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St Edward Homes Limited
Report

Date
March, 2016

GREEN PARK VILLAGE **GROUND** **INVESTIGATION** **REPORT**

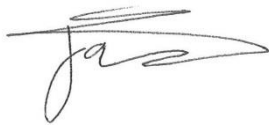
GREEN PARK VILLAGE GROUND INVESTIGATION REPORT

Revision **1**
Date **04/01/2017**
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Description **Ground Investigation Report**

Ref 1620000492/RPT/002

Revision	Date	Purpose / Status	Document Ref.	Comments
-	17/03/2016	Draft/Comment	1620000492/RPT/002	
1	04/01/2017	Use/Final	1620000492/RPT/002	Updated to include for remediation works undertaken in Phase 1 and Phase 5

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CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	3
1.1 Objectives and Scope of Report	3
1.2 Existing Reports and Information Sources	3
1.3 Report Limitations	4
2. EXISTING INFORMATION	4
2.1 Location and Site Description	4
2.2 Proposed Development	4
2.3 Site History	5
2.4 Geology	6
2.5 Topography	6
2.6 Hydrology and Hydrogeology	6
2.7 Flood Risk	7
3. EXISTING GROUND INVESTIGATION	7
3.1 General	7
3.2 Laboratory Testing	8
4. ADDITIONAL GROUND INVESTIGATION	9
4.1 General	9
4.2 Sampling and In-situ Testing	10
5. GROUND CONDITIONS	10
5.1 Site Wide Geology	10
5.2 Topsoil	10
5.3 Made Ground	10
5.4 Alluvium	11
5.5 River Terrace Deposits	11
5.6 Lambeth Group	12
5.7 Chalk Formation	12
5.8 Groundwater	13
6. CHARACTERISTIC MATERIAL PROPERTIES	13
6.1 Commentary on the Selection and Use of Parameters	13
6.2 Alluvium	15
6.3 River Terrace Deposits	16
6.4 Lambeth Group	16
6.5 Upper Chalk Formation	16
6.6 Summary of Geotechnical Parameters	16
7. GEOTECHNICAL RECOMMENDATIONS FOR DEVELOPMENT	17
7.1 Earthworks	17
7.1.1 General Requirements for Imported Fill for Earthworks	18
7.1.2 Phase 1, 3, 4 and 5 Earthworks	18
7.1.3 Phase 1C and Phase 2	19
7.1.4 Phase 6	20
7.2 Foundation Design	20
7.2.1 Phase 1 Zones 1 and 2	21
7.2.1.1 Ground Improvement	21
7.2.1.2 Pile Foundations	22
7.2.1.3 Buried Concrete	23
7.2.2 Phase 1 Zone 3	23
7.2.3 Phase 2	23

7.2.4	Phase 3, 4 and 5	24
7.2.5	Phase 6	25
8.	GEOTECHNICAL RISK REGISTER	27
9.	REFERENCES	30

TABLES

Table 1	Summary of site history	5
Table 2	Summary of ground investigations	8
Table 3	Summary of geotechnical laboratory tests	9
Table 4	Geological descriptions	10
Table 5	Summary of exploratory holes where full thickness of River Terrace Deposits were encountered	12
Table 6	Typical stratum levels for the Lambeth Group	12
Table 7	'Table 1' from BS 8002:2015	14
Table 8	Summary of characteristic geotechnical parameters	17
Table 9	Estimated fill volumes	17
Table 10	Summary of fill thickness	19
Table 11	BH105 ground profile	22
Table 12	Estimated safe working loads for 400 mm and 500 mm diameter CFA piles	22
Table 13	Ground profiles for pile design for Phase 2	23
Table 14	Suggested ground profile for Phase 5	24
Table 15	Estimated safe working loads for 300 mm and 400 mm diameter CFA piles in Phase 5	25
Table 16	Suggested ground profile for Phase 6	25
Table 17	Estimated safe working loads for 400 mm and 500 mm diameter CFA piles in Phase 6	26
Table 18	Geotechnical risk register	29

FIGURES

Figure 1	Site Location
Figure 2	Phase Plan
Figure 3	Overview of Exploratory Hole Locations
Figure 4	Location of Phase 1 Exploratory Hole Locations
Figure 5	Location of Phase 2 Exploratory Hole Locations
Figure 6	Location of Phase 3 Exploratory Hole Locations
Figure 7	Location of Phase 4 Exploratory Hole Locations
Figure 8	Location of Phase 5 Exploratory Hole Locations
Figure 9	Location of Phase 6 Exploratory Hole Locations
Figure 10	Plan of estimated fill volumes
Figure 11	Plan showing extent of infill of Trout Lakes
Figure 12	Plan showing extents of Zones 1, 2 and 3 of Phase 1
Figure 13	Apartment blocks in Phase 5

APPENDICES

APPENDIX 1

EXPLORATORY HOLE LOCATIONS AND GEOLOGICAL SECTIONS

APPENDIX 2

DATA PLOTS FOR GEOTECHNICAL TESTS

APPENDIX 3

TEST RESULTS FOR EXISTING FILL MATERIAL

APPENDIX 4

GCL PLANS AND SECTIONS

APPENDIX 5

REPORT RELIANCE

EXECUTIVE SUMMARY

Scope

Purpose of the report

This report is a Ground Investigation Report (GIR) which summarises historical ground investigations and supplementary ground investigations and presents an interpretation of the factual data. Geotechnical design parameters have been derived for earthworks and foundation design and are summarised in Table 7.

Proposed development

At the time of writing the proposed development comprises six separate phases. Phases 1, 4 and 5 contain residential units, Phase 2 contains community facilities and Phase 3 contains residential units and a wetland habitat. Phase 6 will be developed with commercial units, a transport interchange and a multi-storey car park.

Site Information

National Grid Reference

SU 69892 70235

Current Site Description

The site covers an irregularly shaped area of approximately 24.65 ha (see Figure 1). The site occupies an area of land which is immediately adjacent to authorised landfills (located north of the site) and historic landfills (located north and west of the site).

The land at the western end of the site has been used for mineral extraction and landfilling. A small industrial site is present in the central part of the site and green space is present in the eastern part of the site.

Ground Investigation

Historic ground investigations

Historic ground investigations undertaken between 2003 and 2015 have been reviewed and summarised in Section 3.

Scope of works

A site specific ground investigation designed by RUK in order to provide supplementary information was undertaken by Terramech Ltd between February 2016 and March 2016. The scope of the investigation consisted of twelve windowless sampler holes and seven hand excavated trial pits.

Ground Conditions

Geology

The geology of the site comprises Topsoil to a depth of 0.6 metres overlying Made Ground of sandy gravelly clay with secondary constituents of brick, ceramic, glass, wood, metal, plastic, rope, refuse, chalk and a car to approximately 3.7 metres below ground level (mbgl). These in turn overlie Alluvium (very soft to soft clay) and River Terrace Deposits (sandy gravel). Beneath the Alluvium and River Terrace Deposits are the firm to stiff clays of the Lambeth Group, overlying the Chalk formation (base not encountered).

Hydrology and Hydrogeology

In the superficial strata, groundwater has been identified at approximate piezometric head elevations of 37.0 metres above ordnance datum (mAOD) to 38.0 mAOD with a

groundwater flow direction towards the northeast. In the Lambeth Group, groundwater piezometric head elevation has been recorded at approximately 36.0 mAOD to 38.0 mAOD with a flow direction towards the east or southeast.

Recommendations

Earthworks

Estimated volumes of fill required to form the proposed development area at approximately 40.20 mAOD are given in Table 8.

Foundations

Recommendations for ground improvement, vibro-stone columns and piled foundations are given in Section 7.

1. INTRODUCTION

Ramboll UK Limited (RUK) has been appointed by the Client, St Edward Homes Limited, to provide engineering consultancy services in relation to the development of Green Park Village, located on the southern fringe of Reading (see Figure 1).

As part of this appointment RUK was engaged to compile a Ground Investigation Report for Green Park Village based upon available ground investigations. The information contained within this report has been collated from previous site investigations, these reports are detailed in Section 1.2.

This report is a geotechnical Ground Investigation Report (GIR), as defined by 'Eurocode 7: Geotechnical Design – Part 2: Ground Investigation and Testing'. This report reasons and details the adopted ground model, and presents the defined characteristic geotechnical material parameters based on the findings of the intrusive ground investigations and subsequent laboratory testing. These findings are produced in line with the principles in Part 2 of EN14688 'Geotechnical investigation and testing – Identification and classification of soils'.

1.1 Objectives and Scope of Report

The scope of this report is to determine the geotechnical aspects for the proposed structures; this is to include location specific ground models and site wide characteristic material parameters. The findings in this report are derived from the interpretation of the ground investigation works undertaken as detailed in Section 1.2.

The report has been written to satisfy the following objectives:

- To summarise the findings of the intrusive ground investigations.
- To interpret the findings of the intrusive ground investigations.
- To provide site wide and location specific ground models.
- To derive site wide characteristic values for geotechnical parameters of the geology encountered based on the factual findings.
- To provide outline recommendations for geotechnical design including spread foundations piled foundations, ground improvement and earthworks.
- To provide a Geotechnical Risk Assessment.

1.2 Existing Reports and Information Sources

The following documentation produced by Peter Brett Associates (PBA) and Drivers Jonas, has been supplied by St Edward Homes Limited has been reviewed.

- Peter Brett Associates, June 2001. Interim Report of Ground Investigation for Clembins Waste Transfer Station, Reading, Berkshire.
- Peter Brett Associates, August 2002. Geoenvironmental Investigation for Phase III, Green Park, Reading.
- Peter Brett Associates, November 2005. Earthwork Material Suitability Assessment. Phase III, Green Park, Reading.
- Drivers Jonas, September 2007. Green Park Village Environmental Statement Volume 1.
- Peter Brett Associates, June 2007. Gas and Water Quality Monitoring Report, Green Park Village.
- Peter Brett Associates, September 2007. Phase 1 and 2 Ground Condition Assessment, Clembins Waste Transfer Station Site, Reading.
- Peter Brett Associates, January 2008. Report of Hydrogeological Risk Assessment, Green Park Village, Reading.
- Peter Brett Associates, April 2008. Phase 2 Supplementary Geoenvironmental Ground Condition Assessment for the Pingemead Industrial Estate, Reading.
- Peter Brett Associates, February 2009. Report on Ground Condition Assessment – Phase 1 and 2. Green Park Station – Temporary Access Road and Park.

- Peter Brett Associates, June 2009. Report on Supplementary Phase 2 Ground Investigation and Tier 2 Risk Assessment. Green Park Railway Station, Reading.
- Peter Brett Associates, October 2009. Phase 2(d) – Report on Targeted Ground Investigation (Contamination Hotspots WS8 and BHC), Green Park Phase 3, Railway Station.
- Peter Brett Associates, July 2010. Synopsis Geoenvironmental Report on Ground Conditions. Green Park Phase III – Green Park Village.
- Peter Brett Associates, May 2015. Report on Ground Investigation for Phase 1A. Green Park Village.

1.3 Report Limitations

This document has been prepared for the exclusive use of St Edward Homes Limited and as such should not be used or copied in whole, or in part, by any third parties without the express written permission from RUK.

Ramboll has endeavoured to assess all the information provided to them, but can make no guarantees or warranties for the completeness or accuracy of the information relied upon.

The geotechnical risk register given in Section 8 of this report relates to details of the proposed development at the time of writing this report. Any substantial alterations to the proposed design may require a reassessment of the risks identified.

Aspects relating to contaminated land and groundwater quality are not covered in this report, for this information the reader should refer to 1620000492/RPT/003.

2. EXISTING INFORMATION

2.1 Location and Site Description

The site is centred at SU 69892 70235 and covers an irregularly shaped area of approximately 24.65 ha (see Figure 1). The site occupies an area of land which is immediately adjacent to authorised landfills (located north of the site) and historic landfills (located north and west of the site).

The land at the western end of the site has been used for mineral extraction and landfilling. A small industrial site is present in the central part of the site and green space is present in the eastern part of the site.

It is understood that a localised area of the eastern part of the site has been used for uncontrolled tipping in recent years. In the western area of the site, the previously quarried gravel pits are now lakes, known as Trout Lakes and are surrounded by earth bunds. It is proposed to fill the north western part of the Trout Lakes as part of the development scheme.

2.2 Proposed Development

The proposed development has been separated into six phases as presented in Figure 2. Phases 1, 4 and 5 contain residential units; Phases 2A, 2B and 2C contain community facilities and Phase 3 contains residential units and a wetland habitat. Phase 6 is to be developed with commercial units, a transport interchange and a multi-storey car park. To do this the smaller of the two trout lakes in the west of the site is to be in-filled.

Phase 1 of the proposed development requires earthworks to elevate the ground level to around 40.0 mAOD. The existing ground levels are discussed in Section 2.5.

2.3 Site History

A summary of the site history is presented in Table 1.

Historical Map	Site Description
1883	- The site was designated as Smallmead Common. - The site was primarily open land with smaller fields. - A railway line was located adjacent to the western perimeter. - A farm was located on the southern perimeter of the site. - Some workings were present (possibly borrow pits) near the western perimeter. - Smallmead Road and Kybes Lane were present within the south of the site.
1900	- Manor Sewerage Works were located to the northeast of the site. - A new farm was built to the south of the site. - Workings in the west of the site were no longer present.
1961	A small structure was located on the southern perimeter of the site.
1976	- The eastern section of the site was extensively quarried for sand. As a result four large pits became present within the site. - To the north of the site an extensive gravel pit was quarried. - To the south east of the site the extent of the sewerage works and associated former sludge beds were delineated. - A small structure on the south perimeter had been constructed. - Small Mead Farm was extended with several additional structures.
1983	- Several structures associated with Pingemead Industrial Estate were located centrally and in the south of the site. - The gravel pit to the north of the site was doubled in size. - A stadium was erected to the north east of the site on the disused sludge beds.
1990's	- A small structure in the south of the site was erected. - In 1992 four lakes, forming the Trout Lakes, were combined following an earlier Green Park construction phase and the north-western lake was partially backfilled, however the type of materials used is unknown. - It was understood by PBA that the Trout Lakes were deepened in the mid-1990s to gain fill material for construction. - The 1992 maps indicated a brewery 1 km southeast of the site boundary
2001	Recorded in the PBA 2001 Interim Report as a waste transfer site with stockpiles of soil and rubbish.
Existing Land Use	- The former quarry pits are in-filled with water creating the Trout Lakes. - An open storage area is located in the centre of the site. - Adjacent to the open storage area is a temporary topsoil store and tree nursery. - Pingemead Business Centre is located in the south of the site. - A maintenance and security depot is located in the east of the site. - Currently under development

Table 1 Summary of site history

2.4 Geology

The British Geological Survey 1:50,000 series Sheet 268 (Solid & Drift edition) [2000] for Reading indicates the site is underlain by Alluvium, Secondary River Terrace Deposits of the Thames Group (drift), overlying the Lambeth Group, which in turn is underlain by the Chalk Formation Group to an approximate depth of 240 metres below ground level (mbgl).

These strata were encountered during the ground investigations identified in Table 2. The geological descriptions are presented in Section 4.

2.5 Topography

This site is effectively split by the Pingemead Industrial Estate and a row of trees that forms the eastern boundary to the industrial estate. Ground levels at the entrance to the industrial estate are approximately 38.85 mAOD and rise towards the north to approximately 39.20 mAOD. Two stock piles/earth mounds are present in the northern part of the industrial estate and are formed to a level of approximately 40.0 mAOD.

To the west of the industrial estate are two Trout Lakes. The largest of the lakes forms a reverse L-shape and the topographic survey indicates the bottom of it to be variable. It has an earth bund surrounding it, where the top of the bund is at a level of approximately 41.0 mAOD. The bed level of the northern part of this lake falls towards the centre line on its three sides, starting at a level of approximately 37.6 mAOD and reducing to a level of approximately 30.0 mAOD. In the southern part of this lake the bed level reduces to approximately 30.0 mAOD.

The smaller of the lakes is square in shape with the topographic survey indicating a lowest bed level of 34.78 mAOD.

The land to the north, south and west of the lakes is relatively flat with the ground level approximately 39.5 mAOD. Earth bunds are formed along the southern and western boundaries of the lakes, the top of which are approximately 41.0 mAOD and 40.0 mAOD respectively. The northwest corner of the site is densely vegetated, with the topographic plan indicating the presence of drainage ditches.

To the east of the industrial estate the site is triangular in shape. The topography of this part of the site has been altered by the placement of fill material forming a number of mounds that have been plateaued off at levels ranging from 39.0 mAOD to 40.2 mAOD. The area to the northeast of these mounds is relatively flat with ground levels varying from approximately 37.8 mAOD to 38.2 mAOD.

The northern boundary of the site is marked on the topographic survey as having a small earth bund. This is off-set into the site from a drainage ditch that forms the northern boundary. Another drainage ditch is present along the south eastern boundary of this part of the site.

2.6 Hydrology and Hydrogeology

Foudry Brook is present to the east of the site, approximately 350 metres from the site boundary and flowing to the northeast. The other water features include Trout Lakes (located in the western portion of the site) which are flooded, former gravel workings. Several drainage ditches are present on site, including a drainage ditch at the eastern boundary of Pingemead Industrial Estate which is understood to flow in a southerly direction. A drainage ditch is also present at the northern boundary of the site which flows in an easterly direction where it joins Foudry Brook.

The River Kennet is present approximately 650 metres to the north of the site, running in a west-east direction and flowing to the east. A flood relief channel (200 metres northeast of the site) was constructed as part of the Green Park Development and flows in a northerly direction. It is understood to be clay lined.

Groundwater bodies have been identified in the superficial strata and in the bedrock. The River Terrace Deposits and Lambeth Group are classified as Secondary 'A' Aquifers by the Environment Agency and the Chalk Formation is classified as a Principal Aquifer. The elevation of the piezometric head within these groundwater bodies differs, and it is likely that they form separate water bodies, although there may be some hydraulic continuity in places.

A number of groundwater abstractions have been identified, including abstractions on site in the area of the industrial estate. Further groundwater abstractions have been identified at Smallmead Landfill located to the northwest of the site where groundwater is abstracted to facilitate the landfill works, according to PBA's June 2009 report.

2.7 Flood Risk

Information pertaining to flood risk is provided in the report by Drivers Jonas, September 2007 Green Park Village Environmental Statement Volume 1. The development requires ground levels to be raised and it is understood that the levels shown in drawing number PL-MPL-014 take flood risk into account.

3. EXISTING GROUND INVESTIGATION

3.1 General

Six intrusive ground investigations were carried out from 2001 to 2015. Table 2 lists the ground investigations, the corresponding report date, and the exploratory hole identification.

Report Title	Date	Exploratory Hole ID
Peter Brett Associates, June 2001. Interim Report of Ground Investigation for Clembins Waste Transfer Station, Reading, Berkshire.	June 2001	BH1 to BH7
		TP1 to TP9
Peter Brett Associates, August 2002. Geoenvironmental Investigation for Phase III, Green Park, Reading.	August 2002	BH101 to BH111
		BHG1 to BHG8
		WS1 to WS7
		TP201 to TP218
		BH1_1987
		14C_1984
Peter Brett Associates, November 2005. Earthwork Material Suitability Assessment. Phase III, Green Park, Reading.	November 2005	G15 to G18
		TP219 to TP231
		BH112
Peter Brett Associates, September 2007. Phase 1 and 2 Ground Condition Assessment, Clembins Waste Transfer Station Site, Reading.	September 2007	WS1_2007 to WS8_2007
		BHA to BHF
		TPA to TPL
Peter Brett Associates, April 2008. Phase 2 Supplementary Geoenvironmental Ground Condition Report.	April 2008	WS08/01, WS08/03, WS08/04, WS08/05, WS08/06, WS08/08, WS08/09
Peter Brett Associates, February 2009. Report on Ground Condition Assessment – Phase 1 and 2. Green Park Station – Temporary Access Road and Park.	February 2009	TPA01 to TPA12

Report Title	Date	Exploratory Hole ID
Peter Brett Associates, June 2009. Report on Supplementary Phase 2 Ground Investigation and Tier 2 Risk Assessment. Green Park Railway Station, Reading.	June 2009	BH2009/01 to BH2009/07
		TP301 to TP314
		RGPTP01 to RGPTP04
		RGPST02 to RGPST03
		RGPWS01 to RGPWS05
		BH_2007_2009
Peter Brett Associates, October 2009. Phase 2(d) – Report on Targeted Ground Investigation (Contamination Hotspots WS8 and BHC), Green Park Phase 3, Railway Station.	October 2009	TP6001 to TP6011
Peter Brett Associates, July 2010. Synopsis Geoenvironmental Report on Ground Conditions. Green Park Phase III – Green Park Village.	July 2010	TP1047 to TP1048
		BH1016
Peter Brett Associates, May 2015. Report on Ground Investigation for Phase 1A. Green Park Village.	May 2015	WS01_2015 to WS04_2015
		TP101 to TP119

Table 2 Summary of ground investigations

3.2 Laboratory Testing

The geotechnical laboratory testing undertaken as part of the ground investigations is detailed in Table 3. The testing consisted of:

- Undrained Unconsolidated Triaxial Testing (UUT)
- Natural Moisture Content (NMC)
- Bulk Density
- Plasticity Index (PI)
- Particle Size Distribution (PSD)
- One Dimensional Consolidation (ODC)
- Compaction Testing
- Triaxial Permeability Testing

Ground Investigation Report	Testing Schedule	Notes
Peter Brett Associates, June 2001. Interim Report of Ground Investigation for Clembins Waste Transfer Station, Reading, Berkshire.	• NMC • UUT • Bulk Density	Not documented in the report. Section 4.0 refers to Appendix 3. Chemical test results are available but no geotechnical results are presented.
Peter Brett Associates, August 2002. Geoenvironmental Investigation for Phase III, Green Park, Reading.	• NMC (21 from PI and 4 from ODC) • PI (21) • PSD (12) • Sedimentation analysis • UUT (15) • ODC (4)	Appendix 4 P160 – P180
Peter Brett Associates, November 2005. Earthwork Material Suitability Assessment.	• NMC • PI • PSD	Appendix 4 P71 – P115

Ground Investigation Report	Testing Schedule	Notes
Phase III, Green Park, Reading.	• Compaction Testing	
Drivers Jonas, September 2007. Green Park Village Environmental Statement Volume 1.	No geotechnical testing undertaken	
Peter Brett Associates, June 2007. Gas and Water Quality Monitoring Report, Green Park Village.	No geotechnical testing undertaken.	
Peter Brett Associates, January 2008. Report of Hydrogeological Risk Assessment, Green Park Village, Reading.	No geotechnical testing undertaken.	
Peter Brett Associates, April 2008. Phase 2 Supplementary Geoenvironmental Ground Condition Assessment for the Pingemead Industrial Estate, Reading.	No geotechnical testing undertaken.	
Peter Brett Associates, February 2009. Report on Ground Condition Assessment – Phase 1 and 2. Green Park Station – Temporary Access Road and Park.	Triaxial Permeability Testing	P518 – 519 Not made available to us.
Peter Brett Associates, October 2009. Phase 2(d) – Report on Targeted Ground Investigation (Contamination Hotspots WS8 and BHC), Green Park Phase 3, Railway Station.	No geotechnical testing undertaken.	
Peter Brett Associates, June 2010. Synopsis Geoenvironmental Report on Ground Conditions. Green Park Phase III – Green Park Village.	No geotechnical testing undertaken.	
Peter Brett Associates, May 2015. Report on Ground Investigation for Phase 1A. Green Park Village.	No geotechnical testing undertaken.	

Table 3 Summary of geotechnical laboratory tests

4. ADDITIONAL GROUND INVESTIGATION

4.1 General

A further phase of detailed ground investigation works for Phase 1b, Phase 1c and Phase 2 was designed by RUK and undertaken by Terramech Ltd between February 2016 and March 2016.

The scope and layout of the ground investigation took into consideration the findings of the previous ground investigation undertaken as detailed in Section 3.1. The ground investigation schedule of works was defined in RUK report 'Outline Proposed Schedule of Works, Pingemead Industrial Estate & Phase 2 Area, Green Park Village, Supplementary Ground Investigation' and comprised the following:

- Twelve windowless sampler holes drilled to a maximum depth of 6.0 mbgl;
- Seven hand excavated trial pits to a maximum of 1.0 mbgl.

The fieldwork was carried under technical supervision of RUK. The results of the ground investigation are presented in the Terramech factual report on the ground investigation (report Ref. 3700A/16).

During the site works a number of amendments were made to the original investigation proposal. These are summarised as follows:

- R_WS404 was changed to a hand dug pit due to groundworks being undertaken in the area;
- R_WS410 was abandoned due to the presence of a newly built road;
- R_WS412 encountered a metal obstruction and was moved 2.0 metres north east and re-named R_WS412a;
- R_HP404 was abandoned at a depth of 0.2 mbgl due to water influx.

4.2 Sampling and In-situ Testing

With the main purpose of the investigation to confirm the ground and groundwater conditions, and obtain samples for environmental chemical analysis, no in-situ testing sampling for geotechnical purposes was required.

5. GROUND CONDITIONS

5.1 Site Wide Geology

The descriptions of the strata encountered are presented in Table 4. An overview of exploratory hole locations is presented in Figure 3 and phase-specific exploratory hole locations are presented in Figure 4 to Figure 9b. Cross sections are presented in Appendix 1.

Stratum	Range of Levels to Base of Stratum (mAOD)	Description
Topsoil	37.2 to 39.75	Brown silty clay with occasional gravel of sandstone, brick and concrete.
Made Ground	35.54 to 39.22	Highly variable from a sandy gravelly clay, sandy gravel, soft to firm silty clay with occasional fine flint gravel, clayey sand. Contains fragments of brick, ceramic, glass, wood, metal, plastic, rope, refuse, chalk and a car.
Alluvium	35.24 to 39.55	Soft to very soft, grey and brown organic clay with occasional sand and gravel lenses.
River Terrace Deposits	33.15 to 35.48	Brownish grey, locally clayey, sandy gravel of flint.
Lambeth Group	19.4 to 22.95	Firm becoming stiff to very stiff with depth, red, brown and grey mottled, slightly sandy in to sandy in places, clay with Interbedded layers of dense to very dense, grey, silty, fine to medium sand. Lignite bands <0.1 metre thick are present.
Chalk Formation	Unproven at 8.4	Off white to greenish, structureless, putty chalk with intact chalk nodules, occasional flint and flint bands.

Table 4 Geological descriptions

5.2 Topsoil

The topsoil varies in thickness from 0.1 metres to 0.4 metres across the site.

5.3 Made Ground

The Made Ground ranges from 0.2 metres to 4.7 metres in thickness. There is a significant amount of rubble within this stratum including a car and tree stumps.

5.4 Alluvium

The Alluvium tends to be present as a thin stratum generally <1.0 metre thick; however across the site it varies in thickness from 0.1 metre (BH1, TP115 and TP306) to 2.6 metres (BH2). The level of the top of the Alluvium ranges from 39.75 mAOD to 35.54 mAOD, with the base encountered at levels ranging from 39.55 mAOD to 35.24 mAOD.

The result of a single Atterberg Limit test records a modified plasticity index of 55%, indicating a material of high volume change.

Standard Penetration Test (SPTs) N values indicate the Alluvium increases in strength with depth (Data Plot 1). Uncorrected N values of less than 10 were recorded to a level of 37.0 mAOD (2.0 mbgl), this generally increases below 37.0 mAOD and ranges from an N value of 11 to an N value of 22, indicating a low to medium strength cohesive material. No undrained unconsolidated triaxial testing or consolidation testing has been carried out on the Alluvium.

5.5 River Terrace Deposits

The thickness of the River Terrace Deposits across the site is variable, ranging from 0.40 metres to 3.55 metres thick. The elevation where full thickness of this stratum was encountered ranges from 39.55 mAOD to 35.00 mAOD. Table 5 summaries the exploratory holes where the full thickness of the River Terrace Deposits was encountered and the level at which it was encountered.

Exploratory Hole No.	Level of River Terrace Deposits	Thickness (m)	Exploratory Hole No.	Level of River Terrace Deposits	Thickness (m)
BH6	37.32	2.20	BH112	35.00	0.6
BH7	39.55	5.50	G10	36.49	2.2
BH1_1987	38.66	3.20	G11	36.80	2.5
14C_1984	36.04	0.35	G12	36.00	1.8
BH101	37.40	2.20	G13	36.33	1.9
BH102	37.25	2.40	G14	36.36	2.0
BH103	36.63	1.40	BHE	37.58	1.75
BH104	36.70	1.50	BHF	37.83	2
BH105	37.60	2.75	TPJ	35.65	0.2
BH106	37.80	2.00	TPL	36.27	0.5
BH107	38.50	2.80	WS08/01	37.55	2.3
BH108	37.55	3.55	WS08/03	37.20	2.25
BH109	37.90	2.90	WS08/04	37.10	1.9
BH110	37.80	2.85	WS08/05	37.00	2.3
BH111	38.10	3.40	BH1_2007_2009	37.87	3.15
BHG1	36.95	1.80	BH2009/01	35.75	2.6
BHG2	36.30	1.35	BH2009/02	37.52	3.4
BHG3	37.80	2.15	BH2009/03	36.65	1.0
BHG4	37.75	3.20	BH2009/04	37.56	1.7
BHG5	36.42	1.10	BH2009/05	37.46	1.5

Exploratory Hole No.	Level of River Terrace Deposits	Thickness (m)	Exploratory Hole No.	Level of River Terrace Deposits	Thickness (m)
BHG6	37.25	2.00	BH2009/06	37.17	1.7
BHG7	37.30	2.75	BH2009/07	35.54	0.4
BHG8	36.90	1.80	WS02_2015	37.51	3.1
WS5	38.37	2.68	TPJ	35.65	0.2
WS6	37.30	2.00			

Table 5 Summary of exploratory holes where full thickness of River Terrace Deposits were encountered

The SPT N values for the River Terrace Deposits (Data Plot 2) across the site range from 4 to 50, over a range in level of 38.10 mAOD to 34.00 mAOD. This indicates a material with a relative density of low to high.

5.6 Lambeth Group

The thickness of the Lambeth Group was proven in boreholes BH1_1987, 14C_1984, some of the BH100 series boreholes and boreholes BH2009/01 and BH2009/05 with the thickness of this stratum ranging from 10.2 metres to 15.55 metres. Table 6 summaries the level the Lambeth Group was encountered at and extended to. However in borehole BH111 the thickness of the Lambeth Group was not proven as greater than 16.2 metres thick.

Borehole No.	Lambeth Group		
	Top of Stratum (mAOD)	Base of Stratum (mAOD)	Thickness (m)
BH1_1987	35.46	22.96	12.50
14C_1984	35.69	22.69	13.00
BH104	35.20	19.90	15.30
BH105	34.85	20.25	14.60
BH108	34.00	20.55	13.45
BH110	34.95	19.40	15.55
BH2009/01	33.15	22.95	10.20

Table 6 Typical stratum levels for the Lambeth Group

Atterberg Limit testing in the cohesive Lambeth Group indicates the material is a low to very high plasticity clay (Data Plot 3).

SPT N values for the Lambeth Group (Data Plot 4) indicates a trend of increased strength with depth; this corresponds with the triaxial test results (Data Plot 5).

5.7 Chalk Formation

The top of Chalk Formation varies in elevation across the site from 22.60 mAOD along the northern boundary to 19.40 mAOD along the southern boundary. All core recovery of the Chalk Formation was heavily weathered and often described as silt and sand sized comminuted chalk. Occasional flints were recorded in some exploratory holes.

Based on the descriptions given the weathered Chalk is structureless, however the SPT N values for the Chalk Formation (Data Plot 6) ranges from 30 to 50 indicating the Chalk mass could be structured.

5.8 Groundwater

In the superficial strata, groundwater has been identified at approximate piezometric head elevations of 37.0 mAOD to 38.0 mAOD with a groundwater flow direction towards the northeast. In the Lambeth Group, groundwater piezometric head elevation has been recorded at approximately 36 mAOD to 38 mAOD with a flow direction towards the east or southeast. Groundwater in the Chalk has been less well characterised, but most likely flows towards the east / southeast with groundwater piezometric head elevations between approximately 35.0 mAOD and 38.0 mAOD.

6. CHARACTERISTIC MATERIAL PROPERTIES

6.1 Commentary on the Selection and Use of Parameters

The commentary presented in this section is based upon the results of the investigations identified in Section 3 and Section 4. Data plots of the various results are presented in Appendix 2.

The derivation of characteristic geotechnical parameters is described for the soils that are expected to be encountered. Where direct measurement of parameters has not been carried out, established correlations with measured properties have been used to derive values for design.

Characteristic values are defined as a cautious estimate of the value affecting the occurrence of a limit state based on Clause 2.4.5.2, from BS EN 1997-1:2004 (Eurocode 7). Characteristic values should be used with appropriate partial factors to achieve appropriate factors of safety, as required.

Strength

Cohesive Soils – Undrained Strength Parameters

Characteristic undrained shear strength for normally and over-consolidated cohesive soils have been assessed from the following information:

- Correlation to SPT N values using Stroud and Butler (1975), with factor f_1 derived from Figure 31 CIRIA 143 (1995) using the Plasticity Index (PI), (f_1 increases with reducing PI and generally an upper bound PI value should be selected to derive f_1),
- Laboratory undrained triaxial shear strength tests,
- Material descriptions from exploratory holes, based on British Standard (BS) 5930: 1999 (British Standards Institute (BSI), (1999) and EC7 (2007).

The representative value for an undrained strength vs. depth plot will be a value (or line) giving a cautious estimate of the strength, excluding any extreme values. Extreme values will be investigated, as appropriate, as they may indicate a different soil type or other anomaly that needs to be accounted for in design.

Granular Soils

Laboratory testing for the shear strength of the granular soils has not been carried out on samples taken from the exploratory holes as indirect methods for determination of strength are deemed acceptable. For soils described as sands and/or gravels, the constant volume effective angle of shearing resistance ($\phi'_{cv,k}$) and the peak effective angle of shearing resistance ($\phi'_{pk,k}$) will be interpreted using the methods described in BS 8002 (2015) as follows:

$$\phi'_{cv,k} = 30 + \phi'_{ang} + \phi'_{PSD}$$

$$\phi'_{pk,k} = \phi'_{cv,k} + \phi'_{dil}$$

Where:

ϕ'_{ang} = angularity of the particles,

ϕ'_{PSD} = grading of the soil from particle size distribution tests.

ϕ'_{dil} = soil dilatancy based on SPT N Value, for fines content < 15% (where fines are more than 25% this value is 0; linear interpolation can be carried out for fines contents between 15% and 25%).

Values of ϕ'_{ang} , ϕ'_{PSD} and ϕ'_{dil} are given in Table 7

ϕ'_{ang}	Parameter (degrees)
Rounded to well-rounded	0
Sub-angular to sub-rounded	2
Very angular to angular	4
ϕ'_{PSD}	Parameter (degrees)
C_u (Uniformity Coefficient) < 2	0
$2 \leq C_u < 6$	2
$C_u \geq 6$	4
ϕ'_{dil} as SPT N Value (modified from BS EN 1997-2)	Parameter (degrees)
< 3	0
3 - 8	0
8 - 25	3
25 - 42	6
> 42	9

Table 7 'Table 1' from BS 8002:2015

Where PSD tests have not been carried out, SPT N values have been used to interpret the effective angle of shearing resistance (Φ') using the relationship of Peck *et al* (Tomlinson 7th 2.13).

Generally for sands and gravels, a value of $c' = 0$ kN/m² will be recommended for design.

Chalk

The engineering parameters of the chalk have been assessed from the results of the ground investigation and the recommendations given in CIRIA C574 and CIRIA C143. Parameters for CFA pile design have been derived using CIRIA PR86.

Stiffness and Compressibility

Cohesive Soils

Where the determination of settlement of foundations on cohesive soils is required, then stiffness has been assessed from SPT N values using the relationship presented in Bowles Table 5-6.

Limited one dimensional oedometer consolidation tests have been carried out to determine the coefficient of volume compressibility (m_v) and coefficient of consolidation (c_v). For the purposes of this report these results have not been presented in this report on the basis that any design or settlement assessment will require values of c_v and m_v to be selected based on in-situ effective stress plus the actual proposed increase in stress.

It should be noted that rates of settlement calculated using c_v values from oedometer testing may be lower than the actual, in-situ, rate of settlement as the small-scale oedometer test specimen may not represent the true fabric/nature of the soil mass. For example, the sample tested may not contain any sand or gravel fraction or sand laminations/partings that may exist in the in-situ soil. The existence of such features would increase the overall permeability of the soil and thus the time required for consolidation would be reduced. This may be the case for the Lambeth Group which is described as stiff sandy clay to clayey sand, with interbedded clays, silts and sands.

Stiffness based on Young's Modulus (E) has been assessed using the following Bowles 5-6:

For Alluvium:

$$E_u = c_u \times 200$$

$$E' = c_u \times 100$$

For the cohesive stratum of the Lambeth Group:

$$E_u = c_u \times 400$$

$$E' = c_u \times 200$$

Granular Soils

Where settlement calculations for foundations in granular soils are required, settlement of granular soils will be determined using semi-empirical methods based on SPT N values. It should be noted that most of the total settlement of foundations on granular soils is likely to take place almost immediately upon the application of load to the soil, therefore the majority of the settlement will be built out as construction proceeds and the foundation load is applied.

The drained Young's Modulus, E' , for granular materials has been derived from SPT N values using CIRIA Report 143 section 8.1.2,

Where:

$$E' = 2000 \times \text{SPT N (kPa)}.$$

Table 8 presents a summary of the derived site wide characteristic geotechnical parameters.

Chalk

The drained stiffness of structured chalk is estimated using CIRIA Report 143 (1995);

$$E' = 5000 \times \text{SPT N (kPa)}.$$

6.2 Alluvium

Based on a single modified plasticity index result of 55%, an f_1 value of 4.5 has been used to correlate the SPT N data to give a c_u range. Data Plot 7 shows the design line for the undrained shear strength of the Alluvium, which is a c_u of 18 kPa to a depth of 1 metre below the top of the stratum, then an increase to c_u of $18 + 16z$ kPa, where z is the depth one metre, below top of stratum.

The maximum recorded thickness is 2.9 metres, resulting in a strength range of 18 kPa to 48 kPa, indicating a very low to medium strength clay.

The corresponding stiffness values are an E_u of 7.2 MPa and an E' of 3.6 MPa to a depth of 1.0 metre below the top of the stratum, increasing to an E_u of $7.2 + 6.4z$ MPa and an E' of $3.6 + 3.1z$ MPa.

No one dimensional consolidation testing of the Alluvium is available to assess the compressibility of the stratum.

6.3 River Terrace Deposits

It has not been possible to define a single site wide internal angle of friction (Φ) for the River Terrace Deposits because the range of N values is too large; however it is possible to give a range based on Peck *et al* (Tomlinson 7th 2.13) of between 29° and 36°.

Based on the SPT N values, the stiffness (E') of the River Terrace Deposits ranges from 8 MPa to 60 MPa.

6.4 Lambeth Group

The Lambeth Group has an average plasticity index of 22% correlating to an f_1 value of 4.5. Data Plot 8 presents the design line for the undrained shear strength of the Lambeth Group and indicates a c_u of 40 kPa to a depth of 3.0 metres below the top of the stratum, then an increase to c_u of $40 + 18z$ kPa, where z is the depth 3.0 metres below the top of stratum.

A maximum recorded thickness of 15.55 metres gives a strength range of c_u 40 kPa to 266 kPa, indicating a medium to very high strength clay.

The corresponding stiffness values of the cohesive deposits are an E_u of 16 MPa and an E' of 8 MPa to a depth of 3 metres below the top of the stratum, increasing to E_u $16 + 7.2z$ MPa and an E' of $8 + 3.6z$ MPa, where z is the depth 3 metres below the top of stratum.

SPT N values for the granular Lambeth Group range from 30 to 50, with a mean SPT N value of 40 corresponding to an E' of 80 MPa and Φ of 38.5 degrees.

6.5 Upper Chalk Formation

Boreholes BH104, BH105, BH108, and BH110 constructed by Foundation Exploration Services (FES) encountered Chalk at depths of 18.0 metres (19.90 mAOD), 17.7 metres (20.25 mAOD), 17.8 metres (20.55 mAOD), and 19.0 metres (19.40 mAOD). The grade of the Chalk is unknown; descriptions imply the chalk is structureless, but this is inconsistent with the SPT N values.

SPTs uncorrected N values are in the range of 30 to >50 blows for 300 mm penetration. Occasional flints are recorded and are the possible reason for some of the very high N values. The engineering behaviour of the chalk has been assessed based upon the description given, the results of the SPTs and the recommendations in CIRIA C574.

NB exploratory holes BH107, BH109, BH109 and BH110 by FES are outside of the site boundary. The logs and laboratory testing undertaken for that investigation to which they are part of are given in PBA report 11321/1300/SNK/KB/RP/LG, August 2002, Geoenvironmental Investigation for Phase 3, Green Park, Reading.

6.6 Summary of Geotechnical Parameters

Table 8 provides a summary of the characteristic values of geotechnical parameters that are to be adopted for the strata on the site.

Stratum	Bulk Density (kN/m ³)	Internal Angle of Friction Φ' (Degrees)	Undrained Shear Strength c_u (kPa)	Effective Cohesion c' (kPa)	Undrained Young's Modulus, E_u (MPa)	Drained Young's Modulus, E' (MPa)
Alluvium	19	-	18 kPa to 1.0 metre below the top of stratum, then $18 + 16z$ kPa	0	$7.2 + 6.4z$	$3.6 + 3.2z$
River Terrace Deposits	19	Lower Bound 29 Upper	-	-	-	20

Stratum	Bulk Density (kN/m ³)	Internal Angle of Friction Φ' (Degrees)	Undrained Shear Strength C_u (kPa)	Effective Cohesion c' (kPa)	Undrained Young's Modulus, E_u (MPa)	Drained Young's Modulus, E' (MPa)
		Bound 36				
Lambeth Group (cohesive)	21	-	40 + 18z kPa	2	16 + 7.2z	8 + 3.6z
Lambeth Group (granular)	21	38.5	-	-	-	80
Upper Chalk Formation	19	33	N/A	5	600	300

Where Z is the depth in metres below the top of stratum.

Table 8 Summary of characteristic geotechnical parameters

Design ground profiles for the various phases of development are discussed in Section 7.

7. GEOTECHNICAL RECOMMENDATIONS FOR DEVELOPMENT

The following gives recommendations for the earthworks and design of foundations for the six phase areas of development (see Figure 2).

7.1 Earthworks

Based on the work undertaken by Peter Brett Associates (PBA) a minimum development level of 40.20 mAOD has been set for the site. It is understood further filling to give a typical finished site level of 40.9 mAOD is required in order to deal with predicted future flood events (as determined by others). These levels are shown on drawing PL-MPL-014. This drawing also gives estimated volumes of fill required and in summary are as follows:

Phase 1 (zones 1, 2 and 3) – 24,760 m³

Phases 2, 3, 4 and 5 – 177,315 m³

Phase 6 Station Interchange – 15,630 m³

Further works undertaken by Glanville Consultants Ltd (GCL), which is included in the Water Recover Plan V1 (ref: GPV WRP v1 06/07/15 by Foresite Projects Ltd on behalf of Wooldridge Ecotec Ltd.), estimates the volumes of fill material presented in Table 9 and Figure 10.

Phase 1 – 44300 m ³	Phase 1C – 17500 m ³	Phase 2A – 13600 m ³
Phase 2B – 20400 m ³	Phase 3 – 82300 m ³	Phase 4 – 32700 m ³
Phase 5 – 36300 m ³	Phase 6 – 64300 m ³	

Table 9 Estimated fill volumes

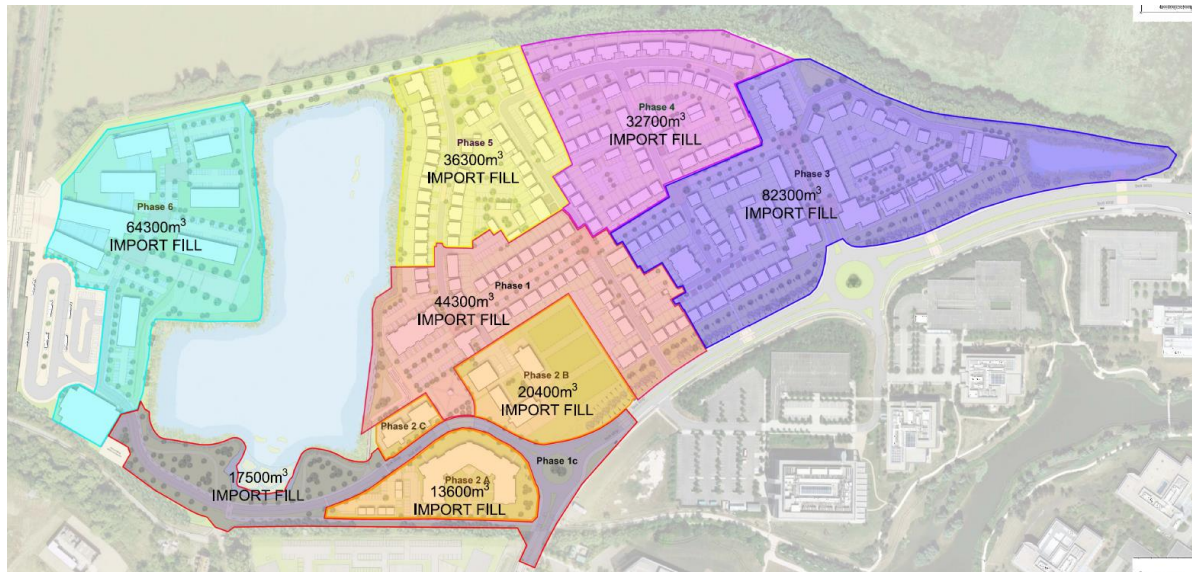


Figure 10 Plan of estimated fill volumes

The plan and sections produced by GCL are given in Appendix 4 (drawing nos. 4140564-1101-P1, 4140564-1102-P1, 4140564-1103-P1 and 4140564-1104-P1).

Of the two Trout Lakes the largest is to remain and the smaller lake is to be drained and infilled. The volume of infill and volume of fill in the area to the north and west of this lake has not been estimated by PBA. Analysis of the 3D topographic survey drawing provided (ref.7134-01) indicates the volume of fill required is in approximately 16,730 m³.

7.1.1 General Requirements for Imported Fill for Earthworks

The suitability and acceptability requirements for fill materials to be imported on to site, along with compaction requirements, are given in RUK's earthworks specification (1620000492/SP/001).

The fill materials covered in the earthworks specification are as follows,

- Class 1 Granular Fill
- Class 2 Cohesive Fill
- Class 6N Fill to structures

In terms of the Class 2 materials with respect to foundation design, these are required not to have a plasticity index exceeding 40%. All material are required to have a soluble sulphate content (SO₄) not exceeding 500 mg/litre when tested to BS 1377:Part 3, clause 5 using a 2:1 water/soil extract.

Where fill is required to form an embankment slope then the angle of the slope should not be steeper than 1:3 (vertical:horizontal).

7.1.2 Phase 1, 3, 4 and 5 Earthworks

Within the areas of Phases 1, 3, 4 and 5 fill materials were placed approximately eight years ago to form the existing ground levels. The plan for the development is to re-work these materials and place them in Zones 1 and 2 of Phase 1 in a controlled manner to allow ground improvement in the form of vibro-stone columns with reinforced strip foundations to be used for the residential buildings. For Zone 3 of Phase 1 and Phases 3, 4 and 5 a similar operation is proposed with the use of imported fill.

A summary of the thickness of on-site fill recorded within trial pits TP101 to TP113 is given in Table 10 and the fill ranges from 0.70 metres to 3.40 metres thick. The original topsoil appears to have been removed prior to the placing of the fill as the exploratory hole records have a thin

layer of "Alluvium" that ranges in thickness from 200 mm to 600 mm and is typically described as firm dark grey slightly sandy silty clay with occasional fine to medium flint gravel.

The Alluvium is underlain by River Terrace Deposits, which have been described as grey sandy fine to medium, occasionally coarse, sub-angular flint gravel. The thickness of this stratum was not proven within the trial pits but boreholes located outside of Phase 1 record it as being 1.40 metres to 3.55 metres thick.

Trial Pit	101	102	103	104	105	106	107	108	109	110	111	112	113
<i>Thickness of Stratum</i>													
Fill	1.20	0.70	1.70	2.10	2.40	1.90	0.20	2.02	2.20	1.55	1.80	1.90	3.40
Alluvium	0.20	0.40	0.20	0.60	0.25	0.30	0.30	0.20	0.15	0.40	0.40	0.60	-

Table 10 Summary of fill thickness

To assess these fill materials better RUK, along with Keller Foundations, visited the site on 15 April 2015 and conducted some additional trial pits. Some samples were taken for moisture content and plasticity index testing and the results of these tests are also given in Appendix 3.

The excavation found very similar strata in terms of the fill type, with the cohesive fill material being firm to stiff in strength and the results of all testing undertaken was used to provide an earthworks specification (ref: 1620000492/SP/0001). The specification also incorporates the requirements set by Keller Foundations for the use of vibro-stone columns through placed fill.

The ground level in Zone 3 of Phase 1 (Pingemead Industrial Estate) is approximately 39.0 mAOD (± 150 mm) and will require in the order of 2.0 metres of fill to be placed to bring it up to the required level of 40.90 mAOD. Imported material will be required to raise levels and this shall be done in accordance with the latest version of RUK's earthworks specification (1620000492/SP/001).

7.1.3 Phase 1C and Phase 2

Phase 2 is also split into three, Phase 2A, Phase 2B and Phase 2C. No finished ground levels have been provided and therefore the following is based upon a required level of 40.90 mAOD.

The existing ground levels in Phase 2A are in the range of approximately 38.45 mAOD to 39.20 mAOD, which will require levels to be raised by approximately 2.45 metres to 1.70 metres.

Existing ground levels in Phase 2B are in the order of 38.05 mAOD to 39.05 mAOD which will require levels to be raised by around 2.85 metres to 1.85 metres.

Existing ground levels in Phase 2C range from 38.66 mAOD to 39.08 mAOD, which will require levels to be raised in the order of 2.24 metres to 1.82 metres.

Phase 1C, as indicated in the Water Recover Plan, relates to the access road that will connect Phase 6 to Longwater Avenue and the area to be landscaped at the southern end of the lake. Ground level increases here will be of a similar magnitude.

Currently it is not known what the fill material type will be, other than that it is to be imported fill material. It is however known that as the buildings for Phase 2 are to be community facilities and that it is proposed that these structures will be founded on piles. Therefore it will be necessary for the earthworks in this area to be adequately compacted to ensure long-term settlements are limited, and in order to do this the method of compaction may need to be altered from that currently specified in the Earthworks Specification.

The current specification allows for the use of a Bomag BW 213 DI-4I BVC polygonal roller compacting in 750 mm thick layers following trial compactions and for any other form of compaction plant to be used in accordance with the Specification for Highway Works Table 6/1 and Table 6/4.

7.1.4 Phase 6

The historic records show that some of the Trout Lakes have been partially infilled as shown in Figure 11.

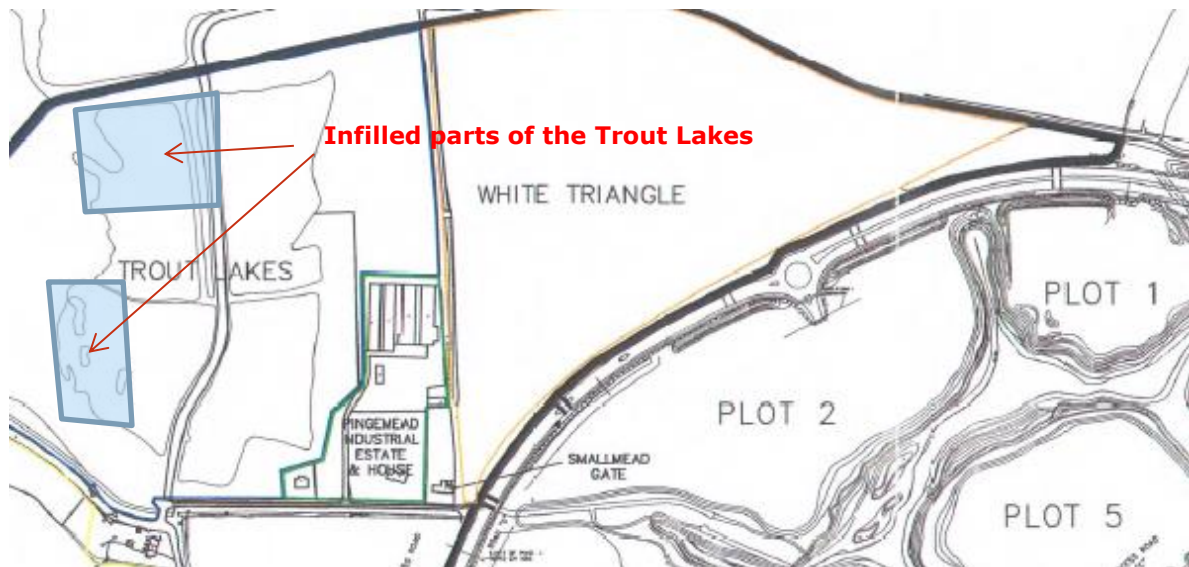


Figure 11 Plan showing extent of infill of Trout Lakes

The smaller of the two remaining lakes is to be infilled. In order to assess the risks associated with the dewatering and infilling works a hydrological assessment was undertaken by RUK (Ref: 1620000492/RPT/007). The conclusions of the assessment are considered that the works can be carried out under temporary discharge of water not require a permit by meeting the conditions described in the Environment Agency's Regulatory Position Statement (RPS) "Dewatering Building Sites and Other Excavations: Environmental Permits". To mitigate the risk of reducing the quality of surface water and discharging to Trout Lake 2 the proposed method of dewatering is to comprise pumping from Trout Lake 1 while filling takes place so as to prevent groundwater flow.

Fill material shall be placed into Trout Lake 1 and compacted by tracking of the earthworks plant. As the lake becomes smaller the groundwater level will increase, the original groundwater level shall be maintained by direct pumping of excess water to settlement tanks. This process should be repeated until the lake is filled to 1.0 metre above the original groundwater level (approximately 38.0 mAOD), at which point the fill material is to be compacted with a deep impact roller. Further placement of fill shall be carried out in accordance with the Earthworks Specification i.e. fill is to be placed in layers followed by the appropriate compaction. On completion it will be necessary for a surcharge load to be imposed on the filled area.

7.2 Foundation Design

Phase 1 is subdivided into three zones; Zone 1, Zone 2 and Zone 3, as indicated in Figure 12. The exploratory holes within Zones 1 and 2, and some of the exploratory holes in Phases 3 and 5 have been used in the review of ground conditions and the foundation solution for the building. These are trial pits referenced TP101 to TP113.



Figure 12 Plan showing extents of Zones 1, 2 and 3 of Phase 1

Within Zones 1 and 2 for Phase 1 ground improvement in the form of vibro-stone columns with reinforced strip foundations is to be utilised with the environmental acceptance of this form of ground improvement being based upon the recommendations by PBA.

7.2.1 Phase 1 Zones 1 and 2

The following is an assessment of the ground investigation data available, in terms of the suitability of this foundation solution, and what design measures need to be implemented.

Plasticity Index results for the cohesive fill material carried out on samples from TP101 to TP113 gives values ranging from 18% to 40%. However, the percentage passing the 425 μm sieve was not determined. Of the Plasticity Index tests carried out on the samples taken on the 15/04/15, the results for the fill samples tested range from 9% to 13% allowing for percentage passing the 425 μm sieve.

The highest plasticity index value was for a sample taken in trial pit TP101 (40%) and out of all the samples taken is the only result that indicates some of the fill as having a high volume change potential (i.e. 40% or greater). It should be noted that this sample was from a level of 38.50 mAOD, from a stratum only 300 mm thick. All of the other tests indicate the volume change potential of low to medium.

Testing carried out on alluvial clay also classifies it as being of medium volume change potential. Therefore on this basis and taking into consideration that the foundations will be outside the zone of influence of any new planting (trees and hedgerows) the minimum founding depth will need to be 0.9 metres (ref. NHBC Chapter 4.2, Table 5) following ground treatment. It is considered that this minimum depth will be sufficient to allow for any seasonal changes that could affect the moisture content of the Fill material.

7.2.1.1 Ground Improvement

Ground treatment is proposed for the residential building of Phase 1, Zones 1 and 2, in order to control settlements following the placing of fill and to provide the following performance criteria,

- Net bearing pressure of 125 kN/m²
- Maximum total settlement of 25 mm
- Maximum differential settlement of 1 in 500

The initial estimate of the spacing of the stone columns is 1.5 metre centres with the stone columns needing to penetrate the fill and be toed a sufficient depth into the underlying natural

soils. Subject to verification on the spacing from the Specialist Contractor, it is anticipated steel mesh reinforcement, placed in the top and bottom strip footing, will be sufficient to reinforce the foundations to allow for the variation on ground stiffness between the stone column and Fill. This structural design of the foundation will be subject to verification by the Structural Engineer (i.e. mesh/bar size and lap length requirements).

A specification for the installation of the vibro-stone columns has been produced in accordance with BRE report BR391 (ref: 1620000492/SP/002).

7.2.1.2 Pile Foundations

A four-storey apartment block is to be constructed in Phase 1, for which piles are to be used to support the superstructure. Borehole BH105 (constructed by Foundation Exploration Services) is the only deep exploratory hole local to the building and the ground profile for this exploratory hole is given in Table 11.

Exploratory Hole No.	Depth to Base of Stratum (mbgl)			
	Topsoil/Alluvium	River Terrace Deposits	Lambeth Group	Upper Chalk
BH105 (37.95 mAOD)	0.35	3.10	17.70	>25.00
Lambeth Group – Stiff Clay and very dense silty sand with clay lenses			3.1 metres to 4.1 metres Stiff clay 4.1 metres to 12.2 metres very dense silty sand 12.2 metres to 13.2 metres very stiff sandy clay/silt 13.2 metres to 16.5 metres very dense silty sand 16.5 metres to 17.7 metres stiff sandy gravelly clay	

Table 11 BH105 ground profile

Based upon this ground profile and the parameters derived for the various strata, Table 12 gives estimated safe working loads for 400 mm and 500 mm diameter CFA piles.

Pile Size	Pile Length (m) Below Existing Ground level	Estimated Safe Working Load (kN) for FoS=2.5	Estimated Safe Working Load (kN) for FoS=3.0
400 mm diameter CFA pile	14	347	290
	15	385	321
	16	441	367
	17	499	416
	18	561	467
	19	580	483
500 mm diameter CFA pile	14	448	374
	15	496	413
	16	565	471
	17	589	490
	18	612	510
	19	636	530

Table 12 Estimated safe working loads for 400 mm and 500 mm diameter CFA piles

The pile lengths are based on the ground profile used may mean piles are embedded into the Upper Chalk. It may therefore be necessary that a Piling Risk Assessment is required by the Environment Agency and the use of such foundations subject to planning conditions (refer to 1620000492/RPT/006 - Foundation Works Risk Assessment).

Detailed design of the piles will need to be carried out in accordance with BS EN 1997-1 and the accompany National Annex.

7.2.1.3 Buried Concrete

Chemical testing carried out on the existing placed fill material by Peter Brett Associates recorded pH values in the range of 7.0 to 7.8 and Water Soluble Sulphate (as SO₄) values of 1.0 mg/l to 170.0 mg/l. Based upon the guidance given in BRE Special Digest 1:2005, Concrete in aggressive ground, these values give an ACEC classification of AC-1, allowing for groundwater to be mobile.

7.2.2 Phase 1 Zone 3

Further ground investigations were undertaken in the Pingemead Industrial Estate. Findings of the geo-environmental results indicated that the use of ground improvement by vibro-stone would not be acceptable to the regulatory authorities. A remediation strategy was produced by Ramboll and remediation undertaken to allow the use of ground improvement. The reader should refer to the following RUK reports;

1620000492/RPT/004	Supplementary Ground Contamination Interpretative Report, Pingemead Industrial Estate
1620000492/RPT/005	Remediation Statement for Pingemead Industrial Estate
1620000492/RPT/006	Foundation Works Risk Assessment
1620000492/RPT/009	Pingemead Industrial Estate Verification Report
1620000492/RPT/010	Pingemead Industrial Estate Controlled Waters Detailed Quantitative Risk Assessment

The demolition of the site will include the removal of buried obstructions and these will need to be replaced with compacted fill in accordance with the earthworks specification.

7.2.3 Phase 2

It is understood that the buildings for the community facilities in Phase 2 are planned to be supported on piles. Currently there are no deep exploratory holes in the Phase 2 area of development (see Figure 5). Boreholes BH105, BH108 and BH110 constructed by FES are local to this part of the development and Table 13 gives the ground profiles encountered in these exploratory holes.

Exploratory Hole No.	Depth to Base of Stratum (mbgl)			
	Topsoil/Alluvium	River Terrace Deposits	Lambeth Group	Upper Chalk
BH105 (37.95 mAOD)	0.35	3.10	17.70	>25.00
BH108 (38.35 mAOD)	0.80	4.35	17.80	>20.20
BH110 (38.40 mAOD)	0.60	3.45	19.00	>30.00

Table 13 Ground profiles for pile design for Phase 2

Therefore for CFA piles the estimated safe working loads given in Table 12 would be applicable.

For geoenvironmental constraints such as ground gas and piling risk, then reference should be made to RUK report no. 1620000492-RPT-003.

7.2.4 Phase 3, 4 and 5

The foundation solutions for Phases 3, 4 and 5 will be dependent upon the findings of additional geoenvironmental investigations.

With regards to Phase 3, which includes the Pingemead Industrial Estate, then as discussed in Section 6.2.2, the preliminary findings of the geoenvironmental results indicate that the use of vibro-stone will not be acceptable to the regulatory authorities. Therefore consideration will need to be given to the foundation options discussed in Section 6.2.2.

With regards to Phase 4 and Phase 5 the foundation solution utilising vibro-stone columns as for Phase 1 will require the risk of ground gas to be assessed further, along with approval for such penetrations from the local authority. With these two phases of the site to have a large volume of fill to be placed the material used is likely to be made up from many source materials. However, all material being brought to site for these phases of development are to meet the property and compaction requirements of the earthworks specification. Therefore, providing proper supervision and control of the filling process is undertaken to ensure compliance with the earthworks specification it may be possible for a spread foundation solution to be utilised for the housing, i.e. strip or raft foundations. Such a solution would require validation of the settlement characteristics of the fill mass either by or using a combination of large plate bearing tests or dummy foundation tests.

As part of Phase 5 there are to be two apartment blocks (shown in Figure 13) for which it is understood pile foundations are to be used.

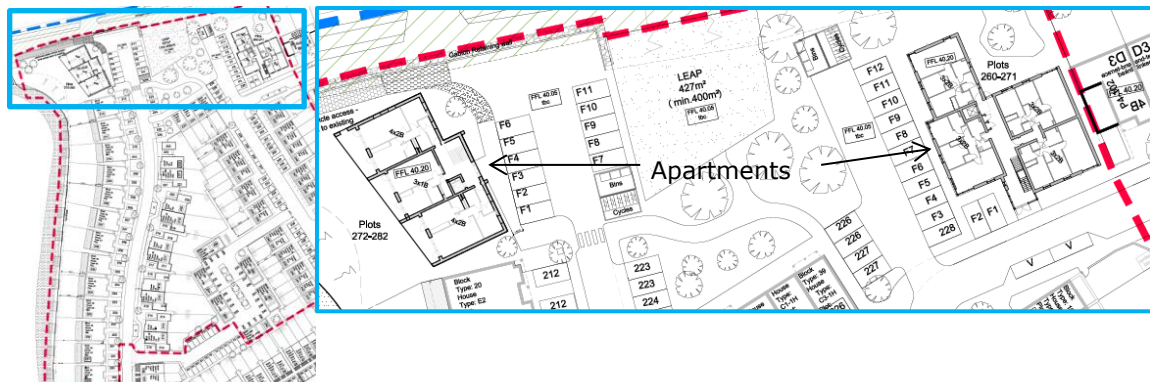


Figure 13 Apartment blocks in Phase 5

Exploratory Hole No.	Depth to Base of Stratum (mbgl)				
	Topsoil/Made Ground	Alluvium	River Terrace Deposits	Lambeth Group	Upper Chalk
BH 14C_1984 Ground level at 38.54	0.30	2.50	2.85	15.85	>24.00
BHG3 Ground level at 39.35	2.10	Not present	4.50	>10.0	-

Table 14 Suggested ground profile for Phase 5

Pile Size	Pile Length (m) Below Existing Ground level	Estimated Safe Working Load (kN) for FoS=2.5
300 mm diameter CFA pile	10	100
	12	137
	14	179
	16	302
	18	370
400 mm diameter CFA pile	10	164
	12	193
	14	250
	16	454
	18	543

Table 15 Estimated safe working loads for 300 mm and 400 mm diameter CFA piles in Phase 5

7.2.5 Phase 6

At the time of writing the development plans for Phase 6 are not complete. However, from what is known of the ground conditions and the proposed structure, the most suitable foundation solution is likely to be piles.

The ground investigation data local to Phase 6 is limited in terms of the number of exploratory holes that go to depth. The ground profile has been derived from the exploratory holes which penetrate to the Chalk (BH112, BH1_2007_2008, BH2009/04 and BH2009/05) and is summarised in Table 16. The ground profile has been used to estimate safe working loads for piles which are presented in Table 16.

Exploratory Hole No.	Depth to Base of Stratum (mbgl)			
	Made Ground/Alluvium	River Terrace Deposits	Lambeth Group	Upper Chalk
BH112 (38.70 mAOD)	3.7	4.3	10.0	-
BH1_2007_2008 (40.22 mAOD)	2.35	5.5	14.35	-
BH2009/04 (40.26 mAOD)	2.7	4.4	10.0	-
BH2009/05 (mAOD)	2.2	3.7	16.9	20.2

Table 16 Suggested ground profile for Phase 6

Pile Size	Pile Length (m) Below Existing Ground level	Estimated Safe Working Load (kN) for FoS=2.5	Estimated Safe Working Load (kN) for FoS=3.0
400 mm diameter CFA pile	14	437	364
	15	490	408
	16	546	455
	17	604	504

Pile Size	Pile Length (m) Below Existing Ground level	Estimated Safe Working Load (kN) for FoS=2.5	Estimated Safe Working Load (kN) for FoS=3.0
500 mm diameter CFA pile	18	665	554
	19	729	607
	14	546	455
	15	613	510
	16	682	569
	17	755	630
	18	832	693
	19	911	759

Table 17 Estimated safe working loads for 400 mm and 500 mm diameter CFA piles in Phase 6

8. GEOTECHNICAL RISK REGISTER

Based upon the project information provided the following risks relating to geotechnical design are given.

Item	Risk/Hazard	Consequences	Control Method(s)	Additional Control Method(s)/CDM Risk Register
Ground Conditions				
Ground investigation data	Insufficient data to undertake geotechnical design Reliability of information – Variation in the ground conditions between two adjacent exploratory	Inappropriate design ground profile and parameters	Scope and carry out additional GI where required to establish ground profiles and parameters. All ground investigation data collated into a single ground investigation report.	Refer to ground investigation report to check information is still appropriate should any changes to the design occur/be required.
Ground Gas				
	Adjacent landfill, alluvial deposit, Made Ground, localised petroleum hydrocarbon impacts, sediments within the trout lake(s).	Use of ground improvement not suitable and alternative foundation solutions are required Use of gas protection measures	Further assessment of ground gas risks prior to design, e.g. ground gas monitoring.	Refer to RUK geoenvironmental report no. 1620000492-RPT-003.
Hydro and Hydrogeological Conditions				
Groundwater	Insufficient data to undertake geotechnical design Reliability of information – Variation in the groundwater conditions	Inappropriate groundwater profiles. Groundwater encountered at higher levels than anticipated	Scope and carry out additional GI where required to establish groundwater levels. All groundwater investigation data collated into a single ground investigation report.	Refer to ground investigation report to check information is still appropriate should any changes to the design occur/be required. Carry out additional GI.

Item	Risk/Hazard	Consequences	Control Method(s)	Additional Control Method(s)/CDM Risk Register
Surface water	Inadequate drainage	Softening of surface fill materials. Increase in pore-water pressure	Drainage design to capture surface water.	Review drainage design to ensure it does not affect earthworks design.
Water bodies	Trout Lakes	Earthworks affect stability of the banks to the lakes	Establish geometry, water levels and ground conditions local to the lakes to enable stability analysis to be undertaken.	Monitor during construction works
Flooding	Flooding compromises earthworks in the short and long-term	Instability to earthworks	Design to flood levels recommended in accordance with the Flood Risk Assessment	
Earthworks				
Fill material	Imported material unsuitable for use	Requires treatment to modify and improve. Cannot be used	Earthworks specification	Supervision and monitoring of earthworks.
Embankment slope stability	Instability	Slope failure requiring embankment slopes to be rebuilt	Establish parameters of the fill material(s) and design slopes in accordance with required standards. Establish ground parameters along the footprint of the embankment.	Earthworks drawings to show slope geometry, construction sequencing and topsoil requirements. Any construction risk that cannot be designed out to be taken forward to the CDM risk register.
Settlement	Excessive settlements cause structural damage	Excessive settlements cause structural damage	Modification of material to improve stiffness Undertake ground improvement of in-situ strata	Review methods/solutions to check they are appropriate. Monitor during construction works

Item	Risk/Hazard	Consequences	Control Method(s)	Additional Control Method(s)/CDM Risk Register
Piling				
Method/type of pile	Contaminated Ground: Piling method provides a migratory route for contaminants.	Groundwater contamination of the Chalk Aquifer.	Method of piling to be such that it minimises this risk, e.g. CFA piling. Undertake groundwater monitoring before, during and after pile installation to assess and monitor groundwater quality. Ground profile from exploratory holes to be reviewed to assess risks and confirmed during constructions	Ground profile from exploratory holes to be reviewed to assess risks and confirmed during constructions.
Working Platform	Working Platform for Piling Rig and other plant: Ground conditions and proximity of services.	Overloading of the ground causing instability of plant and machinery, and or overloading of services resulting in damage.	Piling platforms to be designed in accordance with BRE 470.	Carry out additional ground investigation specific to the design of the working platform where insufficient existing GI data is available
Obstructions	Existing sub-structures	Unable to penetrate and install pile	Undertake probing in areas where obstructions are at risk of being encountered.	Appropriate investigations and piling methods to be adopted following review of information relating to existing structures by the Piling Contractor.

Table 18 Geotechnical risk register

9. REFERENCES

BGS British Geological Survey Map, 1:50,000 scale, Sheet 268 Reading (2000)

BRE report BR391, Specifying Vibro Stone Columns (2000)

BRE Special Digest 1:2005, Concrete in Aggressive Ground

BS 1377-3:1990, Methods of Test for Soils for Civil Engineering Purposes – Part 3: Chemical and Electro-chemical Tests

BS 5930:2015 Code of Practice for Ground Investigations

BS 8002:2015 Code of Practice for Earth Retaining Structures

BS EN 1997-1:2004 Eurocode 7: Geotechnical design – Part 1: General Rules

BS EN 1997-1:2004 Eurocode 7: Geotechnical design –Part 2: Ground investigation and testing

CIRIA C574 – Engineering in Chalk (2002)

CIRIA P86 – Shaft Friction of CFA Piles in Chalk (2003)

CIRIA R143 – The Standard Penetration Test (SPT): Methods and Use

Highways Agency - IAN 73/06 Revision 1 (2009) Design Guidance for Road Pavement Foundations

FIGURES

Figure 1 Site Location

Figure 2 Phase Plan

Figure 3 Overview of Exploratory Hole Locations

Figure 4 Location of Phase 1 Exploratory Hole Locations

Figure 5 Location of Phase 2 Exploratory Hole Locations

Figure 6 Location of Phase 3 Exploratory Hole Locations

Figure 7 Location of Phase 4 Exploratory Hole Locations

Figure 8 Location of Phase 5 Exploratory Hole Locations

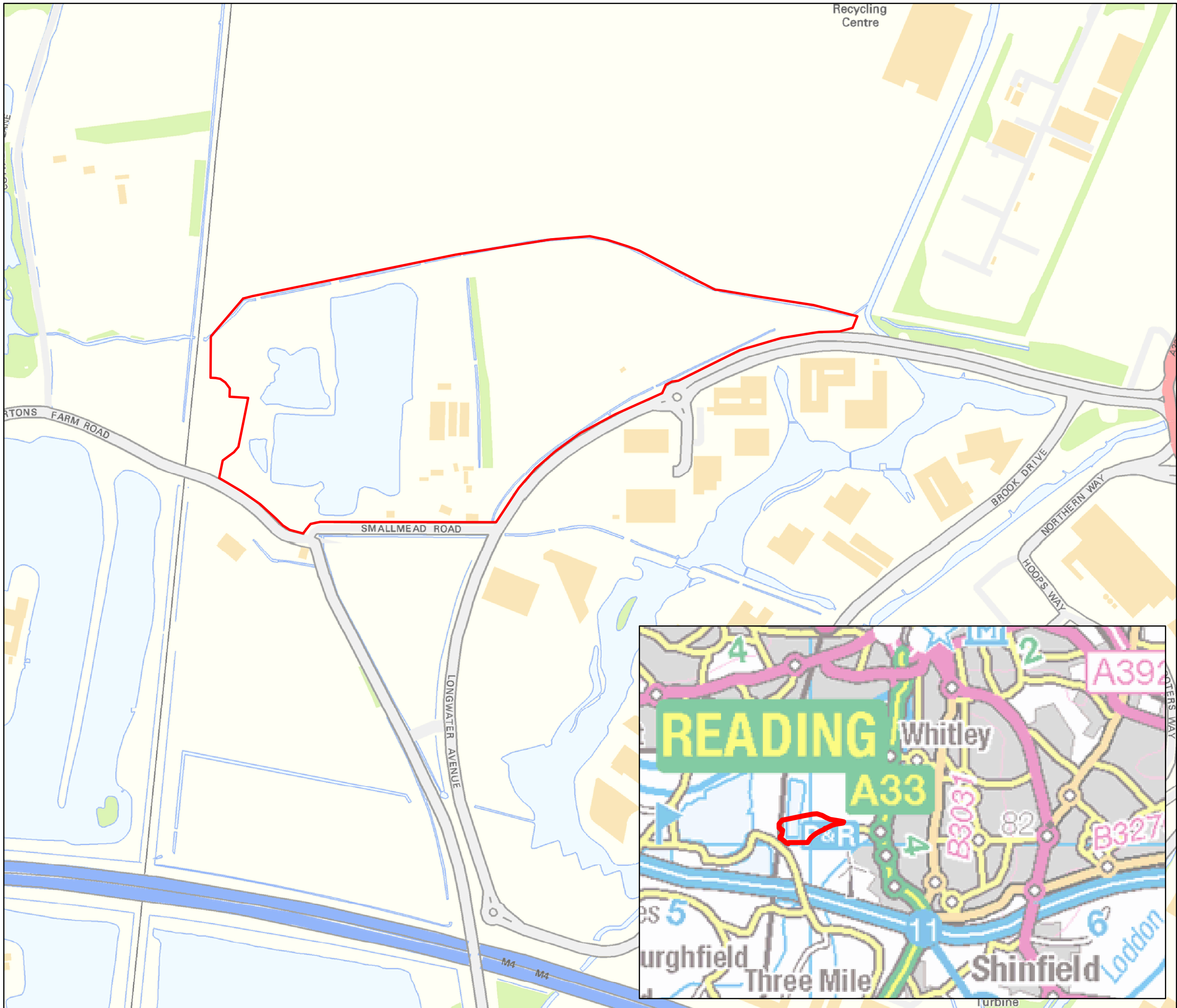
Figure 9 Location of Phase 6 Exploratory Hole Locations

Figure 10 Plan of estimated fill volumes

Figure 11 Plan showing extent of infill of Trout Lakes (within body of text)

Figure 12 Plan showing extents of Zones 1, 2 and 3 of Phase 1 (within body of text)

Figure 13 Apartment Blocks in Phase 5



Site Boundary

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Figure Title

Site Location Plan



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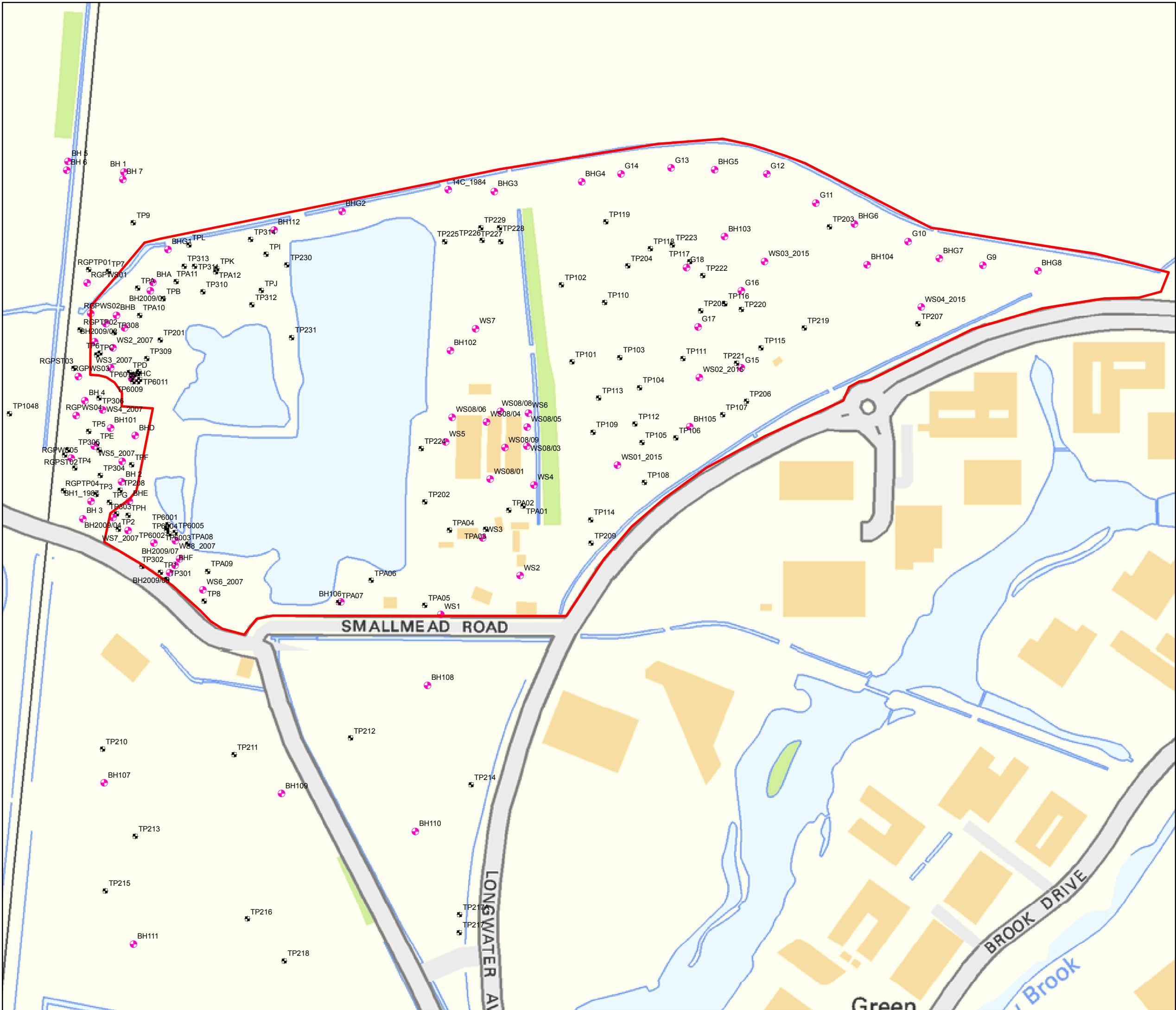
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Date
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BH

Figure No.
Figure 1

Revision
01



- Site Boundary
- Borehole (BH)
- Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
	14C_1984 *	Up to 21.86
November 2005	G15 to G18	2.0 to 3.0
November 2005	TP219 to TP231	2.5 to 4.5
July 2007	G9 to G14	Up to 4.5
September 2007	BH112	Up to 10
September 2007	BHA to BHF	4.5 to 5.5
September 2007	WS1_2007 to WS8_2007	2.8 to 5.0
April 2008	TPA to TPL	1.6 to 3.9
February 2009	TPA01 to TPA12	0.5 to 2.5
June 2009	BH2009/01 to BH2009/07	5 to 20
	TP301 to TP314	Up 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5
	RGPT02 to RGPT03 *	Up to 2
	RGPWS01 to RGPWS05 *	Up to 5
October 2009	BH_2007_2009 *	14.35
October 2009	TP6001 to TP6011	Up 4.5
July 2010	TP1047 to TP1048 *	Up to 5
May 2015	BH1016 *	Up to 12
May 2015	WS01_2015 to WS04_2015	2.5 to 4
May 2015	TP101 to TP119	0.8 to 3.8

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Historic Ground Investigations

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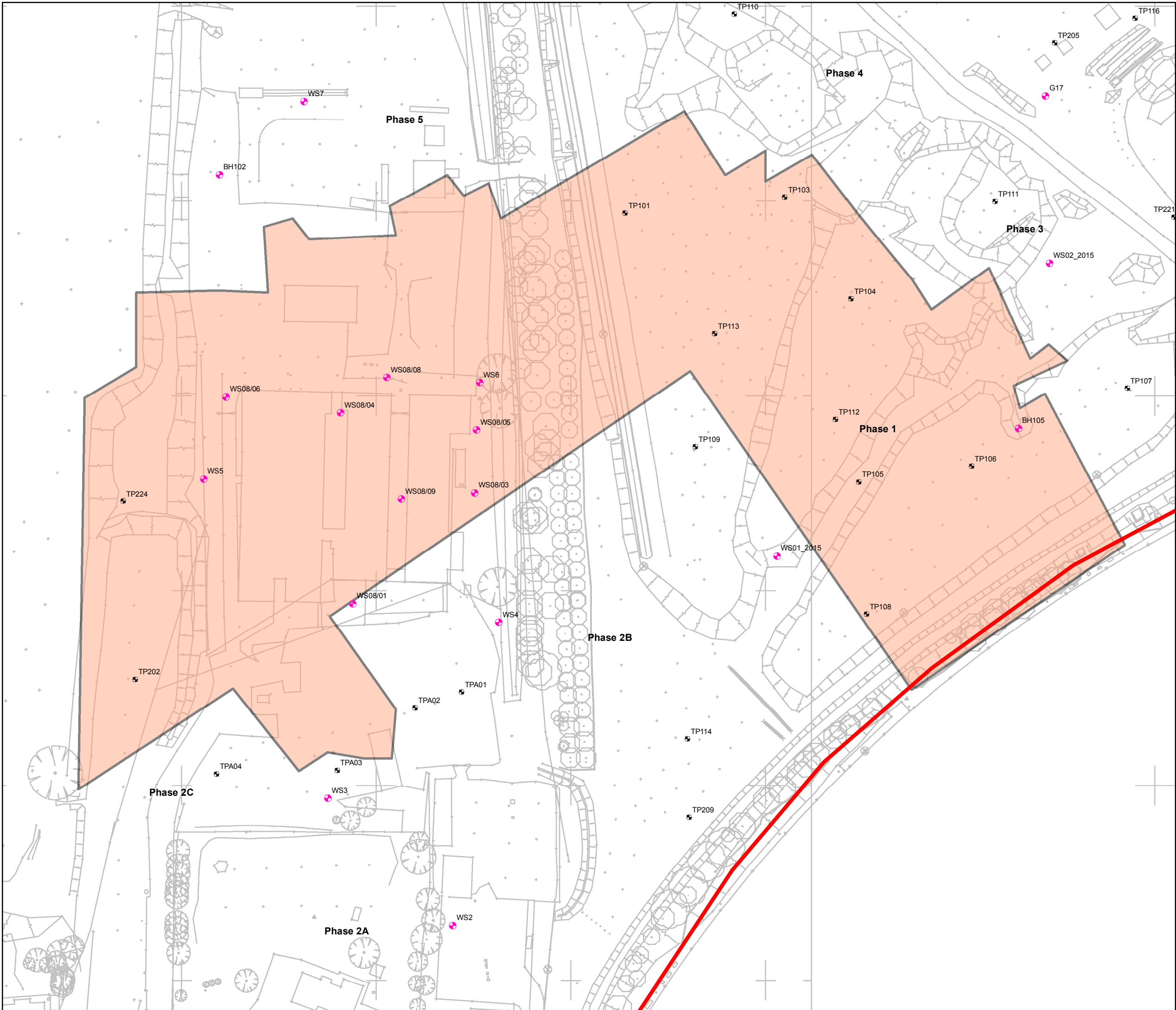
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Figure No.
Figure 3

Revision
01



- Site Boundary
- Phase 1
- Borehole (BH)
- Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
	14C_1984 *	Up to 21.86
November 2005	G15 to G18	2.0 to 3.0
	TP219 to TP231	2.5 to 4.5
July 2007	G9 to G14	Up to 4.5
	BH112	Up to 10
September 2007	BHA to BHF	4.5 to 5.5
	WS1_2007 to WS8_2007	2.8 to 5.0
	TPA to TPL	1.6 to 3.9
April 2008	WS08/01, WS08/03, WS08/04, WS08/05, WS08/06, WS08/08, WS08/09	3.8 to 4.6
February 2009	TPA01 to TPA12	0.5 to 2.5
	BH2009/01 to BH2009/07	5 to 20
	TP301 to TP314	Up 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5 to 2.5
	RGPT02 to RGPST03 *	Up to 2
	RGPWS01 to RGPWS05 *	Up to 5
October 2009	BH_2007_2009 *	14.35
	TP6001 to TP6011	Up 4.5
July 2010	TP1047 to TP1048 *	Up to 5
	BH1016 *	Up to 12
May 2015	WS01_2015 to WS04_2015	2.5 to 4
	TP101 to TP119	0.8 to 3.8

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Figure Title
**Phase 1 Historic Ground
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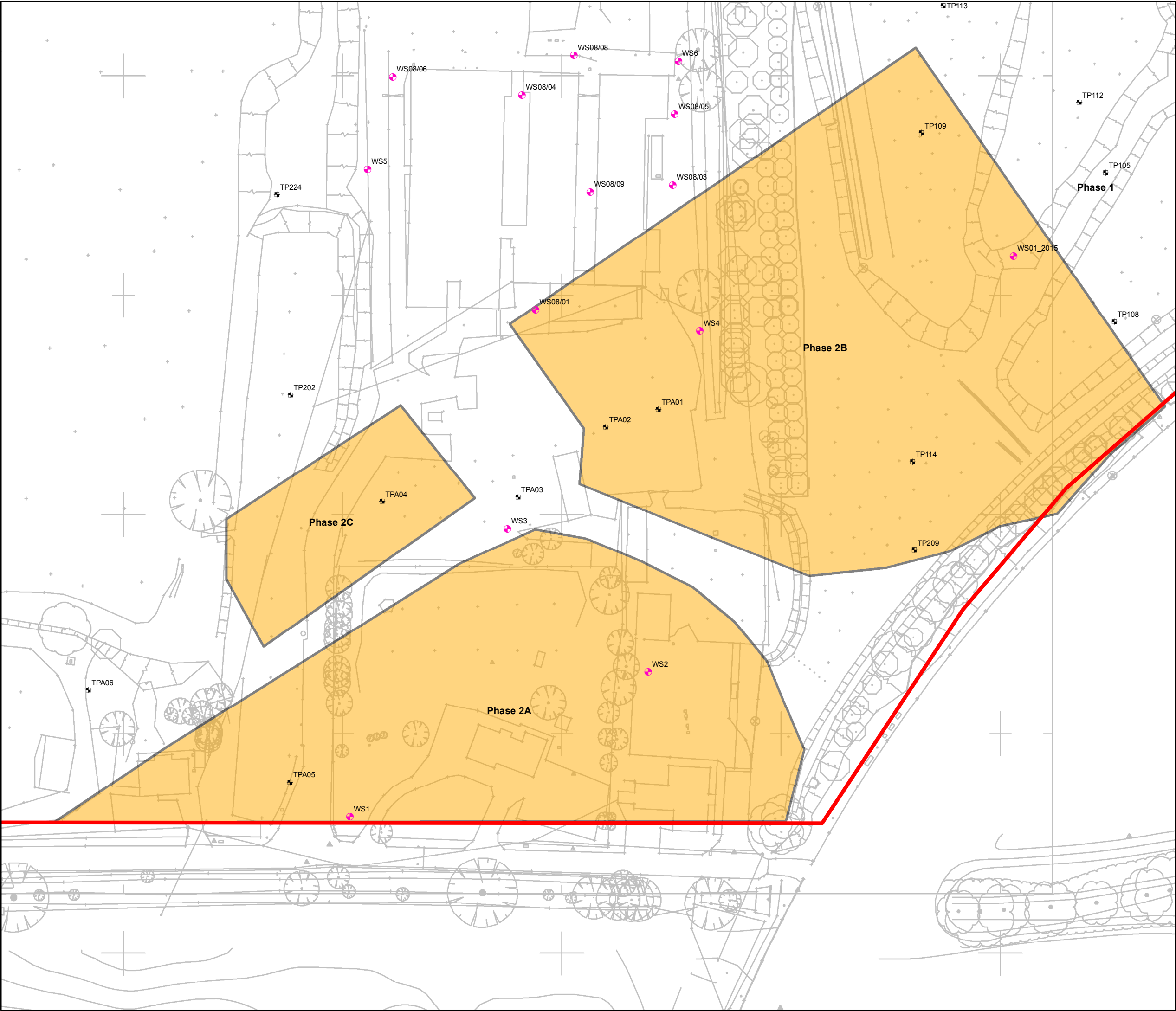
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Figure No.
Figure 4

Revision
01



- Internal Site Boundary
- Phase 2A
- Phase 2B
- Phase 2C
- Borehole (BH)

Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
	14C_1984 *	Up to 21.86
November 2005	G15 to G18	2.0 to 3.0
	TP219 to TP231	2.5 to 4.5
July 2007	G9 to G14	Up to 4.5
	BH112	Up to 10
September 2007	BHA to BHF	4.5 to 5.5
	WS1_2007 to WS8_2007	2.8 to 5.0
	TPA to TPL	1.6 to 3.9
April 2008	WS08/01, WS08/03, WS08/04, WS08/05, WS08/06, WS08/08, WS08/09	3.8 to 4.6
February 2009	TPA01 to TPA12	0.5 to 2.5
June 2009	BH2009/01 to BH2009/07	5 to 20
	TP301 to TP314	Up 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5 to 2.5
	RGPT02 to RGPST03 *	Up to 2
	RGPWS01 to RGPWS05 *	Up to 5
	BH_2007_2009 *	14.35
October 2009	TP6001 to TP6011	Up 4.5
July 2010	TP1047 to TP1048 *	Up to 5
	BH1016 *	Up to 12
May 2015	WS01_2015 to WS04_2015	2.5 to 4
	TP101 to TP119	0.8 to 3.8

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Figure Title
Phase 2 (A, B & C) Historic Ground Investigation Plan



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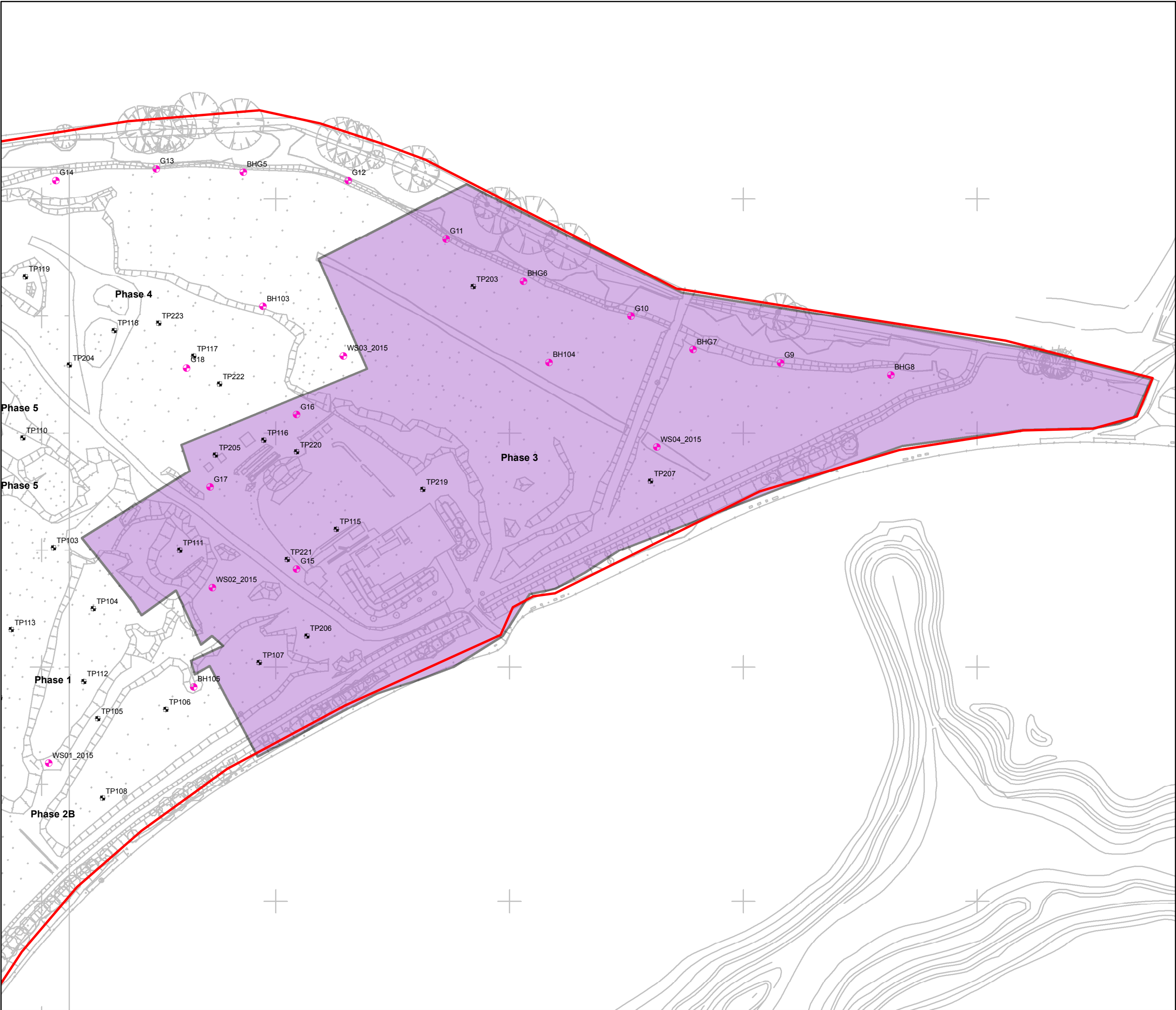
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Date
17/02/2016

Prepared By
BH

Figure No.
Figure 5

Revision
01



- Site Boundary
- Phase 3
- Borehole (BH)
- Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
November 2005	14C_1984 *	Up to 21.86
	G15 to G18	2.0 to 3.0
	TP219 to TP231	2.5 to 4.5
July 2007	G9 to G14	Up to 4.5
	BH112	Up to 10
September 2007	BHA to BHF	4.5 to 5.5
	WS1_2007 to WS8_2007	2.8 to 5.0
	TPA to TPL	1.6 to 3.9
April 2008	WS08/01, WS08/03, WS08/04, WS08/05, WS08/06, WS08/08, WS08/09	3.8 to 4.6
February 2009	TPA01 to TPA12	0.5 to 2.5
	BH2009/01 to BH2009/07	5 to 20
	TP301 to TP314	Up to 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5 to 2.5
	RGPT02 to RGPT03 *	Up to 2
June 2009	RGPWS01 to RGPWS05 *	Up to 5
	BH_2007_2009 *	14.35
	TP6001 to TP6011	Up to 4.5
	TP1047 to TP1048 *	Up to 5
October 2009	BH1016 *	Up to 12
	WS01_2015 to WS04_2015	2.5 to 4
July 2010	TP101 to TP119	0.8 to 3.8
May 2015		

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Figure Title

**Phase 3 Historic Ground
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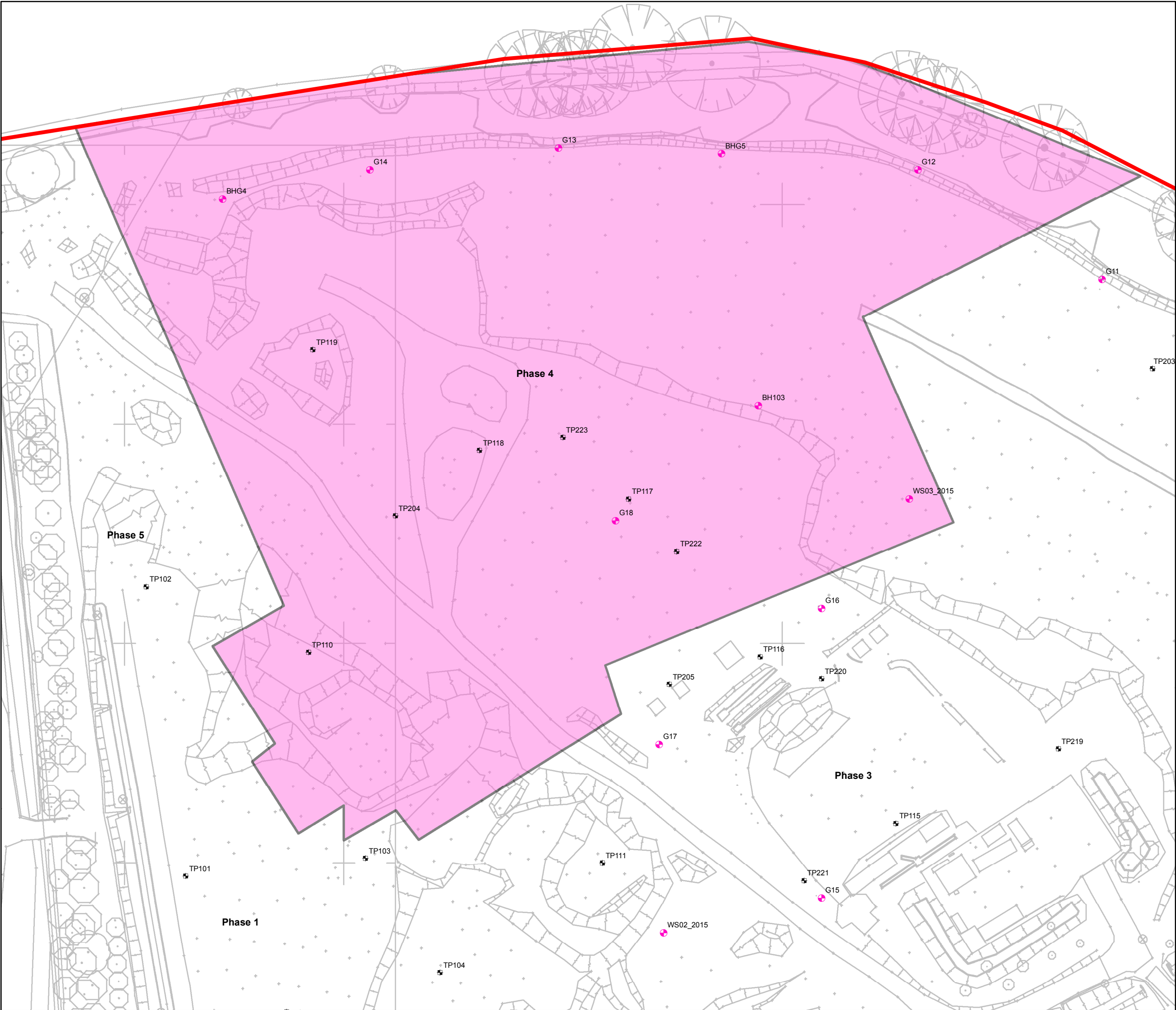
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BH

Figure No.
Figure 6

Revision
01



- Site Boundary
- Phase 4
- Borehole (BH)
- Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
	14C_1984 *	Up to 21.86
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	BHA to BHF	4.5 to 5.5
	WS1_2007 to WS8_2007	2.8 to 5.0
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	WS08/01, WS08/03, WS08/04, WS08/05, WS08/06, WS08/08, WS08/09	3.8 to 4.6
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June 2009	BH2009/01 to BH2009/07	5 to 20
	TP301 to TP314	Up 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5 to 2.5
	RGPT02 to RGPST03 *	Up to 2
	RGPWS01 to RGPWS05 *	Up to 5
	BH_2007_2009 *	14.35
October 2009	TP6001 to TP6011	Up 4.5
July 2010	TP1047 to TP1048 *	Up to 5
May 2015	BH1016 *	Up to 12
	WS01_2015 to WS04_2015	2.5 to 4
TP101 to TP119		0.8 to 3.8

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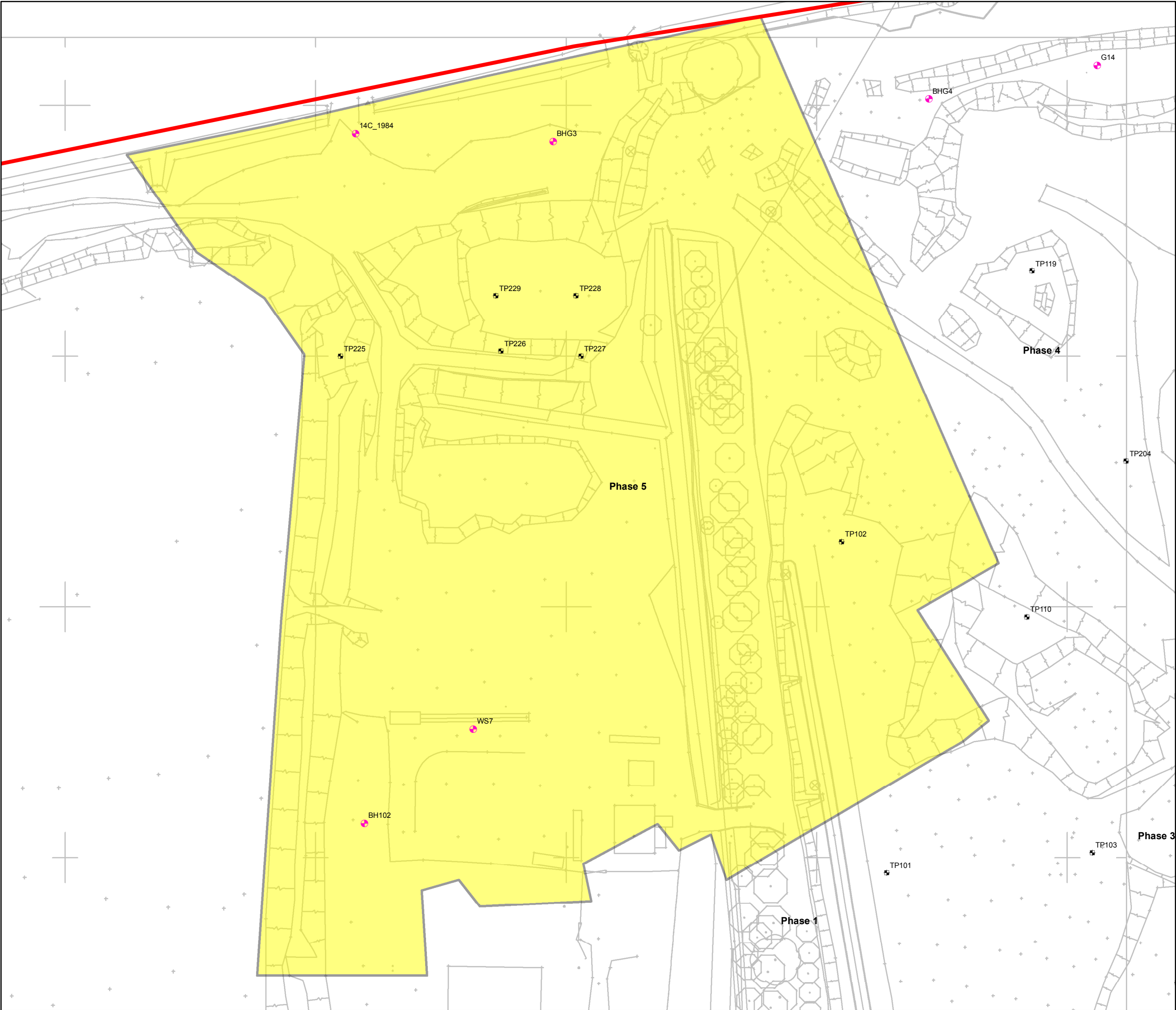
Figure Title

**Phase 4 Historic Ground
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Date	17/02/2016	Prepared By	BH
Figure No.	Figure 7	Revision	01



- Site Boundary
- Phase 5
- Borehole (BH)
- Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
	14C_1984 *	Up to 21.86
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	TP219 to TP231	2.5 to 4.5
July 2007	G9 to G14	Up to 4.5
	BH112	Up to 10
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April 2008	WS08/01, WS08/03, WS08/04, WS08/05, WS08/06, WS08/08, WS08/09	3.8 to 4.6
February 2009	TPA01 to TPA12	0.5 to 2.5
June 2009	BH2009/01 to BH2009/07	5 to 20
	TP301 to TP314	Up 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5 to 2.5
	RGPT02 to RGPST03 *	Up to 2
	RGPWS01 to RGPWS05 *	Up to 5
	BH_2007_2009 *	14.35
October 2009	TP6001 to TP6011	Up 4.5
July 2010	TP1047 to TP1048 *	Up to 5
	BH1016 *	Up to 12
May 2015	WS01_2015 to WS04_2015	2.5 to 4
	TP101 to TP119	0.8 to 3.8

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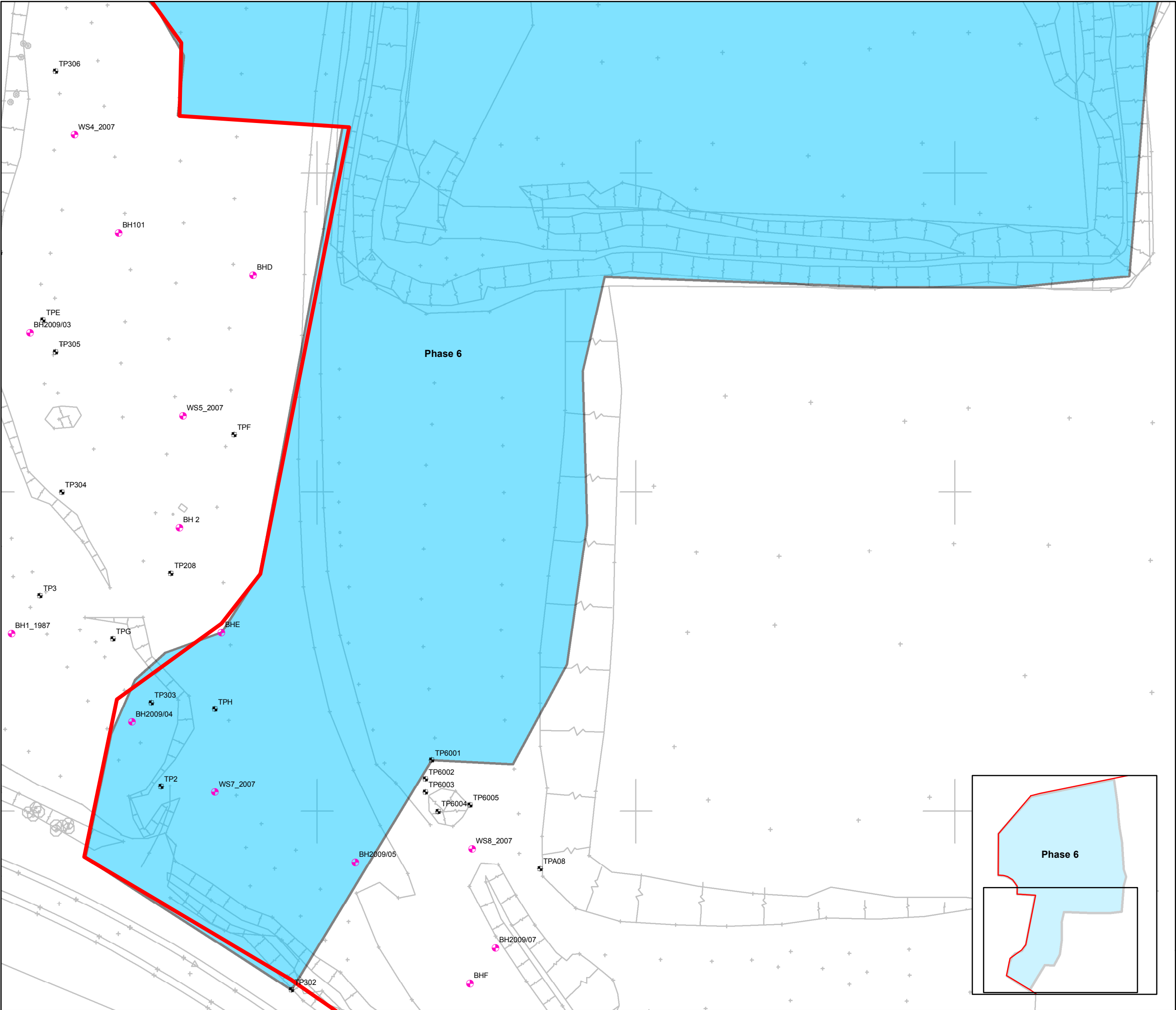
Figure Title

Phase 5 Historic Ground Investigation Plan

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Date	17/02/2016	Prepared By	BH
Figure No.	Figure 8	Revision	01



- Site Boundary
- Phase 6
- Borehole (BH)
- Trial Pit (TP)

Date	Ground Investigation	Depths (m bgl)
June 2001	BH6 to BH7	Up to 10
	BH1 to BH5	0.5 to 5.0
	TP1 to TP9	1.8 to 3.4
August 2002	BH101 to BH111	5.0 to 30.0
	BHG1 to BHG8	Up to 5.0
	WS1 to WS7	3.0 to 4.0
	TP201 to TP218	Up to 4.0
	BH1_1987 *	Up to 16.8
November 2005	14C_1984 *	Up to 21.86
	G15 to G18	2.0 to 3.0
November 2005	TP219 to TP231	2.5 to 4.5
	G9 to G14	Up to 4.5
July 2007	BH112	Up to 10
	BHA to BHF	4.5 to 5.5
September 2007	WS1_2007 to WS8_2007	2.8 to 5.0
	TPA to TPL	1.6 to 3.9
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	TP301 to TP314	Up 2.9
	RGPTP01 to RGPTP04 *	Up to 0.5 to 2.5
	RGPT02 to RGPT03 *	Up to 2
	RGPWS01 to RGPWS05 *	Up to 5
	BH_2007_2009 *	14.35
October 2009	TP6001 to TP6011	Up 4.5
July 2010	TP1047 to TP1048 *	Up to 5
	BH1016 *	Up to 12
May 2015	WS01_2015 to WS04_2015	2.5 to 4
	TP101 to TP119	0.8 to 3.8

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Client
**Berkeley Homes
(Western) Ltd**

Project Title
Green Park Village

Project Number
1620000492

Figure Title
**Phase 6 Historic Ground
Investigation Plan**

RAMBOLL

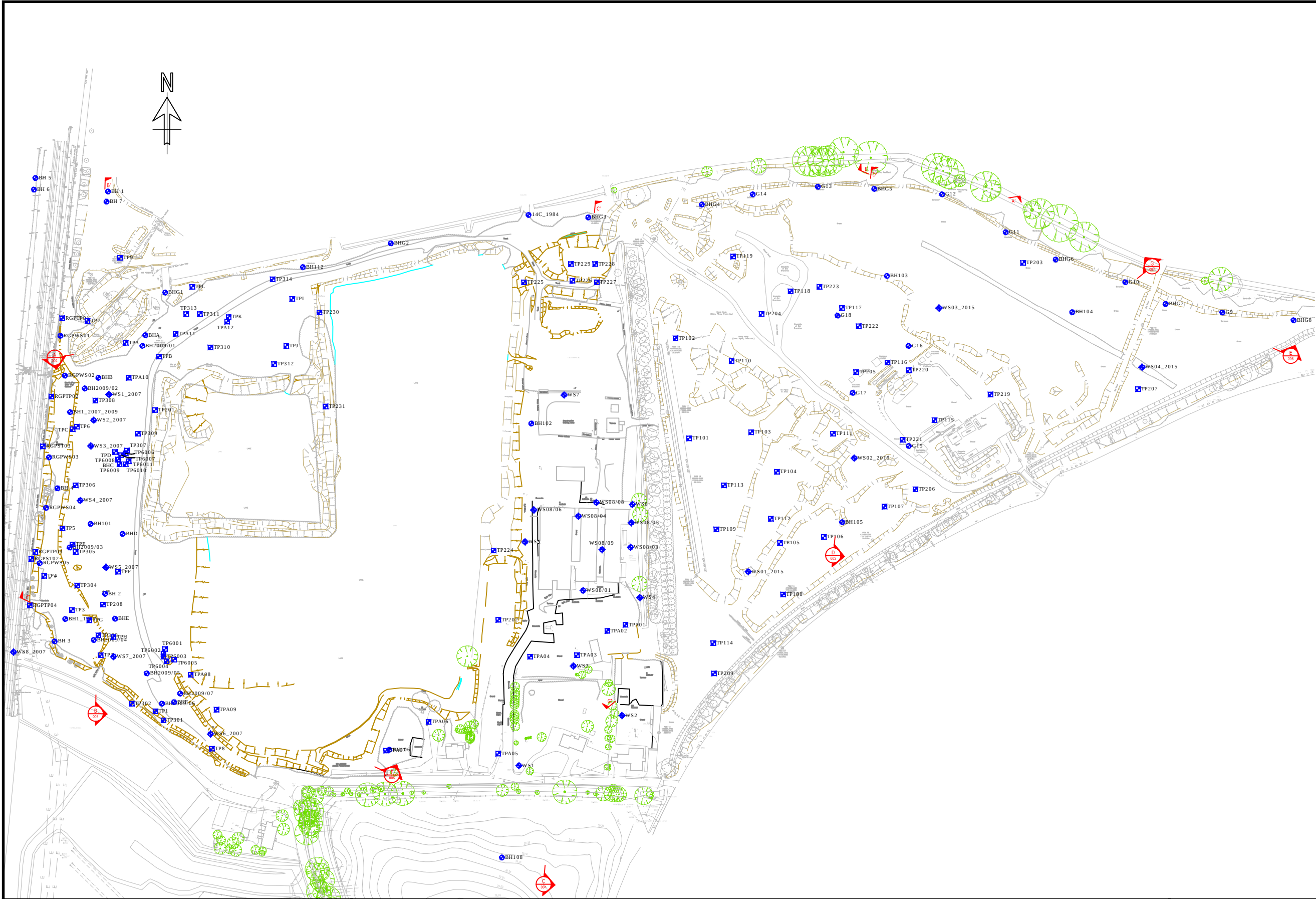
Tel: 023 8081 7500
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Date	17/02/2016	Prepared By	BH
Figure No.	Figure 9b	Revision	01

APPENDIX 1

EXPLORATORY HOLE LOCATIONS AND GEOLOGICAL SECTIONS



- NOTES:
1. DO NOT SCALE FROM THIS DRAWING.
 2. ALL DIMENSIONS ARE MILLIMETRES U.N.O.
 3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O.
 4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
 5. ALL EXPLORATORY HOLE LOCATION ARE INDICATIVE ONLY AND SHOULD NOT BE SCALED.
 6. FOR STRATA DETAILS REFER TO EXPLORATORY HOLE LOGS

- KEY
- HISTORICAL BOREHOLE LOCATION
 - HISTORICAL WINDOW SAMPLE LOCATION
 - HISTORICAL TRIAL PIT LOCATION



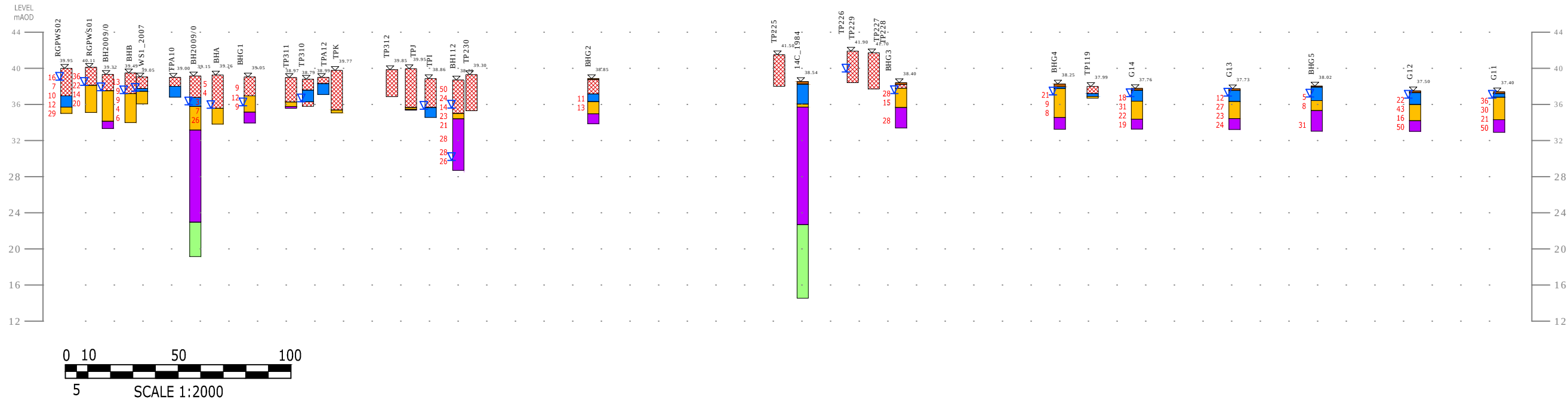
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GREEN PARK VILLAGE READING

EXPLORATORY HOLE LOCATION PLAN

Rev	Description	Date	By Chk	App
FOR INFORMATION				
Project No: 1620000492		Scale (@A3): 1:2500	Drawn: SKH	Date: FEB.16
Drawing No: RAM-GDR-00-DR-CG-001				Rev: I01

- NOTES:
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SECTION
A-A'
1: 1:2000(H), 1:400(V)

KEY

TOPSOIL

MADE GROUND

ALLUVIUM

RIVER TERRACE DEPOSITS

LAMBETH GROUP

CHALK

'N'

WATERSTRIKE

SPT 'N' VALUE

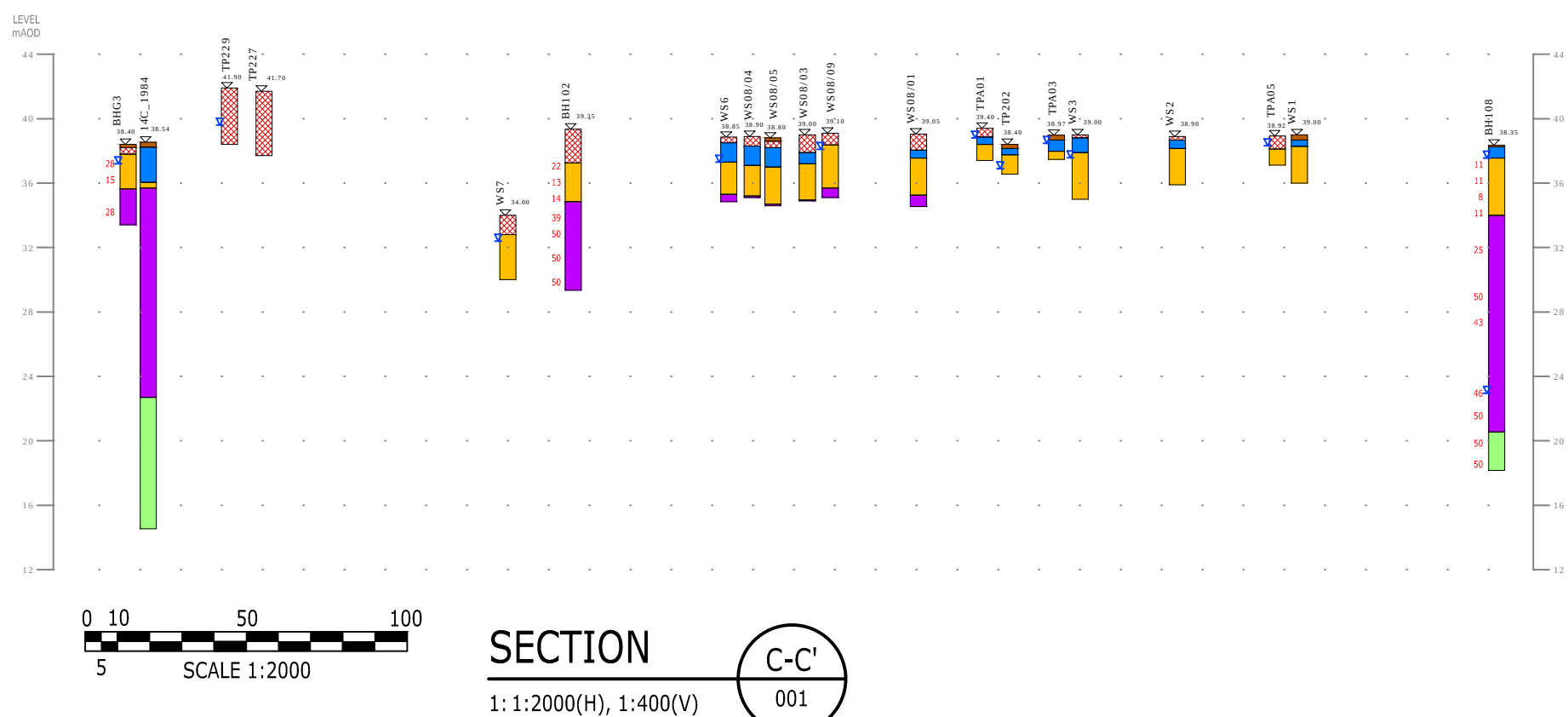


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GREEN PARK VILLAGE
READING

GEOLOGICAL SECTION A-A'

Rev	Description	Date	By	App
FOR INFORMATION				
Project No: 1620000492		Scale (@A3): AS SHOWN	Drawn: SKH	Date: FEB.16
Drawing No: RAM-GDR-XX-DR-CG-002				Rev: I01



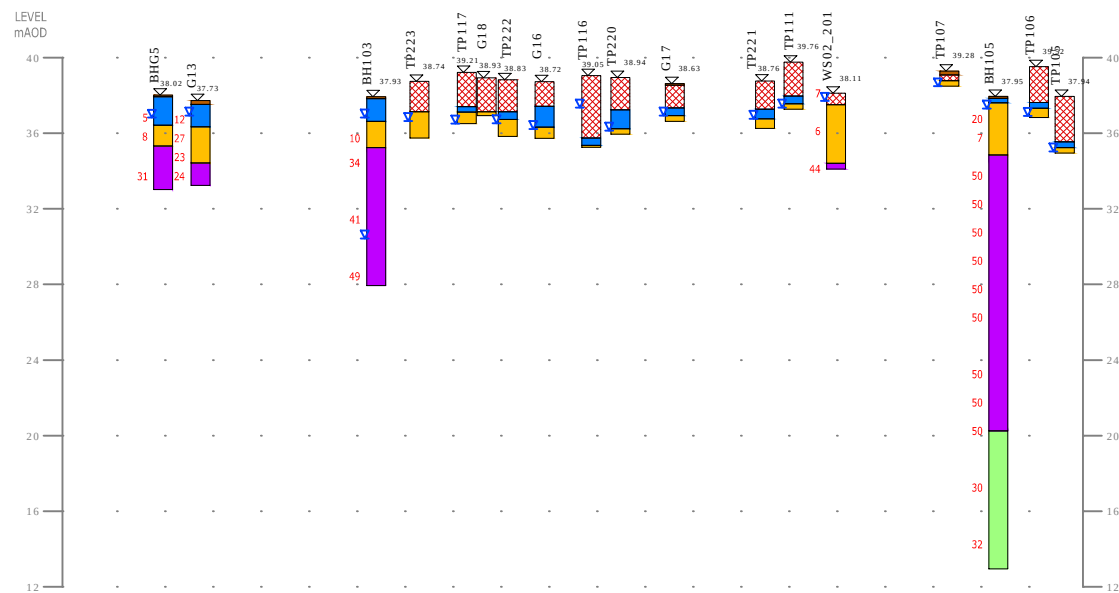
- # KEY
- | | |
|---|------------------------|
|  | TOPSOIL |
|  | MADE GROUND |
|  | ALLUVIUM |
|  | RIVER TERRACE DEPOSITS |
|  | LAMBETH GROUP |
|  | CHALK |
|  | SPT 'N' VALUE |
|  | WATERSTRIKE |



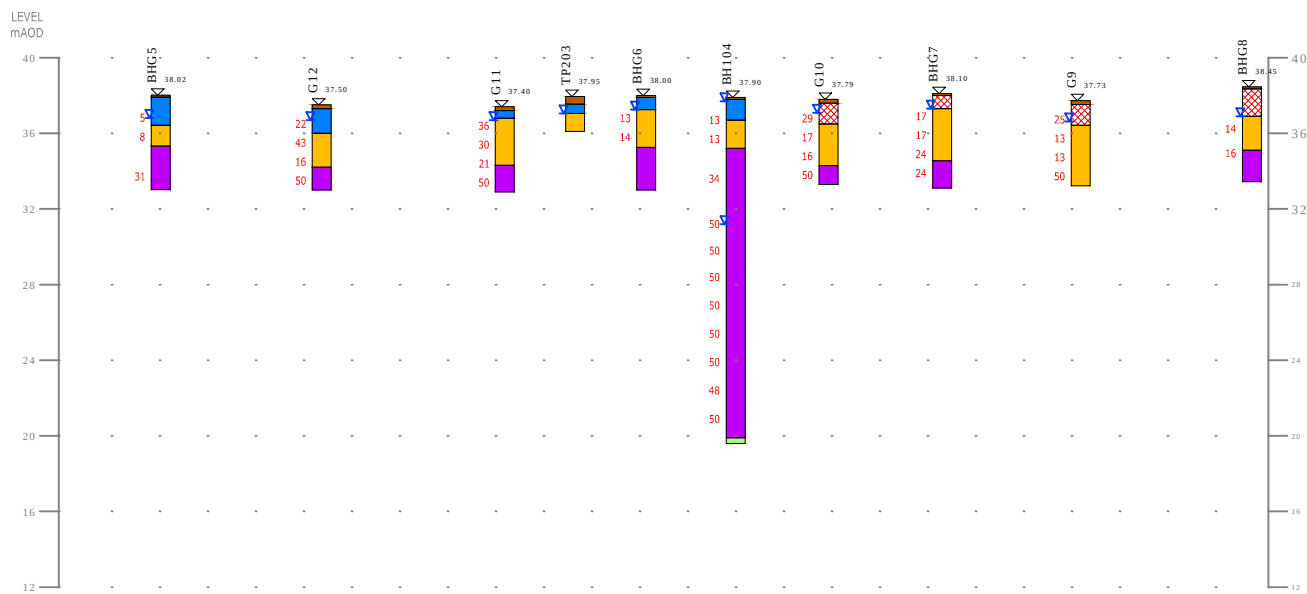
GREEN PARK VILLAGE
READING

GEOLOGICAL SECTION B-B' & C-C'

Rev	Description	Date	By Chk	App
FOR INFORMATION				
Project No: 1620000492	Scale (@A3): AS SHOWN	Drawn: SKH	Date: FEB.16	
Drawing No: RAM-GDR-XX-DR-CG-003			Rev: I01	



SECTION D-D'
1: 1:2000(H), 1:400(V)
001



SECTION E-E'
1: 1:2000(H), 1:400(V)
001

- NOTES:
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 - 6. FOR STRATA DETAILS REFER TO EXPLORATORY HOLE LOGS

KEY

TOPSOIL

MADE GROUND

ALLUVIUM

RIVER TERRACE DEPOSITS

LAMBETH GROUP

CHALK

'N'

 SPT 'N' VALUE

▽

 WATERSTRIKE

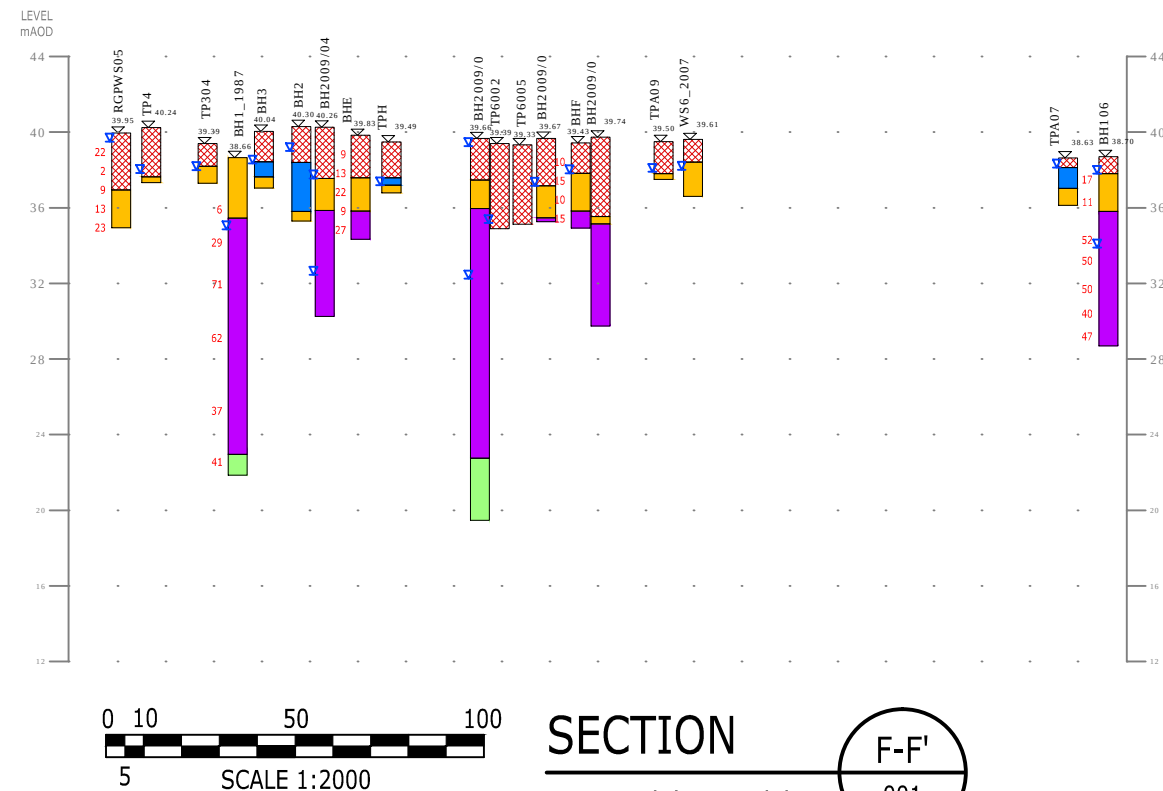


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GREEN PARK VILLAGE
READING

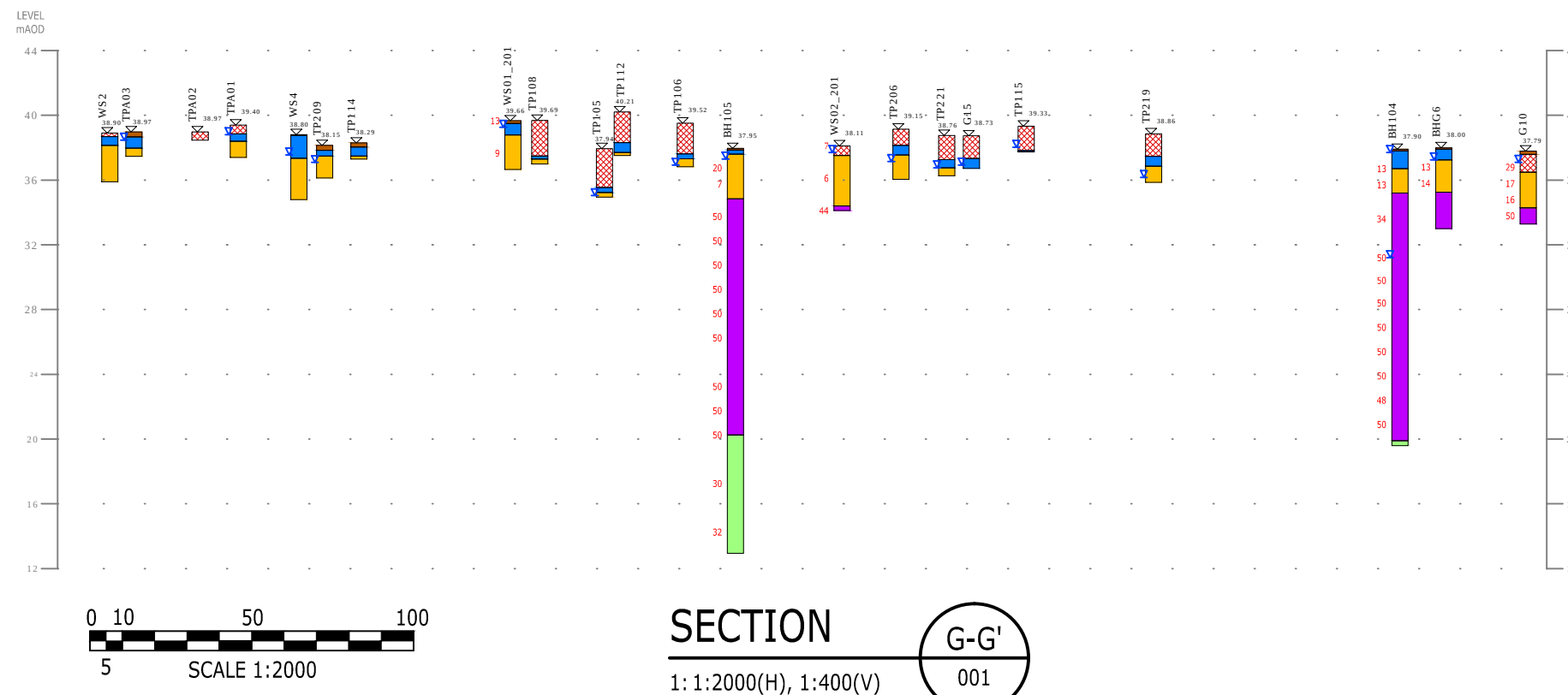
GEOLOGICAL SECTION D-D' & E-E'

Rev	Description	Date	By Chk	App
FOR INFORMATION				
Project No: 1620000492		Scale (@A3): AS SHOWN	Drawn: SKH	Date: FEB.16
Drawing No: RAM-GDR-XX-DR-CG-004				Rev: I01



- NOTES:
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- KEY
- TOPSOIL
 - MADE GROUND
 - ALLUVIUM
 - RIVER TERRACE DEPOSITS
 - LAMBETH GROUP
 - CHALK
 - 'N' SPT 'N' VALUE
 - WATERSTRIKE



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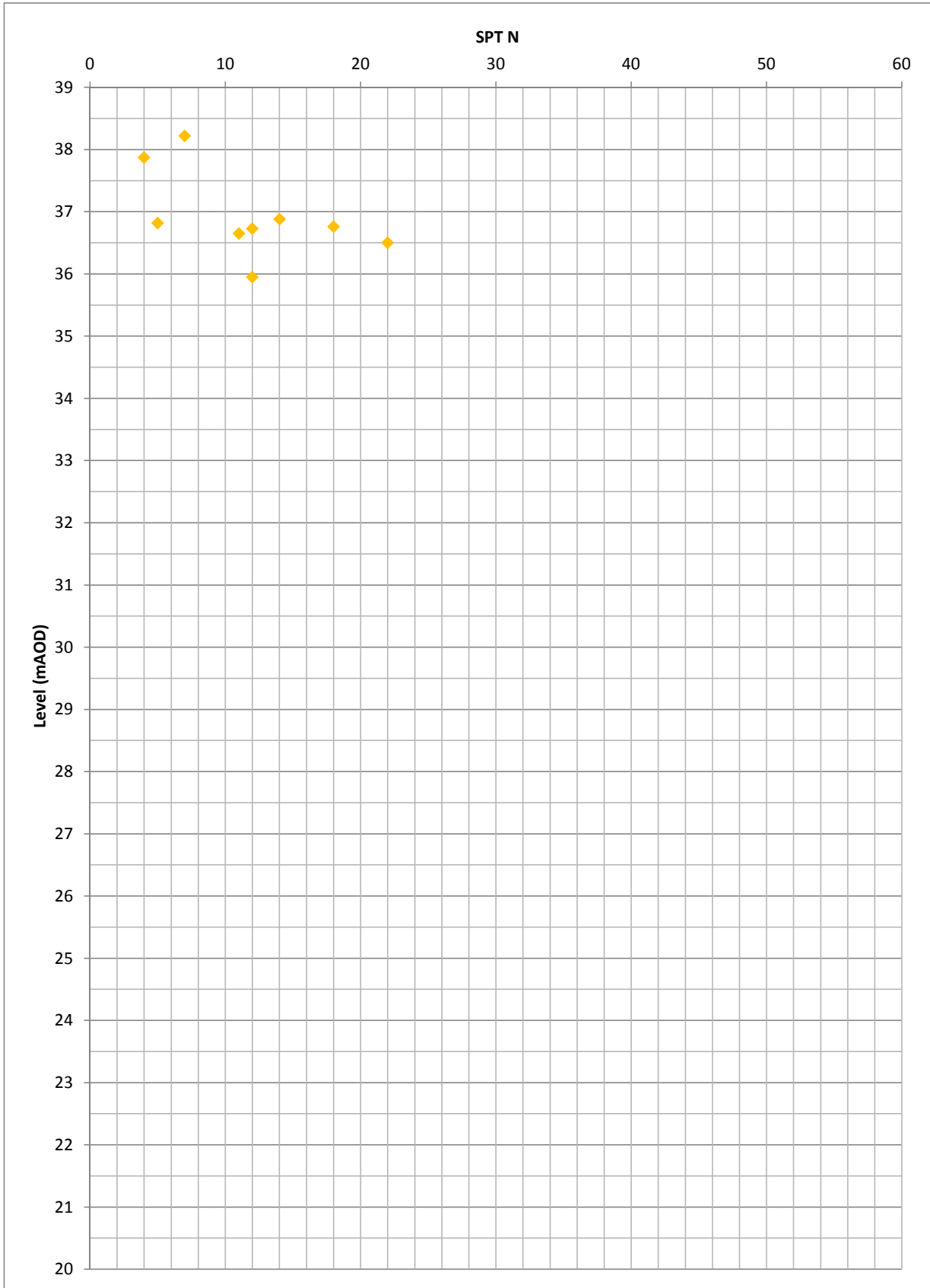
GREEN PARK VILLAGE
READING

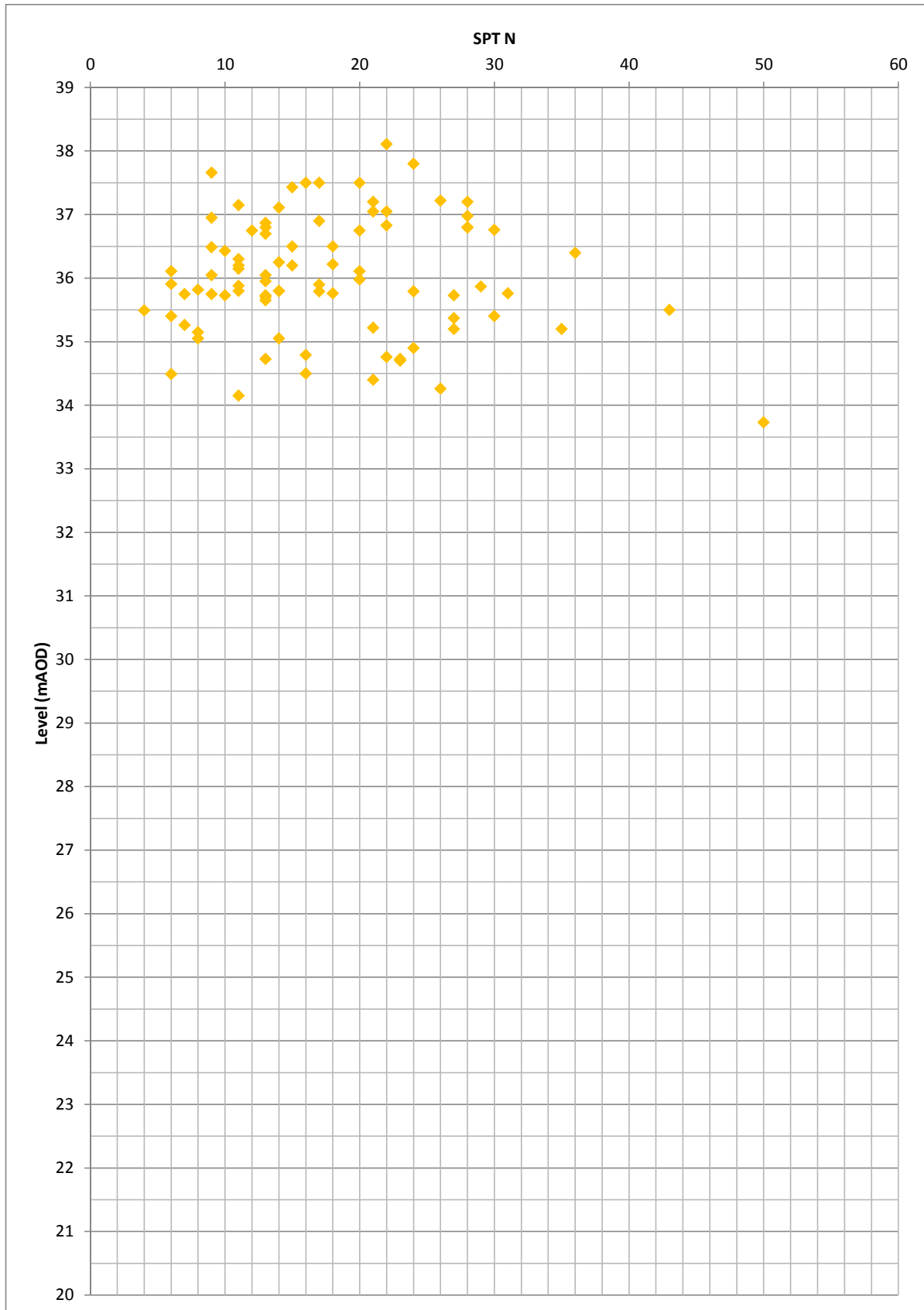
GEOLOGICAL SECTION F-F' & G-G'

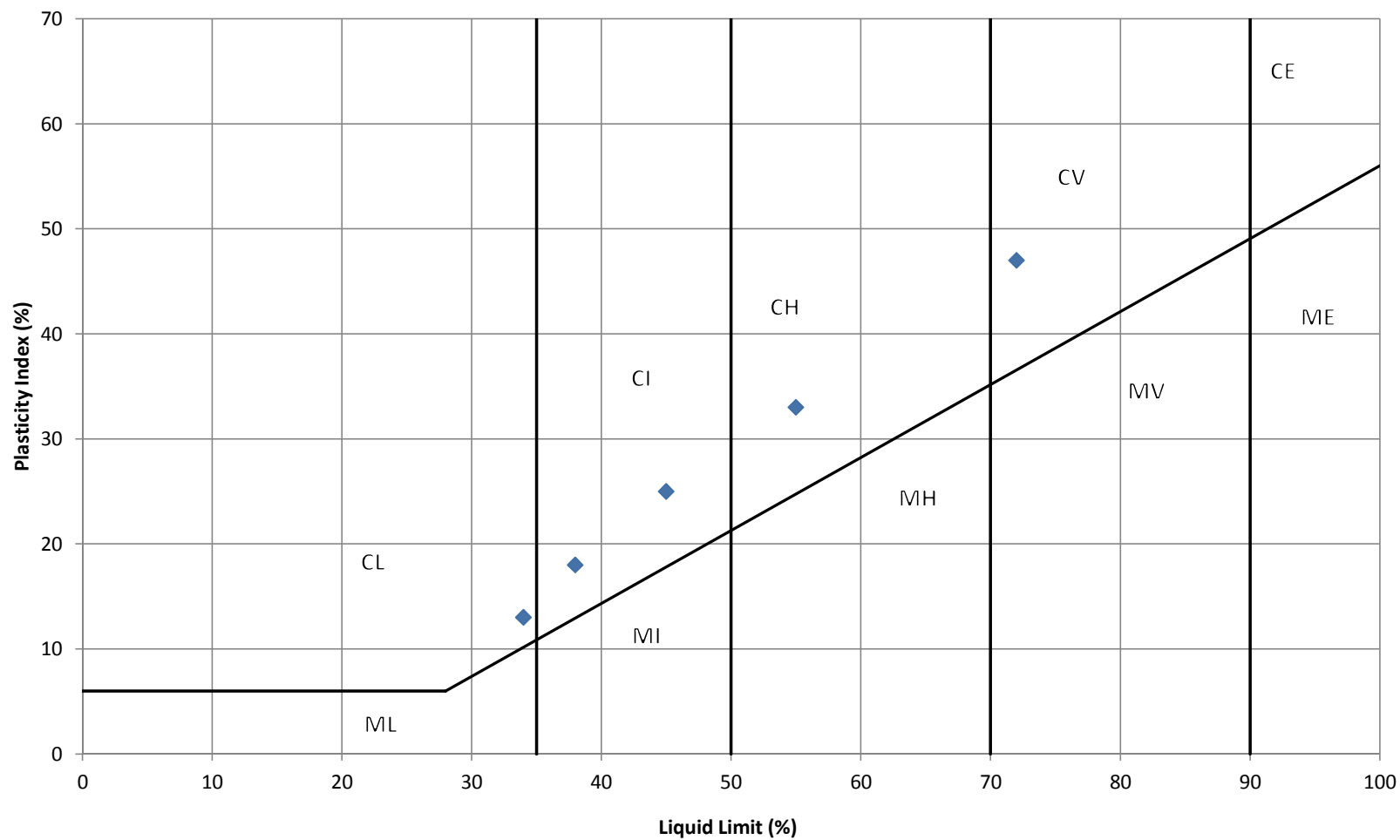
Rev	Description	Date	By Chk	App
FOR INFORMATION				
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Drawing No: RAM-GDR-XX-DR-CG-005				Rev: I01

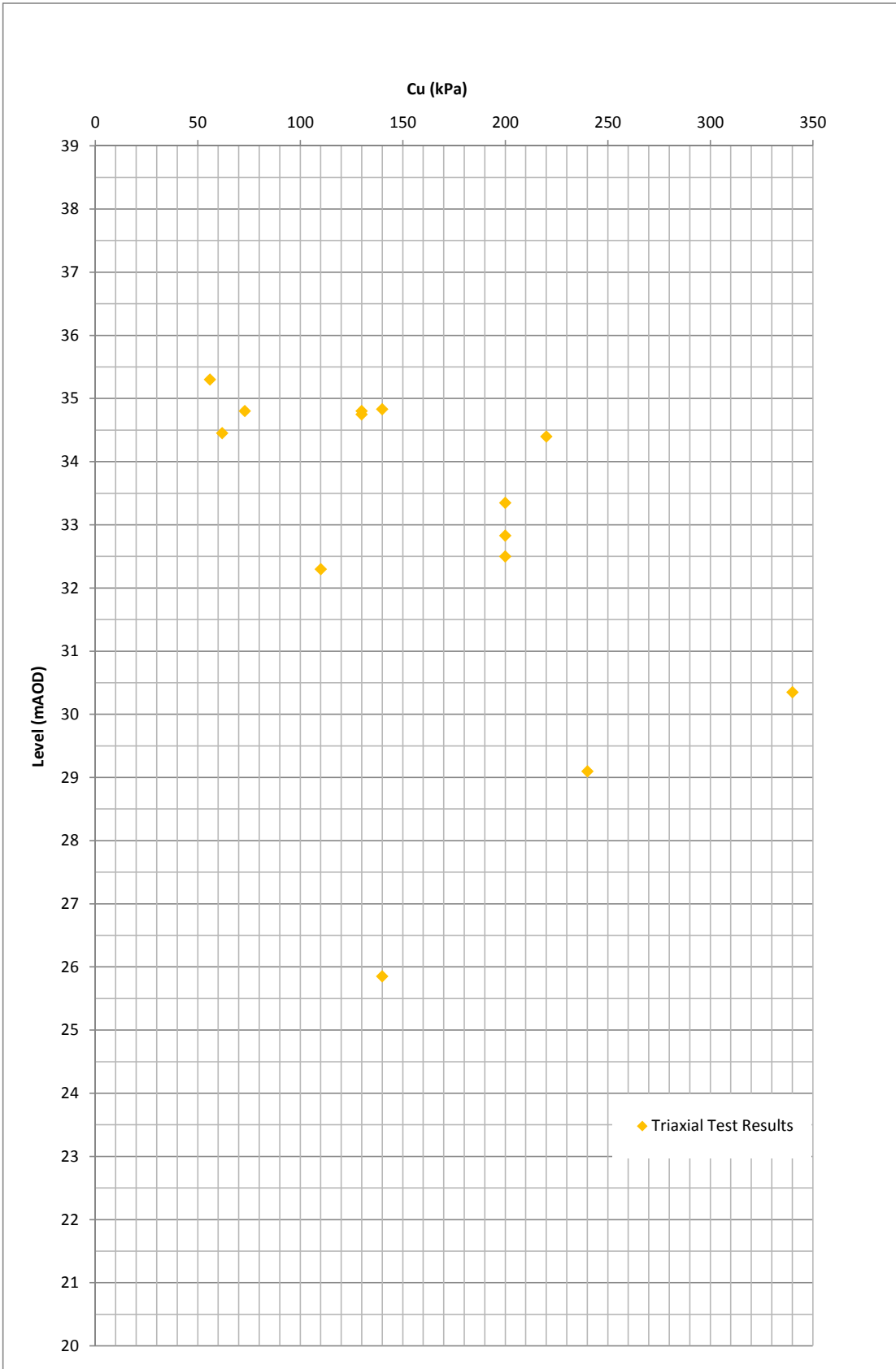
APPENDIX 2

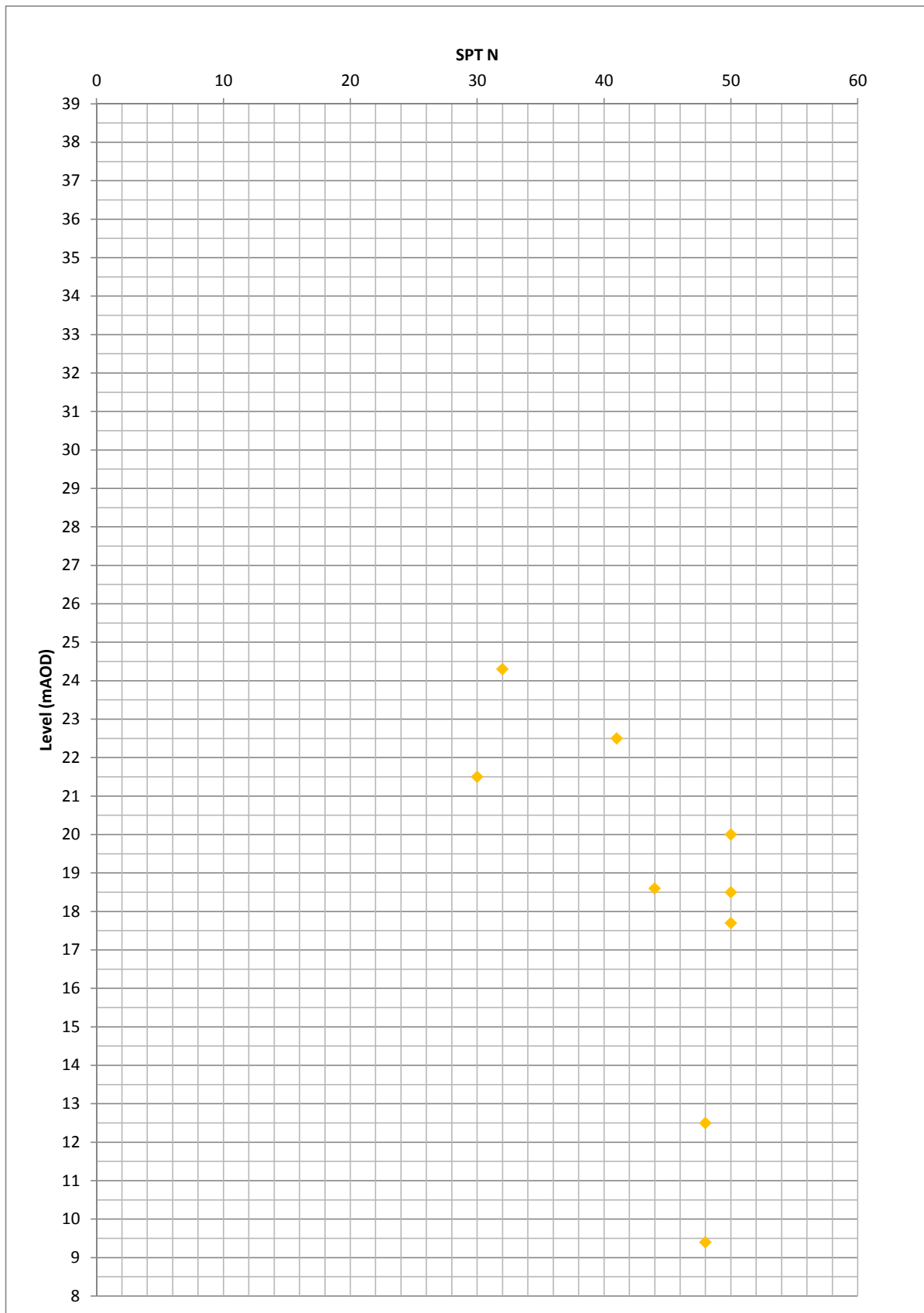
DATA PLOTS FOR GEOTECHNICAL TESTS

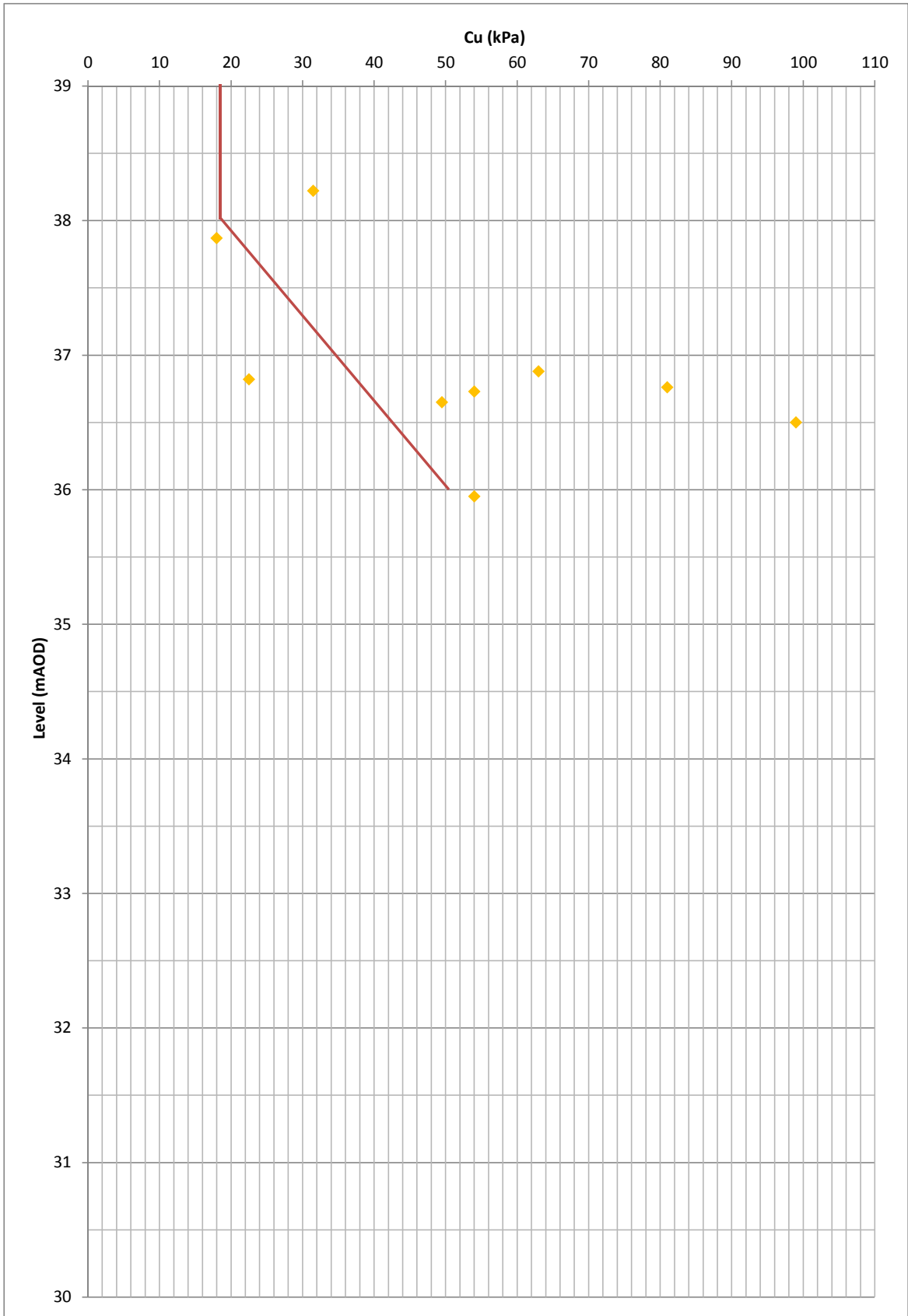


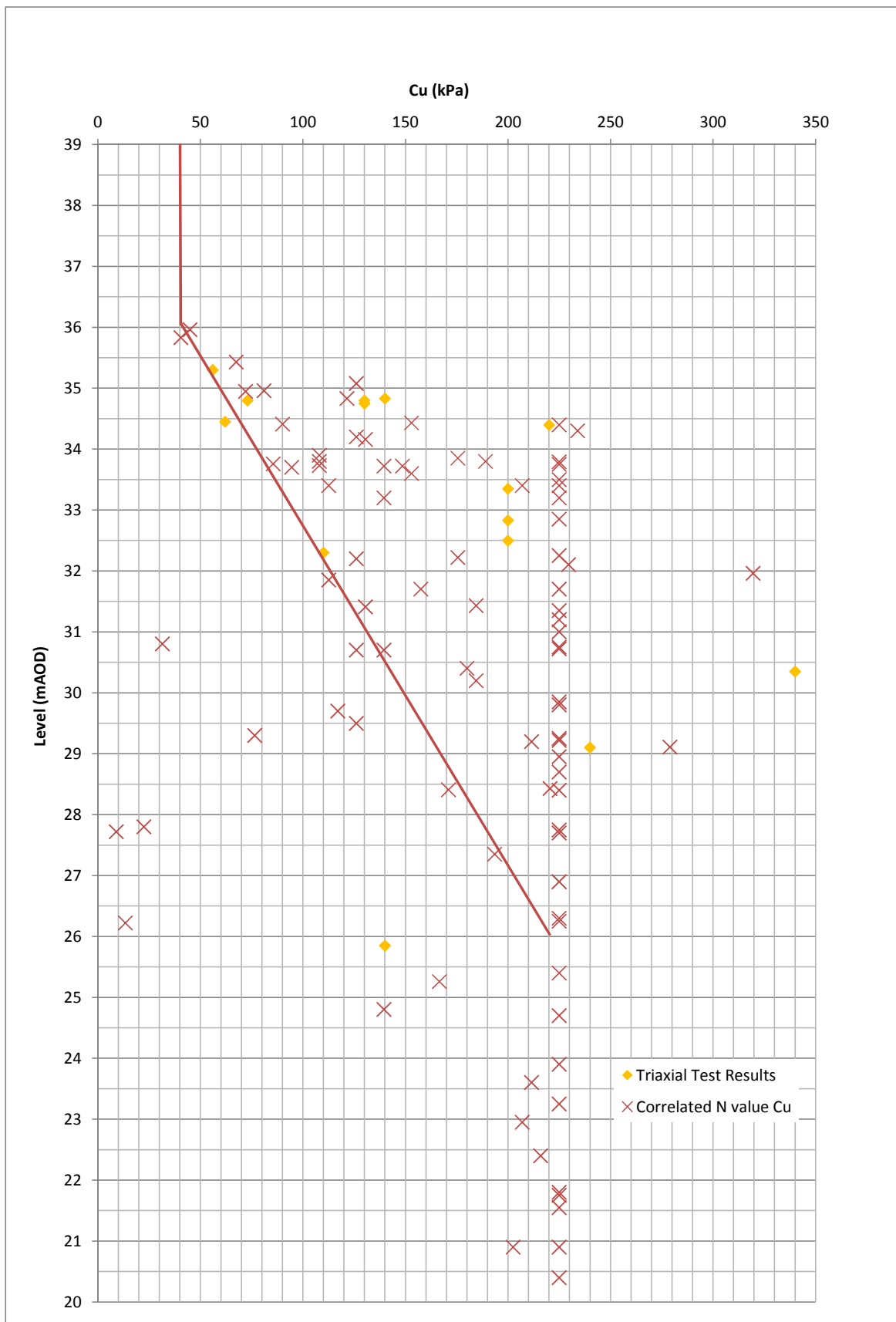












APPENDIX 3

TEST RESULTS FOR EXISTING FILL MATERIAL

PAGE:	JOB 3700	PLASTICITY INDEX
DATE:18.02.15	GREEN PARK VILLAGE, READING	

LIQUID AND PLASTIC LIMIT RESULTS

To BS 1377: Part 2 Methods 4.6 & 5.3 Air dried sample.

SAMPLE NUMBER	BRIEF SOIL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX NORMAL	% PASSING MODIFIED 425 SIEVE
V 3700/TP4 D.....	Silty CLAY [Alluvium].....	53.....	39.....	14.....	13..... 90.7%
	Clay fraction category:Undetermined				Sample moisture content 26.4%
	Classification to BS 5930				SILT of high plasticity. Subgroup: MH
	NHBC volume change potential:				LOW Minimum recommended depth of foundations 0.75m.
V 3700/TP6 D.....	Gravelly clayey SILT [FILL]....	41.....	26.....	15.....	9..... 62.6%
	Clay fraction category:Undetermined				Sample moisture content 17.8%
	Classification to BS 5930				SILT of intermediate plasticity. Subgroup: MI
	NHBC Classification:				NON SHRINKABLE.
V 3700/TP3 D..	Gravelly sandy clayey SILT [FILL].	38.....	28.....	10.....	9..... 86.5%
	Clay fraction category:Assumed 30-59%				Sample moisture content 21.5%
	Classification to BS 5930				SILT of intermediate plasticity. Subgroup: MI
	NHBC Classification:				NON SHRINKABLE.
V 3700/TP4 D..	Slightly sandy clayey SILT [FILL].	55.....	40.....	15.....	14..... 91.3%
	Clay fraction category:Assumed 30-59%				Sample moisture content 34.1%
	Classification to BS 5930				SILT of high plasticity. Subgroup: MH
	NHBC volume change potential:				LOW Minimum recommended depth of foundations 0.75m.

V = Visual description only.

NOTE: Based on the NHBC Chapter 4.2 'Building near Trees' 2006.

Modified PI = Normal PI x fraction passing 425 micron sieve.

For the modified PI to be used "sufficient sample should be taken to provide confidence that the test results are representative of the soil volume change potential for the site. If in doubt use the higher value of volume change potential". (NHBC Building near trees, Chapter 4.2D5(b)).

Foundation depths given are based on the foundations being outside the influence of existing and newly planted trees and shrubs.

PAGE:	JOB 3700	PLASTICITY INDEX
DATE:18.02.15	GREEN PARK VILLAGE, READING	

LIQUID AND PLASTIC LIMIT RESULTS

To BS 1377: Part 2 Methods 4.6 & 5.3 Air dried sample.

SAMPLE NUMBER	BRIEF SOIL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX NORMAL	% PASSING MODIFIED 425 SIEVE
V 3700/TP5 D...	Very gravelly silty CLAY [FILL]..	50.....	25.....	25.....	21..... 85.2%
	Clay fraction category:Assumed >60% Sample moisture content 24.7%				
	Classification to BS 5930 CLAY of high plasticity. Subgroup: CH				
	NHBC volume change potential: MEDIUM Minimum recommended depth of foundations 0.90m.				
V 3700/TP3 D.....	Silty Clay [Alluvium].....	67.....	47.....	20.....	19..... 97.4%
	Clay fraction category:Undetermined Sample moisture content 50.1%				
	Classification to BS 5930 SILT of high plasticity. Subgroup: MH				
	NHBC volume change potential: LOW Minimum recommended depth of foundations 0.75m.				
V 3700/TP5 D..	Gravelly silty CLAY [Alluvium]....	39.....	28.....	11.....	9..... 84.6%
	Clay fraction category:Undetermined Sample moisture content 26.6%				
	Classification to BS 5930 SILT of intermediate plasticity. Subgroup: MI				
	NHBC Classification: NON SHRINKABLE.				
V 3700/Layer2 D.	Gravelly sandy clayey SILT [FILL].	40.....	29.....	11.....	9..... 86.1%
	Clay fraction category:Assumed 30-59% Sample moisture content 19.1%				
	Classification to BS 5930 SILT of intermediate plasticity. Subgroup: MI				
	NHBC Classification: NON SHRINKABLE.				
V 3700/Layer3 D.	Gravelly sandy silty CLAY [FILL].	47.....	30.....	17.....	13..... 78.8%
	Clay fraction category:Assumed >60% Sample moisture content 15.9%				
	Classification to BS 5930 SILT of intermediate plasticity. Subgroup: MI				
	NHBC volume change potential: LOW Minimum recommended depth of foundations 0.75m.				

V = Visual description only.

NOTE: Based on the NHBC Chapter 4.2 'Building near Trees' 2006.

Modified PI = Normal PI x fraction passing 425 micron sieve.

For the modified PI to be used "sufficient sample should be taken to provide confidence that the test results are representative of the soil volume change potential for the site. If in doubt use the higher value of volume change potential". (NHBC Building near trees, Chapter 4.2D5(b)).

Foundation depths given are based on the foundations being outside the influence of existing and newly planted trees and shrubs.

SUMMARY OF CHEMICAL TESTS ON SOIL	
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[illegible]

Analysis Performed by: i2 Analytical Ltd, 7 Woodshots Meadow, Croxley Green, Watford, WD18 8YS

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

Green Park Village
Project Ref.: 30158



Determination of Dry Density / Moisture Content Relationship

TP No.: TP 101
 Sample Ref.: -
 Depth (m): 0.90 - 1.10

Description:
 Dark brown and brown peaty silty CLAY with rare fine gravel

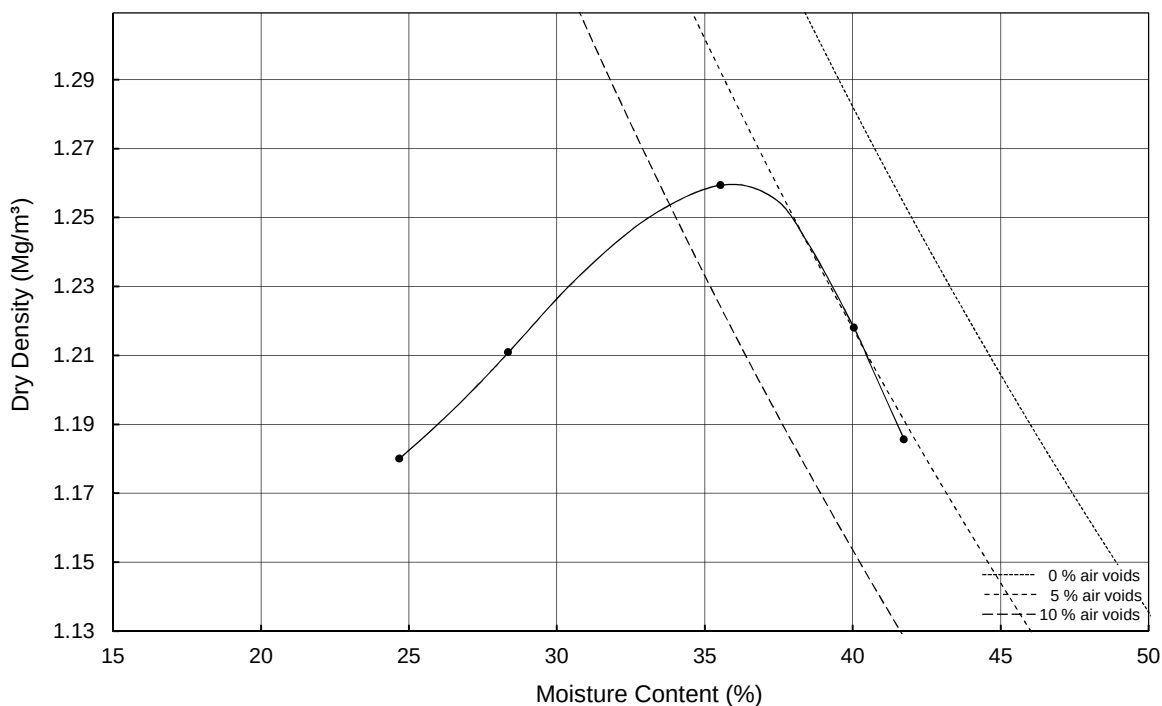
BS1377 : Part 4 : Clause 3.3.4.1 : 1990 2.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.65 (assumed)

Material retained on 37.5 mm test sieve (%): 0

Material retained on 20 mm test sieve (%): 0

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	25	28	36	40	42	%
Dry Density	1.18	1.22	1.26	1.22	1.19	Mg/m³

Maximum Dry Density **1.26 Mg/m³**
 Optimum Moisture Content **36 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

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Project Number:

GEO / 22299

Project Name:

**Green Park Village
 Project Ref.: 30158**

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Determination of Dry Density / Moisture Content Relationship

TP No.: TP 101
 Sample Ref.: -
 Depth (m): 0.90 - 1.10

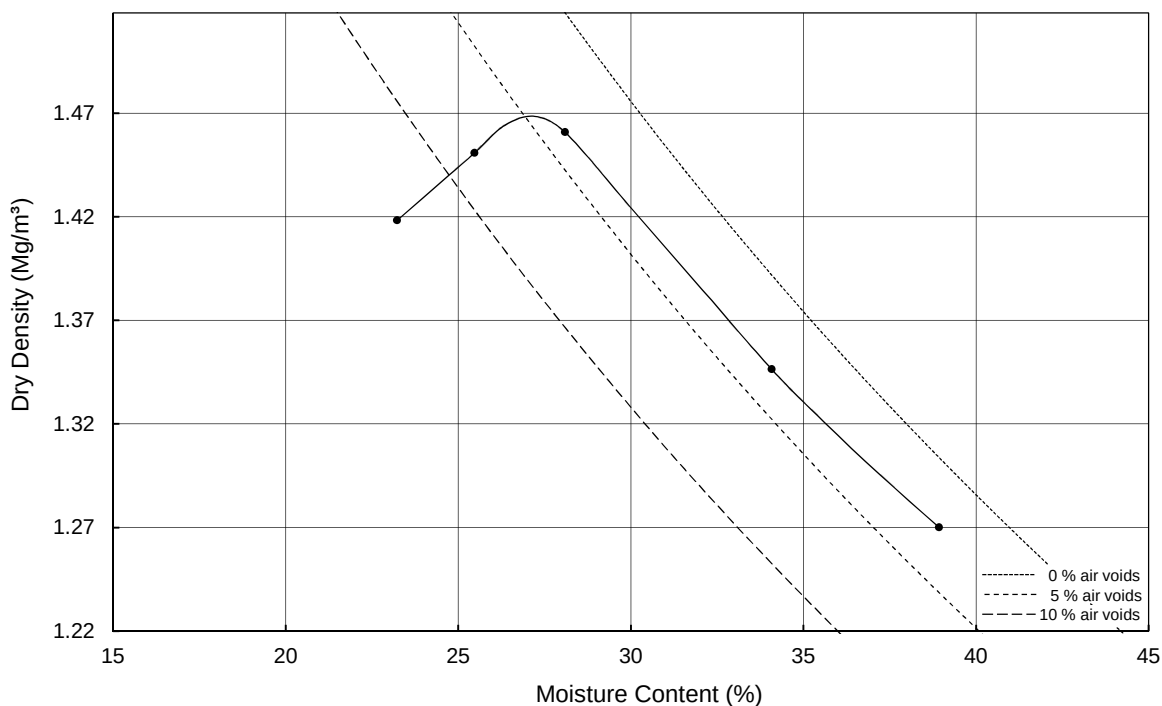
Description:
 Dark brown and brown peaty silty CLAY with rare fine gravel

BS1377 : Part 4 : Clause 3.5.4.1 : 1990 4.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.65 (assumed)

Material retained on 37.5 mm test sieve (%): 0
 Material retained on 20 mm test sieve (%): 0

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	23	25	28	34	39	%
Dry Density	1.42	1.45	1.46	1.35	1.27	Mg/m³

Maximum Dry Density **1.47 Mg/m³**
 Optimum Moisture Content **27 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

**Green Park Village
 Project Ref.: 30158**

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Determination of Dry Density / Moisture Content Relationship

TP No.: TP 105
 Sample Ref.: -
 Depth (m): 1.20 - 1.50

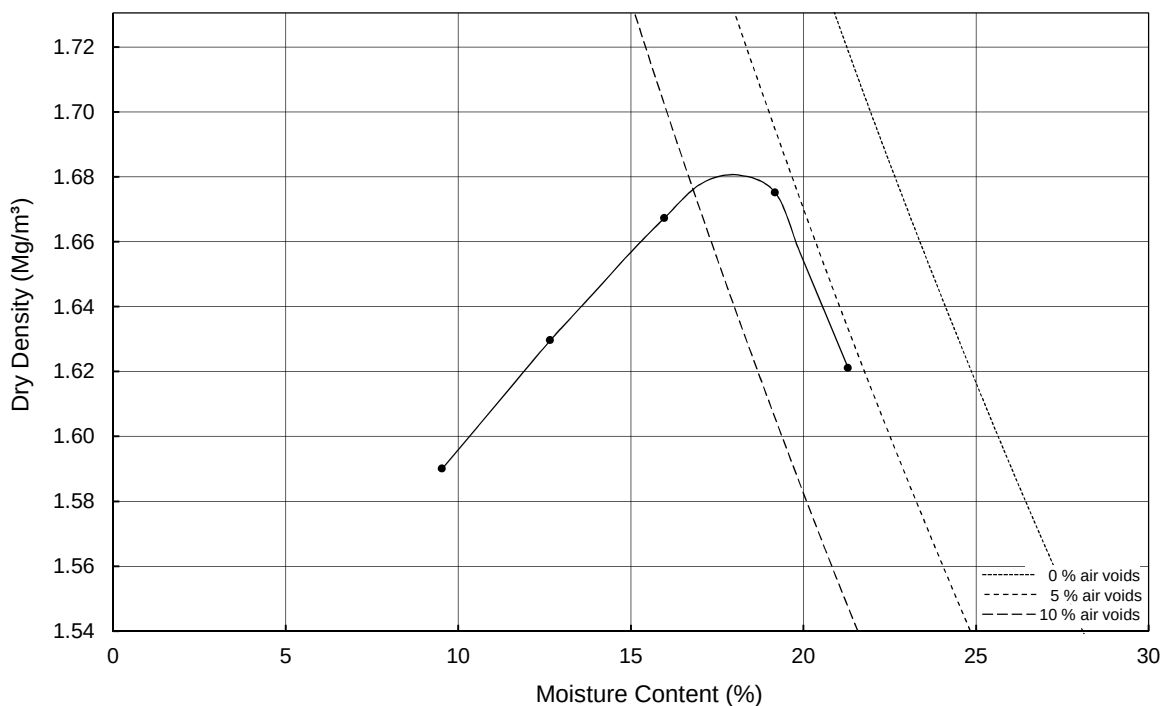
Description:
 Dark brown sandy silty gravelly CLAY. Gravel is fine to medium.

BS1377 : Part 4 : Clause 3.3.4.1 : 1990 2.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.70 (assumed)

Material retained on 37.5 mm test sieve (%): 0
 Material retained on 20 mm test sieve (%): 4

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	9.5	13	16	19	21	%
Dry Density	1.59	1.62	1.66	1.67	1.62	Mg/m³

Maximum Dry Density **1.68 Mg/m³**
 Optimum Moisture Content **18 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

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Project Name:

Green Park Village
Project Ref.: 30158

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Determination of Dry Density / Moisture Content Relationship

TP No.: TP 105
 Sample Ref.: -
 Depth (m): 1.20 - 1.50

Description:
 Dark brown sandy silty gravelly CLAY. Gravel is fine to medium.

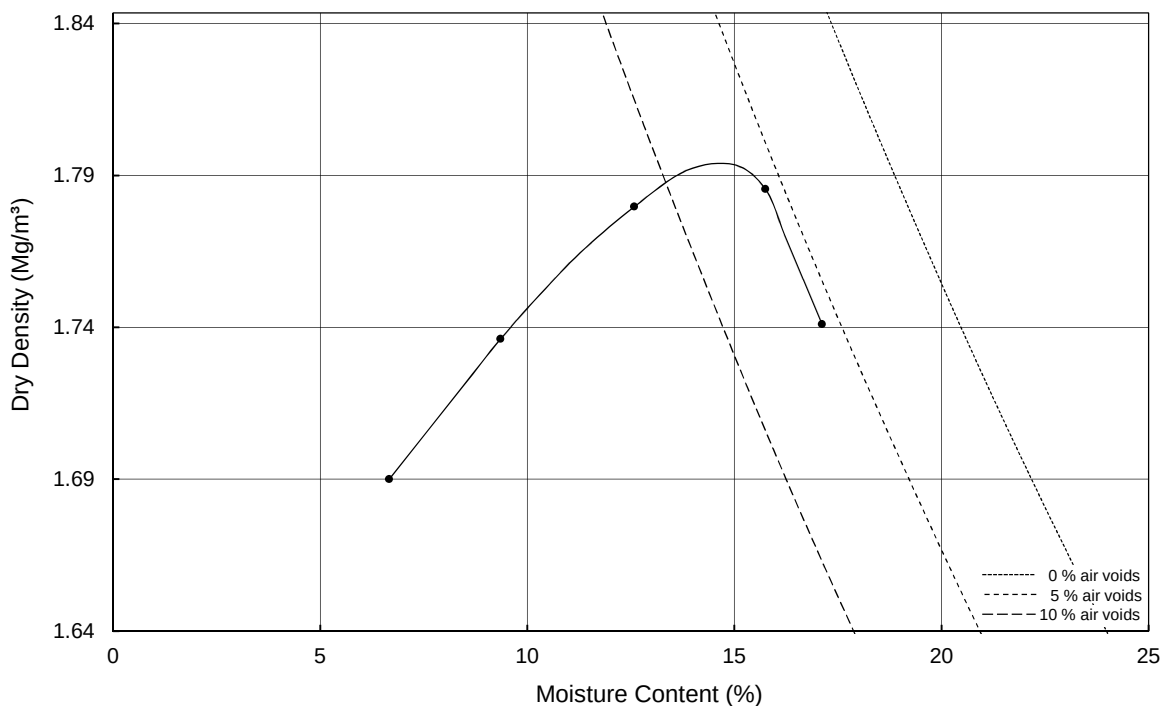
BS1377 : Part 4 : Clause 3.5.4.1 : 1990 4.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.70 (assumed)

Material retained on 37.5 mm test sieve (%): 0

Material retained on 20 mm test sieve (%): 4

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	6.7	9.4	13	16	17	%
Dry Density	1.69	1.74	1.78	1.78	1.74	Mg/m³

Maximum Dry Density **1.79 Mg/m³**
 Optimum Moisture Content **15 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

Green Park Village
Project Ref.: 30158

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Determination of Dry Density / Moisture Content Relationship

TP No.: TP 108
 Sample Ref.: -
 Depth (m): 0.20 - 0.40

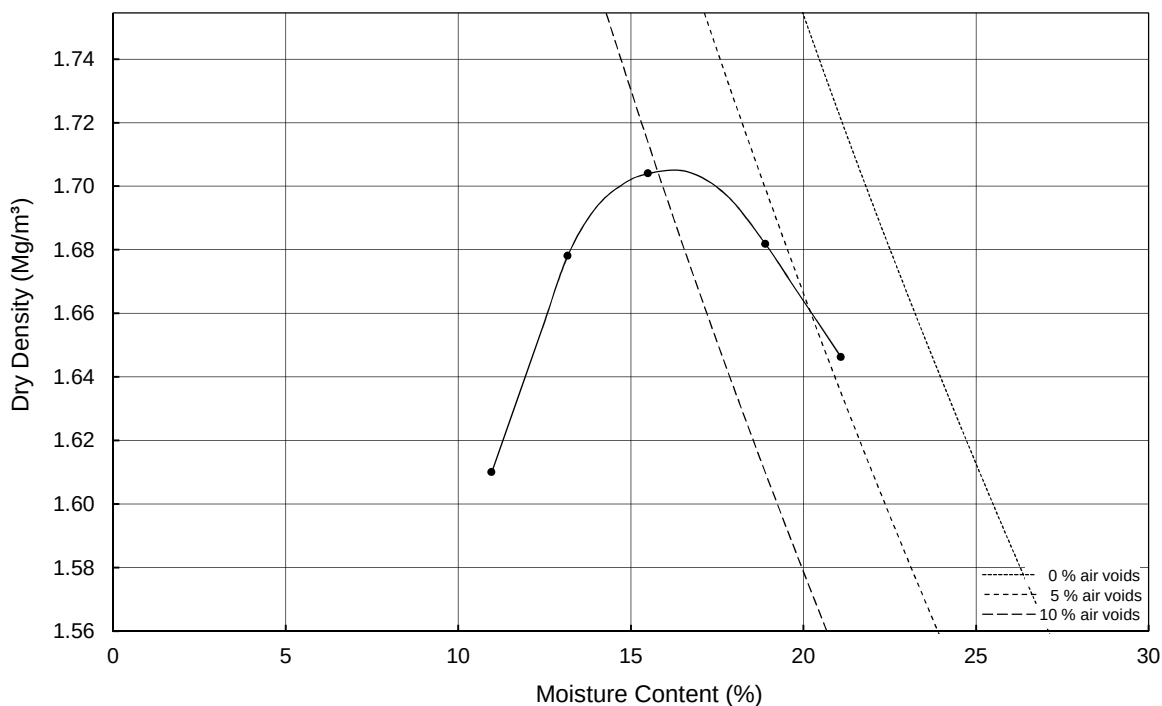
Description:
 Brown silty clayey SAND with lumps of greyish brown gravelly sandy silty CLAY. Gravel is fine to medium.

BS1377 : Part 4 : Clause 3.3.4.1 : 1990 2.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.70 (assumed)

Material retained on 37.5 mm test sieve (%): 0
 Material retained on 20 mm test sieve (%): 0

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	11	13	16	19	21	%
Dry Density	1.61	1.68	1.70	1.68	1.65	Mg/m³

Maximum Dry Density **1.70 Mg/m³**
 Optimum Moisture Content **17 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

**Green Park Village
 Project Ref.: 30158**

GEOLABS



Determination of Dry Density / Moisture Content Relationship

TP No.: TP 108
 Sample Ref.: -
 Depth (m): 0.20 - 0.40

Description:
 Brown silty clayey SAND with lumps of greyish brown gravelly
 sandy silty CLAY> Gravel is fine to medium.

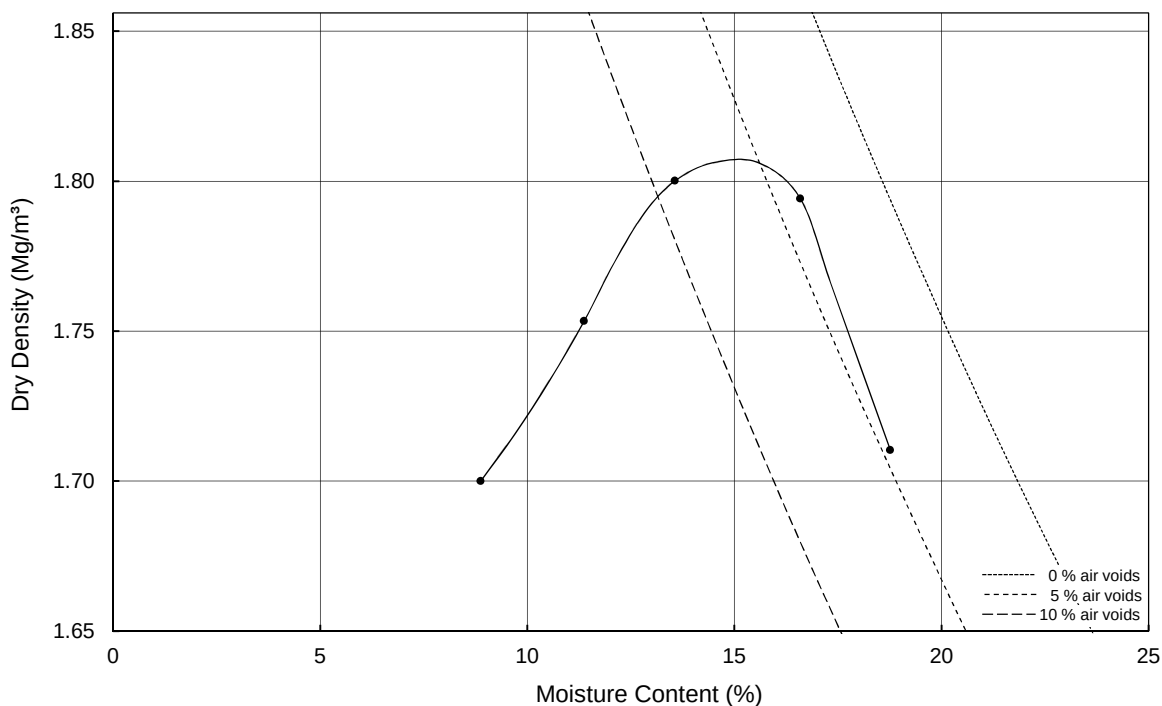
BS1377 : Part 4 : Clause 3.5.4.1 : 1990 4.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.70 (assumed)

Material retained on 37.5 mm test sieve (%): 0

Material retained on 20 mm test sieve (%): 0

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	8.9	11	14	17	19	%
Dry Density	1.70	1.75	1.80	1.79	1.71	Mg/m³

Maximum Dry Density **1.80 Mg/m³**
 Optimum Moisture Content **16 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

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Project Number:

GEO / 22299

Project Name:

**Green Park Village
 Project Ref.: 30158**

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Determination of Dry Density / Moisture Content Relationship

TP No.: TP 109
 Sample Ref.: -
 Depth (m): 1.50 - 1.70

Description:
 Greyish brown gravelly sandy silty CLAY

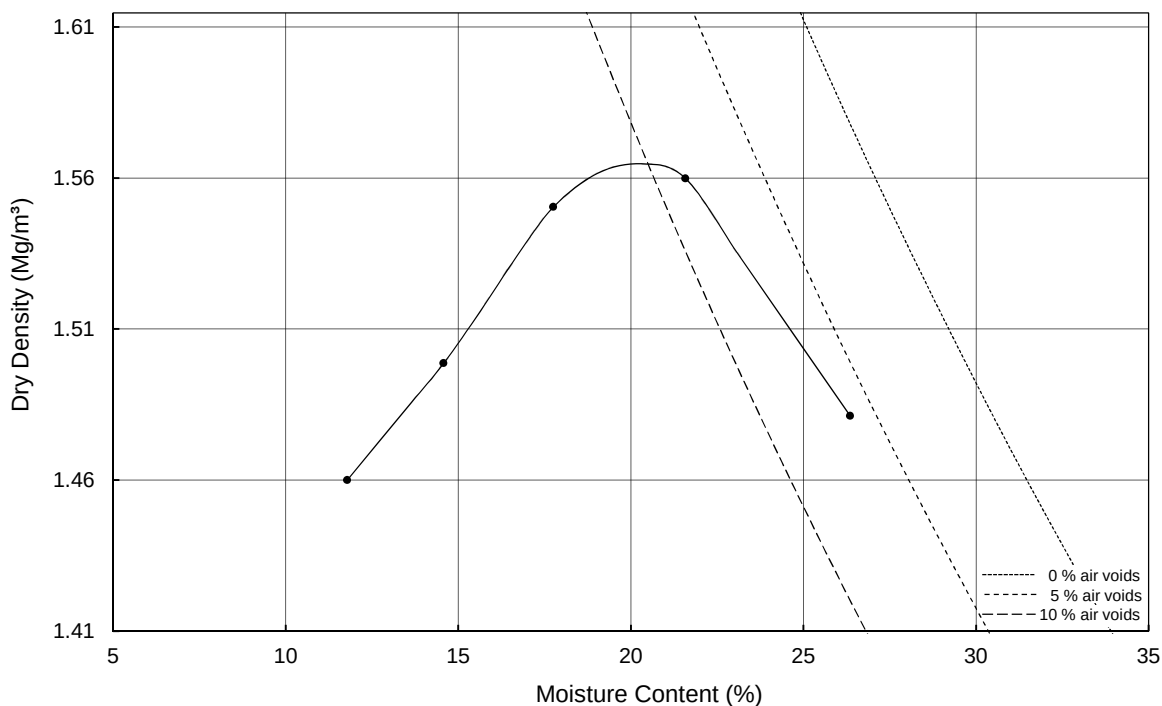
BS1377 : Part 4 : Clause 3.3.4.1 : 1990 2.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.70 (assumed)

Material retained on 37.5 mm test sieve (%): 0

Material retained on 20 mm test sieve (%): 3

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	12	15	18	22	26	%
Dry Density	1.46	1.50	1.55	1.56	1.48	Mg/m³

Maximum Dry Density **1.56 Mg/m³**
 Optimum Moisture Content **20 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

**Green Park Village
 Project Ref.: 30158**

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Determination of Dry Density / Moisture Content Relationship

TP No.: TP 113
 Sample Ref.: -
 Depth (m): 1.10 - 1.30

Description:
 Greyish brown gravelly sandy silty CLAY

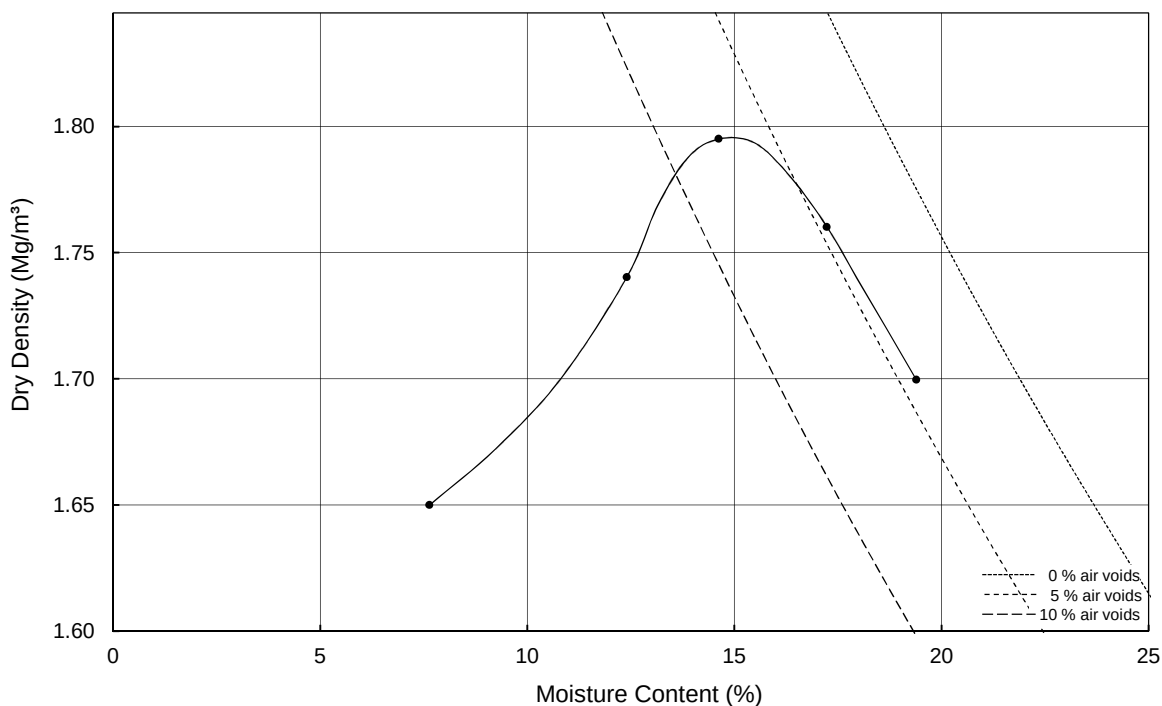
BS1377 : Part 4 : Clause 3.3.4.1 : 1990 2.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 No particles were removed.
 Particle Density: 2.70 (assumed)

Material retained on 37.5 mm test sieve (%): 0

Material retained on 20 mm test sieve (%): 2

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	7.6	12	15	17	19	%
Dry Density	1.65	1.74	1.79	1.76	1.70	Mg/m³

Maximum Dry Density **1.79 Mg/m³**
 Optimum Moisture Content **15 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

**Green Park Village
 Project Ref.: 30158**

GEOLABS



Determination of Dry Density / Moisture Content Relationship

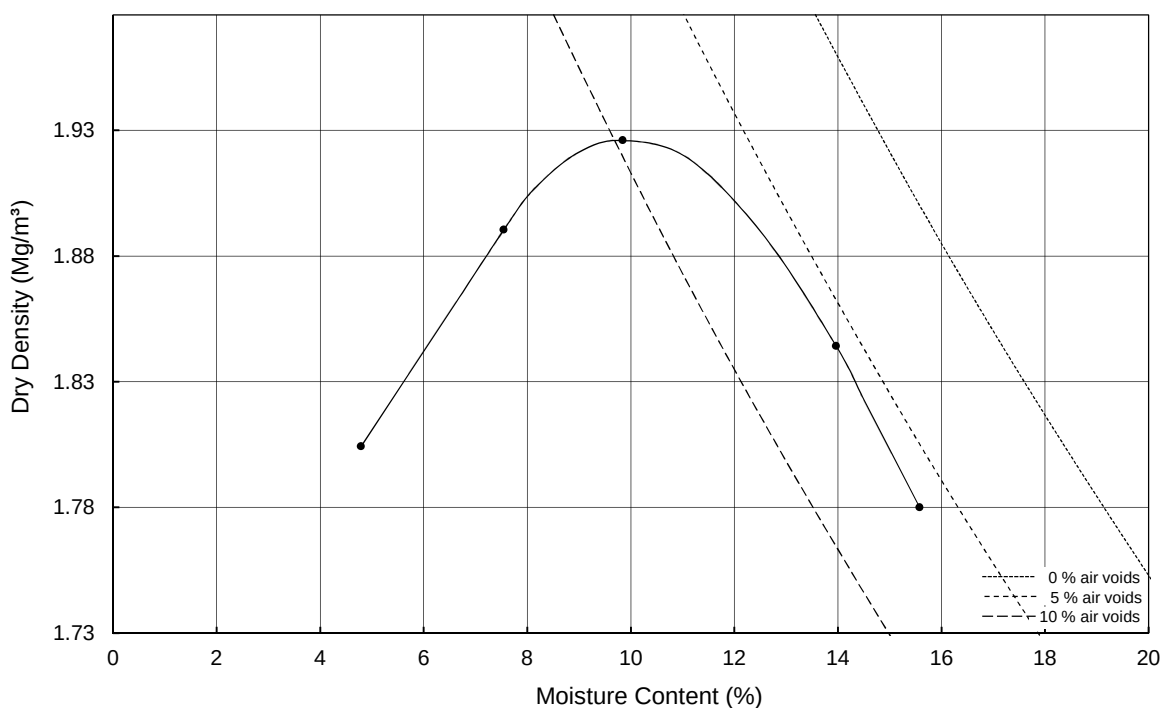
TP No.: TP 113
 Sample Ref.: -
 Depth (m): 1.90 - 2.10

Description:
 Greyish brown gravelly silty CLAY and SAND. Gravel includes brick and broken pipe.

BS1377 : Part 4 : Clause 3.6.4.1 : 1990 4.5 kg Compaction Test

Sample preparation: Material was air dried. Single sample.
 Particles greater than 37.5 mm were replaced by 20 to 37.5 mm material.
 Particle Density: 2.70 (assumed)
 Material retained on 37.5 mm test sieve (%): 5
 Material retained on 20 mm test sieve (%): 12

Compaction (Dry Density/Moisture Content)



Point	1	2	3	4	5	
Moisture Content	4.8	7.5	9.8	14	16	%
Dry Density	1.80	1.89	1.93	1.84	1.78	Mg/m³

Maximum Dry Density **1.93 Mg/m³**
 Optimum Moisture Content **9.8 %**

Checked and Approved by

JS

J Sturges (Ops Mgr)

Date: 18/03/2015

Project Number:

GEO / 22299

Project Name:

Green Park Village
Project Ref.: 30158

GEOLABS



SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Unconfined Compressive Strength				Chemical Tests			Other tests and comments
TP No.	Sample No.	Depth (m)	Type	Description	MC (%)	LL (%)	PL (%)	PI	<425 µm (%)	Bulk (Mg/m³)	Dry (Mg/m³)	N/A	N/A	UCS (kPa)	Failure Sketch	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
TP 101	-	0.90 - 1.10	B	Dark brown and brown peaty silty CLAY with rare fine gravel	50	72	32	40	x										Particle Size Distribution, Chemical, 2.5kg Compaction, 4.5kg Compaction
TP 102	-	0.40 - 0.60	B		19	52	18	34	x										Particle Size Distribution
TP104	-	0.40 - 0.40	B		19	49	22	27	x										Particle Size Distribution
TP104	-	1.10 - 1.30	B	Dark brown silty sandy CLAY. Gravel includes concrete and mortar.	19	46	21	25	x										Particle Size Distribution, Chemical, 2.5kg Compaction
TP 105	-	0.30 - 0.50	B		13	NP	NP	NP	x										Particle Size Distribution. Atterberg is Non-plastic
TP 105	-	1.20 - 1.50	B	Brown silty clayey SAND with lumps of greyish brown gravelly sandy silty CLAY. Gravel is fine to medium.	26	43	19	24	x										Particle Size Distribution, Chemical, 2.5kg Compaction, 4.5kg Compaction
TP 108	-	0.20 - 0.40	B	Brown silty clayey SAND with lumps of greyish brown gravelly sandy silty CLAY. Gravel is fine to medium.	22	38	19	19	x										Particle Size Distribution, 2.5kg Compaction, 4.5kg Compaction
TP 109	-	1.50 - 1.70	B	Greyish brown gravelly sandy silty CLAY	34	52	25	27	x										Particle Size Distribution, Chemical, 2.5kg Compaction
TP 110	-	0.50 - 0.70	B		27	56	21	35	x										Particle Size Distribution
TP 112	-	0.40 - 0.60	B		25	32	14	18	x										Particle Size Distribution
TP 113	-	1.10 - 1.30	B	Greyish brown gravelly sandy silty CLAY	20	41	15	26	x										Particle Size Distribution, Chemical, 2.5kg Compaction
TP 113	-	1.90 - 2.10	B	Greyish brown gravelly silty CLAY and SAND. Gravel includes brick and broken pipe.	x														Particle Size Distribution, 4.5kg Compaction

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by	Project Number:	GEO / 22299 Green Park Village Project Ref.: 30158	
	Project Name:		
Date:			

APPENDIX 4

GCL PLANS AND SECTIONS



This drawing should not be scaled. For construction purposes work to figured dimensions only

0mm

40mm

80mm

ORIGINAL SHEET SIZE

A1

NOTES

1.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DETAIL DESIGN DRAWINGS AND SPECIFICATIONS. DISCREPANCIES FOUND BETWEEN INFORMATION SHOWN ON THIS AND ANY OTHER DRAWING SHALL BE REPORTED TO GLANVILLE'S ENGINEER.

2.

FINAL DETAILED LEVELS WILL VARY SLIGHTLY TO FACILITATE THE PROPOSED DRAINAGE IN PAVED AREAS.

P1	PRELIMINARY ISSUE	02/06/15	MG
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Rev.	Description	Date	Chkd



Glanville

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Hemel Hempstead, Herts. HP2 7TE
Tel: (01442) 835999 Fax: (01442) 258924
postbox@glanvillegroup.com www.glanvillegroup.com

Client :



Designed for life

Project :

GREEN PARK VILLAGE
READING

Title :

PLAN LAYOUT OF PROPOSED
DEVELOPMENT SECTIONS

Project Engineer :

MG

Scale :

1:1000 @ A1

Project Director :

HBG

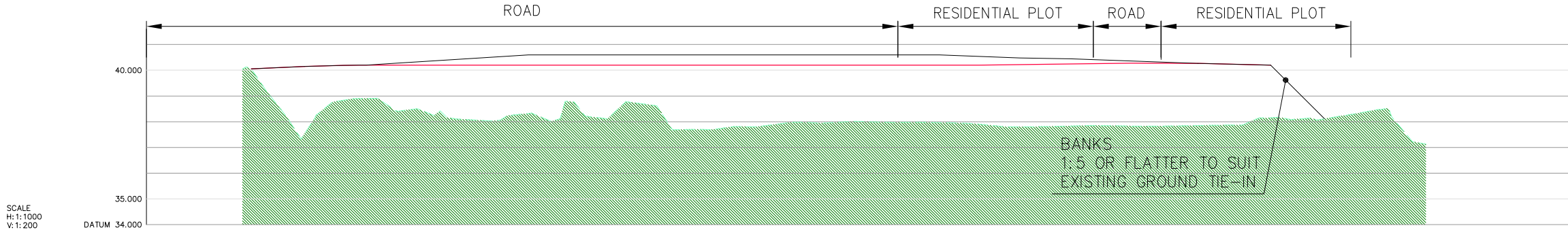
Date :

JUNE 2015

Status :

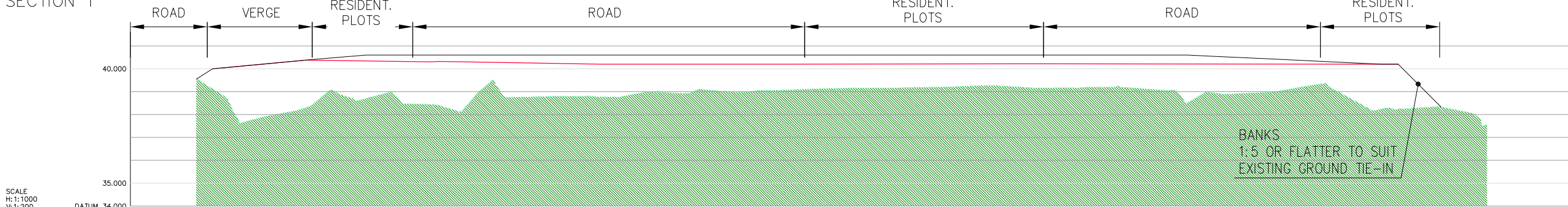
PRELIMINARY

Drawing No.	4140564-1101	Rev	P1
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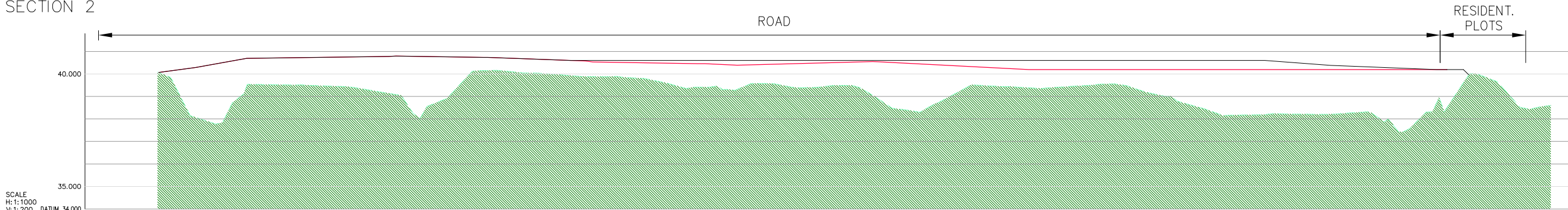
CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	276.297
EXISTING GROUND LEVEL			40.082	37.349	38.889	38.436	38.112	38.217	38.090	38.186	38.368	37.696	37.836	37.955	38.004	37.976	37.931	37.804	37.834	37.836	37.838	37.868	38.173	38.149	38.483				
GLANVILLE EARTHWORKS LEVEL					40.196	40.293	40.420	40.547	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.553	40.474	40.440	40.368	40.295	40.230	40.200						
PBA EARTHWORKS LEVEL					40.196	40.200	40.200	40.199	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.222	40.248	40.274	40.268	40.230							

SECTION 1



CHAINAGE	0.000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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SECTION 2



CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	300.000	310.000	320.000	330.000
EXISTING GROUND LEVEL			39.461	37.816	39.530	39.494	39.388	39.054	38.881	40.157	40.041	39.892	39.846	39.550	39.454	39.577	39.395	39.492	38.460	38.774	39.483	39.384	39.460	39.521	39.010	38.353	38.183	38.214	38.253	37.865	38.635	39.938	38.468	37.854
GLANVILLE EARTHWORKS LEVEL			40.166	40.484	40.709	40.735	40.761	40.794	40.763	40.731	40.657	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.480	40.353	40.278	40.202				
PBA EARTHWORKS LEVEL			40.166	40.484	40.709	40.735	40.761	40.794	40.763	40.731	40.657	40.594	40.515	40.482	40.438	40.415	40.469	40.523	40.504	40.401	40.299	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200				

SECTION 3

This drawing should not be scaled. For construction purposes work to figured dimensions only



NOTES

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- FINAL DETAILED LEVELS WILL VARY SLIGHTLY TO FACILITATE THE PROPOSED DRAINAGE IN PAVED AREAS.

KEY:

- EXISTING GROUND LEVEL
- GLANVILLE EARTHWORKS LEVEL
- PBA EARTHWORKS LEVEL

P1	PRELIMINARY ISSUE	02/06/15	MG
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Rev.	Description	Date	Chkd
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3 Grovelands Business Centre
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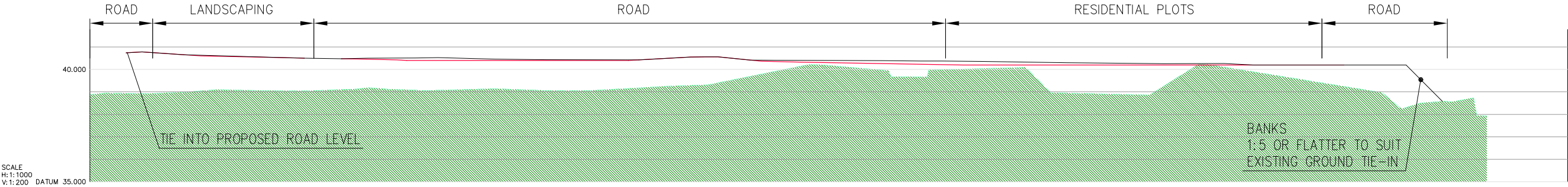
Client : **Berkeley**
Designed for life

Project : GREEN PARK VILLAGE
READING

Title : PROPOSED LEVELS
DEVELOPMENT SECTIONS
SHEET 1 OF 3

Project Engineer :	MG	Scale :	AS SHOWN
Project Director :	HGB	Date :	JUNE 2015
Status :	PRELIMINARY		

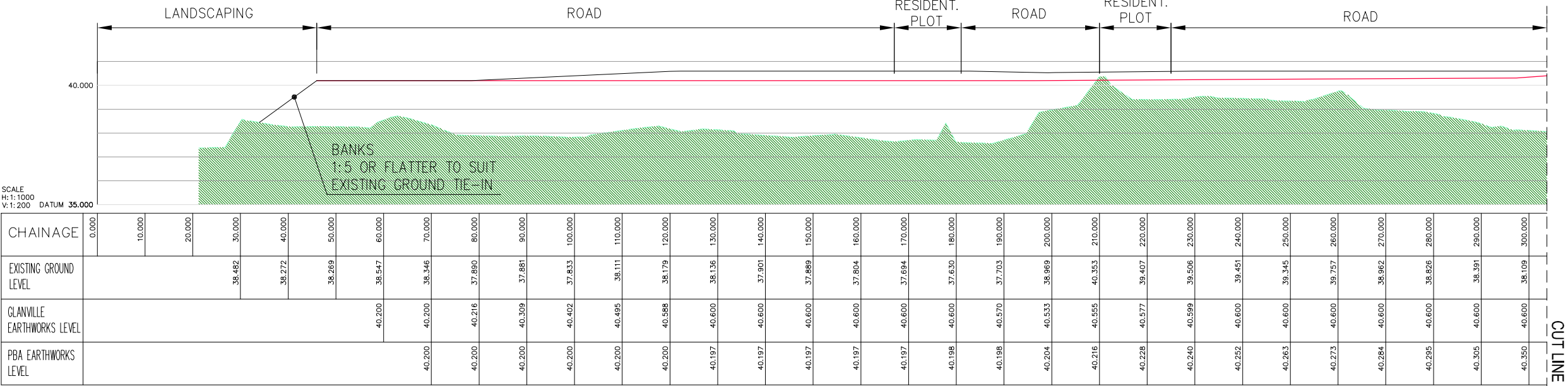
Drawing No.	4140564-1102	Rev	P1
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SCALE
H: 1:1000
V: 1:200 DATUM 35.000

CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	300.000	310.000	320.000	329.856
EXISTING GROUND LEVEL	38.875	38.926	38.980	39.092	39.051	39.052	39.139	39.095	39.084	39.138	39.074	39.054	39.148	39.258	39.394	39.795	40.195	40.087	39.669	39.988	40.041	39.872	38.933	38.889	39.293	40.206	39.883	39.561	39.238	38.703	38.549	37.939		
GLANVILLE EARTHWORKS LEVEL	40.764	40.764	40.670	40.606	40.549	40.498	40.491	40.507	40.512	40.463	40.436	40.429	40.427	40.400	40.400	40.415	40.408	40.399	40.386	40.372	40.353	40.323	40.295	40.276	40.258	40.200	40.200	40.200	40.200	40.200	40.200	40.200		
PBA EARTHWORKS LEVEL	40.764	40.670	40.670	40.582	40.538	40.498	40.464	40.407	40.308	40.285	40.282	40.305	40.398	40.400	40.400	40.364	40.320	40.286	40.251	40.217	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200	40.200		

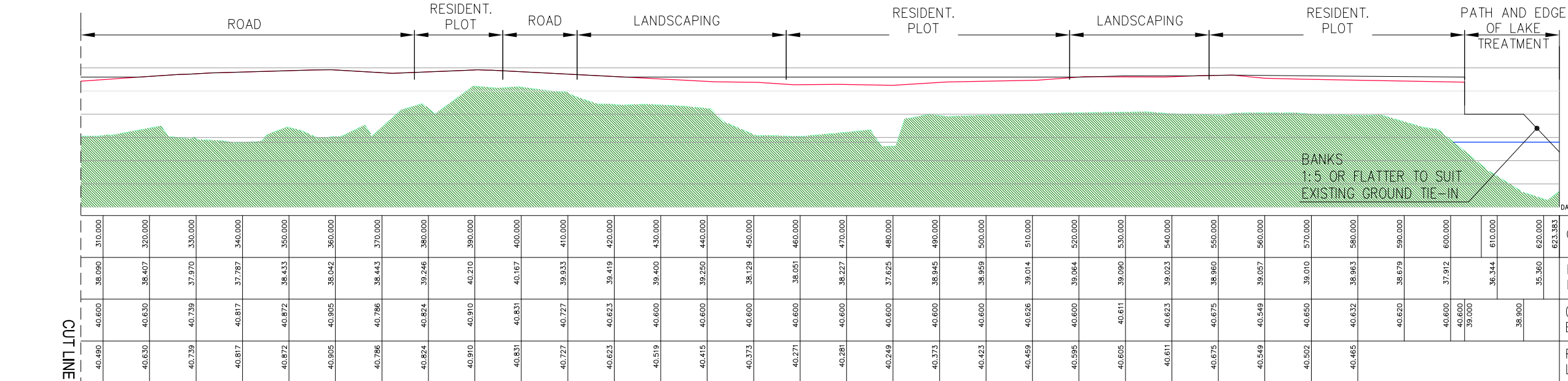
SECTION 4



SCALE
H: 1:1000
V: 1:200 DATUM 35.000

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SECTION A-part 1



SCALE
H: 1:1000
V: 1:200 DATUM 35.000

CHAINAGE	310.000	320.000	330.000	340.000	350.000	360.000	370.000	380.000	390.000	400.000	410.000	420.000	430.000	440.000	450.000	460.000	470.000	480.000	490.000	500.000	510.000	520.000	530.000	540.000	550.000	560.000	570.000	580.000	590.000	600.000	610.000	620.000	623.383
EXISTING GROUND LEVEL	38.090	38.407	37.970	37.787	38.433	38.042	38.443	38.246	40.210	40.167	39.933	39.419	38.400	39.250	38.129	38.051	38.227	37.625	38.945	38.959	39.014	39.084	39.090	39.023	38.960	39.057	39.010	38.963	38.679	37.912	36.344	35.360	
GLANVILLE EARTHWORKS LEVEL	40.600	40.630	40.739	40.817	40.872	40.905	40.786	40.824	40.910	40.831	40.727	40.623	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.626	40.600	40.611	40.623	40.675	40.549	40.650	40.632	40.620	40.600	40.600	40.600	
PBA EARTHWORKS LEVEL	40.490	40.630	40.739	40.817	40.872	40.905	40.786	40.824	40.910	40.831	40.727	40.623	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.600	40.626	40.600	40.611	40.623	40.675	40.549	40.502	40.465	40.620	40.600	40.600	40.600	

SECTION A-part 2

This drawing should not be scaled. For construction purposes work to figured dimensions only



NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DETAIL DESIGN DRAWINGS AND SPECIFICATIONS. DISCREPANCIES FOUND BETWEEN INFORMATION SHOWN ON THIS AND ANY OTHER DRAWING SHALL BE REPORTED TO GLANVILLE'S ENGINEER.
- FINAL DETAILED LEVELS WILL VARY SLIGHTLY TO FACILITATE THE PROPOSED DRAINAGE IN PAVED AREAS.

KEY:

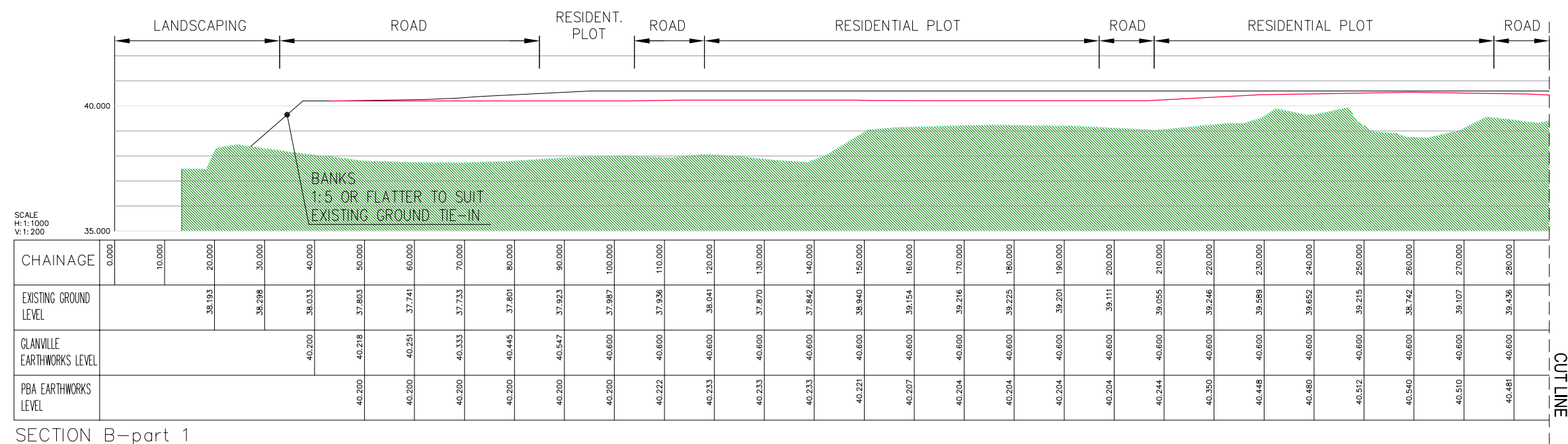
- EXISTING GROUND LEVEL
- GLANVILLE EARTHWORKS LEVEL
- PBA EARTHWORKS LEVEL

P1	PRELIMINARY ISSUE	02/06/15	MG
Rev.	Description	Date	Chkd

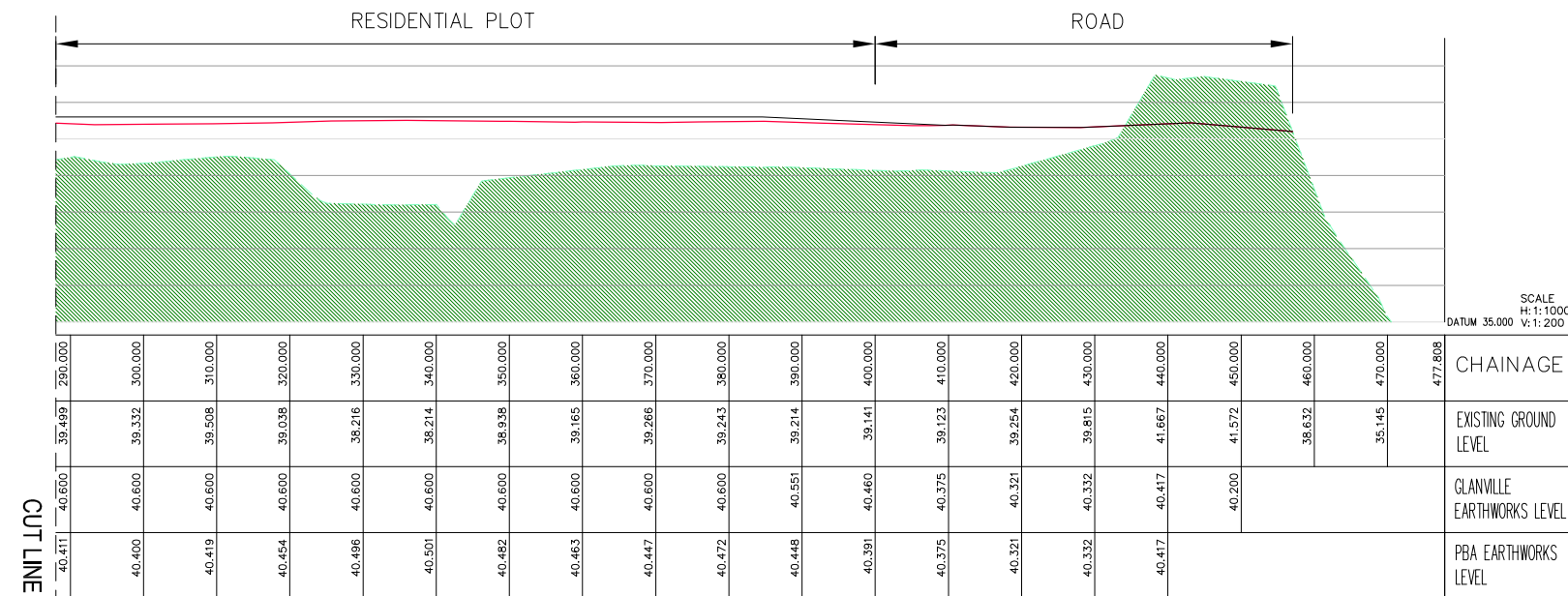
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Hemel Hempstead, Herts. HP2 7TE
Tel: (01442) 835999 Fax: (01442) 258924
postbox@glanvillegroup.com www.glanvillegroup.com

Client :	Berkeley Designed for life
Project :	GREEN PARK VILLAGE READING
Title :	PROPOSED LEVEL DEVELOPMENT SECTIONS SHEET 2 OF 3
Project Engineer :	MG Scale : AS SHOWN
Project Director :	HGB Date : JUNE 2015
Status :	PRELIMINARY

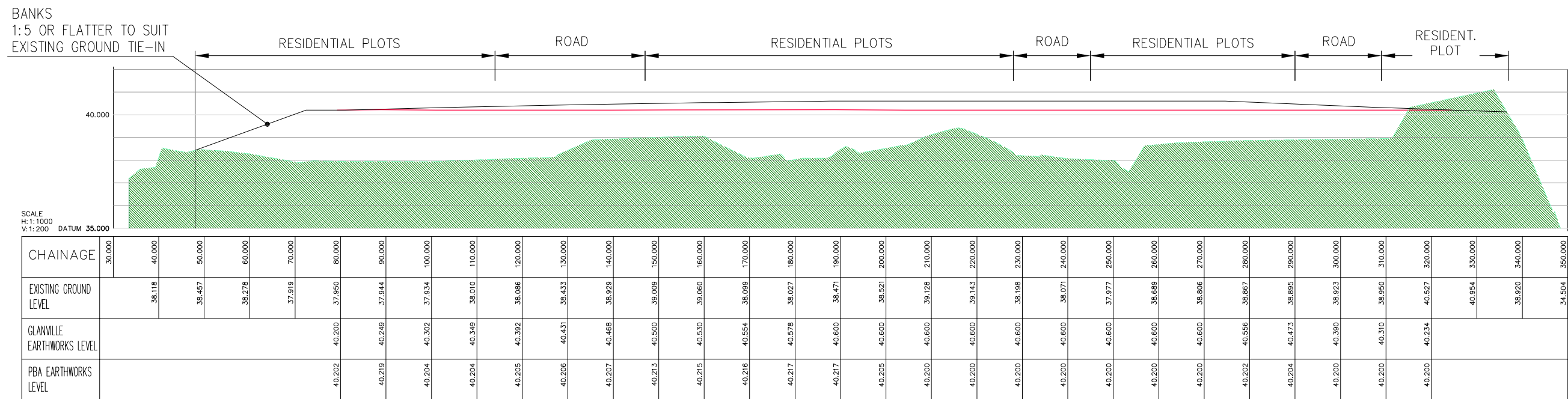
Drawing No.	4140564-1103	Rev	P1
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SECTION B-part 1



SECTION B-part 2



SECTION C

This drawing should not be scaled. For construction purposes work to figured dimensions only



NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DETAIL DESIGN DRAWINGS AND SPECIFICATIONS. DISCREPANCIES FOUND BETWEEN INFORMATION SHOWN ON THIS AND ANY OTHER DRAWING SHALL BE REPORTED TO GLANVILLE'S ENGINEER.
2. FINAL DETAILED LEVELS WILL VARY SLIGHTLY TO FACILITATE THE PROPOSED DRAINAGE IN PAVED AREAS.

KEY:

- EXISTING GROUND LEVEL
- GLANVILLE EARTHWORKS LEVEL
- PBA EARTHWORKS LEVEL

P1	PRELIMINARY ISSUE	02/06/15	MG
Rev.	Description	Date	Chkd

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Client : **Berkeley**
Designed for life

Project : GREEN PARK VILLAGE READING

Title : PROPOSED LEVEL DEVELOPMENT SECTIONS SHEET 3 OF 3

Project Engineer :	MG	Scale :	AS SHOWN
Project Director :	HBG	Date :	JUNE 2015
Status :	PRELIMINARY		

Drawing No.	4140564-1104	Rev	P1
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APPENDIX 5 REPORT RELIANCE

Notwithstanding any other provisions of this report and in consideration of the sum of ten pounds (£10.00) paid by both St Edward Homes Limited, Berkeley Homes (Western) Limited and Berkeley Homes plc, we Ramboll UK Limited hereby acknowledge receipt of the aforementioned consideration and hereby irrevocably acknowledge and agree that St Edward Homes Limited, Berkeley Homes (Western) Limited and Berkeley Homes plc and any parties acquiring an interest in the works to be carried out at the site and/or the property/properties in respect of which this report has been carried out and/or the property and/or the land in respect of which this report has been carried out or any part or parts thereof (the **Project**) and/or any party providing finance and/or refinance in connection with the Project and any contractors involved in the development of the site/property to which this report relates and their assigns shall have relied and will continue to rely on the findings of this report and in so doing we acknowledge a duty of care to them provided that the duty of care shall be no greater in terms of obligation than that owed to the company/body who has commissioned the report from us as if the beneficiary had been named jointly with the company/body who have commissioned the report in such commission/appointment.