Fourfields: Stage 1&2 Ground Investigation Interpretative Report

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NorthConnect: Fourfields Stage 1&2 Ground Investigation Interpretative Report

1 Purpose

This document sets out the results of the Stage 1&2 ground investigations carried out on the proposed Fourfields converter station and AC cable route site near to Peterhead, which is the proposed UK landing point for the HVDC interconnector. Comprising trial pit observation, borehole drilling, sampling and various in-situ and laboratory testing, the basic purpose of the investigations were to inform the EIA and Planning proposals stage of the UK onshore works permitting process.

2 Objectives

The ground investigation and interpretative reporting has been carried out with the following objectives for the NorthConnect project:

- To carry out investigation for the soil characteristics and testing parameters which, defined in collaboration with the NorthConnect team, were judged to be necessary and sufficient to inform the EIA and Planning proposal work;
- To plan manage and undertake the site investigation, sampling and soil testing;
- To provide NorthConnect with results and interpretation to include commentary on the soil characteristics and testing in the context of both the current proposed plans for the converter station, and its future, post-consent design development requirements; and
- To input the necessary geotechnical information and proposals into the “consent design” which will be described in the Environmental Statement and other associated documents for the public consultation and Planning application.

3 Site, Proposed Scheme & Desk Study Findings

Location & General Description

The Fourfields site is located approximately 1.2km south west of Boddam and Stirling Village on the Buchan Coast, to the south of the port town of Perterhead, Aberdeenshire. A site location map is shown in Figure 1.

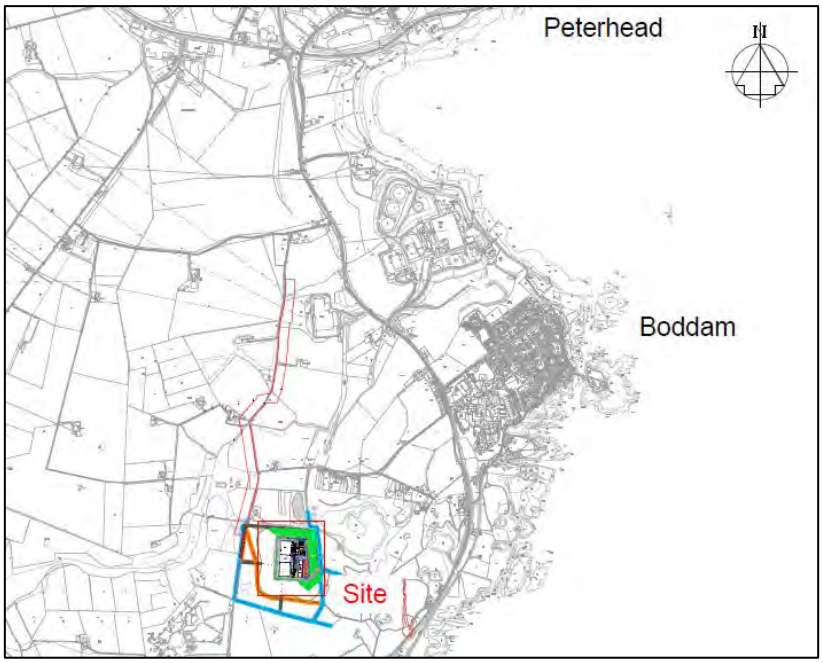

***Figure 1**: Area map with proposed Fourfields site and AC cable route location*

The site is bordered to the east by the Stirling Hill Quarry, to the north by a secondary quarry access road and a trout pond belonging to a nearby property known as Highfield, and to the south and west by open arable land. The A90 trunk road runs north east to south west approximately 600m to the east of the site and a minor road, Lendrum Terrace runs east-west approximately 400m to the north. Highfield is the closest property, with others located slightly further away on Lendrum Terrace to the north of the quarry. An MoD aircraft radar station, RAF Buchan Ness, is located on top of the hill approximately 700m to the south west.

The area around the site and Stirling Hill is in a generally elevated position, however, the site itself occupies a dip in the landscape with the ground profile sloping upwards moderately steeply through the quarry to the east and the fields to the south and west. The ground is generally flat immediately to the north and across the northern third of the proposed converter station footprint. It then slopes gently upwards north east to south west over the remainder of the footprint, and thereafter slightly more steeply up the field to the south and west.

The proposed cable track routes up the hill to the west of Fourfields and turns north to follow the crest of the hill along the west side of the track to the property Highfield, and then the metalled lane past the derelict Denend Farm. It then crosses to the east side of the lane into SSE Generation property, to follow the lane north into the substation connection site.

Designations

The site itself has no national environmental designations, however, the Bullers of Buchan Coast Site of Special Scientific Interest (SSSI) and Bullers of Buchan Geological Conservation Review Site (GCRS) is located approximately 700m East and South of the Fourfields site, its main geological features being the Coastal Geomorphology of Scotland

and Marine cliff. The Hill of Longhaven SSSI is located approximately 2.8km to the West of the Fourfields and AC cable route sites, its features being Quaternary geology and geomorphology. The Den of Boddam (Flint mining complex) Scheduled Monument archaeological heritage site is located approximately 400m to the west.

In terms of local designations, the Fourfields site, access road and most of the AC cable route is located within the Stirling Hill-Dudwick-Skelmuir Hill LNCS and previous Stirling Hill-Dudwick-Longhaven Coast SESA. The coastal SESA's are both noted for the same geomorphological reasons as the SSSI and GCRS above. The Stirling Hill-Dudwick-Skelmuir Hill LNCS is noted for the pre-glacial Buchan Gravels Formation which blankets the ridge. Related deposits also occur at nearby Windyhills, from which the Stirling Hill-Dudwick-Skelmuir Hill LNCS differs by being rich in flints, and these are under active research. The LNCS is considered to be of a unique nature in a Scottish context and also includes the Den of Boddam glacial meltwater channel (Aberdeenshire Council, 2013).

Proposed Scheme

The NorthConnect scheme is a joint venture project with the aim to plan, build and operate a HVDC power interconnector between Norway and the United Kingdom. The interconnector system involves DC subsea cables and AC/DC converter stations at either end of the link to connect into the closest national grid substations. The proposals for the Fourfields site include the UK converter station equipment, buildings and associated infrastructure, and also the underground AC and DC cable route approaches to the converter station. Only the AC cable route is included in the first onshore works EIA and Planning application.

NorthConnect have an outline design for the converter station site, shown in Appendix A, which has been the product of electrical, civil, environmental and landscape layout design undertaken over the course of the EIA process. The converter station will comprise a main building, steel framed and clad, approximately 190m long by 58m wide and 26.6m high at the crest of the roof. This will house the majority of the converter equipment except for the transformers, which will be housed in casings within two outdoor pens. The rest of the site footprint will comprise smaller buildings for ancilliary equipment, such as switchgear, cooling plant, fire suppression systems, and hardstanding for approach roads, services and site drainage. There are also elements of both hard and soft landscaping incorporated into the design, with substantial earth mounding proposed around the site for landscape and visual screening purposes.

Foundations will be as standard for a large, steel-framed building. The converter "halls" will require a reinforced concrete platform foundation / flooring, with depth and reinforcement increased in areas to support the heavier electrical equipment. Although certain cable and service ducting will be required within the flooring, the equipment is located substantially above floor level, so there are no large "basement" requirements per se within the foundation design. The base of the structural frame columns will require mass reinforced concrete pad or block footings appropriately sized. Where rockhead is encountered at or above foundation level, which is likely in this location over much of the building footprint, then smaller optimised rock founding options become available. The nature of electrical installations such as this, usually divide works into two different contracts: one for the civil "enabling" works including wider area infrastructure, site layout and groundworks up to "working platform" level; and then buildings, including foundations, will be constructed as part of the main electrical works and HVDC system packages. Having the converter station, and hence the working platform, all on one level is preferable for ease of operation and maintenance, however, the stations

can also potentially be two tiered at different levels depending upon landform, rock depth or other engineering or environmental constraints. NorthConnect have opted for a single tier design.

The cable route to the substation will comprise two AC circuits of three cables per circuit. Each circuit will be installed in a separate 1.5m wide trench set 7m apart, with the minimum depth to the top of the cables being 1200mm and total engineered depth including bedding material being approximately 1.5m. Deeper sections may be required at certain points to account for localized landform and two buried jointing bays will also be required along the cable route.

Previous Work

This study forms part of the examination which NorthConnect have undertaken of the Fourfields site specifically, however, NorthConnect previously commissioned walkover assessments and interpretation of another potential converter station site located 600m to the north west, and also of the potential cable landing point located 700m south east of Fourfields.

Both of these studies examined BGS area mapping of drift and solid geology, among other area-wide information, from which general conclusions and geological characteristics can also be drawn for the Fourfields site. The results of these studies can be found in:

- *"North Collielaw & Denend, Peterhead, Desk Study"*, ERS (Nov-13)[1]
- *"NorthConnect Landfall Option Study"*, Technip (Dec-13)[2]

A review and summary of relevant geological, hydrological and hydrogeological information to Fourfields in these reports is given in the following sections.

Geology

The solid and drift geology for the site is derived from the sources listed under Previous Work above. A review of the existing site data contained in these sources was undertaken.

Extracts from the 1:50,000 solid and drift geology BGS maps are reproduced in Appendix B.

Drift Geology

The BGS map indicates that most of the Peterhead area heading southward is mantled by glacial drift of Pleistocene Age, fluvioglacial and glacial sand and gravel and glacio-lacustrine deposits. Recent drift overlay includes coastal deposits of a very thin to absent alluvium associated with watercourses on the coast resulting from erosion. Over much of the inland area, glacial deposit comprises diamicton (otherwise known as boulder clay) of mainly red Hatton Till formation. These Hatton Till formation deposits are frequently very variable and fissured in nature, with sediment type varying rapidly horizontally and vertically. In general, there appears to be increase in thickness towards the north and east of the site location where the inferred form of the bedrock is highly irregular.

Solid Geology

The BGS maps also indicate the underlying bedrock of the area is dominated by Peterhead Pluton granite which creates a ragged coastline, highly sculpted/fractured cliffs and sea stacks. In general the granite, understood to belong to pre-Lower Old Red Sandstone Age, is a coarsely crystalline red rock, resting un-conformably on the old platform of slates and schists. The strata consist mainly of conglomerates and sandstones, associated with lenticular bands of andesite indicating contemporaneous volcanic action.

Anticipated Geology

The generalised soil conditions anticipated at the site are summarised in Table 1 below.

Age	Geological Unit	Depth (mbgl)	Lithology
Drift (Recent and Pleistocene)	Lake Alluvial (undifferentiated)	0.2 to 4m	Flood-plain, river-terrace and alluvial fan deposits of clay, silt, sand and gravel
	Hatton Till Formation (Diamicton)	Typically 2m, locally up to 10m	Unsorted glacial deposits of clay, sandy clay, sand with pebbles and boulders
Solid (Silurian)	Red Peterhead Pluton granite	Typically 1 to 10m	Conglomerate, with subsidiary horizons of sandstone and clay

***Table 1**:* Anticipated geology at the proposed site

Hydrology & Hydrogeology

The hydrology and hydrogeology for the site can be assessed in general terms from the sources listed under Previous Work above, and from observation at the site in trial pits and boreholes.

Hydrology

There are no classified water courses in the vicinity of the Fourfields site, however, the closest unclassified surface water features consist of:

- An unnamed burn flowing north along the eastern boundary of the site;
- A field drain flowing east along part of the northern boundary to meet the above burn at the north east corner of Fourfields;
- A large fish pond known as Braeside Trout Fishery beyond the northern boundary of the site; and
- Settlement ponds for the quarry, also beyond the northern boundary of the site on the eastern side of the above burn.

The eastern boundary of the site is designated as medium risk of flooding by SEPA along the line of the eastern field drain / ditch described above.

Surface water features along the AC cable route consist of:

- An unnamed burn flowing north east from the Den of Boddam Dam which crosses the cable route and unnamed road leading north from Lendrum Terrace; and
- Another unnamed burn, flowing east across the unnamed road, close to the point at which the cable route is proposed to cross the road just south of the property known as Hjaltland.

Hydrogeology

The interactive map of the 2008-2015 River Basin Management Plan (RBMP) published by SEPA shows that the groundwater body in the area is part of the "Peterhead bedrock and localised sand and gravel aquifer". However, from other evidence, the granite bedrock geology beneath the site appears to be typically impermeable and a poor aquifer for the following reasons. The BGS and SEPA classify the regional bedrock aquifer to be of low productivity (0.1-1 l/s) characterised by fracture flow processes within an unnamed igneous intrusion of late Silurian to early Devonian age. These rocks have negligible intergranular porosity and, therefore, can store groundwater only within fractures. All groundwater flow is through fractures, along bedding planes, joints or fault lines. Small amounts of groundwater are likely in the near surface weathered zones and secondary fractures, and there are also rare springs.

Similarly within the drift strata, SEPA state that the Hatton Till Formation deposits are likely to have sand and gravel lenses which may be of local importance to private water supplies, however, at the site itself no information regarding major aquifers or vulnerability has been identified, and there are no private water supply wells recorded within 250m of the site. Hence, there is not considered likely to be a significant drift aquifer in this area.

Despite the above desk findings, the position of the site within the landform at the base of a 'dip' or shallow valley oriented northwards, opens the possibility of localised groundwater flows within the drift deposits, providing the underlying Peterhead Pluton granite surface follows a similar northerly down-slope profile. If there is any groundwater flow at the site, it may be in hydraulic continuity with the local surface water ditches and drains. The fish pond beyond the northern boundary of the site has no visible inflow watercourse but does have an overflow pipe which falls into the above ditches a little to the north of the site. It is possible, therefore, that the pond may be spring or groundwater fed. It should be noted that access could not be gained to make a thorough investigation around the edges of the Trout Pond.

Given the above findings from the desk study information, a significant focus of the physical ground investigation was concerned with establishing potential risk to these various local water bodies. Hence, in addition to the topographical survey information available, investigation and testing locations were targeted at the northern and eastern boundaries between the site and the surrounding water bodies.

Historic Mining Activity

From historic maps of the area, the proposed site is adjacent to areas where quarrying has formerly taken place. Therefore, there is a possibility that the development may encounter contaminated spoil and waste from quarrying operations and unmarked, infilled pits.

From site walkover surveys and observations as part of the ground investigation, there is surface evidence of old quarry workings around Stirling Hill beyond the south east boundary of the site, such as: pits; exposed faces; ponds; and other uneven ground features which appear man-made. However, these do not seem to extend beyond the present quarry boundary, formed by the burn, into NorthConnect's proposed Fourfields site area itself. There is no evidence in the archaeological records including historical mapping of the area that quarry works extended into Fourfields. There were no crop marks identified during site visits over two years, which might be an indication of such subsurface features. Contamination testing is undertaken as part of this study.

4 Method of Investigation

The Stage 1 & 2 ground investigations were undertaken for NorthConnect in March and October 2014 respectively. The Stage 1 investigation comprising trial pits and contamination testing at Fourfields was undertaken pre-environmental scoping, in order that basic data could be gathered to allow stakeholders to comment and set out their requirements for the main EIA work over 2014. The larger Stage 2 investigation comprising boreholes and other in-situ and laboratory testing at Fourfields, and also trial pits along the AC cable route to the substation, was undertaken during the main EIA work. This was targeted at deriving information around the stakeholder scoping concerns and engineering requirements of the consent design proposals. It should be noted that the ground investigation so far has been limited to the level of definition required for consent design, and further detailed engineering design will probably require more detailed ground investigations as the project develops further.

The methods of study for the Stage 1 & 2 ground investigations were developed in discussion with NorthConnect, and are described below.

General

The scope of the fieldwork was undertaken in general accordance with Eurocode 7 / BS EN 1997-2:(2007)[3] and its related technical standards together with the relevant sections of BS5930:(1999)[4] and BS 10175:(2011)[5].

The co-ordinates and reduced levels were surveyed by the contractor to National Grid and Ordnance Datum. The borehole, trial pit and resistivity test positions are shown on the site plans given in Appendix C for Stage 1 and Appendix D for Stage 2.

Representative disturbed samples of all materials encountered were obtained and placed in sealed containers. Geotechnical samples were transported to storeroom for temporary retention prior to testing at an accredited laboratory, whilst geoenvironmental Stage 1 samples were transported from site directly to an accredited laboratory.

The soil and rock samples recovered from the boreholes and trial pits were described by a Geotechnical Engineer in accordance with BS EN ISO 14688-1:(2002)[6] and BS EN ISO 14688-2:(2004)[7]. The detailed description of all strata encountered, groundwater conditions and the position and type of samples taken are included on the borehole and trial pit logs contained in Appendices C and D.

Trial Pits

As part of the Stage 1 GI categorisation process, on 12th March 2014, three trial pits were dug across the Fourfields site using the back-actor of a JCB-3CX excavator. Soil was removed in layers by the excavator driver, under instruction of the geotechnical engineer, so that the relevant observations and measurements could be made at various depths, and at any visible changes in ground characteristics. The physical soil characteristics were

documented from site observation, and several samples taken and sent for analysis in order to gain detailed understanding of physical and chemical characteristics. The depth of the pits was extended until either solid rock was encountered, or until side-wall stability rendered further excavation impossible. The location of the pits was chosen at the consent design stage simply to establish the ground, rock and groundwater conditions at the two extents of the site and on the cable approach route for scoping purposes. The location of the pits is shown in Appendix C and a summary of their locations is as follows:

Trial Pit 1 (TP01) (E412054:N841468): Located at the north east corner of the proposed converter station footprint. At 61.92 metres above (sea level) ordnance datum (mAOD), it is at the lowest point of the current ground surface profile within the proposed Fourfields site area, and also close to the current surface water features of the field ditches / drains and the Braeside Trout Fishery on the neighbouring land.

Trial Pit 2 (TP02) (E411924:N841273): Located at the south west corner of the proposed converter station footprint. At 74.24 mAOD, it is at the highest point of the current ground surface profile within the proposed Fourfields site area.

Trial Pit 3 (TP03) (E411800:N841485): Located at the north west corner of the Fourfields area, a few hundred metres west of the proposed converter station location, but on the proposed AC cable tracks down into the site. At 76.40 mAOD, it is up the hill to the west of the proposed site area close to the property known as Highfield.

As part of the Stage 2 GI categorisation process, on 7th October 2014, four further trial pits were dug along the AC cable route to the substation. These trial pits and testing were for the purpose of determining the ground's physical properties and basic soil classification for cable installation. The methodology was the same as described above for the Stage 1 pits. Their locations are shown in Appendix D and summarised as follows:

Trial Pit 4 (TP04) (E411752:N841685): Located at the western side of the Highfield access track, to the north of where the cable route exits Fourfields, and at 74.09 mAOD still on the crest of the hill to the north west of Fourfields.

Trial Pit 5 (TP05) (E411748:N841908): Located further north at the western side of the unnamed road, halfway down the hill (60.94 mAOD) towards the unnamed burn which runs northeasterly from the Den of Boddam Dam past the derelict Denend Farm.

Trial Pit 6 (TP06) (E411823:N842219): Located at 50.63 mAOD to the western side of the unclassified road in the north east corner of the field beyond Denend Farm, close to the property known as Hjaltland and where the cable route will cross the unnamed road into the field south of the substation location.

Trial Pit 7 (TP07) (E411734:N842095): Located at 53.96 mAOD in the south east corner of the field just beyond the derelict Denend Farm buildings' access track.

Boreholes

The Stage 2 investigation included the drilling of three boreholes on the Fourfields site. The principally aim was to establishing rock depth and groundwater characteristics over the northern portion of the converter site, but also to gain further information on soil and rock characteristics. One further borehole was inserted on the AC cable route to try to establish rock depth. The borehole locations are also shown in Appendix D.

Borehole 1 (BH01) (E412061:N841458): Located in the north-east corner of the Fourfields site at a ground elevation of 62.18 mAOD. Due to heavy rain and standing water in that corner of the field, it had to be sited approximately 15m in from the fence-line.

Borehole 2 (BH02) (E411969:N841483): Located at 64.72 mAOD ground elevation, adjacent to the northern boundary of the Fourfield site at the approximate mid-point of the northern edge of the proposed converter station platform area and close to the small field drain/ditch which runs down to the north-east corner of the Fourfields.

Borehole 3 (BH03) (E412094:N841338): Located at 65.54 mAOD ground elevation, adjacent to the eastern boundary at the approximate mid-point of the long edge of the converter station platform area and close the small field drain / ditch which runs along the eastern boundary of the Fourfields.

Borehole 4 (BH04) (E411766:N842128): Located on the AC cable route at 55.35 mAOD ground elevation, at the western side of the unnamed road between the derelict Denend farm and the property known as Hjaltland.

The boreholes were were formed to depths between 2.05 mbgl and 3.10 mbgl employing dynamic cable percussive techniques together with 127mm diameter temporary steel casings.

One undisturbed 100mm diameter tube sample was obtained during the boring operations where suitable cohesive material was encountered. Standard Penetration Tests (SPT) were carried out using either a split spoon sampler or a solid 60° cone (CPT). The results of these tests are given as a Standard Penetration "N" value or as a blow count for a given penetration at the appropriate position on the borehole logs, where the use of either the sampler or cone is also recorded.

Three boreholes (Nos. BH01 to BH03) were continued by rotary percussive open-hole and coring techniques to depths between 5.00 mbgl and 12.00 mbgl. The boreholes were sunk in order to obtain rock core samples to provide geotechnical information for foundation. Unfortunately, core recovery was low but this is not uncommon in weathered granites which predominated around the borehole locations close to the field drains / ditches.

Photographs of the rock core recovered are provided in Appendix D.

Installation / Instrumentation

Upon completion, BH01 to BH03 were installed with 50mm diameter HDPE (piezometer) pipe for permeability testing and future monitoring of gas or groundwater level if required. This comprises a geosock and 2-5mm washed gravel over the slotted section of the pipe, which allows groundwater from lower levels to enter the pipe whilst keeping it clear from blockages. It also then comprises cement bentonite grout around the plain section at the top of the pipe, which seals it from infiltration by standing or percolating surface water in the upper reaches of the soil. Each installation was capped with a bolted metal upstand to prevent debris entering and marked with a large, coloured stake so that agricultural vehicles are aware of their locations.

***Figure 2**: Borehole Groundwater Installation (Piezometer)*

Logging, Sampling & In-Situ Testing

In all trial pits and boreholes, the stratigraphy and depths in metres below ground level (mbgl) of ground and groundwater conditions were logged on standard Log sheets, which are also presented in Appendices C and D. An initial soil description was also recorded of each soil type, including the observed density description. Properties were to be later confirmed and refined by further laboratory testing of disturbed and undisturbed samples. The following samples and measurements were undertaken where possible at each trial pit or borehole sample depth:

For physical soil characteristics or index properties:

- Disturbed 10kg bulk bag samples
- Disturbed 1kg tub samples
- Undisturbed block samples in Stage 1 trial pits
- Undisturbed U100 samples from borehole cores
- Standard penetration test (SPT's)

For various chemical (contamination) soil testing in Stage 1 trial pits:

- 1kg glass jar samples
- 60g glass pot samples

At boreholes BH02 and BH03, permeability tests were carried out within the installations by an engineer with a submersible pump, dipmeter and water bowser to give an understanding of the permeability of the materials surrounding the response zone. Falling head tests were carried out in accordance with BS5930[4] + A2 2010 and the results presented in Appendix D of this report. A falling head test is carried out by adding water to a borehole and measuring the rate of flow into the response zone.

Resistivity testing was also carried out across the Fourfields site over the proposed converter station footprint. This testing is to determine the electrical conductivity properties of the soil, in order that adequate earthing can be designed for electrical equipment, and also for the building, which is designed as a Faraday Cage to minimise electro-magnetic field interference outside the building skin. Locations of the centre of each test are shown on the location plan in Appendix D. The tests were carried out in accordance with the IEEE Standard No.81 (IEEE 1983)[8] guidance, as specified by NorthConnect's HVDC electrical consultant (Mott Macdonald 2014)[9]. The results are presented in Appendix D of this report. The data is to be used by the electrical consultants in checking earthing potential for electrical consent design and layout of the converter station. The results will not be discussed further within this geotechnical report.

Laboratory Testing

The samples taken were transported to certificated soil testing laboratories, where the following tests were undertaken to UKAS accredited standards and BS 10175 (2001)[5] for laboratory standards.

The geotechnical tests listed below were carried out in accordance with BS 1377[10] procedures and the results are given on the summary sheets with individual test plots presented in Appendices C and D of this report.

B.S. TEST NO.	DESCRIPTION
Part 2:3	Moisture Content
Part 2:4,5	Atterberg Limits
Part 2: 7.2	Bulk Density : Linear Measurement
Part 2:8.2 & 8.3	Particle Density
Part 2:9	Particle Size Distribution
Part 4: 3.5	Compaction Test
Part 4: 5.4	Determination of the MCV of a sample of soil at its natural moisture content
Part 4: 5.5	Determination of the MCV/moisture content relation of a soil
Part 5:3	One Dimensional Consolidation test results
Part 7:9	Determination of Multi Stage Undrained Shear Strength in Triaxial Compression
ASTM D7012-10[11]	Unconfined Compressive Strength

***Table 2**:* Geotechnical tests

And for the samples from Stage 1 trial pits, the following contamination testing suites were carried out:

- Metals;
- Inorganics;
- Aromatic compounds;
- Polycyclic aromatic hydrocarbons (PAH);
- Chlorinated hydrocarbons; and
- Pesticides.

The contamination tests each measured either the *Detected Concentration* level of a particular chemical or compound, or defaulted to a deminimus *Traceability Limit*, i.e. the lowest concentration at which a contaminant can be detected by the testing equipment. From these results a human health risk assessment was carried out in accordance with CLEA (Contaminated Land Exposure Assessment)[12] derived generic assessment criteria.

5 Ground & Groundwater Conditions

Lithology & Stratigraphy

Through the trial pit and borehole observations, logging and the later laboratory soil classification and PSD testing, the soil types encountered across the study site can be identified and categorised into the approximate stratigraphy shown in Table 3. The sample descriptions are mapped to the appropriate BGS lithology description and then also assigned a simplified geotechnical grouping for engineering purposes and further interpretation within the project engineering. This is a summary table of the generalised encountered stratigraphy at the study site. The full details of soil depths, height and descriptions at each investigation location, are presented in Trial Pit and Borehole log sheets in Appendices C and D.

Sample Descriptions	*BGS Area-Wide Lithology*	*Depth (mbgl)*	*Geotechnical Grouping*
Loose soft dark brown slightly silty slightly gravelly sandy clayey TOPSOIL with rootlets noted. Gravel is fine rounded to sub-rounded of mixed lithologies.	(N/A – Topsoil / ploughing layer)	Zero to 0.35m	Topsoil
Loose red clayey slightly gravelly SAND. Gravel is fine to coarse sub-rounded to angular of mixed lithologies.	* Hatton Till Formation (Diamicton): Unsorted glacial deposits of clay, sandy clay, sand with pebbles and boulders	Typically from 0.3m to between 1.25m and 3.1m	Glacial Till
Medium dense orangey brown slightly clayey gravelly SAND. Gravel is angular to rounded of mixed lithologies.			
Soft to firm orange brown sandy slightly gravelly CLAY with cobbles and boulders. Gravel is subangular to subrounded fine to coarse of mixed lithology.			
Stiff to very stiff orange brown sandy slightly gravelly CLAY with cobbles and boulders. Gravel is subangular to subrounded fine to coarse of mixed lithology.			
Weathered GRANITE recovered as pink and orange angular fine to coarse gravel.	Red Peterhead Pluton granite: Conglomerate, with subsidiary horizons of sandstone and clay	Typically from 1.25m to 3.1m	Granite Bedrock
Moderately strong pink and grey GRANITE. Fractures: close to medium spaced subhorizontal dipping approximatley 45°, rough stepped.			

* Examples of Hatton Till sample descriptions are given to show the range of soil types encountered. Several other descriptions were obtained which varied slightly from the above.

***Table 3**:* Encountered stratigraphy sequence at the proposed site

The general finding of stratigraphy at the site was in line with the area-wide BGS expectations of Topsoil over Glacial (Hatton) Till over (Peterhead Pluton) Granite. Neither the Lake Alluvium indicated in BGS area maps, nor the Buchan Gravels formation noted in the LNCS local designation, appear to be present at any of the Fourfields site area or AC cable route test locations in question.

Topsoil

The topsoil was encountered extending to a consistent depth of 0.30 to 0.35m at all trial pit and borehole locations across both the converter site and AC cable route. There was a sharply defined change in all cases at ploughing depth, to the underlying undisturbed ground beneath. As the proposed converter station and AC cable route are all located within similar stretches of arable land, it can be expected that this condition will be encountered site wide, but later detailed design investigations will verify this.

The soil is a typical loose topsoil medium of mixed lithologies and, although the current farm manager reports the ground at Fourfields is not very productive arable land, this is probably due to the poor draining, high clay content subsoil medium (the Glacial Till), rather than the topsoil itself. In terms of grass, shrub and tree planting for landscaping post-construction, the topsoil should provide a reasonably good growing medium.

Neither the Stage 1 trial pits or the Stage 2 boreholes showed any evidence of “made ground” below the topsoil, which could have indicated any man-made quarry workings, infill pits or spoil cast, should they be present. Hence the risk of finding infill pits or spoil areas related to historic quarry workings is deemed to be very low. Nevertheless, contamination testing was undertaken at the Fourfields site and the results are discussed in Section 6.

Glacial Till

These were the predominant drift geology strata from the Hatton Till Formation (Diamicton) encountered across all test locations. They were generally undifferentiated and ranged from loose, slightly gravelly sand, to firm to stiff and very stiff, sandy, slightly gravelly clay. These strata covered the full depth at all test locations on the Fourfields site from below the topsoil to the rock level at between 1.20 to 3.10 mbgl. This was also the case at all test locations on the AC cable route, either down to rock or at least to the extent of the trial pits when rock was not encountered.

In TP03 up the hill to the west of the proposed converter station site, a single cobble sized piece of black, friable, glassy rock was encountered within the Glacial Till, possibly a type of flint or similar diagenetic sedimentary particle which has become entrained in the Till during glaciation (see Figure 3). It was about 100mm in size and was embedded in the side wall of the trial pit at a depth of 0.7m, having been partially dislodged by the excavator bucket.

Figure 3: Flint cobble entrained in Glacial Till at TP03

Referring to the BGS map for the area, the site is located on the intersection of three different surface drift materials: the Lake Alluvium to the east; the Glacial (Hatton) Till Formation to the north; and Head 1 Flinty Gravel deposits to the west. A designated archaeological site for Neolithic flint workings also lies approximately 500m further west of the TP03 location. This would indicate that further up the hill to the west of the Fourfields site may be close to the overlap of the Glacial Till with the Head 1 Flinty Gravel. As the flint cobble was found 400mm down within the undisturbed ground at TP03, and as there was no evidence of other flint pieces in the trial pit, then it is believed that the occurrence is geological rather than archaeological at this particular location.

Granite Bedrock

The Peterhead Pluton Granite was encountered in all trial pits and boreholes on the Fourfields site. This ranged from a minimum of 1.25m depth to 3.10m. The rockhead was generally shallower towards the south and west of the converter station site area higher up the hill and deeper towards the north and east boundaries of Fourfields at the lower parts of the site. There was also a greater degree of weathering of the granite towards the same boundaries, coinciding with the locality of the burn / field drains and presence of groundwater, which therefore may be connected with hydraulic related weathering. The rock was stronger and more competent the higher up the site to the south and west it was encountered.

The rock was only encountered in the first trial pit on the AC cable route on the top of the hill close to the property Highfield (TP04) at a depth of 1.30m. At all other test locations along the cable route lower down the hill to the north, rockhead was absent down to at least 3m below ground, and so appears to be well below the proposed minimum engineered depth of the cable installation of 1.5m, and allowing the possibility for the cables to be installed deeper if required for topographical or other constraint reasons.

Groundwater Conditions

Groundwater was encountered in TP01 at 1.7 metres below ground level (mbgl) and BH01 at 3.0 mbgl, both located in the north-east corner of Fourfields, and in BH03 at 1.3 mbgl along the eastern boundary. It was struck at or close to the rockhead level of the Peterhead Pluton granite, but then in TP01 and BH01 had a rebound effect up to around 1.0-1.3 mbgl. The presence of groundwater seems to be localised and coincident with the occurrence of weathered granite in these particular locations.

Firstly, this would be consistent with the BGS and SEPA data that, *"These rocks have negligible intergranular porosity and, therefore, can store groundwater only within fractures. All groundwater flow is through fractures, along bedding planes, joints or fault lines. Small amounts of groundwater are likely in the near surface weathered zones and secondary fractures, and there are also rare springs"*. Secondly, the rebound would suggest that the groundwater present within the weathered rock has a slight artesian effect due to the relatively impermeable overlaying Glacial Till, although this effect was not observed at BH03 on the eastern boundary close to the burn. The permeability of the ground was measured in TP01, BH02 and BH03 at an average of 0.5 l/s, which is very low and in line with the BGS and SEPA classification that, *"The regional bedrock aquifer to be of low productivity (0.1-1 l/s)"*.

Given the strike depth at BH03, it is possible the groundwater is in hydraulic continuity with the burn at this location. However, further down the field in the north east corner, the strike depth of 3mbgl and slight artesian effect would suggest that it is not in hydraulic continuity with the burn and field drain / ditch at this location.

Groundwater was not encountered at all in BH02 on the northern boundary next to the small field drain / ditch, which would suggest this is surface water drainage only and, indeed, this ditch has been observed to be dry in the summertime. The neighbouring Braeside Trout Fishery pond is also situated around 50m north of the TP01 / BH01 and BH02 locations. However, the water level in the fishery pond was found to be 1.2m above the rebound (artesian head) level of the groundwater in TP01/BH01 and, as stated above, no groundwater was encountered in BH02. Furthermore, the pond has low embankments around three sides (north, south and east), raising it up slightly above the level of the nearby field drains / ditches and the ground level of the adjacent areas of Fourfields. The pond embankments therefore, are assumed to be engineered (e.g. clay core or similar) or naturally impermeable (e.g. built up from the glacial till) to isolate the pond from the surrounding groundwater, otherwise the pond would simply drain away via the ditches. All of this evidence would point to the fact that the groundwater below the site cannot be in hydraulic continuity with the pond, substantiating the possibility that the pond is fed by either a spring emanating from a discontinuity within the granite around Highfield, or perched groundwater / surface water run-off from the rising ground west of the pond.

The quarry settlement ponds also beyond the northern boundary, east of the fishery pond, are used for primary treatment of run-off or any pumping which is collected from the quarry working areas. As such, they are hydro-geologically isolated from the surrounding ground, and cut-off from any possible groundwater pathways from Fourfields by the burn in between.

Finally, groundwater was not encountered in any of the AC cable route test locations. The areas of the AC cable construction that will be different in this respect are the burn and field ditch crossings, where groundwater is likely to be encountered, and appropriate pollution and sediment control measures will need to be employed here.

6 Laboratory Testing Results

The laboratory testing methodologies were contained within Section 4 and the field and in-situ test results were presented and discussed throughout Sections 4 and 5. This section now presents the laboratory results in terms of firstly the physical properties of soil samples tested at various locations followed by discussion of the human health risk assessment carried out for the laboratory contamination testing results.

Physical Testing / Index Properties

The geotechnical tests carried out in the Stage 1 categorisation can be found in Appendix C and the Stage 2 categorisation in Appendix D. The following commentary does not distinguish between the two, but provides interpretation of the range of properties for the soil type categories encountered across both investigations for the site as a whole. Of most relevance for earthworks and foundation proposals will be the engineering properties of the Glacial Till and the Granite Bedrock.

Moisture Content

Natural moisture content within the Glacial Till strata at Fourfields generally varied from 9.4% to 15% with a mean value of 12% (Note: one outlier datum of 26% was discounted). The nature of clay is that a proportion of water molecules are chemically bonded into the particle matrix, so the general condition of water content found here should be sufficiently low not to create inherent problems for bogging-down, rutting, etc. of standard earthworks plant. Similar values were even found in the sub-strate below the bottom north east corner of Fourfields which is known to have regular standing surface water. The south east corner of the platform area may be more at risk in this respect where the groundwater level could be above platform level. However, it is possible this may be at rock level rather than within the Glacial Till, thereby mitigating the risk of bogging down in wet clay.

The moisture content on the AC cable route is generally higher ranging from 9.7% to 27% with an average of 19%, however, more data points are required to make judgements. In mitigation, the cable route earthworks proposals include a central haul road which will be of a temporary construction, such as structural matting or a floating road arrangement of geotextile under Type 1 fill, for the bearing of plant and machinery. Further CBR and MCV testing of the soils along the route will allow this to be determined and designed accordingly during detailed construction planning.

Density Measurements

Dry densities of the predominant Glacial Till drift strata at Fourfields ranges from 1.56 – 2.14 Mg/m^3 with an average of 1.87 Mg/m^3. From the limited data obtained there appears to be a marginal trend of increasing density with depth.

Only one data point at BH04 exists for the AC cable route with a dry density of 1.58 Mg/m^3 which may correspond with the higher moisture content of 27% found within this sample, i.e. a softer, less stiff clay.

Particle density (specific gravity) of the Glacial Till constituent material is very consistent, varying from unit weight 2.60 - 2.63 (mean 2.62) at Fourfields and 2.56 – 2.61 (mean 2.58) on the AC cable route.

Rock dry density of the Peterhead Pluton Granite Bedrock was 2.49 Mg/m^3.

Compressibility, Recompaction & Shear Strength

Atterberg tests on the Glacial Till all revealed the matrix to be of low plasticity, which corresponds with particle size results in that the material is generally an unsorted but well graded clay matrix containing reasonable proportions of silt and sand sized particles. Liquid Limit was generally around 30%, which is on the cusp between low and medium compressibility for fine grained soils. One-dimensional consolidation testing up to 400 kPa was undertaken on three samples from Fourfields and revealed C_v values between 6 – 8 m^2/year.

All samples tested were around a minimum of 10% by weight of clay passing except at the TP06 location which contained around 33% clay by weight. This is reasonably close to BH04 which, as described above, may have a softer, less stiff and hence more compressible clay matrix around this location.

Compaction tests were undertaken on three samples of the Glacial Till from Fourfields using a 4.5 kg rammer and gave an optimum moisture content of around 11% to achieve a maximum dry density of around 1.97 Mg/m^3 with 3 – 4% air voids. With the naturally occurring moisture content of the Glacial Till on Fourfields having an average value of 12%, close to optimum compaction should be achieved for the majority of the operations without the need for additional wetting. Moisture Condition Value testing also revealed a good moisture content relationship, so the in-situ testing target for optimum compaction of the Glacial Till will be represented by an MCV count of around 12-13.

Undrained triaxial shear strength testing of three undisturbed samples of the Glacial Till from Fourfields were undertaken and found cohesive strength to be in the range 16 – 30 kPa with friction angles between 6.3 – 11.4^0 . Due to the focus of the ground investigation at the consent design stage, it should be noted that these samples do not correspond with intended foundation locations on the site. Further investigation should be undertaken in this respect at a later stage of development for location specific foundation design.

Similarly, the borehole locations close to the watercourses generally found only weak weathered rock at these locations and only one intact rock core for strength testing was recoverable from 5 mbgl at BH01. The unconfined compressive shear strength recorded in the test was 25.5 MPa. This puts the rock in this sample into the category of Moderately Strong, but even this would only be acceptable for use as general fill, with the standard for use as Type 1 fill for road sub-base being 30 MPa and upwards. However, from geological hammer blows on the rockhead encountered at the base of TP02 and TP03 further up the site to the south and west, the rock strength was estimated at around 100 MPa in the range Strong to Very Strong.

It is recommended that further investigation is required of the Granite Bedrock over the whole area and depths to be excavated to create the converter station platform. The Strong to Very Strong rock described above would certainly be suitable for re-use as structural fill for road bases and foundations and further unconfined compressive, point load, aggregate crushing and CBR strength tests should be carried out to determine its quality. In addition, further tests such as magnesium sulphate, flakiness, Los Angeles abrasion and water absorption tests can be carried out to determine the rock's suitability for use as concrete aggregate for foundations, floors and structures within the converter station.

Chemical (Contamination) Testing

The headings of the various suites of tests were outlined in Section 5. Each of these suites covered testing for the presence of multiple individual base chemicals or compounds. A full set of results is given in Appendix C.

The tests were carried out in approved and certificated soil testing laboratories to UKAS accredited standards and BS 10175 (2001)[5]. Each test measures the *Detected Concentration* level of a particular chemical or compound, but has a deminimus *Traceability Limit*, i.e. the lowest concentration at which a contaminant can be detected by the testing equipment.

Detected concentrations were then compared to Generic Assessment Criteria (GAC) derived from the Contaminated Land Exposure Assessment (CLEA) model v1.06 (Environment Agency, 2009)[12] as described below.

Choice of GAC

UK Soil Guideline Values (SGV) are GAC for assessing chronic risks to human health from long-term exposure to contaminated soils produced by the Environment Agency (2009)[13]. The primary purpose of the SGV is to act as an *intervention value*, which may be used to inform judgments' about the need for action to ensure the land use does not pose an unacceptable risk to the health of the intended users. SGV are derived using established Health Criteria Values (HCV): the HCV of a chemical is the level of exposure at which long-term exposure to the chemical in soil is tolerable, or poses a minimal risk. There are currently 11 SGV available for 6 organic and 5 inorganic chemicals, based on a soil organic matter (SOM) of 6%.

Land Quality Management (LQM) and Chartered Institute of Environmental Health (CIEH) produced GAC using the CLEA model for 89 chemicals (January 2015)[14] for the standard land uses given in CLEA, and two public open space land uses, for three SOM percentages (1%, 2.5% and 6%). A set of GAC for 35 substances, for the same three SOM percentages, has been jointly published by CL:AIRE, Environmental Industries Commission (EIC) and the Association of Geotechnical and Geoenvironmental Specialists (AGS)[15]. Both sets of figures have been accepted by the contaminated land industry and we have referred to these GAC for the Tier 1 human health risk assessment.

It is considered that the site's end use as a converter station site, described above, most closely matches the commercial standard land use described in CLEA and will be assessed accordingly.

As SOM concentrations were not available from the sample data, the most conservative GAC have been referred to (SOM 1%), and all soil results have been compared to GAC for a standard commercial land use for a SOM of 1%. The resulting Tier 1 human health risk assessment table is included as Appendix E.

Human Health Risk Assessment

All contaminants of concern were recorded below the GAC or laboratory limits of detection, therefore, it is concluded that the concentrations recorded in the soil samples taken are unlikely to pose a risk to human health.

(Note: potential Environmental receptors will be considered separately in the Land Quality and Water Quality chapters of the Environmental Statement).

7 Geotechnical Assessment, Discussion & Conclusions

This concluding section of the report makes an outline assessment of geotechnical implications of the Stage 1 and 2 findings. This will help to inform further discussion with stakeholders and technical teams through the process of EIA and also post-Planning development. It is based on the resolution of the current information derived from the Stage 1 and 2 investigations and it should be noted that there is a need for further detailed investigation and interpretation prior to full engineering design being undertaken by a design and build contractor.

The following geotechnical areas or issues will need to be considered in relation to the future design development.

General

In the context of the overall scope and proposals for NorthConnect's UK converter station, it can be concluded from the evidence of the Stage 1 and 2 investigations that the Fourfields site is generally suitable and presents no major problem from a geotechnical perspective.

The nature of the overlying ground as predominantly cohesive, firm to stiff clay with medium dense granular content will present no significant issues for standard methods of earthworks excavation, recompaction and foundation design. It is likely that rock is going to be encountered in relation to a significant proportion of the groundworks and the design and construction approaches will have to be adapted accordingly to cater for this. This is discussed below under Platform Engineering.

The focus of the Stage 2 investigation was to establish the groundwater conditions over the northern sector of the proposed site. Conclusions have been drawn from this that seem to indicate that groundwater and contamination pathways will not be an issue for the development proposals, but this should be kept under scrutiny during further investigation and design development of the site. In particular, the permanent / temporary works design, plus construction sequencing, will need to consider potential pathways and receptors in order to minimise or eliminate environmental risk. Should further evidence alter the current

conclusions, options for surface water management and protection of groundwater can be considered and adapted in the detailed geotechnical design.

Foundation Design

Standard mass reinforced concrete foundation design for either building column footings or electrical equipment plinths should be suitable for the predominantly Glacial (Hatton) Till Formation overburden material with the appropriate checks on shear failure and settlement tolerances. It is possible that pre-cast or cast in-situ concrete piling may need to be considered for localized strengthening of heavy equipment footings in this material when detailed layout plans and equipment specifications are known in relation to Till depths and extent of rock weathering at specific locations. However, the proposed design has the main building and the Transformers located away from the north east corner of the site area where this risk is highest. The proposed layout plan would actually imply that most of the footings will be founded in competent rock, which opens the option of rock bolting, either directly through base plates, or extending bolts into the re-bar arrangements of small reinforced concrete footings bonded with the rock.

Three undisturbed core sample of the Glacial Till were recovered during the Stage 2 investigation and shear strength testing was undertaken giving cohesive strength of between 16 – 30 kPa and friction angles from 6.3 – 11.4^{o}. All of the foundation footings will be situated on or below level ground, whether that be natural or engineered, and none are near to the top of slopes or embankments and, as stated above, the majority of the high loading foundations are likely to be in rock on the basis of the current consent design.

A risk in this area may be the lateral and vertical extent of the weathered granite. The boreholes in the Stage 2 investigation were targeted mainly at securing groundwater information close to the eastern and northern field drains / ditches at the boundary of the site. In these locations, the depth of the weathered zone is substantial, generally down to around 5 mbgl, with Weak rock encountered below that. At the southern and western extents of the site, however, we know from the trial pit data that relatively competent, unweathered, Strong to Very Strong rock is encountered at just 1.25 mbgl. So, it is expected that the weathering is likely to be localised to the areas around the field drains / ditches at the bottom of the slopes (i.e. hydraulic weathering in the areas where groundwater is present) and not extend too far away from these boundaries. None of the building foundations will be close to these locations and even the outdoor equipment footings will be some distance away due to the landscape mounding around the periphery of the site. The transformer bases will be the largest, closest foundations to these boundaries. More detailed investigation will be required alongside further design development to core the rock at specific foundation and equipment locations in order to determine the extent of weathering and adapt foundation methods accordingly.

Platform Engineering

For the Converter Station site, a suitable construction platform will need to be created. It is intended that this will be achieved as a single tier through a balanced cut and fill operation incorporating the platform and screening mounds, thereby minimising the need for import or export of materials. In addition, the excavated rock may be able to be crushed and graded for use as sub-base or base course material for hardstanding areas, blinding base course for

foundations or even aggregate for concrete batching if suitable. The same rock as occurs on the NorthConnect site is quarried commercially as structural fill and concrete aggregate at the Stirling Hill quarry site, immediately to the east. The rock can be locally quite variable in terms of strength and weathering profile, so further testing should be undertaken to determine its suitability as structural fill. As general fill for the screening mounds however, all of the excavated rock is likely to be suitable.

The platform height has been considered to balance a number of issues including: engineering, environmental, noise reduction and landscape and visual factors. The optimum level to satisfy these constraints for the proposed Converter Station site has been estimated at 63m above sea level, cutting it into the landscape, with the excess fill to be used to create screening mounds around the periphery of the site. The same cut and fill balance could be achieved with the platform at a variety of heights, but this would impact on other environmental factors, e.g. lower the platform but impact on groundwater and raise the screening mound to a height which might make them difficult to engineer or unacceptable in visual terms; or raise the platform height but then make the building more visible, possibly with adverse noise effects and having less material available for screening.

With this assumption of 63m above sea level, it is estimated around 331,000 m^3 of material will be excavated, made up of 211,000 m^3 of rock, 85,000 m^3 of glacial till and 35,000 m^3 of topsoil.

Topsoil will be stripped from the platform area, and also from the area beneath the northern and eastern permanent screening mounds, and stockpiled for future topsoil reinstatement of landscaped areas. The Glacial Till will then also be stripped from across the platform area, down to foundation level, or to rockhead where rock will be encountered above foundation level (which is likely to be over the majority of the site). The exposed rock will then be excavated down to platform or foundation level over the remainder of the site. Overcut to below platform depth will be necessary in places, to allow for foundations, drainage arrangements and other underground infrastructure to be installed. Detail of this will be developed through the detailed design process.

As described above, the Peterhead Pluton Granite is anticipated to be significantly weathered on the east and north of the site, but transition to strong and very strong moving away from those boundaries (up to 100 MPA). Hence, standard excavation may be possible in some areas, but hard ripping and blasting are likely to be required over a significant area. An outline assessment of the blasting requirements, giving anticipated charge weights and the effect of blasts on surrounding receptors, has been carried out separately to this investigation (Vibrock, 2015)[16]. As the largest batters for the excavated rock will be towards the south west corner of the platform (i.e. into the hillside) where the very strong, competent rock is anticipated, then slope angles can be steep. A slope of 75% has been assumed for the consent design but, for example, the working face of the quarry immediately to the east in similar rock is vertical.

In order to re-utilise the ripped or blasted granite as a fill material, it will be necessary to have crushing and grading facility available either on site, or possibly at the neighbouring quarry. In addition to being used as general fill, covered with other material and topsoil, the granite should provide an excellent sub-base and base course for foundations, plinths, hardstanding and site drainage infrastructure. Additional testing will need to be carried out for suitability as concrete aggregate.

The 'fill' operations also have yet to be geotechnically designed, as they will vary across the site dependent on the detailed building and equipment designs and their various load bearing foundation requirements. In outline, however, the base of any fill areas will be formed using the excavated rock, requiring crushing and grading of any harder rock, which will be placed in layers using compaction plant (e.g. sheeps-foot rollers). Across equipment areas, this will incorporate a membrane to prevent plant growth but, in landscaped or other grassed areas of the site, varying depths of the stockpiled glacial till and then topsoil will be built up on top of the crushed rock.

Foundations directly on rock will be fixed and, with re-compacted granite, providing it is of structural fill quality and engineered correctly, settlements will also be negligible. The use of the Glacial Till as a more compressible material presents the risk of differential settlements spatially across the site. The highest risk structure in this respect will be the main converter building. The Stage 2 investigation was targeted mainly at the groundwater and rock profiles on the north and east boundaries of the site, so it is recommended that further testing needs to be undertaken of the compressibility and compaction characteristics of the materials to be excavated from the rest of the site. From this and the detailed layout plans still to be developed, the appropriate foundation and screening mound designs can be planned and a detailed earthworks specification developed accordingly.

Landscaping

The principal landscaping issue from a geotechnical perspective will be the formation of the landscape screening mounds around the periphery of the site platform area. As described above, a cut and fill balance has been achieved for a platform height of 63m above sea level and the screening mounds have been designed by a landscape architect to have smooth and gently sloping external faces. For the volumetric calculations involved in this, the following assumption has been made regarding bulking factors of the excavated materials.

Geotechnical Grouping	Bulking Factor *
Topsoil (ploughed)	1.00
Topsoil (undisturbed)	1.25 – 1.45
Glacial Till	1.20 – 1.40
Granite Bedrock	1.50 – 1.80

* Loose tipped, not re-compacted

***Table 4**: Bulking factors of the encountered strata (estimated from Horner, 1988)*[17]

No bulking was applied (i.e. a factor of 1:00) to the topsoil, as the vast majority of the site area is covered by working arable land which is ploughed regularly. During the Stage 1 investigation, it was noted that the Glacial Till appears to have a pattern of increasing density with depth. However, it was judged that the above quoted bulking factor range should provide a reasonable estimate and the mid-point value was used. Similarly, given the current evidence of possible variability of the granite rock across the site from weak to very strong, the mid-point value above was used for current estimates. Note that these are the loose-tipped factors and that detailed earthworks specifications can be adapted for a greater or lesser degree of re-compaction when more detailed information is available.

For the outer faces of the landscape screening mounds, slope stability will need to be checked with further investigation, however, given that landscape and visual design guidance

limits them to 1 in 3 gradients, it is not anticipated that the nature of any of the excavated and re-compacted materials will present a problem with slope stability given adequate drainage. The fact the core fill material will be crushed rock should in turn present no issues for mound drainage.

Given space constraints on the site however, the inner slopes of the screening mounds are likely to need to be engineered with steeper slopes (approximately 75^{o}) and a crib-wall type construction has been proposed and a typical configuration detail included in the consent design. These designs will need to be further developed, section by section around the site, as detailed investigations and earthworks specification takes place. The key considerations will be the overall slope stability of the soil-structure interactions of the wall design and its drainage conditions. Similar to above, the predominance of crushed rock as the core fill material should reduce the drainage-related stability risks for the designs.

Cable Laying

The proposed cable route is along the northern edge of the Fourfields site, past Highfield and into the fields on the west side of the Highfield access road. The cables then run due north, parallel to the access track, and along the west side of the unnamed road past Denend, with the cables then passing under the road between Denend and Hjaltland. From here it will continue northward, on the east side of the unnamed road, before turning east to connect into the proposed 400kV extension to the Planned New Peterhead Substation. The cable circuits will comprise six underground cables (3 cables per circuit) and will be buried in two separate trenches, three cables in each, with each trench measuring 1.5m deep and 1.5m wide, and separated by a temporary 7m wide haul road.

The main geotechnical issue for the engineering of the cables will be the relative depth of the rockhead. With the provision for laying the cables within a granular bedding material in the trenches, then the minimum engineered depth below the ground surface for the cables is 1.55m, but this may go deeper in places due to undulation of the ground's topography or, for example, below ditches, watercourses or the unnamed road crossing. This may present localized water issues for cable-laying but standard methodologies and poluution prevention measures can be applied.

Although the rock depth on the cable route immediately away from the converter station is greater than the engineered depth of 1.55m, by the time the cable has reached the location of TP03 at the top of the hill in the north west corner of Fourfields, the rock depth has decreased to around 1.25m and the rock is competent with very little weathering of the surface. At TP04 along the crest of the hill to the north of Highfield, however, although the rockhead was encountered at 1.3 mbgl, it was recovered as weathered silty, sandy gravel with relative ease by the excavator bucket down to more competent rock at 1.9 mbgl. The rest of the trial pits and BH04 along the cable route to the north did not encounter rock at all down to their termination depth of between 2.5 – 3.0 mbgl.

The conclusion, therefore, is that the cables laying will only require rock excavation via hard-ripping over a minimal proportion of the route (approximately 150m) in the north west corner of Fourfields and across the Den of Boddam access path. As the route passes into the field west of Highfield, sufficient depth of traditionally excavatable material should once again be encountered for the rest of the cable route.

Groundwater & Surface Water Implications

A significant focus of these consent stage ground investigations have been to identify and address potential risks to neighbouring water bodies. The desk findings have been discussed at length in Section 3 Hydrology and Hydrogeology, and the field investigation findings in Section 5 Groundwater Conditions. A conclusion from this evidence to date is that any surface water run-off from Fourfields appears to be intercepted by the burn and field drain / ditch along the east and north of the site respectively, and flow away to the north within the above burn. These water courses receive outflows from, but do not have any inflows into, the Trout Pond and Quarry Settlement Ponds, therefore it is concluded that there are no surface water pathways from Fourfields into these nearby water bodies.

Similarly, there does not appear to be any groundwater continuity with the water bodies. Any groundwater encountered on Fourfields appears to be localised within the weathered zones of the rockhead and, crucially, the groundwater level at the north east corner is lower than in the nearby burn and ditch, which are in turn lower than the water level in the Trout Pond. It is feasible there could be some groundwater flow in the opposite direction (i.e. away from the Trout Pond), but anything greater than a very low seepage rate would likely mean the Pond draining away via the surrounding ditches.

In terms of the implications for the development proposals, for surface water, temporary drainage design will be required to collect and provide treatment for any siltation arising from construction activities, as well as providing attenuation mitigation and treatment for the risk of any pollution incidents reaching the watercourse. The details of this will need to be planned and managed by the earthworks contractor. Furthermore, the proposed construction methodology for building the northern and eastern screening mounds around the site as one of the first activities, will ensure that surface water on the site is physically isolated from any accidental discharges to the watercourses.

For groundwater, a key mitigation to any potential impacts is firstly that the platform level has been designed at 63m AOD to be approximately 2.5m above the groundwater level in the northeast corner of the site. It is possible the groundwater level may be higher and intercept with the platform level for a small portion over the south east corner of the platform. It is thought the groundwater at this location is in hydraulic continuity with the burn, however, the platform will be lower than the burn here, so the platform excavation may well change the direction of groundwater flow over a localised area, from towards the burn, to instead draining / seeping into the excavation. Given the low permeability of the ground, the seepage rates into the excavation over the area concerned have been estimated as amounting to less than 0.5 l/s. One option for mitigating this would be to construct a groundwater cut-off underneath the landscape screening bund at that corner of the site, however, this would have greater environmental impacts than the issue it was solving, due to the additional temporary excavation required close to the burn. The preferred solution would be to simply install a toe-drain and divert the flow into the temporary (and later permanent) site drainage, which will gravitate down through the treatment arrangements and then back into the burn a maximum of 200m distant. This should be reviewed later during detailed design.

It was concluded from the Stage 1 testing that potential existing sources of contamination do not represent a material risk to human health. Therefore, no special further measures need be taken for the site and the development, other than a watching brief on any further ground investigations in case evidence arises of made ground or historic mining activities. The

temporary and permanent works design, along with the construction activities themselves, will present a higher risk of potential silt or pollution incident contamination via either surface or groundwater sources, but these can be mitigated by good construction practice and temporary drainage design as discussed above.

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11 ASTM International: ASTM D7012-14*, "Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures"*, 2005.

12 Environment Agency: CLEA software (version 1.06), *"Contaminated land exposure assessment (CLEA) tool"*, EA, May 2014.

13 Environment Agency: Various, *"Soil guideline values (SGVs) for chemicals to assist in the assessment of risks from contaminated land"*, March 2009.

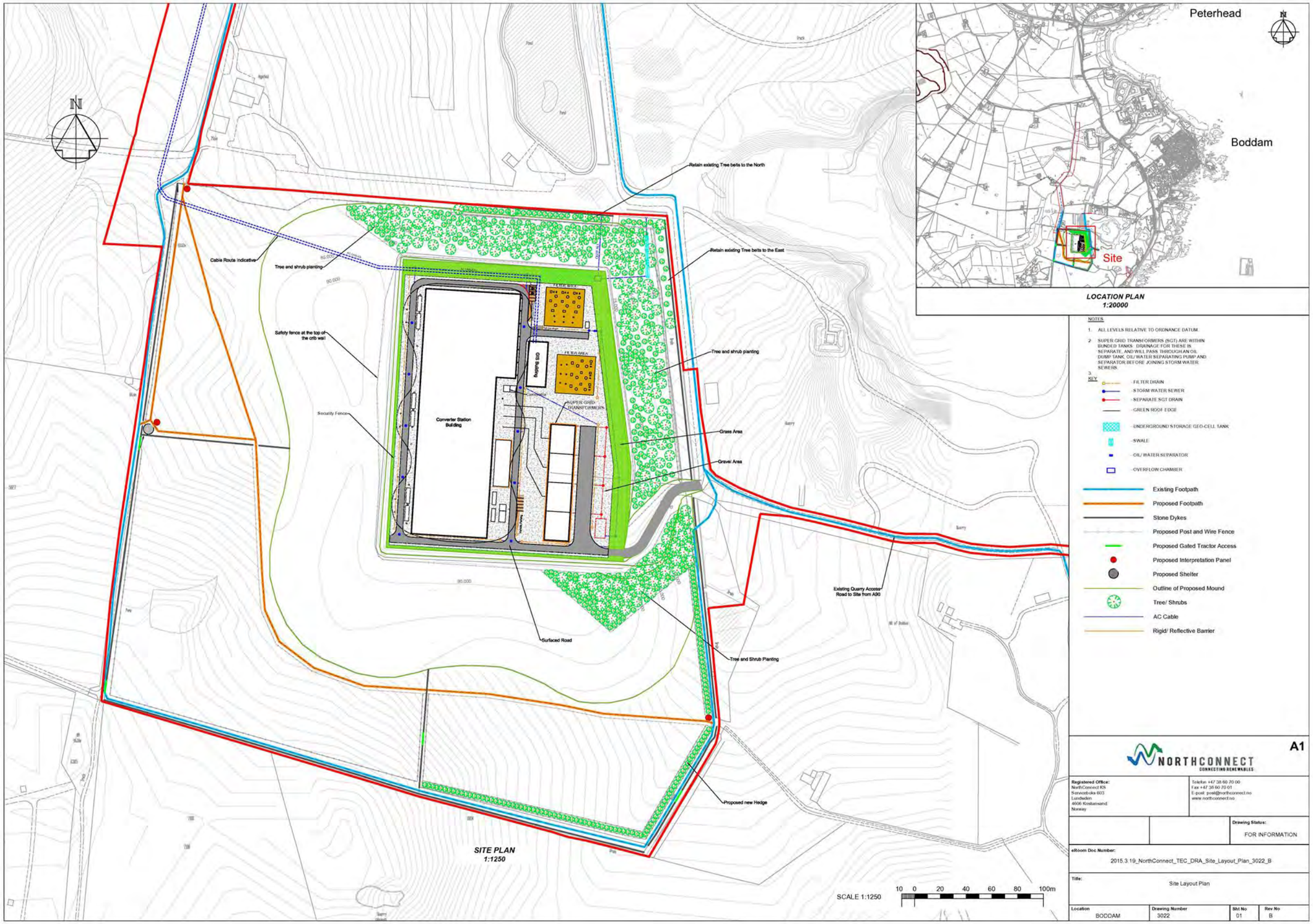
14 Nathanail, C.P. *et al*: *"LQM/CIEH Suitable 4 Use Levels"*, Land Quality Press, Nottingham, January 2015.

15 EIC/AGS/CL:AIRE: ISBN 978-1-905046-20-1, *"Soil Generic Assessment Criteria for Human Health Risk Assessment"*, CL:AIRE, January 2010.

16 Vibrock: R15.8589/2/AF, *"Assessment of Environmental Impact of Blasting at Fourfields Interconnector Converter Station Site, Aberdeenshire"*, March 2015.

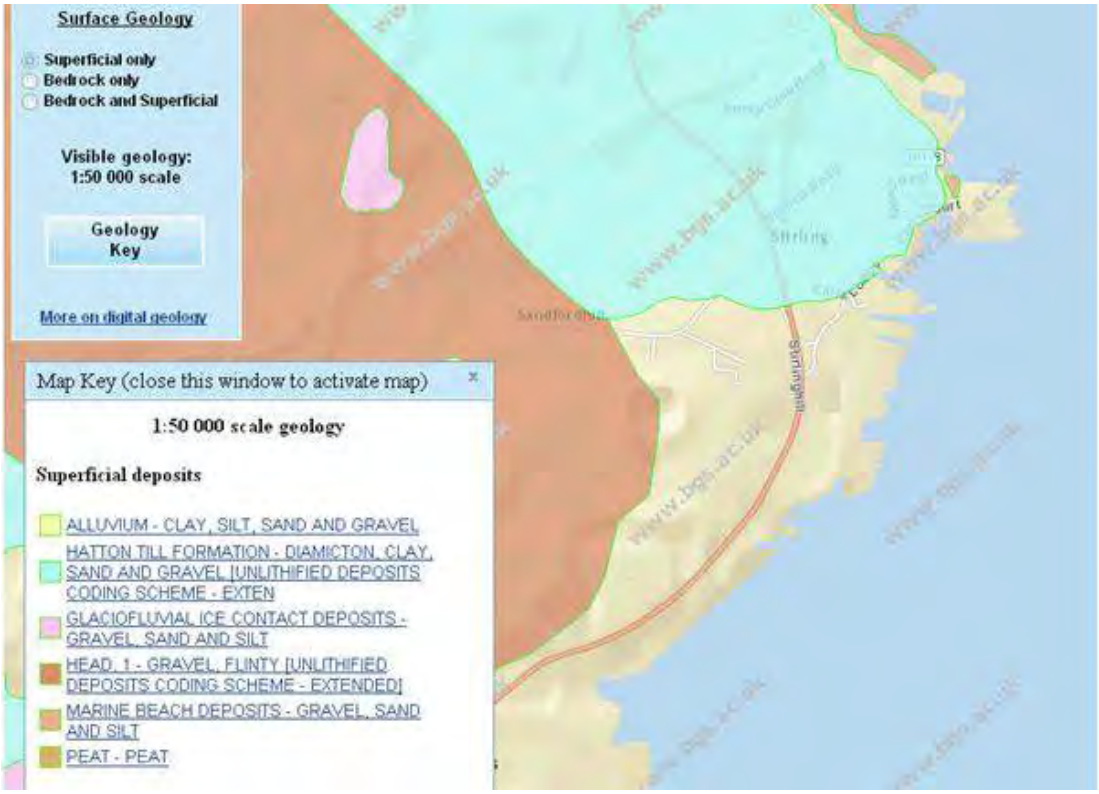
17 Horner, P.C.: *"Planning & Construction for Earthworks Projects"*, 1988.

Appendix A – Converter Station Layout



Appendix B – BGS Solid & Drift Geology

BGS Solid Geological profile of the area



BGS Drift Geological profile of the area

Appendix C – Stage 1 Ground Investigation Data

Stage 1 Trial Pit Layout Drawing

Stage 1 Trial Pit Logs

SYNERGIST PROJECTS
Trial Pit Log

TP No.: **TP1**
Sheet 1 of 1

Level (mAOD): **61.92**
Coordinates: **E: 412053.726**
N: 841467.833
Date: **12-Mar-14**
Plant: **JCB-3CX**

Location: **Four Fields**
Client: **NorthConnect KS**
Engineer: **R.Blanchfield**

Depth (mbgl)	Level (mAOD)	Legend	DESCRIPTION OF STRATA	Samples Tests	Depth (mbgl)
			Loose soft dark brown slightly silty slightly gravelly sandy TOPSOIL with rootlets noted. Gravel is fine rounded to sub-rounded of mixed lithologies.	D (S1)	0.00
0.35	61.57		Medium dense orangey brown gravelly SAND. Gravel is medium to coarse angular to sub-rounded of mixed lithologies.	D/B (S2)	0.40
0.50	61.42		Medium dense firm to stiff orangey red sandy slightly gravelly CLAY. Gravel is fine to medium sub-rounded of mixed lithologies.	D/B (S3)	1.00
				▼	1.35
1.65	60.27		Loose red clayey slightly gravelly SAND. Gravel is fine to coarse sub-rounded to angular of mixed lithologies.	D (S4)	1.70
1.75	60.17		Trial Pit complete (Could not proceed further due to risk on side/base stability and also the deposition of wet clayey sand onto recently ploughed field)		

ANNOTATED SKETCH DRAWING (Not to Scale)

SAMPLES / TESTS
T Environmental sample
D Disturbed
B Bulk
W Water
HV Hand Vane
▽ Water strike
▼ Water level

OTHER INFORMATION
Side stability: Vertical faces stable. Groundwater flow area at base looser.
Other details:
1. TP location recently ploughed. Topsoil consisted grass onto clay at field boundaries.
2. Groundwater flow observed in below 1.65 mbgl layer
3. 3" Pump (1.4 l/sec) marginally overcame inflow rate in 1.5m x 1.5m base of excavation

Logged by:	R.Blanchfield	Project No.:
Checked by:	-	NCK-GEO01

SYNERGIST PROJECTS
Trial Pit Log

TP No.: **TP2**
Sheet 1 of 1

Level (mAOD): **74.24**
Coordinates: **E: 411924.425**
N: 841273.086
Date: **12-Mar-14**
Plant: **JCB-3CX**

Location: **Four Fields**
Client: **NorthConnect KS**
Engineer: **R.Blanchfield**

Depth (mbgl)	Level (mAOD)	Legend	DESCRIPTION OF STRATA	Samples Tests	Depth (mbgl)
			Loose soft dark brown slightly silty slightly gravelly sandy TOPSOIL with rootlets noted. Gravel is fine rounded to sub-rounded of mixed lithologies.		
0.30	73.94		Medium dense orangey brown slightly clayey gravelly SAND. Gravel is angular to rounded of mixed lithologies.	D (S1)	0.45
				B (S2)	0.70
1.20	73.04		Clayey sandy COBBLES consisting weathered rock head onto bedrock.		
1.30	72.94		Proved bedrock. Strong to very strong red GRANITE (probably Red Peterhead Pluton Granite)		
			Trial Pit complete		

ANNOTATED SKETCH DRAWING (Not to Scale)

SAMPLES / TESTS

T	Environmental sample
D	Disturbed
B	Bulk
W	Water
HV	Hand Vane
▽	Water strike
▼	Water level

OTHER INFORMATION

Side stability: Vertical faces stable.
Other details: 1. TP location recently ploughed. Topsoil consisted grass onto clay at field boundaries.
2.
3.

Logged by:	R.Blanchfield	Project No.:
Checked by:	-	NCK-GEO01

SYNERGIST PROJECTS
Trial Pit Log

TP No.: **TP3**
Sheet 1 of 1

Level (mAOD): **76.40**
Coordinates: **E: 411800.148**
N: 841485.033
Date: **12-Mar-14**
Plant: **JCB-3CX**

Location: **Four Fields**
Client: **NorthConnect KS**
Engineer: **R.Blanchfield**

Depth (mbgl)	Level (mAOD)	Legend	DESCRIPTION OF STRATA	Samples Tests	Depth (mbgl)
			Loose soft dark brown slightly silty slightly gravelly sandy TOPSOIL with rootlets noted. Gravel is fine rounded to sub-rounded of mixed lithologies.		
0.30	76.10		Medium dense orangey brown slightly clayey gravelly SAND. Gravel is angular to sub-rounded of mixed lithologies.	D/B (S1)	0.50
1.25	75.15		Clayey sandy COBBLES consisting weathered rock head onto bedrock.		
1.35	75.05		Proved bedrock. Strong to very strong red GRANITE (probably Red Peterhead Pluton Granite)		
			Trial Pit complete		

ANNOTATED SKETCH DRAWING (Not to Scale)

Intrusion of a medium dense grey brown clayey slightly gravelly SAND observed across corner of trial pit between the TOPSOIL and underlying orangey brown layers:

SAMPLES / TESTS

T	Environmental sample
D	Disturbed
B	Bulk
W	Water
HV	Hand Vane
▽	Water strike
▼	Water level

OTHER INFORMATION

Side stability: Vertical faces stable.

Other details:
1. TP location recently ploughed. Topsoil consisted grass onto clay at field boundaries.
2. Cobble (100mm) piece of black friable rock observed in face at 0.70 mbgl (possibly flint)
3.

Logged by:	R.Blanchfield	Project No.:
Checked by:	-	NCK-GEO01

Stage 1 Physical / Index Property Test Results

Trial Pit	Sample	Testing	Block Dimensions			Tub	Tub + Bulk Mass	Tub + Dry Mass	Bulk Mass	Dry Mass	Bulk Density ρ	Dry Density ρ_d	Moisture Content w	Geotech. Group
(I.D.)	(I.D.)	(I.D.)	(mm)	(mm)	(mm)	(kg)	(kg)	(kg)	(kg)	(kg)	(Mg/m^3)	(Mg/m^3)	(%)	(I.D.)
TP1	S1	SAL	*(Undisturbed sample recovery not possible)*										23.0%	Topsoil
TP1	S2	Synergist	145	95	60	0.850	2.393	2.230	1.543	1.380	1.867	1.670	11.8%	Lake Alluvium
		SAL	*(Back calculation from SAL moisture content results)*						1.532	-	1.853	-	11.0%	
TP1	S3	Synergist	110	100	40	0.887	1.930	1.830	1.043	0.943	2.370	2.143	10.6%	Glacial Till
		SAL	*(Back calculation from SAL moisture content results)*						1.032	-	2.345	-	9.4%	
TP1	S4	SAL	*(Undisturbed sample recovery not possible)*										15.0%	
TP2	S2	Synergist	110	95	45	0.818	1.692	1.588	0.874	0.770	1.859	1.637	13.5%	
		SAL	*(Back calculation from SAL moisture content results)*						0.847	-	1.801	-	10.0%	
TP3	S1	Synergist	145	95	60	0.901	2.355	2.188	1.454	1.287	1.759	1.557	13.0%	
		SAL	*(Back calculation from SAL moisture content results)*						1.416	-	1.713	-	10.0%	

Permeability (Ring) Test Calculations Record Sheet

Trial Pit	Depth	Layer Location	Ring Area	1st Litre Time	2nd Litre Time	3rd Litre Time	Flow Rate	Permeab-ility
(I.D.)	(mbgl)	(I.D.)	(m^2)	(secs)	(secs)	(secs)	(l/s)	($l/s/m^2$)*
TP1	0.10	S1	0.0363	39			0.026	0.706
					45		0.022	0.612
						65	0.015	0.424
				Average			0.020	0.555
Other layers unsuccesful for method used								

Permeability (Base Pumping) Test Calculations Record Sheet

Trial Pit	Depth	Layer Location	Base Area of Excavation Below Groundwater Level				Max. Pump Flow Rate	Min. Permeab-ility
(I.D.)	(mbgl)	(I.D.)	(mm)	(mm)	(mm)	(m^2)	(l/s)	($l/s/m^2$)*
TP1	1.65 - 1.75	S4	1550	1450	100	2.548	1.38	0.543

T1/S1

Dark brown slightly silty slightly gravelly sandy TOPSOIL with rootlets noted. Gravel is fine rounded to sub-rounded of mixed lithologies.

T1/S2

Light orangey brown gravelly SAND. Gravel is medium to coarse angular to sub-rounded of mixed lithologies.

T1/S3

Soft orangey red sandy slightly gravelly CLAY. Gravel is fine to medium sub-rounded of mixed lithologies.

T1/S4

Orangey red clayey slightly gravelly SAND. Gravel is fine to coarse sub-rounded to angular of mixed lithologies.

T2/S1

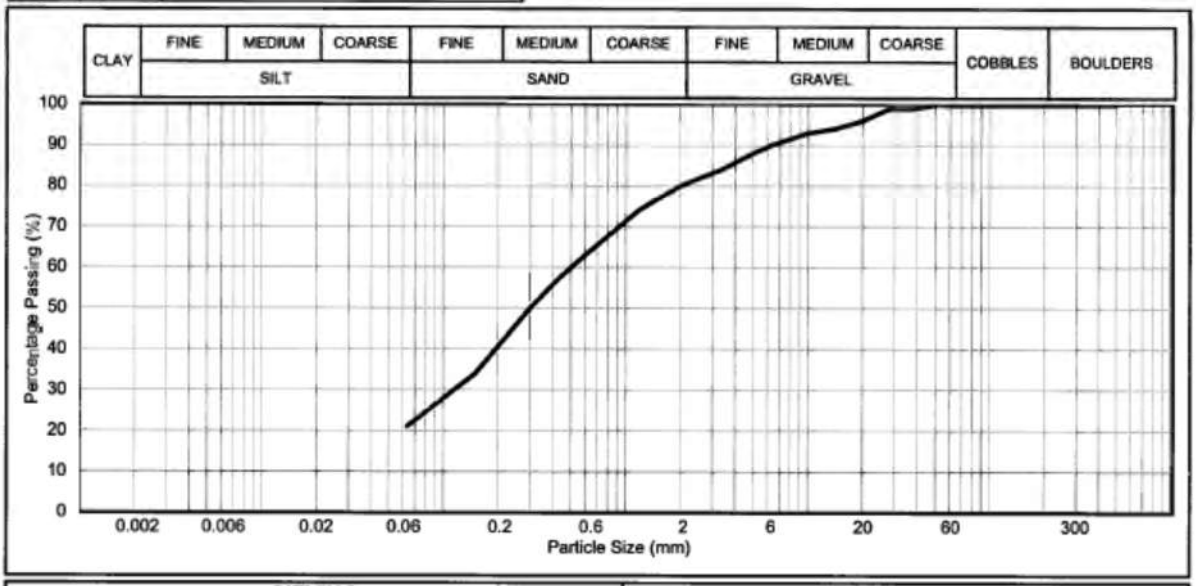
Light orangey brown slightly clayey gravelly SAND. Gravel is angular to rounded of mixed lithologies.

T3/S1

Light orangey brown slightly clayey gravely SAND. Gravel is angular to sub-rounded of mixed lithologies.

Borehole	-
Sample	382656/001
Depth (m)	-

T1/S1



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	100	-	-		
37.5	99	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	99	-	-		
20.0	96	-	-		
14.0	94	-	-		
10.0	93	-	-	**PERCENTAGE SOIL TYPES**	
6.30	90	-	-		
5.00	88	-	-		
3.35	84	-	-		
2.00	80	-	-		
1.18	74	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.600	63	-	-		
0.425	57	-	-		
0.300	50	-	-		
0.212	42	-	-		
0.150	34	-	-		
0.063	21	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	21	59	20	0

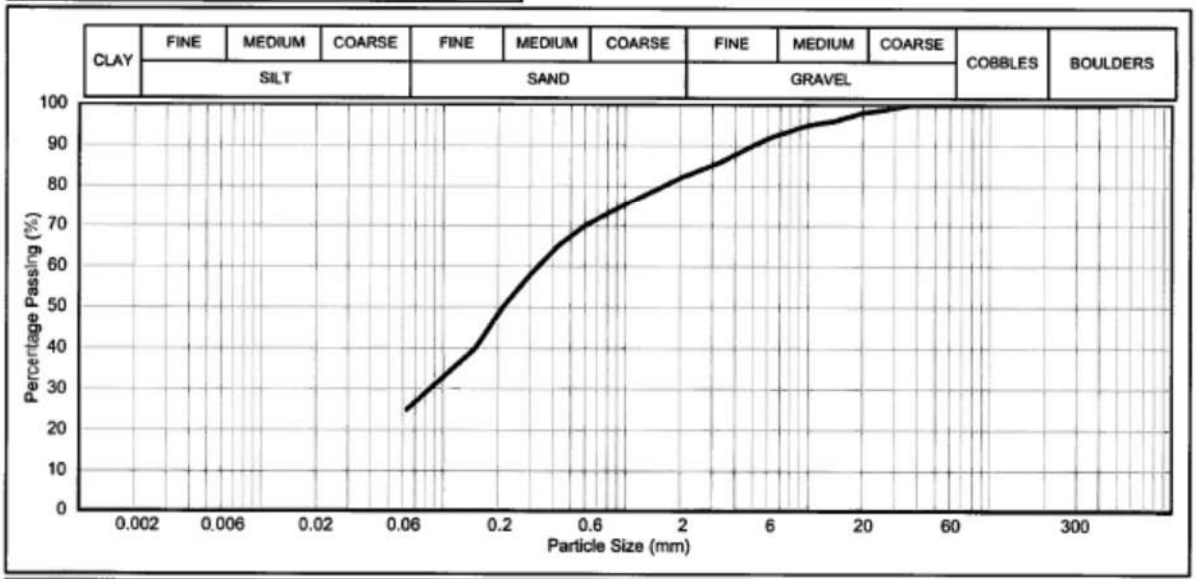
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Borehole	-
Sample	382656/002
Depth (m)	-

T1/S2



SIEVING			
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable	
		Lower %	Upper %
500.0	100	-	-
300.0	100	-	-
125.0	100	-	-
90.0	100	-	-
75.0	100	-	-
63.0	100	-	-
50.0	100	-	-
37.5	100	-	-
28.0	99	-	-
20.0	98	-	-
14.0	96	-	-
10.0	95	-	-
6.30	92	-	-
5.00	90	-	-
3.35	86	-	-
2.00	82	-	-
1.18	77	-	-
0.600	70	-	-
0.425	65	-	-
0.300	58	-	-
0.212	50	-	-
0.150	40	-	-
0.063	25	-	-

SEDIMENTATION	
Particle Size (mm)	Percentage Passing (%)
0.020	
0.006	
0.002	

GRADING CLASSIFICATION (SHW TABLE 6/2)
-
Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.

PERCENTAGE SOIL TYPES				
CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	25	57	18	0

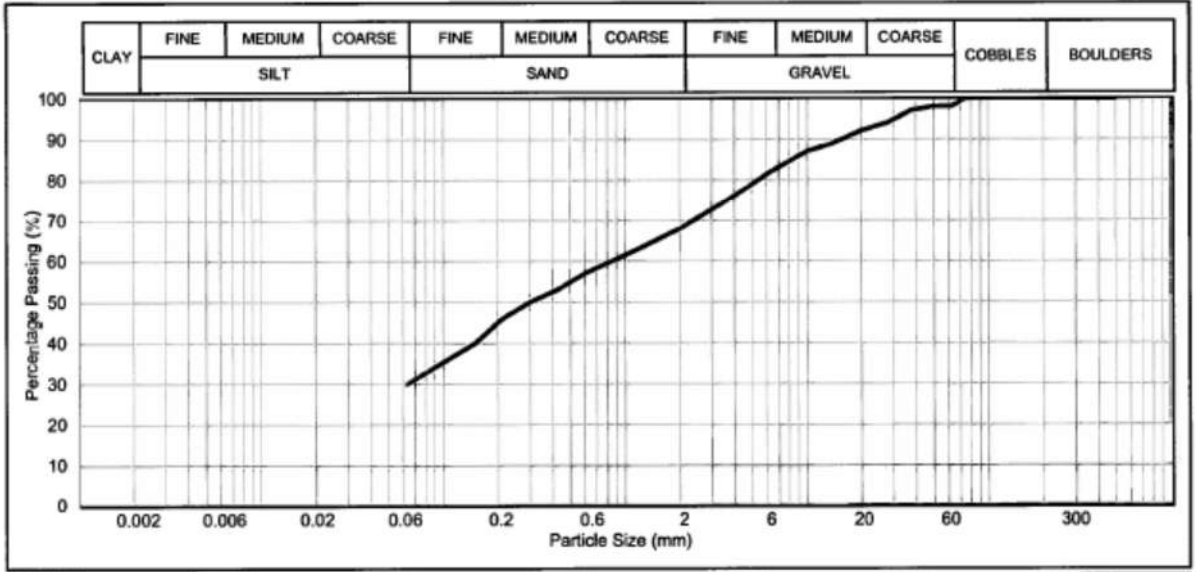
UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)		
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Borehole	-
Sample	382656/003
Depth (m)	-

T1/S3



SIEVING			
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable	
		Lower %	Upper %
500.0	100	-	-
300.0	100	-	-
125.0	100	-	-
90.0	100	-	-
75.0	100	-	-
63.0	98	-	-
50.0	98	-	-
37.5	97	-	-
28.0	94	-	-
20.0	92	-	-
14.0	89	-	-
10.0	87	-	-
6.30	82	-	-
5.00	79	-	-
3.35	74	-	-
2.00	68	-	-
1.18	63	-	-
0.600	57	-	-
0.425	53	-	-
0.300	50	-	-
0.212	46	-	-
0.150	40	-	-
0.063	30	-	-

SEDIMENTATION	
Particle Size (mm)	Percentage Passing (%)
0.020	
0.006	
0.002	

GRADING CLASSIFICATION (SHW TABLE 6/2)
-
Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.

PERCENTAGE SOIL TYPES				
CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	30	38	30	2

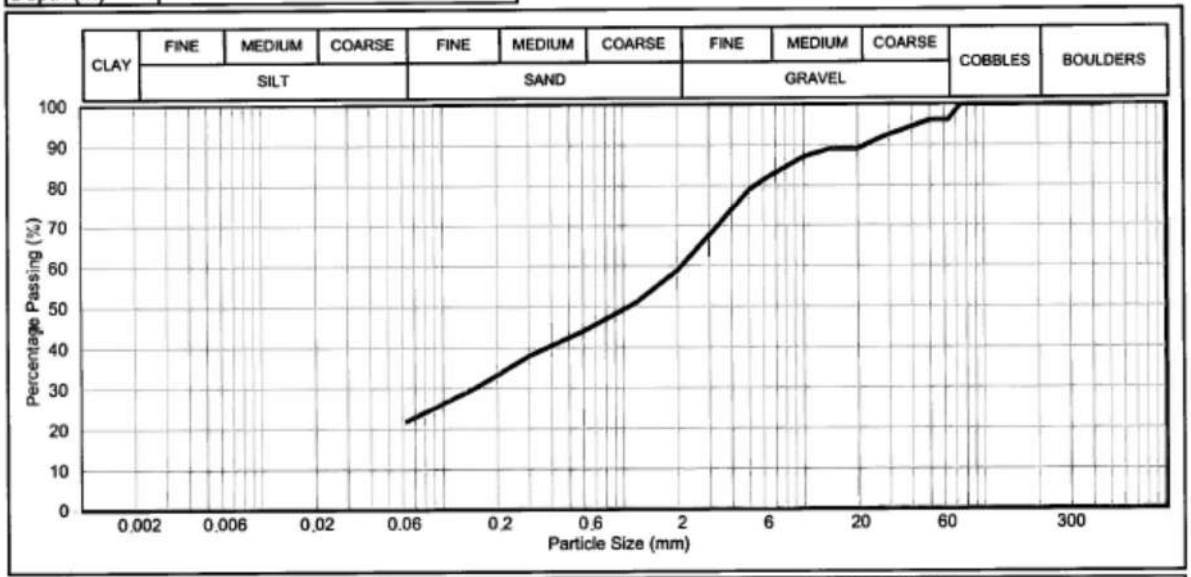
UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)		
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Borehole	-
Sample	382656/004
Depth (m)	-

T1/S4



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-		
63.0	96	-	-		
50.0	96	-	-		
37.5	94	-	-		
28.0	92	-	-		
20.0	89	-	-		
14.0	89	-	-		
10.0	87	-	-		
6.30	82	-	-		
5.00	79	-	-		
3.35	70	-	-		
2.00	59	-	-		
1.18	51	-	-		
0.600	44	-	-		
0.425	41	-	-		
0.300	38	-	-		
0.212	34	-	-		
0.150	30	-	-		
0.063	22	-	-		

GRADING CLASSIFICATION (SHW TABLE 6/2)

-

Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.

PERCENTAGE SOIL TYPES

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	22	37	37	4

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)

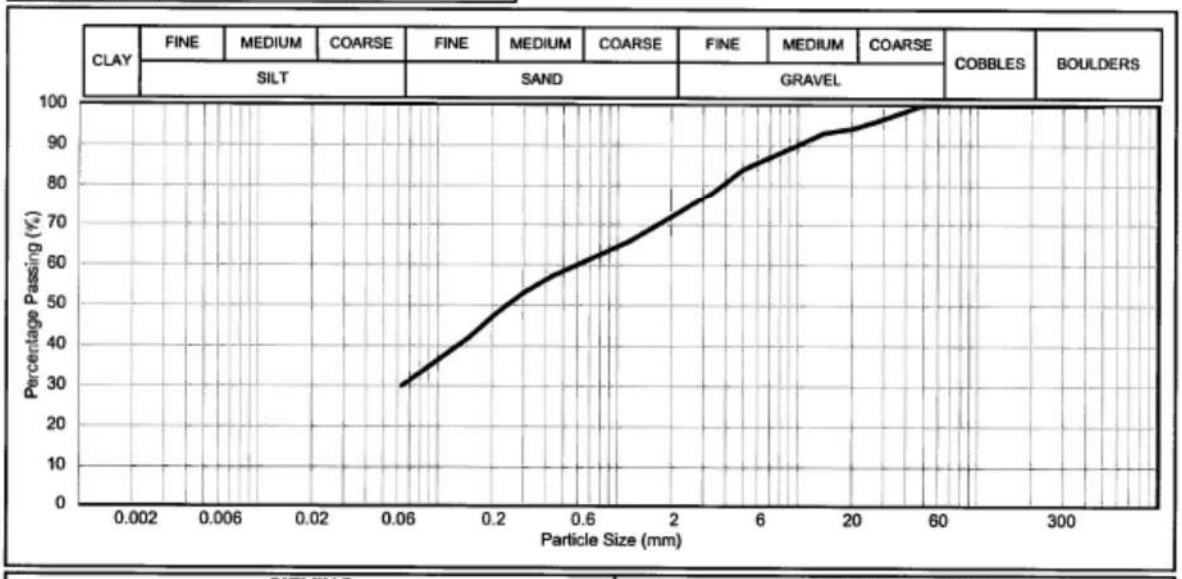
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT -		-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Borehole	-
Sample	382656/005
Depth (m)	-

T2/S1



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-		
63.0	100	-	-		
50.0	100	-	-		
37.5	98	-	-		
28.0	96	-	-		
20.0	94	-	-		
14.0	93	-	-		
10.0	90	-	-		
6.30	86	-	-		
5.00	84	-	-		
3.35	78	-	-		
2.00	72	-	-		
1.18	66	-	-		
0.600	60	-	-		
0.425	57	-	-		
0.300	53	-	-		
0.212	48	-	-		
0.150	42	-	-		
0.063	30	-	-		

GRADING CLASSIFICATION (SHW TABLE 6/2)
-
Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.

PERCENTAGE SOIL TYPES				
CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	30	42	28	0

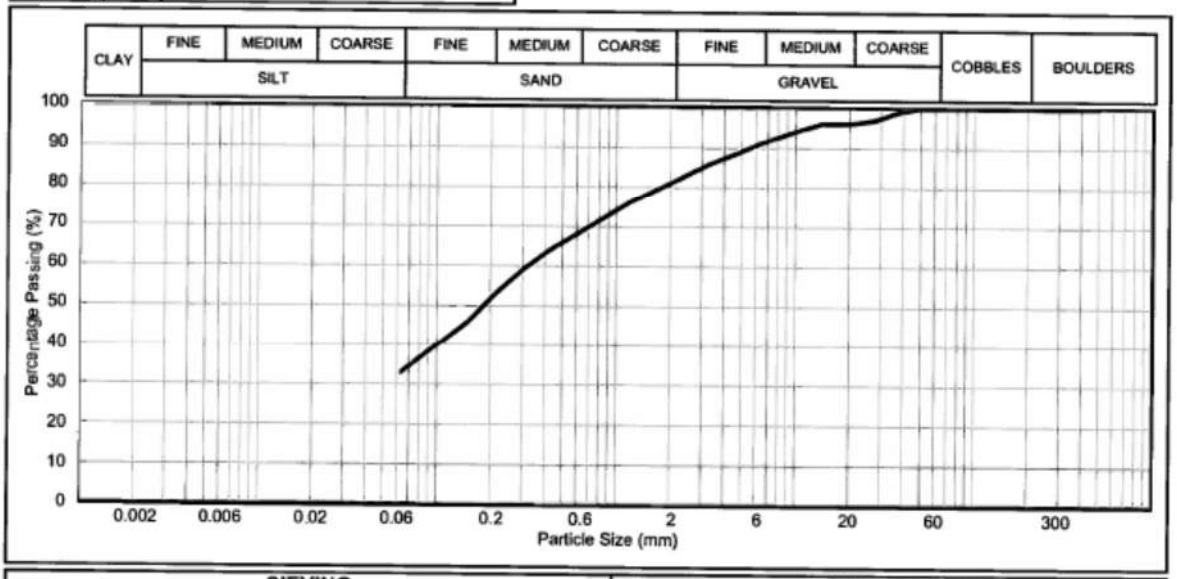
UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)		
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, *i.e.*, particles of diameter less than 63 microns

Borehole	-
Sample	382656/006
Depth (m)	-

T3/S1



SIEVING			
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable	
		Lower %	Upper %
500.0	100	-	-
300.0	100	-	-
125.0	100	-	-
90.0	100	-	-
75.0	100	-	-
63.0	100	-	-
50.0	100	-	-
37.5	99	-	-
28.0	97	-	-
20.0	96	-	-
14.0	96	-	-
10.0	94	-	-
6.30	91	-	-
5.00	89	-	-
3.35	86	-	-
2.00	81	-	-
1.18	76	-	-
0.600	68	-	-
0.425	64	-	-
0.300	59	-	-
0.212	53	-	-
0.150	46	-	-
0.063	33	-	-

SEDIMENTATION	
Particle Size (mm)	Percentage Passing (%)
0.020	
0.006	
0.002	

GRADING CLASSIFICATION (SHW TABLE 6/2)
-
Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.

PERCENTAGE SOIL TYPES				
CLAY	SILT ₸	SAND	GRAVEL	COBBLES
/	33	48	19	0

UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)		
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT -		-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Stage 1 Chemical / Contamination Test Results

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil
Organophosphorous insecticides

					SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
					Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
					Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units						
Azinphos methyl	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Dimethoate	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Mevinphos	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Parathion	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Pirimiphos methyl	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil
Organophosphorous insecticides

					SAL Reference	382656 006
					Customer Sample Reference	TP3/S1
					Date Sampled	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units		
Azinphos methyl	T16	AR	0.01	mg/kg		<0.01
Diazinon	T16	AR	0.01	mg/kg		<0.01
Dichlorvos	T16	AR	0.01	mg/kg		<0.01
Dimethoate	T16	AR	0.01	mg/kg		<0.01
Fenitrothion	T16	AR	0.01	mg/kg		<0.01
Malathion	T16	AR	0.01	mg/kg		<0.01
Mevinphos	T16	AR	0.01	mg/kg		<0.01
Parathion	T16	AR	0.01	mg/kg		<0.01
Pirimiphos methyl	T16	AR	0.01	mg/kg		<0.01

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil — Analysed as Soil
Organochlorine Insecticides

					SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
					Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
					Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units						
Aldrin	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
DDD	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
DDE	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
DDT	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulphan	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene	T1	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorocyclohexane	T16	AR	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil — Analysed as Soil
Organochlorine Insecticides

					SAL Reference	382656 006
					Customer Sample Reference	TP3/S1
					Date Sampled	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units		
Aldrin	T16	AR	0.01	mg/kg		<0.01
Chlordane	T16	AR	0.01	mg/kg		<0.01
DDD	T16	AR	0.01	mg/kg		<0.01
DDE	T16	AR	0.01	mg/kg		<0.01
DDT	T16	AR	0.01	mg/kg		<0.01
Dieldrin	T16	AR	0.01	mg/kg		<0.01
Endosulphan	T16	AR	0.01	mg/kg		<0.01
Endrin	T16	AR	0.01	mg/kg		<0.01
Heptachlor	T16	AR	0.01	mg/kg		<0.01
Heptachlor epoxide	T16	AR	0.01	mg/kg		<0.01
Hexachlorobenzene	T1	AR	0.01	mg/kg		<0.01
Hexachlorocyclohexane	T16	AR	0.01	mg/kg		<0.01

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil
Semi-Volatile Organic Compounds (USEPA 625)

					SAL Reference	382656 006	382656 007
					Customer Sample Reference	TP3/S1	SVOC Blank
					Date Sampled	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units			
Phenol	T16	AR	0.1	mg/kg		<0.1	<0.1
Bis (2-chloroethyl) ether	T16	AR	0.1	mg/kg		<0.1	<0.1
2-Chlorophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
1,3-Dichlorobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
1,4-Dichlorobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
1,2-Dichlorobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
Bis (2-chloroisopropyl) ether	T16	AR	0.1	mg/kg		<0.1	<0.1
2-methyl phenol	T16	AR	0.1	mg/kg		<0.1	<0.1
3/4-Methylphenol	T16	AR	0.1	mg/kg		<0.1	<0.1
Hexachloroethane	T16	AR	0.1	mg/kg		<0.1	<0.1
Nitrobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
Isophorone	T16	AR	0.1	mg/kg		<0.1	<0.1
2-Nitrophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
2,4-Dimethylphenol	T16	AR	0.1	mg/kg		<0.1	<0.1
Bis (2-chloroethoxy) methane	T16	AR	0.1	mg/kg		<0.1	<0.1
2,4-Dichlorophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
1,2,4-Trichlorobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
Naphthalene	T16	AR	0.1	mg/kg		<0.1	<0.1
4-Chloroaniline	T16	AR	0.1	mg/kg		<0.1	<0.1
Hexachlorobutadiene	T16	AR	0.1	mg/kg		<0.1	<0.1
4-Chloro-3-methylphenol	T16	AR	0.1	mg/kg		<0.1	<0.1
2-Methylnaphthalene	T16	AR	0.1	mg/kg		<0.1	<0.1
Hexachlorocyclopentadiene	T16	AR	0.1	mg/kg		<0.1	<0.1
2,4,6-Trichlorophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
2,4,5-Trichlorophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
2-Chloronaphthalene	T16	AR	0.1	mg/kg		<0.1	<0.1
2-Nitroaniline	T16	AR	0.1	mg/kg		<0.1	<0.1
Dimethyl phthalate	T16	AR	0.1	mg/kg		<0.1	<0.1
2,6-Dinitrotoluene	T16	AR	0.1	mg/kg		<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg		<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg		<0.1	<0.1
3-Nitroaniline	T16	AR	0.1	mg/kg		<0.1	<0.1
2,4-Dinitrophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
Dibenzofuran	T16	AR	0.1	mg/kg		<0.1	<0.1
2,4-Dinitrotoluene	T16	AR	0.1	mg/kg		<0.1	<0.1
4-Nitrophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
Diethyl phthalate	T16	AR	0.1	mg/kg		<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg		<0.1	<0.1
4-Chlorophenyl phenylether	T16	AR	0.1	mg/kg		<0.1	<0.1
4-Nitroaniline	T16	AR	0.1	mg/kg		<0.1	<0.1
Azobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
4-Bromophenyl phenylether	T16	AR	0.1	mg/kg		<0.1	<0.1
Hexachlorobenzene	T16	AR	0.1	mg/kg		<0.1	<0.1
Pentachlorophenol	T16	AR	0.1	mg/kg		<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg		<0.1	<0.1
Anthracene	T16	AR	0.1	mg/kg		<0.1	<0.1
Carbazole	T16	AR	0.1	mg/kg		<0.1	<0.1
Di-n-butylphthalate	T16	AR	0.1	mg/kg		<0.1	<0.1
Fluoranthene	T16	AR	0.1	mg/kg		<0.1	<0.1
Pyrene	T16	AR	0.1	mg/kg		<0.1	<0.1
Butyl benzylphthalate	T16	AR	0.1	mg/kg		<0.1	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg		<0.1	<0.1
Chrysene	T16	AR	0.1	mg/kg		<0.1	<0.1
Bis (2-ethylhexyl)phthalate	T16	AR	0.1	mg/kg		<0.1	<0.1
Di-n-octylphthalate	T16	AR	0.1	mg/kg		<0.1	<0.1
Benzo(bfk)Fluoranthene	T16	AR	0.1	mg/kg		<0.1	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg		<0.1	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg		<0.1	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg		<0.1	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg		<0.1	<0.1

SAL Reference: 382656

Customer Reference: Northconnect (NCK5)

Soil — Analysed as Soil

Semi-Volatile Organic Compounds (USEPA 625)

				SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
				Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
				Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units					
Phenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bis (2-chloroethyl) ether	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2-Chlorophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
1,3-Dichlorobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
1,4-Dichlorobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bis (2-chloroisopropyl) ether	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2-methyl phenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
3/4-Methylphenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachloroethane	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Isophorone	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2-Nitrophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,4-Dimethylphenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bis (2-chloroethoxy) methane	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,4-Dichlorophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
1,2,4-Trichlorobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
4-Chloroaniline	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorobutadiene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
4-Chloro-3-methylphenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2-Methylnaphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorocyclopentadiene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,4,6-Trichlorophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,4,5-Trichlorophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2-Chloronaphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2-Nitroaniline	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethyl phthalate	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,6-Dinitrotoluene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
3-Nitroaniline	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,4-Dinitrophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzofuran	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
2,4-Dinitrotoluene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
4-Nitrophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diethyl phthalate	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
4-Chlorophenyl phenylether	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
4-Nitroaniline	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Azobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
4-Bromophenyl phenylether	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorobenzene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pentachlorophenol	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Carbazole	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Di-n-butylphthalate	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Butyl benzylphthalate	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bis (2-ethylhexyl)phthalate	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Di-n-octylphthalate	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil
REC Ltd 002EK

Analysed as Soil

					SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
					Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
					Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units						
Arsenic	T82	A40	2	mg/kg		6	6	6	4	7
Cadmium	T82	A40	1	mg/kg		<1	<1	<1	<1	<1
Chromium	T82	A40	1	mg/kg		28	29	40	37	36
Chromium VI	T82	A40	1	mg/kg		<1	<1	<1	<1	<1
Copper	T82	A40	1	mg/kg		10	14	22	23	20
Lead	T82	A40	3	mg/kg		15	12	12	12	14
Mercury	T82	A40	1	mg/kg		<1	<1	<1	<1	<1
Nickel	T82	A40	1	mg/kg		13	20	34	35	21
Selenium	T82	A40	3	mg/kg		<3	<3	<3	<3	<3
SO4(Total)	T82	A40	0.01	%		0.12	0.02	0.02	0.02	0.02
SO4(2:1)	T112	A40	10	mg/l		12	<10	18	14	14
Zinc	T82	A40	1	mg/kg		38	71	83	71	56
Cyanide(Total)	T4	AR	1	mg/kg		<1	<1	<1	<1	<1
Phenols(Mono)	T4	AR	1	mg/kg		<1	<1	<1	<1	<1
pH	T7	A40				6.3	6.1	4.9	5.2	5.1

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil
REC Ltd 002EK

Analysed as Soil

					SAL Reference	382656 006
					Customer Sample Reference	TP2/S1
					Date Sampled	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units		
Arsenic	T82	A40	2	mg/kg		5
Cadmium	T82	A40	1	mg/kg		<1
Chromium	T82	A40	1	mg/kg		38
Chromium VI	T82	A40	1	mg/kg		<1
Copper	T82	A40	1	mg/kg		20
Lead	T82	A40	3	mg/kg		10
Mercury	T82	A40	1	mg/kg		<1
Nickel	T82	A40	1	mg/kg		25
Selenium	T82	A40	3	mg/kg		<3
SO4(Total)	T82	A40	0.01	%		0.01
SO4(2:1)	T112	A40	10	mg/l		15
Zinc	T82	A40	1	mg/kg		57
Cyanide(Total)	T4	AR	1	mg/kg		<1
Phenols(Mono)	T4	AR	1	mg/kg		<1
pH	T7	A40				5.0

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil — Analysed as Soil
Total and Speciated USEPA16 PAH (EK)

				SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
				Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
				Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units					
Naphthalene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	T149	AR	0.01	mg/kg	0.02	<0.01	<0.01	<0.01	<0.01
Pyrene	T149	AR	0.01	mg/kg	0.02	<0.01	<0.01	<0.01	<0.01
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	T149	AR	0.01	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
PAH(total)	T149	AR	0.01	mg/kg	0.06	<0.01	<0.01	<0.01	<0.01

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil — Analysed as Soil
Total and Speciated USEPA16 PAH (EK)

				SAL Reference	382656 006
				Customer Sample Reference	TP3/S1
				Date Sampled	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units	
Naphthalene	T149	AR	0.01	mg/kg	<0.01
Acenaphthylene	T149	AR	0.01	mg/kg	<0.01
Acenaphthene	T149	AR	0.01	mg/kg	<0.01
Fluorene	T149	AR	0.01	mg/kg	<0.01
Phenanthrene	T149	AR	0.01	mg/kg	<0.01
Anthracene	T149	AR	0.01	mg/kg	<0.01
Fluoranthene	T149	AR	0.01	mg/kg	<0.01
Pyrene	T149	AR	0.01	mg/kg	<0.01
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	<0.01
Chrysene	T149	AR	0.01	mg/kg	<0.01
Benzo(b)fluoranthene	T149	AR	0.01	mg/kg	<0.01
Benzo(k)fluoranthene	T149	AR	0.01	mg/kg	<0.01
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	<0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	<0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	<0.01
PAH(total)	T149	AR	0.01	mg/kg	<0.01

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil

Total Petroleum Hydrocarbons Banded (C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)

					SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
					Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
					Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units						
TPH (C8-C10)	T8	AR	1	mg/kg		<1	<1	<1	<1	<1
TPH (C10-C12)	T8	AR	1	mg/kg		<1	<1	<1	<1	<1
TPH (C12-C16)	T8	AR	1	mg/kg		<1	<1	<1	<1	<1
TPH (C16-C21)	T8	AR	1	mg/kg		<1	<1	(13) <1	<1	(13) <1
TPH (C21-C35)	T8	AR	1	mg/kg		<1	<1	<1	<1	<1
TPH (C35-C40)	T8	AR	1	mg/kg		<1	<1	<1	<1	<1

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil

Total Petroleum Hydrocarbons Banded (C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)

					SAL Reference	382656 006
					Customer Sample Reference	TP3/S1
					Date Sampled	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units		
TPH (C8-C10)	T8	AR	1	mg/kg		<1
TPH (C10-C12)	T8	AR	1	mg/kg		<1
TPH (C12-C16)	T8	AR	1	mg/kg		<1
TPH (C16-C21)	T8	AR	1	mg/kg		(13) <1
TPH (C21-C35)	T8	AR	1	mg/kg		<1
TPH (C35-C40)	T8	AR	1	mg/kg		<1

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil
Volatile Organic Compounds (USEPA 624)

				SAL Reference	382656 001	382656 002	382656 003	382656 004	382656 005
				Customer Sample Reference	TP1/S1	TP1/S2	TP1/S3	TP1/S4	TP2/S1
				Date Sampled	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014	13-MAR-2014
Determinand	Method	Test Sample	LOD	Units					
Dichlorodifluoromethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Chloromethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Vinyl chloride	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Bromomethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Chloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Trichlorofluoromethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1-Dichloroethylene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Dichloromethane	T54	AR	50	µg/kg	<50	<50	<50	<50	<50
Trans-1,2-Dichloroethene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1-Dichloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Cis-1,2-Dichloroethylene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
2,2-Dichloropropane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Chloroform	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Bromochloromethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1-Dichloropropene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Carbon tetrachloride	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,2-Dichloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Benzene	T54	AR	1	µg/kg	[10] <1	[12] <1	[13] <1	[13] <1	[13] <1
1,2-Dichloropropane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1,2-Trichloroethylene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Bromodichloromethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Dibromomethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Cis-1,3-Dichloropropene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Toluene	T54	AR	1	µg/kg	<1	<1	<1	<1	<1
Trans-1,3-Dichloropropene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1,2-Trichloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,3-Dichloropropane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Tetrachloroethene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Chlorodibromomethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,2-dibromoethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Chlorobenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1,1,2-Tetrachloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
EthylBenzene	T54	AR	1	µg/kg	<1	<1	<1	<1	<1
M/P Xylene	T54	AR	1	µg/kg	<1	<1	<1	<1	<1
O Xylene	T54	AR	1	µg/kg	<1	<1	<1	<1	<1
Styrene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Bromoform	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Isopropyl benzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,2,3-Trichloropropane	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
n-Propylbenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
Bromobenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,3,5-Trimethylbenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
T-Butylbenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
S-Butylbenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
p-Isopropyltoluene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
2-Chlorotoluene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
4-Chlorotoluene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,3-Dichlorobenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	T54	AR	5	µg/kg	<5	<5	<5	<5	<5

SAL Reference: 382656
Customer Reference: Northconnect (NCKS)

Soil Analysed as Soil

Volatile Organic Compounds (USEPA 624)

SAL Reference	382656 006
Customer Sample Reference	TP3/S1
Date Sampled	13-MAR-2014

Determinand	Method	Test Sample	LOD	Units	
Dichlorodifluoromethane	T54	AR	5	µg/kg	<5
Chloromethane	T54	AR	5	µg/kg	<5
Vinyl chloride	T54	AR	5	µg/kg	<5
Bromomethane	T54	AR	5	µg/kg	<5
Chloroethane	T54	AR	5	µg/kg	<5
Trichlorofluoromethane	T54	AR	5	µg/kg	<5
1,1-Dichloroethylene	T54	AR	5	µg/kg	<5
Dichloromethane	T54	AR	50	µg/kg	<50
Trans-1,2-Dichloroethene	T54	AR	5	µg/kg	<5
1,1-Dichloroethane	T54	AR	5	µg/kg	<5
Cis-1,2-Dichloroethylene	T54	AR	5	µg/kg	<5
2,2-Dichloropropane	T54	AR	5	µg/kg	<5
Chloroform	T54	AR	5	µg/kg	<5
Bromochloromethane	T54	AR	5	µg/kg	<5
1,1,1-Trichloroethane	T54	AR	5	µg/kg	<5
1,1-Dichloropropene	T54	AR	5	µg/kg	<5
Carbon tetrachloride	T54	AR	5	µg/kg	<5
1,2-Dichloroethane	T54	AR	5	µg/kg	<5
Benzene	T54	AR	1	µg/kg	[03] <1
1,2-Dichloropropane	T54	AR	5	µg/kg	<5
1,1,2-Trichloroethylene	T54	AR	5	µg/kg	<5
Bromodichloromethane	T54	AR	5	µg/kg	<5
Dibromomethane	T54	AR	5	µg/kg	<5
Cis-1,3-Dichloropropene	T54	AR	5	µg/kg	<5
Toluene	T54	AR	1	µg/kg	<1
Trans-1,3-Dichloropropene	T54	AR	5	µg/kg	<5
1,1,2-Trichloroethane	T54	AR	5	µg/kg	<5
1,3-Dichloropropane	T54	AR	5	µg/kg	<5
Tetrachloroethene	T54	AR	5	µg/kg	<5
Chlorodibromomethane	T54	AR	5	µg/kg	<5
1,2-dibromoethane	T54	AR	5	µg/kg	<5
Chlorobenzene	T54	AR	5	µg/kg	<5
1,1,1,2-Tetrachloroethane	T54	AR	5	µg/kg	<5
EthylBenzene	T54	AR	1	µg/kg	<1
M/P Xylene	T54	AR	1	µg/kg	<1
O Xylene	T54	AR	1	µg/kg	<1
Styrene	T54	AR	5	µg/kg	<5
Bromoform	T54	AR	5	µg/kg	<5
Isopropyl benzene	T54	AR	5	µg/kg	<5
1,1,2,2-Tetrachloroethane	T54	AR	5	µg/kg	<5
1,2,3-Trichloropropane	T54	AR	5	µg/kg	<5
n-Propylbenzene	T54	AR	5	µg/kg	<5
Bromobenzene	T54	AR	5	µg/kg	<5
1,3,5-Trimethylbenzene	T54	AR	5	µg/kg	<5
T-Butylbenzene	T54	AR	5	µg/kg	<5
1,2,4-Trimethylbenzene	T54	AR	5	µg/kg	<5
S-Butylbenzene	T54	AR	5	µg/kg	<5
p-Isopropyltoluene	T54	AR	5	µg/kg	<5
2-Chlorotoluene	T54	AR	5	µg/kg	<5
4-Chlorotoluene	T54	AR	5	µg/kg	<5
1,3-Dichlorobenzene	T54	AR	5	µg/kg	<5
1,4-Dichlorobenzene	T54	AR	5	µg/kg	<5
1,2-Dichlorobenzene	T54	AR	5	µg/kg	<5

Scale of Rock Strength

Description	Field Test	Uniaxial Compressive Strength (UCS) - (MPa)	Characteristic Rocks
Very weak	Crumbles under sharp blows with geological pick point, can be cut with pocket knife	<1.25	Weathered and weakly compacted sedimentary rocks (chalk, rock salt)
Weak	Shallow cuts or scraping with pocket knife with difficulty, pick point indents deeply with firm blow	1.25 to 5	Weakly cemented sedimentary rocks (coal, siltstone, also schist)
Moderately weak	Only thin slabs, corners or edges can be broken off with heavy hand pressure	5 to 12.5	Moderate cementation of sedimentary rock
Moderately strong	Knife cannot be used to scrape or peel surface, shallow indentations under firm blow from pick point	12.5 to 50	Competent sedimentary rocks (sandstone, shale, slate)
Strong	Hand held sample breaks with one firm blow from hammer end of geological pick	50 to 100	Competent igneous and metamorphic rocks (marble, granite, gneiss)
Very strong	Requires many blows from geological pick to break intact sample	100 to 200	Dense fine-grained igneous and metamorphic rocks (quartzite, dolerite, gabbro, basalt)
Extremely strong	Rock rings on hammer blows. Only broken by sledge hammer	>200	Very dense fine-grained metamorphic rocks (quartzite, dolerite, gabbro, basalt)

Scale of rock strength, based on UCS values (modified from BS 5930:1999; BSI, 1999).

Scale of rock strength

Stage 1 Site Investigation Photographs

TP1(1)

TP1(2)

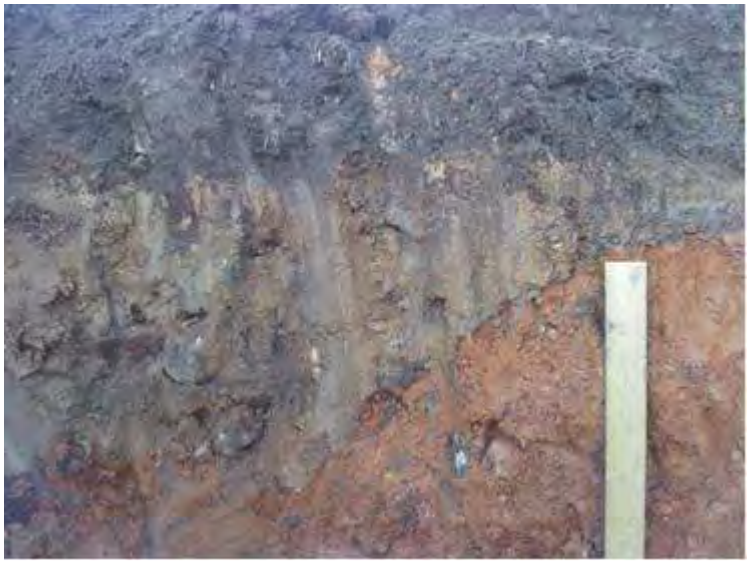
TP1(3)

TP1(4)

TP2(1)

TP2(2)

TP2(3)

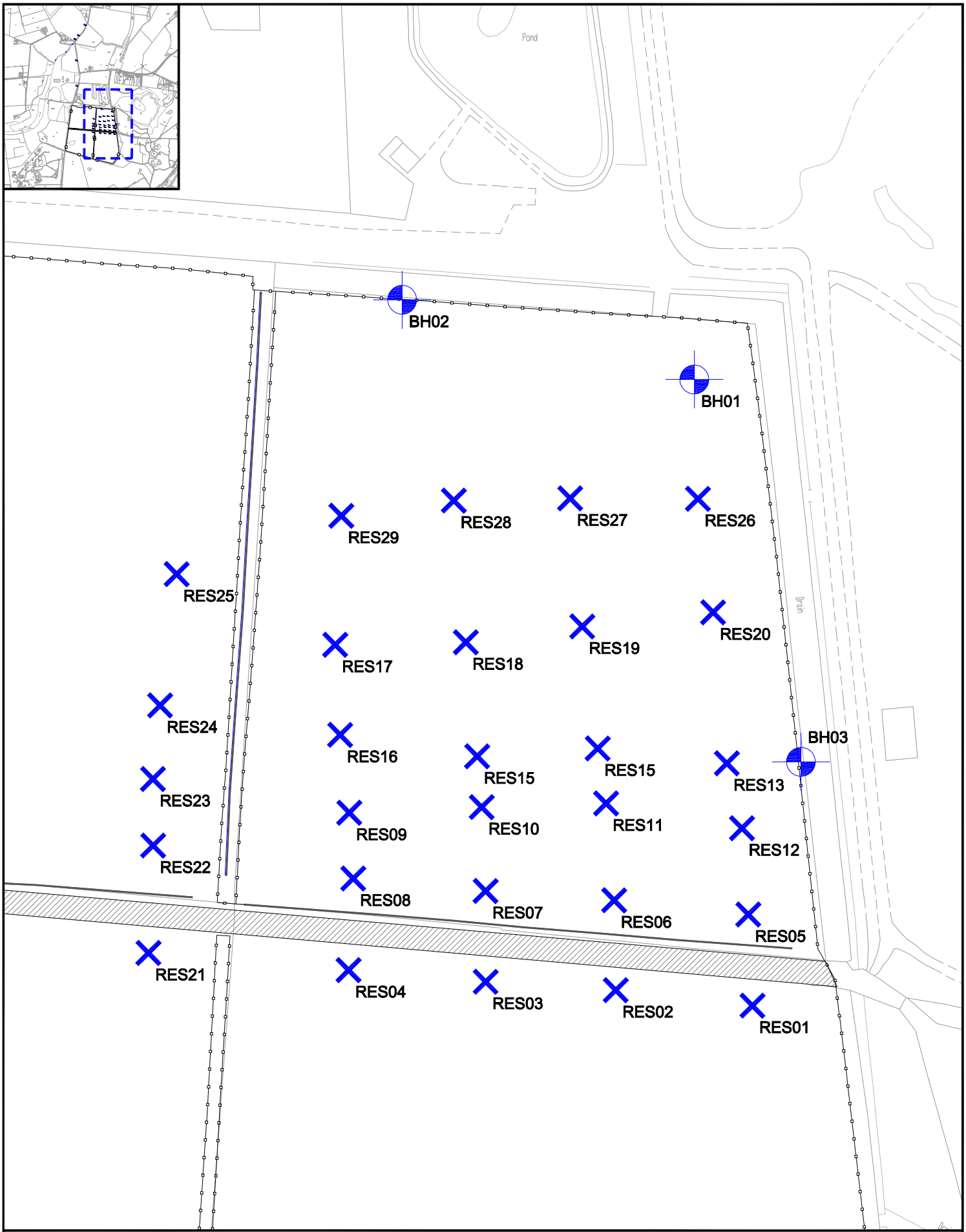


TP3(1)

TP3(2)

TP3(3)

Appendix D – Stage 2 Ground Investigation Data



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Legend

Trial Pit Location

Resistivity Test Locations

Drawing Title: Figure A2, Borehole and Resistivity Test Locations

Project Name: Fourfields, Peterhead

Project#: 0955-001

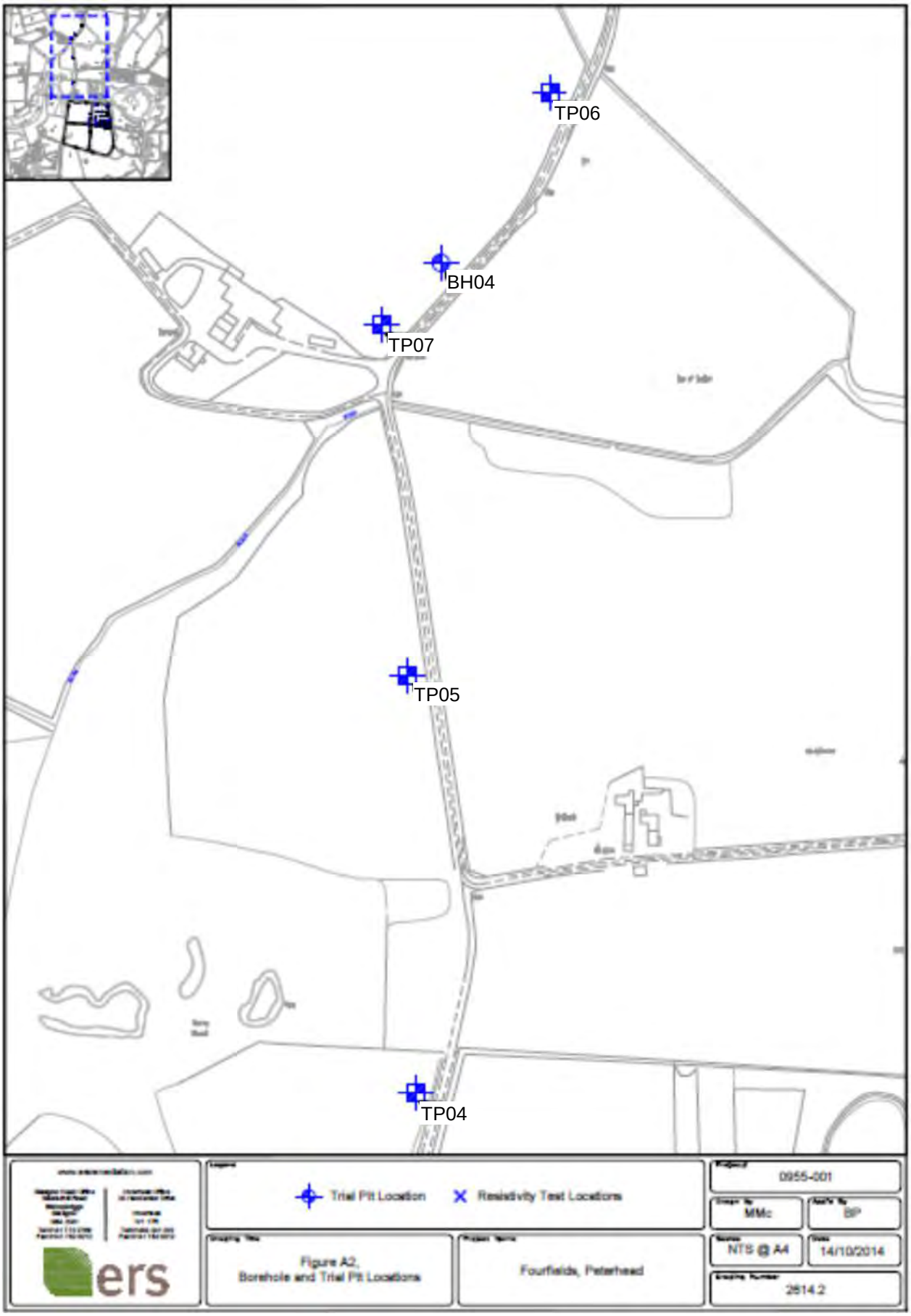
Drawn By: MMc

App'd By: BP

Scales: NTS @ A4

Date: 14/10/2014

Drawing Number: 2614.1


TP06
BH04
TP07
TP05
TP04
Trial Pit Location
Resistivity Test Locations
0955-001
MMc
BP
NTS @ A4
14/10/2014
Figure A2.
Borehole and Trial Pit Locations
Fourfields, Peterhead
2614.2
ers

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Site Name	Fourfields, Boddam, Peterhead	Contract No
Client	North Connect	**955001**
Consultant	North Connect	
Contractor	ERS	

KEY TO TRIAL PIT AND BOREHOLE RECORDS

SOIL SAMPLES

U (x)	Undisturbed driven tube sample, 100mm nominal diameter unless noted; (x) No. of blows to drive sampler
P	Undisturbed pushed piston sample, 100mm nominal diameter unless noted
TW	Thin wall tube (pushed)
CBR	CBR mould sample
B	Bulk sample
LB	Large Bulk sample
T	Small disturbed sample
E	Environmental sample (Many containers)
J	Amber Jar sample
V	Vial sample

IN-SITU AND FIELD TESTS

SPT=X a/b (pen)	Standard Penetration Test (split spoon sampler)
CPT=X a/b (pen)	Cone Penetration Test (solid cone) Note: 'a' is blow/75mm for seating drive; 'b' is blows/75mm for test drive; (pen) is test drive penetration if less than 300mm
CBR	California Bearing Ratio Test
K	Field Permeability Test
V,PP	Field Vane Test
PID	Photo-Ionization Detector

CORE RECOVERY AND ROCK QUALITY

TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Designation (%)
If	Fracture Index

GROUNDWATER

W	Groundwater sample
▽	Groundwater encountered
▼	Depth to which groundwater rose

LEGENDS

Material Legends are in accordance with BS 5930:1999 (see attached)

before a description indicates that it is based on the Driller`s record only. Other descriptions based on visual assessment only.

INSTALLATIONS (BACKFILL)


Concrete


Gravel


Bentonite or Grout


Spoil / Fill


Solid Pipe


Wooden Plug

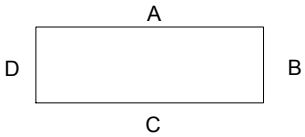

Sand


Slotted Pipe

DIMENSIONS

All dimensions in metres unless otherwise stated

TRIAL PIT FACES



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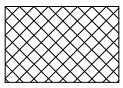
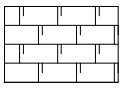
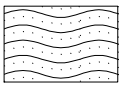
Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No **955001**

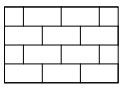
SYMBOLS FOR SOILS AND ROCKS

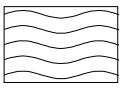

Made Ground

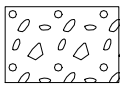

Chalk

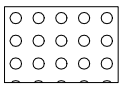

Metamorphic Coarse Grained

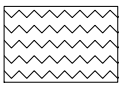

Boulders and Cobbles

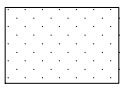

Limestone

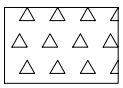

Metamorphic Medium Grained

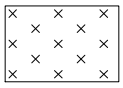

Gravel


Conglomerate

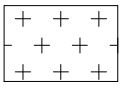

Metamorphic Fine Grained

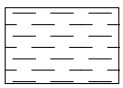

Sand

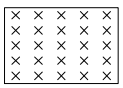

Breccia

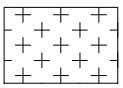

Silt

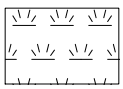

Sandstone

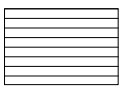

Igneous Coarse Grained

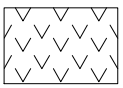

Clay


Siltstone


Igneous Medium Grained

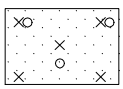

Peat

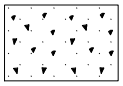

Mudstone

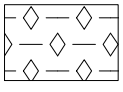

Igneous Fine Grained

NOTE : Composite soil types will be signified by combined symbols e.g.


Coal


Silty Gravelly Sand


Pyroclastic (Volcanic Ash)


Evaporites (Gypsum, Rocksalt, etc)

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No **955001**

Exploratory Hole	Final Depth	Hole Type	Start Date	End Date	Easting mE	Northing mN	Elevation mAOD	Comments	Figure No.
BH01	6.00	RO	08/10/2014	08/10/2014	412060.656	841457.963	62.18		01
BH02	5.00	RO	07/10/2014	09/10/2014	411969.219	841482.929	64.72		02
BH03	12.50	RO	07/10/2014	09/10/2014	412094.035	841338.388	65.54		03
BH04	3.00	WLS	08/10/2014	08/10/2014	411765.689	842128.200	55.35		04
TP04	1.90	TP	07/10/2014	07/10/2014	411752.013	841684.808	74.09		05
TP05	2.90	TP	07/10/2014	07/10/2014	411747.832	841908.244	60.94		06
TP06	2.50	TP	07/10/2014	07/10/2014	411823.407	842219.115	50.63		07
TP07	2.70	TP	07/10/2014	07/10/2014	411734.130	842095.230	53.96		08
RES01	0.00				412078.854	841262.108	69.19		09
RES02	0.00				412036.053	841268.958	71.27		10
RES03	0.00				411995.337	841269.576	72.39		11
RES04	0.00				411962.425	841273.229	72.59		12
RES05	0.00				412077.544	841290.634	68.25		13
RES06	0.00				412035.576	841295.065	70.32		14
RES07	0.00				411995.253	841298.056	70.75		15
RES08	0.00				411953.903	841301.891	70.65		16
RES09	0.00				411962.669	841322.466	69.84		17
RES010	0.00				411994.111	841324.239	69.39		18
RES011	0.00				412033.023	841325.384	68.90		19
RES012	0.00				412075.575	841317.619	67.32		20
RES013	0.00				412070.827	841337.929	66.57		21
RES014	0.00				412030.418	841342.575	67.89		22
RES015	0.00				411992.670	841340.123	68.51		23
RES016	0.00				411949.814	841346.837	69.03		24
RES017	0.00				411948.261	841375.029	67.65		25
RES018	0.00				411969.137	841375.818	66.80		26
RES019	0.00				412025.571	841380.759	66.11		27
RES020	0.00				412066.529	841385.163	64.91		28
RES021	0.00				411889.805	841278.594	76.02		29
RES022	0.00				411891.292	841312.202	73.50		30
RES023	0.00				411891.219	841333.033	72.24		31
RES024	0.00				411893.448	841356.077	71.87		32
RES025	0.00				411898.632	841397.131	71.33		33
RES026	0.00				412061.786	841420.891	63.16		34
RES027	0.00				412021.792	841420.847	64.67		35
RES028	0.00				411986.397	841420.153	65.32		36
RES029	0.00				411960.176	841415.392	66.52		37

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Borehole No: **BH01**

Location:	North: 841457.9632	East: 412060.6554	Ground Level: 62.18	Inclination: -90	Scale: 1:50
Dates: 08/10/2014 - 08/10/2014	Driller(s): JL CT	Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples & Test

Depth	Sample Type	In-situ Tests
0.30	B	
		Pen. N Cas. Wat.
1.00-2	U	1.00 S 300 6 1.00
		Pen. N Cas. Wat.
2.00-3	U	2.00 S 300 5 2.00
		Pen. N Cas. Wat.
		3.00 S 0 >50 2.00

From	To	TCR	SCR	RQD	FI
4.00	5.00	100	65	61	7
5.00	6.00	96	59	29	9

STRATA DETAILS

Depth	Description	Legend	Level mOD
0.30	Dark brown clayey TOPSOIL		61.88
	Soft becoming firm orange brown slightly mottled grey sandy slightly gravelly CLAY with cobbles. Gravel is subangular to subrounded fine to coarse of mixed lithology.		
1.80	Soft grey slightly sandy gravelly CLAY with cobbles. Gravel is subangular to subrounded fine to coarse of mixed lithology.		60.38
3.10	Weathered GRANITE recovered as pink and orange angular fine to coarse gravel.		59.08
4.00	Medium strong pink and grey GRANITE. Weathering between 4.70m and 5.00m has reduced strength to weak and rock is recovered as angular coarse gravel. Fractures: close to medium spaced subhorizontal dipping approximatley 45°, rough stepped.		58.18
6.00			56.18

(End of Borehole)

Water

Level	Depth
1 08/10(m)	1.00
1	3.00

Backfill

Depth	Legend
0.50	
1.00	
3.00	
6.00	

Remarks:

Soil Boring Casing			Water Added			Chiselling			Rotary Casing			Flush Details			
From	To	Diameter (mm)	From	To	Amount	From	To	Time (hrs)	From	To	Diameter (mm)	From	To	Type	Returns (%)
0.00	3.50	140							0.00	3.50	140	0.00	6.00	Air Mist	100

Hole Type			Drill Rig Type	Boring / Drilling Progress			Water Levels		Waterstrike				Figure No
From	To	Type		Date	Hole Depth	Casing Depth	Morning	Evening	Struck	Rose To	Time (min)	Cut Off	01
0.00	3.10	WLS	Dando Terrier 2002 / Massenza MI6	08-10-14	6.00	3.50	1.00		3.00	1.00	20.00		Sheet
3.10	4.00	RO											1 of 1
4.00	6.00	RC											

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Borehole No: **BH02**

Location:	North: 841482.9289	East: 411969.2194	Ground Level: 64.72	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 09/10/2014	Driller(s): JL CT	Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples & Test				STRATA DETAILS			Level	Water	Backfill	
Depth	Sample Type	In-situ Tests	Depth	Description	Legend	mOD	Level	Depth	Legend
0.30	B		0.30	Dark brown clayey TOPSOIL		64.42		0.50	
		Pen. N Cas. Wat.		Soft to firm orange brown slightly sandy gravelly CLAY with cobbles and boulders. Gravel is subangular to subrounded fine to coarse of mixed lithology.				1.00	
1.00-2	U	1.00 S 300 9 1.00							
		Pen. N Cas. Wat.	2.00			62.72			
		2.00 S 300 33 2.00		Stiff to very stiff orange brown sandy slightly gravelly CLAY with cobbles and boulders. Gravel is subangular to subrounded fine to coarse of mixed lithology.					
		Pen. N Cas. Wat.	2.55			62.17		3.30	
		2.55 S 0 >50 2.00		Weathered GRANITE recovered as pink and orange angular fine to coarse gravel.					
		Pen. N Cas. Wat.							
		3.50 S 275 >50 2.50							
			5.00			59.72		5.00	

(End of Borehole)

Remarks:
Borehole drilled to 5.00m, but caved in to 3.30m

Soil Boring Casing			Water Added			Chiselling			Rotary Casing			Flush Details			
From	To	Diameter (mm)	From	To	Amount	From	To	Time (hrs)	From	To	Diameter (mm)	From	To	Type	Returns (%)
0.00	2.00	140							0.00	2.00	140	0.00	5.00	Air Mist	100
2.00	5.00	110													

Hole Type			Drill Rig Type	Boring / Drilling Progress			Water Levels		Waterstrike				Figure No
From	To	Type		Date	Hole Depth	Casing Depth	Morning	Evening	Struck	Rose To	Time (min)	Cut Off	02
0.00	2.55	WLS	Dando Terrier 2002 / Massenza MI6	07-10-14	2.55								Sheet
2.55	3.50	RC		09-10-14	5.00	2.50							1 of 1
3.50	5.00	RO											

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Borehole No: **BH03**

Location:	North: 841338.3876	East: 412094.0351	Ground Level: 65.54	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 09/10/2014	Driller(s): JL CT	Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples & Test

Depth	Sample Type	In-situ Tests
0.30	B	
		Pen. N Cas. Wat.
1.00-1.6	U 1.00 S	300 6 1.00
		Pen. N Cas. Wat.
	1.60	300 >50 1.60

STRATA DETAILS

Depth	Description	Legend	Level mOD	Water Level	Backfill Depth	Backfill Legend
0.30	Dark brown clayey TOPSOIL		65.24		0.50	
	Soft grey brown slightly sandy gravelly CLAY, tending to clayey sand gravel, with cobbles. Gravel is subangular to subrounded fine to coarse of mixed lithology.				1.00	
1.30	Weathered GRANITE recovered as pink and orange angular fine to coarse gravel.		64.24	07/10(m)	1.30	
5.40	Strong pale grey and pink GRANITE.		60.14		6.00	
5.70	Weak pink and grey GRANITE. Highly weathered throughout reducing strength to very weak and in places recovered as coarse angular gravel. Fractures: non intact to very closely spaced rough.		59.84			

From	To	TCR	SCR	RQD	FI
5.40	6.90	47	15	0	NI
9.50	11.00	48	23	0	NI

Remarks:

Soil Boring Casing			Water Added			Chiselling			Rotary Casing			Flush Details			
From	To	Diameter (mm)	From	To	Amount	From	To	Time (hrs)	From	To	Diameter (mm)	From	To	Type	Returns (%)
0.00	2.50	140							0.00	2.50	140	0.00	12.50	Air Mist	100
2.00	12.50	110													

Hole Type			Drill Rig Type	Boring / Drilling Progress			Water Levels		Waterstrike				Figure No
From	To	Type		Date	Hole Depth	Casing Depth	Morning	Evening	Struck	Rose To	Time (min)	Cut Off	03
0.00	2.05	WLS	Dando Terrier 2002 / Massenza MI6	07-10-14	1.60	3.00	1.30						Sheet
2.05	5.40	RO											1 of 2
5.40	6.90	RC											
6.90	9.50	RO											

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Borehole No: **BH03**

Location:	North: 841338.3876	East: 412094.0351	Ground Level: 65.54	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 09/10/2014	Driller(s): JL CT	Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Rock Coring						STRATA DETAILS		Level	Water		Backfill
From	To	TCR	SCR	RQD	FI	Depth	Description	Legend	mOD	Level	Depth	Legend
9.50	11.00	48	23	0	NI		Weak pink and grey GRANITE. Highly weathered throughout reducing strength to very weak and in places recovered as coarse angular gravel. Fractures: non intact to very closely spaced rough. *(continued)*					
11.00	12.50	61	33	33	5	12.50			53.04		12.50	

(End of Borehole)

Remarks:

Soil Boring Casing			Water Added						Rotary Casing			Flush Details			
From	To	Diameter (mm)	From	To	Amount	From	To	Time (hrs)	From	To	Diameter (mm)	From	To	Type	Returns (%)

Hole Type			Drill Rig Type	Boring / Drilling Progress			Water Levels		Waterstrike				Figure No
From	To	Type		Date	Hole Depth	Casing Depth	Morning	Evening	Struck	Rose To	Time (min)	Cut Off	03
			Dando Terrier 2002 / Massenza MI6	08-10-14	12.50	2.50							Sheet: 2 of 2

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Borehole No: **BH04**

Location:	North: 842128.1995	East: 411765.6687	Ground Level: 55.35	Inclination:	Scale: 1:50
Dates: 08/10/2014 - 08/10/2014	Driller(s): JL CT	Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples & Test			STRATA DETAILS			Level	Water	Backfill	
Depth	Sample Type	In-situ Tests	Depth	Description	Legend	mOD	Level	Depth	Legend
0.30-1	U		0.30	Dark brown clayey TOPSOIL		55.05			
1.00-2	U			Orange brown sandy slightly gravelly CLAY with occasional pockets of sand and gravel. Gravel is angular to rounded fine to coarse of mixed lithology.					
2.00-3	U		3.00			52.35		3.00	

(End of Borehole)

Remarks:

Soil Boring Casing			Water Added			Chiselling			Rotary Casing			Flush Details			
From	To	Diameter (mm)	From	To	Amount	From	To	Time (hrs)	From	To	Diameter (mm)	From	To	Type	Returns (%)
0.00	3.00	128													

Hole Type			Drill Rig Type	Boring / Drilling Progress			Water Levels		Waterstrike				Figure No
From	To	Type		Date	Hole Depth	Casing Depth	Morning	Evening	Struck	Rose To	Time (min)	Cut Off	04
0.00 1.20	1.20 3.00	IP WLS	Dando Terrier 2002	08-10-14	3.00	3.00							Sheet
													1 of 1

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: 955001

Trial Pit No: TP04

Location:	North: 841684.8084	East: 411752.0133	Ground Level: 74.09	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 07/10/2014		Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples		Tests			STRATA DETAILS			Level	Water	Backfill	
Depth	Type	Depth	Type	Results	Depth	Description	Legend	mAOD	Level	Depth	Legend
0.20	E				0.35	Dark brown clayey TOPSOIL.		73.74			
0.60	B					Firm orange brown sandy gravelly CLAY with cobbles, boulders and pockets of clayey sand. Gravel is angular to rounded fine to coarse predominantly of granite.					
0.60	T				1.30			72.79			
1.40	B					Weathered GRANITE, recovered as pink and orange silty very sandy angular fine to coarse gravel. Excavator able to dig material with moderate ease. At 1.90m rock becomes competent and is very difficult to extract.					
1.40	T				1.90			72.49		1.90	

(End of Trial Pit)

Remarks

Hole Type			Plant(s) Used	Dimensions	Water Levels		Waterstrike				Figure No
From	To	Type		0.8m x 3.6m	Morning	Evening	Struck	Rose To	Time (min)		05
0.00	1.90	TP	JCB 3CX								Sheet
											1 of 1

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Trial Pit No: TP05

Location:	North: 841908.2441	East: 411747.8323	Ground Level: 60.94	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 07/10/2014		Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples		Tests			STRATA DETAILS			Level	Water		Backfill
Depth	Type	Depth	Type	Results	Depth	Description	Legend	mAOD	Level	Depth	Legend
0.50	B				0.30	Dark brown clayey TOPSOIL.		60.64			
0.50	T					Firm orange brown sandy slightly gravelly CLAY with low cobble and boulder content, and pockets of clayey sand. Gravel is angular to rounded fine to coarse of mixed lithology including flint.					
0.80	B										
0.80	T										
1.50	VPP(45 kPa, 66kPa)										
2.00	B				1.80	Soft to firm orange brown sandy gravelly CLAY with low to medium cobble and boulder content, and pockets of clayey sand. Gravel is angular to rounded fine to coarse of mixed lithology.		59.14			
2.00	T										
					2.90			58.04		2.90	

(End of Trial Pit)

Hole Type			Plant(s) Used	Dimensions	Water Levels		Waterstrike				Figure No
From	To	Type		0.8m x 3.5m	Morning	Evening	Struck	Rose To	Time (min)		06
0.00	2.90	TP	JCB 3CX								Sheet
											1 of 1

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Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Trial Pit No: TP06

Location:	North: 842219.115	East: 411823.4068	Ground Level: 50.63	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 07/10/2014		Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples		Tests			STRATA DETAILS			Level	Water	Backfill	
Depth	Type	Depth	Type	Results	Depth	Description	Legend	mAOD	Level	Depth	Legend
0.40	E				0.60	Dark brown clayey TOPSOIL.		50.03			
1.00	B					Firm brown slightly sandy slightly gravelly CLAY with low to medium cobble and boulder content, and pockets of clayey sand. Gravel is angular to rounded fine to coarse of mixed lithology.					
1.00	T										
2.00	VPP(66kPa)				2.00	Stiff brown slightly sandy slightly gravelly CLAY with low to medium cobble and boulder content, and pockets of clayey sand. Gravel is angular to rounded fine to coarse of mixed lithology.		48.63			
2.20	B										
2.20	T				2.50			48.13		2.50	

(End of Trial Pit)

Remarks:

Hole Type			Plant(s) Used	Dimensions	Water Levels		Waterstrike				Figure No
From	To	Type		0.8m x 3.1m	Morning	Evening	Struck	Rose To	Time (min)		07
0.00	2.50	TP	JCB 3CX								Sheet
											1 of 1

ERS
Westerhill Road
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G64 2QH
Tel: 0141 772 2759
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info@ersenvironmental.com

Site Name	Fourfields, Boddam, Peterhead
Client	North Connect
Consultant	North Connect
Contractor	ERS

Contract No: **955001**

Trial Pit No: TP07

Location:	North: 842095.2302	East: 411734.1303	Ground Level: 53.96	Inclination:	Scale: 1:50
Dates: 07/10/2014 - 07/10/2014		Logged By: BP	Data Input: BP	Checked By: GA	Status: Final

Samples		Tests			STRATA DETAILS			Level	Water		Backfill
Depth	Type	Depth	Type	Results	Depth	Description	Legend	mAOD	Level	Depth	Legend
0.10	E				0.20	Dark brown clayey TOPSOIL		53.76			
0.40	B					Firm brown sandy slightly gravelly CLAY with low to medium cobble and boulder content, and pockets of clayey sand. Gravel is angular to rounded fine to coarse of mixed lithology.					
0.40	T				1.10			52.86			
1.20	VPP(32 kPa)					Firm brown mottled grey sandy slightly gravelly CLAY with with low to medium cobble and boulder content, and pockets of clayey sand. Gravel is angular to rounded fine to coarse of mixed lithology.					
1.50	B										
1.50	T				2.10			51.86			
2.50	B					Light brown slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse of mixed lithology.					
2.50	T				2.70			51.26		2.70	

(End of Trial Pit)

Remarks:

Hole Type			Plant(s) Used	Dimensions	Water Levels		Waterstrike				Figure No
From	To	Type		0.8m x 2.8m	Morning	Evening	Struck	Rose To	Time (min)		08
0.00	2.70	TP	JCB 3CX								Sheet
											1 of 1

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 1

Coordinates at centre of test
Easting 412078.85
Northing 841262.11

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	16	100.53	**107.15**
2	7.9	**99.27**	100.98
3	5.9	**111.21**	112.07
4		**0.00**	0.00
5	7.6	238.76	**239.43**
6		0.00	**0.00**

Wenners Arrangement

'4 x π xA x R
1+(2xA /(√(A2+4B2))) -(A /(√(A2+B2)))

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 2

Coordinates at centre of test
Easting 412036.05
Northing 841266.96

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	26	163.36	**174.13**
2	17.8	**223.68**	227.54
3	16.2	**305.36**	307.72
4	14.6	**366.94**	368.54
5	13	408.41	**409.55**
6	11.9	448.62	**449.49**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA\ /(\sqrt{(A2+4B2)})) -(A\ /(\sqrt{(A2+B2)}))}$$

Comments

Fig. 10

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 3

Coordinates at centre of test
Easting 411995.34
Northing 841269.58

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	27	169.65	**180.82**
2	21.1	**265.15**	269.72
3	15.6	**294.05**	296.32
4	12.5	**314.16**	315.53
5	10.9	342.43	**343.39**
6	9.5	358.14	**358.84**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 4

Coordinates at centre of test
Easting 411952.43
Northing 841273.23

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	28	175.93	**187.52**
2	15.7	**197.29**	200.69
3	10.6	**199.81**	201.35
4	7.8	**196.04**	196.89
5	6.6	207.35	**207.92**
6	5.5	207.35	**207.75**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 5

Coordinates at centre of test
Easting 412077.54
Northing 841290.63

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	19.4	121.89	**129.92**
2	13.8	**173.42**	176.40
3	14.3	**269.55**	271.63
4	9.8	**246.30**	247.37
5	9.4	295.31	**296.13**
6	9.2	346.83	**347.51**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 6

Coordinates at centre of test
Easting 412035.58
Northing 841295.06

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	20.7	130.06	**138.63**
2	17.1	**214.88**	218.59
3	15.6	**294.05**	296.32
4	13.9	**349.35**	350.87
5	13.3	417.83	**419.00**
6	12.6	475.01	**475.93**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 7

Coordinates at centre of test
Easting 411995.25
Northing 841298.06

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	16.9	106.19	**113.18**
2	14.4	**180.96**	184.07
3	13.8	**260.12**	262.13
4	13.3	**334.27**	335.72
5	11.5	361.28	**362.29**
6	10.6	399.61	**400.39**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 8

Coordinates at centre of test
Easting 411953.90
Northing 841301.89

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	22	138.23	**147.34**
2	14.4	**180.96**	184.07
3	11.4	**214.88**	216.54
4	9.8	**246.30**	247.37
5	8.4	263.89	**264.63**
6	7.3	275.20	**275.74**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig.16

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 9

Coordinates at centre of test
Easting 411952.67
Northing 841322.47

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	17.8	111.84	**119.21**
2	9.9	**124.41**	126.55
3	6.7	**126.29**	127.27
4	5.5	**138.23**	138.83
5	4.6	144.51	**144.92**
6	3.8	143.26	**143.53**

Test 21

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 10

Coordinates at centre of test
Easting 411994.11
Northing 841324.24

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	24	150.80	**160.73**
2	17.8	**223.68**	227.54
3	15.1	**284.63**	286.83
4	13.2	**331.75**	333.20
5	10.8	339.29	**340.24**
6	9.8	369.45	**370.17**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig.18

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 11

Coordinates at centre of test
Easting 412033.02
Northing 841325.38

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	31	194.78	**207.61**
2	23	**289.03**	294.01
3	20.2	**380.76**	383.70
4	18.7	**469.98**	472.03
5	16	502.65	**504.06**
6	13.8	520.25	**521.26**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 12

Coordinates at centre of test
Easting 412075.58
Northing 841317.62

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	81	508.94	**542.47**
2	121	**1520.53**	1546.73
3	18.2	**343.06**	345.71
4	17.3	**434.80**	436.69
5	15.5	486.95	**488.31**
6	16.3	614.50	**615.69**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 13

Coordinates at centre of test
Easting 412070.83
Northing 841337.93

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	12.2	76.65	**81.71**
2	7.3	**91.73**	93.32
3	5.7	**107.44**	108.27
4	4.9	**123.15**	123.69
5	5.9	185.35	**185.87**
6	5.2	196.04	**196.42**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 14

Coordinates at centre of test
Easting 412030.42
Northing 841342.58

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	19	119.38	**127.25**
2	15.2	**191.01**	194.30
3	13.3	**250.70**	252.64
4	13.5	**339.29**	340.77
5	12	376.99	**378.04**
6	12	452.39	**453.27**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 15

Coordinates at centre of test
Easting 411992.67
Northing 841340.12

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	17.9	112.47	**119.88**
2	15.3	**192.27**	195.58
3	15.6	**294.05**	296.32
4	11.3	**284.00**	285.24
5	10.2	320.44	**321.34**
6	9.6	361.91	**362.61**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 16

Coordinates at centre of test
Easting 411949.81
Northing 841346.84

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	19.5	122.52	**130.59**
2	12.3	**154.57**	157.23
3	10.7	**201.69**	203.25
4	9.6	**241.27**	242.33
5	8.1	254.47	**255.18**
6	7.6	286.51	**287.07**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig. 24

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 17

Coordinates at centre of test
Easting 411948.26
Northing 841375.03

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	20.8	130.69	**139.30**
2	17.9	**224.94**	228.81
3	11.8	**222.42**	224.14
4	10.3	**258.87**	260.00
5	8.4	263.89	**264.63**
6	8.7	327.98	**328.62**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig. 25

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 18

Coordinates at centre of test
Easting 411989.14
Northing 841375.82

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	21.6	135.72	**144.66**
2	11.5	**144.51**	147.00
3	10.1	**190.38**	191.85
4	8.6	**216.14**	217.08
5	7.9	248.19	**248.88**
6	7.2	271.43	**271.96**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig. 26

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 19

Coordinates at centre of test
Easting 412025.57
Northing 841380.76

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	19.7	123.78	**131.93**
2	12.3	**154.57**	157.23
3	10.4	**196.04**	197.55
4	10.2	**256.35**	257.47
5	9.9	311.02	**311.89**
6	9.7	365.68	**366.39**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 20

Coordinates at centre of test
Easting 412066.53
Northing 841385.16

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	21.8	136.97	**146.00**
2	19.6	**246.30**	250.54
3	23	**433.54**	436.89
4	18.8	**472.50**	474.55
5	19.1	600.04	**601.72**
6	16.4	618.27	**619.47**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig. 28

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 21

Coordinates at centre of test
Easting 411889.81
Northing 841278.59

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	17.3	108.70	**115.86**
2	9.4	**118.12**	120.16
3	6.4	**120.64**	121.57
4	5.2	**130.69**	131.26
5	4.6	144.51	**144.92**
6	4.2	158.34	**158.64**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 22

Coordinates at centre of test
Easting 411891.29
Northing 841312.20

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	17.5	109.96	**117.20**
2	11.7	**147.03**	149.56
3	9.1	**171.53**	172.86
4	7.1	**178.44**	179.22
5	5.6	175.93	**176.42**
6	4.7	177.19	**177.53**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 23

Coordinates at centre of test
Easting 411891.22
Northing 841333.03

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	28	175.93	**187.52**
2	16	**201.06**	204.53
3	11.9	**224.31**	226.04
4	8.8	**221.17**	222.13
5	7.6	238.76	**239.43**
6	6.2	233.73	**234.19**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 24

Coordinates at centre of test
Easting 411893.45
Northing 841356.08

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	25	157.08	**167.43**
2	14.4	**180.96**	184.07
3	11.3	**213.00**	214.65
4	9.4	**236.25**	237.28
5	8.2	257.61	**258.33**
6	7.2	271.43	**271.96**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 25

Coordinates at centre of test
Easting 411898.63
Northing 841397.13

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	22	138.23	**147.34**
2	12.4	**155.82**	158.51
3	9.8	**184.73**	186.15
4	8	**201.06**	201.94
5	7.1	223.05	**223.68**
6	6.3	237.50	**237.97**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA /(\sqrt{(A2+4B2)})) -(A /(\sqrt{(A2+B2)}))}$$

Comments

Fig. 33

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 26

Coordinates at centre of test
Easting 412061.79
Northing 841420.69

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	14.8	92.99	**99.12**
2	8.9	**111.84**	113.77
3	7	**131.95**	132.97
4	6.4	**160.85**	161.55
5	5.5	172.79	**173.27**
6	4.7	177.19	**177.53**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 27

Coordinates at centre of test
Easting 412021.79
Northing 841420.85

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	44	276.46	**294.68**
2	14.7	**184.73**	187.91
3	9.8	**184.73**	186.15
4	7.1	**178.44**	179.22
5	5.4	169.65	**170.12**
6	5.1	192.27	**192.64**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA\ /(\sqrt{(A2+4B2)})) -(A\ /(\sqrt{(A2+B2)}))}$$

Comments

Fig. 35

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 28

Coordinates at centre of test
Easting 411985.40
Northing 841420.15

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	26	163.36	**174.13**
2	11.8	**148.28**	150.84
3	8.6	**162.11**	163.36
4	8.4	**211.12**	212.04
5	6.6	207.35	**207.92**
6	6.3	237.50	**237.97**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Soil Resistivity Survey

Project Name: Four Fields, Boddam
Project Number: 955001

Test Number 29

Coordinates at centre of test
Easting 411950.18
Northing 841415.39

Weather Bright breezy with occaisonal showers

Depth of probes (B) 0.2 cm

Spacing (A)	Resistance (R)	Soil Resistivity ρ	
		10>A/B<20	Full formulae
m	Ω	Ωm	Ωm
1	65	408.41	**435.32**
2	14.2	**178.44**	181.52
3	11.2	**211.12**	212.75
4	8.9	**223.68**	224.66
5	7.8	245.04	**245.73**
6	7.6	286.51	**287.07**

Wenners Arrangement

$$\frac{'4 \times \pi \times A \times R}{1+(2xA/(\sqrt{(A2+4B2)})) -(A/(\sqrt{(A2+B2)}))}$$

Comments

Fig. 37

ERS
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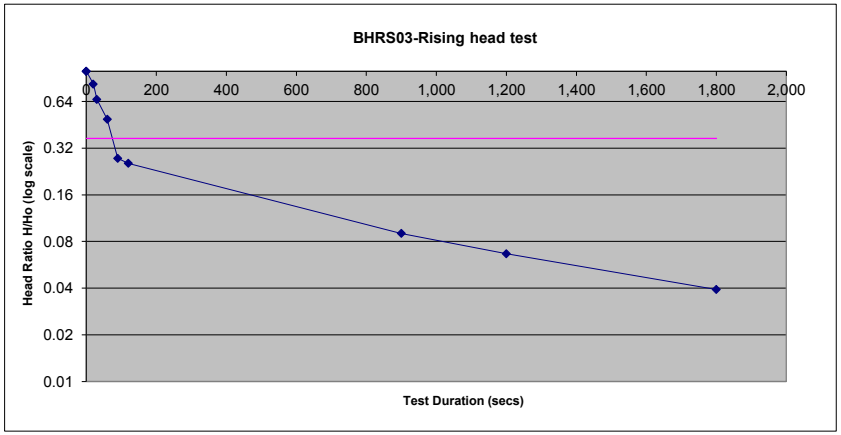
FALLING HEAD TEST INTERPRETATION (BH02)

Contract Name:	Fourfields Boddam
Site:	Fourfields Boddam
Date:	
Instrument Type:	Manual Dipmeter
Start of test (t1):	
End of test:	

Contract No.:	955001
Engineer:	BP
Weather:	Rain

Borehole No.	BH02	**Depth:**	2.55 mbgl
Resting Water Depth	2.55		
Head Added	2.55		

Standpipe diameter (d)	0.128	m
Casing diameter (D)	0.128	m
Length of test section (L)	0.55	m
Cross sectional area (A)	1.29E-02	m²
Intake factor (F)	1.79	(obtained from BS5930:1999, Section 4, Figure 6, Scenario D)
Time lag (T)	74	s
Hydraulic conductivity (K)	9.69E-05	m/s
	3.49E-01	m/hr
	8.38E+00	m/day
Comments		



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Web: www.ersremediation.com

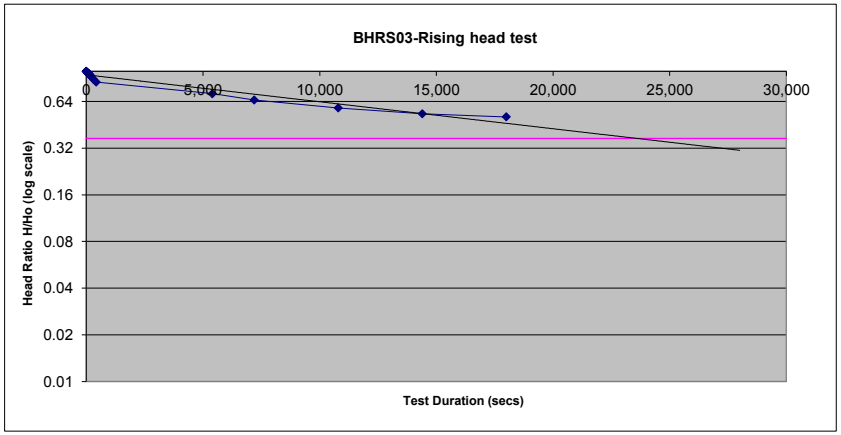
FALLING HEAD TEST INTERPRETATION (BH03)

Contract Name:	Fourfields Boddam
Site:	Fourfields Boddam
Date:	
Instrument Type:	Manual Dipmeter
Start of test (t1):	
End of test:	

Contract No.:	955001
Engineer:	BP
Weather:	Heavy rain

Borehole No.	BH03	**Depth:**	2.05 mbgl
Resting Water Depth	2.05		
Head Added	2.05		

Standpipe diameter (d)	0.128	m
Casing diameter (D)	0.128	m
Length of test section (L)	0.55	m
Cross sectional area (A)	1.29E-02	m²
Intake factor (F)	1.44	(obtained from BS5930:1999, Section 4, Figure 6, Scenario D)
Time lag (T)	23500	s
Hydraulic conductivity (K)	3.82E-07	m/s
	1.37E-03	m/hr
	3.30E-02	m/day
Comments		



BOREHOLE	SAMPLE	DEPTH (m)	SAMPLE DESCRIPTION
BH01	U	0.00-0.85	Mottled brown slightly gravelly sandy CLAY with root fibres. Gravel is fine to coarse.
BH01	U	1.00-1.82	Mottled brown sandy gravelly CLAY with cobbles. Gravel is fine to coarse.
BH02	U	0.00-0.46 0.46-0.97	Dark brown sandy CLAY with root fibres. Reddish brown gravelly sandy CLAY. Gravel is fine to coarse.
BH02	U	1.00-2.00	Reddish brown sandy gravelly CLAY with cobbles and bands of fine to coarse sand. Gravel is fine to coarse.
BH03	U	0.00-0.90	Mottled brown slightly gravelly sandy CLAY with root fibres. Gravel is fine to coarse.
BH03	U	1.00-1.60	Mottled brown very sandy very gravelly CLAY with bands of fine to coarse sand. Gravel is fine to coarse.
BH04	U	1.00-1.93	Reddish brown very sandy silty slightly gravelly CLAY with bands of silty sand. Gravel is fine to medium.

SUMMARY OF SAMPLE DESCRIPTIONS

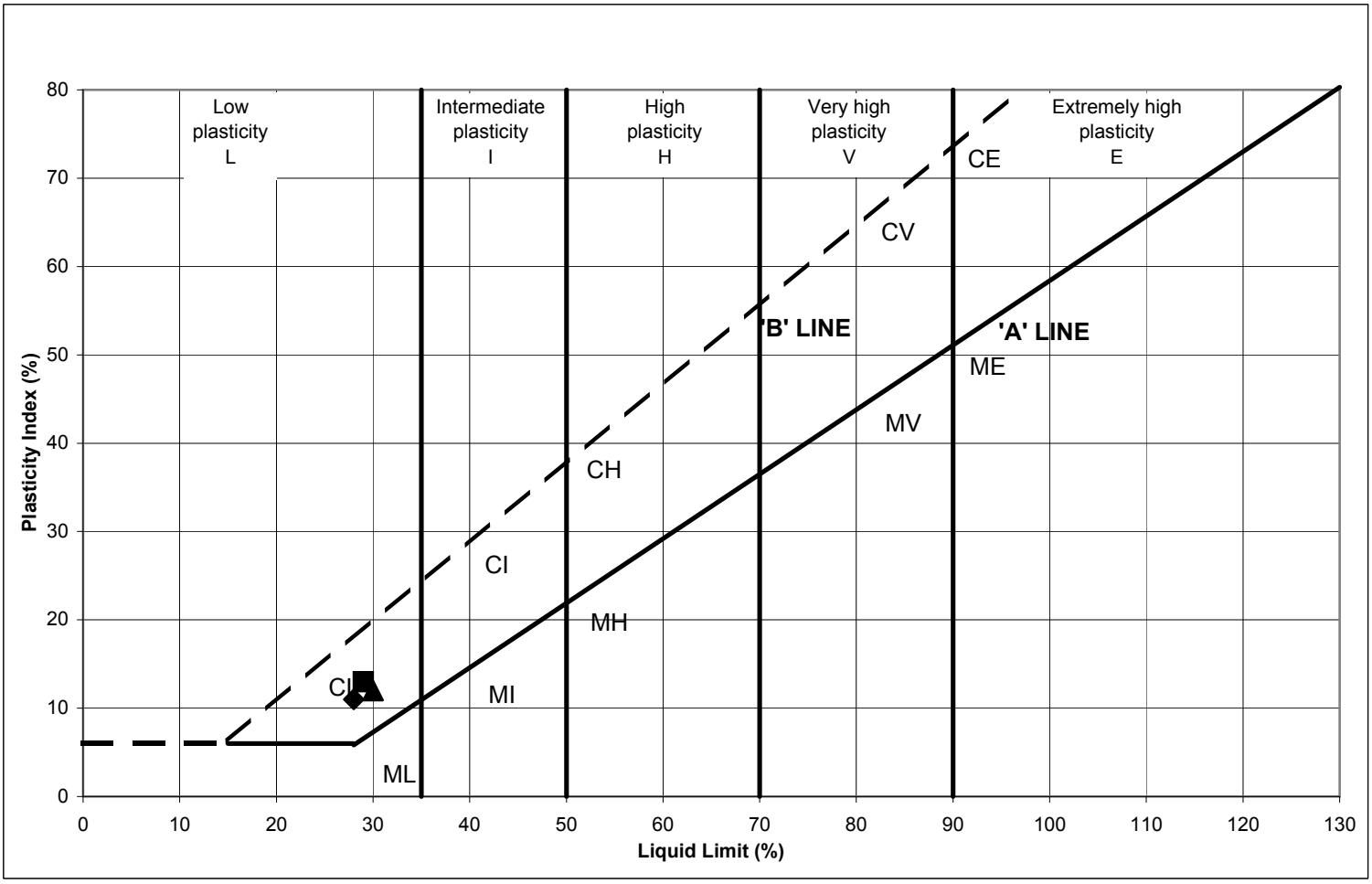
TRIAL PIT	SAMPLE	DEPTH (m)	SAMPLE DESCRIPTION
TP04	B	1.40	Red / brown clayey fine to coarse SAND and GRAVEL.
TP05	B	0.80	Dark reddish brown sandy gravelly CLAY with cobbles. Gravel is fine to coarse.
TP06	B	1.00	Red / brown sandy gravelly CLAY with black staining. Gravel is fine to coarse.
TP07	B	1.50	Reddish brown sandy gravelly CLAY. Gravel is fine to coarse.

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)
BH04	U	1.00-1.50	24

Tested in accordance with BS 1377: Part 2: 1990: Clause 3

SUMMARY OF MOISTURE CONTENT TEST RESULTS

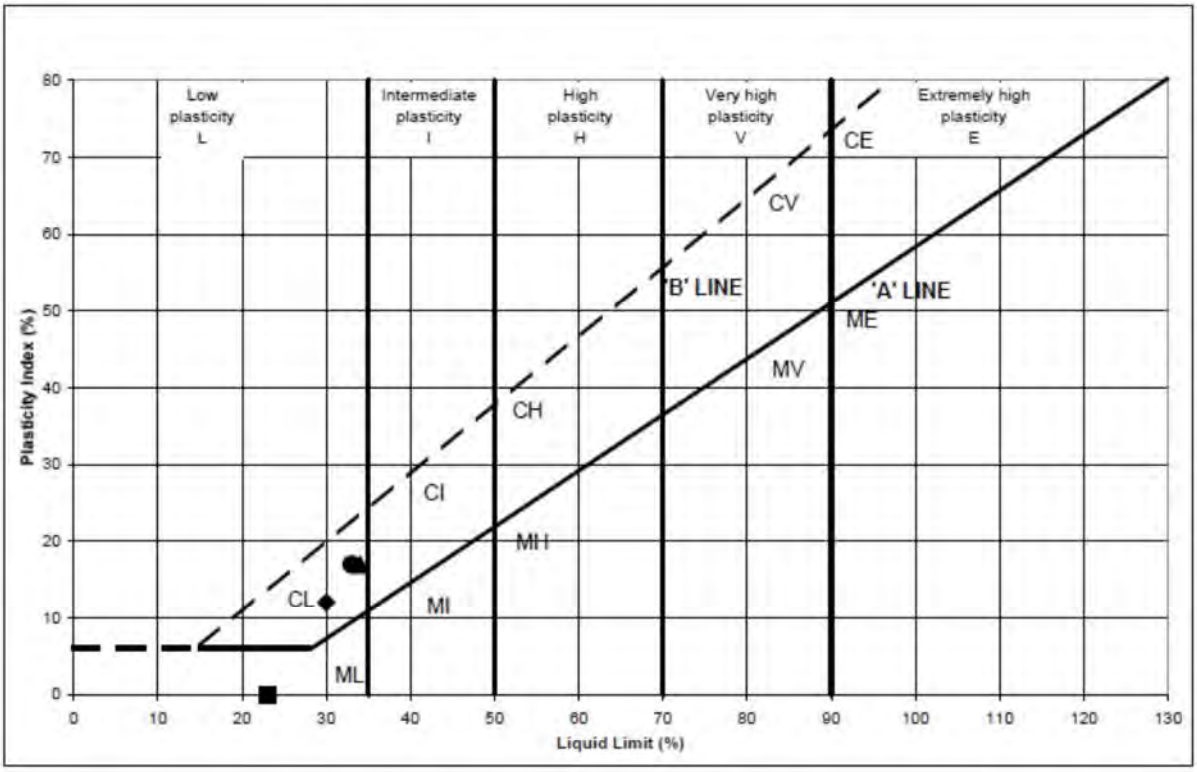
TRIAL PIT	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)
TP04	B	1.40	9.7
TP05	B	0.80	13
TP06	B	1.00	25
TP07	B	1.50	14



Symbol	Borehole	Sample	Depth	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing 0.425mm Sieve	Remarks
■	BH01	U	1.40	-	29	16	13	49	Clay with low plasticity
◆	BH02	U	1.60	-	28	17	11	46	Clay with low plasticity
▲	BH03	U	1.00	-	30	18	12	33	Clay with low plasticity
●									
□									
◇									
△									
○									
×									
✳									

All samples were tested in accordance with BS 1377 : Part 2 : 1990 Clause 4.3, 5.3 and 5.4.
All samples were washed on a 0.425mm test sieve prior to test.

SUMMARY OF ATTERBERG LIMITS TEST RESULTS



Symbol	Trial Pit	Sample	Depth	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing 0.425mm Sieve	Remarks
■	TP04	B	1.40	9.7	23	Non Plastic	Non Plastic	30	
◆	TP05	B	0.80	13	30	18	12	56	Clay with low plasticity
▲	TP06	B	1.00	25	34	17	17	83	Clay with low plasticity
●	TP07	B	1.50	14	33	16	17	65	Clay with low plasticity
□									
◇									
△									
○									
×									
✳									

All samples were tested in accordance with BS 1377 : Part 2 : 1990 Clause 4.3, 5.3 and 5.4.
All samples were washed on a 0.425mm test sieve prior to test.

SUMMARY OF ATTERBERG LIMITS TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	PARTICLE DENSITY (Mg/m³)
BH01	U	1.30	2.62
BH02	U	1.50	2.63
BH03	U	1.00	2.60
BH04	U	1.50	2.56

Tested in accordance with BS 1377: Part 2: 1990: Clause 8.2
(Gasjar method)

SUMMARY OF PARTICLE DENSITY TEST RESULTS

TRIAL PIT	SAMPLE	DEPTH (m)	PARTICLE DENSITY (Mg/m³)
TP04	B	1.40	2.61
TP05	B	0.80	2.59
TP06	B	1.00	2.57
TP07	B	1.50	2.58

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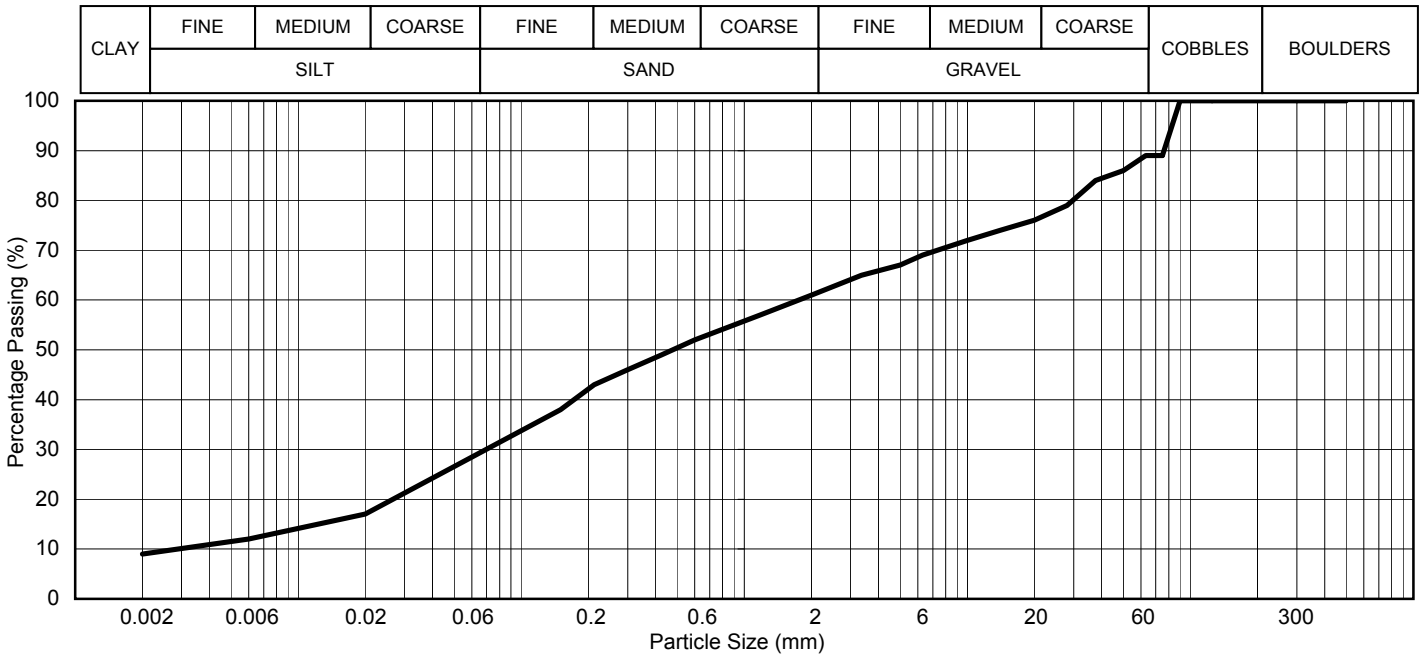
Borehole	BH01
Sample	U
Depth (m)	1.00-1.30



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	17
300.0	100	-	-	0.006	12
125.0	100	-	-	0.002	9
90.0	100	-	-		
75.0	89	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	89	-	-	-	
50.0	86	-	-		
37.5	84	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	79	-	-		
20.0	76	-	-		
14.0	74	-	-		
10.0	72	-	-	**PERCENTAGE SOIL TYPES**	
6.30	69	-	-		
5.00	67	-	-		
3.35	65	-	-		
2.00	61	-	-		
1.18	57	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.600	52	-	-		
0.425	49	-	-		
0.300	46	-	-		
0.212	43	-	-		
0.150	38	-	-		
0.063	29	-	-		

CLAY	SILT Ŧ	SAND	GRAVEL	COBBLES
9	20	32	28	11

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

Ŧ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Sample does not meet minimum mass requirement for material type

SIEVE ANALYSIS AND SEDIMENTATION - BS 1377 : PART 2 : 1990 : CLAUSE 9.2 & 9.4

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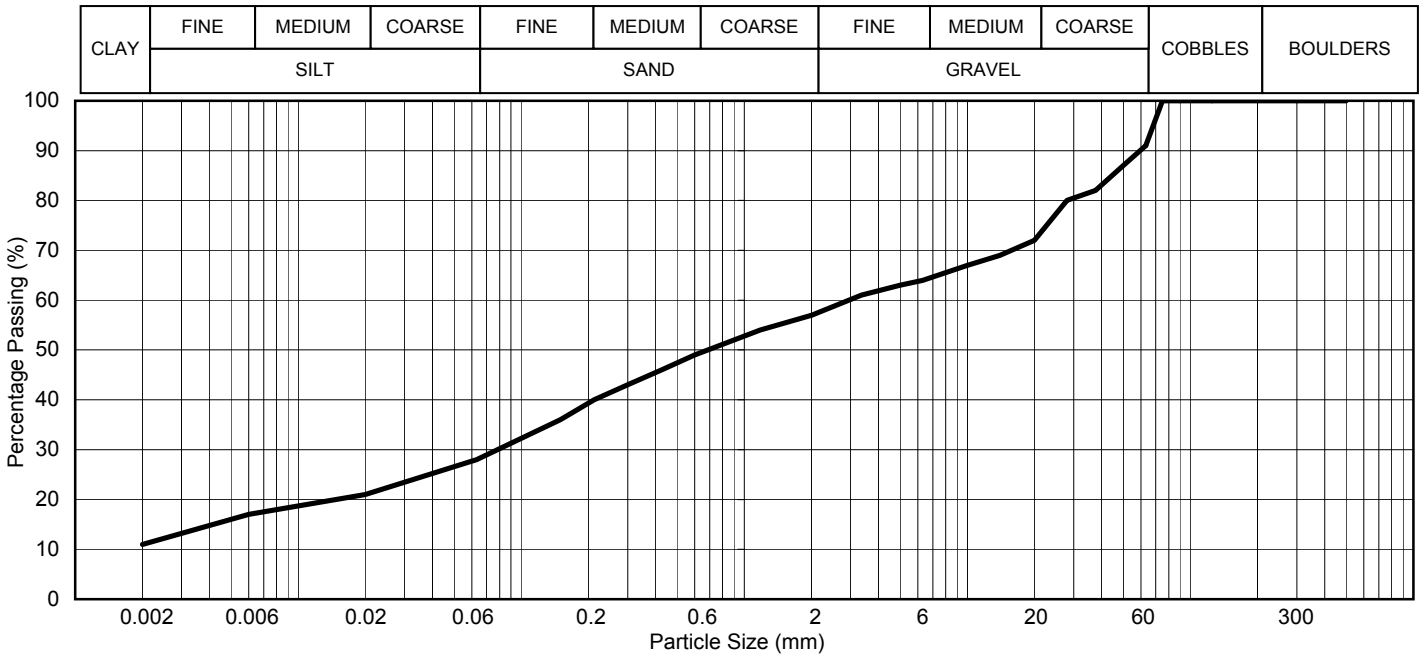
Borehole	BH02
Sample	U
Depth (m)	1.00-1.50



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	21
300.0	100	-	-	0.006	17
125.0	100	-	-	0.002	11
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	91	-	-	-	
50.0	87	-	-		
37.5	82	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	80	-	-		
20.0	72	-	-		
14.0	69	-	-		
10.0	67	-	-	**PERCENTAGE SOIL TYPES**	
6.30	64	-	-	**CLAY** / **SILT ₸** / **SAND** / **GRAVEL** / **COBBLES**	
5.00	63	-	-		
3.35	61	-	-	11 / 17 / 29 / 34 / 9	
2.00	57	-	-		
1.18	54	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.600	49	-	-	**D10** / **D60** / **Specification**	
0.425	46	-	-		
0.300	43	-	-	- / -	
0.212	40	-	-	**UNIFORMITY COEFFICIENT** - / -	
0.150	36	-	-		
0.063	28	-	-		

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Sample does not meet minimum mass requirement for material type

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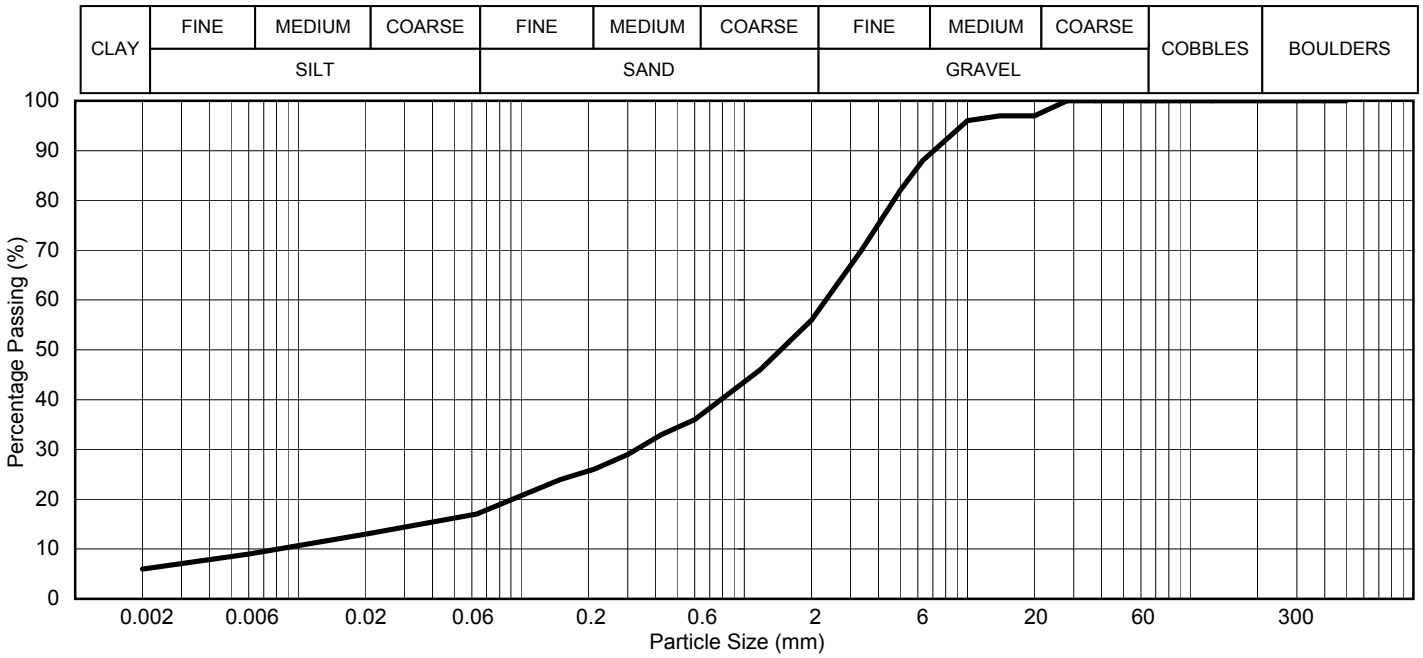
Borehole	BH03
Sample	U
Depth (m)	1.00-1.30



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	13
300.0	100	-	-	0.006	9
125.0	100	-	-	0.002	6
90.0	100	-	-		
75.0	100	-	-	**GRADING CLASSIFICATION (SHW TABLE 6/2)**	
63.0	100	-	-	-	
50.0	100	-	-		
37.5	100	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	100	-	-		
20.0	97	-	-		
14.0	97	-	-		
10.0	96	-	-	**PERCENTAGE SOIL TYPES**	
6.30	88	-	-		
5.00	82	-	-		
3.35	70	-	-		
2.00	56	-	-		
1.18	46	-	-	**UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)**	
0.600	36	-	-		
0.425	33	-	-		
0.300	29	-	-		
0.212	26	-	-		
0.150	24	-	-		
0.063	17	-	-		

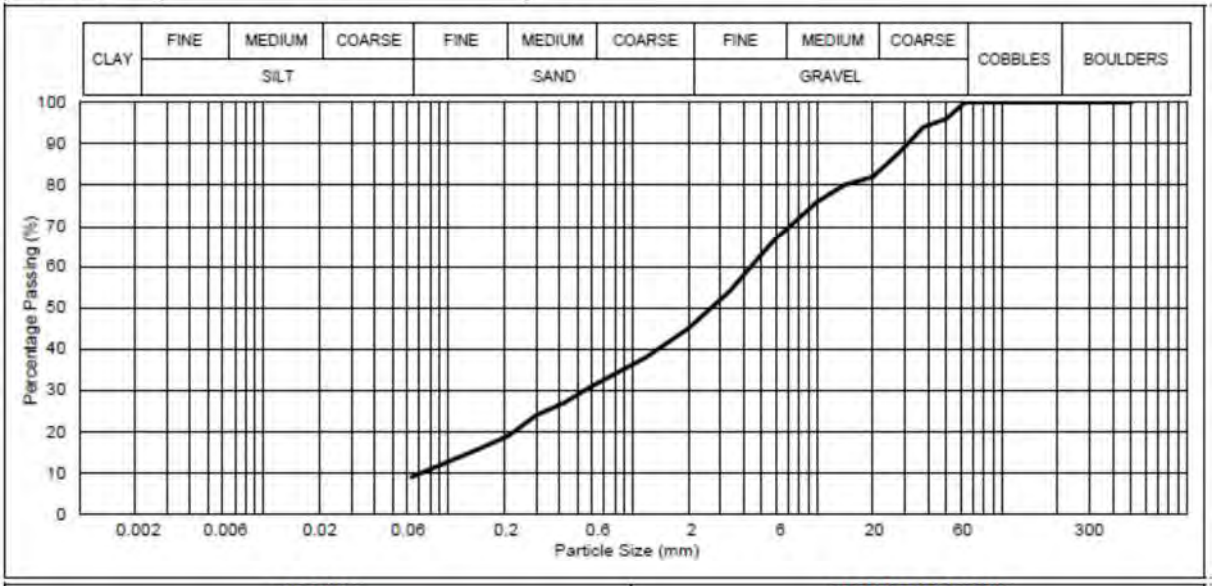
CLAY	SILT ₸	SAND	GRAVEL	COBBLES
6	11	39	44	0

D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Trial Pit	TP04
Sample	B
Depth (m)	1.40



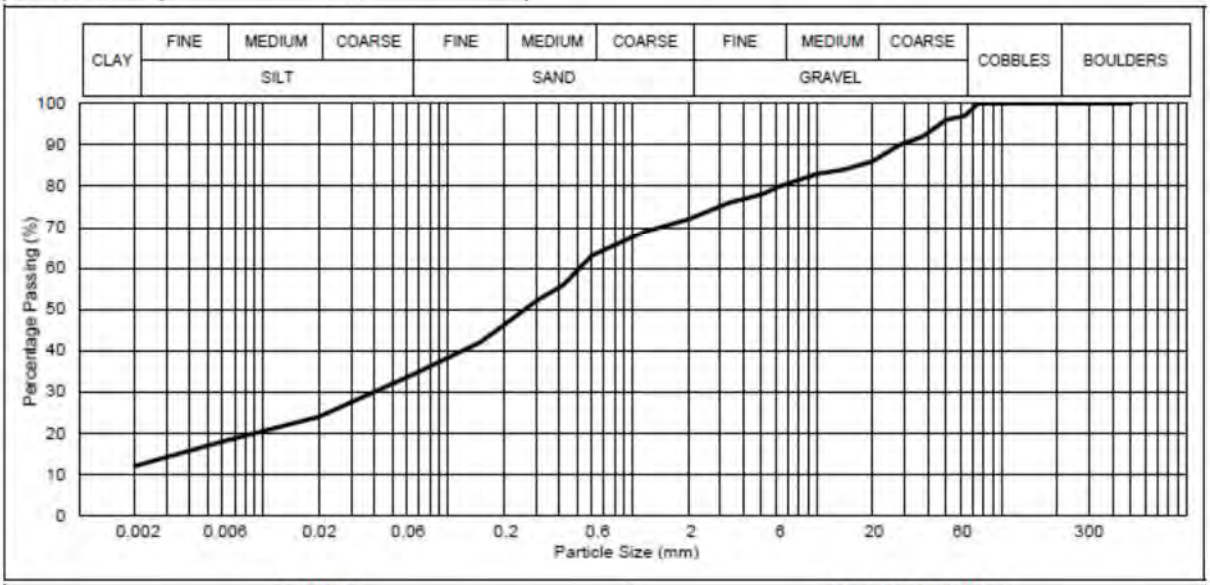
SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	
300.0	100	-	-	0.006	
125.0	100	-	-	0.002	
90.0	100	-	-		
75.0	100	-	-	GRADING CLASSIFICATION (SHW TABLE 6/2)	
63.0	100	-	-	-	
50.0	96	-	-		
37.5	94	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	88	-	-		
20.0	82	-	-		
14.0	80	-	-		
10.0	76	-	-	PERCENTAGE SOIL TYPES	
6.30	68	-	-	CLAY / SILT ₸ / SAND / GRAVEL / COBBLES	
5.00	63	-	-		
3.35	54	-	-	/ 9 36 55 0	
2.00	45	-	-		
1.18	38	-	-	UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)	
0.600	31	-	-	D10 / D60 / Specification	
0.425	27	-	-		
0.300	24	-	-	- -	
0.212	19	-	-	UNIFORMITY COEFFICIENT - -	
0.150	16	-	-		
0.063	9	-	-		

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS - BS 1377 : Part 2 : 1990 : CLAUSE 9.2

Trial Pit	TP05
Sample	B
Depth (m)	0.80



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	24
300.0	100	-	-	0.006	18
125.0	100	-	-	0.002	12
90.0	100	-	-		
75.0	100	-	-	GRADING CLASSIFICATION (SHW TABLE 6/2)	
63.0	97	-	-	-	
50.0	96	-	-		
37.5	92	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	90	-	-		
20.0	86	-	-		
14.0	84	-	-		
10.0	83	-	-	PERCENTAGE SOIL TYPES	
6.30	80	-	-		
5.00	78	-	-		
3.35	76	-	-		
2.00	72	-	-		
1.18	69	-	-		
0.600	63	-	-		
0.425	56	-	-		
0.300	52	-	-		
0.212	47	-	-		
0.150	42	-	-		
0.063	34	-	-		

CLAY	SILT ₸	SAND	GRAVEL	COBBLES
12	22	38	25	3

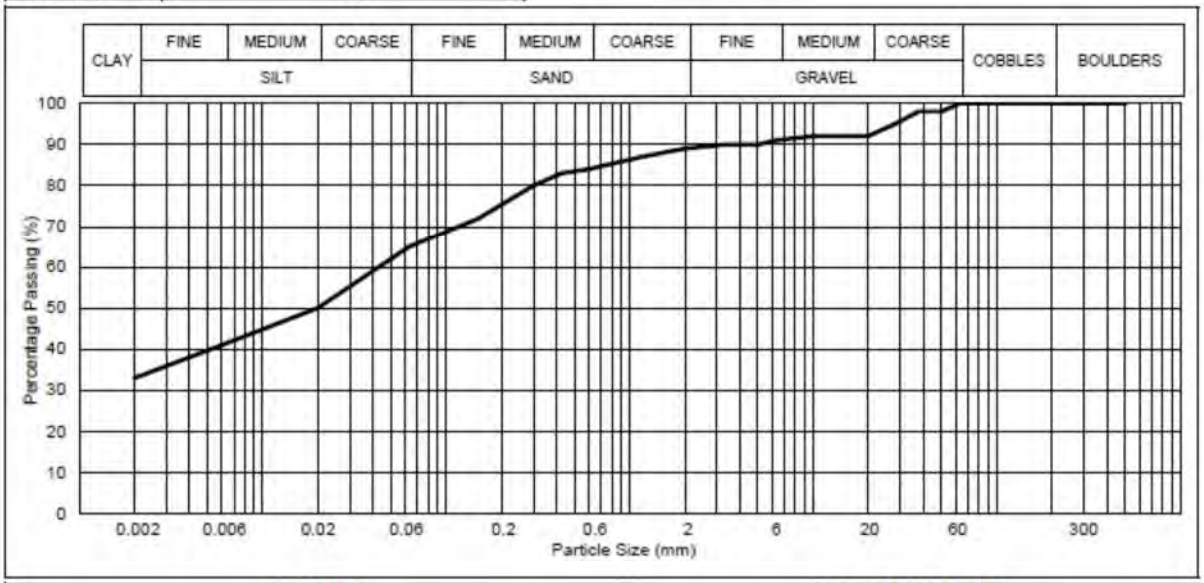
UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)		
D10	D60	Specification
-	-	
UNIFORMITY COEFFICIENT	-	-

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS AND SEDIMENTATION - BS 1377 : PART 2 : 1990 : CLAUSE 9.2 & 9.4

Trial Pit	TP06
Sample	B
Depth (m)	1.00



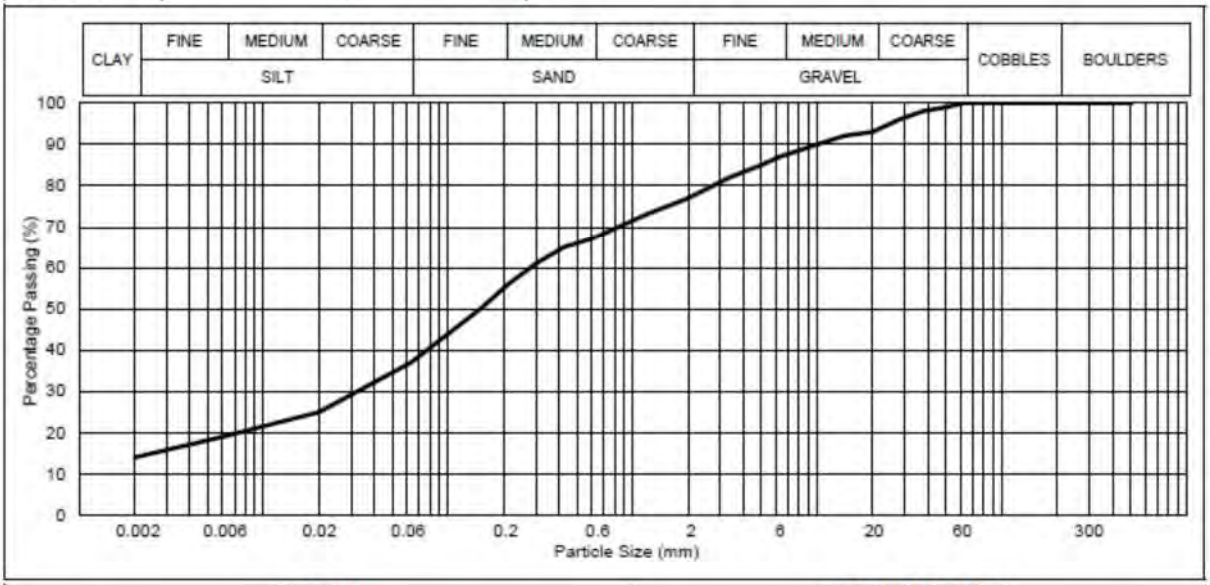
SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable Lower %	Specification Not Applicable Upper %	Particle Size (mm)	Percentage Passing (%)
500.0	100	-	-	0.020	50
300.0	100	-	-	0.006	41
125.0	100	-	-	0.002	33
90.0	100	-	-		
75.0	100	-	-	GRADING CLASSIFICATION (SHW TABLE 6/2)	
63.0	100	-	-	-	
50.0	98	-	-		
37.5	98	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	95	-	-		
20.0	92	-	-		
14.0	92	-	-		
10.0	92	-	-	PERCENTAGE SOIL TYPES	
6.30	91	-	-	CLAY / SILT ₸ / SAND / GRAVEL / COBBLES	
5.00	90	-	-		
3.35	90	-	-	33 / 32 / 24 / 11 / 0	
2.00	89	-	-		
1.18	87	-	-	UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)	
0.600	84	-	-	D10 / D60 / Specification	
0.425	83	-	-		
0.300	80	-	-	- / -	
0.212	76	-	-	UNIFORMITY COEFFICIENT - / -	
0.150	72	-	-		
0.063	65	-	-		

Remarks

₸ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS AND SEDIMENTATION - BS 1377 : PART 2 : 1990 : CLAUSE 9.2 & 9.4

Trial Pit	TP07
Sample	B
Depth (m)	1.50



SIEVING				SEDIMENTATION	
Sieve Size (mm)	Percentage Passing (%)	Specification Not Applicable		Particle Size (mm)	Percentage Passing (%)
		Lower %	Upper %		
500.0	100	-	-	0.020	25
300.0	100	-	-	0.006	19
125.0	100	-	-	0.002	14
90.0	100	-	-		
75.0	100	-	-	GRADING CLASSIFICATION (SHW TABLE 6/2)	
63.0	100	-	-	-	
50.0	99	-	-		
37.5	98	-	-	Grading classification proves the material has met the relevant grading requirements only. Further testing may be required to assess compliance with SHW.	
28.0	96	-	-		
20.0	93	-	-		
14.0	92	-	-		
10.0	90	-	-	PERCENTAGE SOIL TYPES	
6.30	87	-	-	CLAY / SILT ∓ / SAND / GRAVEL / COBBLES	
5.00	85	-	-		
3.35	82	-	-	14 / 23 / 40 / 23 / 0	
2.00	77	-	-		
1.18	73	-	-	UNIFORMITY COEFFICIENT (SHW TABLE 6/1 NOTE 5)	
0.600	67	-	-	D10 / D60 / Specification	
0.425	65	-	-		
0.300	61	-	-	- / -	
0.212	56	-	-	UNIFORMITY COEFFICIENT -	-
0.150	50	-	-		
0.063	37	-	-		

Remarks

∓ Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

SIEVE ANALYSIS AND SEDIMENTATION - BS 1377 : PART 2 : 1990 : CLAUSE 9.2 & 9.4

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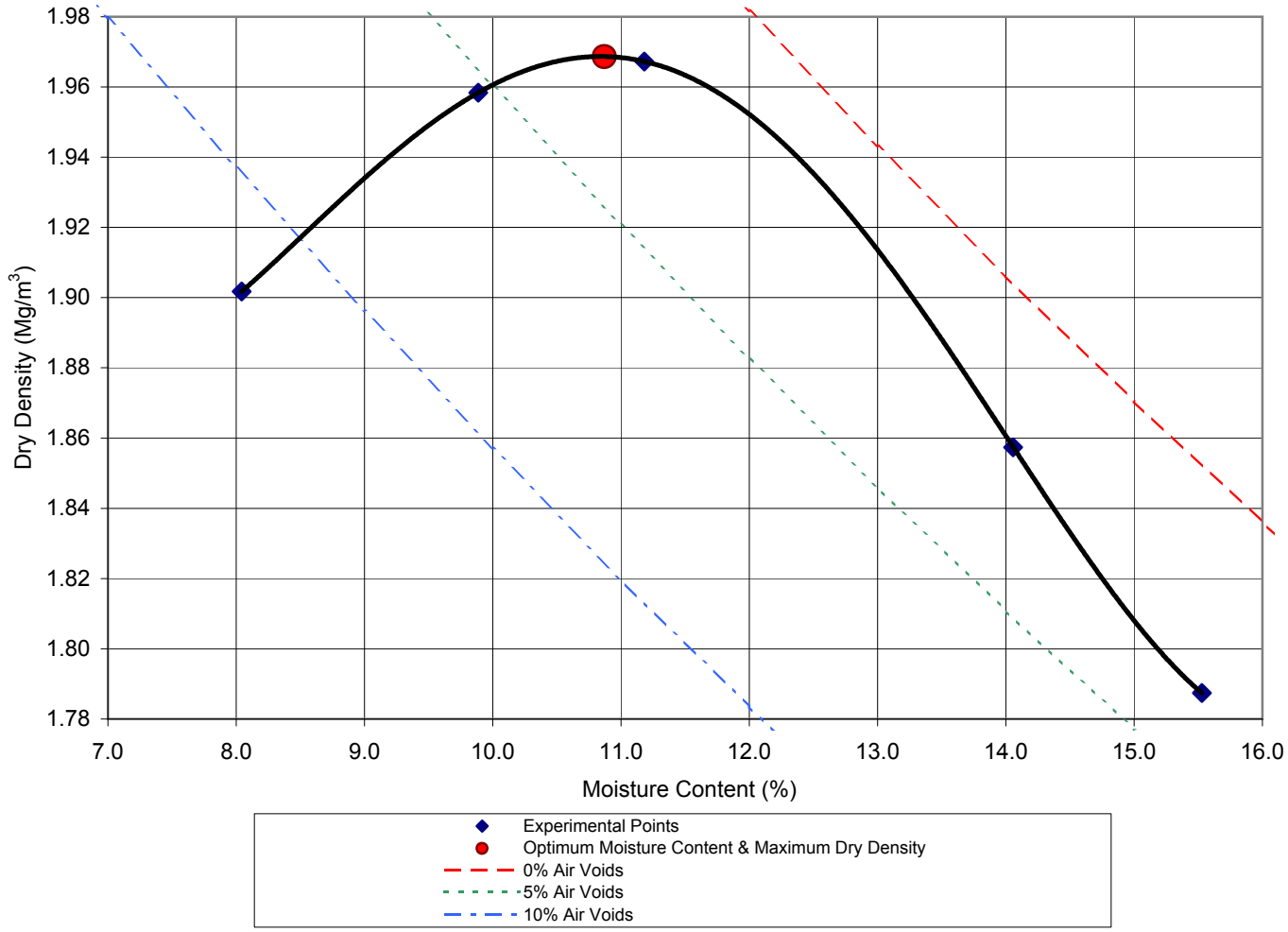
Moisture Content / Dry Density Experimental Points



Test Method	:	Clause 3.5: 4.5kg rammer, 5 layers, 27 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	100
% Passing 20mm	:	97
Grading Zone	:	2
Particle Density	:	2.60 (Assumed)

Experimental Points	
Moisture Content (%)	Dry Density (Mg/m^3)
8.0	1.90
9.9	1.96
11.2	1.97
14.1	1.86
15.5	1.79

Optimum Moisture Content (%)	**Maximum Dry Density (Mg/m^3)**
10.9	**1.97**

Remarks

Borehole :	BH01
Sample :	U
Depth (m) :	0.00-0.85

Tested in accordance with BS 1377 : Part 4 : 1990

DETERMINATION OF MOISTURE CONTENT / DRY DENSITY RELATIONSHIP BY COMPACTION

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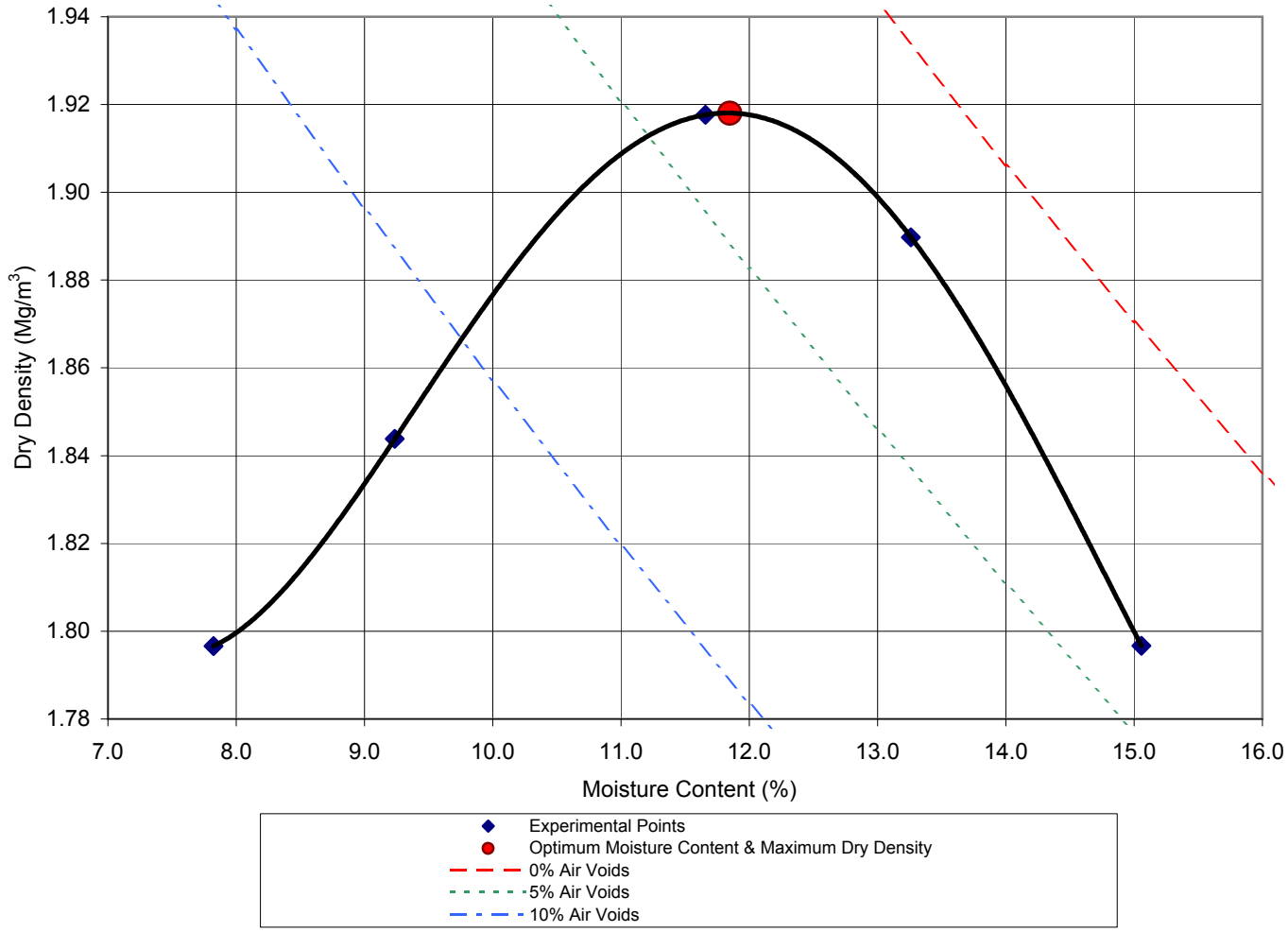


Test Method	:	Clause 3.5: 4.5kg rammer, 5 layers, 27 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	100
% Passing 20mm	:	97
Grading Zone	:	2
Particle Density	:	2.60 (Assumed)

Experimental Points	
Moisture Content (%)	Dry Density (Mg/m^3)
7.8	1.80
9.2	1.84
11.7	1.92
13.3	1.89
15.1	1.80

Optimum Moisture Content (%)	**Maximum Dry Density (Mg/m^3)**
11.9	**1.92**

Remarks

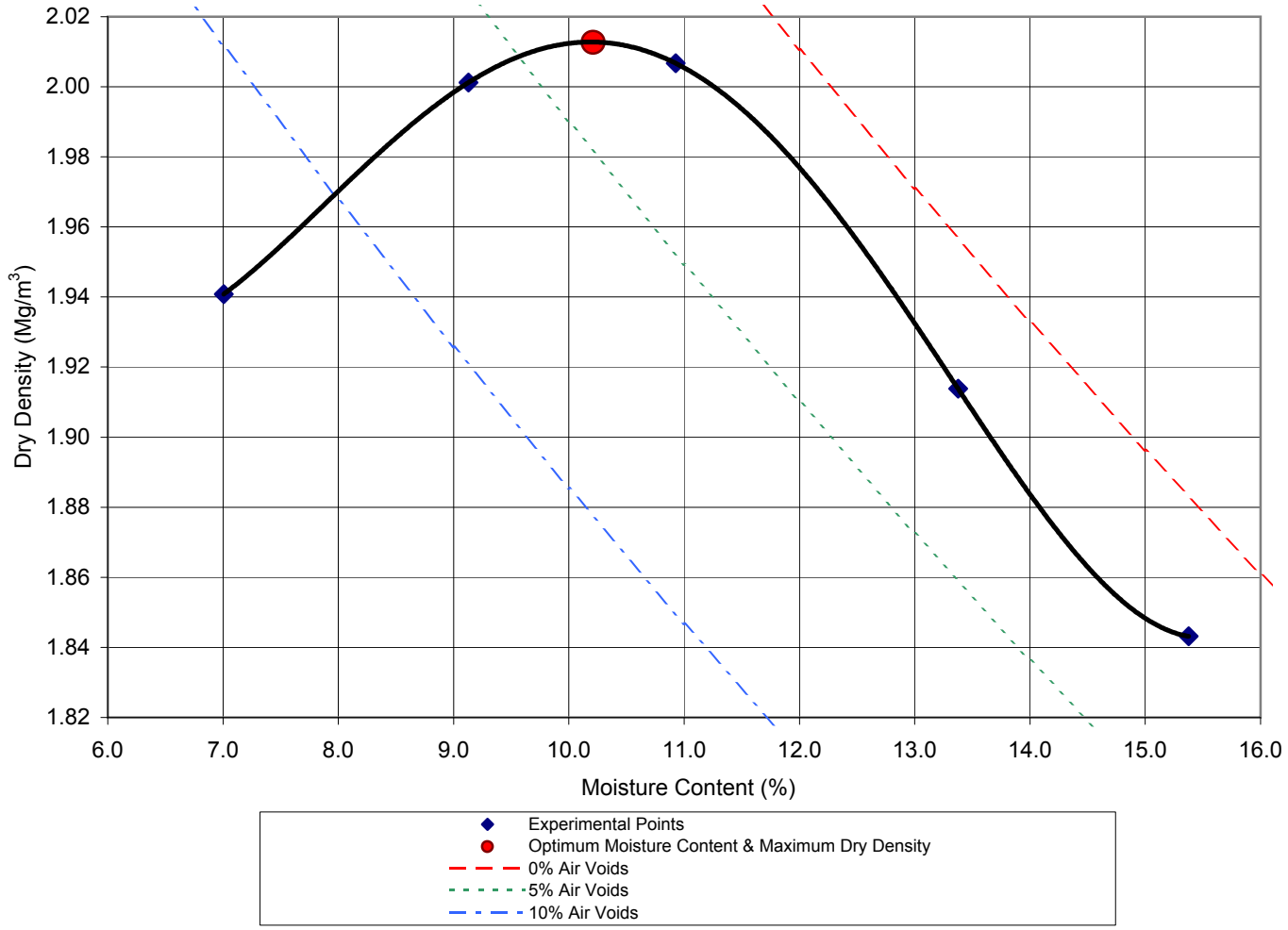
Borehole :	BH02
Sample :	U
Depth (m) :	0.00-0.97

Tested in accordance with BS 1377 : Part 4 : 1990

DETERMINATION OF MOISTURE CONTENT / DRY DENSITY RELATIONSHIP BY COMPACTION

MATtest Limited
materials testing & consultancy

Moisture Content / Dry Density Experimental Points



Test Method	:	Clause 3.5: 4.5kg rammer, 5 layers, 27 blows/layer
Preparation Method	:	Separate samples
% Passing 37.5mm	:	100
% Passing 20mm	:	97
Grading Zone	:	2
Particle Density	:	2.65 (Assumed)

Experimental Points	
Moisture Content (%)	Dry Density (Mg/m^3)
7.0	1.94
9.1	2.00
10.9	2.01
13.4	1.91
15.4	1.84

Optimum Moisture Content (%)	**Maximum Dry Density (Mg/m^3)**
10.2	**2.01**
Remarks	

Borehole :	BH03
Sample :	U
Depth (m) :	0.00-0.90

Tested in accordance with BS 1377 : Part 4 : 1990

DETERMINATION OF MOISTURE CONTENT / DRY DENSITY RELATIONSHIP BY COMPACTION

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH04	U	1.70	27	2.00	1.58

Tested in accordance with BS1377 Part 2 : 1990
Bulk Density : Linear Measurement

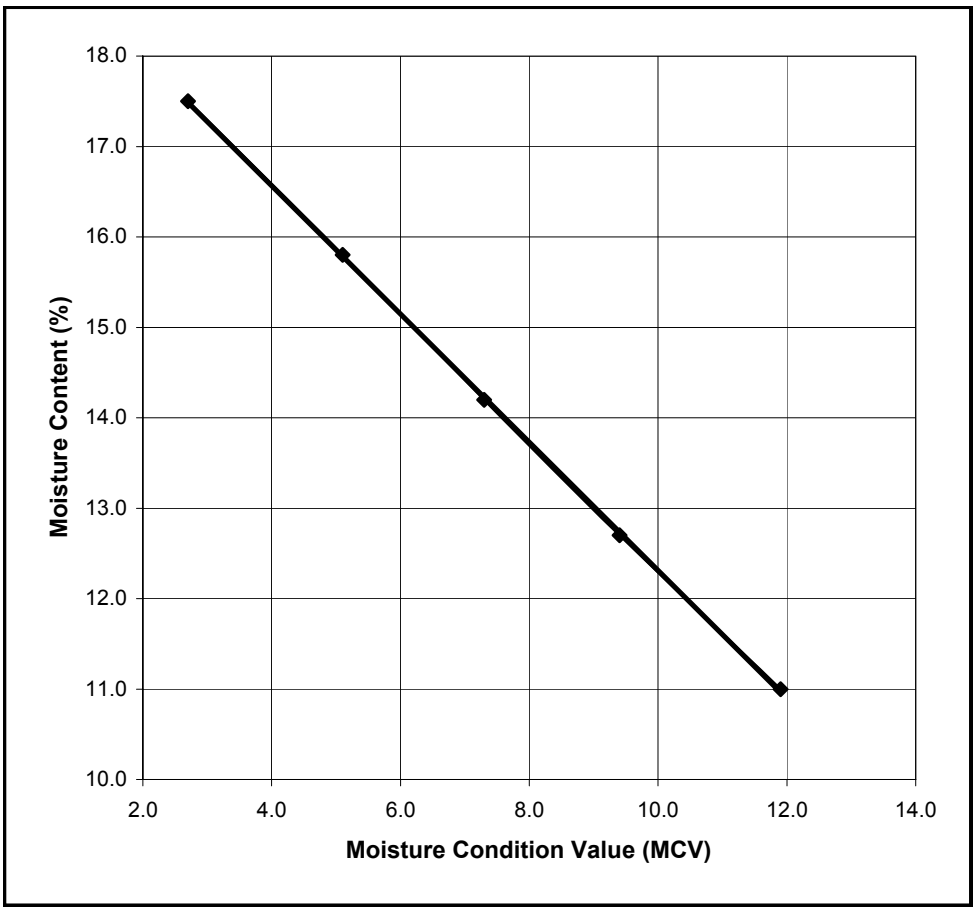
SUMMARY OF MOISTURE CONTENT AND DENSITY TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	% MATERIAL GREATER THAN 20mm	MOISTURE CONTENT (%)	MOISTURE CONDITION VALUE (MCV)
BH01	U	0.00-0.85	3	14.2	7.3
BH02	U	0.00-0.97	3	26.1	0.0
BH03	U	0.00-0.90	3	12.2	11.0

Method of interpretation for all test results - steepest line
Tested in accordance with BS 1377 : Part 4 : 1990 : Clause 5.4

SUMMARY OF MOISTURE CONDITION VALUE (MCV) TEST RESULTS TESTED AT AS RECEIVED MOISTURE CONTENT

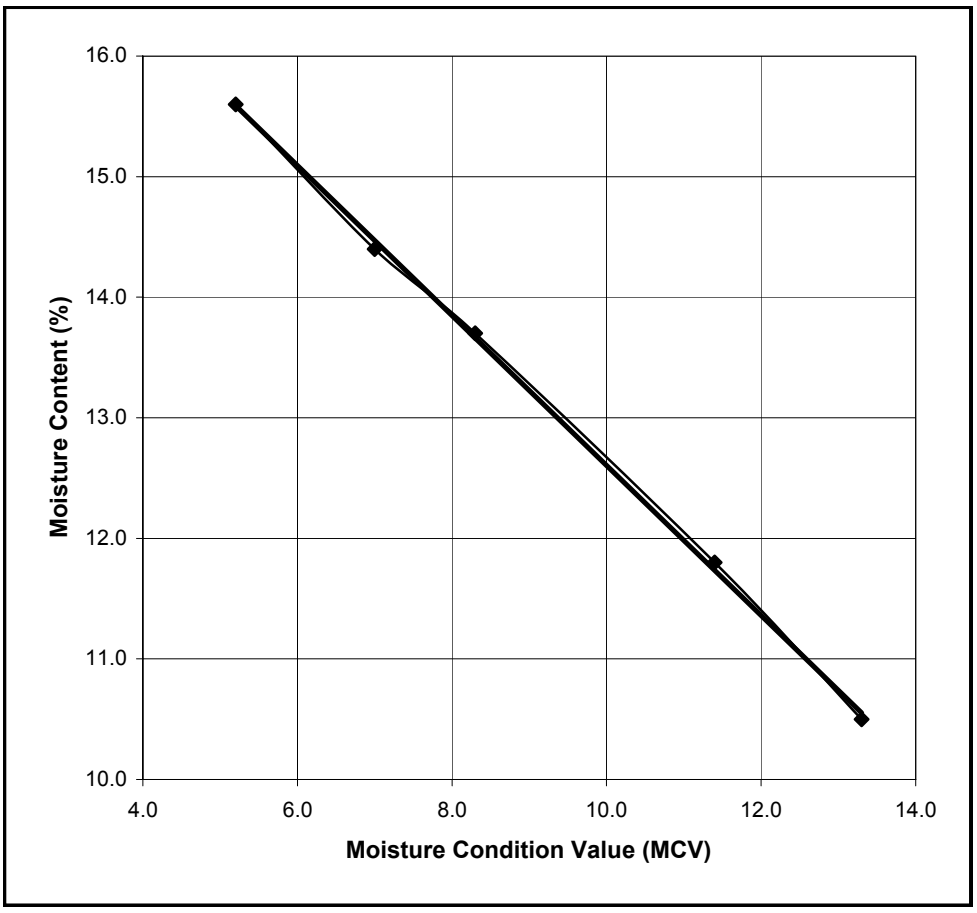
BOREHOLE	SAMPLE	DEPTH (m)	% MATERIAL GREATER THAN 20mm	MOISTURE CONTENT (%)	M.C.V.
BH01	U	0.00-0.85	3	11.0 12.7 14.2 15.8 17.5	11.9 9.4 7.3 5.1 2.7



*Material Passing 20mm sieve,separate samples used for each point
Tested in accordance with BS 1377: Part 4 : 1990: Clause 5.5

SUMMARY OF MOISTURE CONDITION TEST RESULTS

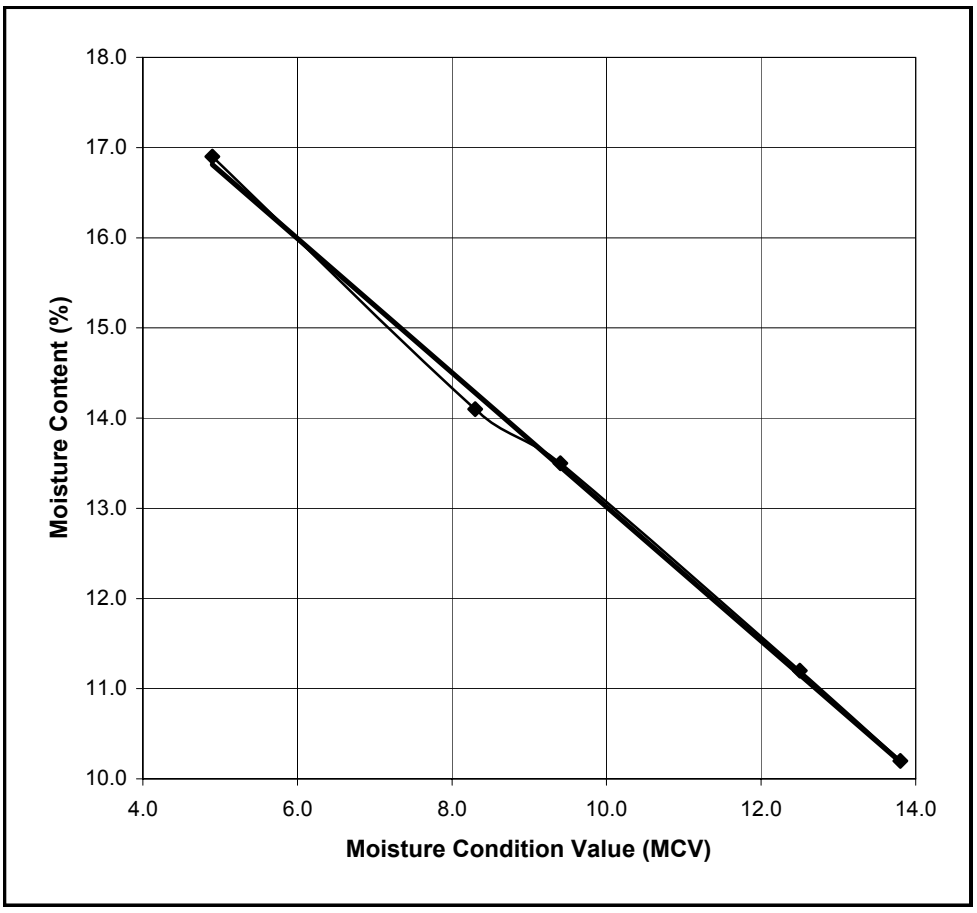
BOREHOLE	SAMPLE	DEPTH (m)	% MATERIAL GREATER THAN 20mm	MOISTURE CONTENT (%)	M.C.V.
BH02	U	0.00-0.97	3	10.5 11.8 13.7 14.4 15.6	13.3 11.4 8.3 7.0 5.2



*Material Passing 20mm sieve,separate samples used for each point
Tested in accordance with BS 1377: Part 4 : 1990: Clause 5.5

SUMMARY OF MOISTURE CONDITION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	% MATERIAL GREATER THAN 20mm	MOISTURE CONTENT (%)	M.C.V.
BH03	U	0.00-0.90	3	10.2 11.2 13.5 14.1 16.9	13.8 12.5 9.4 8.3 4.9



*Material Passing 20mm sieve,separate samples used for each point
Tested in accordance with BS 1377: Part 4 : 1990: Clause 5.5

SUMMARY OF MOISTURE CONDITION TEST RESULTS

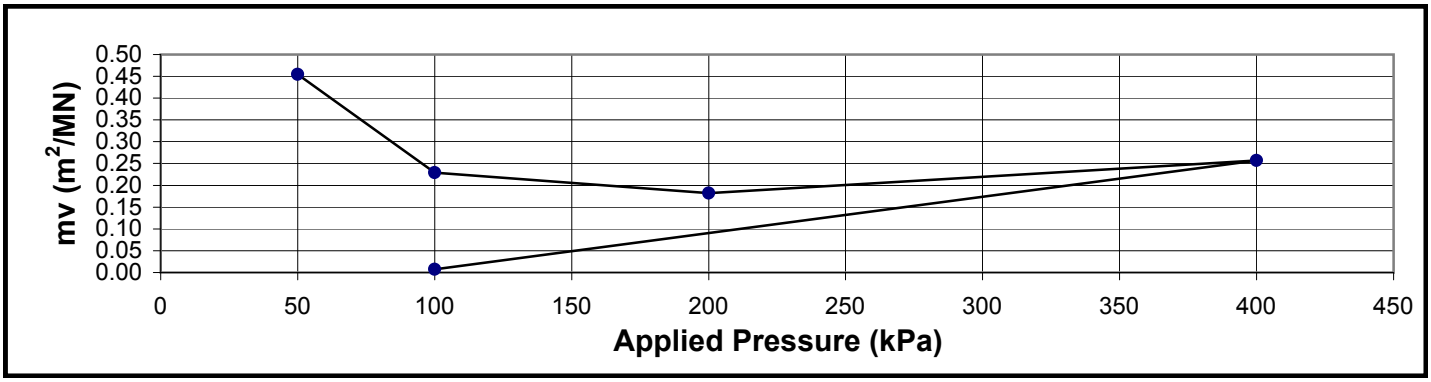
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH01	U	1.50	15	2.23	1.94

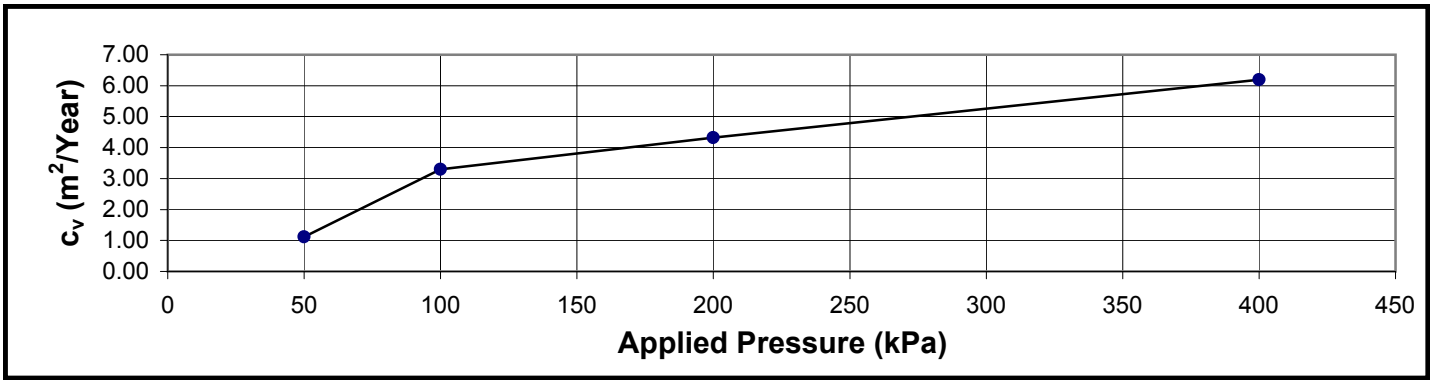
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
74.91	20.11	2.62	0.354	100	N/A

The value detailed for Particle Density is a measured value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v ($m^2/Year$)	c_{sec}
50	19.65	0.323	0.45	1.12	-
100	19.43	0.308	0.23	3.30	-
200	19.07	0.284	0.18	4.32	-
400	18.10	0.218	0.26	6.19	-
100	18.14	0.221	0.01		

m_v indicates values of coefficient of volume compressibility, c_v indicates values of coefficient of consolidation

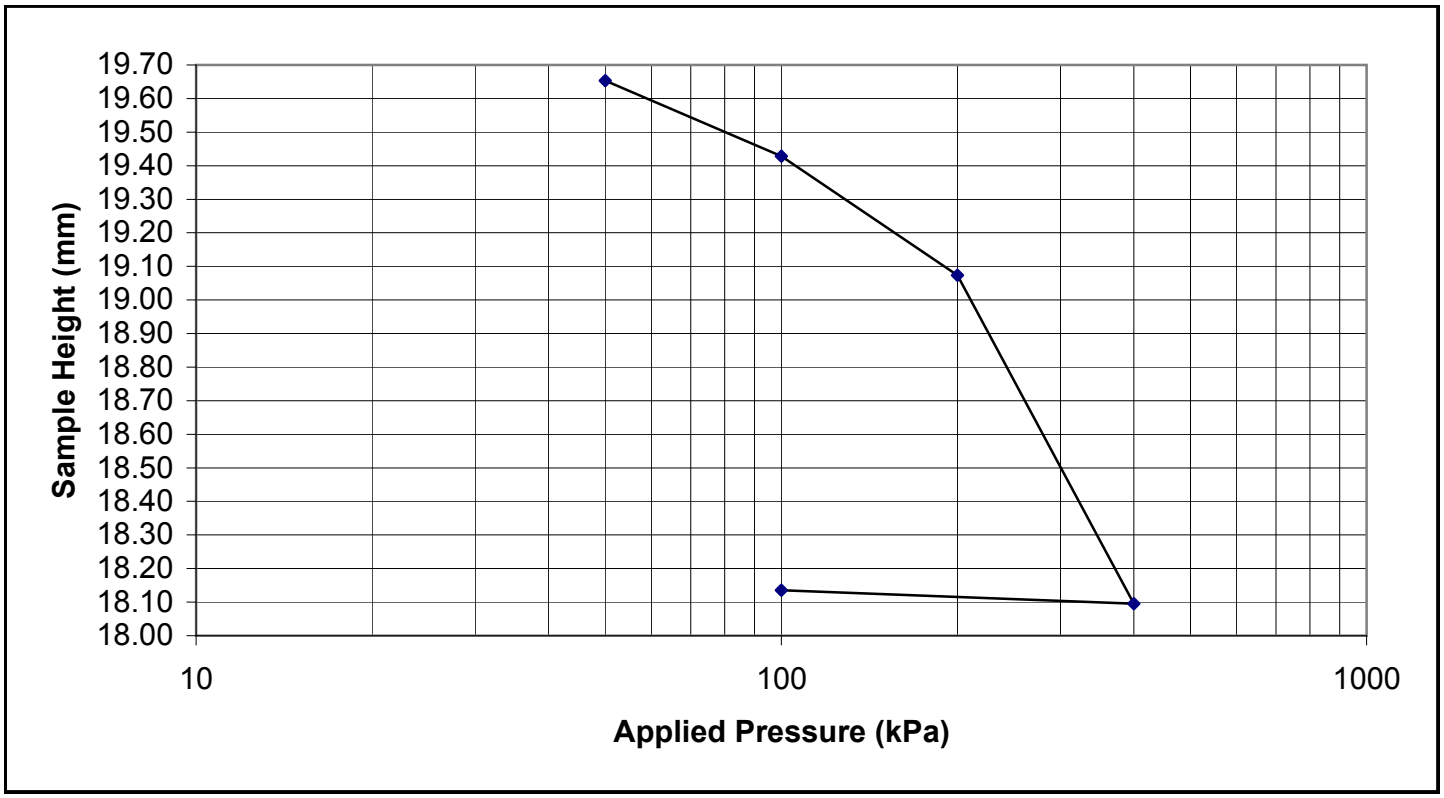


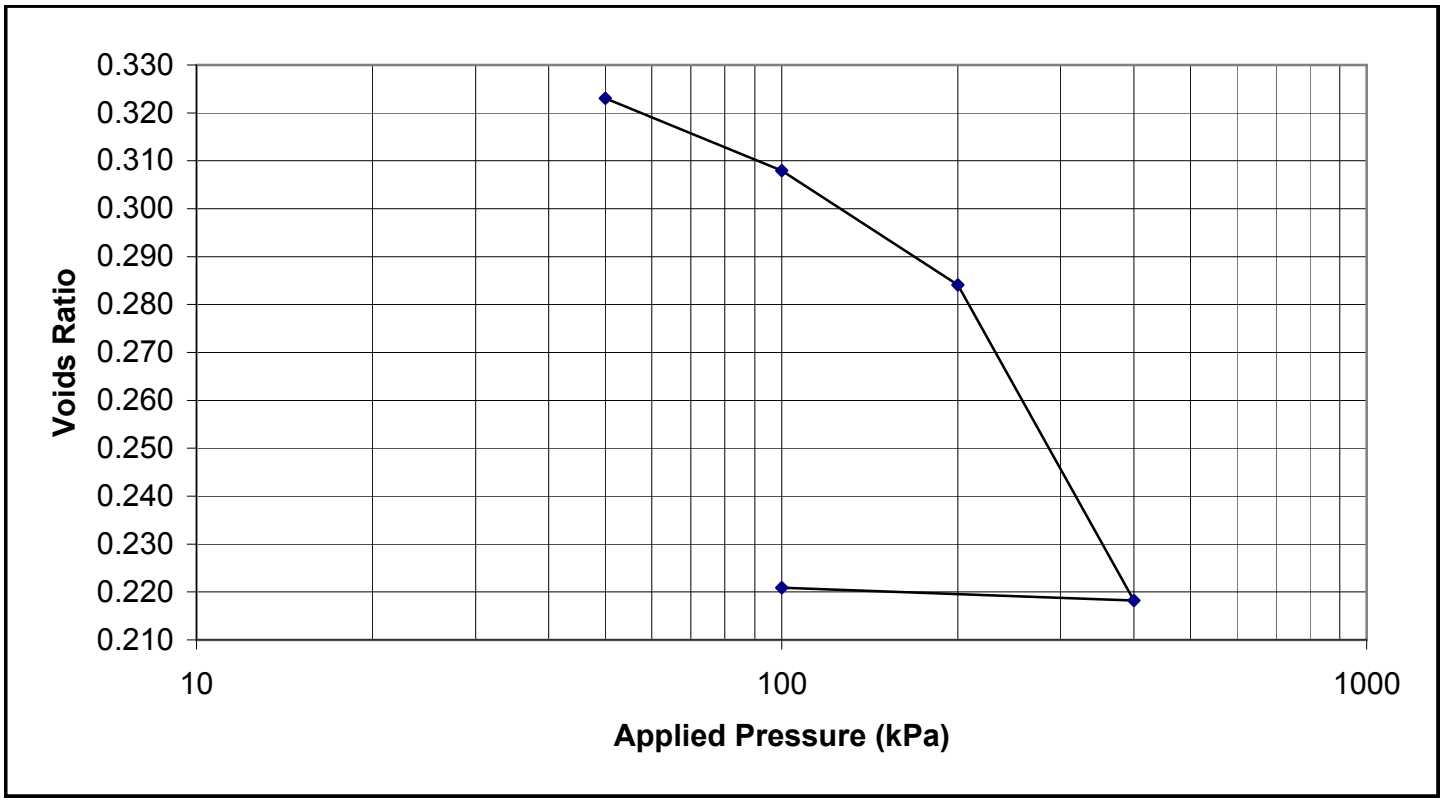


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	INITIAL VOIDS RATIO	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH01	U	1.50	0.354	15	2.23	1.94





Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

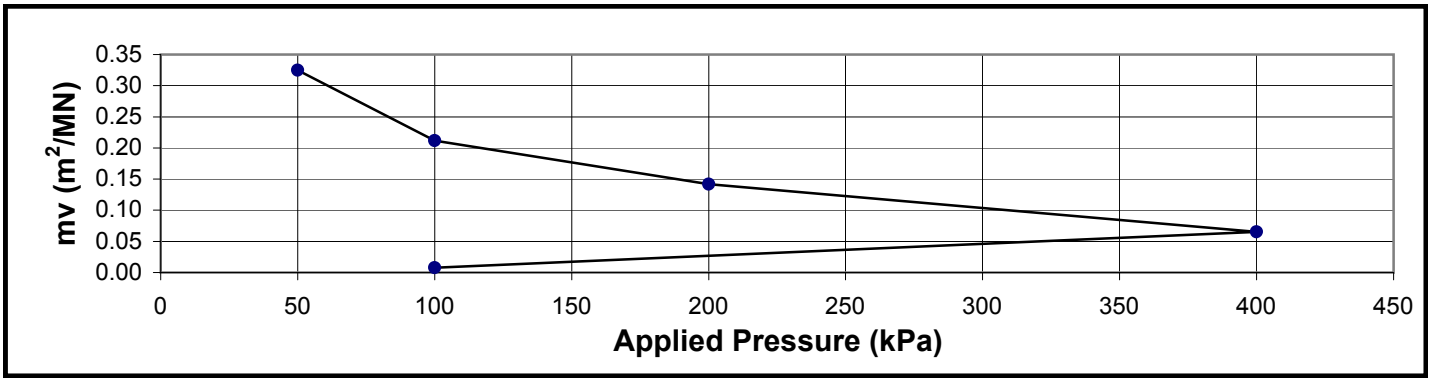
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH02	U	1.70	14	2.26	1.98

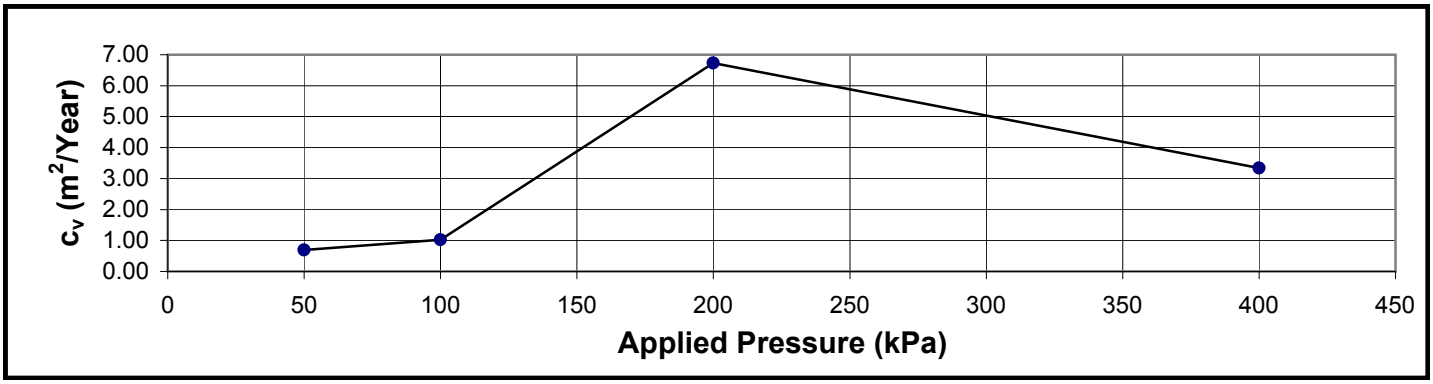
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
74.98	20.06	2.63	0.330	100	N/A

The value detailed for Particle Density is a measured value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v ($m^2/Year$)	c_{sec}
50	19.73	0.309	0.33	0.69	-
100	19.53	0.295	0.21	1.02	-
200	19.25	0.276	0.14	6.73	-
400	19.00	0.260	0.07	3.34	-
100	19.04	0.263	0.01		

m_v indicates values of coefficient of volume compressibility, c_v indicates values of coefficient of consolidation

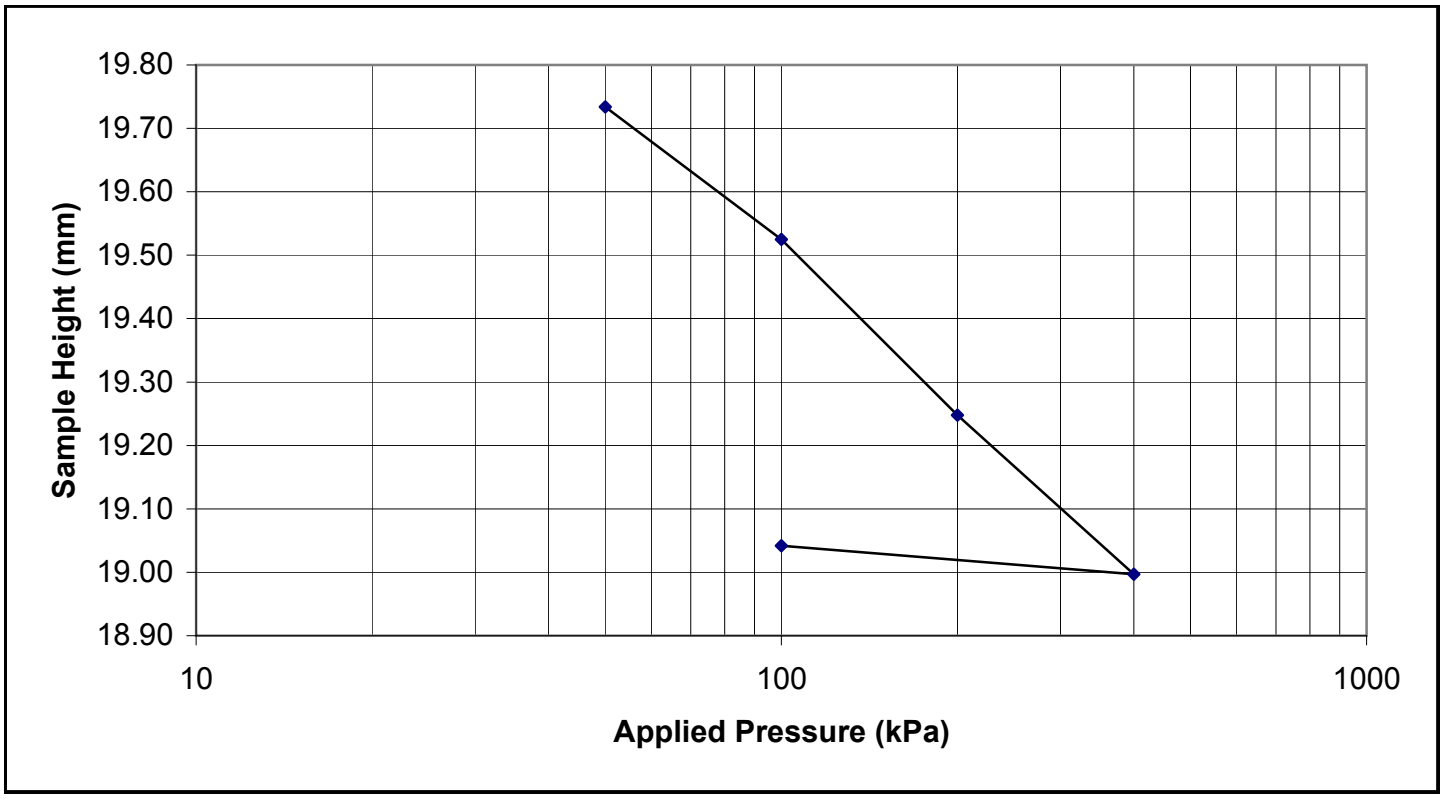


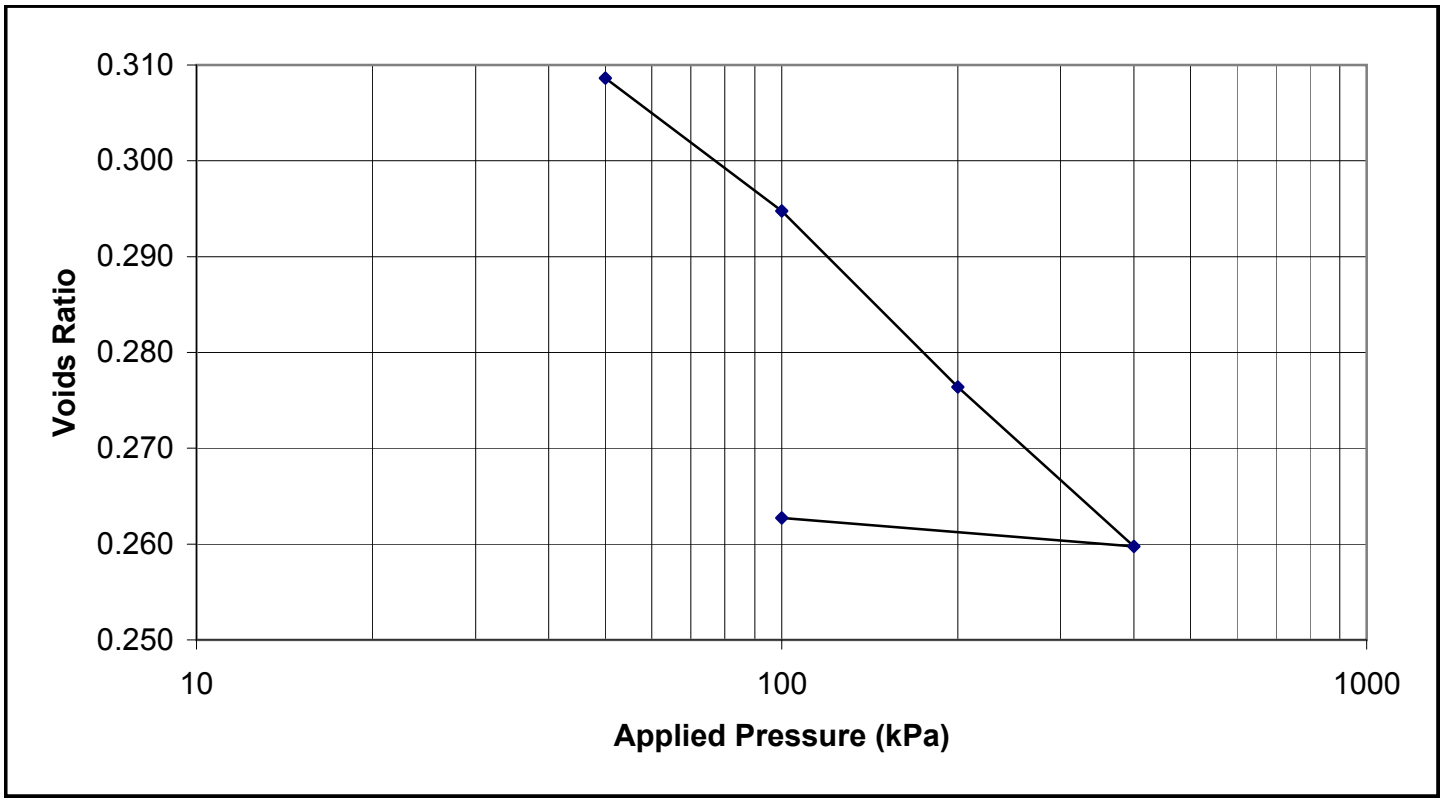


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	INITIAL VOIDS RATIO	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH02	U	1.70	0.330	14	2.26	1.98





Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

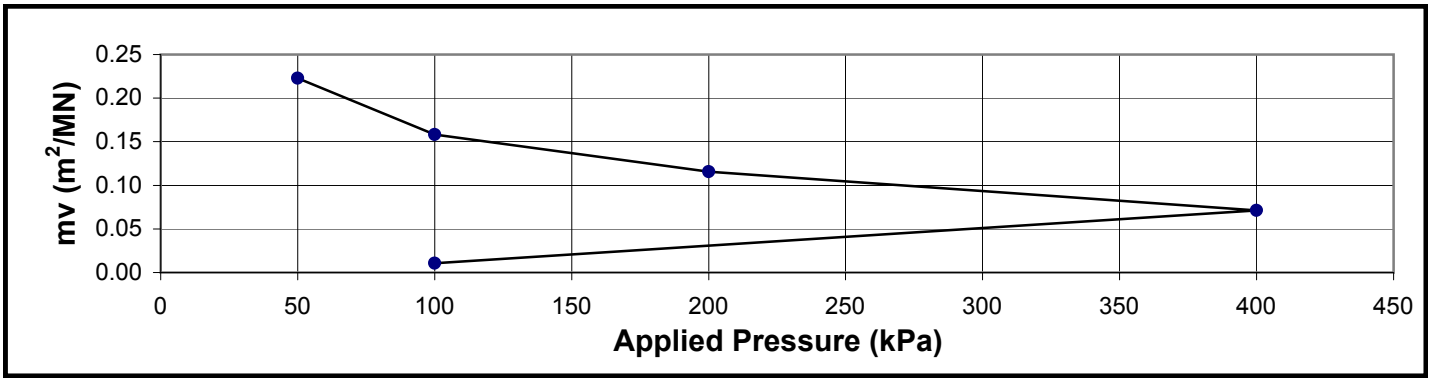
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH03	U	1.30	11	2.25	2.02

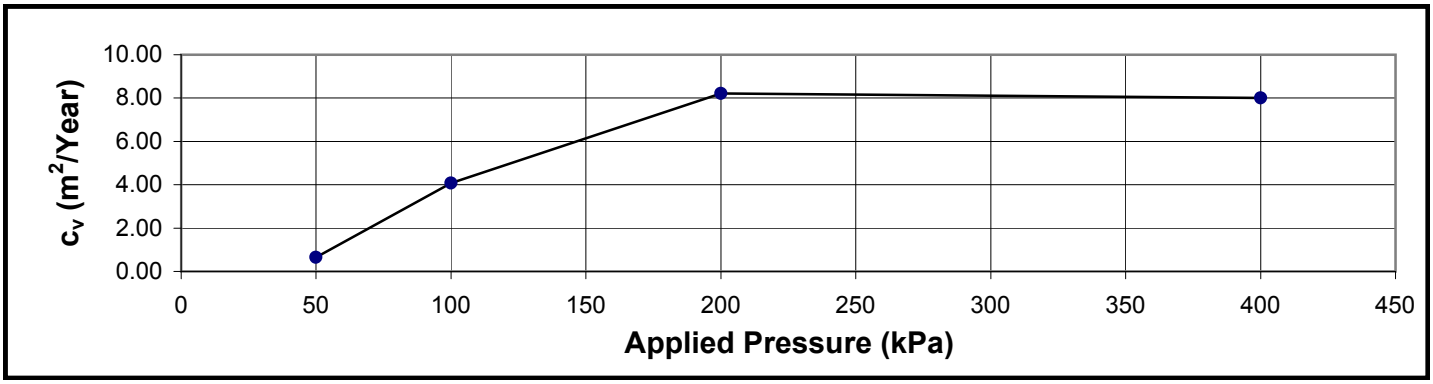
SAMPLE DIAMETER (mm)	SAMPLE HEIGHT (mm)	PARTICLE DENSITY (Mg/m^3)	INITIAL VOIDS RATIO	DEGREE OF SATURATION (%)	SWELLING PRESSURE (kPa)
75.02	20.20	2.6	0.285	100	N/A

The value detailed for Particle Density is a measured value

PRESSURE (kPa)	SAMPLE HEIGHT (mm)	VOIDS RATIO	m_v (m^2/MN)	c_v ($m^2/Year$)	c_{sec}
50	19.98	0.271	0.22	0.66	-
100	19.82	0.261	0.16	4.07	-
200	19.59	0.246	0.12	8.22	-
400	19.31	0.229	0.07	8.01	-
100	19.37	0.233	0.01		

m_v indicates values of coefficient of volume compressibility, c_v indicates values of coefficient of consolidation

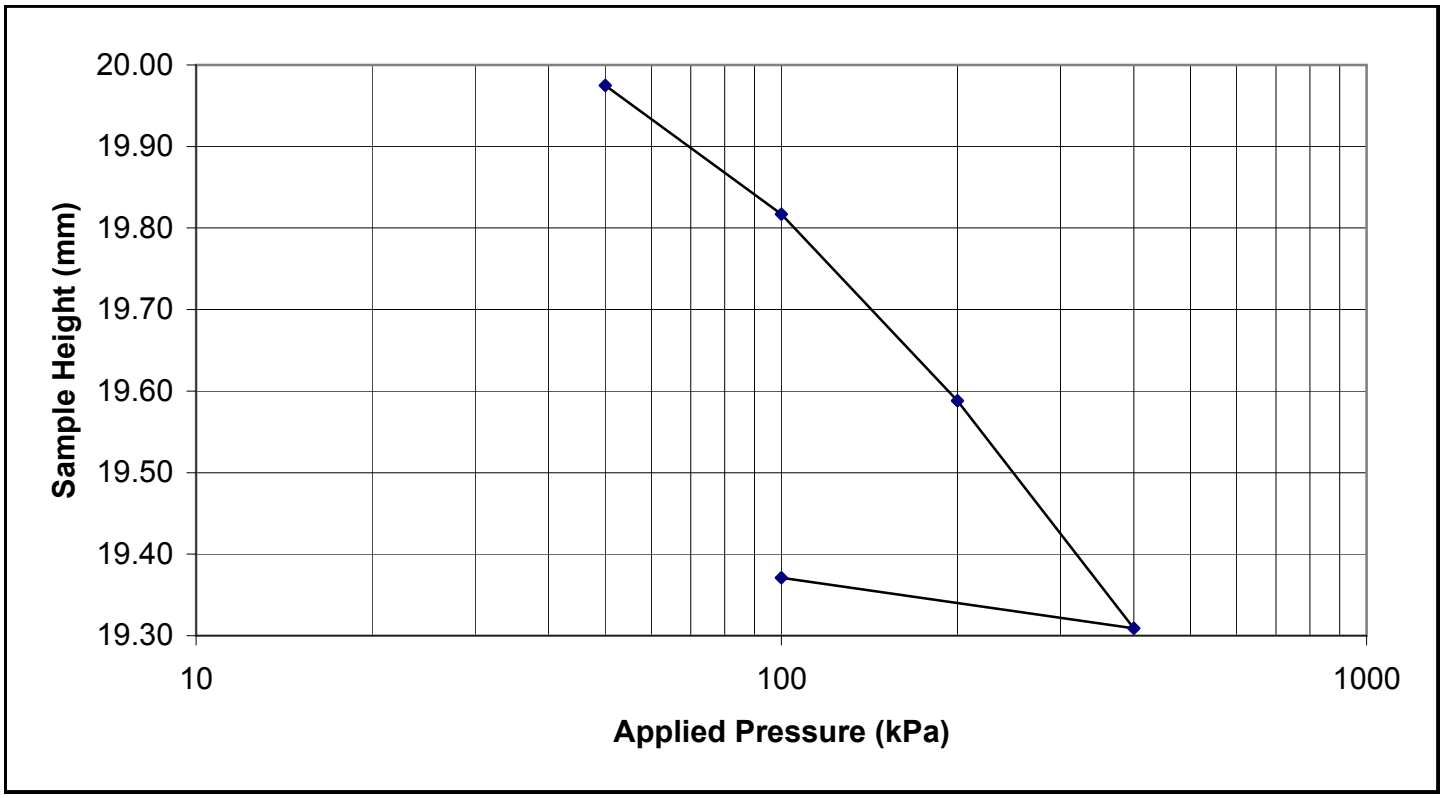


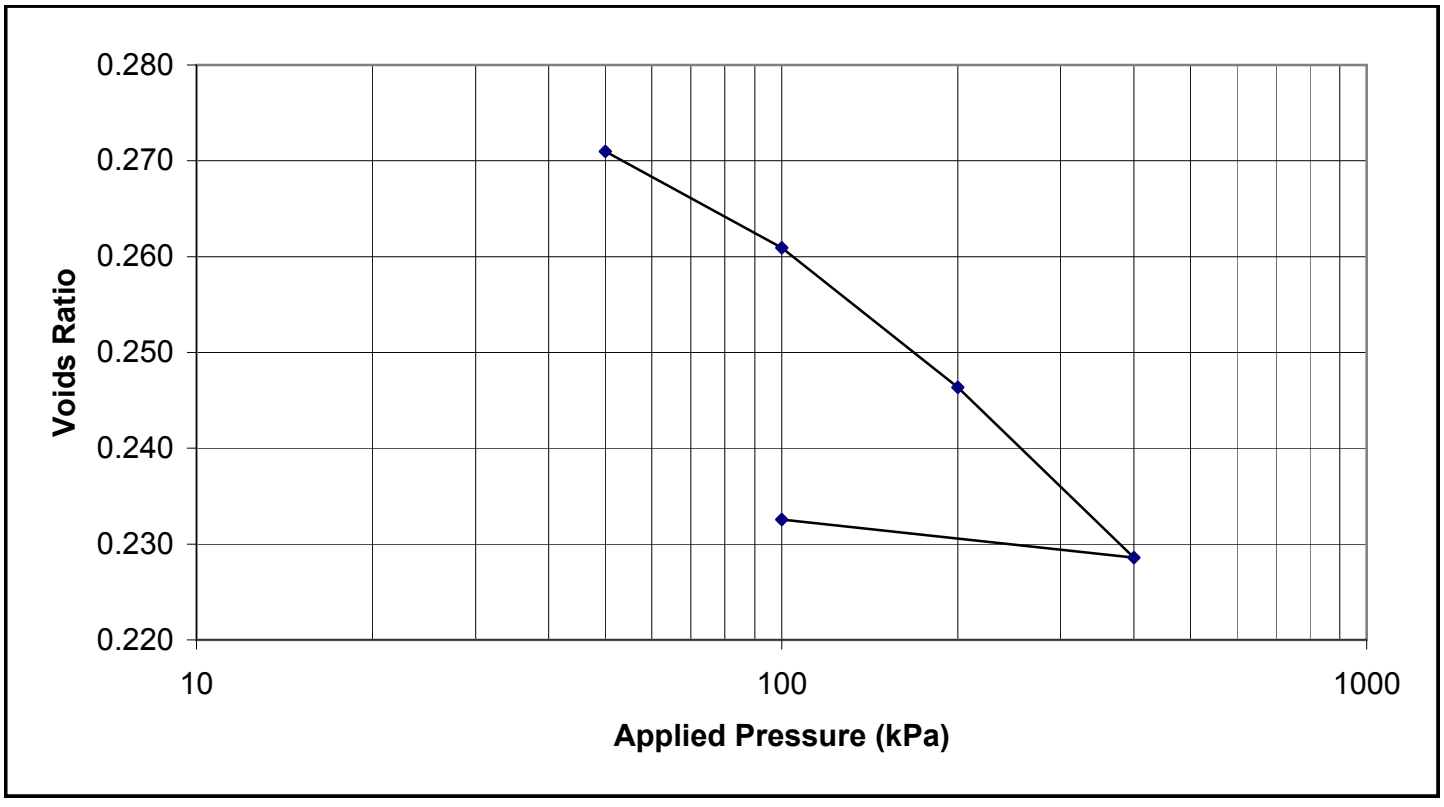


Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	INITIAL VOIDS RATIO	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH03	U	1.30	0.285	11	2.25	2.02





Sample was extruded directly from an undisturbed sample and vertical axis was maintained during testing

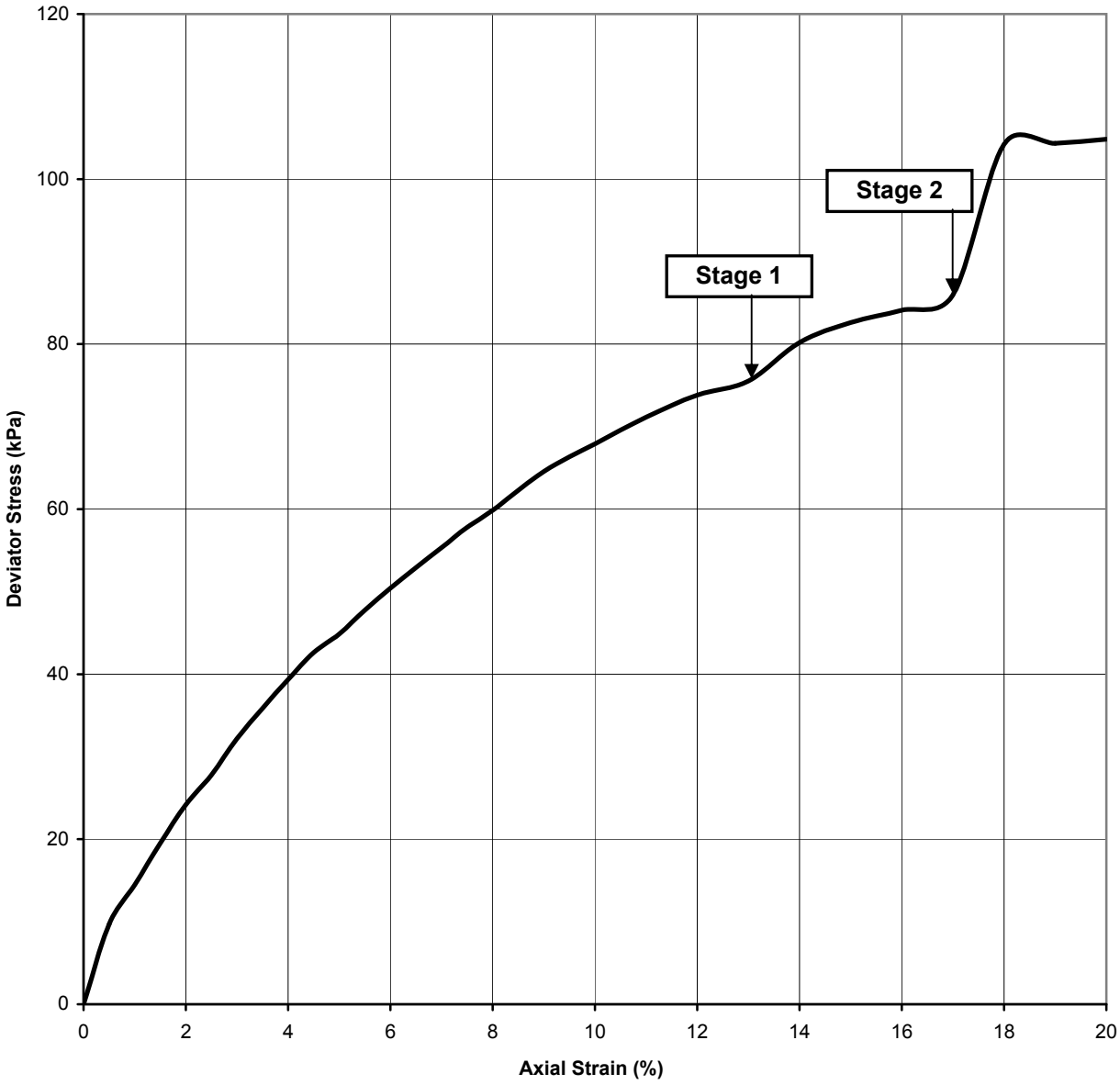
Tested in a temperature controlled room at 20 +/- 2°C
Tested in accordance with BS 1377: Part 5: 1990: Clause 3

ONE DIMENSIONAL CONSOLIDATION TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	COHESION (kPa)	FRICTION ANGLE (^{o})
BH01	U	1.60	27.8	10.9
BH02	U	1.80	16.3	11.4
BH03	U	1.40	29.1	6.8

Tested in accordance with BS1377: Part 7: 1990: Clause 9

SUMMARY OF FRICTION ANGLE & COHESION



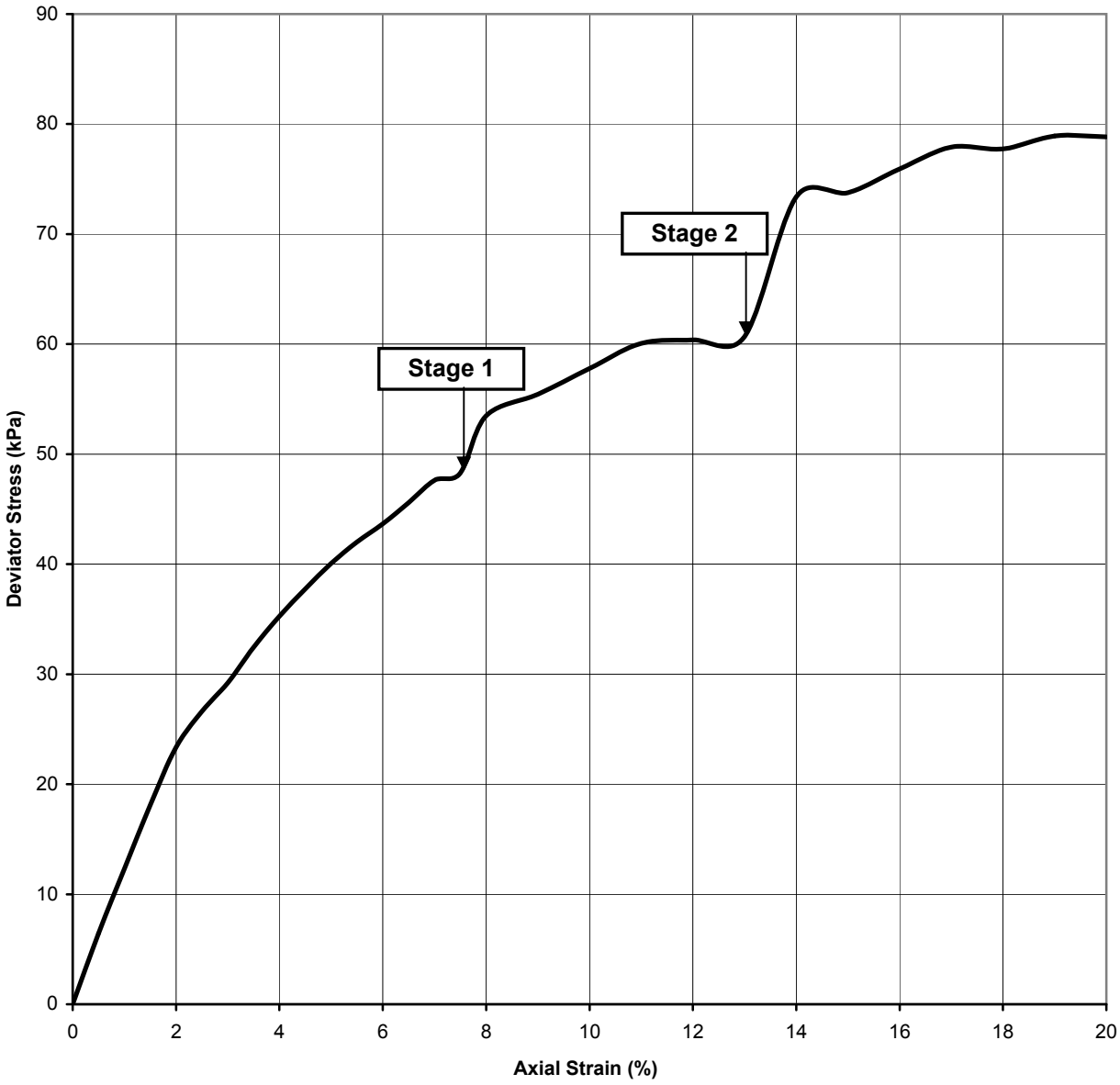
Undisturbed sample, taken directly from the sample tube and retaining axial orientation

Failure Conditions				
Cell pressure	(kPa)	20	40	80
Membrane correction	(kPa)	0.6	0.7	0.8
Strain at failure	(%)	13.0	17	20
Failure Type		Plastic	Plastic	Plastic
Corrected deviator stress	(kPa)	76	86	105
Undrained shear strength	(kPa)	38	43	52

Initial Conditions							
Sample length	194.3	mm	Rate of strain	2.0	%/min	Borehole	BH01
Sample diameter	97.1	mm	Bulk Density	2.16	Mg/m^3	Sample	U
Membrane type	Latex		Dry Density	1.90	Mg/m^3	Depth (m)	1.60
Membrane thickness	0.2	mm	Moisture Content	14	%		

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990



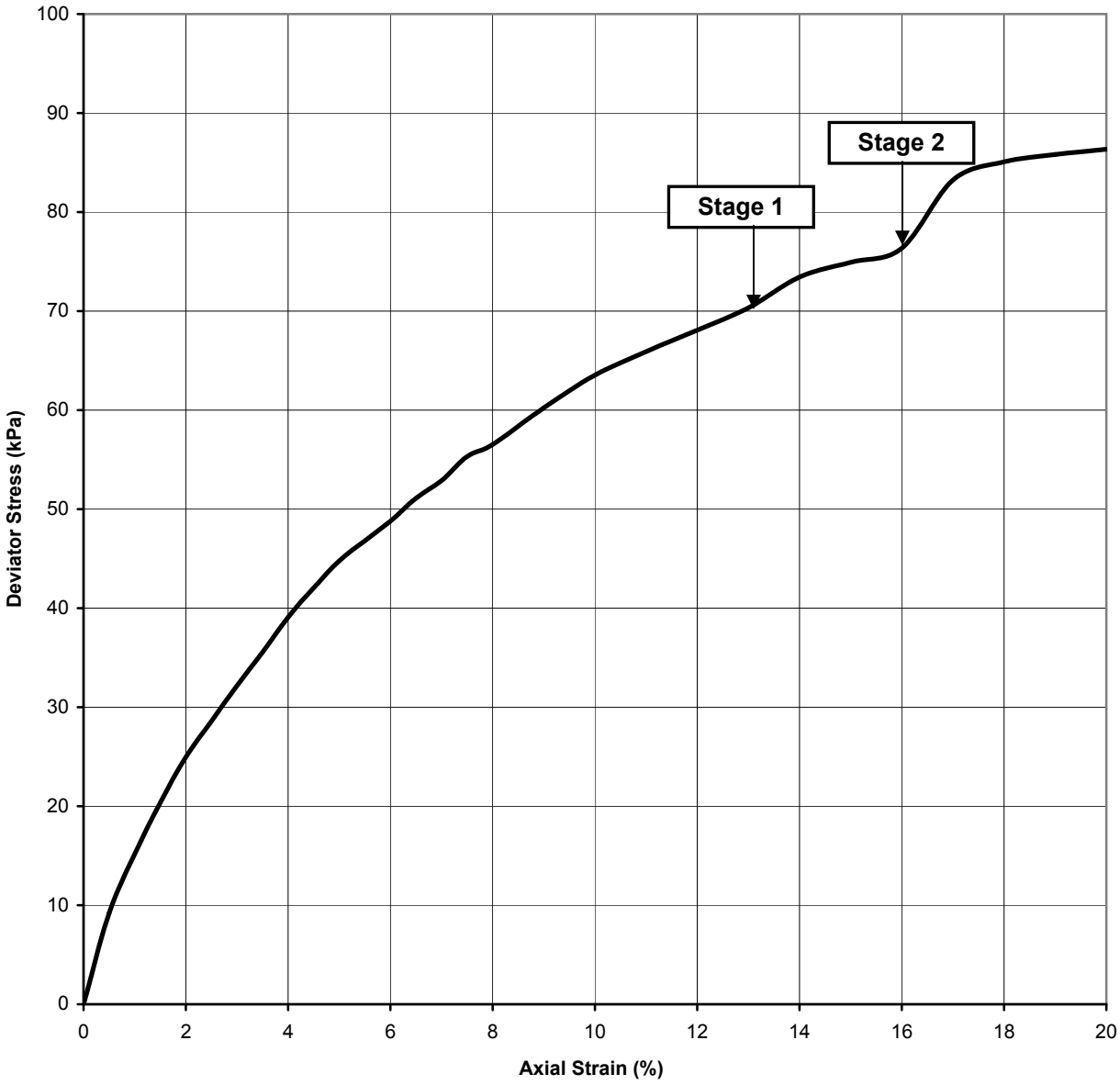
Undisturbed sample, taken directly from the sample tube and retaining axial orientation

Failure Conditions				
Cell pressure	(kPa)	20	40	80
Membrane correction	(kPa)	0.4	0.6	0.7
Strain at failure	(%)	7.5	13	17
Failure Type		Intermediate	Intermediate	Intermediate
Corrected deviator stress	(kPa)	48	61	78
Undrained shear strength	(kPa)	24	30	39

Initial Conditions							
Sample length	204.3	mm	Rate of strain	2.0	%/min	Borehole	BH02
Sample diameter	99.5	mm	Bulk Density	2.12	Mg/m^3	Sample	U
Membrane type	Latex		Dry Density	1.88	Mg/m^3	Depth (m)	1.80
Membrane thickness	0.2	mm	Moisture Content	13	%		

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990



Undisturbed sample, taken directly from the sample tube and retaining axial orientation

Failure Conditions				
Cell pressure	(kPa)	20	40	80
Membrane correction	(kPa)	0.6	0.7	0.8
Strain at failure	(%)	13.0	16	20
Failure Type		Plastic	Plastic	Plastic
Corrected deviator stress	(kPa)	70	76	86
Undrained shear strength	(kPa)	35	38	43

Initial Conditions							
Sample length	176.9	mm	Rate of strain	2.0	%/min	Borehole	BH03
Sample diameter	94.3	mm	Bulk Density	2.19	Mg/m^3	Sample	U
Membrane type	Latex		Dry Density	1.95	Mg/m^3	Depth (m)	1.40
Membrane thickness	0.2	mm	Moisture Content	12	%		

DETERMINATION OF MULTI STAGE UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

Tested in accordance with BS 1377 : Part 7 : 9.0 : 1990

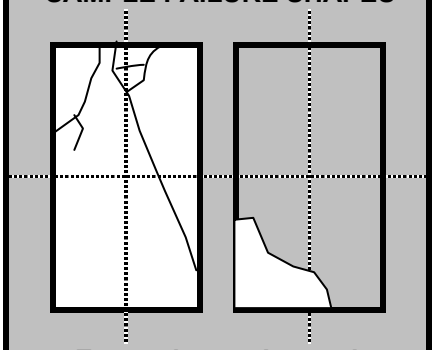
BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m^3)	DRY DENSITY (Mg/m^3)
BH01	-	5.00	0.9	2.51	2.49

Tested in accordance with "ISRM Suggested Methods"

SUMMARY OF MOISTURE CONTENT AND DENSITY TEST RESULTS

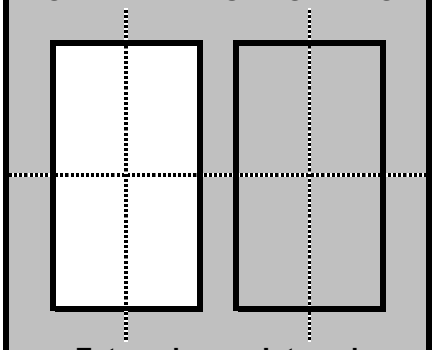
BOREHOLE		BH01
CORE RUN		-
DEPTH		5.00
SAMPLE DIAMETER	mm	72.60
SAMPLE HEIGHT	mm	141.94
WATER CONTENT	%	0.9
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.3
TEST DURATION	min.sec	5.53
DATE OF TESTING		15-Nov-14
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Unknown
FAILURE LOAD	kN	105.6
UNCONFINED COMPRESSIVE STRENGTH	MPa	25.5

SAMPLE FAILURE SHAPES



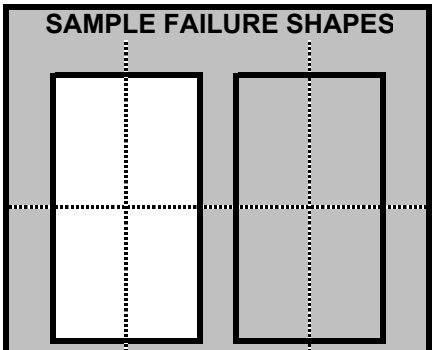
BOREHOLE		
CORE RUN		
DEPTH		
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
WATER CONTENT	%	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	

SAMPLE FAILURE SHAPES



BOREHOLE		
CORE RUN		
DEPTH		
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
WATER CONTENT	%	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	

SAMPLE FAILURE SHAPES



Tested in accordance with ASTM D7012 - 10

SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

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EXPLORATORY HOLE PHOTOGRAPHS

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BH03

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TP05

Appendix E – Tier 1 Human Health Risk Assessment Table

Tier 1 Human Health Risk Assessment Table

Contaminants of Concern (COC)	GAC Source	LOD	Units	No. Samples Analysed	No. Non Detects	Maximum Concentration	GAC Commercial	Number of Samples Exceeding GAC
Arsenic	LQM	2	mg/kg	6	0	7	640	0
Cadmium	LQM	1	mg/kg	6	6	<1	190	0
Chromium (III)	LQM	1	mg/kg	6	0	43	8,600	0
Chromium VI	LQM	1	mg/kg	6	6	<1	33	0
Copper	LQM	1	mg/kg	6	0	23	68,000	0
Lead	SGV	3	mg/kg	6	0	15	750	0
Mercury, inorganic	LQM	1	mg/kg	6	6	<1	1,100	0
Nickel	LQM	1	mg/kg	6	0	35	980	0
Selenium	LQM	3	mg/kg	6	6	<3	12,000	0
SO4(Total)	NR	0.01	%	6	0	0.12	-	-
SO4 (2:1)	NR	10	mg/l	6	1	18	-	-
Zinc	LQM	1	mg/kg	6	0	71	730,000	0
Total Cyanide	NC	1	mg/kg	6	6	<1	-	-
Phenol	LQM	1	mg/kg	6	6	<1	760	0
pH	NR		mg/kg	6	0	8.3	-	-
TPH Banded								
TPH(C8-10)	LQM	1	mg/kg	6	6	<1	2,000 (78)^{sol} *	0
TPH(C10-12)	LQM	1	mg/kg	6	6	<1	2,000 (78)^{sol} *	0
TPH(C12-16)	LQM	1	mg/kg	6	6	<1	2,000 (78)^{sol} *	0
TPH(C16-21)	LQM	1	mg/kg	6	6	<1	2,000 (78)^{sol} *	0
TPH(C35-40)	LQM	1	mg/kg	6	6	<1	2,000 (78)^{sol} *	0
Speciated PAH USEPA16								
Naphthalene	LQM	0.01	mg/kg	6	6	<0.01	190 (76.4)^{sol}	0
Acenaphthylene	LQM	0.01	mg/kg	6	6	<0.01	83,000 (86.1)^{sol}	0
Acenaphthene	LQM	0.01	mg/kg	6	6	<0.01	84,000 (57)^{sol}	0
Fluorene	LQM	0.01	mg/kg	6	6	<0.01	63,000 (30.9)^{sol}	0
Phenanthrene	LQM	0.01	mg/kg	6	6	<0.01	22,000	0
Anthracene	LQM	0.01	mg/kg	6	6	<0.01	520,000	0

Contaminants of Concern (COC)	GAC Source	LOD	Units	No. Samples Analysed	No. Non Detects	Maximum Concentration	GAC Commercial	Number of Samples Exceeding GAC
Fluoranthene	LQM	0.01	mg/kg	6	5	0.02	23,000	0
Pyrene	LQM	0.01	mg/kg	6	5	0.02	54,000	0
Benzo(a)anthracene	LQM	0.01	mg/kg	6	5	0.01	170	0
Chrysene	LQM	0.01	mg/kg	6	6	<0.01	350	0
Benzo(b)fluoranthene	LQM	0.01	mg/kg	6	5	0.01	44	0
Benzo(k)fluoranthene	LQM	0.01	mg/kg	6	6	<0.01	1,200	0
Benzo(a)pyrene	LQM	0.01	mg/kg	6	6	<0.01	35	0
Indeno(1,2,3,c,d)pyrene	LQM	0.01	mg/kg	6	6	<0.01	500	0
Dibenzo(a,h)anthracene	LQM	0.01	mg/kg	6	6	<0.01	3.5	0
Benzo(g,h,i)perylene	LQM	0.01	mg/kg	6	6	<0.01	3,900	0
VOC USEPA 624								
Benzene	LQM	0.001	mg/kg	6	6	<0.001	27,000	0
Ethylbenzene	LQM	0.001	mg/kg	6	6	<0.001	5,700^{vap}(518)	0
Toluene	LQM	0.001	mg/kg	6	6	<0.001	56,000^{vap}(869)	0
m Xylene	LQM	0.001	mg/kg	6	6	<0.001	6,200^{vap}(625)	0
o Xylene	LQM	0.001	mg/kg	6	6	<0.001	6,600^{sol}(478)	0
p Xylene	LQM	0.001	mg/kg	0	0	<0.001	5,900^{sol}(576)	0
All remaining VOC were below the limits of detection.								
Organophosphorous Pesticides (OPP)								
Azinphos methyl	NC	0.01	mg/kg	6	6	<0.01	-	-
Diazinon	NC	0.01	mg/kg	6	6	<0.01	-	-
Dichlorvos	LQM	0.01	mg/kg	6	6	<0.01	140	0
Dimethoate	NC	0.01	mg/kg	6	6	<0.01	-	-
Fenitrothion	ERS	0.01	mg/kg	6	6	<0.01	9,375	0
Malathion	ERS	0.01	mg/kg	6	6	<0.01	36,580	0
Mevinphos	NC	0.01	mg/kg	6	6	<0.01	-	-
Parathion	NC	0.01	mg/kg	6	6	<0.01	-	-
Pirimiphos methyl	NC	0.01	mg/kg	6	6	<0.01	-	-
Organochlorine Pesticides (OCP)								
Aldrin	LQM	0.01	mg/kg	6	6	<0.01	120	0
Chlordane	NC	0.01	mg/kg	6	6	<0.01	-	-

Contaminants of Concern (COC)	GAC Source	LOD	Units	No. Samples Analysed	No. Non Detects	Maximum Concentration	GAC Commercial	Number of Samples Exceeding GAC
DDD	NC	0.01	mg/kg	6	6	<0.01	-	-
DDE	NC	0.01	mg/kg	6	6	<0.01	-	-
DDT	ERS	0.01	mg/kg	6	6	<0.01	1,042	0
Dieldrin	LQM	0.01	mg/kg	6	6	<0.01	170	0
Endosulphan	LQM	0.01	mg/kg	6	6	<0.01	5,600 (0.003)^{vap}**	0
Endrin	NC	0.01	mg/kg	6	6	<0.01	-	-
Heptachlor	NC	0.01	mg/kg	6	6	<0.01	-	-
Heptachlor epoxide	NC	0.01	mg/kg	6	6	<0.01	-	-
Hexachlorobenzene	NC	0.01	mg/kg	6	6	<0.01	-	-
Hexachlorocyclohexane	LQM	0.01	mg/kg	6	6	<0.01	65***	0

NC – Not calculated. Toxicity data and/or chemical data could not be sourced to enable a GAC to be derived. As Cyanide concentration below LOD, no further assessment undertaken.

NR – Not relevant. According to CLR 8, humans are not a receptor for this COC.

^{sol} - GAC presented exceeds solubility based saturation limit (in brackets).

^{vap} - GAC presented exceeds vapour based saturation limit (in brackets).

*Compared all TPH results to lowest GAC for TPHCWG fractions.

**Compared to lowest GAC of two endosulphan isomers.

***Compared to lowest GAC of three HCH isomers.