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Phase 2 Ground Investigation
Taylor's Lane
Rathfarnham
Dublin

53.1388422
-72.9917328

Client: MCCL

July 2021
Issue 2

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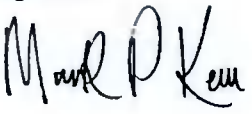
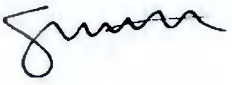
			Signature 	Signature 

Executive Summary	
Site Setting	
Site Address	Taylor's Lane road, Rathfarnham, Dublin
Grid Reference	SG 141 846
Site Area	0.63 hectares
Current Site Use	The site is currently derelict and in poor condition but was a former Builders Merchant.
Proposed Development	It is understood that MCCL propose to re-develop the site to a Residential Nursing Home. The proposed development will include a multi-storey build, with accosiated access road, parking, green spaces and private gardens. The proposed development intends to retain the existing entrance for the new development. There is a stream on site noted in the proposed site plan, which is proposed to be utilised as a feature within the development.
Adjacent Site Uses	The site is bounded on the north by Taylor's Lane, the west by a Petrol Station and the south and west by residential property.
Topography	The site is gently sloping; there is an approximate 3.00m declining slope from south to north.
Geology	Superficial Geology – the site is underlain by clay Bedrock Geology – the site is underlain by Granite
Hydrogeology	It is known an unnamed water feature exists on site, considered to be a stream as noted in the proposed site plan.
Ecology & Archeology	No areas of ecological or archaeological significance were identified from the Phase 1 Desk Study, site walkover or intrusive site investigation.
Environmental Searches	
Site History	The earliest Historical Maps date from 1837, which recorded a paper mill on site. From 1888 Newbrook House was identified on site. Further unspecified developments recorded in 1995. The potential sources of contamination identified off-site from historical maps include petrol station, car wash, tyre shop and coach company
Intrusive Ground Investigation	
Site work was conducted from 14/12/20 to the 17/12/20, comprising boreholes, in-situ testing and sampling and standpipe installation, and was carried out generally in accordance with BS 10175 and BS 5930.	
Ground Conditions	**Made Ground:** was encountered across the site in all exploratory positions excluding WS01. Made ground strata's were encountered to a maximum depth of 1.50m. Made ground strata's encountered varied from concrete, gravel and clay with various made components, including brick fragments.
	Superficial Deposits: included clay and boulder clay were encountered across the site. Clay was soft to very stiff, increasing in strength with depth, recorded as variations of sandy gravelly clay.
	Bedrock: was not encountered in any of the exploratory positions.
	Groundwater: groundwater strikes were encountered in WS02, WS04, WS05 and WS06 between 0.40 – 2.40m.
Contamination	
Soil Contamination	The results of laboratory tests, from the intrusive site investigation together with consideration of the conceptual and exposure models for the proposed development, suggest that the remediation strategy needs to address the presence of arsenic, lead and Dibenz(a,h)Anthracene. One 'hotspots' was identified within the investigation, located at WS05. The results of the laboratory tests, from the intrusive site investigations together with consideration of the conceptual and exposure models for the proposed development, it is considered remedial measures are necessary.
Asbestos	None

Ground Gas	The results from the ground gas and water monitoring will be added to this report as an addendum.
Geotechnical Assessment	
Foundation Options	From a review of the proposed buildings development on site, the development would typically generate loads of approximately 80-100kN/m. From inspection of the ground conditions, we would suggest a potential bearing capacity of the stiff clay in the order of 100-120kN/m2 and on this basis we would recommend reinforced concrete strip foundation as the most suitable foundation solution. It is considered foundations should be cast below the made ground in the natural stiff boulder clay. Alternatively, in areas where the stiff clay is encountered in deeper strata's, the concrete foundation solution could be cast on engineered fill upon the stiff clay.
Sulphate Assessment	*Design Sulphate Class: DS-1 / ACEC-AC-1.*
Carriageway Design	From the CBR results an adoptable road would be approved by local council during an RCC application it will be necessary to design for a capping layer of 350mm below any areas of adoptable road.
Soakaway	Soakaways may not be a viable drainage solution.
Developed Conceptual Site Model (CSM)	
Human Health	Contaminants within soil and groundwater beneath the site were identified within the intrusive site investigation, it is considered that unidentified contaminants may potentially be present beneath the site. Construction workers and site operatives should be made aware of the possibility of encountering contamination and a watching brief should be maintained during any excavation works undertaken at the site. Construction workers should also be provided with appropriate levels of PPE and follow personal hygiene protocols. The risk to construction workers and future site personnel is moderate. It is considered that the soil on site has exceeded guideline values for contaminants on site, based on the guideline for a residential property without home-grown produce. It is considered that there will not be home-grown produce on site, on this basis the risk is low.
Controlled Water	From the intrusive site investigation and chemical soil testing, contaminants were recorded. There is the possibility of encountering further unidentified sources of contamination on the site, which were not disclosed by the investigation. There is also the possibility that this investigation uncovered and disclosed the full extent of contamination on site, on this basis the risk to groundwater beneath the site is low to moderate. Given the distance from the site to local water features the overall risk of substances derived from the site impacting these water courses is low to moderate.
Contamination & Remediation	
It is considered that the site would be considered at this time as "contaminated land" by local authority. It is further considered that remedial measures will be necessary to close off the pathway between potential contaminant and receptor. The results of laboratory tests, from the intrusive site investigation together with consideration of the conceptual and exposure models for the proposed development, suggest that the remediation strategy needs to address the presence of arsenic, lead and Dibenz(a,h)Anthracene. One 'hotspots' was identified within the investigation, located at WS05. One 'hotspots' was identified within the investigation, located at WS05. It is considered that the most appropriate option would be to cap the contaminated area, covered by buildings, hard standing or hard landscaping by the proposed development.	

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Appendices

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1.0 Introduction

Ardmore Point Ltd was commissioned by MCCL, in December 2020, to complete a Phase 2 Ground Investigation for a site known as Taylor's Lane road, located in Rathfarnham, Dublin, for a proposed new build development.

This report has been prepared in accordance with British Standards BS5930:2015 and BS10175:2011+A2:2017 and all normative references, including Land Contamination Risk Management guidance, Model Procedures for the Management of Land Contamination, adopted by local authorities as good practice in Scotland.

This investigation was undertaken in consideration of the Phase 1 Desk Study, to identify the prevailing ground conditions, potential soil contamination and to establish factors relevant to foundation design, potential remedial works and highlight abnormalities in respect of engineering properties of the substrata.

This report is based upon facts established by observation, excavation, and in-situ testing. It should be recognised that natural strata may vary considerably from point to point, and that man-made deposits may be subject to even greater random variation. Groundwater regime may be influenced by seasonal or other factors. While it is attempted in reporting to assess the likelihood and extent of such variations, conditions may nevertheless exist which remain undisclosed by the investigation.

This report has been prepared for MCCL and their professional advisors and may not be relied upon by a third party for any purpose without the written consent of this practice.

2.0 Proposed Development

It is understood that the MCCL proposed to re-develop the site to a Residential Nursing Home. The proposed development will include a multi-storey build, with accosiated access road, parking, green spaces and private gardens.

The proposed development intends to retain the existing entrance for the new development. There is a stream on site noted in the proposed site plan which is proposed to be utilised as a feature within the development.

The new build Nursing Home is a multi-storey build, including 90 bedrooms over the 3 storeys and 4 retirement cottages which will incorportate Newbrook House. Newbrook House will be carefully retained, protected and incorportated into the Nursing Home facility. Newbrook House is the listed build on site, located to the south-west of the site, which will be converting for Admin/ Visiting Lounge/ Dinning.

Below is an extract of the ground floor from the proposed site plan, a detailed proposed site plan is included in Appendix A.

3.0 Site Investigation

Exploratory positions have been advanced to provide information on baseline conditions across the site and to collect geotechnical information to assist in the design and construction of the development. An Exploratory Hole Location Plan is presented as in Appendix B.

3.1 General

A ground investigation was designed based on the findings of the desk study with exploratory holes advanced to target specific potential contaminant sources summarised in Phase 1. The following potential sources of contamination were identified on site and within 100m of the site boundary: builders' merchant, car garages, tanks, and car dealerships.

Table 1: Hazard Assessment – Source, Pathway, Receptor

Source	Potential Contamination of Concern		Potential Pathways	Receptor Group
The potential sources of contamination on site and within 100m of the site were considered: • builders' merchant • car garages • tanks • car dealerships • other unidentified potential contaminative sources	**Metals** • Arsenic • water soluble boron • cadmium • chromium • copper • lead • mercury • nickel • zinc **Inorganic** • total cyanide • organic matter • Sulphate Aqueous Extract as SO4 Others **Petroleum Hydrocarbon** • Aliphatic C5-C6 • Aliphatic C6-C8 • Aliphatic C8-C10 • Aliphatic C10-C12 • Aliphatic C12-C16 • Aromatic C5-C7 • Aromatic C7-C8 • Aromatic C8-C10 • Aromatic C10-C12 • Aromatic C12-C16 • Aromatic C16-C21 • Aromatic C21-C35	**PAHs** • Naphthalene • Acenaphthylene • Acenaphthene • Fluorene • Phenanthrene • Anthracene • Fluoranthene • Pyrene • Benzo(a)anthracene • Chrysene • Benzo(b)fluoranthene • Benzo(k)fluoranthene • Benzo(a)pyrene • Indeno(1,2,3-c,d)pyrene • Dibenzo(a,h)anthracene • Benzo(g,h,i)perylene • Total PAH - USEPA 16 **Asbestos** • Chrysotile • Amosite • crocidolite • anthophyllite • tremolite • actinolite	Others • Ingestion of contaminated soil • Ingestion of vegetables grown in contaminated soil • Entry of contaminants by skin or eye contact with contaminated soils or dust • Inhalation of contaminated dust • Inhalation or migration of toxic/ explosives gases/ vapours	Humans • Site users • Construction workers • Neighboring site users
			• Lateral Migration • Surface run-off Infiltration	Water Environment • Groundwater •Surface Water
			Direct contact or contaminants with building materials	Buildings, Materials and Services • Concrete • Plastic pipes & services

3.2 Site Work

Site work was conducted from the 14/12/20 to the 17/12/20, comprising boreholes, in-situ testing and sampling and standpipe installation, carried out generally in accordance with BS 10175 and BS 5930.

Eight window sample boreholes, designated WS01 to WS08, were sunk by cable percussion methods. The depths of the boreholes, descriptions of the strata encountered, and comments on the groundwater conditions, are given in the borehole records in Appendix C. Representative disturbed samples were taken in the various strata at the depths shown in the records. Standard penetration tests, SPT, were made at regular intervals. The values of penetration resistance are given in the borehole records in Appendix C.

Combined ground gas and groundwater monitoring standpipes were installed in all 8 of the boreholes, BH01-BH08. Details of the installations are given in the borehole records. The results are given in Appendix C.

In-situ California Bearing Ratio (CBR) tests were performed in CBR location DCP01, DCP02, DCP03, DCP04 and DCP05, in accordance with BS 1377, and the results are given in Appendix D.

The positions of the exploratory positions are as shown in the site plan in Appendix B.

3.3 Summary of Site Work

The ground conditions encountered during the investigation were in line with the expected geology in accordance with the BGS Geological Maps. Superficial deposits of boulder clay were encountered on site in all exploratory positions under made ground.

Table 2: Summary of Site Work

Location Hole	Date	Type	Method	Depth	Reason for Termination	Groundwater
WS01	17/12/20	Window Sample Borehole	Cable Percussion	0.00 – 3.00	Refusal	Dry
WS02	14/12/20			0.00 – 3.00	Refusal	Water Strike at 2.40m
WS03	15/12/20			0.00 – 3.00	Refusal	Dry
WS04	14/12/20			0.00 – 4.00	Refusal	Water Strike at 1.20m
WS05	15/12/20			0.00 – 2.80	Refusal	Water Strike at 1.00m
WS06	16/12/20			0.00 – 2.70	Refusal	Water Strike at 0.40m
WS07	16/12/20			0.00 – 2.80	Refusal	Dry
WS08	16/12/20			0.00 – 4.00	Refusal	Dry

Table 3: Summary of Site Installation

Location Hole	Potential Source/ Rational	Maximum Depth (m, bgl)	Monitoring Wells Response Zone (m, bgl)
WS01	Baseline Conditions & Ground Gas	3.00	0.40 – 3.00
WS02	Baseline Conditions & Ground Gas	3.00	0.90 – 3.00
WS03	Baseline Conditions & Ground Gas	3.00	0.90 – 3.00
WS04	Baseline Conditions & Ground Gas	4.00	0.40 – 1.50
WS05	Baseline Conditions & Ground Gas	2.80	0.90 – 2.80
WS06	Baseline Conditions & Ground Gas	2.70	0.40 – 1.50
WS07	Baseline Conditions & Ground Gas	2.80	0.90 – 2.80
WS08	Baseline Conditions & Ground Gas	4.00	0.50 – 4.00

The Ground Gas and Water Monitoring Results are included in Appendix C.

3.4 In-Situ Testing

3.4.1 Standard Penetration Test - Specification

In-situ geotechnical testing was conducted on site using Standard Penetration Tests (SPT).

3.4.2 Standard Penetration Test – Results

Table 4: Standard Penetration Test Results

Exploratory Hole Position	Start Depth	Strata Description	SPT 'N' Value	Consistency (Cohesive)
WS01	2.00	CLAY	15	Firm
	3.00	CLAY	50	Very Stiff
WS02	2.00	CLAY	18	Stiff
	3.00	CLAY	51	Very Stiff
WS03	2.00	CLAY	29	Stiff
	3.00	CLAY	50	Very Stiff
WS04	1.20	CLAY	6	Soft
	3.00	CLAY	28	Stiff
	4.00	CLAY	51	Very Stiff
WS05	1.20	CLAY	5	Soft
	2.80	CLAY	50	Very Stiff
WS06	2.00	CLAY	18	Stiff
	2.70	CLAY	50	Very Stiff
WS07	1.20	CLAY	10	Firm
	2.80	CLAY	50	Very Stiff
WS08	12	CLAY	12	Firm
	26	CLAY	26	Stiff
	50	CLAY	50	Very Stiff

4.0 Ground & Groundwater Conditions Encountered

4.1 Summary of Ground Conditions

A summary of the strata encountered are summarised below.

Table 5: Summary of Strata

Strata	Typical Description	Depth to Top (m)	Depth to Base (m)	Maximum Strata Thickness (m)
Topsoil	Topsoil	0.00	0.30	0.30
Made Ground	Bitmac	0.00	0.05	0.05
	Concrete paving slabs	0.00	0.10	0.10
	Gravel with low cobble content	0.05	0.15	0.10
	Gravelly topsoil	0.00	0.30	0.30
	Clayey gravel	0.00	0.30	0.30
	Concrete	0.15	0.35	0.20
	Sandy gravelly clay (with low cobble content & or rootlets)	0.30	0.80 – 1.00	0.70
	Sandy gravel with low cobble content	0.00 – 0.35	0.60 – 1.00	0.65
	Sandy gravelly clay with medium cobble content and brick fragments	0.80	1.50	0.70
	Sandy gravelly clay with rootlets	0.60	1.00	0.40
	Sandy gravelly clay with low cobble content	0.60	1.50	0.90
Superficial Deposits	Sandy gravelly CLAY with low cobbles content	0.30 – 1.50	2.40 – 3.00	2.20
	Sandy gravelly CLAY	0.90 – 3.00	2.00 – 4.00	2.10
Bedrock	Not Proven	-	-	-

The main elements of this succession are described in the following sections.

4.2 Made Ground

Made ground was encountered across the site in all exploratory positions excluding WS01. Made ground strata's were encountered to a maximum depth of 1.50m. Made ground strata's encountered varied from concrete, gravel and clay with various made components, including brick fragments.

4.3 Superficial Deposits

Superficial deposits of clay and boulder clay were encountered across the site. Clay was soft to very stiff, increasing in strength with depth, recorded as variations of sandy gravelly clay.

4.4 Bedrock

Bedrock was not encountered in any of the exploratory positions.

4.5 Groundwater

Groundwater strikes encountered in WS02, WS04, WS05 and WS06 between 0.40 – 2.40m.

4.6 Ecology & Archaeology

No areas of ecological or archaeological significance were identified from the Phase 1 Desk Study, site walkover or intrusive site investigation.

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5.0 Laboratory Testing

Soil samples destined for chemical analysis were collected in appropriate sampling containers. All samples were subsequently stored in cooled boxes prior to submission to analytical laboratory. The samples were collected using appropriate PPE and sampling equipment and a more detailed copy of sampling methodology and laboratory chain of custody forms can be provided upon request.

Samples were analysed by the lab, for potential sources of contamination on site. The nature of the analyses is detailed below:

Metals – arsenic, water soluble boron, cadmium, chromium, copper, lead, mercury, nickel, zinc

Inorganic – total cyanide, organic matter, Sulphate Aqueous Extract as SO4

Petroleum Hydrocarbon - Aliphatic C5-C6, Aliphatic C6-C8, Aliphatic C8-C10, Aliphatic C10-C12, Aliphatic C12-C16, Aromatic C5-C7, Aromatic C7-C8, Aromatic C8-C10, Aromatic C10-C12, Aromatic C12-C16, Aromatic C16-C21, Aromatic C21-C35

PAHs – Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-c,d)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, Total PAH - USEPA 16

Asbestos - chrysotile, amosite, crocidolite, anthophyllite, tremolite and actinolite

The Soil Analysis Laboratory results are included in Appendix D.

6.0 Environmental Risk Assessment

6.1 Contaminated Land

The statutory definition of contaminated land is given in the Environmental Protection Act 1990 and was introduced by the Environment Act 1995. It is land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of water environment is being caused, or there is a significant possibility of such pollution being caused.

6.2 Risk Assessment

The definition of contaminated land is based on the principle of risk assessment. Risk is defined as a combination of:

- the probability, or frequency of exposure to a substance with the potential to cause harm, and;
- the seriousness of the consequence.

6.3 Pollution Linkage

The basis of an environmental risk assessment involves identifying a 'source' of contamination, a 'pathway' along which the contamination may migrate and a 'receptor' at risk from the contamination.

Current legislation defines the various elements of the pollution linkage as:

- a contaminant is a substance which is in or under the ground and which has the potential to cause harm or to cause pollution of the water environment.
- a pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- a receptor is either a living organism, an ecological system, a piece of land or property, or the water environment.

A pollutant linkage indicates that all three elements have been identified.

The hazard identification and hazard assessment have been based upon the historical study, and form the initial conceptual model outlined in Phase 1.

6.4 Risk Estimation – Humans

The risk assessment has been based upon the guidelines for residential development without home-grown produce. The exposure assumptions for the main receptor in this case is based on a female child being exposed to the contaminant(s) within garden areas and indoors. Should any more sensitive end-use be envisaged, the assessment should be revised accordingly. The results of the soils analyses have been compared to the LQM/S4ULs, and the DEFRA C4SLs for lead, determined in accordance with current legislation and guidance. The comparison is tabulated below.

Soil samples were selected at the site engineer's discretion during the intrusive site investigation; during site work no odours or visual signs of any contamination were identified by the site engineer.

The Soil Laboratory Analysis Results are included in Appendix D.

Table 6: Soil Sampling Specification

Exploratory Location	Depth (m)	Soil Description
WS01	0.50	Clay
WS01	1.00	Clay
WS02	0.50	Made Ground: Clay
WS02	1.00	Clay
WS03	0.50	Made Ground: Clay
WS03	1.00	Clay
WS03	1.50	Clay
WS04	0.50	Made Ground: Gravel
WS04	1.00	Made Ground: Clay
WS04	1.50	Clay
WS05	0.30	Made Ground: Concrete/ Gravel
WS05	0.80	Made Ground: Gravel
WS05	1.20	Clay
WS06	0.50	Made Ground: Gravel
WS06	1.00	Clay
WS07	0.50	Made Ground: Gravel
WS07	1.00	Made Ground: Clay
WS08	0.50	Made Ground: Gravel
WS08	1.00	Clay
WS08	2.00	Clay

Table 7: Soil Contamination

Contaminant	LOD	Effect	Concentration Range (mg/kg)	Guidance Level (mg/kg)	No. Samples Tested	No. of Exceedances	Pass / Fail
Metals							
Arsenic	1.00	Toxic	14 to 56	40	20	1	Fail
Boron, Water Soluble	0.40	Toxic	<0.40 to 0.99	11000	20	0	Pass
Cadmium	0.50	Toxic	0.34 to 2.2	85	20	0	Pass
Chromium	0.50	Toxic	15 to 45	910	20	0	Pass
Copper	0.50	Toxic	22 to 360	7100	20	0	Pass
Lead	0.50	Toxic	15 to 910	310	20	2	Fail
Mercury	0.10	Toxic	<0.10 to 11	1.2	20	0	Pass
Nickel	0.50	Toxic	29 to 55	180	20	0	Pass
Zinc	0.50	Toxic	66 to 410	40000	20	0	Pass
Inorganic							
pH			8.4 to 10.8	-	20	0	Pass
Cyanide, Total	0.50	Toxic	<0.50 to 1.5	40	20	0	Pass
Organic matter %	0.40		<0.40 to 5.9	-	20	0	Pass
Sulphate Aqueous Extract as SO4 mg/l	0.010	Toxic	<0.010 to 0.060	-	20	0	Pass
Petroleum Hydrocarbons							
Aliphatic C5-C6	1.0	Toxic	<1.0 to <1.0	42	20	0	Pass
Aliphatic C6-C8	1.0	Toxic	<1.0 to <1.0	100	20	0	Pass
Aliphatic C8-C10	1.0	Toxic	<1.0 to <1.0	27	20	0	Pass
Aliphatic C10-C12	1.0	Toxic	<1.0 to <1.0	130	20	0	Pass
Aliphatic C12-C16	1.0	Toxic	<1.0 to <1.0	2400	20	0	Pass

Total Aliphatic Hydrocarbons			<5.0 to 270		20	0	Pass
Aromatic C5-C7	1.0	Toxic	<1.0 to <1.0	690	20	0	Pass
Aromatic C7-C8	1.0	Toxic	<1.0 to <1.0	1800	20	0	Pass
Aromatic C8-C10	1.0	Toxic	<1.0 to <1.0	110	20	0	Pass
Aromatic C10-C12	1.0	Toxic	<1.0 to <1.0	250	20	0	Pass
Aromatic C12-C16	1.0	Toxic	<1.0 to <1.0	2300	20	0	Pass
Aromatic C16-C21	1.0	Toxic	<1.0 to <1.0	1900	20	0	Pass
Aromatic C21-C35	1.0	Toxic	<1.0 to 130	1900	20	0	Pass
Total Aromatic Hydrocarbons	5.0	Toxic	<5.0 to 630		20	0	Pass
Total Petroleum Hydrocarbons	10.0	Toxic	<10.0 to 900		20	0	Pass
PAHs0							
Naphthalene	0.10	Toxic	<0.10 to 0.30	5.6	20	0	Pass
Acenaphthylene	0.10	Toxic	<0.10 to 0.35	4600	20	0	Pass
Acenaphthene	0.10	Toxic	<0.10 to <0.10	4700	20	0	Pass
Fluorene	0.10	Toxic	<0.10 to 0.11	3800	20	0	Pass
Phenanthrene	0.10	Toxic	<0.10 to 1.1	1500	20	0	Pass
Anthracene	0.10	Toxic	<0.10 to 0.43	35000	20	0	Pass
Fluoranthene	0.10	Toxic	<0.10 to 4.0	1600	20	0	Pass
Pyrene	0.10	Toxic	<0.10 to 4.6	210	20	0	Pass
Benzo(a)anthracene	0.10	Toxic	<0.10 to 2.5	14	20	0	Pass
Chrysene	0.10	Toxic	<0.10 to 5.8	31	20	0	Pass
Benzo(b)fluoranthene	0.10	Toxic	<0.10 to 3.3	4	20	0	Pass
Benzo(k)fluoranthene	0.10	Toxic	<0.10 to 1.2	110	20	0	Pass
Benzo(a)pyrene	0.10	Toxic	<0.10 to 2.2	3.2	20	0	Pass
Indeno(1,2,3-c,d)pyrene	0.10	Toxic	<0.10 to 1.4	46	20	0	Pass
Dibenzo(a,h)anthracene	0.10	Toxic	<0.10 to 0.65	0.32	20	1	Fail
Benzo(g,h,i)perylene	0.10	Toxic	<0.10 to 2.0	360	20	0	Pass
PAH - USEPA 16, Total	2.0	Toxic	<2.0 to 25	2100	20	0	Pass
Other							
Benzene	1.0	Toxic	<1.0 to <1.0		20	0	Pass
Toluene	1.0	Toxic	<1.0 to <1.0	880	20	0	Pass
Ethylbenzene	1.0	Toxic	<1.0 to <1.0	83	20	0	Pass
m & p-Xylene	1.0	Toxic	<1.0 to <1.0	79[1]	20	0	Pass
o-Xylene	1.0	Toxic	<1.0 to <1.0	88	20	0	Pass
Total Phenols	0.30	Toxic	<0.30 to <0.30		20	0	Pass
At 1% soil organic matter.							

From the soil analysis it has been found that contamination or potential sources of contamination were encountered, laboratory test results demonstrate values above SGV trigger values for residential development. Where the guideline value for any contaminant has been exceeded, remedial measures may be required.

6.5 Risk Estimation – Sulphate Assessment

Sulphate Assessment: Data is based on BS 8500-1 & 2 and BRE Special Digest 1, which covers a range of chemical aggressiveness.

Design Sulphate Class: DS-1 / ACEC-AC-1.

6.6 Risk Estimation – Asbestos

Table 8: Asbestos Contamination

Location	Depth (m)	Asbestos	Comment
WS01	0.50	None	N/A
WS02	0.50	None	N/A
WS03	0.50	None	N/A
WS04	0.50	None	N/A
WS05	0.30	None	N/A
WS05	0.80	None	N/A
WS06	0.50	None	N/A
WS07	0.50	None	N/A
WS08	0.50	None	N/A

Where the guideline value for any contaminant has not been exceeded, it may be removed from further consideration. It is concluded that in the absence of significant contamination, no remedial strategy is required.

6.7 Risk Estimation – Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report C665 (Assessing risks posed by hazardous ground gases to buildings, 2007).

Ground gas and water monitoring wells were installed in all exploratory borehole positions BH01-BH08. The borehole gas and groundwater response zones were selected to maximise the information that could be obtained from continual monitoring. The selection of borehole gas and groundwater response zones will allow for a comparison in ground gas and water monitoring results from natural and made ground.

The following risk criteria for ground gas generation potential has been extracted from CIRCIA C665 – Assessing Risk Posed by Hazardous Ground Gases to Buildings.

Table 9: Typical/idealised periods of monitoring (after Wilson et al, 2005)

		Generation Potential of Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of Development	Low (Commercial)	1 Month	2 Month	3 Month	6 Month	12 Month
	Moderate (Flats)	2 Month	3 Month	6 Month	12 Month	24 Month
	High (Residential with Gardens)	3 Month	6 Month	6 Month	12 Month	24 Month

Table 10: Typical/idealised frequency of monitoring (after Wilson et al, 2005)

		Generation Potential of Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of Development	Low (Commercial)	4	6	6	12	12
	Moderate (Flats)	6	6	9	12	24
	High (Residential with Gardens)	6	9	12	24	24

For a multi-storey residential development, the current guidance requires that a minimum total of six visits should be made over a two-month period, with a maximum of twenty-four visits being made over a 24-month period.

In accordance with CIRIA 665, the site was considered on a preliminarily basis to be classed as having a low generation potential. The site is considered to have a low generation potential due to the initial findings from the intrusive ground investigation.

For a multi-storey residential development, with a low generation potential the current guidance requires that a minimum total of 6 visits should be made over a minimum of a two-month period. Following the completion of the boreholes and ground gas and water monitoring installations a monitoring schedule was made, with the view to continually review the gas generation potential of the site. Ground gas and water monitoring was scheduled for 4 weekly visits followed by 2 bi-weekly visits.

The ground gas and water monitoring results will be added as an addendum to this report, along with any implicit revision of the GSV.

6.8 Risk Estimation – Phytotoxicity

The soil test results have been compared to BS 3882. From the soil analysis conducted the following SGV exceedances were found:

Table 11: Phototoxicity – Soil Contamination

Location	Depth (m)	Contamination	pH Value	Guidance Levels (mg/kg)	Concentration (mg/kg)
WS05	0.80	Arsenic	8.7	40	56
WS05	0.30	Lead	9.0	310	510
WS05	0.80	Lead	8.7	310	910
WS05	0.30	Dibenz(a,h)Anthracene	9.0	0.32	0.65

The soil on site would not be classed as suitable and remedial measures will be necessary.

6.9 Risk Evaluation – Human

It is considered that the site would be considered at this time as "contaminated land" by local authority.

The nature of the proposed development is classed as a residential development with green spaces, the site will be largely covered by the proposed build, hardstanding, and associated access road and parking and areas of soft landscaping. The proposed development is such that pathways from potential contaminants in the soil and groundwater to the human environment will be closed across much of the site. In areas of soft landscaping and garden areas there will remain a potential pathway between potential contaminant and receptor.

Potential exposure to contamination in the made ground may therefore arise during the construction phase or when the site is developed. During ground works remedial measures should be put in place to mitigate the risk of contamination affecting site workers and personnel from neighbouring sites or the public. These represent normal good practice for the construction industry and include:

- Informing the site workers of possible contamination on site and the potential health effects from exposure.

- The provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of contamination. It is considered that site workers should avoid dermal contact with the soil and water on site during construction, even when the material does not appear to be contaminated.
- Dust monitoring, and if necessary, suppression measures should be put into practice where potential contamination may become airborne, just as air mist.

Particular vigilance should apply in respect of the identification of any materials suspected to comprise or include asbestos fibres, consultation being made if necessary, with an appropriately licenced asbestos removal specialist.

It is further considered that remedial measures will be necessary to close off the pathway between potential contaminant and receptor.

7.0 Geotechnical Assessment

7.1 Foundation Design

It is presumed that finished site levels will not deviate significantly from the existing ground level, and we understand that the proposed FFL would typically be 200mm above existing ground level and that foundations will be placed at the shallowest convenient depth.

From a review of the proposed buildings development on site, the proposed 3 storey development would typically generate loads of approximately 80-100kN/m.

From inspection of the ground conditions, we would suggest a potential bearing capacity of the stiff clay in the order of 100-120kN/m2 and on this basis we would recommend reinforced concrete strip foundation as the most suitable foundation solution. It is considered foundations should be cast below the made ground in the natural stiff boulder clay. Alternatively, in areas where the stiff clay is encountered in deeper strata's, the concrete foundation solution could be cast on engineered fill upon the stiff clay.

7.2 Geotechnical Testing

7.2.1 In-situ California Bearing Ratio (CBR)

The results of the CBR tests are tabled below and are included in Appendix D.

Table 12: CBR Test Results

Test Pit No.	Sample Depth (mm bgl)		Depth bgl (mm)	CBR (%)
	Top of Layer	Base of Layer		
DCP01	0	205	29	8.5
	205	370	55	4.4
	370	890	33	7.6
DCP02	0	135	23	11
	135	540	68	3.5
	540	660	40	6.1
	660	695	12	23
	695	845	50	4.8
	845	900	7.9	34
DCP03	100	190	3.8	75
	190	320	10	23
	320	370	2.3	>100
	370	720	35	7
DCP04	100	160	3.2	90
	160	375	15	17
	375	425	3.3	85
	425	880	28	8.8
DCP05	100	190	9	30
	190	305	19	13
	305	875	32	7.8

From the CBR results an adoptable road would be approved by local council during an RCC application it will be necessary to design for a capping layer of 350mm below any areas of adoptable road.

7.2 Soakaways

With consideration of the site topography and the ground conditions encountered, cohesive glacial till, predominantly described as stiff clay, it is considered that soakaways are not a viable drainage solution for the proposed development and an alternative option will be require.

7.3 Ground Gas

The results from the ground gas and water monitoring will be added to this report as an addendum.

8.0 Revised Conceptual Site Model

8.1 Sources of Contamination

The results of laboratory tests, from the intrusive site investigation together with consideration of the conceptual and exposure models for the proposed development, suggest that the remediation strategy needs to address the presence of arsenic, lead and Dibenz(a,h)Anthracene. One 'hotspots' was identified within the investigation, located at WS05.

The results of the laboratory tests, from the intrusive site investigations together with consideration of the conceptual and exposure models for the proposed development, it is considered remedial measures are required.

8.2 Remediation Strategy

For the proposed development, the remediation strategy should address either the 'source' or 'pathway' within the pollutant linkage.

One possible solution might be the removal of the contamination sources. This would require risk management during the excavation of the soils to minimise the potential impact on ground-workers and neighbouring site users. The removal of the identified contaminated material will reduce the long-term liabilities associated with the site. If excavated contaminated material is to be relocated on site, a remediation scheme or material management plan must be agreed with the Planning Authority before the plan is implemented.

The contaminated area could be excavated to remove the contaminated material to a licenced landfill site. Removing the contaminated material from site will effectively remove any potential 'source' from the 'pathway' and 'receptor'.

If the source of contamination is not effectively removed or treated, measures are required to be taken to close off the pathway to potential receptors. In this instance the nature of the proposals suggests that large parts of the site will be covered by buildings, hard standing or hard landscaping. It is considered that the most appropriate option would be to cover the contaminated area covered by buildings, hard standing or hard landscaping, resulting in there being no pathway between the source of contamination and the human receptors by ingestion or dermal contact.

Alternatively, if the area is not to be covered by either building or hard standing, i.e. soft landscaping, a minimum capping layer of 600mm of inert 'clean' fill from a licensed approved contractor, is recommended as cover over any existing made ground. The capping layer should comprise 450mm or suitable subsoil and 150m of suitable topsoil.

To minimise the impact on future maintenance workers, where services are to be placed at a depth that puts them at or below the level of the source of contamination, it would be prudent to line the trenches and surround the services with clean inert material.

8.3 Management of unidentified Sources of Contamination

There is the possibility that other unidentified sources of contamination may be present on the site, which were not disclosed by the investigation. Should such contamination be identified or suspected during development or during any works on site, these should be dealt with accordingly.

- Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material and potential contaminant under consideration, this could be either a skip or a lined area.
- Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual assessment of the material, and sampling for verification purposes.
- As in the remedial strategy, if contaminated material is to be buried on site, measures are required to be taken to close off the pathway to potential receptors.
- The contaminated material may be covered by buildings or hard standing, as there is no pathway between the source of contamination and the human receptors.

Particular vigilance should apply in respect of the identification of any materials suspected to comprise or include asbestos fibres, consultation being made if necessary, with an appropriately licenced asbestos removal specialist.

8.4 Risk Management During Site Work

During ground works, some simple measures may have to be put in place to mitigate the risk of contamination affecting the site workers and the environment. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the potential risk of contamination on site and the potential health effects from exposure.
- Where appropriate, the provision of suitable PPE for workers who may be potentially impacted by working in areas of the contamination.
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating, or drinking without washing their hands first and moving away from the work site to a designated safe zone with appropriate welfare facilities.
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.
- Particular vigilance should apply in respect of the identification of any material suspected to comprise or include asbestos fibres, consultation being made if necessary, with an appropriately licenced asbestos removal specialist.

9.0 Risk Assessment

9.1 Assessment of Environmental Risks Methodology

The identification of potential pollutant linkages is a key aspect of the evaluation of potentially contaminated land. An approach based on CIRIA report C552 has been adopted. For each of the pollutant linkages, an estimate is made of the potential 'Severity of Risk' and the 'Probability of Risk Occurring'. These are then used for an overall qualitative evaluation of the level of risk, as defined below in tables taken from CIRIA report C552.

Table 13: Preliminary Risk Assessment – Severity of Risk

Risk factor	Typical Examples
Severe	Acute risks to human health. Major pollution of the water environment.
Medium	Chronic (long-term) risk to human health. Pollution of the water environment.
Minor	Damage to non-sensitive species or ecosystems, buildings or services.

Table 14: Preliminary Risk Assessment – Probability of Risk Occurring

Probability Rating	Description
High Likelihood	Pollutant linkage may be present, and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
Low Likelihood	Pollutant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

Table 15: Preliminary Risk Assessment – Risk rating Evaluation

		Severity		
		Severe	**Medium**	**Minor**
Probability	**High Likelihood**	Very High Risk	High Risk	Moderate/ Low Risk
	Likely	High Risk	Moderate Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/ Low Risk	Very Low Risk
	Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk

9.2 Risk Assessment

The following table details the potential risks associated with the various potential pollutant linkages identified through the assessment of the data collated in this report. The risk category should be reviewed if further information is made available or the environmental setting of the site changes, for example through a proposed change in the development layout or end use.

9.2.1 Risk Assessment – Water Receptor

Table 16: Preliminary Risk Assessment – Water Receptor

Source	Pathway	Receptor	Severity	Probability	Risk Rating	Comment
Potential Sources of Contaminants	Leaching and downward migration of contaminants in soils.	Made ground on the surface strata on site Subsoils in deeper strata	Medium	Low Likelihood	Low/ Moderate Risk	From the intrusive site investigation and chemical soil testing, potential contaminants were recorded. There is the possibility of encountering unidentified sources of contamination on the site, which were not disclosed by the investigation. There is also the possibility that this investigation uncovered and disclosed the full extent of contamination on site. On this basis the risk to groundwater beneath the site is low to moderate.
	Lateral groundwater migration Migration via man made pathways (services, service trench backfill) Surface water run off	Unnamed land drains/ ditches Local Water Features	Medium	Low Likelihood	Low/ Moderate Risk	As discussed above, the intrusive site investigation did record contamination on site and there may be further contaminated material on site yet undiscovered. Given the distance from the site to local water features the overall risk of substances derived from the site impacting these water courses is low to moderate.

9.2.2 Risk Assessment – Human Receptor

Table 17: Preliminary Risk Assessment – Human Receptor

Source	Pathway	Receptor	Severity	Probability	Risk Rating	Comment
Potential Sources of Contaminants	Soil Ingestion Dermal contact Inhalation of soil dust/ vapours Permeation/ corrosion of water supply pipes	Construction workers Future site users Neighboring site users	Severe	Low Likelihood	Moderate Risk	Contaminants within soil beneath the site were identified within the intrusive site investigation, it is considered that further unidentified contaminants may potentially be present beneath the site. Construction workers and site operatives should be made aware of the possibility of encountering contamination and a watching brief should be maintained during any excavation works undertaken at the site. Construction workers should also be provided with appropriate levels of PPE and follow personal hygiene protocols. The risk to construction workers and future site personnel is moderate.
	Consumption of home grown produce	Future site users	Medium	Unlikely	Low Risk	It is considered that the soil on site has exceeded guideline values for contaminants on site, based on the guideline for a residential property without home-grown produce. It is considered that there will not be home-grown produce on site, on this basis the risk is low.

10.0 Conclusion & Recommendations

10.1 Ground Conditions

Made Ground: encountered across the site in all exploratory positions excluding WS01. Made ground strata's were encountered to a maximum depth of 1.50m. Made ground strata's encountered varied from concrete, gravel and clay with various made components, including brick fragments.

Superficial Deposits: of clay and boulder clay were encountered across the site. Clay was soft to very stiff, increasing in strength with depth, recorded as variations of sandy gravelly clay.

Bedrock: Bedrock was not encountered in any of the exploratory positions.

Groundwater: Groundwater strikes were encountered in WS02, WS04, WS05 and WS06 between 0.40 – 2.40m.

Ecology & Archaeology: No areas of ecological or archaeological significance were identified from the Phase 1 Desk Study, site walkover or intrusive site investigation.

10.2 Geotechnical Assessment

Foundation Design: From a review of the proposed buildings development on site, the proposed 3 storey development would typically generate loads of approximately 80-100kN/m. From inspection of the ground conditions, we would suggest a potential bearing capacity of the stiff clay in the order of 100-120kN/m2 and on this basis we would recommend reinforced concrete strip foundation as the most suitable foundation solution. It is considered foundations should be cast below the made ground in the natural stiff boulder clay. Alternatively, in areas where the stiff clay is encountered in deeper strata's, the concrete foundation solution could be cast on engineered fill upon the stiff clay.

Soakaway Design: From the ground conditions encountered it can be concluded infiltration-based soakaways are unsuitable for this site, and alternative options will be required to deal with storm water and foul discharge.

Carriageway Design: From the CBR results an adoptable road would be approved by local council during an RCC application it will be necessary to design for a capping layer of 350mm below any areas of adoptable road.

Ground Gas: The results from the ground gas and water monitoring will be added to this report as an addendum.

Sulphate Assessment: Data is based on BS 8500-1 & 2 and BRE Special Digest 1, which covers a range of chemical aggressiveness.

Design Sulphate Class: DS-1 / ACEC-AC-1.

10.3 Contamination & Remediation

From the soil analysis it has been found that contamination or potential sources of contamination were encountered, contaminants demonstrate values above SGV trigger values for residential development. It is considered that the site would be considered at this time as "contaminated land" by local authority. It

is further considered that remedial measures will be necessary to close off the pathway between potential contaminant and receptor.

The results of laboratory tests, from the intrusive site investigation together with consideration of the conceptual and exposure models for the proposed development, suggest that the remediation strategy needs to address the presence of arsenic, lead and Dibenz(a,h)Anthracene. One 'hotspots' was identified within the investigation, located at WS05. One 'hotspots' was identified within the investigation, located at WS05.

It is considered that the most appropriate option would be to cover the contaminated area covered by buildings, hard standing or hard landscaping.

10.4 Revised Conceptual Site Model

Human Health: Contaminants within soil and groundwater beneath the site were identified within the intrusive site investigation, it is considered that unidentified contaminants may potentially be present beneath the site.

Construction workers and site operatives should be made aware of the possibility of encountering contamination and a watching brief should be maintained during any excavation works undertaken at the site. Construction workers should also be provided with appropriate levels of PPE and follow personal hygiene protocols. The risk to construction workers and future site personnel is moderate.

It is considered that the soil on site has exceeded guideline values for contaminants on site, based on the guideline for a residential property without home-grown produce. It is considered that there will not be home-grown produce on site. On this basis the risk is low.

Water Environment: From the intrusive site investigation and chemical soil testing, contaminants were recorded. There is the possibility of encountering unidentified sources of contamination on the site, which were not disclosed by the investigation. There is also the possibility that this investigation uncovered and disclosed the full extent of contamination on site. On this basis the risk to groundwater beneath the site is low to moderate.

Given the distance from the site to local water features the overall risk of substances derived from the site impacting these water courses is low to moderate.

11.0 REFERENCES

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Appendix A:
Proposed Site Plan

Holmes Miller

4801 - Newbrook House Luxury Suites

4801-SK-001 - SKETCH SITE LAYOUT

ACCOMMODATION SCHEDULE SUMMARY

NEW BUILD CARE HOME ELEMENT

	GIA(m²)	NO. OF BEDS
LEVEL 2	1300	32
LEVEL 1	1300	30
LEVEL 0	1307	28
TOTAL	3907	90

PROTECTED STRUCTURE CONVERSION

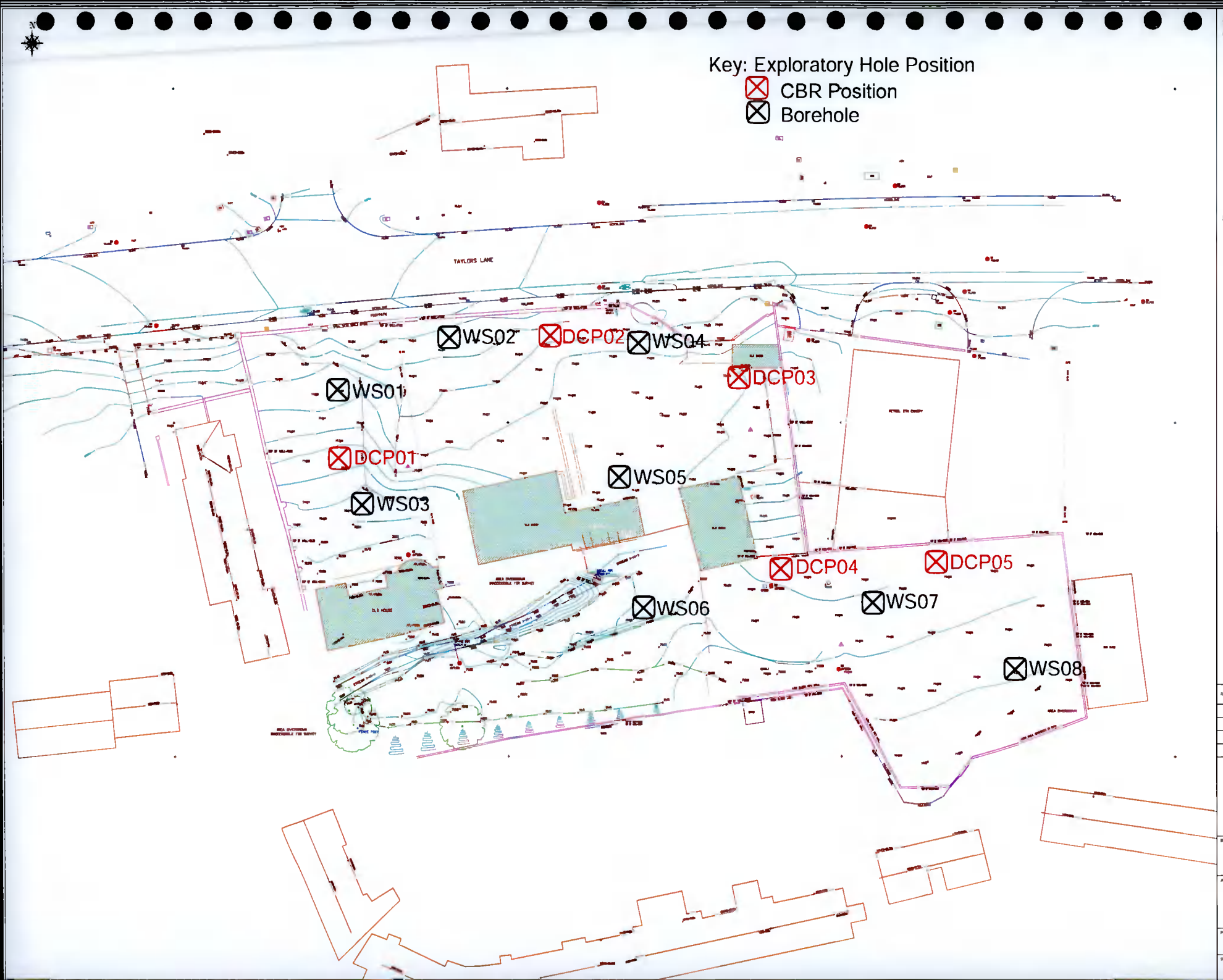
EXISTING LAYOUT TBC UPON BUILDING SURVEY
CURRENTLY PROPOSED ACCOMMODATION INCLUDES ADMINISTRATION OFFICES, VISITOR LOUNGE & DINING

RETIREMENT COTTAGES

4 NO. 2 BEDROOM COTTAGES AT 126m² EACH

ardmore point

Appendix B:
Exploratory Hole Location Plan



DATUM

BENCHMARK BASED ON ORDNANCE DATUM MALIN HEAD (OSGM02)
SURVEY GRID IS IRISH TRANSVERSE MERCATOR
Part Survey by GPS (VRS) with commensurate accuracies

REV SUFF	DATE	INIT	REVISION DETAILS
A	18/03/19	KOS	SURVEY TO REAR EXTENDED

Laser Surveys
SUITE 12, BLOCK 1, BROOMHALL BUSINESS PARK
RATHNEW CO WICKLOW
Tel 0404 61401 Fax 0404 61402
Mobile 087 236 4811 Email kevin@lasersurveys.ie

BUILDER/ARCHITECT

bba Architecture

JOB TITLE

Site Survey
Taylors Lane, Rathfarnham
Dublin

PROJECT No	SCALE	DATE
1902 905_ITM Survey_2D	1:250	05/03/19

SURVEYOR	DRAWN BY	DRAWING No	SHEET SIZE
KOS	CD	905_01_2D	A1

ardmore point

Appendix C:
Borehole Logs

July 2021
Issue 2

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham	Borehole ID
20-1358	Client: Ardmore Point	WS01
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 3.00 m	Start Date: 17/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	3.00	713969.97 E 727054.87 N	Elevation: mOD	End Date: 17/12/2020	Logger: MFG	Scale: 1:50 DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
								TOPSOIL
0.30 - 1.00	B4					0.30		Firm brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse.
1.00 - 2.00	B5							
1.20	U1	Ublow=74 100%		Dry				
2.00	D2							
2.00 - 2.45	SPT (S)	N=15 (2,3/3,4,3,5) Hammer SN = 0269		Dry				
2.50 - 3.00	B6					2.50		Very stiff black slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
3.00	D3					3.00		End of Borehole at 3.00m
3.00 - 3.45	SPT (S)	N=50 (8,11/12,12,13,13) Hammer SN = 0269		Dry				

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

Termination Reason: Terminated at refusal.

Last Updated: 18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham	Borehole ID
20-1358	Client: Ardmore Point	WS02
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 3.00 m	Start Date: 14/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	3.00	713991.66 E 727060.93 N	Elevation: mOD	End Date: 14/12/2020	Logger: MFG	Scale: 1:50 DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Gravelly TOPSOIL		
0.30 - 0.80	B3					0.30		MADE GROUND: Soft dark brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES1									
						0.80		Firm, becoming stiff, brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.		
1.00	ES2									
1.00 - 2.00	B4									
1.20	U8	Ublow=53 90%								
2.00	D6									
2.00 - 2.45	SPT (S)	N=18 (3,4/4,3,4,7) Hammer SN = 0269								
						2.40		Very stiff black slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
2.40 - 3.00	B5	Slight seepage at 2.40m								
3.00	D7					3.00		End of Borehole at 3.00m		
3.00 - 3.40	SPT (S)	N=51 (6,9/51 for 250mm) Hammer SN = 0269								

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter
2.40	2.40				

Remarks

Termination Reason

Terminated at refusal.

Last Updated

18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name	Borehole ID
20-1358	Taylor's Lane, Rathfarnham	WS03
	Client: Ardmore Point	
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	3.00	713980.99 E 727035.50 N

Final Depth:	3.00 m	Start Date:	15/12/2020	Driller:	JL
Elevation:	mOD	End Date:	15/12/2020	Logger:	MFG

Sheet 1 of 1
Scale: 1:50
DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.30 - 1.00	B3					0.30		MADE GROUND: Grey slightly clayey subangular to subrounded fine to coarse GRAVEL		
0.50	ES1							MADE GROUND: Soft brown slightly gravelly slightly sandy CLAY with rootlets. Sand is fine to coarse. Gravel is subrounded fine to medium.		
1.00 - 2.00	B4					1.00		Stiff, becoming very stiff, light brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.		
1.50	ES2									
2.00	D6									
2.00 - 3.00	B5									
2.00 - 2.45	SPT (S)	N=29 (3,4/3,7,8,11) Hammer SN = 0269		Dry						
3.00	D7					3.00		End of Borehole at 3.00m		
3.00 - 3.44	SPT (S)	N=50 (9,10/50 for 295mm) Hammer SN = 0269		Dry						

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

Termination Reason
Terminated at refusal.

Last Updated
18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham			Borehole ID
20-1358	Client: Ardmore Point			WS04
	Client's Rep:			

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 4.00 m	Start Date: 14/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	4.00	714019.53 E 727062.75 N	Elevation: mOD	End Date: 14/12/2020	Logger: MFG	Scale: 1:50 DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
						0.05		MADE GROUND: BITMAC
0.15 - 0.80	B4					0.15		MADE GROUND: Grey angular medium to coarse GRAVEL with low cobble content.
0.50	ES1							MADE GROUND: Grey slightly sandy angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular.
0.80 - 1.50	B5					0.80		MADE GROUND: Soft greyish brown slightly sandy gravelly CLAY with medium cobble content and fragments of red brick. Sand is fine to coarse. Gravel is subangular fine to coarse.
1.00	ES2							
1.20	D8							
1.20 - 1.65	SPT (S)	N=6 (1,2/2,1,1,2) Slight seepage at 1.20m		Dry		1.50		Soft brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine tom coarse.
1.50	ES3							
2.00	U11	Ublow=55 50%						
2.00 - 3.00	B6							
3.00	D9					3.00		Stiff black slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
3.00 - 4.00	B7							
3.00 - 3.45	SPT (S)	N=28 (5,5/7,7,7,7)		Dry				
4.00	D10					4.00		End of Borehole at 4.00m
4.00 - 4.45	SPT (S)	N=51 (7,12/12,13,13,13)		Dry				

Water

Backfill

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter
1.20	1.20				

Remarks

Termination Reason: Terminated at refusal.

Last Updated: 18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham	Borehole ID
20-1358	Client: Ardmore Point	WS05
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 2.80 m	Start Date: 15/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	2.80	714016.26 E 727042.32 N	Elevation: mOD	End Date: 15/12/2020	Logger: MFG	Scale: 1:50 DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
						0.05		MADE GROUND: BITMAC		
						0.15		MADE GROUND: Grey angular fine to coarse GRAVEL with high cobble content and fragments of red brick.		
0.30	ES1					0.35		MADE GROUND: CONCRETE		
0.35 - 1.00	B4							MADE GROUND: Grey slightly sandy angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular.		
0.80	ES2									
1.00 - 2.00	B5	Slight seepage at 1.0				1.00		Soft greenish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
1.20	D8									
1.20	ES3									
1.20 - 1.65	SPT (S)	N=5 (1,2/1,1,2,1) Hammer SN = 0269								
2.00	U7	Ublow=120 60%		Dry		2.00		Stiff black slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is angular fine to coarse.		
2.00 - 2.80	B6									
2.80	D9					2.80		End of Borehole at 2.80m		
2.80 - 3.13	SPT (S)	N=50 (25 for 82mm/50 for 250mm) Hammer SN = 0269								

Water Strikes				Casing Details		Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter	
1.00	1.00					

Termination Reason
Terminated at refusal.

Last Updated
18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham	Borehole ID
20-1358	Client: Ardmore Point	WS06
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 2.70 m	Start Date: 16/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	2.70	714017.45 E 727022.54 N	Elevation: mOD	End Date: 16/12/2020	Logger: MFG	Scale: 1:50 DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.00 - 0.60	B3							MADE GROUND: Grey slightly sandy angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular.
		Seepage at 0.						
0.50	ES1					0.60		
0.60 - 1.00	B4							MADE GROUND: Soft dark blackish brown sandy gravelly CLAY with rootlets. Sand is fine to coarse. Gravel is subrounded fine to medium.
1.00	ES2					1.00		
1.00 - 2.00	B5							Firm becoming stiff slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is angular fine to coarse.
1.20	U7	Ublow=66 100%						
2.00 - 2.70	B6							
2.00 - 2.45	SPT (S)	N=18 (4,5/4,4,5,5) Hammer SN = 0269						
2.70	D8					2.70		End of Borehole at 2.70m
2.70 - 2.98	SPT (S)	N=50 (30 for 82mm/50 for 200mm) Hammer SN = 0269						

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
0.40	0.40		

Casing Details

To (m)	Diameter

Remarks

Termination Reason

Terminated at refusal.

Last Updated

18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham	Borehole ID
20-1358	Client: Ardmore Point	WS07
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 2.80 m	Start Date: 16/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	2.80	714049.95 E				Scale: 1:50
				727025.37 N	Elevation: mOD	End Date: 16/12/2020	Logger: MFG	DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
						0.10		MADE GROUND: CONCRETE paving slabs.
0.50	ES1							MADE GROUND: Grey slightly sandy angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular.
0.60 - 1.00	B3					0.60		MADE GROUND: Soft black sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
1.00	ES2							
1.00 - 2.00	B4							
1.20	D6							
1.20 - 1.65	SPT (S)	N=10 (2,3/2,2,3,3) Hammer SN = 0269		Dry		1.50		Firm, becoming stiff, brown slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
2.80	B5					2.80		End of Borehole at 2.80m
2.80	D7							
2.80 - 3.19	SPT (S)	N=50 (27 for 145mm/50 for 245mm) Hammer SN = 0269		Dry				

Water | Backfill

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

Termination Reason: Terminated at refusal.

Last Updated: 18/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Taylor's Lane, Rathfarnham	Borehole ID
20-1358	Client: Ardmore Point	WS08
	Client's Rep:	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 4.00 m	Start Date: 16/12/2020	Driller: JL	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	4.00	714076.33 E				Scale: 1:50
				727015.02 N	Elevation: mOD	End Date: 16/12/2020	Logger: MFG	DRAFT

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
						0.10		MADE GROUND: CONCRETE paving slabs.		
0.40 - 0.90	B4							MADE GROUND: Brownish grey very sandy subangular fine to medium GRAVEL. Sand is fine to coarse.		
0.50	ES1					0.60		MADE GROUND: Soft blackish brown sandy gravelly CLAY with rootlets. Sand is fine to coarse. Gravel is subrounded fine to coarse.		
						0.90		Firm brownish green sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
1.00	ES2									
1.00 - 2.00	B5									
1.20	D8									
1.20 - 1.65	SPT (S)	N=12 (1,2/2,3,3,4) Hammer SN = 0269		Dry						
2.00	ES3									
2.00	U11	Ublow=83 100%								
2.00 - 3.00	B6									
3.00	D9					3.00		Stiff orangish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
3.00 - 4.00	B7									
3.00 - 3.45	SPT (S)	N=26 (7,7/6,6,7,7) Hammer SN = 0269		Dry						
4.00	D10					4.00		End of Borehole at 4.00m		
4.00 - 4.39	SPT (S)	N=50 (25 for 115mm/50 for 275mm) Hammer SN = 0269		Dry						

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

Termination Reason: Terminated at refusal.

Last Updated: 18/12/2020

AGS

ardmore point

Appendix D:
Soil Analysis Test Results

CAUSEWAY GEOTECH

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SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

21 January 2021

Project Name:	Taylor's Lane, Rathfarnham
Project No.:	20-1358
Client:	Ardmore Point

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s).

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Project Name: Taylor's Lane, Rathfarnham

Report Reference: Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report.

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	7
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	7
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	5

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – subcontracted to Pro Soils Limited *(UKAS 4043)*	Direct Shear Strength using 60mm Small Shearbox (up to 3 days)	BS 1377-7: 1990: Cl 4	7
	Extra over days (more than initial 3 days)		21
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	pH Value of Soil		7

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.	Project Name
20-1358	Taylor's Lane, Rathfarnham

Hole No.	Sample Ref	Top	Base	Type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
WS01	1	1.20		U	Brown sandy gravelly silty CLAY.			14.0	65	27 -1pt	16	11		CL
WS02	4	1.00	2.00	B	Brown sandy gravelly silty CLAY.			15.0	58	23 -1pt	15	8		CL
WS03	4	1.00	2.00	B	Brown sandy slightly gravelly silty CLAY.			16.0	70	31 -1pt	18	13		CL
WS04	5	0.80	1.50	B	Brown sandy slightly gravelly silty CLAY.			22.0	74	29 -1pt	18	11		CL
WS05	5	1.00	2.00	B	Brown sandy slightly gravelly silty CLAY.			21.0	53	29 -1pt	17	12		CL
WS06	5	1.00	2.00	B	Brown sandy slightly gravelly silty CLAY.			15.0	72	27 -1pt	16	11		CL
WS07	4	1.00	2.00	B	Brown sandy slightly gravelly silty CLAY.			19.0	82	36 -1pt	22	14		CI

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 4

Key

Density test | Liquid Limit | Particle density

Linear measurement unless | 4pt cone unless | sp - small pyknometer

wd - water displacement | cas - Casagrande method | gj - gas jar

wi - immersion in water | 1pt - single point test

Date Printed: 14/01/2021

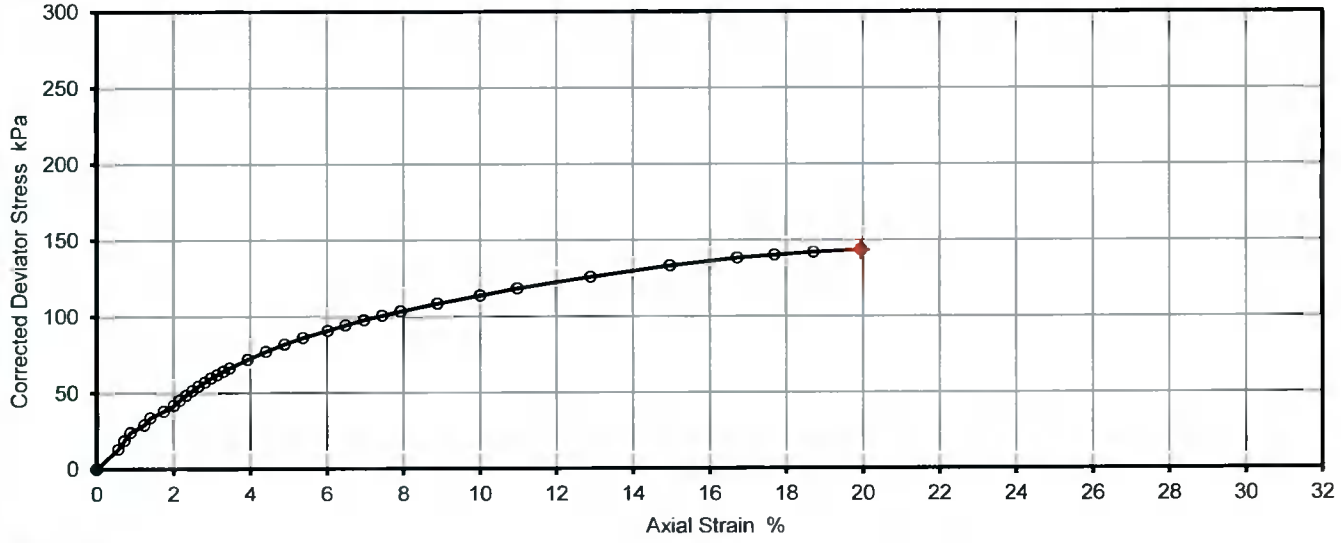
Approved By: Stephen.Watson

UKAS TESTING 10122

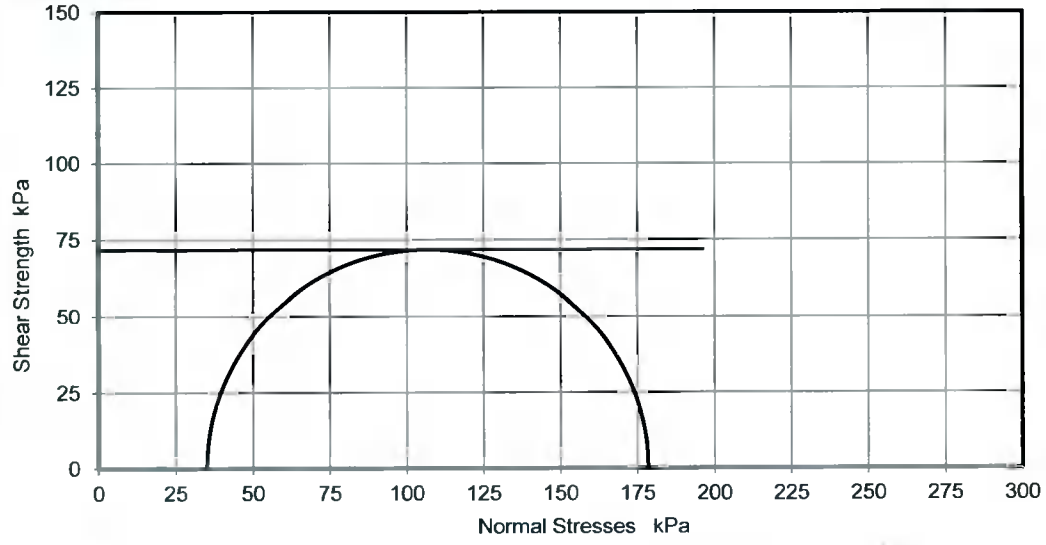
CAUSEWAY GEOTECH	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				Job Ref	20-1358
					Borehole/Pit No.	WS01
Site Name	Taylor's Lane, Rathfarnham				Sample No.	1
Soil Description	Brown sandy gravelly silty CLAY.				Depth	1.20
Specimen Reference	6	Specimen Depth	1.25	m	Sample Type	U
Specimen Description	Firm brown sandy gravelly silty CLAY.				KeyLAB ID	Caus2021010587
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	11/01/2021

Test Number		1	
Length		208.5	mm
Diameter		104.4	mm
Bulk Density		2.28	Mg/m3
Moisture Content		13.2	%
Dry Density		2.02	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		35	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	143	kPa
	Undrained Shear Strength, cu	72	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen.Watson

Printed: 14/01/2021 15:20

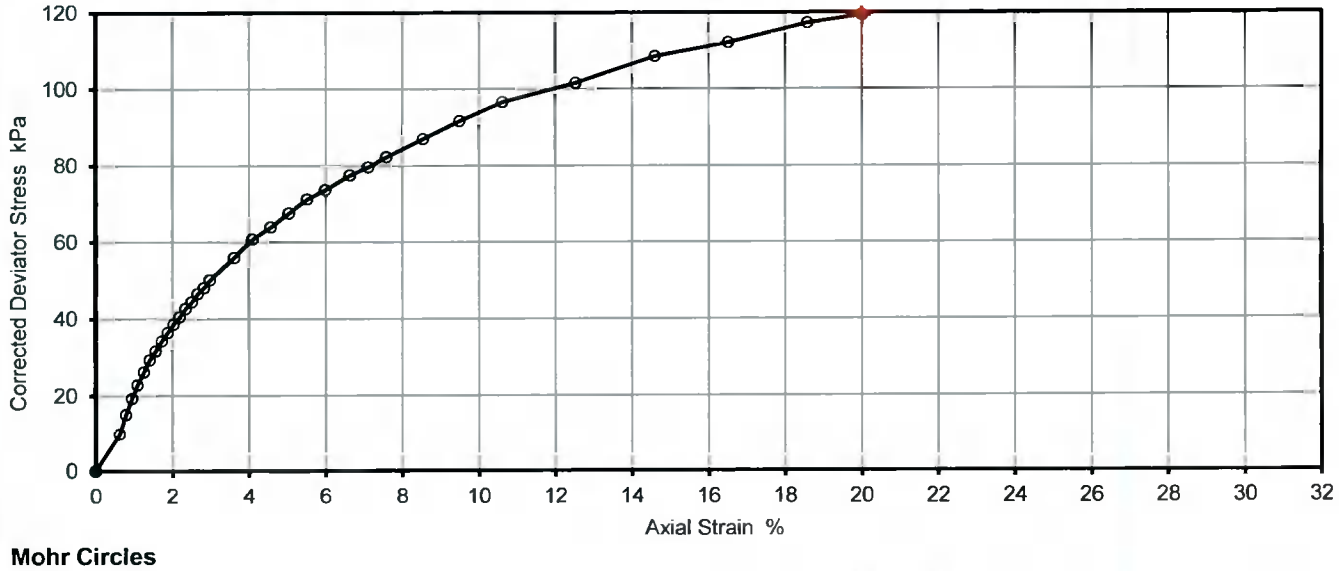
LAB 15R Version 4

UKAS TESTING
10122

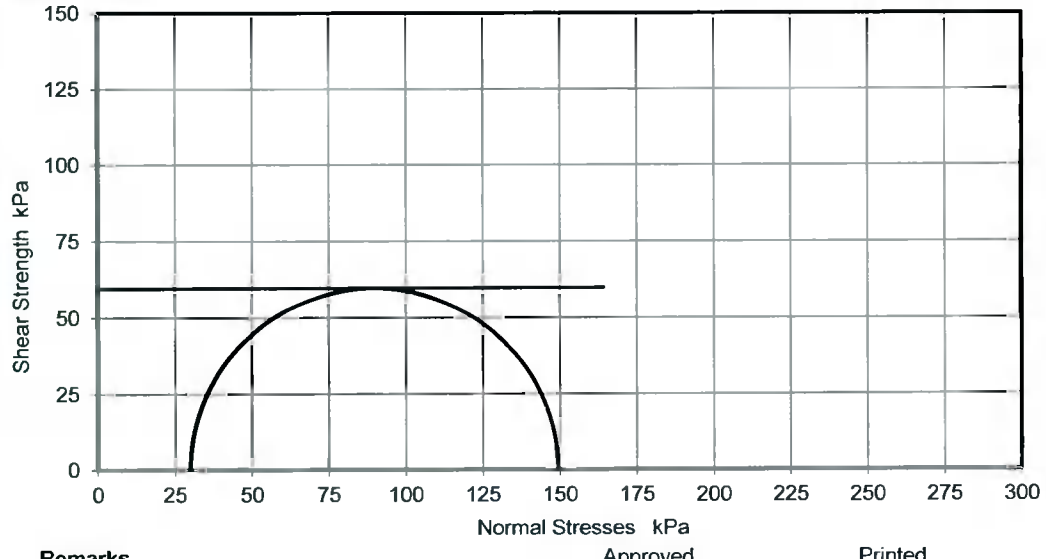
CAUSEWAY GEOTECH	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				Job Ref	20-1358
					Borehole/Pit No.	WS02
Site Name	Taylor's Lane, Rathfarnham				Sample No.	8
Soil Description	Brown sandy gravelly silty CLAY.				Depth	1.20
Specimen Reference	2	Specimen Depth	1.25	m	Sample Type	U
Specimen Description	Firm brown sandy gravelly silty CLAY.				KeyLAB ID	Caus2021010590
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	12/01/2021

Test Number		1	
Length		209.0	mm
Diameter		103.6	mm
Bulk Density		2.22	Mg/m3
Moisture Content		14.0	%
Dry Density		1.95	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		30	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	119	kPa
	Undrained Shear Strength, cu	60	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen.Watson

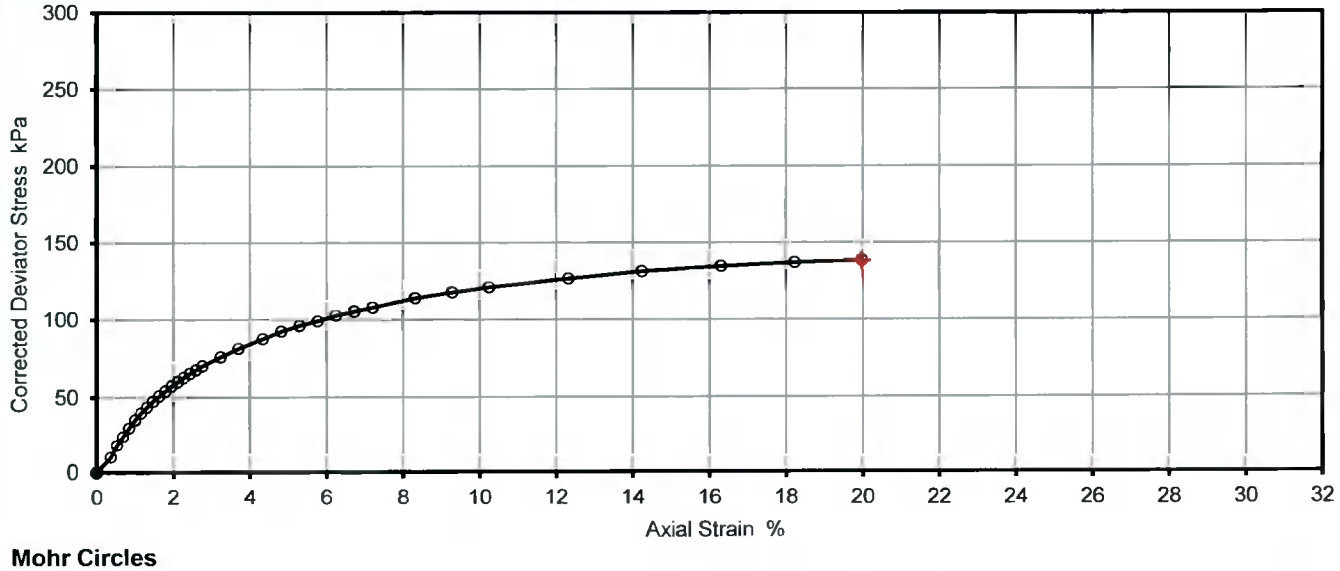
Printed: 14/01/2021 15:20

UKAS TESTING
10122

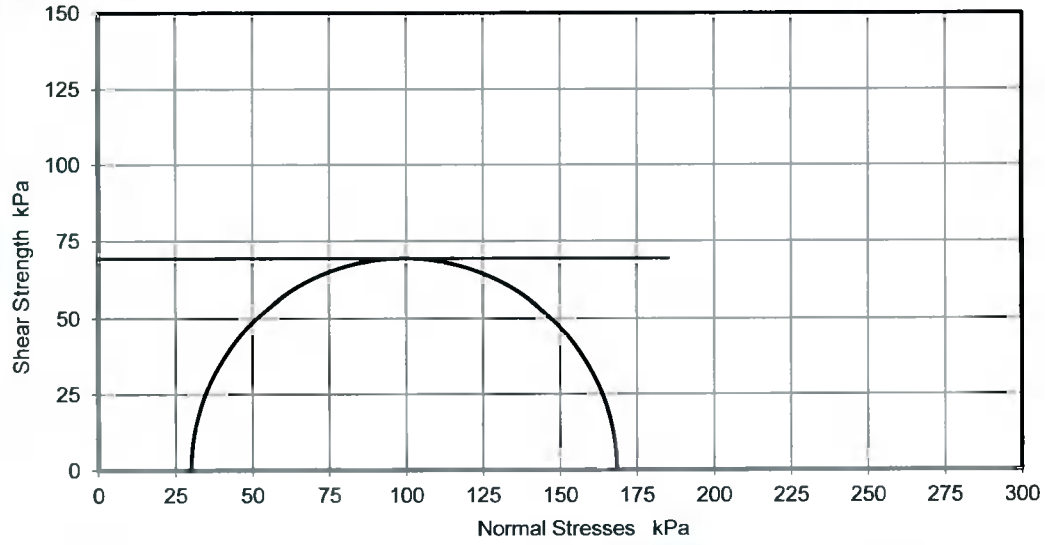
CAUSEWAY GEOTECH	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				Job Ref	20-1358
					Borehole/Pit No.	WS03
Site Name	Taylor's Lane, Rathfarnham				Sample No.	8
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth	1.20
Specimen Reference	2	Specimen Depth	1.25	m	Sample Type	U
Specimen Description	Firm brown sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus2021010592
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	12/01/2021

Test Number		1	
Length		208.7	mm
Diameter		103.8	mm
Bulk Density		2.27	Mg/m3
Moisture Content		14.1	%
Dry Density		1.99	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		30	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	138	kPa
	Undrained Shear Strength, cu	69	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen.Watson

Printed: 14/01/2021 15:20

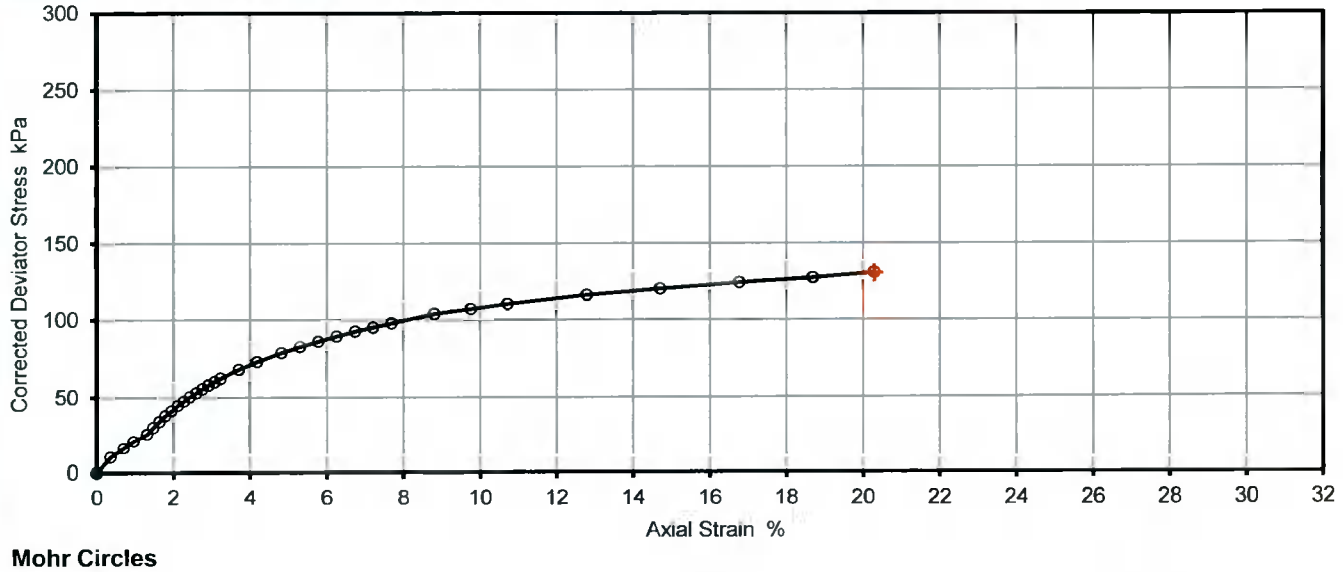
UKAS TESTING
10122

LAB 15R Version 4

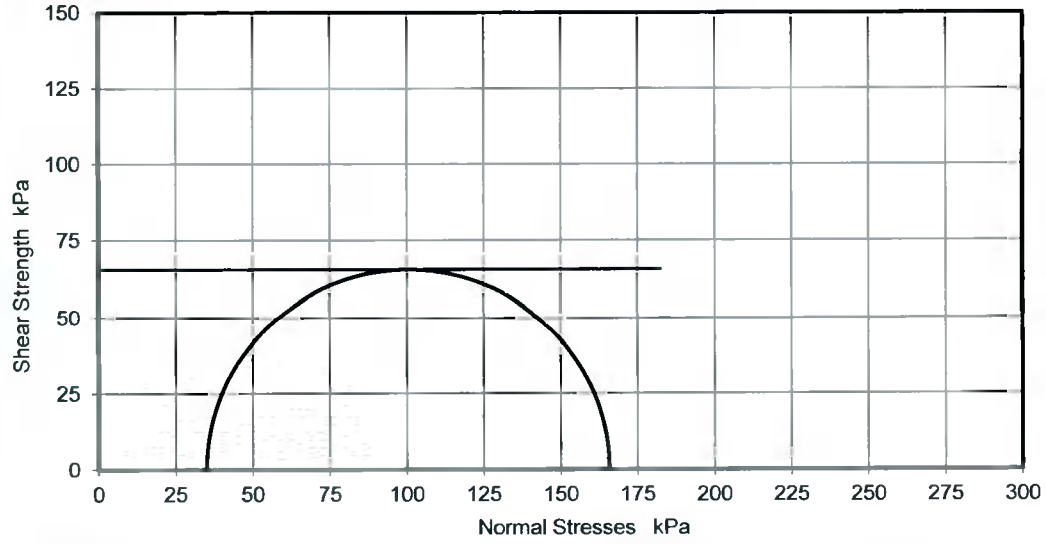
CAUSEWAY GEOTECH	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				Job Ref	20-1358
					Borehole/Pit No.	WS06
Site Name	Taylor's Lane, Rathfarnham				Sample No.	7
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth	1.20
Specimen Reference	2	Specimen Depth	1.25	m	Sample Type	U
Specimen Description	Firm brown sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus2021010599
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	12/01/2021

Test Number		1	
Length		208.9	mm
Diameter		104.0	mm
Bulk Density		2.32	Mg/m3
Moisture Content		15.0	%
Dry Density		2.02	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		35	kPa
At failure	Axial Strain	20.3	%
	Deviator Stress, (σ1 - σ3)f	131	kPa
	Undrained Shear Strength, cu	65	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen.Watson

Printed: 14/01/2021 15:20

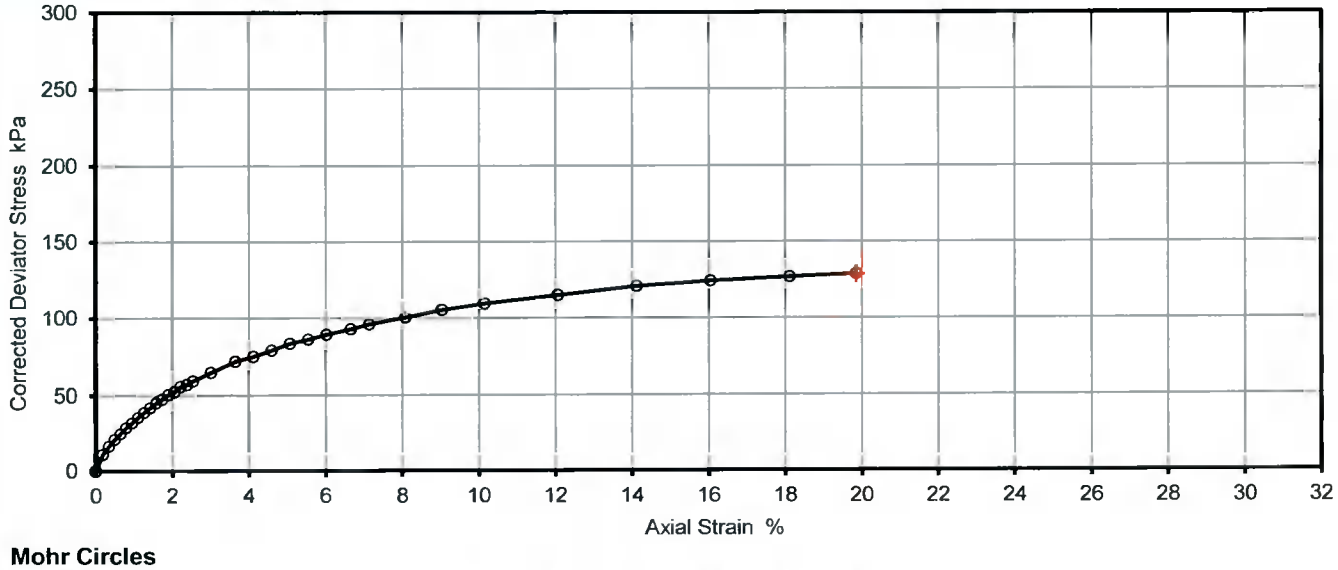
UKAS TESTING
10122

LAB 15R Version 4

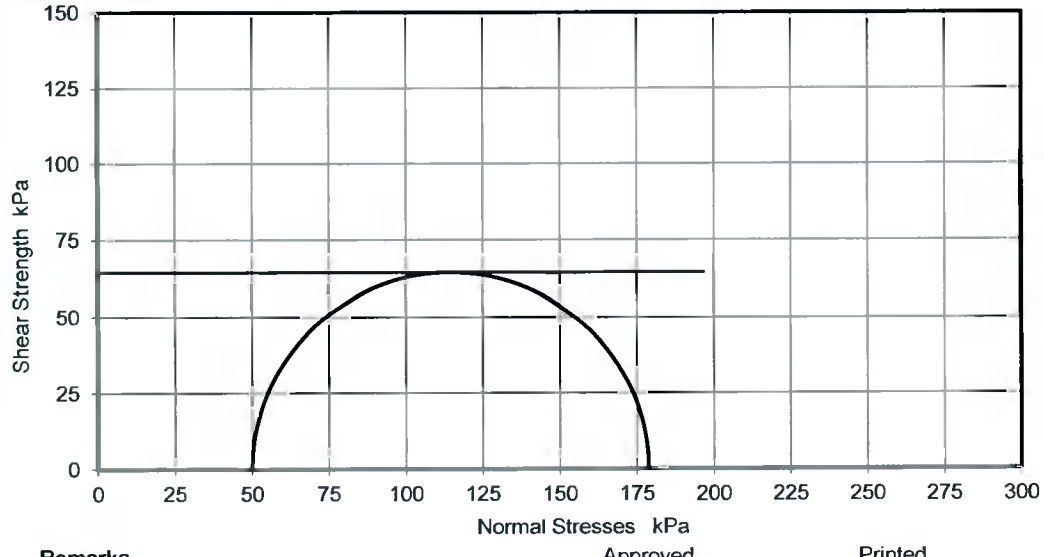
CAUSEWAY GEOTECH	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				Job Ref	20-1358
					Borehole/Pit No.	WS07
Site Name	Taylor's Lane, Rathfarnham				Sample No.	8
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth	2.00
Specimen Reference	2	Specimen Depth	2.05	m	Sample Type	U
Specimen Description	Firm brown sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus20210105102
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	12/01/2021

Test Number		1	
Length		209.2	mm
Diameter		104.2	mm
Bulk Density		2.26	Mg/m3
Moisture Content		13.0	%
Dry Density		2.00	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		50	kPa
At failure	Axial Strain	19.9	%
	Deviator Stress, (σ1 - σ3)f	129	kPa
	Undrained Shear Strength, cu	64	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen Watson

Printed: 14/01/2021 15:20

UKAS TESTING
10122

LABORATORY REPORT

4043

Contract Number: PSL21/0322

Report Date: 21 January 2021

Client's Reference: 20-1358

Client Name: Causeway Geotech
8 Drumahiskey Road
Ballymoney
Co.Antrim
BT53 7QL

For the attention of: Stephen Watson

Contract Title: Taylor's Lane, Rathfarnham

Date Received: 12/1/2021
Date Commenced: 12/1/2021
Date Completed: 21/1/2021

Notes: **Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins (Director)
R Berriman (Quality Manager)
S Royle (Laboratory Manager)

L Knight (Senior Technician)
S Eyre (Senior Technician)
H Daniels (Senior Technician)

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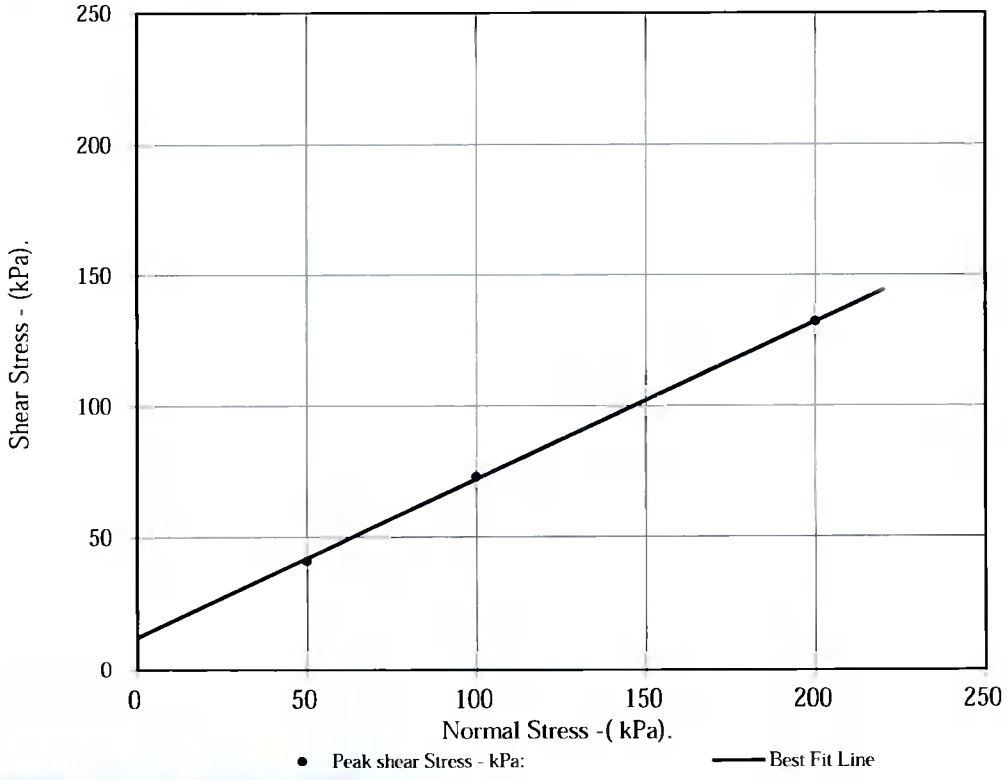
awatkins@prosoils.co.uk

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	WS01		Top Depth:	1.00
Sample Number:	5		Base Depth:	2.00
Sample Conditions:	Submerged		Sample Type	B
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort.			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	16	16	16
Bulk Density - Mg/m3:	2.14	2.14	2.14
Dry Density - Mg/m3:	1.84	1.84	1.84
Voids Ratio:	0.443	0.443	0.443
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	18.94	18.43	17.93
Shearing Stage			
Rate of Strain - mm/min	0.045	0.045	0.045
Displacement at peak shear stress - mm	2.71	3.61	4.51
Peak shear Stress - kPa:	41	73	132
Final Consolidated Conditions			
Moisture Content - %:	17	17	15
Bulk Density - Mg/m3:	2.26	2.33	2.39
Dry Density - Mg/m3:	1.93	1.99	2.07
Peak			
Angle of Shearing Resistance: (θ)	**31**		
Effective Cohesion - kPa:	**12**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

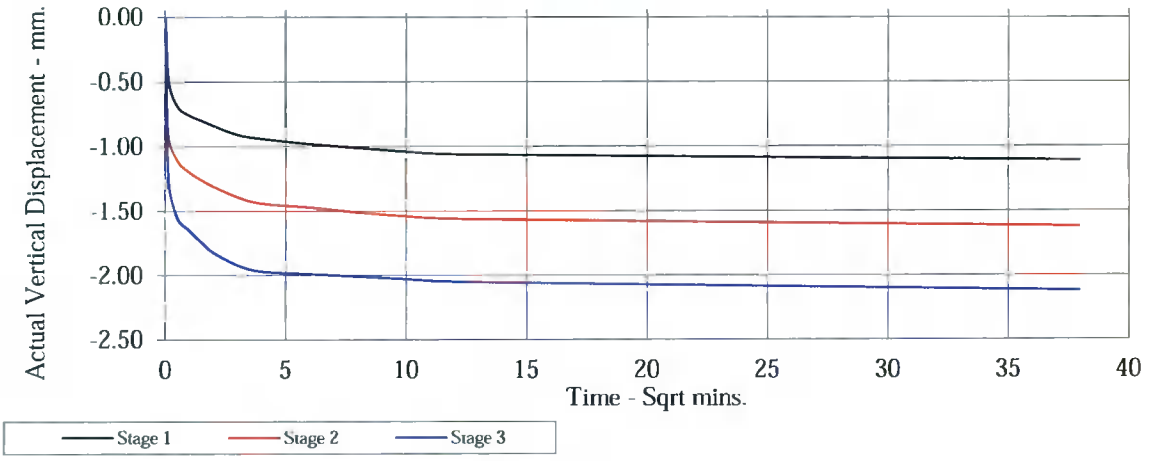
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

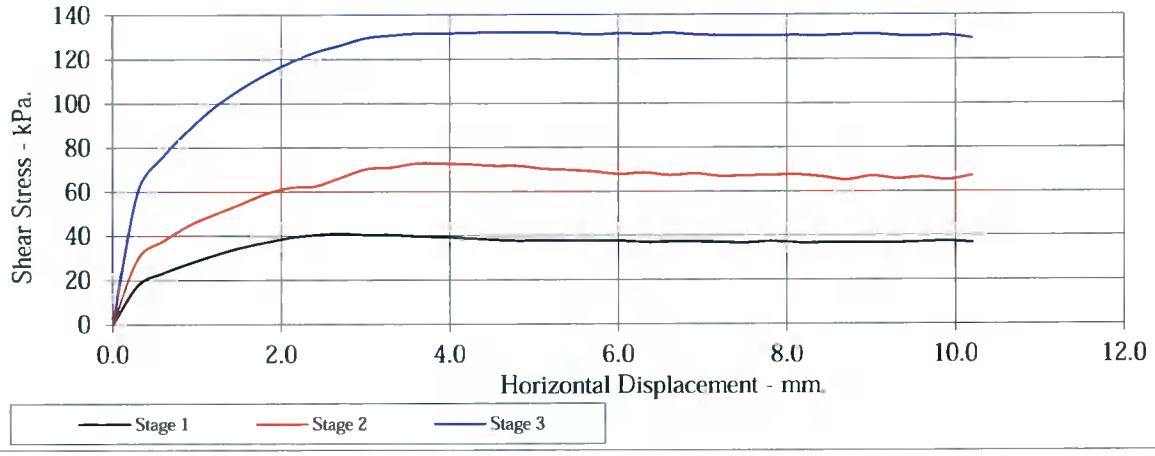
BS1377:Part 7:1990 Clause 4

Hole Number:	**WS01**	Top Depth:	**1.00**
Sample Number:	**5**	Base Depth:	**2.00**

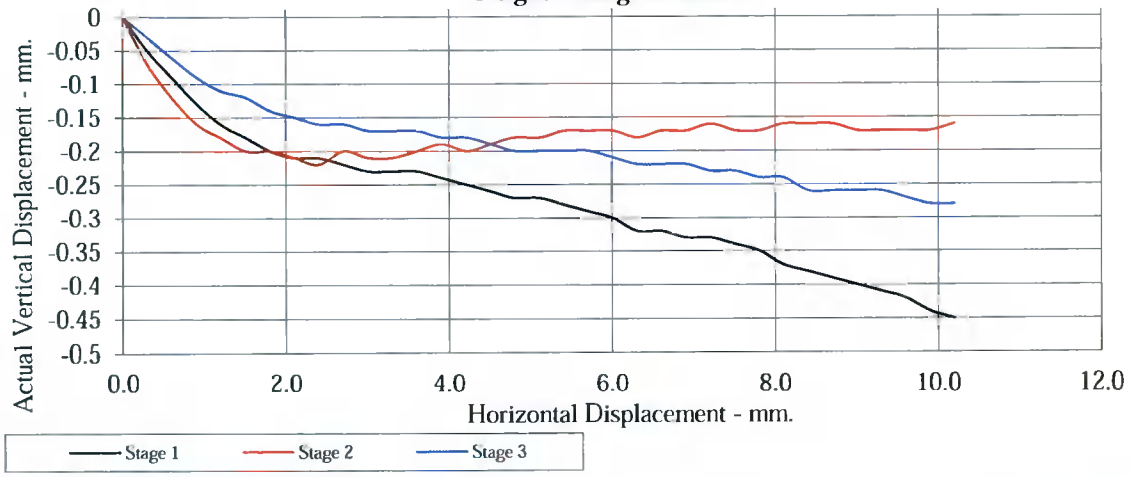
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

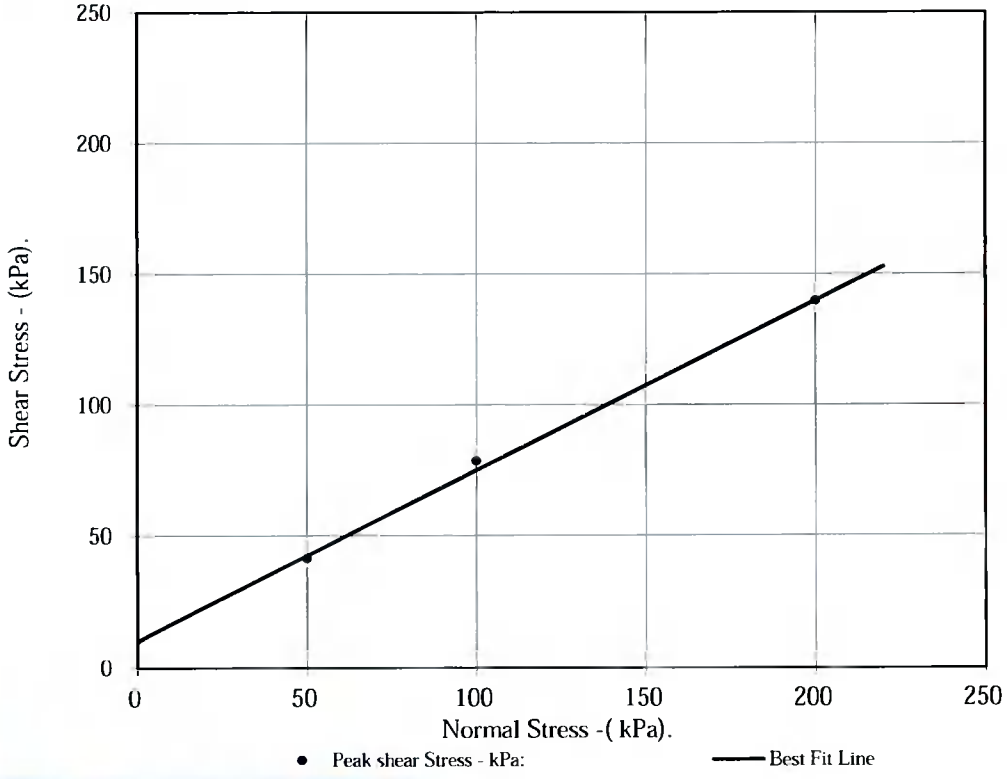
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	WS02		Top Depth:	1.00
Sample Number:	4		Base Depth:	2.00
Sample Conditions:	Submerged		Sample Type	B
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort.			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	12	12	12
Bulk Density - Mg/m3:	2.13	2.13	2.13
Dry Density - Mg/m3:	1.90	1.90	1.90
Voids Ratio:	0.394	0.394	0.394
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	19.03	18.26	18.03
Shearing Stage			
Rate of Strain - mm/min	0.045	0.045	0.045
Displacement at peak shear stress - mm	3.01	10.20	3.61
Peak shear Stress - kPa:	41	79	140
Final Consolidated Conditions			
Moisture Content - %:	15	15	14
Bulk Density - Mg/m3:	2.24	2.34	2.37
Dry Density - Mg/m3:	1.95	2.04	2.08
Peak			
Angle of Shearing Resistance: (θ)	**33**		
Effective Cohesion - kPa:	**10**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

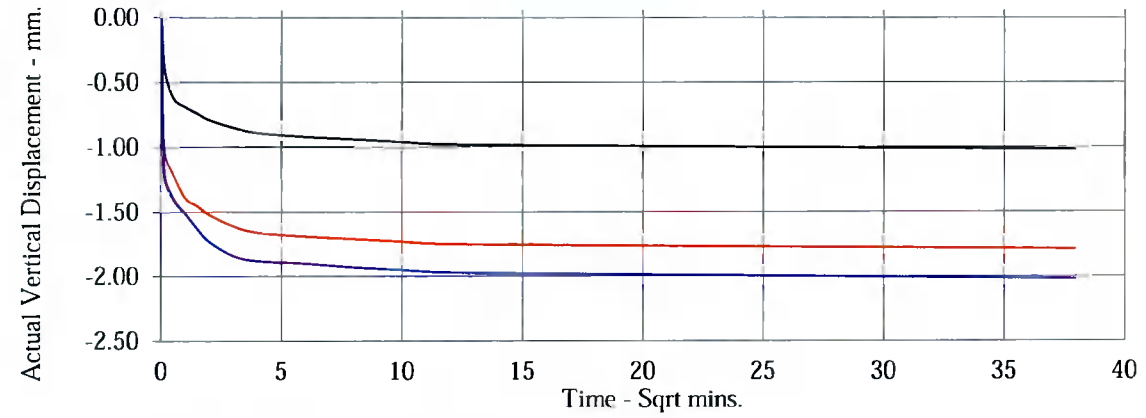
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

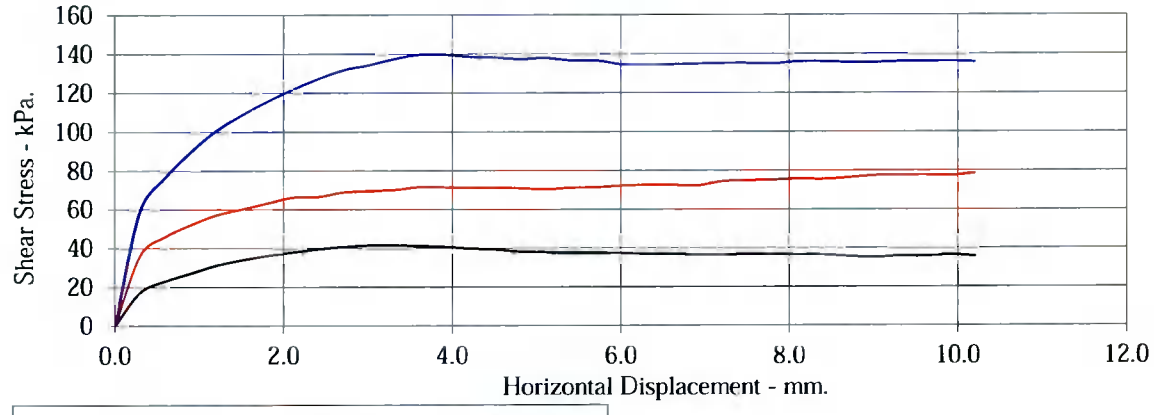
BS1377:Part 7:1990 Clause 4

Hole Number:	WS02	Top Depth:	1.00
Sample Number:	4	Base Depth:	2.00

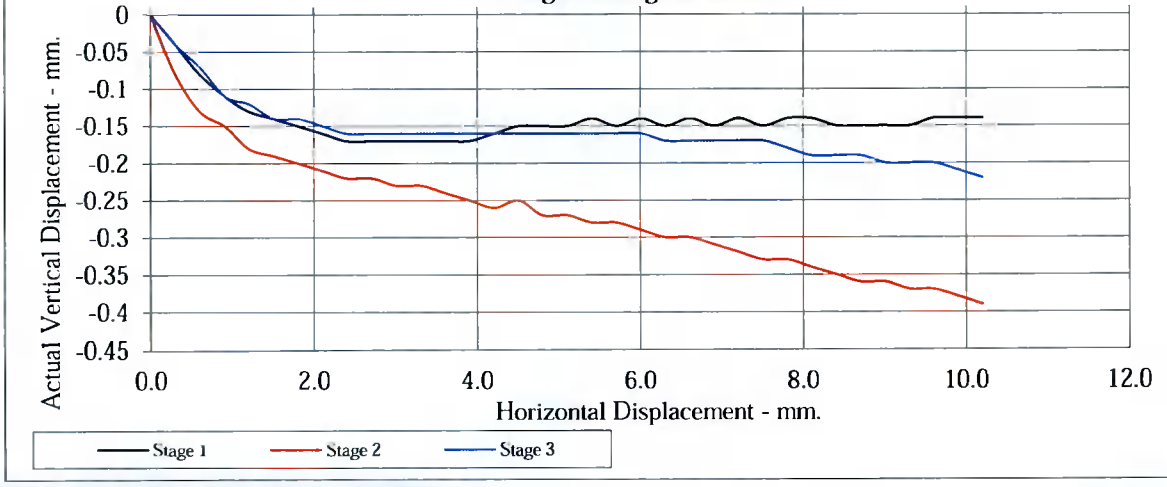
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

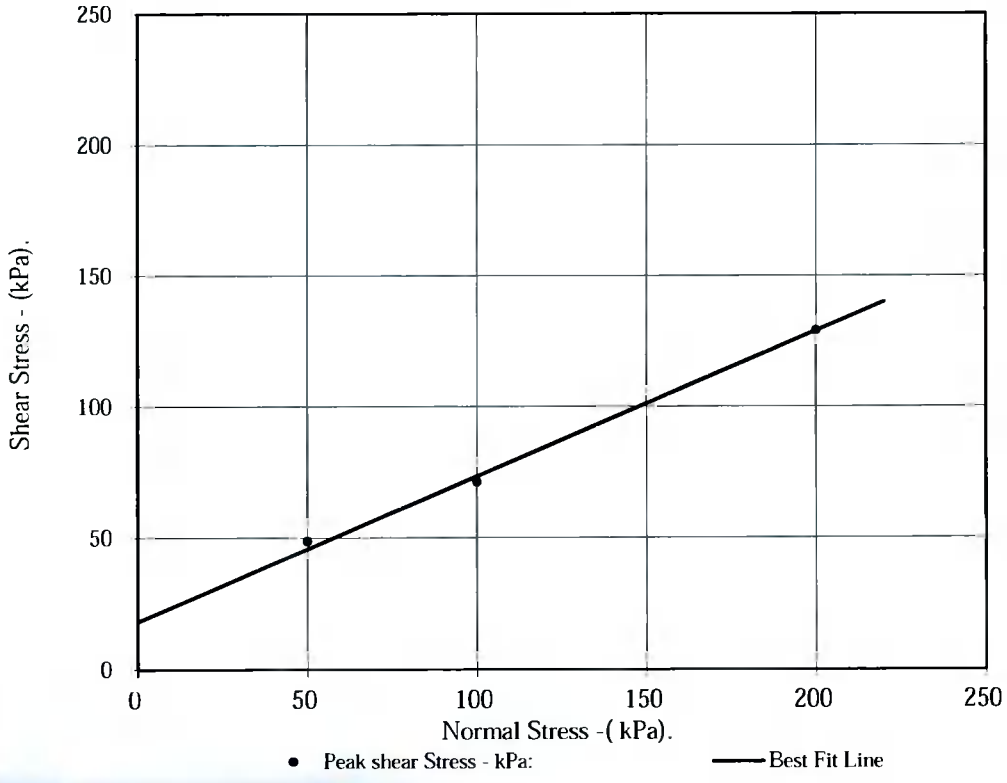
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	WS03		Top Depth:	1.00
Sample Number:	4		Base Depth:	2.00
Sample Conditions:	Submerged		Sample Type	B
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	1	2	3
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	18	18	18
Bulk Density - Mg/m3:	2.08	2.08	2.08
Dry Density - Mg/m3:	1.76	1.76	1.76
Voids Ratio:	0.503	0.506	0.506
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	19.73	19.22	18.60
Shearing Stage			
Rate of Strain (mm/min)	0.051	0.051	0.051
Displacement at peak shear stress (mm)	5.00	4.00	5.00
Peak shear Stress - kPa:	49	71	129
Final Consolidated Conditions			
Moisture Content - %:	19	19	18
Bulk Density - Mg/m3:	2.11	2.17	2.24
Dry Density - Mg/m3:	1.78	1.83	1.90
Peak			
Angle of Shearing Resistance: (θ)	**29**		
Effective Cohesion - kPa:	**18**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

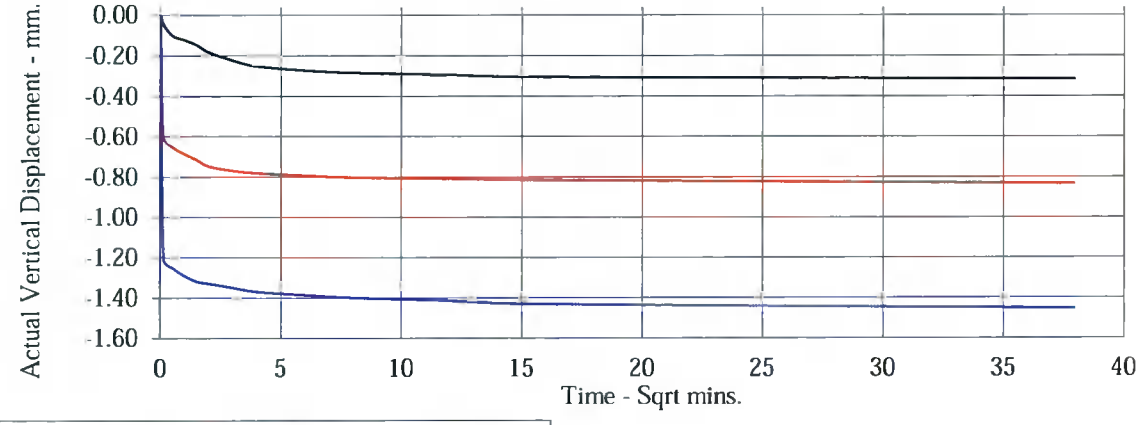
Contract No:
PSL21/0322
Client Ref:
21-1358

CONSOLIDATED DRAINED SHEARBOX TEST

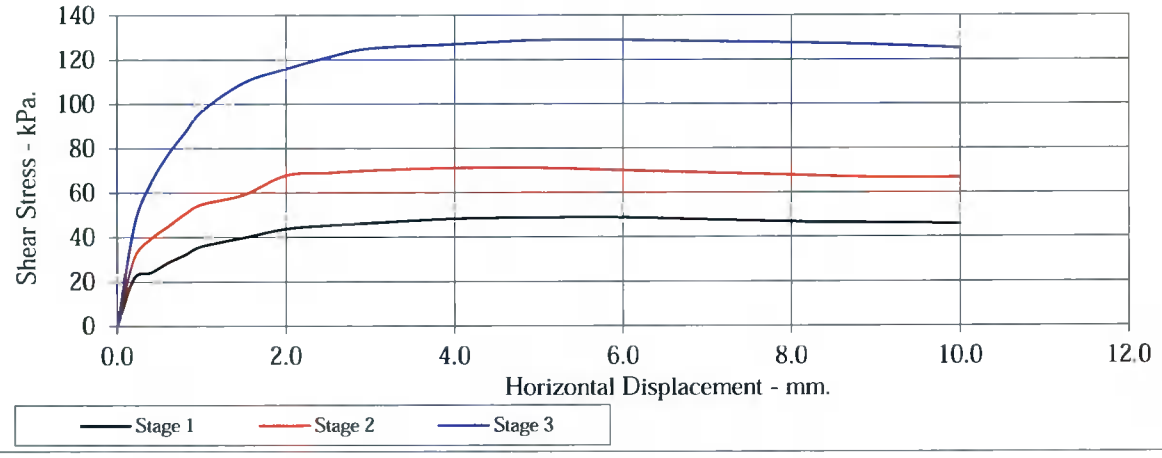
BS1377:Part 7:1990 Clause 4

Hole Number:	**WS03**	Top Depth:	**1.00**
Sample Number:	**4**	Base Depth:	**2.00**

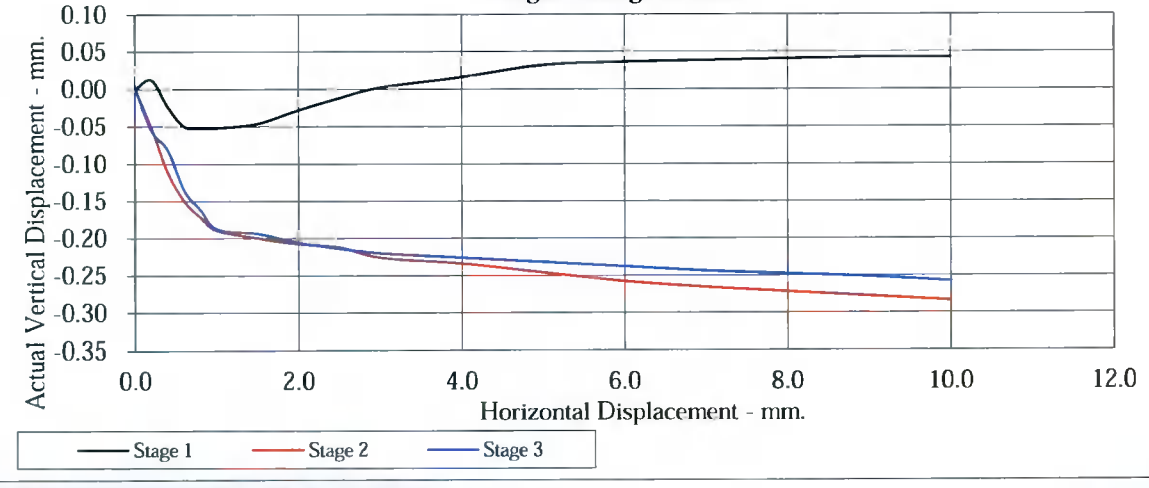
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

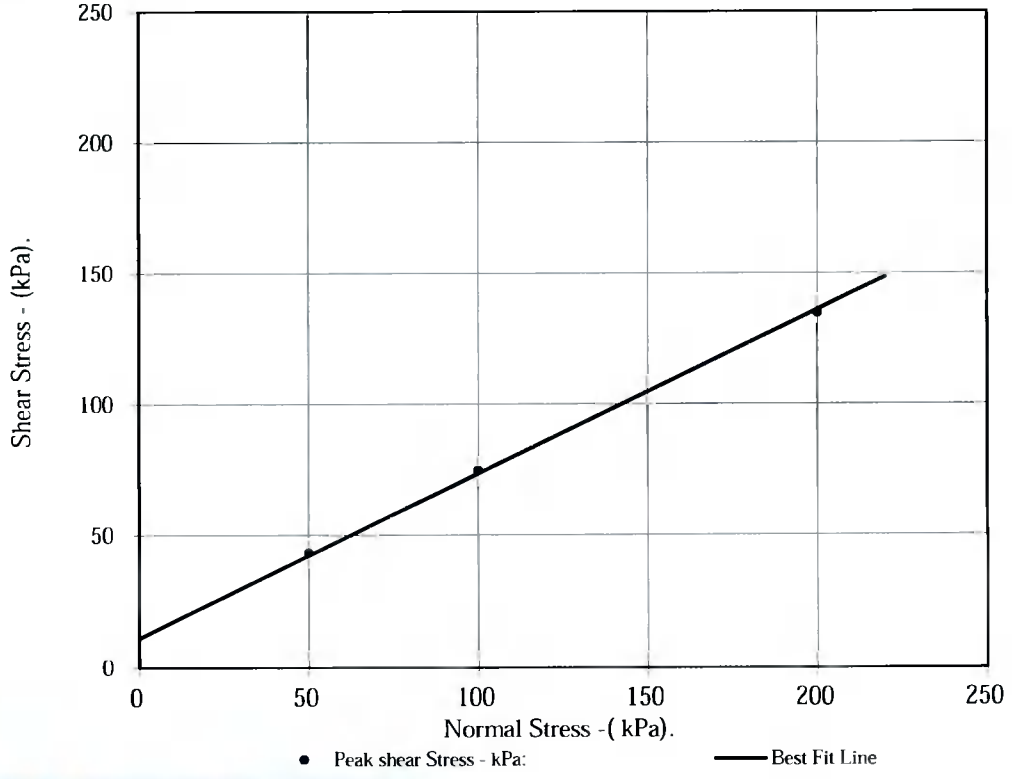
Contract No:
PSL21/0322
Client Ref:
21-1358

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	WS04		Top Depth:	0.80
Sample Number:	5		Base Depth:	1.50
Sample Conditions:	Submerged		Sample Type	B
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort.			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	19	19	19
Bulk Density - Mg/m3:	2.02	2.02	2.02
Dry Density - Mg/m3:	1.70	1.70	1.70
Voids Ratio:	0.559	0.559	0.559
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	18.72	17.90	17.74
Shearing Stage			
Rate of Strain - mm/min	0.048	0.048	0.048
Displacement at peak shear stress - mm	5.71	9.91	8.41
Peak shear Stress - kPa:	43	75	135
Final Consolidated Conditions			
Moisture Content - %:	21	20	18
Bulk Density - Mg/m3:	2.17	2.27	2.29
Dry Density - Mg/m3:	1.79	1.89	1.94
Peak			
Angle of Shearing Resistance: (θ)	**32**		
Effective Cohesion - kPa:	**11**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

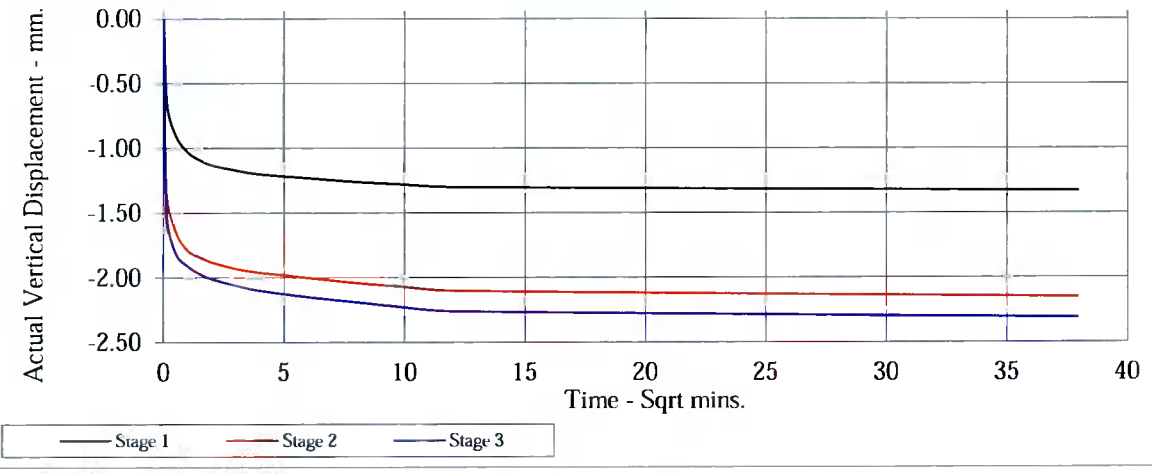
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

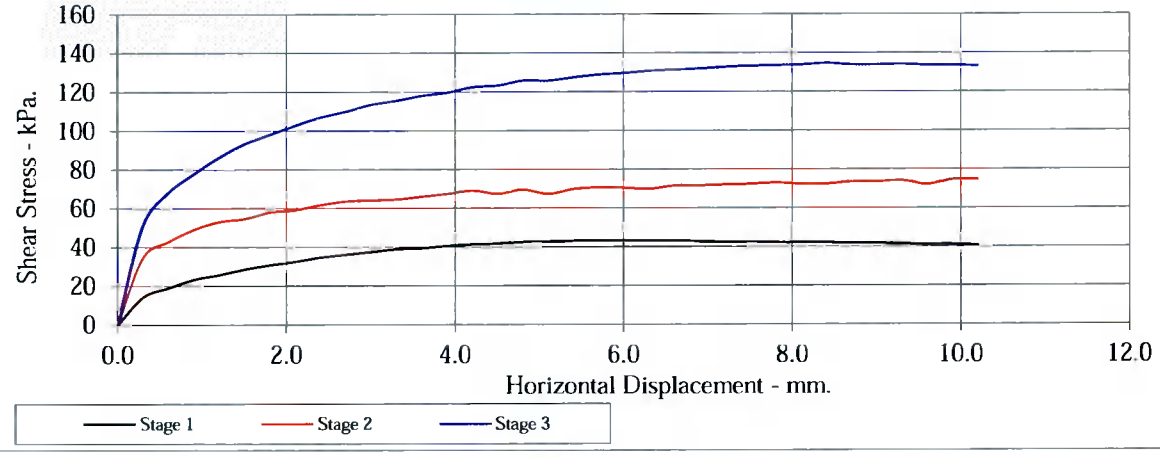
BS1377:Part 7:1990 Clause 4

Hole Number:	**WS04**	Top Depth:	**0.80**
Sample Number:	**5**	Base Depth:	**1.50**

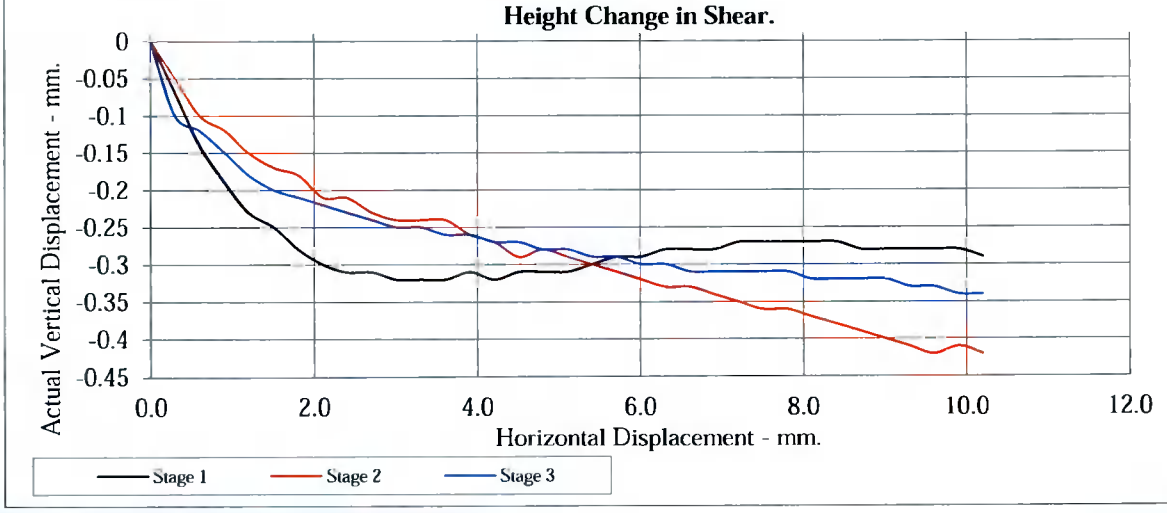
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

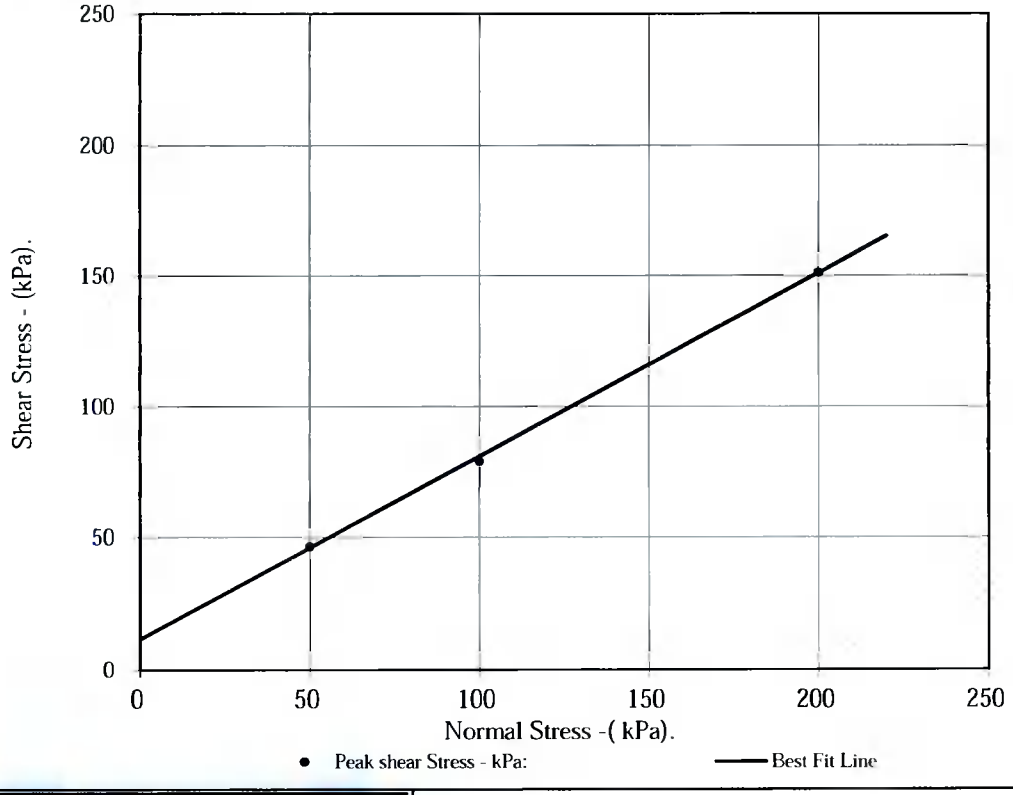
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	WS05		Top Depth:	1.00
Sample Number:	5		Base Depth:	2.00
Sample Conditions:	Submerged		Sample Type	B
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort.			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	21	21	21
Bulk Density - Mg/m3:	2.03	2.03	2.03
Dry Density - Mg/m3:	1.67	1.67	1.67
Voids Ratio:	0.584	0.584	0.584
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	19.29	18.94	18.08
Shearing Stage			
Rate of Strain - mm/min	0.044	0.044	0.044
Displacement at peak shear stress - mm	3.01	3.91	3.31
Peak shear Stress - kPa:	46	79	151
Final Consolidated Conditions			
Moisture Content - %:	23	22	20
Bulk Density - Mg/m3:	2.11	2.15	2.25
Dry Density - Mg/m3:	1.71	1.76	1.87
Peak			
Angle of Shearing Resistance: (θ)	**35**		
Effective Cohesion - kPa:	**11**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

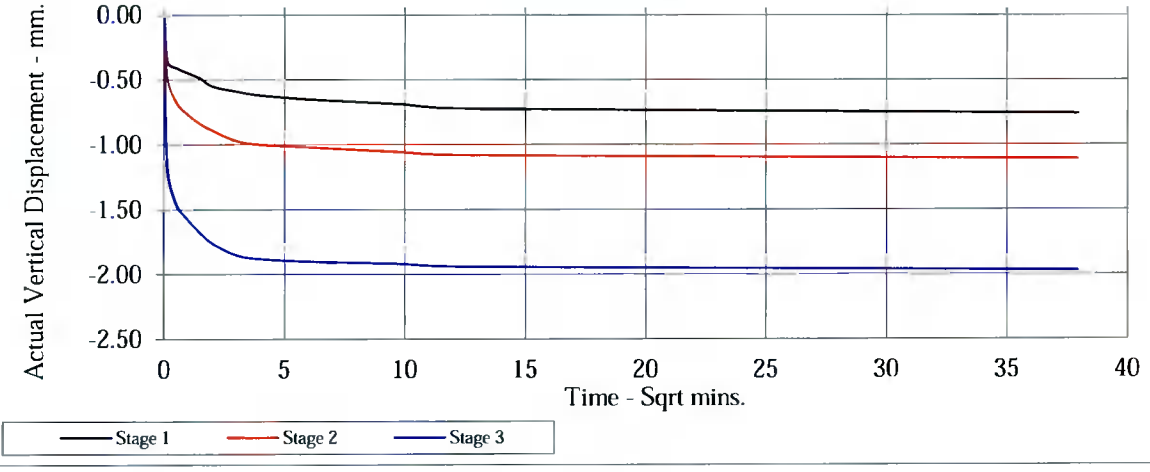
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

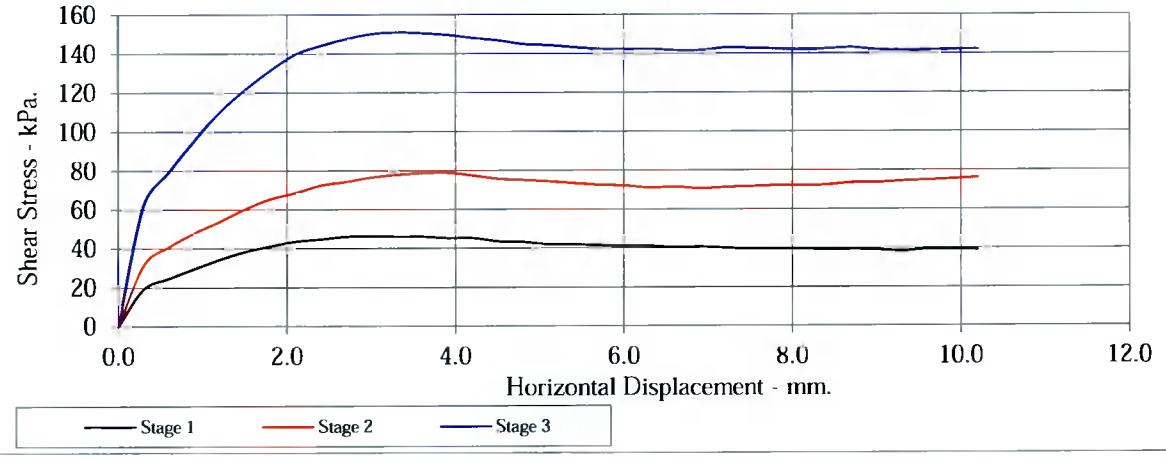
BS1377:Part 7:1990 Clause 4

Hole Number:	**WS05**	Top Depth:	**1.00**
Sample Number:	**5**	Base Depth:	**2.00**

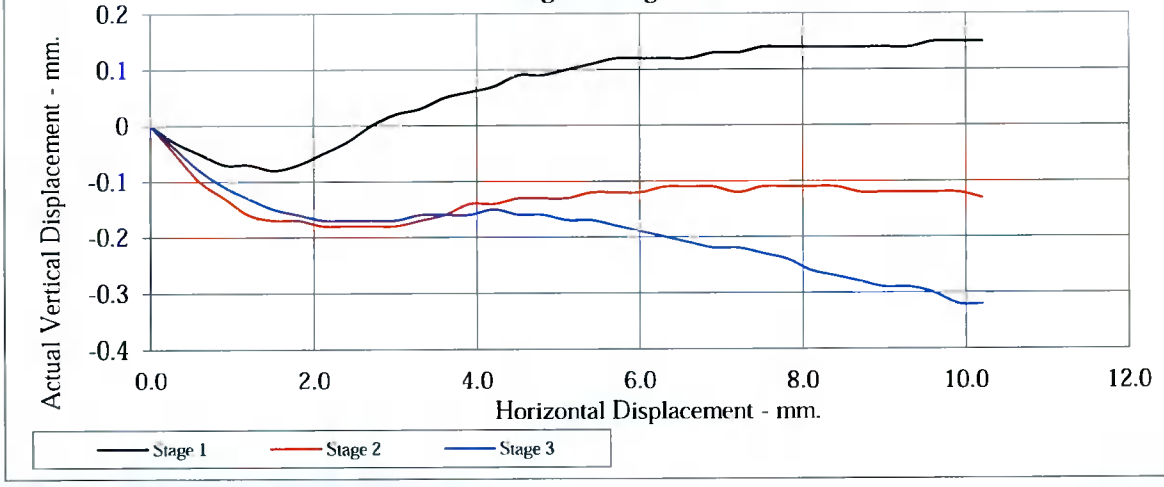
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

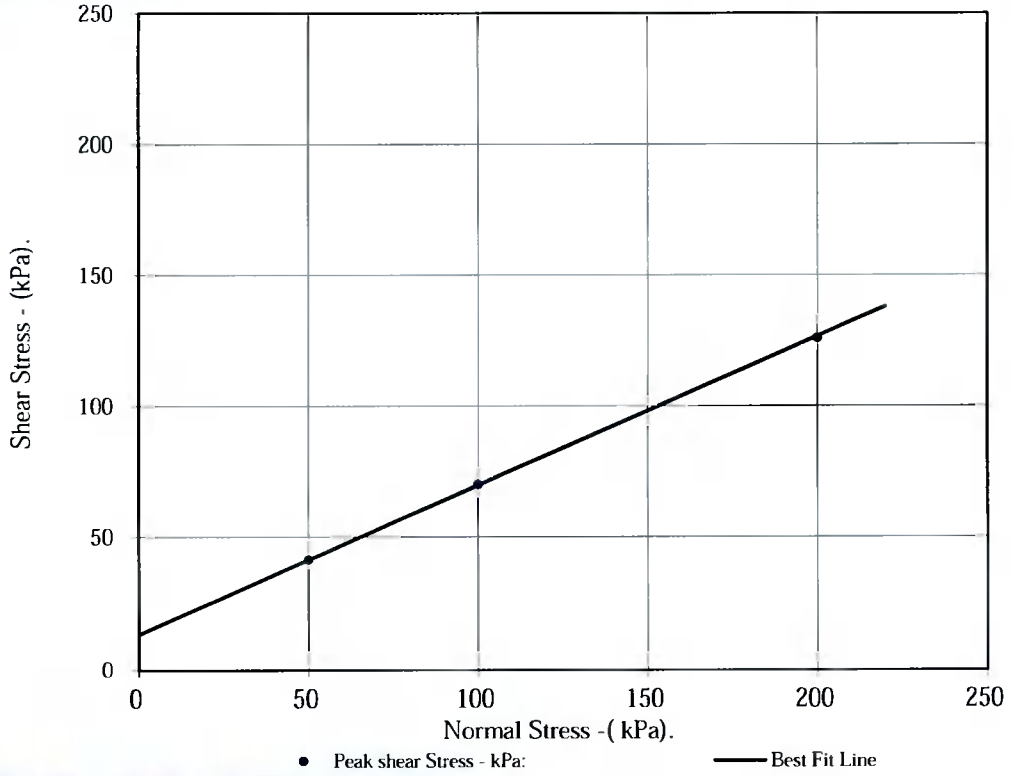
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	**WS06**		Top Depth:	**1.00**
Sample Number:	**5**		Base Depth:	**2.00**
Sample Conditions:	Submerged		Sample Type	**B**
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort.			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	15	15	15
Bulk Density - Mg/m3:	2.16	2.16	2.16
Dry Density - Mg/m3:	1.87	1.87	1.87
Voids Ratio:	0.415	0.415	0.415
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	18.97	18.04	17.74
Shearing Stage			
Rate of Strain - mm/min	0.050	0.050	0.050
Displacement at peak shear stress - mm	3.31	4.21	7.51
Peak shear Stress - kPa:	41	70	126
Final Consolidated Conditions			
Moisture Content - %:	16	16	15
Bulk Density - Mg/m3:	2.28	2.40	2.44
Dry Density - Mg/m3:	1.96	2.07	2.12
Peak			
Angle of Shearing Resistance: (θ)	**30**		
Effective Cohesion - kPa:	**13**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

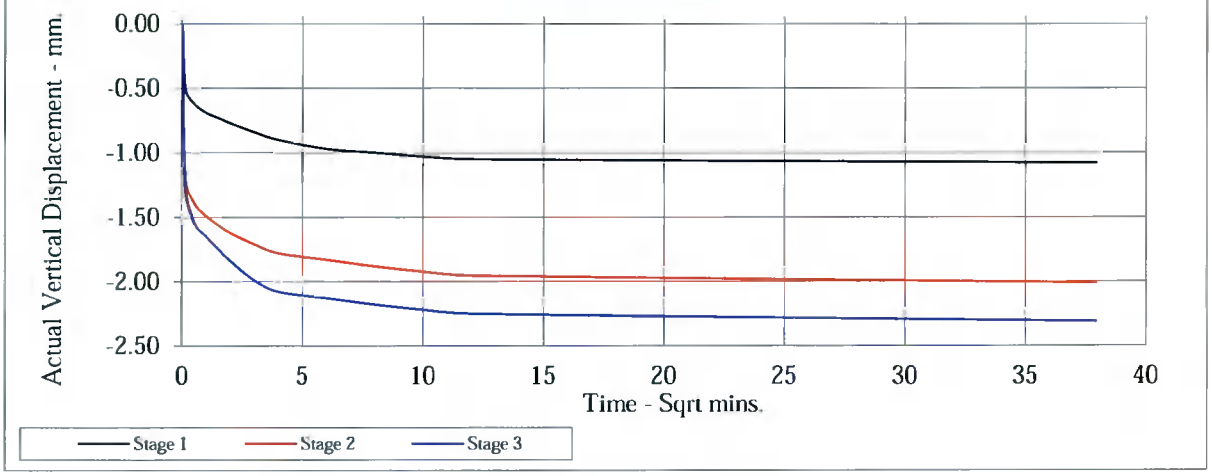
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

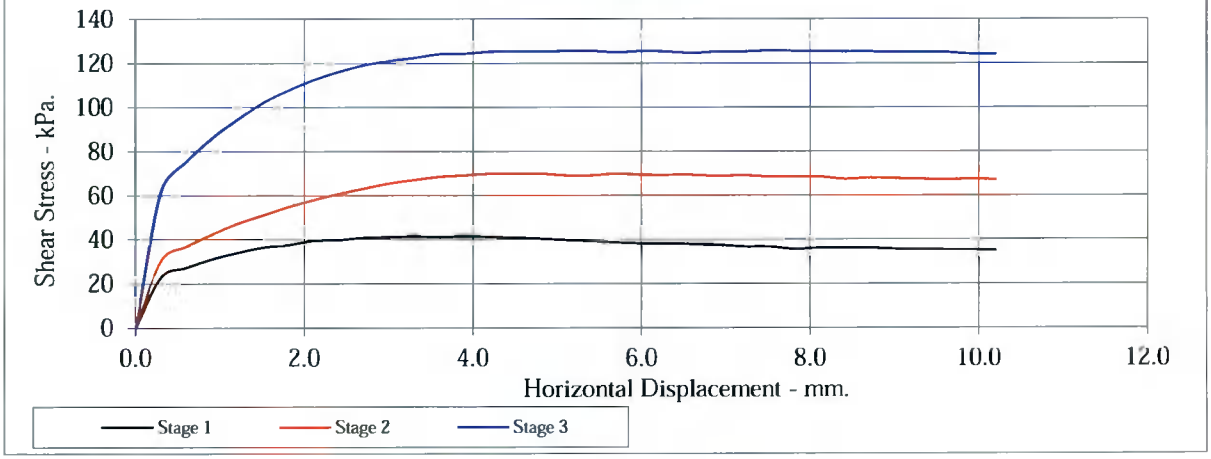
BS1377:Part 7:1990 Clause 4

Hole Number:	WS06	Top Depth:	1.00
Sample Number:	5	Base Depth:	2.00

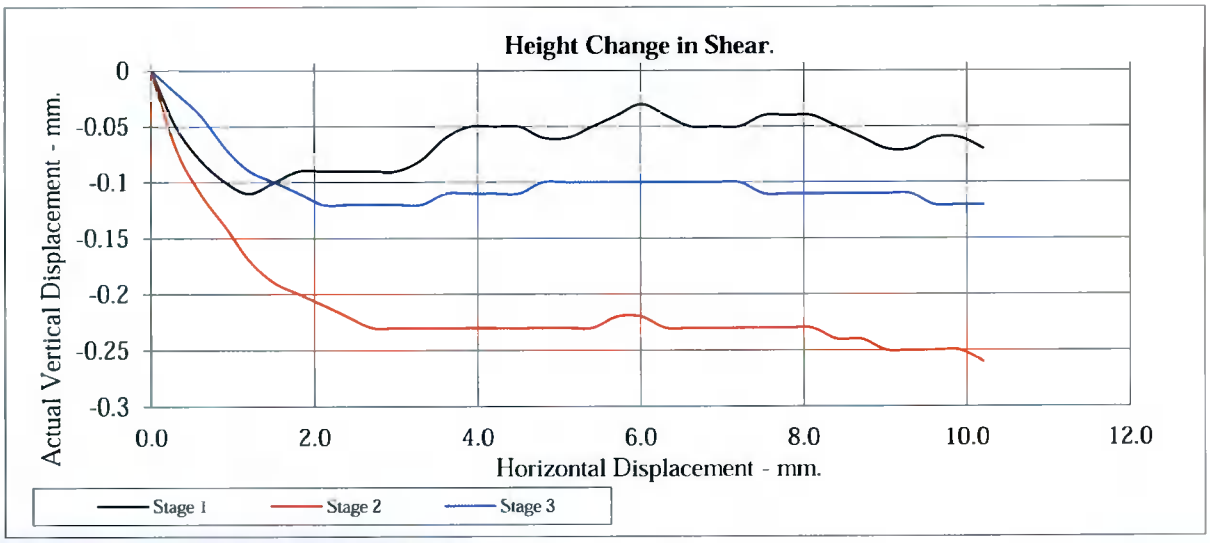
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

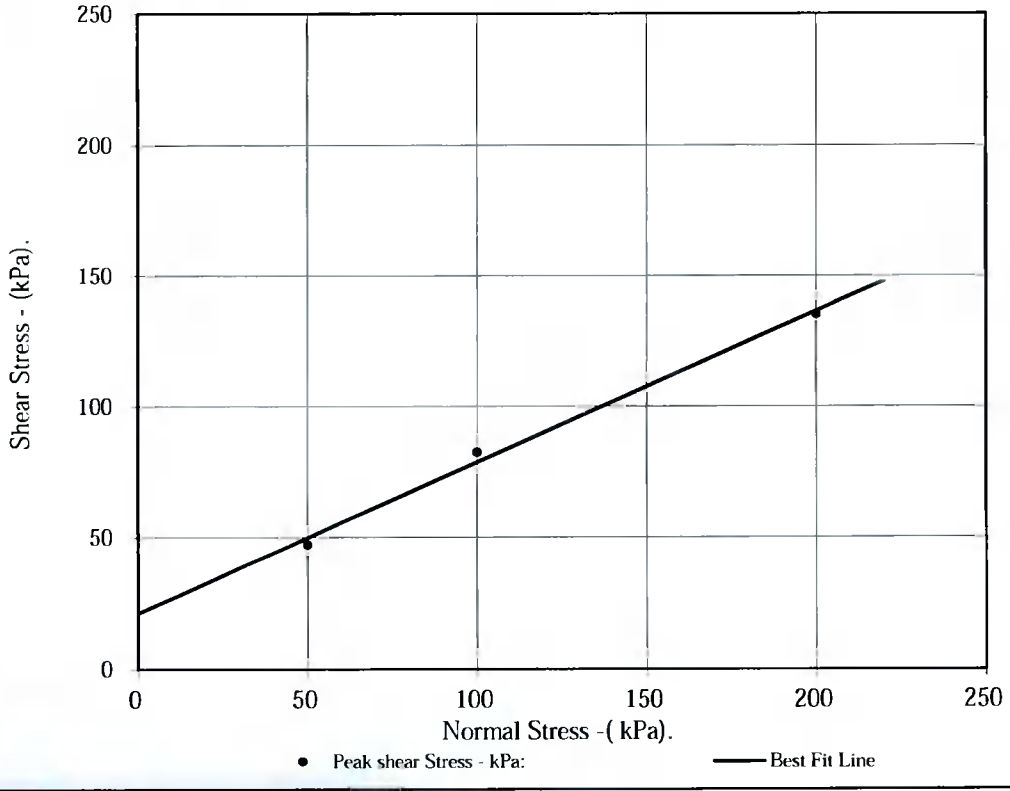
Contract No:	
PSL21/0322	
Client Ref:	
20-1358	

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	WS07		Top Depth:	1.00
Sample Number:	4		Base Depth:	2.00
Sample Conditions:	Submerged		Sample Type	B
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort.			
Sample Description:	**Brown gravelly sandy CLAY.**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.05	20.05	20.05
Length - mm:	59.97	59.97	59.97
Moisture Content - %:	17	17	17
Bulk Density - Mg/m3:	2.15	2.15	2.15
Dry Density - Mg/m3:	1.84	1.84	1.84
Voids Ratio:	0.438	0.438	0.438
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	18.59	18.08	17.70
Shearing Stage			
Rate of Strain - mm/min	0.057	0.057	0.057
Displacement at peak shear stress - mm	4.21	4.21	5.41
Peak shear Stress - kPa:	47	83	135
Final Consolidated Conditions			
Moisture Content - %:	17	17	16
Bulk Density - Mg/m3:	2.32	2.38	2.44
Dry Density - Mg/m3:	1.98	2.04	2.09
Peak			
Angle of Shearing Resistance: (θ)	**30**		
Effective Cohesion - kPa:	**21**		



UKAS TESTING 4043

PSL Professional Soils Laboratory

Taylors Lane, Rathfarnham

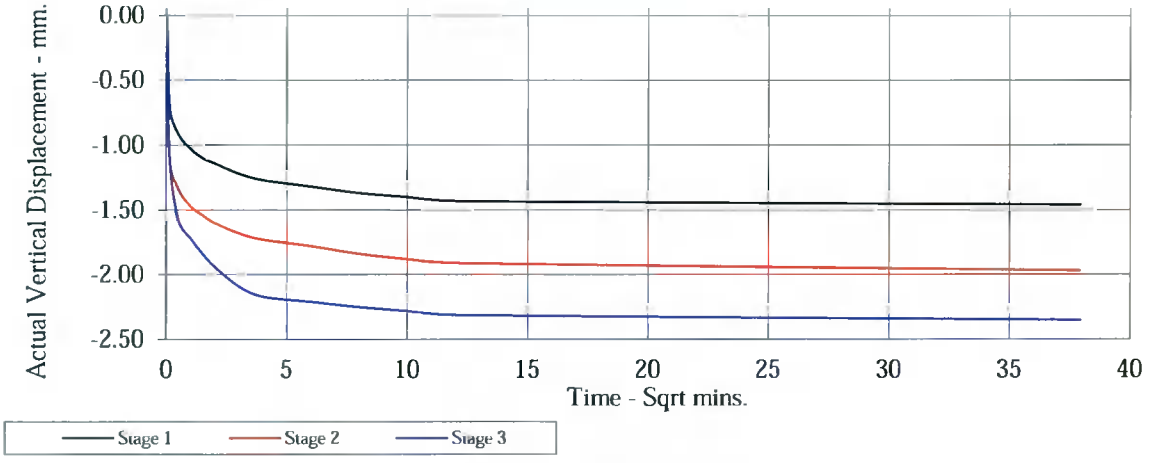
Contract No:
PSL21/0322
Client Ref:
20-1358

CONSOLIDATED DRAINED SHEARBOX TEST

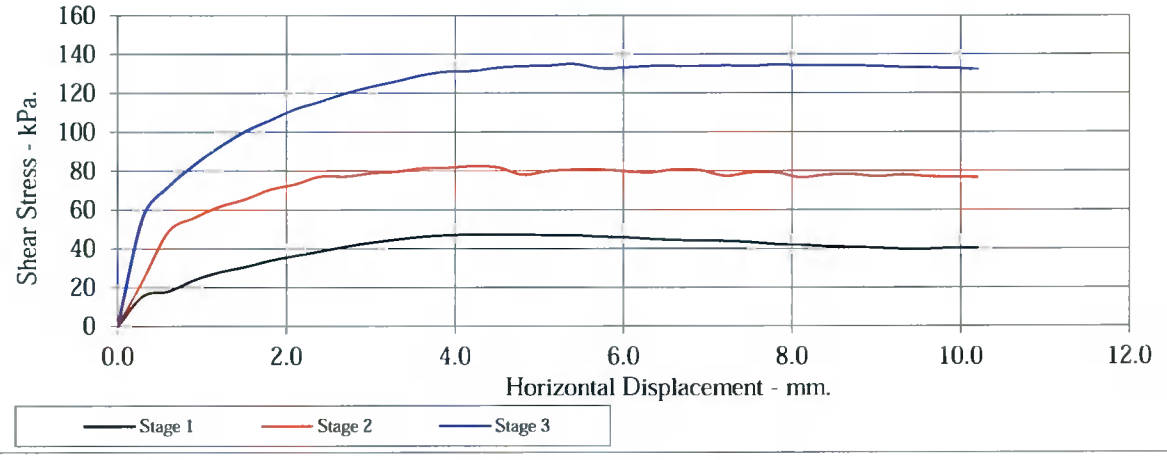
BS1377:Part 7:1990 Clause 4

Hole Number:	WS07	Top Depth:	1.00
Sample Number:	4	Base Depth:	2.00

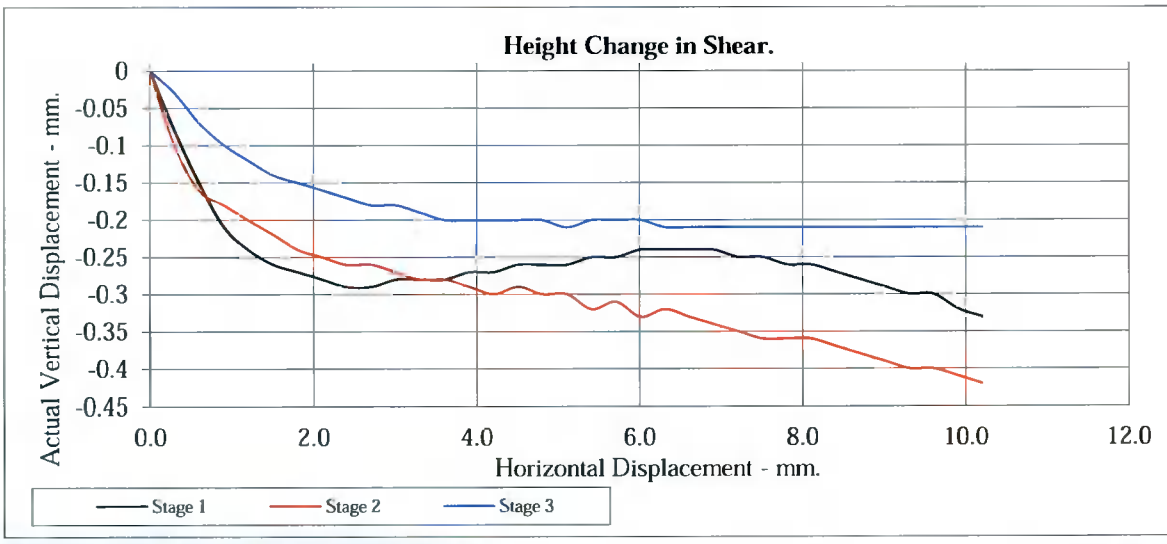
Consolidation Stage.



Shearing Stage.



Height Change in Shear.



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Contract No:	
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eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	21-00267-1
Initial Date of Issue:	11-Jan-2021
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Carin Cornwall Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-1358 Taylors Lane Rathfarnham

Quotation No.:		**Date Received:**	08-Jan-2021
Order No.:		**Date Instructed:**	08-Jan-2021
No. of Samples:	7		
Turnaround (Wkdays):	5	**Results Due:**	14-Jan-2021
Date Approved:	11-Jan-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 20-1358 Taylors Lane Rathfarnham

Client: Causeway Geotech Ltd				Chemtest Job No.:	21-00267	21-00267	21-00267	21-00267	21-00267	21-00267	21-00267
Quotation No.:				Chemtest Sample ID.:	1121569	1121570	1121571	1121572	1121573	1121574	1121575
Order No.:				Client Sample Ref.:	2	4	4	5	5	5	6
				Sample Location:	WS01	WS02	WS03	WS04	WS05	WS06	WS07
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	2.00	1.00	1.00	0.80	1.00	1.00	1.20
				Date Sampled:	07-Jan-2021	07-Jan-2021	07-Jan-2021	07-Jan-2021	07-Jan-2021	07-Jan-2021	07-Jan-2021
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	11	9.2	12	15	11	12	15
pH	U	2010		4.0	8.8	8.8	8.7	8.5	8.5	8.6	8.4

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

CAUSEWAY GEOTECH

LABORATORY RESTRICTION REPORT

Project Reference	20-1358	To	Matthew Gilbert
Project Name	Taylor's Lane, Rathfarnham	Position	Project Manager
TR reference	20-1358 /	From	Joseph Nicholl
		Position	Laboratory Quality Manager

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

Hole Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
WS04	11	2.00	U	UU Triaxial	Unable to obtain test specimen - incohesive material	CANCEL
WS05	7	2.00	U	UU Triaxial	Unable to obtain test specimen - very high coarse gravel content	CANCEL

For electronic reporting a form of electronic signature or printed name is acceptable

Laboratory Signature	Project Manager Signature
Joseph Nicholl	Matthew Gilbert
Date	Date
13 January 2021	