6.0 LAND, SOILS, GEOLOGY & HYDROGEOLOGY

6.1 INTRODUCTION

This chapter assesses and evaluates the potential impacts of the proposed development described in Chapter 2 (Description of the Proposed Development) on the land, soils and geological and hydrogeological environment. The impact on hydrology is addressed in Chapter 5.

6.2 METHODOLOGY

6.2.1 Guidelines

The Assessment has been carried out generally in accordance with the following guidelines:

- Environmental Protection Agency (EPA) Draft *'Guidelines on the Information to be contained in Environmental Impact Assessment Reports'* (2017);
- Institute of Geologists of Ireland (IGI) '*Guidelines for the preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements*' (2013); and
- National Roads Authority (NRA) '*Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* (2009).

The principal attributes (and impacts) to be assessed include the following:

- Geological heritage sites in the vicinity of the perimeter of the subject site;
- Landfills, industrial sites in the vicinity of the site and the potential risk of encountering contaminated ground;
- The quality, drainage characteristics and range of agricultural uses of soil around the site;
- Quarries or mines in the vicinity, the potential implications (if any) for existing activities and extractable reserves;
- The extent of topsoil and subsoil cover and the potential use of this material on site as well or requirement to remove it off-site as waste for recovery or disposal;
- High-yielding water supply springs/wells in the vicinity of the site to within a 2km radius and the potential for increased risk presented by the proposed development;
- Classification (regionally important, locally important etc.) and extent of aquifers underlying the site perimeter area and increased risks presented to them by the proposed development associated with aspects such as, for example, removal of subsoil cover, removal of aquifer (in whole or part), drawdown in water levels, alteration in established flow regimes, change in groundwater quality;
- Natural hydrogeological/ karst features in the area and potential for increased risk presented by the activities at the site;
- Groundwater-fed ecosystems and the increased risk presented by operations both spatially and temporally; and
- Vulnerability of the proposed development to major disasters from a geological and hydrogeological standpoint such as landslides & seismic activity.

6.2.2 Sources of Information

Desk-based geological and hydrogeological information on the substrata underlying the extent of the site and surrounding areas was obtained through accessing databases and other archives where available. Data was sourced from the following:

- Geological Survey of Ireland (GSI) - online mapping, Geo-hazard Database, Geological Heritage Sites & Sites of Special Scientific Interest, Bedrock Memoirs and 1:100,000 mapping;
- Teagasc soil and subsoil database;
- Ordnance Survey Ireland - aerial photographs and historical mapping;
- Environmental Protection Agency (EPA) – website mapping and database information;
- National Parks and Wildlife Services (NPWS) – Protected Site Register; and
- Dublin City Council - illegal landfill information.

Site specific data was derived from the following sources:

- Environmental Impact Statement for 'Proposed Environmental Remediation Scheme for a 22 years old unauthorised waste landfill' on lands at Clonshaugh, Belcamp, Dublin 15. O'Laoire Russell Associates Environmental Consulting, January 2006;
- Environmental Remediation: Environmental Impact Assessment (EIS), AECOM, 2008. This report is based on a historic unauthorised illegal landfill in close proximity of the R139;
- Diamond Innovations Ireland Operations (DIIO), Independent Closure Audit, AWN 2014 and licence information on EPA licence file;
- AWN (April 2016) Due Diligence report for the site entitled 'Environmental due diligence, Dublin 17".' Prepared for Clifton Scannell Emerson Associates (CSEA);
- Site investigation data included in previous IGSL Investigation Report No. 18342, May 2015; (see Appendix 6.1);
- Site investigation reports relevant to the proposed development site include report numbers 78, 230, 2499, 4326, 5174, 5675, 6502 and 6432 all available from the GSI geotechnical web viewer.
- Environmental Impact Statement for 'Proposed Data Centre – DUB64' on lands at Clonshaugh Business & Technology Park, Belcamp, Dublin 15. Prepared for Clifton Scannell Emerson Associates, January 2017;
- Environmental Impact Assessment Report for 'Proposed Data Centres – DUB74 & DUB84' on lands at Clonshaugh Business & Technology Park, Belcamp, Dublin 15. Prepared for Clifton Scannell Emerson Associates (CSEA), May 2018;
- Various design site plans and drawings; and
- Consultation with design engineers, CSEA.

6.3 RECEIVING ENVIRONMENT

The receiving environment is discussed in terms of; land use, geomorphology; superficial and solid geology and site history including potential for contamination.

The proposed development comprises the provision of an underground double circuit 110kV underground transmission cable installation between the existing Belcamp 220kV Substation, to the permitted Darndale 110kV Substation located at the former Diamond Innovations Site. The two substations are located c. 2.1 kilometres apart, and are separated by industrial buildings, greenfield lands, parklands and roadways.

6.3.1 Topography & Setting

The site is relatively flat in terms of topography with an elevation to ordnance datum (AOD Malin) ranging between 52.7m AOD – 39.3m AOD west to east.

The proposed route is bound by greenfield/scrubland, the M50 and M1, and enters the Belcamp Substation located north along the R139. The surrounding area is predominantly commercial/industrial with some undeveloped land. There are no areas of environmental or geological sensitivity within 1km of the site. There is no potential loss of currently utilised agricultural land within the proposed route corridor.

The Mayne River flows mostly in a culvert under the M50-M1 interchange and part of the adjacent hotel, filling station site and roundabout to the north of R139 until it emerges in the Belcamp land . The proposed transmission cable installation crosses this river southwest of the Belcamp substation. This is discussed further in Chapter 5 – Hydrology.

6.3.2 Areas of Geological Interest & Historic Land-Use

The GSI online data base confirmed that no geological heritage site has been identified in the vicinity of the proposed development site. The closest County Geological Site is Feltrim Quarry which is located some 4km to the northeast of the site.

Details of the site history and previous land use are included in Chapter 11 Archaeology, Architectural and Cultural Heritage.

Fingal Co Co confirmed that there is an illegal landfill located adjacent to the R139 near Belcamp. This is further discussed below. Fingal Co Co have no record of any further illegal landfills in the vicinity of the development.

6.3.3 Regional Soils

The general lithological/geological sequence of the overburden within the Dublin area comprises the following units:

Superficial Deposits
Made Ground
Estuarine/alluvial clays and silts
Estuarine/alluvial gravels and sands
Glaciomarine clays, silts and sands
Glacial Till (drift)
Glacial gravels and sands

Table 6.1 Superficial Deposits in Dublin Region

The proposed route is predominantly underlain by made ground along the R139 and natural clays in the undeveloped land to the north of the permitted Darndale substation.

The subsoil has been classified as limestone till (Carboniferous). This is the dominant subsoil type in the region and is a glacial deposit which is known as Dublin Boulder Clay. The subsoils map for the proposed transmission cable installation route is illustrated in Figure 6.1. This till resulted from glaciations which covered the region during the Pleistocene and Quaternary periods. It is known that the ice thickness in Dublin was c.1km. The grinding action of this ice sheet as it eroded the underlying limestone and shale, together with the loading effect resulted in the

formation of a very dense/hard low-permeability deposit with pockets or lenses of coarse gravel. The lenses are generally less than 2m wide and less than 0.5m thick. They are generally self-draining within 24hrs and have poor interconnectivity.

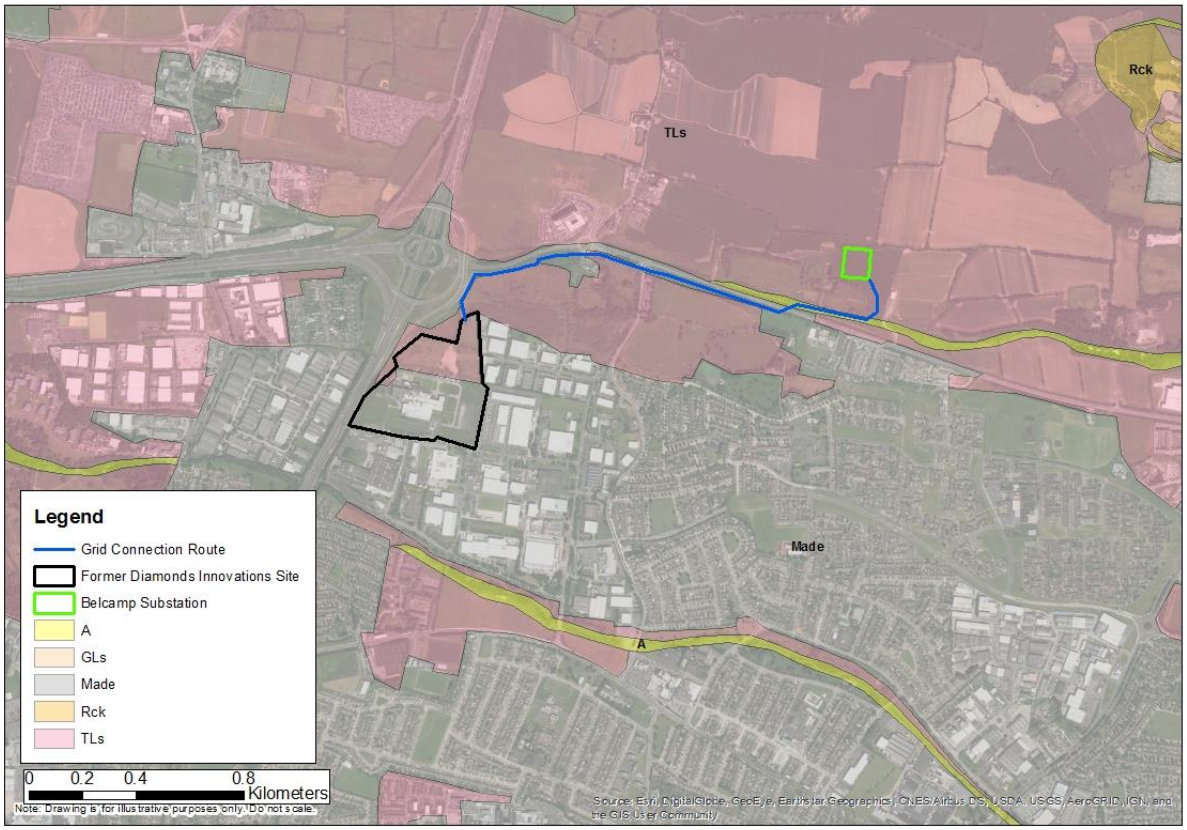


Figure 6.1 Subsoils map for the proposed route (boundary indicated in black) (Source: www.gsi.ie)

Investigation within the Clonshaugh Business & Technology Park confirmed a soil thickness of > 20m.

The construction of the Dublin Port Tunnel and associated studies of the Dublin Boulder Clay has resulted in the identification of four distinct formations within the clay namely; the upper brown boulder clay (UBrBC), the upper black boulder clay (UBkBC), the lower brown boulder clay (LBrBC) and the lower black boulder clay (LBkBC). The upper two units are the most commonly encountered in excavations.

The boulder clays generally exhibit very low permeability in the order of $1x10^{-7}$ to $1x10^{-9}$ m/s or lower. The glacial boulder clay will tend to act as an aquitard or aquiclude between the other more permeable formations including the limestone bedrock (fracture dominated flow).

6.3.4 Regional Geology

The bedrock of the greater Dublin region consists of Dinantian Upper Impure Limestone which is part of the Lucan Formation (Figure 6.2). The limestone is known as Calp and is estimated to be up to 800m thick. The homogeneous sequence consists of dark grey massive limestones, shaley limestones and massive mudstones. The average bed thickness is less than 1m, but these normally thin-bedded lithologies can reach thicknesses of 2m or more.

The Calp is almost completely obscured across central Dublin under the Dublin Boulder Clay. A number of outcrops are recorded to the south of the proposed development site (Collins Avenue West and Abbyfield). There are no faults mapped in the vicinity of the site. The depth to bedrock is mapped as 5 -10m on the GSI GeoUrban viewer however site-specific information indicates bedrock is deeper (>20m below ground level) at the Clonshaugh Business & Technology Park part of the proposed route.

The Belcamp substation and a small percentage of the proposed underground double circuit 110kV transmission cable installation is underlain by Tober Colleen Formation. This formation is made up of calcareous shale, limestone conglomerate.

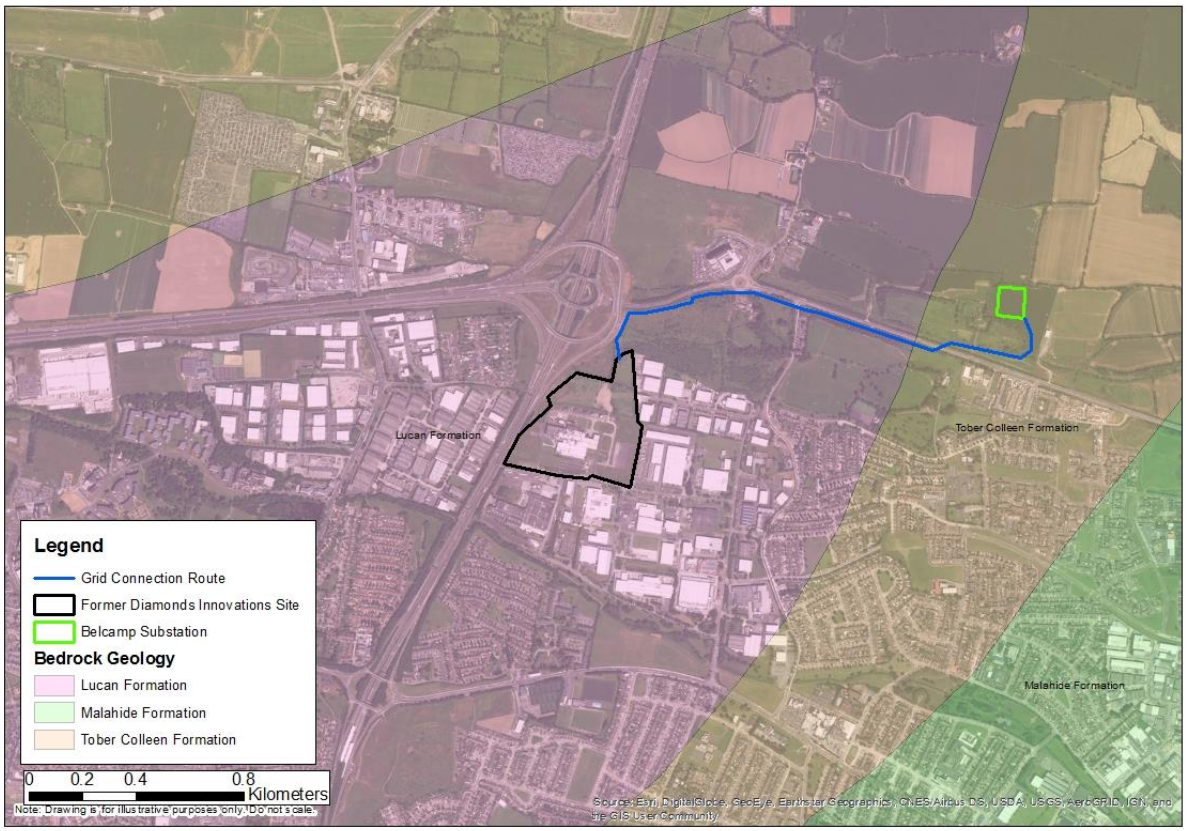


Figure 6.2 Bedrock geology map (Source: www.gsi.ie).

6.3.5 Regional Hydrogeology

6.3.5.1 Description of Water Body

The GSI has devised a system for classifying the bedrock aquifers in Ireland. The aquifer classification for bedrock depends on a number of parameters including, the areal extent (km^2), well yield (m^3/d), specific capacity ($m^3/d/m$) and groundwater throughput (mm^3/d). There are three main classifications: regionally important, locally important and poor aquifers. Where an aquifer has been classified as regionally important, it is further subdivided according to the main groundwater flow regime within it. This sub-division includes regionally important fissured aquifers (Rf) and regionally important karstified aquifers (Rk). Locally important aquifers are sub-divided into those that are generally moderately productive (Lm) and those that are generally moderately productive only in local zones (Ll). Similarly, poor aquifers are classed as either generally unproductive except for local zones (Pl) or generally unproductive (Pu).

The bedrock aquifer underlying the majority of the proposed route connection according to the GSI (www.gsi.ie/mapping) National Draft Bedrock Aquifer Map is classified as a Locally Important Aquifer (Ll) which is described as *Bedrock which is Moderately Productive only in Local Zones*. See Figure 6.3. According to the GSI, the aquifer is not considered to have any primary porosity and flow will be primarily fracture controlled.

The bedrock aquifer underlying the Belcamp Substation and a small section of the proposed underground double circuit 110kV underground transmission cable installation is classed as a Poor Aquifer (Pu) which is described as *Bedrock which is Generally Unproductive expect for Local Zones.* See Figure 6.3, below.

Figure 6.3 Aquifer Classification map (*Source: www.gsi.ie*)

The site is underlain by the Dublin Groundwater Body (EU code: IE_EA_G_008) which has been investigated by the GSI and is described as having a groundwater flow regime of PP which is poorly productive bedrock aquifer.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. Due to the nature of the flow of groundwater through bedrock in Ireland, which is almost completely through fissures/ fractures, the main feature that protects groundwater from contamination, and therefore the most important feature in the protection of groundwater, is the subsoil (which can consist solely/of mixtures of peat, sand, gravel, glacial till, clays or silts).

The GSI currently classifies the bedrock aquifer in the region of the subject site primarily as having (L) - Low Vulnerability status (indicating >10 m of low permeability soil) which was confirmed during site investigation by IGSL in May 2015 (See Figure 6.4). This soil thickness was also confirmed by the surrounding geotechnical

boreholes for the M50/M1 interchange. The IGSL site investigation report is attached as Appendix 6.1.

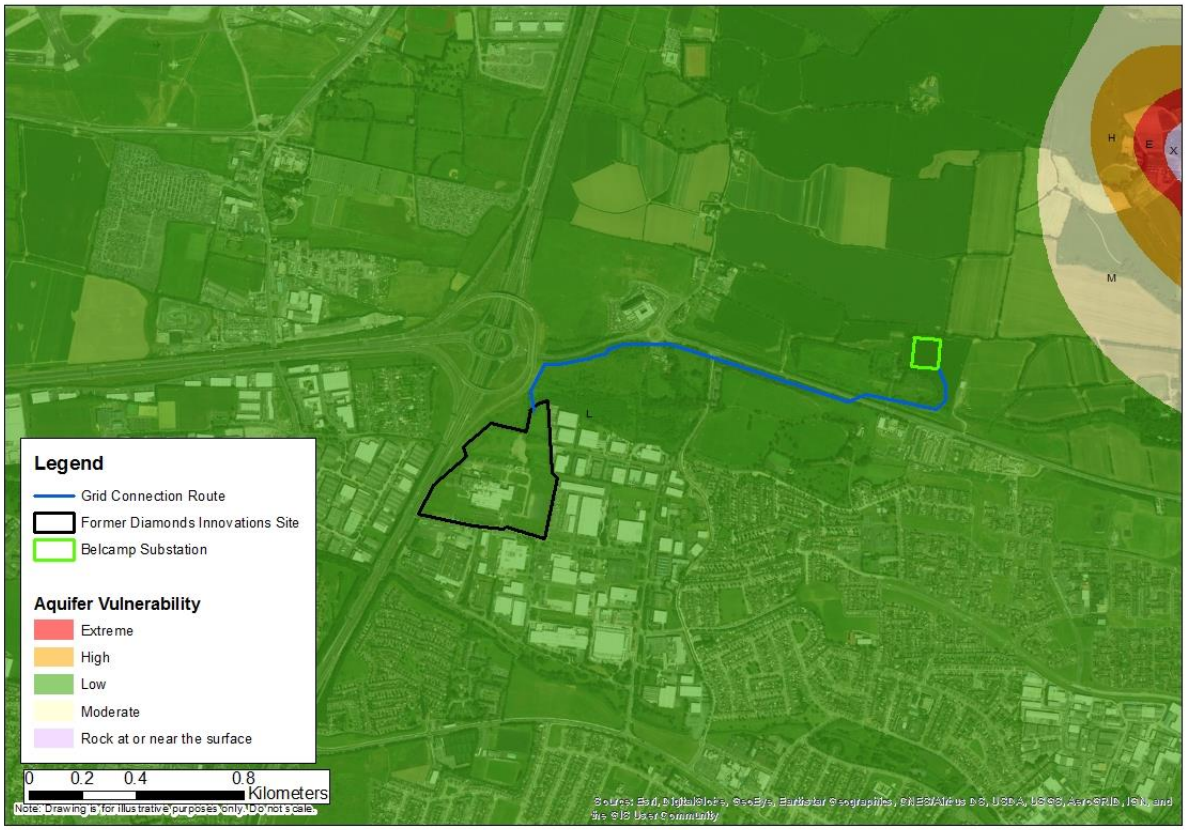


Figure 6.4 Aquifer Vulnerability map (*Source: www.gsi.ie*)

It is unlikely based on survey levels and overburden thickness present that the Santry River or Mayne River are in hydraulic connection with the bedrock aquifer.

6.3.5.2 Groundwater Wells and Flow Direction

There are no recorded groundwater resource protection zones in the area of the proposed site, i.e. zones surrounding a groundwater abstraction area.

The GSI Well Card Index is a record of wells drilled in Ireland, water supply and site investigation boreholes. It is noted that this record is not comprehensive as licensing of wells is not currently a requirement in the Republic of Ireland. This current index, however, shows a number of groundwater monitoring and abstraction wells within a 3km radius of the site. The maximum borehole depth was 122m below ground level (bgl). Bedrock was encountered from between 10 – 23m bgl and water yields were recorded between 87 and 300 m^3/day. The well on the former Diamond Innovation site has been decommissioned as part of the closure of the site. The well at the adjacent Butlers site was installed in overburden only and there is no abstraction undertaken. As the area is served by public mains, it is unlikely that there are any boreholes in the area are used for potable water supply.

Figure 6.5 below presents the GSI well search for the area surrounding the site.

Figure 6.5 GSI Well Search (*Source:* www.gsi.ie)

The flow direction in the overburden generally follows no fixed pattern or trend. Flows of this nature are typical of cohesive clay strata with intermittent fill areas, where often the water level dipped represents pore water seepages into the monitoring well or disconnected perched groundwater conditions.

From static water levels measured during previous site investigations at surrounding sites, the deeper confined bedrock aquifer infers a north-easterly groundwater flow orientation towards Dublin Bay.

6.3.5.3 Groundwater Quality

The European Communities Directive 2000/60/EC established a framework for community action in the field of water policy (commonly known as the Water Framework Directive [WFD]). The WFD required '*Good Water Status'* for all European water by 2015, to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both *'Good Ecological Status'* and *'Good Chemical Status'*.

The Groundwater Body (GWB) underlying the site is the Dublin GWB (EU Groundwater Body Code: IE_EA_G_008). Currently, the EPA classifies the Dublin GWB as having 'Good Status', with a WFD risk score of 2b, '*Expected to achieve good status'*. Figures 6.6 below present the most recent data from the EPA website.

Figure 6.6 GWB WFD Status (period 2010-2015). Green = Good Status. Cross marks area of proposed route.

6.3.5.4 Hydrogeological Features

According to the GSI Karst database there is no evidence of karstification in this area.

6.3.5.5 Areas of Conservation

There are no Special Protection Areas, candidate Special Areas of Conservation or proposed Natural Heritage Areas within or immediately adjacent to the facility. The nearest areas which are designated for environmental conservation is Baldoyle Bay (004006) located approximately 4.2km to the northeast of the site and North Bull Island (004006) which is located approximately 7km south east of the site. These areas are proposed Natural Heritage Areas (pNHA), Special Protection Areas (SPA) and Special Areas of Conservation (SAC). There are no direct linkages between the aquifer beneath the proposed route and these areas of conservation, based on the poor connectivity of fracturing within the Calp limestone and overlying low permeability boulder clay. Refer to Chapter 7 Biodiversity for further details.

6.3.5.6 Cross Sections

Figures 6.7 and 6.8 presents the location of representative cross sections through the site to provide a local hydrogeology conceptual site model (CSM).

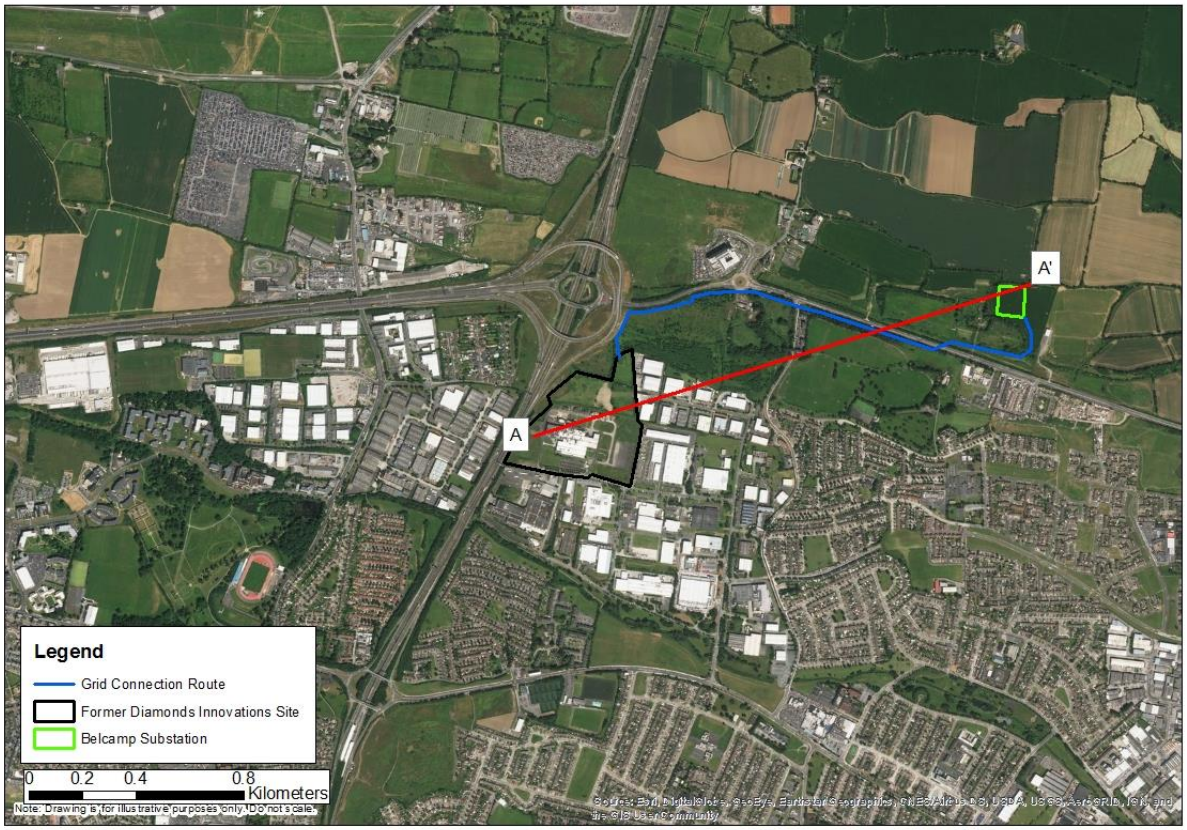


Figure 6.7 Location of cross sections for CSM.

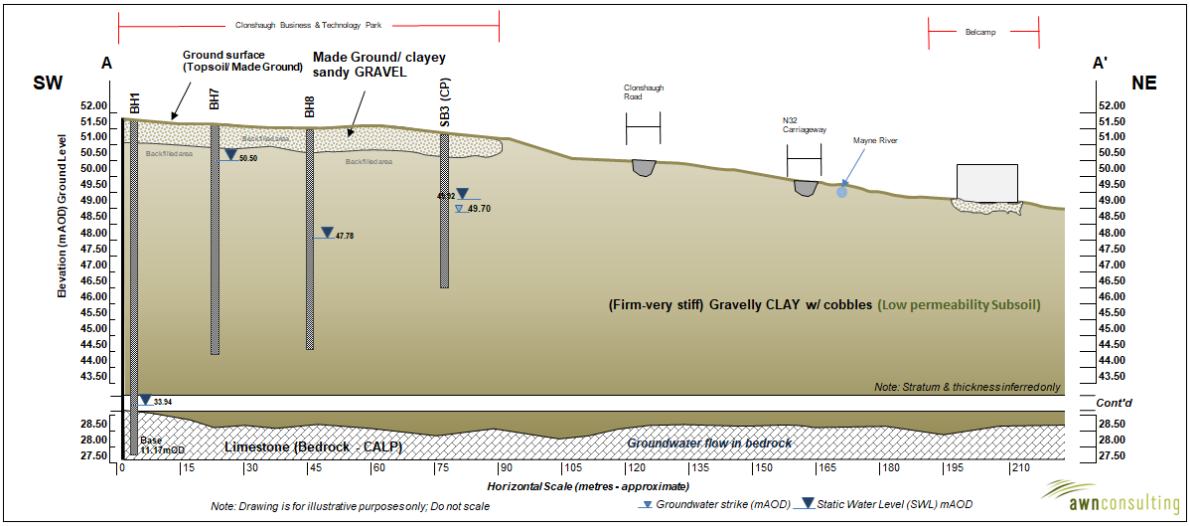


Figure 6.8 A-A' cross section.

6.3.5.7 Rating of site importance of the geological and hydrogeological features

Based on the NRA/IGI criteria for rating the importance of hydrogeological features (refer to Appendix 6.2), the importance of the hydrogeological features at this site is rated as ***Low Importance to Medium Importance***. This is based on the assessment that the attribute has a medium quality significance or value on a local scale. The aquifers along the proposed underground double circuit 110kV underground transmission cable installation range from *locally important* (Ll) bedrock aquifer to *Bedrock which is Generally Unproductive except for Local Zones* (Pl) It is unlikely to be used for public water supply or widely used for potable use. In addition, it does not host any groundwater dependent ecosystems (SACs/NHAs).

6.3.6 Local Soils & Geology

Based on a review of the existing ground investigation information for the surrounding area, the local underlying geology can be summarised as follows:

	Local Geology	
Strata underlying Clonshaugh data storage facility & roadway	**Strata underlying greenfield area**	**Comments**
Made Ground		Consisting of tarmac, concrete and granular sub-base material
Firm brown silt/CLAY with sand, gravels and cobbles	Firm brown silt/CLAY with sand, gravels and cobbles	Topsoil over Brown Dublin Boulder Clay in top c. 2m
Firm to stiff to very stiff to hard grey/black slightly sandy, gravelly CLAY with cobbles	Firm to stiff to very stiff to hard grey/black slightly sandy, gravelly CLAY with cobbles	Black Dublin Boulder Clay generally dry
Bedrock – Limestone/Mudstone	Bedrock – Limestone/Mudstone	Bedrock was not encountered on site but was encountered in an adjoining site at c. 23mBGL

Table 6.2 Summary of Local Geology along proposed route.

The ground conditions on the former Diamond Innovations Industrial Site generally consist of either topsoil or made ground (maximum depth of 0.8m bgl), overlying firm brown grey silt/clay with stiff to very stiff, brown/black gravelly clay with cobbles to a maximum depth of 3.8m bgl. This stratum overlies very stiff to hard black gravelly clay at an average depth of 5.7m bgl. This black clay was penetrated to final refusal depths between 5.2 and 6.2m. Cobbles and boulders were encountered during boring in the black gravelly clay. The brown and black clays represent glacial till deposition and are likely to represent the Upper Brown and Upper Black Dublin Boulder Clays.The IGSL geotechnical report for the former Diamond Innovation Site is included as Appendix 6.1 of this EIA Report.

Based on the available geotechnical boreholes along the proposed transmission cable route, the ground conditions are similar to the ground conditions on the former Diamond Innovations site in Clonshaugh Business and Technology Park. There are a wide range of geotechnical boreholes located in close proximity of the M50/M1 motorway. The boreholes range in depth from 3.50mOD to 15mOD. These boreholes do not encounter bedrock. The nearest borehole that reached bedrock at 23.70mOD is located along the Clonshaugh Road 500m south of the R139.

<u>Soil Quality</u>
Shallow soil quality along the R139, will potentially have elevated hydrocarbons and heavy metals based on impact from road run-off. Soil testing (waste acceptance criteria testing) will be undertaken during initial works to determine a suitable licenced site for disposal. It is estimated that 52,840 m^3 will require excavation during the proposed trench development works.

6.3.7 Economic Geology

The EPA Extractive Industry Register and the GSI mineral database were consulted to determine whether there were/are any mineral sites close to the subject site. As detailed in Section 6.3.2, the closest County Geological Site is Feltrim Quarry which is located some 4km to the northeast of the site. There are no historical mines at or adjacent to the proposed development site.

6.3.8 Radon

According to the EPA (now incorporating the Radiological Protection Institute of Ireland) the site location in Clonshaugh is a Very Low Radon Area where is it estimated that less than 1% of dwellings will exceed the Reference Level of 200 Bq/m^3. This is the lowest of the five radon categories which are assessed by the EPA.

6.3.9 Geohazards

Much of the Earth's surface is covered by unconsolidated sediments which can be especially prone to instability. Water often plays a key role in lubricating the slope failure. Instability is often significantly increased by man's activities in building houses, roads, drainage and agricultural changes. Landslides, mud flows, bog bursts (in Ireland) and debris flows are a result. In general, Ireland suffers few landslides. Landslides are more common in unconsolidated material than in bedrock, and where the sea constantly erodes the material at the base of a cliff landslides and falls lead to recession of the cliffs. Landslides have also occurred in Ireland in recent years in upland peat areas due to disturbance of peat associated with construction activities. The GSI landslide database was consulted and the nearest landslide to the proposed development was 11.6km to the west, referred to as the Diswellstown event which occurred on 24th December 1999. There have been no recorded landslide events at the site. Due to the local topography and the underlying strata there is a negligible risk of a landslide event occurring at the site.

In Ireland, seismic activity is recorded by the Irish National Seismic Network. The Geophysics Section of the School of Cosmic Physics at the Dublin Institute for Advanced Studies (DIAS) has been recording seismic events in Ireland since 1978. The station configuration has varied over the years. However, currently there are five permanent broadband seismic recording stations in Ireland and operated by DIAS. The seismic data from the stations comes into DIAS in real-time and are studied for local and regional events. Records since 1980 show that the nearest seismic activity to the proposed location was in the Irish sea (1.0 – 2.0 M_l magnitude) and ~55 km to the south in the Wicklow Mountains. There is a very low risk of seismic activity to the proposed development site.

There are no active volcanoes in Ireland so there is no risk from volcanic activity.

6.3.10 Land Take

The proposed route runs from the Darndale substation located on the former Diamond Innovation Site directly north into a greenfield area not currently used for agriculture. Currently, the land is located south of the R139 and is zoned as Employment/Enterprise Zone. There will be a narrow land take along the proposed route due to the liner nature of this proposed development. The proposed route of the transmission cable installation will run within the southern edge of R139 and then within greenfield within the Belcamp lands. There will be no loss of agricultural land required for this proposed development.

The land north of the R139 where the transmission cable installation will enter the Belcamp substation is zoned as HT – High Technology; Provide for office, research and development and high technology/high technology manufacturing type employment in a high quality built and landscaped environment.

6.3.11 Unauthorised Landfill facility within the Belcamp Lands

In 2001 IDA Ireland granted leeway to Dublin City Council to construct the Clonshaugh spur of the North Fringe Sewer through IDA Ireland lands. It was during the construction of this sewer that an unauthorised landfill containing approximately 20,000m^3 of mixed commercial/industrial, municipal and construction & demolition waste was uncovered on IDA lands at Belcamp.

It is understood that the waste was placed in the natural depression of the Mayne River Valley either directly on the natural boulder clay or on imported soil mixed with construction and demolition waste/material. The waste body was covered with imported material, predominantly clay soils containing some construction and demolition rubble. Site investigation documentation indicates that the waste is contained and isolated from key potential environmental receptors by low permeability boulder clay up to 35 metres (m) deep beneath the waste body. The Mayne River, which runs close to the southern site boundary, is considered to be protected from potential contamination migration as it is culverted at this point. Refer to Figure 6.9 below which presents the known extent of the waste body within the IDA lands. The full southern extent of the Belcamp Illegal Landfill is not fully assessed to date.

The route of the proposed transmission cable installation will run along the southern edge of R139 which is expected to be outside of the waste body. However, the excavation could encounter the southern edge of the waste body during the construction phase of the proposed development.

Figure 6.9 Waste body delineation based on site investigations in 2006 & 2008.

6.3.12 Summary & Type of Geological/Hydrogeological Environment

Based on the regional and site-specific information available the type of Geological/Hydrogeological Environment as per the IGI Guidelines is:

Type A – Passive geological/hydrogeological environment.

A summary of the site geology and hydrogeology is outlined thus:

- The proposed development will comprise the laying of an underground 110kV circuit transmission cable installation between the two no. aforementioned substations. The two substations are located c. 2 kilometres apart, and are separated by industrial buildings, greenfield lands, parklands, the Mayne River and roadways;
- Previous site investigations were carried out in the general area of the proposed transmission cable installation route and within the Clonshaugh Industrial Park. These include site investigations at the former industrial Diamond Innovation Site and the construction of the M50/M1 interchange;
- Apart from a short stretch of greenfield area, the proposed transmission cable installation route is generally underlain by made ground which is in turn underlain by glacial till known as Dublin Boulder Clay which is c. 20m thick, has considerable strength and low permeability;
- The majority of the proposed transmission cable route is underlain by the Lucan Formation comprising dark shaley limestone known as Calp. The Belcamp substation and the remaining proposed transmission cable installation route is underlain by the Tober Collen Formation. This formation is made up of calcareous shale, limestone conglomerate. Both are *locally Important* aquifers. The glacial till generally have discontinuous perched water tables with low inflow. A shallow perched water table may exist within the made ground; and
- Made ground along the R139 is assumed to have some contamination due to road run-off. No contamination is anticipated in greenfield areas.

6.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

There are a number of elements associated with the construction of the proposed development which have the potential to impact on the environment with respect to land, soils, geology and hydrogeology. There are no potential impacts associated with the operational phase of the proposed development.

A detailed description of the proposed development is provided in Chapter 2 of this EIA Report. The activities associated with the proposed development which are relevant to the land, soils, geology and hydrogeological environment are detailed in Table 6.3.

Phase	Activity	Description
Construction	Discharge to Ground	Run-off percolating to ground during construction of the shallow trench
	Earthworks: Excavation of Superficial Deposits	Cut and fill will be required to facilitate construction, installation of the transmission cable from the Darndale substation to the Belcamp substation, and ancillary works. Topsoil/subsoil stripping and localised stockpiling of soil will be required for short periods of time during construction. The average cut depth for the installation of the transmission cable will be 1.25m bgl but may increase up to approximately c. 3m in places. It is estimated that approximately 48,840m^3 of topsoil/subsoils will be excavated to facilitate construction of the proposed development. It is estimated 2,000m^3 of tarmacadam and 2,000m^3 of tress & shrubbery to be excavated during the construction works.
	Storage of hazardous Material	Fuel and chemical storage will be stored in the already approved contractors compound at the Applicant's site during construction phase.

Phase	Activity	Description
	Import/Export of Materials	It is envisaged that all excavated material will be removed as a waste off site. Any material re-used offsite for beneficial use on other sites with appropriate planning/waste permissions/derogations (e.g. in accordance with Article 27 of the European Communities (Waste Directive) Regulations 2011) or will be recovered and/or disposed off-site at appropriately authorised waste facilities. The removal of waste from the site will be carried out in accordance with Waste Regulations, Regional Waste Plan and Waste Hierarchy/Circular Economy Principals. Refer to Chapter 14 Waste Management for further detail. The importation of clean engineered fill will be required to facilitate construction. In the event of any soils/stones being imported onto the site from another construction site as a by-product, this will also be done in accordance with Article 27. (EPA agreement should be obtained before use of soils/stones as a by-product.)
Operation	No Operation Activities.	

Table 6.3 Site Activities Summary

As outlined in Table 6.3 the activities required for the construction phase of the proposed development represents the greatest risk of potential impact on the geological environment. These activities primarily pertain to the site preparation, excavation, levelling and infilling activities required to facilitate construction of the shallow trenches for the installation of the proposed underground double circuit 110kV underground transmission cable.

6.5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

The potential geological and hydrogeological impacts during the construction and operations are presented below. Mitigation measures to address these potential impacts are presented in Section 6.6.

6.5.1 Construction Phase

- As with all construction projects there is potential for water (rainfall and/or discontinuous perched groundwater) to become contaminated with pollutants associated with construction activity. Contaminated water which arises from construction sites can pose a significant short-term risk to groundwater quality for the duration of the construction if contaminated water is allowed percolate to the aquifer. It is noted that there is no bulk hydrocarbon storage along the proposed route and refuelling will occur within the construction compound within the Clonshaugh data centre site at the former Diamond Innovation site. The potential main contaminants include:
    - Suspended solids (muddy water with increase turbidity) – arising from excavation and ground disturbance;
    - Cement/concrete (increase turbidity and pH) – arising from construction materials; and,
    - Hydrocarbons– accidental spillages from construction plant.
- There is no loss of agricultural land as a result of this development and no overall change to recharge to the aquifer.

6.5.2 Operational Phase

There are no potential land, geological and hydrogeological impacts during the operational phase of this proposed development. The cable is due to be inspected every three years, and there will be no impact as a result of this inspection.

6.5.3 Do Nothing Scenario

The proposed transmission cable installation route will encompass industrial buildings, unused greenfield lands, parklands and roadways. Should the proposed development not take place, lands will remain at their current use. Once the construction phase is complete, the land, soils, geological and hydrogeological environment will not change.

6.6 REMEDIAL AND MITIGATION MEASURES

This section describes appropriate mitigation measures designed to avoid, reduce or offset any potential adverse geological and hydrogeological impacts identified.

6.6.1 Construction Phase

In order to reduce impacts on the land, soils and geology environment a number of mitigation measures will be adopted as part of the construction works on site. The measures will address the main activities of potential impact which include:

- Control of soil excavation and export from site;
- Sources of fill and aggregates for the proposed development;
- Fuel and chemical handling, transport and storage during the construction period; and
- Control of water during construction, if encountered during the construction of the proposed transmission cable route.

Construction Environment Management Plan
In advance of work starting on site the works Contractor will author a Construction Methodology document taking into account their approach and any additional requirements of the Design Team or Planning Regulator. The Contractor will also prepare a Construction Environment Management Plan (CEMP) which will include the schedule of mitigation measures included with this EIAR. . The CEMP will set out the overarching vision of how the construction of the proposed development will be managed in a safe and organised manner by the Contractor as per client requirements. The CEMP will be a live document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIA Report and any subsequent conditions relevant to the proposed development.

Control of Soil Excavation and Export of Material from Site
Topsoil and subsoil will be excavated to facilitate the construction of the proposed transmission cable installation route and other ancillary works. It is envisioned that all soil/stones (topsoil & subsoil) arising on the site will be removed from the site and disposed of as a waste or, where appropriate, as a by-product by a licensed contractor. Soil tested and classified as hazardous or non-hazardous in accordance with the EPA *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* publication, HazWasteOnline tool or similar approved

method. The material will then need to be classified as inert, non-hazardous, stable non-reactive hazardous or hazardous in accordance with *EC Decision 2003/33/EC*.

The construction will be carefully planned to ensure only material required to be excavated will be removed off site as a waste by a licence contractor and be replaced with 'clean' engineering fill.

There will be no stockpiling on site. It is proposed that the soil will be removed as it is excavated. The soil will be removed off site by a licence contractor to a licence facility.

Dust suppression measures (e.g. damping down during dry periods), vehicle wheel washes, road sweeping and general housekeeping will ensure that the surrounding environment are free of nuisance dust and dirt on roads.

It is envisioned that all soil/stones arising on the site will be removed from the site.

Sources of Fill and Aggregates
All fill and aggregate for the proposed development will be sourced from reputable suppliers as per the project Contract and Procurement Procedures. All suppliers will be vetted for:

- Aggregate compliance certificates/declarations of conformity for the classes of material specified for the proposed development;
- Environmental Management status; and
- Regulatory and Legal Compliance status of the Company.

Fuel and Chemical Handling During Construction
All storage of fuel and refuelling will occur on the already permitted construction compound within the former Diamond Innovation site. The following mitigation measures will be taken at the construction site in order to prevent any spillages to ground of fuels during machinery activities and prevent any resulting soil and/or groundwater quality impacts:

- Refuelling will be undertaken off site ,
- Where mobile fuel bowsers are used the following measures will be taken:
    - Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use;
    - The pump or valve will be fitted with a lock and will be secured when not in use;
    - All bowsers to carry a spill kit and operatives must have spill response training; and
    - Portable generators or similar fuel containing equipment will be placed on suitable drip trays.

The aforementioned list of measures is non-exhaustive and will be included in the CEMP.

Control of Water during Construction
Run-off into excavations/earthworks cannot be prevented entirely and is largely a function of prevailing weather conditions. Earthwork operations will be carried out such that surfaces, as they are being raised, shall be designed with adequate drainage, falls and profile to control run-off and prevent ponding and flowing. Correct

management will ensure that there will be minimal inflow of shallow/perched groundwater into any excavation. Due to the very low permeability of the Dublin Boulder Clay and the relative shallow nature for foundation excavations, infiltration to the underlying aquifer is not anticipated.

Care will be taken to ensure that exposed soil surfaces are stable to minimise erosion. All exposed soil surfaces will be within the main excavation site which limits the potential for any offsite impacts. All run-off will be prevented from directly entering into any water courses as no construction will be undertaken directly adjacent to open water (refer to Chapter 5).

No significant dewatering will be required during the construction phase which would result in the localised lowering of the water table. No discharge of construction water is anticipated during the construction of the proposed underground double circuit 110kV underground transmission cable installation. There may be localised pumping of surface run-off from the shallow excavations (up to 3m) during and after heavy rainfall events to ensure that the trenches are kept relatively dry.

6.6.2 Operational Phase

During the operational phase of the proposed development site there is limited potential for site activities to impact on the geological and hydrogeological environment of the area due to the type of development. There will be no direct emissions to ground or potential for indirect emission from operational activities which only include maintenance.

6.7 PREDICTED IMPACT OF THE PROPOSED DEVELOPMENT

This section describes the predicted impact of the proposed development with and without the implementation of the remedial and mitigation measures described above.

6.7.1 Construction Phase

The predicted impacts on the geological and hydrogeological environment even without mitigation measures during the construction phase are considered as ***temporary, imperceptible*** *significance with a* ***neutral*** *impact on quality* (following EPA, 2017). Following the NRA criteria for rating the magnitude and significance of impacts on the geological and hydrogeological related attributes, the magnitude of impact is considered ***Negligible****.*

The implementation of mitigation measures outlined in Section 6.6.1 will ensure that the predicted impacts on the geological and hydrogeological environment do not occur during the construction phase and that the residual impact will be ***temporary-imperceptible-neutral****.* Following the NRA criteria for rating the magnitude and significance of impacts on the geological and hydrogeological related attributes, the magnitude of impact is considered ***Negligible****.*

6.7.2 Operational Phase

The predicted impacts on the geological and hydrogeological environment during the operational phase will be ***long-term imperceptible*** *significance with a* ***neutral*** *impact on quality* (following EPA, 2017). Following the NRA criteria for rating the magnitude and significance of impacts on the geological and hydrogeological related attributes, the magnitude of impact is considered ***Negligible****.*

6.8 RESIDUAL IMPACTS

There are no likely significant impacts on the land, geological or hydrogeological environment associated with the proposed operational development of the site. As such the impact is considered to have a ***long-term, imperceptible*** significance with a ***neutral*** impact on quality.

The cumulative impact assessment is addressed Chapter 15 of this EIA Report.

Interactions are addressed in Chapter 16 of this EIA Report.

6.9 REFERENCES

- Environmental Impact Statement for 'Proposed Environmental Remediation Scheme for a 22 years old unauthorized waste landfill' on lands at Clonshaugh, Belcamp, Dublin 15. O'Laoire Russell Associates Environmental Consulting, January 2006;
- Environmental Remediation: Environmental Impact Assessment (EIS), AECOM, 2008. This report is based on a historic unauthorized illegal landfill in close proximity of the N32 Carriageway;
- AWN Consulting Ltd. (AWN) (2014) Diamond Innovations Irish Operations: Independent Closure Audit (ICA) – Report on Soil and Water Quality;
- Clifton Scannell Emerson Associates (CSEA) (April 2016) Balmoral Lands – DUB 54 Due Diligence Report;
- Dublin Institute of Advanced Studies (DIAS) Catalogue of Local Earthquakes (mapping) https://www.insn.ie/confirmed/ (accessed 07th February 2018);
- Environmental Protection Agency (EPA) (2012); Guidance to Licensees on Surrender, Cessation and Closure of Licenced Sites;
- Environmental Protection Agency (EPA) – website mapping and database information (see: http://gis.epa.ie);
- IGSL Investigation Report No. 18342, May 2015;
- Environmental Impact Statement for 'Proposed Data Centre – DUB64' on lands at Clonshaugh Business & Technology Park, Belcamp, Dublin 15. Prepared for Clifton Scannell Emerson Associates, January 2017;
- Environmental Impact Assessment Report for 'Proposed Data Centres – DUB74 & DUB84' on lands at Clonshaugh Business & Technology Park, Belcamp, Dublin 15. Prepared for Clifton Scannell Emerson Associates, May 2018;
- Geological Survey of Ireland (GSI) (2018) - on-line mapping, Geo-hazard Database, Geological Heritage Sites & Sites of Special Scientific Interest, Bedrock Memoirs and 1:100,000 mapping (see http://www.gsi.ie/mapping
- Long, M., Brannigan, C., Menkiti, C.O., Looby, M., Casey,P. (2012) Retaining Walls in Dublin Boulder Clay. *Proceedings of the ICE – Geotechnical Engineering,* 165 (4): 247-266;
- Ordnance Survey Ireland (OSI) - aerial photographs and historical mapping; and
- Teagasc soil and subsoil database.

APPENDIX 6.1

IGSL INVESTIGATION REPORT

IGSL Ltd.

APPENDIX 6.2

NRA CRITERIA FOR RATING THE MAGNITUDE AND SIGNIFICANCE OF IMPACTS AT EIA STAGE

NATIONAL ROADS AUTHORITY (NRA, 2009)

Table 1 Criteria for rating site importance of Geological Features (NRA)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or high fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

Table 2 Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on soil / geology attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 3 Criteria for rating Site Attributes - Estimation of Importance of Hydrogeology Attributes (NRA)

Magnitude of Impact	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple well fields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source

Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

Table 4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeology Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

Table 5: Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	Magnitude of Importance			
	Neglible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

CLONSHAUGH
INDUSTRIAL AREA
DUE DILIGENCE PROJECT

CLIFTON SCANNELL
EMERSON (CSE)
CONSULTING ENGINEERS

CONTENTS

APPENDICES

FOREWORD

The following Conditions and Notes on Site Investigation Procedures should be read in conjunction with this report.

General.

Recommendations made, and opinions expressed in the report are based on the strata observed in the exploratory holes, together with the results of in-situ and laboratory tests. No responsibility can be held for conditions which have not been revealed by exploratory work, or which occur between exploratory hole locations. Whilst the report may suggest the likely configuration of strata, both between exploratory hole locations, or below the maximum depth of the investigation, this is only indicative, and liability cannot be accepted for its accuracy.

Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

Boring Procedures.

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

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

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

Routine Sampling.

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

In-Situ Testing.

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

Groundwater.

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

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

Retention of Samples.

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

REPORT ON A SITE INVESTIGATION
FOR A DUE DILIGENCE PROJECT
AT CLONSHAUGH INDUSTRIAL ESTATE
DUBLIN
FOR
CLIFTON SCANNELL EMERSON ASSOCIATES
CONSULTING ENGINEERS

Report No. 18342 **MAY 2015**

I Introduction

An existing brownfield site at Clonshaugh Industrial Estate is being assessed as part of a due diligence process. The site consists of an existing industrial building on approximately 9 Hectares.

A detailed investigation of sub soil conditions in the area has been ordered by Clifton Scannell Emerson (CSE)

The programme of the investigation included the construction of ten boreholes and nine trial pits to establish detailed geotechnical criteria. Work was carried out in accordance with BS 5930, Code of Practice for Site Investigations (1999) and appropriate Euro-codes.

A comprehensive programme of laboratory testing to confirm geotechnical soil parameters followed site operations.

This report includes all factual data pertaining to the project and comments on the findings relative to the future development of the site.

An environmental assessment of the site was carried out by specialists under the direction of CSE. IGSL provided excavation equipment to assist in this operation. No comment on environmental issues is provided in this report.

II Fieldwork

The site is located at Clonshaugh Industrial Estate. Borehole and trial pit locations are noted on the site plan enclosed in Appendix IV. Details on this plan have been provided by CSE.

Prior to boring each location was electronically scanned to determine if services were present. In addition a 1.20 metre pit was opened by hand to 1.20 metres to confirm this.

a. Boreholes

The exploratory holes were bored with conventional 200mm cable-tool methods using a Dando Exploratory Rig.

Detailed geotechnical records are contained in Appendix I to this report - the records give details of stratification, sampling, in-situ testing and groundwater. Note is also taken of any obstructions to normal boring requiring the use of the heavy chisel for advancement. In general it was not possible to recover undisturbed samples because of the high stone/cobble content of the strata encountered.

A high degree of consistency in stratification was observed during the cable percussion boring operation.

Thin surface deposits of top-soil and fill extend to a maximum depth of 1.20 metres and overlie firm to stiff brown sandy gravelly silt/clay. This stratum overlies very stiff to hard black gravelly clay at an average depth of 2.00 metres. This black clay was penetrated to final refusal depths between 6.60 and 8.50 metres. Cobbles and boulders were encountered during boring in the black gravelly clay. The brown and black clays represent glacial till deposition, locally referred to as boulder clay.

The final bored depths should not be taken as indicative of the local limestone bedrock horizon. Proof core drilling to establish bedrock parameters was not carried out as part of this investigation.

Ground water was encountered in some locations during the course of boring, Water ingress was describes as light seepage and details are noted on the individual records. No ground water was present at BH 2, 3, 4 and 8. Long-term ground water observation was not required.

b. Trial Pits

Trial pits were opened at nine locations using a tracked excavator under geotechnical engineering supervision. Samples were recovered at intervals, ground water was noted where relevant and detailed trial pit records prepared. These records are contained in Appendix II to this report.

The trial pits generally confirm the borehole findings with top-soil/fill overlying firm to stiff brown gravelly clay in turn overlying stiff to hard black gravelly clay. The interface between the brown and black boulder clay is at about 2.00 metres and excavation was completed in the black boulder clay at 3.00 metres.

Excavations were generally dry with only one minor water ingress noted in TP 4.

III Testing

***(a) In-Situ* :**

Standard penetration tests were carried out at approximate 1.00 metre intervals in the geotechnical boreholes to measure relative in-situ soil strength. N values are noted in the right hand column of the boring records, representing the blow count required to drive the standard sampler 300mm into the soil, following initial seating blows. Where full test penetration was not achieved the blow count for a specific penetration is recorded, or refusal is indicated where appropriate

The results of the tests are summarised as follows:

STRATUM	N VALUE RANGE	COMMENT
Made Ground	7	Loose
Brown gravelly CLAY	14 to 24	Firm to Stiff
Black Boulder CLAY	35 to 75	Very Stiff to Hard

Several limited penetration SPT tests were recorded on cobbles or boulders in the boulder clay stratum and at the base of the respective boreholes.

(b) Geotechnical Laboratory :

All geotechnical samples from the boreholes and trial pits have been returned to the IGSL laboratory for initial visual inspection, a schedule of testing was prepared and tests as appropriate carried out. The programme of testing included the following elements and all results are presented in Appendix III. All tests except chemical tests were carried out by IGL. Sulphate and pH tests were carried out by Jones Environmental Laboratory.

a. Moisture Content and Classification (Liquid and Plastic Limits)
b. Particle size distribution (Sieve Analysis and Hydrometer)
c. Dry Density / M.C. Relationship
d. MCV and Natural M.C.
e. C.B. R
f. Sulphate and pH determination (Jones Environmental)

Classification

The liquid and plastic limits were established for samples of the glacial soils. Results are plotted on the standard Casagrande Chart, falling in the CL/CI zones , indicative of sensitive clay soil of low plasticity. The moisture contents were also determined, varying from 8 to 18 %, but more generally from 9 to 12%

Grading

Grading and hydrometer tests were carried out on the glacial clay and confirm that the material is graded evenly through the clay to coarse gravel fraction. The straight line grading is typical of glacial till material.

Dry Density / MCV / CBR

Tests were carried out on four samples of the glacial till taken from trial pits to determine the suitability of the soils for re-use or for road and pavement construction.

Sulphate and pH

Chemical tests on nine borehole samples indicate low sulphate (SO4) concentration and near neutral pH. No special precautions are deemed necessary to protect foundation concrete from sulphate aggression.

IV Discussion

The investigation has been carried out as part of a due diligence process to determine the suitability of the site for commercial development.

A detailed investigation of ground conditions has been carried out on the instructions of CSE, involving borehole and trial pit investigation with back up geotechnical laboratory soil tests.

A separate environmental assessment has been carried out by others and reported on independently.

SUMMARY FINDINGS

The geotechnical findings reflect the typical glacial stratification of the north city area with shallow surface top soil/ fill deposits overlying the glacial till succession of brown and black boulder clay. The boreholes were terminated between 7.00 and 9.00 metres.

The heterogeneous nature of the glacial tills is emphasised with variations typical of the deposition. Isolated sand or gravel zones, often water bearing can randomly occur.

Generally, stiff brown gravelly clay is present from about 0.60 to 2.00 metres. Very stiff to hard black gravelly clay underlies this stratum and extends to at least 7.00 metres. Bedrock parameters have not been established. Some minor water seepages were observed.

The characteristics of the glacial till or boulder clay in the area are very well documented and the laboratory tests carried out for this project confirm the consistency and behavioural characteristics of the soils.

Foundations:

The upper brown gravelly clay is generally of stiff consistency and should readily support loads of 150 to 200 kN/sq.m. at about 1.00 metre BGL.

Higher foundation loads should be transferred to the very stiff to hard grey black gravelly clay at an average depth of about 2.00 metres where an allowable bearing pressure of 300 to 350 kN/sq/m. is available. This black boulder clay will clearly be the founding medium where basement construction is to be carried out.

Settlement of foundations under the loads indicated above in the pre-consolidated glacial soils should be low (<10mm) and differential movement should be negligible. The glacial clays are very sensitive to moisture content variation and should be protected by blinding as soon as possible after excavation.

All excavations should be inspected by competent site staff to ensure uniformity and suitability of the founding medium. Any obviously soft or suspect material and all made ground should be removed and replaced by low-grade concrete.

Ground Floor Slab

Floor slabs can be supported directly on the generally firm gravelly clay directly underlying the surface top-soil or shallow fill deposits. An allowable bearing pressure of 75 to 100 kN/sq.m. can be assumed for the upper horizon of the brown gravelly clay. Careful visual inspection of excavated formation is advised.

Roads and Pavements

CBR tests on the upper brown gravelly clay suggest that an average CBR value of 3% be adopted for site road and pavement design. We would point out that prolonged wet weather may have resulted in increased moisture content in the upper zone (GL to 1.00 metres or so). This increased moisture content will be reflected in lower CBR values. Further in-situ CBR testing would be advised at construction stage to confirm design parameters.

Earthworks

The glacial till deposits encountered will be suitable for re-use as engineered fill under roads or pavement areas. The material is susceptible to water softening and should be protected if stored over an extended period.

Excavation

Deep service trench excavation in the glacial till will remain vertically stable in the short term. Statutory safety regulation however prohibit personnel entering unsupported excavations greater than 1.20 metres deep.

Long term excavation slopes in boulder clays should be designed at 2:1 horizontal to vertical.

Ground Water

Some isolated water seepages were recorded during the investigation. Such ingress into deep excavations should be readily controlled by light conventional pumping.

IGSL/JC
May 2015

Appendix I Boring Records

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH01
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	28/03/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	28/03/2015
	BOREHOLE DEPTH (m) 7.70		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.30						
	Firm to stiff grey/brown SILT/CLAY with some gravel				AA29448	B	1.00		N = 17 (1, 3, 3, 4, 4, 6)	
1										
				2.10	AA29449	B	2.00		N = 24 (2, 2, 2, 6, 7, 9)	
2	Very stiff to hardlack sandy gravelly CLAY with cobbles and occasional boulders									
					AA29450	B	3.00		N = 37 (3, 6, 7, 7, 11, 12)	
3										
					AA31051	B	4.00		N = 50 (5, 10, 9, 12, 14, 15)	
4										
					AA31052	B	5.00		N = 69 (7, 11, 15, 15, 19, 20)	
5										
					AA31053	B	6.00		N = 46/150 mm (10, 10, 21, 25)	
6										
					AA31054	B	7.00		N = 43/150 mm (8, 14, 18, 25)	
7										
				7.70	AA31055	B	7.50-7.70		N = 25/75 mm (21, 25)	
	Obstruction									
8	End of Borehole at 7.70 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.5	5.8	0.5	
6.4	6.7	0.75	
7.5	7.7	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.00	4.00	4.70	3.60	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
28-03-15	7.70	Nil	Nil	BH was dry on completion

REMARKS Hand excavated pit for services . Water sample taken at 4.00m

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH02
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	26/03/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	26/03/2015
	BOREHOLE DEPTH (m) 8.50		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.30						
	Firm to stiff brown slightly sandy CLAY with gravel and occasional cobbles				AA29431	B	1.00		N = 20 (2, 2, 4, 3, 6, 7)	
1				1.40						
	Firm grey/brown SILT/CLAY with some gravel			1.70						
	Very stiff to hard black sandy gravelly CLAY with some cobbles				AA29432	B	2.00		N = 44 (3, 8, 9, 11, 11, 13)	
2										
					AA29433	B	3.00		N = 56 (4, 7, 12, 14, 15, 15)	
3										
					AA29434	B	4.00		N = 61 (6, 12, 12, 14, 15, 20)	
4										
					AA29435	B	5.00		N = 42 (7, 14, 8, 9, 10, 15)	
5										
					AA29436	B	6.00		N = 75 (8, 14, 15, 19, 19, 22)	
6										
					AA29437	B	7.00		N = 45/150 mm (12, 16, 20, 25)	
7										
					AA29438	B	8.00		N = 25/75 mm (10, 21, 25)	
8				8.50						
	Obstruction End of Borehole at 8.50 m				AA29439	B	8.50		N = 25/75 mm (23, 25)	
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.1	7.8	1	
8.2	8.5	1.5	

WATER STRIKE DETAILS

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

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand excavated pit for services.

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	**BOREHOLE NO.**	**BH03**
		SHEET	Sheet 1 of 1
CO-ORDINATES	**RIG TYPE** Dando 2000	**DATE COMMENCED**	24/03/2015
GROUND LEVEL (m AOD)	**BOREHOLE DIAMETER (mm)** 200	**DATE COMPLETED**	24/03/2015
	BOREHOLE DEPTH (m) 6.60		
CLIENT	**SPT HAMMER REF. NO.**	**BORED BY**	E.L
ENGINEER CSEA	**ENERGY RATIO (%)**	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.20						
	MADE GROUND (Comprised of brown clay with cobbles and timber fragments)			0.40						
	MADE GROUND (Comprised of CL.804 angular stone fill)			0.70						
1	Firm grey/brown SILT/CLAY with some gravel			1.40	AA29417	B	1.00		N = 19 (2, 3, 5, 5, 5, 4)	
	Firm grey/brown gravelly CLAY with some cobbles			2.00						
2	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders				AA29418	B	2.00		N = 35 (3, 6, 6, 7, 10, 12)	
3					AA29419	B	3.00		N = 47 (6, 8, 8, 11, 13, 15)	
4					AA29420	B	4.00		N = 59 (4, 8, 14, 13, 15, 17)	
5					AA29421	B	5.00		N = 74 (7, 11, 18, 16, 17, 23)	
6					AA29422	B	6.00		N = 25/75 mm (10, 15, 25)	
				6.60	AA29423	B	6.60		N = 25/75 mm (22, 25)	
7	Obstruction End of Borehole at 6.60 m									
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.5	3.9	0.75	
5.7	6.6	2	

WATER STRIKE DETAILS

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

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand excavated pit for services

Sample Legend

UT - Undisturbed 100mm Diameter

BH LOG 18342.GPJ IGSL.GDT 10/4/15

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH04
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	25/03/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	25/03/2015
	BOREHOLE DEPTH (m) 7.50		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.30						
	MADE GROUND (Comprised of brown clay with gravel,cobbles,red brick fragmments)			0.80						
1	Firm grey/brown SILT/CLAY with some gravel			1.35	AA29424	B	1.00		N = 18 (1, 4, 4, 4, 5, 5)	
	Firm grey/brown sandy CLAY with gravel			1.80						
2	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders				AA29425	B	2.00		N = 37 (4, 4, 7, 10, 10, 10)	
3					AA29426	B	3.00		N = 47 (5, 7, 7, 12, 14, 14)	
4					AA29427	B	4.00		N = 59 (6, 9, 13, 15, 15, 16)	
5					AA29428	B	5.00		N = 69 (7, 10, 15, 17, 17, 20)	
6					AA29429	B	6.00		N = 71 (8, 13, 14, 18, 18, 21)	
7				7.00						
	Black sandy gravelly CLAY with some cobbles and occasional boulders			7.50	AA29430	B	7.00-7.50		N = 25/75 mm (16, 25)	
	Obstruction End of Borehole at 7.50 m								N = 25/75 mm (25, 25)	
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.4	5.6	0.75	
7	7.5	1.5	

WATER STRIKE DETAILS

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

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Hand excavated pit for services. Water sample taken at 4.00m

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH05
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	07/04/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	07/04/2015
	BOREHOLE DEPTH (m) 7.70		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.30						
	MADE GROUND (Comprised of brown clay with cobbles and red brick fragments)			1.20	AA31086	B	1.00		N = 16 (1, 3, 3, 5, 4, 4)	
1	Firm grey/brown SILT/CLAY with gravel and occasional cobbles			2.10	AA31087	B	2.00		N = 40 (3, 6, 9, 9, 11, 11)	
2	Very stiff to hard black sandy gravelly CLAY with cobbles and occasional boulders				AA31088	B	3.00		N = 45 (4, 8, 8, 10, 13, 14)	
3					AA31089	B	4.00		N = 57 (4, 12, 14, 14, 14, 15)	
4					AA31090	B	5.00		N = 60 (6, 10, 13, 15, 15, 17)	
5					AA31091	B	6.00		N = 69 (8, 10, 16, 18, 17, 18)	
6					AA31092	B	7.00		N = 44/150 mm (10, 15, 19, 25)	
7					AA31093	B	7.40-7.70			
				7.70						
8	Obstruction End of Borehole at 7.70 m								N = 25/75 mm (25, 25)	
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
6.5	6.9	0.5	
7.4	7.7	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.60	3.60	4.10	3.30	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
07-04-15	7.70	Nil	7.40	End of BH

REMARKS Hand excavated pit for services

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	**BOREHOLE NO.**	**BH06**
		SHEET	Sheet 1 of 1
CO-ORDINATES	**RIG TYPE** Dando 2000	**DATE COMMENCED**	01/04/2015
GROUND LEVEL (m AOD)	**BOREHOLE DIAMETER (mm)** 200	**DATE COMPLETED**	01/04/2015
	BOREHOLE DEPTH (m) 7.60		
CLIENT	**SPT HAMMER REF. NO.**	**BORED BY**	E.L
ENGINEER CSEA	**ENERGY RATIO (%)**	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.30						
	Firm brown sandy CLAY			0.60						
1	Firm to stiff brown SILT/CLAY with occasional gravel and some cobbles			2.00	AA31070	B	1.00		N = 16 (3, 3, 3, 4, 4, 5)	
2	Very stiff to hard black sandy gravelly CLAY with occasional cobbles				AA31071	B	2.00		N = 32 (3, 6, 7, 7, 8, 10)	
3					AA31072	B	3.00		N = 49 (6, 9, 9, 12, 14, 14)	
4					AA31073	B	4.00		N = 55 (5, 6, 11, 12, 15, 17)	
5					AA31074	B	5.00		N = 67 (6, 10, 13, 18, 18, 18)	
6					AA31075	B	6.00		N = 64 (5, 12, 12, 15, 17, 20)	
7					AA31076	B	7.00		N = 25/75 mm (8, 16, 25)	
					AA31077	B	7.30-7.60		N = 25/75 mm (25, 25)	
	Obstruction			7.60						
8	End of Borehole at 7.60 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
7.3	7.6	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.40	4.40	5.00	4.10	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
01-04-15	7.60	Nil	Nil	BH was dry on completion

REMARKS Hand excavated pit for service

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH07
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	02/04/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	02/04/2015
	BOREHOLE DEPTH (m) 7.60		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	MADE GROUND (Comprised of clay,gravel,cobbles,red brick fragments			0.60						
1	Firm brown sandy SILT/CLAY with gravel and occasionbal cobbles			1.90	AA31078	B	1.00		N = 14 (2, 2, 4, 3, 3, 4)	
2	Very stiff to hard black sandy gravelly CLAY with cobbles				AA31079	B	2.00		N = 34 (3, 5, 8, 8, 9, 9)	
3					AA31080	B	3.00		N = 43 (4, 7, 10, 10, 11, 12)	
4					AA31081	B	4.00		N = 52 (5, 7, 8, 13, 15, 16)	
5					AA31082	B	5.00		N = 57/225 mm (5, 13, 15, 17, 25)	
6					AA31083	B	6.00		N = 65 (8, 12, 14, 16, 17, 18)	
7				7.30	AA31084	B	7.30-7.60		N = 42/150 mm (5, 14, 17, 25)	
8	Obstruction End of Borehole at 7.60 m								N = 25/75 mm (25, 25)	
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.8	5.3	1.25	
7.3	7.6	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.90	3.90	No	3.50	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
02-04-15	7.60	Nil	6.80	End of BH

REMARKS Hand excavated pit for services . Water sample .

Sample Legend

UT - Undisturbed 100mm Diameter

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH08
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	31/03/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	31/03/2015
	BOREHOLE DEPTH (m) 6.80		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.20						
	MADE GROUND (Comprised of brown sandy clay with cobbles)			0.70						
1	Firm to stiff brown SILT/CLAY with some gravel and occasional cobbles				AA31063	B	1.00		N = 17 (1, 3, 3, 5, 4, 5)	
2				2.20	AA31064	B	2.00		N = 33 (2, 4, 4, 9, 10, 10)	
	Very stiff to hard black sandy gravelly CLAY with cobbles									
3					AA31065	B	3.00		N = 53 (4, 8, 12, 12, 14, 15)	
4					AA31066	B	4.00		N = 58 (5, 7, 10, 16, 16, 16)	
5					AA31067	B	5.00		N = 72 (8, 12, 14, 18, 20, 20)	
6					AA31068	B	6.00		N = 47/150 mm (7, 18, 22, 25)	
				6.50	AA31069	B	6.50-6.80			
	Hard black sandy very gravelly CLAY with cobbles and occasional boulders (Possibly clayey gravel)			6.80					N = 25/75 mm (25, 25)	
7	Obstruction End of Borehole at 6.80 m									
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.8	5.5	0.75	
6.5	6.8	2	

WATER STRIKE DETAILS

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

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
31-03-15	6.80	Nil	Nil	BH was dry on completion

REMARKS Hand excavated pit for services

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH09
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	27/03/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	27/03/2015
	BOREHOLE DEPTH (m) 7.40		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.20						
	MADE GROUND (Comprised brown clay with gravel,cobbles,red brick fragments)			0.40						
1	Stiff grey/brown SILT/CLAY with some gravel and occasional cobbles				AA29440	B	1.00		N = 18 (5, 5, 5, 4, 4, 5)	
2				2.10	AA29441	B	2.00		N = 33 (2, 5, 7, 8, 8, 10)	
	Very stiff to hard black sandy gravelly CLAY with cobbles									
3					AA29442	B	3.00		N = 45 (5, 5, 8, 11, 12, 14)	
4					AA29443	B	4.00		N = 51 (5, 10, 10, 13, 13, 15)	
5					AA29444	B	5.00		N = 61 (7, 9, 12, 15, 16, 18)	
6					AA29445	B	6.00		N = 74 (8, 11, 14, 19, 19, 22)	
7				7.10	AA29446	B	7.00		N = 25/75 mm (14, 25)	
	Hard black sandy very gravelly CLAY with cobbles and occasional boulders			7.40	AA29447	B	7.40		N = 25/75 mm (25, 25)	
	Obstruction									
8	End of Borehole at 7.40 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.5	2.7	0.5	
4.5	4.8	0.75	
7.1	7.4	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.50	4.50	5.30	4.00	30	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
27-03-15	7.40	Nil	Nil	BH was dry on completion

REMARKS Hand excavated pit for services.Water sample taken at 4.50m

Sample Legend

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	BOREHOLE NO.	BH10
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	30/03/2015
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	30/03/2015
	BOREHOLE DEPTH (m) 7.50		
CLIENT	SPT HAMMER REF. NO.	BORED BY	E.L
ENGINEER CSEA	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.30						
1	Stiff to very stiff brown/grey SILT/CLAY with gravel and occasional cobbles (Possibly fill)			1.50	AA31056	B	1.00		N = 7 (2, 2, 1, 1, 2, 3)	
2	Stiff dark grey CLAY with some gravel			2.20	AA31057	B	2.00		N = 35 (3, 4, 4, 8, 11, 12)	
3	Very stiff to hard black sandy gravelly CLAY with occasional cobbles				AA31058	B	3.00		N = 48 (4, 7, 11, 11, 13, 13)	
4					AA31059	B	4.00		N = 61 (7, 7, 12, 15, 17, 17)	
5					AA31060	B	5.00		N = 57/225 mm (6, 12, 14, 18, 25)	
6					AA31061	B	6.00		N = 72 (6, 10, 15, 16, 20, 21)	
7					AA31062	B	6.90-7.30		N = 25/75 mm (25, 25) N = 25/75 mm (25, 25)	
				7.50						
8	Obstruction End of Borehole at 7.50 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5	5.3	0.75	
6.9	7.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.80	3.80	No	3.50	20	Slow

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
30-03-15	7.30	Nil	6.90	End of BH

REMARKS Hand excavated pit for services

Sample Legend

Appendix II Trial Pit Records

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation
TRIAL PIT NO.	**TP01**
SHEET	Sheet 1 of 1
LOGGED BY	D.Coss
CO-ORDINATES	
DATE STARTED	25/03/2015
DATE COMPLETED	25/03/2015
CLIENT	
GROUND LEVEL (m)	
EXCAVATION METHOD	Tracked Excavator
ENGINEER	CSEA

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
MADE GROUND comprised of dense grey very sandy GRAVEL with a high cobble content. Gravel is fine to coarse angular of limestone. (clause 6F2)		0.35							
		0.60							
Firm becoming stiff brown sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32409	CBR	0.70-0.70		
1.0					AA32410	B	1.00-1.00		
2.0					AA32411	B	2.00-2.00		
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		2.20							
3.0 End of Trial Pit at 3.00m		3.00			AA32412	B	3.00-3.00		
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

IGSL_TP LOG 18342.GPJ IGSL.GDT 10/4/15

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation
LOGGED BY	D.Coss
CLIENT	
ENGINEER	CSEA
CO-ORDINATES	
GROUND LEVEL (m)	
TRIAL PIT NO.	TP02
SHEET	Sheet 1 of 1
DATE STARTED	25/03/2015
DATE COMPLETED	25/03/2015
EXCAVATION METHOD	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
Stiff brown/grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		0.40			AA32405	CBR	0.50-0.50		
1.0					AA32406	B	1.00-1.00		
2.0 Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		1.95			AA32407	B	2.00-2.00		
End of Trial Pit at 2.80m		2.80			AA32408	B	2.80-2.80		
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

IGSL TP LOG 18342.GPJ IGSL.GDT 10/4/15

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	**TRIAL PIT NO.**	**TP03**
		SHEET	Sheet 1 of 1
LOGGED BY	D.Coss	**CO-ORDINATES**	
		DATE STARTED	25/03/2015
		DATE COMPLETED	25/03/2015
CLIENT		**GROUND LEVEL (m)**	
ENGINEER	CSEA	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Stiff brown/mottled sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32401	CBR	0.50-0.50		
1.0					AA32402	B	1.00-1.00		
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		1.90							
2.0					AA32403	B	2.00-2.00		
3.0 End of Trial Pit at 3.00m		3.00			AA32404	B	3.00-3.00		
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

IGSL TP LOG 18342.GPJ IGSL.GDT 10/4/15

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	**TRIAL PIT NO.**	**TP04**
		SHEET	Sheet 1 of 1
LOGGED BY	D.Coss	**CO-ORDINATES**	
		DATE STARTED	25/03/2015
		DATE COMPLETED	25/03/2015
CLIENT		**GROUND LEVEL (m)**	
ENGINEER	CSEA	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
MADE GROUND comprised of stiff dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32413	CBR	0.50-0.50		
1.0		1.20							
Firm brown/mottled sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies. (Possible made ground)					AA32414	B	1.50-1.50		
2.0									
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		2.60			AA32415	B	2.50-2.50		
3.0 End of Trial Pit at 3.00m		3.00			AA32416	B	3.00-3.00		
4.0									

Groundwater Conditions
Seepage at 2.0mbgl in gravel lense

Stability
Stable

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation
TRIAL PIT NO.	**TP05**
SHEET	Sheet 1 of 1
LOGGED BY	D.Coss
CO-ORDINATES	
DATE STARTED	25/03/2015
DATE COMPLETED	25/03/2015
CLIENT	
GROUND LEVEL (m)	
EXCAVATION METHOD	Tracked Excavator
ENGINEER	CSEA

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Firm to stiff brown/mottled sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32417	CBR	0.50-0.50		
1.0									
					AA32418	B	1.50-1.50		
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		1.80							
2.0									
					AA32419	B	2.50-2.50		
End of Trial Pit at 2.70m		2.70							
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation
TRIAL PIT NO.	**TP06**
SHEET	Sheet 1 of 1
LOGGED BY	D.Coss
CO-ORDINATES	
DATE STARTED	25/03/2015
DATE COMPLETED	25/03/2015
CLIENT	
GROUND LEVEL (m)	
EXCAVATION METHOD	Tracked Excavator
ENGINEER	CSEA

	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	TOPSOIL									
	Stiff brown/mottled sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		0.45			AA32430	CBR	0.50-0.50		
1.0						AA32431	B	1.50-1.50		
	Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		1.90							
2.0						AA32432	B	2.50-2.50		
	End of Trial Pit at 2.80m		2.80							
3.0										
4.0										

Groundwater Conditions
Dry

Stability
Stable

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation
LOGGED BY	D.Coss
CLIENT	
ENGINEER	CSEA
CO-ORDINATES	
GROUND LEVEL (m)	
TRIAL PIT NO.	TP07
SHEET	Sheet 1 of 1
DATE STARTED	25/03/2015
DATE COMPLETED	25/03/2015
EXCAVATION METHOD	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Stiff grey brown sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32420	CBR	0.50-0.50		
1.0					AA32421	B	1.00-1.00		
2.0					AA32422	B	2.00-2.00		
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		2.20							
3.0 End of Trial Pit at 3.00m		3.00			AA32423	B	3.00-3.00		
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

IGSL TP LOG 18342.GPJ IGSL.GDT 10/4/15

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation	**TRIAL PIT NO.**	**TP08**
		SHEET	Sheet 1 of 1
LOGGED BY	D.Coss	**CO-ORDINATES**	
		DATE STARTED	25/03/2015
		DATE COMPLETED	25/03/2015
CLIENT		**GROUND LEVEL (m)**	
ENGINEER	CSEA	**EXCAVATION METHOD**	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.45							
Firm brown/mottled sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32427	CBR	0.50-0.50		
1.0					AA32428	B	1.50-1.50		
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		1.90							
2.0					AA32429	B	2.50-2.50		
End of Trial Pit at 2.90m		2.90							
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

IGSL TP LOG 18342.GPJ IGSL.GDT 10/4/15

TRIAL PIT RECORD

REPORT NUMBER 18342

CONTRACT	DUB 54 Due Diligence, Site Investigation
LOGGED BY	D.Coss
CLIENT	
ENGINEER	CSEA
CO-ORDINATES	
GROUND LEVEL (m)	
TRIAL PIT NO.	TP09
SHEET	Sheet 1 of 1
DATE STARTED	25/03/2015
DATE COMPLETED	25/03/2015
EXCAVATION METHOD	Tracked Excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL with rootlets.		0.45							
Firm to stiff grey/brown/mottled sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.					AA32424	CBR	0.50-0.50		
1.0					AA32425	B	1.50-1.50		
Very stiff/hard dark grey sandy very gravelly CLAY with a high cobble and low boulder content. Gravel is fine to coarse subround to subangular of various lithologies.		1.80							
2.0					AA32426	B	2.50-2.50		
End of Trial Pit at 2.80m		2.80							
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Stable

General Remarks

Appendix III Geotechnical Tests

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2, 4.3, 4.4 & 5.3

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. **R64406** Contract No. 18341 Contract Name: Clonshaugh Industrial Estate

Customer CSE

Samples Received: 10/04/15 Date Tested: 15/04/15

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
TP01	AA32409/11	0.60-2.00	A15/1401	B	10	34	17	17	52	WS	4.4	C L	Mottled brown slightly sandy, slightly gravelly, CLAY
TP03	AA32401/03	0.30-1.90	A15/1402	B	18	41	20	21	59	WS	4.4	C I	Brown slightly sandy, slightly gravelly, CLAY
TP07	AA32420/22	0.30-2.20	A15/1403	B	15	44	21	23	53	WS	4.4	C I	Mottled brown slightly sandy, gravelly, CLAY
TP09	AA32424/26	0.50-2.80	A15/1404	B	12	35	17	18	60	WS	4.4	C L	Mottled brown slightly sandy, slightly gravelly, CLAY
BH01	AA29448	1.00	A15/1379	B	13	30	16	14	57	WS	4.4	C L	Brown sandy gravelly CLAY
BH01	AA29450	3.00	A15/1380	B	9.3	33	15	18	49	WS	4.4	C L	Dark Brown slightly sandy, gravelly, CLAY
BH02	AA29432	2.00	A15/1381	B	8.7	31	14	17	45	WS	4.4	C L	Dark Brown slightly sandy, gravelly, CLAY
BH03	AA29418	2.00	A15/1382	B	12	31	15	16	45	WS	4.4	C L	Dark Brown sandy gravelly CLAY
BH03	AA29420	4.00	A15/1383	B	13	30	14	16	49	WS	4.4	C L	Dark Brown slightly sandy, slightly gravelly, CLAY
BH04	AA29426	3.00	A15/1384	B	9.0	28	14	14	50	WS	4.4	C L	Dark Brown slightly sandy, slightly gravelly, CLAY
BH05	AA31088	3.00	A15/1385	B	11	30	15	15	53	WS	4.4	C L	Dark Brown sandy gravelly CLAY
BH05	AA31091	6.00	A15/1386	B	13	34	16	18	48	WS	4.4	C L	Dark Brown slightly sandy, slightly gravelly, CLAY
BH06	AA31070	1.00	A15/1387	B	12	32	15	17	50	WS	4.4	C L	Mottled grey/brown sandy gravelly CLAY
BH06	AA31072	3.00	A15/1388	B	8.0	28	16	12	54	WS	4.4	C L	Dark Brown slightly sandy, gravelly, CLAY with some cobbles
BH07	AA31079	2.00	A15/1389	B	12	30	15	15	42	WS	4.4	C L	Brown sandy gravelly CLAY

Notes: Preparation: WS - Wet sieved
AR - As received
NP - Non plastic

Liquid Limit Clause: 4.3 Cone Penetrometer definitive method
4.4 Cone Penetrometer one point method

Sample Type: B - bulk disturbed
U - Undisturbed

Remarks:

Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

Approved by	Date	Page
H.Byrne	11/05/15	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2, 4.3, 4.4 & 5.3

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. **R64407** Contract No. 18341 Contract Name: Clonshaugh Industrial Estate

Customer CSE

Samples Received: 10/04/15 Date Tested: 15/04/15

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH08	AA31063	1.0	A15/1394	B	13	38	18	20	55	WS	4.4	C I	Mottled brown sandy gravelly CLAY with root hairs
BH08	AA31066	4.0	A15/1395	B	9.5	28	14	14	50	WS	4.4	C L	Dark Brown slightly sandy, slightly gravelly, CLAY
BH09	AA29440	1.0	A15/1396	B	12	35	18	17	59	WS	4.4	C L	Brown sandy gravelly CLAY
BH09	AA29442	3.0	A15/1397	B	10	30	15	15	59	WS	4.4	C L	Dark Brown slightly sandy, gravelly, CLAY with some cobbles
BH10	AA31956	1.0	A15/1398	B	14	34	17	17	52	WS	4.4	C L	Brown sandy gravelly CLAY
BH10	AA31057	2.0	A15/1399	B	11	30	15	15	48	WS	4.4	C L	Dark Brown/Grey very sandy gravelly CLAY
BH10	AA31058	3.0	A15/1400	B	8.2	29	13	16	46	WS	4.4	C L	Dark Brown slightly sandy, gravelly, CLAY with some cobbles

Notes: Preparation: WS - Wet sieved; AR - As received; NP - Non plastic

Liquid Limit Clause: 4.3 Cone Penetrometer definitive method; 4.4 Cone Penetrometer one point method

Sample Type: B - bulk disturbed; U - Undisturbed

Remarks:

Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

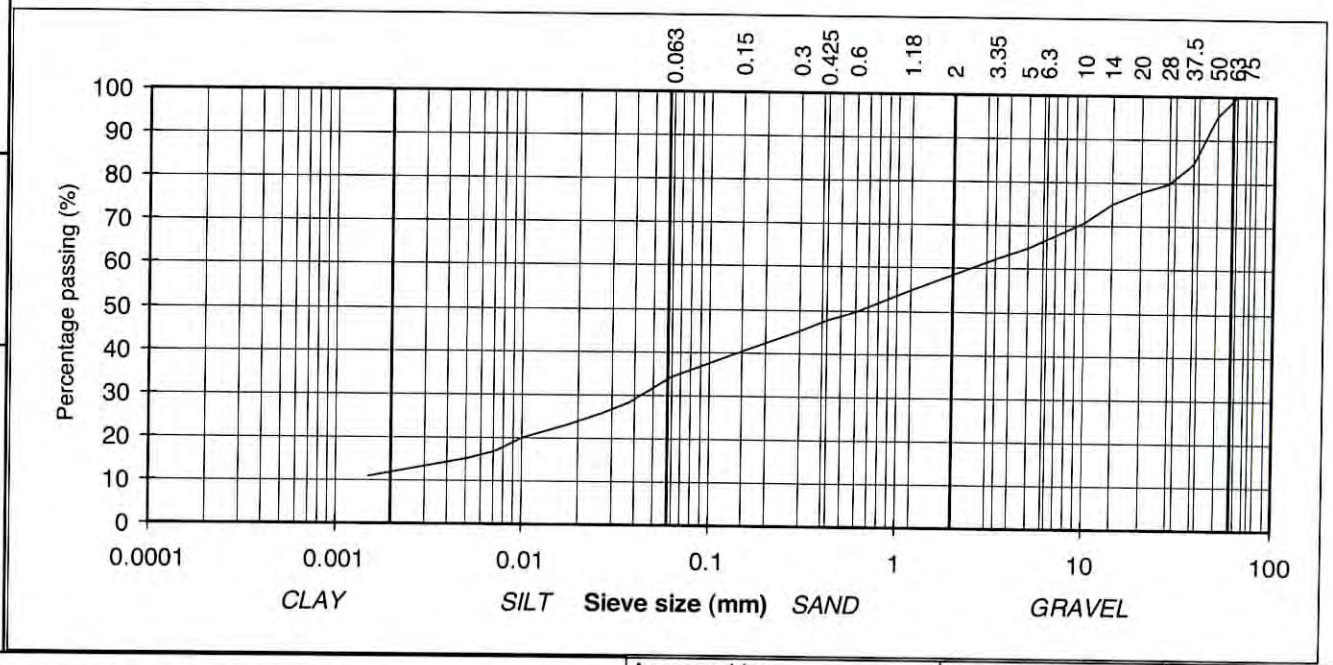
Approved by	Date	Page
H.Byrne	11/05/15	1 of 1

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	96	GRAVEL
37.5	84	
28	80	
20	78	
14	75	
10	71	
6.3	67	
5	65	
3.35	62	
2	58	
1.18	55	SAND
0.6	50	
0.425	47	
0.3	45	
0.15	40	
0.063	34	SILT/CLAY
0.037	28	
0.027	26	
0.017	23	
0.010	20	
0.007	17	
0.005	15	
0.002	11	

Contract No: 18341 Report No. R64507
Contract: Clonshaugh Industrial Estate
Bh: BH01
Sample No. AA29450 Lab. Sample No. A15/1380
Sample Type: B
Depth (m) 3.00m Customer: CSE
Date Received 10/04/2015 Date Testing started 15/04/2015
Description: Dark Brown slightly sandy, gravelly, CLAY

Remarks



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	94	GRAVEL
37.5	92	
28	85	
20	82	
14	79	
10	76	
6.3	71	
5	69	
3.35	66	
2	62	
1.18	58	SAND
0.6	52	
0.425	50	
0.3	48	
0.15	43	
0.063	37	SILT/CLAY
0.037	33	
0.026	29	
0.017	26	
0.010	24	
0.007	22	
0.005	20	
0.001	15	

Contract No: 18341 Report No. R64450

Contract: Clonshaugh Industrial Estate

Bh: BH02

Sample No. AA29432 Lab. Sample No. A15/1381

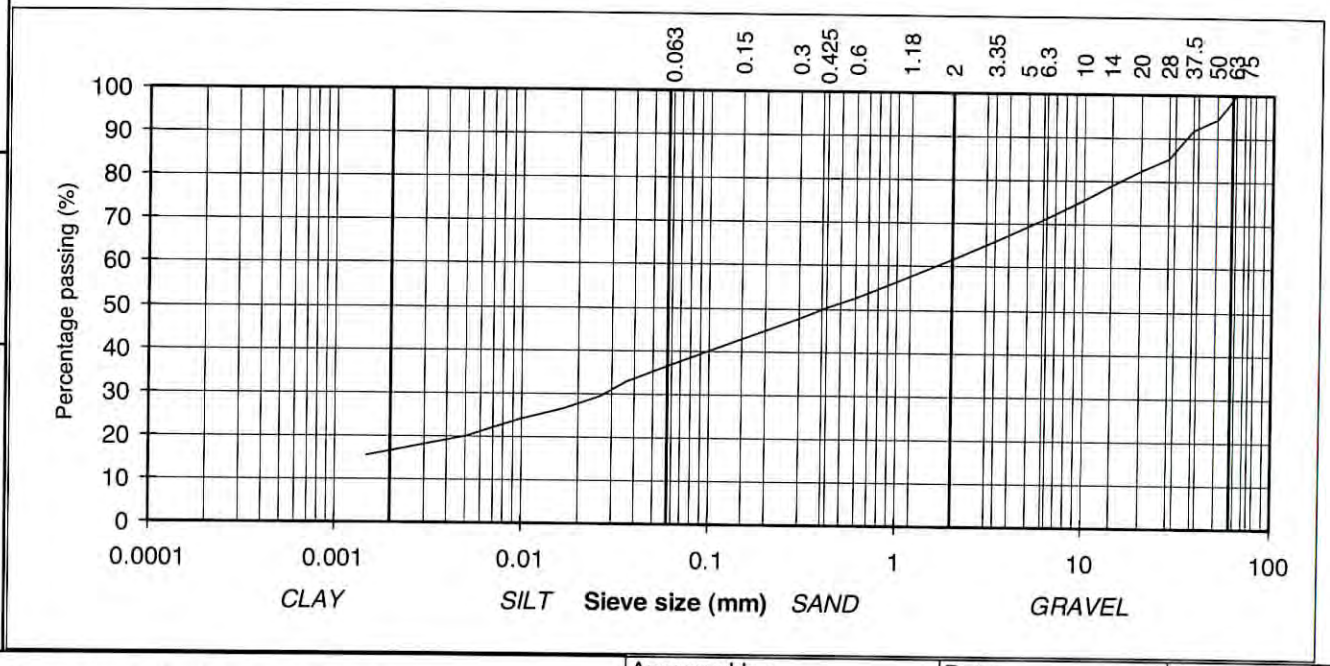
Sample Type: B

Depth (m) 2.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, gravelly, CLAY

Remarks



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

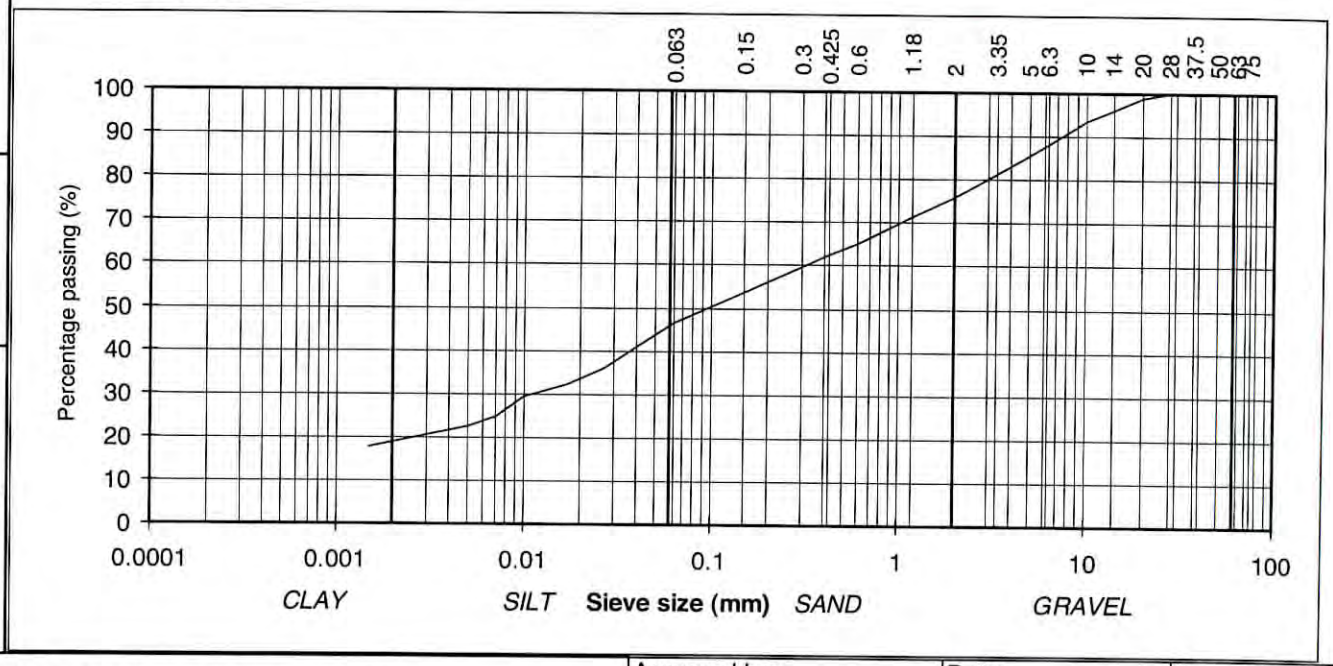
Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	99	
14	96	
10	93	
6.3	88	
5	85	
3.35	81	
2	76	
1.18	71	SAND
0.6	65	
0.425	62	
0.3	60	
0.15	54	
0.063	46	SILT/CLAY
0.037	40	
0.027	36	
0.017	32	
0.010	29	
0.007	25	
0.005	23	
0.002	18	

Contract No: 18341 Report No. R64451
Contract: Clonshaugh Industrial Estate
Bh: BH03
Sample No. AA29420 Lab. Sample No. A15/1383
Sample Type: B
Depth (m) 4.00m Customer: CSE
Date Received 10/04/2015 Date Testing started 15/04/2015
Description: Dark Brown slightly sandy, slightly gravelly, CLAY

Remarks



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	95	
20	94	
14	88	
10	84	
6.3	79	
5	77	
3.35	73	
2	69	
1.18	64	SAND
0.6	59	
0.425	56	
0.3	53	
0.15	48	
0.063	41	SILT/CLAY
0.037	34	
0.027	31	
0.017	28	
0.010	25	
0.007	22	
0.005	20	
0.002	16	

Contract No: 18341 Report No. R64452

Contract: Clonshaugh Industrial Estate

Bh: BH04

Sample No. AA29426 Lab. Sample No. A15/1384

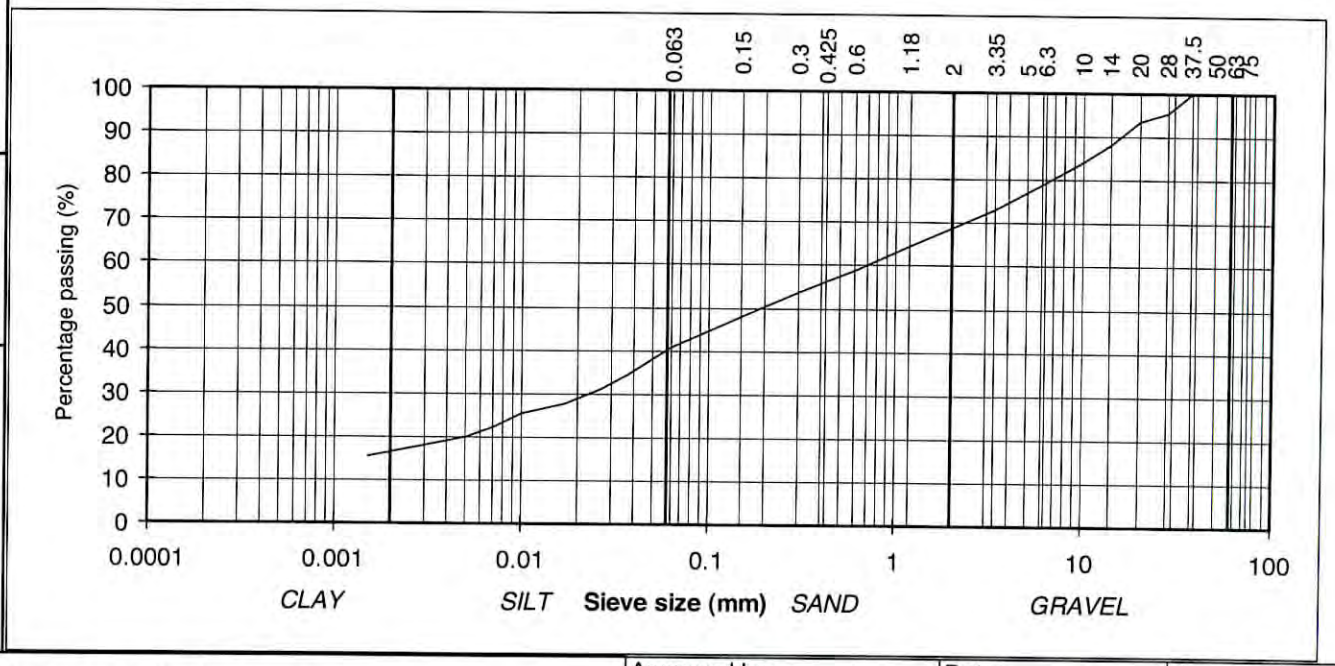
Sample Type: B

Depth (m) 3.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, slightly gravelly, CLAY

Remarks



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	97	
20	94	
14	90	
10	85	
6.3	80	
5	78	
3.35	74	
2	68	
1.18	64	SAND
0.6	58	
0.425	56	
0.3	53	
0.15	48	
0.063	42	SILT/CLAY
0.038	36	
0.027	33	
0.017	30	
0.010	28	
0.007	26	
0.005	24	
0.001	20	

Contract No: 18341 Report No. R64508

Contract: Clonshaugh Industrial Estate

Bh: BH05

Sample No. AA31091 Lab. Sample No. A15/1386

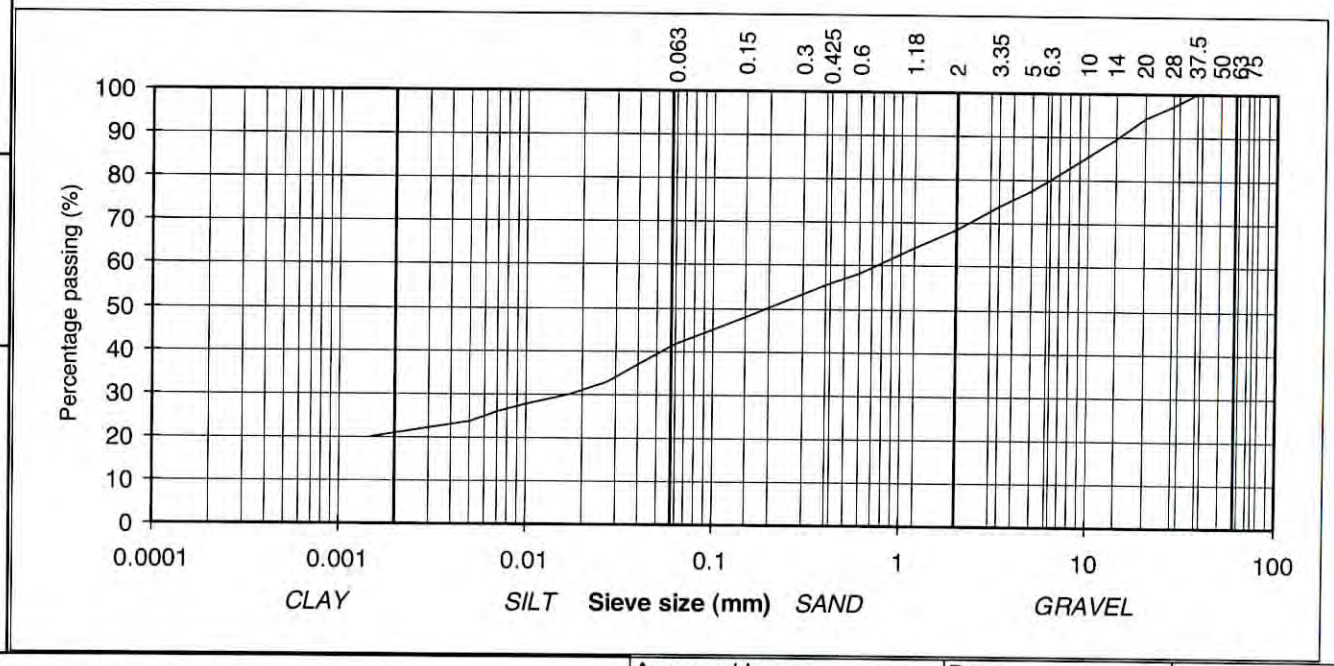
Sample Type: B

Depth (m) 6.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, slightly gravelly, CLAY

Remarks



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	91	
50	85	GRAVEL
37.5	85	
28	82	
20	79	
14	76	
10	74	
6.3	69	
5	67	
3.35	64	
2	60	
1.18	56	SAND
0.6	51	
0.425	49	
0.3	46	
0.15	41	
0.063	35	SILT/CLAY
0.038	31	
0.027	29	
0.017	26	
0.010	24	
0.007	22	
0.005	19	
0.002	16	

Contract No: 18341 Report No. R64453

Contract: Clonshaugh Industrial Estate

Bh: BH06

Sample No. AA31072 Lab. Sample No. A15/1388

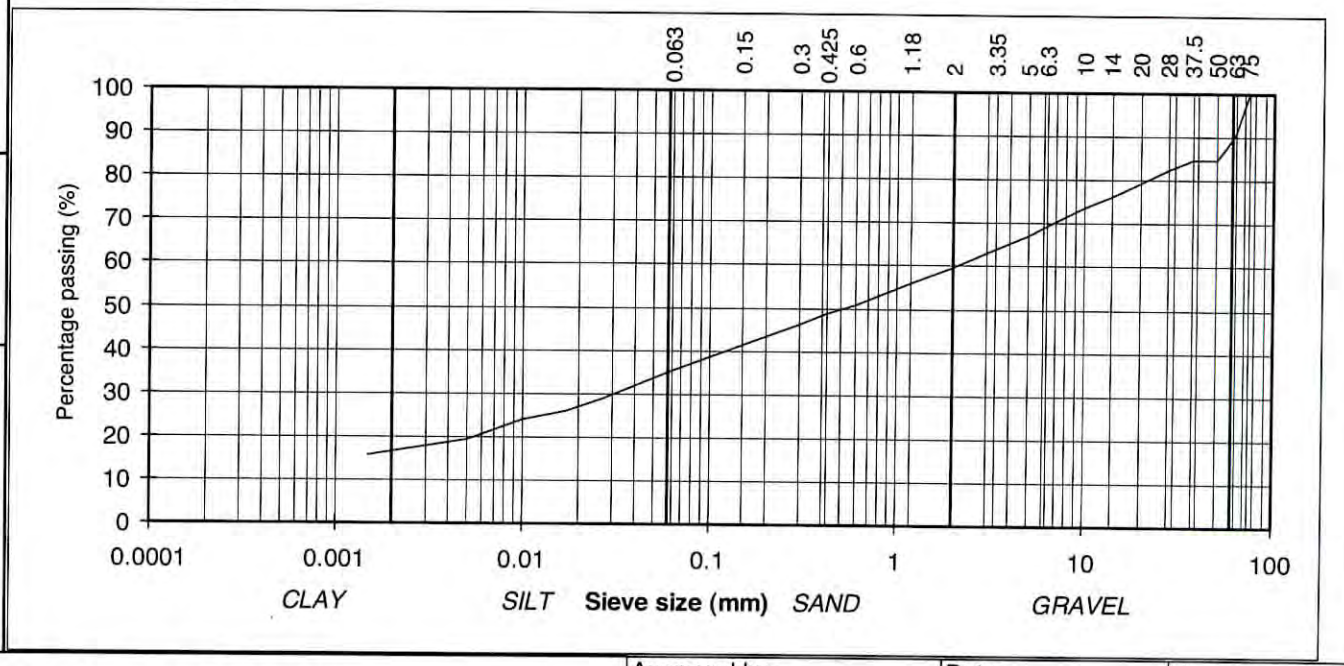
Sample Type: B

Depth (m) 3.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, gravelly, CLAY with some cobbles

Remarks



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	97	
20	96	
14	92	
10	89	
6.3	83	
5	81	
3.35	75	
2	70	
1.18	65	SAND
0.6	59	
0.425	56	
0.3	54	
0.15	48	
0.063	42	SILT/CLAY
0.037	36	
0.026	33	
0.017	29	
0.010	26	
0.007	24	
0.005	22	
0.001	18	

Contract No: 18341 Report No. R64454

Contract: Clonshaugh Industrial Estate

Bh: BH08

Sample No. AA31066 Lab. Sample No. A15/1395

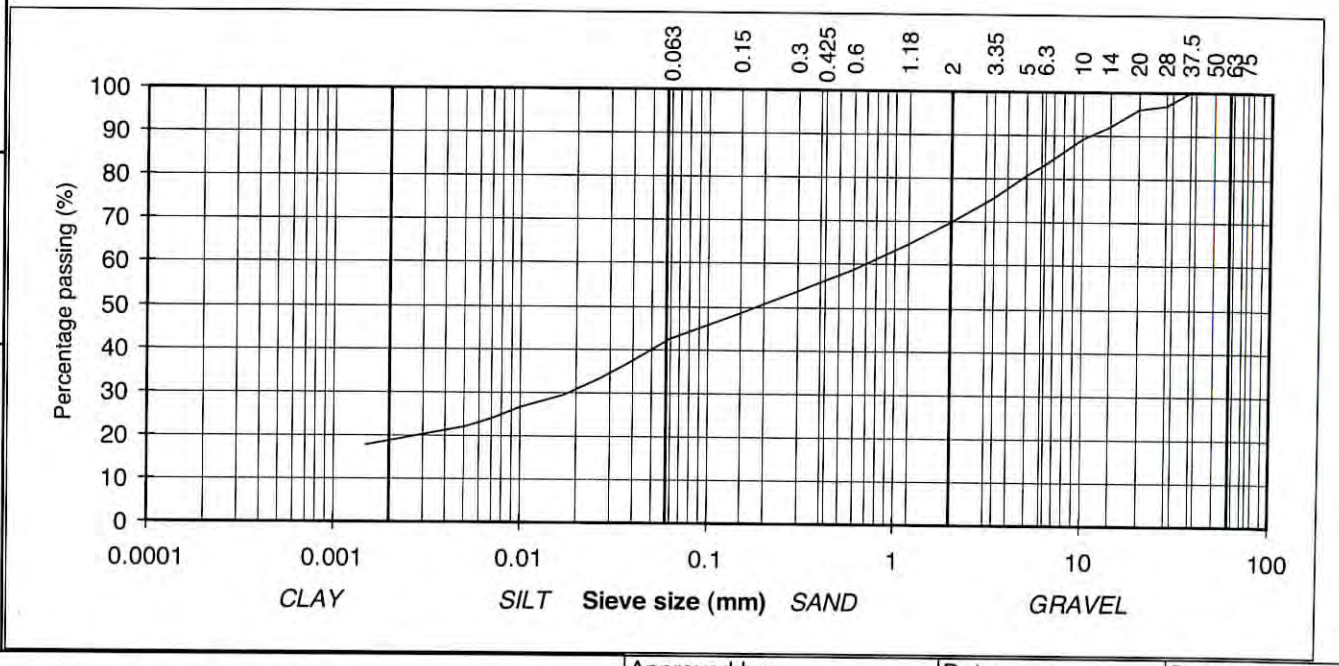
Sample Type: B

Depth (m) 4.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, slightly gravelly, CLAY

Remarks



IGSL Ltd Materials Laboratory

Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	82	
50	82	GRAVEL
37.5	78	
28	72	
20	68	
14	66	
10	63	
6.3	60	
5	58	
3.35	56	
2	52	
1.18	49	SAND
0.6	44	
0.425	42	
0.3	40	
0.15	36	
0.063	31	SILT/CLAY
0.037	27	
0.027	24	
0.017	21	
0.010	19	
0.007	18	
0.005	16	
0.002	12	

Contract No: 18341 Report No. R64509

Contract: Clonshaugh Industrial Estate

Bh: BH09

Sample No. AA29442 Lab. Sample No. A15/1397

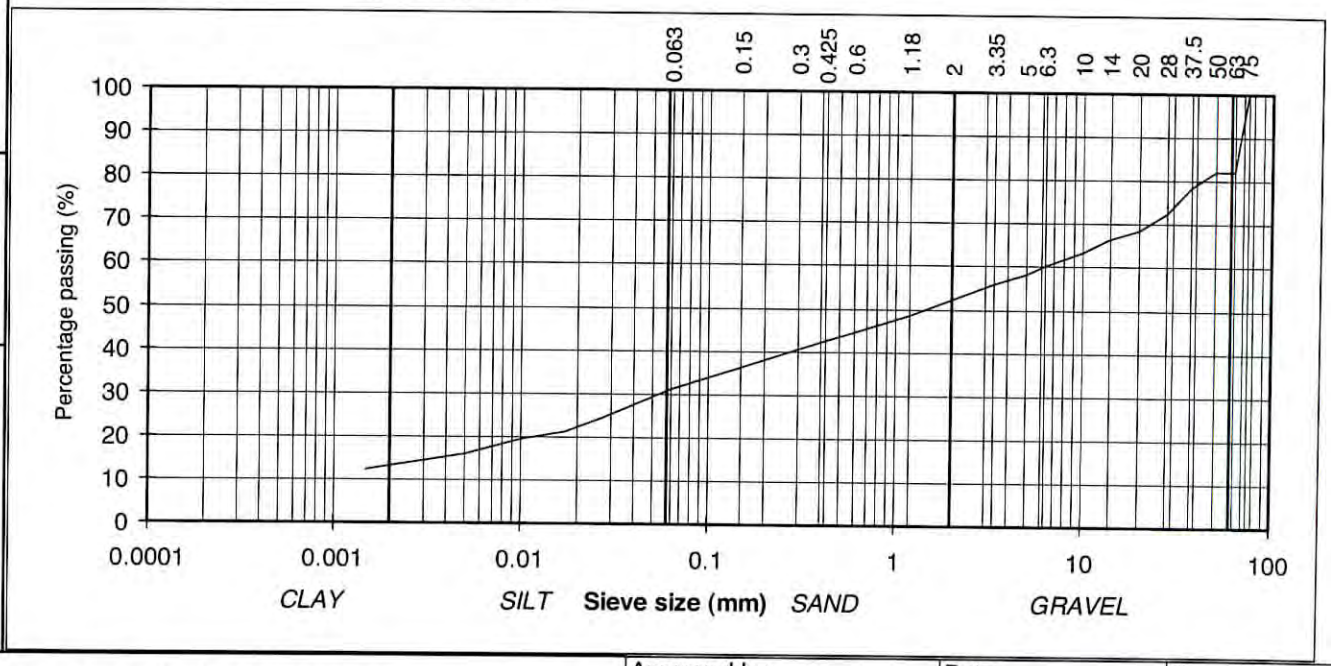
Sample Type: B

Depth (m) 3.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, gravelly, CLAY with some cobbles

Remarks Sample size did not meet the requirements of BS1377



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	90	
50	90	GRAVEL
37.5	88	
28	86	
20	82	
14	81	
10	78	
6.3	74	
5	71	
3.35	68	
2	63	
1.18	59	SAND
0.6	53	
0.425	51	
0.3	48	
0.15	43	
0.063	37	SILT/CLAY
0.037	32	
0.027	29	
0.017	27	
0.010	24	
0.007	22	
0.005	19	
0.001	16	

Contract No: 18341 Report No. R64455

Contract: Clonshaugh Industrial Estate

Bh: BH10

Sample No. AA31058 Lab. Sample No. A15/1400

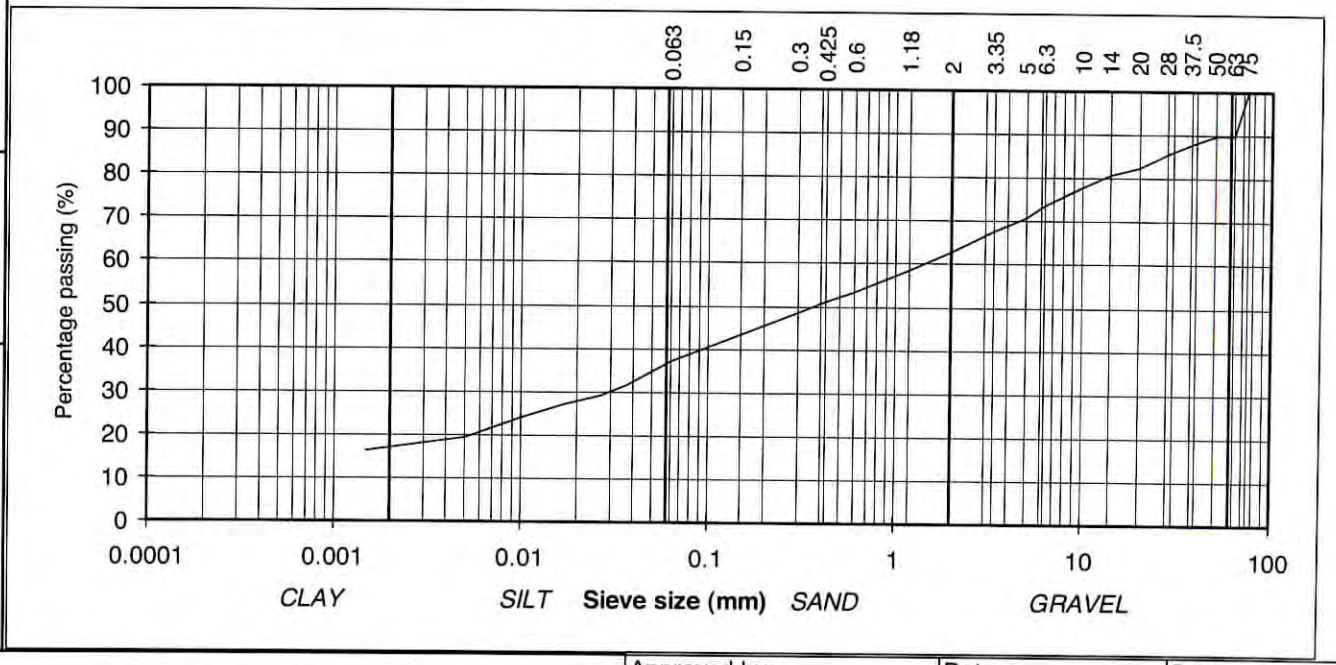
Sample Type: B

Depth (m) 3.00m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Dark Brown slightly sandy, gravelly, CLAY with some cobbles

Remarks Sample size did not meet the requirements of BS1377



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	98	
28	96	
20	92	
14	87	
10	82	
6.3	78	
5	75	
3.35	72	
2	68	
1.18	64	SAND
0.6	58	
0.425	56	
0.3	53	
0.15	48	
0.063	41	SILT/CLAY
0.037	35	
0.027	31	
0.017	27	
0.010	24	
0.007	21	
0.005	19	
0.002	15	

Contract No: 18341 Report No. R64510

Contract: Clonshaugh Industrial Estate

TP: TP01

Sample No. AA32409/11 Lab. Sample No. A15/1401

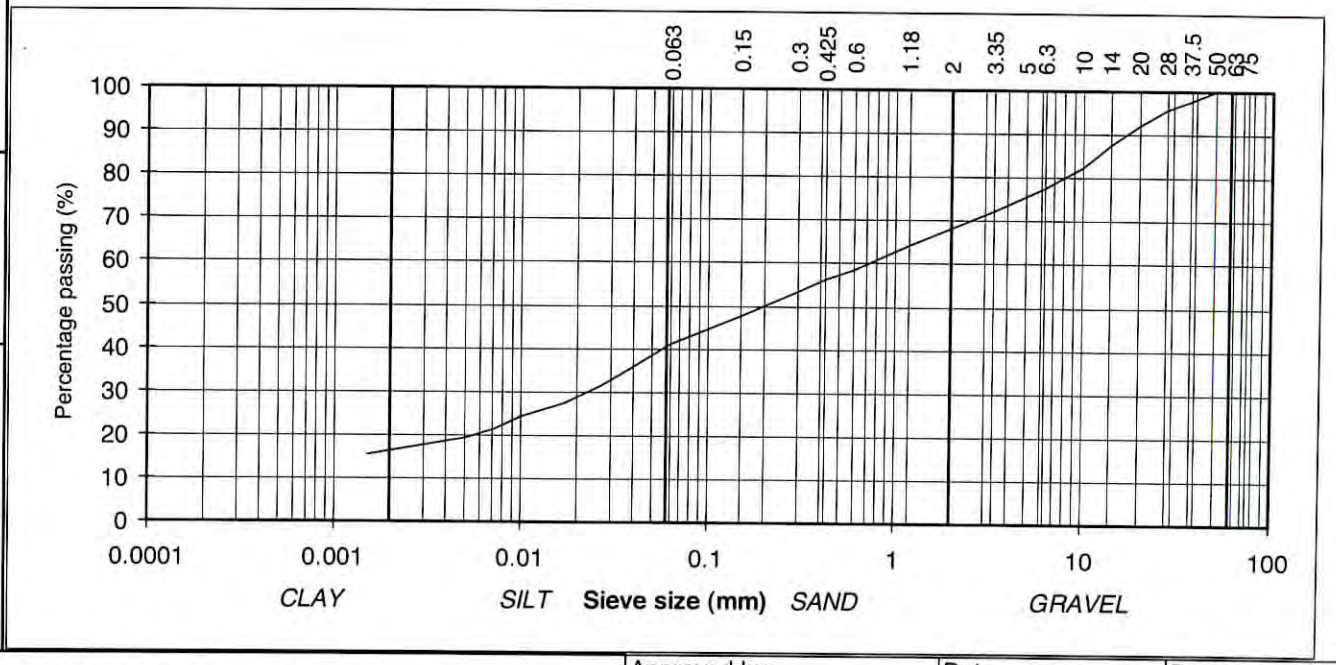
Sample Type: B

Depth (m) 0.60-2.20m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Mottled brown slightly sandy, slightly gravelly, CLAY

Remarks



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

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TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	99	
20	96	
14	94	
10	92	
6.3	88	
5	86	
3.35	83	
2	79	
1.18	75	SAND
0.6	71	
0.425	69	
0.3	67	
0.15	62	
0.063	54	SILT/CLAY
0.037	48	
0.027	44	
0.017	39	
0.010	34	
0.007	30	
0.005	28	
0.002	22	

Contract No: 18341 Report No. R64511

Contract: Clonshaugh Industrial Estate

TP: TP03

Sample No. AA32401/3 Lab. Sample No. A15/1402

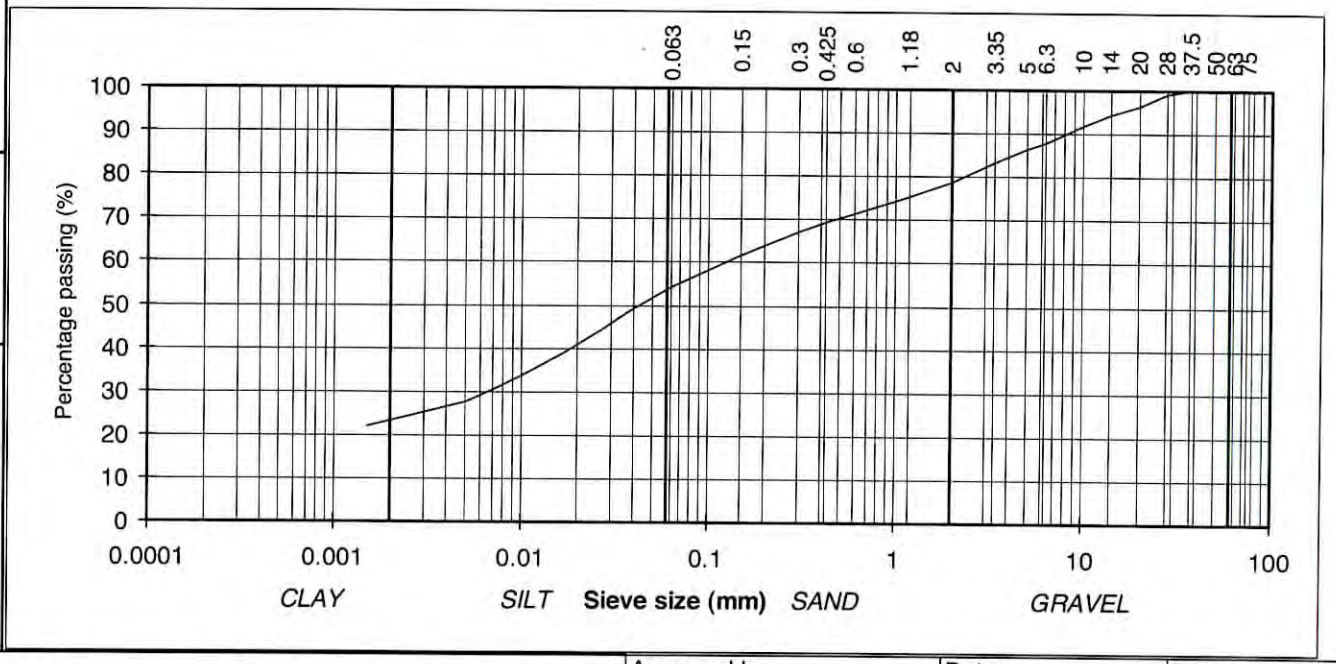
Sample Type: B

Depth (m) 0.30-1.90m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Brown slightly sandy, slightly gravelly, CLAY

Remarks



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	96	GRAVEL
37.5	86	
28	80	
20	75	
14	70	
10	67	
6.3	62	
5	61	
3.35	58	
2	54	
1.18	51	SAND
0.6	47	
0.425	45	
0.3	42	
0.15	37	
0.063	30	SILT/CLAY
0.037	25	
0.027	23	
0.017	21	
0.010	19	
0.007	18	
0.005	16	
0.001	14	

Contract No: 18341 Report No. R64456

Contract: Clonshaugh Industrial Estate

Bh: TP07

Sample No. AA32420/2 Lab. Sample No. A15/1403

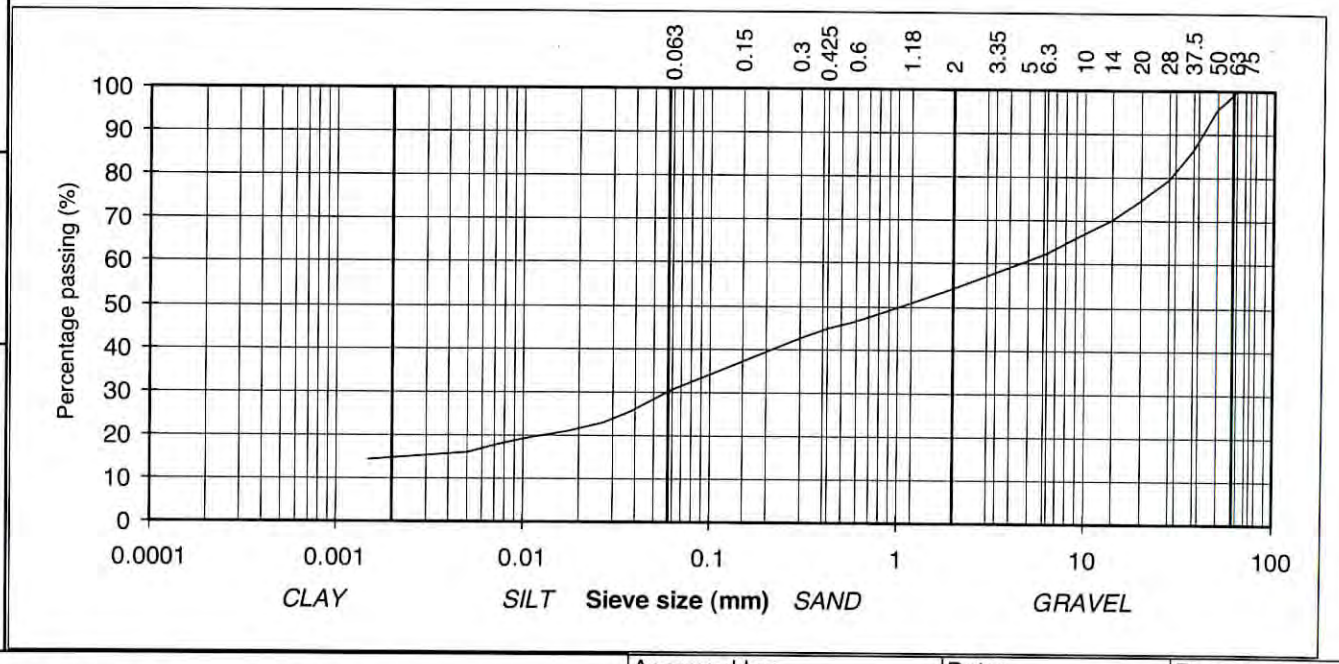
Sample Type: B

Depth (m) 0.30-2.20m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Mottled brown slightly sandy, gravelly, CLAY

Remarks



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H Byrne	11/05/15	1 of 1

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TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	95	
20	93	
14	90	
10	86	
6.3	82	
5	79	
3.35	75	
2	70	
1.18	66	SAND
0.6	60	
0.425	58	
0.3	55	
0.15	50	
0.063	44	SILT/CLAY
0.037	39	
0.027	35	
0.017	32	
0.010	28	
0.007	26	
0.005	24	
0.001	19	

Contract No: 18341 Report No. R64457

Contract: Clonshaugh Industrial Estate

TP: TP09

Sample No. AA32424/6 Lab. Sample No. A15/1404

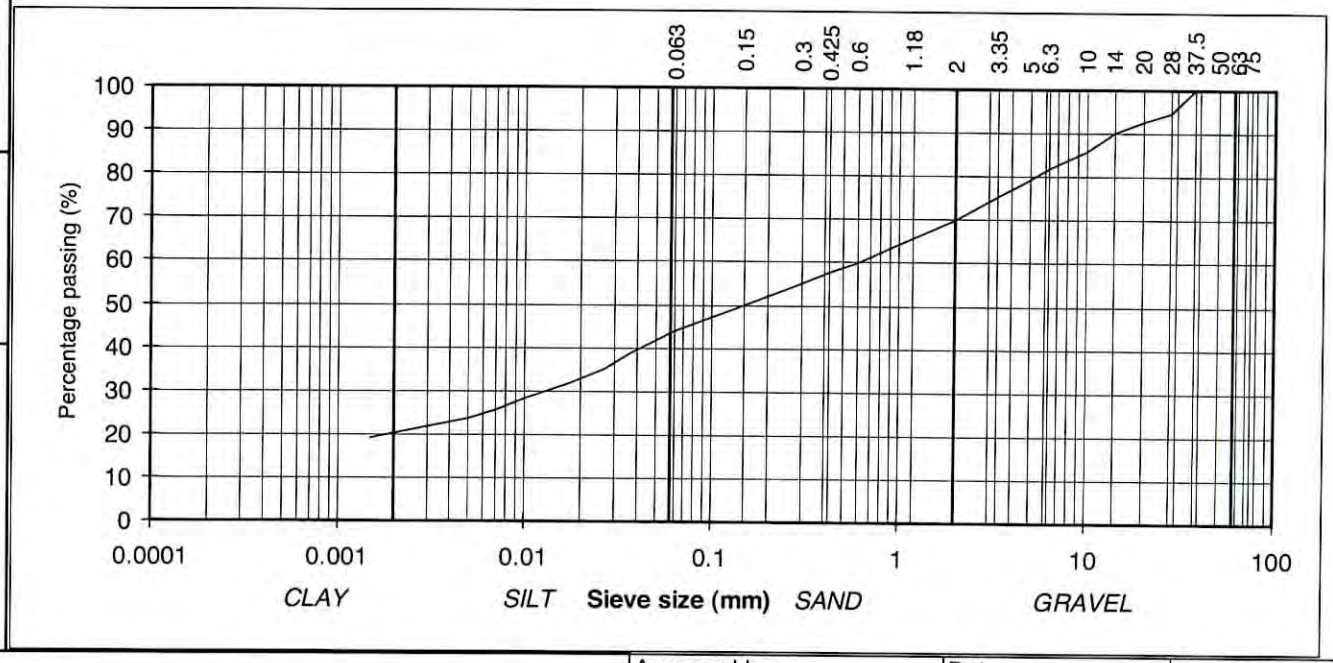
Sample Type: B

Depth (m) 0.50-2.80m Customer: CSE

Date Received 10/04/2015 Date Testing started 15/04/2015

Description: Mottled brown slightly sandy, slightly gravelly, CLAY

Remarks



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Approved by:	Date:	Page no:
H Byrne	11/05/15	1 of 1

Persons authorized to approve reports: J Barrett (Deputy Quality Manager) H Byrne (Quality Manager)

IGSL Ltd
Unit J5, Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. R64783 Contract No. 18341

Contract Name: Clonshaugh Industrial Estate

Lab Contract No. 18341 Location: TP01

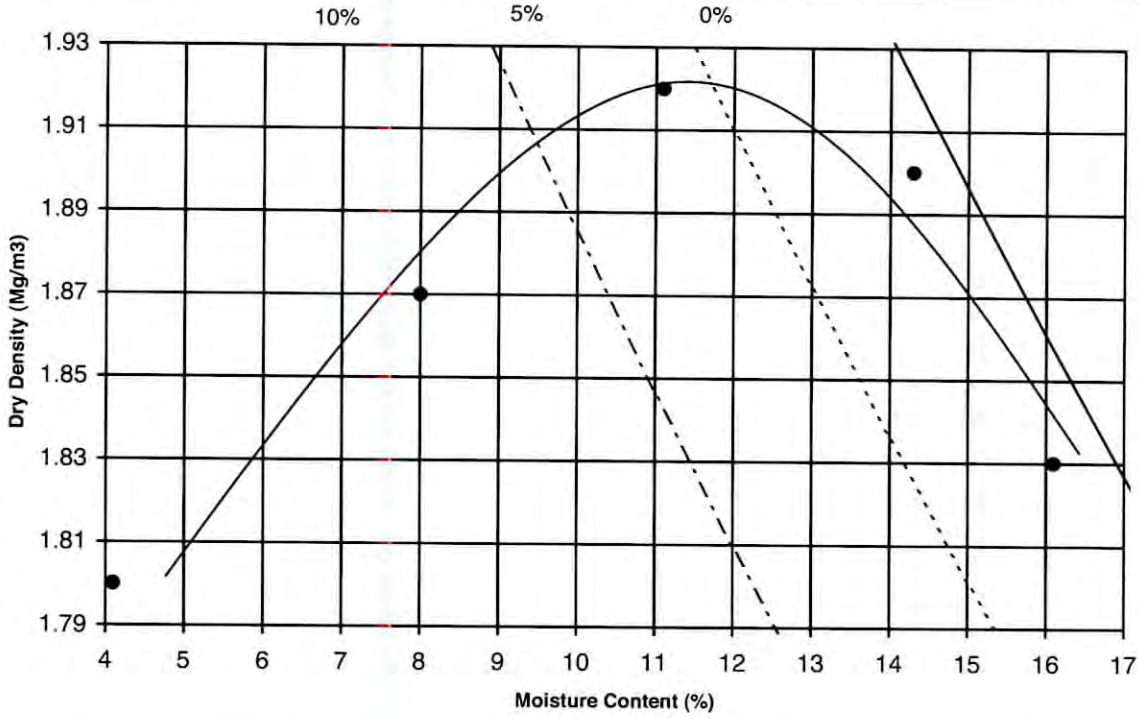
Sample No. AA32409/11 Depth (m) 0.60-2.20m Material Type B

Lab sample no. A15/1401 Customer: CSE

Date Received: 10/04/2015 Test Method: 2.5 KG Rammer

Date Tested: 20/04/2015 BS1377:Part 4:1990 3.3

Dry Density (Mg/m^3)	1.90	1.92	1.87	1.80	1.83		
Moisture Content (%)	14	11	8.0	4.1	16		



Maximum Dry Density (Mg/m^3): 1.92 Optimum Moisture Content (%): 11

Description: Mottled brown slightly sandy, slightly gravelly, CLAY

Sample Preparation: Material passing 20mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.65 Particle Density: Assumed

% retained on 20/37.5mm sieve: 11

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd
Unit J5, Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. R64719 Contract No. 18341

Contract Name: Clonshaugh Industrial Estate

Lab Contract No. 18341 Location: TP03

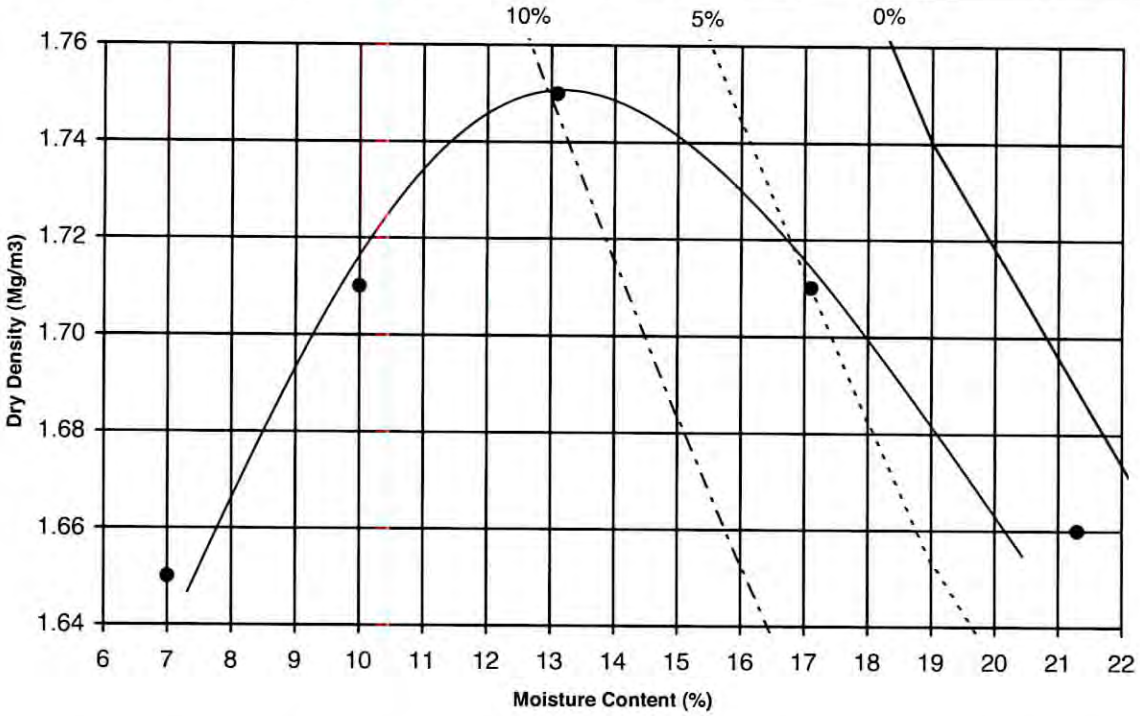
Sample No. AA32401/3 Depth (m) 0.30-1.90m Material Type B

Lab sample no. A15/1402 Customer: CSE

Date Received: 10/04/2015 Test Method: 2.5 KG Rammer

Date Tested: 20/04/2015 BS1377:Part 4:1990 3.3

Dry Density (Mg/m^3)	1.66	1.71	1.75	1.71	1.65		
Moisture Content (%)	21	17	13	10	7.0		



Maximum Dry Density (Mg/m^3): 1.75 Optimum Moisture Content (%): 13

Description: Brown slightly sandy, slightly gravelly, CLAY

Sample Preparation: Material passing 20mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.60 Particle Density: Assumed

% retained on 20/37.5mm sieve: 8.4

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd
Unit J5, Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No. R64786 Contract No. 18341

Contract Name: Clonshaugh Industrial Estate

Lab Contract No. 18341 Location: TP07

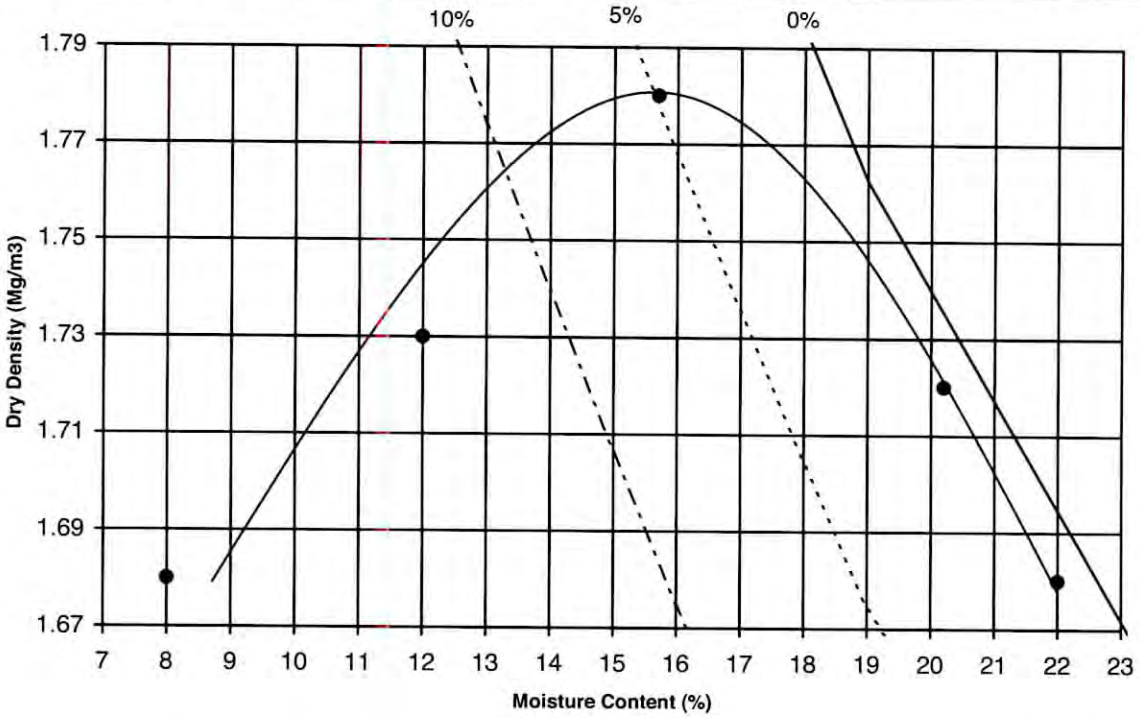
Sample No. AA32420/1 Depth (m) 0.30-2.20m Material Type B

Lab sample no. A15/1403 Customer: CSE

Date Received: 10/04/2015 Test Method: 2.5 KG Rammer

Date Tested: 20/04/2015 BS1377:Part 4:1990 3.3

Dry Density (Mg/m^3)	1.72	1.78	1.73	1.68	1.68		
Moisture Content (%)	20	16	12	8.0	22		



Maximum Dry Density (Mg/m^3): 1.78 Optimum Moisture Content (%): 16

Description: Mottled brown slightly sandy, gravelly, CLAY

Sample Preparation: Material passing 20mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.65 Particle Density: Assumed

% retained on 20/37.5mm sieve: 13

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd
Unit J5 Materials Laboratory
M7 Business Park
Naas
Co. Kildare

Test Report

Dry Density/Moisture Content Relationship

Tested in accordance with BS1377:Part 4:1990

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1337

Report No. R64789 Contract No. 18341

Contract Name: Clonshaugh Industrial Estate

Lab Contract No. 18341 Location: TP09

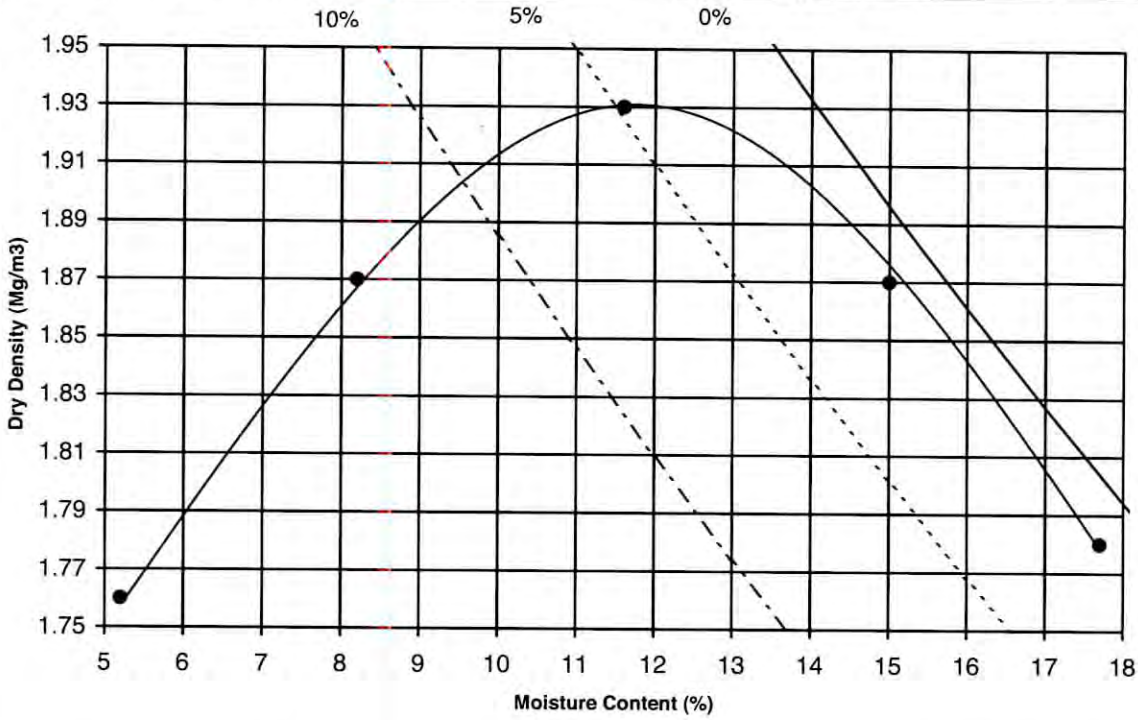
Sample No. AA32424/6 Depth (m) 0.50-2.80m Material Type B

Lab sample no. A15/1404 Customer: CSE

Date Received: 10/04/2015 Test Method: 2.5 KG Rammer

Date Tested: 20/04/2015 BS1377:Part 4:1990 3.3

Dry Density (Mg/m^3)	1.78	1.87	1.93	1.87	1.76		
Moisture Content (%)	18	15	12	8.2	5.2		



Maximum Dry Density (Mg/m^3): 1.93 Optimum Moisture Content (%): 12

Description: Mottled brown slightly sandy, slightly gravelly, CLAY

Sample Preparation: Material passing 20mm ~~Single~~ / Separate samples used

Particle Density (Mg/m^3): 2.65 Particle Density: Assumed

% retained on 20/37.5mm sieve: 7.2

The result relates to the specimen tested.
Opinions and interpretations are outside the scope of accreditation

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Materials Laboratory	Approved by	Date	Page
	H Byrne	08/05/15	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

Report No.	**R64785**
Contract No.	18341
Contract Name:	Clonshaugh Ind.Estate
Customer:	CSE
BH/TP	TP01
Sample No.	AA32409/11
Depth (m)	0.60-2.20m
Sample Type:	B
Lab Sample No.	A15/1401
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	10/04/15
Date Tested:	21/04/15
Sample Cert:	N/A
Moisture Content (%):	14
% Particles > 20mm (By dry mass):	12.3
MCV:	7.4
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Mottled brown slightly sandy, slightly gravelly, CLAY

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
	H Byrne	08/05/15	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.1331

Report No.	**R64721**
Contract No.	18341
Contract Name:	Clonshaugh Ind.Estate
Customer:	CSE
BH/TP	TP03
Sample No.	AA32401/3
Depth (m)	0.30-1.90m
Sample Type:	B
Lab Sample No.	A15/1402
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	10/04/15
Date Tested:	20/04/15
Sample Cert:	N/A
Moisture Content (%):	21
% Particles > 20mm (By dry mass):	10
MCV:	11.3
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Brown slightly sandy, slightly gravelly, CLAY

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
	H Byrne	05/05/15	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	**R64788**
Contract No.	18341
Contract Name:	Clonshaugh Ind.Estate
Customer:	CSE
BH/TP	TP07
Sample No.	AA32420/1
Depth (m)	0.30-2.20m
Sample Type:	B
Lab Sample No.	A15/1403
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	10/04/15
Date Tested:	21/04/15
Sample Cert:	N/A
Moisture Content (%):	20
% Particles > 20mm (By dry mass):	15.3
MCV:	5.7
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Mottled brown slightly sandy, gravelly, CLAY

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
	H Byrne	08/05/15	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

Test Report

Determination of Moisture Condition Value at Natural Moisture Content

Tested in accordance with BS1377:Part 4:1990, clause 5.4

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 13/31

Report No.	**R64791**
Contract No.	18341
Contract Name:	Clonshaugh Ind.Estate
Customer:	CSE
BH/TP	TP09
Sample No.	AA32424/6
Depth (m)	0.50-2.20m
Sample Type:	B
Lab Sample No.	A15/1404
Source (if applicable)	unknown
Material Type (if applicable):	B
Sample Received:	10/04/15
Date Tested:	21/04/15
Sample Cert:	N/A
Moisture Content (%):	18
% Particles > 20mm (By dry mass):	8.5
MCV:	6.9
Interpretation of Plot:	Steepest Straight Line
Description of Soil:	Mottled brown slightly sandy, slightly gravelly, CLAY

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Sampling and opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory	Approved by	Date	Page
	H Byrne	08/05/15	1 of 1

IGSL Ltd
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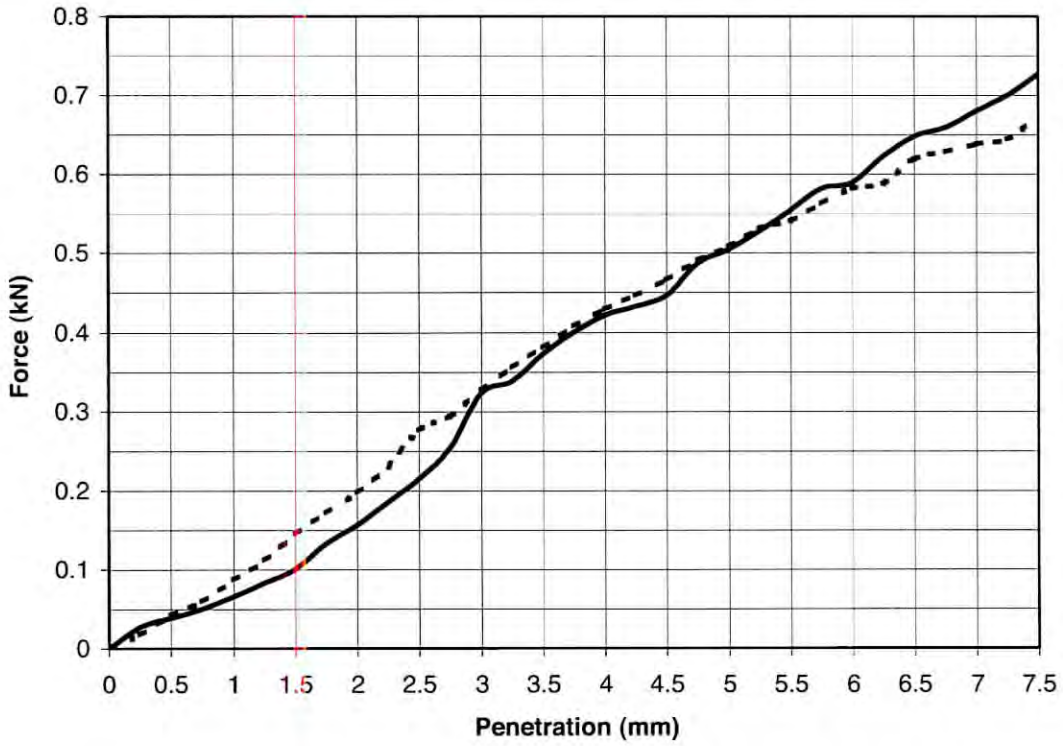
Unit J5,M7 Business Park
Naas Co.Kildare
045 899324

TEST REPORT
Determination of California Bearing Ratio (CBR)

Tested in accordance with BS1377:Part 4:1990, clause 7

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1337

Report No.	R64784	Contract	Clonshaugh Industrial Estate
Contract No.	18341	Customer	CSE
Date received	10/04/15	Date Tested	21/04/15
BH/TP No.	TP01	Sample No.	AA32409/11 Type: B
Depth (m)	0.60-2.20m	Lab sample No.	A15/1401



Key: ———— Top ---------- Base

Description: Mottled brown slightly sandy, slightly gravelly, CLAY

Initial Condition:	Unsoaked		
Moisture Content (%):	14	Bulk Density (Mg/m^3):	2.20
Surcharge (kg):	4	Dry Density (Mg/m^3):	1.92
% Material >20mm:	11		
Method of compaction:	Static Compaction Method 2		

Test Result	Top	Base
CBR %	**2.5**	**2.6**
Moisture Content %	14	15

Persons authorized to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory

Approved by	Date	Page No.
H Byrne	08/05/15	1 of 1

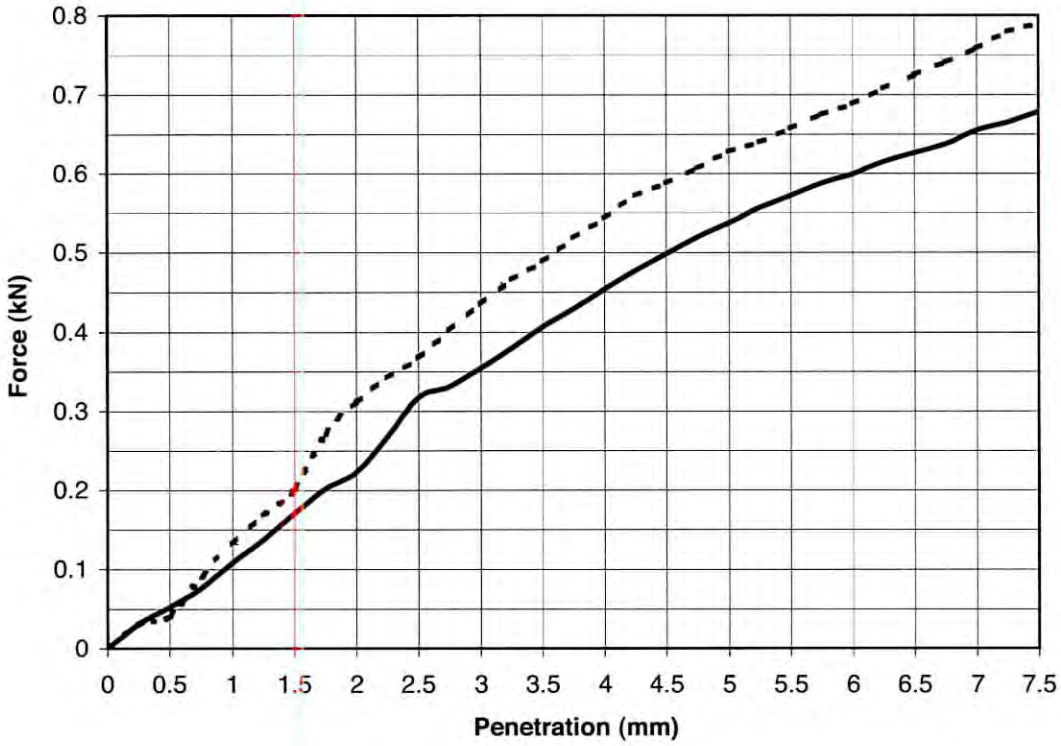
IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas Co.Kildare
045 899324

TEST REPORT
Determination of California Bearing Ratio (CBR)

Tested in accordance with BS1377:Part 4:1990, clause 7

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	R64720	Contract	Clonshaugh Industrial Estate
Contract No.	18341	Customer	CSE
Date received	10/04/15	Date Tested	20/04/15
BH/TP No.	TP03	Sample No.	AA32401/3 Type: B
Depth (m)	0.30-1.90,	Lab sample No.	A15/1402



Key: ——— Top ---------- Base

Description:	Brown slightly sandy slightly gravelly CLAY		
Initial Condition:	Unsoaked		
Moisture Content (%):	21	Bulk Density (Mg/m^3):	2.05
Surcharge (kg):	4	Dry Density (Mg/m^3):	1.69
% Material >20mm:	8.4		
Method of compaction:	Static Compaction Method 2		

Test Result	Top	Base
CBR %	**2.7**	**3.2**
Moisture Content %	21	22

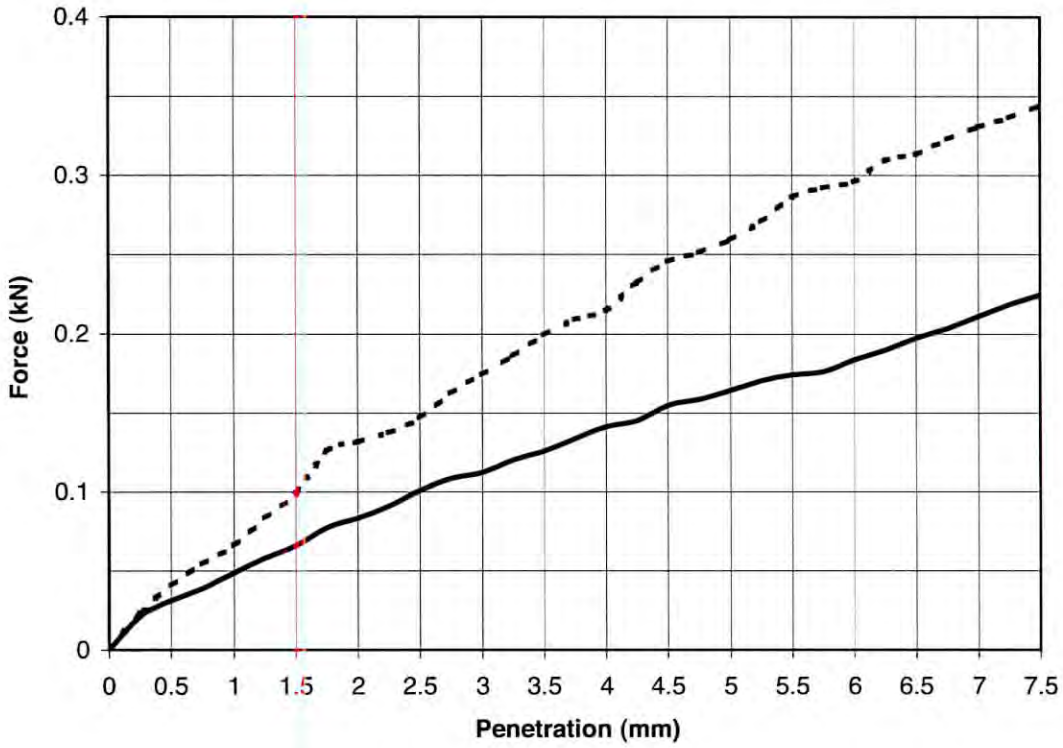
Persons authorized to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory

Approved by	Date	Page No.
H Byrne	05/05/15	1 of 1

IGSL Ltd Materials Laboratory Unit J5,M7 Business Park Naas Co.Kildare 045 899324	TEST REPORT Determination of California Bearing Ratio (CBR) Tested in accordance with BS1377:Part 4:1990, clause 7	ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	R64787	Contract	Clonshaugh Industrial Estate		
Contract No.	18341	Customer	CSE		
Date received	10/04/15	Date Tested	21/04/15		
BH/TP No.	TP07	Sample No.	AA32420/1	Type:	B
Depth (m)	0.30-2.20m	Lab sample No.		A15/1403	



Key: ———— Top ---------- Base

Description:	Mottled brown slightly sandy, gravelly, CLAY		
Initial Condition:	Unsoaked		
Moisture Content (%):	20	Bulk Density (Mg/m^3):	2.07
Surcharge (kg):	4	Dry Density (Mg/m^3):	1.72
% Material >20mm:	13		
Method of compaction:	Static Compaction Method 2		

Test Result	Top	Base
CBR %	**0.8**	**1.3**
Moisture Content %	20	20

Persons authorized to approve reports

J Barrett (Dep. Quality Manager)

H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory

Approved by	Date	Page No.
H Byrne	08/05/15	1 of 1

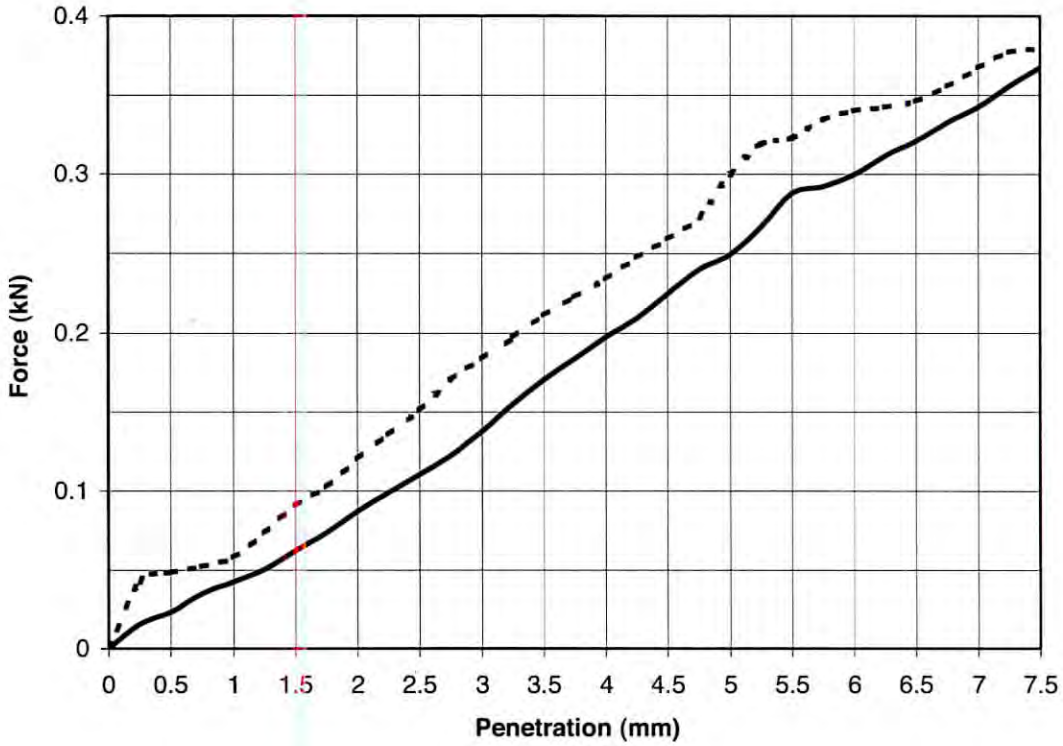
IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas Co.Kildare
045 899324

TEST REPORT
Determination of California Bearing Ratio (CBR)

Tested in accordance with BS1377:Part 4:1990, clause 7

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Report No.	R64790	Contract	Clonshaugh Industrial Estate
Contract No.	18341	Customer	CSE
Date received	10/04/15	Date Tested	21/04/15
BH/TP No.	TP09	Sample No.	AA32424/26 Type: B
Depth (m)	0.50-2.80m	Lab sample No.	A15/1404



Key: ———— Top ---------- Base

Description:	Mottled brown slightly sandy, slightly gravelly, CLAY		
Initial Condition:	Unsoaked		
Moisture Content (%):	18	Bulk Density (Mg/m^3):	2.17
Surcharge (kg):	4	Dry Density (Mg/m^3):	1.84
% Material >20mm:	7.3		
Method of compaction:	Static Compaction Method 2		

Test Result	Top	Base
CBR %	**1.3**	**1.5**
Moisture Content %	18	18

Persons authorized to approve reports
J Barrett (Dep. Quality Manager)
H Byrne (Quality Manager)

IGSL Ltd Materials Laboratory

Approved by	Date	Page No.
H Byrne	08/05/15	1 of 1

Jones Environmental Laboratory

Unit 3 Deeside Point
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Deeside Industrial Park
Deeside
CH5 2UA

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Fax: +44 (0) 1244 833781

IGSL
Unit F
M7 Business Park
Naas
Co Kildare
Ireland

4225

Attention :	Darren Keogh
Date :	8th May, 2015
Your reference :	Clonshaugh
Our reference :	Test Report 15/6544
Location :	
Date samples received :	24th April, 2015
Status :	Final report
Issue :	1

Nine samples were received for analysis on 24th April, 2015 of which nine were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Where Waste Acceptance Criteria Suite (EC Decision of 19 December 2002 (2003/33/EC)) has been requested, all analyses have been performed using the relevant EN methods where they exist.

Compiled By:

Belinda Lewsley BA
Project Co-ordinator

Bob Millward BSc FRSC
Principal Chemist

Jones Environmental Laboratory

Client Name: IGSL
Reference: Clonshaugh
Location:
Contact: Darren Keogh
JE Job No.: 15/6544

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1	2	3	4	5	6	7	8	9				
Sample ID	BH1	BH2	BH4	BH5	BH6	BH7	BH8	BH9	BH10				
Depth	1.0	2.0	3.0	6.0	1.0	2.0	4.0	1.0	2.0		Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	J	J	J	J	J	J	J	J	J				
Sample Date	22/04/2015	22/04/2015	22/04/2015	22/04/2015	22/04/2015	22/04/2015	22/04/2015	22/04/2015	22/04/2015				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	24/04/2015	24/04/2015	24/04/2015	24/04/2015	24/04/2015	24/04/2015	24/04/2015	24/04/2015	24/04/2015		LOD/LOR	Units	Method No.
Sulphate as SO4 (2:1 Ext) #	0.0135	0.2777	0.2647	0.0969	0.0095	0.0158	0.4082	0.0098	0.0476		<0.0015	g/l	TM38/PM20
pH #	8.73	8.12	8.08	8.32	8.77	8.65	8.05	8.70	8.52		<0.01	pH units	TM73/PM11

Appendix IV Site Location Plan

NOTES | A1

N

TP 9 — TRIAL PIT LOCATION

BH 10 — BOREHOLE LOCATION

REV.	DATE	DESCRIPTION	CHK'D	APP'D

FOR INFORMATION ONLY

Clifton Scannell Emerson Associates

PROJECT: DUB 54 CLONSHAUGH

TITLE: DUB 54 GE SUPERABRASIVES GEOTECHNICAL INVESTIGATIONS

DATE:	DESIGNED:	DRAWN:
06/03/15	DK	DK

SCALE:	PROJECT NO.:	DRAWING NO & REV.:
1:1000	14_219	14_219_103

CLIENT APPROVAL: DATE: