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**EMSWORTH PRIMARY SCHOOL
VICTORIA ROAD
EMSWORTH, HAMPSHIRE**

**GEOTECHNICAL REPORT
ON THE GROUND INVESTIGATION**

Report No. LW24121 June 2013

Report prepared for the benefit of:

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INVESTOR IN PEOPLE

**EMSWORTH PRIMARY SCHOOL
VICTORIA ROAD
EMSWORTH, HAMPSHIRE**

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ON THE GROUND INVESTIGATION**

Report No. LW24121 June 2013

FACTUAL REPORT	
Prepared By:	Approved By:
	
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GEOTECHNICAL ASSESSMENT	
Prepared By:	Approved By:
	
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**EMSWORTH PRIMARY SCHOOL
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1. INTRODUCTION

It is proposed to construct a new extension at Emsworth Primary School, Victoria Road, Emsworth, Hampshire.

Ashdown Site Investigation Limited was commissioned to carry out a ground investigation and geotechnical assessment of the site by the:

Geotechnics Group
Economy, Transport and Environment Department
Hampshire County Council
The Castle
Winchester
Hampshire
SO23 8UD

The scope of the investigation, designed by Hampshire County Council, and information relating to the Geotechnical Work Package was received from the client on the 1st May 2013. Subsequently a purchase order (No. 9002515213) for the works was received, dated 14th May 2013. The information provided by Hampshire County Council pertaining to the project is presented in Appendix C.

The purpose of the works was to:

- i. assess shallow ground and groundwater conditions prevailing at the site;
- ii. investigate the form of foundations to existing structures; and
- iii. provide information to assist others in undertaking design of spread foundations and ground floors.

The analysis and discussions contained in this report are based on the ground conditions encountered during the recent site work together with the findings from a programme of laboratory analyses. The possibility of a variation in ground and groundwater conditions away from the positions investigated should not be overlooked. Groundwater conditions can vary both seasonally and due to other effects.

The investigation was undertaken and the report prepared for Hampshire County Council and their consultant partners. It is noted that the investigation was undertaken specifically for the proposed development identified in the Geotechnical Work Package and the recommendations given may not be appropriate to alternative schemes. The copyright for the report and licence for its use shall remain vested in Ashdown Site Investigation Limited (the Company) who disclaim all responsibility or liability (whether at common law or under the express or implied terms of the Contract between the Company and the Client) for any loss or damage of whatever nature in the event that this report is relied on by a third party, or is issued in circumstances or for projects for which it was not originally commissioned, or where the exploratory hole records and test results contained therein are interpreted by anyone other than the Company.

2. SITE DETAILS

2.1 Site Description

The site was visited by Ashdown Site Investigation Ltd on the 8th May 2013 in order to ascertain site conditions in advance of the ground investigation works.

The Emsworth Primary School grounds are located at Victoria Road, Emsworth Hampshire and are centred on the approximate Ordnance Survey national grid reference SU 7421 0633. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively.

The main school buildings occupied the western part of the school grounds with an access road from Victoria Road to the south west of the school building. To the east and south of the school were asphalt surface hard play areas. The eastern part of the site comprised a grassed surface playing field.

The area under investigation was located along the eastern elevation of the single storey main school building and comprised a mixed paving slab and asphalt surfaced hard play area with wooden seating and overhead canopies.

2.2 Site History

An examination of historical Ordnance Survey maps (provided by Hampshire County Council) was undertaken to determine the history of the site and surrounding areas. It is noted that each map presents information applicable at the time of the survey (or revision date) and may be subject to surveying and cartographic errors and/or advances. Revisions to maps are made at irregular intervals and it is possible that significant developments may have taken place on or within the vicinity of the site that have not been revealed by the maps.

Epoch 1 1843 – 1893: The site comprises open fields. Immediately to the north of the site is a railway line aligned west to east. Several buildings are marked to the south east of the site.

Epoch 2 1891 – 1912: No significant changes noted on this map.

Epoch 3 1904 – 1939: No significant changes noted on site. Further residential development is shown to the south of the site.

Epoch 4 1919 – 1943: No significant changes noted on this map.

Current mapping shows the site occupied by the school buildings and grounds. The railway line is present to the north of the school and significant residential development is shown to the west, south and east of the site.

2.3 Expected Geology

The stratigraphic succession expected to underlie the site is presented in the following table. In preparing the table reference has been made to the 1:10,00 scale maps provided by Hampshire County Council, the British Geological Survey 1:50,000 series scale map and the British Geological Survey lexicon of named rock units.

Table 1. Expected Geological Strata

Type	Stratum	Age
Superficial Deposits	River Terrace Deposits	Quaternary
Bedrock Geology	London Clay Formation	Eocene

2.3.1 River Terrace Deposits

The River Terrace Deposits generally comprise well graded sandy fine to coarse gravel of flint. Locally sand or gravel strata may predominate. Gravels normally include a high proportion of subangular flint and chert and Lower Greensand rock types.

2.3.2 London Clay Formation

The London Clay Formation comprises a blue grey silty clay, which tends to weather to brown near to the upper surface. With depth, the clay becomes very stiff/hard, is frequently fissured and can contain some inclusions and beds of weak mudstone and siltstone.

2.4 Radon

Information provided by Hampshire County Council indicates that no specific measures are required to protect buildings against ingress of Radon gas.

2.5 Aquifer Status and Groundwater Source Protection Zones

The Environment Agency designates aquifers in accordance with the Water Framework Directive. These designations not only reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. Reference has been made to Aquifer Designation Maps available on the Environment Agency website (<http://www.environment-agency.gov.uk>).

The River Terrace Deposits expected beneath the site are classified as a Secondary A Aquifer. Secondary A Aquifers are characterised by permeable

layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The London Clay Formation soils are classed as Unproductive Strata. Unproductive Strata are deposits with low permeability that have negligible significance for water supply or river base flow.

The site does not lie within an Environment Agency Source Protection Zone with regard to the protection of the quality of groundwater that is abstracted for potable supply.

2.6 Hydrology

The nearest significant surface water feature is a tributary of the Emsworth Channel located some 300m to the west of the site.

The site does not lie within an Environment Agency Zone 2 or Zone 3 floodplain and there are no flood defences, areas benefiting from flood defences or areas used for flood storage within 250m of the site.

3. GROUND INVESTIGATION

3.1 Introduction

The ground investigation comprised the excavation of a series of dynamic sampler boreholes together with hand dug foundation inspection pits. The fieldwork was carried out on 28th May 2013. The exploratory hole locations are shown on the Site Plan (Figure 2).

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records given in Appendix A. Notes to assist in the interpretation of the records are also contained in the appendix.

3.2 Exploratory Holes

3.2.1 *Dynamic Sampler Boreholes*

Two boreholes (designated WS1 and WS2) were each drilled to a depth of 6.0m below ground level.

The dynamic sampler boreholes were formed by a series of 1.0m long hollow steel tubes, reducing in diameter from 100mm to 35mm, driven into the ground by means of a track-mounted drop weight. The sampler was extracted from the ground using a hydraulically operated jack and the enclosed samples recovered in 1.0m long plastic liners. The system enables sub-samples to be taken for detailed examination and laboratory testing.

3.2.2 *Foundation Inspection Pits*

Two pits (designated TP1 and TP2) were excavated using hand-tools to depths of 1.0m and 0.7m below ground level, respectively, to enable inspection of the foundations to existing buildings.

3.3 Sampling

Disturbed samples of soil were taken at the depths shown in the exploratory hole records and collected in either plastic bags, plastic tubs or amber jars fitted with gas tight lids. On collection the amber jars were stored in cool boxes with cooling blocks to maintain temperatures below 4°C until transferred to refrigerators upon return to the office and subsequently forwarded to the external accredited laboratory.

3.4 In Situ Testing

The depths of in situ testing, together with the test results, are given on the exploratory hole records or are summarised separately in Appendix A. Notes providing additional information on the tests that were performed are also included in Appendix A.

3.4.1 DPSH Dynamic Probe (Super Heavy) Testing

Dynamic probe testing was carried out adjacent to both of the dynamic sampler boreholes WS1 and WS2. The dynamic probing was undertaken in accordance with BS EN ISO 22476-2:2005 using a super heavy probing geometry.

The DPSH-B configuration is similar to that of the standard penetration test (SPT) except that the tip comprises a 90° cone, the driving rods are lighter than those used for SPT testing and the blow counts are recorded over 100mm increments rather than 300mm, as is the case for the SPT. The blow counts recorded and calculated dynamic point resistances are presented on the probe records; the latter account for inertia of the anvil and driving rods.

3.4.2 Undrained Shear Strength

Undrained shear strength determinations were made in situ within the fine grained soils using a Geonor hand shear vane as part of the investigation.

Additionally undrained shear strength determinations were made within samples of the fine grained soils held in the dynamic sampler liners using a hand penetrometer. Although samples taken by the dynamic sampling technique cannot be regarded as being undisturbed for testing purposes, penetrometer testing can provide a useful indication of the strength of the material.

3.5 Laboratory Testing

Laboratory testing was scheduled by Ashdown Site Investigation Ltd and approved by Hampshire County Council. Results from the laboratory tests are provided in Appendix B.

Geotechnical testing was undertaken by Ashdown Site Investigation Ltd in accordance with the methods given in BS1377:1990 Parts 1 to 8 'Methods of test for soils for civil engineering purposes'. Chemical testing of selected samples was undertaken by a laboratory with recognised (UKAS and MCERTS) accreditation for quality control. Notes to assist with the interpretation of the tests are contained within Appendix B.

The types and numbers of tests carried out are detailed in the following table. The test results are discussed in Section 5.

Table 2. Geotechnical Testing

Type of test	No. of samples tested
Moisture Content	6
Atterberg Limits	6
Particle Size Distribution	4
BRE SD1 suite	4

4. GROUND CONDITIONS

4.1 Stratigraphy

4.1.1 Surface Covering

Each of the exploratory holes was excavated through a surface cover of asphalt some 100mm to 150mm in thickness.

4.1.2 Made Ground

Made ground, generally comprising clayey sandy gravel containing a variable quantity of flint, concrete, brick, crystalline rock, glass and plastic fragments was recorded at each exploratory hole position to depths of between 0.3m and 0.7m below ground level.

4.1.3 River Terrace Deposits

Underlying the made ground, the investigation progressed into undisturbed generally firm to stiff clays containing a variable proportion of gravel of flint, chalk and ironstone. These clay deposits were recorded to the full depth of the trial pits and to a depth of 1.3m in each of the dynamic sampler boreholes.

Beneath the clay soils, the boreholes typically encountered loose and loose to medium dense clayey sands containing gravel of flint. These coarse grained deposits were recorded to depths of 4.7m and 3.8m in boreholes WS1 and WS2 respectively.

These clay soils and underlying sand deposits are considered to represent the River Terrace Deposits indicated on the published geological map.

4.1.4 London Clay Formation

Beneath the River Terrace Deposits the dynamic sampler boreholes encountered generally very stiff clay to the full depth of investigation of 6m below ground level. These soils are considered to be representative of the London Clay Formation soils indicated on the published geology map.

4.2 Stability

Instability was recorded locally within the coarser grained soils encountered.

4.3 Groundwater Conditions

Groundwater seepages were encountered within the dynamic sampler boreholes at depths of between 2.0m and 3.0m below ground level. On completion of drilling

standing water depths of 1.4m and 1.5m below ground level were recorded in boreholes WS1 and WS2, respectively.

Perched groundwater was noted within trial pit TP1 at a depth of between 0.6m and 0.75m.

4.4 Existing Foundations

Details of the foundations encountered within the foundation inspection pits are included as Figure 3 of this report.

The foundations exposed in trial pits TP1 and TP2 appeared to comprise mass concrete spread foundations projecting some 150mm and 300mm from the building, respectively, and bearing at depths of 0.75m and 0.55m below ground level at the respective positions.

The foundations were supported within the River Terrace Deposits.

5. GEOTECHNICAL ASSESSMENT

The geotechnical assessment has been prepared in connection with the development proposals shown on the drawing produced by Hampshire County Council (Reference P09163 A 003, dated August 2013).

In summary the drawing indicates the proposed development to comprise the construction of a new single storey extension along the eastern elevation of the existing main school building.

It is understood that foundation loading for the proposed new structure will be in the region of 40kN/m.

5.1 Foundations

5.1.1 Soil Shrinkage/Heave Potential

The fine grained soils of the River Terrace Deposits have been classified as clays of intermediate to high plasticity and with modified plasticity indices in the range of 14% to 33% the soils may be expected to exhibit a low to medium volume change potential. The underlying sand soils of the River Terrace Deposits were recorded to contain less than 35% fines and as such may be considered to be non-plastic and hence non-shrinkable.

Two classification tests carried out on the London Clay Formation soils indicate they are clays of high plasticity and have modified plasticity indices of 24% and 41% inciting a medium to high volume change potential. However given that the London Clay Deposits were encountered below depths of 3.8m and 4.7m and that the water table appears to be at approximately 1.5m the presence of high volume change potential soil of the London Clay Formation is not expected to significantly affect foundation design.

It is recommended that the design of precautions against shrinkage and heave for any new foundation system should assume a medium volume change potential for the fine grained River Terrace Deposits and take into account current guidance such as that given by the Building Research Establishment (BRE) or the National House Builders Council (NHBC).

Whilst this report has been prepared to provide advice to assist designers in undertaking detailed design, the report itself does not represent a detailed design statement. All detailed foundation design including assessment of minimum founding depths and requirements for placement of void formers must take into account the volume change potential of the soil and the presence of trees (previous, present and proposed).

It is recommended that an arboriculturalist should be consulted to establish the species and maturity of existing trees in the area of the proposed works. It would be prudent to review any available historical photographs or detailed site plans (if

available) to establish the location of any felled trees that may affect foundation design. The information obtained from the arboricultural survey, information on proposed planting schemes and the findings of this report should be provided to the structural engineers responsible for design of foundation systems.

5.1.2 Spread Foundations

Any made ground and any soils disturbed by the construction or removal of any previously existing foundations or services should be regarded as potentially variable in nature and state of compaction and, as such, unsuitable as a founding medium for shallow footings. New footings should be constructed so as to bear below such soils and onto undisturbed, competent, natural deposits.

For design purposes, a net allowable bearing capacity of 100kN/m² may be assumed for the construction of spread (pad or strip) foundations up to 1.0m across bearing within the firm to stiff clays and loose to medium dense sands of the River Terrace Deposits. The quoted bearing capacity is expected to limit settlement to less than 25mm. In general a minimum depth to formation of 0.9m should be adopted, though foundations may need to be deepened where made ground is found to extend below this depth or where there is a requirement to protect foundations against deep seasonal soil volume changes induced by trees.

Attention is drawn to the presence of interbedded fine grained and coarse grained soils beneath the site. Where there is the potential for mixed soil conditions to be present beneath footings, designers will need to consider whether foundations need to be reinforced due to the potential for cracking of foundations to occur as a result of differential settlement across individual foundations, as coarse grained and fine grained soils will settle at different rates under loading.

Care must be taken to ensure that new foundations do not undermine or impose additional loading (vertical or lateral) on existing foundations. Similarly, the construction of new foundations must be carefully undertaken and monitored in those situations where temporary works may affect existing foundations.

5.2 Groundwater

Groundwater was recorded within boreholes WS1 and WS2 at depths of 1.4m and 1.5m below ground level.

Excavations beneath the water table, and particularly within coarse grained soils, will require active groundwater control to maintain adequately dry working conditions and excavation stability.

For excavations made above the water table it is expected that ingress of perched water, if any, or surface run off should be adequately managed by pumping from sumps or natural drainage.

5.3 Stability of Excavations

All unsupported excavations should be assumed to be subject to short term instability. Where stable excavations are required they should be suitably supported or side slopes battered back to a safe angle of repose.

Where personnel access is required into any excavation, its stability must be assessed by a suitably qualified, experienced and responsible person. In any case it is recommended that where personnel access into excavations greater than 1.2m depth is necessary, excavations should be fully supported or side slopes battered back to a safe angle of repose.

Particular attention must be paid to ensuring the stability of adjacent structures.

5.4 Aggressivity to Concrete

In view of the soils encountered beneath the site it is considered that 'natural ground conditions' may be assumed for the purposes of assessing the aggressivity of the chemical environment for concrete classification (ACEC class). Given the noted occurrence of groundwater, 'mobile groundwater' conditions should be assumed.

Chemical analysis of the soil indicates a sulphate content falling into Design Sulfate Class DS-1 of Table C1 of the Building Research Establishment Special Digest No 1 "Concrete in aggressive ground", 2005. The results of the pH tests indicate that the underlying soils are slightly alkaline.

In accordance with the BRE digest, a DS-1 Design Sulfate Class and an AC-1 ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground at the site.

5.5 Ground Floors

In view of the presence of soils of up to medium volume change potential underlying the site, it is recommended that ground floors be suspended for all sensitive structures.

Ground bearing floor slabs may, however, be considered where made ground soils are not present or are to be removed from beneath building footprints and the depth of foundations required to protect against seasonal soil volume changes close to trees is less than 1.5m. In such circumstances further works should be undertaken to demonstrate, that close to the time of construction, no significant soil desiccation is present.

If ground bearing floors are adopted it is recommended that the potential for differential movement both between the floor slab and walls and across the floor slab itself should be anticipated. Such floors should be fully debonded from walls. Formations should be adequately proof rolled and any excessively soft materials excavated and replaced with a suitable well graded granular fill. The depth of any

fill should be limited to a maximum of 600mm unless placed to an engineering specification designed to limit internal settlement of the fill materials to a tolerance to be advised by the designer. The detailing of services through, or under, ground-bearing floors should incorporate flexible connections and, where appropriate, enhanced falls.

6. CONCLUSIONS

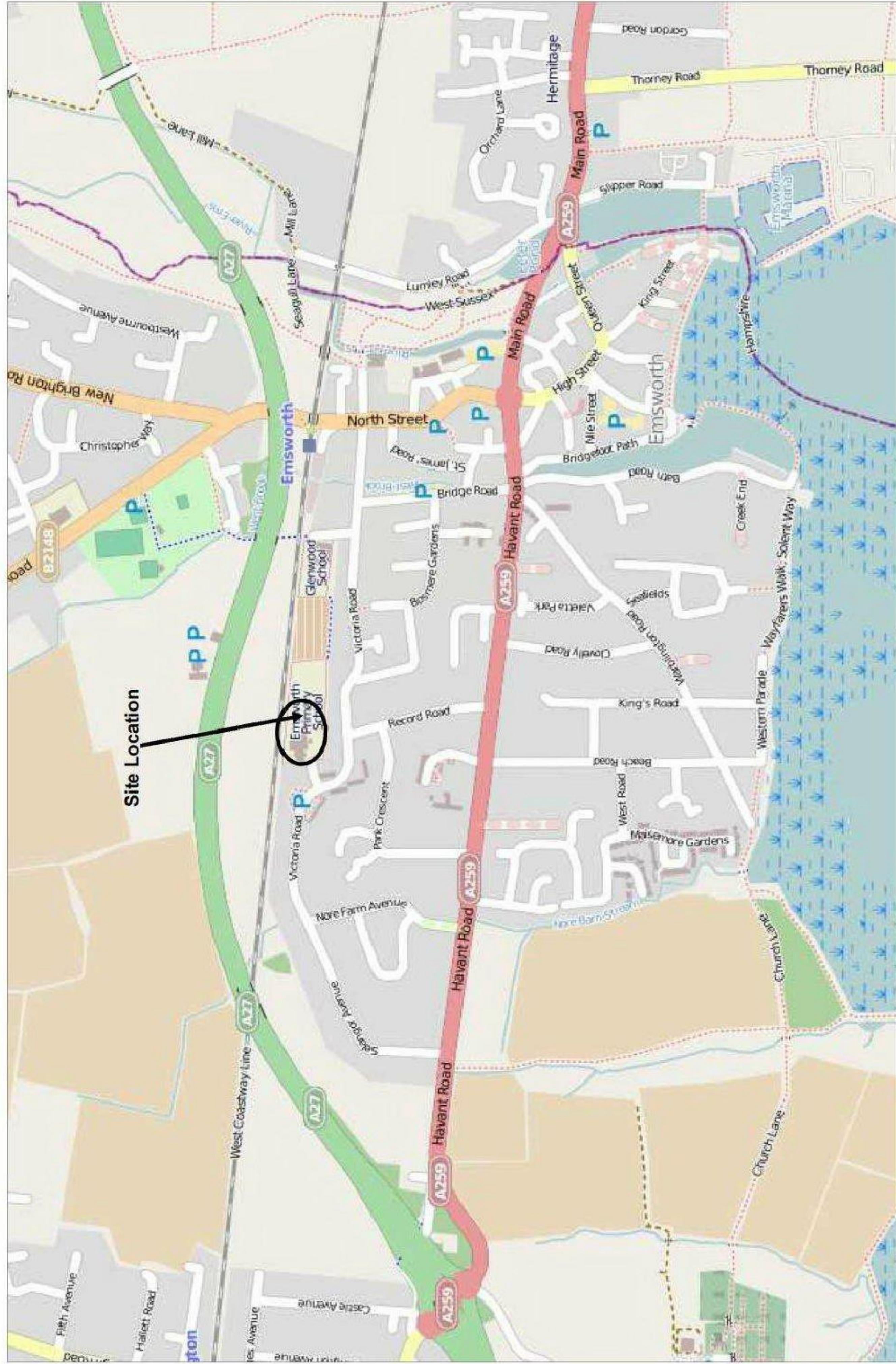
The following conclusions present a summary of the main findings of the investigation. However, no reliance should be placed on any point of the conclusions until the whole of the report has been read, as other sections of the report may put into context the information contained herein.

- The ground investigation confirmed the underlying soils to comprise a shallow thickness of made ground, overlying clays and, in turn, sands of the River Terrace Deposits and the London Clay Formation deposits.
- Groundwater was recorded within boreholes WS1 and WS2 at depths of 1.4m and 1.5m below ground level.
- Precautions against shrinkage and heave for any new foundation system should assume a medium volume change potential for the fine grained River Terrace Deposits and take into account current guidance such as that given by the Building Research Establishment (BRE) or the National House Builders Council (NHBC). The sand soils of the River Terrace Deposits may be considered to be non-plastic and hence non-shrinkable.
- A net allowable bearing capacity of 100kN/m² may be assumed for the construction of spread (pad or strip) foundations up to 1.0m across bearing within the firm to stiff clays and loose to medium dense sands of the River Terrace Deposits.
- Excavations beneath the water table, and particularly within coarse grained soils, will require active groundwater control to maintain adequately dry working conditions and excavation stability. For excavations made above the water table it is expected that ingress of perched water, if any, or surface run off should be adequately managed by pumping from sumps or natural drainage.
- All unsupported excavations within River Terrace Deposits should be assumed to be subject to short term instability. Where stable excavations are required they should be suitably supported or side slopes battered back to a safe angle of repose.
- A DS-1 Design Sulfate Class and an AC-1 ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground.
- In view of the presence of soils of up to medium volume change potential, it is recommended that ground floors be suspended for all sensitive structures. Ground bearing floors may be considered where the conditions outlined in this report are met.

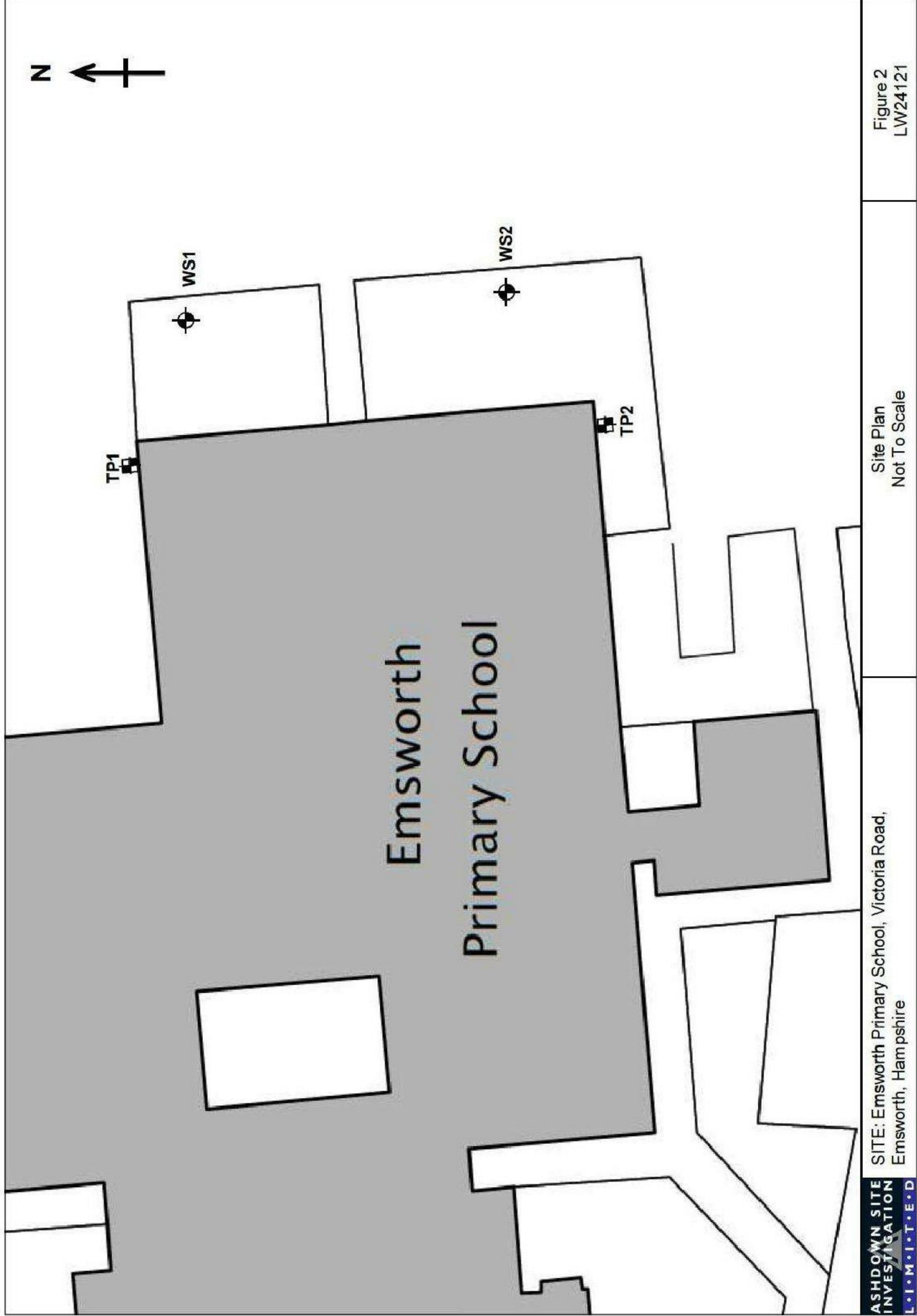
Ashdown Site Investigation Limited
June 2013

FIGURES

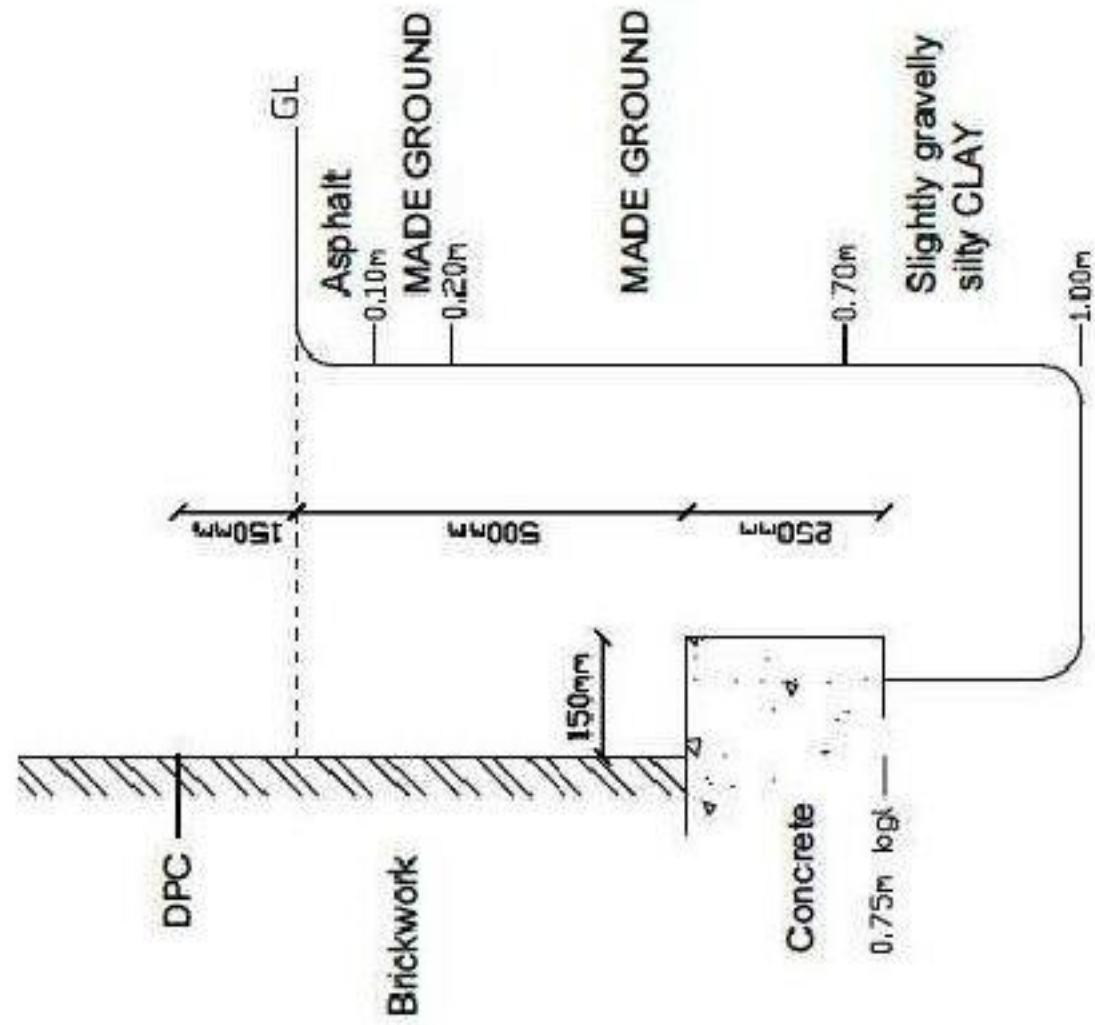
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|----------|--------------------|
| Figure 1 | Site Location Plan |
| Figure 2 | Site Plan |
| Figure 3 | Foundation Details |



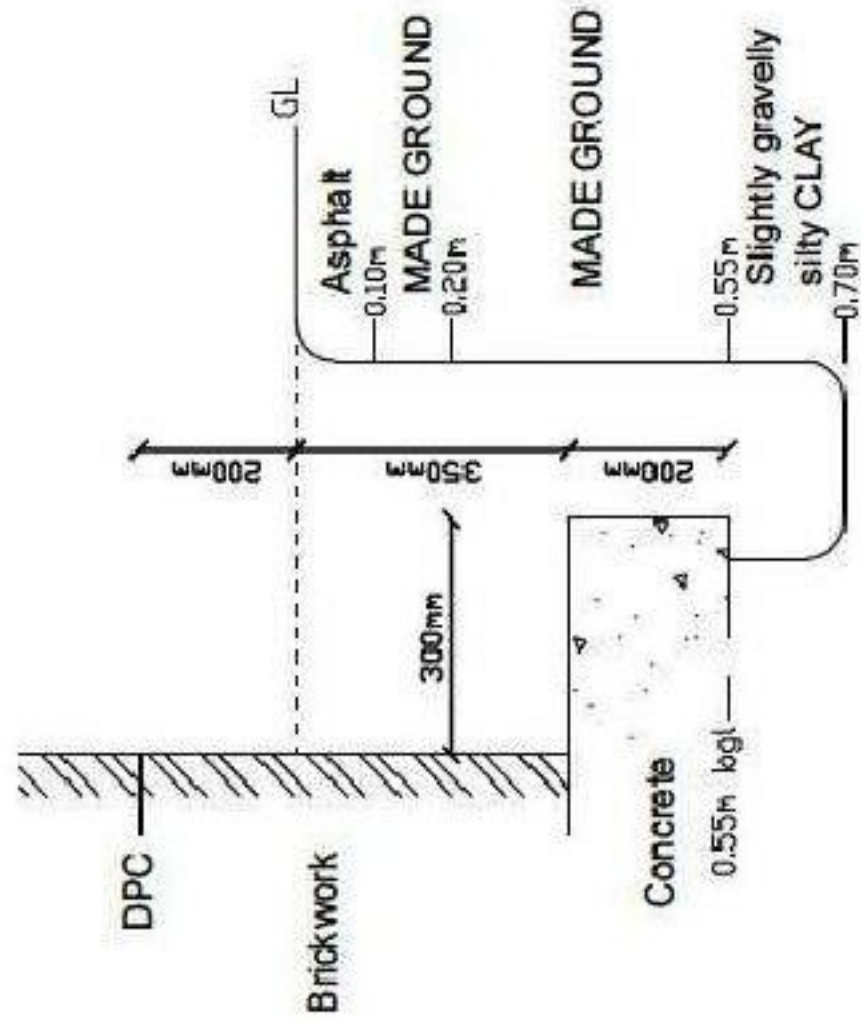
© OpenStreetMap contributors, CC BY-SA



TP1



TP2



ASHDOWN SITE INVESTIGATION LIMITED			The Old Dairy, Swanborough Farm, Swanborough, Lewes, East Sussex BN7 3PF Tel: 01273 483119 Fax: 01273 483104 email: contact@ashdownsi.co.uk	
DRAWN BY: TSH	DATE: May 2013	SCALE (at A4) 1:20		
SITE Emsworth Primary School Victoria Road Emsworth Hampshire				
REPORT REF.: LW24121		FIGURE NO.: 3		
DRAWING TITLE: Foundation Details				

APPENDIX A

Exploratory Hole Notes

In Situ Testing Notes

Exploratory Hole Records

DPSH Continuous Dynamic Probe Records

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U	'Undisturbed' Sample: - also known as 'U100' or 'U4' - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo	Sample not obtained.
U*	Full penetration of sample not obtained.
U**	Full penetration obtained but limited sample recovered.
Pi	Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D	Disturbed Sample.
R	Root Sample.
B	Bulk Disturbed Sample.
W	Water Sample.
J	Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T	Tub Sample
E	Environmental Suite (including a jar sample, tub sample and vial sample)

In situ Testing

S	Standard penetration test (SPT): In the borehole record the depth of the test is that at the start of the normal 450mm penetration, the number of blows to achieve the standard penetration of 300mm (the 'N' value) is shown after the test index letter, but the seating blows through the initial 150mm penetration are not reported unless the full penetration of 450mm cannot be achieved. In the latter case, the symbols below are added to the test index letter:-
S(R)	Refusal of standard penetration test. Blow count reported includes seating blows. Total penetration of refused SPT reported in mm in brackets on borehole record.
So	'Split spoon' SPT sampler sank under its own weight. The test is usually completed when the number of blows reaches 50 (25 blows for seating count). The depths of both the top and bottom of the test drive are shown in the sample column on the Borehole Record. If a sample is not recovered in the sampler, a disturbed sample is taken over the depth of the test as boring continues.
C	Standard Penetration Test (SPT) conducted usually in coarse grained soils or weak rocks using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone fitted in place of the sampler. Variations in test results are indicated by the same symbols as for the SPT (above).
V	Shear Vane Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.
H	Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.
P	Perth Penetrometer Test: See Insitu Testing Notes in Appendix C for full description. Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column. In sand the number of blows is approximately equivalent to the SPT "N" value.

2 **Soil Description**

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002) and Part 2 Principles of classification (BS EN 14688-2:2004).

Fine Grained Soils

The consistency of fine grained soils given in the report is based on visual inspection of the samples and the strength is based on results of in situ and/or laboratory undrained shear strength tests when carried out.

The consistency is determined on the following basis:

Consistency	Manual Test
Very Soft	Soil exudes between fingers when squeezed in hand
Soft	Soils can be moulded by light finger pressure
Firm	Cannot be moulded by finger but rolled to 3mm threads without breaking/crumbling
Stiff	Crumbles/breaks when rolled to 3mm thick threads but can be moulded into a lump again
Very Stiff	Cannot be moulded and crumbles under pressure, can be indented by thumbnail

Based on BS EN ISO 14688-1:2002

The terms used for the designation of the undrained shear strength are as follows:

Undrained Shear Strength	
Extremely to Very Low	<20 kPa
Low	20-40 kPa
Medium	40-75 kPa
High	75-150 kPa
Very High	150-300 kPa
Extremely high	300-600 kPa

Based on BS EN ISO 14688-2:2004

Note: The undrained shear strength of the soils is measured either by laboratory testing or in the field using hand penetrometer or shear vane.

It is recognised that any coarse grained soil that has in excess of approximately 35% fine grained soil (clay and silt) can often be expected to behave as a fine grained soil despite the dominance of coarse grained material within the soil mass. To reflect this, it is the soil type that dominates the behaviour of the soil mass that appears on the exploratory hole records.

Coarse Grained Soils

The relative densities of coarse grained soils (sand and gravel) given in the report are based on field estimations and the results of the Standard Penetration Test (SPT) and equivalent correlation from other testing. The classification in terms of "N" Values is as follows:

SPT 'N' Value	Relative Density
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Greater than 50	Very Dense

3 **Rock Description**

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003).

The description of rock mass includes the type of rock, structure, discontinuities and weathering.

The unconfined compressive strength of rock material is determined on the following basis:

Term	Field Identification	Unconfined Compressive Strength (MPa)
Extremely Weak	Indented by thumbnail	Less than 1
Very Weak	Crumbles under firm blows with point of geological hammer, peeled by pocket knife	1 to 5
Weak	Peeled by pocket knife with difficulty, shallow indentations made by firm blow with geological hammer	5 to 25
Medium Strong	Cannot be peeled or scraped with knife, can be fractured with single firm blow of geological hammer	25 to 50
Strong	Requires more than one blow of geological hammer to fracture	50 to 100
Very Strong	Requires many blows of geological hammer to fracture it	100 to 250
Extremely Strong	Can only be chipped with geological hammer	Greater than 250

The terms describing discontinuity and bedding spacing are as follows:

Bedding Thickness

Very Thick	>2000mm
Thick	2000-600mm
Medium	600-200mm
Thin	200-60mm
Very Thin	60-20mm
Thickly Laminated	20-6mm
Thinly Laminated	<6mm

Discontinuity Spacing

Very Wide	>2000mm
Wide	2000-600mm
Medium	600-200mm
Close	200-60mm
Very Close	60-20mm
Extremely Close	<20mm

Chalk

Chalk description is based on BS EN ISO 14688 and BS EN ISO 14689. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.

IN-SITU TESTING NOTES

1 Standard Penetration Testing

Standard penetration testing (SPT) is carried out within a cased cable percussion borehole. The test is performed using either a split spoon (barrel) sampler in finer grained deposits, or, in coarser grained soils or weak rocks, using a 50mm diameter, 60° apex solid cone fitted in place of the sampler.

The sampler is driven into the deposits at the base of the borehole by means of a 63.5kg hammer falling freely through 760mm.

In the borehole record the depth of the test is that at the start of the normal 450mm penetration, the number of blows to achieve the standard penetration of 300mm (the "N" value) is shown after the test index letter, but the seating blows through the initial 150mm penetration are not reported unless the full penetration of 450mm cannot be achieved.

(BS EN ISO 22476-3:2005, Geotechnical investigation and testing – Field Testing, Part 3)

2 Dynamic Probe Testing

The DPH (heavy) dynamic probing rig drives a 32mm diameter rod with a 15cm² area, 90° end cone into the ground by means of a 50kg hammer which falls freely through a distance of 0.5m. The number of blows per 100mm penetration (N_{100}) is recorded.

The DPSH (super heavy) dynamic probing rig drives a 35mm diameter rod with a 20cm² area, 90° end cone into the ground by means of a 63.5kg hammer that falls freely through a distance of 0.75m. The number of blows per 100mm penetration (N_{100}) is recorded. The results can provide a useful indication of the relative strength of the material. The dynamic probing is carried out in accordance with BS EN ISO 22476-2:2005.

A tentative correlation with the Standard Penetration Test (SPT) N value can be made summing three consecutive the N_{100} blow counts.

3 Perth Penetrometer Test

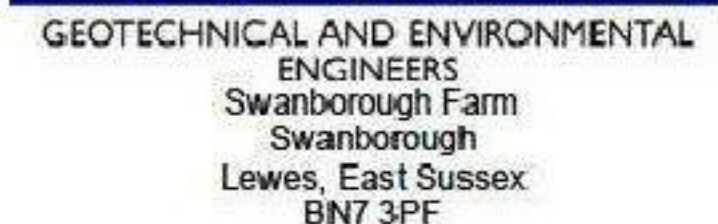
In this test a hardened stainless steel rod is driven into the deposit by a 9.5kg sliding hammer falling freely through 600mm. After an initial penetration of 150mm the number of blows required to drive the rod a further 300mm is recorded. In sand the Perth blow count gives a close correlation to the "N-value" that could be expected from a standard penetration test (SPT) made in similar materials. The results are less reliable in coarser grained materials but can give an indication of their engineering properties. The perth penetrometer test is carried out in accordance with the Australian Standard AS 1289:6.3.3-1997, Method of Testing Soils for Engineering Purposes, there is no European equivalent code.

4 Undrained Shear Strength

Undrained shear strength determinations are made in situ within the fine grained soils using a Geonor hand shear vane or (usually in the case of window sampler boreholes) a hand penetrometer. The test records the undrained shear strength (cohesion) in kN/m². The shear vane records a maximum shear strength of 130kN/m² and the hand penetrometer records a maximum shear strength of 250kN/m².

3 California Bearing Ratio Test

In this test a hand held Farnell cone penetrometer apparatus is pushed into the deposits for the estimation of the California bearing ratio of the subgrade (for use in pavement design). The test equipment is design for the estimation of the bearing ratio of fine grained soils (clay and silt) only and is unsuitable for use in coarse grained soils and rock.



End Date: 28/05/2013

Made By: DC

Borehole No.: WS1

Site Name: Emsworth Primary School, Victoria Road, Emsworth, Hampshire

Job No.: LW24121

Start Date: 28/05/2013

End Date: 28/05/2013

Standpipe Installation	Samples and Testing					Strata		
	Sample Type	Depths		Vane/ Pen Test N Value	DPSH Profile Blows/100mm 5 , 15 , 25	Legend	Depth / Reduced Level	Strata Descriptions
		From (m)	To (m)					
							6.00	Very stiff/ hard blue grey CLAY/ MUDSTONE. (London Clay Formation) no sample recovery below 5.0m depth.
								End of Borehole

Remarks:

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: DC

Borehole No.: WS2

Site Name: Emsworth Primary School, Victoria Road, Emsworth, Hampshire

Job No.: LW24121

Start Date: 28/05/2013

End Date: 28/05/2013

Standpipe Installation	Samples and Testing					Strata		
	Sample Type	Depths		Vane/ Pen Test N Value	DPSH Profile Blows/100mm 5, 15, 25	Legend	Depth / Reduced Level	Strata Descriptions
		From (m)	To (m)					
							0.00	Ground Level
							0.15	Asphalt.
	J T	0.20					0.30	MADE GROUND: Grey brown and orange mottled sandy clayey fine to coarse gravel of flint, brick and concrete.
	J T H	0.40		90				Firm to stiff orange brown and grey mottled gravelly silty CLAY. Gravel is fine to coarse flint and ironstone. (River Terrace Deposits)
	D	0.50						becoming very gravelly between 0.8m and 1.0m depth.
	H	0.70		60				becoming sandy below 1.0m depth.
	J T H	1.00		90				becoming very sandy below 1.2m depth.
	H	1.20		90			1.30	Loose orange brown and grey mottled gravelly clayey fine to coarse SAND. Gravel is fine to coarse flint. (River Terrace Deposits)
	D	1.50						becoming loose to medium dense below 1.6m depth.
	H	1.90		90				
								becoming medium dense below 2.4m depth.
	D	2.50						
	D	3.50						becoming brown grey sandy CLAY below 3.5m depth.
	D	3.80					3.80	becoming very gravelly with a trace of chalk towards base.
	H	4.00		115				Very stiff blue grey silty CLAY. (London Clay Formation)
	D	4.80						
	H	5.00		115				

Remarks:

Groundwater encountered between 2.0m and 3.0m depth. Standing water level at 1.5m on completion of borehole.

Borehole unstable in coarse grained deposits. Borehole collapsed to 1.7m depth on completion.

Dynamic probe carried out adjacent to borehole.

Excavation Method: Dynamic Sampler

Borehole Diameter: Various

Made By: DC