	0.93	1.9

RECOVERY REPORT (Sally Version 6.7)

Job Number : 37310E Sample Number : 37310EBL Client Id :-
Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.004\D0808.DAT
File Text : Method Blank
Sample Employed : 10.0 g

Compound Name	Recovery %	Standard Addition / ng
Dioxins		
13C 1,2,3,4-TCDD		
13C 2,3,7,8-TCDD	71	1.00
13C 1,2,3,7,8-PeCDD	74	1.00
13C 1,2,3,6,7,8-HxCDD	79	1.00
13C 1,2,3,4,6,7,8-HpCDD	65	1.00
13C OCDD	67	1.00
Furans		
13C 1,2,3,4-TCDD		
13C 2,3,7,8-TCDF	73	1.00
13C 1,2,3,7,8-PeCDF	54	1.00
13C 1,2,3,4,7,8-HxCDF	82	1.00
13C 1,2,3,4,6,7,8-HpCDF	79	1.00
13C OCDD	67	1.00

SAL Sample Tracking Form : Issue 6

PLEASE INITIAL AND DATE ALL ENTRIES

Job Number 37309/310/336/419 273 **Sample Number** BLK **Analysis** PCDD/F + PCB (WHO12)

Sample Extraction

Weight/Volume Extracted THIMBLE — 05-08-03 PSH

PCCD/F Internal Standard id/Lot #/Volume EDF957/32461-83/46 3µL — 05-08-03 PSH

PCB Internal Standard id/Lot #/Volume PCBWH012 070703/A 20µL — 05-08-03 PSH

Extraction Method/Solvent/Volume SOXHLET DCM : Hexane 800ml — 05-08-03 PSH

Extraction Start 16:00 05-08-03 PSH **End** 09:00 — 06-08-03 PSH

Additional Comments

Extract Clean-up

Clean-up 1 COMBINATION COLUMN — 06-08-03 PSH

Clean-up 2 FLORISIL COLUMN — 06-08-03 PSH

Clean-up 3

Additional Comments

GC/MS Analysis

Instrument ULTIMA **Analyte** PCDD/F **Injection** 174584 — 08/08/03

Instrument **Analyte** **Injection**

Instrument **Analyte** **Injection**

Quantitation

Method SALLY (DIOXIN) — 10/08/03

Additional Comments

8.23 Extraction and Clean Up Procedures

Each sample was processed in accordance with the procedures defined in SAL SOP #1. In summary an accurately weighed 10g aliquot of the 'dried and ground' soil sample was placed into a Soxhlet thimble that was then spiked with labelled internal standards. The samples were extracted with 300 mls of toluene for in excess of sixteen hours.

A method blank was prepared in the same way.

Following extraction, the toluene was reduced to incipient dryness *in vacuo*, prior to reconstitution in *ca* 5 ml hexane and purification by elution through a column combining sulphuric acid impregnated silica, potassium hydroxide impregnated silica and anhydrous sodium sulphate. The entire eluate from this column was further purified via activated Florisil column chromatography and then concentrated to near-dryness prior to GC/MS analysis.

Immediately prior to analysis by GC/MS nonane spiked with recovery standard $^{13}C_6$-1,2,3,4-TCDD and nonane were added to the samples and the blank (see the sample tracking form for the respective amounts). An aliquot of this solution was then injected onto the GC/MS system.

9.23 Analytical Procedures

The analytical methods may be summarised as follows,

Stable isotopically labelled internal standards are added at known concentration to the samples prior to extraction and clean up.

A standard solution containing the known first and last eluting isomers of the tetra, penta, hexa and hepta furans is injected onto the GC/MS system with ions monitored for all the homologues. This allows the setting up of appropriate acquisition windows for the more specific multi-group data acquisition for the sample analysis. The resulting elution windows are incorporated into the multi group acquisition tables.

Following this, another standard solution containing the 2378 TCDD native compound and the known close eluting isomers is injected. This permits the ability of the column to identify 2378-TCDD to be evaluated.

Two masses each are monitored for each native and isotopically labelled congener, this allows the isotope ratio to be checked with the theoretical value as additional confirmation of the compound's identity. Note that although the mass spectrometer is operated at 10,000 resolving power there are still other compounds which may survive the clean up and may be close enough in mass to yield a response in the dioxin or furan channels. To aid in identification of these interferences two other QA masses are monitored, firstly the molecular ion species for polychlorinated diphenyl ethers which yield fragments in their mass spectra of exactly the same mass as the furans, if a response is observed in this channel coincident with the furan masses then the peaks are discarded if appropriate. Secondly, as part of the system's performance checks, a "lock mass" from perfluorokerosene (present in the batch inlet throughout the entire GC run) is monitored and scanned to compensate for any mass drift during the run. Use is made of this feature to monitor the lock mass before it has been used to correct for drift. This trace would, if no large components were present, appear as a continuous line, however, if a large (many nanograms/micrograms) peak elutes from the GC column the ion source sensitivity is suppressed and a negative going "peak" will be seen. If such a peak coelutes with possible interferences they may also be discarded, (see each sample's narrative).

Standards of both the isotopically labelled and native 2378 containing congeners of interest are injected sequentially, starting with the least concentrated. The composition of these are given later. The resulting target results and relative response factors are given.

All 2378 containing native congeners are quantitated by isotope dilution methods relative to their carbon-13 labelled internal standards. For quantitation of the "totals" of all non-2378 containing congeners, the relative response factor is assumed to be the same as for the first eluting native 2378 congener of the same homologue group. For example, non-2,3,7,8-chlorinated PeCDFs are quantified using the RRF derived for 1,2,3,7,8-PeCDF.

As a check upon the efficiency of the extraction/clean up, $^{13}C_6$-1,2,3,4-TCDD was added to the samples immediately prior to injection onto the GC/MS system. This is also used to help evaluate the method detection limit in the case where no peak is detected for one of the targeted analytes. A recovery table is printed in each sample's report.

A nonane blank is injected prior to sample analysis. This blank must contain no target isomers above noise before the analysis of samples can continue.

The sample log sheet for the job is given at the end of the report.

10.24 (a) GC Conditions for the Analysis, Acquisition System Used for Window Standard.

Column 60m J&W DB5-ms, 0.25u film thickness, 0.25mm i.d., head pressure 30 p.s.i.

Program 140° C for 4 minutes, then 15 C°/min to 220 ° C, then 1.5 C°/min to 240 ° C, hold for 2 minutes, then 4 C°/min to 310 ° C, which is held for 10 minutes.

Injection Conditions Temperature 300 ° C, Splitless mode, valve time 2 minutes.

(b) GC/MS Acquisition System, Window Standard

Group Time, 0:01:0 to 0:50:0

Masses Monitored

Component	Mass	Sample Time(ms)	Delay Time(ms)
TCDF	305.8987	40	10
PeCDF	339.8597	40	10
HxCDF	373.8208	40	10
HpCDF	407.7818	40	10

This test is performed at 1000 resolving power (10% valley definition).

11.25 Mass Spectrometer Conditions and Instrumentation Used

The operating parameters for the mass spectrometer used during sample analysis are listed below.

Resolving Power	10,000 (10% valley definition).
Source Conditions	Electron Energy 30 eV. Trap Current 700 μA. Source Temperature 250 °C.
Interface Temperatures	280 °C.
Detector Conditions	Amplifier Range 10^{-6} Amps Full Scale. Amplifier Response Time 0.01 ms. Multiplier Voltage 320 volts.

GC/MS system VG Autospec Ultima Mass Spectrometer equipped with HP 5890A Gas Chromatograph. Data system is a VG OPUS. Samples were injected with an HP7673B autosampler.

12.25 Compounds Present in the Window Determination Standard.

	First eluting isomer	Last eluting isomer
Tetra Furan	1368	1289
Penta Furan	13468	12389
Hexa Furan	123468	123489
Hepta Furan	1234678	1234789

Only one isomer exists for the octachlorinated furan and so no standard is necessary to define the acquisition window.

Please note that 1,2,8,9-TCDF elutes after 1,3,4,6,8-PeCDF on the DB-5ms column. On the basis of operator experience, it has been decided that the acquisition windows be set to permit measurement of 1,3,4,6,8-PeCDF, which is far more prevalent in samples than 1,2,8,9-TCDF. The data reported here for "total non-targeted TCDFs" therefore, omits 1,2,8,9-TCDF.

Compounds in Column Performance Standard

The following TCDD isomers:

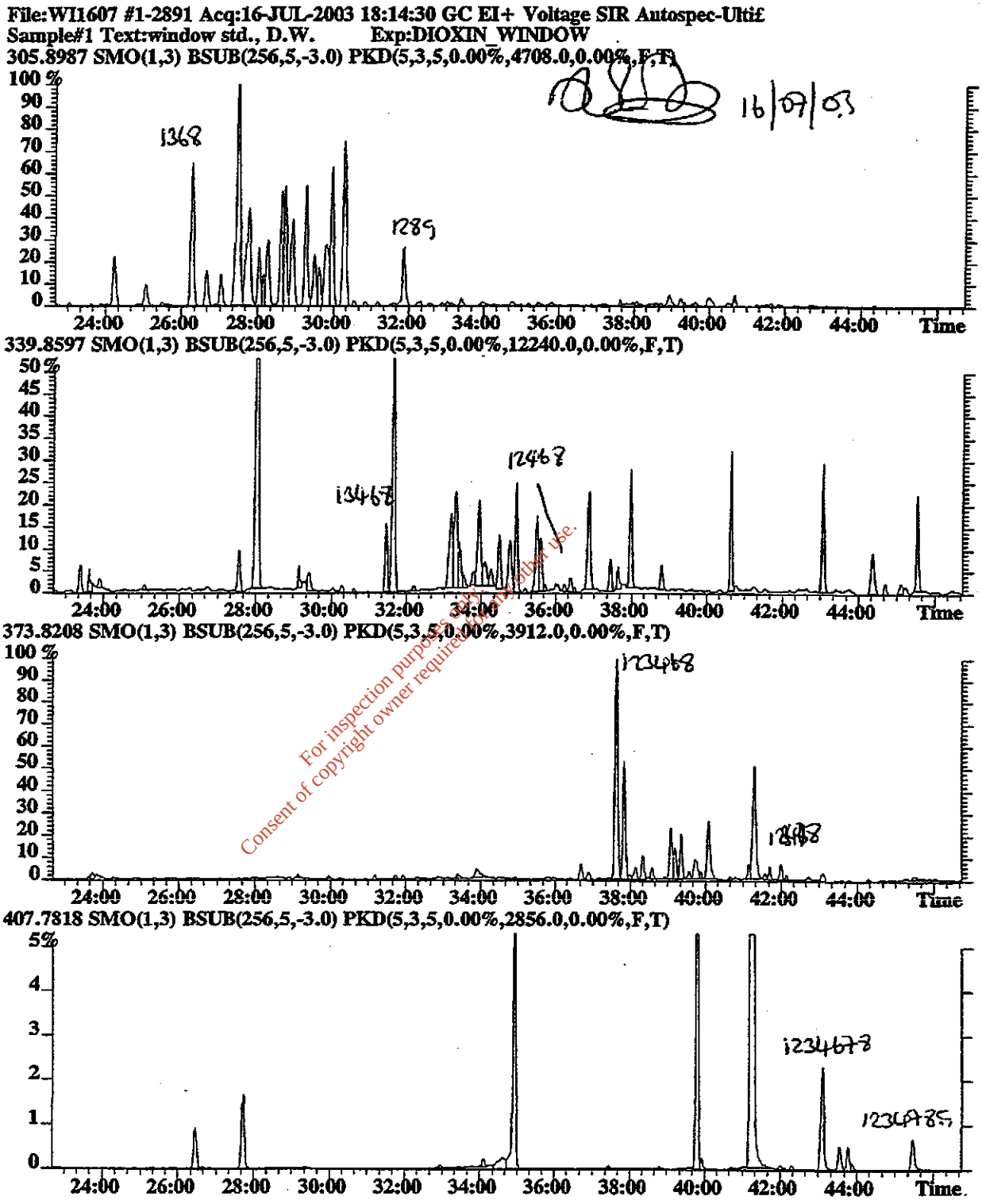
1478, 1234, 1237/1238, 2378, 1278, 1267

Note :- The DB5-ms column chosen achieves satisfactory resolution of 2378 TCDF from its close eluting isomers.

EPA protocols require that the separation between 1237/1238 and 2378 TCDD be better than 25% valley, clearly easily achieved on the DB5-ms column used.

Please note that the DB5-ms column employed does not effect satisfactory resolution of 2,3,4,7,8-PeCDF and 1,2,3,7,8,9-HxCDF from their close-eluting isomers. The amount reported for these isomers are therefore the *maximum possible*. The amount of the 2,3,4,7,8-PeCDF may be over reported by as much as 25%, based upon the analysis of five extracts chosen at random that were then confirmed on a polar column.

13.26 Raw Data from the Window Determination Standard, Including Peak Identifications.



14.27 Acquisition Systems Used for Sample Analysis.

Group 1

Component	Mass	Sample Time(ms)	Delay Time(ms)	
PFK	292.9825	10	5	Lock Mass Check
PFK	292.9825	50	10	Lock Mass
TCDF	303.9015	100	10	
TCDF	305.8987	100	10	
^{13}C TCDF	315.9419	30	10	
^{13}C TCDF	317.9389	30	10	
TCDD	319.8965	100	10	
TCDD	321.8936	100	10	
^{13}C6 1234 TCDD	325.9166	30	10	Recovery Std.
^{13}C6 1234 TCDD	327.9137	30	10	Recovery Std.
^{13}C 2378 TCDD	331.9368	30	10	
^{13}C 2378 TCDD	333.9339	30	10	
CDPE	375.8364	30	50	Furan Interference

Group 2

Component	Mass	Sample Time(ms)	Delay Time(ms)	
PeCDF	339.8597	100	10	
PeCDF	341.8567	100	10	
^{13}C PeCDF	351.9000	30	10	
^{13}C PeCDF	353.8970	30	10	
PeCDD	355.8546	100	10	
PeCDD	357.8516	100	10	
PFK	366.9792	10	5	Lock Mass Check
PFK	366.9792	50	10	Lock Mass
^{13}C PeCDD	367.8949	30	10	
^{13}C PeCDD	369.8919	30	10	
CDPE	409.7974	30	50	Furan Interference

Group 3

Component	Mass	Sample Time(ms)	Delay Time(ms)	
HxCDF	373.8208	100	10	
HxCDF	375.8358	100	10	
^{13}C HxCDF	383.8639	30	10	
^{13}C HxCDF	385.8610	30	10	
HxCDD	389.8157	100	10	
HxCDD	391.8127	100	10	
PFK	392.9760	10	5	Lock Mass Check
PFK	392.9760	50	10	Lock Mass
^{13}C HxCDD	401.8559	30	10	
^{13}C HxCDD	403.8529	30	10	
CDPE	445.7555	30	50	Furan Interference

Group 4

Component	Mass	Sample Time(ms)	Delay Time(ms)	
HpCDF	407.7818	100	10	
HpCDF	409.7789	100	10	
^{13}C HpCDF	417.8253	30	10	
^{13}C HpCDF	419.8220	30	10	
HpCDD	423.7766	100	10	
HpCDD	425.7737	100	10	
PFK	430.9729	10	5	Lock Mass Check
PFK	430.9729	50	10	Lock Mass
^{13}C HpCDD	435.8169	30	10	
^{13}C HpCDD	437.8140	30	10	
CDPE	479.7165	30	50	Furan Interference

Group 5

Component	Mass	Sample Time(ms)	Delay Time(ms)	
OCDF	441.7428	100	10	
PFK	442.9728	10	5	Lock Mass Check
PFK	442.9728	50	10	Lock Mass
OCDF	443.7399	100	10	
^{13}C OCDF	453.7830	30	10	
^{13}C OCDF	455.7800	30	10	
OCDD	457.7377	100	10	
OCDD	459.7348	100	10	
^{13}C OCDD	469.7835	30	10	
^{13}C OCDD	471.7750	30	10	
CDPE	513.6775	30	50	Furan Interference

15.29 Dioxin and Furan Calibration Standards Preparation Certificate.

Dioxin/Furan Calibration Standards Preparation Certificate

This certifies that a set of five dioxin/furan calibration standards were prepared in accordance with SAL SOP 2, issue 3.

The batch numbers of the stock dioxin and furan reference standards used in the preparation of the calibrations standards were:

$^{13}C_6$-1,2,3,4-TCDD (080299)

Mixed labelled/native standards CS1-CS5 (EDF-4947), batch numbers 34752-77A, 33384-42B, 35005-04, 3384-42D and 34752-77E respectively.

All the above standards are traceable to certified reference standards purchased from Cambridge Isotope Laboratories.

	Signature	Name	Position
Standards prepared by	[signature]	**P.Harrington**	**Dioxin Analyst**

Date of Preparation :- CS2: 26/11/01, CS3: 28/06/02, CS1,4,5: 14/08/02 .

Standard Codes :- CS1/140802, CS2/261101, CS3/280602, CS4/140802, CS5/140802

Please note that these standards contain $^{13}C_{12}$-OCDF and are suitable for use in method EN1948 analysis (SAL SOP1c).

The continuing calibration solution, CS3, is in constant use and is exhausted regularly. This standard is prepared on an as needed basis, the current standard being CS3/~~280602.~~

~~[illegible]~~ P

~~[illegible]~~ P

170503 PSL

16.30 Initial Calibration Results Table (IC1707)

CALIBRATION RESULTS (Sally Version 6.7)

File Number	Date (d:m:year)	File Name
1	17-Jul-03	R:\DIOXINV\IC1707\SAMPLE.001\IC1707.DAT
2	17-Jul-03	R:\DIOXINV\IC1707\SAMPLE.003\IC1707.DAT
3	17-Jul-03	R:\DIOXINV\IC1707\SAMPLE.002\IC1707.DAT
4	17-Jul-03	R:\DIOXINV\IC1707\SAMPLE.004\IC1707.DAT
5	17-Jul-03	R:\DIOXINV\IC1707\SAMPLE.005\IC1707.DAT

File	1	2	3	4	5	Average	%s.d.
13C 1,2,3,4-TCDD-R						Retention Time Standard	
13C 1,2,3,4-TCDD							
Recovery Standard							
Amount	91.0	91.0	91.0	91.0	91.0		
RF	1.00	1.00	1.00	1.00	1.00	1.00	
RRF	1.00	1.00	1.00	1.00	1.00	1.00	0
13C 2,3,7,8-TCDD							
Internal Standard							
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.847	0.718	0.784	0.848	0.920	0.00	
RRF	0.847	0.718	0.784	0.848	0.920	0.949	0.00
2,3,7,8-TCDD							
Analyte							
Amount	0.5	9.1	1.8	36.0	182.0		
RF	0.005	0.103	0.023	0.472	2.16	0.553	
RRF	1.04	1.03	1.14	1.19	1.08	1.10	6
13C 1,2,3,7,8-PeCDD							
Internal Standard							
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.649	0.574	0.653	0.712	0.800	0.00	
RRF	0.649	0.574	0.653	0.712	0.800	0.690	0.00
1,2,3,7,8-PeCDD							
Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.020	0.435	0.090	1.84	8.84	2.25	
RRF	0.808	0.872	0.903	0.922	0.884	0.878	5
13C 1,2,3,4,7,8-HxCDF-T						Retention Time Standard	
13C 1,2,3,6,7,8-HxCDD							
Internal Standard							
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.458	0.412	0.456	0.501	0.582	0.00	
RRF	0.458	0.412	0.456	0.501	0.582	0.505	0.00

1,2,3,6,7,8-HxCDD

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.024	0.541	0.099	2.08	10.8	2.70	
RRF	0.971	1.08	0.987	1.04	1.08	1.03	5

1,2,3,4,7,8-HxCDD

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.021	0.411	0.099	1.82	8.50	2.17	
RRF	0.845	0.824	0.986	0.911	0.850	0.883	7

1,2,3,7,8,9-HxCDD

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.021	0.455	0.093	1.91	9.10	2.32	
RRF	0.849	0.913	0.929	0.955	0.910	0.911	4

13C 1,2,3,4,6,7,8-HpCDD-R Retention Time Standard

13C 1,2,3,4,6,7,8-HpCDD

Internal	Standard						
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.323	0.272	0.307	0.336	0.401	0.00	
RRF	0.323	0.272	0.307	0.336	0.401	0.394	0.00

1,2,3,4,6,7,8-HpCDD

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.022	0.465	0.093	1.96	9.32	2.37	
RRF	0.899	0.932	0.927	0.978	0.932	0.934	3

13C OCDD

Internal	Standard						
Amount	182.0	182.0	182.0	182.0	182.0		
RF	0.394	0.349	0.375	0.403	0.504	0.00	
RRF	0.197	0.175	0.187	0.201	0.252	0.234	0.00

OCDD

Analyte							
Amount	4.5	91.0	18.0	360.0	1820.0		
RF	0.024	0.499	0.103	2.12	10.6	2.68	
RRF	0.980	0.999	1.04	1.07	1.06	1.03	4

13C 1,2,3,4-TCDD-R Retention Time Standard

13C 1,2,3,4-TCDD

Recovery	Standard						
Amount	91.0	91.0	91.0	91.0	91.0		
RF	1.00	1.00	1.00	1.00	1.00	1.00	
RRF	1.00	1.00	1.00	1.00	1.00	1.00	0

13C 2,3,7,8-TCDF

Internal	Standard						
Amount	91.0	91.0	91.0	91.0	91.0		
RF	1.07	0.904	1.03	1.07	1.15	0.00	
RRF	1.07	0.904	1.03	1.07	1.15	1.05	0.00

2,3,7,8-TCDF

Analyte							
Amount	0.5	9.1	1.8	36.0	182.0		
RF	0.005	0.102	0.022	0.448	2.09	0.534	
RRF	1.00	1.02	1.09	1.13	1.05	1.06	5

13C 1,2,3,7,8-PeCDF

Internal Standard							
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.750	0.673	0.849	0.890	0.934	0.00	
RRF	0.750	0.673	0.849	0.890	0.934	0.941	0.00

1,2,3,7,8-PeCDF

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.024	0.480	0.094	1.83	9.38	2.36	
RRF	0.973	0.962	0.938	0.914	0.938	0.945	2

2,3,4,7,8-PeCDF

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.023	0.467	0.090	1.80	9.12	2.30	
RRF	0.930	0.936	0.897	0.900	0.912	0.915	2

13C 1,2,3,4,7,8-HxCDF-T Retention Time Standard

13C 1,2,3,4,7,8-HxCDF

Internal Standard							
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.539	0.468	0.557	0.580	0.668	0.00	
RRF	0.539	0.468	0.557	0.580	0.668	0.619	0.00

1,2,3,4,7,8-HxCDF

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.027	0.520	0.112	2.19	10.4	2.64	
RRF	1.07	1.04	1.12	1.09	1.04	1.07	3

1,2,3,6,7,8-HxCDF

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.026	0.566	0.118	2.31	11.1	2.81	
RRF	1.05	1.13	1.18	1.15	1.11	1.13	4

2,3,4,6,7,8-HxCDF

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.021	0.474	0.092	1.90	8.87	2.27	
RRF	0.858	0.950	0.923	0.950	0.887	0.914	4

1,2,3,7,8,9-HxCDF

Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.015	0.336	0.066	1.31	6.59	1.66	
RRF	0.603	0.673	0.660	0.654	0.659	0.650	4

13C 1,2,3,4,6,7,8-HpCDD-R					Retention Time Standard		
13C 1,2,3,4,6,7,8-HpCDF							
Internal	Standard						
Amount	91.0	91.0	91.0	91.0	91.0		
RF	0.322	0.300	0.343	0.345	0.411	0.00	
RRF	0.322	0.300	0.343	0.345	0.411	0.405	0.00

1,2,3,4,6,7,8-HpCDF							
Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.032	0.615	0.128	2.62	12.4	3.16	
RRF	1.27	1.23	1.28	1.31	1.24	1.27	2

1,2,3,4,7,8,9-HpCDF							
Analyte							
Amount	2.3	45.4	9.1	182.0	910.0		
RF	0.018	0.368	0.070	1.46	7.46	1.87	
RRF	0.723	0.737	0.704	0.728	0.746	0.728	2

13C OCDD							
Internal	Standard						
Amount	182.0	182.0	182.0	182.0	182.0		
RF	0.394	0.349	0.375	0.403	0.504	0.00	
RRF	0.197	0.175	0.187	0.201	0.252	0.234	0.00

OCDF							
Analyte							
Amount	4.5	91.0	18.0	360.0	1820.0		
RF	0.021	0.462	0.098	1.83	9.49	2.38	
RRF	0.856	0.925	0.988	0.924	0.949	0.928	5

17.34 Continuing Calibration Check, 8th August 2003

Standard 'CS3/170503' is injected onto the 60m DB5-ms column prior to sample analysis. The relative response factors are determined for all analytes and must not have changed by more than 25% from the initial values for analysis to proceed.

The differences are reported in the table below and are acceptable.

Compound Name	Mean RRF	%SD	RRFcc	%Delta
2,3,7,8-TCDD	1.10	6	1.13	-3
1,2,3,7,8-PeCDD	0.878	5	0.870	1
1,2,3,6,7,8-HxCDD	1.03	5	1.10	-6
1,2,3,4,7,8-HxCDD	0.883	7	0.847	4
1,2,3,7,8,9-HxCDD	0.911	4	1.06	-16
1,2,3,4,6,7,8-HpCDD	0.934	3	0.974	-4
OCDD	1.03	4	1.03	0
2,3,7,8-TCDF	1.06	5	1.06	0
1,2,3,7,8-PeCDF	0.945	2	1.03	-9
2,3,4,7,8-PeCDF	0.915	2	1.07	-17
1,2,3,4,7,8-HxCDF	1.07	3	1.04	3
1,2,3,6,7,8-HxCDF	1.13	4	1.24	-10
2,3,4,6,7,8-HxCDF	0.914	4	1.00	-10
1,2,3,7,8,9-HxCDF	0.650	4	0.744	-14
1,2,3,4,6,7,8-HpCDF	1.27	2	1.31	-3
1,2,3,4,7,8,9-HpCDF	0.728	2	0.800	-10
OCDF	0.928	5	1.06	-14

TARGETING REPORT (Sally Version 6.7)

Date Acquired : 08-Aug-03 Acquired File : A:D0808
Operator : D. Wood Instrument : Ultima Column :DB5-ms
PC File : R:\DIOXINV\D0808\sample.001\D0808.DAT

Compound Name	M1	M2	M1/M2 thry	M1/M2 actl	Ok	Retention Time theory	Retention Time found	Area
Dioxins								
13C 1,2,3,4-TCDD	326	328	0.78	0.84	Y	00:30:06	00:29:30	227274
13C 2,3,7,8-TCDD	332	334	0.78	0.83	Y	00:30:38	00:30:01	165886
2,3,7,8-TCDD	320	322	0.78	0.77	Y	00:30:39	00:30:03	18743
13C 1,2,3,7,8-PeCDD	368	370	1.55	1.58	Y	00:35:52	00:35:19	162041
1,2,3,7,8-PeCDD	356	358	1.55	1.56	Y	00:35:53	00:35:21	70308
13C 1,2,3,6,7,8-HxCDD	402	404	1.24	1.21	Y	00:40:20	00:39:49	119228
1,2,3,6,7,8-HxCDD	390	392	1.24	1.28	Y	00:40:21	00:39:50	65284
1,2,3,4,7,8-HxCDD	390	392	1.24	1.27	Y	00:40:13	00:39:42	50393
1,2,3,7,8,9-HxCDD	390	392	1.24	1.27	Y	00:40:44	00:40:12	62893
13C 1,2,3,4,6,7,8-HpCDD	436	438	1.05	1.05	Y	00:44:34	00:44:02	87537
1,2,3,4,6,7,8-HpCDD	424	426	1.05	1.02	Y	00:44:35	00:44:03	42555
13C OCDD	470	472	0.89	0.86	Y	00:49:16	00:48:38	115785
OCDD	458	460	0.89	0.84	Y	00:49:17	00:48:39	59486
Furans								
13C 1,2,3,4-TCDD	326	328	0.78	0.84	Y	00:30:06	00:29:30	227274
13C 2,3,7,8-TCDF	316	318	0.78	0.68	Y	00:29:56	00:29:19	226840
2,3,7,8-TCDF	304	306	0.78	0.74	Y	00:29:57	00:29:20	23969
13C 1,2,3,7,8-PeCDF	352	354	1.55	1.46	Y	00:34:27	00:33:53	182700
1,2,3,7,8-PeCDF	340	342	1.55	1.54	Y	00:34:28	00:33:55	94232
2,3,4,7,8-PeCDF	340	342	1.55	1.59	Y	00:35:34	00:35:01	97661
13C 1,2,3,4,7,8-HxCDF	384	386	0.51	0.53	Y	00:39:12	00:38:39	146104
1,2,3,4,7,8-HxCDF	374	376	1.24	1.22	Y	00:39:12	00:38:40	75858
1,2,3,6,7,8-HxCDF	374	376	1.24	1.23	Y	00:39:21	00:38:50	90434
2,3,4,6,7,8-HxCDF	374	376	1.24	1.19	Y	00:40:04	00:39:33	73153
1,2,3,7,8,9-HxCDF	374	376	1.24	1.21	Y	00:41:15	00:40:44	54197
13C 1,2,3,4,6,7,8-HpCDF	418	420	0.46	0.44	Y	00:43:06	00:42:35	99240
1,2,3,4,6,7,8-HpCDF	408	410	1.05	1.01	Y	00:43:07	00:42:36	64700
1,2,3,4,7,8,9-HpCDF	408	410	1.05	1.00	Y	00:45:28	00:44:53	39628
13C OCDD	470	472	0.89	0.86	Y	00:49:16	00:48:38	115785
OCDF	442	444	0.89	0.90	Y	00:49:42	00:49:03	61476

18.36 Estimation of Method Detection Limits

The 'CS3' continuing calibration standard responses for the day when this sample was run (using standard CS3/170503) were used to estimate the method detection limits for the targeted analytes. The criteria is a minimum S/N of 2.5:1 for both isotope peaks.

Analyte	Std Amount(pg)	S/N	Detection Limit(pg)
Dioxins			
2,3,7,8-TCDD	10	500:1	0.05
1,2,3,7,8-PeCDD	50	2000:1	0.05
1,2,3,4,7,8-HxCDD	50	2000:1	0.05
1,2,3,6,7,8-HxCDD	50	2000:1	0.05
1,2,3,7,8,9-HxCDD	50	2000:1	0.05
1,2,3,4,6,7,8-HpCDD	50	1500:1	0.08
OCDD	100	2000:1	0.1
Furans			
2,3,7,8-TCDF	10	500:1	0.05
1,2,3,7,8-PeCDF	50	2000:1	0.05
2,3,4,7,8-PeCDF	50	2000:1	0.05
1,2,3,4,7,8-HxCDF	50	2000:1	0.05
1,2,3,6,7,8-HxCDF	50	2000:1	0.05
2,3,4,6,7,8-HxCDF	50	2000:1	0.05
1,2,3,7,8,9-HxCDF	50	1000:1	0.1
1,2,3,4,6,7,8-HpCDF	50	2000:1	0.05
1,2,3,4,7,8,9-HpCDF	50	1000:1	0.1
OCDF	100	2000:1	0.1

Note that these detection limits are given in **pg injected** , so the sample detection limits are obtained by using the following equation. The proportion of the sample injected may be determined from the sample tracking form included with each sample report.

$$\text{Analyte detection limit} = \frac{\text{Injection detection limit (above)}}{\text{(portion of sample injected) x (amount sample)}}$$

In the case of poor recoveries of the internal standards this amount should be further increased by multiplying by 100/(recovery %).

The detection limits for these samples, where *ca* 1/30th was injected and recoveries were *ca* 70% were between 0.2 and 0.4 ng/kg per congener in the soil samples, depending upon the specific sample.

19.37 GC Performance Check

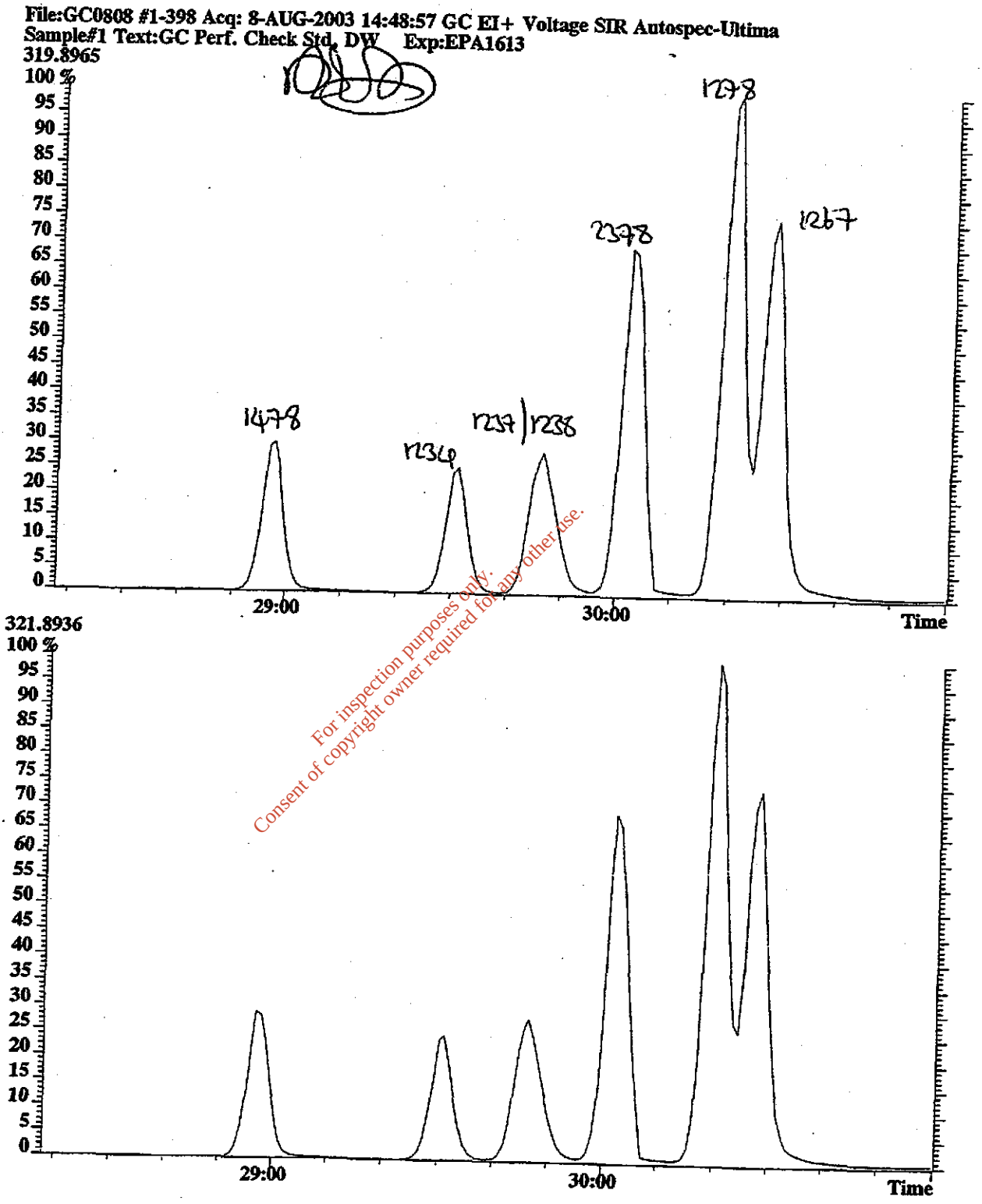
The ability of the GC column used to resolve the known close eluting isomers of the Tetra Dioxins was tested prior to analysis. A performance check standard containing the following isomers is injected. The TCDD traces are given on the following pages.

TCDD isomers contained in the GC Performance Check Standard in elution order.

1,4,7,8
1,2,3,4
1,2,3,7/1,2,3,8
2,3,7,8
1,2,7,8
1,2,6,7

The criterion for acceptance of this test is that the 2,3,7,8 TCDD must be separated by a valley of at least 25% from its nearest neighbours.

20.38 GC Performance Check Data, DB5-ms Column, 8th August 2003



21.39 Sample Log Sheet

Job 37310-1

ALCONTROL B02557 ...

for Quotation Ref Q10093-1

Customer Mr Paul Barton at Alcontrol Laboratories Ltd, Brunel Science Park, Kingston Lane, Uxbridge, Middlesex UB8 3PQ

Tel 01895 271271 Fax 01895 271272

Logged in: 31 July 2003 Report due: 11 August 2003

Date	SAL Contact	Contact	Subject	Action
01-AUG-03	MILESW		TURNAROUND INVOICING	WILL NEED SURCHARGE ADDED FOR 7 DAY TURNAROUND
01-AUG-03	MILESW		PURCHASE ORDER & SAMPLE REFERENCES	PO NUMBER IS 08737. PLEASE PUT FULL ALCONTROL REFERENCE IN THANKS (03-BO2557-S0004-A01 AND 03-BO2557-S0005-A01)

Sample Information

Soil

SAL	Customer Reference	Condition	Logged In By	Location
001	03-B02557-S0004-A01 TP9(0.7-0.9)	Ok	LTAYLOR	Box
002	03-B02557-S00005-A01 TP2(1.0-1.1)	Ok	LTAYLOR	Box

Tests	Technique	Accreditation
Dioxins and Furans (Based on US EPA 1613)	GCMS (HR)	UKAS

Audit Trail

State	Set By	When	Why
Unfinished	LTAYLOR	31-Jul-2003 11:36:04	
Analyst Review Required	LTAYLOR	31-Jul-2003 11:37:59	
Analyst Review Underway	VHIGHAM	01-Aug-2003 10:27:40	
Sales Review Required	VHIGHAM	01-Aug-2003 10:29:12	
Sales Review Underway	MILESW	01-Aug-2003 12:12:08	
Failed Sales Review	MILESW	01-Aug-2003 13:42:52	
Analyst Review Required	LTAYLOR	01-Aug-2003 13:48:22	
Analyst Review Underway	VHIGHAM	01-Aug-2003 14:58:43	
Sales Review Required	VHIGHAM	01-Aug-2003 14:58:51	
Sales Review Underway	NSUMMERS	01-Aug-2003 18:16:55	
Analysis Underway	NSUMMERS	01-Aug-2003 18:17:48	

22.40 SAL Authorised Signatories Register

SAL AUTHORISED SIGNATORIES SPECIMEN SIGNATURES
CURRENT AS OF 14-APR-2003. ISSUE: 32
MASTER COPY

Name	Signature	Initials
Sarah Bannister		
Saber Chaudhry		
Bill Cohen		
Lindsay Collins		
Steve Coulam		
Will Crossley		
Sebastian Dahl		
Chris Field		
Jane Fletcher		
Jane Fox		
Subhash Gadher		
Phillip George		
Paul Harrington		
Iain Haslock		
Ian Hayes		
Vanessa Higham		
Eifion Hollywell		
Pam Knott		

Name	Signature	Initials
Himanshu Lad		
Helen Mason		
Mike Maxwell		
Vic Parr		
Thi Pham		
Jane Pilot		
Mercy Prak		
Lee Quibell		
Suzanne Quick		
Gary Quirk		
Clifford Rodger		
Charlotte Riley		
Graham Small		
Robert Smith		
Nicola Summers		
Keith Thompson		
Leanne Taylor		
Peter Verrechia		
David Wood		