



**Phase I-II
Geo-Environmental Site Assessment**

**Residential Development
Lovedean Lane
Waterlooville
Hampshire
PO8 9RN**

Prepared for

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Quality Assurance

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Executive Summary	
Site Address	Residential Development, Lovedean Lane, Waterlooville, Hampshire, PO8 9RN
National Grid Reference	468747, 112257
Site Area	0.262ha
Current Site Use	The site at Lovedean Lane, Waterlooville is located approximately 2.7km north of Waterlooville Town Centre and was accessed via Lovedean Lane from the east of the site. At the time of the walkover the site comprised an irregular plot of land with a single rectangular wooden building in a poor state of repair in the centre of the site. There were two wooden rectangular sheds located in the centre and to the south-east of the site utilised for storage of building and garden equipment. The north of the site was covered by a sub-base type material and to the south with soft standing. The majority of the west of the site comprised a wooded area of mature deciduous trees on a steep slope (approximately 1.5m above the current ground level of the site). The site was undulating in nature comprising of varying ground levels.
Site History	Site forms part of an undeveloped parcel of land on mapping dating from c.1868 until 1958 where unspecified buildings were present on site. From interviews with the former owner of the site is understood that the site was formerly used as a brick-makers yard and a builders yard, although has been vacant now for a number of years. In 1969 the site changed configuration of the buildings which matches the current configuration, evident on mapping dated 2014.
Geology, Hydrology & Hydrogeology	Soils underlying the site are classified as a Principal Aquifer, which is attributed to the Chalk of the Tarrant Chalk Member. No licenced groundwater abstractions or potable groundwater abstractions are noted within 250m of the site. The ground investigation encountered the following geology: Made Ground was encountered within all intrusive locations to a maximum depth of 3.50m bgl within WS103, however Made Ground was encountered between 0.10-0.25m bgl across the remainder of the site. Made Ground typically comprised a superficial layer of presumed sub-base material overlying a dark brown silty medium <u>SAND</u> with varying gravel content and a soft to firm, gravelly <u>CLAY</u>, with varying anthropogenic material of concrete, rare plastic, chalk and cobble sized brick. Made Ground within WS103 which extended to 3.50m bgl also comprised of soft to firm brown gravelly <u>CLAY</u> with anthropogenic material of subangular brick, chalk and rare clinker. Made Ground was underlain by cohesive deposits comprising of a soft to firm, brownish orange <u>CLAY</u> with variable sand and gravel content attributed to Head Deposits. Bedrock deposits attributed to the Tarrant Chalk Member were encountered immediately beneath the cohesive deposits. The chalk bedrock was recovered as a creamish white structureless <u>CHALK</u> composed of slightly sandy, gravelly <u>SILT</u>, encountered from depths of approximately 1.20m bgl with a maximum proven thickness of 1.90m within WS101. Gravel was recorded as weak, low density, white with frequent black specks and rounded in a brownish cream matrix. This unit was encountered within all locations with the exception of WS103. The encountered chalk was considered to be grade Dm.
Landfill Sites & Ground Gases	The Groundsure Report did not identify any Environment Agency historic landfill sites, landfills or waste treatment site within 250m of the site.
Radon	With reference to the HPA Radon Atlas for England and Wales, less than 1% of properties are above the action level. At this level BRE publication BR211 indicates that no radon protective measures are required in the construction of new extensions or dwellings.
Revised Conceptual Site Model	

Following the completion of the Tier 1 risk assessment, pollution linkages involving elevated concentrations of Cadmium and PAH were identified which are considered to present a significant risk to future site users. The ground gas assessment undertaken for the site has demonstrated that due to a single exceedance of CO₂ in WS103 requiring further gas monitoring is required to fully assess the gas regime of the site.

Geotechnical Assessment

At a depth of 1.00m bgl within encountered natural cohesive strata, two SPT N values were obtained with N values of N=2 and N=10, providing correlated in-situ shear strengths ranging between 9kPa to 45kPa. Based on this, it is considered founding at this depth would provide insufficient bearing capacity

An SPT N value of N=6 was encountered at a depth of 2.00m bgl within natural cohesive strata, providing a correlated in-situ shear strength of 27kPa. Utilising a shear strength of 27kPa a traditional strip foundation no greater than 1.00m width provides an allowable bearing capacity in the range of 50-100kN/m².

Given the inherently low 'N' values for the cohesive strata and the poor quality of the encountered chalk unit (Grade Dm) it is considered unlikely that traditional shallow foundations are suitable for the proposed development, therefore alternative foundations solutions should be considered.

Concrete Classification

Soils encountered beneath the site have been classified in accordance with **DS-1**, Aggressive Chemical Environment for Concrete Classification (ACEC) **AC-1** with the recommendations provided in BRE Special Digest 1 (2005).

Recommendations

Elevated concentrations of Cadmium and PAH have been identified in the near surface Made Ground in the vicinity of location WS101. It is therefore considered that further in the vicinity of WS101 is required by the advancement of shallow hand dug pits to delineate the extent of potential contamination within the Made Ground. If contamination is identified from further testing remedial action will be required to render the pollution linkages inactive with remedial works set out within a standalone Remediation Method Statement (RMS) which should be submitted to the Local Authority for approval.

Concentrations of CO₂ up to 5.0% v/v have been detected within WS103 on a single visit during initial monitoring rounds. It is recommended that further monitoring is undertaken to fully assess the ground gas regime of the site comprising of at least one visits under low pressure conditions (<999mbar).

Where bearing capacities are insufficient for the proposed scheme, alternative foundation solutions, such as a piled foundation solution may be suitable for the site. However, further ground investigation works would be required in order to prove competency of the encountered Grade Dm chalk strata to a sufficient depth.

If, during the development stage any evidence of contamination is identified, works should be halted and contact made with a suitably qualified Environmental Consultant. As determined appropriate by the Consultant, further investigation and sampling may be required to determine the appropriate actions. Upon completion contact should be made with the regulator to achieve sign off of the works.

In terms of foundation options, advice should be sought from a piling contractor and it is likely that a deeper cable percussive borehole will be required in order to obtain the relevant data for pile depth and diameters to be designed.

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1.0 INTRODUCTION

1.1 Background

Omnia Environmental Consulting (OEC) have been commissioned by PMC Construction and Development Services (PMC) Ltd to undertake a Phase I & II Geo-Environmental Site Assessment at the site of the Proposed Residential Development, Lovedean Lane, Waterloooville, PO8 9RN.

A site location plan is provided as Figure 1.0, within Appendix III.

1.2 Proposed Development

It is understood that PMC propose to develop the above site for a residential end use comprising three (3no.) to four (4no.) residential houses, as specified within the provided Feasibility Site Plan, dated May 2018.

The proposed layout is identified as Figure 2.0 within Appendix III.

1.3 Objectives

The objectives of the Phase I-II Geo-Environmental Site Assessment are to:

- Undertake a site walkover and inspection including interviews with key site representatives if available;
- 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 an assessment of the near surface through intrusive site investigation;
- 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; and,
- Provide a factual and interpretative report relating to the site and provide recommendations on any potential development issues with particular consideration of Residential, Construction Worker and Environmental receptors.

1.4 Sources of Information

Background information was sought from the following sources:

- British Geological Survey Map Sheet 316, Fareham, Solid & Drift Edition at a scale of 1: 63,360;
- Environment Agency Groundwater Vulnerability Map (www.environment-agency.gov.uk/wiyby);
- Groundsure Environmental Database Search (GS-5072745);
- Historical Ordnance Survey Mapping (1868 – 2014);
- Tomlinson, M.J. (2001). *Foundation Design and Construction*. 7th Edition. Pearson Prentice Hall.

1.5 Limitations

The limitations of this report are presented in Appendix I.

1.6 Confidentiality

OEC 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 OEC; a charge may be levied against such approval.

2.0 SITE SETTING

2.1 Site Details

Site Address	Residential Development, Lovedean Land, Waterlooville, Hampshire, PO8 9RN
National Grid Reference	468747, 112257

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

2.2 Current Site Use

Site Description

The site at Lovedean Lane, Waterlooville is situated approximately 2.7km north of Waterlooville Town Centre and was accessed via Lovedean Lane. The site was roughly rectangular in shape, narrowing towards the north, with the long axis of the site aligned approximately north to south. The site was accessed via a driveway leading from a small residential cul-de-sac to the east of Lovedean Lane (*Photograph 1*), via a locked wooden gated entrance.

At the time of the walkover, the site comprised of a single rectangular building located in the centre of the site, orientating east to west (*Photograph 3*). The building was constructed of metal corrugated sheeting and was in a poor state of repair. At the time of the site walkover the building was locked and was utilised for the storage of building material including fencing and wooden fence panels (*Photograph 4*). Two (2no.) caravans were located adjacent to the site entrance which were presumed abandoned and in a poor state of repair (*Photograph 2*). Two (2no.) rectangular sheds were also present on site, one located adjacent to the central corrugated building, which was in a very poor state of repair and one in the south of the site comprising a wooden structure with a metal apex corrugated roof, measuring approximately 3.00m (l) x 1.50m (w). The shed in the south of the site was observed to contain mixed building materials and garden equipment (*Photograph 7*) and had a metal green bunded water tanker to the east of the building (*Photograph 6*). Immediately to the north of the shed was a stockpile of large wooden logs.

The north of the site comprised an area capped with a sub-base type material and the south of the site was capped by an area of un-kept soft landscaping. The site was bound by wooden fencing around the perimeter of the site with residential housing immediately beyond.

The topography on site was undulating and generally sloped towards the east. The western area of the site was elevated by approximately 1.50m and comprised a wooded area containing mature deciduous trees.

Hazardous Materials Storage

No hazardous material storage was observed during the site walkover.

Potential Asbestos Containing Material (PACM)

During the site walkover, no visible PACM was observed. It should be noted that the building was built

before the year 2000 and therefore asbestos may be present within the building fabric. It is therefore recommended that an asbestos survey is undertaken prior to the commencement of demolition or renovation works in line with current asbestos legislation.

Waste Storage

The storage of mixed building and domestic waste and equipment was noted within the building located in the centre of the site and the shed in the south of the site.

2.3 Surrounding Area

The surrounding land uses are summarised below:

Direction	Land Use
North	Residential Dwellings with private gardens.
East	Residential Dwellings with private gardens. Lovedean Lane beyond.
South	Residential Dwellings with private gardens.
West	Residential Dwellings with private gardens.

3.0 SITE HISTORY

3.1 On-Site Historical Development

A review of historical maps pertinent to the site and within a 250m radius is summarised in Table 3.1 below. Historical maps are included within the Groundsure report presented within Appendix V.

Table 3.1 Summary of Potentially Contaminative Historical Land Uses.

Map Edition	Historical Land Use	
	On Site	Off Site
1868 (1:2,500)	The site area is irregular in shape and occupied by deciduous trees. The eastern most part of the site comprises part of a larger Old Chalk Pit.	Well, ~120m south-west. Old Chalk Pit, ~130m north-west. Old Chalk Pit, ~175m north-east. Old Chalk Pit, ~200m north-west.
1897 (1:2,500)	No significant change.	Old Chalk Pit, ~100m north-west. Old Sand Pit, ~190m east. No other significant change.
1909 (1:2,500)	No significant change	Old Sand Pit ~190m east now identified as Old Chalk Pit.
1932 (1:2,500)	No significant change.	Old Chalk Pits no longer labelled. Residential housing with private gardens ~70m to ~250m west.
1958-1963 (1:2,500)	There are now two (2no.) rectangular shaped buildings to the east of the site.	Expansion of residential development. Pond ~220m south.
1960-1965 (1:2,500)	No significant change.	No significant change.
1973-1974 (1:1,250)	Chalk Pit in the east is no longer visible on mapping.	Chalk pit appear to have been infilled. Electrical sub-station ~50m north-east. Electrical sub-station ~120m east. Tennis Court ~130m south-west. Electrical Sub-station ~175m south-east. Car park ~175m south. Swimming pool ~180m south west.
1969-1974 (1:2,500)	There is now only a single rectangular building on site.	Expansion of residential development in all directions. Electrical sub-station ~160m south.
1976-1977 (1:2,500)	No significant change from partial mapping.	No significant change from partial mapping.
1979 (1:1,250) Faded Mapping	No significant change.	No significant change.

Map Edition	Historical Land Use	
	On Site	Off Site
1984-1990 (1:2,500)	No significant change.	No significant change.
1990-1993 (1:1,250)	No significant change.	No significant change.
1993 (1:1,250)	No significant change.	No significant change.
1995 (1:1,250)	No significant change.	No significant change.
2002 (1:10,000)	No significant change from scale of mapping.	No significant change from scale of mapping.
2010 (1:10,000)	No significant change from scale of mapping.	No significant change from scale of mapping.
2014 (1:10,000)	No significant change from scale of mapping.	No significant change from scale of mapping.

3.2 Historical Tank Database

The Groundsure Report did not identify any tanks within a 250m radius of the site.

From an interview with a former site owner no historical tanks were located on site.

3.3 Planning History

OEC has undertaken a review of on-line planning records held by Havant Borough Council. No environmentally pertinent records for the site or surrounding area were identified.

4.0 ENVIRONMENTAL SETTING

4.1 Geology & Hydrogeology

British Geological Survey Map (Sheet 316, Fareham, Solid & Drift Edition at a scale of 1: 63,360) indicates that the site is underlain by the following geological sequence:

Geological Unit	Classification	Description	Aquifer Classification
Superficial	Head Deposits – <i>Bordering north-eastern boundary</i>	Clay, Silt, Sand and Gravel	Secondary – undifferentiated Layers
Bedrock	Tarrant Chalk Member	Chalk	Principal Aquifer
	Lambeth Group – <i>South-east of the site</i>	Clay, Silt and Sand	Secondary (A) Aquifer – Permeable Layers

BGS records indicate that the area is underlain directly by Bedrock deposits of the Tarrant Chalk Member, classed as a Principal Aquifer. Superficial Head Deposits are present adjacent to the north-eastern boundary of the site, classified as a Secondary undifferentiated Aquifer.

The Groundsure report indicates that the site is located within a groundwater Source Protection Zone (SPZ) Zone 1 (Inner Catchment) and that no potable water and/or groundwater abstraction licenses have been identified within a 250m radius of the site.

Groundwater vulnerability data indicates that the site is underlain by deposits classified as having a high leaching potential.

Based on local topography and the location of surface watercourses it is considered that shallow groundwater, if present, will flow to the south.

4.2 Hydrology

From review of the data presented within the Groundsure report, no surface water abstraction licenses have been identified within a 250m radius of the site. The Groundsure report did not identify any surface water courses within a 250m radius of the site.

The environmental database indicates that the site is not located within a currently defined flood risk area with the site indicated to have a risk from rivers and the sea (RoFRaS) rating of 'Very Low'.

The site is located within 50m of a BGS groundwater flooding susceptibility area associated with Clearwater Flooding. The Groundsure report goes on to state that / Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding) or with unconfined aquifers (Clearwater Flooding).

4.3 Geotechnical Data

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

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

4.4 Mining & Ground Workings

The site is not located within 50m of an area that is affected by coal mining related works and therefore a Coal Authority Coal Mining Report has not been obtained for the purpose of this investigation. However, the Groundsure report identifies a single non-coal mining related works on site associated with chalk. The Groundsure report states, 'Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered.'

4.5 Radon Risk Potential

The Groundsure report indicates that the site is not in a radon affected area as defined by the Health Protection Agency (HPA) as less than 1% of the properties are above the Action Level. At this level BRE publication BR211 indicates that radon protective measures are not required in the construction of new extensions or dwellings.

4.6 Industrial Land Uses

There are five (5no.) industrial land use entries within a 250m radius of the subject site, and comprise:

- 25m north, Electricity Sub-station – Electrical Feature;
- 136m east, Lovedean Hardware – General Construction Supplies;
- 143m east, Electricity Sub-station – Electrical Feature;
- 154m south, Electricity Sub-station – Electrical Feature; and,
- 171m south-east, Electricity Sub-station – Electrical Feature.

The Groundsure report did not identify any Petrol and Fuel Sites within a 250m radius of the site.

4.7 Sensitive Land Uses

The Groundsure report identified three (3no.) sensitive land uses within a 250m radius of the subject site as follows:

- Nitrate Vulnerable Zone (NVZ), on site;
- Un-named Ancient Replanted Woodland, 113m west; and,
- Un-named Ancient and Semi-Natural Woodland, 321m south-east.

4.8 Site Sensitivity Assessment

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

- Underlying Principal Aquifer;
- Underlying deposits with high leaching potential;
- The site is located within a NVZ; and,
- Two (2no.) records of ancient woodland within 250m of the site.

5.0 CONSULTATIONS

5.1 Contaminated Land Officer

Contact was made with Havant Borough Council as to whether the council were aware of any environmental issues pertaining to the site. A conversation was had with the Contaminated Land Officer on the 31st July 2018 confirming that the site was not under a Part IIA or a Contaminated Land register within the borough of Havant.

5.2 Site representatives

An interview with the former owner of the site is understood that the site was formerly used as a brick-makers yard and a builders yard, although has been vacant now for a number of years.

5.3 Landfill & Waste Treatment Sites

The Groundsure Report did not identify any Environment Agency historic landfill sites, landfills or waste treatment sites within 250m of the site.

5.4 Potentially Infilled Land Sites

The Groundsure report identified thirty nine (39no.) potentially infilled land sites within 250m of the subject site. However from review of the information, these have been condensed to eight (8no.) potentially infilled land areas due to multiple entries being attributed to the same point, as follows:

- Old Chalk Pit, on-site, dating from 1867-1959;
- Old Chalk Pit and unspecified pits, 75m to 124m north-west, dating from, 1867 to 1959;
- Old Chalk Pit and unspecified pits, 141m to 149m north-east, dating from, 1867 to 1977;
- Old Chalk Pit and Old Sand Pit, 166m to 176m east, dating from, 1895 to 1959;
- Old Chalk Pit and Unspecified Quarry, 208m to 212m north-west, dating from, 1895 to 1959;
- Pond, 218m south, dated 1942;
- Unspecified Pit, 227m north-west, dated 1867; and,
- Unspecified Pit, 247m south, dated 1959.

5.5 Regulatory Database

The following information has been obtained from a commercially available environmental database. Table 5.1 only includes records not otherwise detailed in the report.

Table 5.1 Summary of Groundsure Data

	0-249m	250-500m	Details
Contaminated Land Register Entries and Notices	0	0	N/A
Authorised industrial processes (IPC/IPPC/LAPPC).	0	1	294m south, Anchor Service Station, 325 Milton Road, Cowplain, Waterlooville, PO8 8LH Process: Petrol Vapour Recovery Status: Revoked Permit Type: Part B
Fuel Stations Entries	0	1	285m south, Anchor Service Station, 325, Milton Road, Milton Road, Cowplain, Waterlooville, Hampshire, PO8 8LH
Licensed radioactive substances	0	0	N/A
Enforcements, prohibitions or prosecutions	0	0	N/A
Discharge Consents	0	1	495m east, Residential Development, Keydell Nurseries Site, Bevan Road, Horndean, Hampshire. Effluent Type: Miscellaneous Discharges – Surface Water. Receiving Water: Freshwater River. Lapsed under schedule 23 Environment act 1995. Issued 29/04/1988 – Revocation: 31/03/1997.
Pollution Incidents	3	1	197m south west, Incident Date: 04-Jun-2002. Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Smoke. Minor water and air impact. 197m south west, Incident Date: 04-Jun-2002. Pollutant: Contaminated Water Pollutant Description: Firefighting Run- Off. Minor water and air impact. 197m south west, Incident Date: 04-Jun-2002. Pollutant: Atmospheric Pollutants and Effects: Contaminated Water Pollutant Description: Smoke: Firefighting Run-Off. Minor water and air impact. 309m south west, Incident Date: 09-Sep-2002. Pollutant: Inert Materials and Wastes Pollutant Description: Construction and Demolition Materials and Wastes. Minor land impact.
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 CONCEPTUAL SITE MODEL (CSM)

6.1 Initial CSM

In accordance with Environment Agency, CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), Omnia Environmental Consulting have developed an initial CSM to identify potential contamination sources, migration pathways and receptors within the study area. A residential end use has been adopted given the proposed site development.

On-site Potential Sources

- Made ground associated with historic development of the site;
- Former Brick-Makers and Builders Yard;
- Old Chalk Pit in the east of the site; and,
- Infilled Old Chalk Pit to the east of the site.

Off-site Potential Sources

- Electrical Sub-stations ~54m north;
- Unspecified Quarry, ~124m north-west and ~208m north-west, dating from 1867-1942;
- Electrical Sub-stations ~143m east, 154m south and 171m south-east;
- Infilled land features within 250m of site, closest ~75m north west relating to an Old Chalk Pit, dated 1895;
- Old Sand pit, ~176m east, dating 1895;
- Pond, ~218m south, dated 1942;
- Unspecified Pit located ~227m north-west and ~247m south dating from 1867-1959.

Potential Pathways

- Ingestion of contaminated soils and vegetables;
- Dermal contact with impacted soil;
- Inhalation of vapours;
- Inhalation of fibres;
- Migration of ground gas into confined spaces; and,
- Vertical and lateral migration.

Potential Receptors

- Future Site Users; and,
- Controlled Waters.

Construction workers are not considered to be a plausible receptor due to management of their exposure through the use of suitable PPE and hygienic working practices as required under HSE/CDM regulations. Furthermore, the length of any exposure is considered to be very short in comparison to the criteria for which the adopted end use has been derived.

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

Table 6.1 Initial Conceptual Site Model

Source	Contaminant	Potential migration pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
On Site							
Made Ground associated with historic use of the site	Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	Potentially Active – Further investigation required.
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Total Petroleum Hydrocarbons (TPH)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
		Inhalation of Vapours	Future Site Users	Moderate	Moderate	Moderate	
	Asbestos	Inhalation of fibres	Future Site Users	Moderate	Low	Low	
	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Low	Severe	High	
Former Brick-Makers and Builders Yard	Metals (As, Cd, Cr, Pb, Hg, Se, Ni) (Cement kiln dust)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	Potentially Active – Further investigation required.
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Total Petroleum Hydrocarbons (TPH)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Asbestos	Inhalation of Vapours	Future Site Users	Moderate	Moderate	Moderate	
	Ground Gas (CO ₂)	Vertical and Lateral	Future Site Users	Moderate	Severe	High	Potentially Active – Further

Source	Contaminant	Potential migration pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
Old Chalk Pit in east of site	and CH ₄)	Migration					investigation required.
Infilled Chalk Pit to the east of the site	Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	Potentially Active – Further investigation required.
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
	Total Petroleum Hydrocarbons (TPH)	Ingestion and Dermal Contact	Future Site Users	Moderate	Moderate	Moderate	
		Vertical and Lateral Migration	Controlled Waters	Low	Minor	Low	
		Inhalation of Vapours	Future Site Users	Moderate	Moderate	Moderate	
	Asbestos	Inhalation of fibres	Future Site Users	Moderate	Low	Low	
	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Low	Severe	High	
Off Site							
Electrical substation (~54m north)	Polychlorinated Biphenyls (PCB)	Lateral Migration	Future Site Users	Low	Low	Low	Inactive – Given that PCBs are highly immobile any contamination would be highly localised in the immediate vicinity of the substation, it is considered that this source does not have the potential to pose a significant risk to human health.
Unspecified Quarry (~124m north-west and ~208m north-west)	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Moderate	Severe	High	Potentially Active – Further investigation required.

Source	Contaminant	Potential migration pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
Electrical substation (~143m east, 154m south and 171m south-east)	Polychlorinated Biphenyls (PCB)	Lateral Migration	Future Site Users	Low	Low	Low	Inactive – Given that PCBs are highly immobile any contamination would be highly localised in the immediate vicinity of the substation, it is considered that this source does not have the potential to pose a significant risk to human health.
Old Chalk Pits within 250m of the site (closest 75m north-west)	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Moderate	Severe	High	Potentially Active – Further investigation required.
Old Sand Pit (~176m east)	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Moderate	Severe	High	Potentially Active – Further investigation required.
Pond (~128m south)	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Moderate	Severe	High	Potentially Active – Further investigation required.
Unspecified Pit (~227m north-west and 247m south)	Ground Gas (CH ₄ and CO ₂)	Vertical and Lateral Migration	Future Site Users	Moderate	Severe	High	Potentially Active – Further investigation required.

7.0 SITE INVESTIGATION

7.1 General

A ground investigation was designed based on the findings of the Phase I Desk Top Study and within the scope set out within OEC Proposal Ref: A10965/180508/L1. Alongside environmental aspects the investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was conducted on the 4th June 2018, and comprised the following:

Table 7.1 Summary of Fieldwork

Potential Source/Rationale	Location Hole	Type	Maximum Depth (m bgl)	Response Zone (m bgl)
General spread across the site for assessment of potential contamination. Assessment of geotechnical properties. Installation of ground gas and groundwater monitoring well.	WS102 WS105	Window Sample	5.00	1.00-3.00 1.00-3.00
General spread across the site for assessment of potential contamination. Assessment of geotechnical properties.	WS101 WS104	Window Sample	5.00	N/A
General assessment for potential contamination. Installation of ground gas and ground water monitoring in location of historical Old Chalk Pit.	WS103	Window Sample	5.00	1.00-3.00
General assessment for ground conditions and potential contamination.	HP101-HP102	Hand Dug Pit	0.30	N/A

The exploratory hole locations are illustrated on Figure 3.0 (Appendix III). The ground conditions encountered are indicated on the exploratory hole logs, which are provided in Appendix VI.

7.2 Laboratory Analysis

Selected soil samples were submitted for a range of chemical analysis including:

- CLEA Metals;
- PAHs;
- Banded TPH;
- Asbestos fibres in soil,
- Phenols,
- Total Cyanide,

- pH; and,
- Water-Soluble Sulphate (2:1 extract).

Exova Jones Environmental undertook the analytical work in accordance with UKAS accreditation where applicable and the testing results are included in Appendix VII and discussed in Section 9.

Selected soil samples were submitted for a range of geotechnical testing at I2 Analytical, in accordance with UKAS methodology where applicable, comprising:

- Moisture Content;
- Atterberg limits; and,
- Particle Size Distribution.

The geotechnical testing results are presented in Appendix IX.

7.3 Ground Gas and Groundwater Monitoring

Following the intrusive phase of site works, three (3no.) ground gas and groundwater monitoring visits were undertaken between the 12th June 2018 and 25th June 2018.

Concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) were measured using an infra-red gas analyser (GA5000), and gas flow rates were measured using an internal flow pod. Gas measurements were recorded until gas concentrations stabilised for three consecutive readings for a minimum duration of ninety seconds at each location, at which point the maximum concentration of CH₄ and CO₂, together with the lowest concentration of O₂ were recorded.

Groundwater monitoring was undertaken using an electronic dip tape to record the depth to groundwater. Ground gas and groundwater results are presented in Section 8.5 and discussed in Section 9.3.

8.0 GROUND AND GROUNDWATER CONDITIONS

8.1 Ground Conditions

8.1.1 Summary of Ground Conditions

The ground investigation generally confirms the published geology and is summarised below and detailed within the geological logs presented as Appendix VI.

8.1.2 Made Ground

Made Ground was encountered within all intrusive locations, with the exception of WS104, to a maximum depth of 3.50m bgl within WS103, but generally encountered to a maximum depth of 0.10-0.40m bgl across the site. Made Ground generally comprised a superficial layer of sub-base material, encountered within WS101, WS102, and WS105, overlying cohesive deposits with anthropogenic material within WS101 and WS103.

Made Ground can be broadly sub-divided into three (3no.) distinct units:

Made Ground comprised a pinkish grey, angular to sub-angular, fine to coarse, sandy GRAVEL of mixed lithology to a maximum depth of 0.25m bgl, attributed to a presumed Type 1 sub-base material encountered within locations WS101, WS102 and WS105.

Within WS101 a dark brown, slightly silty, gravelly medium SAND was present with the gravel component comprising angular to sub-rounded, fine to coarse flint, brick, chalk and rare plastic. This was encountered between the depths of 0.15-0.40m bgl.

Potentially infilled Old Chalk Pit – east of the site

Observations from historical mapping indicate that location WS103 is located within a former chalk pit, dating from c.1868 to c.1974.

Within WS103 Made Ground comprised a soft to firm, gravelly CLAY to a maximum depth of 3.50m bgl. The gravel component was angular to subrounded, fine to coarse flint with varying anthropogenic material comprising flint, concrete, plastic, chalk and cobble sized brick. Rare wood material was present at a depths of 2.70-2.80m bgl. Between the depths of 0.36-0.72m bgl a chalk fill was recovered within WS103.

The great thickness of Made Ground within WS103 is likely attributed to infilled material of the chalk pit identified within historical mapping.

8.1.3 Topsoil

Topsoil was encountered within locations HP101 and HP102 to a maximum depth of 0.05m bgl and comprised vegetation cover over a dark brown slightly silty, gravelly, fine to medium SAND. The gravel component was angular to subrounded, fine to coarse flint with frequent rootlets.

HP101 and HP102 were advanced in the wooded area to the west of the site to confirm the extent of Made Ground on site.

8.1.4 Superficial Deposits – Head Deposits

Superficial deposits attributing to Head Deposits were encountered within all intrusive locations. Made Ground was found to be immediately underlain by a soft to firm, brownish orange CLAY with variable sand and gravel content, with a maximum proven thickness of 1.90m within WS101. The gravel component was angular to subrounded, fine to coarse flint in nature and the sand component was fine to medium grained.

Within HP101 and HP102 the cohesive deposits were overlain by Topsoil and were noted as to the friable to soft, light brown sandy CLAY with varying gravel content. The gravel component was angular to subrounded, fine to coarse flint in nature and the sand component was fine grained.

8.1.5 Bedrock Deposits – Tarrant Chalk Formation

Superficial deposits was underlain by bedrock attributed to the Tarrant Chalk Formation, with a maximum proven thickness of 3.8m as recorded in WS102. The base of the unit was not encountered during the ground investigation.

The chalk bedrock was recovered as structureless CHALK composed of creamish white slightly gravelly slightly sandy SILT. Gravel is weak, low density, white with frequent black specks and rounded in a brownish cream matrix (Grade Dm). This unit was encountered within all locations with the exception of WS103.

Within WS103 a firm orangeish brown mottled grey and red CLAY was encountered between 3.50m bgl and 5.0m bgl. Subrounded chalk gravels were noted present from a depth of 4.0m bgl.

8.2 Laboratory Classification

Soil classification testing, including Atterberg limits and Moisture Content are summarised in the following sections.

8.2.1 Soil Plasticity Analysis

Table 8.1 Summary of Soil Plasticity

Location	Depth (m)	Natural Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Percentage Passing 425µm sieve (%)	Modified Plasticity Index	Remarks	
								Plasticity	Volume Change Potential
WS101	1.50-2.00	28	24	60	36	79	28	High	Medium
WS102	0.80-1.20	22	26	83	57	87	50	Very High	High
WS104	0.50-1.00	20	21	37	16	88	14	Medium	Low
WS105	1.00-	31	30	83	53	92	49	Very High	High

	1.50								
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The results presented in Table 8.1 indicates that fine-grained soils are of Medium to Very High plasticity with a Low to High Volume Change Potential.

8.2.2 pH and Sulphate

Chemical analyses for pH and soluble sulphate content are presented in Appendix VII and are summarised in Table 8.2 below.

Table 8.2 Summary of pH and Sulphate Data

Location	Depth (m bgl)	SO ₄ in 2:1 water / soil (mg/l)	pH Value
WS101	0.15-0.25	15.3	7.84
	2.70-2.80	9.0	8.9
WS102	0.20-0.30	<1.5	7.46
	1.20-1.30	10.0	9
WS103	0.10-0.20	<1.5	8.23
	3.50-3.60	111.1	7.88
WS104	0.30-0.40	14.4	7.47
WS105	0.60-0.70	12.1	7.38

Due to the presence of worked ground with anthropogenic material present and the historical use of the site, the site has been classified utilising Table C2 of BRE Special Digest 1 (2005) for a brownfield development.

Utilising the data presented in Table 8.2 the soils encountered beneath the site have been classified as **DS-1**, Aggressive Chemical Environment for Concrete Classification (ACEC) **AC-1**.

This classification has been calculated utilising the mean of the highest 20% water soluble sulphate (2:1) result of **63.2** and the mean of the lowest 20% of pH results as stated in BRE Special Digest (2005), with a pH of **7.42**.

8.3 In-Situ Testing

8.3.1 Standard Penetration Tests (SPT)

In-situ testing was undertaken within the underlying soils through Standard Penetration Tests (SPT) in accordance with techniques outlined in BS1377, to assess the strength/density of the underlying strata. The 'N' values (Number of blows per 300mm penetration) was recorded for each test. The results of these in-situ tests are presented in Table 8.3 below and are presented on the boreholes logs within Appendix VI.

Table 8.3 Summary of SPT Values

Location	Start Depth (m bgl)	Strata Type	CPT/SPT "N" Value	Relative Density (Granular)	Terzaghi & Peck Approximate Undrained Shear Strength (kN/m ²)**	Soil Strength (Cohesive)
WS101	1.00	Cohesive	6	-	27	Low
	2.00	Cohesive	6	-	27	Low

	3.00	Chalk (Grade Dm)	11	-	-	-
	4.00	Chalk (Grade Dm)	6	-	-	-
	5.00	Chalk (Grade Dm)	20	-	-	-
WS102	1.00	Cohesive	10	-	45	Medium
	2.00	Chalk (Grade Dm)	13	-	-	-
	3.00	Chalk (Grade Dm)	13	-	-	-
	4.00	Chalk (Grade Dm)	5	-	-	-
	5.00	Chalk (Grade Dm)	7	-	-	-
WS103	1.00	Made Ground	12	-	-	-
	2.00	Made Ground	9	-	-	-
	3.00	Made Ground	5	-	-	-
	4.00	Cohesive	8	-	36	Low
	5.00	Cohesive	11	-	49.5	Medium
WS104	1.00	Cohesive	2	-	9	Extremely Low
	2.00	Chalk (Grade Dm)	24	-	-	-
	3.00	Chalk (Grade Dm)	5	-	-	-
	4.00	Chalk (Grade Dm)	8	-	-	-
	5.00	Chalk (Grade Dm)	13	-	-	-
WS105	1.00	Cohesive	10	-	45	Medium
	2.00	Chalk (Grade Dm)	10	-	-	-
	3.00	Chalk (Grade Dm)	7	-	-	-
	4.00	Chalk (Grade Dm)	6	-	-	-
	5.00	Chalk (Grade Dm)	15	-	-	-

8.4 Groundwater Conditions

Groundwater was not encountered within intrusive locations during site investigation.

8.5 Ground Gas & Groundwater

The results of the gas and groundwater monitoring are presented in Table 8.4 overleaf.

Table 8.4 Summary of Ground Gas and Groundwater Monitoring Results

Well	Date	CH ₄ Peak %v/v	CH ₄ Steady %v/v	CH ₄ GSV l/hr	CO ₂ Peak %v/v	CO ₂ Steady %v/v	CO ₂ GSV l/hr	O ₂ %v/v	Atmos (mb)	Atmos. Dynamic	Flow (l/hr)	Depth to Base (m bgl)	Depth to Water (m bgl)
WS102	12/06/2018	<0.1	<0.1	0.0001	1.6	1.6	0.0016	19.5	1013	Rising	0.1	3.00	DRY
	18/06/2018	<0.1	<0.1	0.0001	3.3	2.6	0.0033	17.3	1014	Rising	0.1	2.99	DRY
	25/06/2018	<0.1	<0.1	0.0001	3.8	3.1	0.0038	16.2	1022	Steady	0.1	2.92	DRY
WS103	12/06/2018	<0.1	<0.1	0.0001	1.0	1.0	0.001	20.2	1014	Rising	0.1	3.07	DRY
	18/06/2018	<0.1	<0.1	0.0001	5.0	5.0	0.005	12.4	1014	Rising	0.1	3.08	DRY
	25/06/2018	<0.1	<0.1	0.0001	3.6	3.6	0.0036	18.3	1022	Steady	0.1	3.09	DRY
WS105	12/06/2018	<0.1	<0.1	0.0001	2.7	2.7	0.0027	18.8	1014	Rising	0.1	3.08	DRY
	18/06/2018	<0.1	<0.1	0.0001	3.1	3.1	0.0031	17.8	1014	Rising	0.1	3.07	DRY
	25/06/2018	<0.1	<0.1	0.0001	3.0	3.0	0.003	17.4	1022	Steady	0.1	3.08	DRY

9.0 TIER 1 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

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

9.1 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 Suitable for Use Levels (S4UL) 2015. Based on the proposed residential use with areas of private gardens, OEC has adopted screening values for a residential end use with home grown produce. The origin of the GAC values are presented within Appendix VIII.

The results of this comparison have been summarised within Table 9.1.

Table 9.1 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End use with Home Grown Produce

Determinand	Units	GAC	n	MC	Loc. of Ex	Pathway	Assessment
Inorganics							
Arsenic	mg/kg	37	5	11.3	N/A	1	No Further Assessment
Beryllium	mg/kg	1.7	5	1.2	N/A	1	No Further Assessment
Boron	mg/kg	290	5	1.6	N/A	1	No Further Assessment
Cadmium	mg/kg	11	5	14.7	WS101 at 0.15-0.25m bgl	1	Further Assessment Required
Chromium (III)	mg/kg	910	5	99.2	N/A	1	No Further Assessment
Chromium (VI)	mg/kg	6	5	<0.3	N/A	1	No Further Assessment
Copper	mg/kg	2400	5	33	N/A	1	No Further Assessment
Lead	mg/kg	200	5	49	N/A	2	No Further Assessment
Mercury	mg/kg	40	5	<0.1	N/A	1	No Further Assessment
Nickel	mg/kg	180	5	19.1	N/A	1	No Further Assessment
Selenium	mg/kg	250	5	2	N/A	1	No Further Assessment
Vanadium	mg/kg	410	5	49	N/A	1	No Further Assessment
General Inorganics							
Asbestos	-	N.D ^(iv)	5	ND	N/A	4	No Further Assessment
Cyanide	mg/kg	50	5	<0.5	N/A	1	No Further Assessment
General Organics							
Phenol	mg/kg	280	5	<0.15	N/A	1	No Further Assessment
PAH							
Naphthalene	mg/kg	2.3	5	0.26	N/A	2	No Further Assessment
Acenaphthylene	mg/kg	170	5	0.14	N/A	3	No Further Assessment
Acenaphthene	mg/kg	210	5	0.38	N/A	1	No Further Assessment
Fluorene	mg/kg	170	5	0.25	N/A	1	No Further Assessment
Phenanthrene	mg/kg	95	5	4.14	N/A	3	No Further Assessment
Anthracene	mg/kg	2400	5	1.69	N/A	3	No Further Assessment
Fluoranthene	mg/kg	280	5	6.97	N/A	3	No Further Assessment
Pyrene	mg/kg	620	5	6.2	N/A	3	No Further Assessment
Benzo(a)Anthracene	mg/kg	7.2	5	3.16	N/A	3	No Further Assessment
Chrysene	mg/kg	15	5	3.92	N/A	3	No Further Assessment

Benzo(b)Fluoranthene ⁽ⁱ⁾	mg/kg	2.6	5	5.53	WS101 at 0.15-0.25m bgl	3	Further Assessment Required
Benzo(k)Fluoranthene ⁽ⁱ⁾	mg/kg	77	5	2.15	N/A	3	No Further Assessment
Benzo(a)Pyrene	mg/kg	2.2	5	4.83	WS101 at 0.15-0.25m bgl	3	Further Assessment Required
Indeno(123-cd)Pyrene	mg/kg	27	5	3.55	N/A	3	No Further Assessment
Dibenzo(a,h)Anthracene	mg/kg	0.24	5	0.64	WS101 at 0.15-0.25m bgl	3	Further Assessment Required
Benzo(ghi)Perylene	mg/kg	320	5	3.43	N/A	3	No Further Assessment
Banded TPH							
TPH C ₄ -C ₆ (aliphatic)*	mg/kg	42	5	<0.1	N/A	2	No Further Assessment
TPH C ₆ -C ₈ (aliphatic)*	mg/kg	100	5	<0.1	N/A	2	No Further Assessment
TPH C ₈ -C ₁₀ (aliphatic)*	mg/kg	27	5	<5	N/A	2	No Further Assessment
TPH C ₁₀ -C ₁₂ (aromatic)*	mg/kg	74	5	<10	N/A	2	No Further Assessment
TPH C ₁₂ -C ₁₆ (aromatic)*	mg/kg	140	5	<10	N/A	1,4	No Further Assessment
TPH C ₁₆ -C ₂₁ (aromatic)*	mg/kg	260	5	15	N/A	1,4	No Further Assessment
TPH C ₂₁ -C ₄₀ (aromatic)*	mg/kg	1100	5	149	N/A	1,4	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; Loc of Ex = Location of Exceedance.

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH/S4UL assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. OEC has utilised the lowest of the aliphatic and aromatic chain lengths in order to adopt a conservative approach, which is considered satisfactory for the protection of human health.

(i) Benzo (b) Fluoranthene (2.6mg/kg) Benzo (k) Fluoranthene (77mg/kg)

Referring to Table 9.1 the results of this direct comparison indicate that the adopted Tier 1 Screening values have been exceeded for the following determinands:

- Heavy metals (Cadmium); and,
- PAH's (Benzo(a)fluoranthene, Benzo(a)Pyrene, and Dibenzo(a,h)Anthracene).

Heavy Metals

Cadmium

A single exceedance of Cadmium was recorded within WS101 (0.15-0.25m bgl).

A review of laboratory data and exploratory hole logs indicates that impacted soils within WS101 are restricted to the near surface Made Ground (0.15-0.25m bgl). The main exposure pathway for Cadmium is via soil ingestion. Therefore it is considered that the pathway for cadmium in WS101 has the potential to present a significant risk to the identified receptors. It is therefore considered that further investigation in the vicinity of WS101 should be undertaken to delineate the extent of the near surface impact through the advancement of shallow dug hand pits. As necessary if concentrations are present that are considered to have the potential to present a significant risk to identified receptors remedial works should be undertaken to sever the pollution linkage and render the exposure pathway inactive.

Polycyclic Aromatic Hydrocarbons (PAH)

Elevated concentrations of Benzo(a)fluoranthene, Benzo(a)Pyrene, and Dibenzo(a,h)Anthracene exceeding the Tier I screening values were identified within locations WS101 (0.15-0.25m bgl). The main exposure pathway for PAHs is via dermal contact and ingestion. Elevated concentrations are restricted to a single near surface location (WS101 at 0.15-0.25m bgl) and limited to Made Ground. It is therefore considered that further investigation in the vicinity of WS101 should be undertaken to delineate the extent of the near surface impact through the advancement of shallow dug hand pits. As necessary if concentrations are present that are considered to have the potential to present a significant risk to identified receptors remedial works should be undertaken to sever the pollution linkage and render the exposure pathway inactive.

9.2 Controlled Waters

It is considered that the site does not have the potential to present a risk to controlled waters for the following reasons:

- Exceedances are limited to the Made Ground which is underlain by a cohesive, impermeable layer overlying the chalk, limiting any potential downward migration to the underlying unsaturated chalk; and,
- No groundwater encountered during site investigation;
- No potable or groundwater abstractions within 250m of the site;;

9.3 Ground Gas Assessment

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report C665 (*Assessing risks posed by hazardous ground gases to buildings*, 2007). However, it is recommended that the full ground gas assessment and any recommended protection measures are agreed with the local authority prior to the adoption of any protection measures on-site. Furthermore, the installation of any gas protection measures should be validated by a suitably qualified engineer.

The results of the ground gas monitoring and calculated Gas Screening Values (GSVs) are presented in Table 8.4.

In total, three (3no.) groundwater and ground gas monitoring visits have been undertaken at locations WS102, WS103 and WS105 between 12th June 2018 to the 25th June 2018 with no concentrations of methane (CH₄) greater than the equipment Limit of Detection (LOD) of 0.1% v/v recorded. Carbon Dioxide (CO₂) concentrations were recorded with a maximum of 5.0% v/v at location WS103 on 18th June 2018.

In accordance with the methodology outlined within the CIRIA publication C665, OEC have utilised the results of the ground gas monitoring visits to calculate tentative Gas Screening Values (GSVs). The maximum GSV calculated for methane was 0.0001l/hr whilst the maximum GSV for carbon dioxide was 0.005l/hr.

It is understood that the proposed development will comprise the construction of three (3no.) to four (4no.) residential houses with associated private gardens and car parking. The proposed development has therefore been classified as Situation B as set out in CIRIA C665 and the gas assessment has been undertaken in accordance with the NHBC Traffic Light System.

Guidance set out in CIRIA C665, stipulates a maximum GSV for methane of 0.16l/hr and carbon dioxide of <0.78l/hr, with typical maximum permissible concentrations of 1% v/v (CH₄) and/or 5% v/v (CO₂) for classification as Green under the NHBC Traffic Light System.

The maximum recorded GSV for carbon dioxide was 0.005l/hr which is below the maximum permissible GSV of 0.78l/hr for a Green classification. The maximum recorded GSV for methane was 0.0001l/hr which is below the maximum permissible GSV of 0.16l/hr for a Green classification, with all return monitoring visits all below 1% v/v.

On the 18th June 2018 CO₂ concentrations were recorded at 5.0%v/v in WS103 exceeding the maximum permissible concentration of CO₂ for a Green Classification. Given this variability in gas concentrations, and the presence of a potential source of ground gas on site (Infilled pit) it is considered that further ground gas monitoring in accordance with CIRIA C665 would be required to allow a comprehensive assessment of the ground gas regime. It is also recommended that at least one gas monitoring visits should be undertaken under low pressure (>999mb) conditions to represent worse-case scenario.

10.0 REVISED CONCEPTUAL SITE MODEL

Following the completion of the Tier 1 risk assessment active pollution pathways have been identified based on residential development of the site.

Table 10.1 Revised Conceptual Site Model

Source	Exposure Pathway	Potential Receptor	Probability of Exposure	Discussion of Pollutant Linkage
Elevated concentrations of Cadmium and PAH within the near surface Made Ground of WS101	Dermal Contact and Ingestion	Future Site Users Construction Workers	Likely	Elevated concentrations of Cadmium and PAH have been identified in the near surface Made Ground in the vicinity of location WS101, which are considered to present a significant risk to human health. It is therefore considered that further testing within the Made Ground within the vicinity of WS101 is required by the advancement of shallow hand dug pits to delineate the extent of potential contamination. If contamination is identified from further testing remedial action will be required to render the pollution linkages inactive with remedial works set out within a standalone Remediation Method Statement (RMS) which should be submitted to the Local Authority for approval.
Ground Gas (CO ₂)	Migration into Confined Spaces	Future Site Users	Likely	Concentrations of CO₂ up to 5.0% v/v have been detected within WS103 on a single visit during initial monitoring rounds. It is recommended that further monitoring is undertaken to fully assess the ground gas regime of the site comprising of at least one visits under low pressure conditions (<999mbar).

11.0 GEOTECHNICAL ASSESSMENT

11.1 Proposed Development

It is understood that PMC intend to develop three (3no.) to four (4no.) residential dwellings with associated car parking and private gardens.

11.2 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.

Any roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting voids in-filled with suitable compacted material. This should also be undertaken for any redundant or re-routed services.

11.3 Encountered Ground Conditions

Made Ground was encountered within all intrusive locations to a maximum depth of 3.5m bgl within WS103, however Made Ground was encountered between 0.10-0.25m bgl across the site. Made Ground typically comprised superficial layer of presumed sub-base material overlying a dark brown silty medium SAND with varying gravel content and a soft to firm, gravelly CLAY, with varying anthropogenic material of concrete, plastic, chalk and cobble sized brick.

Made Ground was further underlain by cohesive deposits comprising of a soft to firm, brownish orange CLAY with variable sand and gravel content attributed to Head Deposits. Bedrock deposits attributed to the Tarrant Chalk Member were encountered immediately beneath the cohesive deposits. The chalk bedrock was recovered structureless CHALK composed of creamish white slightly gravelly slightly sandy SILT(Grade Dm), encountered from depths of approximately 1.20m bgl with a maximum proven thickness of 1.90m within WS101. Gravel is weak, low density, white with frequent black specks and rounded in a brownish cream matrix. This unit was encountered within all locations with the exception of WS103.

Review of laboratory testing indicates the presence of medium to very high plasticity cohesive soils within the subsurface with a low to high Volume Change Potential (VCP). It was noted on site that a mature oak tree was present to the north of the site, which is proposed to be removed. As such consideration should be given to the plasticity and VCP on any shallow foundations upon removal of tree roots. Reference should be made to current guidance NHBC Chapter 4.2- *Building near Trees*.

11.4 Foundation Bearing Capacities

At a depth of 1.00m bgl within encountered natural cohesive strata, two SPT N values were obtained with N values of N=2 and N=10, providing correlated in-situ shear strengths ranging between 9kPa to 45kPa. Based on this, it is considered founding at this depth would provide insufficient bearing capacity

An SPT N value of N=6 was encountered at a depth of 2.00m bgl within natural cohesive strata, providing a correlated in-situ shear strength of 27kPa. Utilising a shear strength of 27kPA a traditional

strip foundation no greater than 1.00m width provides an allowable bearing capacity in the range of 50-100kN/m².

Whilst the most conservative test result has been adopted in assessing the presumed bearing capacity, it is noted that the encountered properties of the soils were typically toward the lower strength range at depths considered suitable for traditional shallow foundations such that they are considered unlikely to be suitable for the proposed development, although this is without knowledge of likely loadings at this stage and could change subject to suitable design.

Where bearing capacities are insufficient for the proposed scheme, alternative foundation solutions, such as a piled foundation solution may be suitable for the site. However, further ground investigation works would be required in order to prove competency of the encountered Grade Dm chalk strata to a sufficient depth.

11.5 Ground Floor Slabs

Due to the presence of shrinkable soils with a medium to high Volume Change Potential in the near surface, and Made Ground observed in excess of 600mm it is considered that a ground bearing floor slab is not suitable for the development without detailed design. Consideration should be given to a suspended block and system with ventilated sub void.

11.6 Concrete Durability

Soils encountered beneath the site have been classified in accordance with **DS-1**, Aggressive Chemical Environment for Concrete Classification (ACEC) **AC-1** with the recommendations provided in BRE Special Digest 1 (2005).

12.0 CONCLUSIONS AND RECOMMENDATIONS

Revised Conceptual Site Model

Following the completion of the Tier 1 risk assessment, pollution linkages involving elevated concentrations of Cadmium and PAH were identified which are considered to present a significant risk to future site users. The ground gas assessment undertaken for the site has demonstrated that due to a single exceedance of CO₂ in WS103 requiring further gas monitoring is required to fully assess the gas regime of the site.

Geotechnical Assessment

At a depth of 1.00m bgl within encountered natural cohesive strata, two SPT N values were obtained with N values of N=2 and N=10, providing correlated in-situ shear strengths ranging between 9kPa to 45kPa. Based on this, it is considered founding at this depth would provide insufficient bearing capacity

An SPT N value of N=6 was encountered at a depth of 2.00m bgl within natural cohesive strata, providing a correlated in-situ shear strength of 27kPa. Utilising a shear strength of 27kPa a traditional strip foundation no greater than 1.00m width provides an allowable bearing capacity in the range of 50-100kN/m².

Given the inherently low 'N' values for the cohesive strata and the poor grading of the chalk unit (Dm) it is considered unlikely that traditional shallow foundations are suitable for the proposed development, therefore alternative foundations solutions should be considered.

Concrete Classification

Soils encountered beneath the site have been classified in accordance with **DS-1**, Aggressive Chemical Environment for Concrete Classification (ACEC) **AC-1** with the recommendations provided in BRE Special Digest 1 (2005).

Recommendations

Elevated concentrations of Cadmium and PAH have been identified in the near surface Made Ground in the vicinity of location WS101. It is therefore considered that further in the vicinity of WS101 is required by the advancement of shallow hand dug pits to delineate the extent of potential contamination within the Made Ground. If contamination is identified from further testing remedial action will be required to render the pollution linkages inactive with remedial works set out within a standalone Remediation Method Statement (RMS) which should be submitted to the Local Authority for approval.

Concentrations of CO₂ up to 5.0% v/v have been detected within WS103 on a single visit during initial monitoring rounds. It is recommended that further monitoring is undertaken to fully assess the ground gas regime of the site comprising of at least one visits under low pressure conditions (<999mbar).

Where bearing capacities are insufficient for the proposed scheme, alternative foundation solutions, such as a piled foundation solution may be suitable for the site. However, further ground investigation works would be required in order to prove competency of the encountered Grade Dm chalk strata to a sufficient depth.

If, during the development stage any evidence of contamination is identified, works should be halted and contact made with a suitably qualified Environmental Consultant. As determined appropriate by the Consultant, further investigation and sampling may be required to determine the appropriate actions. Upon completion contact should be made with the regulator to achieve sign off of the works.

In terms of foundation options, advice should be sought from a piling contractor and it is likely that a deeper cable percussive borehole will be required in order to obtain the relevant data for pile depth and diameters to be designed

APPENDIX I
LIMITATIONS

-
1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between OE 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. 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.
 7. 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.
 8. 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.
 9. OE cannot 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 OE 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 OE in this connection without their explicit written agreement there to by OE.
 10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
-

APPENDIX II

GLOSSARY

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

DRAWINGS

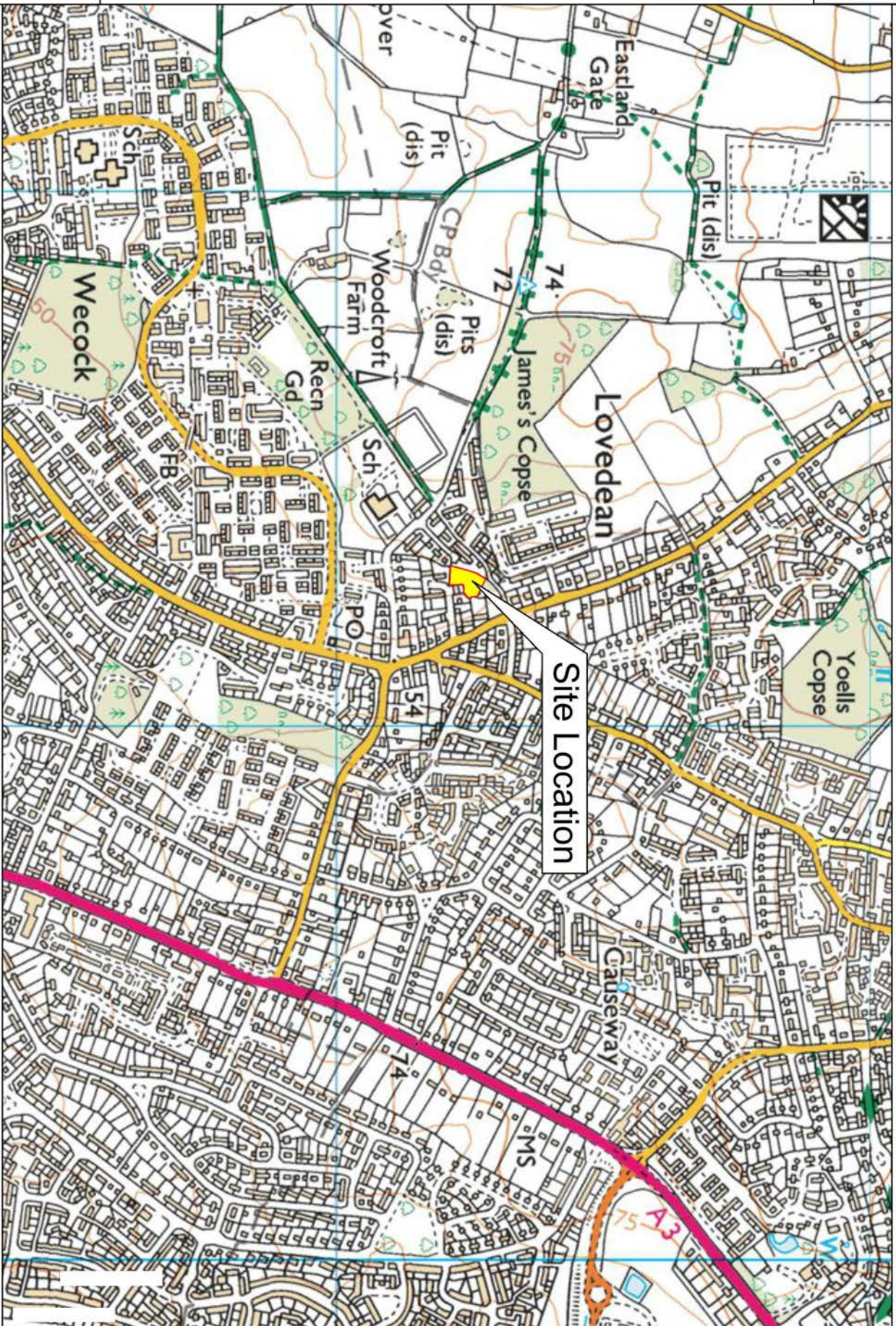
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W: www.omnia-consulting.co.uk



OMNIA
ENVIRONMENTAL CONSULTING



1.0 - Site Location

Key



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W: www.omnia-consulting.co.uk



ENVIRONMENTAL CONSULTING



Proposal A - 4 Units



Proposal B - 3 Units

HGP
ARCHITECTS

NOTE: LAYOUT INDICATIVE AND SUBJECT TO SURVEY



LOVEDEAN LANE, WATERLOOVILLE
Proposed Site Layouts - 1/500 @ A3 - May 2018

Job Title:

Lovedean Lane, Waterloooville

Client:

PMC

Project No:

A10965

Date:

19/07/18

Drawing Title:

2.0 - Proposed layout

Drawn By:

G.Larcombe

Authorised By:

T.Mitchell

Scale:

NTS

Notes:

APPENDIX IV
PHOTOGRAPHS



Photograph 1 Facing east, showing wooden gated entrance to the site, accessed via Lovedean Lane and leading into a residential housing area.



Photograph 2 Facing north-west, showing two caravans placed near the entrance to the site.



Photograph 3 Facing north, showing corrugated building in a poor state of repair located in the centre of the site.



Photograph 4 Interior of the building in the centre of the site, showing storage of building materials, fencing and wooden fence panels.



Photograph 5 Facing south-west, showing the southern section of the site - an area of soft landscaping. to the west of the site an elevated area comprising densely spaced mature trees.

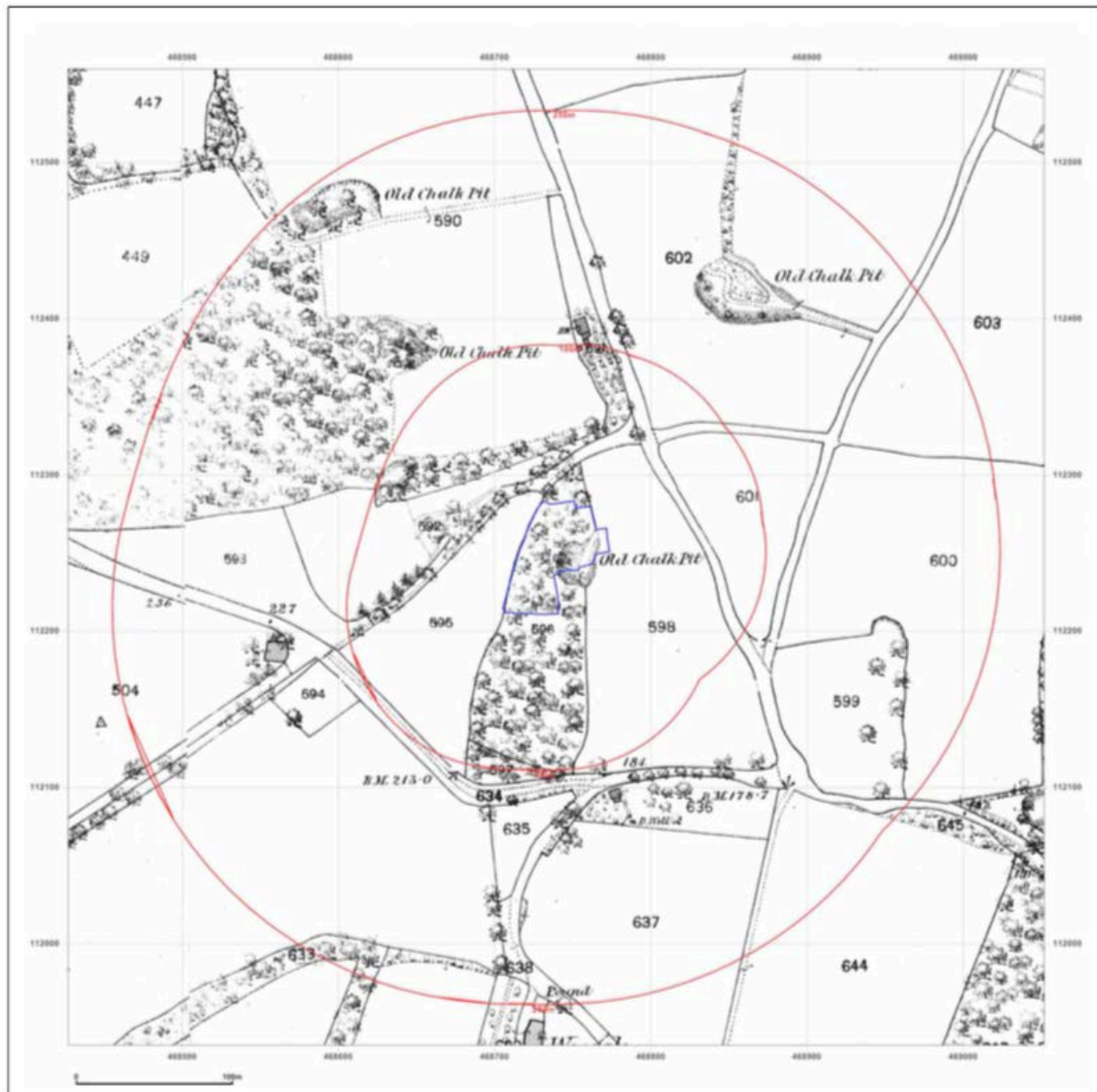


Photograph 6 Facing south, storage of large timber logs (left), a wooden shed with a corrugated metal roof, a green metal water tanker with a tap is attached to the shed for the presumed collection of rainwater.

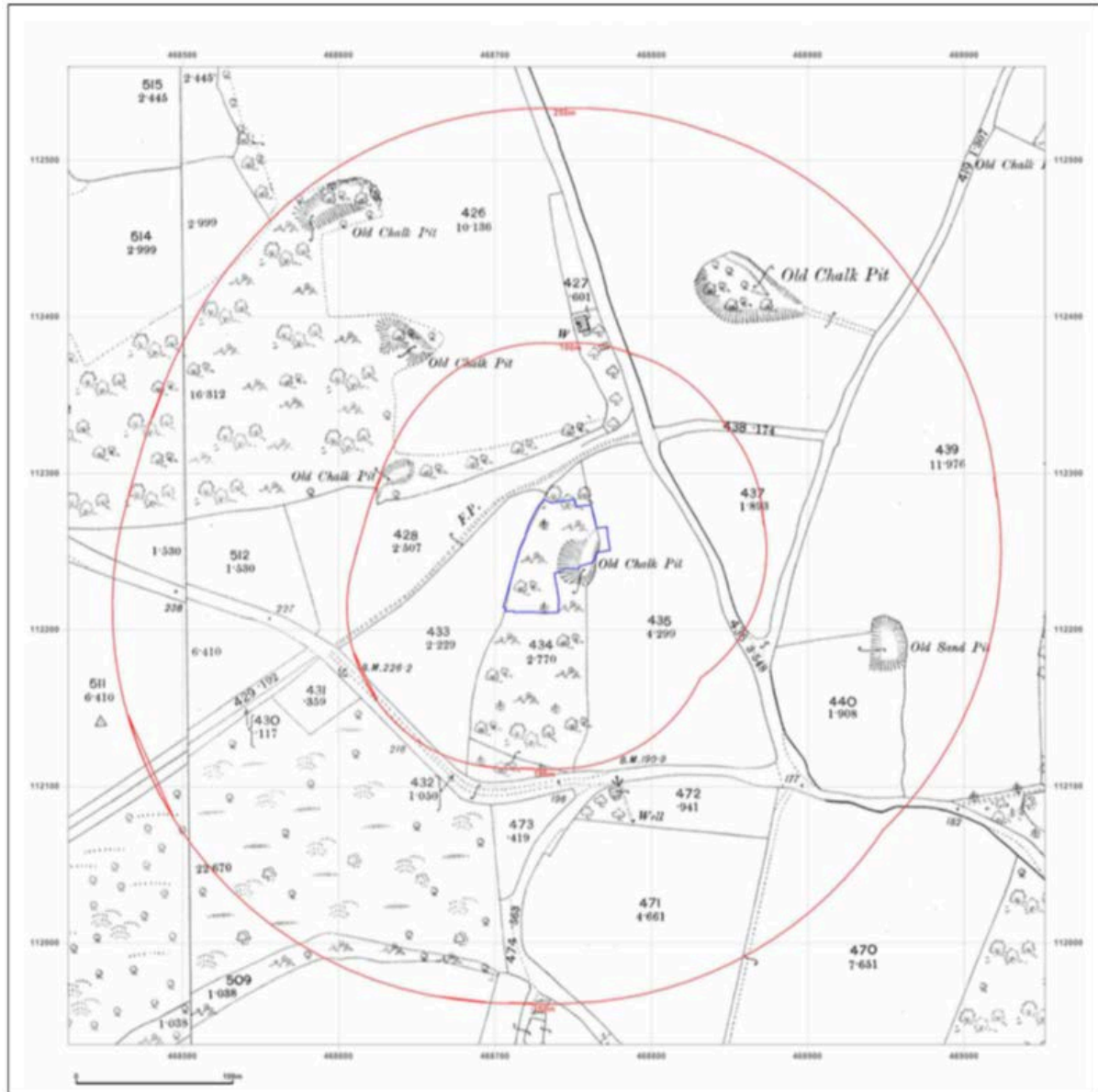


Photograph 7 Interior of the shed in the south of the site for the storage of garden and household equipment.

APPENDIX V
HISTORICAL MAP EXTRACTS



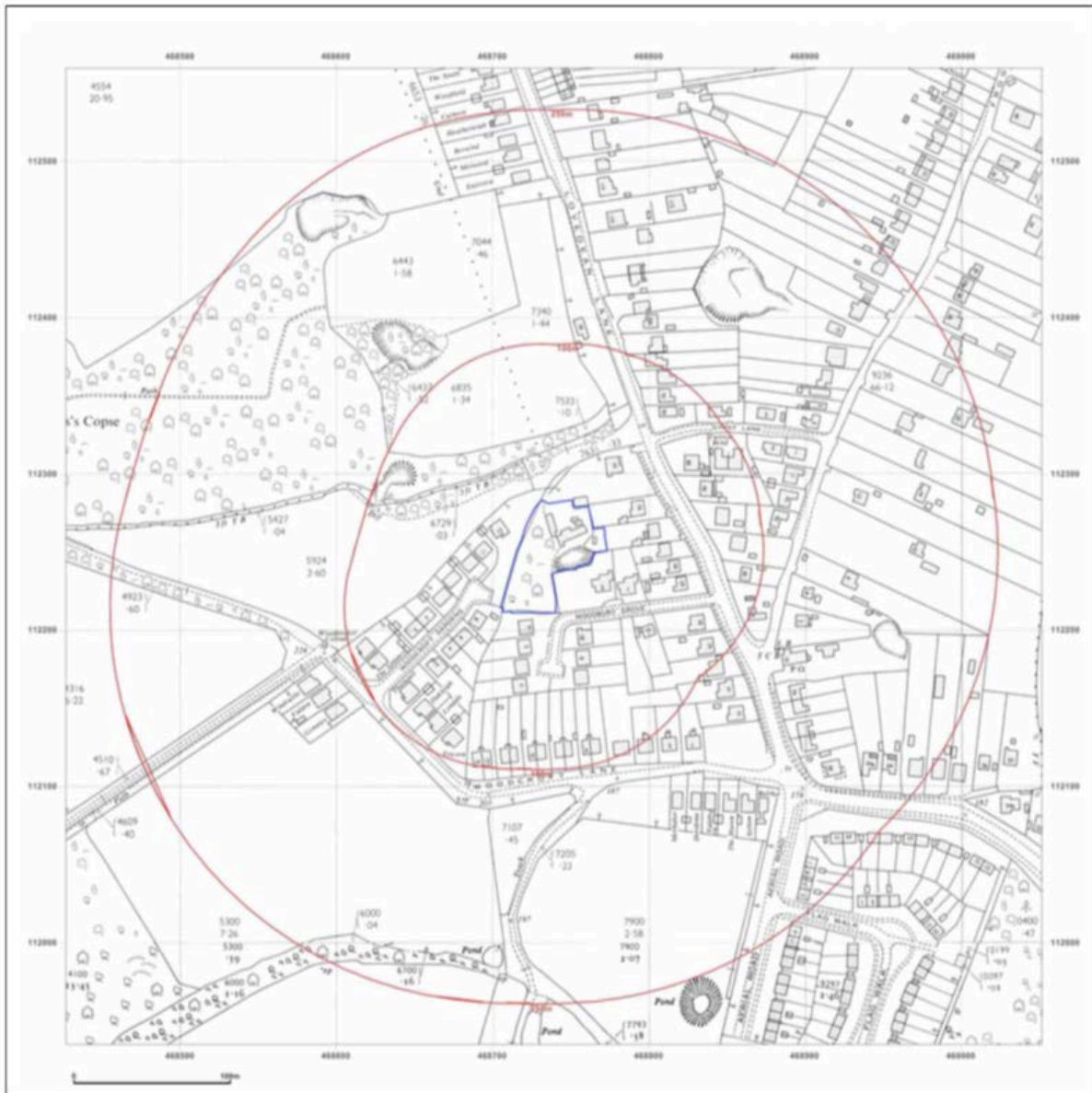
Lovedean Lane, Waterloooville
Grid Reference: 468739, 112247
Historic Map
1:2,500
Date: 1868



Lovedean Lane, Waterloooville
Grid Reference: 468739, 112247
Historic Map
1:2,500
Date: 1897



Lovedean Lane, Waterloooville
Grid Reference: 468739, 112247
Historic Map
1:2,500
Date: 1932



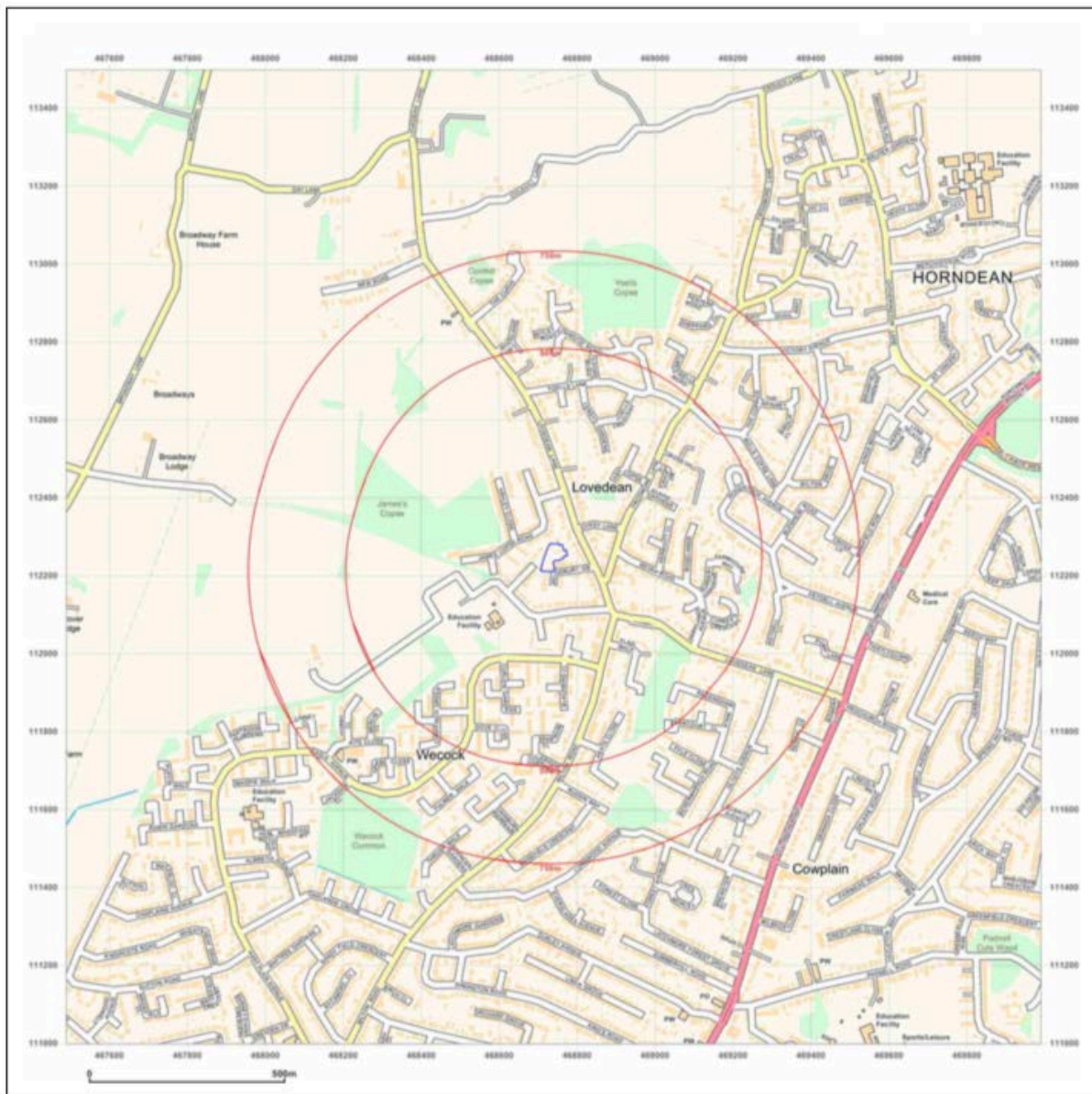
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Grid Reference: 468739, 112247
Historic Map
1:2,500
Date: 1958-1963



Lovedean Lane, Waterloooville
Grid Reference: 468739, 112247
Historic Map
1:2,500
Date: 1969-1974



Lovedean Lane, Waterloooville
Grid Reference: 468739, 112247
Historic Map
1:2,500
Date: 1995



Lovedean Lane, Waterloooville
Grid Reference: 468739, 112247
Historic Map
1:10,000
Date: 2014

APPENDIX VI
EXPLORATORY HOLES LOGS

Trial Pit Log

Trialpit No

HP101

Sheet 1 of 1

Project Name:	Lovedean Lane
---------------	---------------

Project No.
A10965

Co-ords:	-
Level:	

Date
04/06/2018

Location: Waterloo

Dimensions
(m):

0.3

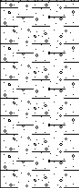
Scale

Client: PMC

Depth
0.30

0.3

1.10
Logged
GL

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20 - 0.30	ES		0.05			TOPSOIL Vegetation cover over dark brown slightly silty gravelly fine to medium SAND. Gravel of angular to subrounded fine to coarse flint with frequent roots.
				0.30			CLAY Friable light brown gravelly slightly sandy CLAY. Sand is fine to medium. Gavel of angular to subrounded fine to coarse flint.
							----- End of pit at 0.30 m

Remarks:	Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 0.30m bgl.
----------	--

Stability: Stable





10 Manor Court
2 Barnes Wallis Road
Segensworth
Fareham
PO15 5TH

Trial Pit Log

Trialpit No

HP102

Sheet 1 of 1

Project Name: Lovedean Lane

Project No.
A10965

Co-ords: -
Level:

Date
04/06/2018

Location: Waterloooville

Dimensions
(m):

0.3

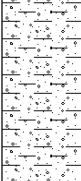
Depth
0.30

0.3

Scale
1:10

Logged
GL

Client: PMC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10 - 0.20	ES		0.05			TOPSOIL Vegetation cover over dark brown slightly silty gravelly fine to medium SAND. Gravel of angular to subrounded fine to coarse flint with frequent roots.
				0.30			CLAY Friable to soft light brown gravelly slightly sandy CLAY. Sand is fine to medium. Gavel of angular to subrounded fine to coarse flint.
							End of pit at 0.30 m

1

2

Remarks: Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 0.30m bgl.

Stability: Stable





10 Manor Court
2 Barnes Wallis Road
Segensworth
Fareham
PO15 5TH

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Lovedean Lane

Project No.
A10965

Co-ords: -

Hole Type
WS

Location: Waterlooille

Level:

Scale
1:25

Client: PMC

Dates: 04/06/2018 -

Logged By
GL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15 - 0.25	ES		0.15			MADE GROUND Pinkish grey angular to subrounded fine to coarse sandy GRAVEL of mixed lithology. (presumed sub-base).	
		0.40 - 0.50	ES		0.40			MADE GROUND Soft orangey brown slightly gravelly CLAY.	
		0.50 - 1.00	D					Gravel of angular to subrounded fine to coarse flint with occasional fragments of brick plastic chalk.	
		0.70 - 0.80	ES		0.80			At 0.65m chalk content increases.	
		1.00		N=6 (2,1/1,2,1,2)				MADE GROUND Dark brown slightly silty gravelly medium SAND. Gravel of angular to subrounded fine to coarse flint brick concrete and plastic.	1
		1.50 - 2.00	D					CLAY Soft brownish orange gravelly CLAY. Gravel of angular to subrounded fine to cobble sized flint and chalk.	
		2.00		N=6 (1,3/2,1,2,1)					2
		2.00 - 2.10	ES						
		2.70 - 2.80	ES		2.70			CHALK Recovered structureless CHALK composed of creamish white slightly gravelly slightly sandy SILT. Gravel is weak low density white with frequent black specks and rounded (Grade Dm).	3
		2.70 - 3.00	D						
		3.00		N=11 (2,1/2,2,3,4)					
		4.00		N=6 (4,2/1,1,2,2)					4
		4.00 - 4.10	ES						
		5.00		N=20 (1,1/3,6,4,7)	5.00			End of borehole at 5.00 m	5

Remarks

Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 5.0m bgl.





10 Manor Court
2 Barnes Wallis Road
Segensworth
Fareham
PO15 5TH

Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: Lovedean Lane

Project No.
A10965

Co-ords: -

Hole Type
WS

Location: Waterloooville

Level:

Scale
1:25

Client: PMC

Dates: 04/06/2018 -

Logged By
GL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20 - 0.30	ES		0.10			MADE GROUND Pinkish grey angular to subrounded fine to coarse sandy GRAVEL of mixed lithology. (presumed sub-base).	
		0.60 - 0.70	ES		0.60			CLAY Friable brownish orange gravelly sandy CLAY. Gavel of angular to subrounded fine to coarse flint. Sand is angular to subangular.	
		0.80 - 1.20	D		0.80			SAND Red clayey gravelly medium to coarse SAND. Gravel of angular to subrounded fine to coarse flint.	
		1.00		N=10 (2,2/3,2,2,3)				CLAY Soft to firm orangeish red slightly sandy gravelly CLAY. Sand is fine to medium. Gravel of angular to subrounded fine to coarse flint.	1
		1.20 - 1.30	ES		1.20			CHALK Recovered structureless CHALK composed of creamish white slightly gravelly slightly sandy SILT. Gravel is weak low density white with frequent black specks and rounded (Grade Dm).	
		1.20 - 1.70	D						
		2.00		N=13 (2,2/3,2,4,4)					2
		3.00		N=13 (2,3/2,3,3,5)					3
		3.50 - 3.60	ES						
		4.00		N=5 (3,2/1,2,1,1)					4
		4.80 - 4.90	ES						
		5.00		N=7 (7,2/2,2,1,2)	5.00			End of borehole at 5.00 m	5

Remarks

Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 5.0m bgl.





10 Manor Court
2 Barnes Wallis Road
Segensworth
Fareham
PO15 5TH

Borehole Log

Borehole No.

WS103

Sheet 1 of 1

Project Name: Lovedean Lane

Project No.
A10965

Co-ords: -

Hole Type
WS

Location: Waterloooville

Level:

Scale
1:25

Client: PMC

Dates: 04/06/2018 -

Logged By
GL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10 - 0.20	ES	N=12 (2,2/3,3,3,3)	0.36			MADE GROUND Soft to firm gravelly CLAY. Gravel of angular to subrounded fine to coarse flint, plastic, concrete with rare to occasional sized cobble brick.	1
					0.72			MADE GROUND Recovered as structureless chalk composed as white sandy GRAVEL. (Chalk fill).	
		0.75 - 0.85	ES					MADE GROUND Soft brown gravelly CLAY. Gravel of angular to subrounded fine to coarse flint, brick, clinker, chalk and occasional cobble sized subangular brick.	
		1.00						At 1.0m bgl clay is firm.	
		1.00 - 1.50	D	N=9 (1,2/1,3,3,2)					2
		1.50 - 1.60	ES						
		2.00							
		2.90 - 3.00	ES	N=5 (0,1/1,1,1,2)				Between 2.70-2.80m bgl black organic wood present.	3
		3.00						Between 3.0-3.3m bgl clay is dark brown with wood fragments.	
		3.50 - 4.00	D	N=8 (1,1/2,1,2,3)	3.50			CLAY Soft to firm orangeish brown mottled grey and red CLAY.	4
		3.60	ES						
								At 4.0mbgl sub angular chalk gravels present.	
		4.00							
		5.00		N=10 (3,2/2,1,4,3)	5.00			End of borehole at 5.00 m	5

Remarks

Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 5.0m bgl.





10 Manor Court
2 Barnes Wallis Road
Segensworth
Fareham
PO15 5TH

Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Lovedean Lane

Project No.
A10965

Co-ords: -

Hole Type
WS

Location: Waterlooille

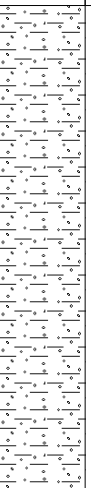
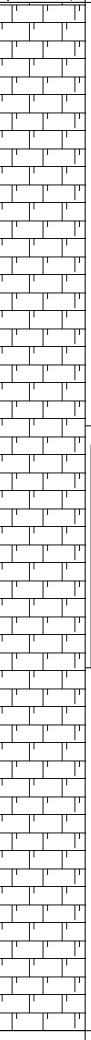
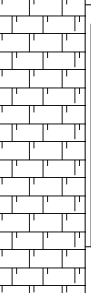
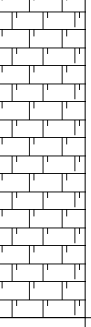
Level:

Scale
1:25

Client: PMC

Dates: 04/06/2018 -

Logged By
GL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		0.30 - 0.40	ES	N=2 (0,0/0,0,1,1)	1.60		CLAY Wood chippings over very soft brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel of angular to subrounded fine to coarse flint. Occasional wood fragments and roots.	1				
		0.50 - 1.00	D									
		0.90 - 1.00 1.00	ES									
		1.60 - 1.70	ES	N=21 (2,4/11,3,3,4)				CHALK Recovered structureless CHALK composed of creamish white slightly gravelly slightly sandy SILT. Gravel is weak low density white with frequent black specks and rounded (Grade Dm).	2			
		2.00 2.00 - 2.50	D									
		3.00										
		4.00		N=5 (3,2/1,1,1,2)						<u>Between 3.0-3.8m bgl poor recovery of soils.</u>	3	
		4.20 - 4.30	ES									
		4.50 - 5.00	D									
		5.00		N=8 (5,3/2,1,3,2)							4	
		4.20 - 4.30	ES									
		4.50 - 5.00	D									
5.00		N=13 (2,2/2,2,4,5)	5.00					5				
											End of borehole at 5.00 m	

Between 3.0-3.8m bgl poor recovery of soils.

End of borehole at 5.00 m

Remarks

Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 5.0m bgl.



Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: Lovedean Lane

Project No.
A10965

Co-ords: -

Hole Type
WS

Location: Waterloooville

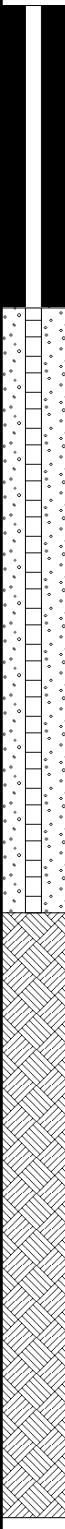
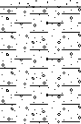
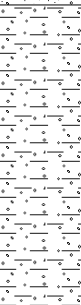
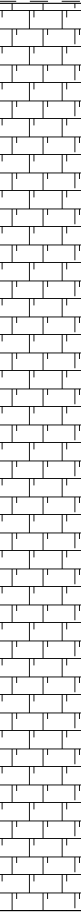
Level:

Scale
1:25

Client: PMC

Dates: 04/06/2018 -

Logged By
GL

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.25 - 0.35	ES		0.25			MADE GROUND Pinkish grey angular to subrounded fine to coarse sandy GRAVEL of mixed lithology. (presumed sub-base).	
		0.60 - 0.70	ES		0.60			SAND Brownish orange slightly gravelly slightly clayey fine to medium SAND. Gravel of angular to subrounded fine to coarse flint.	
		1.00 1.00 - 1.10 1.00 - 1.50	ES D	N=10 (1,2/2,3,2,3)	1.00			CLAY Soft to firm greyish brown mottled orange slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel of angular to subrounded fine to coarse flint with occasional roots.	1
		2.00 2.00 - 2.10	ES	N=10 (3,3/2,3,3,2)	2.00			CLAY Soft to firm to stiff orangey brown slightly gravelly CLAY. Gravel of angular to subrounded fine to coarse flint.	
		3.00 3.00 - 3.50	D	N=7 (3,2/2,1,2,2)				At 1.7mbgl angular to subrounded fine to coarse chalk gravels present. CHALK Recovered structureless CHALK composed of creamish white slightly gravelly slightly sandy SILT. Gravel is weak low density white with frequent black specks and rounded (Grade Dm).	2
		4.00		N=6 (2,2/1,1,2,2)				At 3.0m bgl chalk becomes putty-like texture.	3
		5.00		N=15 (2,1/2,3,5,5)	5.00			End of borehole at 5.00 m	4
									5

Remarks

Cleared by Cable Avoidance Tool. No groundwater encountered. Hole terminated at 5.0m bgl.

APPENDIX VII
CHEMICAL ANALYSIS RESULTS



Exova Jones Environmental

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

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

Omnia
10 Manor Court
2 Barnes Wallis Road
Segensworth
Fareham
PO15 5TH

Tel: +44 (0) 1244 833780

Fax: +44 (0) 1244 833781



Attention :	Grace Larcombe
Date :	18th June, 2018
Your reference :	A10965
Our reference :	Test Report 18/8807 Batch 1
Location :	Lovedan Lane, Waterloooville
Date samples received :	7th June, 2018
Status :	Final report
Issue :	1

Eight samples were received for analysis on 7th June, 2018 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

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

Compiled By:

Bruce Leslie
Project Co-ordinator

Client Name: Omnia
Reference: A10965
Location: Lovedan Lane, Waterloooville
Contact: Grace Larcombe
JE Job No.: 18/8807

Report : Solid

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

J E Sample No.	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16			Please see attached notes for all abbreviations and acronyms		
Sample ID	WS101	WS102	WS103	WS104	WS105	WS101	WS102	WS103					
Depth	0.15-0.25	0.20-0.30	0.10-0.20	0.30-0.40	0.60-0.70	2.70-2.80	1.20-1.30	3.50-3.60					
COC No / misc													
Containers	V J	V J	V J	V J	V J	V J	V J	V J					
Sample Date	04/06/2018	04/06/2018	04/06/2018	04/06/2018	04/06/2018	04/06/2018	04/06/2018	04/06/2018					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018			LOD/LOR	Units	Method No.
Arsenic #	5.2	7.7	11.3	6.1	4.8	-	-	-			<0.5	mg/kg	TM30/PM15
Barium #	83	33	106	42	61	-	-	-			<1	mg/kg	TM30/PM15
Beryllium	<0.5	0.6	0.9	0.5	1.2	-	-	-			<0.5	mg/kg	TM30/PM15
Cadmium #	14.7	<0.1	0.6	0.4	<0.1	-	-	-			<0.1	mg/kg	TM30/PM15
Chromium #	20.0	50.4	56.6	99.2	39.7	-	-	-			<0.5	mg/kg	TM30/PM15
Copper #	33	5	15	8	<1	-	-	-			<1	mg/kg	TM30/PM15
Lead #	49	17	41	23	15	-	-	-			<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-			<0.1	mg/kg	TM30/PM15
Nickel #	9.8	10.1	19.1	13.0	18.6	-	-	-			<0.7	mg/kg	TM30/PM15
Selenium #	2	1	1	<1	<1	-	-	-			<1	mg/kg	TM30/PM15
Vanadium	12	38	43	25	49	-	-	-			<1	mg/kg	TM30/PM15
Water Soluble Boron #	0.8	0.7	1.6	0.9	1.1	-	-	-			<0.1	mg/kg	TM74/PM32
Zinc #	3480 ^{AA}	39	247	45	67	-	-	-			<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	0.26	<0.04	<0.04	<0.04	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
Acenaphthylene	0.14	<0.03	0.10	<0.03	<0.03	-	-	-			<0.03	mg/kg	TM4/PM8
Acenaphthene #	0.38	<0.05	<0.05	<0.05	<0.05	-	-	-			<0.05	mg/kg	TM4/PM8
Fluorene #	0.25	<0.04	<0.04	<0.04	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
Phenanthrene #	4.14	<0.03	0.54	0.11	<0.03	-	-	-			<0.03	mg/kg	TM4/PM8
Anthracene #	1.69	<0.04	0.21	<0.04	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
Fluoranthene #	6.97	0.07	1.49	0.34	<0.03	-	-	-			<0.03	mg/kg	TM4/PM8
Pyrene #	6.20	0.07	1.31	0.32	<0.03	-	-	-			<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	3.16	<0.06	0.76	0.18	<0.06	-	-	-			<0.06	mg/kg	TM4/PM8
Chrysene #	3.92	0.06	0.69	0.17	<0.02	-	-	-			<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	7.68	0.16	1.65	0.38	<0.07	-	-	-			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	4.83	0.12	0.96	0.21	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	3.55	0.09	0.65	0.15	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	0.64	<0.04	0.12	<0.04	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	3.43	0.09	0.64	0.15	<0.04	-	-	-			<0.04	mg/kg	TM4/PM8
PAH 16 Total	47.2	0.7	9.1	2.0	<0.6	-	-	-			<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	5.53	0.12	1.19	0.27	<0.05	-	-	-			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	2.15	0.04	0.46	0.11	<0.02	-	-	-			<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	111	107	86	103	108	-	-	-			<0	%	TM4/PM8
EPH >C8-C10 #	<5	<5	<5	<5	<5	-	-	-			<5	mg/kg	TM5/PM8
EPH >C10-C12 #	<10	<10	<10	<10	<10	-	-	-			<10	mg/kg	TM5/PM8
EPH >C12-C16 #	<10	<10	<10	<10	<10	-	-	-			<10	mg/kg	TM5/PM8
EPH >C16-C21 #	15	<10	<10	<10	<10	-	-	-			<10	mg/kg	TM5/PM8
EPH >C21-C40	149	<10	101	<10	<10	-	-	-			<10	mg/kg	TM5/PM8
EPH >C8-C40	164	<30	101	<30	<30	-	-	-			<30	mg/kg	TM5/PM8
GRO (>C4-C6)	<100	<100	<100	<100	<100	-	-	-			<100	ug/kg	TM36/PM12
GRO (>C6-C8) #	<100	<100	<100	<100	<100	-	-	-			<100	ug/kg	TM36/PM12

Please see attached notes for all abbreviations and acronyms

Client Name: Omnia
Reference: A10965
Location: Lovedan Lane, Waterloooville
Contact: Grace Larcombe

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

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

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

Signed on behalf of Jones Environmental Laboratory:



Ryan Butterworth
 Asbestos Team Leader

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
18/8807	1	WS101	0.15-0.25	2	13/06/2018	General Description (Bulk Analysis)	Soil/Stones
					13/06/2018	Asbestos Fibres	NAD
					13/06/2018	Asbestos Fibres (2)	NAD
					13/06/2018	Asbestos ACM	NAD
					13/06/2018	Asbestos ACM (2)	NAD
					13/06/2018	Asbestos Type	NAD
					13/06/2018	Asbestos Type (2)	NAD
					13/06/2018	Asbestos Level Screen	NAD
18/8807	1	WS102	0.20-0.30	4	13/06/2018	General Description (Bulk Analysis)	Soil/Stones
					13/06/2018	Asbestos Fibres	NAD
					13/06/2018	Asbestos Fibres (2)	NAD
					13/06/2018	Asbestos ACM	NAD
					13/06/2018	Asbestos ACM (2)	NAD
					13/06/2018	Asbestos Type	NAD
					13/06/2018	Asbestos Type (2)	NAD
					13/06/2018	Asbestos Level Screen	NAD
18/8807	1	WS103	0.10-0.20	6	12/06/2018	General Description (Bulk Analysis)	Soil/Stone
					12/06/2018	Asbestos Fibres	NAD
					12/06/2018	Asbestos Fibres (2)	NAD
					12/06/2018	Asbestos ACM	NAD
					12/06/2018	Asbestos ACM (2)	NAD
					12/06/2018	Asbestos Type	NAD
					12/06/2018	Asbestos Type (2)	NAD
					12/06/2018	Asbestos Level Screen	NAD
18/8807	1	WS104	0.30-0.40	8	12/06/2018	General Description (Bulk Analysis)	Soil/Stone
					12/06/2018	Asbestos Fibres	NAD
					12/06/2018	Asbestos Fibres (2)	NAD
					12/06/2018	Asbestos ACM	NAD
					12/06/2018	Asbestos ACM (2)	NAD
					12/06/2018	Asbestos Type	NAD
					12/06/2018	Asbestos Type (2)	NAD
					12/06/2018	Asbestos Level Screen	NAD
18/8807	1	WS105	0.60-0.70	10	12/06/2018	General Description (Bulk Analysis)	Soil/Stones
					12/06/2018	Asbestos Fibres	NAD
					12/06/2018	Asbestos Fibres (2)	NAD

[illegible]

Matrix : Solid

[illegible]

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NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 18/8807

SOILS

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

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

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

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

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

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

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

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

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

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

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

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

WATERS

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

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

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

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

DEVIATING SAMPLES

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

SURROGATES

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

DILUTIONS

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

BLANKS

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

NOTE

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

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

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Please include all sections of this report if it is reproduced

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Exova Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

JE Job No: 18/8807

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes

JE Job No: 18/8807

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM74	Analysis of water soluble boron (20:1 extract) by ICP-OES.	PM32	Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio.	Yes		AD	Yes
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM45	As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide and Thiocyanate analysis.	Yes		AR	Yes
NONE	No Method Code	NONE	No Method Code			AR	Yes

APPENDIX VIII
ORIGIN OF GAC VALUES

Residential End Use with Homegrown Produce – OECv3 Oct 2017

Constituent	Unit	GAC	Origin of Risk Assessment Value
Arsenic	mg/kg	37	LQM CIEH Suitable for Use Levels (S4UL) 2015- Inorganic Arsenic
Beryllium	mg/kg	1.7	LQM CIEH Suitable for Use Levels (S4UL) 2015
Boron	mg/kg	290	
Cadmium	mg/kg	11	
Chromium (III)	mg/kg	910	
Chromium (VI)	mg/kg	6	
Copper	mg/kg	2400	
Lead	mg/kg	200	Category 4 Screening Level (C4SL) utilising exposure parameters from CLEA SR3 report.
Mercury	mg/kg	40	LQM CIEH Suitable for Use Levels (S4UL) 2015- Inorganic Mercury
Nickel	mg/kg	180	LQM CIEH Suitable for Use Levels (S4UL) 2015
Selenium	mg/kg	250	
Vanadium	mg/kg	410	
Zinc	mg/kg	3700	
General Inorganics			
Cyanide	mg/kg	50	Dutch Intervention Values 2010 - Complex Cyanide
Organics			
General Organics			
Phenol	mg/kg	280	LQM CIEH Suitable for Use Levels (S4UL) 2015 1%SOM
PAH			
Naphthalene	mg/kg	2.3	LQM CIEH Suitable for Use Levels (S4UL) 2015 based on a sandy loam as defined in SR3 (EA 2009) 1% SOM
Acenaphthylene	mg/kg	170	
Acenaphthene	mg/kg	210	
Fluorene	mg/kg	170	
Phenanthrene	mg/kg	95	
Anthracene	mg/kg	2400	
Fluoranthene	mg/kg	280	
Pyrene	mg/kg	620	
Benzo(a)Anthracene ^l	mg/kg	7.2	
Chrysene	mg/kg	15	
Benzo(b)Fluoranthene	mg/kg	2.6	
Benzo(k)Fluoranthene	mg/kg	77	
Benzo(a)Pyrene	mg/kg	2.2	
Indeno(123-cd)Pyrene	mg/kg	27	
Dibenzo(a,h)Anthracene	mg/kg	0.24	
Benzo(ghi)Perylene	mg/kg	320	

Residential End Use with Homegrown Produce – OECv3 Oct 2017

Constituent	Unit	GAC	Origin of Risk Assessment Value
BTEX			
Benzene	mg/kg	0.087	LQM CIEH Suitable for Use Levels (S4UL) 2015 1%SOM
Toluene	mg/kg	130	
Ethylbenzene	mg/kg	47	
Xylenes	mg/kg	56	LQM CIEH Suitable for Use Levels (S4UL) 2015 1% SOM o-Xylene
TPH CWG			
Aliphatic			LQM CIEH Suitable for Use Levels (S4UL) 2015 based on a sandy loam as defined in SR3 (EA 2009) 1% SOM
Aliphatic EC 5-6	mg/kg	42	
Aliphatic EC >6-8	mg/kg	100	
Aliphatic EC >8-10	mg/kg	27	
Aliphatic EC >10-12	mg/kg	130	
Aliphatic EC > 12-16	mg/kg	1100	
Aliphatic EC > 16-35	mg/kg	65000	
Aliphatic EC >35-44	mg/kg	65000	
Aromatic			LQM CIEH Suitable for Use Levels (S4UL) 2015 based on a sandy loam as defined in SR3 (EA 2009) 1% SOM
Aromatic EC 5-7	mg/kg	70	
Aromatic EC>7-8	mg/kg	130	
Aromatic EC> 8-10	mg/kg	34	
Aromatic EC> 10-12	mg/kg	74	
Aromatic EC> 12-16	mg/kg	140	
Aromatic EC> 16-21	mg/kg	260	
Aromatic EC> 21-35	mg/kg	1100	
Aromatic EC> 35-44	mg/kg	1100	
Banded TPH			
Aliphatic EC 5-6	mg/kg	42	LQM CIEH Suitable for Use Levels (S4UL) 2015 based on a sandy loam as defined in SR3 (EA 2009) 1% SOM, utilising the most conservative of the Ali/Aro chain lengths.
Aliphatic EC >6-8	mg/kg	100	
Aliphatic EC >8-10	mg/kg	27	
Aromatic EC> 10-12	mg/kg	74	
Aromatic EC> 12-16	mg/kg	140	
Aromatic EC> 16-21	mg/kg	260	
Aromatic EC> 21-35	mg/kg	1100	
Aromatic EC> 35-44	mg/kg	1100	
Herbicides and Pesticides			
Bromoxynil	mg/kg	74	Derived from USEPA Screening Criteria
Dicamba	mg/kg	2700	
MCPA	mg/kg	45	
MCPB	mg/kg	390	

Residential End Use with Homegrown Produce – OECv3 Oct 2017

Constituent	Unit	GAC	Origin of Risk Assessment Value
Pentachlorophenol	mg/kg	14	
Picloram	mg/kg	6200	
DDE	mg/kg	2.0	
DDT	mg/kg	1.9	

APPENDIX IX
GEOTECHNICAL ANALYSIS RESULTS



4041

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: OMNIA Environmental Consulting
Client Address: 10 Manor Court
Barnes Wallis Road
Segensworth
Fareham
PO15 5TH
Contact: Grace Larcombe
Site Name: Lovedean Lane, Waterlooille
Site Address: Not Given

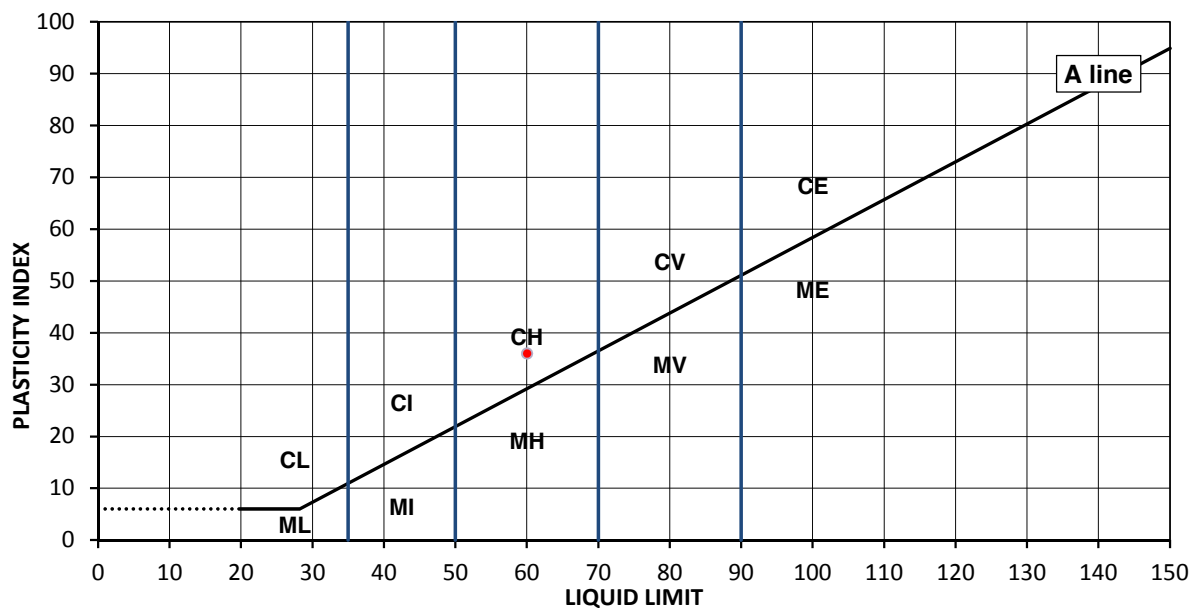
Client Reference: A10965
Job Number: 18-88303
Date Sampled: 04/06/2018
Date Received: 06/06/2018
Date Tested: 13/06/2018
Sampled By: Not Given

Test Results

Laboratory Reference: 977451
Hole No.: WS101
Sample Reference: Not Given
Soil Description: Yellowish brown slightly gravelly CLAY with fragments of chalk
Sample Preparation: Tested after washing to remove >425um

Depth Top [m]: 1.50
Depth Base [m]: 2.00
Sample Type: D

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
28	60	24	36	79



Legend, based on BS 5930:2015 Code of practice for site investigations

Plasticity		Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
L	Low	50 to 70
I	Medium	70 to 90
H	High	exceeding 90
V	Very high	
E	Extremely high	
Organic		O append to classification for organic material (eg CHO)

Remarks:

Approved:

Dariusz Piotrowski
PL Laboratory
Manager
Date Reported: 20/06/2018

Signed:

Darren Berrill
Geotechnical General
Manager

for and on behalf of i2 Analytical Ltd

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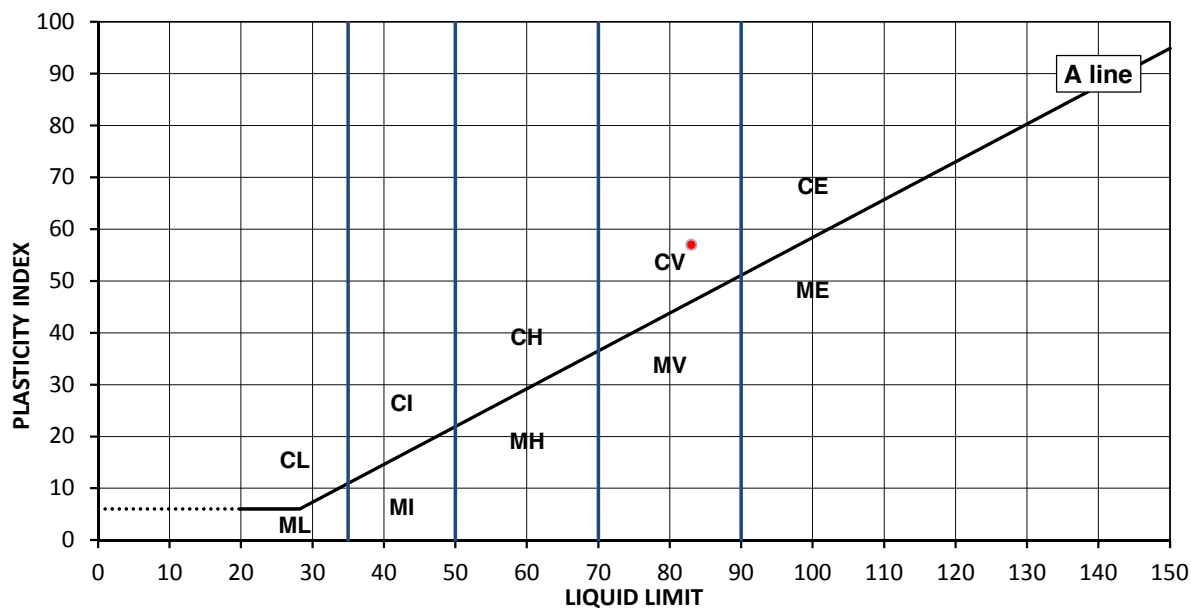
Client Reference: A10965
Job Number: 18-88303
Date Sampled: 04/06/2018
Date Received: 06/06/2018
Date Tested: 13/06/2018
Sampled By: Not Given

Test Results

Laboratory Reference: 977452
Hole No.: WS102
Sample Reference: Not Given
Soil Description: Orangish brown slightly gravelly CLAY with fragments of chalk
Sample Preparation: Tested after washing to remove >425um

Depth Top [m]: 0.80
Depth Base [m]: 1.20
Sample Type: D

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
22	83	26	57	87



Remarks:

Approved:

Dariusz Piotrowski
PL Laboratory
Manager
Date Reported: 20/06/2018

Signed:

Darren Berrill
Geotechnical General
Manager

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Site Address: Not Given

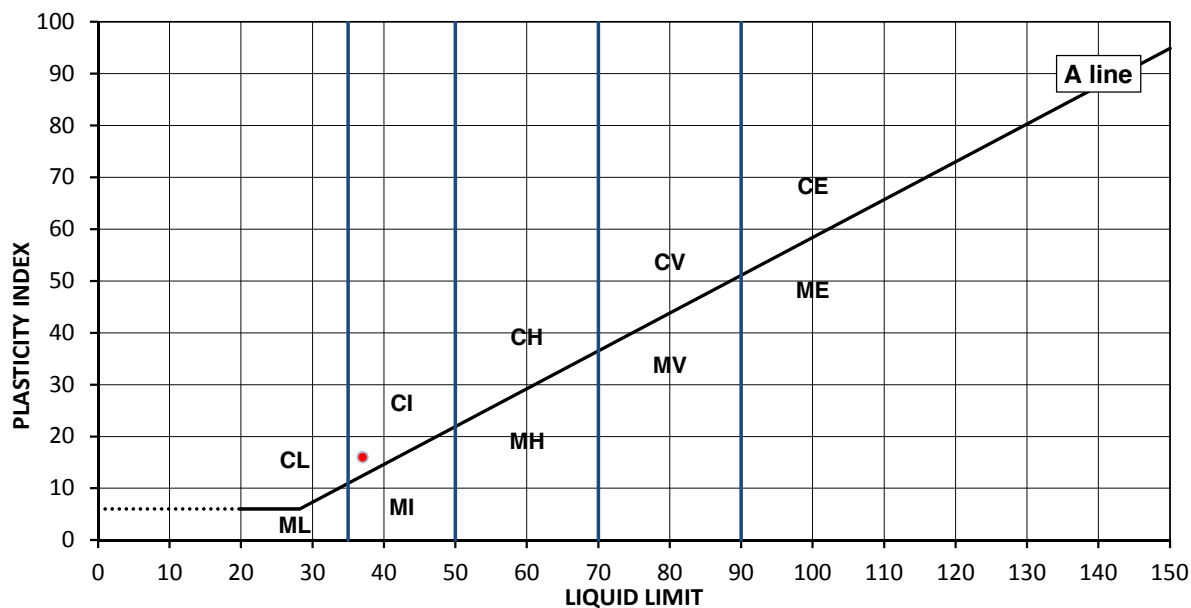
Client Reference: A10965
Job Number: 18-88303
Date Sampled: 04/06/2018
Date Received: 06/06/2018
Date Tested: 13/06/2018
Sampled By: Not Given

Test Results

Laboratory Reference: 977453
Hole No.: WS104
Sample Reference: Not Given
Soil Description: Brown slightly gravelly sandy CLAY
Sample Preparation: Tested after >425um removed by hand

Depth Top [m]: 0.50
Depth Base [m]: 1.00
Sample Type: D

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
20	37	21	16	88



Legend, based on BS 5930:2015 Code of practice for site investigations

Plasticity		Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
L	Low	50 to 70
I	Medium	70 to 90
H	High	exceeding 90
V	Very high	
E	Extremely high	
Organic	O	append to classification for organic material (eg CHO)

Remarks:

Approved:

Dariusz Piotrowski
PL Laboratory
Manager
Date Reported: 20/06/2018

Signed:

Darren Berrill
Geotechnical General
Manager

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Determination of Liquid and Plastic Limits

Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

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PO15 5TH
Contact: Grace Larcombe
Site Name: Lovedean Lane, Waterlooille
Site Address: Not Given

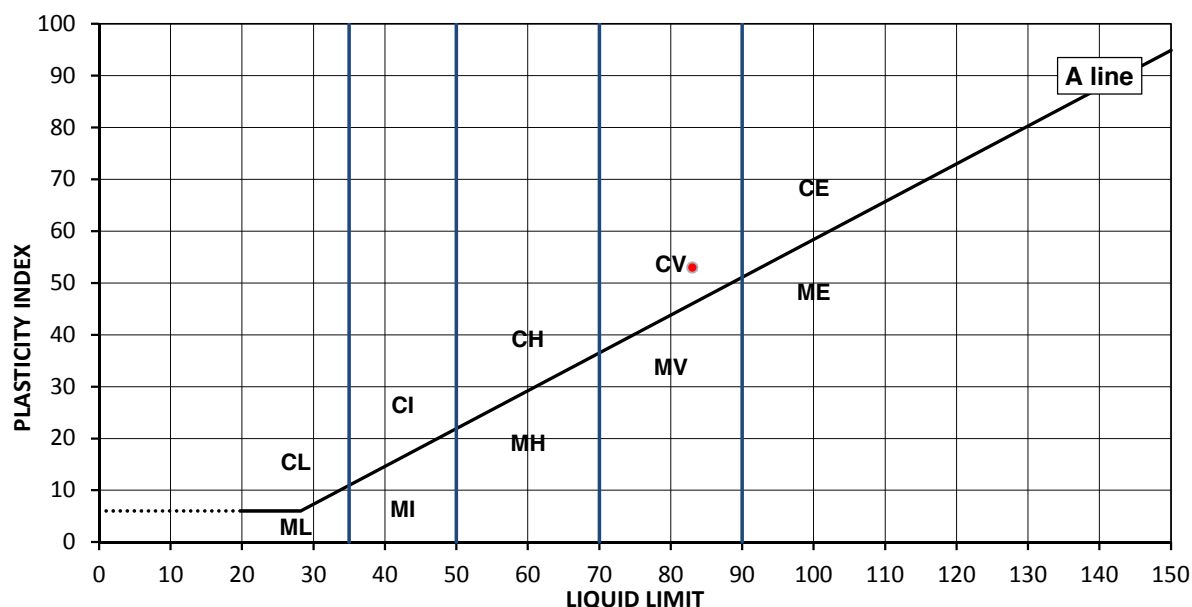
Client Reference: A10965
Job Number: 18-88303
Date Sampled: 04/06/2018
Date Received: 06/06/2018
Date Tested: 13/06/2018
Sampled By: Not Given

Test Results

Laboratory Reference: 977454
Hole No.: WS105
Sample Reference: Not Given
Soil Description: Yellowish brown slightly gravelly CLAY
Sample Preparation: Tested after >425um removed by hand

Depth Top [m]: 1.00
Depth Base [m]: 1.50
Sample Type: D

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	83	30	53	92



Legend, based on BS 5930:2015 Code of practice for site investigations

Plasticity		Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
L	Low	50 to 70
I	Medium	70 to 90
H	High	exceeding 90
V	Very high	
E	Extremely high	
Organic		O append to classification for organic material (eg CHO)

Remarks:

Approved:

Dariusz Piotrowski
PL Laboratory
Manager
Date Reported: 20/06/2018

Signed:

Darren Berrill
Geotechnical General
Manager

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Summary of Classification Test Results

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7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



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PO15 5TH
Contact: Grace Larcombe
Site Name: Lovedean Lane, Waterlooille
Site Address: Not Given

Client Reference: A10965
Job Number: 18-88303
Date Sampled: 04/06/2018
Date Received: 06/06/2018
Date Tested: 13/06/2018
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	M/C	Atterberg				Density		Total Porosity
		Reference	Top depth [m]	Base depth [m]	Type			% Passing 425um	LL	PL	PI	bulk	PD	
							%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3
977451	WS101	Not Given	1.50	2.00	D	Yellowish brown slightly gravelly CLAY with fragments of chalk	28	79	60	24	36			
977452	WS102	Not Given	0.80	1.20	D	Orangish brown slightly gravelly CLAY with fragments of chalk	22	87	83	26	57			
977453	WS104	Not Given	0.50	1.00	D	Brown slightly gravelly sandy CLAY	20	88	37	21	16			
977454	WS105	Not Given	1.00	1.50	D	Yellowish brown slightly gravelly CLAY	31	92	83	30	53			

Comments:

Approved:

Dariusz Piotrowski
PL Laboratory Manager
Geotechnical Section

Date Reported: 20/06/2018

Signed:

Darren Berrill
Geotechnical General Manager

for and on behalf of i2 Analytical Ltd

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