

**HIGHWAYS AGENCY AREA 6
MANAGING AGENT CONTRACTOR CONTRACT**

A47 NORTH BURLINGHAM DITCH

**PRELIMINARY SOURCES STUDY/ REMEDIAL OPTIONS STUDY
REPORT**

March 2015

HA GDMS Report Number 27732

Notice

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1. Scope and Objective

Atkins has been commissioned by the Highways Agency to prepare a combined Preliminary Sources Study Report and Ground Investigation Report (PSS/GIR) to investigate the possible cause(s) of instability along the A47 westbound carriageway near North Burlingham, Norfolk and identify preliminary options for the remedial works.

The site is located approximately 2km west of North Burlingham, adjacent to the westbound carriageway on a single carriageway section of the A47 at OSGR 634624 309930 (Figure 1). Two failures are records within HAGDMS A47_7666_535882 and 535883. A defect was first recorded here within the system in 2004. Currently there is varioguard in place between the carriageway and the ditch. It is not known when this was installed but it appears in the inspection photo in 2004.

It is also understood that the adjacent landowner has submitted a claim for damage to his crops in the low part of his field due to standing water issues. Comment on that is outside the scope of this report.

This report includes an assessment of the local topographical, geological and hydrological conditions and other information available to Atkins together with a summary of the scheme specific ground investigation and interpretation of relevant material properties. Preliminary options for remedial works are also included.

In accordance with HD22/08, 'Managing Geotechnical Risk' [Ref 1], the Statement of Intent which this report follows, classified this scheme as Geotechnical Category 2.

The objectives of the desk study and ground investigation report are detailed in the Statement of Intent (Document reference GTG.20081676/149/R.001 [Ref 2]). The objectives are to determine;

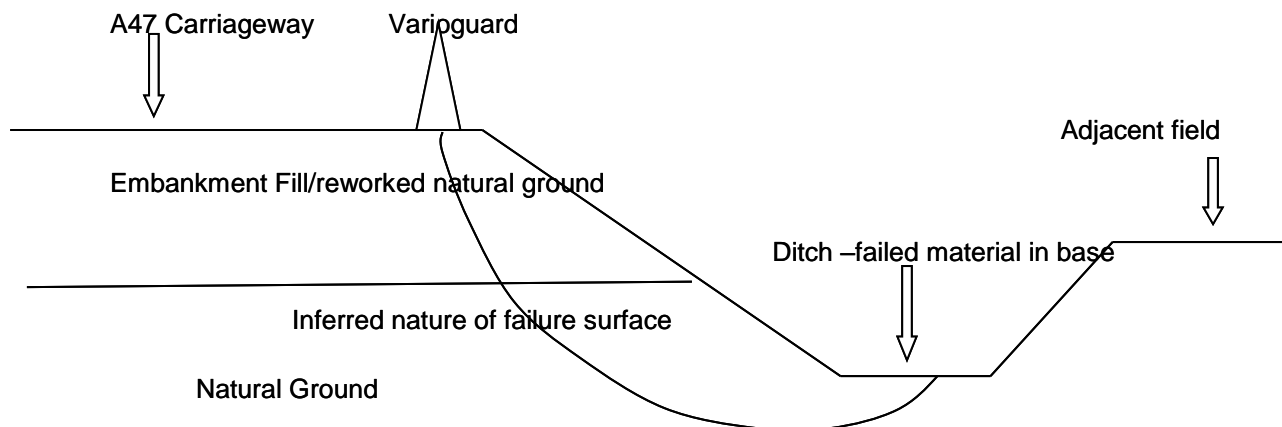
- The nature and composition of the road pavement and underlying sub-base layers,
- The composition of materials that form the sides of the drainage channel and formation soils beneath the made ground and any variations therein,
- The relative strength and density of the embankment fill and natural ground identifying in particular, zones of soft/ weak materials,
- Geotechnical properties of the various strata encountered,
- The groundwater profile.
- Options to stabilise the ditch side and to provide permanent road restraint barrier, if required

2. Existing Information & Desk Study

2.1. Geography and Topography

The A47 is a single carriageway two-way road at this location that is orientated east-west. Much of the rest of the A47 is dual carriageway. The site is located approximately 2km west of North Burlingham, at OSGR 634624 309930 (Figure 1). The carriageway is elevated on an embankment that is approximately 1-2m in height. The ditch and the defects are located adjacent to the west bound carriageway. The topography of the area is relatively flat with a gradual fall in elevation from north to south in the area around this site. The ditch lies at the low point in the A47 profile. The land on both sides of the carriageway is predominantly agricultural.

No topographical survey of the site or surroundings has yet been carried out. An indicative sketch only is shown below.



2.2. Geology

Geological mapping information obtained from HA GDMS ^[Ref 3] and the BGS GeoIndex ^[Ref 4] indicates that the geology at the site comprises Happisburgh Glacigenic Formation (sands and sandy clay) overlying Crag Group (sands, gravels, silts and clays). The embankment fill is expected to comprise predominantly cohesive material.

The Happisburgh Glacigenic Formation (previously known as the Corton Formation) consists of a range of diamictos, sands and gravels, sands and laminated silts and clays. The diamictos (Happisburgh Till, Corton Till and California Till members) are typically sandy matrix-supported diamictos that contain a high abundance of flint and quartzose lithologies relative to chalk, distinguishing them from the more chalky tills of the overlying Lowestoft Formation. The Corton Till has previously been identified in boreholes in this area (Boreholes TG30NW75, TG30NW69 and TG31SW35 from the BGS website ^[Ref 4]). Based on this information, the Happisburgh Glacigenic Formation is anticipated at this site.

The Crag Group is a suite of shallow-water marine and estuarine sands, gravels, silts and clays deposited on the southwest flank of the North Sea Basin. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'. The gravels in the lower part of the group are almost entirely composed of flint. Those higher in the group include up to 10% of quartzite from the Midlands, igneous rocks from Wales, and chert from the Upper Greensand of southeastern England ^[Ref 4].

2.3. Hydrology & Hydrogeology

The flood risk map presented on the Environment Agency website ^[Ref 5] indicates that the site is not at risk of flooding. No groundwater information is available from the Ground investigation data. It is considered most likely that the groundwater will be close to, or slightly above the water levels within the ditch. It is not clear from the ground investigation how the ditch behaviour is related to the overall groundwater regime.

2.4. Drainage

An open drainage channel is present identified adjacent to the A47 westbound carriageway. The drainage channel was partially filled with water at the time of the site visit in January 2014. A drainage pipe (approximately 100mm in diameter) runs underneath the carriageway and outfalls into the above mentioned ditch.

It is understood that that this ditch acts as a soakaway and needs to be cleared out to maintain its function.

See photographs in Appendix A

2.5. Contaminated Land

An online geographic information system called MAGIC was used to check for contaminated land at this site. The MAGIC website provides authoritative geographic information about the natural environment from across government. The information covers rural, urban, coastal and marine environments across Great Britain.

MAGIC ^[Ref 6] does not identify any significant geo-environmental or contamination spillages in the vicinity of the site.

Potential contaminants at, or in the vicinity of the site, may include hydrocarbons (both lead and non-lead based) and heavy metals from the A47 carriageway although no visual or olfactory evidence of this was seen during the walkover surveys or ground investigations.

2.6. Site Walkover Survey

A site walkover survey was undertaken by representatives of Atkins Ground Engineering in August 2013 and 15 January 2014. The details of the site highlighted during the walkover survey include;

- The drainage ditch at the site appeared to act as a soakaway, was partially filled with water and in need of maintenance. (photos 1,5, 6)
- 2 areas of the side of the ditch adjacent to the road side had failed, slumping into the ditch base. Photos 5 and 6
- A varioguard system was in place to protect traffic from the drainage ditch. The carriageway underneath the varioguard has now been undermined in parts. (photos 2and 3)
- Reinstatement of the carriageway foundation, cabinet and manhole ring at the site may be required.
- A large number of burrow holes were visible in the area but not at the site itself.
- The edge of the road pavement where the material had failed was shown to have extensive layers of concrete below the road pavement. The nature and composition of the road pavement and underlying sub-base layers need to be determined. (Photo 3)
- A black HDPE drainage pipe (approx 100mm in diameter) outfalls into the ditch at the area of one of the failures. This is possibly a cross carriageway drain. The east bound carriageway appears to fall to the east bound verge away from the ditch.
- A previous repair or outfall detail had been carried out around the outfall pipe (Photo 8) . This was not visible on site although part of the bagwork appeared to be in place adjacent to the outfall pipe Photo 2
- An additional pipe with water flowing was found at the slope failure location (Photo 7)

Photographs taken during the January visit and the 2004 principal inspection are presented in Appendix A.

3. Ground Investigation

3.1. Summary

A ground investigation was undertaken in February 2014 by Geotechnical Engineering Ltd. Soil property testing was carried out by Soil Property Testing Ltd. Approximate borehole locations are shown in Figure 2.

The planned scope of the site investigation changed during the works due to the pavement conditions encountered. Details of all the changes that took place during the site investigation are given in Section 3.1 of the factual report from Geotechnical Engineering Ltd (See Appendix B). A summary of the work undertaken is as follows:

- 2no. windowless sample boreholes to a maximum depth of 6.0m bgl.
- 3no. pavement cores

Borehole logs and the accompanying Ground Investigation Location Plan are provided within the Factual Report provided by Geotechnical Engineering Ltd and are included within Appendix B of this report.

In situ testing comprised the following:

- Standard Penetration Testing

Sampling of materials comprised:

- Disturbed samples were recovered within the windowless sample liner which was split and sub-sampled on site.

Geotechnical testing consisted of:

- Moisture Content
- Atterberg limits
- Sulphate tests
- pH value

Laboratory test results are included within the Factual Report supplied by Geotechnical Engineering Ltd and are summarised in Table 1. A copy of the factual report is provided within Appendix B.

3.2. Exploratory Hole Logs

Exploratory hole logs were prepared by Geotechnical Engineering Ltd in accordance with BS EN ISO 14688-1 ^[Ref 7] and BS EN ISO 14688-2 ^[Ref 8] Copies of the exploratory hole logs are presented within the Geotechnical Engineering Ltd Factual Report in Appendix B.

3.3. Ground Conditions

The ground conditions encountered in both boreholes are in line with the anticipated ground conditions discussed in Section 0 of this technical note. Descriptions of the strata encountered and a summary of results of the laboratory and in-situ testing are provided in the following sections.

WS01 was unable to be progressed beyond 1.2m depth due to the risk of services being present (a strong signal was recorded during CAT Scanning) The hole was terminated in concrete or pavement construction

3.3.1. BH01B

3.3.1.1. Road Pavement Construction

Road pavement cores undertaken to facilitate windowless sampling showed that the pavement construction consisted of 0.7m Tarmacadam consisting of 40% blue orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix.

Three holes were aborted (01, 01A and 02) at approximately 0.35-0.5m depth. This was due to strong signals from the Cat scanner.

3.3.1.2. Embankment Fill

The embankment fill encountered in this borehole is described as stiff mottled grey and orangey brown sandy silty CLAY. The embankment fill material is 0.65m thick at this location.

3.3.1.3. Natural Ground - Happisburgh Glacigenic & Crag Formations

The natural ground below the embankment is generally described as a yellowish brown slightly sandy silty CLAY. Occasional fine sand and gravel pockets were encountered. The clay material was occasionally described as having light orangey brown and yellow mottling. The material alternates from firm to soft with depth.

This material description is in line with the BGS descriptions of the Happisburgh Glacigenic Formation. The orangey brown and yellow mottling encountered in the clay may be the Crag Formation.

3.3.2. BH03

3.3.2.1. Road Pavement Construction

Road pavement cores undertaken to facilitate windowless sampling showed that the pavement construction consisted of 2.0m Tarmacadam consisting of 40% blue orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix.

3.3.2.2. Embankment Fill

The embankment fill encountered in this borehole is described as firm dark yellowish brown sandy silty CLAY. The embankment fill is 0.9m thick at this location.

3.3.2.3. Natural Ground - Happisburgh Glacigenic Formation

The natural ground below the embankment is generally described as a yellowish brown slightly sandy silty CLAY. It is locally sandy and occasionally gravelly. The natural material is described as soft throughout this borehole.

This material description is in line with the BGS descriptions of the Happisburgh Glacigenic Formation.

3.3.3. Groundwater

Limited ground water information is available as no monitors were installed during the site investigation. The below water levels were recorded during the site investigation.

- BH03 was recorded as dry
- BH01B was recorded as dry

It should be noted that water flush was being used for BH01B and 03.

3.4. Laboratory and in situ Test Results

Geotechnical testing was undertaken by Soil Property Testing within a UKAS approved laboratory in accordance with BS1377:1990 [Ref 9]. All geotechnical tests were scheduled by Atkins Ground Engineering. Results of the tests are included within the Geotechnical Engineering Ltd Factual Report included within Appendix B and summarised in Table 1.

Due to the difficulty in clearly distinguishing between the Happisburgh Glacigenic & Crag Formations, the test results in Table 1 have been combined.

Table 1. Summary of laboratory and in situ test results

Material	Geotechnical Property	Result		No. of Tests
		Range	Average	
Embankment Fill (Reworked Natural Material, Cohesive)	Moisture Content %	14 – 19	16.5	2
	<u>Atterberg Limits %</u> Liquid Limit (LL), Plastic Limit (PL), Plasticity Index (PI)	22 - 23 14 - 15 7 - 9	22.5 14.5 8	2
	Water Soluble Sulphate 2:1 SO ₃ g/l	0.05 – 0.10	0.075	2
	pH Value	7.1 – 7.5	7.3	2
	SPT 'N' blow count	-	-	0
Happisburgh Glacigenic Formation & Crag Group	Moisture Content %	13 – 22	16.2	16
	<u>Atterberg Limits %</u> Liquid Limit (LL), Plastic Limit (PL), Plasticity Index (PI)	22 - 30 12 - 15 7 - 16	25.5 13.2 12.3	6
	Water Soluble Sulphate 2:1 SO ₃ g/l	0.03 – 0.05	0.04	3
	pH Value	7.1 – 7.3	7.4	3
	SPT 'N' blow count	7 - 13	9.5	9

3.5. Material Properties

The geotechnical design of this project will be carried out in accordance with BS EN 1997 (Eurocode 7) [Ref 10]. It is therefore necessary to determine a characteristic value for each design parameter relative to the limit state for which it is being used. The available data for each of the

strata encountered at this site was discussed in Section 3.4 of this report. Details on the derivation of one or more characteristic values for each design parameter are discussed in this section. Data from all the available information was used to derive the characteristic values in Table 2.

Due to the difficulty in clearly distinguishing between the Happisburgh Glacigenic & Crag Formations, the characteristic parameters in Table 2 have been conservatively combined.

No SPT results were available within the embankment fill and therefore no strength or stiffness parameters were derived.

3.5.1. Bulk Density

No Bulk Density tests were carried out as part of the site investigations. One bulk density test result within the Corton Till (Happisburgh Glacigenic Formation) was available in historical borehole number TG30NW75. The result was 1.88Mg/m³.

3.5.2. Shear Strength

3.5.2.1. Undrained

The undrained shear strength C_u of cohesive soils was derived from SPT N values using the relationship developed by Stroud and Butler 1975 [Ref 11] and further detailed in CIRIA 143 [Ref 12], $C_u = f_1 N_{60}$, which relates undrained shear strength to the SPT N value and the Plasticity Index of the soil. An $f_1 = 5$ was chosen based on the available Plasticity Index content values. A plot of SPT 'N' with depth is shown in Figure 2.

$$C_u = 5 * N_{60}$$

3.5.2.2. Drained

The procedure outlined in BS8002 [Ref 13], which takes into account grain angularity, uniformity coefficient of the soil grading and characteristic SPT N values was used to determine the effective angle of shearing resistance for the granular soils. The procedures detailed in this document for cohesive material take into account the plasticity index of the material. Given the variation between granular and cohesive material at this site (along with descriptions ranging from soft to firm), an effective angle of shearing resistance of 25° is deemed appropriate.

3.5.3. Stiffness

Stroud and Butler 1975 [Ref 11] report that many case histories of settlement of structures in overconsolidated clays shows that the ratio of drained elastic modulus to the N value is constant for overconsolidated clay. The assumption that the clay in at this site is overconsolidated is reasonable considering the Happisburgh Formation is glacial and the Crag Formation is of marine origin.

Stroud and Butler 1975 [Ref 11] derived the empirical equation $E_v' = 130C_u$ for the vertical drained Young's modulus, which assumes a Poisson's ratio of 0.1. Given the small amount of information available for this site the more conservative equation below has been adopted;

$$E_v' = 100C_u$$

Furthermore, Stroud and Butler 1975 [Ref 11] state that a 'reasonable estimate' of the undrained vertical Young's modulus can be made by using the equation $E_{vu} = 220C_u$. Given the small amount of information available for this site the more conservative equation below has been adopted;

$$E_{vu} = 200C_u$$

Table 2. Summary of Characteristic Geotechnical Parameters

Material	Bulk Density	SPT 'N'	Undrained Shear Strength (Cu)	Effective Strength	Moisture Content	Undrained Elastic Modulus Eu	Drained Elastic Modulus E'
	Mg/m ³	-	kN/m ²	kN/m ²	%	MN/m ²	MN/m ²
Embankment Fill (Reworked Natural Material, Cohesive)	1.9	-	-	c' = - φ' = -	16	-	-
Happisburgh Glacigenic Formation & Crag Group	1.9	8	40	c' = 0 φ' = 25	16	8	4

4. Cause of Observed Defect

The probable cause of this defect is a combination of relatively soft ground conditions, steep ditch sides and water pipes outfalling to the ditch.

5. Remedial Options

No topographical Survey has yet been carried out and the option table overleaf should be reviewed and refined when the accurate geometry of the road, verge, ditch and land beyond has been established. The drainage system also will need to be verified as assumptions have been made during this work. It is recommended that these surveys are progressed as soon as practicable.

Consideration should also be given to the verification of the material within the embankment haunches and ditch sides. This poses some Health and Safety implications and may be difficult to achieve safely, particularly while the varioguard remains in place restricting the working areas.

It is not proposed to identify a preferred option at this time but to create a first ideas register to explore some of the options. This may be added to as more information has been established. Some items have been marked as 'discard' as seemingly impractical or of high cost.

Table 3. Summary of remedial options

Option	Description	Civil & Construction	Operational (Maintenance)	Health and safety /Environmental	Advantages	Disadvantages	Option appraisal
1	Do nothing /Do minimum	None	Clear out debris from base of varioguard to allow drainage from road to ditch Varioguard maintenance and inspection required	Varioguard remains in place (now in place for >10yrs)	Very low cost	Varioguard remains in place Ditch sides continue to deteriorate	Discard
2a	Repair ditch sides with earthworks	Clear out of ditch, bench into existing side slopes and replace sides with granular fill	Maintenance of ditch as existing	Narrow verge remains, ditch adjacent to road some	Low cost No specialist equipment required	Presence of the deepened pavement will add difficulty in keying into the surrounding ground to prevent future failure Ditch sides will remain steep with the same profile as existing and likely to experience further failures Outfalls to ditch form drains may need erosion protection Narrow verge to ditch	Discard

Option	Description	Civil & Construction	Operational (Maintenance)	Health and safety /Environmental	Advantages	Disadvantages	Option appraisal
						remains	
2b	Repair ditch sides with gabions, bagwork, crib wall, porcupine wall or similar	Clear out of ditch and failed material and reconstruction with chosen steepened sides or wall construction	Maintenance of ditch as existing	Loss of habitat in the short term. Possible safety barrier installation option	Possible widening of verge would allow safety barrier to be installed if required Relatively low cost Would provide erosion protection at drain outfall locations	Dependant on geometry of ditch : not yet known It appears that a bagwork repair/headwall/erosion protection visible in 2004 has failed in part.	
2c	Repair ditch sides with retaining wall eg sheet piling	Install sheet piled wall to restrain the ditch side adjacent to the road	Inspections on normal cycle would be required	Ditch would be further away from road, but will vertical drop into ditch Habitat removed on piled side	Possible widening of verge would allow safety barrier to be installed if required	Very high cost of sheet piled wall, specialist plant required and vertical edge to ditch remains	Discard
2d	Repair ditch sides with strengthened earthworks	Soil nailing of ditch side or earthworks strengthened with geogrids	None		None	Soil nailing will not address failed sections of ditch Geogrid reinforcement would require excavation of road to install the grids and reinstatement of road	Discard

Option	Description	Civil & Construction	Operational (Maintenance)	Health and safety /Environmental	Advantages	Disadvantages	Option appraisal
						surface. Relatively high cost	
3a	Infill ditch with granular material	Ditch to be cleared out, geotextile separator to wrap the granular infill to ditch	No maintenance possible, ditch will silt up with time and soakaway function will become less effective	No ditch feature next to road, any habitat will be removed	Lateral restraint to road will be provided by granular fill Possible widening of verge would allow safety barrier to be installed if required	Will reduce the capacity of the drainage ditch	Discard
3b	Infill ditch 'with egg box soakaway'	Ditch to be excavated and modular soakaway drainage systems such as Stormbloc or geolight to be installed and the surface covered.	Clearing out of the system will be possible if required	No ditch feature next to road, any habitat will be removed	Drainage capacity of the system remains similar, no ditch adjacent to road, lateral restraint possibly provided to road pavement	High cost of proprietary drainage tank/filler Excavation could undermine road pavement	

Option	Description	Civil & Construction	Operational (Maintenance)	Health and safety /Environmental	Advantages	Disadvantages	Option appraisal
3c	Provide box culvert within ditch and infill	Clear out and over excavate ditch and insert precast culvert or pipe	Will require to be cleaned periodically,	may constitute a confined space so access precluded loss of habitat	No ditch adjacent to road Will provide lateral restraint for road pavement	Will reduce soakaway capacity Relatively high cost Excavation for culvert could affect road pavement	Discard
3d	Infill ditch, construct new drainage feature	Ditch can be constructed at a greater distance from the road into the farmers field or with an increased depth or change of shape	As existing	Ditch will no longer be adjacent to road Habitat potential will be restored	Simple and low cost solution Work mainly to be carried out away from the carriageway minimising disruption	Additional land may need to be obtained from farmer	
4	Infill ditch and provide alternative drainage	Alternative drainage could be long SUDS feature, pumping facility, other	Depends on option		SUDs option might require further land take	Pumping option will be high cost and high maintenance Suds would still flow to low point so larger soakaway feature would still be required	Discard

6. Risk Register

A preliminary hazard identification and risk assessment has been prepared to review the possible geotechnical risks and their potential impacts. The geotechnical risk register quantifies the risk of the hazards to the project by evaluating the probability of the hazard occurring and the estimated impact of the risk occurring on the cost, programme and safety aspects of the project. The assessment then identifies risk control measures to be implemented and reassesses the risk of the hazard following implementation of those measures.

The following hazards have been identified:

- Road pavement collapse causing hazard and/ or injury to road users,
- Uneven road surfaces represent a driving hazard,
- Flooding

Although not a geotechnical risk it is highlighted here that the varioguard appears to have been in place for 10 years, and is thus well over the HA recommended 4 years limit. However until the ditch defect is remediated it will be required to remain in place.

A summary of the geotechnical risk register and the mitigation measures is provided in Table 3 below.

Hazard	Cause	Consequence	Prior to RCM						Risk Control Measures (RCM)	Post long term RCM							
			Probability	Impact			Deg. of Risk			Probability	Impact			Deg. of Risk			
				Capital cost	Programme	Safety	Capital cost	Programme			Safety	Capital cost	Programme	Safety			
Pavement collapse	<ul style="list-style-type: none">Voiding beneath road pavement and/ or footpath due to continued deterioration in the ditch sides	<ul style="list-style-type: none">Hazard or injury to road usersPotential compensation claims	4	3	2	4	12	8	16	<u>Short Term RCM's</u> <ul style="list-style-type: none">Continue monitoring of earthworksContinue monitoring of pavementContinue maintenance of varioguardCarry out drainage and topographic and ecological surveysCleanout base of ditch <u>Long Tern RCM's</u> <ul style="list-style-type: none">Confirm the nature of the material in ditch and embankment sidesInstigate the preferred ditch repair optionInstall safety barrier if requiredClean out existing ditch to ensure functionality	1	3	2	4	3	2	4
Uneven road / pavement surfaces	<ul style="list-style-type: none">Settlement of road carriageway due to loss of lateral support of the road and settlement due to continued ditch side failures.	<ul style="list-style-type: none">Trip hazard or injury to pedestriansPotential compensation claims	4	3	2	3	12	8	12		1	2	3	3	2	3	3
Flooding	<ul style="list-style-type: none">Drainage ditch with insufficient permeability , may be exacerbated by debris in base of ditch	<ul style="list-style-type: none">Flooding to adjacent fieldFlooding of road (less likely)	2	2	2	4	8	6	8		1	2	2	4	4	3	4

Table 4. Geotechnical Risk Register

KEY:

Probability:	Probable	4	Impact:	Very High	4
	Likely	3		High	3
	Unlikely	2		Low	2
	Negligible	1		Very Low	1

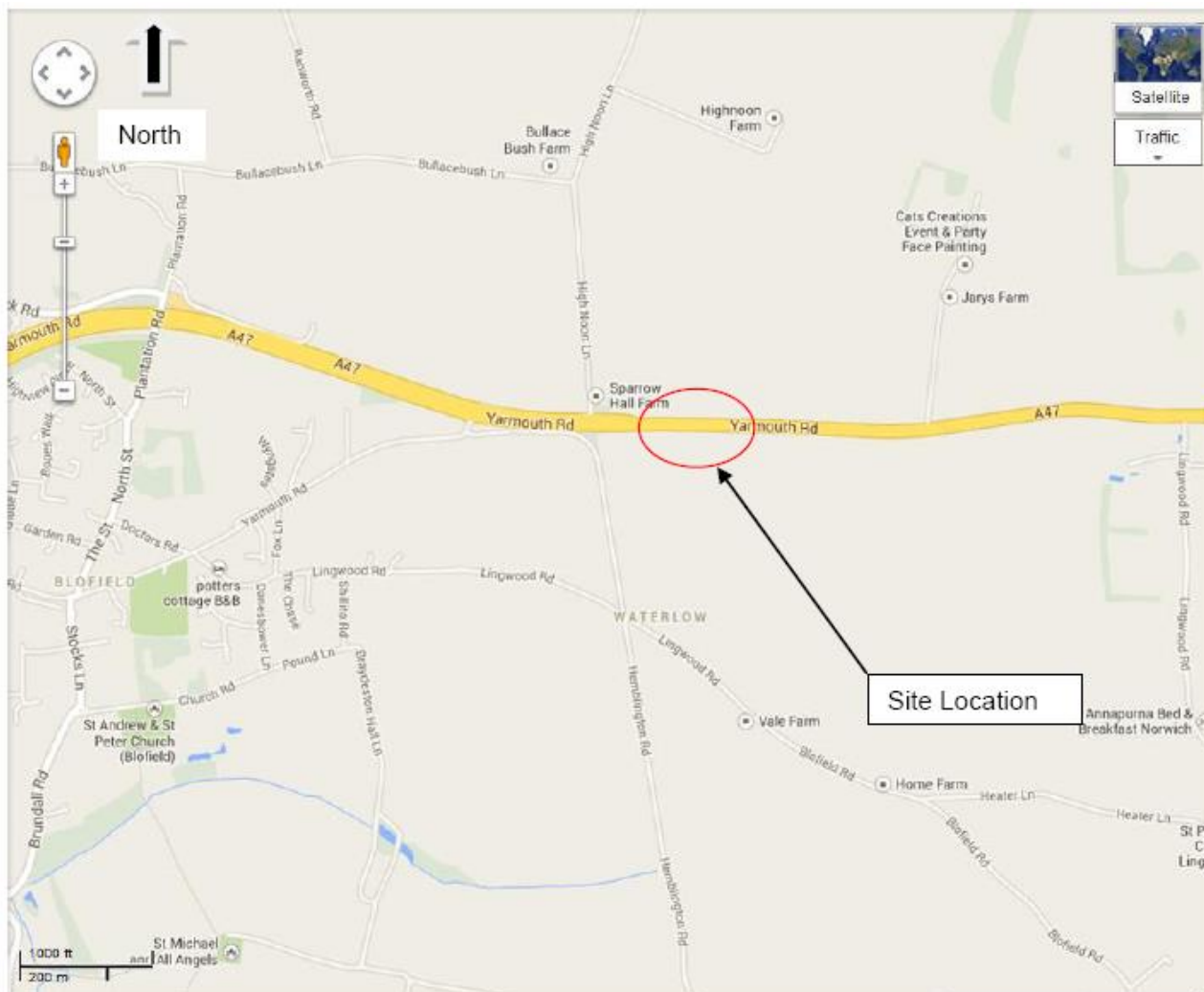
Degree of Risk:	1 to 4	Trivial (no action required)
	5 to 8	Significant (consider more cost effective solutions or improvements at no extra cost)
	9 to 12	Substantial (work must not start until risk has been reduced. Additional resource required)
	13 to 16	Intolerable (work must not start until risk has been reduced. If risk cannot be reduced, project should not proceed).

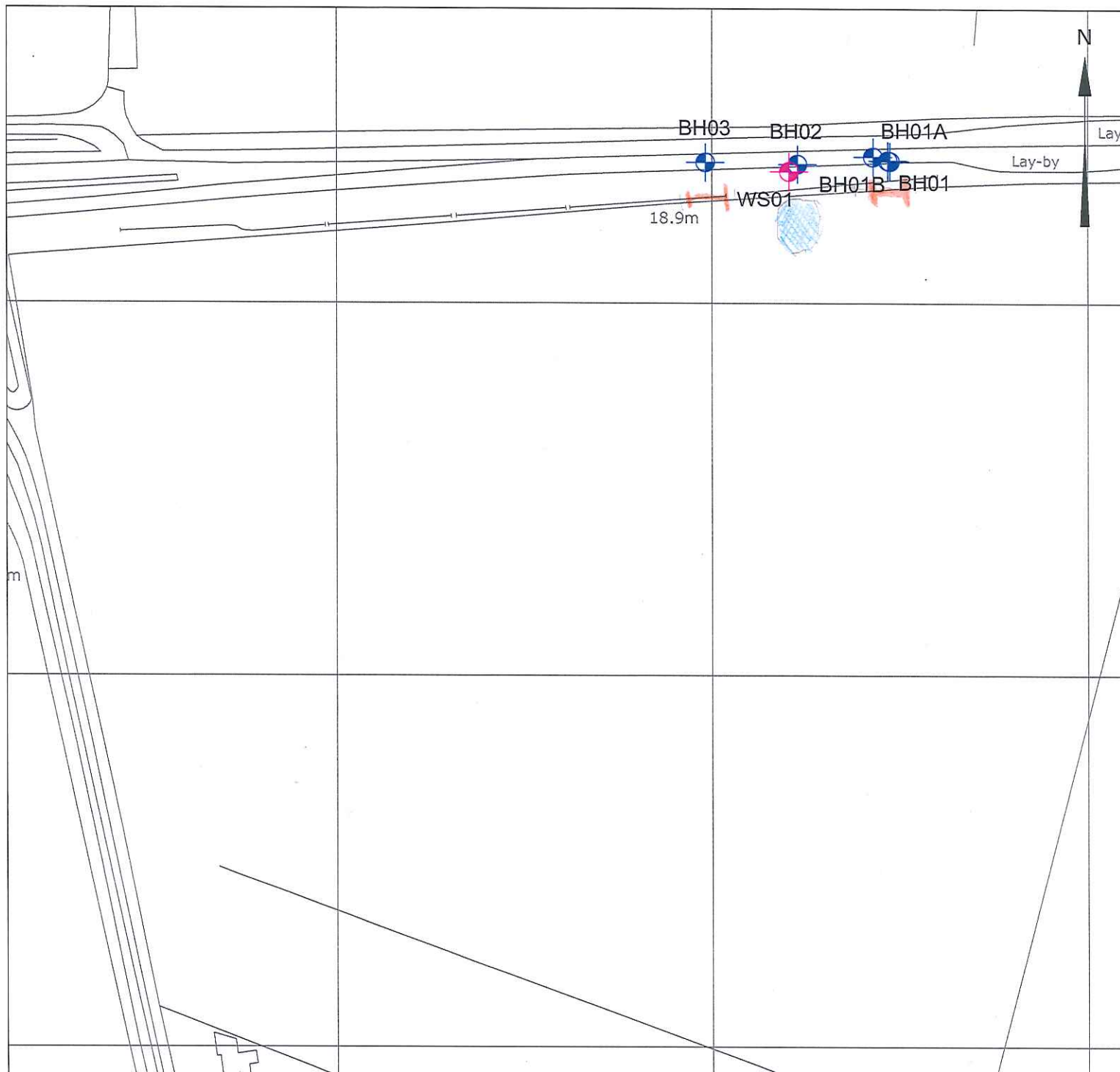
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Figures

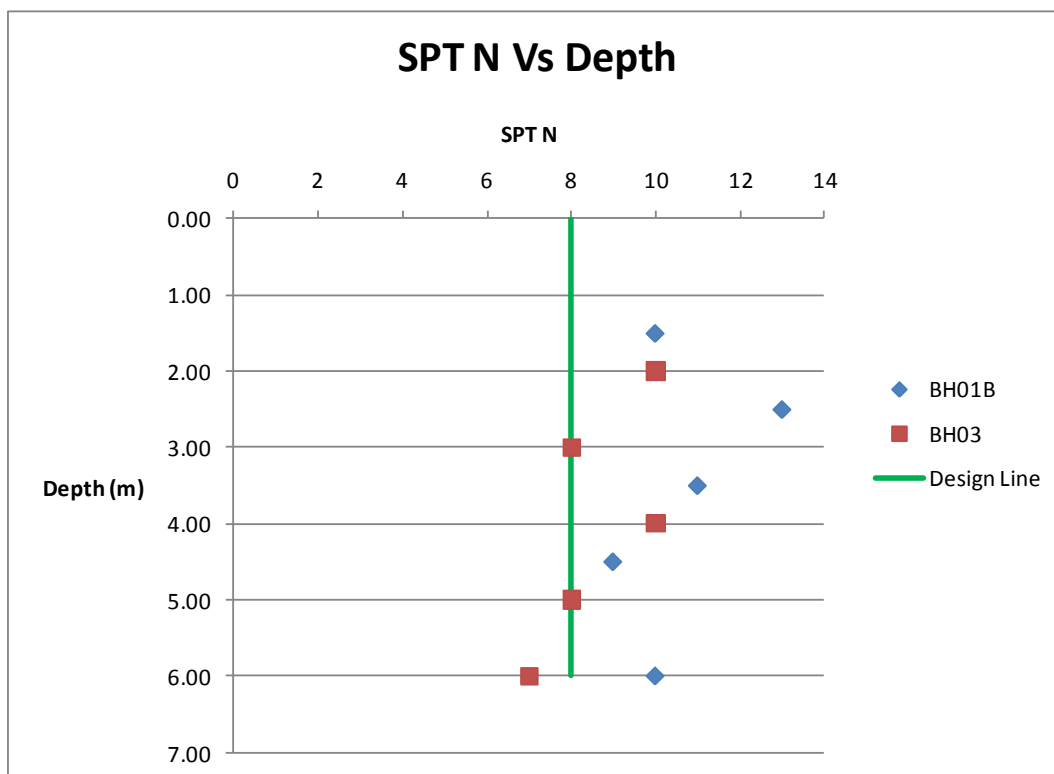
Figure 1: Site Location Plan





<p>Key:</p> <ul style="list-style-type: none"> Borehole Location Window Sample Location AREA OF STANDING WATER CLASS 1A DEFECT 		
<p>Notes:</p> <p>Drawing supplied by client.</p> <p>FIGURE 2</p>		
<p>geotechnical Geotechnical Engineering Ltd</p> <p>Centurion House, Olympus Park, Quedgeley, Gloucester GL2 4NF Telephone: (01452) 527743 Facsimile: (01452) 729314 E-mail: geotech@geoeng.co.uk Web: www.geoeng.co.uk</p>		
<p>Client:</p> <p>SKANSKA</p>		
<p>Consultant:</p> <p>ATKINS</p>		
<p>Site:</p> <p>A47 North Burlingham Ditch</p>		
<p>Title:</p> <p>Exploratory Hole Location Plan</p>		
<p>Drawn By:</p> <p>GJS</p>	<p>Checked By:</p> <p>JT</p>	<p>Paper Size:</p> <p>A3</p>
<p>Scale:</p> <p>1:1000</p>	<p>Date:</p> <p>March 2014</p>	
<p>Contract:</p> <p>28998</p>		<p>Figure:</p> <p>01</p>

Figure 3: SPT N Design Line



Appendix A – Photographs



Photo 1 Looking along ditch with failure material in foreground and level with car



Photo 2 Area of failed material with black pipe visible through brambles – possible bag work repair on right



Photo 3 Area of failed material exposing depth of concrete under road pavement, possibly reflecting haunch repairs



Photo 4 Field showing area of standing water



Photo 5 Ditch showing failed material in ditch base



Photo 6 Ditch showing failed material in ditch base



Photo 7 water flowing from possible pipe outfall



Photo 7 : 2004 inspection showing bag work with outfall pipe and varioguard in place

Appendix B – Geotechnical Engineering Ltd Factual Report



A47 NORTH BURLINGHAM DITCH

FACTUAL REPORT ON GROUND INVESTIGATION

Prepared for SKANSKA

Report Ref: 28998

Geotechnical Engineering Ltd
Centurion House, Olympus Park
Quedgeley, Gloucester. GL2 4NF

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A47 NORTH BURLINGHAM DITCH


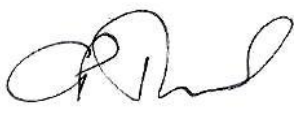
FACTUAL REPORT ON GROUND INVESTIGATION

Prepared for SKANSKA

Report Ref: 28998

PROJECT: EMBANKMENT STABILITY INVESTIGATION

CONSULTANT: ATKINS

VOLUME - VERSION	STATUS	ORIGINATOR	CHECKER	APPROVED	DATE
1 of 1 – A	FINAL	JT	CT	-	
ORIGINATOR			APPROVER		
					
James Taylor Senior Engineering Geologist			Colin Thomas Geotechnical Consultant		

The report is not to be used for contractual or engineering purposes unless this sheet is signed and the report designated "Final".

The report has been prepared for the sole use and reliance by Atkins. GEL accepts no liability as a result of the use or reliance of this report by any other parties.



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REPORT	PAGE
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2. SITE LOCATION AND GEOLOGY	1
3. GROUND INVESTIGATION	1
3.1 Fieldwork	1
3.2 Logging	3
4. REFERENCES	4

APPENDICES

APPENDIX A	FIELDWORK DATA
APPENDIX B	PHOTOGRAPHY
APPENDIX C	LABORATORY TESTING



1. INTRODUCTION

It is proposed to investigate several areas of instability present on the westbound A47 near North Burlingham, Norfolk. Geotechnical Engineering Limited (GEL) was instructed by Skanska acting on behalf of the Highways Agency to carry out an investigation to determine the ground conditions.

The scope of works and terms and conditions of appointment were specified by Skanska and GEL correspondence reference T18410. The investigation was carried out under direction and supervision of the Atkins and Skanska.

This report describes the investigation and presents the findings.

2. SITE LOCATION AND GEOLOGY

The site is situated on the A47 near to the village of North Burlingham, Norfolk and may be located by its National Grid co-ordinates TG 347 099.

British Geological Survey (BGS) England and Wales (Sheet No. 162, 1:50,000) and the BGS online geology (1:50,000) indicate the site is underlain by Happisburgh Glacigenic Formation over the Crag Group.

3. GROUND INVESTIGATION

3.1 Fieldwork

The fieldwork was carried out in general accordance with BS5930:1999+A2:2010 during the night of the 13th and 14th February along with a return visit on the 5th and 6th of March and



comprised two boreholes and four diamond drill road pavement cores one of which was extended by hand digging.

The exploratory hole locations were selected by the Atkins and set out by GEL. The ground level and co-ordinates at each exploratory hole were established by GEL using GPS techniques.

The boreholes, referenced BH01B and BH03 along with the coreholes referenced BH01, BH01A and BH02 (Appendix A), were formed using a track-mounted Geotechnical Pioneer Rig. Initially water flush rotary diamond drilling (250mm), reducing to (146mm) in BH01B and BH03 was carried out at each location to penetrate the road surface. At locations BH01, BH01A and BH02, beneath a layer of tarmacadam, concrete was encountered, the position was re-scanned using a CAT and a strong power signal detected therefore these holes were terminated. At locations BH03 tarmacadam was encountered to a greater depth than 1.20m. At the base of the tarmacadam heavy duty dynamic sampling techniques were then employed to produce a continuous disturbed sample of 97mm nominal diameter reducing to 70mm as the borehole was advanced. The samples were recovered in semi-rigid plastic liner.

The dynamic samples and core were extracted horizontally from the sampler and core barrel respectively, the semi-rigid liner was cut to length and caps placed at each end to retain moisture. All samples and core were retained in sequence in labelled, wooden coreboxes.

Standard penetration tests (SPT) were carried out in general accordance with BS EN ISO 22476-3:2005+A1:2011. A split barrel or a solid cone was used depending upon the materials encountered and the split barrel samples retained in airtight jars. The SPT N value was taken as the number of blows to penetrate the 300mm test drive following a 150mm seating drive. Detailed SPT results, together with the energy ratio (E_r), are presented in Appendix A and summarised as uncorrected N values on the borehole logs.



The borehole, referenced WS01 (Appendix A), was formed using a Terrier 2000 rig. Initially, hand held concrete diamond drilling techniques (200mm) were carried out to penetrate the road surface. Then an inspection pit was hand excavated at the borehole location to a depth of 1.20m to check for buried services. Due to the presence of concrete at 1.20m the pit was terminated at 1.20m. Disturbed samples were taken and retained in a combination of plastic tubs, bags and glass jars.

On completion, all boreholes were backfilled with bentonite pellets and the road surface reinstated with lean mix concrete, bitumen sealant spray and highway repair macadam.

On completion of fieldwork some samples were brought to GEL's laboratory for testing and storage the majority of samples were retained by Atkins.

3.2 Logging

The logging of soils and rocks was carried out by an Engineering Geologist in general accordance with BS5930:1999+A2:2010. A key to the exploratory hole logs is presented in Appendix A.

Detailed descriptions of the core and samples are given in the borehole logs, Appendix A, along with details of sampling, in situ testing, groundwater ingress and relevant comments on drilling techniques.

Prior to logging, photographs of the samples and core were taken and are presented separately in Appendix B. Atkins arranged for their own laboratory testing to be carried out by Soil Property Testing Ltd the results are attached in Appendix C.

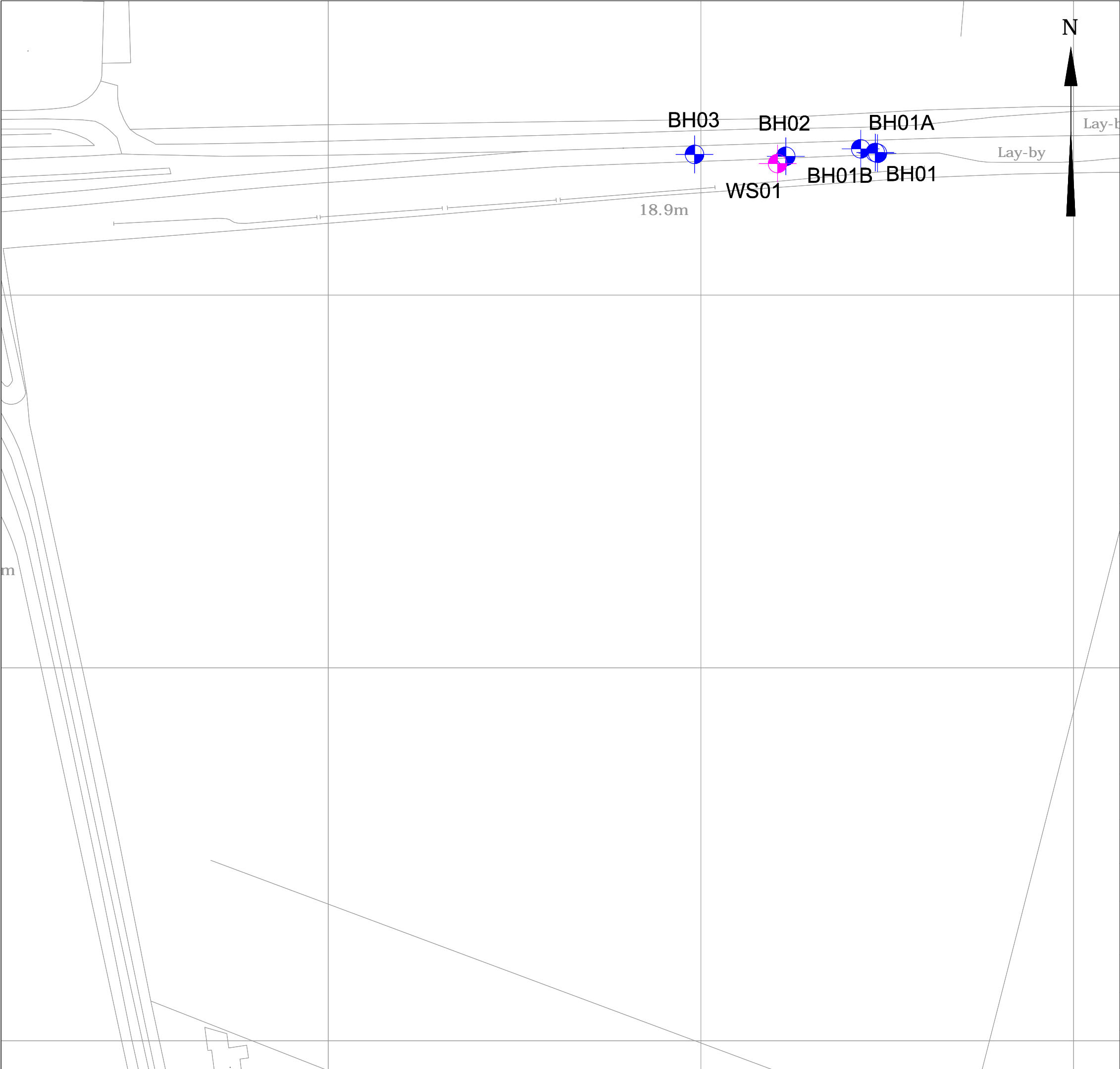
GEOTECHNICAL ENGINEERING LIMITED




4. REFERENCES


British Standards Institution (1999): Code of practice for site investigations. BS 5930 incorporating Amendments No. 1 & 2. Amendment 1 removes text superseded by BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and BS EN ISO 14689-1:2003, and makes reference to the relevant standard for each affected sub clause. Amendment 2 removes text superseded by BS EN 22475-1:2006 and makes reference to the relevant standard for each affected sub clause.

British Standards Institution (2012): Geotechnical investigation and testing. Field testing. Standard penetration test. BS EN ISO 22476-3:2005+A1:2011.



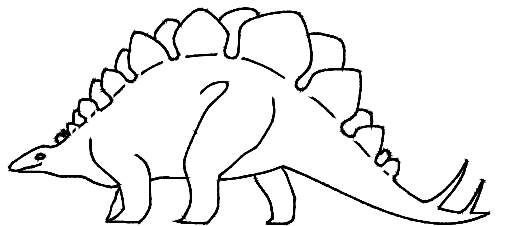
Key.

 Borehole Location

 Window Sample Location

Notes:

Drawing supplied by client.



geotechnical
Geotechnical Engineering Ltd

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Telephone: (01452) 527743 Facsimile: (01452) 729314
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Client:
SKANSKA

Consultant:
ATKINS

Site:
A47 North Burlingham Ditch

Title:
Exploratory Hole Location Plan

Drawn By:	GJS	Checked By:	JT	Paper Size:	A3
Scale:	1:1000		Date:	March 2014	
Contract:	28998			Figure:	01



APPENDIX A

FIELDWORK DATA

KEY TO EXPLORATORY HOLE LOGS



Sample type

D Small disturbed	D* Contamination	B Bulk disturbed	LB Large bulk disturbed	W Water	Cs Core subsample (prepared)
X Dynamic	C Core	U Undisturbed	UT Undisturbed thin wall	P Piston	

Test type

S SPT - Split spoon sampler followed by uncorrected SPT 'N' Value

C SPT - Solid cone followed by uncorrected SPT 'N' Value

(*250 - Where full test drive not completed, linearly extrapolated 'N' value reported, ** - Denotes no effective penetration)

H Hand vane - direct reading in kPa - not corrected for BS1377 (1990). Re* denotes refusal

M Mackintosh probe - number of blows to achieve 100mm penetration

PP Pocket penetrometer - direct reading in kg/sq.cm

Vo Headspace vapour reading, uncorrected peak values in ppm, using a PID (calibrated with Isobutylene, using a 10.6eV bulb)

Sample/core range/I_f

| Dynamic sample

█ Undisturbed sample - open drive including thin wall. Symbol length reflects recovery

x x = Total Core Recovery (TCR) as percentage of core run

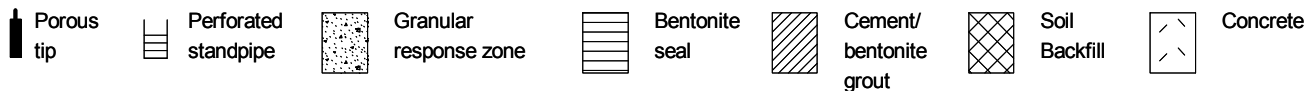
y y = Solid Core Recovery (SCR) as percentage of core run. Assessment of core is based on full diameter.

z z = Rock Quality Designation (RQD). The amount of solid core greater than 100mm expressed as percentage of core run.

Where SPT has been carried out at beginning of core run, disturbed section of core excluded from SCR and RQD assessment.

I_f - fracture spacing - the average fracture spacing (mm) over the indicated length of core. Where spacing varies significantly, the minimum, average and maximum values are given. NI = non-intact core NA = not applicable

Instrumentation



Stratum boundaries

----- Estimated boundary -.-.-.-.- Grading boundary

Logging

The logging of soils and rocks has been carried out in general accordance with BS 5930:1999 incorporating Amendments 1 (2006) & 2 (2010). Amendment 1 removes text superceded by BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and BS EN ISO 14689-1:2003, and makes reference to the relevant standard for each affected sub clause. Amendment 2 removes text superceded by BS EN ISO 22475-1:2006 and makes reference to the relevant standard for each affected sub clause.

Chalk is logged in general accordance with Lord et al (2002) CIRIA C574. Where possible, dynamic samples in chalk have been logged in accordance with CIRIA C574; descriptions and gradings should be treated with caution given the potential for sample disturbance.

For rocks the term fracture has been used to identify a mechanical break within the core. Where possible incipient and drilling induced fractures have been excluded from the assessment of fracture state. Where doubt exists, a note has been made in the descriptions. All fractures are considered to be continuous unless otherwise reported.

Made Ground is readily identifiable when, within the material make up, man made constituents are evident. Where Made Ground appears to be reworked natural material the differentiation between in situ natural deposits and Made Ground is much more difficult to ascertain. The interpretation of Made Ground within the logs should therefore be treated with caution.

The descriptors "topsoil" and "tarmacadam" are used as generic terms and do not imply conformation to any particular standard or composition.

General Comments

The process of drilling and sampling will inevitably lead to disturbance, mixing or loss of material in some soil and rocks.

Indicated water levels are those recorded during the process of drilling or excavating exploratory holes and may not represent standing water levels.


Legends are drawn in accordance with BS 5930:1999 incorporating Amendment 2.

All depths are measured along the axis of the borehole and are related to ground level at the point of entry.




BH01

Depth 0.34 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru -ment	description	depth (m)	reduced level (m)	legend
05/03/14 2100hrs 05/03/14 2130hrs Dry	1C	0.00 - 0.35	Nil		100			TARMACADAM consisting of 40% blue and orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix. (MADE GROUND)	0.35	18.85	
								Borehole completed at 0.34m.			

EQUIPMENT: Geotechnical Pioneer rig.
METHOD: Waterflush rotary core drilled (300mm) 0.00-0.34m.
CASING: Not used.
BACKFILL: On completion, hole backfilled with lean mix concrete and highways repair macadam with bitumen seal.
REMARKS: Strong power signal detected on CAT scanner in concrete below road surface, hole abandoned.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks		CONTRACT 28998	CHECKED CT
				Groundwater not encountered prior to use of water flush.			



BH01A

CLIENT SKANSKA

SITE A47 NORTH BURLINGHAM DITCH

Sheet 1 of 1

Start Date 5 March 2014

Easting 634746.8

Scale 1 : 25

End Date 5 March 2014

Northing 309938.2

Ground level 19.17mOD

Depth 0.50 m

progress date/time	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru- ment	description	depth (m)	reduced level (m)	legend
05/03/14 2130hrs	1C	0.00 - 0.50	Nil		100			TARMACADAM consisting of 40% blue and orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix. (MADE GROUND)	0.50	18.67	
05/03/14 2230hrs Dry								Borehole completed at 0.50m.			

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Waterflush rotary core drilled (300mm) 0.00-0.50m.

CASING: Not used.

BACKFILL: On completion, hole backfilled with lean mix concrete and highways repair macadam with bitumen seal.

REMARKS: Strong power signal detected on CAT scanner in concrete below road surface, hole abandoned.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
------------------	------------	-------------	--------------------	---------

Groundwater not encountered prior to use of water flush.



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BOREHOLE LOG



CLIENT SKANSKA

BH01B

SITE A47 NORTH BURLINGHAM DITCH

Sheet 1 of 1

Start Date 7 March 2014

Easting 634742.9

Scale 1 : 50

End Date 7 March 2014

Northing 309939.2 Ground level 19.30mOD

Depth 6.45 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
07/03/14 0030hrs	1C	0.00 - 0.70	Nil		100		TARMACADAM consisting of 40% blue and orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix. (MADE GROUND)			
	X	0.70 - 1.50					0.60 - 0.70m: Recovered as angular to subrounded medium and coarse gravel.	0.70	18.60	
	2D*	0.90					Light reddish brown slightly clayey slightly gravelly fine SAND. Gravel is subangular and subrounded fine to coarse flint. (MADE GROUND)	1.00	18.30	
	3D	1.20					Firm light brown mottled reddish brown slightly sandy silty CLAY with rare subrounded medium flint gravel. (MADE GROUND)	1.35	17.95	
	4D	1.50 - 1.95	Nil	S 10			Loose to medium dense reddish brown clayey fine SAND.	2.10	17.20	
	X	1.50 - 2.50					Soft to firm light brown very sandy CLAY.			
	5D*	1.50					2.65 - 2.75m: Yellowish brown slightly clayey fine sand.			
	6D	1.90					2.85 - 2.90m: Yellowish brown slightly clayey fine sand.	3.10	16.20	
	7D*	2.20					Medium dense orangish brown very clayey fine SAND.			
	8D	2.50 - 2.95	Nil	S 13						
	X	2.50 - 3.50								
	9D	3.50 - 3.95	Nil	S 11						
	X	3.50 - 4.50								
	10D	3.70								
	11D	4.50 - 4.95	Nil	S 9						
	X	4.50 - 6.00								
	12D	4.70								
	13D	5.70					Soft light brown sandy CLAY.	5.40	13.90	
	14D	6.00 - 6.45	Nil	S 10			Loose to medium dense orangish brown very clayey fine SAND.	6.10	13.20	
07/03/14 0300hrs Dry							Soft white CHALK.	6.40	12.90	
							Borehole completed at 6.45m.	6.45	12.85	
								{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Waterflush rotary core drilled (146mm) 0.00-0.70m. Dynamic sampled (113mm) 0.70-4.50m and (98mm) 4.50-6.00m.

CASING: Not used.

BACKFILL: On completion, hole backfilled with bentonite pellets 6.45-0.70m, lean mix concrete and highways repair macadam with bitumen seal 0.70-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered.

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BH02

CLIENT SKANSKA

SITE A47 NORTH BURLINGHAM DITCH

Sheet 1 of 1

Start Date 5 March 2014

Easting 634722.8


Scale 1 : 25

End Date 5 March 2014

Northing 309937.2

Ground level 19.16mOD

Depth 0.35 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru- ment	description	depth (m)	reduced level (m)	legend
05/03/14 2230hrs 05/03/14 2330hrs Dry	1C	0.00 - 0.35	Nil		100			TARMACADAM consisting of 40% blue and orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix. (MADE GROUND)	0.35	18.81	
								Borehole completed at 0.35m.			

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Waterflush rotary core drilled (300mm) 0.00-0.35m.

CASING: Not used.

BACKFILL: On completion, hole backfilled with lean mix concrete and highways repair macadam with bitumen seal.

REMARKS: Strong power signal detected on CAT scanner in concrete below road surface, hole abandoned.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
------------------	------------	-------------	--------------------	---------

Groundwater not encountered.



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BOREHOLE LOG



BH03

CLIENT SKANSKA

SITE A47 NORTH BURLINGHAM DITCH

Sheet 1 of 1

Start Date 6 March 2014

Easting 634698.3

Scale 1 : 50

End Date 6 March 2014

Northing 309937.7 Ground level 19.26mOD

Depth 6.45 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
06/03/14 2130hrs	1C	0.00 - 0.40	Nil		100		TARMACADAM consisting of 40% blue and orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix. (MADE GROUND)			
	2C	0.40 - 1.30	Nil		100					
	3C	1.30 - 2.00	Nil		100					
	X 4D*	2.00 - 2.45 2.00 - 3.00 2.10	Nil	C 10				2.00	17.26	
	5D	2.50					Soft locally firm brown slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine and medium flint. (MADE GROUND)			
	6D X	3.00 - 3.45 3.00 - 4.00	4.00	S 8			Loose dark brown silty fine and medium SAND.	2.90	16.36	
	7D*	3.20								
	8D	3.50						3.70	15.56	
	9D X	4.00 - 4.45 4.00 - 5.00	4.00	S 10			Soft light brown silty fine and medium SAND.	4.00	15.26	
	10D*	4.20					Soft to firm light brown slightly sandy silty CLAY.			
	11D	4.40								
	12D X	5.00 - 5.45 5.00 - 6.00	4.00	S 8						
	13D*	5.20					Soft locally very soft light brown slightly sandy silty CLAY.	5.20	14.06	
	14D	5.50								
06/03/14 2345hrs Dry	15D	6.00 - 6.45	4.00	S 7				6.45	12.81	
							Borehole completed at 6.45m.			
								{8.00}		

EQUIPMENT: Geotechnical Pioneer rig.

METHOD: Waterflush rotary core drilled (250mm) 0.00-0.40m and (146mm) 0.40-2.00m. Dynamic sampled (113mm) 2.00-6.00m.

CASING: 140mm to 4.00m

BACKFILL: On completion, hole backfilled with bentonite pellets 6.45-0.70m, lean mix concrete and highways repair macacadam with bitumen seal 0.70-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered prior to use of water flush.

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BOREHOLE LOG



WS01

CLIENT SKANSKA

SITE A47 NORTH BURLINGHAM DITCH





Sheet 1 of 1

Start Date 13 February 2014

Scale 1 : 25

End Date 14 February 2014

Depth 1.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range		instru- ment	description	depth (m)	reduced level (m)	legend
13/02/14 1945hrs	1C 2B 3D* 4B 5D*	0.00 - 0.25 0.25 0.25 0.50 0.50						TARMACADAM consisting of 60% blue and pink angular to subrounded fine and medium crystalline clasts and 40% black fine matrix. (MADE GROUND)	0.10 0.25		
								TARMACADAM consisting of 40% blue and orange subangular to subrounded fine to coarse crystalline clasts and 60% black fine matrix. (MADE GROUND)	0.50		
								Black sandy angular to subangular fine to coarse concrete and tarmacadam GRAVEL with high concrete cobble content. (MADE GROUND)			
14/02/14 0330hrs Dry	6B 7D*	1.00 1.00						Black sandy angular to subrounded fine to coarse concrete GRAVEL with high concrete cobble content. (MADE GROUND) 1.00 - 1.20m: Blackish brown angular to rounded gravel.	1.20		
								Borehole completed at 1.20m.			

EQUIPMENT: Geotechnical Terrier 2000 rig.

METHOD: Waterflush rotary core drilled (250mm) 0.00-0.25m, hand dug inspection pit 0.25-1.20m.

BACKFILL: On completion, hole backfilled with lean mix concrete and highways repair macadam with bitumen seal

REMARKS: Concrete still present at 1.00m. Client refused drilling.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
------------------	------------	-------------	--------------------	---------

Groundwater not encountered.



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Geotechnical Engineering Limited

STANDARD PENETRATION TEST



CLIENT SKANSKA

SITE A47 NORTH BURLINGHAM DITCH

borehole no.	borehole depth (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
					blows	pen (mm)	blows		pen (mm)				
BH01B	1.50	1.95	Nil	Dry	1 2	75 75	2 3 2 3	75 75 75 75		S	10	66	
BH01B	2.50	2.95	Nil	Dry	2 2	75 75	2 4 3 4	75 75 75 75		S	13	66	
BH01B	3.50	3.95	Nil	Dry	2 2	75 75	2 3 3 3	75 75 75 75		S	11	66	
BH01B	4.50	4.95	Nil	Dry	2 2	75 75	2 2 2 3	75 75 75 75		S	9	66	
BH01B	6.00	6.45	Nil	Dry	2 2	75 75	2 2 2 4	75 75 75 75		S	10	66	
BH03	2.00	2.45	Nil	0.40	2 2	75 75	2 3 2 3	75 75 75 75		C	10	66	
BH03	3.00	3.45	Nil	1.24	2 2	75 75	2 2 2 2	75 75 75 75		S	8	66	
BH03	4.00	4.45	4.00	1.74	2 2	75 75	2 2 3 3	75 75 75 75		S	10	66	
BH03	5.00	5.45	4.00	2.14	2 2	75 75	2 2 2 2	75 75 75 75		S	8	66	
BH03	6.00	6.45	4.00	2.54	1 1	75 75	1 2 2 2	75 75 75 75		S	7	66	

- notes:
- 1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
 - 2. N values have not been subjected to any correction.
 - 3. Test carried out using split spoon S, solid cone C.
 - 4. Where full test drive not completed, linearly extrapolated N value reported.
 - 5. <1 Denotes hammer self weight penetration (sank under own weight).
 - 6. ** Denotes no effective penetration.

CONTRACT	CHECKED
28998	CT



APPENDIX B

PHOTOGRAPHY



28998. BH01 0.00-0.34m



28998. BH01A 0.00-0.35m





28998. BH02 0.00-0.31m



28998. BH03 0.00-0.40m



28998. BH03 0.40-3.00m



28998. BH03 3.00-6.00m



28998.WS01 0.00-0.25m



APPENDIX C

LABORATORY TESTING



TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : 17/03/14 PAGE 1 of 17 Pages

Contract

Serial No.

A47 North Burlingham

S27441



CLIENT:

Atkins Highways and
Transportation
Wellbrook Court
Girton Road
CAMBRIDGE,
CB3 0NA

Soil Property Testing

18 Halcyon Court, St Margarets Way,
Stukeley Meadows, Huntingdon,
Cambs. PE29 6DG.

Telephone (01480) 455579 Fax (01480) 453619
Email SPTownend@btclick.com

SAMPLES SUBMITTED BY:

Atkins Highways and

APPROVED SIGNATORIES:

- ☐ S.P.TOWNEND FGS
Technical Director
- ☐ W. JOHNSTONE
Deputy Technical/Quality Manager
- ☒ J.C.GARNER B.Eng (Hons.) FGS
Quality Manager

SAMPLES LABELLED:

A47 North Burlingham

DATE RECEIVED: 10/03/14

SAMPLES TESTED BETWEEN 10/03/14 and 17/03/14

REMARKS: For the attention of Angela Bellis

- NOTES:**
- 1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.
 - 2 (a) UKAS - United Kingdom Accreditation Service.
(b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
 - 3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.
 - 4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT.

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Contract
A47 North Burlingham

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S27441

SCHEDULE OF LABORATORY TESTS

[illegible]

Scheduled by: Atkins Highways and

Target Date: 17/03/14



TEST REPORT.

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S27441



DETERMINATION OF MOISTURE CONTENT

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH03	2.50	D2.5	19	Firm dark yellowish brown sandy silty CLAY	
BH03	3.00	S3.0	21	Soft yellowish brown sandy silty CLAY	
BH03	-3.45 3.50	D3.5	19	Soft yellowish brown slightly gravelly slightly sandy silty CLAY with occasional organic clay pockets. Gravel is fine rounded to subangular	
BH03	4.40	D4.4	15	Soft yellowish brown slightly sandy silty CLAY locally sandy	
BH03	5.00	S5.0	16	Soft light yellowish brown slightly sandy silty CLAY locally sandy	
BH03	5.50	D5.5	17	Soft mottled grey and orangey brown sandy silty CLAY with rare fine and medium gravel	
BH03	6.00	S6.0	19	Soft yellowish brown slightly gravelly slightly sandy silty CLAY locally sandy. Gravel is fine and medium rounded to subangular	
BH01B	1.20	D1.2	14	Stiff mottled grey and orangey brown sandy silty CLAY	
BH01B	1.50	S1.5	15	Firm yellowish brown slightly sandy silty CLAY locally sandy	
BH01B	1.90	D1.9	15	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is fine and medium rounded to subangular	
BH01B	2.50	D2.5	13	Soft yellow and yellowish brown sandy silty CLAY locally slightly sandy	
BH01B	2.50 -2.95	S2.5	13	Soft yellowish brown sandy silty CLAY with yellow fine sand pockets and occasional brown, light orangey brown and yellow mottling	
BH01B	3.50	S3.5	14	Firm yellowish brown slightly sandy silty CLAY with occasional light orangey brown mottling	
BH01B	3.70	D3.7	13	Firm yellowish brown sandy silty CLAY with occasional light orangey brown mottling	

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3

METHOD OF TEST : BS 1377:PART 2:1990:3.2

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



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DETERMINATION OF MOISTURE CONTENT

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH01B	4.50	S4.5	15	Soft yellowish brown slightly sandy silty CLAY locally sandy	
BH01B	4.70	D4.7	15	Soft yellowish brown sandy silty CLAY locally slightly sandy with occasional light orangey brown mottling	
BH01B	5.70	D5.7	22	Very soft yellowish brown slightly sandy silty CLAY locally sandy with occasional light orangey brown mottling	
BH01B	6.00	S6.0	17	Very soft locally soft and firm yellowish brown slightly gravelly slightly sandy silty CLAY locally sandy. Gravel is fine and medium rounded to subangular	

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3

METHOD OF TEST : BS 1377:PART 2:1990:3.2

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



TEST REPORT.

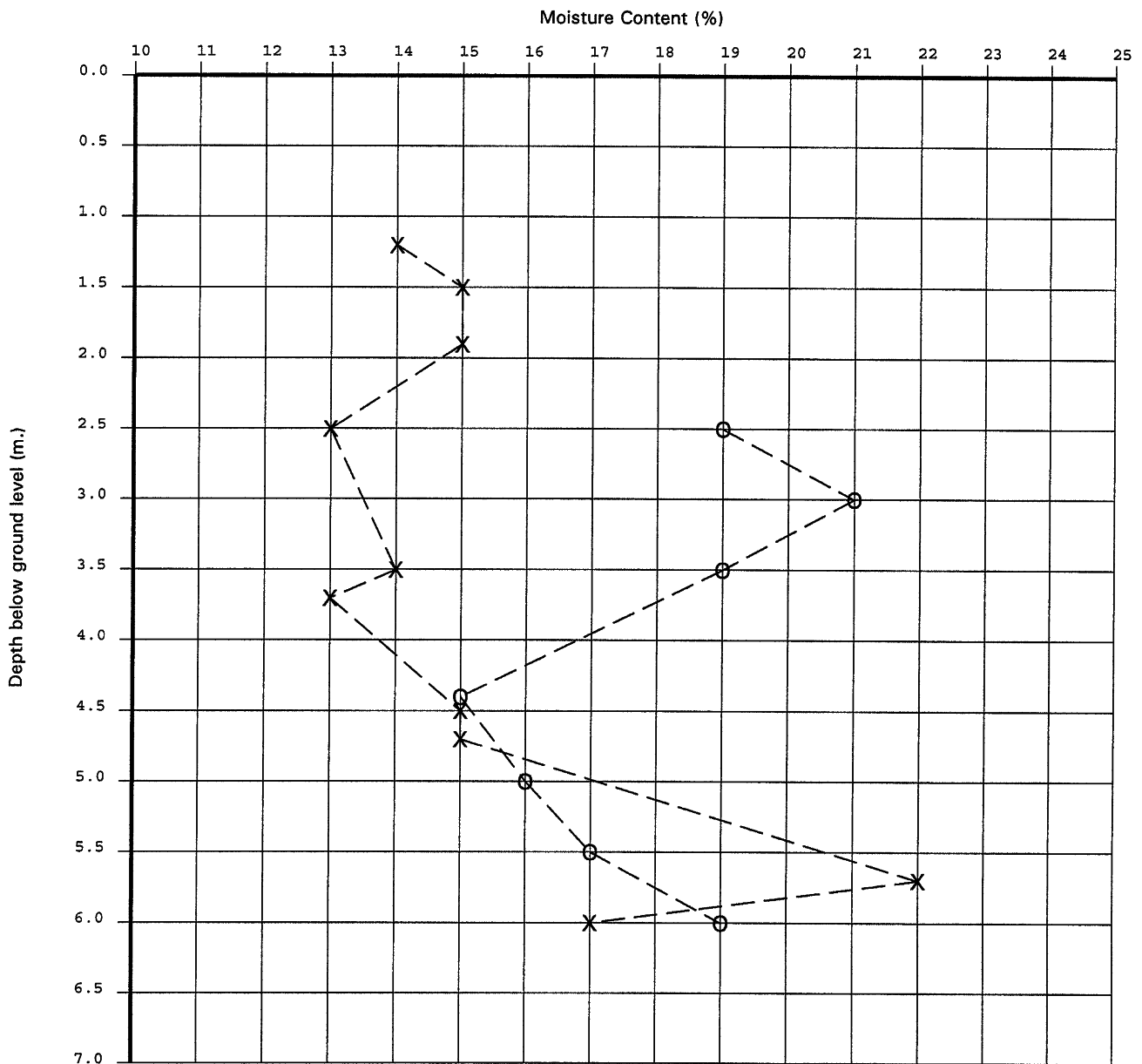
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Moisture Content (%) vs Depth below ground level (m.).



Key to
Data Points

X : BH01B O : BH03



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SUMMARY OF MOISTURE CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index (%)	SAMPLE PREPARATION				Description	CLASS
								Method S/N	Ret'd 0.425mm (%)	Corr'd M/C <0.425mm	Curing Time (hrs.)		
BH03	2.50	D2.5	19	22	15	7.0	0.57	N	0 (A)		74	Firm dark yellowish brown sandy silty CLAY	CL
BH03	3.50	D3.5	19	22	15	7.0	1.00*	S	14 (M)	22	73	Soft yellowish brown slightly gravelly slightly sandy silty CLAY with occasional organic clay pockets. Gravel is fine rounded to subangular	CL
BH03	5.00	S5.0	16	26	13	13	0.23	N	0 (A)		73	Soft light yellowish brown slightly sandy silty CLAY locally sandy	CL
BH01B	1.20	D1.2	14	23	14	9.0	0.00	N	0 (A)		73	Stiff mottled grey and orangey brown sandy silty CLAY	CL
BH01B	1.50	S1.5	15	30	14	16	0.06	N	0 (A)		25	Firm yellowish brown slightly sandy silty CLAY locally sandy	CL
BH01B	1.90	D1.9	15	24	12	12	0.33*	S	7 (M)	16	74	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is fine and medium rounded to subangular	CL
BH01B	4.50	S4.5	15	24	13	11	0.18	N	0 (A)		73	Soft yellowish brown slightly sandy silty CLAY locally sandy	CL
BH01B	6.00	S6.0	17	27	12	15	0.47*	S	10 (M)	19	26	Very soft locally soft and firm yellowish brown slightly gravelly slightly sandy silty CLAY locally sandy. Gravel is fine and medium rounded to subangular	CL

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2 S = Wet Sieved Specimen
N = prepared from Natural

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample,
C = Core Cutter. A = Assumed, M = Measured

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin
of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



TEST REPORT.

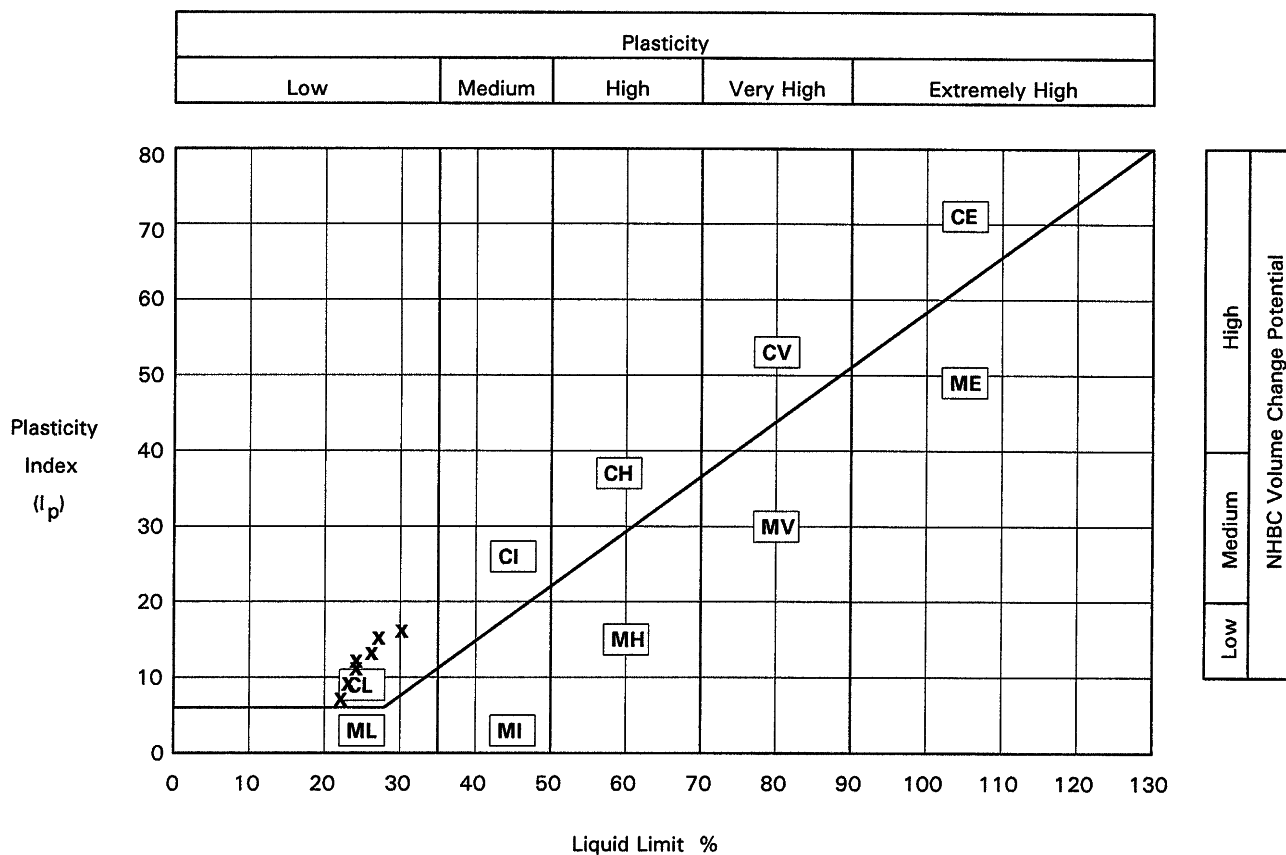
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PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
PLASTICITY CHART BS5930:1999:Figure 18



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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

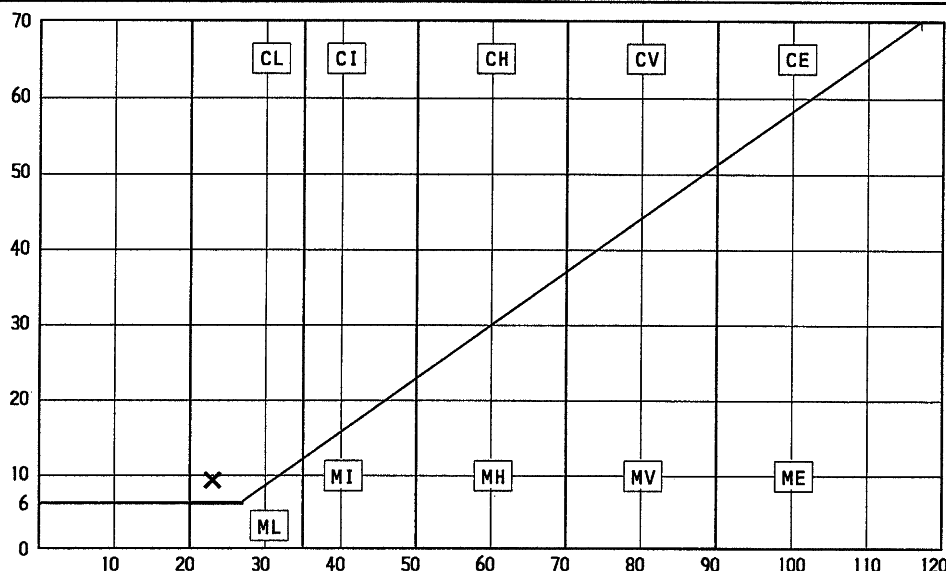
Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH01B	1.20	D1.2	14	Stiff mottled grey and orangey brown sandy silty CLAY	

PREPARATION				Liquid Limit	23 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	14 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	9.0 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.00
Curing Time 73 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.

C = CLAY

Plasticity
Index %
(I_p)

M = SILT



High
Medium
Low

NHBC Volume Change Potential

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'_p = I_p x (% less than 425 microns/100)



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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

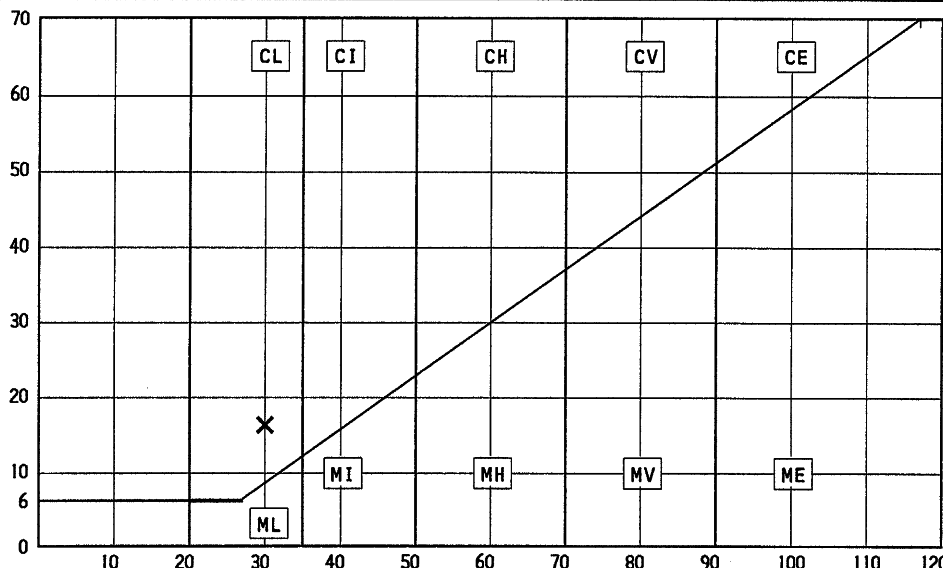
Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH01B	1.50	SI.5	15	Firm yellowish brown slightly sandy silty CLAY locally sandy	

PREPARATION				Liquid Limit	30 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	14 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	16 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.06
Curing Time 25 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.

C = CLAY

Plasticity
Index %
(I_p)

M = SILT



High
Medium
Low

NHBC Volume Change Potential

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p' = I_p x (% less than 425 microns/100)



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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

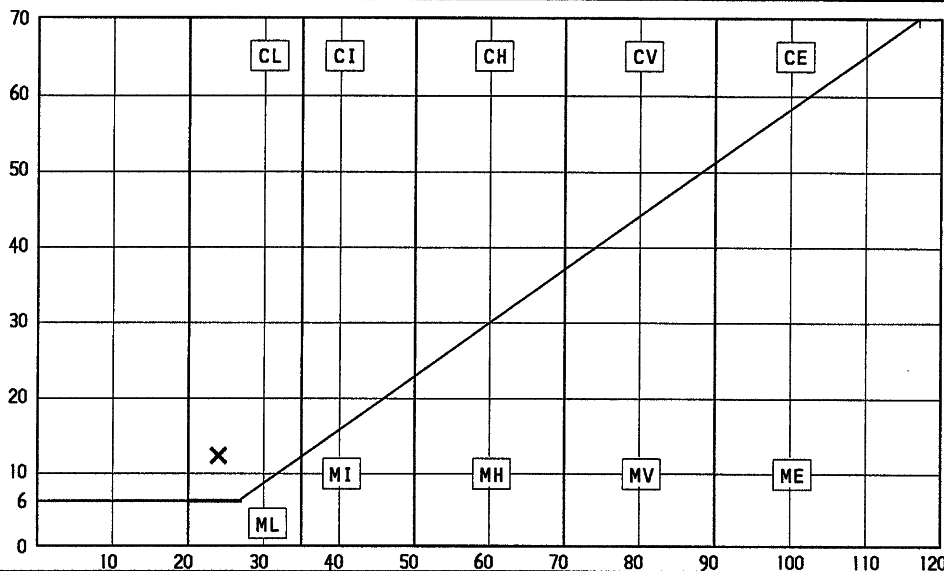
Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH01B	1.90	D1.9	15	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is fine and medium rounded to subangular	

PREPARATION				Liquid Limit	24 %
Method of Preparation Sieved Specimen				Plastic Limit	12 %
Sample retained 0.425 sieve (Measured) 7 %				Plasticity Index	12 %
Corrected moisture content for material passing 0.425mm 16 %				Liquidity Index	0.33
Curing Time 74 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.

C = CLAY

Plasticity
Index %
(I_p)

M = SILT



High
Medium
Low

NHBC Volume Change Potential

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p' = I_p x (% less than 425 microns/100)
2% RETAINED ON 2mm SIEVE
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.



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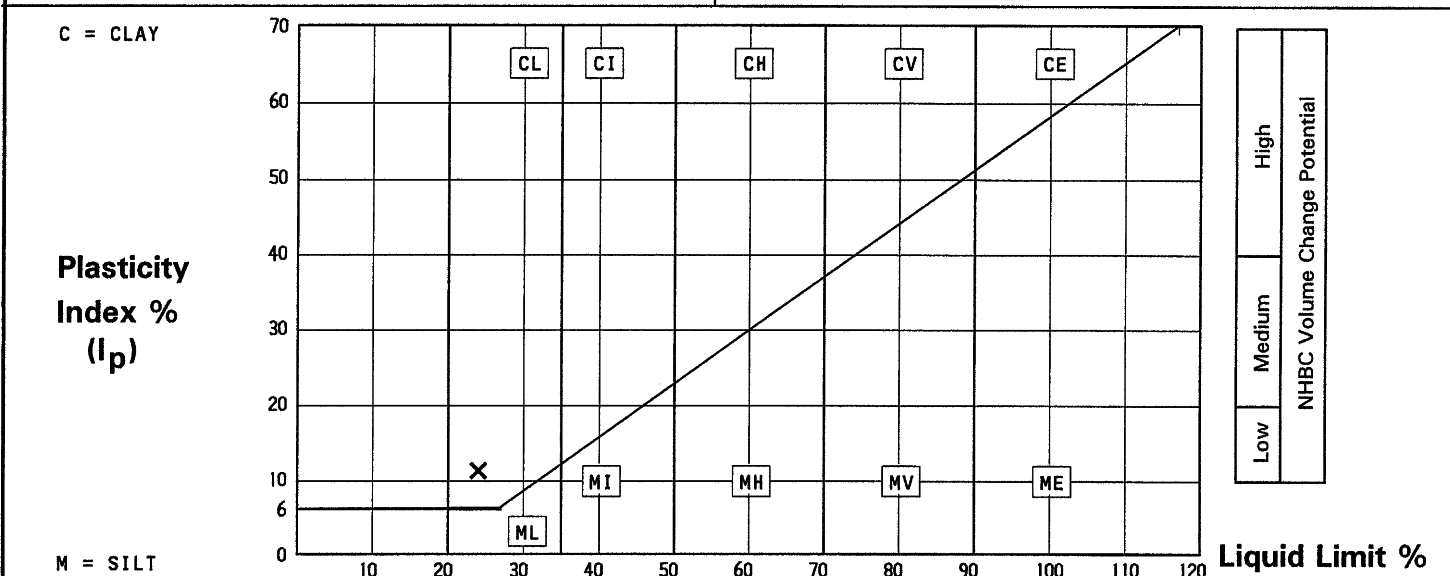
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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH01B	4.50	S4.5	15	Soft yellowish brown slightly sandy silty CLAY locally sandy	

PREPARATION				Liquid Limit	24 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	13 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	11 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.18
Curing Time 73 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample,
C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p = I_p x (% less than 425 microns/100)



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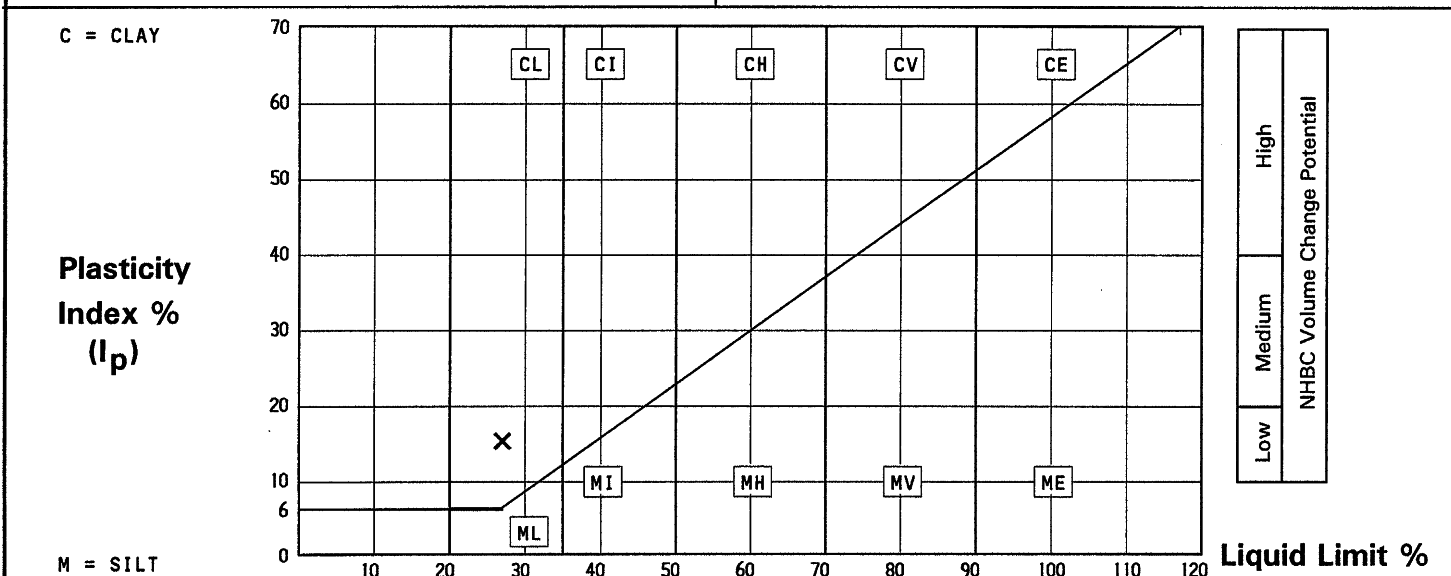
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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH01B	6.00	S6.0	17	Very soft locally soft and firm yellowish brown slightly gravelly slightly sandy silty CLAY locally sandy. Gravel is fine and medium rounded to subangular	

PREPARATION				Liquid Limit	27 %
Method of Preparation Sieved Specimen				Plastic Limit	12 %
Sample retained 0.425 sieve (Measured) 10 %				Plasticity Index	15 %
Corrected moisture content for material passing 0.425mm 19 %				Liquidity Index	0.47
Curing Time 26 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index $I'_p = I_p \times (\% \text{ less than } 425 \text{ microns}/100)$
3% RETAINED ON 2mm SIEVE
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.



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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

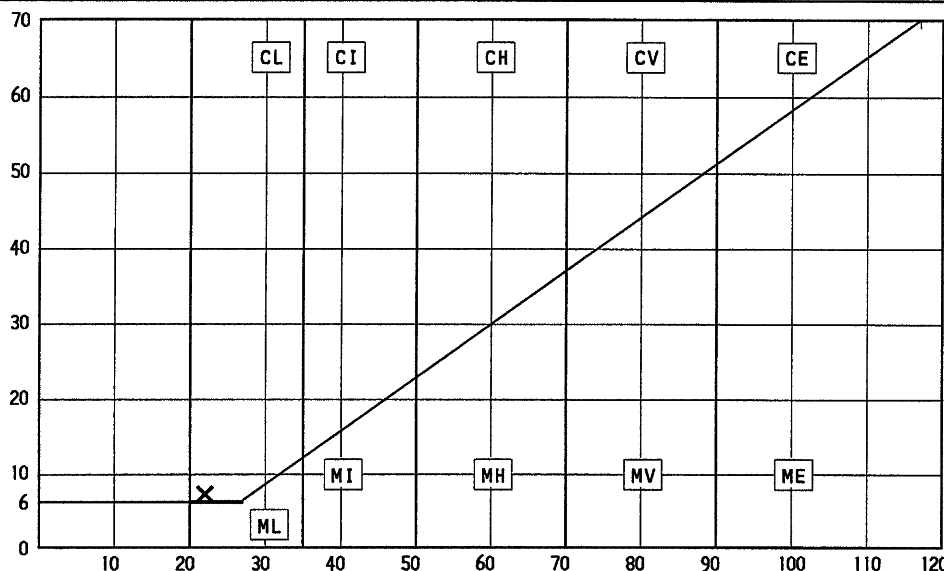
Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH03	2.50	D2.5	19	Firm dark yellowish brown sandy silty CLAY	

PREPARATION				Liquid Limit	22 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	15 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	7.0 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.57
Curing Time 74 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.

C = CLAY

Plasticity
Index %
(I_p)

M = SILT



High
Medium
Low

NHBC Volume Change Potential

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'_p = I_p x (% less than 425 microns/100)



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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

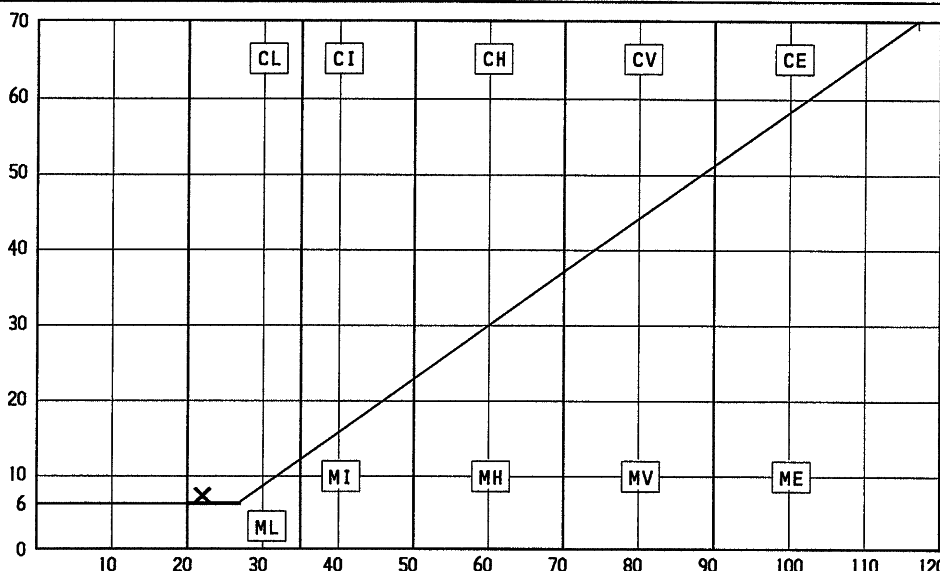
Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH03	3.50	D3.5	19	Soft yellowish brown slightly gravelly slightly sandy silty CLAY with occasional organic clay pockets. Gravel is fine rounded to subangular	

PREPARATION				Liquid Limit	22 %
Method of Preparation Sieved Specimen				Plastic Limit	15 %
Sample retained 0.425 sieve (Measured) 14 %				Plasticity Index	7.0 %
Corrected moisture content for material passing 0.425mm 22 %				Liquidity Index	1.00
Curing Time 73 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.

C = CLAY

Plasticity
Index %
(I_p)

M = SILT



High
Medium
Low

NHBC Volume Change Potential

Liquid Limit %

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p = I_p x (% less than 425 microns/100)
1% RETAINED ON 2mm SIEVE
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.



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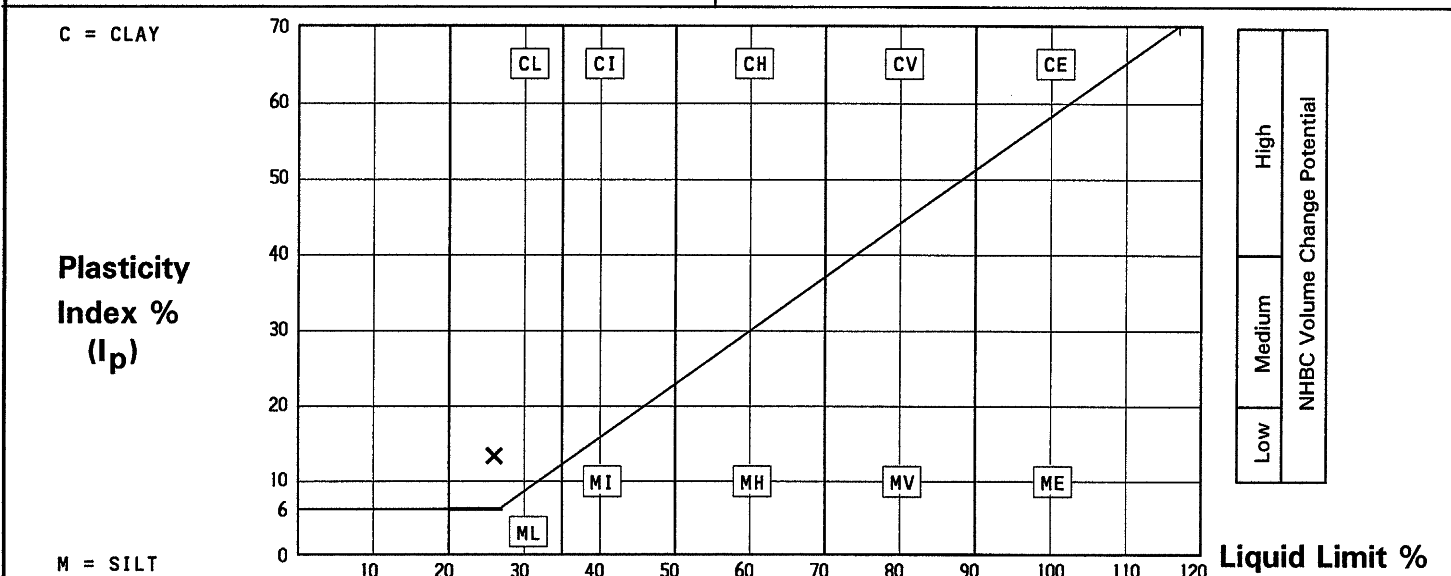
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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH03	5.00	S5.0	16	Soft light yellowish brown slightly sandy silty CLAY locally sandy	

PREPARATION				Liquid Limit	26 %
Method of Preparation Specimen from Natural Soil				Plastic Limit	13 %
Sample retained 0.425 sieve (Assumed) 0 %				Plasticity Index	13 %
Corrected moisture content for material passing 0.425mm %				Liquidity Index	0.23
Curing Time 73 Hours				Clay Content	Not analysed. %
				Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample,
C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I_p = I_p x (% less than 425 microns/100)



TEST REPORT.

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DETERMINATION OF THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Pit No.	Depth m.	Sample	Concentration of Soluble Sulphate			% of sample passing 2mm sieve	Description	Remarks
			Soil	Water	Groundwater			
			Acid Soluble SO ₃ %	Soluble 2:1 SO ₃ g/l	g/l			
BH03	2.50	D2.5		0.05		100	Firm dark yellowish brown sandy silty CLAY	
BH03	3.00 -3.45	S3.0		0.03		100	Soft yellowish brown sandy silty CLAY	
BH03	5.50	D5.5		0.05		100	Soft mottled grey and orangey brown sandy silty CLAY with rare fine and medium gravel	
BH01B	1.20	D1.2		0.10		100	Stiff mottled grey and orangey brown sandy silty CLAY	
BH01B	1.90	D1.9		0.04		98	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is fine and medium rounded to subangular	

METHOD OF PREPARATION: BS 1377:PART 1:1990:7.5 BS1377:PART 3:1990:5.2 Acid Soluble, 5.3 Soil/Water Extract :5.4 Groundwater

METHOD OF TEST : BS 1377:PART 3:1990:5.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Test not UKAS accredited.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.



TEST REPORT.

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DETERMINATION OF THE pH VALUE

Borehole/ Pit No.	Depth m.	Sample	pH Value	Description	Remarks
BH03	2.50	D2.5	7.1	Firm dark yellowish brown sandy silty CLAY	
BH03	3.00	S3.0	7.1	Soft yellowish brown sandy silty CLAY	
BH03	-3.45 5.50	D5.5	7.3	Soft mottled grey and orangey brown sandy silty CLAY with rare fine and medium gravel	
BH01B	1.20	D1.2	7.5	Stiff mottled grey and orangey brown sandy silty CLAY	
BH01B	1.90	D1.9	7.2	Soft yellowish brown slightly gravelly sandy silty CLAY. Gravel is fine and medium rounded to subangular	

METHOD OF PREPARATION: BS 1377:PART 1:1990:7 BS 1377:PART 3:1990:9.4

METHOD OF TEST : BS 1377:PART 3:1990:9.5

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Test not UKAS accredited.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

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GEOTECHNICAL CERTIFICATE

Scheme Title A47 North Burlingham Ditch

(Scheme specific) Certificate Seq. No.
HAGDMS No.

002
27732

GEOTECHNICAL CERTIFICATE

Form of Certificate to be used by the Designer for certifying the design of geotechnical works

1. We certify that the Report*, ~~Design Data*~~, ~~Drawings*~~ or Documents* for the Geotechnical Activities listed below have been prepared by us with reasonably professional skill, care and diligence, and that in our opinion:
 - i. constitute an adequate and economic design for the project
 - ii. solutions to all the reasonably foreseeable geotechnical risks have been incorporated
 - iii. the work intended is accurately represented and conforms to the ~~Employer's*~~/Client's* requirements
 - iv. with the exception of any item listed below or appended overleaf, the documentation has been prepared in accordance with the relevant standards from the Design Manual for Roads and Bridges and the Manual of Contract Documents for Highway Works.

2. LIST OF REPORTS, DESIGN DATA, DRAWINGS OR DOCUMENTS

GTG20081676/149/R.002 A47 North Burlingham Ditch – PSS-GIR Technical Memo Rev. 2

3. DEPARTURES FROM STANDARDS

None

*Report finished by Atkins/skanska
under Residual Duties*

*4. INCORPORATION OF GEOTECHNICAL DATA INTO CONSTRUCTION DETAILS

where the certificate is accompanying final design data the following statement shall also be included

The Reports, Design Data Drawings or Documents listed in 2 above have been accurately translated onto the construction drawings or other design documents bearing the unique numbers listed below/appended overleaf.

Signed: Dr W Belli
Designer (Designers Geotechnical Advisor)

Name: Mrs Angela Bellis

Date: 25/8/16

On behalf of: Atkins Limited

*Signed: M. S. Shaw
*Contractor (Agent or Contracts Director)

*Name: MARK GRIMLEY

*Date: 12/09/2016

*On behalf of: SKANSKA UK

This Certificate is:

- (a) received* (see note)
- (b) ~~received with comments as follows:~~* (see note)
- (c) ~~returned marked "comments" as follows:~~* (see note)

Signed: M. S. Shaw
Overseeing Organisation Geotechnical Advisor

Name: M. SHAW

Date: 20/9/16

Note:

'Received' = Submission accompanying certificate is accepted.

'Received with comments' = Submission accompanying certificate generally acceptable but require minor amendment which can be addressed in subsequent revisions.

'Returned marked comments' = Submission accompanying certificate unacceptable and should be revised and resubmitted.