



Spenborough Pool

Geo-Environmental Report

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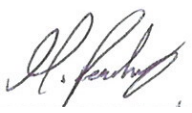
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Table of Contents

0.0	Executive Summary	1
1.0	Introduction	3
1.1	General	3
1.2	Previous reports	3
1.3	Limitations	3
2.0	Site Details	4
2.1	Proposed Development	4
2.2	Site Location & Description	4
2.3	Site History	4
2.4	Published Geology	5
2.5	Coal Mining Risk	6
2.6	Waste Management, Pollution Incidents and Gas Monitoring	6
2.7	Hydrogeology and Hydrology	6
2.8	Sensitive Land Use	7
2.9	Potential Sources of Contamination	7
3.0	Ground Investigation	8
3.1	Fieldwork	8
3.2	Laboratory Testing	9
4.0	Ground and Groundwater Conditions	11
4.1	Topsoil	11
4.2	Made Ground	11
4.3	Alluvial Deposits	11
4.4	Lower Pennine Coal Measures	11
4.5	Ground Conditions Summary	13
4.6	Groundwater	14
4.7	Ground Gases	15
5.0	Material Properties and Geotechnical Design Parameters	17
5.1	General	17
5.2	Made Ground	17
5.3	Alluvial Deposits	19
5.4	Lower Pennine Coal Measures	20
5.1	Geotechnical Parameters	22
6.0	Ground Contamination Assessment	24
6.1	General	24
6.2	Screening Methodology	27
6.3	Contaminant Screening Assessment	29
6.4	Ground Gas Assessment	29
7.0	Ground Engineering Considerations	31



7.1	Proposed Development.....	31
7.2	Site Clearance Works and Earthworks.....	31
7.3	Deep Excavations.....	32
7.4	Groundwater Control Measures	32
7.5	Foundation Design	33
7.6	Floor Slabs.....	34
7.7	Geotechnical Risks.....	35
7.8	Car Park Pavement Design.....	36
7.9	Design Concrete Class	36
8.0	Conclusions and Recommendations	38

Drawings

A097478-1-LDS-01 Site Location and Layout Plan

A097478-1-LDS-02 WYG Borehole Location Plan

Appendices

Appendix A - Report Conditions

Appendix B - WYG Engineering Ltd, Site Layout and Section Extracts from Stage 2 Report, 2017

Appendix C – Rotary Core Mounted Photographs

Appendix D – WYG Exploratory Hole Logs & SPT Certs

Appendix E – Gas and Groundwater Monitoring Results

Appendix F – Plot of SPT 'N' vs Depth within Made Ground

Appendix G – Geotechnical Laboratory Certificates

Appendix H – Chemical Laboratory Certificates

Appendix I – WYG Tier 1 Soil Screening Values

Appendix J – WYG Tier 1 Water Resources Screening Values

Appendix K – Typical Foundation Detail

0.0 Executive Summary

Site Details
Spenborough Fitness Centre is located within a suburban, mixed use area, on the River Spen, approximately 2km east of the M62 and 1km north of Liversedge. The site is roughly rectangular in shape and covers an area of approximately 5.81 hectare (ha). The majority of the site comprises playing fields and outdoor space, with the main central building situated across the eastern portion of the site, with 2 smaller buildings to the North adjacent to the running track and access road. Spen river runs adjacent to the south-western boundary of the site.
Proposed Development
It is proposed to demolish the existing structures and replace them with anew pol complex. The new building will house two swimming pools, one 25m and a 10m (learner) pool. The new swimming pools will be slightly off-set from the existing two pools.
Site Investigation
Ground Investigation (GI) works were carried out by WYG between 6 th and 9 th February 2017 and comprised the drilling of 2 no. deep boreholes (BH01 and BH02), 7 no. windowless sample boreholes (WS01 to WS07) drilled to a maximum depth of 6.43m bgl and 6 Plate Load CBR tests were undertaken directly below the topsoil within the Made Ground.
Ground and Groundwater Conditions
Ground conditions generally comprised Made Ground (thickest in the western part of the site) overlying Lower Pennine Coal Measure comprising of interbedded mudstone sandstone and siltstone. A thin covering of Alluvium was encountered at the southern part of the site. Groundwater depths across site were found to vary with no definitive ground water flow established. It is likely that groundwater will be present within granular portions of the Made Ground and Alluvium as observed within boreholes BH01 and BH02 where groundwater has been measured at between 1.64m and 1.90m bgl respectively.
Ground Contamination
Soils. A total of eight soil samples from the site were analysed and the results screened against WYG SSVs. All determinands were recorded at concentrations below the relevant SSV with one exception. Groundwaters. A total of seven groundwater samples (WS02, WS03, WS04, WS05, BH01, BH02 and BH02A) were retrieved for laboratory testing. In general, all determinands were recorded at concentrations below WYG screening values, with the exception of one sample from borehole WS02. It is noted that groundwater at this borehole is found to be resting within Made Ground would present a very localised area where elevated concentrations are present. This is further confirmed by the concentrations observed within boreholes WS01 and WS02 (western part of the site), where no exceedences were recorded.
Ground Engineering Considerations
Site clearance and earthworks Site clearance works will involve the demolition of the current building and removal of existing building foundations that affect the new structure. (Note - We do not have any information on the nature and depth of the existing foundations). Significant excavations will also be required for the construction of the two new pools. The new pool locations will be off-set from the existing pool locations, which will leave voids at the western and eastern extents of the swimming pool footprints. These voids will require infilling with suitable engineered fill material. Relict concrete slabs and foundations could be crushed and re-used on site as general granular fill materials (e.g capping or sub-base). Materials excavated from the new pools may comprise Made Ground and is likely to be a Class 2 material. This may be suitable for re-use within other parts of the site (swimming pool voids) as a general fill material, provided that it meets all necessary placement and validation criteria. If the material is to be disposed off-site, based on chemical laboratory testing results, it is likely to classified as non-hazardous.

Topsoil should be stripped under the proposed development footprint and stockpiled for re-use or removed from site.

Foundations

Structural loadings. It is considered that the Made Ground would not be a suitable founding material for the proposed structure and all structural loads should be taken to found on the underlying Weathered Coal measures. Depths to this are estimated to range between 2m in the north and 5m in the south. Assuming weak strength, this should give an allowable bearing capacity of around 500kPa for spread foundations not exceeding 3m width.

Floor Slabs

It is considered that lightly loaded ground bearing floor slabs (typically 10kN/m²) would be acceptable in areas located outwith the extent of the new and existing pools. The floor slabs located between the existing and proposed pool locations and those located over the existing pools should be suspended.

Deep Excavations.

Deep excavations of up to 3.5m will be required for the new pool locations and are likely to be within the weathered Coal Measures. It is anticipated that the weathered rock can be excavated utilising mechanical means, however due to the material being heavily fractured, it is recommended that the side slopes are battered back or a temporary support system is adopted to provide stability to the excavation.

A permeant retaining wall will be required for the swimming pool walls. Detailed design should consider the effect of groundwater pressures on the side walls and uplift pressures at the base. Whilst the swimming pool is full of water, uplift pressures associated with groundwater are not likely to be an issue, however, detailed design should consider a scenario where the pool has been emptied. In addition to this, consideration should be made to seasonal variations in groundwater levels.

Coal Mining Risk

Based on the information obtained from the recent WYG Ground Investigation, it is considered that the risk from coal mining at the site is minimal.

Pavement Design

Based on the laboratory PSD results for the cohesive Made Ground, the material on site is likely to classify as HA Class 2 cohesive material. A CBR of 2.5% is considered suitable for the design of road pavement in accordance with IAN 73/06.

A Class 2 Restricted Foundation Design comprising sub-base onto capping is proposed for the car park. A Class 2 foundation is required to provide a Foundation Surface Modulus of around 100MPa. Based upon an CBR value of 2.5% (Sub-grade Stiffness Modulus of 32MPa) and in accordance with IAN 73/06 Figure 3.1, a minimum capping layer thickness of around 260mm is required. Further to this, for unbound mixtures (MCHW1 803, 804 (mixture not more than 5msa), 805 and 806, a Subbase thickness of 320mm is required. For bound mixtures (MCHW1 821, 822 or 840 soil cement strength C3/4 or C5/6, a Subbase thickness of 280mm is required. During construction, the sub-grade formation should be proof rolled and inspected by the Supervising Engineer. Should localised soft areas of inadequate sub-grade be encountered at sub-formation level, these should be excavated and replaced with adequately compacted capping material or sub-base. All materials within 450mm of the road surface shall be non-frost susceptible in accordance with IAN 73/06.

Design Concrete Class

Based on the sulphate concentrations, groundwater conditions and pH values obtained from laboratory test data, subsurface ground conditions appear to be consistent with ACEC Class AC-1s with respect to buried concrete (BRE Special Digest 1: 2005 "Concrete in aggressive ground"). The Design Sulphate Class is DS-1.

1.0 Introduction

1.1 General

WYG Environment Planning Transport Limited (WYG) was commissioned by WYG Engineering, on behalf of Kirklees Council, to undertake ground investigation works to support the design and construction of a proposed new leisure facility in Spenborough. This report presents a factual and interpretive summary of the works undertaken. The proposed development is shown within the WYG Stage 2 Report, reference below. A proposed layout and section drawing extract from the Stage 2 Report is presented within Appendix B.

1.2 Previous reports

The following reports should be read alongside this document and, where relevant, information has been taken from and included within this document:

- AHR Building Consultancy Stage 1 Desk Study, January 2016, which includes a Rogers Geotechnical Services Report on a Geotechnical Ground Investigation, November 2015, (Report No. J3055/15/E) and a Rogers Geotechnical Services Phase 1 Desk Study, November 2015;
- WYG Engineering Ltd, Spenborough Leisure Centre, Spenborough, Stage 2 Report, January 2017.

1.3 Limitations

This report presents the findings and interpretation of site works carried out between 6th and 9th February 2017 and provides records of the boreholes, CBR testing, gas and groundwater monitoring and laboratory test results. Attention is drawn to the Report Conditions held in Appendix A and the terms and conditions of the engagement.

2.0 Site Details

For full site details reference should be made to AHR Building Consultancy Stage 1 Desk Study, January 2016.

2.1 Proposed Development

It is understood that Kirklees Council propose to develop the site with the construction of a new leisure facility, which will replace the existing Spenborough Swimming Pool on the same site. The new building will house two swimming pools, one 25m and a 10m (learner) pool. The new swimming pools will be slightly off-set from the existing two pools as shown in Appendix B. The overall building footprint in the most part is proposed to sit on the same footprint as the existing building at the same level and will. The development will also include on site hardstanding areas for vehicle parking and pedestrian access. Due to the proposed swimming pools being slightly off-set from the existing pools, and with the proposed building area being larger than the existing building, it is anticipated that a certain amount excavation and infilling will be required on site. The earthworks requirements will be discussed within Section 7.0 of this report.

The full overview of the proposed development is presented within the WYG Stage 2 Report, 2017.

2.2 Site Location & Description

The current Spenborough Fitness Centre is located within a suburban, mixed use area, on the River Spen, approximately 2km east of the M62 and 1km north of Liversedge. The site address is Bradford Road, Liversedge, WF15 6LW and the approximate National Grid Reference location is 419939E, 424446N. A site location plan is presented as drawing no. A097478-1-LDS-01.

The site is roughly rectangular in shape and covers an area of approximately 5.81 hectare (ha). The majority of the site comprises playing fields and outdoor space, with the main central building situated across the eastern portion of the site, with 2 smaller buildings to the North, adjacent to the running track and access road. The A638 (Bradford Road) runs along the north-eastern boundary of the site where the site is accessed from. Spen river runs adjacent to the south-western boundary of the site. Residential development lies adjacent to the south-eastern boundary of the site. Commercial development runs adjacent to the north-western boundary of the site. A site layout plan is presented within Appendix B.

2.3 Site History

In **1854** the site was undeveloped. In **1894** a small cluster of buildings were situated upon the eastern portion of where the present day main building lies. A pond existed on the southwestern boundary of the site which was infilled by 1922. Within 250m of the site includes woollen mills and reservoir (immediately

E), tramway (immediately N), ground workings (immediately SW), dye works (100m NW) and a railway line (200m SW and 200m NE). In **1931** no further construction is noted onsite. A football ground and playing fields occupies the majority of the site. Ground level changes are noted across the site sloping west. Within 250m of the site includes a leather works (200m NW) and a colliery air shaft (225m SW). In **1968** the site has been completely redeveloped into its present form. A running track has been constructed within the playing fields, a hockey pitch to the south of the main centre and two smaller buildings erected. It appears that significant cut and fill earthworks was carried out as part of this development. The site has remained unchanged since then.

2.4 Published Geology

2.4.1 Made Ground

The BGS Online Viewer indicates no Made Ground to be present underneath the site however it is anticipated there will be deposits of Made Ground due to previous phases of onsite development.

2.4.2 Superficial Geology

The BGS (2003) Map Sheet 77 for Huddersfield; Solid and Drift Edition and the BGS Online Viewer indicates alluvium to underlie the site comprising soft to firm normally consolidated, compressible silty clay with layers of silt, sand, peat and basal gravel.

2.4.3 Bedrock Geology

The BGS (2003) Map Sheet 77 for Huddersfield, Solid and Drift Edition (Scale 1: 50,000) and the BGS Online Viewer indicates the Pennine Lower Coal Measures Formation to underlie the site comprising interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils within the lower part and more numerous and thicker coal seams within the upper part.

2.4.4 Previous Ground Investigations

Rogers Geotechnical Services completed a Ground Investigation and produced a corresponding Factual Report in November 2015, (Report No. J3055/15/E). The ground Investigation identified, beneath a capping of topsoil, lies significant Made Ground deposits comprising firm silty clay between 1.0 and 7.0m bgl. Underlying the Made Ground are Alluvial sands and gravels identified between 9.0 and 12.0m bgl. The alluvial deposits are recorded as possible Made Ground, however. If they are natural deposits it evidences the existence of a relic scarp slope structure created by a former course of the River Spen. The bedrock, which directly underlies the alluvium, is recorded as the Pennine Lower Coal Measures Formation to a

maximum recorded depth of 18.0m bgl. It is recorded to comprise sandstones, mudstones, siltstones and shales. No coal seams were recorded.

The report proposes that extensions to the building could be constructed upon shallow foundations founded within the Made Ground (and alluvium) which is improved by the use of vibro stone columns or piles extending to the underlying solid geology. The report also concludes the site has elevated CO₂ concentrations designating it a medium to high risk gas site requiring reinforced concrete cast in-situ floor slab with at least 1200g DPM and passive underfloor venting or beam and block or pre-cast concrete slab with 2000g DPM including a reinforced gas membrane and passive underfloor venting. The design sulphate class for construction was estimated within the report to be DS-2 with an ACEC classification of AC-1s.

2.5 Coal Mining Risk

A Coal Authority Report, obtained in Jan 2015 (Ref: 51000735387001) as part of the 2015, phase 1 desk study, indicates the site is in a likely zone of influence from workings in 1 coal seam at 80 to 100m bgl which was last worked in 1895. Ground movement is expected to have stopped by now. Coal is believed to exist at or close to the surface which might have been worked in the past before records began. The site is not recorded to be within the zone of influence from present or future underground coal workings nor is within an area where the Coal Authority has granted nor is considering granting a licence to extract coal from underground methods. No notice of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991. There are no known coal mine entries nor shafts on or within 20m of the site boundary.

Coal mining risk is discussed further in Section 7.7.2 of this report.

2.6 Waste Management, Pollution Incidents and Gas Monitoring

Thirteen minor pollution incidents are recorded within 250m of the site, 3 of which occurred on the site in 2002 involving biodegradable and household waste.

A Groundsure report indicates one landfill operation within 250m of the site and that Made Ground to significant depth was recorded with monitoring undertaken. The results concluded gas protection/remedial measures are required for development.

2.7 Hydrogeology and Hydrology

A Groundsure report indicates the site is situated within a Secondary A Aquifer defined as permeable layers capable of supporting water supplies at a local rather than strategic scale and potentially forming a source of base flows into rivers.

No groundwater, surface water nor portable abstraction licences are listed within 250m of the site.

There are numerous river networks within 250m of the Site including the River Spen and associated drainage channels.

The Environment Agency Flood map shows part of the site, south of the main centre building pool is at risk of flooding from rivers without defences.

2.8 Sensitive Land Use

The site is recorded within an area of greenbelt and nitrate vulnerable zone however it is not expected to impact, nor be impacted by the proposed development. The site is not within a source protection zone.

2.9 Potential Sources of Contamination

The following potential sources of contamination are identified:

- Artificial Made Ground (On-site): Made Ground Fill;
- Infilled Ground (Immediately SW AND 225m SW): Made Ground Fill;
- Sub-Station (On-site, 64m E, 201m E and 226m E): Electrical Features;
- Historical Dye Works (100m NW): Textile and Dye Works;
- Historical Leather Works (200m NW): Textile and Dye Works;
- Chimney (Onsite): Unspecified Works, Factories or Features;
- Historical Mills (Immediately E, 100m NW and 250m SE): Unspecified Works, Factories or Features;
- Historical Works (200m NW): Unspecified Works, Factories or Features;
- Birkett Cutmaster Ltd. (14m NW): Unspecified Works, Factories or Features;
- Apex Postformers Ltd. (100m NW): Unspecified Works, Factories or Features;
- D&M Middleston & Son (173m NW): Unspecified Works, Factories or Features;
- Landfill (200m SW and NE): Waste Management Activities;
- Historic Railway Line (200m SW and NE): Railway Land;
- Historic Tramway (Immediately N): Railway Land;
- Saftek Ltd. (207m NW): Road Vehicle Servicing, Garages and Filling Stations; and
- Bensons Automotive Services Ltd (118m NW): Road Vehicle Servicing, Garages and Filling Stations.

3.0 Ground Investigation

3.1 Fieldwork

Ground Investigation (GI) works were designed and carried out by WYG in general accordance with BS5930 (2015) between 6th and 9th February 2017 and comprised of the following:

- 2 no. deep boreholes (BH01 and BH02) utilising combined dynamic sampling, rotary coring and rotary open holing using water flush drilled to a maximum depth of 30.00m bgl;
- 7 no. windowless sample boreholes (WS01 to WS07) drilled to a maximum depth of 6.43m bgl;
- Installation of groundwater and ground gas monitoring wells within all borehole locations;
- 6 Plate Load CBR tests were undertaken directly below the topsoil within the Made Ground;
- Collection of geo-environmental and geotechnical soil samples;
- Geo-environmental and geotechnical laboratory testing of soil samples;
- Positioning and levelling of all borehole locations; and
- Four ground gas and groundwater monitoring visits. Groundwater samples were taken during the first round of monitoring.

Exploratory hole locations were set out by WYG with the locations and elevations surveyed on completion by Surveys Systems. The locations of the exploratory holes are presented on WYG Drawing No. A097478-1-LDS-N-02. Prior to the commencement of any intrusive works, exploratory hole locations were scanned using a calibrated Cable Avoidance Tool (CAT) and service inspection pits were hand excavated to 1.20m bgl. Disturbed soils samples were taken from hand dug pits and borehole arisings. Selected samples were submitted by WYG to an approved and United Kingdom accredited laboratory (UKAS accredited) under a completed chain of custody.

Photographs of the rotary core are presented in Appendix C. For full details of the lithology, water strikes and samples taken during the GI works, reference should be made to the individual borehole records presented in Appendix D. Groundwater and ground gas results are presented in Appendix E.

3.2 Laboratory Testing

3.2.1 Geotechnical Testing

Soil and rock samples obtained during the ground investigation were sent to Professional Soils Laboratory Limited (PSL) for geotechnical testing and their approved subcontractors (ChemTest) for BRE SD1 Suite testing. All the tests were performed in accordance with BS1377:1990 'Soils for Civil Engineering Purposes'. A summary of the geotechnical testing undertaken is presented in Table 3.2.1. The laboratory certificates presenting the results for the geotechnical testing undertaken are included within Appendix G.

Table 3.2.1 – Summary of Geotechnical Testing

Geotechnical Test	No. of Tests Scheduled
Moisture Content	23
Atterberg Limits	11
Particle Density	9
Particle Size Distribution Analysis	9
BRE Full Suite & Acid Soluble Sulphate	15
Unconfined Compressive Strength (UCS)	8
Point Load Test	12

3.2.2 Chemical Testing – Soils

Soil samples obtained during the ground investigation were sent to Jones Environmental Laboratory, a UKAS and MCERTs accredited laboratory for chemical testing. A summary of the chemical testing undertaken is presented in Table 3.2.2. The laboratory certificates presenting the results for the chemical testing undertaken are included within Appendix H.

Table 3.2.2 – Summary of Soils Chemical Testing

Geochemical Test	No. of Tests Scheduled
Soil Testing	
WYG Soil Suite B	8

3.2.3 Chemical Testing - Groundwater

Groundwater samples obtained during the first monitoring round were sent to Jones Environmental Laboratory, a UKAS and MCERTs accredited laboratory for chemical testing. A summary of the chemical testing undertaken is presented in Table 3.2.3. The laboratory certificates presenting the results for the chemical testing undertaken are included within Appendix H.

Table 3.2.3 – Summary of Groundwater Chemical Testing

Geochemical Test	No. of Tests Scheduled
Water Testing	
WYG Water Suite B	7

4.0 Ground and Groundwater Conditions

This section summarises the ground and groundwater conditions encountered during the WYG February 2017 Ground Investigation.

4.1 Topsoil

Topsoil was encountered from ground level to a maximum recorded depth of 0.40m bgl within all exploratory holes. The Topsoil typically consists of dark grey mottled black sandy clay with plant rootlets.

4.2 Made Ground

Made Ground was encountered directly below the Topsoil within all boreholes across the site to depths of between 2.00 and 5.00m bgl. The maximum recorded thickness was generally within the western part of the site. The Made Ground was generally found to be cohesive typically comprising of firm to stiff, light brown mottled brown, slightly sandy, slightly gravelly, silty clay.

Non-cohesive Made Ground was encountered within boreholes WS01 and WS02 from between 1.30m and 3.10m bgl and typically consists of light brown, clayey fine to coarse sands and black mottled brown, slightly clayey, sandy, angular to sub-rounded, fine to coarse clinker and sandstone gravel.

4.3 Alluvial Deposits

Alluvial deposits were encountered directly below the Made Ground deposits within boreholes WS03, WS04 and WS05 at depths of between 2.80 and 5.00m bgl to a maximum depth of between 6.43m bgl (WS03). The Alluvial deposits typically comprise a mixed matrix of orangish brown, slightly sandy, clayey gravel and firm, brown, slightly sandy, gravelly clay.

4.4 Lower Pennine Coal Measures

The Lower Pennine Coal Measures Bedrock was encountered directly below either the Made Ground or the Alluvial Deposits from between 2.00m and 3.50mbgl and proven to a depth of 30.00m bgl. The rock typically consists of a sandstone layer typically 1.20m thick between 2.00 and 4.70m bgl onto underlying mudstone, with widely spaced coal seams from below 12.60m bgl between 0.20 and 0.60m thick, and localised siltstone between 6.10 and 7.20m bgl.

The upper sandstone layer was typically recorded in BH01 and BH02 as rusty orangish brown, extremely weak to weak, non-intact to intact with two main sets of fractures including:

- (i) Extremely closely to closely spaced, 0 to 15°, planar, rough, open to moderately wide and reddish brown stained and clean fractures; and

- (ii) Closely to medium spaced 75 to 90°, planar, rough, tight to partly open, reddish brown stained and clean fractures.

The mudstone with coal seams was typically recorded in BH01 and BH02 as light to dark grey, non-intact to intact, extremely weak and weathered at shallow depth becoming intact and weak to medium strong at increasing depth with two main sets of fractures including:

- (i) Extremely closely to closely spaced, 0 to 15°, planar, smooth, tight to partly open and clean and clay infilled fractures; and
- (ii) Closely to medium spaced, 75 to 90°, planar, smooth, tight and clean and clay infilled fractures.

Very widely spaced coal seams between 0.20 and 0.60m thick were recorded in BH01 and BH02 within the mudstone bedrock below 12.60m bgl at the following depths:

- 12.60 and 12.90mbgl (BH01);
- 15.10 and 15.30mbgl (BH01);
- 18.10 and 18.50mbgl (BH01);
- 27.30 and 27.60mbgl (BH01);
- 15.30 and 15.90mbgl (BH02); and
- 19.30 and 19.70mbgl (BH02).

Siltstone was typically recorded as creamy light grey, medium strong with thin to thick laminations of weak dark grey mudstone with one main fracture set including:

- (i) Extremely closely spaced to closely spaced, 0 to 10°, planar, rough and smooth, partly open to moderately wide and stained dark grey and clean and clay infilled fractures.

4.5 Ground Conditions Summary

A summary of the ground conditions across the site is presented in Table 4.5. The information is based on the exploratory hole logs presented in Appendix D.

Table 4.5: Factual Summary of Ground Conditions

Strata	Lithological Description and Location	Depth to Measured Top of Stratum (mbgl)	Depth to Measured Base of Stratum (mbgl)	Minimum Recorded Stratum Thickness (m)	Maximum Recorded Stratum Thickness (m)
Topsoil	Dark grey mottled black sandy clay with plant rootlets (All locations).	0.00	0.10 – 0.40	0.10	0.40
Made Ground	Non-Cohesive: light brown, clayey fine to coarse sands and black mottled brown, slightly clayey, sandy, angular to sub-rounded, fine to coarse clinker and sandstone gravel (WS01, WS02 and WS06).	0.10 – 2.70	1.00 – 4.95 (Base not proven)	0.45	1.80
	Cohesive: Firm to stiff, light brown mottled brown slightly sandy, slightly gravelly, silty clay (All Locations).	0.10 – 0.50	2.00 – 5.00 (Base not proven)	0.60	4.85
Alluvial Deposits	Orangish brown slightly sandy clayey gravel or firm brown sandy gravelly clay.	2.80 - 6.00 (Ground Level)	0.50 – 6.43 (Base not proven)	0.40	0.70
Lower Pennine Coal Measures Bedrock	Sandstone: Rusty orangish brown extremely weak to weak, non-intact to intact with two main sets of fractures (BH01 and BH02).	2.00 – 3.50	3.20 – 4.70	1.20	1.20
	Mudstone with Coal Seams: Light to dark grey, non-intact to intact, extremely weak and	3.20 – 5.40	30.00 (Base not Proven)	22.80	26.80

Strata	Lithological Description and Location	Depth to Measured Top of Stratum (mbgl)	Depth to Measured Base of Stratum (mbgl)	Minimum Recorded Stratum Thickness (m)	Maximum Recorded Stratum Thickness (m)
	weathered at shallow depth becoming intact and weak to medium strong at increasing depth with two main sets of fractures. With very widely spaced coal seams between 0.20m and 0.60m thick below 12.60mbgl (BH01 and BH02).				
	Siltstone: Creamy light grey, medium strong with thin to thick laminations of weak dark grey mudstone with two main sets of fractures (BH102).	6.10	7.20	1.10	1.10

4.6 Groundwater

Since the completion of the fieldwork, groundwater levels have been monitored on four occasions between 17th February and 20th March 2017 within all nine installations. Results do not suggest any definitive groundwater flow direction, however due to the location of the River Spem to the south, it may be inferred to flow to the south.

A summary of the groundwater observations is presented within Table 4.6. This information is based upon observations during the drilling of exploratory holes and from monitoring data in Appendix E.

Table 4.6: Factual Summary of Groundwater Conditions

Exploratory Hole	Ground Elevation (m AOD)	Depth of Water Strike (Investigation) (mbgl)	Groundwater Range Observed During Monitoring (mbgl)
BH01	67.48	2.30	1.64 – 2.18
BH02	64.37	5.10	1.90 – 2.12
WS01	67.37	4.10	4.69 – 4.89
WS02	66.93	Dry	3.62 – 3.76
WS03	66.97	5.00	4.45 – 4.59
WS04	64.65	2.80	2.31 – 2.45
WS05	64.56	4.00	3.34 – 3.57
WS06	67.11	Dry	Dry
WS07	68.11	Dry	1.89 – 2.70

4.7 Ground Gases

Since the completion of the fieldwork, the ground gas has been monitored on four occasions between 17th February and 10th March 2017 within all nine installations using a GFM5000 gas analyser. Gas monitoring was undertaken in line with guidance within CIRIA C665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings, 2007' during varying atmospheric pressure conditions including falling pressure as a poor case scenario. A summary of the results of the gas monitoring is presented in Table 4.7. This information is based on monitoring data in Appendix E.

Table 4.7: Factual Summary of Ground Gas Monitoring Results

Exploratory Hole	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (%v/v)	Flow (l/h)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)
BH01	0.0	1.1	20.5	1.0	0.0	0.0
BH02	0.0	2.1	20.4	0.1	0.0	0.0
WS01	0.0	2.0	18.8	0.2	0.0	0.0
WS02	0.0	0.8	17.2	0.2	0.0	0.0



Exploratory Hole	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (%v/v)	Flow (l/h)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)
WS03	0.0	1.8	19.1	0.1	0.0	0.0
WS04	0.0	1.3	18.8	0.2	0.0	0.0
WS05	0.0	1.1	19.7	-0.6	0.0	0.0
WS06	0.0	0.6	20.8	0.1	0.0	0.0
WS07	0.0	2.4	20.0	0.2	0.0	0.0

5.0 Material Properties and Geotechnical Design Parameters

5.1 General

The ground conditions encountered at the site are summarised in Section 4. The geotechnical properties for the materials present on site are summarised below. All test results are presented in Appendix D of this report.

5.2 Made Ground

Made Ground was encountered within all borehole locations to a maximum depth of 5.00m bgl at borehole WS03. The Made Ground encountered was generally cohesive, however relatively small amounts of granular Made Ground was encountered at boreholes WS01, WS02 and WS06. The majority of the granular Made Ground was encountered within the western part of the site, which will be a car parking area for the proposed new development. Therefore, due to the limited amount of granular Made Ground encountered during the 2017 Investigation, it will not be assessed any further and the Made Ground will be considered to be cohesive for design purposes.

A summary of the geotechnical testing for the Made Ground, is summarised in Table 5.1 below:

Table 5.1 - Summary of Testing on Made Ground

Type of test	No. of Tests	Results
In situ:		
Standard Penetration Test (SPT)	25	5 to >50 (N Value)
California Bearing Ration (CBR)	6	0.7 to 9.0 (%)
Laboratory:		
Natural Moisture Content %	14	17 to 32
Liquid Limit %	10	36 to 62
Plastic Limit %	10	18 to 28
Plasticity Index %	10	18 to 35
Particle Size Distribution (PSD)	7	Gravelly sandy Clay
Laboratory: BRE Concrete classification		
pH	4	5.6 to 6.6
Chloride (mg/l)	4	3.3 to 12
Nitrate (mg/l)	4	<1.0 to 18
Magnesium (mg/l)	4	<10

Sulfate aqueous extract as SO ₄ (mg/l)	4	<10 to 120
Total sulfate (%)	4	0.02 to 0.07
Total sulfur (%)	4	<0.01 to 0.04

5.2.1 Standard Penetration Testing

As part of the investigations at the site 25 No. SPTs were carried out in the Made Ground, giving N values of between 5 and >50, ref Appendix C. A plot showing SPT vs depth is presented within Appendix F. The SPT results do not generally increase with depth between 1.2m and 3.0m bgl and a characteristic SPT value of 10 can be assumed between this depth. The higher SPT N values between these depths are assumed to be associated with more granular material and are not representative of the soil matrix as a whole. SPT N values do generally increase below 3.0m bgl and a characteristic N value of 20 is considered appropriate for design purposes below this depth.

5.2.2 Classification Testing

Particle size distribution (PSD) tests were performed on seven samples of the Made Ground and the results are presented in Appendix G. The results show the material to be reasonably consistent and generally comprises a gravelly sandy clay.

Atterberg limits tests were performed on 10 samples of the Made Ground. These gave liquid limit ranges of 36% to 62% with a mean of 48% and plastic limits ranging from 18% to 28% with a mean of 23%, ref Appendix G Plasticity index values ranged from 18% to 35% with a mean of 25%. The results plot above the 'A' line on a plasticity chart indicating the material to be clay of intermediate to high plasticity, ref Appendix G.

The natural moisture content of 14 No. samples ranged from 17% to 32% with a mean of 23%; ref Appendix G. The natural moisture content of individual specimens was typically above the plastic limit. The consistency index for the samples ranges from 0.55 to 1.24 with a mean of 1.09, which classifies the material as having a consistency of soft to stiff which is consistent with the anticipated consistency from exploratory hole logs.

Empirical correlations between moisture content and specific gravity, assuming an average specific gravity of 2.64Mg/m³ indicates a bulk density of between 1.89Mg/m³ and 2.13Mg/m³ with a mean bulk density of 2.03Mg/m³.

BS8002 (2015) provides suggested values for characteristic weight density of soils. For a medium strength (firm) clay a typical weight density of 16kN/m³ to 20kN/m³ is suggested.

Typical values of bulk density are provided in Tomlinson (2001). For a firm clay a bulk density of between 1.75Mg/m^3 to 2.10Mg/m^3 is suggested.

Therefore, a mass density of 2.00Mg/m^3 is considered an appropriate derived value for the Made Ground, which corresponds to a weight density of 19.6kN/m^3 .

5.2.3 Undrained Shear Strength

An estimate of the undrained shear strength of the Made Ground was made using the relationship suggested by Stroud (1975) between SPT N values and undrained shear strength with a correlation factor (f_1) of 4.8 based on the mean plasticity index of 25%. This gives undrained shear strength values for the Made Ground as follows:

- 0.0 – 3.0m bgl: 48kN/m^2 (assumed design value of 50kN/m^2)
- > 3.0m bgl: 96kN/m^2 (assumed design value of 100kN/m^2)

5.2.4 Consolidation, Compressibility

Design parameters are also required for the “settlement characteristics” of the Made Ground in order that an assessment can be made of the likely deformation under loading imposed by the new swimming pool structure. Given the nature of the Made Ground it is considered that the majority of the settlement will be consolidation settlement. The material is described as predominately firm, refer to Section 5.2.1 above. As such, with reference to Stroud and Butler (1975) the recorded SPT N values from the site and a mean plasticity index of 25%, a value of $f_2=0.48$ is appropriate which using the correlation of coefficient of volume compressibility (m_v) = $1/f_2.N$ gives estimated values of m_v of $0.21\text{m}^2/\text{MN}$ (0.0 to 3.0m bgl) and $0.10\text{m}^2/\text{MN}$ (>3.0m bgl).

Alternatively, Carter and Bentley (1991) give values of coefficient of volume compressibility (m_v) of between $0.1\text{m}^2/\text{MN}$ to $0.3\text{m}^2/\text{MN}$ for firm clays, which is consistent with the derived values above.

5.3 Alluvial Deposits

Alluvium was encountered within four boreholes to a maximum depth of 5.40m bgl at borehole WS03. The thickness of Alluvium encountered was generally small, with a maximum thickness of 1.43m at borehole WS03 in the western part of the site. The borehole information does suggest that the amount of Alluvium present within the footprint of the proposed new leisure centre is likely to be very minimal, where only two boreholes (WS04 and WS05) closest to the proposed building encountered a maximum thickness of Alluvium of 0.7m. It is noted that the Alluvium was only encountered within the western and southern parts of the site suggesting that the old river channel did not extend much beyond the southern boundary of the current pool building.

A summary of the geotechnical testing for the Alluvium, is summarised in Table 5.2 below.

Table 5.2 - Summary of Testing on Alluvium

Type of test	No. of Tests	Results
In situ:		
Standard Penetration Test (SPT)	5	20 to >50 (N Value)
Laboratory:		
Natural Moisture Content %	4	9.2 to 18
Liquid Limit %	1	38
Plastic Limit %	1	19
Plasticity Index %	1	19
Particle Size Distribution (PSD)	2	Sandy clayey Gravel
Laboratory: BRE Concrete classification		
pH	1	6.8
Chloride (mg/l)	1	13
Nitrate (mg/l)	1	<1.0
Magnesium (mg/l)	1	<10
Sulfate aqueous extract as SO ₄ (mg/l)	1	110
Total sulfate (%)	1	0.04
Total sulfur (%)	1	0.02

It has been discussed previously that the Alluvium is unlikely to be present beneath the proposed footprint of the new leisure centre building. Therefore, this material will not be considered within the ground model and subsequent foundation assessments at this location. The depth at which it was encountered within the western and southern parts of the sites are not considered to impact on the performance of the car parking and access roads within these areas due to depth of the strata and the likelihood that it will be less compressible than the Made Ground above it.

5.4 Lower Pennine Coal Measures

Solid geology of the Lower Pennine Coal Measures comprising of interbedded mudstone and sandstone was encountered in six boreholes from 2.00m bgl to a maximum proven depth of 30.0m bgl. A summary of the geotechnical test results for the solid geology is presented in Table 5.3.

Table 5.3 - Summary of Testing on Lower Pennine Coal Measures

Type of test	No. of Tests	Results
In situ:		
Standard Penetration Test (SPT)	8	31 to >50 (N Value).
Laboratory:		
Natural Moisture Content %	5	3.2 to 7.2
Unconfined Compressive Strength (UCS) Test (MPa)	1	19.2
Point Load Test IS50 (MPa)	8	0.11 – 0.79
Laboratory: BRE Concrete classification		
pH	6	5.1 to 6.9
Chloride (mg/l)	6	1.8 to 15
Nitrate (mg/l)	6	<1.0
Magnesium (mg/l)	6	<10 to 28
Sulfate aqueous extract as SO ₄ (mg/l)	6	<10 to 500
Total sulfate (%)	6	0.02 to 0.25
Total sulfur (%)	6	<0.01 to 0.23

5.1 Geotechnical Parameters

Design parameters for the superficial and solid geology encountered below the site have been derived using the available lab and field test data as well as published guidance and derivations. They are presented in Table 5.4 below.

Table 5.4 - Summary of Geotechnical Design Parameters

Stratum	Material Parameter	Characteristic Value	Rationale
Made Ground	Unit Weight (kN/m ³)	19.6	Derived value using particle density and moisture content and published values for stiff Clay (BS 8002, 2015 and Tomlinson, MJ. 2001).
	Undrained shear strength, c_u (kN/m ²)	50 (from 0.0 – 3.0m bgl) 100 (> 3.0m bgl)	Cautious estimate from empirical relationship with SPT N (Stroud et al 1975).
	Coefficient of volume compressibility, M_v (m ² /MN)	0.3	Cautious estimate from empirical relationship with SPT N (Stroud et al 1975).
	Coefficient of consolidation, C_v (m ² /yr)	2.7	From published value for silty clay (Carter and Bentley, 1991).
	California Bearing Ratio (%)	2.5	Characteristic In-situ CBR values
Alluvium	Unit Weight (kN/m ³)	18	From published value for dense gravel (BS8002, 2015).
	Angle of Friction ϕ' (°)	33	Cautious estimate from empirical relationship with SPT (Carter and Bentley, 1991).
	Cohesion, c' (kN/m ²)	0	Conservative value.
Lower Pennine Coal Measures	Unit Weight (kN/m ³)	23	From published value for Mudstone (Waltham, T. 2002) and from UCS result at BH01.
	Intact Uniaxial Compressive Strength (MN/m ²)	10 (mudstone) 10 (sandstone)	Cautious estimate based on UCS (Sandstone) perpendicular point load test results (Mudstone, $q_u = 24I_{s(50)}$) and field descriptions.
	Weathered	5 (mudstone)	Cautious estimate from Table 25 within

Stratum	Material Parameter	Characteristic Value	Rationale
	Uniaxial Compressive Strength (MN/m ²)	5 (sandstone)	BS5930:2015.
	Angle of Friction ϕ' (°)	24	Conservative value (Tomlinson, M.J. 2001).

6.0 Ground Contamination Assessment

6.1 General

In order to assess the potential risk posed by any contaminants contained within the soils at the site, a generic quantitative risk assessment (gQRA) has been undertaken by comparing site data to generic soil screening values (SSVs) or Tier 1 Screening Values (TSVs).

Contaminant concentrations below the TSVs/SSVs are considered not to warrant further risk assessment. It should be noted that exceeding the TSVs/SSVs does not necessarily require that the site be remediated.

All relevant information has been collated and evaluated to establish a qualitative risk assessment for the site. The risk assessment identifies environmental hazards posed both by and to the site in its current status as well as potential future risks. The site has been considered in line with the current UK guidelines, namely the Contaminated Land (England) Regulations 2000 and Part 2A of the Environmental Protection Act 1990.

For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source, i.e. a substance that is capable of causing pollution or harm;
- A receptor (or target), i.e. something which could be adversely affected by the contaminant;
- A pathway, i.e. a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

Potential sources, pathways and receptors have been identified and the risks associated with possible pollutant linkages outlined. The site assessment is undertaken based on the proposed use of the site as comprising ongoing use as a commercial site, where adult site workers would be the critical human health receptor. Note the scope of this assessment does not include the playing fields associated with the leisure centre and is focussed on the proposed footprint of the redevelopment building and car park.

Sources of Contamination

The principal source of contamination on the site is the Made Ground that is known to be present across site with larger thicknesses within the western section of the site.

The main sources of off-site contamination are associated industrial commercial land usage. The specific potential sources are referenced in Section 2.8 of this report.

Potential Contaminant Pathways

It is understood that the site is to continue as a leisure centre (commercial land use) on which the critical receptors will be site workers/ users, the drainage channels / surface water bodies on site, and the groundwater in the underlying aquifer. The following potential contaminant pathways are considered likely to be active given the potential contaminants and receptors identified. However, it is important to note that there will be significant amounts of hardstanding across the site.

Human (site users and neighbouring site users) Exposure Pathways

- Inhalation / Ingestion of dusts;
- Dermal contact with soils;

Migration Pathways

- Migration through drainage / services / perched groundwater;
- Surface water run-off;
- Groundwater flow.

Potential Receptors

Potential receptors given the proposed ongoing use of the site may include the following:

Human Health

- Site users (future and current workers and visitors / trespassers / neighbouring site users).

Environmental Receptors

- Local surface waters (drainage channels on site / local tributary channels linking to the River Spen to the south);
- Groundwater (Coal Measures and Alluvium – Secondary A aquifer).

Given that the site will largely be covered in buildings or hardstanding, flora and fauna are not considered to be significant receptors.

Qualitative Risk Assessment

By considering the sources, pathways and receptors, an assessment of the environmental risks is made with reference to the significance and degree of the risk. This assessment is based on the consideration of whether the source of contamination is likely to reach a receptor and hence whether it may cause an adverse impact. The qualitative risk assessment has been undertaken in accordance with BS10175:2011

and CIRIA Document C552: Contaminated Land Risk Assessment, A Guide to Good Practice. The source – pathway – receptor linkages are developed around the information presented above.

Potential risks from on-site sources are considered in relation to the proposed ongoing commercial (leisure centre) use of the site. Potential risks from off-site sources are considered only in relation to on-site receptors to ensure protection of the site. The risk assessment has been carried out by assessing the severity of the potential consequence, taking into account the potential severity of the hazard, sensitivity of the target and probability of the hazard occurring, based on the categories detailed in Tables 6.1 and 6.2.

Table 6.1 Categorisation of Risk

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures
Mild	Pollution of non sensitive waters, minor damage to buildings or structures
Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non sensitive ecosystems or species

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Table 6.2 Categorisation of Probability

Category	Definition
High Likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
Low Likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so

Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable
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The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the matrix in Table 6.3 in order to give a level of risk for each potential hazard.

Table 6.3 Risk Matrix Categories

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability Of Risk	High Likelihood	Very high	High	Moderate	Low/Moderate
	Likely	High	Moderate	Low/Moderate	Low
	Low Likelihood	Moderate	Low/Moderate	Low	Very low
	Unlikely	Low/Moderate	Low	Very low	Very low

6.2 Screening Methodology

6.2.1 Soils

The SSVs used to screen soil analytical results at the site derive from various sources. Preferentially WYG have used Category 4 Screening Levels (C4SL) derived by DEFRA with CL:AIRE (Contaminated Land: Assessment in Real Environment) ¹ as the first source of SSVs. Where C4SLs are unavailable, 'Suitable For Use Levels' (S4ULs) ² developed by LQM/CIEH (2015) have been used.

C4SLs are currently available for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead ³. The C4SLs, which were developed originally to support the categorisation of sites in accordance with Part 2A are

¹ DEFRA, 2014. SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document

² LQM/CIEH (3rd Edition) "Suitable for Use Levels (S4ULs) for Human Health Risk Assessment (2015)"

³ Arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI, lead assuming 6% SOM (1% SOM C4SL also published for benzene)

also, based on DEFRA guidance, considered suitable for use during the assessment of sites as part of the planning process.

The LQM/CIEH S4ULs provide GACs based on minimal or tolerable risk intended to be protective of human health for individual or mixtures of substances. It is considered conservative and appropriate to use these values for contaminants for which C4SLs are unavailable. SSV for volatile and semi-volatile organic compounds (VOC and SVOC) not presented in the S4UL document are sourced from CL:AIRE "Soil Generic Assessment Criteria for Human Health Risk Assessment" (January 2010).

For organic contaminants SSV have been sourced for 1%, 2.5% and 6% soil organic matter (SOM) values. An average value of SOM of 1% has been calculated from 8 samples of Made Ground therefore SSV based on a SOM value of 1% have been used where applicable.

The derivation of SSVs is an ongoing developing process and, as such, methodologies and input parameter values may alter as new guidance is published. This may result in regular updates to the SSV list as research and development work progresses.

The CLEA model states that "For most exposure pathways, the contamination is assumed to be at or within one metre of the surface" (Science Report SC050021/SGV, Environment Agency 2009, p19). It is considered that at depths greater than 1.0m, the probability of human exposure via the direct contact pathways are significantly reduced, leaving inhalation of volatile compounds as the dominant pathway with regard to human health risks. Typically, volatile compounds only significantly affect the indoor inhalation pathway. The same screening concentrations have been used for all depths at this stage, though it is noted that these are highly conservative for depths below 1.0m bgl.

Proposed End Use

It is understood that the site is to be re-developed with a leisure centre building with associated car parking and access roads along with soft landscaping. In view of this, screening values for a "Commercial" development have been used. It is assumed that risks to end-users will be significantly lower in areas of hardstanding than from bare soil in landscaped areas, as several of the contaminant pathways (e.g. direct contact) will be restricted.

6.2.2 Groundwater

Tier 1 screening values have been developed by WYG and are presented as Appendix J within this report. All criteria are sourced from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2015 except Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2010; WHO Guidelines for Drinking Water Quality, Third Edition, WHO, 2008; WHO Guidelines for Drinking Water Quality, Fourth Edition, WHO, 2011; Petroleum Products in Drinking Water, WHO, 2005 and Water Supply (Water Quality) Regulations 1989.

6.3 Contaminant Screening Assessment

6.3.1 Soils

A total of eight soil samples from the site were analysed and the results screened against WYG SSVs. Screened summary sheets are presented in Appendix I. All determinands were recorded at concentrations below the relevant SSV with one exception, where a lead concentration of 3541 mg/kg was recorded at WS02 (1.5m), less than twice the TSV of 2300 mg/kg. The maximum lead concentration was 7 times higher than the next highest lead concentration and is unlikely to be representative of widespread lead concentrations across the site. The risk to future site users in accordance with the risk matrix in Table 6.3 is considered to be Low.

All samples were subject to a screen for asbestos containing materials / asbestos fibres with no positive asbestos identifications made.

6.3.2 Groundwater

One round of groundwater sampling was undertaken from all borehole positions on site. A total of seven groundwater samples (WS02, WS03, WS04, WS05, BH01, BH02 and BH02A) were retrieved for laboratory testing. Borehole WS01 was found to be dry and could not be sampled. For quality assurance, a duplicate sample was taken at BH02 and was labelled as BH02A.

All determinands were recorded at concentrations below WYG screening values, with the exception of one sample from borehole WS02. The majority of the determinands tested at borehole WS02, exceeded the WYG screening values by up to 100 times. It is noted that groundwater at this borehole is found to be resting within Made Ground. It is likely that the exceedences are associated with the Made Ground and would present a very localised area where elevated concentrations are present. This is further confirmed by the concentrations observed within boreholes WS01 and WS02 (western part of the site), where no exceedences were recorded. Therefore, based on the initial groundwater monitoring results, the risk to groundwater resources (River Spen and Secondary A aquifer) is considered to be low in accordance with the risk matrix in Table 6.3.

6.4 Ground Gas Assessment

Soil gas concentrations were found to be generally low, with no measurable concentrations of methane and a maximum recorded carbon dioxide concentration of 2.9% by volume in air and no recorded carbon monoxide concentrations. The maximum recorded flow rate was 0.2 l/hr. Gas monitoring results are presented within Appendix E.



Calculation of Gas Screening Values indicates the gas results for the site conform to Characteristic Situation 1 in accordance with CIRIA C665 guidance and subsequently no specific ground gas protection measures are considered necessary.

It is noted that the Rogers Geotechnical Factual Report characterised the site as a Characteristic Situation 2. The actual determined characterisation was Characteristic Situation 1. A Characteristic Situation 2 was proposed based on the maximum recorded carbon dioxide concentration of 4.4% being close to the 5% limit as outline within CIRIA C665. This is considered to be very conservative given that the carbon dioxide didn't actually exceed the CIRIA guidance value and the flow rate for the reading of 4.4% was 0.0 l/hr.

Therefore, it is considered suitable to characterise the site as a Characteristic Situation 1.

7.0 Ground Engineering Considerations

7.1 Proposed Development

It is understood that Kirklees Council propose to develop the site with the construction of a new leisure facility, which will replace the existing Spenborough Swimming Pool on the same site. The new building in the most part is proposed to sit on the same footprint as the existing building at the same level. The development will also include on site hardstanding areas for vehicle parking and pedestrian access. The full overview of the proposed development is presented within the WYG Stage 2 Report, 2017. An extract from the WYG Stage 2 Report showing a site section through the proposed pool hall is provided in Appendix

The new leisure centre will consist of two floors, where the main steel frame will be supported on concrete 'stub' columns. The building will house two new swimming pools, one 25m in length to a maximum depth of 1.8m and a 10m pool to a depth of 2.8m. The new pools will be off-set to the west from the exiting swimming pools on site and therefore, will require excavation and filling within the extents of the existing and proposed swimming pool footprints. The actual extents of earthworks required will be determined during detailed design.

It is currently understood that a ground floor slab level of 67.7m AOD is proposed as shown within the WYG Stage 2 Report. Between the extents of the swimming pools, the ground floor slab will be suspended on the stub columns to allow for the variations in height of the ground profile from north to south. A typical foundation detail sketch is presented in Appendix K along with foundation layout detail drawing.

A maximum column load of circa 1500kN is anticipated, however it is noted that column loading will vary across the structure, and actual design loadings will be verified during stage 3 (detailed design) of the design process.

It is not known at what depth the current building is founded and indeed what the foundations are, therefore, formation levels cannot be established at this stage. Based on the observed depths to the base of the Made Ground from the borehole logs, pad foundations on bedrock may result in circa 4-5m of excavation at the southeast end of the building, reducing in depth to the northwest to approximately 2.0m.

7.2 Site Clearance Works and Earthworks

Site clearance works will involve the demolition of the current building and removal of existing building foundations that affect the new structure. (Note - We do not have any information on the nature and depth of the existing foundations). Significant excavations will also be required for the construction of the two new pools. The new pool locations will be off-set from the existing pool locations, which will leave voids at the

western and eastern extents of the swimming pool footprints. These voids will require infilling with suitable engineered fill material.

Relict concrete slabs and foundations could be crushed and re-used on site as general granular fill materials (e.g capping or sub-base). Materials excavated from the new pools may comprise Made Ground and is likely to be a Class 2 material. This may be suitable for re-use within other parts of the site (swimming pool voids) as a general fill material, provided that it meets all necessary placement and validation criteria. If the material is to be disposed off-site, based on chemical laboratory testing results, it is likely to be classified as non-hazardous.

Topsoil should be stripped under the proposed development footprint and stockpiled for re-use or removed from site.

It is recommended that a suitably qualified geotechnical engineer inspect the formation conditions of each foundation to ensure it meets the requirements stated in this report and any subsequent detailed design.

7.3 Deep Excavations

Deep excavations of up to 3.5m will be required for the new pool locations and are likely to be within the weathered Coal Measures. It is anticipated that the weathered rock can be excavated utilising mechanical means, however due to the material being heavily fractured, it is recommended that the side slopes are battered back or a temporary support system is adopted to provide stability to the excavation.

A permeant retaining wall will be required for the swimming pool walls. Detailed design should consider the effect of groundwater pressures on the side walls and uplift pressures at the base. Whilst the swimming pool is full of water, uplift pressures associated with groundwater are not likely to be an issue, however, detailed design should consider a scenario where the pool has been emptied. In addition to this, consideration should be made to seasonal variations in groundwater levels.

7.4 Groundwater Control Measures

Groundwater levels across site were found to vary with no definitive ground water flow established. It is likely that groundwater will be present within granular portions of the Made Ground and Alluvium as observed within boreholes BH01 and BH02 where groundwater has been measured at between 1.64m and 1.90m bgl respectively. Therefore, groundwater ingress will need to be monitored during any deep excavation works. Due to the cohesive nature of the Made Ground it is likely that water ingress rates will be low and can be controlled by pumping the water from the base of excavations. It should also be noted that

groundwater level will be subject to natural seasonal variations which should be taken into account when planning excavations etc.

7.5 Foundation Design

7.5.1 Spread Foundations

The previous section highlighted the potential variable nature of the Made Ground on site. Depending on loadings associated with the new leisure centre it may be possible that this material will provide suitable bearing capacities for the building foundations. The benefit of this is the potential for reducing the amount of excavation required to excavate the Made Ground down to bedrock. Therefore, a bearing capacity check for foundations founded within the Made Ground will be undertaken to form an initial assessment of the potential foundation options. If Made Ground is present beneath the current swimming pool building, this is assumed to have undergone significant consolidation since the building was opened in March 1969 resulting in an increased shear strength material. Taking this into account, it is considered appropriate for outline design to assume the higher characteristic undrained shear strength value ($>3.0\text{m bgl}$) of 100kN/m^2 as presented within table 5.4 above.

For the purpose of providing outline foundation designs, indicative column loadings have been assumed to be in the region of 1500kN as provided by the WYG structural engineer. The calculated design resistances in the sections below are outline at this stage, and should be considered as such. Detailed design should be undertaken once final design actions and actual founding levels have been determined.

Made Ground

Bearing capacity calculations for the proposed structure have been undertaken using the Brinch Hansen equation (Tomlinson, 2001). A Eurocode design approach (BS EN1997-1:2004 +A1:2013 and NA to BS EN1997-1:2004 +A1:2013 incorporating national Amendment No.1) was not adopted for the purpose of this outline design because actual design actions are not available at this stage. Therefore, a presumed safe bearing capacity for the Made Ground has been calculated to give an approximate guide to the strength of these soils.

The safe bearing capacity for a spread footing founded in Made Ground with a minimum undrained shear strength of 100kN/m^2 at a minimum depth of 3.0m has been calculated as 225kN/m^2 for foundations with an approximate area of 4.0m^2 . This has assumed an overall Factor of Safety of 3 for permanent works design. Assuming an imposed design action of $1,500\text{kN}$, an applied bearing pressure of 375kN/m^2 is expected, which is greater than the safe bearing capacity of the Made Ground indicating that it would not be a suitable founding material.

Once the anticipated design actions for the structure are known, then detailed design using Eurocode approach methods should be undertaken to better inform the overdesign factor for bearing of the structure.

Weathered Bedrock

Weathered sandstone and mudstone was encountered directly beneath the Made Ground to a maximum depth of 5.70m bgl at borehole BH02. Due to the weathered rock profile extending approximately 2.0m in thickness, it is considered that all foundations will be founded on this material at approximately 2.0m and 4.0m bgl.

It is noted that the field description of the material suggests that it has been weathered, which would result in a reduced presumed allowable bearing capacity. In accordance with BS5930:2015, for a very weak to weak rock, a uniaxial compressive strength of 5MPa is considered appropriate for an initial assessment.

An assessment of presumed allowable bearing pressure is provided with Figure G1, Group 3 within BS EN1997-1:2004 +A1:2013. Taking an average discontinuity spacing of closely spaced (100mm), and a uniaxial compressive strength of 5MPa, a presumed allowable bearing pressure of 500kN/m² is considered appropriate for outline foundation design. With an applied bearing pressure of 375kN/m², the weathered bedrock is considered satisfactory as a founding stratum

7.5.2 Deep Foundations

It is understood that pile foundations are not being considered as a design option, however, should large pad foundations or rafts not be considered a cost-effective option for the new leisure centre, then piled foundations could be considered. It is likely that if pile foundations were considered then they would be end bearing or rock socketed into the competent bedrock material at possible depths of between 2.0 and 4.0m.

7.6 Floor Slabs

Floor slabs. It is considered that lightly loaded ground bearing floor slabs (typically 10kN/m²) would be acceptable in areas located outwith the extent of the new and existing pools. The floor slabs located between the existing and proposed pool locations and those located over the existing pools should be suspended.

7.7 Geotechnical Risks

7.7.1 General

Granular soils which include the Made Ground and Alluvium which have been recorded at the site are likely to be unstable during any excavation works. Cohesive soils are likely to remain stable in the short term however their stability cannot be relied on for excavations which are open for longer periods of time. Therefore, where necessary, excavations should be supported or battered back to a stable angle to ensure adequate stability is achieved for the duration of any works. No excavation shall be left open overnight or for prolonged periods and the contractor shall ensure that excavated areas can be backfilled within a suitable timescale to reduce the risk of instability to surrounding structures.

Any excavations requiring entry by site personnel should be fully supported for reasons of safety and the main works Contractor shall satisfy themselves at all times of the suitability and stability of excavated strata and adopt shoring techniques where required.

Presence of unsuitable material within the Made Ground or upper layers of Glacial Till deposits that require removal and replacement prior to foundation construction (only relevant for shallow foundation options). Unsuitable material may comprise:

- Soft silt or clay and very loose to loose sand (Undrained Shear Strength $<50\text{kN/m}^2$);
- Soil comprising a high organic content and/or debris (i.e. plant debris, wood, etc...).

7.7.2 Coal Mining

The risk of mine workings at depth is considered to be low as suggested within Section 2.5 of this report. However, it was highlighted that coal seams have been worked at depth in the area, therefore, it was considered prudent to assess the ground conditions at a greater depth than has previously been undertaken. The maximum depth previously drilled at the site was to 18.0m bgl during the Rogers Geotechnical Services November 2015 ground investigation. The WYG Ground Investigation, 2017 aimed to establish the presence of coal seams beneath the site and to investigate to depths of around 30.0m bgl.

Two boreholes (BH01 and BH02) were drilled to 30.0m bgl. There were no recorded voids during drilling and no evidence of previous workings.

Borehole BH01 encountered coal at 12.60m at a recorded thickness of 0.30m. Bedrock was encountered at 2.0m bgl, therefore, overburden rock cover was found to be 35 times the seam thickness.

Borehole BH02 encountered coal at 15.30m at a recorded thickness of 0.90m. Bedrock was encountered at 3.5m bgl, therefore, overburden rock cover was found to be 13.0 times seam thickness.

Based on the information obtained from the recent WYG Ground Investigation, it is considered that the risk from coal mining at the site is minimal.

7.8 Car Park Pavement Design

Based on the laboratory PSD results for the cohesive Made Ground, the material on site is likely to classify as HA Class 2 cohesive material. Therefore, design thicknesses for the car park areas are based upon Foundation Class 2 ($\geq 100\text{MPa}$) and a Restricted Foundation Design approach. The design is undertaken in accordance with IAN 73/06 (Rev 1) and HD26/06. A CBR of 2.5% is considered suitable for the design of road pavement in accordance with IAN 73/06 assuming the formation comprises firm stiff clay or dense granular material.

A Class 2 Restricted Foundation Design comprising sub-base onto capping is proposed for the access roads and car park areas. A Class 2 foundation is required to provide a Foundation Surface Modulus of around 100MPa. Based upon an CBR value of 2.5% (Sub-grade Stiffness Modulus of 32MPa) and in accordance with IAN 73/06 Figure 3.1, a minimum capping layer thickness of around 260mm is required. For bound mixtures (MCHW1 821, 822 or 840 soil cement strength C3/4 or C5/6, a sub-base thickness of 280mm is required.

During construction, the sub-grade formation should be proof rolled and inspected by the Supervising Engineer. Should localised soft areas of inadequate sub-grade be encountered at sub-formation level, these should be excavated and replaced with adequately compacted capping material or sub-base.

All materials within 450mm of the road surface shall be non-frost susceptible in accordance with IAN 73/06.

7.9 Design Concrete Class

Based on the sulphate concentrations, groundwater conditions and pH values obtained from laboratory test data, subsurface ground conditions appear to be consistent with ACEC Class AC-1s with respect to buried concrete (BRE Special Digest 1: 2005 "Concrete in aggressive ground"). The Design Sulphate Class is DS-1.

The concrete class has been assumed based on groundwater at foundation level being relatively static and most probably not present at shallow depths. If pile foundations are adopted or high water ingress is encountered during excavation for shallow foundations, the design concrete class will need to be re-assessed assuming mobile groundwater.

It is noted that the Rogers Geotechnical Factual Report proposed a Design Sulphate Class of DS-2. It is assumed that the Design Sulphate Class has been determined based on the chemical testing results within



Appendix 5. This was based on two results (WS2 and WS3) which gave pH levels of 7.8 and 8.0 and Sulphate (2:1 Water Soluble) as SO_4 of <0.010 for both results. These results would be consistent with a Design Sulphate Class DS-1 and is consistent with the current WYG, 2017 Ground Investigation.

8.0 Conclusions and Recommendations

The following points provide a summary of the report:

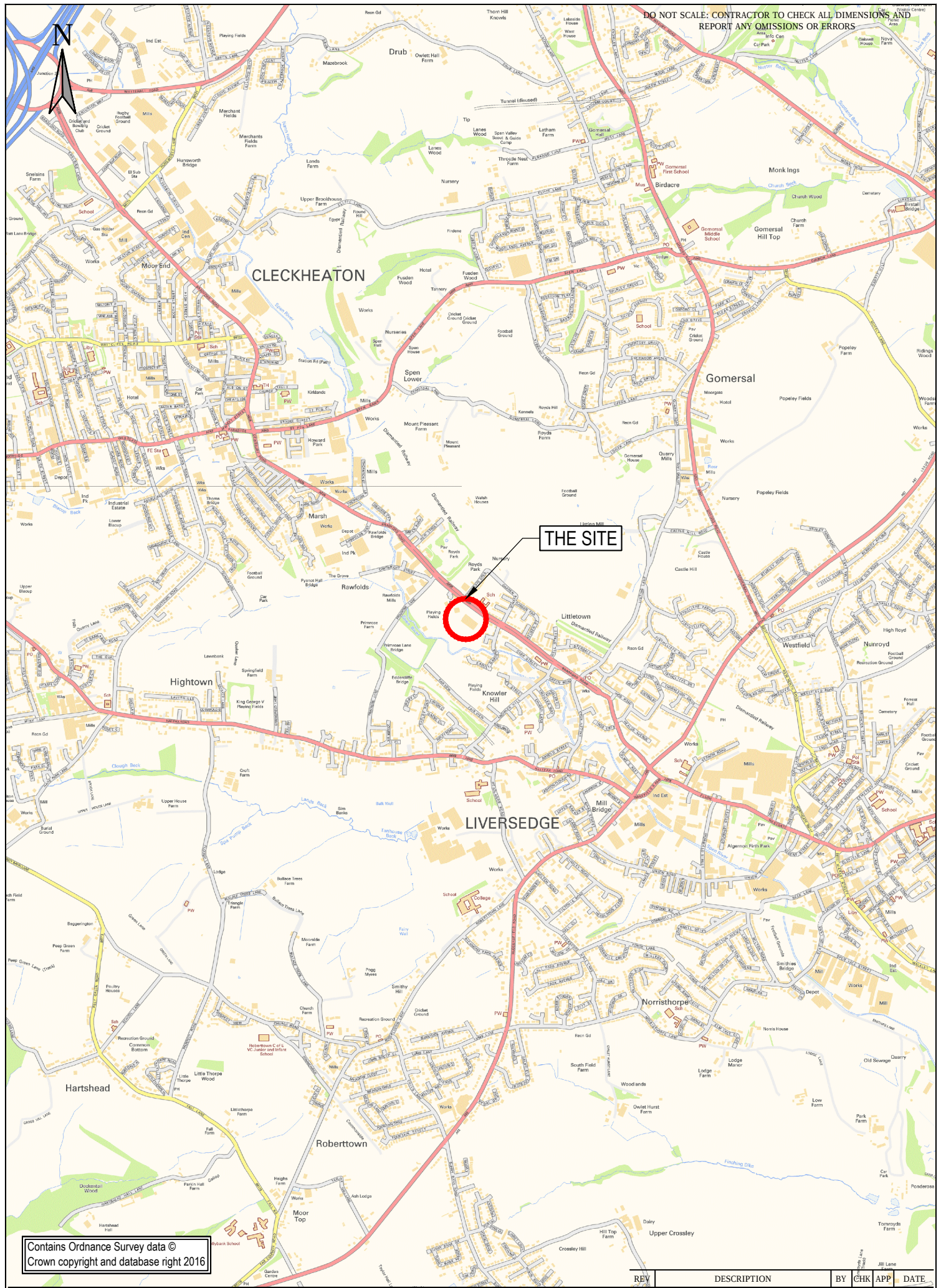
- Ground conditions generally comprised Made Ground (thickest in the western part of the site) overlying Low Pennine Coal Measure comprising of interbedded mudstone sandstone and siltstone. A thin covering of Alluvium was encountered at the southern part of the site. This was not considered within the foundation assessments as it is considered not to extend within the footprint of the proposed leisure centre building;
- Spread foundations are suitable at the surface of the weathered bedrock;
- Water ingress may occur at shallow depths where granular lenses are encountered within the Made Ground. This should be monitored and controlled by pumping the water from base of the excavation;
- No definitive groundwater flow direction could be inferred;
- Single exceedance of Tier 1 screening value for lead in soil from sample of made ground at 1.5m bgl. Exceedance less than twice the screening value. Risk to future site users considered to be low. The risk to groundwater and surface water resources is considered to be Low;
- Topsoil should be stripped and re-used where possible;
- An additional phase of ground investigation should be undertaken post demolition to inform on ground conditions within the footprint of the new leisure centre building;
- Excavations and infilling activities will be required within the extents of the swimming existing and proposed swimming pool locations;
- Deep excavations of up to 3.5m will be required for the new pool locations and are likely to be within the weathered Coal Measures. It is anticipated that the weathered rock can be excavated utilising mechanical means, however due to the material being heavily fractured, it is recommended that the side slopes are battered back or a temporary support system is adopted to provide stability to the excavation.
- A permeant retaining wall will be required for the swimming pool walls. Detailed design should consider the effect of groundwater pressures on the side walls and uplift pressures at the base, particularly during periods when the swimming pools are emptied;



- Floor slabs. It is considered that lightly loaded ground bearing floor slabs (typically 10kN/m²) would be acceptable in areas located outwith the extent of the new and existing pools. The floor slabs located between the existing and proposed pool locations and those located over the existing pools should be suspended.
- The majority of any potentially excavated material onsite would classify as HA Class 2 cohesive material if used;
- CBRs of 2.5% should be assumed for the design of the access roads and car park areas;
- Once the anticipated design actions for the structure are known, then detailed design using Eurocode approach methods should be undertaken to better inform the overdesign factor for bearing of the structure;
- A design concrete class of DS-1 AC-1s, is considered suitable for near surface deposits where groundwater is considered to be static. Re-assessment of design concrete class should be undertaken if deeper foundation options are required.



Drawings



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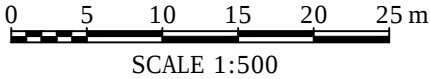
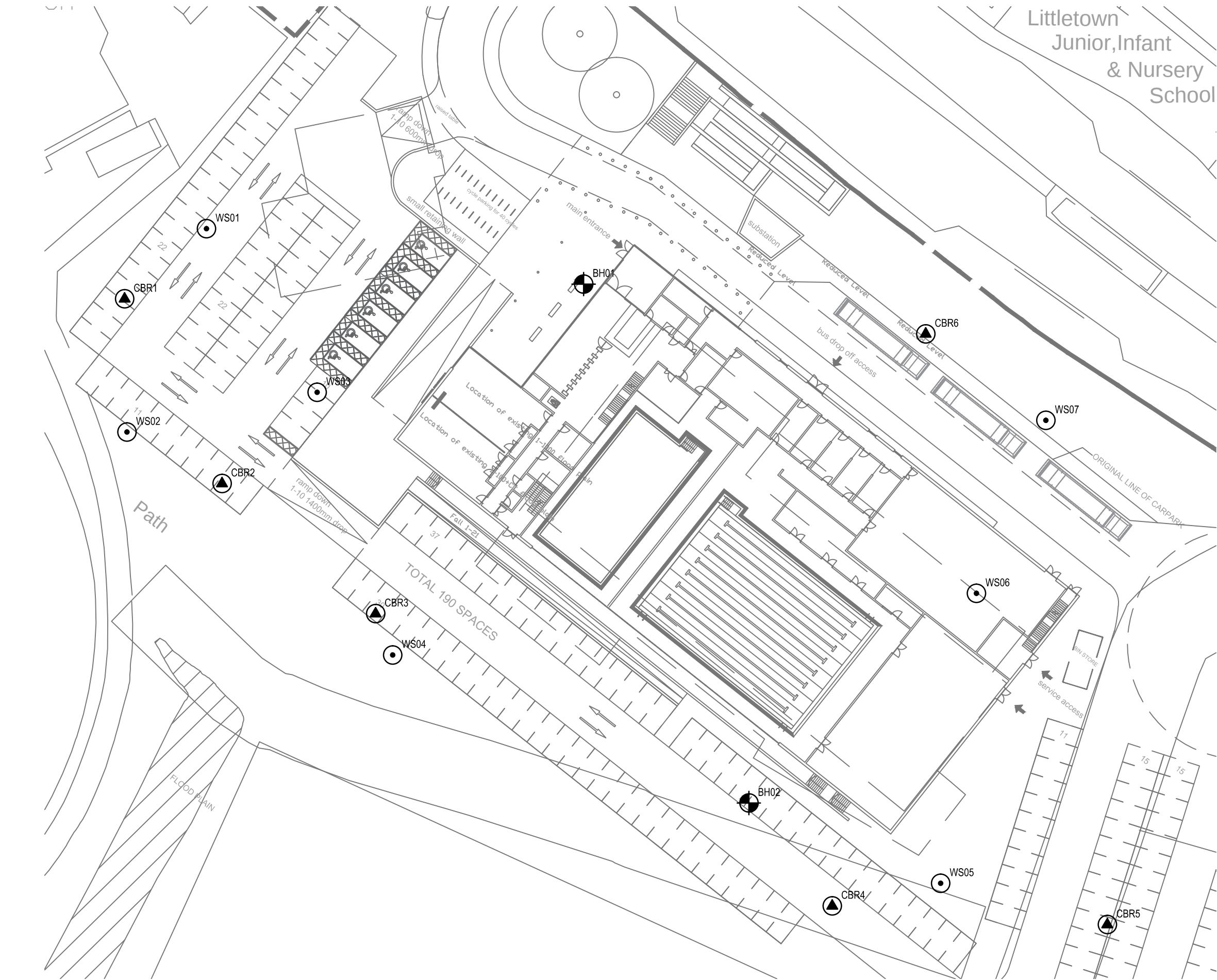
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WYG ENGINEERING

Project:
SPENBOROUGH POOL

Drawing Title:
SITE LOCATION PLAN

REV		DESCRIPTION		BY	CHK	APP	DATE
Scale @ A4		Drawn	Date	Checked	Date	Approved	Date
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Project No.	Office	Type	Drawing No.	Revision			
A097478-1	LDS	N	01				

-  BOREHOLE
-  CBR
-  WINDOW SAMPLE



REV	DESCRIPTION	BY	CHK	APP	DATE
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Client:

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Project:

SPENBOROUGH POOL

Drawing Title:

EXPLORATORY HOLE LOCATION PLAN

Scale @ A3 1:500	Drawn JT	Date 03.03.17	Checked	Date	Approved	Date
Project No. A097478-1	Office LDS	Type N	Drawing No. 02		Revision	



Appendices



Appendix A – Report Conditions

WYG Environment Planning Transport Ltd

Report Conditions

A097478-1: Spenborough Pool

This report is produced solely for the benefit of **WYG Engineering** and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to WYG. In time improved practices, fresh information or amended legislation may necessitate a re-assessment. Opinions and information provided in this report are on the basis of WYG using due skill and care in the preparation of the report.

This report refers, within the limitations stated, to the environment of the site in the context of the surrounding area at the time of the inspections. Environmental conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

This report is limited to those aspects reported on, within the scope and limits agreed with the client under our appointment. It is necessarily restricted and no liability is accepted for any other aspect. It is based on the information sources indicated in the report. Some of the opinions are based on unconfirmed data and information and are presented as the best obtained within the scope for this report.

Reliance has been placed on the documents and information supplied to WYG by others but no independent verification of these has been made and no warranty is given on them. No liability is accepted or warranty given in relation to the performance, reliability, standing etc of any products, services, organisations or companies referred to in this report.

Whilst skill and care have been used, no investigative method can eliminate the possibility of obtaining partially imprecise, incomplete or not fully representative information. Any monitoring or survey work undertaken as part of the commission will have been subject to limitations, including for example timescale, seasonal and weather related conditions.

Although care is taken to select monitoring and survey periods that are typical of the environmental conditions being measured, within the overall reporting programme constraints, measured conditions may not be fully representative of the actual conditions. Any predictive or modelling work, undertaken as part of the commission will be subject to limitations including the representativeness of data used by the model and the assumptions inherent within the approach used. Actual environmental conditions are typically more complex and variable than the investigative, predictive and modelling approaches indicate in practice, and the output of such approaches cannot be relied upon as a comprehensive or accurate indicator of future conditions.

The potential influence of our assessment and report on other aspects of any development or future planning requires evaluation by other involved parties.

The performance of environmental protection measures and of buildings and other structures in relation to acoustics, vibration, noise mitigation and other environmental issues is influenced to a large extent by the degree to which the relevant environmental considerations are incorporated into the final design and specifications and the quality of workmanship and compliance with the specifications on site during construction. WYG accept no liability for issues with performance arising from such factors

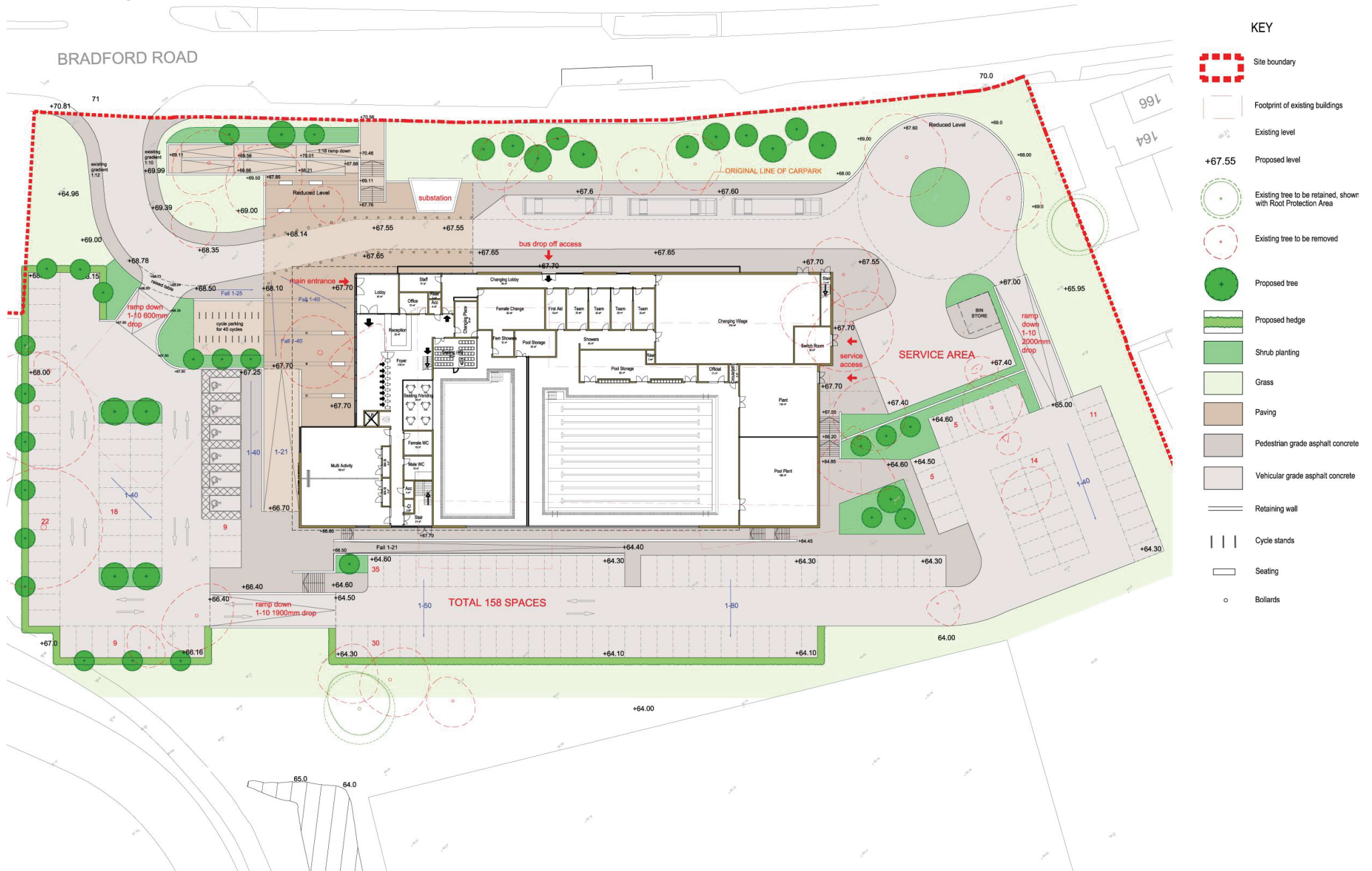
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WYG Environment Planning Transport Ltd



Appendix B – WYG Drawing Extracts from Stage 2 Report

5.0 – Design (contd)

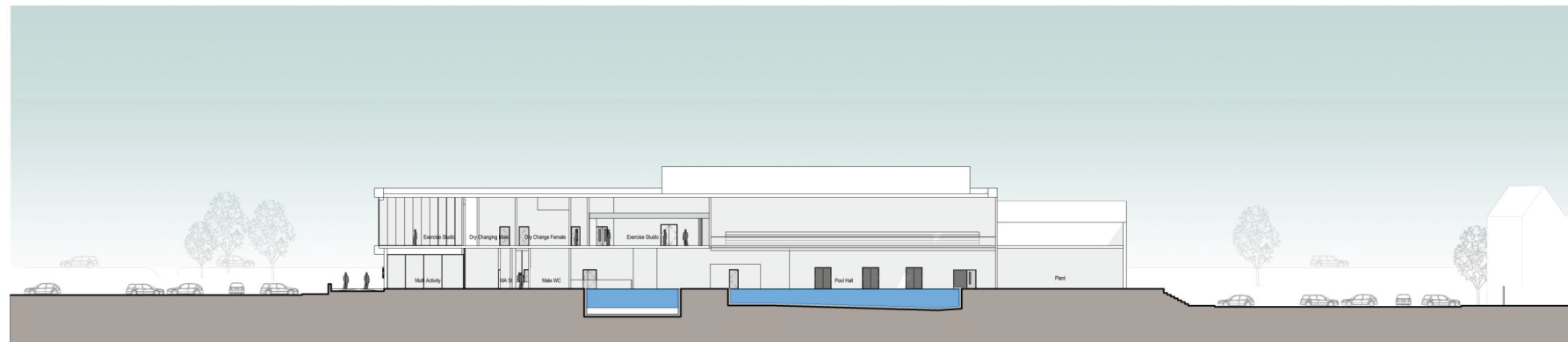


Site Plan

5.0 - Design (contd)



Site Section through Foyer



Site Section through Pool Hall



Appendix C – Rotary Core Mounted Logs



Project :- Spenborough Pool

Core Photographs

Client:- WYG Engineering & Kirklees Council

Project No. :- A097478-1

Date :- 3rd March 2017

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**Environmental Consultancy
Ground Technologies & Investigation**

Photograph 1: BH01 2.20 – 4.70m



Project :- Spenborough Pool

Core Photographs

Client:- WYG Engineering & Kirklees Council

Project No. :- A097478-1

Date :- 3rd March 2017

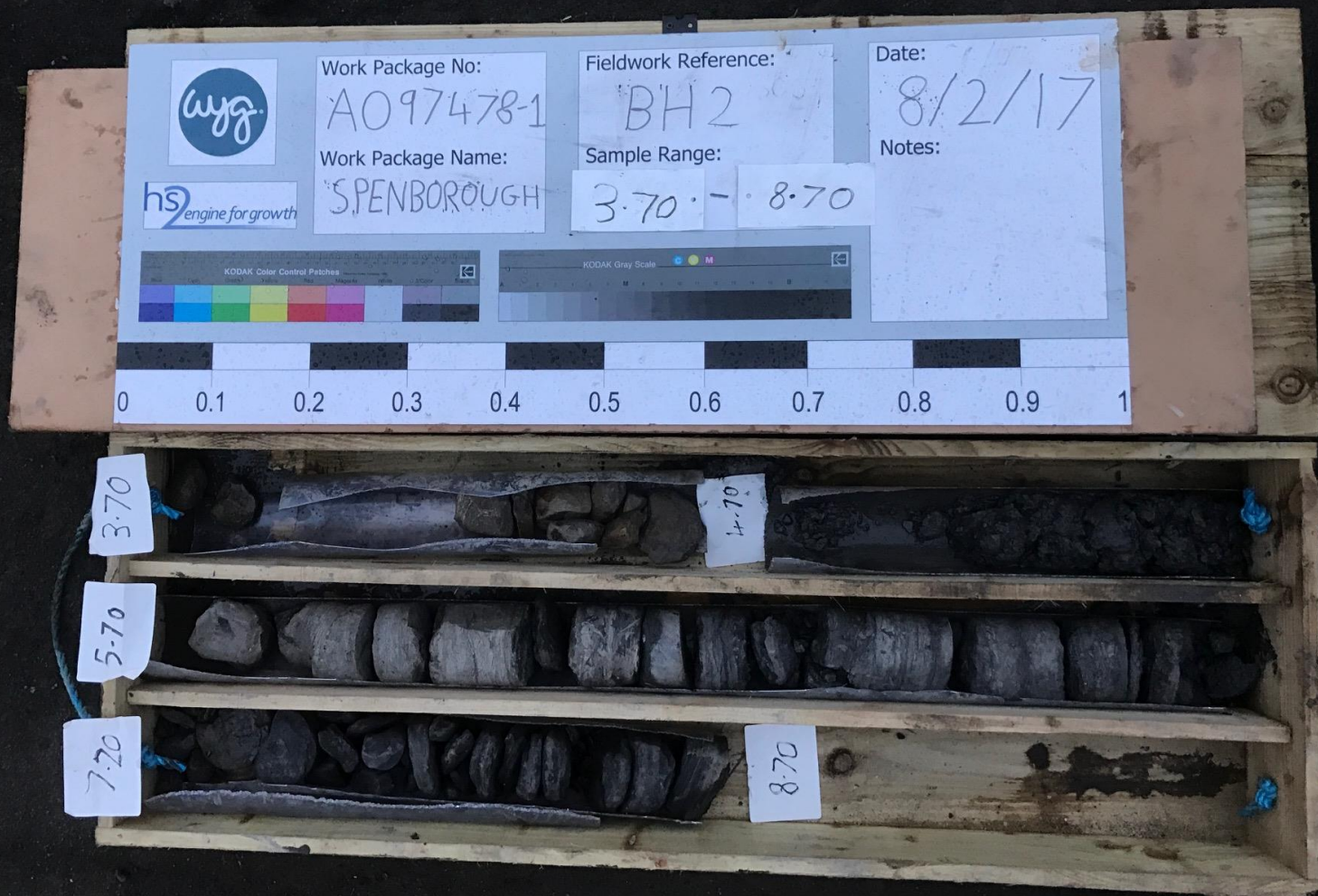
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**Environmental Consultancy
Ground Technologies & Investigation**



Photograph 2: BH01 4.70 – 9.20m



Project :- Spenborough Pool

Core Photographs

Client:- WYG Engineering & Kirklees Council

Project No. :- A097478-1

Date :- 3rd March 2017

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Ground Technologies & Investigation**

Photograph 3: BH02 3.70 – 8.70m



Project :- Spenborough Pool

Core Photographs

Client:- WYG Engineering & Kirklees Council

Project No. :- A097478-1

Date :- 3rd March 2017

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Ground Technologies & Investigation**



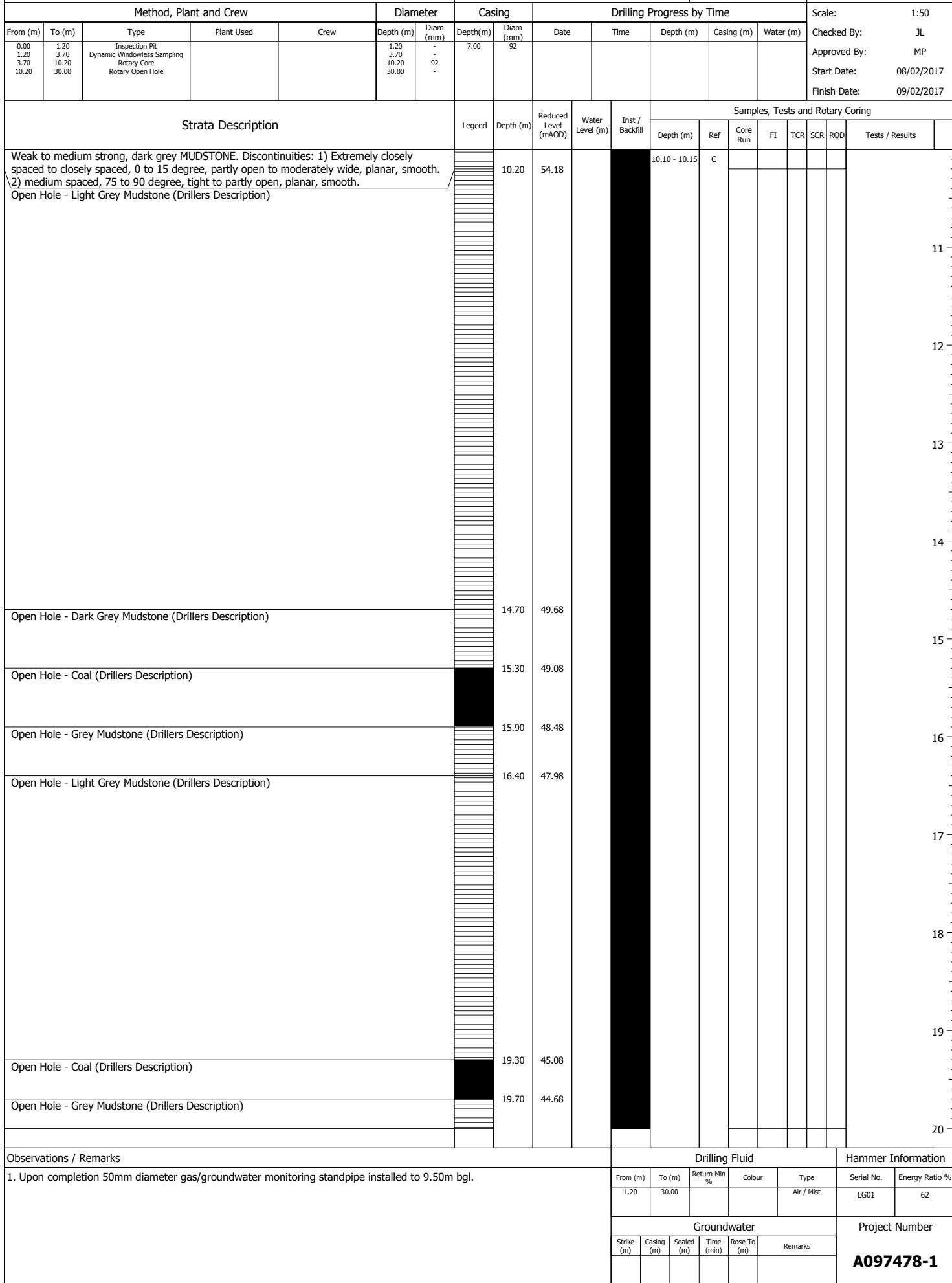
Photograph 4: BH02 8.70 – 10.20m

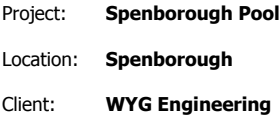


Appendix D – WYG Exploratory Hole Logs

	Project: Spenborough Pool	Location Details				Status		Borehole Number																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Date	Time	Depth (m)	Casing (m)	Water (m)	Checked By: JL	Approved By: MP	Start Date: 06/02/2017	Finish Date: 07/02/2017																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse. MADE GROUND: Soft to firm light brown mottled brown slightly sandy, gravelly, CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone.								0.10	67.38			Depth (m)	Ref	Core Run	FI	TCR	SCR	RQD	Tests / Results																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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 Project: Spenborough Pool Location: Spenborough Client: WYG Engineering					Location Details					Status		Borehole Number								
					Easting: 420027.80 Northing: 424395.83 Level: 64.38mAOD Depth: 30.00m Logger: JL+Driller Type: RC Inclination: 90°					FINAL		BH02								
					Sheet 1 of 3															
Method, Plant and Crew					Diameter		Casing		Drilling Progress by Time					Scale: 1:50						
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Date	Time	Depth (m)	Casing (m)	Water (m)	Checked By:	JL					
0.00	1.20	Inspection Pit			1.20	-	7.00	92						Approved By:	MP					
1.20	3.70	Dynamic Windowless Sampling			3.70	-								Start Date:	08/02/2017					
3.70	10.20	Rotary Core			10.20	92								Finish Date:	09/02/2017					
10.20	30.00	Rotary Open Hole			30.00	-														
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples, Tests and Rotary Coring								
MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse.								0.20	64.18			Depth (m)	Ref	Core Run	FI	TCR	SCR	RQD	Tests / Results	
												0.50	D							
MADE GROUND - Firm to stiff light brown mottled brown slightly sandy, slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone, mudstone. and rare red brick.								2.00 - 2.45	64.18			2.20	D							SPT(S) 1.20m, N=10 (1,3/2,3,3,2)
Weathered, extremely weak orangish brown SANDSTONE recovered as slightly clayey, angular to subangular, fine to coarse gravel. Assumed Zone of Core Loss								3.50	60.88			3.20	D							SPT(S) 2.20m, N=9 (3,3/2,3,2,2)
Weathered, extremely weak, grey mottled rusty orangish brown SANDSTONE recovered as non-intact, angular to subangular, coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to medium wide, orangish red stained, planar, rough. 2) Extremely closely spaced to closely spaced, 80 to 90 degree, open to medium wide, orangish red stained, planar, rough. Assumed Zone of Core Loss								3.70	60.68			3.70	D	3.70 4.70	AZCL	30	0	0		SPT(S) 3.20m, N=36 (5,5/8,10,10,8)
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								4.40	59.98											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								4.70	59.68			4.70 5.70	AZCL	30	0	0				
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								5.40	58.98											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								5.70	58.68											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								6.10	58.28			6.30 - 6.40	C	5.70 7.20	AZCL	73	73	15		SPT(S) 3.70m, 50 (25 for 135mm/50 for 125mm)
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								6.30 - 6.40	58.28			6.75 - 6.85	C		14					
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								7.20	57.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								8.20	56.18			8.65 - 8.70	C	7.20 8.70	AZCL	33	33	0		
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								8.65 - 8.70	56.18			9.20 - 9.25	C		28					
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.20 - 9.25	56.18			9.70 - 9.75	C	8.70 10.20		100	87	0		
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
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Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
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Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss								9.70 - 9.75	56.18											
Weathered, extremely weak, grey mottled dark grey MUDSTONE recovered as non-intact very clayey, angular to subangular, fine to coarse gravel. Discontinuities: 1) Extremely closely spaced, 0 to 15 degree open to moderately wide, in-filled with clay, planar, smooth. 2) Extremely closely spaced to closely spaced, 75 to 90 degree, partly open to open, in-filled with clay, planar, smooth. Assumed Zone of Core Loss																				





Location Details

Easting:	420027.80	Northing:	424395.83
Level:	64.38mAOD	Depth:	30.00m
Logger:	JL+Driller	Type:	RC
		Inclination:	90°

Status

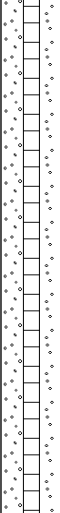
FINAL

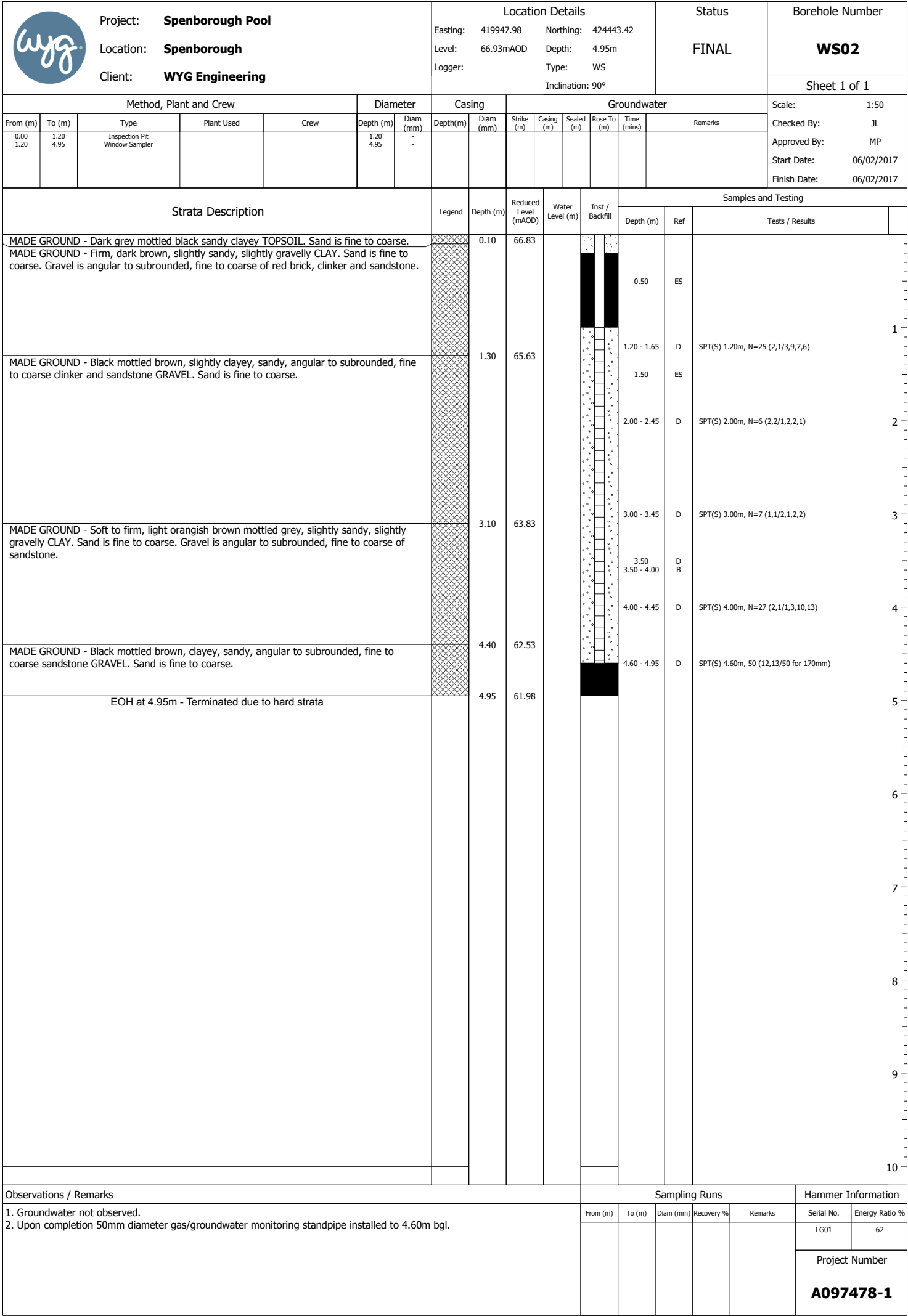
Borehole Number

BH02

Sheet 3 of 3

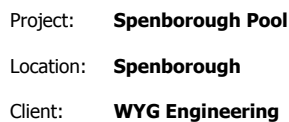
Method, Plant and Crew					Diameter		Casing		Drilling Progress by Time					Scale: 1:50																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Date	Time	Depth (m)	Casing (m)	Water (m)	Checked By: JL	Approved By: MP																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0.00 1.20 3.70 10.20	1.20 3.70 10.20 30.00	Inspection Pit Dynamic Windowless Sampling Rotary Core Rotary Open Hole			1.20 3.70 10.20 30.00	- - 92 -	7.00	92						Start Date: 08/02/2017	Finish Date: 09/02/2017																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples, Tests and Rotary Coring																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Open Hole - Grey Mudstone (Drillers Description)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

 Project: Spenborough Pool Location: Spenborough Client: WYG Engineering						Location Details						Status FINAL		Borehole Number WS01				
						Easting: 419958.24 Northing: 424469.51 Level: 67.38mAOD Depth: 5.40m Logger: Type: WS Inclination: 90°								Sheet 1 of 1				
						Method, Plant and Crew					Diameter		Casing		Groundwater			
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Strike (m)	Casing (m)	Sealed (m)	Rose To (m)	Time (mins)	Remarks	Checked By:	JL		
0.00 1.20	1.20 5.40	Inspection Pit Window Sampler			1.20 5.40	- -			4.00	-	-	4.00	20		Approved By:	MP		
															Start Date:	06/02/2017		
															Finish Date:	06/02/2017		
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples and Testing						
												Depth (m)	Ref	Tests / Results				
MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse.								0.10	67.28				0.50	ES	SPT(S) 1.20m, N=7 (6,3/2,2,1,2)			
MADE GROUND - Firm, orangish brown mottled grey, slightly sandy, slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of red brick, wood fragments, sandstone and coal.																		
MADE GROUND - Light brown, clayey, fine to coarse SAND.								2.70	64.68			2.50	D	SPT(S) 2.00m, N=11 (1,1/2,3,3,3)				
MADE GROUND - Firm, light brown mottled grey, slightly sandy, slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone.								3.50	63.88			3.50	D	SPT(S) 3.00m, N=14 (3,3/3,3,4,4)				
Orangish brown, clayey, gravelly fine to coarse SAND. Gravel is angular to subrounded, fine to coarse of sandstone.								4.10	63.28			4.00 - 4.45	D	SPT(S) 4.00m, N=24 (4,4/5,5,7,7)				
Weathered, extremely weak orangish brown SANDSTONE recovered as slightly clayey, angular to subangular, fine to coarse gravel.								4.80	62.58			4.50 - 4.80	B	SPT(S) 5.00m, N=50 (13,7/50 for 295mm)				
EOH at 5.40m - Terminated due to bedrock encountered								5.40	61.98									
Observations / Remarks												Sampling Runs				Hammer Information		
1. Upon completion 50mm diameter gas/groundwater monitoring standpipe installed to 4.50m bgl.												From (m)	To (m)	Diam (mm)	Recovery %	Remarks	Serial No.	Energy Ratio %
																	LG01	62
																		Project Number
												A097478-1						



 Project: Spenborough Pool Location: Spenborough Client: WYG Engineering					Location Details					Status		Borehole Number																																																																																																																																																																																																																																																																																																																																																																																																																
					Easting: 419972.44 Northing: 424448.52 Level: 66.97mAOD Depth: 6.43m Logger: Type: WS Inclination: 90°					FINAL		WS03																																																																																																																																																																																																																																																																																																																																																																																																																
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Method, Plant and Crew					Diameter		Casing		Groundwater					Scale: 1:50																																																																																																																																																																																																																																																																																																																																																																																																														
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Strike (m)	Casing (m)	Sealed (m)	Rose To (m)	Time (mins)	Remarks	Checked By: JL																																																																																																																																																																																																																																																																																																																																																																																																													
0.00 1.20	1.20 6.43	Inspection Pit Window Sampler			1.20 6.43	- -			5.00	-	-	5.00	20		Approved By: MP																																																																																																																																																																																																																																																																																																																																																																																																													
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples and Testing			Start Date: 06/02/2017																																																																																																																																																																																																																																																																																																																																																																																																													
												Depth (m)	Ref	Tests / Results		Finish Date: 06/02/2017																																																																																																																																																																																																																																																																																																																																																																																																												
MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone.								0.15	66.82			0.50	ES	SPT(S) 1.20m, N=12 (2,3/5,3,2,2)	1																																																																																																																																																																																																																																																																																																																																																																																																													
																MADE GROUND - Firm dark grey mottled black, slightly sandy, slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of red brick, sandstone, mudstone and coal.	2.80	64.17	3.00 - 3.45	D	SPT(S) 2.00m, N=6 (2,1/2,2,1,1)	2																																																																																																																																																																																																																																																																																																																																																																																																						
																							MADE GROUND - Firm to stiff, light brown mottled brown, slightly sandy, slightly gravelly CLAY. Sand is fine to coarse. Gravel is very angular to rounded, fine to coarse of sandstone.	3.40	63.57	4.00 - 4.45	D	SPT(S) 3.00m, N=6 (1,1/1,2,1,2)	3																																																																																																																																																																																																																																																																																																																																																																																															
																														Orangish brown, slightly sandy, clayey, angular to subrounded, fine to coarse sandstone and mudstone GRAVEL. Sand is fine to coarse.	5.00	61.97	5.00 - 5.45	D	SPT(S) 4.00m, N=17 (2,2/4,4,4,5)	4																																																																																																																																																																																																																																																																																																																																																																																								
																																					Firm, brown, slightly sandy, slightly gravelly CLAY. Sand is fine to coarse. Gravel is very angular to rounded, fine to coarse of sandstone, mudstone and coal.	5.40	61.57	6.00 - 6.42	D	SPT(S) 5.00m, N=20 (5,7/5,5,5,5)	5																																																																																																																																																																																																																																																																																																																																																																																	
																																												Orangish brown, sandy, very clayey, angular to subrounded, fine to coarse sandstone and mudstone GRAVEL. Sand is fine to coarse.	6.00	60.97	6.20	D	SPT(S) 6.00m, 50 (8,10/50 for 260mm)	6																																																																																																																																																																																																																																																																																																																																																																										
																																																			EOH at 6.43m - Target depth reached	6.43	60.54																																																																																																																																																																																																																																																																																																																																																																							

Project: Spenborough Pool Location: Spenborough Client: WYG Engineering						Location Details						Status		Borehole Number		
						Easting: 419982.13 Northing: 424414.76 Level: 64.65mAOD Depth: 4.42m Logger: Type: WS Inclination: 90°						FINAL		WS04		
																Sheet 1 of 1
Method, Plant and Crew					Diameter		Casing		Groundwater						Scale: 1:50	
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Strike (m)	Casing (m)	Sealed (m)	Rose To (m)	Time (mins)	Remarks	Checked By: JL	Approved By: MP
0.00 1.20	1.20 4.43	Inspection Pit Window Sampler			1.20 4.43	-			4.00	-	-	4.00	20		Start Date: 07/02/2017	Finish Date: 07/02/2017
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples and Testing				
												Depth (m)	Ref	Tests / Results		
MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse.								0.40	64.25			0.20	ES			
MADE GROUND - Firm to stiff light brown mottled brown slightly sandy, slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone and mudstone and rare red brick.												0.50 0.50 - 1.00	D B			
												1.20 - 1.65	D			SPT(S) 1.20m, N=10 (3,3/2,2,3,3)
												1.60	ES			
												2.00 - 2.45	D			SPT(S) 2.00m, N=5 (1,2/1,1,2)
Orangish brown, slightly sandy, clayey, angular to subrounded, fine to coarse sandstone and mudstone GRAVEL. Sand is fine to coarse.							2.80	61.85			2.50	D				
											3.00 - 3.45	D			SPT(S) 3.00m, N=21 (11,10/5,5,5,6)	
											3.25	D				
Weathered, extremely weak light grey MUDSTONE recovered as slightly clayey, angular to subangular, fine to coarse gravel.							3.50	61.15			3.75	D				
											4.00 - 4.42	D			SPT(S) 4.00m, 50 (9,11/50 for 275mm)	
EOH at 4.42m - Terminated due to bedrock encountered								4.43	60.22							



Easting:	420052.37	Northing:	424385.50
Level:	64.57mAOD	Depth:	5.07m
Logger:		Type:	WS
		Inclination:	90°

FINAL

WS05

Sheet 1 of 1

[illegible]

Project: **Spennborough Pool**
Location: **Spennborough**
Client: **WYG Engineering**

Location Details

Easting:	420057.03	Northing:	424422.69
Level:	67.11mAOD	Depth:	2.80m
Logger:		Type:	WS
		Inclination:	90°

Status

FINAL

Borehole Number

WS06

Sheet 1 of 1

Method, Plant and Crew					Diameter		Casing		Groundwater						Scale:	1:50
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Strike (m)	Casing (m)	Sealed (m)	Rose To (m)	Time (mins)	Remarks	Checked By:	JL
0.00 1.20	1.20 2.80	Inspection Pit Window Sampler			1.20 2.80	- -									Approved By:	MP
															Start Date:	07/02/2017
															Finish Date:	07/02/2017
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples and Testing				
												Depth (m)	Ref	Tests / Results		
MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse. MADE GROUND - Dark brown, slightly clayey, gravelly fine to coarse SAND. Gravel is very angular to subrounded, fine to coarse of red brick, concrete, glass, sandstone and mudstone.								0.10	67.01		0.50	ES	SPT(S) 1.20m, N=20 (3,2/4,5,5,6)		1	
MADE GROUND - Firm to stiff light brown mottled brown slightly sandy, slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone and mudstone.								1.00	66.11		1.20 - 1.65	D				
Weathered, extremely weak light grey MUDSTONE recovered as slightly clayey, angular to subangular, fine to coarse gravel.								2.00	65.11		2.00 - 2.45	D				SPT(S) 2.00m, N=31 (3,5/7,7,7,10)
2.70 to 2.80 non-intact, with 1 No. thin bed of extremely weak black shale. EOH at 2.80m - Terminated due to hard strata								2.80	64.31		2.40	D	SPT(S) 2.80m, 50 (25 for 0mm/50 for 0mm)		3	
																4
															6	
															7	
															8	
															9	
															10	
Observations / Remarks										Sampling Runs				Hammer Information		
1. Groundwater not observed. 2. Upon completion 50mm diameter gas/groundwater monitoring standpipe installed to 2.80m bgl.										From (m)	To (m)	Diam (mm)	Recovery %	Remarks	Serial No.	Energy Ratio %
															LG01	62
																Project Number
						A097478-1										

 Project: Spenborough Pool Location: Spenborough Client: WYG Engineering						Location Details Easting: 420065.91 Level: 68.11mAOD Logger: Northing: 424444.91 Depth: 4.44m Type: WS Inclination: 90°						Status FINAL	Borehole Number WS07					
Method, Plant and Crew						Diameter		Casing		Groundwater						Scale: 1:50		
From (m)	To (m)	Type	Plant Used	Crew	Depth (m)	Diam (mm)	Depth(m)	Diam (mm)	Strike (m)	Casing (m)	Sealed (m)	Rose To (m)	Time (mins)	Remarks		Checked By: JL		
0.00	0.50	Inspection Pit Window Sampler			0.50	-										Approved By: MP		
0.50	4.44				4.44	-										Start Date: 07/02/2017		
																Finish Date: 07/02/2017		
Strata Description							Legend	Depth (m)	Reduced Level (mAOD)	Water Level (m)	Inst / Backfill	Samples and Testing						
												Depth (m)	Ref	Tests / Results				
MADE GROUND - Dark grey mottled black sandy clayey TOPSOIL. Sand is fine to coarse.								0.20	67.92			0.50	ES					
MADE GROUND - Firm to stiff light brown mottled brown slightly sandy, slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of sandstone and mudstone.												1.20 - 1.65	D	SPT(S) 1.20m, N=20 (5,4/5,4,5,6)		1		
												2.00 - 2.45	D	SPT(S) 2.00m, N=25 (3,3/5,7,7,6)		2		
												2.50	D					
												3.00 - 3.45	D	SPT(S) 3.00m, N=28 (5,7/7,7,7)		3		
Weathered, extremely weak light grey MUDSTONE recovered as slightly clayey, angular to subangular, fine to coarse gravel.								3.80	64.32			4.00 - 4.44	D	SPT(S) 4.00m, 50 (8,10/50 for 290mm)		4		
EOH at 4.44m - Terminated due to bedrock encountered								4.44	63.68									
																5		
																6		
																7		
																8		
																9		
																10		
Observations / Remarks												Sampling Runs			Hammer Information			
1. Groundwater not observed. 2. Upon completion 50mm diameter gas/groundwater monitoring standpipe installed to 4.00m bgl.											From (m)	To (m)	Diam (mm)	Recovery %	Remarks	Serial No.		
											0.50	1.00	87	100		LG01		
											1.00	2.00	87	100		62		
											2.00	3.00	87	100				
											3.00	4.00	56	100				
											Project Number							
											A097478-1							



Appendix E – Gas and Groundwater Monitoring Results

WYG GEO-ENVIRONMENT

Arndale Court, Headingley, LEEDS, LS6 2UJ
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GROUND GAS MONITORING RECORD SHEET - 1st Monitoring Round

Client:	WYG Engineering				Job No:		A097478-1				Instruments Used:		Gas Analyser, Interface Metre, Dip Metre, PID Metre					
Project:	Spenborough Pool				Date:		17/02/2017				Make / Model :		GA5000					
Weather:	Clear				Monitored By:		Joe Levien											
Exploratory Hole No.	Elevation of Ground (mAOD)	Peak ¹		Time to Reach Steady Concentration (secs)	Steady ²						Flow Rate Peak (L/hr)	Time to reach steady flow (secs)	Flow Rate Steady (L/hr)	Atmospheric Pressure (mbar)	Groundwater Level (mbgl)	*Base Depth of Installation (mbgl)	Groundwater Level (mAOD)	Remarks
		CH ₄	CO ₂		CH ₄	CO ₂	O ₂	H ₂ S ³	CO ³	PID								
		(% vol)	(% vol)		(% vol)	(% vol)	(% vol)	(ppm)	(ppm)	(ppm)								
WS01	67.37	0.0	2.2	120.0	0.0	2.2	19.3	0	3	N/A	0.1	60.0	0.1	1018	4.89	5.03		
WS02	66.93	0.0	7.0	85.0	0.0	2.1	13.4	0	0	N/A	0.1	60.0	0.1	1019	3.68	4.67		
WS03	66.97	0.0	2.3	150.0	0.0	2.3	19.4	0	0	N/A	0.1	60.0	0.1	1018	4.55	5.67		
WS04	64.65	0	1.2	60.0	0	1.2	19.4	0	0	N/A	0.2	60.0	0.2	1020	2.36	3.41		
WS05	64.56	0.0	0.3	85.0	0.0	0.3	21.2	0	0	N/A	0.1	60.0	0.1	1021	3.43	4.80		
WS06	67.11	0.0	0.9	60.0	0.0	0.9	21.3	0	0	N/A	0.1	60.0	0.1	1019	DRY	2.80		
WS07	68.11	0.0	2.3	200.0	0.0	2.3	20.0	0	0	N/A	0.2	60.0	0.2	1021	2.50	4.07		
BH01	67.48	0.0	0.8	200.0	0.0	0.8	20.6	0	0	N/A	3.3	140.0	3.3	1019	1.88	9.20		
BH02	64.37	0.0	0.8	75.0	0.0	1.4	20.9	0	0	N/A	0.2	60.0	0.2	1021	2.12	9.61		

Boreholes have been dipped from ground level.

	Day -3	Day -2	Day -1	Day 0	Falling, Steady or Rising
Weather Conditions					
Atmospheric Pressure (millibar)					

Atmospheric pressure obtained from:

http://www.metoffice.gov.uk/weather/uk/uk_latest_pressure.html

Ambient Gas Levels:

	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	PID (ppm)	Atmos (mbar)
Before Monitoring	0.0	0.1	21.3	0.0	0.0	N/A	1018
After Monitoring	0.0	0.1	21.7	0.0	0.0	N/A	1021

1 The peak reading is the maximum recorded level during a monitoring event.

2 The steady reading is the level which remained constant after approximately 1 minute.

3 Recorded values are calculated from the Ambient Gas readings (live zero)

WYG GEO-ENVIRONMENT

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GROUND GAS MONITORING RECORD SHEET - 2nd Monitoring Round

Client:	WYG Engineering				Job No:		A097478-1				Instruments Used:		Gas Analyser, Interface Metre, Dip Metre, PID Metre					
Project:	Spenborough Pool				Date:		21/02/2017				Make / Model :		GA5000					
Weather:	Clear				Monitored By:		Joe Levien											
Exploratory Hole No.	Elevation of Ground (mAOD)	Peak ¹		Time to Reach Steady Concentration (secs)	Steady ²						Flow Rate Peak (L/hr)	Time to reach steady flow (secs)	Flow Rate Steady (L/hr)	Atmospheric Pressure (mbar)	Groundwater Level (mbgl)	*Base Depth of Installation (mbgl)	Groundwater Level (mAOD)	Remarks
		CH ₄	CO ₂		CH ₄	CO ₂	O ₂	H ₂ S ³	CO ³	PID								
		(% vol)	(% vol)		(% vol)	(% vol)	(% vol)	(ppm)	(ppm)	(ppm)								
WS01	67.37	0.0	1.9	140.0	0.0	1.9	18.9	0	2	N/A	0.1	60.0	0.1	1010	4.69	5.03		
WS02	66.93	0.0	6.5	115.0	0.0	2.4	15.6	0	0	N/A	0.2	60.0	0.2	1010	3.62	4.67		
WS03	66.97	0.0	2.4	120.0	0.0	2.4	19.1	0	0	N/A	0.2	60.0	0.2	1010	4.59	5.67		
WS04	64.65	0	1.3	75.0	0	1.3	18.5	0	0	N/A	0.2	60.0	0.2	1010	2.45	3.41		
WS05	64.56	0.0	0.4	60.0	0.0	0.4	20.9	0	0	N/A	0.1	60.0	0.1	1010	3.54	4.80		
WS06	67.11	0.0	1.1	115.0	0.0	1.1	20.7	0	0	N/A	0.2	60.0	0.2	1010	DRY	2.80		
WS07	68.11	0.0	2.2	170.0	0.0	2.2	20.4	0	0	N/A	0.1	60.0	0.1	1010	2.70	4.07		
BH01	67.48	0.0	0.8	135.0	0.0	0.8	20.5	0	0	N/A	0.2	140.0	0.2	1010	2.10	9.20		
BH02	64.37	0.0	0.9	90.0	0.0	0.9	20.6	0	0	N/A	0.1	60.0	0.1	1010	1.90	9.61		

Boreholes have been dipped from ground level.

	Day -3	Day -2	Day -1	Day 0	Falling, Steady or Rising
Weather Conditions					
Atmospheric Pressure (millibar)					

Atmospheric pressure obtained from:

http://www.metoffice.gov.uk/weather/uk/uk_latest_pressure.html

Ambient Gas Levels:

	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	PID (ppm)	Atmos (mbar)
Before Monitoring	0.0	0.1	21.2	0.0	0.0	N/A	1010
After Monitoring	0.0	0.1	21.5	0.0	0.0	N/A	1010

1 The peak reading is the maximum recorded level during a monitoring event.

2 The steady reading is the level which remained constant after approximately 1 minute.

3 Recorded values are calculated from the Ambient Gas readings (live zero)

WYG GEO-ENVIRONMENT

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GROUND GAS MONITORING RECORD SHEET - 3rd Monitoring Round

Client:	WYG Engineering				Job No:		A097478-1				Instruments Used:			Gas Analyser, Interface Metre, Dip Metre, PID Metre				
Project:	Spenborough Pool				Date:		01/03/2017				Make / Model :			GA5000				
Weather:	Clear				Monitored By:		Joe Levien											
Exploratory Hole No.	Elevation of Ground (mAOD)	Peak ¹		Time to Reach Steady Concentration (secs)	Steady ²						Flow Rate Peak (L/hr)	Time to reach steady flow (secs)	Flow Rate Steady (L/hr)	Atmospheric Pressure (mbar)	Groundwater Level (mbgl)	*Base Depth of Installation (mbgl)	Groundwater Level (mAOD)	Remarks
		CH ₄	CO ₂		CH ₄	CO ₂	O ₂	H ₂ S ³	CO ³	PID								
		(% vol)	(% vol)		(% vol)	(% vol)	(% vol)	(ppm)	(ppm)	(ppm)								
WS01	67.37	0.0	2.3	150.0	0.0	2.3	18.2	1	0	N/A	0.2	60.0	0.2	982	4.82	5.03	62.55	
WS02	66.93	0.0	0.1	60.0	0.0	0.1	20.6	0	0	N/A	0.2	60.0	0.2	982	3.76	4.67	63.17	
WS03	66.97	0.0	2.9	185.0	0.0	2.9	18.8	0	0	N/A	0.1	60.0	0.1	982	4.45	5.67	62.52	
WS04	64.65	0.0	2.5	240.0	0.0	1.7	18.7	0	0	N/A	0.1	60.0	0.1	982	2.31	3.41	62.34	
WS05	64.56	0.0	4.8	175.0	0.0	1.8	16.5	0	0	N/A	-2.8	60.0	-2.8	982	3.34	4.80	61.22	
WS06	67.11	0.0	0.7	60.0	0.0	0.7	20.8	0	0	N/A	0.1	60.0	0.1	982	DRY	2.80	#VALUE!	
WS07	68.11	0.0	1.9	90.0	0.0	1.9	19.5	0	0	N/A	0.1	60.0	0.1	982	1.89	4.07	66.22	
BH01	67.48	0.0	1.1	210.0	0.0	1.1	20.3	0	0	N/A	0.2	60.0	0.2	982	1.64	9.20	65.84	
BH02	64.37	0.0	2.3	165.0	0.0	2.3	19.9	0	0	N/A	0.1	60.0	0.1	982	2.09	9.61	62.28	

Boreholes have been dipped from ground level.

	Day -3	Day -2	Day -1	Day 0	Falling, Steady or Rising
Weather Conditions					
Atmospheric Pressure (millibar)					

Atmospheric pressure obtained from:

http://www.metoffice.gov.uk/weather/uk/uk_latest_pressure.html

Ambient Gas Levels:

	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	PID (ppm)	Atmos (mbar)
Before Monitoring	0.0	0.1	20.8	0.0	0.0	N/A	982
After Monitoring	0.0	0.1	20.7	0.0	0.0	N/A	982

1 The peak reading is the maximum recorded level during a monitoring event.

2 The steady reading is the level which remained constant after approximately 1 minute.

3 Recorded values are calculated from the Ambient Gas readings (live zero)

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GROUND GAS MONITORING RECORD SHEET - 4th Monitoring Round

Client:	WYG Engineering				Job No:		A097478-1				Instruments Used:			Gas Analyser, Interface Metre, Dip Metre, PID Metre				
Project:	Spenborough Pool				Date:		20/03/2017				Make / Model :			GA5000				
Weather:					Monitored By:		Mark Peachey											
Exploratory Hole No.	Elevation of Ground (mAOD)	Peak ¹		Time to Reach Steady Concentration (secs)	Steady ²						Flow Rate Peak (L/hr)	Time to reach steady flow (secs)	Flow Rate Steady (L/hr)	Atmospheric Pressure (mbar)	Groundwater Level (mbgl)	*Base Depth of Installation (mbgl)	Groundwater Level (mAOD)	Remarks
		CH ₄	CO ₂		CH ₄	CO ₂	O ₂	H ₂ S ³	CO ³	PID								
		(% vol)	(% vol)		(% vol)	(% vol)	(% vol)	(ppm)	(ppm)	(ppm)								
WS01	67.37	0.0	2.0	120.0	0.0	2.0	18.8	0	0	N/A	0.2	60.0	0.2	991	4.78	4.92		
WS02	66.93	0.0	0.8	85.0	0.0	0.8	19.3	0	0	N/A	0.1	60.0	0.1	991	3.69	4.62		
WS03	66.97	0.0	1.8	145.0	0.0	1.8	18.9	0	0	N/A	0.1	60.0	0.1	991	4.55	5.60		
WS04	64.65	0	1.3	60.0	0	1.3	18.7	0	0	N/A	0.2	60.0	0.2	991	2.34	3.35		
WS05	64.56	0.0	1.1	80.0	0.0	1.1	20.1	0	0	N/A	0.1	60.0	0.1	991	3.57	4.82		
WS06	67.11	0.0	0.6	125.0	0.0	0.6	20.2	0	0	N/A	0.1	60.0	0.1	991	DRY	2.89		
WS07	68.11	0.0	2.4	150.0	0.0	2.4	20.2	0	0	N/A	0.2	60.0	0.2	991	2.64	4.04		
BH01	67.48	0.0	1.1	120.0	0.0	1.1	20.4	0	0	N/A	0.2	140.0	0.2	991	2.18	9.20		
BH02	64.37	0.0	2.1	120.0	0.0	2.1	20.1	0	0	N/A	0.1	60.0	0.1	991	1.99	9.55		

Boreholes have been dipped from ground level.

	Day -3	Day -2	Day -1	Day 0	Falling, Steady or Rising
Weather Conditions					
Atmospheric Pressure (millibar)					

Atmospheric pressure obtained from:

http://www.metoffice.gov.uk/weather/uk/uk_latest_pressure.html

Ambient Gas Levels:

	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	PID (ppm)	Atmos (mbar)
Before Monitoring	0.0	0.1	20.5	0.0	0.0	N/A	991
After Monitoring	0.0	0.1	20.4	0.0	0.0	N/A	991

1 The peak reading is the maximum recorded level during a monitoring event.

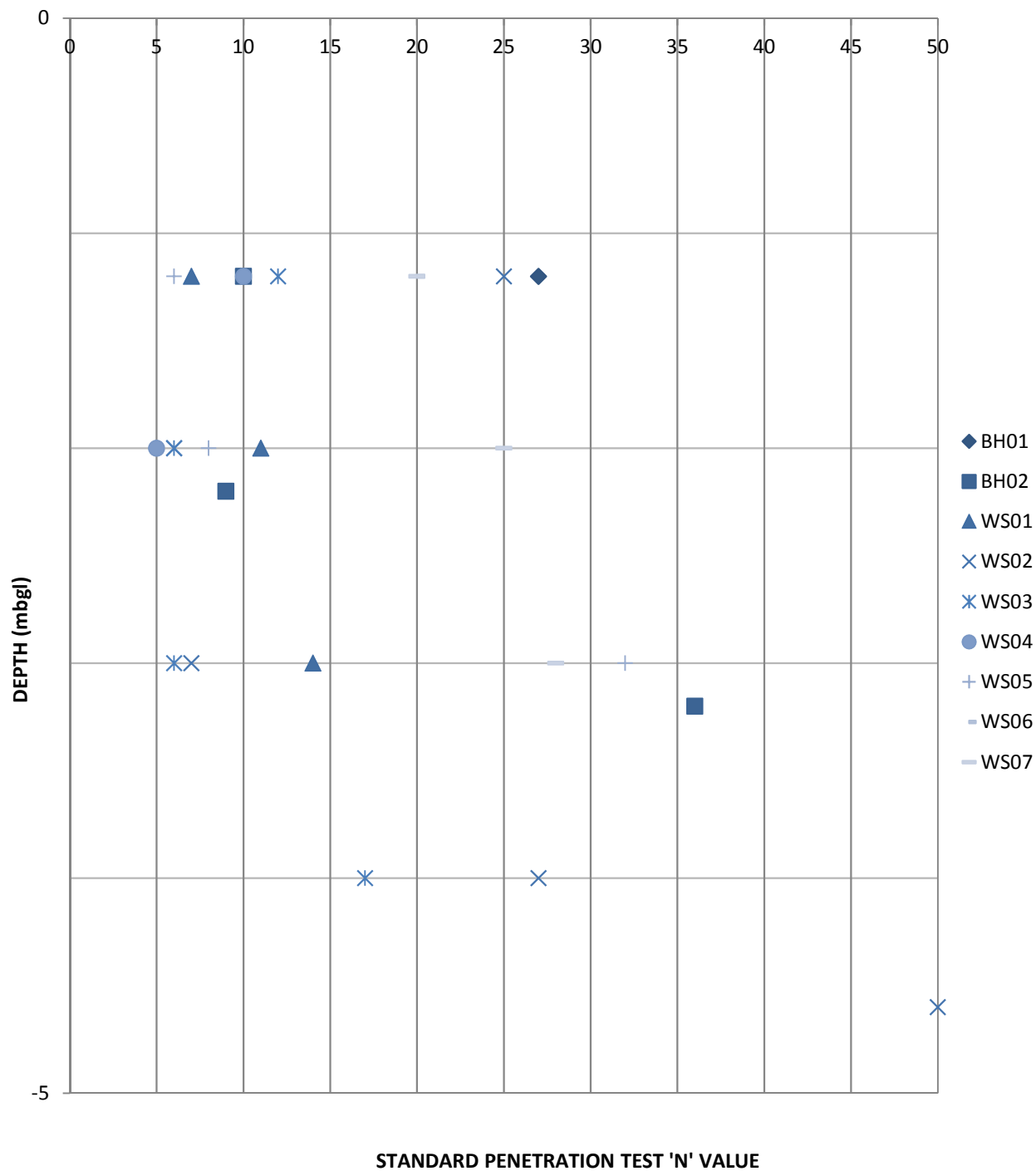
2 The steady reading is the level which remained constant after approximately 1 minute.

3 Recorded values are calculated from the Ambient Gas readings (live zero)



Appendix F – Plot of SPT 'N' vs Depth for Made Ground

Spennborough Pool





Appendix G – Geotechnical Laboratory Certificates



LABORATORY REPORT



4043

Contract Number: PSL17/0567

Report Date: 08 February 2017

Client's Reference:

Client Name: WYG Leeds
Arndale Court
Headingley
Leeds
LS6 2UJ
LS6 2UJ

For the attention of: Mark Peachey

Contract Title: Spenborough Pool

Date Received: 7/2/2017

Date Commenced: 7/2/2017

Date Completed: 8/2/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:


R Gunson
(Director)

A Watkins
(Director)

R Berriman
(Quality Manager)

L Knight
(Senior Technician)

S Royle
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Page 1 of

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 07-Feb-17

Test Position: 1

Depth (m): 0.30

Plate Area (m2): 0.2922467

Type of Kentledge: Wheeled

Maximum Applied Pressure (kPa):

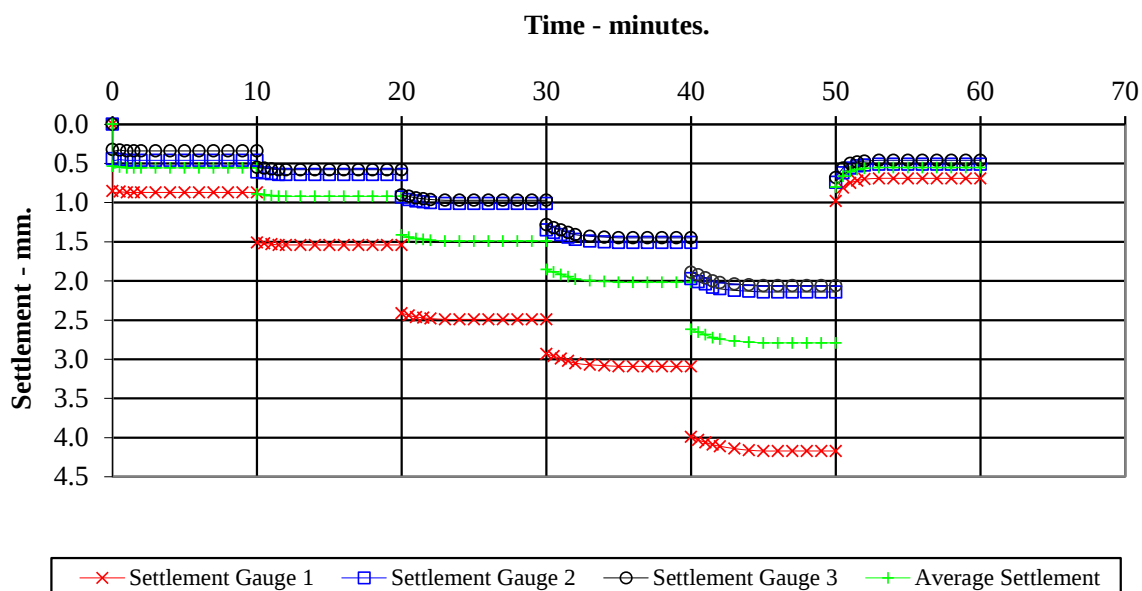
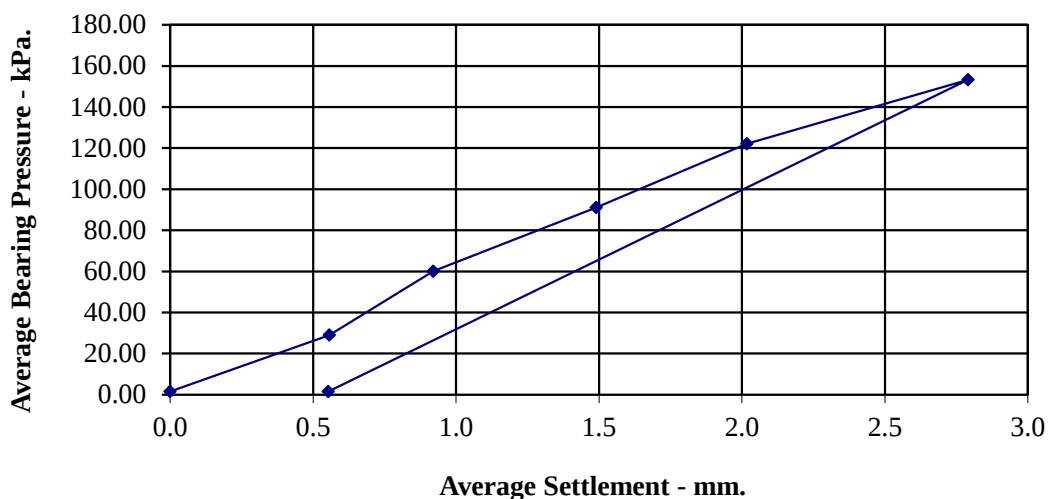
153.18

Maximum Deformation (mm):

2.79

Description:

Brown gravelly sandy CLAY.



—x— Settlement Gauge 1 —□— Settlement Gauge 2 —○— Settlement Gauge 3 —+— Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>SD</i>	08/02/17	<i>RE</i>	08/02/17	<i>RE</i>	08/02/17	PSL17/0567
Spenborough Pool						Page of

Calculation of Equivalent CBR Value from Plate Bearing Test
Design Manual for Roads and Bridges Volume 7 Section 2 Chapter 4
Incorporating IAN 73/06

Date of Test	7-Feb-17
Test Position	1
Depth (m)	0.30
Description	Brown gravelly sandy CLAY.
Maximum Deflection	2.79 mm
Deflection required for CBR value	1.25 mm
Load(@1.25mm)	79.0 kN/m ²
Plate diameter	610 mm
Conversion factor for plate diameter	0.816
K ₇₆₂ (modulus of subgrade reaction)	51.6 kN/m ² /mm
CBR Value	9.0 %

Checked/Approved	Date
	08/02/17

Spenborough Pool

Contract No.
PSL17/0567

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 07-Feb-17

Test Position: 2

Depth (m): 0.30

Plate Area (m2): 0.2922467

Type of Kentledge: Wheeled

Maximum Applied Pressure (kPa):

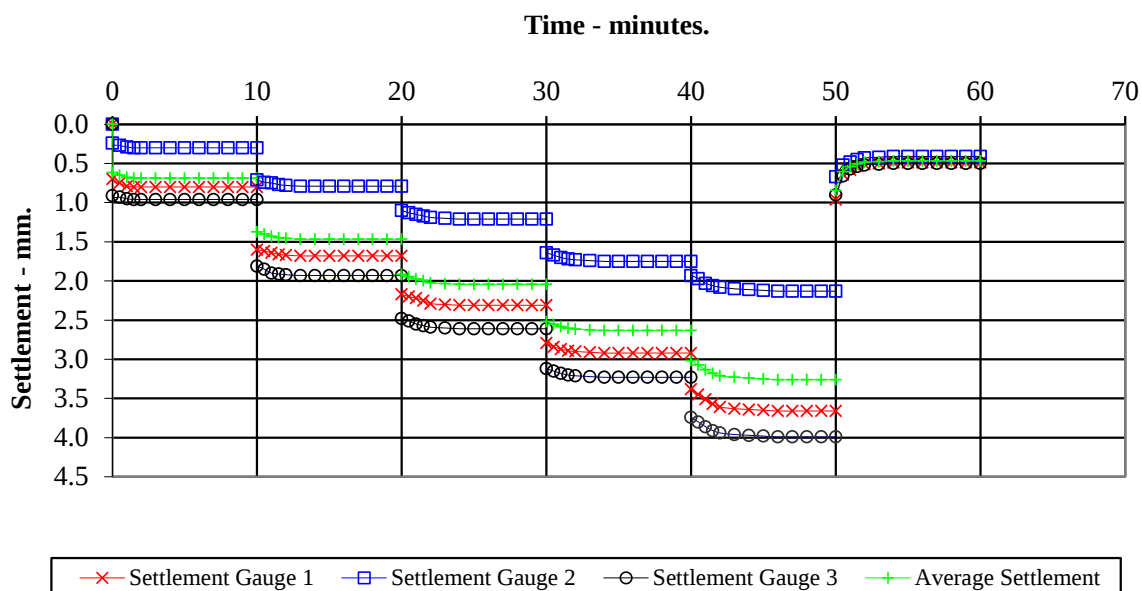
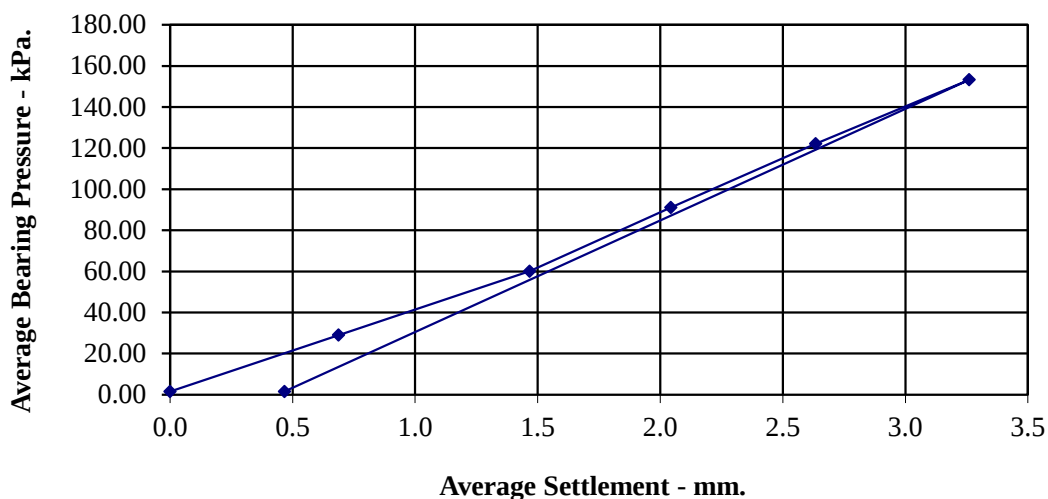
153.18

Maximum Deformation (mm):

3.26

Description:

Brown gravelly sandy CLAY.



—x— Settlement Gauge 1 —□— Settlement Gauge 2 —○— Settlement Gauge 3 —+— Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>SD</i>	08/02/17	<i>Re</i>	08/02/17	<i>Re</i>	08/02/17	PSL17/0567
Spenborough Pool						Page of

Calculation of Equivalent CBR Value from Plate Bearing Test
Design Manual for Roads and Bridges Volume 7 Section 2 Chapter 4
Incorporating IAN 73/06

Date of Test	7-Feb-17
Test Position	2
Depth (m)	0.30
Description	Brown gravelly sandy CLAY.
Maximum Deflection	3.26 mm
Deflection required for CBR value	1.25 mm
Load(@1.25mm)	52.0 kN/m ²
Plate diameter	610 mm
Conversion factor for plate diameter	0.816
K ₇₆₂ (modulus of subgrade reaction)	34.0 kN/m ² /mm
CBR Value	4.3 %

Checked/Approved	Date
	08/02/17

Spenborough Pool

Contract No.
PSL17/0567

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 07-Feb-17

Test Position: 3

Depth (m): 0.30

Plate Area (m2): 0.2922467

Type of Kentledge: Wheeled

Maximum Applied Pressure (kPa):

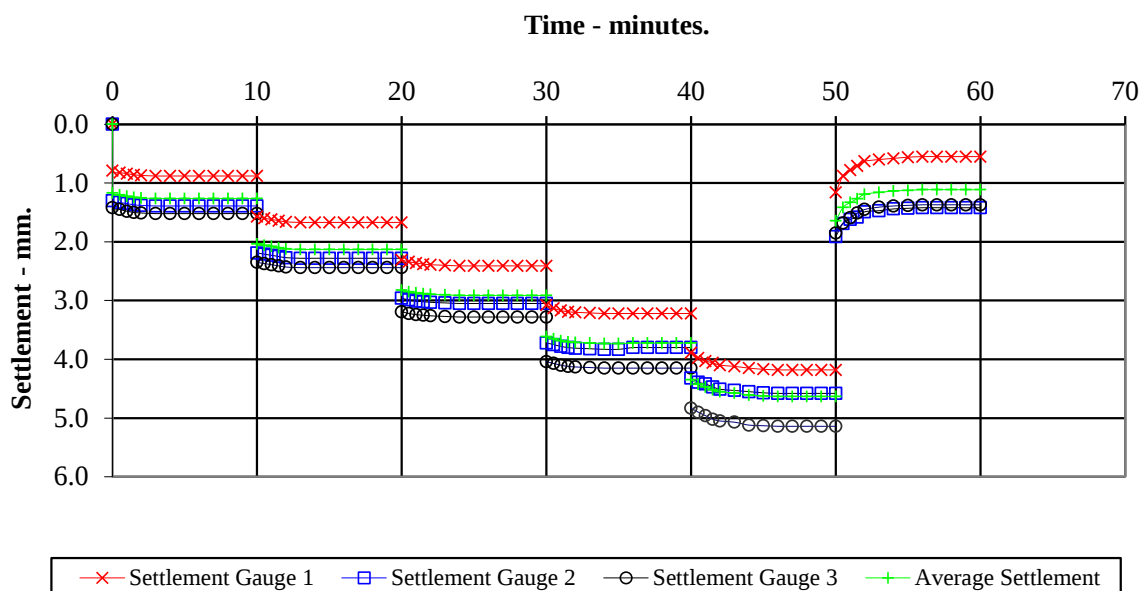
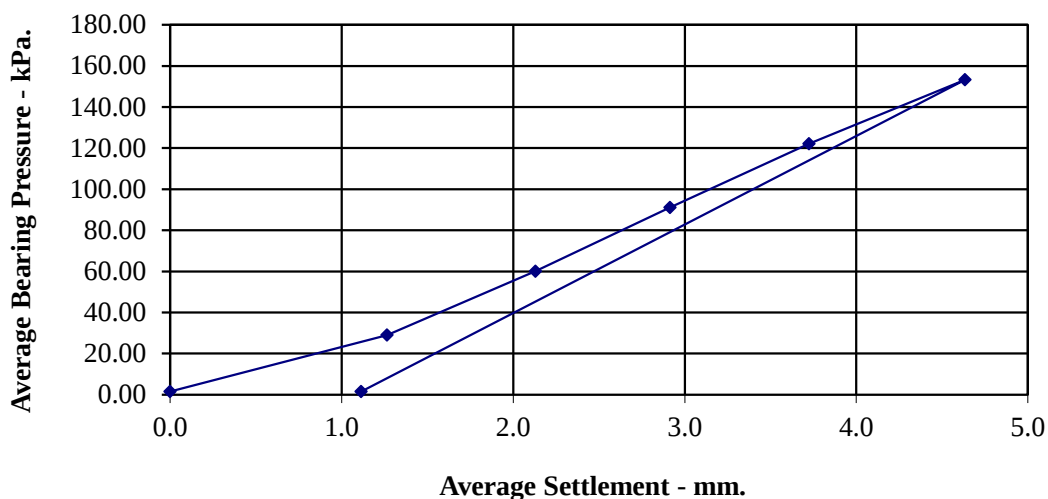
153.18

Maximum Deformation (mm):

4.63

Description:

Brown gravelly sandy CLAY.



—x— Settlement Gauge 1 —□— Settlement Gauge 2 —○— Settlement Gauge 3 —+— Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>SD</i>	08/02/17	<i>Re</i>	08/02/17	<i>Re</i>	08/02/17	PSL17/0567
Spenborough Pool						Page of

Calculation of Equivalent CBR Value from Plate Bearing Test
Design Manual for Roads and Bridges Volume 7 Section 2 Chapter 4
Incorporating IAN 73/06

Date of Test	7-Feb-17
Test Position	3
Depth (m)	0.30
Description	Brown gravelly sandy CLAY.
Maximum Deflection	4.63 mm
Deflection required for CBR value	1.25 mm
Load(@1.25mm)	29.0 kN/m ²
Plate diameter	610 mm
Conversion factor for plate diameter	0.816
K ₇₆₂ (modulus of subgrade reaction)	18.9 kN/m ² /mm
CBR Value	1.6 %

Checked/Approved	Date
	08/02/17

Spenborough Pool

Contract No.
PSL17/0567

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 07-Feb-17

Test Position: 4

Depth (m): 0.30

Plate Area (m2): 0.2922467

Type of Kentledge: Wheeled

Maximum Applied Pressure (kPa):

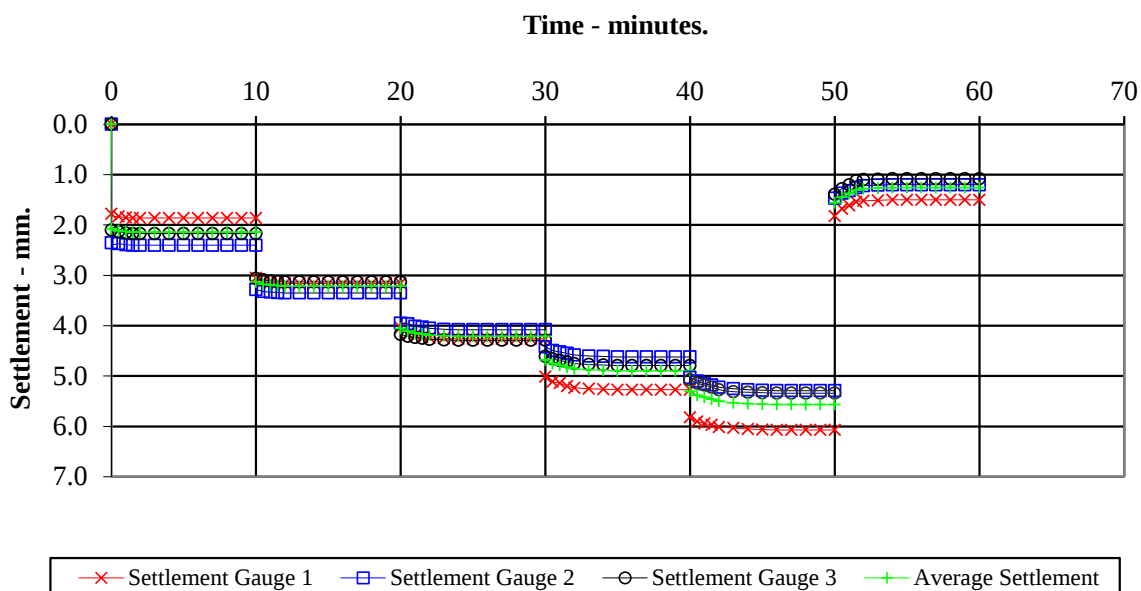
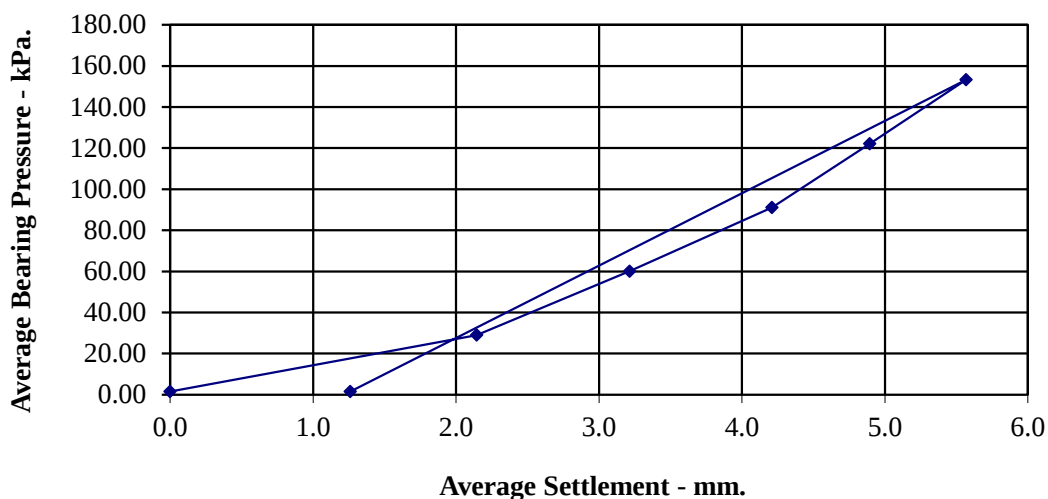
153.18

Maximum Deformation (mm):

5.57

Description:

Brown gravelly sandy CLAY.



—x— Settlement Gauge 1 —□— Settlement Gauge 2 —○— Settlement Gauge 3 —+— Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>SD</i>	08/02/17	<i>Re</i>	08/02/17	<i>Re</i>	08/02/17	PSL17/0567
Spenborough Pool						Page of

Calculation of Equivalent CBR Value from Plate Bearing Test
Design Manual for Roads and Bridges Volume 7 Section 2 Chapter 4
Incorporating IAN 73/06

Date of Test	7-Feb-17
Test Position	4
Depth (m)	0.30
Description	Brown gravelly sandy CLAY.
Maximum Deflection	5.57 mm
Deflection required for CBR value	1.25 mm
Load(@1.25mm)	18.0 kN/m ²
Plate diameter	610 mm
Conversion factor for plate diameter	0.816
K ₇₆₂ (modulus of subgrade reaction)	11.8 kN/m ² /mm
CBR Value	0.7 %

Checked/Approved	Date
	08/02/17

Spenborough Pool

Contract No.
PSL17/0567

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 07-Feb-17

Test Position: 5

Depth (m): 0.30

Plate Area (m2): 0.2922467

Type of Kentledge: Wheeled

Maximum Applied Pressure (kPa):

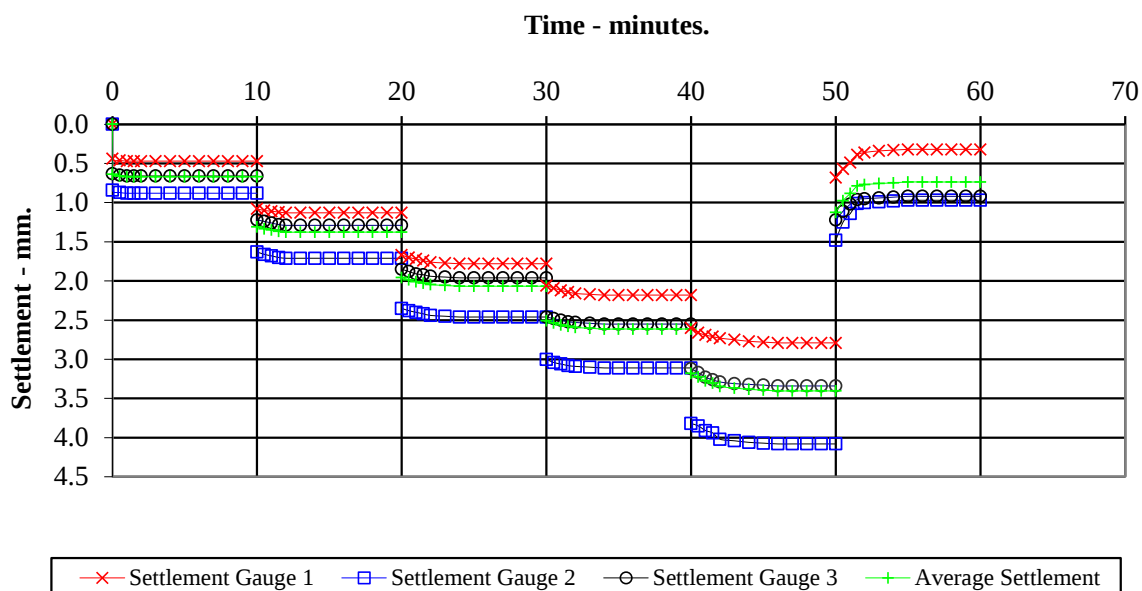
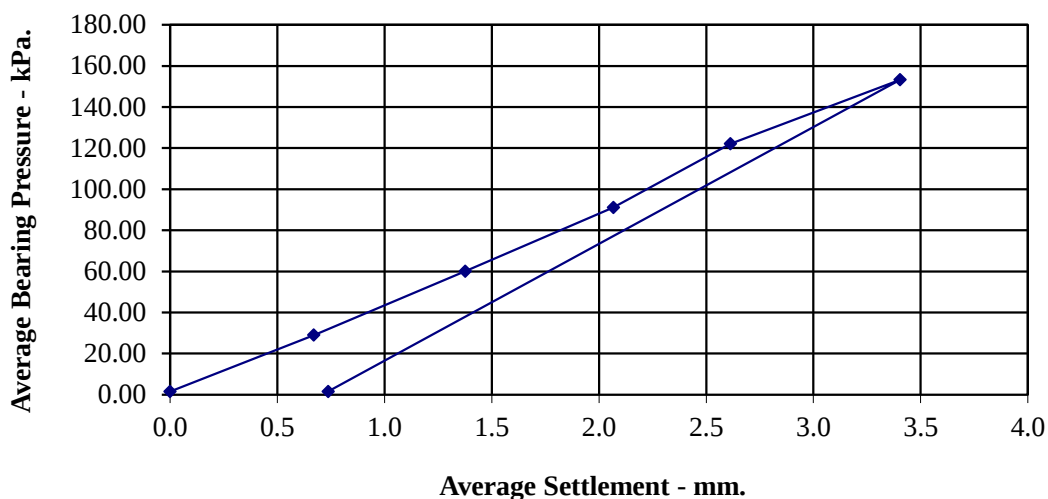
153.18

Maximum Deformation (mm):

3.40

Description:

Brown gravelly sandy CLAY.



—x— Settlement Gauge 1 —□— Settlement Gauge 2 —○— Settlement Gauge 3 —+— Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>SD</i>	08/02/17	<i>Re</i>	08/02/17	<i>Re</i>	08/02/17	PSL17/0567
Spenborough Pool						Page of

Calculation of Equivalent CBR Value from Plate Bearing Test
Design Manual for Roads and Bridges Volume 7 Section 2 Chapter 4
Incorporating IAN 73/06

Date of Test	7-Feb-17
Test Position	5
Depth (m)	0.30
Description	Brown gravelly sandy CLAY.
Maximum Deflection	3.40 mm
Deflection required for CBR value	1.25 mm
Load(@1.25mm)	55.0 kN/m ²
Plate diameter	610 mm
Conversion factor for plate diameter	0.816
K ₇₆₂ (modulus of subgrade reaction)	35.9 kN/m ² /mm
CBR Value	4.8 %

Checked/Approved	Date
	08/02/17

Spenborough Pool

Contract No.
PSL17/0567

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 07-Feb-17

Test Position: 6

Depth (m): 0.50

Plate Area (m²): 0.2922467

Type of Kentledge: Wheeled

Maximum Applied Pressure (kPa):

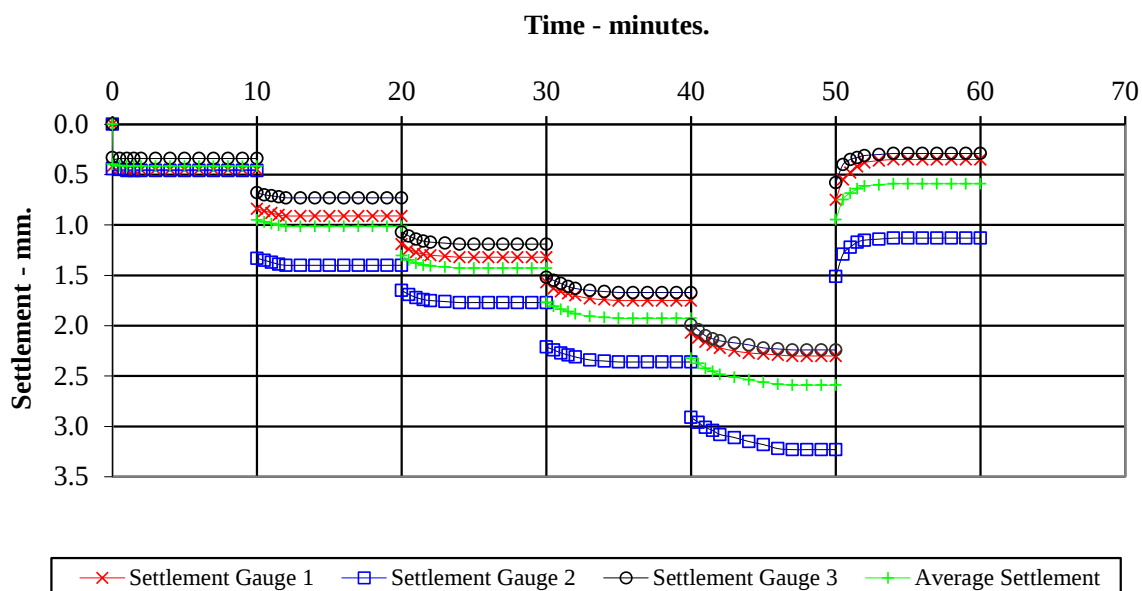
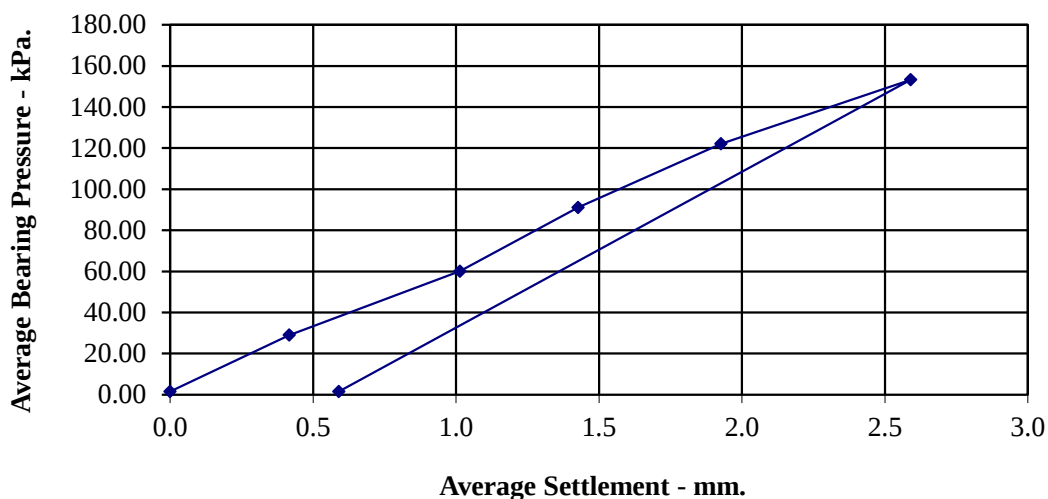
153.18

Maximum Deformation (mm):

2.59

Description:

Brown gravelly sandy CLAY.



—x— Settlement Gauge 1 —□— Settlement Gauge 2 —○— Settlement Gauge 3 —+— Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>SD</i>	08/02/17	<i>Re</i>	08/02/17	<i>Re</i>	08/02/17	PSL17/0567
Spenborough Pool						Page of

Calculation of Equivalent CBR Value from Plate Bearing Test
Design Manual for Roads and Bridges Volume 7 Section 2 Chapter 4
Incorporating IAN 73/06

Date of Test	7-Feb-17
Test Position	6
Depth (m)	0.50
Description	Brown gravelly sandy CLAY.
Maximum Deflection	2.59 mm
Deflection required for CBR value	1.25 mm
Load(@1.25mm)	79.0 kN/m ²
Plate diameter	610 mm
Conversion factor for plate diameter	0.816
K ₇₆₂ (modulus of subgrade reaction)	51.6 kN/m ² /mm
CBR Value	9.0 %

Checked/Approved	Date
	08/02/17

Spenborough Pool

Contract No.
PSL17/0567



LABORATORY REPORT



4043

Contract Number: PSL17/0938

Report Date: 20 March 2017

Client's Reference: A097478-1

Client Name: WYG Leeds
Arndale Court
Headingley
Leeds
LS6 2UJ

For the attention of: Mark Peachey

Contract Title: Spenborough Pool, Spenborough

Date Received: 1/3/2017

Date Commenced: 1/3/2017

Date Completed: 20/3/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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Checked and Approved Signatories:

R Gunson
(Director)

L Knight
(Senior Technician)

A Watkins
(Director)

S Royle
(Senior Technician)

R Berriman
(Quality Manager)

A Fry
(Senior Technician)

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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH01		B	1.00	1.50	Brown mottled grey gravelly sandy CLAY.
BH02		D	0.50		Brown slightly gravelly slightly sandy very silty CLAY.
BH02		D	2.00	2.45	Brown slightly gravelly slightly sandy CLAY.
WS01		D	1.50		Brown slightly gravelly slightly sandy CLAY
WS01		B	1.50	2.00	Brown slightly gravelly slightly sandy CLAY
WS01		B	3.00	3.50	Brown slightly gravelly very sandy CLAY.
WS01		B	4.50	4.80	Brown mottled grey gravelly sandy CLAY.
WS02		B	3.50	4.00	Brown mottled grey slightly gravelly very sandy CLAY.
WS02		D	3.50		Brown mottled grey slightly gravelly very sandy CLAY.
WS03		D	1.60	1.65	Brown slightly gravelly sandy CLAY.
WS03		D	6.20	6.45	Brown very gravelly sandy CLAY.
WS04		D	0.50		Brown slightly gravelly sandy very silty CLAY.
WS04		B	0.50	1.00	Brown slightly gravelly sandy very silty CLAY.
WS04		D	3.00	3.45	Brown mottled grey very sandy very clayey GRAVEL.
WS05		B	0.50	1.00	Brown very gravelly slightly sandy CLAY.
WS05		D	2.50		Brown mottled grey slightly gravelly sandy CLAY.
WS05		B	2.50	3.00	Brown mottled grey slightly gravelly sandy CLAY.
WS05		D	4.00	4.45	Brown sandy very clayey GRAVEL.
WS07		D	2.50		Brown gravelly sandy CLAY.



Spenborough Pool

Contract No:

PSL17/0938

Client Ref:

A097478-1

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m ³ Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH01		B	1.00	1.50	21		2.64	43	21	22	79	Intermediate plasticity CI.
BH01		C	2.70	2.85	7.2							
BH01		C	9.06	9.15	3.2							
BH02		D	0.50		31			58	28	30	99	High plasticity CH.
BH02		D	2.00	2.45	27		2.65	61	27	34	96	High plasticity CH.
BH02		C	6.30	6.40	5.4							
BH02		C	8.65	8.70	4.7							
BH02		C	9.70	9.75	6.8							
WS01		D	1.50		24							
WS01		B	1.50	2.00	26			59	26	33	84	High plasticity CH.
WS01		B	3.00	3.50	18		2.65					
WS01		B	4.50	4.80	18		2.63					
WS02		B	3.50	4.00	17		2.64	36	18	18	80	Intermediate plasticity CI.
WS02		D	3.50		18							
WS03		D	1.60	1.65	18			40	20	20	94	Intermediate plasticity CI.
WS03		D	6.20	6.45	12			38	19	19	68	Intermediate plasticity CI.
WS04		D	0.50		18			39	22	17	72	Intermediate plasticity CI.
WS04		B	0.50	1.00			2.64					
WS04		D	3.00	3.45	15							

SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:

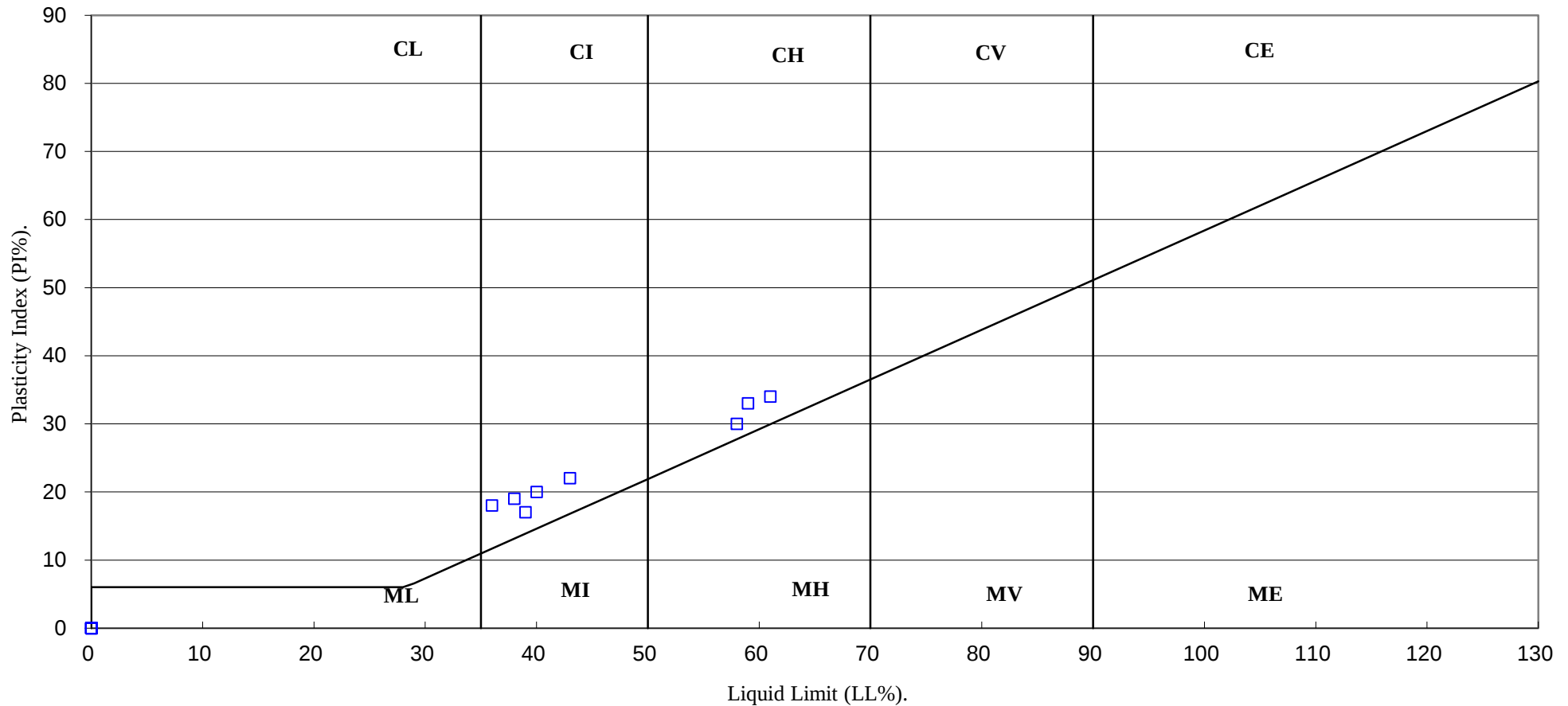
PSL17/0938

Client Ref:

A097478-1

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:

PSL17/0938

Client Ref:

A097478-1

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:

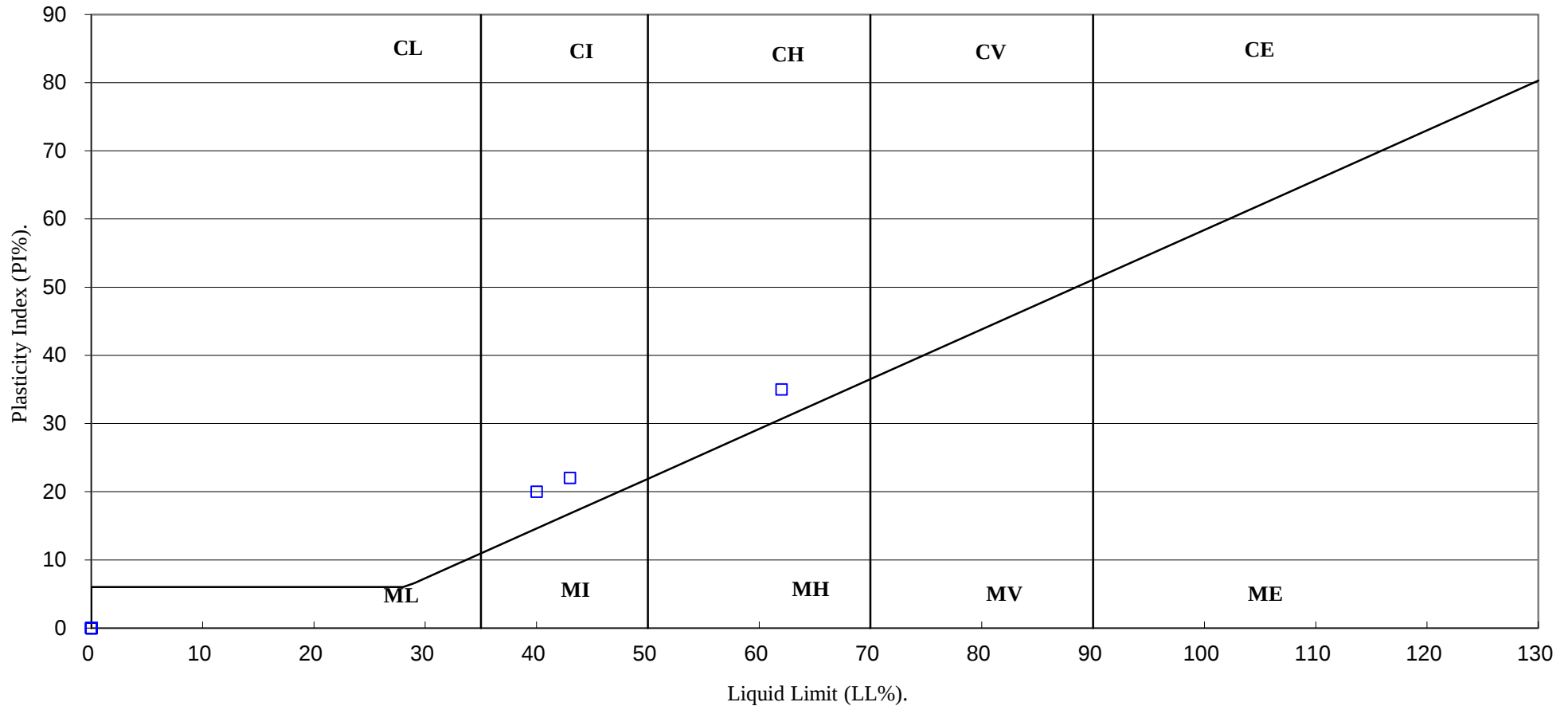
PSL17/0938

Client Ref:

A097478-1

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:

PSL17/0938

Client Ref:

A097478-1

PARTICLE SIZE DISTRIBUTION TEST

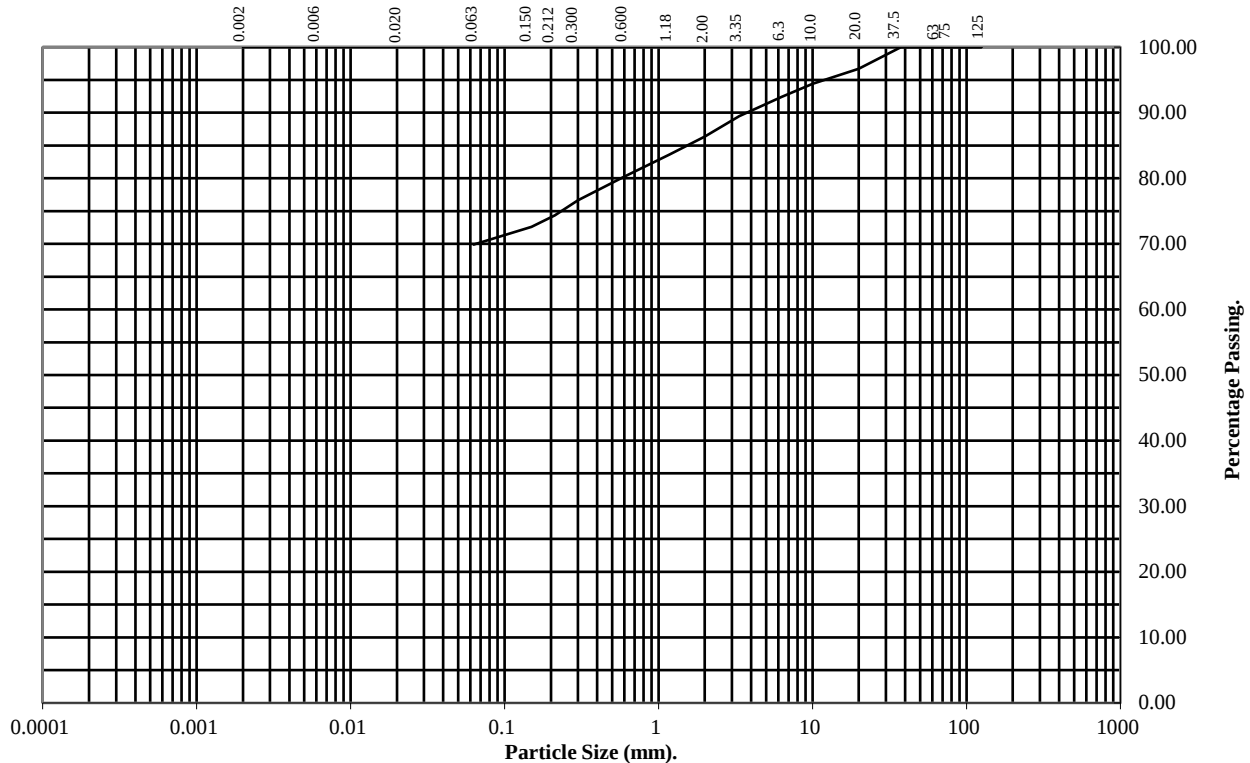
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH01 Top Depth (m): 1.00

Sample Number: Base Depth(m): 1.50

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	94
6.3	92
3.35	89
2	86
1.18	84
0.6	80
0.3	77
0.212	74
0.15	73
0.063	70

Soil Fraction	Total Percentage
Cobbles	0
Gravel	14
Sand	16
Silt/Clay	70

Remarks:

See summary of soil descriptions.



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

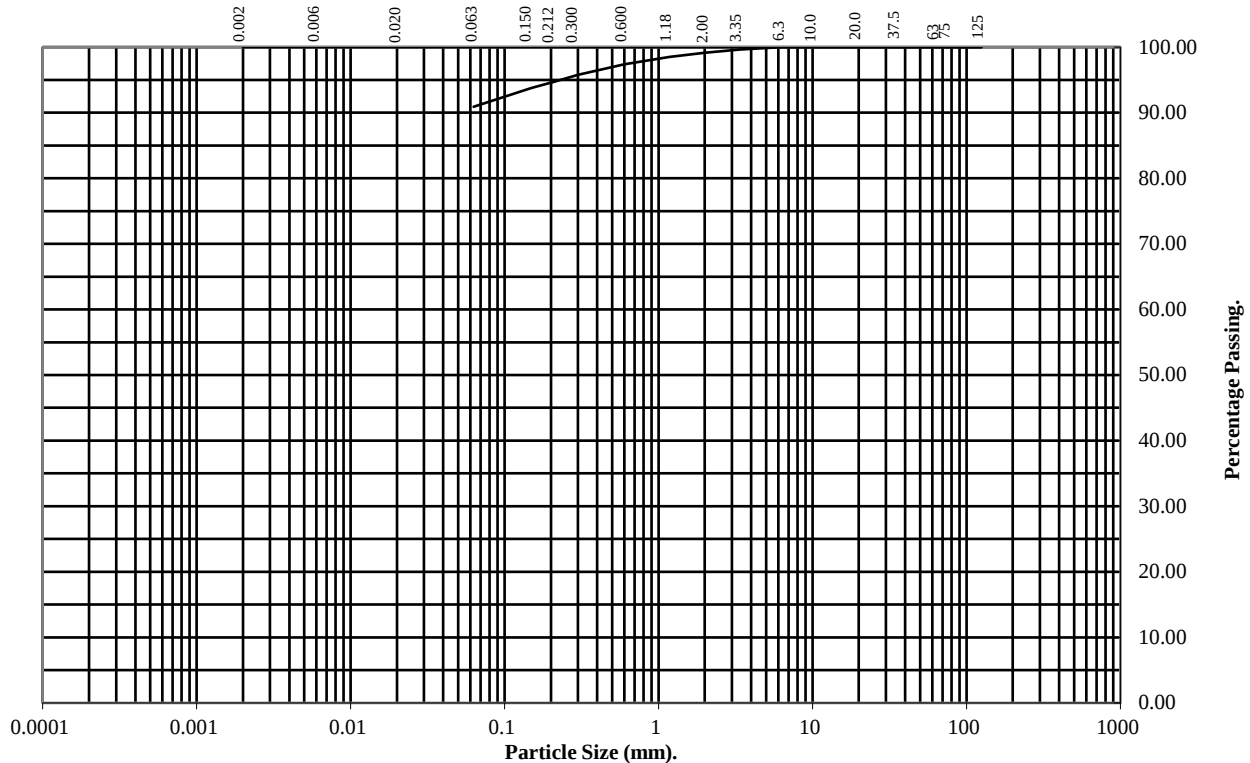
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH02 Top Depth (m): 2.00

Sample Number: Base Depth(m): 2.45

Sample Type: D



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	99
1.18	99
0.6	97
0.3	96
0.212	95
0.15	94
0.063	91

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	8
Silt/Clay	91

Remarks:

See summary of soil descriptions.



Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

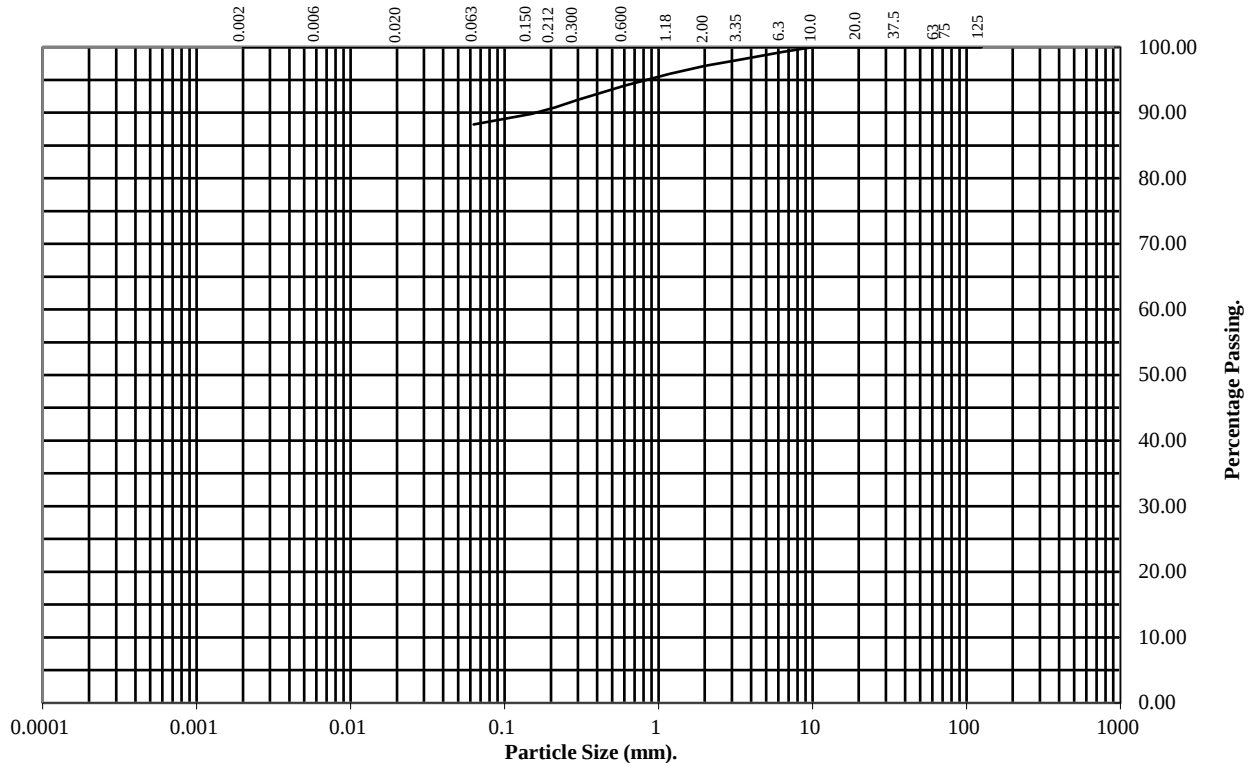
Hole Number: WS01

Top Depth (m): 1.50

Sample Number:

Base Depth(m): 2.00

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	99
3.35	98
2	97
1.18	96
0.6	94
0.3	92
0.212	91
0.15	90
0.063	88

Soil Fraction	Total Percentage
Cobbles	0
Gravel	3
Sand	9
Silt/Clay	88

Remarks:

See summary of soil descriptions.



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

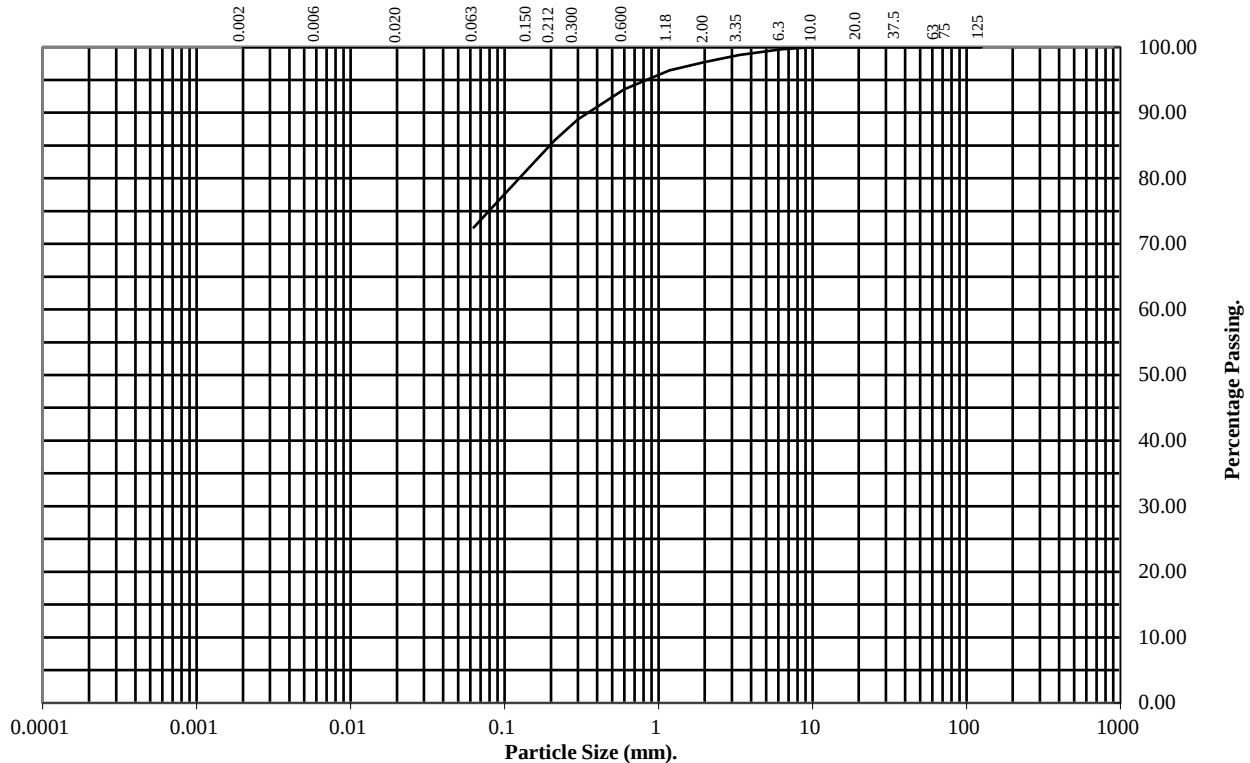
Hole Number: WS01

Top Depth (m): 3.00

Sample Number:

Base Depth(m): 3.50

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	99
2	98
1.18	96
0.6	94
0.3	89
0.212	86
0.15	82
0.063	72

Soil Fraction	Total Percentage
Cobbles	0
Gravel	2
Sand	26
Silt/Clay	72

Remarks:

See summary of soil descriptions.



Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

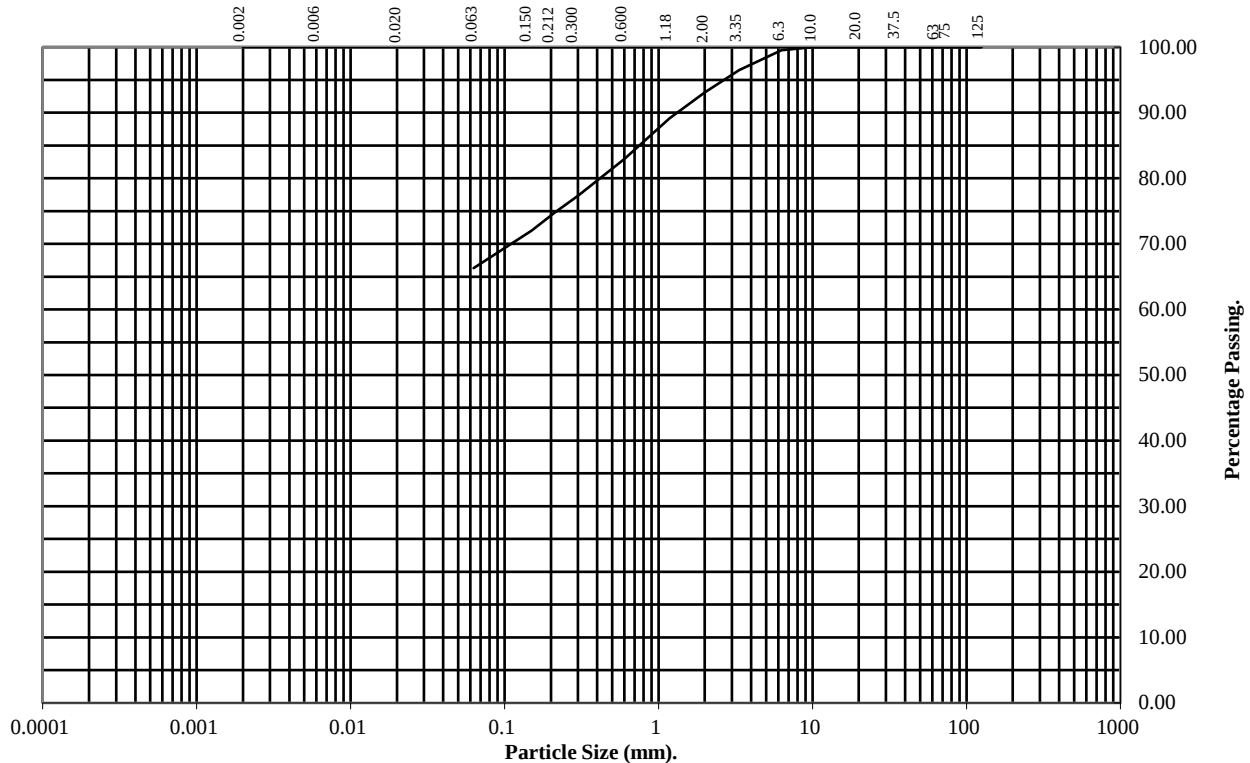
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: WS02 Top Depth (m): 3.50

Sample Number: Base Depth(m): 4.00

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	96
2	93
1.18	89
0.6	83
0.3	77
0.212	75
0.15	72
0.063	66

Soil Fraction	Total Percentage
Cobbles	0
Gravel	7
Sand	27
Silt/Clay	66

Remarks:

See summary of soil descriptions.



Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

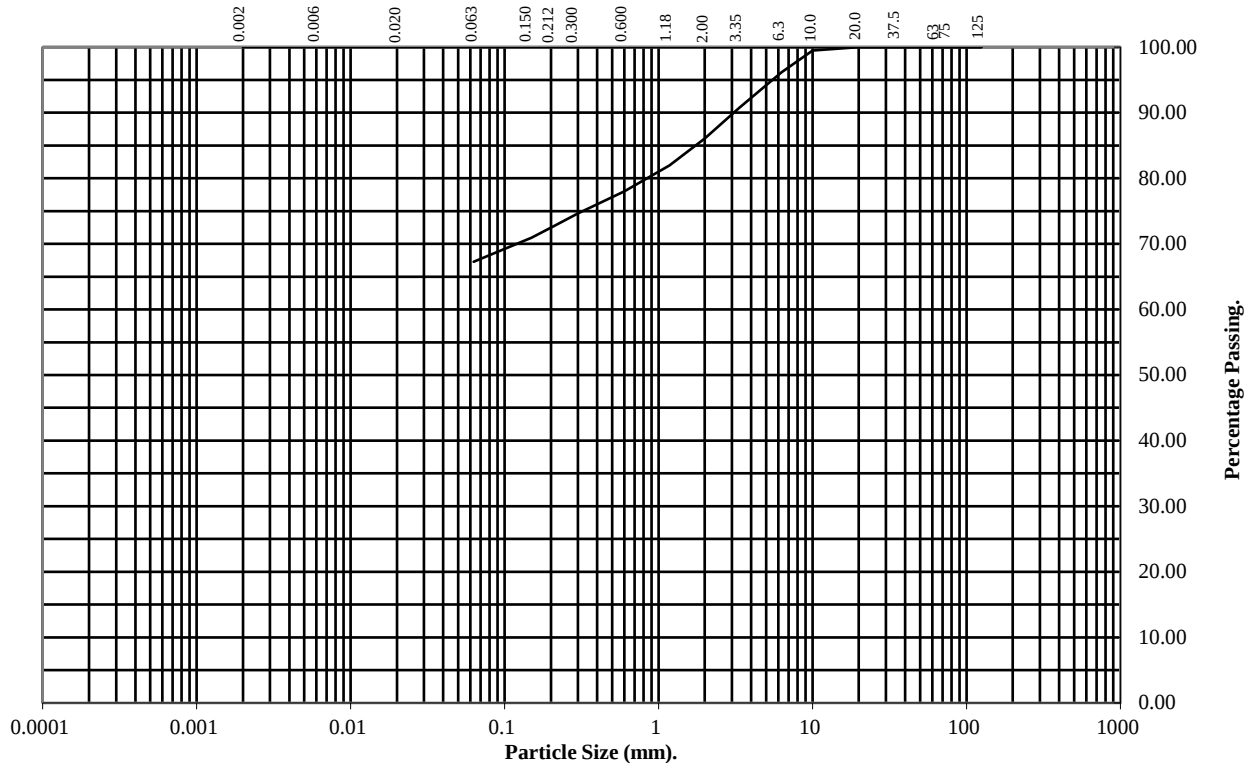
Hole Number: WS04

Top Depth (m): 0.50

Sample Number:

Base Depth(m): 1.00

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	99
6.3	96
3.35	91
2	86
1.18	82
0.6	78
0.3	75
0.212	73
0.15	71
0.063	67

Soil Fraction	Total Percentage
Cobbles	0
Gravel	14
Sand	19
Silt/Clay	67

Remarks:

See summary of soil descriptions.



Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

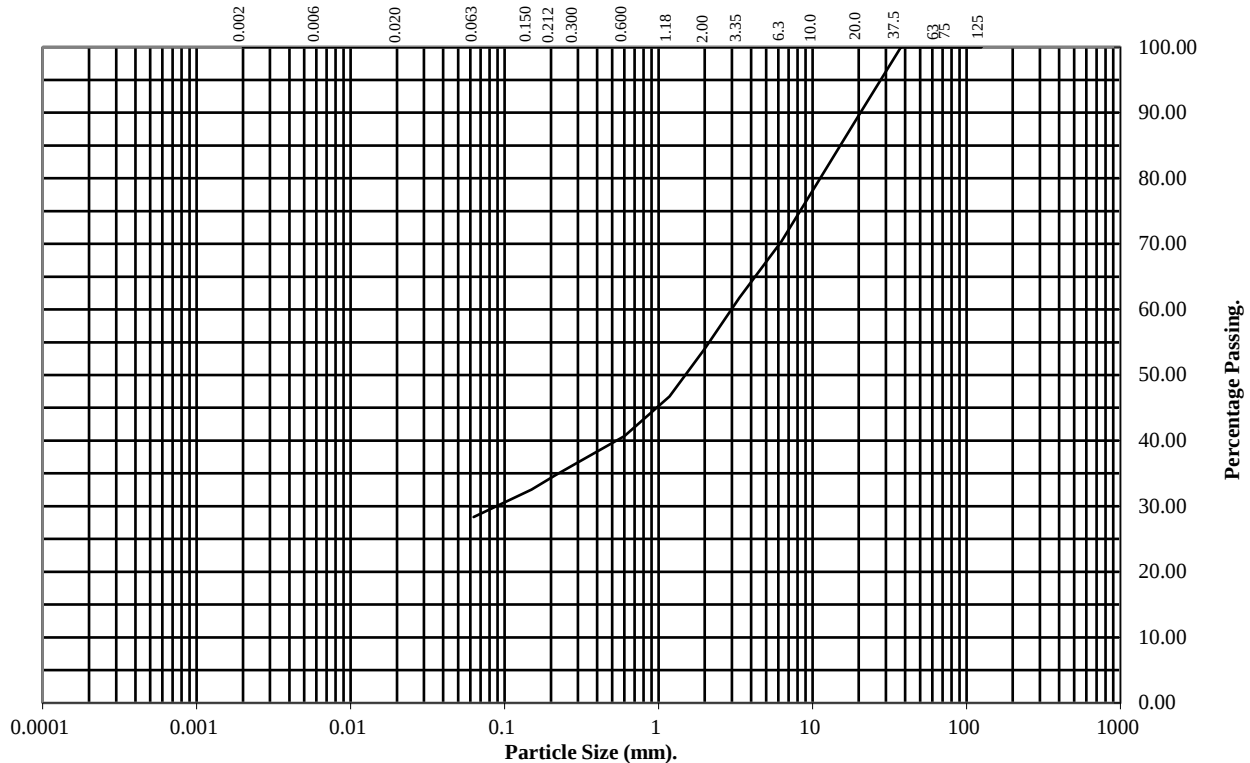
Hole Number: WS04

Top Depth (m): 3.00

Sample Number:

Base Depth(m): 3.45

Sample Type: AMAL



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	90
10	78
6.3	70
3.35	62
2	54
1.18	47
0.6	41
0.3	37
0.212	35
0.15	33
0.063	28

Soil Fraction	Total Percentage
Cobbles	0
Gravel	46
Sand	26
Silt/Clay	28

Remarks:

See summary of soil descriptions.



Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

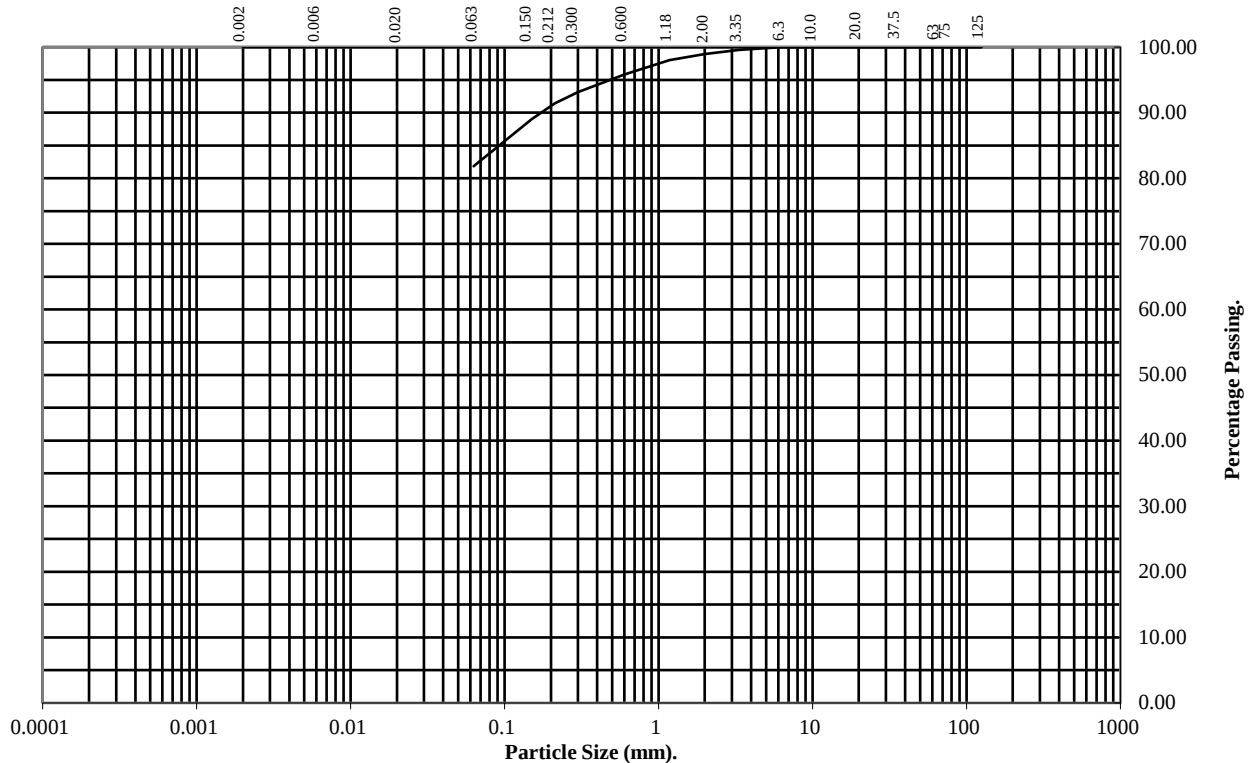
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: WS05 Top Depth (m): 2.50

Sample Number: Base Depth(m): 3.00

Sample Type: B



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	99
1.18	98
0.6	96
0.3	93
0.212	91
0.15	89
0.063	82

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	17
Silt/Clay	82

Remarks:

See summary of soil descriptions.



PSL
Professional Soils Laboratory

Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

PARTICLE SIZE DISTRIBUTION TEST

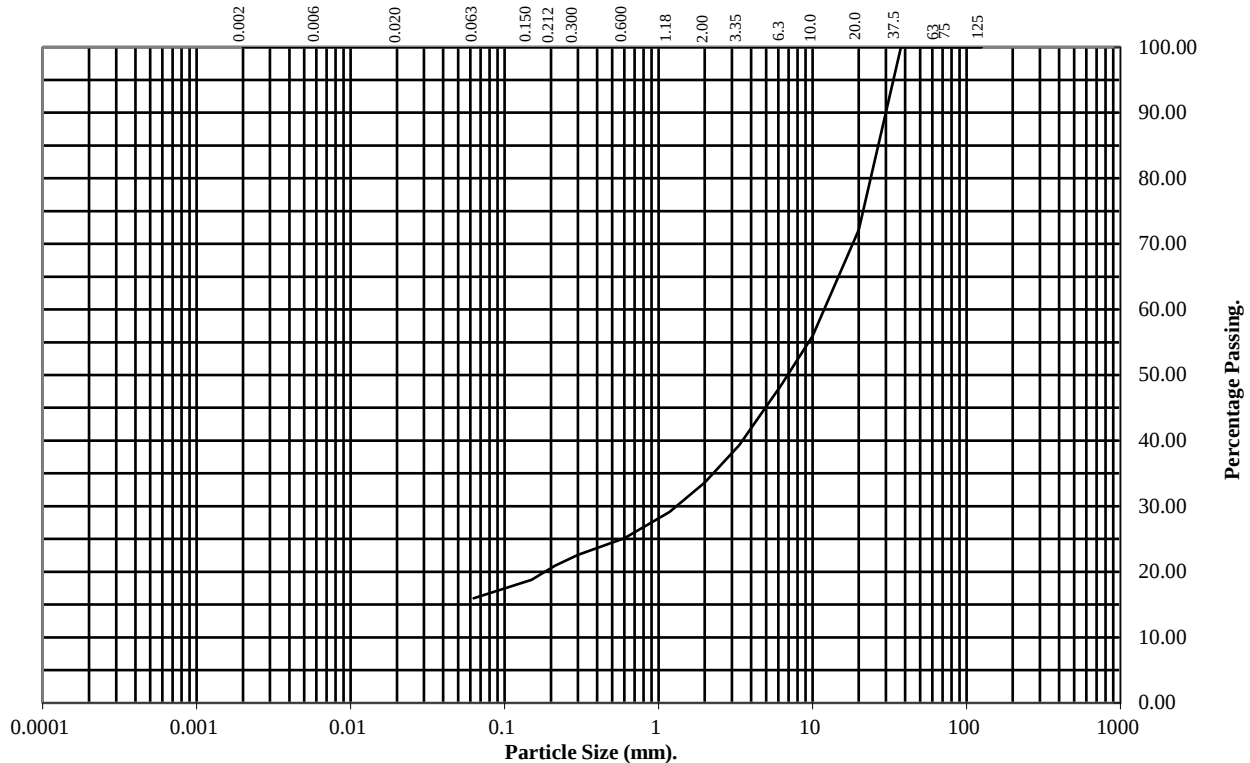
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: WS05 Top Depth (m): 4.00

Sample Number: Base Depth(m): 4.45

Sample Type: AMAL



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	72
10	56
6.3	49
3.35	39
2	34
1.18	29
0.6	25
0.3	23
0.212	21
0.15	19
0.063	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	66
Sand	18
Silt/Clay	16

Remarks:

See summary of soil descriptions.



Spenborough Pool

Contract No:
PSL17/0938
Client Ref:
A097478-1

DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111 –116, 1981.

[illegible]

Spenborough Pool

Contract No:

PSL17/0938

Client Ref:

A097478-1

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

[illegible]

***Note** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular



Spensborough Pool

Contract No:

PSL17/0938

Client Ref:

A097478-1

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

[illegible]

***Note** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular



Spenborough Pool

Contract No:

PSL17/0938

Client Ref:

A097478-1



Certificate of Analysis

Certificate Number 17-93430

13-Mar-17

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 17-93430

Client Reference PSL/0938

Order No (not supplied)

Contract Title Spenborough pool

Description 11 Soil samples.

Date Received 05-Mar-17

Date Started 05-Mar-17

Date Completed 13-Mar-17

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 17-93430

Client Ref PSL/0938

Contract Title Spenborough pool

Lab No	1137811	1137812	1137813	1137814	1137815	1137816	1137817	1137818	1137819	1137820	1137821
Sample ID	BH01	BH01	BH01	BH01	BH01	WS01	WS01	WS02	WS04	WS04	WS07
Depth	1.00	2.20	4.70	6.20	7.70	2.50	4.50	3.50	0.50	3.75	4.00
Other ID											
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	n/s	n/s	n/s	n/s	n/s	06/02/17	n/s	06/02/17	07/02/17	07/02/17	07/02/17
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units											
Metals														
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	28	< 10
Inorganics														
pH	DETSC 2008#			5.6	6.9	5.6	6.7	5.7	6.6	6.8	6.6	6.6	5.1	6.7
Chloride Aqueous Extract	DETSC 2055	1	mg/l	12	15	8.9	1.8	6.8	7.0	13	4.8	3.3	4.1	4.8
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.6	< 1.0	18	2.9	< 1.0	< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	20	56	23	< 10	< 10	37	110	120	< 10	500	31
Sulphur as S, Total	DETSC 2320	0.01	%	0.02	< 0.01	0.23	0.02	0.06	0.04	0.02	0.02	< 0.01	0.20	0.02
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.05	0.03	0.03	0.03	0.04	0.04	0.04	0.07	0.02	0.25	0.03

Information in Support of the Analytical Results

Our Ref 17-93430
Client Ref PSL/0938
Contract Spenborough pool

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1137811	BH01 1.00 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), Total Sulphur ICP (365 days), Total Sulphate ICP (730 days), Metals ICP Prep (365 days), pH + Conductivity (7 days)	
1137812	BH01 2.20 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), Total Sulphur ICP (365 days), Total Sulphate ICP (730 days), Metals ICP Prep (365 days), pH + Conductivity (7 days)	
1137813	BH01 4.70 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), Total Sulphur ICP (365 days), Total Sulphate ICP (730 days), Metals ICP Prep (365 days), pH + Conductivity (7 days)	
1137814	BH01 6.20 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), Total Sulphur ICP (365 days), Total Sulphate ICP (730 days), Metals ICP Prep (365 days), pH + Conductivity (7 days)	
1137815	BH01 7.70 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), Total Sulphur ICP (365 days), Total Sulphate ICP (730 days), Metals ICP Prep (365 days), pH + Conductivity (7 days)	
1137816	WS01 2.50 SOIL	06/02/17	PT 1L	pH + Conductivity (7 days)	
1137817	WS01 4.50 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), Total Sulphur ICP (365 days), Total Sulphate ICP (730 days), Metals ICP Prep (365 days), pH + Conductivity (7 days)	
1137818	WS02 3.50 SOIL	06/02/17	PT 1L	pH + Conductivity (7 days)	
1137819	WS04 0.50 SOIL	07/02/17	PT 1L	pH + Conductivity (7 days)	
1137820	WS04 3.75 SOIL	07/02/17	PT 1L	pH + Conductivity (7 days)	
1137821	WS07 4.00 SOIL	07/02/17	PT 1L	pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months



Appendix H – Chemical Laboratory Certificates



Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

WYG
Arndale Court
Arndale Centre
Otley Road
Leeds
LS6 2UJ

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780

Fax: +44 (0) 1244 833781



4225



Attention :	Mark Peachey
Date :	22nd February, 2017
Your reference :	A097478-1
Our reference :	Test Report 17/3667 Batch 1
Location :	Spenborough
Date samples received :	9th February, 2017
Status :	Final report
Issue :	1

Ten samples were received for analysis on 9th February, 2017 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie
Project Co-ordinator

Exova Jones Environmental

Client Name: WYG
Reference: A097478-1
Location: Spenborough
Contact: Mark Peachey
JE Job No.: 17/3667

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-3	4	5	6	7-8	9-11	15-17	18-20			Please see attached notes for all abbreviations and acronyms		
Sample ID	WS04	WS01	WS02	WS02	WS03	WS05	WS06	WS07					
Depth	1.60	0.50	1.50	0.50	0.50	0.50	0.50	0.50					
COC No / misc													
Containers	V J T	T	T	T	T	V J T	V J T	V J T					
Sample Date	07/02/2017	06/02/2017	06/02/2017	06/02/2017	06/02/2017	07/02/2017	07/02/2017	07/02/2017					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	09/02/2017	09/02/2017	09/02/2017	09/02/2017	09/02/2017	09/02/2017	09/02/2017	09/02/2017			LOD/LOR	Units	Method No.
Arsenic ^{#M}	33.5	26.6	49.3	39.4	30.6	36.2	21.6	30.3			<0.5	mg/kg	TM30/PM15
Beryllium	2.1	1.9	2.6	2.3	1.8	2.1	3.1	2.1			<0.5	mg/kg	TM30/PM15
Cadmium ^{#M}	<0.1	0.2	5.9	0.7	<0.1	<0.1	0.9	<0.1			<0.1	mg/kg	TM30/PM15
Chromium ^{#M}	48.0	79.8	52.6	93.6	43.6	49.2	81.5	54.5			<0.5	mg/kg	TM30/PM15
Copper ^{#M}	67	66	191	222	39	49	54	58			<1	mg/kg	TM30/PM15
Lead ^{#M}	234	190	3541 ^{AA}	551	68	74	74	100			<5	mg/kg	TM30/PM15
Mercury ^{#M}	<0.1	0.1	<0.1	0.3	0.1	<0.1	<0.1	<0.1			<0.1	mg/kg	TM30/PM15
Nickel ^{#M}	40.2	41.9	48.4	38.9	24.6	28.9	25.0	30.7			<0.7	mg/kg	TM30/PM15
Selenium ^{#M}	2	2	2	2	2	2	2	2			<1	mg/kg	TM30/PM15
Vanadium	49	38	89	46	35	43	42	42			<1	mg/kg	TM30/PM15
Water Soluble Boron ^{#M}	0.6	0.7	0.6	1.2	1.2	0.7	5.9	0.7			<0.1	mg/kg	TM74/PM32
Zinc ^{#M}	214	250	2907 ^{AA}	338	128	127	171	160			<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene ^{#M}	0.19	0.05	0.50	<0.04	<0.04	<0.04	0.28	0.56			<0.04	mg/kg	TM4/PM8
Acenaphthylene	0.19	0.23	0.07	<0.03	<0.03	<0.03	0.15	<0.03			<0.03	mg/kg	TM4/PM8
Acenaphthene ^{#M}	1.12	0.12	1.50	0.11	<0.05	0.07	0.39	0.71			<0.05	mg/kg	TM4/PM8
Fluorene ^{#M}	0.81	0.08	1.24	0.07	<0.04	<0.04	0.31	0.44			<0.04	mg/kg	TM4/PM8
Phenanthrene ^{#M}	8.30	0.91	13.18	0.98	0.17	0.67	2.75	4.04			<0.03	mg/kg	TM4/PM8
Anthracene [#]	1.76	0.52	3.36	0.25	<0.04	0.18	0.69	1.02			<0.04	mg/kg	TM4/PM8
Fluoranthene ^{#M}	10.63	3.03	13.86	1.74	0.43	1.17	3.68	5.58			<0.03	mg/kg	TM4/PM8
Pyrene [#]	9.08	3.16	11.17	1.47	0.38	1.00	3.02	4.62			<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene [#]	4.10	1.88	5.35	0.78	0.25	0.54	1.41	2.26			<0.06	mg/kg	TM4/PM8
Chrysene ^{#M}	4.93	2.09	4.85	0.70	0.25	0.61	1.70	2.64			<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene ^{#M}	7.02	4.15	8.34	1.25	0.28	0.86	2.67	4.05			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene [#]	4.52	2.71	5.12	0.82	0.16	0.56	1.58	2.51			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene ^{#M}	2.47	1.84	3.20	0.52	0.09	0.31	1.00	1.51			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene [#]	0.60	0.24	0.35	0.07	<0.04	0.08	0.24	0.40			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene [#]	2.29	1.47	2.81	0.42	0.08	0.29	0.93	1.33			<0.04	mg/kg	TM4/PM8
PAH 16 Total	58.0	22.5	74.9	9.2	2.1	6.3	20.8	31.7			<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	5.05	2.99	6.00	0.90	0.20	0.62	1.92	2.92			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	1.97	1.16	2.34	0.35	0.08	0.24	0.75	1.13			<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	100	104	105	107	101	103	101	108			<0	%	TM4/PM8
EPH (C8-C40) ^{#M}	1528	322	341	596	139	466	281	116			<30	mg/kg	TM5/PM8
GRO (>C4-C8) ^{#M}	<100	<100	<1000 ^{AB}	<100	<100	<100	<100	<100			<100	ug/kg	TM36/PM12
GRO (>C8-C12) ^{#M}	<100	<100	<1000 ^{AB}	<100	<100	<100	<100	<100			<100	ug/kg	TM36/PM12
GRO (>C4-12) ^{#M}	<100	<100	<1000 ^{AB}	<100	<100	<100	<100	<100			<100	ug/kg	TM36/PM12
MTBE [#]	<5	<5	<50 ^{AB}	<5	<5	<5	<5	<5			<5	ug/kg	TM31/PM12
Benzene [#]	<5	<5	<50 ^{AB}	<5	<5	<5	<5	<5			<5	ug/kg	TM31/PM12
Toluene [#]	<5	<5	<50 ^{AB}	<5	<5	<5	<5	<5			<5	ug/kg	TM31/PM12
Ethylbenzene [#]	<5	<5	<50 ^{AB}	<5	<5	<5	<5	<5			<5	ug/kg	TM31/PM12
m/p-Xylene [#]	<5	<5	<50 ^{AB}	<5	<5	<5	<5	<5			<5	ug/kg	TM31/PM12

Client Name: WYG
Reference: A097478-1
Location: Spenborough
Contact: Mark Peachey

Note:

Analysis was carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Jones Environmental Laboratory consultant, Jones Environmental Laboratory cannot be responsible for inaccurate or unrepresentative sampling.

Signed on behalf of Jones Environmental Laboratory:



Ryan Butterworth
 Asbestos Team Leader

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
17/3667	1	WS04	1.60	2	17/02/2017	General Description (Bulk Analysis)	soil/stones
					17/02/2017	Asbestos Fibres	NAD
					17/02/2017	Asbestos Fibres (2)	NAD
					17/02/2017	Asbestos ACM	NAD
					17/02/2017	Asbestos ACM (2)	NAD
					17/02/2017	Asbestos Type	NAD
					17/02/2017	Asbestos Type (2)	NAD
					17/02/2017	Asbestos Level Screen	NAD
17/3667	1	WS01	0.50	4	18/02/2017	General Description (Bulk Analysis)	Soil/Stones
					18/02/2017	Asbestos Fibres	NAD
					18/02/2017	Asbestos Fibres (2)	NAD
					18/02/2017	Asbestos ACM	NAD
					18/02/2017	Asbestos ACM (2)	NAD
					18/02/2017	Asbestos Type	NAD
					18/02/2017	Asbestos Type (2)	NAD
					18/02/2017	Asbestos Level Screen	NAD
17/3667	1	WS02	1.50	5	18/02/2017	General Description (Bulk Analysis)	Soil/Stones
					18/02/2017	Asbestos Fibres	NAD
					18/02/2017	Asbestos Fibres (2)	NAD
					18/02/2017	Asbestos ACM	NAD
					18/02/2017	Asbestos ACM (2)	NAD
					18/02/2017	Asbestos Type	NAD
					18/02/2017	Asbestos Type (2)	NAD
					18/02/2017	Asbestos Level Screen	NAD
17/3667	1	WS02	0.50	6	18/02/2017	General Description (Bulk Analysis)	Soil/Stones
					18/02/2017	Asbestos Fibres	NAD
					18/02/2017	Asbestos Fibres (2)	NAD
					18/02/2017	Asbestos ACM	NAD
					18/02/2017	Asbestos ACM (2)	NAD
					18/02/2017	Asbestos Type	NAD
					18/02/2017	Asbestos Type (2)	NAD
					18/02/2017	Asbestos Level Screen	NAD
17/3667	1	WS03	0.50	7	18/02/2017	General Description (Bulk Analysis)	Soil/Stones
					18/02/2017	Asbestos Fibres	NAD
					18/02/2017	Asbestos Fibres (2)	NAD

Client Name: WYG
Reference: A097478-1
Location: Spensborough
Contact: Mark Peachey

[illegible]

Matrix : Solid

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/3667

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
SA	ISO17025 (SANAS) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution
AB	x10 Dilution

JE Job No: 17/3667

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes	Yes	AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes	Yes	AR	Yes
PM13	A visual examination of the solid sample is carried out to ascertain sample make up, colour and any other inclusions. This is not a geotechnical description.	PM0	No preparation is required.			AR	
TM21	Modified USEPA 415.1. Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO ₂ generated is quantified using infra-red detection.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.	Yes	Yes	AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes	Yes	AD	Yes

JE Job No: 17/3667

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes	Yes	AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.			AR	
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes	Yes	AR	No
TM74	Analysis of water soluble boron (20:1 extract) by ICP-OES.	PM32	Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio.	Yes	Yes	AD	Yes
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM45	As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide and Thiocyanate analysis.			AR	Yes



Exova Jones Environmental

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Attention :	Mark Peachey
Date :	2nd March, 2017
Your reference :	A097478-1
Our reference :	Test Report 17/3667 Batch 2
Location :	Spenborough
Date samples received :	22nd February, 2017
Status :	Final report
Issue :	1

Seven samples were received for analysis on 22nd February, 2017 of which seven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied. All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie
Project Co-ordinator

Client Name: WYG
Reference: A097478-1
Location: Spenborough
Contact: Mark Peachey
JE Job No.: 17/3667

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H₂SO₄, Z=ZnAc, N=NaOH, HN=HNO₃

J E Sample No.	24-27	28-32	33-37	38-42	43-47	48-52	53-57				Please see attached notes for all abbreviations and acronyms		
Sample ID	WS02	WS03	WS04	WS05	BH01	BH02	BH02A						
Depth													
COC No / misc													
Containers	V H G	V H P G	V H P G	V H P G	V H P G	V H P G	V H P G						
Sample Date	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017						
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water						
Batch Number	2	2	2	2	2	2	2						
Date of Receipt	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017				LOD/LOR	Units	Method No.
Dissolved Antimony [#]	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM30/PM14
Dissolved Arsenic [#]	6.6	3.0	<0.9	<0.9	<0.9	1.9	4.3				<0.9	ug/l	TM30/PM14
Dissolved Barium [#]	104.2	65.4	33.5	30.2	39.4	24.0	27.5				<1.8	ug/l	TM30/PM14
Dissolved Boron	279	66	120	37	41	160	178				<12	ug/l	TM30/PM14
Dissolved Cadmium [#]	1.47	0.31	<0.03	<0.03	<0.03	<0.03	<0.03				<0.03	ug/l	TM30/PM14
Dissolved Calcium [#]	126.2	109.1	81.9	47.2	71.8	85.2	84.0				<0.2	mg/l	TM30/PM14
Total Dissolved Chromium [#]	0.4	<0.2	<0.2	0.4	<0.2	<0.2	<0.2				<0.2	ug/l	TM30/PM14
Dissolved Copper [#]	4	<3	<3	<3	<3	<3	<3				<3	ug/l	TM30/PM14
Dissolved Lead [#]	40.9	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4				<0.4	ug/l	TM30/PM14
Dissolved Mercury [#]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.5	ug/l	TM30/PM14
Dissolved Nickel [#]	10.5	5.3	2.0	7.4	6.7	0.2	0.6				<0.2	ug/l	TM30/PM14
Dissolved Selenium [#]	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2				<1.2	ug/l	TM30/PM14
Dissolved Zinc [#]	919.6	5.8	2.6	10.9	4.3	<1.5	<1.5				<1.5	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	372	332	280	231	248	355	349				<1	mg/l	TM30/PM14
PAH MS													
Naphthalene	0.7 ^B	<0.1 ^B	<0.1 ^B	<0.1 ^B	<0.1 ^B	<0.1 ^B	<0.1 ^B				<0.1	ug/l	TM4/PM30
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Acenaphthene	0.23	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Fluorene	0.19	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Phenanthrene	1.74	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Anthracene	0.40	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Fluoranthene	1.80	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Pyrene	1.52	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(a)anthracene	0.70	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Chrysene	0.76	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(b)fluoranthene	1.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(a)pyrene	0.64	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Indeno(123cd)pyrene	0.43	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Dibenzo(ah)anthracene	0.11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene	0.37	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
PAH 16 Total	10.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	ug/l	TM4/PM30
Benzo(b)fluoranthene	0.77	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	0.30	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	83	80	79	80	79	81	79				<0	%	TM4/PM30
EPH >C8-C10	90	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM30
EPH >C10-C20	420	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM30
EPH >C20-C30	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM30
EPH >C30-C40	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM30
EPH >C8-C40 [#]	510	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM30
GRO (>C5-C10)	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12

Client Name: WYG
Reference: A097478-1
Location: Spenborough
Contact: Mark Peachey

Matrix : Liquid

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/3667

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
SA	ISO17025 (SANAS) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 17/3667

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

JE Job No: 17/3667

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			



Appendix I – WYG Tier 1 Soil Screening Values

Derwent Riverside - Tier 1 Soils Screen															
Project / Site name: Spenborough Pool															
Using Commerical Values and 2.5% SOM															
Sample Reference				WS01	WS02	WS02	WS03	WS04	WS05	WS06	WS07				
Depth (m)				0.50	0.50	1.50	0.50	1.60	0.50	0.50	0.50				
Date Sampled				06/02/2017	06/02/2017	06/02/2017	07/02/2017	06/02/2017	07/02/2017	07/02/2017	07/02/2017				
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	WYG TSV												
Moisture Content	%	N/A		31.1	33.9	23	30.6	19.5	27.6	12.3	22.1	8	33.9		
Asbestos in Soil Screen / Identification Name	Type	N/A		-	-	-	-	-	-	-	-	31	0	1	
Asbestos in Soil	Type	N/A	Presence	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	31	0	1	
General Inorganics															
pH - Automated	pH Units	N/A	9	8.04	7.82	7.49	7.88	6.97	8.15	7.35	8.26	8	8.26	3	0.9
Free Cyanide	mg/kg	0.5	40	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	31	0	0	0.0
Fraction Organic Carbon (FOC)	N/A	0.001		0.051	0.069	0.27	0.044	0.113	0.054	0.054	0.044	8	0.27		
Total Phenols															
Total Phenols (monohydric)	mg/kg	0.01	440	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	31	0	0	0.0
Speciated PAHs															
Naphthalene	mg/kg	0.04	190	0.05	<0.04	0.5	<0.04	0.19	<0.04	0.28	0.56	31	0.56		0.0
Acenaphthylene	mg/kg	0.03	83000	0.23	<0.03	0.07	<0.03	0.19	<0.03	0.15	<0.03	31	0.23		0.0
Acenaphthene	mg/kg	0.05	84000	0.12	0.11	1.5	<0.05	1.12	0.07	0.39	0.71	31	1.5		0.0
Fluorene	mg/kg	0.04	63000	0.08	0.07	1.24	<0.04	0.81	<0.04	0.31	0.44	31	1.24		0.0
Phenanthrene	mg/kg	0.03	22000	0.91	0.98	13.18	0.17	8.3	0.67	2.75	4.04	31	13.18		0.0
Anthracene	mg/kg	0.04	520000	0.52	0.25	3.36	<0.04	1.76	0.18	0.69	1.02	31	3.36		0.0
Fluoranthene	mg/kg	0.03	23000	3.03	1.74	13.86	0.43	10.63	1.17	3.68	5.58	31	13.86		0.0
Pyrene	mg/kg	0.03	54000	3.16	1.47	11.17	0.38	9.08	1	3.02	4.62	31	11.17		0.0
Benzo(a)anthracene	mg/kg	0.06	170	1.88	0.78	5.35	0.25	4.1	0.54	1.41	2.26	31	5.35		0.0
Chrysene	mg/kg	0.02	350	2.09	0.7	4.85	0.25	4.93	0.61	1.7	2.64	31	4.93		0.0
Benzo(b)fluoranthene	mg/kg	0.05	44	2.99	0.9	6	0.2	5.05	0.62	1.92	2.92	31	6	1	0.1
Benzo(k)fluoranthene	mg/kg	0.02	1200	1.16	0.35	2.34	0.08	1.97	0.24	0.75	1.13	31	2.34		0.0
Benzo(a)pyrene	mg/kg	0.04	77	2.71	0.82	5.12	0.16	4.52	0.56	1.58	2.51	31	5.12		0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.04	500	1.84	0.52	3.2	0.09	2.47	0.31	1	1.51	31	3.2		0.0
Dibenz(a,h)anthracene	mg/kg	0.04	3.5	0.24	0.07	0.35	<0.04	0.6	0.08	0.24	0.4	31	0.6	1	0.2
Benzo(ghi)perylene	mg/kg	0.04	3900	1.47	0.42	2.81	0.08	2.29	0.29	0.93	1.33	31	2.81		0.0
Total PAH															
Speciated Total EPA-16 PAHs	mg/kg	0.6	-	22.5	9.2	74.9	2.1	58	6.3	20.8	31.7	31	74.9		
Heavy Metals / Metalloids															
Arsenic (aqua regia extractable)	mg/kg	0.5	640	26.6	39.4	49.3	30.6	33.5	36.2	21.6	30.3	31	49.3		0.1
Beryllium (aqua regia extractable)	mg/kg	0.5	12	1.9	2.3	2.6	1.8	2.1	2.1	3.1	2.1	31	3.1		0.3
Boron (water soluble)	mg/kg	0.1	240000	0.7	1.2	0.6	1.2	0.6	0.7	5.9	0.7	31	5.9		0.0
Cadmium (aqua regia extractable)	mg/kg	0.1	410	0.2	0.7	5.9	<0.1	<0.1	<0.1	0.9	<0.1	31	5.9		0.0
Chromium (III)	mg/kg	0.5	8600	79.8	93.6	52.6	43.6	48	49.2	81.5	54.5	31	93.6		0.0
Chromium (aqua regia extractable)	mg/kg	0.5	8600	19	22	65	28	22	21	23	23	31	65		0.0
Copper (aqua regia extractable)	mg/kg	1	68000	66	222	191	39	67	49	54	58	31	0		0.0
Lead (aqua regia extractable)	mg/kg	5	2300	190	551	3541	68	234	74	74	100	31	3541	1	1.5
Mercury (aqua regia extractable)	mg/kg	0.1	25.8	0.1	0.3	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	31	0		0.0
Nickel (aqua regia extractable)	mg/kg	0.7	980	41.9	38.9	48.4	24.6	40.2	28.9	25.0	30.7	31	0		0.0
Selenium (aqua regia extractable)	mg/kg	1	12000	2	2	2	2	2	2	2	2	31	0		0.0
Vanadium (aqua regia extractable)	mg/kg	1	9000	38	46	89	35	49	43	42	42	31	0		0.0
Zinc (aqua regia extractable)	mg/kg	5	730000	250	338	2907	128	214	127	171	160	31	2907		0.0
Monoaromatics															
Benzene	ug/kg	5	27000	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	31	0		0.0
Toluene	ug/kg	5	56000000	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	31	0		0.0
Ethylbenzene	ug/kg	5	57000000	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	31	0		0.0
p & m-xylene	ug/kg	5	59000000	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	31	0		0.0
o-xylene	ug/kg	5	66000000	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	31	0		0.0
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	5	-	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	31	0		
EPH															
EPH (C8-C40)	mg/kg	30	2000	322	596	341	139	1528	466	281	116		1528		0.8

Result above respective TSV

Result above arbitrary value

All results below TSV

At least one result above TSV



Appendix J – WYG Tier 1 Water Resources Screening Values

TIER 1 WATER QUALITY STANDARDS (ENGLAND AND WALES)

Status: FINAL	Issue No: 8a	Date of Release	08/07/2016
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Choose water quality standard based upon scenario at the site

Use WYG flow chart to determine which standards to use. Where more than one value is applicable use the most conservative. If in doubt use WYG TSV Freshwater, defined as most conservative of DWS, River Water EQS, Freshwater Lake EQS,Groundwater Drinking Water Protected Areas Values and General Quality of Groundwater Body Values. Determine River, Freshwater Lake and/or Transitional and Coastal Waters type using classification tables before screening. If after initial screening it is considered that groundwater may significantly impact surface water it is recommended that individual Groundwater Impacts on Surface Water Threshold Values applicable to a groundwater body, given in its Environment Agency River Basin Management Plan, are consulted.

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Name of Determinand	TSV Freshwater (WYG Tier 1 Screening Value) Defined as most conservative of DWS, River Water EQS and Freshwater Lake EQS		Origin of TSV	River Water EQS		Freshwater Lakes EQS		Transitional and Coastal Waters EQS		Drinking Water Standards
All units µg/l unless otherwise stated										
Electrical Conductivity (µS/cm)	1000		Freshwater Lake EQS 2015			1000 (AA)	No saline interface			2,500
pH (pH value) ¹	6.0-9 (5%ile-95%ile)		River Water EQS 2015	6-9 (5% to 95%ile - good quality)						6.5-9.5
Acid Condition (Mev/L) ⁴	> 20 (AA)		Freshwater Lake EQS 2015			> 20 (AA)				
Dissolved oxygen ⁴	>75% Saturation (10%ile)	Types 1,2,4,6 and salmonid	River Water EQS 2015	75% Saturation (10%ile)	Types 1,2,4,6 and salmonid - 'good'	7000 (July - August Mean)	Salmonid	4000 (5%ile 1 yr compliance)	Salinities normalised to 35	
	7000 (July - August Mean)	Salmonid	Freshwater Lake EQS 2015	60% Saturation (10%ile)	Types 3,5 and 7 - 'good'	6000 (July - August Mean)	Cyprinid	5000 - (0.028 x salinity) (5%ile)	Salinities < 35	
BOD (Biological Oxygen Demand) ⁴	4000 (90%ile)	Types 1,2,4 and 6, and Salmonid Waters	River Water EQS 2015	4000 (90%ile)	Types 1,2,4 and 6, and Salmonid Waters - 'good'					
	5000 (90%ile)	Types 3,5 and 7	River Water EQS 2015	5000 (90%ile)	Types 3,5 and 7 - 'good'					
Acrylamide	0.1		DWS 2010							0.1
Alachlor ¹	0.3(AA)		Inland Surface Waters EQS 2015	0.3 (AA), 0.7 (MAC)				0.3 (AA), 0.7 (MAC)		20
Aldicarb	10		DWS 2011							10
Aldrin	0.03		DWS 2010							0.03
Aluminium	200		DWS 2010							200
Ammonium	500		DWS 2010							500
Total Ammonia as Nitrogen ⁴	300	Types 1,2,4 and 6	River Water EQS, Freshwater Lake EQS 2015	300 (90%ile)	Types 1,2,4 and 6	300 (90%ile)	Types 1,2,4 and 6			
	600	Types 3,5 and 7		600 (90%ile)	Types 3,5 and 7	600 (90%ile)	Types 3,5 and 7			
Un-ionised Ammonia (Only applicable to Saltwater)								21 (AA)		
Anthracene ¹	0.1(AA)		Inland Surface Waters EQS 2015	0.1 (AA), 0.1(MAC)				0.1 (AA), 0.1 (MAC)		
Antimony	5		DWS 2010							5
Arsenic	10		DWS 2010	50 (AA)(Dissolved As)				25 (AA) (Dissolved As)		10
Atrazine ¹	0.6 (AA)		Inland Surface Water EQS 2015	0.6 (AA), 2(MAC)				0.6 (AA), 2(MAC)		100
Barium	700		DWS 2008							700
Bentazone ²	500 (AA)		Inland Surface Water EQS 2015	500 (AA)				500 (AA)		
Benzene ¹	1		DWS 2010	10 (AA), 50(MAC)				8 (AA), 50(MAC)		1
Benzo(a)pyrene ¹	0.00017 (AA)		Inland Surface Water EQS 2015	0.00017 (AA), 0.27 (MAC)				0.00017 (AA), 0.27 (MAC)		0.01
Benzo(b)fluoranthene	0.017 (MAC)		Inland Surface Water EQS 2015	0.017 (MAC)				0.017 (MAC)		
Benzo (k)fluoranthene	0.017 (MAC)		Inland Surface Water EQS 2015	0.017 (MAC)				0.017 (MAC)		
Benzo(ghi)perylene	0.0082 (MAC)		Inland Surface Water EQS 2015	0.0082 (MAC)				0.0082 (MAC)		
Benzyl butyl phthalate	7.5 (AA)		Freshwater EQS 2015	7.5 (AA), 51 (95%ile)				0.75 (AA), 10 (95%ile)		
Boron	1000		DWS 2010							1000
Bromate	10		DWS 2010							10
Brominated diphenyl ether	0.14 MAC		Inland Surface Water EQS 2015	0.14 (MAC)				0.014 (MAC)		
Bromodichloromethane	60		DWS 2011							60
Bromoform	100		DWS 2011							100
C10-13 chloroalkanes ¹	0.4(AA)		Inland Surface Waters EQS 2015	0.4 (AA), 1.4 (MAC)				0.4 (AA), 1.4 (MAC)		
Cadmium (and its compounds) ¹	≤0.08 (AA)	CaCO ₃ <40 mg/l	Inland Surface Waters EQS 2015	≤0.08 (AA), ≤0.45(MAC)	CaCO ₃ <40 mg/l	≤0.08 (AA), ≤0.45(MAC)	CaCO ₃ <40 mg/l	0.2 (AA)		5
	0.08 (AA)	CaCO ₃ 40 - <50 mg/l		0.08 (AA), 0.45 (MAC)	CaCO ₃ 40 - <50 mg/l	0.08 (AA), 0.45 (MAC)	CaCO ₃ 40 - <50 mg/l			
	0.09 (AA)	CaCO ₃ 50 - <100 mg/l		0.09 (AA), 0.6 (MAC)	CaCO ₃ 50 - <100 mg/l	0.09 (AA), 0.6 (MAC)	CaCO ₃ 50 - <100 mg/l			
	0.15 (AA)	CaCO ₃ 100 - <200 mg/l		0.15 (AA), 0.9 (MAC)	CaCO ₃ 100 - <200 mg/l	0.15 (AA), 0.9 (MAC)	CaCO ₃ 100 - <200 mg/l			
	0.25 (AA)	CaCO ₃ >200 mg/l		0.25 (AA), 1.5 (MAC)	CaCO ₃ >200 mg/l	0.25 (AA), 1.5 (MAC)	CaCO ₃ >200 mg/l			
Carbendazim	0.15 (AA)		Freshwater EQS 2015	0.15 (AA), 0.7 (95%ile)						
Carbofuran	7		DWS 2011							7
Carbon tetrachloride ¹	4		DWS 2011	12 (AA)				12 (AA)		4
Chlorate	700		DWS 2011							700
Chordane	0.2		DWS 2011							0.2
Chloride (water soluble)	250,000		DWS 2010							250,000
Chlorine	2(AA)		Freshwater EQS 2015	2 (AA), 5 (95%ile)				10 (95%ile - of total residual oxidant)		5,000
Chlorite	700		DWS 2011							700
Chlorfenvinphos ¹	0.1 (AA)		Inland Surface Waters EQS 2015	0.1 (AA), 0.3 (MAC)				0.1 (AA), 0.3 (MAC)		
4-Chloro-3-Methyl-Phenol ^{2,9}	40(AA)		Inland Surface Fresh Waters EQS 2010	40 (AA)				40 (AA)		
Chloroform (Trichloromethane)	2.5(AA)		Inland Surface Waters EQS 2015	2.5(AA)				2.5(AA)		300
Chloronitrotoluenes ^{2,6}	10(AA)		Inland Surface Fresh Waters EQS 2010	10 (AA)				10 (AA)		
2-Chlorophenol ^{2,6}	50(AA)		Inland Surface Fresh Waters EQS 2010	50 (AA)				50 (AA)		
Chlorpyrifos ^{1,6}	0.03(AA)		Inland Surface Waters EQS 2010	0.03 (AA), 0.1 (MAC)				0.03 (AA), 0.1 (MAC)		30
Chlorothalonil	0.035(AA)		Freshwater EQS 2015	0.035 (AA), 1.2 (95%ile)						
Chlortoluron	30		DWS 2011							30
Chromium (Total)	50		DWS 2010							50
Chromium III	4.7(AA)		Freshwater EQS 2015	4.7 (AA), 32 (95%ile)						
Chromium VI	3.4(AA)		Freshwater EQS 2015	3.4 (AA)				0.6 (AA), 32 (95%ile)		
Clostridium perfringens (including spores) (count per 100ml)	0		DWS 2010							0
Coliform bacteria (count per 100ml)	0		DWS 2010							0
Copper ⁷	1 (AA) bioavailable		Freshwater EQS 2015	1 (AA) bioavailable				3.76 where DOC ≤1 mg/l,		2,000
Cyanazine	0.6		DWS 2011							0.6
Cyanide (Free and Total)	1(AA)		Freshwater EQS 2015	1 (AA), 5 (95%ile)				1 (AA), 5 (95%ile)		50
Cyanogen chloride ⁶	70		DWS 2008							70
Cyclodiene pesticides (Sum of aldrin, dieldrin, endrin) ¹	0.01(AA)		Inland Surface Waters EQS 2015	0.01 (AA)				0.005 (AA)		
Cypermethrin	0.0001(AA)		Freshwater EQS 2015	0.0001 (AA), 0.0004 (95%ile)				0.0001 (AA), 0.0004 (95%ile)		
2,4-D (2,4-dichlorophenoxyacetic acid) ¹	0.3(AA)		Inland Surface Waters EQS 2015	0.3(AA), 1.3(95%ile)				0.3(AA), 1.3(95%ile)		30
2,4-Dichlorophenoxybutyric acid.	90		DWS 2011							90
DDT and metabolites	1		DWS 2011							1
DDT (Total all 4 isomers) ¹	0.025(AA)		Inland Surface Waters EQS 2015	0.025 (AA)				0.025 (AA)		

TIER 1 WATER QUALITY STANDARDS (ENGLAND AND WALES)

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Name of Determinand	TSV Freshwater (WYG Tier 1 Screening Value) Defined as most conservative of DWS, River Water EQS and Freshwater Lake EQS	Origin of TSV	River Water EQS	Freshwater Lakes EQS	Transitional and Coastal Waters EQS	Drinking Water Standards
All units µg/l unless otherwise stated						
Para- Para- DDT ¹	0.01(AA)	Inland Surface Waters EQS 2015	0.01 (AA)		0.01 (AA)	
Diazinon ⁷	0.01(AA)	Freshwater EQS 2015	0.01 (AA), 0.02 (95%ile)		0.10 (AA), 0.26 (95%ile)	
Dibromoacetonitrile	70	DWS 2011				70
Dibromochloromethane	100	DWS 2011				100
1,2-Dibromo-3-chloropropane	1	DWS 2011				1
1,2-Dibromoethane	0.4	DWS 2011				0.4
Dichloroacetate	50	DWS 2011				50
Dichloroacetonitrile	20	DWS 2011				20
3,4-Dichloroaniline	0.2 (AA)	Freshwater EQS 2015	0.2 (AA), 5.4 (95%ile)		0.2 (AA), 5.4 (95%ile)	
1,2-Dichlorobenzene	1,000	DWS 2011				1,000
1,4-Dichlorobenzene	300	DWS 2011				300
1,2-Dichloroethane ¹	3	DWS 2010	10 (AA)		10 (AA)	3
1,2-Dichloroethene	50	DWS 2011				50
Dichloromethane ¹	20	DWS 2011	20 (AA)		20 (AA)	20
2,4-Dichlorophenol ⁷	4.2 (AA)	Freshwater EQS 2015	4.2 (AA), 140 (95%ile)		0.42 (AA), 6 (95%ile)	
2,4-Dichlorophenoxyacetic acid (free acid)	0.3 (AA)	Freshwater EQS 2015	0.3 (AA), 1.3 (95%ile)		0.3 (AA), 1.3 (95%ile)	30
4-(2,4-Dichlorophenoxy)butyric acid (2,4 - DB)	90	DWS 2011				90
1,2-Dichloropropane	40	DWS 2011				40
1,3-Dichloropropene	20	DWS 2011				20
Dichlorprop	100	DWS 2011				100
Di(2ethylhexyl)phthalate	1.3(AA)	River Water EQS, Freshwater Lake EQS 2015	1.3 (AA)		1.3 (AA)	8
Dichlorvos ²	0.001(AA)	Inland Surface Fresh Waters EQS	0.001 (AA)		0.04 (AA)	
Dieldrin	0.03	DWS 2011				0.03
Dimethoate	0.48(AA)	Freshwater EQS 2015	0.48 (AA), 4 (95%ile)		0.48 (AA), 4 (95%ile)	6
1,4-Dioxane	50	DWS 2011				50
Diuron ¹	0.2 (AA)	River Water EQS, Freshwater Lake EQS 2015	0.2 (AA), 1.8 (MAC)		0.2 (AA), 1.8 (MAC)	
Ethylene diaminetetraacetic acid (EDTA)	600	DWS 2011				600
Endrin	0.6	DWS 2011				0.6
Endosulphan ^{1,6}	0.005(AA)	Inland Surface Waters EQS 2010	0.005 (AA), 0.01 (MAC)		0.0005 (AA), 0.004 (MAC)	
Enterococci (count per 100ml)	0	DWS 2010				0
Epichlorohydrin	0.1	DWS 2010				0.1
Escherichia coli (E. Coli) (count per 100ml)	0	DWS 2010				0
Ethylbenzene ⁵	20(AA)	Freshwater EQS, Saltwater EQS	20(AA), 200 (MAC)		20(AA), 200(MAC)	300
Fenitrothion ^{2,6}	0.01(AA)	Inland Surface Fresh Waters EQS 2010	0.01 (AA)		0.01 (AA)	
Fenoprop	9	DWS 2011				9
Fluoranthene ¹	0.0063(AA)	Inland Surface Waters EQS 2015	0.0063 (AA), 0.12 (MAC)		0.0063 (AA), 0.12 (MAC)	
Fluoride	1,500	DWS 2010				1,500
Formaldehyde ⁵	5 (AA)	Freshwater EQS	5 (AA), 50 (MAC)			
Glyphosate	196 (AA)	Freshwater EQS 2015	196 (AA), 398 (95%ile)		196 (AA), 398 (95%ile)	
Heptachlor	0.03	DWS 2010				0.03
Heptachlor epoxide	0.03	DWS 2010				0.03
Hexachlorobenzene ¹	0.05(MAC)	Inland Surface Waters EQS 2015	0.05 (MAC)		0.05 (MAC)	
Hexachlorobutadiene ¹	0.6(MAC)	Inland Surface Waters EQS 2015	0.6 (MAC)		0.6 (MAC)	0.6
Hexachlorocyclohexane ¹	0.02(AA)	Inland Surface Waters EQS 2015	0.02 (AA), 0.04 (MAC)		0.002 (AA), 0.02 (MAC)	
Hydroxyatrazine	200	DWS 2011				200
Iron (dissolved)	200	DWS 2010	1000 (AA)		1000 (AA)	200
Isoproturon ¹	0.3(AA)	Inland Surface Waters EQS 2015	0.3 (AA), 1 (MAC)		0.3 (AA), 1 (MAC)	9
Lead (and its compounds) ^{1,7}	1.2 bioavailable (AA)	Inland Surface Waters EQS 2015	1.2 bioavailable (AA), 14 (MAC)		1.3 (AA), 14 (MAC)	10
Lindane	2	DWS 2011				2
Linuron	0.5(AA)	Freshwater EQS 2015	0.5 (AA), 0.9 (95%ile)		0.5 (AA), 0.9 (95%ile)	
Malathion ^{2,8}	0.01(AA)	Inland Surface Fresh Waters EQS 2010	0.01 (AA)		0.02(AA)	
Manganese ⁷	50	DWS 2010	123 (AA) bioavailable			50
Mecoprop	10	DWS 2011	18 (AA), 187 (95%ile)		18 (AA), 187 (95%ile)	10
Mercury (and its compounds) ¹	0.07 (MAC)	Inland Surface Waters EQS 2015	0.07 (MAC)		0.07 (MAC)	1
Methiocarb ⁷	0.01 (AA)	Freshwater EQS 2015	0.01 (AA), 0.77 (95%ile)			
Methoxychlor	20	DWS 2011				20
2-Methyl-4-Chlorophenoxyacetic acid (MCPA)	2	DWS 2011				2
Metolachlor	10	DWS 2011				10
Microcystin-LR	1	DWS 2011				1
Molinate	6	DWS 2011				6
Molybdenum ⁶	70	DWS 2008				70
Monochloramine	3000	DWS 2011				3000
Monochloroacetate (Monochloroacetic Acid)	20	DWS 2011				20
MTBE	15	DWS 2005 (odour threshold)				15
Naphthalene ¹	2 (AA)	Inland Surface Waters EQS 2015	2 (AA), 130 (MAC)		2 (AA), 130 (MAC)	
Nickel (and its compounds) ^{1,7}	4 bioavailable (AA)	Inland Surface Waters EQS 2015	4 bioavailable (AA), 34 (MAC)		8.6 (AA), 34 (MAC)	20
Nitrate	50,000	DWS 2010				50,000
Nitritotriacetic acid (NTA)	200	DWS 2011				200
Nitrite (as NO ₂ ⁻)	500	DWS 2010				500
Inorganic Nitrogen (mM/l) ^{1,4}					Coastal Waters	
					18 (01/11-28/2 Mean)	Clear, Salinity 30 to 34.5
					70 (01/11-28/2 99%ile)	Intermediate turbidity, Salinity 30 to 34.5
					180 (01/11-28/2 99%ile)	Medium turbidity, Salinity 30 to 34.5

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Use WYG flow chart to determine which standards to use. Where more than one value is applicable use the most conservative. If in doubt use WYG TSV Freshwater, defined as most conservative of DWS, River Water EQS, Freshwater Lake EQS,Groundwater Drinking Water Protected Areas Values and General Quality of Groundwater Body Values. Determine River, Freshwater Lake and/or Transitional and Coastal Waters type using classification tables before screening. If after initial screening it is considered that groundwater may significantly impact surface water it is recommended that individual Groundwater Impacts on Surface Water Threshold Values applicable to a groundwater body, given in its Environment Agency River Basin Management Plan, are consulted.

All criteria are sourced from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2015 except Drinking Water Standards sourced from The Water Supply (Water Quality) Regulations 2010;WHO Guidelines for Drinking Water Quality, Third Edition, WHO, 2008; WHO Guidelines for Drinking Water Quality, Fourth Edition, WHO, 2011; Petroleum Products in Drinking Water, WHO, 2005 and Water Supply (Water Quality) Regulations 1989.

Name of Determinand	TSV Freshwater (WYG Tier 1 Screening Value) Defined as most conservative of DWS, River Water EQS and Freshwater Lake EQS		Origin of TSV	River Water EQS	Freshwater Lakes EQS		Transitional and Coastal Waters EQS		Drinking Water Standards
All units µg/l unless otherwise stated									
Inorganic Nitrogen (mg/l) (Only applicable to Transitional and Coastal Water)							270 (01/11-28/2 99%ile)	Very Turbid, Salinity 30 to 34.5	
							Transitional Waters		
							30 (01/11-28/2 Mean)	Clear, Salinity 25	
							70 (01/11-28/2 99%ile)	Intermediate turbidity, Salinity 25	
							180 (01/11-28/2 99%ile)	Medium turbidity, Salinity 25	
							270 (01/11-28/2 99%ile)	Very Turbid, Salinity 25	
N-Nitrosodimethylamine (NMDA)	0.1		DWS 2011						0.1
Nonylphenol (4 - Nonylphenol) ¹	0.3(AA)		Inland Surface Waters EQS 2015	0.3 (AA), 2 (MAC)		0.3 (AA), 2 (MAC)			
Octylphenosl ¹	0.1(AA)		Inland Surface Waters EQS 2015	0.1 (AA)		0.01 (AA)			
PAH: Sum of benzo(b)fluoranthene,benzo(k)fluoranthene, benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene1	0.1		DWS 2010						0.1
Pendimethalin ⁷	0.3 (AA)		Freshwater EQS 2015	0.3 (AA), 0.58(95%ile)					20
Pentachlorobenzene ^{1,6}	0.007(AA)		Inland Surface Waters EQS 2010	0.007 (AA)		0.0007 (AA)			
Pentachlorophenol ¹	0.4 (AA)		Inland Surface Waters EQS 2015	0.4 (AA), 1 (MAC)		0.4 (AA), 1 (MAC)			9
Permethrin (cis- and trans-)	0.001 (AA)		Freshwater EQS 2015	0.001 (AA), 0.01 (95%ile)		0.0002 (AA), 0.001 (95%ile)			
Pesticides: Other individual pesticide	0.3		DWS 2010						0.3
Pesticides: Total	0.5		DWS 2010						0.5
Phenol	7.7 (AA)		Freshwater EQS 2015	7.7 (AA), 46 (95%ile)		7.7 (AA), 46 (95%ile)			
Phosphorous ⁴	12.65	Good annual mean	River EQS 2015	12.65 - minimum good annual mean value calculated from Schedule 2, Table 5 of Water Framework Directions 2015. River EQS	16 (AA)	High Alkalinity, Shallow, Region 1			
	5 (AA)	Low Alkalinity, Deep	Freshwater Lake EQS 2015		25 (AA)	High Alkalinity, Shallow, Region 2			
					23 (AA)	High Alkalinity,Very Shallow, Region 1			
					35 (AA)	High Alkalinity, Very Shallow, Region 2			
					8 (AA)	Moderate Alkalinity, Deep			
					11 (AA)	Moderate Alkalinity, Shallow			
					15 (AA)	Moderate Alkalinity, Very Shallow			
					5 (AA)	Low Alkalinity, Deep			
					7 (AA)	Low Alkalinity, Shallow			
					9 (AA)	Low Alkalinity, Very Shallow			
					9 (AA)	Marl, Shallow			
					10 (AA)	Marl, Very Shallow			
Pyriproxyfen ⁶	300		DWS 2008						300
Selenium	10		DWS 2010						10
Silver ²	0.05 (AA)		Freshwater EQS	0.05 (AA), 0.1 (MAC)		0.5 (AA), 1 (MAC)			
Simazine ¹	1 (AA)		Inland Surface Water EQS 2015	1 (AA), 4 (MAC)		1 (AA), 4 (MAC)			2
Sodium	200,000		DWS 2010						200,000
Sodium dichloroisocyanurate	50,000		DWS 2011						50,000
Sodium dichloroisocyanurate (as cyanuric acid)	40,000		DWS 2011						40,000
Styrene	20		DWS 2011						20
Sulphate	250,000		DWS 2010						250,000
Terbutylazine	7		DWS 2011						7
Tetrachloroethane	140 (AA)		Freshwater EQS 2015	140 (AA), 1848 (95%ile)					
Tetrachloroethene ¹	10		DWS 2010	10(AA)		10 (AA)			10
Tetrachloromethane	3		DWS 2010						3
Tin ²	25 (AA)		Freshwater EQS	25 (AA)		10 (AA)			
Toluene ¹	74(AA)		Freshwater EQS 2015	74 (AA), 380 (95%ile)		74 (AA), 370 (95%ile)			700
Total Indicative Dose, excluding tritium, potassium-40, radon and radon decay products (mSv/year)	0.1		DWS 2010						0.1
TPH EC5-EC7 aromatic (Benzene) ³	1		DWS 2010	10 (AA), 50(MAC)		8 (AA), 50(MAC)			1
TPH EC6-EC8 aromatic (Toluene)	10		DWS 1989	74 (AA), 380 (95%ile)		74 (AA), 370 (95%ile)			10
TPH EC8-EC10 aromatic (Xylene/ Ethylbenzene)	10		DWS 1989	20(AA)		20(AA)			10
TPH EC10-EC12 aromatic (Naphthalene) ³	2		Inland Surface Waters EQS 2015	2(AA)		2 (AA)			10
TPH EC12-EC16 aromatic	10		DWS 1989						10
TPH EC16-EC21 aromatic (inc Benzo(a)pyrene) ³	0.00017		Inland Surface Waters EQS 2015	0.00017 (AA), 0.27 (MAC)		0.00017 (AA), 0.27 (MAC)			10
TPH EC21-EC35 aromatic (inc Benzo(g,h,i)perylene) ³	0.0082		Inland Surface Waters EQS 2015	0.0082 (MAC)		0.0082 (MAC)			10
TPH EC5-EC6 aliphatic	10		DWS 1989						10
TPH EC7-EC8 aliphatic	10		DWS 1989						10
TPH EC9-EC10 aliphatic	10		DWS 1989						10
TPH EC10-EC12 aliphatic	10		DWS 1989						10
TPH EC12-EC16 aliphatic	10		DWS 1989						10
TPH EC16-EC21 aliphatic	10		DWS 1989						10
TPH EC21-EC35 aliphatic	10		DWS 1989						10
Tributyltin compounds ¹	0.0002(AA)		Inland Surface Waters EQS 2015	0.0002(AA), 0.0015(MAC)		0.0002(AA), 0.0015(MAC)			
Trichloroacetate	200		DWS 2011						200
Trichlorobenzenes ¹	0.4(AA)		Inland Surface Waters EQS 2015	0.4 (AA)		0.4 (AA)			
Trichloroethene ¹	10		DWS 2010	10 (AA)		10 (AA)			10
1,1,1-Trichloroethane ^{2,6}	100 (AA)		Inland Surface Waters EQS 2010	100(AA)		100(AA)			
1,1,2-Trichloroethane ^{2,6}	400 (AA)		Inland Surface Waters EQS 2010	400 (AA)		300 (AA)			
Trichloromethane ¹ (Chloroform)	2.5(AA)		Inland Surface Waters EQS 2015	2.5(AA)		2.5(AA)			300
2,4,6 Trichlorophenol	200		DWS 2011						200

TIER 1 WATER QUALITY STANDARDS (ENGLAND AND WALES)

Status: FINAL	Issue No: 8a	Date of Release	08/07/2016
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Choose water quality standard based upon scenario at the site

Use WYG flow chart to determine which standards to use. Where more than one value is applicable use the most conservative. If in doubt use WYG TSV Freshwater, defined as most conservative of DWS, River Water EQS, Freshwater Lake EQS,Groundwater Drinking Water Protected Areas Values and General Quality of Groundwater Body Values. Determine River, Freshwater Lake and/or Transitional and Coastal Waters type using classification tables before screening. If after initial screening it is considered that groundwater may significantly impact surface water it is recommended that individual Groundwater Impacts on Surface Water Threshold Values applicable to a groundwater body, given in its Environment Agency River Basin Management Plan, are consulted.

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Name of Determinand	TSV Freshwater (WYG Tier 1 Screening Value) Defined as most conservative of DWS, River Water EQS and Freshwater Lake EQS		Origin of TSV	River Water EQS		Freshwater Lakes EQS		Transitional and Coastal Waters EQS	Drinking Water Standards
All units µg/l unless otherwise stated									
2,4,5-Trichlorophenoxyacetic acid (2,4,5 - T)	9		DWS 2011						9
Triclosan	0.1 (AA)		Freshwater EQS 2015	0.1 (AA), 0.28 (95%ile)				0.1 (AA), 0.28 (95%ile)	
Trifluralin ¹	0.03(AA)		Inland SurfaceWaters EQS 2015	0.03 (AA)				0.03 (AA)	20
Trihalomethanes (sum of chloform, bromoform, dibromochloromethane and bromodichloromethane)	100		DWS 2010						100
Triphenyltin and its derivatives ^{2,6}	0.02(AA)		Inland Surface Waters EQS 2010	0.02 (AA)				0.008 (AA)	
Tritium (for radioactivity) (Bq/l)	100		DWS 2010						100
Uranium	30		DWS 2011						30
Vanadium ⁶	20 (AA)	0-200 mg/l CaCO ₃	Freshwater EQS 2010	20(AA)	0-200 mg/l CaCO ₃	20(AA)	0-200 mg/l CaCO ₃	100(AA)	
	60 (AA)	200+ mg/l CaCO ₃	Freshwater EQS 2010	60(AA)	200+ mg/l CaCO ₃	60(AA)	200+ mg/l CaCO ₃		
Vinyl Chloride	0.5		DWS 2010						0.5
Xylenes ⁶	30 (AA)		Inland Surface Fresh Waters EQS 2010	30 (AA)				30 (AA)	500
Zinc (total) ^{7,8}	10.9 bioavailable + ABC		Freshwater EQS 2015	10.9 bioavailable + ABC				7.9	

Use these values for initial assessment of all water and leachate results

AA = Annual Average (Mean), MAC = Maximum allowable, concentration, 5%ile = 5th Percentile Value, 10%ile = 10th Percentile Value, 90%ile = 90th Percentile Value, 95%ile = 95th Percentile Value, ABC = Ambient Background Concentration

An n%ile concentration is the concentration of a determinand calculated with statistics that the determinand exceeds 100-n% of the time in a given sample set.

Notes:

- For these determinands the EQS given is for Inland Surface Waters. Inland Surface Waters encompass rivers and lakes and related artificial or heavily modified water bodies. The Other Surface Waters EQS given in the the WFD 2015 document is assumed to be applicable to Transitional and Coastal Waters.
- For these determinands the ISFW EQS given in the the WFD 2015 document is assumed to be applicable to River Water and Freshwater Lakes. The Coastal Waters and Relevant Territorial Waters EQS given in the the WFD 2015 document is assumed to be applicable to Transitional and Coastal Waters.
- If determinand in brackets has been assessed seperately to TPH band use 10µg/l as the TSV.
- For these determinands EQS values have been given for a good quality surface water body. If the surface water receptor is particularly sensitive an EQS value for a high quality surface water body may be more appropriate. These values are presented in the WFD 2015 document.
- Environmental Quality Standard, proposed as part of the implementation of the Dangerous Substances Directive (76/464.EEC)
- Revoked Water Framework Directive 2010 EQS values and WHO 2008 values used in absence of more up to date standards
- Updated 2015 Environmental Quality Standard. To determine bioavailable amounts use UKTAG Metal Bioavailability Assessment Tool (PNEC estimator) <http://www.wfduk.org/tagged/bioavailability-assessment-tool>
- Receptor specific DOC, pH and calcium surface water values required to determine bioavailable fraction. If no data is available assume 100% of Copper, Lead, Manganese, Nickel and Zinc is bioavailable.
- To determine ABC for zinc consult Zinc Ambient Background Concentrations tab

References

Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015

UK Government
http://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksi0d_20151623_en.pdf

DWS (2010) The Water Supply (Water Quality) Regulations 2010: UK Government drinking water standards applicable at consumers tap

http://www.legislation.gov.uk/wsi/2010/994/pdfs/wsi_20100994_en.pdf

DWS (2011) WHO Guidelines for Drinking Water Quality, Fourth Edition, WHO, 2011

WHO Website
http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf

DWS (2005) Petroleum Products in Drinking Water, WHO, 2005

WHO Website
http://www.who.int/water_sanitation_health/dwq/chemicals/Petroleum%20Productsrev071105.pdf

DWS (1989) Water Supply (Water Quality) Regulations 1989 (SI 1989/1147): UK Government drinking water standards

THIS IS NOT AN EXHAUSTIVE LIST OF QUALITY STANDARDS. IF THE SUBSTANCE OF CONCERN IS NOT LISTED HERE CONSULT OTHER SOURCES

For the assessment of risk to surface water intended for drinking water abstraction,to bathing water or to shellfish in saltwater from bacteria it is recommended that the following Environment Agency website is consulted:

<http://evidence.environment-agency.gov.uk/ChemicalStandards/Home.aspx>

If no UK, EU or WHO value is available consider the use of U.S., Canadian and Dutch Screening Criteria



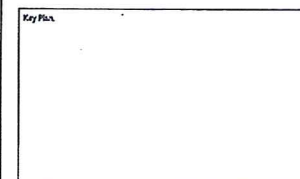
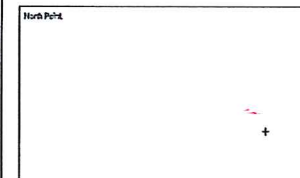
Appendix K – Typical Foundation Detail

● STOB COLUMN/
TO SUPPORT
GROUND FLOOR
SLAB.

● COLUMN OVER/
STOB COLUMN

--- STRIP FOOTING
(SEE DETAIL).

REFER TO SK-08
FOR SECTION X-X
DETAIL

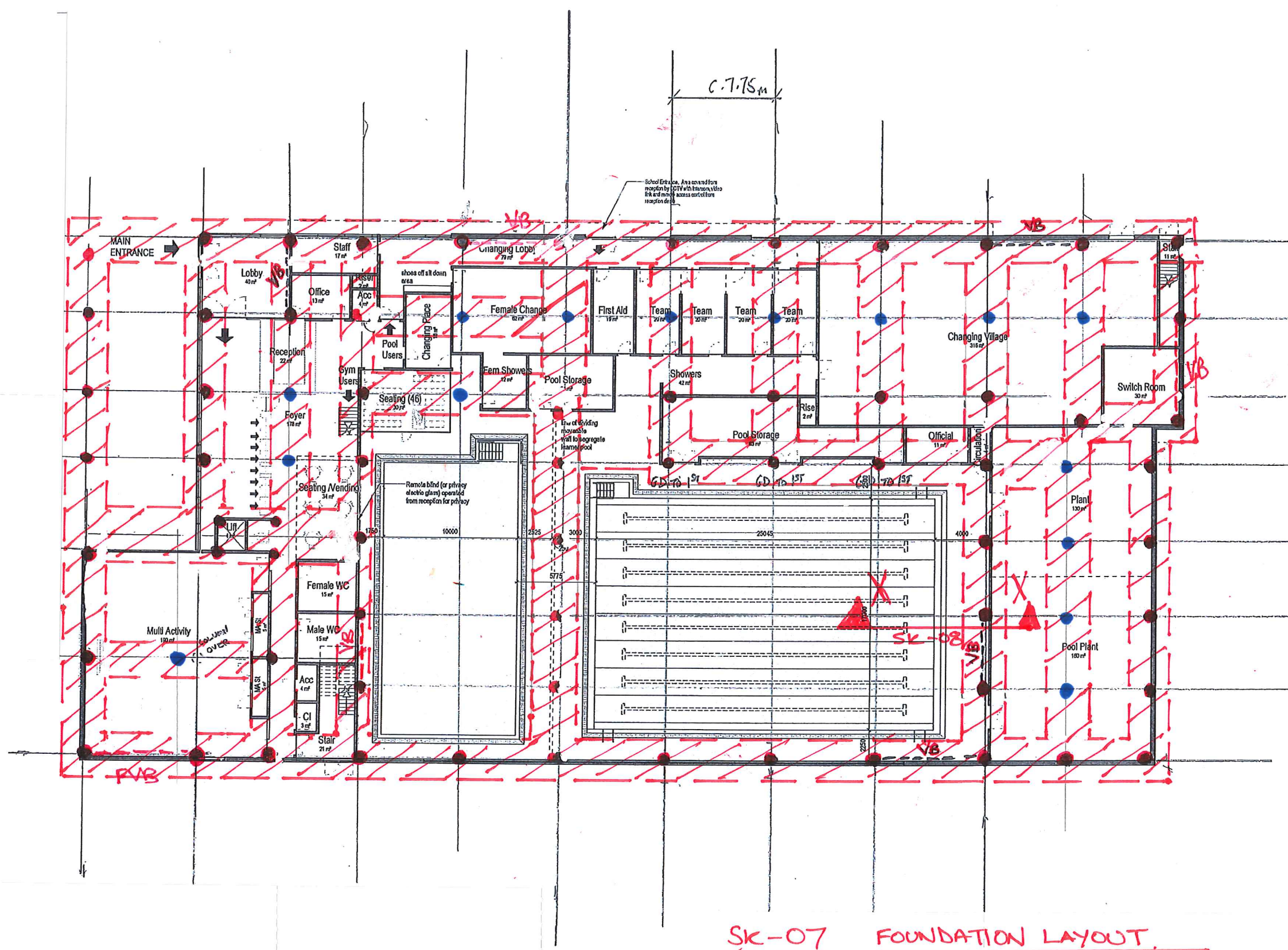


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Johin Spenborough			
Drawing Ground Floor Plan			
Scale			
Drawn by	Date	Checked by	Rev. No.
Author	12/2/16	Checker	1:100
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Continued Drawing No.			



SK-07 FOUNDATION LAYOUT.



Project
No **A097478-1**

Calculation
Sheet No **SK-08**

Office

Division

Project Title **SPENBOROUGH**

Prepared by

Work Section **TYPICAL FOUNDATION DETAIL**

Date **MAR 17'**

