BURO HAPPOLD

Survey

Project	The People's Project
Subject	Regent Road – Factual Report on Ground Investigation
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1 Document cover sheet

The document below is the Bramley-Moore Dock Wall Factual Report on Ground Investigation, produced by Structural Soils Ltd, November 2019

Bramley Moore Dock Wall

Factual Report on Ground Investigation

Project No: 764954

Client: Everton Stadium Development Limited

NOVEMBER 2019

STRUCTURAL SOILS LTD

Project No.:	764954
Report No.:	764954-1 (02)
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Document Title	Factual Report on Ground Investigation
Client:	Everton Stadium Development Limited
Engineer:	Buro Happold
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CONTENTS

1 INTRODUCTION

Structural Soils Limited (SSL) have been instructed by Buro Happold (the Engineer) on behalf of Everton Stadium Development Limited (the Client) to undertake a ground investigation at the site of Everton Football Club's new stadium at Bramley Moore Dock, Liverpool.

Pedestrian access for the new stadium is proposed to be via Regents Road, through several large new openings to be formed at various locations along the existing boundary wall between the dock and Regents Road. The purpose of the work was to obtain geotechnical and structural information to gain a detailed understanding of the structural build up of the wall. This information will determine what structural interventions may be required to support these new openings.

The works included an intrusive investigation (comprising horizontal masonry cores through the dock wall, hand and machine excavated trial pits at the base of the wall, and Dynamic Cone Penetrometer testing) together with non-intrusive Ground Penetrating Radar (GPR) scans of the wall, laboratory testing and the preparation of this report.

The ground investigation has been carried out in accordance with the contract specification, and the general requirements of BS 5930:2015, BS 10175:2011+A2:2017, BS EN 1997-2 (2007), BS EN ISO 22475-1 (2006) and their relevant standards.

SSL have undertaken a previous ground investigation at Bramley Moore Dock. Full details of the investigation are presented in the 764393: Project Blue Ground Investigation report.

This report presents the factual records of the fieldwork carried out and laboratory testing. Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks. All information given in this report is based on the ground conditions encountered during the site work, and on the results of laboratory and field tests performed during the investigation. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes.

This report was prepared by SSL for the sole and exclusive use of Buro Happold in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded. No liability will be accepted after a period of 6 years from the date of the report.

2 SITE DESCRIPTION

2.1 Site Location

The site which extends to 8.67 hectares, comprises Bramley-Moore Dock (BMD), on the River Mersey (centred on National Grid Reference (NGR) SJ3345292491).

To the north of BMD is Wellington Dock, which has been infilled and houses the United Utilities Wastewater Treatment Works (UU WwTW) (Planning Ref: 11F/1581, approved 12/01/2012), whilst to the northwest lies Sandon Half-Tide Dock, which remains connected to BMD via a pair of dock gates. Sandon Half-Tide Dock lies within the operational Port.

To the east of BMD, on the opposite side of Regent Road, lies a timber retailer, tyre retailer, and offices/residential uses. There is a public house, The Bramley Moore, across Regent Road from the southeast corner of the site.

To the south lies Nelson Dock, the connective dock gate to which is sealed with hydraulic connectivity maintained via pipe works/sluice gates. The dock comprises hard-standing to the perimeter of the dock water body and existing surface water drainage discharges into the River Mersey.

The western boundary of the site is the elevated River Mersey (sea / crown) wall, which forms a flood defence to the site.

2.2 Geology

Information on the geology of the site was obtained from the following sources published by the British Geological Survey (BGS):

- BGS map (Sheet 96, Liverpool, scale 1:50,000, published 2006).
- The BGS digital geology map, which utilises the most up to date names for geological units (www.bgs.ac.uk/data).
- The BGS Lexicon of Named Rock Units, which provides typical descriptions for most geological units (www.bgs.ac.uk/lexicon).

The site is shown to be underlain by the following descending sequence of strata:

TABLE 1 : SUMMARY OF EXPECTED SITE GEOLOGY	
Geological Unit Name	**Description**
DRIFT DEPOSITS	
Made Ground	Deposits associated with major industrial complexes and dockland areas.
Tidal Flat Deposits	Clay, Silt and Sand. Superficial deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by shorelines.
Till Devensian	Clay, Sandy, Gravelly Cobbly. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions.

SOLID GEOLOGY	
Chester Formation – Sandstone (Sherwood Sandstone Group)	Pebbly (gravelly). Sedimentary Bedrock formed approximately 247 to 250 million years ago in the Triassic Period. Local environment previously dominated by rivers
OTHER FEATURES	
A named fault, the Castle Street Fault, is noted approximately 150m to the east of the site. The fault generally trends north-south with downthrow to the east.	

Note: Information obtained from BGS digital records © NERC.

2.3 General

The ground investigation was carried out and supervised by SSL between 29 July and 31 July 2019. The scope of works and positions were determined by the Engineer and were set out and surveyed by SSL. Positions were adjusted where necessary to take account of buried or overhead services, or other restrictions on site.

The exploratory hole and in-situ test locations are shown on the Exploratory Hole Location Plan presented in Appendix A.

2.4 Scope of Works

The exploratory holes are listed in the following table.

TABLE 2 : SCOPE OF INTRUSIVE WORKS

Quantity	Exploratory Hole Type	Maximum depth (m)	Hole / Test Numbers
1	Hand & Machine Dug Trial Pits	1.70	TP01
2	Machine Dug Trial Pits.	2.60	TP02/TP03
3	Horizontal Masonry Cores	(Max wall thickness) 0.64	CR01/ CR02/ CR03
4	Dynamic Cone Penetrometer tests.	1.97	TRL DCP 1/2/3

The exploratory hole logs are presented in Appendix B. These provide information including the equipment and methods used, samples taken, tests carried out, water observations and descriptions of the strata encountered. Explanation of the terms and abbreviations used on the logs is given in the Key to Exploratory Hole Records in Appendix B, together with other explanatory information.

The holes were logged by an engineering geologist in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1). Detailed descriptions, together with relevant comments, are given on the logs.

On completion of the works, a survey of the exploratory hole locations was undertaken using specialist Differential Global Positioning System (DGPS) equipment. The coordinates of each exploratory hole were measured relative to British National Grid, and the level relative to Ordnance Datum. These are shown on the exploratory hole logs which have been printed with a reduced level column.

2.5 Buried Service Avoidance

In order to reduce the risk of damaging buried services, prior to the commencement of any exploratory hole or intrusive test a scan was carried out at surface using a cable avoidance tool (CAT) and signal generator ('genny'). In addition, all mechanically excavated trial pits, horizontal concrete cores and DCP probe locations were scanned using ground penetrating radar (GPR) equipment in line with SSL procedures.

2.6 Trial Pits

Three trial pits were excavated to a maximum depth of 2.60 m using a tracked mechanical excavator with the aim of determining the extent and make-up of the buried foundations of the dock side of the boundary wall.

The trial pits were logged by an engineering geologist who provided a detailed description of the ground conditions encountered in each pit, the foundation materials and construction; and also obtained disturbed soil samples at regular intervals for geotechnical analysis.

The strata encountered in the trial pits are described on the trial pit logs presented in Appendix B of this report together with detailed sketches and photographs of the faces and foundations.

On completion the trial pits were backfilled using arisings.

2.7 Horizontal Masonry Cores

In order to determine the construction layout and materials of the wall, a portable coring device was attached to the wall at the required locations to allow coring in a horizontal direction. A total of eight samples were obtained using a diamond tipped coring bit to form cores of 57 mm nominal diameter.

The cores were logged by an engineering geologist who provided a detailed description of the materials encountered and construction methods. Cores were retained for specialist laboratory testing.

The strata encountered are described in the core logs presented in Appendix B of this report together with photographs of the recovered cores.

2.8 Ground Penetrating Radar Survey

A non-intrusive horizontal GPR survey was undertaken of the dock boundary wall at three locations as determined by the Engineer. The survey was undertaken using specialist GPR techniques by RSK Geophysical, a division of RSK Environment Limited.

The surveyed sections were each approximately 8 m in length and conducted from ground level for the full height of the wall at each location. The survey locations were selected to correlate with the location of the masonry cores in order that validation of the GPR results could be undertaken.

Full details of the survey including the methods employed and interpretation of the results are presented in the RSK Geophysical Report presented in Appendix F.

2.9 In-situ Testing

2.9.1 TRL Dynamic Cone Penetrometer Tests

Four dynamic cone penetrometer (DCP) tests were undertaken immediately next to the trial pits (two next to TP02, and one each next to TP01 & TP03 respectively).

Tests were conducted in accordance with the manufacturer's guidance using conventional equipment comprising a 60° cone connected by a series of rods to an 8 kg drop weight hammer. The rods were driven into the ground by the drop weight falling through a height of 575 mm and the number of blows versus rod penetration was recorded.

Tests were performed to a maximum depth of 2.00 m or where low penetration rates indicated a subsurface obstruction.

Results of the tests are presented in Appendix C together with an interpreted assessment of the California Bearing Ratio with depth at each location.

3 LABORATORY TESTING

Samples for potential geotechnical testing were returned to the Company's UKAS accredited laboratory facilities in Castleford. Laboratory tests were scheduled by the Engineer and tests were carried out in accordance with MCERTS/UKAS standards where noted on the results sheets.

3.1 Geotechnical Laboratory Testing

Geotechnical laboratory testing was generally carried out in accordance with the relevant part of BS1377: 1990, *Methods of Test for Soils for Civil Engineering Purposes*, or, where superseded, by the relevant part of BS EN ISO 17892:2014+ *Geotechnical investigation and testing – Laboratory Testing of Soil*.

The number of tests completed and the test methods used are summarised below.

- Liquid and plastic (Atterberg) limits (including moisture content, carried out in accordance with BS 1377-2:1990)
- Particle size distribution by sieving.
- Particle size distribution by sedimentation.

Where non-standard procedures have been undertaken, this is recorded on the report sheet. The results are reported in tabular and/or graphical form and included as Appendix D of this report.

3.2 Masonry Core Testing

A programme of masonry core testing was specified by the Engineer. The scheduled tests comprised the following:

- Compressive strength in accordance with BS EN 1926:2006
- Determinations of mix proportions of mortar in accordance with BS 4551: 2005+A2: 2013.

Tests were performed by the specialist materials and structures laboratory of RSK Environment Ltd. The test results are be presented in Appendix E of this report.

4 REFERENCES

4.1 BS 5930:2015 *Code of practice for ground investigations*

4.2 BS EN 1997-1:2004 *Eurocode 7 — Geotechnical Design Part 1 - General Rules* incorporating corrigendum Feb 2009 and Amemdment A1 2013

4.3 BS EN 1997-2:2007 Eurocode 7 — *Geotechnical design Part 2: Ground Investigation and testing*

4.4 BS 10175:2011 *Investigation of potentially contaminated sites: Code of practice*, including amendment A2 2017

4.5 British Geological Survey sheet 96 scale 1:50,000, published C2006

4.6 British Geological Survey online digital geological map, www.bgs.ac.uk/data

4.7 British Geological Survey Lexicon of Named Rock Units, www.bgs.ac.uk/lexicon

4.8 BS EN ISO 14688-1:2018 *Geotechnical investigation and testing – Identification and classification of soil: Part 1: Identification and description.*

4.9 BS EN ISO 14688-2:2018 *Geotechnical investigation and testing – Identification and classification of soil: Part 2: Principles for a classification.*

4.10 BS EN ISO 14689-1:2003 *Geotechnical investigation and testing – Identification and classification of rock: Part 1: Identification and description*

4.11 BS EN ISO 22475-1:2006 *Geotechnical Investigation and Testing – Sampling methods and groundwater measurements, Part 1 Technical principals for execution*

4.12 BS 1377:1990 *Method of Test for Soils for Civil Engineering Purposes*

4.13 BS EN ISO 17892:2014 *Geotechnical investigation and testing – Laboratory Testing of Soil*

4.14 SSL Report: 764393 Project Blue Ground Investigation Factual Report (2018)

APPENDIX A -
PLANS AND DRAWINGS

(i) Site Location Plan

(ii) Exploratory Hole Location Plan

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REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	29.08.2019	-	NP	IH	-

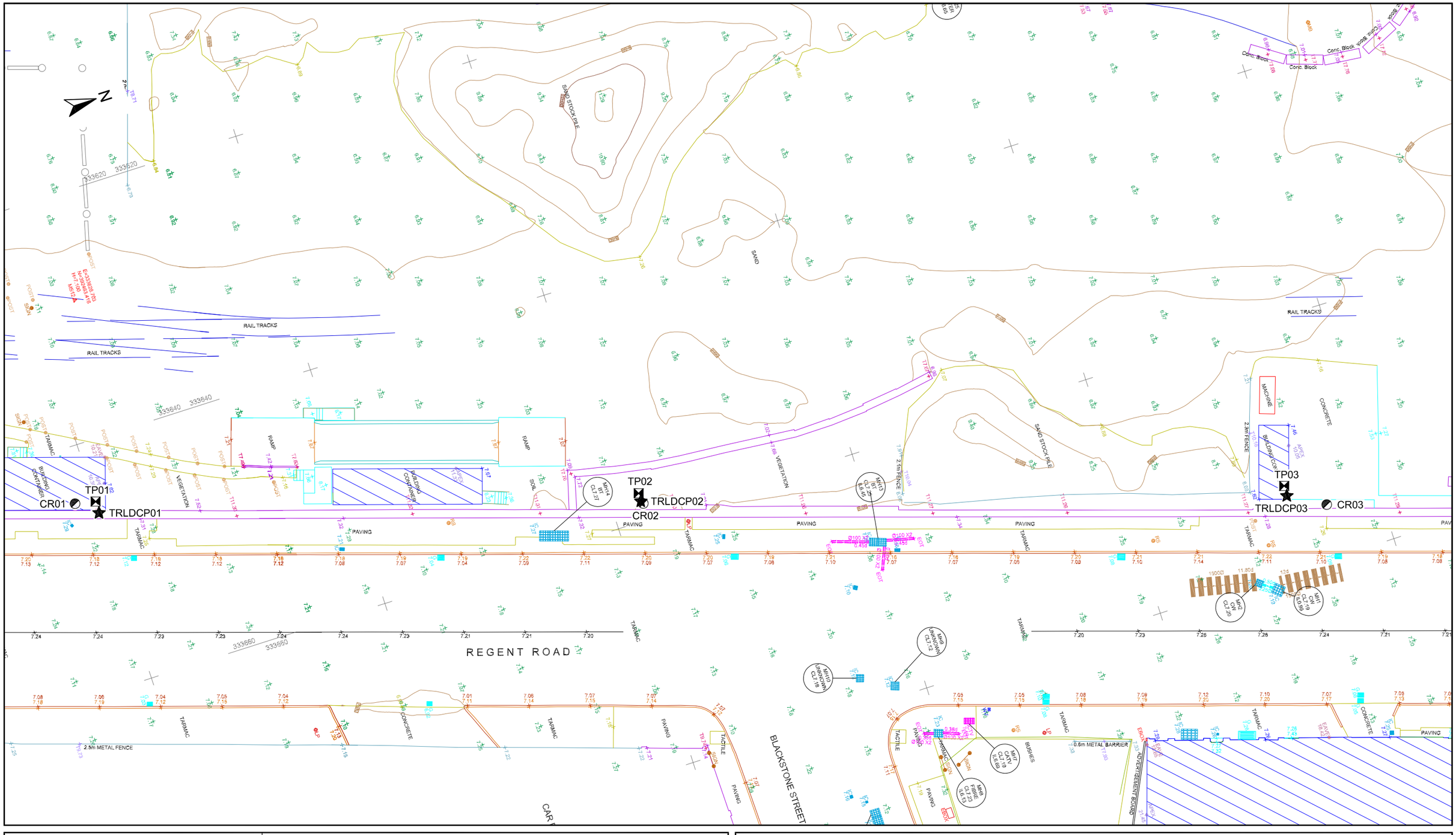
DIMENSION	SCALE	DRAWING STATUS
m	1:25,000	-

CLIENT
Everton Stadium Development Limited

PROJECT
Bramley Moore Dock Wall

TITLE
SITE LOCATION MAP

JOB NO	GRID REF	SCALE BAR	ORIGIN SIZE	FIGURE
764954	SJ 336 925	0 250 500 750 1,000m	A4	1



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REV	DATE	DESCRIPTION	BY	CHD	APR
00	10.09.2019	-	MW	IH	-

DIMENSION	SCALE	ORIGIN SIZE
m	1:300	A3

CLIENT: Everton Stadium Development Limited

PROJECT: Bramley Moore Dock Wall

TITLE: EXPLORATORY HOLE LOCATION PLAN

JOB NO	SCALE BAR	FIGURE
764954	0 4 8 12 16m	2

LEGEND

- Trial Pit Location
- Dynamic Cone Penetration Location
- Concrete Core Location

APPENDIX B - EXPLORATORY HOLE RECORDS

(i) Key to Exploratory Hole Logs

(ii) Masonry Core Logs

(iii) Trial Pit Logs

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

SAMPLING

Sample type codes

B	=	Bulk disturbed sample.
C	=	Core sample.
D	=	Small disturbed sample.

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.
2. Material types divided by a broken line (- - -) indicates an unclear boundary.
3. The data on any sheet within the report showing the AGS icon is available in the AGS format.

GINT_LIBRARY_V8_07.GLB|GrfcText G - LEGEND - 1 OF 2 | 764954 - BRAMLEY MOORE DOCK WALL.GPJ - v8_07 | 27/08/19 - 09:35 | IH1
Structural Soils Ltd, Branch Office - Castleford: The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email:north@soils.co.uk.

STRUCTURAL SOILS

Contract Reference: **764954**

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

WATER COLUMN SYMBOLS

First water strike, second water strike etc.

Standing water level following first strike, standing water level following second strike etc.

Seepage.

Standing water level recorded at documented date.

MATERIAL GRAPHIC LEGENDS

MADE GROUND

Sandstone

Sandy gravelly CLAY

Sandy gravelly silty CLAY

Gravelly silty SAND

INSTRUMENTATION SYMBOLS

Backfill

Cement grout

STRUCTURAL SOILS

FINAL

GENERAL LOG

Contract:	Client:	Exploratory position:
Bramley Moore Dock Wall	**Everton FC**	**CR01**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
764954	**30.07.19**	**7.11**	**E:333644.7 N:392458.5**	**1** of **4**

Depth	Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
0.00-0.10			Very strong non-jointed non-fractured yellowish grey with frequent black specks GRANITE. (MADE GROUND)	(0.10) 0.10	
0.10-0.50			Strong occasionally jointed grey to dark grey gravelly HYDRAULIC CEMENT with medium cobble content, angular 60-120mm of sandstone. Gravel is angular to rounded 1-3mm of mixed lithologies including sandstone, quartzite & augite. 15% voids, 2-40mm size. (MADE GROUND)	(0.40) 0.50	
0.50-0.64			Very strong non-jointed non-fractured yellowish grey with frequent black specks GRANITE. (MADE GROUND)	(0.15) 0.64	
			Core terminated at 0.64m distance (thickness of wall).		

General Remarks

1. Hole backfilled with concrete and re-faced with existing granite facings upon completion.
2. Dockside wall 4.0m high, granite facings with sandstone rubble and hydraulic cement fill. Topped with flush rounded coping stones of granite.
3. Horizontal concrete core through wall at 0 degrees from horizontal.

All dimensions in metres | Scale: **1:4**

Method Used:	Plant Used:	Logged By:	Checked By:
Concrete core	**Hilti Concrete Corer**	**IHayes**	NG

STRUCTURAL SOILS

FINAL

GENERAL LOG

Contract:		Client:		Exploratory position:
Bramley Moore Dock Wall		**Everton FC**		**CR01**
Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
764954	**30.07.19**	**7.11**	**E:333644.7 N:392458.5**	**2** of **4**

Core 01

Method Used:	Plant Used:	Logged By:	Checked By:
Concrete core	**Hilti Concrete Corer**	**IHayes**	**NG**

STRUCTURAL SOILS

FINAL

GENERAL LOG

Contract:		Client:		Exploratory position:
Bramley Moore Dock Wall		**Everton FC**		**CR01**
Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
764954	**30.07.19**	**7.11**	**E:333644.7 N:392458.5**	**3** of **4**

Core 01 close up 1

Core 01 close up 2

Method Used:	Plant Used:	Logged By:	Checked By:
Concrete core	**Hilti Concrete Corer**	**IHayes**	**MG**