



Resource & Environmental Consultants Ltd

PHASE I & PHASE II GEO-ENVIRONMENTAL SITE INVESTIGATION

**Former works at 59 – 61 West Street
West Street
Havant
PO9 1LN**

**REC Report: 20586 v1.1 DRAFT
Issued: February 2014**

Prepared for:

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National Consultancy, Locally Delivered



QUALITY ASSURANCE

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EXECUTIVE SUMMARY

Site Address	59 – 61 West Street, Havant, PO9 1LN
Grid Reference	471427,106291
Site Area	0.29ha
Current Site Use	The subject site comprises of a roughly square plot with a large iron access gate to the north west of the site. The site comprises of three roughly rectangular buildings, with a large area of tarmac covered hard standing. A stockpile of waste varnish, oil and creosote containers were observed towards the east of the site. The ground topography is slopes slightly north to south.
Site History	Historical maps indicate that the site was comprised of assumed residential housing from 1869 until ca 1897. From Pre 1897 the site was occupied by a parchment works until ca 1969. The land use was recorded as a builder's yard from this period and comprised of five buildings on the site. By 1989 there were three remaining building footprints on the site.
Environmental Setting	The site is underlain by a Principal Aquifer. Within 2.0km of the site boundary there are three ground water abstraction licenses. The site is within flood plain zones two and three. There is one designated environmentally sensitive land use within a 1.0 km boundary of the site.
Utility Locations	Service plans were provided by the client for use in determining the locations of the intrusive investigations in this report.
Landfill Sites & Ground Gases	There are no operational or historical landfill sites within a 500 m radius of the site.
Radon	The GroundSure Report indicates the site is situated in an area where 3% to 5% of properties are above the Action Level.
Geology, Hydrology & Hydrogeology	Drift – Head Deposits Bedrock –Lewes Nodular Chalk Formation Groundwater – Principal Aquifer
Intrusive Ground Investigation	
Ground Conditions	Made Ground Fine grained soils (either clay or silt) with a variable mix of coarse grained minor constituents consisting of brick, clinker, flint and chalk to a max depth of 1.30 m bgl. Drift – Head Deposits Soft to firm light brown slightly sandy gravelly CLAY. Gravel of sub-angular to sub-rounded fine to coarse flint, with medium cobble content and occasional angular chalk fragments. Solid Geology – None discovered (expected Lewes Nodular Chalk Formation) Ground Water – ranged from 0.90m to 1.20m bgl.

Geotechnical Assessment

It is estimated that within fine grained soils at 2.0m bgl an approximate allowable bearing capacity of 100kPa is possible with pad foundations, with a width of 1.0m, limiting total settlement to less than 25mm, with a factor of safety of 3.

It is estimated within coarse grained soils at 1.0m bgl an approximate allowable bearing capacity of 100kPa is achievable for pad foundation, with a width of 1.0m bgl, a factor of safety of 3, limiting total settlement to less than 25mm.

It is considered that the soils at the site would have a CBR design of 8%, with any value greater than 8% accounting for the variability of the Made Ground.

At a depth of 1.0m to 2.0m bgl an approximate permeability of 1×10^{-1} to 4×10^{-2} m/sec has been calculated for the encountered gravels. This indicates a high permeability and therefore soakaways systems within encountered granular deposits are considered viable for the site

The soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE Special Digest 1 (2005).

Revised Conceptual Site Model

The Tier I Human Health Risk Assessment has identified elevated concentrations of Lead and Benzo(a)Pyrene that have the potential to present a significant risk to controlled waters. The current investigation has identified a number of potential sources of ground gas that have the potential to pose a significant risk to human health.

Recommendations

It is recommended that further investigation work is carried out within building footprints post demolition to investigate the inaccessible areas of the site for potential contamination.

It is recommended that the historical underground storage tank is removed and the excavation validated by a suitably qualified geo-environmental engineer.

Due to the presence of up to 1.3m of Made Ground, the presence of an underground petroleum storage tank, and the presence of historical ground workings within a 250m radius of the subject site, it is recommended that a period of ground gas and groundwater level monitoring is undertaken to facilitate an assessment of the risks posed by ground gas in line with CIRIA C665.

Given the presence of a spring beneath the site together with the presence of a high groundwater level and the close proximity of springs utilised by Portsmouth Water for the supply of potable water and an adjacent surface watercourse, it is recommended that groundwater sampling and analysis is undertaken to determine whether the shallow groundwater has been impacted by the leaching of contaminants from the Made Ground.

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A CD containing all relevant environmental database information, historical & geological mapping and a complete PDF version of this report is attached to hard copy of the report.

1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants Ltd (REC) have been commissioned by Foreman Homes Ltd to undertake a Phase I geoenvironmental desktop study & Phase II Intrusive site Investigation at 59 – 61 West Street, Havant, PO9 1LN. A site location map is presented as Figure 1 in Appendix III.

The scope of work consisted of a Phase I desk study followed by an intrusive ground investigation, comprising five window sample probeholes with three holes being completed as environmental monitoring installations. Trial pitting was also undertaken across the site.

1.2 Proposed Development

REC understands that the proposed development at the above site will comprise the demolition of a number of existing redundant buildings, the construction of a number of terraced and semi-detached residential properties with private gardens and the refurbishment of a historical parchment works building into residential units with associated soft landscaping and car parking. The proposed site layout is presented as Figure 2 in Appendix III.

1.3 Objectives

The objectives of the geo-environmental investigation are to:

- Review historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Desk Study in line with Environment Agency (EA) document Model Procedures for the Management of Contaminated Land (Contaminated Land Report 11 (CLR11));
- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified;
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs;
- Provide an assessment of the soakage of the underlying soils to assist in the design of infiltration based SuDS.
- Provide recommendations regarding future works, if required.

1.4 Limitations

The limitations of this report are presented in Appendix I.

1.5 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed.

Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 SITE SETTING

2.1 Site Details

Site Address	59 – 61 West Street, Havant, PO9 1LN
National Grid Reference	471427,106291
Site Area	0.29ha

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location map is presented as Figure 1 in Appendix III.

2.2 Current Site Use

Site Description

At the time of the site walkover, the subject site comprised a roughly rectangular plot of land secured by a large iron access gate in the northwest corner of the site. Three roughly rectangular buildings were present, with the remainder of the site comprising a large area of tarmac hard standing and gravel cover. The largest building was located centrally along the northern boundary of the site, and was observed to be two storeys high and of brick construction. This building had a more recent brick built single storey extension to the rear with a high peaked roof with corrugated iron covering. A timber framed structure in a poor state of repair was adjoined to the rear extension to the east. Although the age of the historic building was unknown, the building style and features observed suggested a building dating from the 19th Century.

The remaining two buildings were located along the southern and western boundaries, and were identified as a solvent and petroleum store (southern building) and combined workshops and offices (western building). No access was gained to any of the buildings at the time of the walkover.

A large mature Yew tree was observed near the north east corner of the site and was surrounded by a small raised grassed area retained by a low concrete brick wall. A roughly rectangular area of gravels and occasional plants was identified in the south east corner of the site, it was suspected that this area was within the footprint of a former building that had been demolished relatively recently.

A single fuel pump labelled as “Unleaded Petrol” was located adjacent to the southwest corner of the rear extension of the main northern building. It was considered likely that that the petrol pump was supplied by an onsite underground storage tank (UST).

A galvanised chimney was present in the southernmost part of the rear extension of the main building, behind a wooden cladded structure.

A stockpile of used creosote, oil, solvent and varnish containers were observed along the eastern wall of the northern building, and at the time of the walkover some of the containers were observed to still contain liquids. An electricity substation was observed within a brick building on the west face of the northernmost building immediately east of the main entrance.

The southernmost building, labelled as a petroleum and solvent store, was observed to have an above ground storage tank on the roof

A storage area was observed along the eastern side of the building, which had various materials in storage (including plastics, plywood and timber).

The westernmost building comprised two parts with separate uses. The northern part of the

building appeared to have served as an office area, whilst the southern part of the building appeared to house garages, assumed to have been used for maintenance or storage.

Signage was present just below roof level on the garage units warning of asbestos and a fragile roof. The roof of the garage units was constructed of corrugated cement sheeting which could contain asbestos.

A representative of Portsmouth Water was present during the site walkover and provided plans indicating the presence of a spring is located beneath the hard standing in the southwest corner of the site. Anecdotal evidence provided by the Portsmouth Water representative suggested that it was likely that the spring would have an associated brick built collecting chamber and clay pipes leading off site to the southwest. The main site features are presented on the Site Plan (Figure 3) in Appendix III.

Hazardous Materials Storage

Three above ground storage tank (ASTs) were observed on the site at the time of the walkover. The first AST comprised a single skinned steel tank located in the southeast corner of the main building and surrounded by a bund of concrete block construction. No signage indicating the capacity or contents of the tank was observed.

The second AST was elevated and located on the roof of the southernmost building. The AST was of a single skinned steel construction with a capacity of 1000 gallons (4500 litres), although no signage was present to indicate the nature of the tank contents. Pipework ran out of the AST down the west facing wall of the building to a pump that was situated near ground level.

A third AST was observed in the southwestern corner of the site between the southernmost wall of the garages and the southern boundary wall of the site. The AST was observed to be of a modern self bunded plastic design, but was in a densely vegetated area which prevented a close inspection, and so the capacity and condition of the tank could not be verified.

An underground storage tank (UST) is believed to be present in the area of the disused unleaded petrol pump (estimated to originate from the 1960's). Scarring was observed to run from the location of the fuel pump towards the southwest corner of the site. Located to the west of the scarring were three round inspection covers, which could be filling points for the UST.

Polychlorinated Biphenyls (PCBs)

An electricity substation was present in the northwest corner of the site, immediately east of the main gate. The substation was enclosed within a small brick building, which was inaccessible at the time of the walkover.

Waste Storage

At the time of the site walkover, a large collection of creosote, oil, solvent and varnish containers were observed to be stockpiled against the east wall of the northernmost building. Some of the containers were observed to contain liquids, and three paint cans were damaged, causing localised paint spillage onto the ground.

Potential Asbestos Containing Materials (PACM)

Signage was present just below roof level on the garage units warning of the presence of asbestos and a fragile roof. The roof of the garage units was observed to be constructed of corrugated cement sheeting of the type which could contain asbestos.

Although the exact age of the buildings present on site is unknown, it is considered that they pre-date 2000 and may therefore contain Asbestos Containing Materials (ACMs) within the building fabric.

Drainage Issues

A formal drainage survey has not been completed but a series of drain covers were observed that at the time of the walkover. Given the presence of a modern office building in the northwest corner of the site, it is considered likely that the site possesses a connection to the foul sewer which is likely to be located within West Street immediately to the north.

2.3 Surrounding Area

The surrounding land uses are summarised below:

Direction	Land Use
North	Residential properties.
East	Commercial properties.
South	The Tanneries business centre.
West	Mixed commercial and residential properties with Brockham Springs beyond.

3.0 SITE HISTORY

3.1 On-Site Historical Development

A review of historical mapping 250 m pertinent to the site is summarised in Table 3.1 below. A summary selection of historic maps can be seen in Appendix IV.

Table 3.1 Summary of Potentially Contaminative Historical Land Uses

Map Edition	Historical Land Use	
	On site	Off site
1869 (1:2,500)	The eastern half of the site comprised a series of terraced housing with associated outbuildings. The western part of the site comprised a series of unreferenced outbuildings surrounded by areas of assumed soft landscaping.	North: Mixed residential and commercial buildings with a union workhouse (~60m north) and open fields beyond. West Street runs west to east adjacent to the northern boundary of the site. An orchard was observed (~100m) northwest of the northern boundary of the site. East: Mixed commercial and residential buildings. The Black Dog Inn was observed (~30m) to the east. A parchment works was identified (~260m) southeast from the eastern boundary of the site. South: Open fields and springs were observed. The closest spring was observed (~5m) south of the southern boundary of the site. West: Mixed commercial and residential buildings along West Street. A series of springs and sluices were identified between ~10m and ~150m west of the site. These were observed to feed into a reservoir (~150m) west of the western boundary of the site. A washing factory was observed (~130m) southwest of the western boundary of the site.
1897 (1:2,500)	The site has been redeveloped with a number of relatively small buildings. The site is identified as a parchment works.	North: Allotment gardens were observed (~150m) north of the northern site boundary. Havant Joint Hospital (for infection diseases) was observed to be (~200m) north of the northern site boundary. East: The Black Dog Inn is no longer indicated on historic maps. Flour mills were observed (~90m) east of the eastern boundary of the site. South: A residential housing estate was observed between (~50m to ~150m) south of the southern border of the site. West: The washing factory was no longer observed on historic maps. The Chamois Leather Works was observed on the location of the former washing factory.

1909 (1:2,500)	Additional buildings are present on the site but there is no significant change in land use.	No significant changes in land use were observed on historic maps.
1932 (1:2,500)	A circular structure is indicated in the area of the spring and overlaps onto the south eastern corner of the site. It is assumed that this structure is associated with the spring. The site is no longer identified as a parchment works although the layout remains unchanged.	North: A miniature rifle range was observed (~130m) north east of the northern boundary of the site. Additional residential and commercial developments were observed beyond the north western boundary of the site. East: Additional residential and commercial properties were observed beyond the eastern boundary of the site. South: Additional large rectangular buildings are indicated (~25m) southwest of the southern site boundary and appear to be associated with the leather works. West: No significant change in land use was observed on historic maps.
1952 (1:2,500)	The circular structure in the south east corner of the site is no longer indicated. No significant change in land use was observed on historic maps.	North: The Havant Fever Hospital and miniature rifle range are no longer indicated. A Council depot is indicated within the grounds of the former hospital. East: The parchment works is no longer indicated. A builder's yard is observed within the grounds of the former parchment works. A pond is indicated (~80m) south east of the southern site boundary. A southerly flowing channel is indicated to extend southwards from the pond to beyond 300m. South: Additional residential and commercial development is indicated south of the site. A miniature rifle range is observed (~140m) south east of the southern boundary of the site. West: The reservoir observed to the west of the site was labelled as Water Works (Portsmouth Water Co).
1960 (1:2,500)	No significant changes in land use were observed on historic maps.	North: No significant changes in land use were observed on historic maps. East: An unnamed works was identified (~90m) to the south east of the eastern boundary of the site. An unnamed garage was identified (~175m) south east of the eastern boundary of the site. South: Leather Works is no longer referenced although buildings remain with one referenced as a works. No other significant changes in land use were observed on historic maps. West: No significant changes in land use were observed on historic maps.

1965-1969 (1:2,500)	The site is referenced as a builder's yard. Several of the smaller buildings located centrally and along the eastern boundary of the site have been removed. An electricity substation is indicated near the north west corner of the site	South: Eight factories are indicated (~130m to ~270m) south to southwest of the southern site boundary. These include engineering works, two plastics factories and an electronics factory. Tanks are referenced (~110m) southwest of the southern boundary of the site.
1971-1973 (1:2,500)	No significant changes in land use were observed on historic maps.	North: Havant day hospital indicated (~140m) north of the northern site boundary. East: No significant changes in land use were observed on historic maps. South: Engineering works referenced adjacent to the southern site boundary. Sheet metal works, engineering works and "The Tannery" are referenced on the site of the leather works to the southwest. Additional factories are indicated (~200m to 250m) south of the southern boundary of the site including two electroplating factories and additional electrical factories. Three tanks are indicated (~110m, ~130m and ~160m west-southwest) on a new business park. Printing works indicated ~125m west-southwest. West: No significant changes in land use were observed on historic maps.
1978-1986 (1:1,250)	Partial Map Coverage – Site not covered.	East: A bus station was observed (~150m) northeast of the eastern boundary of the site. No other significant changes in land use were observed on historic maps.
1987-1989 (1:2,500)	No significant changes in land use were observed on historic maps.	No significant changes in land use were observed on historic maps.
2012 (1:2,500)	No significant changes in land use were observed on historic maps.	No significant changes in land use were observed on historic maps.

3.2 Off-Site Historical Development

A review of potentially contaminative uses identified on historical Ordnance Survey maps within a 250m radius of the site is summarised below in Table 3.2.

Table 3.2 Summary of Potentially Contaminative Off-Site Historical Land Uses

Surrounding Feature	Distance	Dates	Direction
Unnamed works <i>Then</i> Unnamed garage <i>Then</i> Unnamed works	~90m	Pre 1960 – Pre 1969 Pre 1969 – Pre 1973 Pre 1973 – Ca 2012	South East
Washing factory <i>Then</i> Chamois leatherworks <i>Then</i> unnamed works (assumed Chamois leatherworks) <i>Then</i> The Tanneries business park	~130m	Pre 1869 to Pre 1897 Pre 1897 to Pre 1960 Pre 1960 to Pre 1973 Pre 1973 to Ca 2012	South West
Unnamed garages	~175m	Pre 1960 – Pre 1989	South East
Additional factories and heavy industry	~200m - ~250m	Pre 1973 – Ca 2012	South
R. C. Burial ground	~230m	Pre 1932 – Ca 2012	North

3.3 Planning History

REC has undertaken a review of on-line planning records held by Havant Borough Council and no environmentally pertinent information relating to the site has been obtained.

4.0 ENVIRONMENTAL SETTING

4.1 Geology & Hydrogeology

The British Geological Survey (BGS) map for the site, (Sheet E316, 1:50,000, Fareham, Solid & Drift edition) indicates that the site is underlain by the following geological sequence:

Geological Unit	Classification	Description	Aquifer Classification
Head Deposits	Superficial	Clayey GRAVEL	Secondary (A) Aquifer
White Chalk Subgroup*	Bedrock	CHALK.	Principal Aquifer

*White Chalk Subgroup comprises: Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations.

The GroundSure report indicates there are three groundwater abstractions within 1.0km radius of the site, two of which are associated with the Bedhampton Springs. The nearest groundwater abstraction source is located 385m west of the site, while the further abstraction sites are located 821m and 915m west of the site. All three locations are used for potable water supplies.

The site is within a groundwater Source Protection Zone 1 (SPZ1) – Inner Catchment, which is ranked as the highest level of groundwater protection by the Environment Agency.

An unnamed spring is located beneath the south west corner of the site, outside of the disused garages. It is assumed that this spring is part of the Brockham Springs, as such it is likely that shallow groundwater, if present, will flow in a south westerly direction towards the springs.

The site is within a 50m radius of a British Geological Survey defined groundwater flooding susceptibility zone, which is classified as having a very high susceptibility to groundwater flooding based on the underlying geological conditions.

4.2 Geotechnical Data

Geotechnical Data presented within the GroundSure report identifies the following ground conditions:

Hazard	Designation
Shrink-Swell Clay	Very Low
Landslides	Very Low
Ground Dissolution	Moderate
Compressible Ground	Moderate
Collapsible Deposits	Very Low
Running Sand	Low

4.3 Historic Ground Workings

The GroundSure Report identified no historic surface or subsurface ground workings on site. One source of Made Ground (undivided) was identified 276m south of the site. Additionally the GroundSure report identified twelve historic surface workings within a 250m radius of the site. The closest workings (between 73m and 153m) are all located in and around Brockham Springs, west of the site. Historic ground workings associated with a water body were also identified between approximately 192 to 220m southeast of the site.

No historical underground workings were identified within a 1km radius of the site. At the time of writing, there is one active ground workings located 417m north of the site, at Havant Park Brick Field. The works are labelled as surface mineralogical workings from a suspected Clay Pit.

4.4 Hydrology

Surface water features in the vicinity of the subject site are as follows:

Surface Water Feature	Quality*	Distance (m)	Direction
Unnamed Primary river	B - Good	2 – 3m	South West

*Chemical water quality as classified under the EA's General Quality Assessment (GQA) Scheme

The western part of the site, adjacent to a stream, is located within a currently defined Environment Agency flood risk zones 2 and 3. The remainder of the site is not located within an area classified as being at risk of flooding. There are no recorded flood risk defences within 250m of the site. There are no surface water abstraction licenses within a 1.0km radius of the site. The nearest surface water features are Brockham Springs, which comprise of springs and lakes, with a large central reservoir located approximately 70m west of the site.

4.5 Radon Risk Potential

The GroundSure Report indicates the site is situated in an area where 3% to 5% of properties are above the Action Level. BRE211 – Radon guidance on protective measures for new buildings reports that basic radon protective measures are required for the construction of new dwellings or extensions.

4.6 Industrial Land Uses

The site is situated within a mixed industrial, commercial and residential area, with the Tanneries business park adjacent to the southern boundary of the site. The GroundSure Report identified forty six industrial land uses within 250m of the site. The closest industrial land uses, which are identified as having a greater risk of contamination, are listed below. Two petrol stations have been identified within a 500m radius of the site. A Texaco petrol station, now obsolete was identified 144m south east of the site, while an active Tesco petrol station was observed 272m south west of the site.

Company	Activity	Distance (m)	Direction
ETech Motorsport Ltd	Vehicle repair, testing and servicing	3m	South
Metalcraft Fabrications	Metal manufacturers, fabricators and stockholders	3m	South
Alandown Motors Ltd	Vehicle repair, testing and	19m	North

	servicing		
Lawrence Warner Specialist Cars Ltd	Vehicle repair, testing and servicing	19m	North
G N X O Motorcycles	Vehicle repair, testing and servicing	42m	South West

4.7 Historic Mining Activity

The GroundSure report has identified that it is highly unlikely that historic chalk mining occurred on site but reported that any chalk mining, if it occurred, is likely to have been on a small scale with restrictions in extent. This implies that there is a very low risk of cavities within the chalk that could pose future subsidence hazards.

4.8 Sensitive Land Uses

The closest residential properties are located adjacent to the subject site. No other environmentally sensitive land uses have been identified within close proximity to the subject site. The nearest designated environmentally sensitive land use is located 815m south east of the site at Chichester Harbour (SPA, RAMSAR and ANOB designations).

4.9 Site Sensitivity Assessment

The site is considered to be located within a high sensitivity setting due to the following reasons:

- Site is underlain by Secondary A (Superficial) and Principal (Bedrock) Aquifers;;
- The underlying geology comprising high permeability strata;
- A spring is located beneath the southwestern corner of the site;
- Springs utilised as a Public Water Supply are located within 25m of the site;
- Site is located within a Source Protection Zone 1 (SPZ1);
- Residential properties are located in close proximity;
- Heavy industrial land uses are located in close proximity; and;
- There is a primary surface watercourse within influencing distance of the site.

5.0 CONSULTATIONS

5.1 Local Authority Contaminated Land Officer

Contact was made with the Contaminated Land Officer at Havant Borough Council regarding the subject site. Concerns about contamination were raised due to the historic industrial land use, and the close proximity of the Brockham Springs which act as a source of potable water supply. As such any further development must have a prior ground contamination assessment as this is a condition of future development.

The council express particular concern about the water storage on the site, as a spring line is known to run beneath the site which feeds directly into the Brockham Springs, the main reservoir of which is located ~150m west of the site. Contamination must be assessed within the ground to assess the risk of contamination dispersing into the groundwater, which will directly affect the springs. The council also mentioned that there is a control on the waters to soakaways on and around the site due to the perceived high level of groundwater.

5.2 Portsmouth Water

Due to the location of the site within an inner Source Protection Zone (SPZ1), and the close proximity of potable water abstraction points to the southeast and southwest of the site, contact was made with Portsmouth Water prior to the commencement of site works.

Portsmouth Water raised concerns regarding drilling operations generating turbidity within the groundwater, and indicated that should the aquiclude above the Chalk aquifer be breached that water under artesian pressure would be encountered resulting in the formation of an artesian well.

Portsmouth Water provided historic plans (presented as Figure 4 in Appendix III) indicating the presence of a spring in the southwestern area of the site and stated that it was believed that infrastructure comprising a brick collecting chamber and clay pipes were present beneath in the southwestern area of the site.

Due to the sensitivity of the site, it was agreed that boreholes would be terminated should evidence of chalk be recovered, and that a representative of Portsmouth Water would be present during the intrusive phase of site investigation.

Portsmouth water was made aware that a historic UST used for the storage of petroleum was present beneath the site in close proximity to the spring. They confirmed that the adjacent public water supply had never suffered from problems associated with petroleum hydrocarbons and that the spring on site was not utilised for supply but was connected to the overflow pipework, and was therefore bypassing the water supply infrastructure.

5.3 Landfill Sites and Waste Treatment Sites

No landfill sites were identified by the GroundSure report within 500m of the subject site. The nearest landfill site is located 681m west of the site, accepting non biodegradable waste. One waste treatment site was identified within a 500m radius of the site, located 446m south of the site at Langstone Technology Park, the site comprises of waste compactor housing and consumable storage.

5.4 Regulatory Database

The following information has been obtained from a commercially available environmental database. The summary table only includes records not otherwise detailed in the report. A full copy of the database report is provided on the CD at the rear of this report.

Table 5.1 Summary of GroundSure Data

Database entry	0-249m	250-500m	Details
Contaminated Land Register Entries and Notices	0	0	n/a
Authorised industrial processes (IPC/IPPC/LAPPC).	1	2	Closest is located 82m southeast and relates to a Part B process involving the recovery of petrol vapour.
Fuel Stations Entries	1	1	The closest relates to an obsolete Texaco petrol station located 144m southeast of the site. The second relates to an active Tesco fuel station located approximately 275m southwest.
Licensed radioactive substances	0	6	Relates to the disposal of radioactive waste at Apollo Fire Detectors Ltd, located 499m southwest of the site.
Enforcements, prohibitions or prosecutions	0	0	n/a
Discharge Consents	3	4	The closest relates to a historic consent located approximately 90m east which was authorised to discharge surface waters and was revoked in 1997.
Pollution Incidents	2	1	The closest relates to spillage of mixed oils and fuel 84m west of the site. This was a category 3 (minor) impact for both land and.
Consents issued under the Planning (Hazardous Substances) Act 1990	0	0	n/a
Control of Major Accident Hazard (COMAH) sites	0	0	n/a

6.0 PREVIOUS SITE INVESTIGATIONS

A Phase 1 site investigation (ref J12129/c02DB - Former Works Site at 59 – 61 West Street, Havant. Contaminated land desk study and preliminary risk assessment) dated November 2012 was undertaken by Wilson Bailey Geotechnical & Environmental. A summary of the findings is presented below:

The desktop study report identified two above ground storage tanks, labelling one as an oil tank and identified the presence of one below ground storage tank (petrol) and a stockpile of waste oil, solvent and varnish containers towards the east of the site.

The report established that Portsmouth Water were responsible for managing the local watercourse, including Brockham springs to the west of the site. The report identified that no significantly elevated levels of contaminants had been found by Portsmouth Water during routine groundwater monitoring at Brockham Springs.

The report recommended that a Phase 2 intrusive ground investigation would be required to assess the extent of the contamination within the underlying geology. The report also recommended that a formal clearance of existing site features (including the above and below ground storage tanks, and stockpile of waste materials) would be required to avoid potential environmental liability with ownership of the site.

7.0 INITIAL CONCEPTUAL SITE MODEL (CSM)

7.1 Initial CSM

In accordance with Environment Agency, CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), REC Ltd have developed an initial CSM to identify potential contamination sources, migration pathways and receptors within the study area.

7.2 Contaminant Sources

On-site Potential Sources

REC have identified the following potential on-site sources of contaminants:

- Made Ground associated with current and historic development of the site;
- Historic land use as a parchment works;
- Historic land use as a builder's yard;
- Potential Asbestos Containing Materials (PACMs) within building fabrics;
- Above and underground storage tanks, and;
- Electrical substation.

Off-site Potential Sources (within 250 m)

REC have identified the following potential off-site sources of contaminants:

- Local industry relating to vehicle repairs, servicing and testing (~3m - ~42m south);
- Alandown Motors Ltd (~19m north);
- Unnamed garage (~90m east),
- Historic Leather Works (~130m southwest); and;
- Infilled ground workings (~200m - ~250m southeast).

7.3 Potential Pathways

REC have identified the following potential pathways:

- Ingestion of contaminated soil and vegetables;
- Dermal contact with contaminated soil;
- Inhalation of dust;
- Inhalation of fibres;
- Inhalation of vapours;
- Migration of gas and vapours into buildings, and;
- Vertical and lateral migration.

7.4 Potential Receptors

REC have identified the following potential receptors:

- Future site users;
- Underlying Principal and Secondary A Aquifers
- Underlying and adjacent springs; and
- Adjacent surface watercourse;

Construction workers are not considered to be a plausible receptor as exposure will be managed through the use of appropriate PPE and hygienic working practices as required under HSE / CDM regulations. Furthermore, the length of any exposure is likely to be for a short duration.

An initial Conceptual Site Model has been prepared for the site and is presented within Table 6.1.

7.5 Conceptual Site Model

Table 7.1 Initial Conceptual Site Model

Source	Contaminant	Potential migration pathways	Potential Receptors	Likelihood of Occurrence On site	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
On site							
Made Ground associated with development	Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Ingestion of contaminated soils and vegetables Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active – Further Investigation
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion of contaminated soils and vegetables Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
	Total Petroleum Hydrocarbons (TPH)	Ingestion of contaminated soils and vegetation Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Vertical and Lateral Migration	Underlying Secondary (A) and Principal Aquifers	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
	Asbestos Fibres in Soil	Inhalation of fibres	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
	Ground Gas (CH ₄ & CO ₂)	Migration into Buildings	Future Site Users	Likely	Severe	High Risk	Potentially Active - Further Investigation
Historic land use as a parchment works	Solvents (including Calcium Hydroxide)	Ingestion of contaminated soils and vegetables	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Dermal contact with contaminated soils					
		Vertical and lateral migration	Underlying Secondary (A)	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation

			and Principal Aquifers				
Historic land use as a builders yard	Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Ingestion of contaminated soils and vegetables Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active – Further Investigation
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion of contaminated soils and vegetables Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
	Sulphides and Sulphates, Creosotes and Solvents	Ingestion of contaminated soils and vegetables Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Vertical and lateral migration	Underlying Secondary (A) and Principal Aquifers	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
	Total Petroleum Hydrocarbons (TPH) PRO/DRO	Ingestion of contaminated soils and vegetation Dermal contact with contaminated soils	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Vertical and Lateral Migration	Underlying Secondary (A) and Principal Aquifers	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
	Asbestos Fibres in Soil	Inhalation of fibres	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation

Potential Asbestos Containing Materials within building fabrics	Asbestos Fibres in building fabrics	Inhalation of fibres	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
Above and underground storage tanks on site	Total Petroleum Hydrocarbons (TPH)	Ingestion of contaminated soils and vegetables	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Dermal contact with contaminated soils					
		Inhalation of vapours					
		Migration of vapours into buildings	Underlying Secondary (A) and Principal Aquifers	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
Electricity substation	PCBs	Ingestion of contaminated soils and vegetables	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Vertical and Lateral Migration	Underlying Secondary (A) and Principal Aquifers	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
Off site							
Alandown Motors Ltd (~19m north)	Total Petroleum Hydrocarbons	Inhalation of vapours	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
		Lateral migration	Future Site	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation

	(TPH)		Users				
	Solvents	Lateral migration	Future Site Users	Likely	Medium	Moderate Risk	Potentially Active - Further Investigation
Vehicle repairs, servicing and testing (~3m - ~42m south)	Total Petroleum Hydrocarbons (TPH)	Inhalation of vapours	Future Site Users	Unlikely	Medium	Low Risk	Inactive – A review of hydrological mapping indicates groundwater flow to the south, away from the subject site. Any contamination generated from this source is likely to migrate away from the subject site as the groundwater movement in a south to south westerly direction.
		Lateral migration	Future Site Users	Unlikely	Medium	Low Risk	
	Solvents	Lateral migration	Future Site Users	Unlikely	Medium	Low Risk	
Unnamed garage (~90m south east)	Total Petroleum Hydrocarbons (TPH)	Lateral migration	Future Site Users	Unlikely	Medium	Low Risk	Inactive – A review of hydrological mapping indicates groundwater flow to the south, away from the subject site. Any contamination generated from this source is likely to migrate away from the subject site as the groundwater movement in a south to south westerly direction.

8.0 SITE INVESTIGATION

8.1 Site Investigation

8.1.1 General

A ground investigation has been designed based on the findings of the Phase I desk study, the proposed site layout as shown in Figure 2 (Appendix III). In addition, the investigation has been used to collect geotechnical information to assist in the design and construction of the proposed developments.

Exploratory fieldwork was completed on the 15th and 16th January 2014. The works are summarised in Table 8.1.

Table 8.1 Summary of Fieldwork

Potential Source/Rationale	Location Hole	Type	Maximum Depth (m bgl)	Monitoring Wells Response Zone
Initial Conceptual Site Model/Geotechnical Information	WS101	Window Sample	3.45	N/A
Initial Conceptual Site Model/Geotechnical Information	WS102	Window Sample	4.45	0.50 – 1.80
Initial Conceptual Site Model/Geotechnical Information	WS103	Window Sample	4.00	0.50 – 1.80
Initial Conceptual Site Model/Geotechnical Information	WS104	Window Sample	0.80	N/A
Initial Conceptual Site Model/Geotechnical Information	WS105	Window Sample	4.45	0.30 - 1.50
Initial Conceptual Site Model/Geotechnical Information	TP101	Trial Pit	2.50	N/A
Initial Conceptual Site Model/Geotechnical Information	TP102	Trial Pit	1.15	N/A
Initial Conceptual Site Model/Geotechnical Information	TP103	Trial Pit	1.50	N/A
Initial Conceptual Site Model/Geotechnical Information	TP104A	Trial Pit	0.80	N/A
Initial Conceptual Site Model/Geotechnical Information	TP104B	Trial Pit	1.30	N/A
Initial Conceptual Site Model/Geotechnical Information	TP105	Trial Pit	1.20	N/A
Initial Conceptual Site Model/Geotechnical Information	TP106	Trial Pit	1.50	N/A
Initial Conceptual Site Model	HA101	Hand Auger	0.50	N/A

Notes

m bgl – metres below ground level.

The window sample holes were designed to provide geotechnical information and confirm the findings of the Initial Conceptual Site Model (ICSM).

Hand pits were excavated to 1.2 m bgl to retrieve environmental samples and check for shallow services. The exploratory hole locations are illustrated in Figure 3 (Appendix III). The ground conditions encountered and details of monitoring well response zones are indicated on the exploratory hole logs which are provided in Appendix V.

8.1.2 *In Situ* Standard Penetration Testing (SPT)

In situ geotechnical testing was conducted using the Standard Penetration Test (SPT) and where the ground was granular, a 60° cone (SPT(C)) was used instead of the split spoon sampling tube. The results are shown in the borehole logs in Appendix V, presented in Table 9.5 and discussed in Section 11.0.

8.2 Laboratory Analysis

Selected soil samples were submitted for a range of chemical analysis comprising, metals, pH, water soluble sulphate (2:1 extract), speciated Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCB) asbestos fibres in soil, bulk asbestos ID and banded Total Petroleum Hydrocarbon (TPH).

Scientific Analysis Laboratories (SAL) Ltd of Braintree undertook the analytical work and the testing results are included in Appendix VII and discussed in Section 10.0.

Selected soil samples were submitted for a range of geotechnical testing at Professional Soils Laboratory Ltd comprising 1 point atterburg limits (to establish the plasticity index), moisture contents, PSDs and 1(no) laboratory CBR test.

9.0 GROUND AND GROUNDWATER CONDITIONS

9.1 Ground Conditions

9.1.1 Summary of Ground Conditions

The ground investigation generally confirms the published geology and identifies the strata set out in Table 9.1 below:

Table 9.1 Summary of Strata

Strata	Typical Description	Min Depth to Top of Strata (m)	Max Depth to Top of Strata (m)	Max Thickness (m)
Made Ground	Fine grained soils (clay) with a variable mix of coarse grained minor constituents such as brick, clinker, flint and chalk.	GL	GL	1.30
Head Deposits	Soft to firm light brown slightly sandy gravelly CLAY. Gravel of sub-angular to sub-rounded fine to coarse flint, with medium cobble content and rare subangular chalk deposits.	0.50	1.30	4.45

9.1.2 Made Ground

Made Ground was encountered within all intrusive locations at the subject site to a maximum depth of 1.30 m bgl (WS102). The unit typically comprised of a fine grained soils (clay) with a variable mix of coarse grained minor constituents such as brick, clinker, flint, chalk and fragments and sheets of Potential Asbestos Containing Material (PACM), in TP104A and WS104.

9.1.3 Superficial Deposits

Head Deposits

Head Deposits were encountered in all intrusive locations, with the exception of TP102 and TP104A at depths ranging from 0.50m bgl (TP105) to 1.30m bgl (WS102). The Head deposits encountered consisted of a sequence of soft to firm light brown slightly sandy gravelly CLAY with localised pale brown clayey GRAVEL, sandy GRAVEL and light brown SAND. The gravel fraction comprised subangular to subrounded, fine to coarse flint, with medium cobble content and rare subangular chalk deposits. The base of the head deposits was not encountered during the intrusive phase of investigation with a maximum thickness of 3.45m in WS105.

9.1.4 Bedrock

Chalk bedrock was not encountered during the intrusive investigation, but is believed to comprise deposits of the White Chalk subgroup.

9.1.5 Potential Asbestos Containing Materials

During the intrusive investigation, two exploratory holes (TP104A, WS104) were terminated at shallow depths (0.80m bgl) due to the presence of potential asbestos containing materials. Bulk samples of the materials were sampled and sent for laboratory analysis. The results of the analysis confirmed the presence of asbestos within the Made Ground at depths of 0.50m – 0.80m bgl. Results are presented in table 9.2 below.

Table 9.2 Asbestos Containing Materials Summary

Location	Depth (m)	Test Type	Asbestos Identified
TP104A	0.50 – 0.80	Asbestos fibres in soil	Chrysotile and Amosite
	0.50 – 0.80	Asbestos bulk ID	Amosite
WS104	0.50 – 0.70	Asbestos fibres in soil	Chrysotile and Amosite
	0.60 – 0.80	Asbestos bulk ID	Amosite

9.1.6 Particle Size Distribution

Three particle size distribution tests were undertaken on samples and the results are presented below in Table 9.3. The results of which were consistent with on-site descriptions.

Table 9.3 PSD Summary

Location	Depth (m)	Strata Description	Granulometric Composition (%)		
			Clay/Silt	Sand	Gravel
TP101	2.00	Brown slightly sandy GRAVEL.	0	1	99
TP106	1.50	Dark brown sandy, very clayey GRAVEL.	22	19	59
WS105	1.00-1.20	Brown slightly sandy silty GRAVEL.	5	6	89

9.1.7 Soil Consistency

Undrained shear strength values were derived from in-situ SPT testing by using the empirical correlation using SPT 'N' value x 4.5. Results of these tests are presented in Table 9.4 and generally indicate fine grained soils of a soft to firm strength.

Table 9.4 In Situ Hand Shear Vane Testing Results

Location	Sample Depth (m)	Field Description	Undrained Shear Strength (kN/m ²)	Consistency
WS101	2.20 – 2.60	Light brown mottled yellowish blue gravelly CLAY (Head Deposits)	157	Very Stiff

Table 9.5 Standard Penetration Test Results

Boreholes	Depth (m bgl) (i)	Material Field Description	CPT/SPT "N" Value	Soil Strength (BS5930)	Approximate Undrained Shear Strength (kN/m ²)**	Terzaghi & Peck Relative Density (Sands)
WS101	2.00 - 2.45	Gravelly CLAY	19	Firm to Stiff	85.5	N/A
	3.00 - 3.45	Gravelly CLAY	11	Firm	49.5	N/A
WS102	1.00 - 1.45	Gravelly CLAY	4	Soft	18	N/A
	2.00 - 2.45	Clayey, gravelly SAND	5	N/A	N/A	Loose
	3.00 - 3.45	Sandy, gravelly CLAY	29	Stiff	130.5	N/A
	4.00 - 4.45	Sandy CLAY	17	Firm to Stiff	76.5	N/A
WS103	1.00 - 1.45	Gravelly CLAY	8	Soft to Firm	36	N/A
	2.00 - 2.45	Gravelly CLAY	7	Soft to Firm	31.5	N/A
	3.00 - 3.45	Clayey GRAVEL	17	N/A	N/A	Medium Dense
WS105	1.00 - 1.45	Clayey GRAVEL	14	N/A	N/A	Medium Dense
	2.00 - 2.45	Clayey, sandy GRAVEL	5	N/A	N/A	Loose
	3.00 - 3.45	Clayey GRAVEL	6	N/A	N/A	Loose

Notes

*N values derived from SPT have been halved due to presence of groundwater above the depth of test.

** Approximate undrained shear strength (C_u) has been calculated using the empirical relationship of $C_u = 4.5 \times N$

9.1.7 Soil Infiltration

In situ variable (falling) head permeability tests were not undertaken within trial pit locations due to the high perched groundwater levels (recorded depths across site ranged from 0.90m bgl to 1.20m bgl). Additionally, with the thickness of Made Ground on site ranging from 0.50m and 1.30m bgl, areas of natural ground lie beneath the existing water table and are therefore considered to be saturated. It is considered that the prevailing ground conditions are unlikely to prove suitable for the application of soakaway drainage.

The application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.

9.1.8 Soil Plasticity

The Atterberg Limits determination test, undertaken within the 5(no.) clay horizon samples, summarised in Table 9.6 below, show the clay in this area to be of intermediate to high plasticity. Natural Moisture Content is generally not close to the Plastic Limit, and the modified plasticity index indicates a predominately low to moderate volume change potential.

Table 9.6 Summary of Plasticity Index Test Results

Location	Depth (m)	Natural Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Percentage passing 425µm sieve (%)	Modified Plasticity Index
WS101	2.60 – 2.70	22	24	51	27	100	27
WS102	1.20 – 1.40	35	23	50	27	100	27
WS103	0.80 – 1.00	46	27	58	31	90	28
WS103	1.70 – 1.90	11	16	27	11	42	5
TP106	0.70	35	27	50	23	85	20

9.1.9 California Bearing Ratio

The California Bearing Ratio (CBR) for the soils was measured using laboratory testing at the location TP104B. The results are summarised in Table 9.7.

Table 9.7 Summary of CBR Testing

Location	Depth (m)	Strata	In Situ or Lab Test	CBR (%)
TP104B	0.20 - 1.20	Inferred - brown sandy very clayey GRAVEL.	Lab	8

9.1.10 pH and Sulphate

Chemical analyses for pH and soluble sulphate content contained in Appendix VII (summarised below in Table 9.8), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE Special Digest 1 (2005).

Table 9.8 Summary of pH and Sulphate Data

Location	Depth (m)	SO ₄ in 2:1 soil (g/l)	pH Value
TP102	0.40	0.11	9.1
TP104B	0.40	0.04	7.8
WS105	0.50 - 0.80	0.05	8.9
WS101	0.60 – 0.80	0.15	8.9
WS102	1.80 – 2.00	0.03	8.6
WS103	0.40 – 0.70	0.05	9.5
WS105	1.60 – 1.80	0.04	9.1

9.2 Groundwater Conditions

Shallow groundwater was encountered during the intrusive investigation within six of the trial pits and four of the five window samples holes. The depth of the seepages and the depth to which groundwater rose are shown on the exploratory hole records and summarised in Table 9.9 below:

Table 9.9 Summary Groundwater Strikes

Location	Depth to strike (m)	Depth to standing water (m)	Notes
TP101	1.10	1.10	-
TP102	1.00	1.00	-
TP103	1.20	1.20	-
TP104B	0.90	0.90	-
TP105	0.90	0.90	-
TP106	1.00	1.00	-
WS101	0.90	-	-
WS102	0.90	-	-
WS103	1.50	-	-
WS105	0.90	-	-

10.0 TIER 1 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

REC has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

10.1 Human Health Risk Assessment

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published by the EA (Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV)) and where absent, Generic Assessment Criteria (GACs) published by LQM/CIEH (2nd edition).

The results of this comparison have been summarised within Table 10.1 (overleaf).

Table 10.1 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use

Determinand	Units	GAC ^{v3}	n	MC	Loc. of Ex	Path way	Assessment
Arsenic	mg/kg	32	7	32	N/A	1	No Further Assessment
Cadmium	mg/kg	10	7	0.8	N/A	1	No Further Assessment
Chromium (Total)	mg/kg	3000	7	18	N/A	1	No Further Assessment
Chromium (VI)	mg/kg	4.3	7	<1	N/A	1	No Further Assessment
Lead ⁽ⁱⁱ⁾	mg/kg	225	7	780	TP104B at 0.40m.	1	Further Assessment
Mercury	mg/kg	11	7	2.1	N/A	2	No Further Assessment
Nickel	mg/kg	130	7	29	N/A	1	No Further Assessment
Selenium	mg/kg	350	7	<3	N/A	1	No Further Assessment
Copper ⁽ⁱⁱ⁾	mg/kg	2330	7	210	N/A	1	No Further Assessment
Zinc ⁽ⁱⁱ⁾	mg/kg	3750	7	320	N/A	1	No Further Assessment
Naphthalene	mg/kg	1.5	6	0.2	N/A	2	No Further Assessment
Acenaphthylene	mg/kg	170	6	0.1	N/A	3	No Further Assessment
Acenaphthene	mg/kg	210	6	0.3	N/A	1	No Further Assessment
Fluorene	mg/kg	160	6	0.1	N/A	1	No Further Assessment
Phenanthrene	mg/kg	92	6	2.3	N/A	3	No Further Assessment
Anthracene	mg/kg	2300	6	0.4	N/A	3	No Further Assessment
Fluoranthene	mg/kg	260	6	2.8	N/A	3	No Further Assessment
Pyrene	mg/kg	560	6	2.2	N/A	3	No Further Assessment
Benzo(a)Anthracene	mg/kg	3.1	6	1.1	N/A	3	No Further Assessment
Chrysene	mg/kg	6	6	1.2	N/A	3	No Further Assessment
Benzo(b/k)Fluoranthene ⁽ⁱ⁾	mg/kg	5.6	6	1.6	N/A	3	No Further Assessment
Benzo(a)Pyrene	mg/kg	0.83	6	0.9	WS103 at 0.40m – 0.70m.	3	Further Assessment
Indeno(123-cd)Pyrene	mg/kg	3.2	6	0.7	N/A	3	No Further Assessment
Dibenzo(a,h)Anthracene	mg/kg	0.76	6	0.3	N/A	3	No Further Assessment
Benzo(ghi)Perylene	mg/kg	44	6	0.7	N/A	3	No Further Assessment
TPH C ₅ -C ₆ (aliphatic)*	mg/kg	30	3	<0.10	N/A	2	No Further Assessment
TPH C ₆ -C ₈ (aliphatic)*	mg/kg	73	3	4.6	N/A	2	No Further Assessment
TPH C ₈ -C ₁₀ (aliphatic)*	mg/kg	19	3	15	N/A	2	No Further Assessment
TPH C ₁₀ -C ₁₂ (aromatic)*	mg/kg	69	3	42	N/A	2	No Further Assessment
TPH C ₁₂ -C ₁₆ (aromatic)*	mg/kg	140	3	<2	N/A	1	No Further Assessment
TPH C ₁₆ -C ₂₁ (aromatic)*	mg/kg	250	3	<2	N/A	1	No Further Assessment
TPH C ₂₁ -C ₃₅ (aromatic)*	mg/kg	890	3	<2	N/A	1	No Further Assessment
PCB EC7	µg/kg	8	1	<20	N/A	3	No Further Assessment

Notes

Main Exposure Pathways: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation.

Abbreviations: GAC = General Assessment Criteria, n = number of samples, MC = Maximum Concentration; Locof Ex = Location of Exceedance.

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. REC has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C₅-C₁₂) and the Tier 1 values for aromatic compound for the non volatile fractions (C₁₂-C₃₅). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

(i) Benzo (b) Fluoranthene (100mg/kg) Benzo (k) Fluoranthene (140mg/kg)

(ii) GAC based on human health criteria. Ecotoxicological assessment will be made using EA guidance (EPR

8.01) on soil spreading (Cu 135mg/kg, Zinc 200mg/kg, Pb 300mg/kg)

Referring to Table 10.1, the results of this direct comparison indicates that there are elevated concentrations of the following determinands:

Lead

Benzo(a)Pyrene

Asbestos fibres (Amosite fibres) were identified in soil samples from locations (TP104A and WS104). Asbestos fibres (Chrysotile and Amosite) were also identified in bulk samples of insulation board recovered from the same intrusive locations. No asbestos fibers were identified within near surface soil samples from any other intrusive locations.

10.2 Further Assessment

10.2.1 Soil

Referring to Table 10.1, the results of the direct comparison show that screening values have been exceeded for Lead at a single location (TP104B).

Given that lead exceeds the Tier 1 screening criteria in only one sample of seven, it is considered that the recorded concentration is not representative of the soils beneath the site.

Location TP104B is located within an area of proposed roadway. It is considered that the presence of the road pavement will break the pollution linkage, and the elevated concentration of lead will not therefore present a risk to future site users.

Furthermore, a review of the geological logs for location TP104B indicated that clinker was identified within the Made Ground in the same horizon that was sampled. Lead is known to be associated with combustion products such as clinker, which can result from the incomplete combustion of coal. It is considered likely that the single elevated concentration of lead can be related to the presence of clinker within the sample analysed.

Within WS103, Benzo(a)Pyrene was recorded at a concentration of 0.9mg/l, exceeding the Tier 1 screening criteria of 0.83mg/l. The exceedance was recorded within Made Ground at a depth of 0.40m – 0.70m bgl within the hand excavated pit. It is considered that the recorded concentration of Benzo(a)Pyrene is not truly representative of the soils beneath the site, as only a single exceedance was recorded. A review of the field logging sheets revealed that the hand excavated pit was unstable with material collapsing in from above. It is considered likely that the exceedance is due the presence of tarmac that has collapsed in from above. The marginal exceedences of the Tier 1 threshold is therefore not considered to present a significant risk to human health in the area of WS103.

10.2.2 Groundwater

Given that the site is underlain by both a Secondary A and a Principal Aquifer, and that potential sources of contamination have been observed on site, it is recommended that a Tier 1 groundwater risk assessment is undertaken at the site.

10.3 Ground Gas

The Phase I report identified the following sources of ground gas:

Historic Surface workings between ~50m and ~155m west of the site.

It is recommended that a period of ground gas monitoring is undertaken to facilitate an assessment of the risks posed by ground gas at the site.

10.4 Revised Conceptual Model

The assessment and conceptual model has identified potentially significant pollutant linkages based on a residential redevelopment of the site.

Table 10.2 Revised Conceptual Model

Source	Exposure Pathway	Potential Receptor	Probability of Exposure	Discussion of Pollutant Linkage
Human Health				
Lead within the Made Ground	Dermal contact with soils. Ingestion of contaminated soils	Secondary (A) Aquifer and Principal Aquifers	Moderate	The current investigation has identified elevated concentrations of lead that have the potential to present a significant risk to the underlying Principal and Secondary (A) Aquifers.
PAH within the Made Ground	Dermal contact with soils. Ingestion of contaminated soils	Secondary (A) Aquifer and Principal Aquifers	Moderate	The current investigation has identified elevated concentrations of Benzo(a)Pyrene that have the potential to present a significant risk to the underlying Principal and Secondary (A) Aquifers.
Ground Gas	Migration into Buildings	Future Site Users	Moderate	The current investigation has identified a number of potential sources of ground gas that have the potential to pose a significant risk to human health.

11.0 GEOTECHNICAL ASSESSMENT

11.1 Proposed Development

It is understood that the proposed development will comprise up to 24 residential properties with associated landscaping and infrastructure. Details of the proposed loadings were not available at the time of writing.

11.2 Summary of Ground Conditions

Ground conditions identified at the site are summarised in Table 11.1 below:

Table 11.1 Summary of Ground Conditions

Strata	Typical Description	Min Depth to Top of Strata (m)	Max Depth to Top of Strata (m)	Max Thickness (m)
Made Ground	Fine grained soils (clay) with a variable mix of coarse grained minor constituents such as brick, clinker, flint and chalk.	GL	GL	1.30
Head Deposits	Localised pale brown clayey GRAVEL, sandy GRAVEL and light brown SAND. The gravel fraction comprised subangular to subrounded, fine to coarse flint, with medium cobble content and rare subangular chalk deposits.	0.50	1.30	4.45

11.3 Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void in-filled with suitable compacted engineered fill;
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,
- At the time of the intrusive investigation buildings were still present on site. Any existing foundations should be excavated from below the proposed development foot print and the resulting void backfilled with suitable compacted engineered fill.

11.4 Foundation Conditions and Bearing Capacity

General

It is considered that the Made Ground is not suitable for a founding material due to the inherent variability of the material. Founding within this stratum with conventional foundations (pad or strip) may give rise to unpredictable total or differential settlements.

Natural ground conditions encountered on site were variable comprising both fine and coarse grained soils. Groundwater was also encountered near surface at depths ranging between 0.90m and 1.50m bgl.

Based on the ground conditions encountered, it is envisaged that an allowable bearing pressure of circa 100kN/m² above the water table and 50kN/m² below the water table could be adopted for the proposed scheme limiting total settlement to less than 25mm, with a factor of safety of 3. This is based on assumed relative density of loose for the coarse grained soils and a consistency of firm for the fine grained soils.

Given the variability of the encountered ground conditions across the site the potential for differential settlement may need to be considered.

Medium plasticity with medium volume change potential clays has been encountered on the site. The NHBC guidance recommends that minimum founding depths for such fine grained soils is 0.9m bgl in the absence of existing or proposed tree planting.

Significant dewatering will be required if conventional foundations are constructed below the water table and the excavations will be liable to constant collapse. Given that springs are located on site and that the site is situated within a very high susceptibility area for groundwater flooding, it is extremely likely that significant environmental constraints will be placed on the development by regulatory authorities with regards to the suitability of foundations. It may therefore be more viable to adopt raft foundations for the proposed development if this can be agreed. At the time of compiling this report the size and location of the proposed structure(s) along with details of structural loadings were not available and therefore the size of any raft foundation is also not known. Calculations of likely raft performance will only be of use once final design parameters are available as settlements across the site may be high.

It should be noted that settlements in such ground conditions will represent a value for consolidation (not total settlement upon loading) and therefore shall occur over a prolonged period of time. It is important that this is taken into consideration when designing a suitable raft as all service connections to the proposed building will have to be flexible enough to withstand settlements of potentially high magnitude.

Additionally it should be noted that the performance of any raft is likely to benefit if it bears onto an engineered Fill layer. This could be created by the removal of the existing near surface Made Ground and replacing it with compacted granular fill. The adoption of an engineered layer may also combat against the potential for differential movement of the raft due to the variable underlying Made Ground.

11.5 Ground Floor Slabs

Due to the presence of substantial thickness of Made Ground and the high groundwater table across the site it is considered that ground bearing floor slabs, whilst viable, will require detailed design to accommodate variability of the formation and account for differential settlement.

Where suspended floor slabs are employed ventilation of the under floor void will be required to address condensation issues. This would also assist in the mitigation of potential gas ingress issues.

11.6 Pavement Construction

An assessment of the likely California Bearing Ratio (CBR) for the Made Ground has been assessed from the following sources:

- Description of the materials encountered in the exploratory holes and;
- Laboratory CBR tests undertaken on re-compacted soil sample.

Near surface soils comprised both fine and coarse grained Made Ground. A laboratory CBR carried out on a compacted sample indicated a value of 8%. However, given that fine grained Made Ground was encountered near surface, consideration should be given to a design CBR value ranging between 2% and 3 % as recommended in Table 2.2 of the Design Manual for Roads and Bridges.

Following excavation the sub formation should be proof rolled and any soft material inspected and removed. Consideration should be given to presence of fine grained soils with medium volume change potential, with potential movement of the sub-base during wet and dry seasons.

11.7 Drainage

The presence of substantial depths of Made Ground across the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

As perched water was encountered within the Made Ground on site, soakaways were unable to be undertaken due to the limited head of water.

Given the environmental sensitivity of the site with regards to high groundwater and controlled surface water, it is unlikely that soakaways could be adopted for the proposed development.

11.8 Concrete Durability

Based upon the results of the chemical analyses summarised init is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with the recommendations provided in BRE Special Digest 1 (2005).

11.9 Excavations

Site observations indicated that excavations should be feasible in the near surface with normal plant, however concrete obstructions were identified in the near surface in a number of locations. It is anticipated that any obstructions will be grubbed out during the reduced level dig for the sub structure works.

Due to the variability of the Made Ground it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA RR97.

11.10 Construction Activity and Inspection

The following activities and inspections should be incorporated in to the site works:

- Due to the variability of the soils at the site it is recommended that sufficient allowance is made for the inspection of formation and sub formations to foundations and pavement construction;
- Excavations where access is required should be subject to a risk assessment from a competent person and where appropriate mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 utilised;
- It is considered that de-watering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond;
- Where access to confined spaces is required appropriate mitigation measures should be addressed within the Construction Stage Health and Safety Plan. Particular account should be taken of the gas results;
- The presence of potential contamination and mitigation measures should be addressed as part of the Construction Stage Health and Safety Plan and should include measures to design out the risks, reduce their impact and finally the use of Personnel Protective Equipment (PPE); and
- Given the location of the site and the risk to groundwater flooding, it is likely that significant environmental constraints will be placed on the development by regulatory authorities.

12.0 CONCLUSIONS & RECOMMENDATIONS

Geotechnical Assessment

It is estimated that within fine grained soils at 2.0m bgl an approximate allowable bearing capacity of 100kPa is possible with pad foundations, with a width of 1.0m, limiting total settlement to less than 25mm, with a factor of safety of 3.

It is estimated within coarse grained soils at 1.0m bgl an approximate allowable bearing capacity of 100kPa is achievable for pad foundation, with a width of 1.0m bgl, a factor of safety of 3, limiting total settlement to less than 25mm.

It is considered that the soils at the site would have a CBR design of 8%, with any value greater than 8% accounting for the variability of the Made Ground.

At a depth of 1.0m to 2.0m bgl an approximate permeability of 1×10^{-1} to 4×10^{-2} m/sec has been calculated for the encountered gravels. This indicates a high permeability and therefore soakaways systems within encountered granular deposits are considered viable for the site

The soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE Special Digest 1 (2005).

Revised Conceptual Site Model

The Tier I Human Health Risk Assessment has identified elevated concentrations of Lead and Benzo(a)Pyrene that have the potential to present a significant risk to controlled waters.

The current investigation has identified a number of potential sources of ground gas that have the potential to pose a significant risk to human health.

Recommendations

It is recommended that further investigation work is carried out within building footprints post demolition to investigate the inaccessible areas of the site for potential contamination.

It is recommended that the historical underground storage tank is removed and the excavation validated by a suitably qualified geo-environmental engineer.

Due to the presence of up to 1.3m of Made Ground, the presence of an underground petroleum storage tank, and the presence of historical ground workings within a 250m radius of the subject site, it is recommended that a period of ground gas and groundwater level monitoring is undertaken to facilitate an assessment of the risks posed by ground gas in line with CIRIA C665.

Given the presence of a spring beneath the site together with the presence of a high groundwater level and the close proximity of springs utilised by Portsmouth Water for the supply of potable water and an adjacent surface watercourse, it is recommended that groundwater sampling and analysis is undertaken to determine whether the shallow groundwater has been impacted by the leaching of contaminants from the Made Ground.

END OF REPORT

**APPENDIX I
LIMITATIONS**

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client as indicated in Section 1.2.
 2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
 3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
 4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
 5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
 6. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
 7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
 8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
 9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
 10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.
 11. REC can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.
 12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
 13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
-

APPENDIX II
GLOSSARY

TERMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

UNITS

m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion
mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million



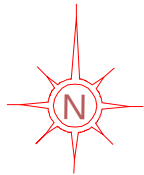
mg/m ³	Milligram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mAOD	Metres Above Ordnance Datum (sea level)
kN/m ²	Kilo Newtons per metre squared
µm	Micro metre

APPENDIX III
FIGURES

Key



Site Location



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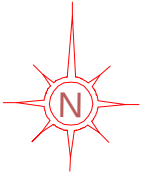
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Key



Site Location



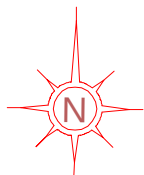
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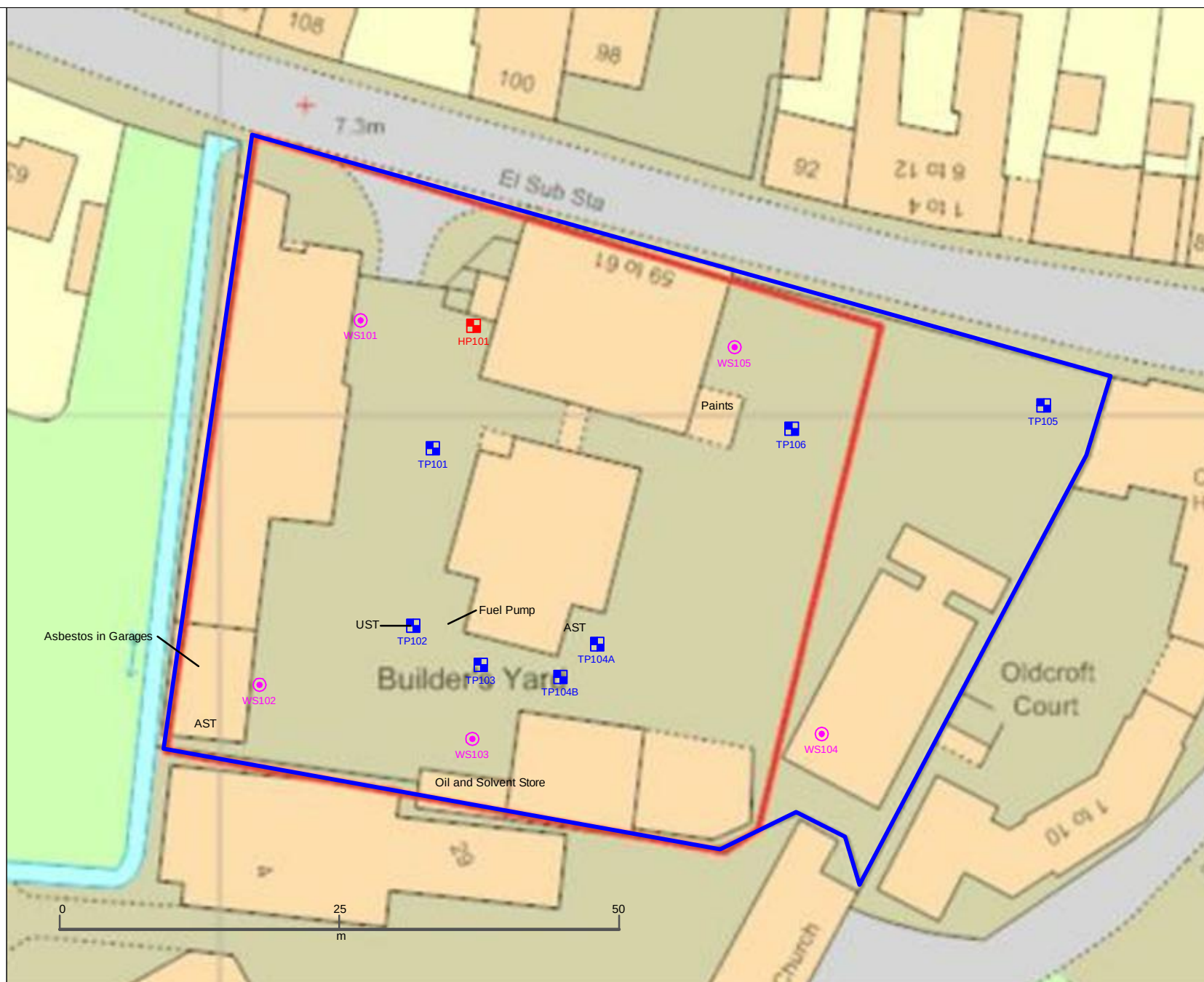
Key

- ⊙ WS101 Approximate Window Sample Probehole Location
- ⊠ TP101 Approximate Trial Pit Location
- ⊠ HP101 Approximate Hand Dug Pit Location
- Site Location



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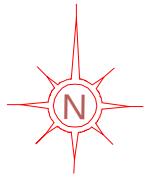
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Key

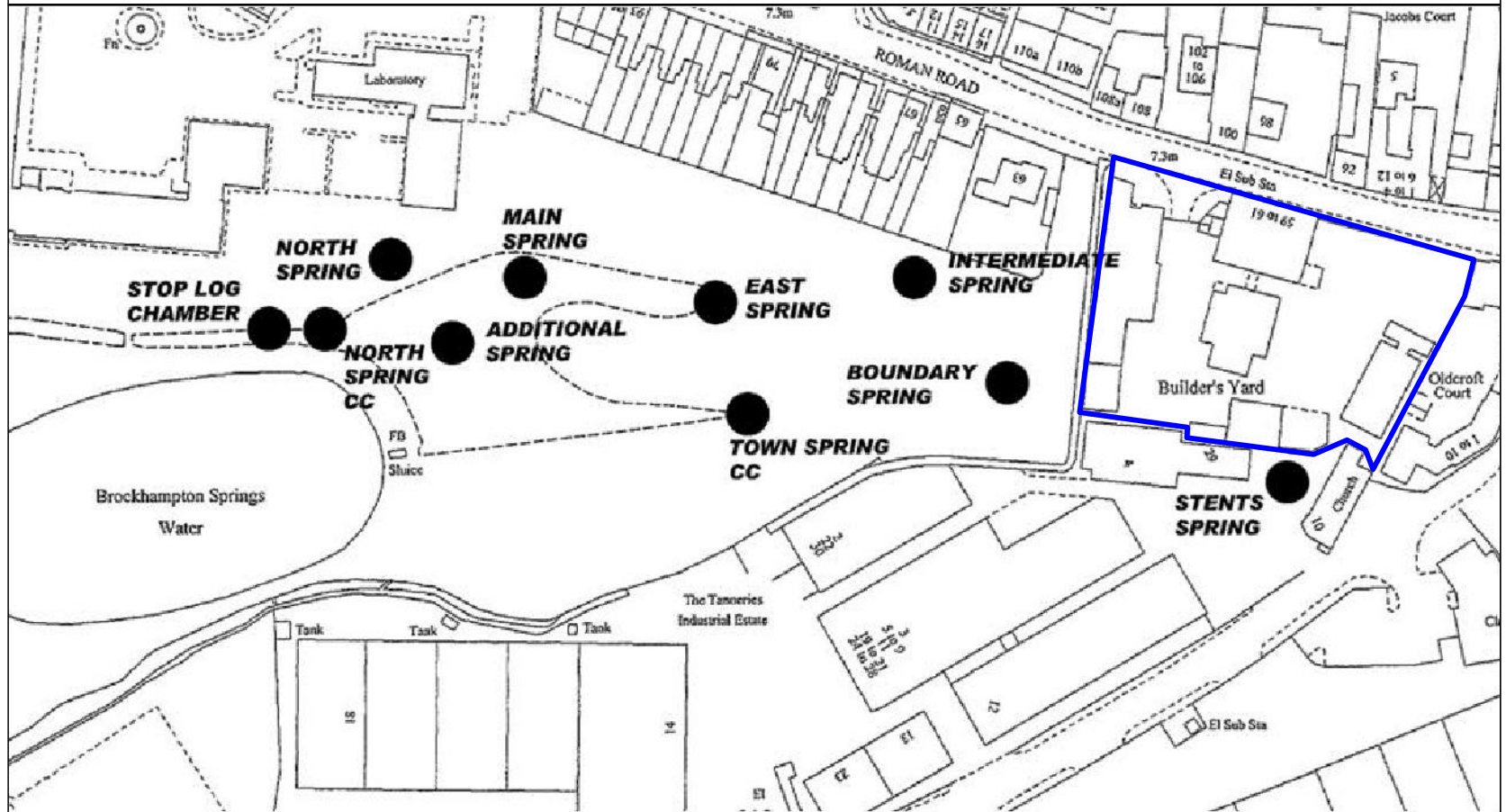


Site Location



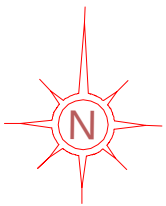
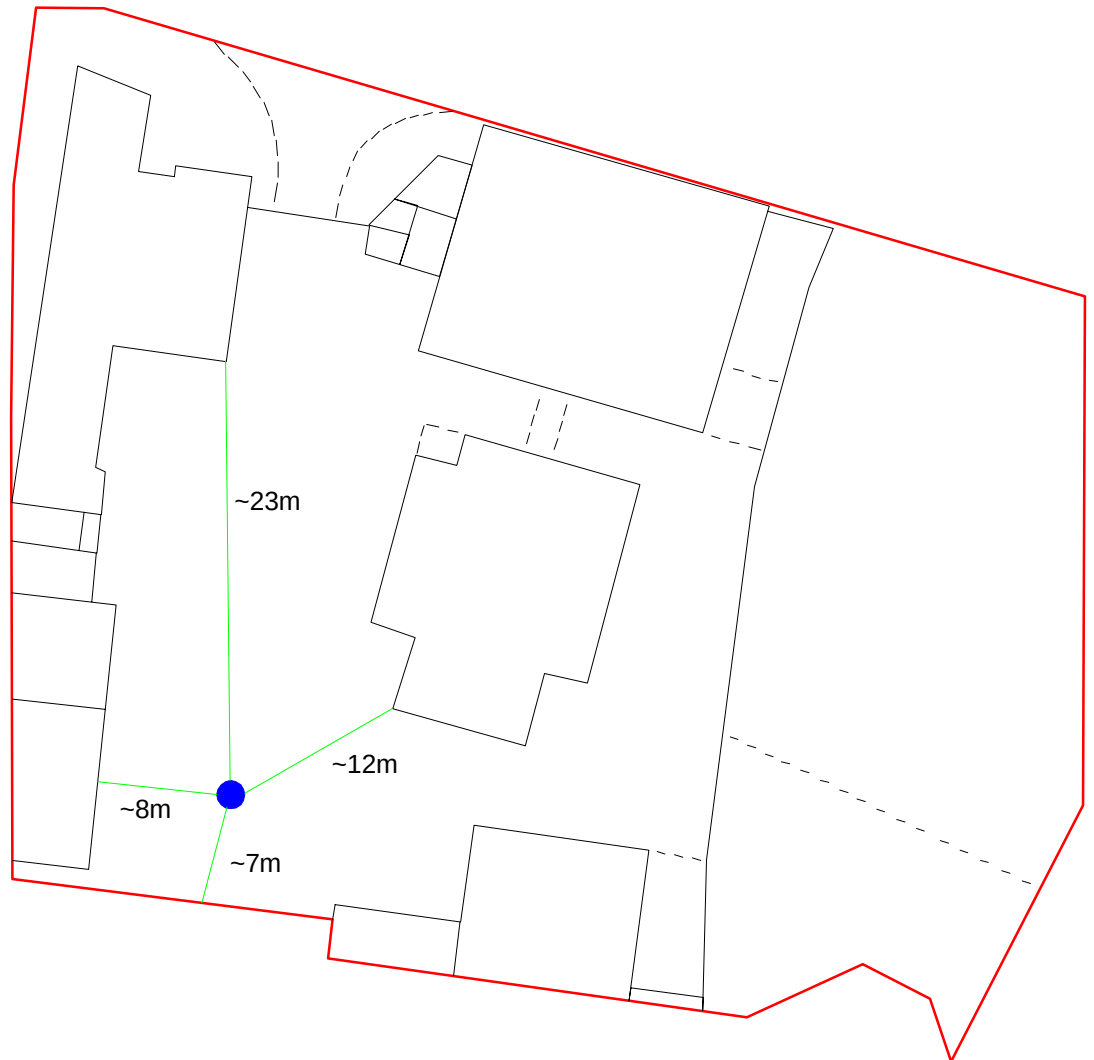
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Key

- Location of Spring
- Measured Distances
- Site Boundary



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Job Title:	Client:	Job No: 20586	DATE 07-02-14	Drawing Title:
West Street, Havant	Foreman Homes Ltd	Drawn by: P.S.Sullivan		Figure 5 Reputed Site Spring Location, With Measurements
		Approved by: T.Mitchell		
		Scale: NTS		

Notes:

Spring location courtesy of Portsmouth Water.

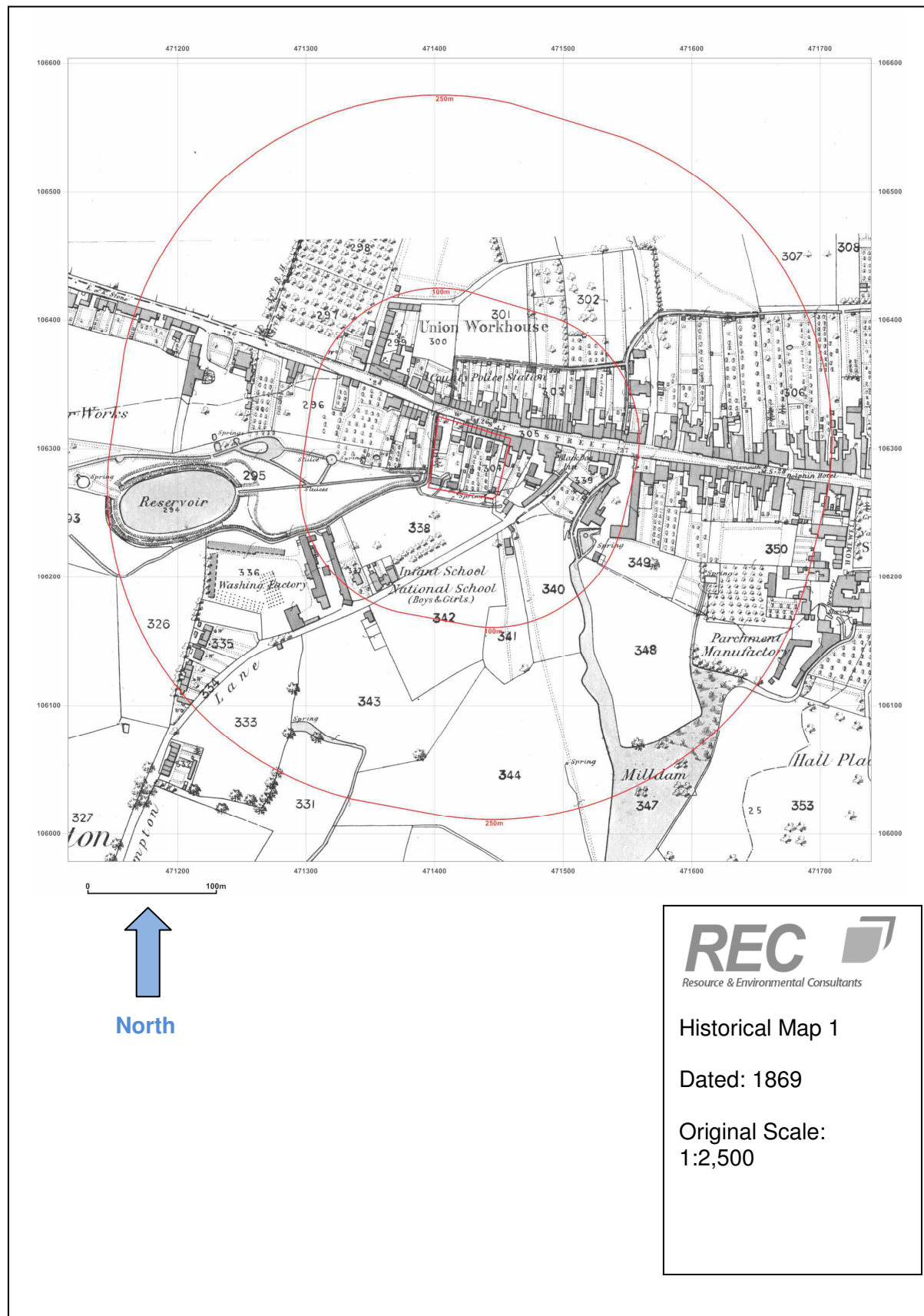
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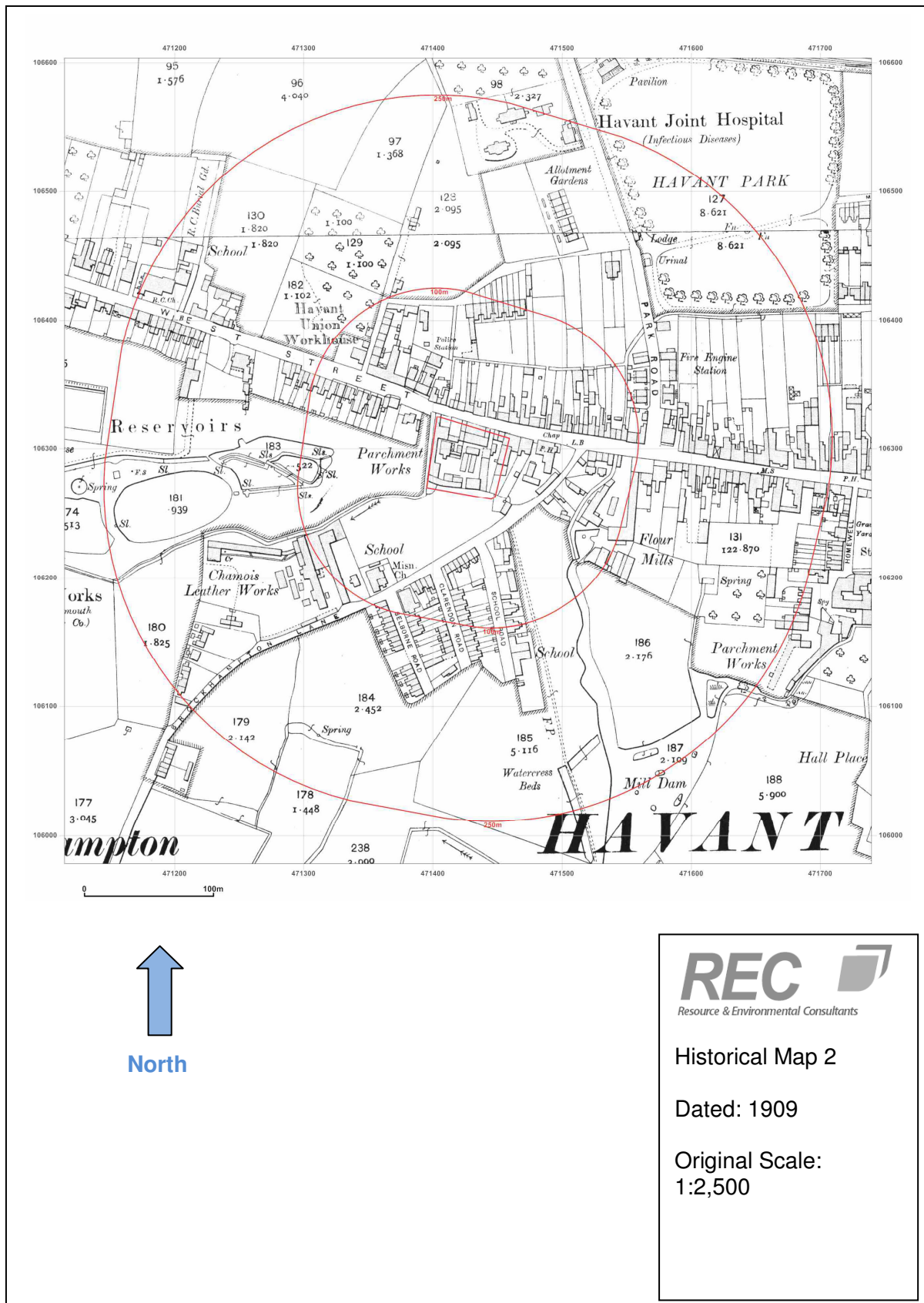
Resource & Environmental Consultants Ltd

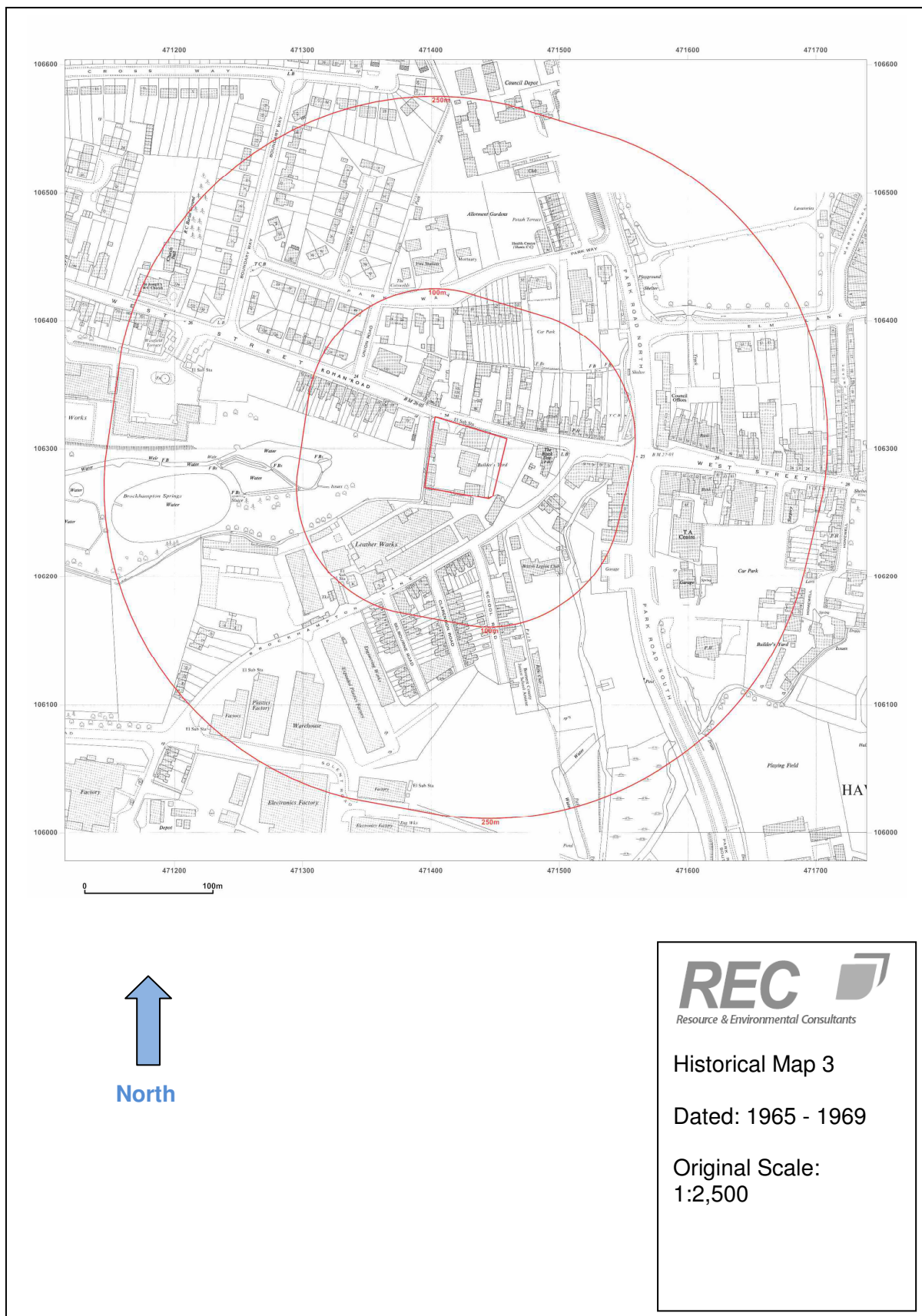


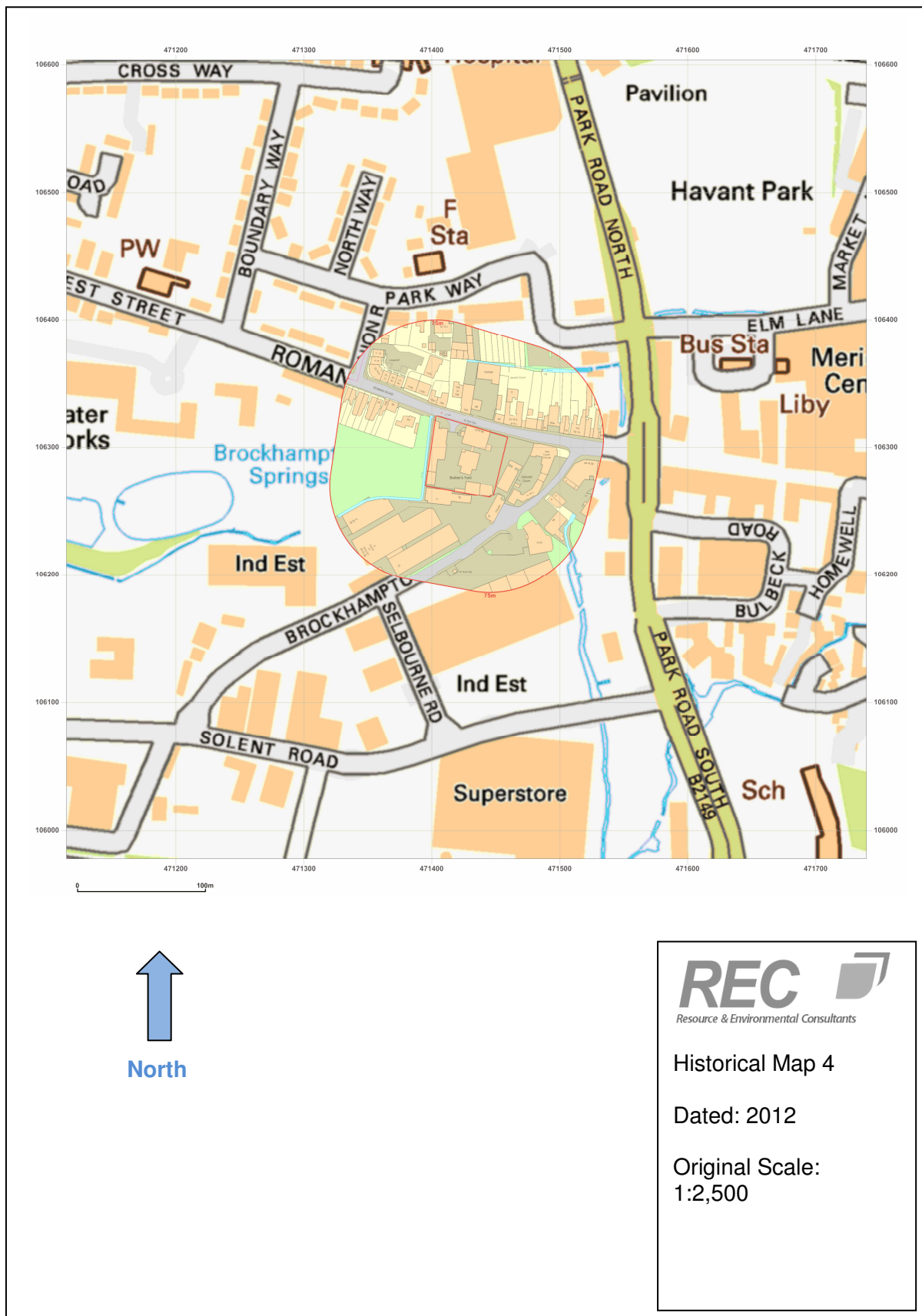
Resource and Environmental Consultants
Ltd
 Environment House, Segensworth Business
 Centre, Segensworth Road (West), Fareham,
 PO15 5RQ
 Tel: 01329 847 783
 Fax: 01329 845 439
 E-mail: sales@rec ltd.co.uk
 Website: www.rec ltd.co.uk

APPENDIX IV
HISTORICAL MAPS









APPENDIX V
REC EXPLORATORY LOGS

Borehole Log

Borehole No.

HA101

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -

Hole Type
HA

Location: Havant

Level:

Scale
1:10

Client: Foreman Homes Ltd

Dates: 15/01/2014 -

Logged By
DH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			Tarmac Cover. (MADE GROUND)
								Dense brown to grey sandy gravelly CLAY. Sand is fine. Gravel of subangular to subrounded, fine to medium flint and brick fragments. Colour becomes dark grey to black with depth. (MADE GROUND)
		0.50	B		0.50			End of borehole at 0.50 m

1

2

Remarks

Hand auger used. No water strike observed.

Trial Pit Log

Trialpit No

TP101

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -
Level:

Date
15/01/2014

Location: Havant

Dimensions
(m):

1.5

Scale

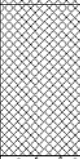
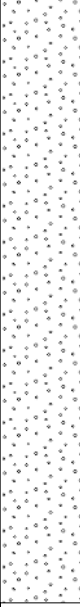
1:20

Client: Foreman Homes Ltd

Depth
2.50

0.7

Logged
HC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10			0.10			Tarmac Cover. (MADE GROUND)	
	0.20	ES					Light brown GRAVEL. Gravel of subangular to subrounded, fine to coarse flint within a coarse sandy matrix. Cobbles of subangular brick present. (MADE GROUND)	
	0.50	ES		0.50			Soft, dark brown, sandy gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded chalk deposits, flint and rare subangular brick. (MADE GROUND)	
	0.90			0.90			Loose, subangular to rounded, fine to coarse GRAVEL of flint within a sandy, slightly clayey matrix. (HEAD DEPOSITS)	
	1.20	ES						
	2.00	ES						
	2.30	ES						
				2.50			End of pit at 2.50 m	

Remarks: JCB 3CX used. Water strike at 1.1m bgl.

Stability: Unstable from 0.80m bgl

Trial Pit Log

Trialpit No

TP102

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -
Level:

Date
16/01/2014

Location: Havant

Dimensions
(m):

2

Scale

1:20

Client: Foreman Homes Ltd

Depth
1.15

0.8

Logged
HC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.07			Tarmac Cover. Top of UST exposed. (MADE GROUND)	
				0.17			Reinforced Concrete. (MADE GROUND)	
	0.40	ES					Reddish brown very gravelly SAND with dark greyish black staining. Sand is medium to coarse. Gravel of subangular to subrounded, fine to coarse flint, chalk deposits and brick. Cobbles of subangular brick and flint. Hydrocarbon odour present. (MADE GROUND)	
	0.80	ES		0.90			Loose gravels of subangular to rounded, fine to coarse flint with occasional cobbled sized flint. Presence of concrete, and corrugated steel at the base of the UST. (MADE GROUND)	1
	1.10	ES		1.15			End of pit at 1.15 m	4

Remarks: JCB 3CX used. Water strike at 1.0m bgl.

Stability: Stable

Trial Pit Log

Trialpit No

TP103

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -
Level:

Date
15/01/2014

Location: Havant

Dimensions
(m):

1.5

Scale

1:20

Client: Foreman Homes Ltd

Depth
1.50

0.45

Logged
HC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.07			Tarmac Cover. (MADE GROUND)	
				0.20			Dark brownish grey GRAVEL. Gravel of subangular to rounded, fine to coarse flint and rare brick. (MADE GROUND)	
				0.30			Light brown gravelly CLAY. Gravel of subangular to subrounded, fine to medium flint and rare subangular, fine brick. (MADE GROUND)	
	0.40	ES		0.40			Stiff to firm, creamy white, chalky CLAY. (MADE GROUND)	
				0.60			Stiff to firm, grey chalky CLAY with occasional clinker. (MADE GROUND)	
	0.80	ES		0.90			Soft light brown gravelly, slightly silty CLAY with occasional dark staining. Gravel of subangular to subrounded, fine to coarse flint and subangular to subrounded fine to cobble sized brick. Odour present. (MADE GROUND)	1
	1.20	ES		1.20			Soft dark brown slightly gravelly CLAY. Gravel of subangular to rounded, fine to medium flint. (HEAD DEPOSITS)	
	1.50	ES		1.50			Loose GRAVEL within a slightly sandy matrix. Gravel of subangular to subrounded fine to coarse flint. (HEAD DEPOSITS)	
							End of pit at 1.50 m	
								2
								3
								4

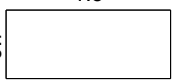
Remarks: JCB 3CX used. Water strike at 1.2m bgl.

Stability: Unstable from 0.90m bgl

Stability: Stable

Trial Pit Log

Trialpit No
TP104B
Sheet 1 of 1

Project Name: 59 - 61 West Street	Project No. 20586	Co-ords: - Level:	Date 15/01/2014
Location: Havant	Dimensions (m): Depth 1.30		Scale 1:20 Logged HC
Client: Foreman Homes Ltd		0.7 	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			Tarmac Cover. (MADE GROUND)	
	0.20	ES		0.25			Light brown GRAVEL. Gravel of subangular to subrounded, fine to coarse flint within a clayey, sandy matrix. Sand is fine to medium. (MADE GROUND)	
	0.40	ES		0.60			Dark grey to black gravelly, clayey SAND. Sand is medium to coarse. Gravel of subangular, fine to coarse flint, subrounded, fine chalk deposits and cobbles of rare subangular brick. Clinker and rare ceramic tile present at 0.35m bgl. (MADE GROUND)	
	0.80	ES		0.90			Dark grey GRAVEL within a clayey matrix. Gravel of subangular to rounded, fine to coarse occasionally cobble sized flint. At 1.2m bgl the cobble content increases to boulder sized subangular to subrounded flint. (MADE GROUND)	1
				1.30			Dark grey GRAVEL within a clayey matrix. Gravel of subangular to rounded, fine to coarse occasionally cobble sized flint. At 1.2m bgl the cobble content increases to boulder sized subangular to subrounded flint. (HEAD DEPOSITS)	2
							End of pit at 1.30 m	3
								4

Remarks: JCB 3CX used. Water strike at 0.9m bgl.	
Stability: Unstable from 0.80m bgl	

				Trial Pit Log			Trialpit No TP105 Sheet 1 of 1		
Project Name: 59 - 61 West Street				Project No. 20586		Co-ords: - Level:		Date 15/01/2014	
Location: Havant				Dimensions (m):		2.1 		Scale 1:20	
Client: Foreman Homes Ltd				Depth 1.20		0.8 		Logged DH	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
▼				0.05			Tarmac Cover. (MADE GROUND)
	0.30	ES		0.30			Whiteish grey sandy GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint with frequent cobble sized flint. Red brick layer present from 0.05m bgl to 0.10m bgl. (MADE GROUND)
				0.50			Light brown gravelly SAND. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint with rare cobble sized subangular to subrounded flint and rare brick fragments. (MADE GROUND)
	0.90	ES		0.90			Dark brown to grey clayey gravelly SAND. Sand is fine to medium. Gravel of subangular to subrounded, fine to medium flint with frequent cobble sized flint and rare flint boulders. (HEAD DEPOSITS)
	1.00	ES					
	1.10	D		1.20			Light yellowish brown, sandy clayey GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to medium frequently cobble and occasionally boulder sized flint. (HEAD DEPOSITS)
End of pit at 1.20 m							

Remarks: JCB 3CX used. Water strike at 0.9m bgl.		
Stability: Unstable from 1.20m bgl		

Trial Pit Log

Trialpit No

TP106

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -
Level:

Date
15/01/2014

Location: Havant

Dimensions
(m):

1.5

Scale

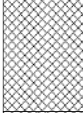
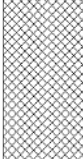
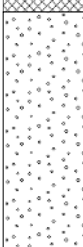
1:20

Client: Foreman Homes Ltd

Depth
1.50

0.7

Logged
HC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			Tarmac Cover. (MADE GROUND)	
	0.30	ES		0.40			Light brown GRAVEL within a sandy matrix. Sand is coarse. Gravel of subangular to subrounded, fine to coarse flint and brick. Occasional cobble sized, subangular brick. (MADE GROUND)	
	0.70	ES		0.85			Soft dark brownish grey, slightly sandy, gravelly CLAY. Gravel of subangular to subrounded fine to coarse chalk deposits, flint and rare brick and ceramic fragments. (MADE GROUND)	
	1.10	ES					Loose GRAVEL within a clayey matrix. Gravel of subangular to rounded, fine to coarse flint. At 1.2m bgl occasional cobble and rare boulder sized subangular flint. (HEAD DEPOSITS)	1
	1.50 1.50	ES D		1.50			End of pit at 1.50 m	
								2
								3
								4

Remarks: JCB 3CX used. Water strike at 1.0m bgl.

Stability: Unstable from 0.80m bgl

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -

Hole Type
WS

Location: Havant

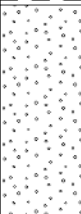
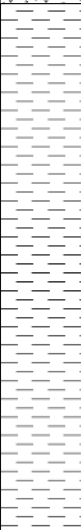
Level:

Scale
1:25

Client: Foreman Homes Ltd

Dates: 16/01/2014 -

Logged By
DH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15			Tarmac Cover. (MADE GROUND)	
		0.30	ES					Light brown, sandy clayey GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to cobble sized flint and rare brick fragments. (MADE GROUND)	
		0.60	ES		0.50			Brown sandy, gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded, fine to cobble sized flint. (HEAD DEPOSITS)	
	▼	0.90	ES		0.90				
		1.20	ES		1.00			Very soft, light brown, slightly sandy, slightly gravelly CLAY. Sand is fine to medium. Gravel of subangular to rounded, fine to medium flint. (HEAD DEPOSITS) Light brown GRAVEL in a clayey matrix. Gravel of subangular to subrounded, fine to cobble sized flint. Rare boulder sized subangular to sub rounded flint. (HEAD DEPOSITS)	1
					1.70			Light brown mottled yellow blue gravelly CLAY. Gravel of subangular to sub rounded, fine to coarse flint. (HEAD DEPOSITS)	2
		2.00		N=19 (2,2/3,5,5,6)					
		2.60	ES						
		3.00		N=11 (2,2/2,2,3,4)					3
					3.45				
								End of borehole at 3.45 m	4
									5

Remarks

Tracked window sampler used. Water strike at 0.9m bgl.

Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -

Hole Type
WS

Location: Havant

Level:

Scale
1:25

Client: Foreman Homes Ltd

Dates: 16/01/2014 -

Logged By
DH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10			Tarmac Cover. (MADE GROUND)	
		0.30	ES		0.30			Reddish yellow sandy GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to cobble sized flint, red brick and rare half brick. (MADE GROUND)	
		0.60	ES					Dark brown occasionally dark staining, sandy, gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded, fine to cobble sized flint, red brick fragments and rare half brick. (MADE GROUND)	
		1.00	ES	N=4 (1,1/1,2,0,1)	1.00			Orangey black, slightly sandy, gravelly CLAY. Sand is fine. Gravel of subangular to subrounded, fine to medium flint and occasional chalk deposits. (MADE GROUND)	1
		1.00			1.30			Soft light brown, clayey, slightly gravelly SAND. Sand is fine to medium. Gravel of subangular to subrounded, fine to medium flint. (HEAD DEPOSITS)	
		1.80	ES						
		2.00		N=10 (2,2/1,3,4,2)					2
					2.80			Light brown sandy, slightly gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded, fine to medium flint. (HEAD DEPOSITS)	3
		3.00		N=29 (5,7/10,6,7,6)					
		3.50	ES						
				N=17 (5,5/5,3,4,5)	3.90			Dark greyish brown slightly sandy CLAY. Sand is fine. (HEAD DEPOSITS)	4
		4.00							
					4.45			End of borehole at 4.45 m	5

Remarks

Tracked window sampler used. Water strike at 0.9m bgl.

Borehole Log

Borehole No.

WS103

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -

Hole Type
WS

Location: Havant

Level:

Scale
1:25

Client: Foreman Homes Ltd

Dates: 16/01/2014 -

Logged By
DH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10			Tarmac Cover. (MADE GROUND)	
		0.30			0.30			Light brown sandy, clayey GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint, brick fragments and occasional whole red brick. Frequent subangular to subrounded boulder sized flint. (MADE GROUND)	
		0.40	ES		0.40			Dark brown flecked white, sandy, clayey GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint, brick fragments with rare half brick and a single whole brick. (MADE GROUND)	
		0.70	ES		0.70			Dark brownish white sandy CLAY. Sand is fine to medium. Occasional subangular to subrounded brick fragments. (MADE GROUND)	
		1.00		N=8 (4,3/3,3,1,1)	1.00			Black slightly gravelly CLAY. Gravel of subangular to subrounded, fine to coarse flint. (HEAD DEPOSITS)	1
		1.20	ES		1.20			Soft dark brown to black sandy, gravelly CLAY. Sand is fine to medium and becomes less frequent with depth. Gravel of subangular to subrounded, fine to cobble sized flint. (HEAD DEPOSITS)	
		1.40			1.40			Light brown sandy gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded fine to cobble sized flint. (HEAD DEPOSITS)	
		1.60	ES		1.60			Pale brown GRAVEL in a clayey matrix. Gravel of subangular to subrounded fine to coarse flint. (HEAD DEPOSITS)	2
		2.00		N=7 (2,2/1,1,3,2)	2.00			Pale brown gravelly CLAY. Gravel of subangular to subrounded, fine to cobble sized flint. (HEAD DEPOSITS)	
		2.70	ES		2.70			Pale brown CLAY. (HEAD DEPOSITS)	
		2.90	D		2.90			Pale brown clayey GRAVEL. Gravel of subangular to subrounded fine to coarse flint. (HEAD DEPOSITS)	3
		3.00		N=34 (2,2/3,6,11,14)	3.00			Stiff brown slightly gravelly CLAY. Gravel of subangular to subrounded fine to coarse flint, gravel deposits increase with depth. (HEAD DEPOSITS)	
		3.10	ES		3.10				
		3.40	ES		3.40				
		4.00			4.00			End of borehole at 4.00 m	4

Remarks

Tracked window sampler used. Water strike at 1.5m bgl.



Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -

Hole Type
WS

Location: Havant

Level:

Scale
1:25

Client: Foreman Homes Ltd

Dates: 16/01/2014 -

Logged By
DH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Tarmac Cover. (MADE GROUND)	1 — — 2 — — 3 — — 4 — — 5 —
		0.30	D		0.40			Dark brown gravelly clayey SAND. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint and brick fragments. Occasional half brick and plastic fragments.	
		0.50	ES					(MADE GROUND)	
		0.60	D					Dark brown to black sandy, gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint with frequent cobble and boulder sized red brick fragments, metal fragments and rare fragments of asbestos insulation board.	
					0.80			(MADE GROUND) End of borehole at 0.80 m	

Remarks

Remarks	Window sample hole terminated at 0.80m bgl due to the presence of asbestos containing materials. No water strike observed.
---------	--

Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: 59 - 61 West Street

Project No.
20586

Co-ords: -

Hole Type
WS

Location: Havant

Level:

Scale
1:25

Client: Foreman Homes Ltd

Dates: 16/01/2014 -

Logged By
DH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.10			Soft landscaping: Dark brown sandy GRAVEL topsoil. Sand is fine to medium. Gravel of subangular to rounded, fine to medium flint. (MADE GROUND)	1
		0.20	ES		0.40			Brown clayey, sandy GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to coarse flint with rare brick fragments and chalk. (MADE GROUND)	
		0.60	ES		1.00			Dark brown to black, sandy gravelly CLAY. Sand is fine to medium. Gravel of fine to cobble sized flint and brick fragments. Rare chalk deposits, boulder sized brick up to half and whole brick size. (MADE GROUND)	
		1.00	ES		1.50			Dark brown to grey clayey GRAVEL. Gravel of subangular to subrounded fine to cobble sized flint. (HEAD DEPOSITS)	
		1.60	ES		2.00			Brown to grey, slightly clayey, sandy GRAVEL. Sand is fine to medium. Gravel of subangular to subrounded, fine to occasionally cobble sized flint. (HEAD DEPOSITS)	2
		2.00		N=27 (7,7/7,7,6,7)	2.60			Poor recovery: Firm sandy gravelly CLAY. Sand is fine to medium. Gravel of subangular to subrounded, fine to medium flint. (HEAD DEPOSITS)	
		2.80	ES		3.00			Poor recovery: Light brown clayey GRAVEL. Gravel of medium to coarse flint. (HEAD DEPOSITS)	3
		3.00		N=10 (3,2/1,3,3,3)	3.80			Light brown, mottled red, slightly sandy, gravelly CLAY. Gravel of subangular to subrounded, fine to medium flint. (HEAD DEPOSITS)	
		3.50	D		4.00				4
		4.00	D	N=11 (2,3/2,3,3,3)	4.45				
		4.00						End of borehole at 4.45 m	5

Remarks

Tracked window sampler used. Water strike at 0.9m bgl.

APPENDIX VI
CHEMICAL TESTING



Scientific Analysis Laboratories is a
limited company registered in England and
Wales (No 2514788) whose address is at
Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories Ltd

Certificate of Analysis

3 Crittall Drive
Springwood Industrial
Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Report Number: 372173-3

Date of Report: 29-Jan-2014

Customer: Resource Environmental Consultants Ltd
Environment House
Segensworth Business Centre
Segensworth Road (West)
Fareham
PO15 5RQ

Customer Contact: Mr Tim Mitchell

Customer Job Reference: 20586

Customer Site Reference: 59 - 61 West Street, Havant

Date Job Received at SAL: 21-Jan-2014

Date Analysis Started: 22-Jan-2014

Date Analysis Completed: 29-Jan-2014

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22



1650

Report checked
and authorised by :
Sarah Watt-Roy
Project Manager

Issued by :
Sarah Watt-Roy
Project Manager

SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586					
Soil Miscellaneous					
Analysed as Soil					
SAL Reference		372173 001		372173 002	
Customer Sample Reference		HA101 ES1 @ GL-0.50m		TP102 ES1 @ 0.40m	
Date Sampled		15-JAN-2014		16-JAN-2014	
Determinand		Method		Test Sample	
LOD		Units			
Asbestos ID		T27		A40	
Asbestos not detected		Asbestos not detected		Chrysotile Detected	
-		-		-	
				Amosite Detected	
				-	
Asbestos not detected		Asbestos not detected		Asbestos not detected	
-		-		-	
				Asbestos not detected	
				-	

SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586					
Soil Miscellaneous					
Analysed as Soil					
SAL Reference		372173 006		372173 008	
Customer Sample Reference		WS101 ES2 @ 0.60-0.80m		WS103 ES1 @ 0.40-0.70m	
Date Sampled		16-JAN-2014		16-JAN-2014	
Determinand		Method		Test Sample	
LOD		Units			
Asbestos ID		T27		A40	
Asbestos not detected		Asbestos not detected		Chrysotile Detected	
-		-		-	
				Amosite Detected	
				-	
Asbestos not detected		Asbestos not detected		Asbestos not detected	
-		-		-	
				Asbestos not detected	
				-	

SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586					
Bulk Product Miscellaneous					
Analysed as Bulk Product					
SAL Reference		372173 012		372173 013	
Customer Sample Reference		WS104 PACM (D2)		TP104A PACM (D1)	
Date Sampled		16-JAN-2014		16-JAN-2014	
Determinand		Method		Test Sample	
LOD		Units			
Asbestos		T27		A40	
Amosite Detected		Amosite Detected			
-		-			

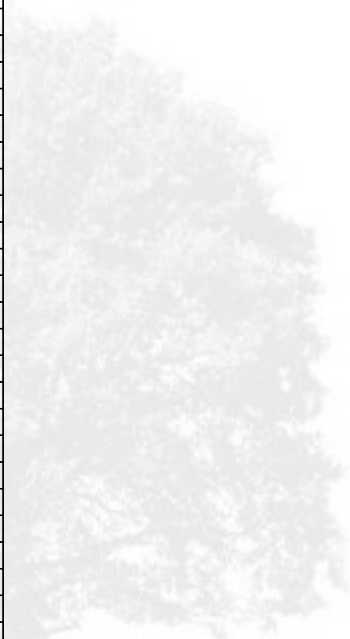
SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586					
Soil Suite C					
Analysed as Soil					
SAL Reference		372173 002		372173 004	
Customer Sample Reference		TP102 ES1 @ 0.40m		TP104B ES2 @ 0.40m	
Date Sampled		16-JAN-2014		15-JAN-2014	
Determinand		Method		Test Sample	
LOD		Units			
TPH (C5-C6)		T54		AR	
0.10		mg/kg		<0.10	
TPH (C6-C8)		T54		AR	
0.10		mg/kg		4.6	
TPH (C8-C10)		T54		AR	
0.10		mg/kg		15	
TPH (C10-C12)		T219		AR	
2		mg/kg		<2	
TPH (C12-C16)		T219		AR	
2		mg/kg		<2	
TPH (C16-C21)		T219		AR	
2		mg/kg		<2	
TPH (C21-C35)		T219		AR	
2		mg/kg		<2	

SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586 Soil Analysed as Soil PCBs EC7 (SE)					
SAL Reference				372173 001	
Customer Sample Reference				HA101 ES1 @ GL-0.50m	
Date Sampled				15-JAN-2014	
Determinand	Method	Test Sample	LOD	Units	
PCB BZ#101	T16	AR	20	µg/kg	<20
PCB BZ#118	T16	AR	20	µg/kg	<20
PCB BZ#138	T16	AR	20	µg/kg	<20
PCB BZ#153	T16	AR	20	µg/kg	<20
PCB BZ#180	T16	AR	20	µg/kg	<20
PCB BZ#28	T16	AR	20	µg/kg	<20
PCB BZ#52	T16	AR	20	µg/kg	<20

SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586 Soil Analysed as Soil Total and Speciated USEPA16 PAH (SE)										
SAL Reference				372173 004	372173 005	372173 006	372173 007	372173 008	372173 011	
Customer Sample Reference				TP104B ES2 @ 0.40m	TP105 ES2 @ 0.50-0.80m	WS101 ES2 @ 0.60-0.80m	WS102 ES4 @ 1.80-2.00m	WS103 ES1 @ 0.40-0.70m	WS105 ES4 @ 1.60-1.80m	
Date Sampled				15-JAN-2014	15-JAN-2014	16-JAN-2014	16-JAN-2014	16-JAN-2014	16-JAN-2014	
Determinand	Method	Test Sample	LOD	Units						
Naphthalene	T16	AR	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	0.2	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	0.5	<0.1	2.3	<0.1	1.1	<0.1
Anthracene	T16	AR	0.1	mg/kg	<0.1	<0.1	0.2	<0.1	0.4	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	0.8	<0.1	2.8	<0.1	2.2	<0.1
Pyrene	T16	AR	0.1	mg/kg	0.7	<0.1	2.2	<0.1	1.9	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	0.3	<0.1	0.6	<0.1	1.1	<0.1
Chrysene	T16	AR	0.1	mg/kg	0.4	<0.1	0.9	<0.1	1.2	<0.1
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	0.6	<0.1	1.0	<0.1	1.6	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	0.3	<0.1	0.4	<0.1	0.9	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	0.2	<0.1	0.4	<0.1	0.7	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	0.1	<0.1	<0.1	<0.1	0.3	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	0.2	<0.1	0.4	<0.1	0.7	<0.1
PAH(total)	T16	AR	0.1	mg/kg	4.4	<0.1	12	<0.1	12	<0.1

Project Site: 59 - 61 West Street, Havant
Customer Reference: 20586

Soil	Analysed as Soil
VOC (SE)	




SAL Reference: 372173 Project Site: 59 - 61 West Street, Havant Customer Reference: 20586	
Soil VOC (SE)	Analysed as Soil

SAL Reference	372173 010
Customer Sample Reference	WS105 ES1 @ 0.20-0.40m
Date Sampled	16-JAN-2014

Determinand	Method	Test Sample	LOD	Units	
Trichlorofluoromethane	T54	AR	5	µg/kg	<5
Vinyl chloride	T54	AR	5	µg/kg	<5

Index to symbols used in 372173-3

Value	Description
A40	Assisted dried < 40C
AR	As Received
13	Results have been blank corrected.
S	Analysis was subcontracted
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Where an asbestos result of none detected is reported this is obtained from analysis of a representative sub sample

Method Index

Value	Description
T82	ICP/OES (Sim)
T7	Probe
T102	ICP/OES (HCl extract)
T54	GC/MS (Headspace)
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T219	GC/FID (SE)
T257	ICP/OES (SIM) (Aqua Regia Extraction)
T27	PLM
T16	GC/MS
T4	Colorimetry
T245	ICP/OES(Aqua Regia Extraction)

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Asbestos	T27	A40			SU	012-013
Asbestos ID	T27	A40			SU	001-006,008-010
PCB BZ#101	T16	AR	20	µg/kg	U	001
PCB BZ#118	T16	AR	20	µg/kg	U	001
PCB BZ#138	T16	AR	20	µg/kg	U	001
PCB BZ#153	T16	AR	20	µg/kg	U	001
PCB BZ#180	T16	AR	20	µg/kg	U	001
PCB BZ#28	T16	AR	20	µg/kg	U	001
PCB BZ#52	T16	AR	20	µg/kg	U	001
Arsenic	T257	A40	2.0	mg/kg	U	002,004-008,011
Cadmium	T257	A40	0.1	mg/kg	U	002,004-008,011
Chromium	T257	A40	0.5	mg/kg	U	002,004-008,011
Copper	T257	A40	2	mg/kg	U	002,004-008,011
Lead	T257	A40	2	mg/kg	U	002,004-008,011
Mercury	T245	A40	1.0	mg/kg	U	002,004-008,011
Nickel	T257	A40	0.5	mg/kg	U	002,004-008,011
Selenium	T257	A40	3	mg/kg	U	002,004-008,011
Zinc	T257	A40	2	mg/kg	U	002,004-008,011
Chromium VI	T82	A40	1	mg/kg	N	002,004-008,011
pH	T7	A40			U	002,004-008,011

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
SO4(Total)	T102	A40	0.01	%	U	002,004-008,011
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	U	002,004-008,011
Phenols(Mono)	T4	AR	0.5	mg/kg	U	002,004-008,011
Cyanide(Total)	T4	AR	1	mg/kg	U	002,004-008,011
TPH (C5-C6)	T54	AR	0.10	mg/kg	N	002,004,007
TPH (C6-C8)	T54	AR	0.10	mg/kg	N	002,004,007
TPH (C8-C10)	T54	AR	0.10	mg/kg	N	002,004,007
TPH (C10-C12)	T219	AR	2	mg/kg	U	002,004,007
TPH (C12-C16)	T219	AR	2	mg/kg	U	002,004,007
TPH (C16-C21)	T219	AR	2	mg/kg	U	002,004,007
TPH (C21-C35)	T219	AR	2	mg/kg	U	002,004,007
Naphthalene	T16	AR	0.1	mg/kg	U	004-008,011
Acenaphthylene	T16	AR	0.1	mg/kg	U	004-008,011
Acenaphthene	T16	AR	0.1	mg/kg	U	004-008,011
Fluorene	T16	AR	0.1	mg/kg	U	004-008,011
Phenanthrene	T16	AR	0.1	mg/kg	U	004-008,011
Anthracene	T16	AR	0.1	mg/kg	U	004-008,011
Fluoranthene	T16	AR	0.1	mg/kg	N	004-008,011
Pyrene	T16	AR	0.1	mg/kg	N	004-008,011
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	U	004-008,011
Chrysene	T16	AR	0.1	mg/kg	U	004-008,011
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	U	004-008,011
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	U	004-008,011
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	U	004-008,011
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	U	004-008,011
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	U	004-008,011
PAH(total)	T16	AR	0.1	mg/kg	U	004-008,011
1,1,1,2-Tetrachloroethane	T54	AR	5	µg/kg	U	010
1,1,1-Trichloroethane	T54	AR	5	µg/kg	U	010
1,1,2,2-Tetrachloroethane	T54	AR	5	µg/kg	U	010
1,1,2-Trichloroethane	T54	AR	5	µg/kg	U	010
1,1,2-Trichloroethylene	T54	AR	5	µg/kg	U	010
1,1-Dichloroethane	T54	AR	5	µg/kg	U	010
1,1-Dichloroethylene	T54	AR	5	µg/kg	U	010
1,1-Dichloropropene	T54	AR	5	µg/kg	U	010
1,2,3-Trichlorobenzene	T54	AR	5	µg/kg	U	010
1,2,3-Trichloropropane	T54	AR	5	µg/kg	U	010
1,2,4-Trichlorobenzene	T54	AR	5	µg/kg	U	010
1,2,4-Trimethylbenzene	T54	AR	5	µg/kg	U	010
1,2-Dibromo-3-Chloropropane	T54	AR	10	µg/kg	U	010
1,2-dibromoethane	T54	AR	5	µg/kg	U	010
1,2-Dichlorobenzene	T54	AR	5	µg/kg	U	010
1,2-Dichloroethane	T54	AR	5	µg/kg	U	010
1,2-Dichloropropane	T54	AR	5	µg/kg	U	010
1,3,5-Trimethylbenzene	T54	AR	5	µg/kg	U	010
1,3-Dichlorobenzene	T54	AR	5	µg/kg	U	010
1,3-Dichloropropane	T54	AR	5	µg/kg	U	010
1,4-Dichlorobenzene	T54	AR	5	µg/kg	U	010
Ethyl-2-Methylbenzene	T54	AR	5	µg/kg	U	010
2,2-Dichloropropane	T54	AR	5	µg/kg	U	010
2-Chlorotoluene	T54	AR	5	µg/kg	U	010
4-Chlorotoluene	T54	AR	5	µg/kg	U	010
Benzene	T54	AR	1	µg/kg	U	010
Bromobenzene	T54	AR	5	µg/kg	U	010
Bromochloromethane	T54	AR	5	µg/kg	U	010
Bromodichloromethane	T54	AR	5	µg/kg	U	010
Bromoform	T54	AR	5	µg/kg	U	010
Bromomethane	T54	AR	5	µg/kg	U	010
Carbon tetrachloride	T54	AR	5	µg/kg	U	010
Chlorobenzene	T54	AR	5	µg/kg	U	010
Chlorodibromomethane	T54	AR	5	µg/kg	U	010
Chloroethane	T54	AR	5	µg/kg	U	010
Chloroform	T54	AR	5	µg/kg	U	010
Chloromethane	T54	AR	5	µg/kg	N	010
Cis-1,2-Dichloroethylene	T54	AR	5	µg/kg	U	010
Cis-1,3-Dichloropropene	T54	AR	5	µg/kg	U	010
Dibromomethane	T54	AR	5	µg/kg	U	010
Dichlorodifluoromethane	T54	AR	5	µg/kg	N	010
EthylBenzene	T54	AR	1	µg/kg	U	010
Hexachlorobutadiene	T54	AR	5	µg/kg	U	010

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Isopropyl benzene	T54	AR	5	µg/kg	U	010
m/p ethyl toluene	T54	AR	5	µg/kg	U	010
M/P Xylene	T54	AR	1	µg/kg	U	010
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	U	010
n-Butylbenzene	T54	AR	10	µg/kg	U	010
n-Propylbenzene	T54	AR	5	µg/kg	U	010
O Xylene	T54	AR	1	µg/kg	U	010
p-Isopropyltoluene	T54	AR	5	µg/kg	U	010
S-Butylbenzene	T54	AR	5	µg/kg	U	010
Styrene	T54	AR	5	µg/kg	U	010
T-Butylbenzene	T54	AR	5	µg/kg	U	010
Tertiary amyl methyl ether	T54	AR	5	µg/kg	U	010
Tetrachloroethene	T54	AR	5	µg/kg	U	010
Toluene	T54	AR	1	µg/kg	U	010
Trans-1,2-Dichloroethene	T54	AR	5	µg/kg	U	010
Trans-1,3-Dichloropropene	T54	AR	5	µg/kg	U	010
Trichlorofluoromethane	T54	AR	5	µg/kg	U	010
Vinyl chloride	T54	AR	5	µg/kg	U	010



APPENDIX VII
ORIGIN OF TIER I VALUES

ORIGIN OF REC TIER I VALUES

Constituent	Origin of Risk Assessment Value
Arsenic	2009 SGV
Cadmium	LQM CIEH 2 nd Edition 2009
Chromium	LQM CIEH 2 nd Edition 2009
Lead	Residential Half 2003 EA SGV based on planned target blood lead level reduction to 5µg/l. Commercial Calculated using commercial exposure equation within lead SGV 2003 with revised input data from HPA and taking proposed blood lead levels into account.
Mercury	2009 SGV
Nickel	2009 SGV
Selenium	Soil guideline value, DEFRA/Environment Agency
Copper	LQM CIEH 2 nd Edition 2009
Zinc	LQM CIEH 2 nd Edition 2009
Cyanide - Total	CLEA 1.06 Derived Value
Phenols - Total.	LQM CIEH 2 nd Edition 2009 – 1% SOM
Naphthalene	General Assessment Criteria (GAC) developed by CIEH / LQM the using CLEA 1-06 with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene ⁽ⁱ⁾	
Chrysene	
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C ₅ -C ₆ (aliphatic)	
TPH C ₆ -C ₈ (aliphatic)	
TPH C ₈ -C ₁₀ (aliphatic)	
TPH C ₁₀ -C ₁₂ (aliphatic)	
TPH C ₁₂ -C ₁₆ (aromatic)	
TPH C ₁₆ -C ₂₁ (aromatic)	
TPH C ₂₁ -C ₃₅ (aromatic)	

APPENDIX VIII
SPT INTERPRETATION SHEET

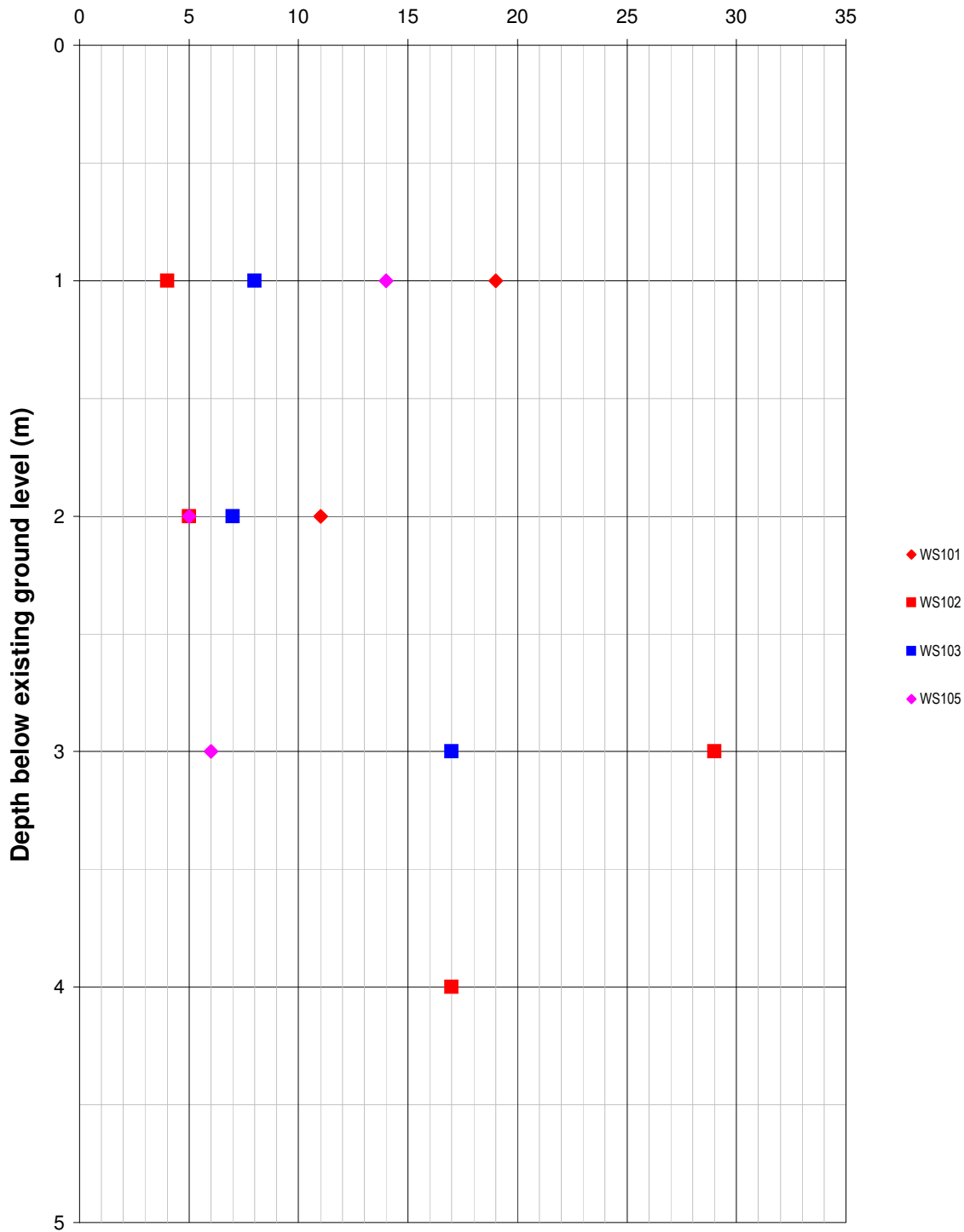
SPT N vs Depth

Site:
SPT N vs Depth

Client:
59 - 61 West Street

Contract No.
20586

SPT N-Value



APPENDIX IX
GEOTECHNICAL TESTING



LABORATORY REPORT



4043

Contract Number: PSL14/0348

Client's Reference:

Report Date: 04 February 2014

Client Name: REC Fareham
Environment House
Segensworth Business Centre
Segensworth Road West
Fareham
PO15 5RQ

For the attention of: D Hull

Contract Title: 59-61 West Street, Havant

Date Received: 22/1/2014

Date Commenced: 22/1/2014

Date Completed: 4/2/2014

Notes: Observations 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 in full, without the prior written approval of the laboratory.

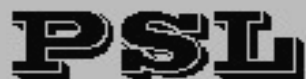
Checked and Approved Signatories:

R Gunson
(Director)

A Watkins
(Director)

M Beastall
(Laboratory Manager)

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	03/02/14		04/02/14		04/02/14
59-61 WEST STREET, HAVANT.				Contract No:	PSL14/0348
				Client Ref:	20586

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

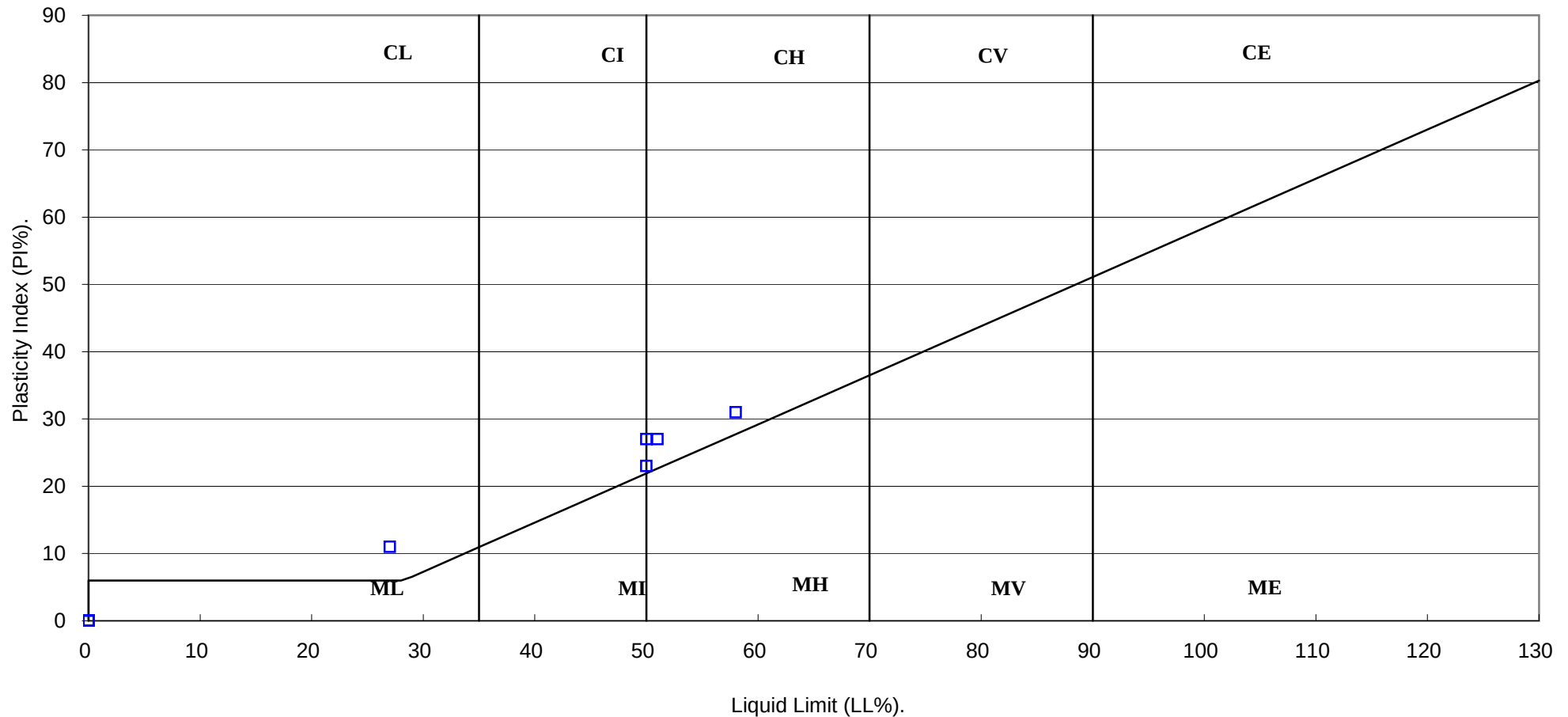


Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	03/02/14		04/02/14		04/02/14
59-61 WEST STREET, HAVANT.				Contract No:	PSL14/0348
				Client Ref:	20586

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



PSL

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	03/02/14		04/02/14		04/02/14
59-61 WEST STREET, HAVANT.				Contract No:	PSL14/0348
				Client Ref:	20586

Particle Size Distribution Test

BS1377 : Part 2 : 1990

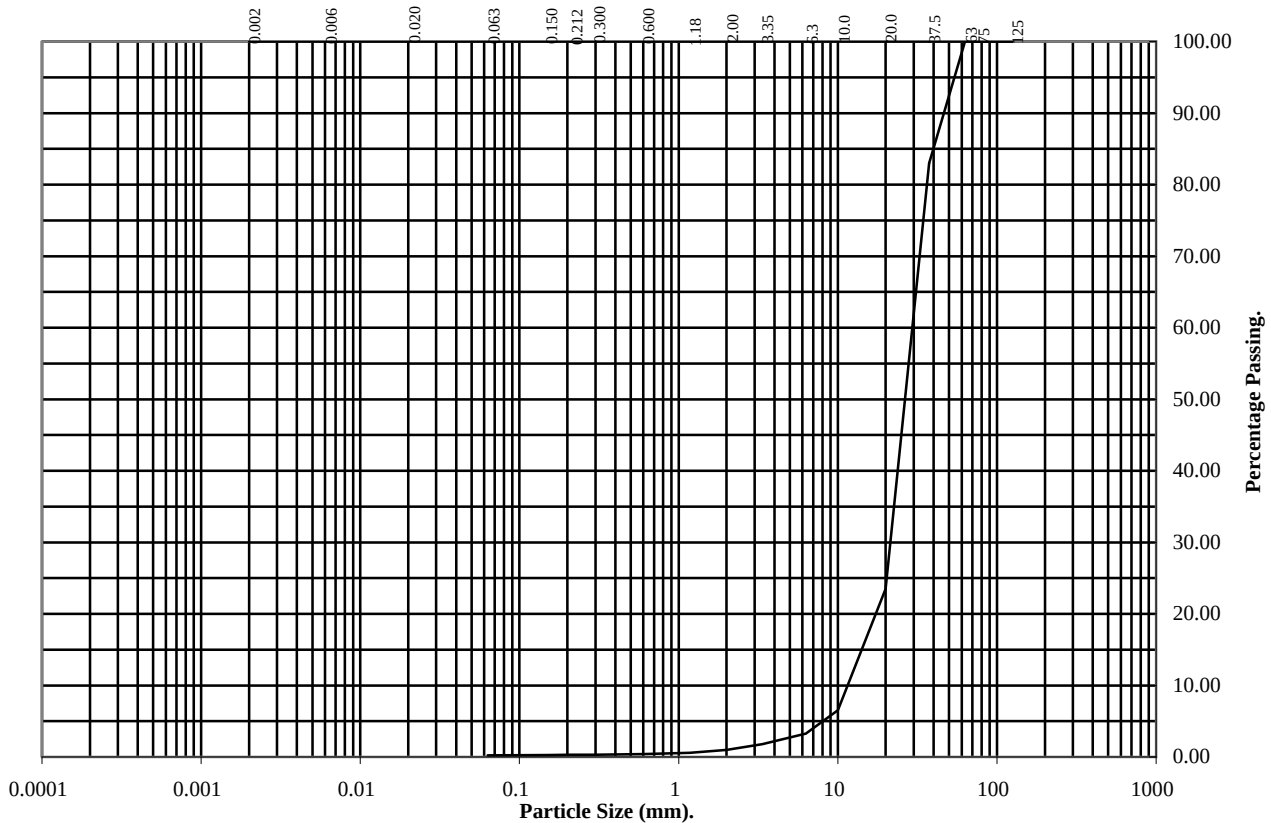
Wet Sieve, Clause 9.2

Hole Number: TP01

Depth (m): 2.00

Sample Number: 4

Sample Type: D



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	83
20	23
10	7
6.3	3
3.35	2
2	1
1.18	1
0.6	0
0.3	0
0.212	0
0.15	0
0.063	0

Soil Fraction	Total Percentage
Cobbles	0
Gravel	99
Sand	1
Silt / Clay	0

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date
<i>M. S.</i>	04/02/14	<i>M. S.</i>	04/02/14

PSL

Professional Soils Laboratory

59-61 WEST STREET, HAVANT.

Contract No.:
PSL14/0348

Particle Size Distribution Test

BS1377 : Part 2 : 1990

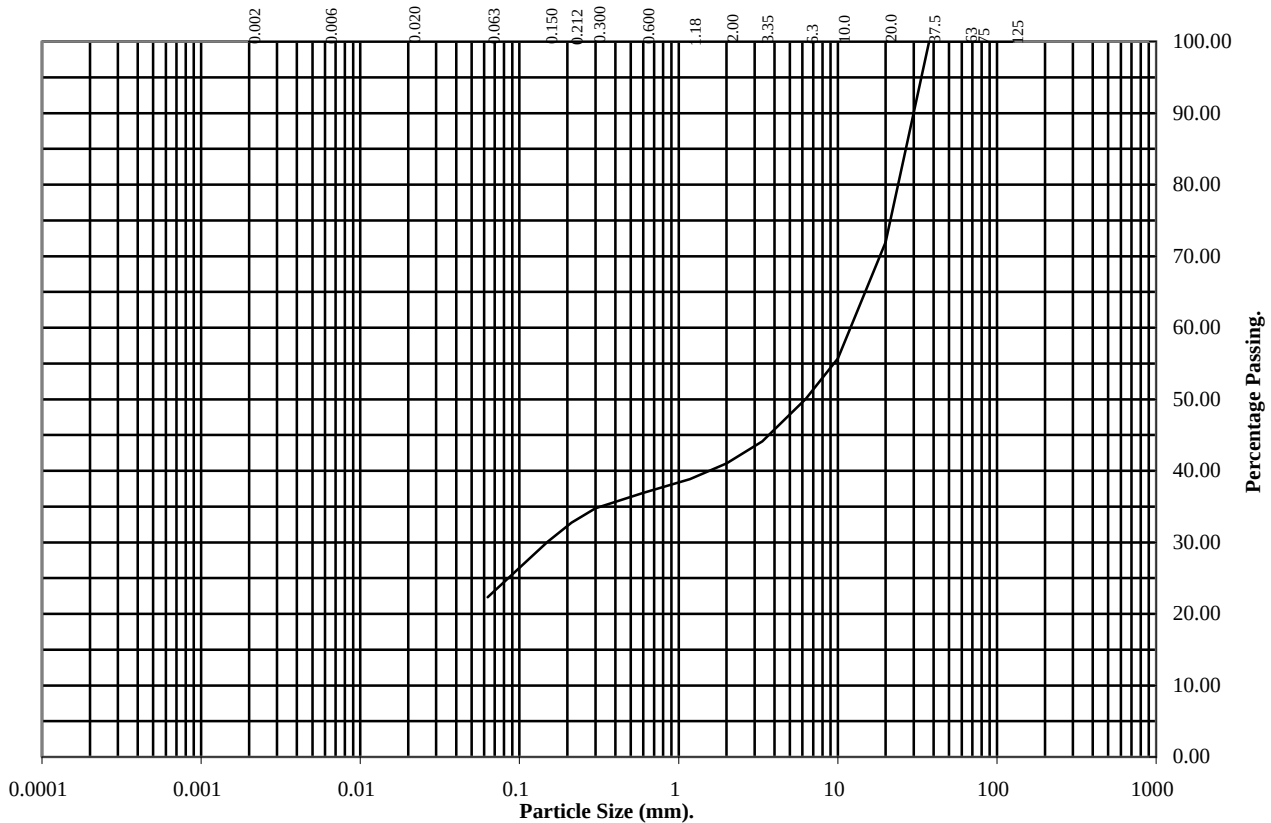
Wet Sieve, Clause 9.2

Hole Number: TP06

Depth (m): 1.50

Sample Number: 4

Sample Type: D



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	72
10	56
6.3	50
3.35	44
2	41
1.18	39
0.6	37
0.3	35
0.212	33
0.15	30
0.063	22

Soil Fraction	Total Percentage
Cobbles	0
Gravel	59
Sand	19
Silt / Clay	22

Remarks:
See summary of soil descriptions.

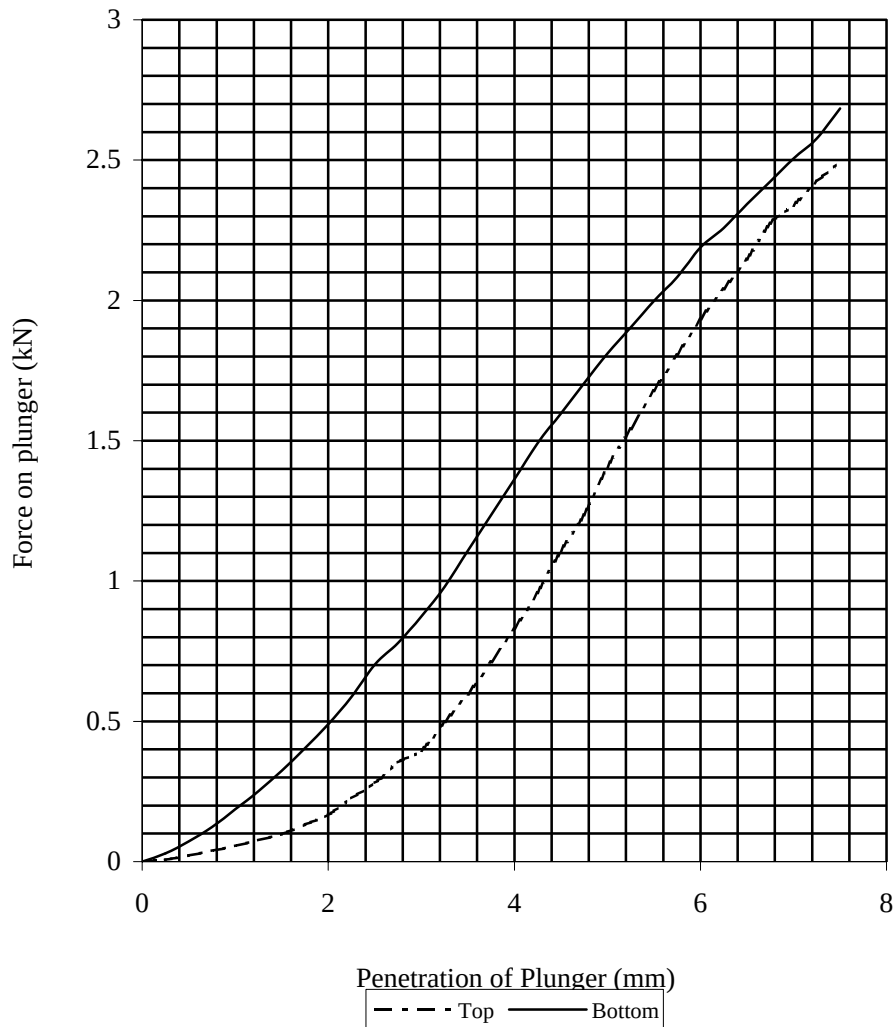
Checked By	Date	Approved By	Date
<i>M. S.</i>	04/02/14	<i>M. S.</i>	04/02/14

California Bearing Ratio Test.

BS 1377 : Part 4 : 1990

Hole Number: TP104B Depth (m): 0.20-1.20

Sample Number: 1 Sample Type: B



Initial Sample Conditions		Test Conditions		Method of compaction 2.5Kg Rammer			
Moisture Content:	17	Surcharge Kg:	4.20	Final Moisture Content %		C.B.R. Value %	
Bulk Density Mg/m ³ :	2.08	Soaking Time hrs	0	Sample Top	17	Sample Top	7.0
Dry Density Mg/m ³ :	1.79	Swelling mm:	0	Sample Bottom	16	Sample Bottom	9.1
Percentage retained on 20mm BS test sieve:	43	Remarks: See Summary of Soil Description.					

Checked by	Date	Approved By	Date
<i>H. be</i>	04/02/14	<i>H. be</i>	04/02/14

PSL Professional Soils Laboratory	59-61 WEST STREET, HAVANT.	Contract No. PSL14/0348
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Particle Size Distribution Test

BS1377 : Part 2 : 1990

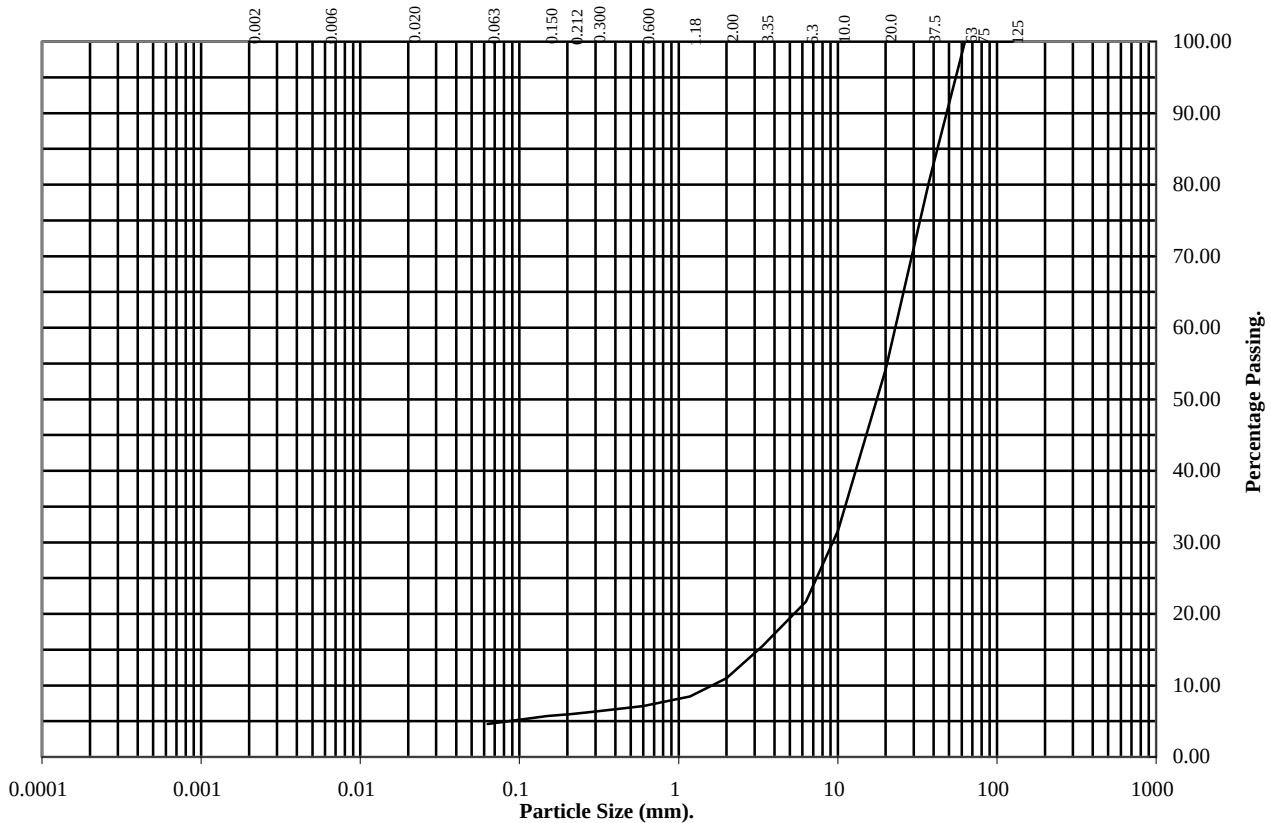
Wet Sieve, Clause 9.2

Hole Number: WS105

Depth (m): 1.00-1.20

Sample Number: 3

Sample Type: D



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	81
20	54
10	32
6.3	22
3.35	15
2	11
1.18	8
0.6	7
0.3	6
0.212	6
0.15	6
0.063	5

Soil Fraction	Total Percentage
Cobbles	0
Gravel	89
Sand	6
Silt / Clay	5

Remarks:

See summary of soil descriptions.

Checked By	Date	Approved By	Date
<i>M. S.</i>	04/02/14	<i>M. S.</i>	04/02/14

PSL

Professional Soils Laboratory

59-61 WEST STREET, HAVANT.

Contract No.:
PSL14/0348

**CD CONTAINING
COMPLETE PDF COPY OF REC REPORT**

REC Ltd is a multi-disciplinary health, safety, environmental and energy consultancy. Our national coverage enables our local experts to provide cost effective and pragmatic consultancy services in an efficient and sustainable manner.



- Phase 1 Habitat Surveys
- Invasive Species
- Legally Protected Species Surveys
- Mitigation Schemes
- Ecological Impact Assessment (EcIA)
- BREEAM & Code 4 Sustainable Homes
- Habitat Management Plans
- Management planning and targeted Biodiversity Action Plan survey
- Environmental Impact Assessment



- Air Quality Impact
- Odour Assessment
- Dispersion Modelling
- Stack Emission Testing
- Pollution Monitoring



- Feasibility Studies
- Ground Source Heat Pumps Installation
- Air Source Heat Pump Installation
- System Design and Maintenance
- Solar Photovoltaic (PV) Systems
- Combined Heat and Power Systems



- Asbestos Management Surveys
- Demolition/Refurbishment Surveys
- Analysis of Asbestos in Soils and Bulk Samples
- Air Testing for Clearances and Reassurance
- Legionella Risk Assessment



- Geotechnical Investigation & Assessment
- Contaminated Land Investigation & Assessment
- Waste Management
- Groundwater Testing
- Environmental Impact Assessment



- Sound Insulation Testing
- Noise at Work Assessment
- Development Related Noise / Vibration
- Environmental Noise / Vibration



- Flood Risk & Consequence Assessment
- Strategic Flood Risk Assessment (SFRA)
- EIA Technical Chapters
- Assessment of Flood Levels
- Hydrology & Hydrogeology
- Flood Defence Structures
- Drainage Systems (SUDS) Design
- Mitigation Measures
- Soakaway Tests



- Health, Safety & Environmental Management Systems
- Divestment / Acquisition Due Diligence Services
- Environment Permit Application & Support
- Compliance Auditing
- Carbon Reporting
- Waste Minimisation