Model Details

Storage is Online Cover Level (m) 50.300

Pipe Structure

Diameter (m)	0.150	Length (m)	60.000
Slope (1:X)	150.000	Invert Level (m)	49.210

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	150.0	Coefficient of Contraction	0.600
Length (m)	40.000	Upstream Invert Level (m)	49.210
Roughness k (mm)	0.600		

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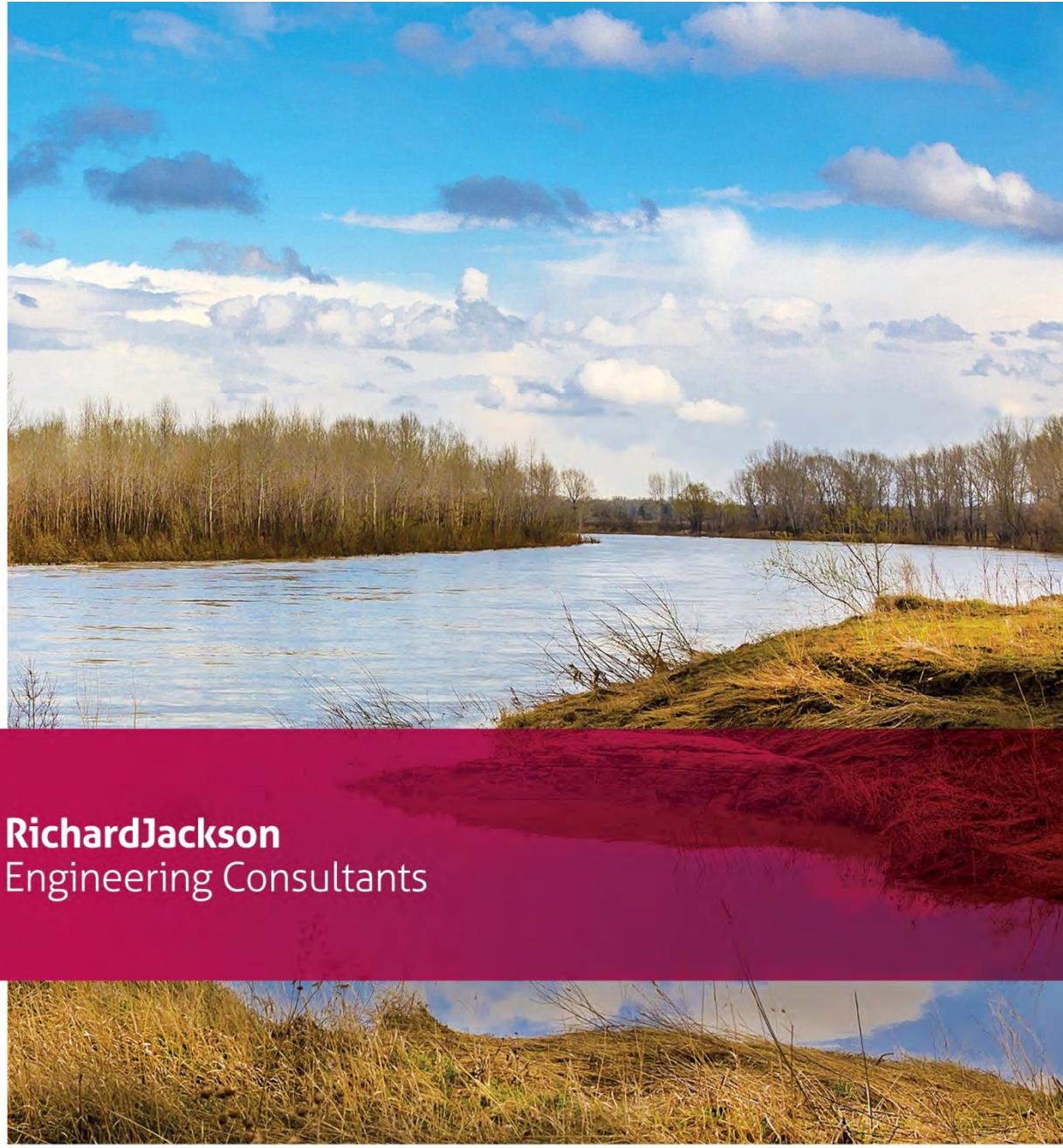
Appendix F

Site Investigation



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PHASE TWO GROUND INVESTIGATION REPORT

Queenswood School, Hatfield, Hertfordshire, AL9 6NS

Ball Hall (Project Management) Limited

March 2017

Project no: 47875

RichardJackson
Engineering Consultants

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EXECUTIVE SUMMARY

Purpose:	Richard Jackson undertook intrusive ground investigation to establish the prevailing ground conditions, recover soil samples and assess the contamination status of the site.
Site Status:	At the time of the investigation the site was occupied by the existing steel-framed sports hall building together with two mobile classrooms and a former plant room to the south of the main structure. The area surrounding the Sports Hall was predominantly soft cover with a large number of mature trees of up to approximately 20m in height.

Review of Previous Investigations:	**Geotechnical & Environmental Associates Ltd, Ground Investigation Letter Report, J09020a/ML/1, October 2009.**
	The investigation was carried out to determine the ground conditions at the site for use in the design of a new sports hall following the demolition of the existing structure. The scope of works included:
	• 4no. open drive (windowless) sampler boreholes to 3.0m below ground level (bgl)
	• 4no. dynamic probe tests to 3.0m bgl
	Ground conditions were summarised as follows:
	• Made ground
	  ○ Brown silty sand with gravel of brick and concrete
	• Pebble Gravel
	  ○ Firm orange brown silty sandy clay
	  ○ Medium dense orange brown mottled grey clayey silty medium to coarse sand
	  ○ Very dense pale grey/orange brown slightly clayey medium to coarse Sand and Gravel Deposit
	Groundwater was not encountered during the investigation.
	Pad/strip foundations at 1.0m – 1.5m bgl bearing onto the firm sandy clay of the Pebble Gravel were considered suitable, with deepening of foundations recommended in the vicinity of trees due to the presence of high shrinkability clays.
	
	Richard Jackson Ltd, Phase One Desk Study, December 2016.
	British Geological Survey (BGS) mapping of the area indicates that the site is underlain by superficial deposits of Sand and Gravel Deposit of Uncertain Age and Origin (Secondary (A) Aquifer), underlain by the London Clay Formation (Unproductive strata).
	Development of the site initially occurred during the 1960s, associated with Queenswood School. The site was subsequently redeveloped with the present-day Sports Hall by the 1990s.
	Potential sources of on-site contamination were identified to be:
	• Localised areas of made ground
	• ACM identified in the fabric of the existing on-site structures
	• Chemical storage in the plant room.
	A moderate / low risk from soil, groundwater and ground gas contamination was considered to affect the site.
	Intrusive ground investigations were recommended to:
	• Confirm the prevailing ground conditions

	• Establish the presence and extent of made ground • Assess the contamination status of the site.
Fieldwork:	The fieldwork comprised the formation of eight trial pits incorporating one infiltration test and two foundation exposures. Soil sampling was undertaken throughout the depth of the trial pits.
Ground Conditions:	The deposits encountered in this investigation comprised the following sequence: • Made ground to a maximum depth of 0.60m bgl • Cohesive deposits of Sand and Gravel Deposit of Uncertain Age and Origin to a maximum depth of 2.3m bgl • Granular deposits of Sand and Gravel Deposit of Uncertain Age and Origin remained unproven at a maximum depth of 3.5m bgl Groundwater was encountered as strikes between 1.5m bgl and 2.7m bgl.
Existing Foundations:	Two foundation exposure trial holes were excavated to depths of 1.1m bgl (TP4) and 1.45m bgl (TP6). The foundations were observed to be 0.9m wide pads, extending to depths of 0.87m bgl (TP6) and 0.95m (TP4) bearing onto firm to stiff orange brown slightly sandy, slightly gravelly clay.
Soil Contamination:	One made ground sample presented concentrations of dibenz(a,h)anthracene marginally in excess of its tier one screening value for human health. However, given that a very conservative screening criteria based upon near constant exposure to contaminants in very young children was applied, remediation of this area is not considered necessary.
Structural Foundations:	Shallow mass concrete foundations were considered appropriate for the proposed development at the site. A safe bearing pressure of 130 kN/m^2 has been determined for 1.5m by 1.5m square pad footings at 1.5m bgl. The proximity of the water table should be considered and foundations should not be excavated below the water table without suitable groundwater control measures.
Ground Floor Construction:	Fully suspended ground floor slabs are recommended for adoption within the extensions to the sports hall and should incorporate a sub floor void appropriate to high volume change potential soils.
Concrete Grade:	A design sulphate class of DS-2 is considered appropriate for use on site, with an aggressive chemical environment for concrete (ACEC) classification of AC-3z recommended.
Drainage:	The relatively shallow depth of groundwater at the site and predominantly cohesive nature of the shallower soils is likely to prevent the adoption of infiltration drainage and alternative methods of surface water disposal should be considered.

1. Introduction

Richard Jackson Ltd received an instruction to undertake ground investigation works in connection with the proposed sports hall redevelopment at Queenswood School, Hatfield, Hertfordshire, AL9 6NS.

The works were instructed by the Client, Ball Hall (Project Management) Limited and were carried out in accordance with our fee proposal of 20th January 2017, reference: BF/47875.

The Client has forwarded an account of previous intrusive investigations at the site as detailed in the Ground Investigation Letter Report prepared by Geotechnical & Environmental Associates, reference J09020a/ML/1, dated October 2009. This is briefly reviewed in this report.

A phase one desk study report has previously been prepared for the site by Richard Jackson Ltd, report reference 47875 dated December 2016. This is briefly reviewed in this report.

The intrusive investigation, on which this report is based, comprised the formation of eight trial pits and included infiltration testing at one location and exposure of the existing sports hall foundations at two locations. In-situ testing and soil sampling were also undertaken.

This report assesses the findings of the intrusive investigation and gives recommendations for use in the design and construction of the proposed scheme.

Chemical analysis has been undertaken in order that the contamination status of the site may be determined and the need for further investigation of remediation assessed.

This report shall be read in conjunction with the limitations of investigation provided in Appendix F.

2. Site Location and Description

Queenswood School was located to the south of Shepherds Way, Hatfield, Hertfordshire, AL9 6NS and the sports hall was located in the northern part of the school grounds. The approximate Ordnance Survey grid reference for the centre of the site was TL 267 035. A site location plan is presented as Figure 1 in Appendix A.

The Sports Hall site was approximately rectangular with maximum approximate dimensions of 50m north to south by 45m east to west. The site was approximately level at an elevation of 130m aOD.

At the time of the investigation the majority of the site was occupied by the existing steel-framed sports hall building, clad in corrugated suspected asbestos cement sheets. To the south of the sports hall were two single-storey mobile classrooms of mid-1960s construction which were suspected

to contain asbestos containing materials (ACM) in the roof and walls. A former plant room structure was also located in this area.

The remainder of the surrounding area was predominantly soft cover comprising wood chip surfacing material or areas of maintained grass.

A large number of mature Oak and Horse Chestnut trees of up to approximately 20m in height were noted in the southern and western parts of the site.

A detailed site description is presented as Section 4 of Phase One Desk Study report, reference 47875, dated December 2016.

3. Review of Previous Investigations

As mentioned in Section 1, previous investigations have been undertaken at the site. These are summarised in the following section.

3.1. Geotechnical & Environmental Associates (GEA) Ltd, Ground Investigation Letter Report, J09020a/ML/1, October 2009

The investigation was carried out to determine the ground conditions at the site and provide an assessment of the existing ground floor slab for use in the design of a new sports hall following the demolition of the existing structure. The scope of works included:

- 4no. open drive (windowless) sampler boreholes to a maximum depth of 3.0m below ground level (bgl) with standard penetration testing undertaken in 2no. of the boreholes
- 4no. dynamic probe tests to a maximum depth of 3.0m bgl

The exploratory holes were located internally, within the existing sport hall.

Ground conditions were summarised as follows:

- Made ground (brown silty sand with gravel of brick and concrete) to a maximum depth of 1.0m bgl
- Pebble Gravel
    - Firm orange brown silty sandy clay to maximum depth of 2.0m bgl
    - Medium dense orange brown mottled grey clayey silty medium to coarse sand which extended to depths of between 2.6m to 3.0m bgl.
    - Very dense pale grey or orange brown slightly clayey medium to coarse sand and fine to coarse subrounded to angular gravel, the base of which remained unproven at 3.0m bgl.

Groundwater was not encountered during the investigation.

Geotechnical testing included:

- Eight natural moisture content (NMC) determinations
- Four atterberg limit tests
- One particle size distribution (PSD) determination
- Two pH value and water soluble sulphate content determinations

GEA Ltd considered that pad/strip foundations at 1.0m – 1.5m bgl bearing onto the firm sandy clay of the Pebble Gravel were suitable. Deepening of foundations was recommended in the vicinity of trees due to the presence of high shrinkability clays. Reuse of the existing ground bearing floor slab was considered to be possible, although given the presence of trees and partially desiccated soils recorded, provision of a root barrier around the building to prevent root penetration was recommended.

3.2. Richard Jackson Ltd, Phase One Desk Study, December 2016

The British Geological Survey (BGS) 1:50,000 scale series mapping of the area indicates that the site is underlain by a superficial deposit of Sand and Gravel Deposit of Uncertain Age and Origin, underlain by the London Clay Formation. The Sand and Gravel Deposit of Uncertain Age and Origin is classified as a Secondary (A) Aquifer, whilst the underlying London Clay Formation is classified as an unproductive stratum in terms of its aquifer capabilities.

The site remained undeveloped woodland until the 1960s, when two small structures associated with Queenswood School were constructed. The site was subsequently developed with the construction of the present-day sports hall in the 1990s with mobile classrooms and plant room to the south.

The surrounding area has been predominantly occupied by woodland throughout the historical period examined (1866-2014). Queenswood School and its associated structures were present to the south of the site from the 1930s.

Potential sources of contamination were identified to be:

- Localised areas of made ground associated with the historic development at the site.
- ACM identified in the fabric of the existing sports Hall, mobile classrooms and the former plant room on-site.
- Historical chemical storage in the plant room on-site.
- Off-site infilled ponds and filter beds (sources of ground gas)
- Off-site above ground diesel storage tank constructed on hardstanding

A moderate / low risk from soil, groundwater and ground gas contamination

was considered to affect the site.

Intrusive ground investigations were recommended to be are undertaken at the site to confirm the prevailing ground conditions, establish the presence and extent of made ground and confirm the depth to the London Clay Formation. It was also recommended that an assessment of the contamination status of the site should be made at this time.

4. Proposed Development

The proposed development is to comprise the refurbishment and extension of the existing sports hall which will include sports courts, studios, amenity areas, offices and a viewing gallery.

Proposed development plans are presented in Appendix A.

5. Factual Ground Investigation Information

The findings of the factual ground investigation are provided in the following sections.

5.1. Fieldwork

The fieldwork on which the report is based was undertaken on 14th February 2017 and comprised the following:

- The machine excavation of eight trial pits – (TP1 – TP2, TP2A, TP3 – TP7)
- Soakage tests in one of the trial pits in accordance with BRE 365 (2007) (TP2A)
- Exposure of existing foundations in two of the trial pits (TP4 and TP6)

An exploratory hole location plan is presented as Figure 2 in Appendix A. Exploratory hole logs are presented in Appendix C and give descriptions and depths of strata encountered, together with details of samples taken, in-situ tests and other relevant information.

Where applicable, investigative techniques, sampling, logging of soils and insitu testing complied with the requirements of British Standard BS5930:- 'Code of Practice for Site Investigations' (2015).

5.1.1. Trial Pitting

A mechanical excavator was used to form eight trial pits (TP1 – TP2, TP2A, TP3 – TP7) to depths of between 1.1m bgl (TP6) and 3.5m bgl (TP3). Trial pits were positioned to provide a representative coverage of the site.

Disturbed soil samples were recovered from throughout the depth of exploratory holes for chemical analyses, geotechnical testing and record

purposes. Samples recovered for chemical analyses were stored in air tight plastic containers and amber glass jars.

All samples recovered for chemical analysis were transported to the analytical laboratory, Chemtest Ltd, in cool boxes under chain of custody protocols.

Where cohesive soils were encountered, a hand shear vane were used to assess the undrained shear strength of the encountered soils. The results of these tests are recorded as the 'IVN' values and are presented on the trial pit logs in Appendix C.

A photo-ionisation detector (PID) was used to screen recovered soil samples for the presence of volatile organic compounds (VOC). Results of this screening are included on the WLS borehole records.

Soakage tests were undertaken in one of the trial pits (TP2A) as discussed in Section 5.1.2 below.

5.1.2. Infiltration Testing

Infiltration testing was undertaken in one of the trial pits (TP2A), in accordance with current guidance given in BRE Digest 365, 'Soakaway Design', (2007).

The trial pit was filled with clean water from a water tanker and the fall in water level in the trial pit was monitored at regular intervals.

Only a single unsuccessful test run was undertaken in the trial pit. This was abandoned and repeat tests were not undertaken due to groundwater seepages disrupting the measurements.

5.1.3. Foundation Exposure Trial Holes

Two of the trial pits (TH4 & TH6) were excavated adjacent to the existing sports hall structure to expose existing foundations.

The trial pits were extended to depths of 1.1m bgl (TP4) and 1.45m bgl (TP6).

The trial holes were terminated once the underside of the existing foundations had been determined, so as not to destabilise them.

The foundations were observed to be 0.9m wide foundations extending to depths of 0.87m bgl (TP6) and 0.95m (TP4) bearing into firm to stiff orange brown slightly sandy, slightly gravelly clay. Strength tests using a hand shear vane were undertaken at the base of the foundations and recorded to be 50kN/m^2 (TP6) and 105kN/m^2 (TP6).

Disturbed samples were recovered from throughout the depth of the trial hole for geotechnical testing.

The trial hole logs are presented in Appendix C and include details of the encountered foundation.

5.2. Laboratory Testing

5.2.1. Geo-Environmental Testing

Chemical analyses were undertaken on a number of soil samples recovered from the site. Details of chemical analyses undertaken are provided in Section 6. Results of chemical analyses are presented in full in Appendix D.

5.2.2. Geotechnical Testing

Disturbed and undisturbed soil samples recovered from the exploratory holes were sent to a UKAS accredited soil testing laboratory Soil Property Testing (SPT) Ltd. The following tests were carried out in accordance with BS1377:1990:

- Eleven natural moisture content (NMC) determinations
- Seven atterberg limit tests (four point liquid limit cone method)
- Three particle size distribution (PSD) determinations
- Eight pH value and sulphate (2:1 water soil extract) content determinations

The results of this testing are presented in Appendix E.

5.3. Ground Conditions

The British Geological Survey (BGS) 1:50,000 scale series mapping of the area Sheet 239, Hertford, drift edition (1978) indicates that the site is underlain by a superficial deposit of Sand and Gravel Deposit of Uncertain Age and Origin, also referred to as Pebble Gravel. This is indicated to be underlain by the London Clay Formation.

The deposits encountered in this investigation comprised the following sequence:

- Made ground
- Sand and Gravel Deposit of Uncertain Age and Origin
    - Cohesive Sand and Gravel Deposit deposits
    - Granular Sand and Gravel Deposit deposits

It should be noted that the encountered ground conditions are broadly consistent with that encountered in GEA Ground Investigation Letter Report reference J09020a/ML/1, dated October 2009. Therefore, the GEA findings have been included in the following sections.

5.3.1. Made Ground

Concrete was encountered from ground level in GEA BH1 - BH4 to a maximum depth of 0.2m bgl. Steel reinforced concrete was underlain by a granular sub-base layer, typically comprising brown silty sand with brick and concrete rubble. The subbase was encountered to a 0.7m bgl.

Made ground was encountered from ground level in TP1 – TP7 and beneath the subbase material in GEA BH1. The maximum depth of the made ground was recorded to be 1.0m bgl (GEA BH1).

Where encountered at the surface in TP1 – TP7 (external exploratory holes) The made ground typically comprised woodchip surfacing over dark brown slightly clayey fine to medium sand or humic clay with roots and decayed plant matter. The gravel was recorded to comprise flint, glass, brick, plastic and tile fragments.

Made ground was also encountered as a soft grey brown gravelly clay in TP2, TP3, TP5, TP6 & TP7 beneath the surface layer. Gravel was recorded to be subangular to subrounded fine to coarse flint.

Headspace screening using the PID was undertaken on a number of samples of made ground from TP1 – TP7, full results of which are presented on the exploratory hole logs. Recorded VOC concentrations ranged from 0.1ppm (TP5 at 0.10m bgl) to 2.4ppm (TP2 at 0.10m bgl).

5.3.2. Sand and Gravel Deposit of Uncertain Age and Origin (GEA Pebble Gravel)

Soils interpreted to represent the Sand and Gravel Deposit of Uncertain Age and Origin (S&G) were encountered beneath the made ground/subbase in each of the exploratory holes.

Soils interpreted to form the Sand and Gravel Deposit were encountered as cohesive (slightly sandy, slightly gravelly clay) deposits, overlying granular (gravelly sand) deposits.

The Sand and Gravel Deposit was encountered to a maximum depth of 3.5m bgl (TP3), the base of which was not penetrated during this investigation.

<u>Cohesive Sand and Gravel Deposit</u>

The cohesive Sand and Gravel Deposit was encountered beneath the made ground/subbase in each of the exploratory holes. The maximum depth to which the cohesive Sand and Gravel Deposit was encountered was 2.3m bgl in TP7.

The cohesive Sand and Gravel Deposit was typically recorded to be a soft becoming firm orange brown mottled grey, slightly sandy, slightly gravelly clay with grey silt partings and gravel of subangular fine to medium flint. The deposit was generally noted to increase in stiffness and become orange and grey mottled, variably sandy/silty clay with occasional flint gravel with increasing depth.

Headspace screening using the PID was undertaken on a number of samples of the cohesive Sand and Gravel Deposit from TP1 – TP7, full results of which are presented on the exploratory hole logs. Recorded VOC concentrations ranged from 0.0ppm to 1.3ppm (TP3 at 0.5m bgl).

In-situ standard penetration tests (SPT) were undertaken throughout the depth of the cohesive Sand and Gravel Deposit deposits in GEA BH2 and BH3 to provide an indication of the soil density / stiffness. The number of blows required to advance a standard split spoon over the final 300mm of a 450mm total drive was recorded as the 'N' value.

The results of these tests ranged from N=15 (GEA BH2 at 1.0m bgl) to N=25 (GEA BH3 at 1.0m bgl) Full results are provided in the BH logs presented with the letter report in Appendix B.

Hand shear vane tests were also undertaken throughout the depth of the cohesive Sand and Gravel Deposit in TP1 – TP7. The results of these tests ranged from 40 kN/m^2 (TP1 at 0.8m bgl and TP2 at 1.2m bgl) to 105 kN/m^2 (TP4 at 1.0m bgl). Full results are provided as the 'IVN' values on the exploratory hole logs and summarised on the 'undrained shear strength – vs- depth plot presented in Appendix C.

Atterberg limit tests were undertaken on seven samples of the cohesive Sand and Gravel Deposit and plasticity indices ranged between 24% and 57%. Full results of these tests are provided in Appendix B and E.

Modified plasticity indices of between 24% and 57% were calculated on the basis of the following relationship:

- Modified plasticity index = (% samples passing 0.425mm sieve x plasticity index) / 100

The results of the atterberg limit tests indicated the cohesive Sand and Gravel Deposit to be of intermediate to very high plasticity and hence of high volume change potential.

Two particle size distribution (PSD) determinations were undertaken on samples of the cohesive Sand and Gravel Deposit. Full results of these tests are provided in Appendix E.

<u>Granular Sand and Gravel Deposit Deposits</u>

The granular Sand and Gravel Deposit deposits were encountered beneath the cohesive Sand and Gravel Deposit deposits in each of the trial pits except for TP2A, TP4 and TP6. The base of the granular Sand and Gravel Deposit deposits remained unproven at a maximum depth of 3.5m bgl (TP3).

The granular Sand and Gravel Deposit deposits were typically recorded to be an orange/grey/brown, very clayey, slightly gravelly fine to coarse sand with a gravel of subangular to subrounded fine to coarse flint. The deposit typically became less clayey and more gravelly with depth.

Headspace screening using the PID was undertaken on a number of samples of the granular Sand and Gravel Deposit deposits in TP1 – TP7, full results of which are presented on the exploratory hole logs. Recorded VOC concentrations ranged from 0.0ppm to 1.0ppm (TP1 at 2.4m bgl).

In-situ standard penetration tests (SPT) were undertaken throughout the depth of the granular Sand and Gravel Deposit deposits in GEA BH2 and BH3 to provide an indication of the soil density. The number of blows required to advance a 60° nose cone over the final 300mm of a 450mm total drive was recorded as the 'N' value.

The results of these tests ranged from N=39 (GEA BH2 at 3.0m bgl) to N=75/245mm (GEA BH3 at 3.0m bgl). Full results are provided in the BH logs presented with the letter report in Appendix B.

One particle size distribution (PSD) determination was undertaken a sample of the granular S&G. Full results of this tests are provided in Appendix E.

5.3.3. Groundwater

Groundwater was encountered in a number of the exploratory holes during formation and subsequent monitoring. Table 1, provides a summary of the groundwater strike depth including the strata in which it was encountered.

Table 1: Summary of Groundwater Strikes During Excavation

Exploratory Hole	Strike Depth (m bgl)	Stratum
TP1	1.5	Granular Sand and Gravel Deposit
TP2	1.8	Cohesive Sand and Gravel Deposit
TP2A	*Not Encountered*	
TP3	2.0	Granular Sand and Gravel Deposit
TP4	0.5 and 1.0	Cohesive Sand and Gravel Deposit
TP5	2.5	Granular Sand and Gravel Deposit
TP6	1.0	Cohesive Sand and Gravel Deposit
TP7	2.7	Granular Sand and Gravel Deposit

No groundwater was encountered strikes were observed in the GEA boreholes.

6. Geo-Environmental Assessment

The purpose of this section is to provide an assessment of the contamination status of the site.

The analysis was undertaken by Chemtest Ltd., a UKAS and MCerts accredited laboratory.

6.1. Soil Analysis

A broad suite of analyses was scheduled, including metals, organic and inorganic compounds.

Six samples of soil have been analysed for a broad suite of contaminants as follows:

Arsenic	pH
Cadmium	Total Sulphate
Chromium	Water Soluble Sulphate
Copper	Total Phenols
Nickel	BTEX Compounds
Lead	Sulphide
Mercury	Speciated Polyaromatic Hydrocarbons (PAH)
Selenium	Organic Matter Content
Zinc	Total Petroleum Hydrocarbons (TPH)

Asbestos screening was undertaken by the analytical laboratory on six samples of soil.

6.1.1. Reference Criteria

Screening values have been adopted for the site to reflect site-specific parameters, such as, intended end use and the Soil Organic Matter (SOM). Screening values have been developed on the basis of current guidance as given in The Land Quality Management / Chartered Institute of Environmental Health document, 'The LQM / CIEH S4ULS for human health assessment', (2015) publication no. S4UL3379.

It is understood that the site is to be developed for use as a sports hall which forms part of a larger boarding school site. Given that end users are likely to include school age children and adults, conservative screening values specific to Residential without homegrown produce have been adopted for the site. It is however acknowledged that without further site specific risk assessment these screening values are likely to be overly conservative.

A SOM of 6% has been adopted for organic chemicals for the purposes of the initial assessment on the basis of laboratory analysis. A SOM of 6% has been adopted for inorganic chemicals as detailed in 'The LQM / CIEH S4ULS for human health assessment', (2015).

In the absence of published S4UL for lead, the DEFRA Category 4 Screening Level (C4SL) for lead has been adopted.

Full details of the reference criteria used to derive the screening values, including the adopted values, are provided in Appendix D and summarised below.

The adopted screening values are also summarised in the following section.

6.1.2. Discussion of Analytical Results – Soils

Results of the chemical analyses undertaken on soils are presented in Appendix D and summarised in Table 2.

Table 2: Results of Chemical Analyses - Soils

Contaminant	No of Samples Tested	Screening Value (mg/kg)	Range of Concentrations (mg/kg)	No of samples exceeding screening value
Arsenic	6	40	1.6 – 16	0
Cadmium	6	85	0.29 – 1.6	0
Chromium	6	910	5.6 – 25	0
Copper	6	7100	5.9 – 38	0
Nickel	6	180	3.4 – 22	0
Lead	6	310	67 – 160	0
Selenium	6	430	< 0.2 – 0.76	0
Mercury	6	56	0.1 – 0.54	0
Zinc	6	40000	29 – 1400	0
Benzo(a)pyrene	6	3.2	< 0.1 – 1.7	0
Dibenz(a,h)anthracene	6	0.32	< 0.1 – 0.34	**1**
Naphthalene	6	13	< 0.1 – 2.2	0
Total Phenols	6	2300	< 0.3	0
TPH Aromatic C_5-C_7	6	1400	< 0.1	0
TPH Aromatic C_7-C_8	6	3900	< 0.1	0
TPH Aromatic C_8-C_{10}	6	270	< 0.1	0
TPH Aromatic C_{10}-C_{12}	6	1200	< 0.1	0
TPH Aromatic C_{12}-C_{16}	6	2500	< 0.1	0
TPH Aromatic C_{16}-C_{21}	6	1900	< 0.1 – 4.7	0
TPH Aromatic C_{21}-C_{35}	6	1900	< 0.1	0
TPH Aliphatic C_5-C_6	6	160	< 0.1	0
TPH Aliphatic C_6-C_8	6	530	< 0.1	0
TPH Aliphatic C_8-C_{10}	6	150	< 0.1	0
TPH Aliphatic C_{10}-C_{12}	6	70	< 0.1	0

Contaminant	No of Samples Tested	Screening Value (mg/kg)	Range of Concentrations (mg/kg)	No of samples exceeding screening value
TPH Aliphatic C_{12}-C_{16}	6	4400	< 0.1	0
TPH Aliphatic C_{16}-C_{35}	6	110000	< 0.1	0
Benzene	6	1.4	< 0.001	0
Toluene	6	3900	< 0.001	0
Ethylbenzene	6	440	< 0.001	0
M & P xylene	6	430	< 0.001	0
O xylene	6	480	< 0.001	0

Asbestos was not detected in the six samples which underwent asbestos screening.

From the above it is evident that one sample presented concentrations of dibenz(a,h)anthracene in excess of its tier one screening value for human health.

6.2. Risk Assessment

6.2.1. Soil Contamination and Sports Hall Users

Considering initially the likely sports hall users, exposure to contaminants would be primarily through direct contact, ingestion or inhalation of contaminated soils where soil is exposed such as in soft landscaping areas.

There is considered to be a significantly reduced risk beneath buildings or in paved areas, as in such areas there is no pathway by which the pollutant linkage may be completed.

As detailed in the preceding sections, an elevated concentration of dibenz(a,h)anthracene was encountered within the soil in TP1 at 0.2m bgl in excess of residential without homegrown screening values. Given that the recorded contamination is only marginally in excess of a very conservative screening criteria based upon near constant exposure to contaminants in very young children, it is therefore not considered that remediation of this area will be necessary.

6.2.2. Soil Contamination and Construction Workers, Maintenance Works and the Public

Risks to site workers and site neighbours during redevelopment arise primarily through dermal contact, ingestion and inhalation of contaminants. It is considered that the degree of contamination observed poses a very low risk to site workers and the general public.