

CHURCHILL RETIREMENT LIVING LIMITED

**LAND AT ELM GROVE, HAYLING ISLAND
HAMPSHIRE
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GROUND INVESTIGATION REPORT

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1. INTRODUCTION

Churchill Retirement Living Limited proposes to redevelop land at 104 to 112 Elm Grove, Hayling Island, Hampshire. The site currently includes a furniture store, Pullingers, together with ancillary small businesses. The proposed development is understood to comprise a two- to three-storey block of apartments together with associated car parking and managed soft landscaped amenity areas. Occupants of these apartments will be of retirement age. Also included in the proposed development is a retail property, with a residential flat above and with hard-surfaced parking and access areas (it is noted that there is no soft landscaping or private garden in this section of the development).

A Desk Study Appraisal for the site was produced by Crossfield Consulting Limited in October 2014 (CCL02592.BV78) to which reference should be made.

Crossfield Consulting Limited has been commissioned to undertake an investigation of the site to identify potential constraints to redevelopment relating to the ground conditions and including a risk-based environmental assessment and recommendations for remediation works, foundations, road pavement design and general construction advice in the context of the above development proposals.

This report presents the information obtained from a desk study and ground investigation. Sections 2 to 5 of the report, together with the associated Figures and Appendices, provides a Ground Investigation Report (GIR), as defined in BS EN 1997-1:2004 and BS EN 1997-2:2007.

A risk-based assessment of potential contamination is included in Section 7 of the report. This assessment makes reference to the desk study, ground investigation information and a Conceptual Site Model. It is considered that the report complies with National Planning Policy Framework and is in general accordance with guidance published by the Environment Agency, Havant Borough Council and the NHBC.

The report also includes information required to form a Geotechnical Design Report as defined in BS EN 1997-1:2004, and the salient information, assessments and recommendations are presented in Sections 8 to 15 of the report, together with the associated Figures and Appendices.

It is considered that the report is suitable for submission in support of a planning application and the report is appropriate to assist in an appraisal of development solutions and costs, together with the preparation of engineering designs for the development. The report also complies with the published guidance relating to the requirements of a Building Control authority.

2. THE SITE

2.1 Location

The site is located on the east side of Elm Grove and is approximately 800 m to the northeast of the centre of West Town and the sea front, as shown on Figure 1. The National Grid Reference for the site is SZ 722 997.

The site is located between Elm Grove and an area of allotments, which border the site to the east. To the south of the site are shops and the rear of residential properties; to the north are additional shops and a bowling green with clubhouse, as shown on Figure 2.

2.2 Site Description

The following site description is based on observations made at the time of the ground investigation on 22 October 2014.

The site comprises a roughly rectangular plot of land with a size of approximately 0.35 ha. The site is relatively flat, at approximately 6 m OD, commensurate with adjoining areas. The northwestern section of the site includes a furniture store and warehouse. The eastern third of the site includes a storage yard for construction materials, and a number of steel containers are used for materials storage. Offices associated with the builder's yard are located on the southern side of the site. The remainder of the site is tarmac surfaced and used for car parking. It is understood that the site is not associated with fuel storage.

A hedge with some trees forms the eastern boundary and also extends along part of the northern site boundary.

2.3 Site History

A detailed site history is provided in the Desk Study Appraisal. In summary, the site was largely undeveloped from the late 1800s to early 1900s, with the exception of a small residential property in northwestern corner. The only other developments to have taken place on the site are the construction of a tennis court, which was subsequently demolished and replaced by the present day furniture store building. The surrounding area has remained largely residential throughout this time.

3. PUBLISHED GEOLOGY

With reference to the 1:50,000 scale solid and drift geology map of Portsmouth (Sheet 331) and associated digital map data published by the British Geological Survey (BGS), superficial deposits are indicated to comprise variable River Terrace/Brickearth deposits.

The solid strata recorded in the vicinity comprise Eocene strata of the London Clay Formation. These strata generally comprise stiff clays, although can also include minor sand horizons.

4. DESK STUDY ENQUIRIES

Detailed desk study information is presented in the Desk Study Appraisal and relevant details are outlined below.

There are no recorded operational or historical landfills within 250 m of the site. There are no waste handling facilities or other such sites within the same search radius.

Hydrogeological information indicates that the underlying superficial deposits are classified as a "Secondary (A)" Aquifer. The underlying solid strata are designated "unproductive" (formerly termed non-aquifer). The site is not located within a Groundwater Source Protection Zone and there are no licenced groundwater abstractions within 750 m of the site.

With reference to borehole data obtained from the British Geological Survey for nearby locations, it is noted that variable superficial deposits are recorded in the vicinity, extending to depths of between 1.7 m and in excess of 4 m. The underlying strata are considered by the British Geological Survey to be within the London Clay Formation.

With reference to the Building Research Establishment Document *BR211 (2007) Radon: Guidance on protective measures for new buildings* indicates the site is not within an area where radon precautions are required.

5. GROUND CONDITIONS AND GEOLOGICAL MODEL

5.1 Ground Investigation

Details of the rationale and scope of the ground investigation and laboratory testing, together with exploratory hole logs, monitoring, in situ and laboratory test results, are given in Appendix I. It is noted that access for the investigation was precluded over much of the site, hence, additional works are recommended in Section 14. The investigation has identified the presence of the following, below the eastern section of the site. In view of the desk study information, it is considered that the strata are likely to extend across the remainder of the site.

5.2 Buried Foundations and Services

Buried foundations or services were not encountered during the ground investigation. However, buried foundation and services associated with the former and current buildings should be expected.

5.3 Strata Encountered

Made Ground

Beneath a thin layer of gravel surfacing, Made Ground comprising stiff consistency, brown gravelly clay with brick and porcelain fragments was recorded to a maximum depth of 0.4 m, but more typically to depth of 0.2 m. It is possible that deeper Made Ground is present within the central/western sections of the site.

River Terrace/Brickearth Deposits

Beneath the Made Ground, variable River Terrace/Brickearth Deposits were recorded to a depth ranging from 3.0 m to 4.0 m. These strata typically comprise stiff consistency clays, but include low strength, soft to firm and locally soft consistency strata. Beneath the clays in all of the exploratory holes, a horizon of loose, orangish brown, gravelly sand, approximately 0.5 m to 1.7 m thick, was recorded at a depth ranging from 2.3 m to 2.5 m.

SPT 'N' values within the Brickearth Deposits range from 2 to 22 blows, but more typically range from 6 to 15 blows.

London Clay Formation

Beneath the River Terrace/Brickearth Deposits, strata of the London Clay Formation were recorded to a depth of 5.0 m, the maximum depth of the investigation. These strata typically comprise firm becoming stiff consistency, medium strength, grey, silty clay, which become high strength below approximately 5.0 m.

5.4 Groundwater

Groundwater was encountered during the fieldwork period at approximately 2.3 m depth.

The groundwater conditions are based on observations made at the time of the fieldwork. It should be noted that groundwater levels may vary due to seasonal and other effects.

6. PROPOSED DEVELOPMENT

The proposed development, which is shown in Figure 3, includes the following:

- A two- to three-storey block of sheltered accommodation
- Areas of car parking
- Areas of managed soft landscaping
- A separate two-storey retail and residential property with hard-surfaced parking and access area

7. ASSESSMENT OF POTENTIAL CONTAMINATION AND GROUND GASES

7.1 Assessment Criteria

Assessment of potential contamination and ground gases has been undertaken using a risk assessment based approach, as recommended within the Environmental Protection Act (1990), CLR11 (2004) CLEA Model (2004-2009), BS 10175 (2011), CIRIA C552 (2001) and NHBC R&D Report 66 (2008). This approach considers the likely source of contamination, given the history and location of the site, and the possible migration pathways by which these potentially hazardous substances may reach likely receptors, such as end users of the site, controlled waters or the wider environment, in the context of the proposed development.

Part IIA of the Environmental Protection Act (1990) states that

“Contaminated Land is any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- (a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) pollution of controlled waters is being, or is likely to be caused;”

All risk assessments carried out as part of this investigation have been carried out with respect to the definition of “contaminated land” within Part IIA of the Environmental Protection Act (1990) and have considered the site both before and on completion of the development. The basis of the risk assessment is the Conceptual Site Model, which is derived from the desk study and initial information and identifies potential pollutant linkages that could affect receptors relevant to the site and the wider environment. The Conceptual Site Model is presented in Table 1.

Based on the model, a ground investigation was designed to obtain relevant information to assess further the identified pollutant linkages. Where relevant this included the recovery of representative samples and subsequent analytical laboratory testing. The rationale for the sampling and testing is set out in Appendix I. The results of the analytical testing are presented in Appendix I and summarised in Table 2. On the basis of the conceptual site model and the results of the analytical laboratory testing, an assessment of the identified pollutant linkages is presented in Table 3.

Due to significant access restrictions, the present ground investigation was constrained. Hence, additional investigation and risk assessment will be required in due course and prior to development, as outlined in Section 14.

7.2 Potential Sources of Contamination

The site has not been associated with past industrial or waste disposal activities. However, the eastern section of the site has included a builder's yard, and this may have been operational since the early 1960s. Such facilities are seldom associated with significantly contaminated ground conditions. The remainder of the site is used for retail operations and car parking on hard-surfaced areas. The potential for such operations to have impacted soils below the site is minimal. Historically, the site included a small residential property and farmland. These developments should not have introduced significant contamination to the site.

There is no evidence of any potential off-site sources of contamination that are likely to have an influence on the site.

Ground conditions at the site comprise a limited thickness of Made Ground overlying natural strata. It is noted that there was no visual or olfactory evidence of potentially contaminating material within the underlying strata.

The current buildings within the site appear to have been constructed in the 1960s/70s and could include asbestos containing construction materials. In compliance with statutory requirements, it will be necessary to carry out a survey for such potential asbestos containing materials within the buildings at the site, prior to any demolition works.

Based on the above information, appropriate and representative soil samples were recovered from the site and tested for potential contaminants. The test data have been summarised in Table 2 and are presented against generic assessment criteria (GAC) relating to the protection of human health within a residential setting. As can be seen from the summarised data, the majority of test result show concentrations of potential contaminants that are below the GAC and, therefore, do not represent an unacceptable level of risk to human health. However, locally, elevated levels of lead have been identified at concentrations above the GAC. These elevated concentrations of potential contaminants may represent an increased level of risk to end users of the proposed development and further consideration of that risk is presented in Section 7.3.1.

The possible risks to buried construction materials are discussed in Section 7.3.2.

Low concentrations of lead have been recorded within the shallow soils at the site. The risks to controlled waters are discussed in Section 7.3.3.

Based on available information, there is no evidence that elevated concentrations of the phytotoxic metals are present within the shallow soils. It is also noted that imported topsoil is necessary to provide a growing medium. Therefore, it is considered that the potential risk to plantings within proposed landscaped areas is negligible and no further consideration is given.

No putrescible materials have been identified at the site and there are no recorded active landfills within influencing distance. The site is not within an area where precautions against the ingress of radon gas are required in new buildings. Therefore, it is considered that there are no sources of hazardous ground gases at the site and ground gas protection is not required for the proposed development.

7.3 Pollutant Linkages – Solids and Liquids

Based on the Conceptual Site Model, consideration is given below to identified pollutant linkages and a risk evaluation is undertaken of each possible source-pathway-receptor linkage that may occur at the site. The risk evaluation considers the potential consequences and probability of occurrence in accordance with CIRIA C552 (2001). Where risks are identified as "negligible", then by implication such risks are within normally accepted levels for the proposed development, and the further reduction of such risks by remediation works

is considered unnecessary. Where risks are identified that are “low” as defined in CIRIA C552 (2001), or worse, then consideration is given to the management of the identified risks, with appropriate recommended actions that may include engineering solutions / remediation works as described in the following sections.

7.3.1 Human Health

A possible pollutant linkage to site end users through dermal contact, ingestion and inhalation of material impacted by the toxic metal, lead, within the soil has been identified. Locally, the recorded concentrations of lead are above the Generic Assessment Criteria (GAC) for a residential end use.

With respect to end users, the large area of the site that will be covered by the building footprint and hard-surfaced car parking will ensure that there are effective barriers between end users and the existing ground across following development. However, some small managed landscaping areas are proposed. Within these locations, there are potential exposure pathways following development. Within landscaping areas, direct dermal contact will not be applicable as site users will have no right to dig within the areas. However, root activity and earth worm activity could mix the existing ground with topsoil materials, thereby returning impact soils to the surface, if limited thicknesses of topsoil are placed. It is considered that, based on a preliminary assessment, the potential pollutant linkage represents a low risk to end users.

It is noted that the GAC used for the preliminary assessment of human health risk are based on end users up to the age of 6 years old. The proposed development is for residents of retirement age and the GAC are considered to be conservative for the proposed development. Therefore, for those potential contaminants where recorded concentrations exceed the GAC, site specific assessment criteria (SSAC) have been generated for the proposed development. The CLEA Model v1.06 software has been used to generate the SSAC. Details of the models used and the outputs obtained are presented in Appendix II.

On the basis of the SSAC, it is evident that the concentrations of lead present at the site are below the SSAC. Therefore, it is considered that, given site-specific and development-specific conditions, the risks to end users are negligible and, based on CIRIA C552 (2001), are acceptable. On this basis, and with respect to future residents, no remedial works are required to protect end-users of the site from potential contaminants in the near-surface soils.

Landscaping contractors employed to manage the landscaping areas should only be involved in works to maintain decorative landscaping and some replanting works involving digging into topsoil materials. Therefore, it is considered that there should be no unacceptable risks to this site user group following completion of the development.

Groundworkers involved in the construction of the new development may be exposed to the potential contaminants identified above. However, it is extremely unlikely that concentrations of lead would be sufficiently high to exceed short-term exposure limits. Notwithstanding this, it is recommended that appropriate personal protective equipment (PPE) be worn and high level of personal hygiene be maintained by groundworkers. To minimise soils at the site becoming airborne and moving beyond the site boundaries during earth moving works, it is recommended that appropriate soil dampening equipment be maintained on site during dry periods to minimise dust generation.

6.3.2 Durability of Buried Structures and Services

In view of the soluble sulphate contents measured, based on guidance within BRE Special Digest 1 (2005), the specified DC Class of concrete for buried structures and foundations should be suitable for an ACEC site classification of AC-1.

Based on the guidance published by UKWIR (2010) with respect to the protection of pipes for potable water supply, the site would not be considered as 'brownfield' as it has not been associated with past fuel or chemical storage. Therefore, conventional plastic materials would be appropriate for the potable water supply pipes in new developments. However, any specific requirements of the water supply company should be identified before finalising potable water supply designs.

7.3.3 Controlled Waters

The superficial deposits beneath the site are classified as a 'Secondary A' aquifer and the solid strata are classified as 'unproductive'. The property is not situated within a groundwater Source Protection Zone and there are no groundwater abstractions used for potable water supply within 750 m.

Groundwater is present at a depth of approximately 2.3 m beneath the site. There is no visual or olfactory evidence of mobile contaminants within the soils beneath the site that have been inspected.

Analytical laboratory testing has identified the presence of the toxic metal, lead, within the shallow soils. Metals typically have low solubility at the recorded soil pH at the site and at standard soil temperatures. Therefore, it is considered unlikely that potential contaminants could leach from the shallow soils into the underlying groundwater. Notwithstanding this, it is considered that, following development, a significant proportion of the site will also be covered in a building or hardstanding and this will limit the availability of water infiltrating the shallow soils for leaching.

On the basis of the above, it is considered that there are no unacceptable risks to controlled waters associated with the ground conditions at the site.

7.4 Recommended Remedial Works

On the basis of the current data, it is considered unlikely that remedial works would be necessary to permit development.

Subject to additional risk assessment following the works outlined in Section 14, it would be prudent at this stage to include a Provisional Allowance for the placement of capping soils/barrier within areas of proposed managed soft landscaping. Typically, such capping soils would be up to 600 mm thick.

7.7 Potential Liabilities

On the basis of the above, it is considered that ownership and development of the site should not present a significant risk of harm to end users or the wider environment and retention of the materials presently at the site should not be associated with any liability following completion of the development.

8. ASSESSMENT OF MINING, QUARRYING AND OVERALL GROUND STABILITY

With reference to the desk study and ground investigation information, it is evident that the site is not located within an area of past mineral extraction, nor within an area of poor ground support related to landslip, ground dissolution or similar effects. Hence, it is considered that the proposed development should not be constrained by issues relating to poor ground support.

With reference to published information provided by the British Geological Survey, and in the context of the low sensitivity of the proposed structure to very minor background seismic events recorded in the UK, it is

considered that the foundation solution should not be constrained by potential ground vibrations from natural sources and that more detailed assessment is not necessary.

9. FOUNDATION RECOMMENDATIONS

9.1 Design Approach

In compliance with the requirements of the National Annex of BS EN 1997-1:2004 the geotechnical design assessment is based on Design Approach 1 (as defined in BS EN 1997-1:2004). As the structural loads for the proposed building are well defined, uncertainty and risks of potential unfavourable conditions (or deviations from characteristic values) are primarily associated with the ground conditions.

Consideration is given to the assessment of ultimate limit state (ULS) conditions, where full collapse or failure conditions are considered, and relevant design information is presented in Appendix III in this regard. In addition, the assessment considers serviceability limit states (SLS), to ensure that the recommended design parameters are compatible with an acceptably low risk of serviceability criteria being exceeded during the standard design life of the structure. It is noted that the SLS has a greater influence on the design parameters in comparison to ULS conditions and this is considered in the following assessment.

9.2 Proposed Structural Loadings and Serviceability Criteria

Details of imposed foundation loads (i.e. actions imposed by the building structure) and serviceability limit values are not currently available for the proposed structures. The geotechnical assessment presented in the report has considered generic values for the proposed development type, which is considered appropriate for the appraisal of engineering solutions and preliminary design, and these are listed below:

Preliminary Values, for appraisal purposes:

- Maximum Imposed Load on Foundations: 190 kN/m run

Serviceability Limit Values (associated with above action)

- Maximum Total Settlement: 25 mm
- Maximum Deflection: 1/1000

If structural loadings or serviceability criteria for the proposed structure differ significantly from the values presented above, further assessment will be required.

9.3 Geotechnical Category of Proposed Structures

In view of the nature of the proposed structure, and with reference to the indicated ground conditions, as outlined in Section 5, it is considered that the development is compatible with Geotechnical Category 2, as defined in BS EN 1997-1:2004, and the necessary information relating to the Ground Investigation and Geotechnical Design Reports has been obtained and assessed on this basis.

9.4 Assessment of Foundation Solutions

With reference to the recorded ground conditions and corresponding Geological Model presented in Section 5, characteristic values relating to the geotechnical properties of the strata within influencing distance

of the proposed structures are presented in Appendix III. Salient elements of the geotechnical model are outlined below.

Ground conditions at the site comprise a limited thickness of Made Ground overlying variable River Terrace and Brickearth Deposits. These strata generally comprise firm to stiff consistency becoming soft to firm consistency, silty, slightly gravelly clay, with horizons of loose sand and very gravelly sand. The underlying solid strata comprise firm to stiff consistency, becoming stiff consistency, silty clay of the London Clay Formation. Groundwater was recorded between a depth of 2.3 m and 2.5 m.

Due to the variability of the shallow strata, including low strength soils, conventional shallow strip footings are considered unsuitable to support the proposed structure. It is considered that the use of vibro-replacement ground treatment (installation of stone columns), in conjunction with shallow reinforced strip footings, should provide a suitable foundation solution, with treatment extending in to the London Clay Formation strata. Alternatives to vibro-replacement ground treatment would be the use of VCCs or a piled foundation solution.

9.5 Recommended Foundation Designs

Subject to the works outlined in Section 14, preliminary designs may be based on the following and the details are presented in Appendix III.

9.5.1 Vibro-Replacement Ground Treatment

It is considered that vibro-replacement ground treatment, in conjunction with shallow reinforced strip footings, should provide the most appropriate foundation solution for the proposed structure. Consideration may be given to the following:

Foundation Strata :	Soft to firm consistency, low to medium strength, silty, slightly gravelly clay (treated by vibro ground treatment) and likely to extend to depths of 4.0 m to 5.0 m. (River Terrace/Brickearth Deposits)
Foundation Depth :	Minimum 0.9 m, deepened within influence of trees, as required.
Foundation Width/Size:	0.6 m to 2.0 m max
Nett Allowable Bearing Pressure:	Approx. 150 kN/m ² (subject to the detailed design of the vibro ground treatment)

It is considered that total settlement of foundations designed on the above basis should be less than the normal serviceability limit state for this development (i.e. total settlements of 25 mm) as outlined in the assessment presented in Appendix III.

9.5.2 Piles

As an alternative to vibro-replacement stone columns, consideration may be given to the use of VCCs or CFA piles. The piles should extend to competent strata within the underlying London Clay strata.

9.5.3 Building near Trees

Laboratory testing results indicate the shallow clayey horizons (above groundwater levels) at the site comprise "medium volume change" potential soils, as defined in NHBC Standards (2014). Within the influence zones of existing or proposed trees, suitable foundation precautions should be adopted, as outlined in NHBC Standards (2014).

9.5.4 Buried Concrete

Based on guidance published within BRE Special Digest 1 (2005), the specified DC Class of concrete for buried structures and foundations should be suitable for an ACEC site classification of AC-1.

9.6 Floor Slab Recommendations

Due to the presence of medium volume change potential soils beneath the site, allowance should be made for the use of a suspended floor slab with an under floor void of at least 250 mm, as defined by NHBC (2014).

9.7 General Construction Advice

Prior to the commencement of vibro or piling operations, it will be necessary to provide a working platform in accordance with the requirements of the Federation of Piling Specialists as outlined in Section 10.

All formations should be cleaned, and subsequently inspected by a suitably qualified engineer prior to placing concrete. Should any soft, compressible or otherwise unsuitable materials be encountered they should be removed and replaced by blinding concrete.

Excavations undertaken after completion of vibro ground treatment works should be designed and undertaken to avoid loosening or disturbing areas of completed treatment/installed columns.

Foundation concrete, or alternatively, a blinding layer of concrete, should be placed immediately after excavation and inspection in order to protect the formation against softening and disturbance.

Care should be taken to ensure that any drains encountered are carefully and satisfactorily blocked to prevent water seeping through the drains and into any excavations.

10. TEMPORARY WORKS

Conventional plant is considered appropriate for shallow excavations within the soil strata at this site. However, it should be noted that in the areas which include current and former buildings (and services), buried structures may remain. Hence, allowance should be made for the use of breaking out plant to remove such structures if encountered in excavations.

Shallow strata are anticipated to remain stable in the short term where above the level of groundwater. However, instability should be anticipated in excavations left open for extended periods of time. Support should be provided, in any excavations requiring man entry.

Damp and occasionally wet strata have been observed below approximately 1.0 m depth and groundwater was recorded at approximately 2.3 m depth. Therefore, it is unlikely that groundwater seepages should be encountered during shallow foundation excavations. However, should perched water seepages be encountered, it should be feasible to control the resultant seepages by conventional sump pumping.

If deeper excavations are required (in excess of approximately 2.0 m depth) then significant instability should be expected and support should be provided together with dewatering from sumps. For deep excavations, it may be necessary to install sheet piles that extend to the London Clay strata.

Before construction and placement of vibro-replacement ground treatment or piles can begin, a stable working platform must be designed and constructed under supervision of an appropriately qualified geotechnical specialist as required by the Federation of Piling Specialists. The working platform is required to ensure the large construction plant involved in piling operations is suitably supported at all times (as outlined in FPS:2002 and BRE BR470:2004).

11. ASSESSMENT OF SOAKAWAY DRAINAGE

The site is underlain by low permeability clay strata together with shallow groundwater. On this basis, it is considered that soakaway drainage is not viable for the proposed development and an alternative method of surface water drainage should be identified.

12. PAVEMENTS

Based on the nature of the shallow soils beneath the site, the guidance published in TRRL LR1132 and with reference to IAN 73/06, it is considered that an Estimated Design Subgrade CBR of 4 % may be used to design pavements at this site located within the River Terrace/Brickearth Deposits.

13. ASSESSMENT OF MATERIALS FOR WASTE DISPOSAL

Made Ground

It is considered that the Made Ground at the site, which largely comprises reworked natural strata with fragments of brick and porcelain, is likely to be classified as "inert" waste if removed from site. However, appropriate waste testing should be undertaken to confirm this assessment.

Natural Strata

The natural strata beneath the site (River Terrace/Brickearth Deposits) should be classified as "inert" waste if taken off site. As these materials comprise in situ natural strata, no analytical testing should be required to confirm waste classification.

14. RECOMMENDATIONS FOR SUPPLEMENTARY GROUND INVESTIGATIONS

It is recommended that allowance be made for a supplementary ground investigation following purchase of the site and demolition of the existing buildings. The investigation should comprise windowless sampling and should aim to confirm the ground conditions in the western section of the site below the current building and car park, which was inaccessible during the ground investigation. The supplementary investigation should also aim to provide further information on excavation stability and the groundwater regime beneath the site. If a piled foundation solution is proposed (or to support more detailed analysis of ground treatment), boreholes should be undertaken.

15. RECOMMENDED SUPERVISION AND MONITORING

In compliance with the requirements in BS EN 1997-1:2004 and BE EN 1997-2:2007, construction and workmanship of the engineering solutions recommended in this report shall be supervised. In particular, issues listed in Section 9.7 General Construction Advice shall be considered in the implementation of the works and design of any necessary temporary works set out in Section 10.

In relation to the foundation solution and ground floor slab recommendations in Section 9, the following supervision and monitoring is recommended.

- Verification testing may be required following vibro stone column or pile installation, subject to the specification used for the works. Reference should also be made to the requirements of NHBC Standards Chapter 4.6 regarding associated liaison and checks.
- Foundation strata will require inspection prior to casting foundation concrete, together with reinforcement placed in foundation bases.

16. SUMMARY

It is proposed to redevelop a site at Elm Grove, Hayling Island for residential and retail purposes. The site is currently occupied by furniture store, Pullingers, together with ancillary small businesses.

The proposed development comprises a two- to three-storey block of sheltered accommodation together with associated parking and areas of soft landscaping. The proposals also include a separate two-storey retail and residential property with hard-surfaced parking and access area.

Ground conditions at the site comprise a limited thickness of Made Ground over River Terrace/Brickearth Deposits. The underlying solid strata comprise the London Clay Formation. Buried foundations and services associated with the existing and former building are expected beneath the site. Groundwater was encountered at a depths ranging from approximately 2.3 m to 2.5 m.

Visual and olfactory observations of the shallow soils, together with analytical laboratory testing, indicates that there is a negligible risk to end users and the water environment associated with the ground conditions.

It is considered that the risks associated with ground gases are negligible and associated precautions to buildings should not be necessary.

On the basis of the recorded ground conditions, it is considered that vibro-replacement ground treatment in conjunction with shallow reinforced strip footings, should provide an appropriate foundation solution for the proposed structure. Piles may provide an alternative foundation solution. Due to the presence of medium volume change potential soils beneath the site, suspended floor slabs are recommended.

It is considered that soakaway drainage is not suitable for the proposed development.

It is recommended that additional investigation is undertaken when access is available throughout the site.

REFERENCES

Site Specific References

Crossfield Consulting Limited (October 2014) – *Land at Elm Grove, Hayling Island, Hampshire, PO11 9EH, Desk Study Appraisal* Report No. CCL02592.BV78

Technical References

BRE (2005) *Special Digest 1 – Concrete in aggressive ground*, CRC Ltd

BRE (2007) *BR211 – Radon: Guidance on protective measures for new buildings* BRE Press

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BSI (2007) *BS EN1997-2:2007 Eurocode 7: Geotechnical Design – Part 2: Ground Investigation and Testing* British Standards Institution

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DoE (1990) *The Environmental Protection Act* Department of The Environment HMSO
Environment Agency (2004) *Model Procedures for the Management of Land Contamination* CLR11 EA

Environment Agency (2005) *Environment Agency Guidance on Requirements for Land Contamination Reports* EA

Highways Agency (2009) *Interim Advice Note 73/06 Revision 1 – Design Guidance for Road Pavements (Draft HD25)* HA

LQM/CIEH (2009) *Generic Assessment Criteria for Human Health Risk Assessment* Land Quality Press

NHBC (2014) *Standards* National House Building Council

Terzaghi, K. and Peck, R.B. (1967) *Soil Mechanics in Engineering Practice Second Edition* John Wiley

Tomlinson, M. J (1995) *Foundation Design and Construction* Sixth Edition, Pitman

TRRL (1989) *LR1132 – The Design of Bituminous Road Pavements* Transport and Road Research Laboratory

UKWIR (2010) *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* Report Ref. No. 10/WM/03/21 UK Water Industry Research

GENERAL NOTES

1. This report is provided in the context of the stated development proposals and should not be used in a different context.
2. The accuracy of map extracts cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
3. Any borehole data from the British Geological Survey sources are included on the following basis: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation.
4. Where any data supplied by the Client or by other external sources, including previous site investigation data, have been used it has been assumed that the information is correct unless otherwise stated. No responsibility can be accepted by Crossfield Consulting Limited for inaccuracies within the data supplied by others.
5. Exploratory hole locations provided in the report are generally established by tape measurement from existing features or boundaries. Hole locations are not accurately surveyed and ground levels at these locations are not obtained unless specifically requested.
6. Any assessments made in this report are based on the ground conditions indicated by the trial pits and/or boreholes, together with the results of any field or laboratory testing undertaken and, where appropriate, other relevant site data which may have been obtained for the site. Variations in ground conditions may occur between exploratory hole locations and there may be special conditions appertaining to the site which have not been revealed by the investigation and which have not been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available.
7. The report is provided for the sole use by the Client or its assignees and is confidential to the Client's professional advisers. No responsibility whatsoever for the contents of this report will be accepted to any person other than the Client or its assignees.
8. New information, improved practices and legislation may necessitate an alteration to the report in whole, or in part, after its submission. Therefore with any change in circumstances or after the expiry of one year from the date of the report, the report should be referred to Crossfield Consulting Limited for re-assessment and, if necessary, re-appraisal.

TABLES

TABLE 1

CONCEPTUAL SITE MODEL

Potential Contaminant Source	Potential Pathway	Receptors and Assessed Pollutant Linkage
Solids <i>On Site -</i> Possible minor source of toxic heavy metals associated with ashes that may be included in Made Ground, if present. Possible minor source of petroleum residues (fuels & oils) associated with former fuel tank, if present. Possible minor source of PAHs including soot, tars, used oils associated with ashes and/or fuels and oils, if present. Possible source of sulphates in natural soils that may be deleterious to certain cement/concrete mixes. <i>Off Site -</i> No evidence of potential source likely to influence ground conditions at the site Liquids No evidence of potential source likely to influence ground conditions at the site Ground Gases Landfill Gases: No evidence of potential source Radon Gas: No significant source	Movement of Solids Potential for air-borne transportation (dust) & direct dermal contact during construction operations. Potential for mixing of imported surface soils/topsoil with underlying Made Ground such that direct dermal contact and dust emission might arise following site development (if a significant source is present). Chemical Reaction If certain cement/concrete mixes are in contact with sulphate-rich soils, and groundwater/moisture is present, chemical reactions may occur. Release into Liquid Phase Not applicable – no evidence of substances likely to be released into liquid phase. Release into Vapour Phase Not applicable – no evidence of substances likely to be released into liquid phase. Movement of Liquids Not applicable – only a very limited thickness of discontinuous permeable strata indicated below the site, such that no viable migration pathways are indicated. Movement of Gases Not applicable – no valid source	Human Health Construction workers – Possible Pollutant Linkage (during construction) Site users after development - Possible Pollutant Linkage Buried Structures & Services Concrete, bricks – Possible Pollutant Linkage (unless sulphate-resistant materials used) Clay pipes – with rubber/plastic gaskets – No Pollutant Linkage Plastic (pipes, membranes) – No Pollutant Linkage Landscape Areas No Pollutant Linkage (however, suitable topsoil for a growing medium is presently absent from the site) Ecology SSSI, bird protection areas, wetlands - No Pollutant Linkage (designated areas remote from site) Controlled Waters (Water Environment) <i>Groundwater:</i> Secondary A aquifer (in thin horizon of superficial deposits) underlain by Unproductive strata, no source protection zone – No Pollutant Linkage <i>Surface Water:</i> (no nearby water bodies) – No Pollutant Linkage Human Health (Ground Gases) No valid source or migration pathway – No Pollutant Linkage

NOTES

1. The above conceptual model is based on CIRIA C552 (2001) and BS 10175 (2011).
2. The Conceptual Site Model is prepared from available desk study information.
3. Where a pollutant linkage is identified, any subsequent ground investigation is designed to obtain relevant information to assess the pollutant linkage. See Table 3 for a summary of pollutant linkage assessments.

TABLE 2

SUMMARY OF ANALYTICAL TEST DATA: SOILS
POTENTIAL RISKS TO HUMAN HEALTH

Determinand	Units	No of Tests	Concentration		Generic Assessment Criteria (mg/kg) Residential without plant uptake		Remarks
			Min	Max	Value	No>Value	
Arsenic	mg/kg	2	8.5	9.6	35 ¹	0	
Cadmium	mg/kg	2	0.4	1.5	18 ¹	0	
Chromium (Total) ⁴	mg/kg	2	21	24	627 ¹	0	
Chromium (VI)	mg/kg	2	<4.0	<4.0	4.3 ¹	0	
Lead	mg/kg	2	180	540	240 ²	1	
Inorganic Mercury	mg/kg	2	<0.3	<0.3	235 ¹	0	
Nickel	mg/kg	2	17	17	130 ¹	0	
Selenium	mg/kg	2	<1.0	<1.0	595 ¹	0	
Copper	mg/kg	2	35	65	6200 ¹	0	
Zinc	mg/kg	2	160	270	40,400 ¹	0	
Boron	mg/kg	2	0.9	1.5	10,300 ¹	0	
Phenols	mg/kg	2	<1.0	<1.0	310 ¹	0	
pH	-	9	7.1	8.0	-	-	
Total Organic Carbon	%	2	0.1	1.0	-	-	

NOTES

- Generic Assessment Criteria (GAC) – Residential without plant uptake. Calculated using CLEA Software version 1.06 (Environment Agency, 2009) and based on toxicology and physical-chemical data published by the Environment Agency (2009) or LQM (2009). For lead, the input data have been obtained from various published sources and details are available on request. GAC assumptions comprise 1% soil organic matter, soil pH of 7 and sandy loam soil type.
- GAC for lead calculated using the formula devised by the Society of Environmental Geochemistry and Health (SEGH). Input values include
 - a target blood lead concentration of 5.6 µg/dL (ATSDR mean LOAEL for neurological disorders in children)
 - background blood lead concentration of 2.5 µg/dL based on UK and American studies that show decreases over time due to removal of leaded fuel and lead-based paints
 - δ value of 3 µg/dL per 1000 µg/g which assumes soft landscaping/gardens will be vegetated
 Further details of input parameters used are available on request
- Soil GAC for Human Health Risk Assessment produced by CL:AIRE (2010) – Residential without consumption of homegrown produce. Assumption of 1% soil organic matter.
- In the absence of desk study or historical map evidence indicating a potential source of chromium (VI) usage at or in the near vicinity of the site (and validated by laboratory test data), total chromium concentrations have been compared to the GAC for chromium (III).

TABLE 3

ASSESSMENT OF POLLUTANT LINKAGES**NOTES:**

1. Pollutant linkage validity assessed following qualitative or semi-quantitative risk assessment.
2. Pollutant linkage assessed following detailed quantitative risk assessment or assuming the recommended remediation or mitigation measures are in place

		Consequence (C)			
		Severe	Medium	Mild	Minor
	High likelihood (HL)	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely (L)	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low likelihood (LL)	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk

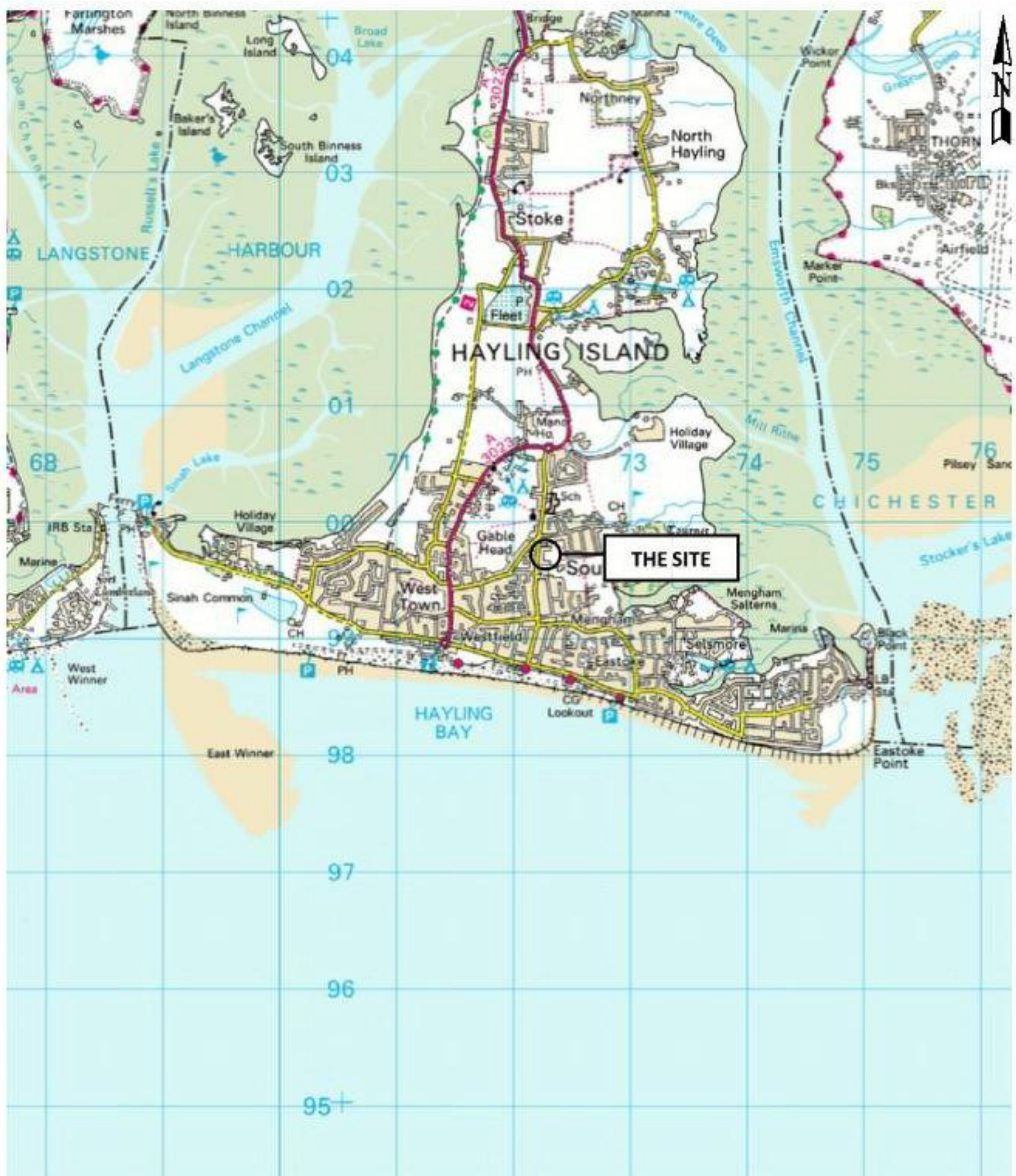
All terminology in accordance with the definitions provided in CIRIA C552 (2001)

Pollutant Linkage			Assessment of Pollutant Linkage following Ground Investigation	Pollutant Linkage Valid? ¹	Risk Rating			Quantitative Risk Assessment	Recommended Remediation/Mitigation (See Section 7 for further details)	Recommended Work Verified?	Pollutant Linkage Valid? ²
Source	Pathway	Receptor			C	P	Risk				
Toxic metals PAHs Petroleum Hydrocarbons	Ingestion (dust), Dermal (dust) Inhalation (vapours)	End Users	Lead elevated above GAC. No visual or olfactory evidence of any other potentially contaminating materials identified	Yes	Med	LL	Mod/Low	Yes, Site specific assessment criteria prepared using CLEA Model v1.06. Lead below the SSAC.	Not applicable	Not applicable	No
Toxic metals PAHs Petroleum Hydrocarbon	Dermal contact, Ingestion, Inhalation	Construction workers	All potential contaminants below concentrations considered to be a short-term (acute) risk. No further assessment required	No	n/a	n/a	n/a	Not applicable	Not applicable but standard personal protective equipment is recommended as good practice	Not applicable	No
Toxic metals PAHs Petroleum Hydrocarbon	Dermal contact (dust), Ingestion (dust)	Neighbours/general public	Lead elevated above GAC	Yes	Med	UL	Low	Not applicable	Soil dampening equipment to be used to minimise potential for airborne migration of fugitive dust from site	Not applicable	No
Phytotoxic metals	Plant uptake	Landscape plantings	Phytotoxic metals not present at concentrations considered a risk to healthy plant growth based on BS 3882:2007	No	n/a	n/a	n/a	Not applicable	Not applicable	Not applicable	No

Note: Due to significant access restrictions, the above assessment should be regarded as preliminary and reference should be made to the supplementary works recommended in Section 14.

FIGURES

FIGURE 1

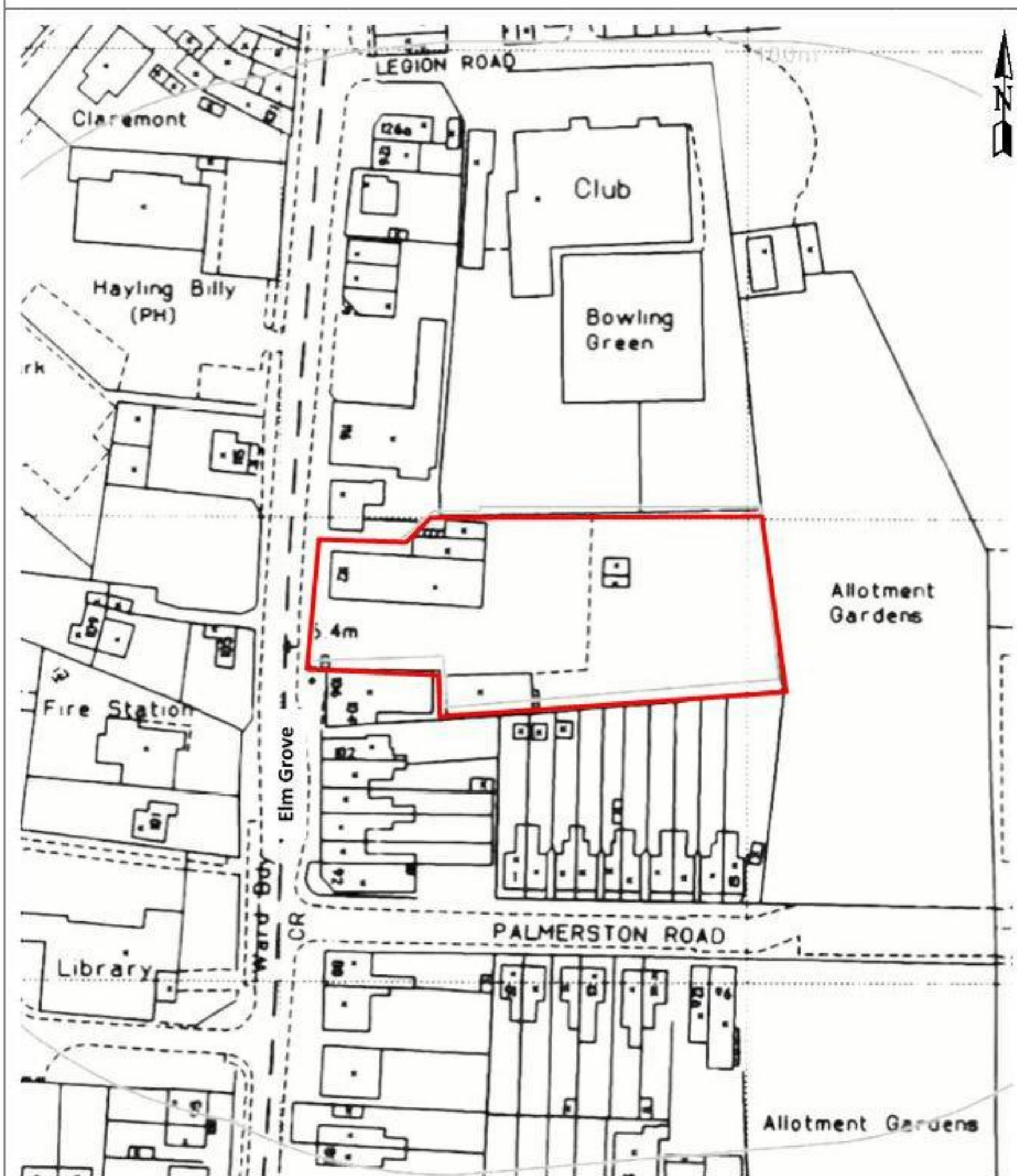


SITE LOCATION PLAN

Scale 1: 50,000

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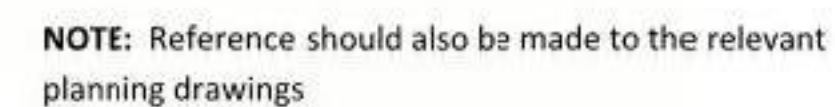
FIGURE 2



SITE PLAN

Scale 1: 1250

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Scale 1:500

Elm Grove, Hayling Island
CCL02592.BW02
November 2014

APPENDIX I

APPENDIX I – GROUND INVESTIGATION

Introduction

This Appendix together with Sections 2 to 4 of the report, forms the Ground Investigation Report for the development described in the report, in compliance with the requirements of BS 5930:1999+A2:2010, BS EN1997-1:2004(2007) and BS EN1997-2:2007(2007).

The site operations were carried out 22 October 2014 under the supervision of a geotechnical engineer from Crossfield Consulting Limited. It was not possible to undertake exploratory holes within the western and central sections of the site due to access restrictions. The scope and rationale for the design of the investigation is presented in Table I-1.

The ground investigation was designed and supervised by qualified and experienced geo-environmental specialists from Crossfield Consulting Limited. Where appropriate, and as outlined below, specialist drilling/sampling equipment was procured together with trained and experienced operators. Unless otherwise indicated, sampling and logging remained the responsibility of trained staff from Crossfield Consulting Limited and field records were prepared on site, during or immediately following drilling/sampling or in situ measurements/tests. The results of in situ tests are presented on the relevant record sheets in this Appendix. Details of any correction factors used in processing the test results are presented in the summary figures.

An exploratory hole location plan is presented as Figure I-1.

Windowless Sampling

Five windowless sampling boreholes, denoted as WS1 to WS5, were sunk by Dynamic Sampling Ltd, to between 5.0 m and 6.5 m depth. Dynamic/driven open-tube soil sampling/boring was undertaken using a Premier Compact rig. Using a 1.0 m long thick-walled open-tube sampler (with plastic liner), Category A and B samples were recovered (sample disturbance being influenced by the specific soils encountered). Where appropriate, small disturbed sub-samples were recovered from the materials recovered in the open-tube sampler.

Standard Penetration Tests (SPT) were carried out at regular intervals to provide data on the in situ density of granular strata and an indication of strength within cohesive strata. A summary of SPT/depth data is presented in this Appendix. The SPTs were carried out in accordance with BS EN ISO 22476-3:2005(2007).

The records from the investigation are presented in this Appendix. These records include the descriptions and depths of the strata encountered, together with sample depths, in situ test results (uncorrected values), groundwater observations, details of installations/backfill within exploratory holes and other pertinent comments.

Soil Samples

All samples for analytical testing were collected in appropriate containers, stored in cool boxes (where appropriate) and sent to the testing laboratory overnight. The sample containers, storage and handling procedures were all compatible with the relevant recommendations of the UKAS accredited testing laboratory for the specific testing proposed.

Samples designated for geotechnical testing were collected, stored and transported in accordance with the published requirements for the specific tests scheduled, such that moisture content and soil structure integrity was maintained, as necessary for the test requirements.

Analytical Laboratory Testing

The rationale for the analytical testing is set out in Table I-2.

Two selected samples of the soils encountered were submitted for screening analysis of the following determinands:

- | | |
|----------------------------|------------------------------|
| • Arsenic (Total) | • Cadmium (Total) |
| • Chromium (Total) | • Copper (Total) |
| • Lead (Total) | • Mercury (Total) |
| • Nickel (Total) | • Zinc (Total) |
| • Selenium (Total) | • Boron (Water soluble) |
| • Cyanide (Total) | • Sulphide (Total) |
| • Sulphate (Water soluble) | • Phenols (Total-monohydric) |
| • pH | • Total Organic Carbon |

Note: Total determinands are based on an aqua-regia extract.

The analyses were carried out by i2 Analytical, a UKAS accredited laboratory, and the results are presented in this Appendix. Soil testing was undertaken in accordance with the Environment Agency's Monitoring Certification Scheme (MCERTS).

Geotechnical Laboratory Testing

The rationale for the geotechnical laboratory testing is set out in the Table I-3.

Selected samples of the soils encountered were submitted for analysis for the following tests:

- Moisture content
- Atterberg Limits
- pH value
- Water soluble sulphate

The analyses were carried out by i2 Analytical and GEO Site & Testing Services Limited UKAS accredited laboratories, and the results are presented in this Appendix.

RATIONALE FOR THE DESIGN OF THE GROUND INVESTIGATION

The scope of the ground investigation was designed with reference to the published geology and ground conditions indicated in the desk study information.

It is noted that access was only available to the eastern section of the site. Hence, supplementary ground investigation will be required in due course to provide data on the ground conditions in the remainder of the site, as outlined in Section 14.

In compliance with the guidance published in BS EN 1997-2:2007, the ground investigation was designed to verify the preliminary ground model, established from the desk study information and to characterise the ground conditions within influencing distance of the proposed structures. In this regard, the exploratory holes were targeted within relevant areas of the site to provide information on the strata profile down to competent materials. With reference to the desk study information and the support requirements of the proposed development, it is evident that adequate support is provided by the strata that continue below the depths of the exploratory holes.

In compliance with the guidance published in BS 10175:2011 and BS 5930:1999+A2:2010, the layout of the exploratory holes and sampling regime also considers the Conceptual Site Model and potential pollutant linkages, such that the spatial arrangement of the investigation provides the necessary information to support a risk assessment of the identified potential pollutant linkages.

Exploratory Hole and Technique	Rationale for Hole Location	Depth (m)	Sampling/In Situ Testing and Monitoring
WS1 to WS5	Within the accessible section of the site, exploratory holes were located to investigate ground conditions in the vicinity of the proposed building to obtain information for foundation design, waste classification and to inspect the Made Ground for potential contaminant issues in areas of proposed managed soft landscaping	5.0 to 6.5	Soil samples were recovered from the Made Ground and approximate foundation depth. SPTs were carried out at 1 m intervals

Key

WS X

Windowless Sample Borehole

TABLE I-2

RATIONALE FOR THE ANALYTICAL TESTING SUITE

Exploratory Hole and Samples	Selection Criteria	Analytical Tests
WS1 0.1-0.2m WS2 0.3-0.4m	To provide data in relevant areas of the site with respect to human health, controlled waters and landscaped areas	Toxic metals Phytotoxic metals

TABLE I-3

RATIONALE FOR THE GEOTECHNICAL TESTING SUITE

Exploratory Hole and Sample	Selection Criteria	Geotechnical Tests
WS1 0.9-0.9 m WS2 1.3-1.4 m WS2 2.7-2.8 m WS3 0.5-0.6 m WS3 3.7-3.8 m WS4 1.1-1.2 m WS5 0.9-1.0 m	To provide data for foundation concrete design.	pH Water soluble sulphate
WS2 1.3-1.4 m WS3 0.5-0.6 m WS3 3.7-3.8 m WS5 0.9-1.0 m	To provide data for soil classification	Moisture content Atterberg limits

WINDOWLESS SAMPLE RECORDS

KEY

Sampling

J	Disturbed Jar Sample
G	Jar Sample in Glass Container
g	Soil Sample in Glass Vial
W	Water Sample
IC	Nett sample recovery ratio (ratio of length of recovered sample to length of sample run)

In Situ Measurements

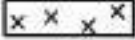
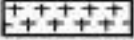
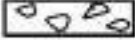
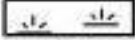
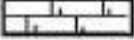
FVT	c_{fv}	Undrained Shear Strength (from hand vane shear vane test)
	c_{rv}	Undrained Remoulded Shear Strength (from hand vane shear vane test)
	c_{fv}^*	Hand Vane Shear Strength Test (on Category A: OS-TK/W soil sample recovered in window sampler)
	S	Standard Penetration Test (SPT: split spoon sampler)
	SPT(C)	SPT carried out with a 60° cone
	'N'	'N' Value from SPT test
	N_{10}	Dynamic Probe Test: Number of blows to drive 100 mm
DPH	N_{H10}	Dynamic Probe Test: Heavy (30 kg mass & 500 mm fall)
DPSH-A	N_{SHA10}	Dynamic Probe Test: Super-Heavy A (63.5 kg mass & 500 mm fall)
DPSH-B	N_{SHB10}	Dynamic Probe Test: Super-Heavy B (63.5 kg mass & 750 mm fall)
	$\frac{x}{y \text{ mm}}$	x Blows per y Driving Distance (for non-standard SPT or DP driving distance)
	T	Torque (max) required to turn rods (unit: Nm, unless otherwise shown)

Notes:

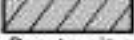
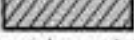
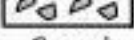
1. All measurement values on record sheets are uncorrected, unless otherwise indicated.
2. For corrected test values, refer to report.
3. Identification and classification of strata is based on the guidance published in the current edition of BS5930 together with BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and BS EN ISO 14689-1:2003
4. Consistency (soft, firm, stiff etc) relates to a manual test/inspection on site (in compliance with BS EN ISO 14688-1:2002 Section 5.14).
5. Undrained shear strength (low, medium, high etc) relates to in situ or laboratory test data and the associated assessed strength of a stratum (in compliance with BS EN ISO 14688-2:2004 Section 5.3 and Table 5).
6. The density of coarse-grained soils is based on SPT N values (or equivalent Dynamic Probe test or CPT data) as outlined in BS5930 and BS EN ISO 14688-2:2004.
7. Rock strength (weak, strong etc) is based on field identification (and/or strength test data), as outlined in BS EN ISO 14689-1:2003 Table 5.

BOREHOLE & DRILLHOLE RECORDS - LEGENDS KEY SHEET

Legend - Strata Encountered in Exploratory Hole

Soil	Rock		
	Sedimentary	Igneous	Metamorphic
 Made Ground	 Mudstone	 Fine-grained	 Fine-grained
 Clay	 Shale	 Medium-grained	 Medium-grained
 Silt	 Siltstone	 Coarse-grained	 Coarse-grained
 Sand	 Sandstone		
 Gravel	 Limestone		
 Peat/Topsoil	 Chalk		
 Organic Sand	 Coal		
 Organic Clay	 Conglomerate		

Legend - Backfill to Borehole and Standpipe Installations

Backfill	Installations
 Soil arisings	 Concrete Cover Over Standpipe
 Bentonite	 Plain Standpipe - Bentonite Surround
 Cement-based Grout	 Perforated Standpipe - Geotextile and Granular Filter Surround
 Gravel	 Perforated Standpipe End Geotextile and Granular Filter Surround

Notes:

1. A combination of the strata symbols are indicative of mixed soil types.
2. The above symbols are based on the guidance published in BS 5930:1999+A2:2010
3. The response zone of a standpipe refers to the section of perforated pipe within a granular surround, where substances may freely enter the standpipe from the surrounding strata.

Windowless Sample Record Sheet

Hole Ref. **WS1**

Project: Elm Grove, Hayling Island, Hampshire

Sheet 1 of 1

Date: 22/10/2014

Job No. CCL02592

Contractor Dynamic Sampling Ltd Equipment Premier Compact 110

Ground Level. m OD

Method 0.0 m to 5.0 m windowless sampling

Co-ordinates

Boring Diameter 100 mm

Logged by: TD Logged on site during drilling operations

Checked by: [REDACTED]

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.10	Gg				Gravel surfacing over stiff consistency brown gravelly clay. Gravel is fine to coarse subangular including brick and porcelain fragments (MADE GROUND)	0.20			
0.80-0.90	JJ				Firm to stiff consistency orangish brown silty CLAY (RIVER TERRACE/BRICEARTH DEPOSITS)				
1.00-1.45	S	1.00		N=4	...becoming soft to firm consistency below 1.0 m				
2.00-2.45	S	1.00	2.30	N=20	...angular flint cobble at 1.8 m to 1.9 m ...becoming stiff consistency below 2.0 m				
					...horizon of fine to medium angular to subangular gravel at 2.2 m to 2.3 m	2.30			
					Medium dense orangish brown SAND (RIVER TERRACE/BRICEARTH DEPOSITS)				
3.00-3.45	S	1.00	2.30	N=6	Firm consistency orangish brown CLAY (RIVER TERRACE/BRICEARTH DEPOSITS)	2.90			
					Firm to stiff consistency grey silty CLAY (LONDON CLAY FORMATION)	3.50			
4.00-4.45	S	1.00	2.30	N=8					
5.00-5.45	S	1.00	2.30	N=15	...becoming stiff consistency at 5.0 m	5.00			

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	100%	5.00	2.30		Strata wet below 1.0 m			
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	100%							
4.00-5.00	100%							

Remarks	Notes
	1. All logging and sampling in accordance with BS 5930:1999+A2:2010 2. The depths to strata change are approximate only 3. Symbols and abbreviations are explained on the accompanying key 4. All linear dimensions are in metres unless otherwise stated 5. Undrained shear strength test value given in kN/m ²

Windowless Sample Record Sheet

Hole Ref. **WS2**

Project: Elm Grove, Hayling Island, Hampshire

Sheet 1 of 1

Date: 22/10/2014

Job No. CCL02592

Contractor Dynamic Sampling Ltd Equipment Premier Compact 110

Ground Level. m OD

Method 0.0 m to 5.0 m windowless sampling

Co-ordinates

Boring Diameter 100 mm

Logged by: TD Logged on site during drilling operations

Checked by: [REDACTED]

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.30-0.40	Gg				Gravel surfacing over stiff consistency dark brown gravelly clay. Gravel is fine to medium angular to subangular including brick (MADE GROUND)	0.40			
1.00-1.45	S	1.00	-	N=2	Firm consistency orangish brown silty CLAY (RIVER TERRACE/BRICKEARTH DEPOSITS) ...becoming soft and soft to firm consistency below 1.0 m				
1.30-1.40	JJ								
2.00-2.45	S	1.00	-	N=15	...becoming firm consistency below 2.0 m	2.50			
2.70-2.80	J				Loose orangish brown slightly gravelly SAND. Gravel is fine to medium subangular (RIVER TERRACE/BRICKEARTH DEPOSITS)				
3.00-3.45	S	1.00	2.50	N=7	...horizon of fine to medium subangular gravel at 2.9 m to 3.0 m				
4.00-4.45	S	1.00	2.50	N=8		4.00			
5.00-5.45	S	1.00	2.50	N=15	Firm becoming stiff consistency grey silty CLAY (LONDON CLAY FORMATION)	5.00			
					Base of Hole				

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	100%	5.00	2.50		Strata damp below 1.0 m			
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	0%							
4.00-5.00	100%							

Remarks	Notes
	1. All logging and sampling in accordance with BS 5930:1999+A2:2010 2. The depths to strata change are approximate only 3. Symbols and abbreviations are explained on the accompanying key 4. All linear dimensions are in metres unless otherwise stated 5. Undrained shear strength test value given in kN/m ²

Windowless Sample Record Sheet

Hole Ref. **WS3**

Project: Elm Grove, Hayling Island, Hampshire

Sheet 1 of 2

Date: 22/10/2014

Job No. CCL02592

Contractor Dynamic Sampling Ltd Equipment Premier Compact 110

Ground Level. m OD

Method 0.0 m to 6.5 m windowless sampling

Co-ordinates

Boring Diameter 100 mm

Logged by: TD Logged on site during drilling operations
Checked by: [REDACTED]

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
					Gravel surfacing over fragments of red brick (MADE GROUND)	0.20			
0.50-0.60	JJ				Firm to stiff consistency light brown and orangish brown silty slightly gravelly CLAY. Gravel is fine to medium angular to subangular (RIVER TERRACE/BRICKEARTH DEPOSITS)				
1.00-1.45	S	1.00	-	N=3	...becoming soft to firm consistency below 0.8 m				
2.00-2.45	S	1.00	-	N=12	...becoming firm and firm to stiff consistency below 2.0 m				
3.00-3.45	S	1.00	2.50	N=8	Loose orangish brown SAND (RIVER TERRACE/BRICKEARTH DEPOSITS)	2.50			
					Firm consistency orangish brown CLAY (RIVER TERRACE/BRICKEARTH DEPOSITS)	3.00			
3.70-3.80	JJ				...horizon of very gravelly sand at 3.4 m to 3.5 m	3.50			
4.00-4.45	SPT(C)	1.00	2.50	N=9	Firm becoming stiff consistency grey silty CLAY (LONDON CLAY FORMATION)				
5.00-5.45	SPT(C)	1.00	2.50	N=14	Continued on Sheet 2				

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	100%	6.50	2.50		Strata wet below 1.0 m			
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	100%							
4.00-5.00	100%							

Remarks	Notes
	1. All logging and sampling in accordance with BS 5930:1999+A2:2010 2. The depths to strata change are approximate only 3. Symbols and abbreviations are explained on the accompanying key 4. All linear dimensions are in metres unless otherwise stated 5. Undrained shear strength test value given in kN/m ²

Project:	Elm Grove, Hayling Island, Hampshire
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Sheet 2 of 2

Date: 22/10/2014

Job No.	CCL02592
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Contractor	Dynamic Sampling Ltd	Equipment	Premier Compact 110
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Ground Level.	m 00
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Method	0.0 m to 6.5 m windowless sampling
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Co-ordinates

Boring Diameter	100 mm
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Logged by:	TD	Logged on site during drilling operations
Checked by:		

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
5.50-5.95	SPT(C)	1.00	2.50	N=18	Continued from Sheet 1 Firm becoming stiff consistency grey silty CLAY (LONDON CLAY FORMATION)				
6.00-6.45	SPT(C)	1.00	2.50	N=28					
6.50-6.95	SPT(C)	1.00	2.50	N=31		6.50			
					Base of Hole				

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	100%		2.50					
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	100%							
4.00-5.00	100%							

Remarks

Notes

1. All logging and sampling in accordance with BS 5930:1999+A2:2010
2. The depths to strata change are approximate only
3. Symbols and abbreviations are explained on the accompanying key
4. All linear dimensions are in metres unless otherwise stated
5. Undrained shear strength test value given in kN/m^2

Windowless Sample Record Sheet

Hole Ref. **WS4**

Project: Elm Grove, Hayling Island, Hampshire

Sheet 1 of 2

Date: 22/10/2014

Job No. CCL02592

Contractor Dynamic Sampling Ltd Equipment Premier Compact 110

Ground Level. m OD

Method 0.0 m to 5.5 m windowless sampling

Co-ordinates

Boring Diameter 100 mm

Logged by: TD Logged on site during drilling operations
Checked by:

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
1.00-1.45	S	1.00	-	N=3	Gravel surfacing over fragments of red brick (MADE GROUND)	0.20			
1.10-1.20	JJ				Firm to stiff becoming soft consistency orangish brown silty slightly gravelly CLAY. Gravel is fine to medium angular to rounded including flint (RIVER TERRACE/BRICKEARTH DEPOSITS)				
1.90-2.00	JJ				...flint cobble at 1.7 m to 1.8 m				
2.00-2.45	S	1.00	2.30	N=23					
3.00-3.45	S	1.00	2.30	N=5	Loose orangish brown very gravelly SAND. Gravel is fine to medium angular to subrounded (RIVER TERRACE/BRICKEARTH DEPOSITS)	2.30			
4.00-4.45	SPT(C)	1.00	2.30	N=7		4.00			
5.00-5.45	SPT(C)	1.00	2.30	N=7	Firm consistency grey silty CLAY (LONDON CLAY FORMATION)				

Continued on Sheet 2

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	100%		2.30		Strata wet below 1.0 m			
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	100%							
4.00-5.00	100%							

Remarks	Notes
	1. All logging and sampling in accordance with BS 5930:1999+A2:2010 2. The depths to strata change are approximate only 3. Symbols and abbreviations are explained on the accompanying key 4. All linear dimensions are in metres unless otherwise stated 5. Undrained shear strength test value given in kN/m ²

Windowless Sample Record Sheet

Hole Ref. **WS5**

Project: Elm Grove, Hayling Island, Hampshire

Sheet 1 of 1

Date: 22/10/2014

Job No. CCL02592

Contractor Dynamic Sampling Ltd Equipment Premier Compact 110

Ground Level. m OD

Method 0.0 m to 5.0 m windowless sampling

Co-ordinates

Boring Diameter 100 mm

Logged by: TD Logged on site during drilling operations
Checked by: [REDACTED]

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.90-1.00	JJ				Gravel surfacing over fragments of red brick (MADE GROUND)	0.20			
1.00-1.45	S	1.00	-	N=3	Stiff consistency becoming soft to firm consistency orangish brown silty slightly gravelly CLAY. Gravel is fine to medium angular to subangular including flint (RIVER TERRACE/BRICEARTH DEPOSITS)				
					...becoming soft consistency at 1.0 m				
2.00-2.45	S	1.00	-	N=19	...horizon of coarse angular flint gravel at 1.9 m to 1.95 m				
					...becoming gravelly at 2.0 m				
3.00-3.45	S	1.00	2.50	N=6	Loose orangish brown mottled light grey SAND (RIVER TERRACE/BRICEARTH DEPOSITS)	2.30			
					...becoming very gravelly at 2.8 m				
4.00-4.45	SPT(C)	1.00	2.50	N=6		4.00			
4.60-4.70	JJ				Firm to stiff consistency grey silty CLAY (LONDON CLAY FORMATION)				
5.00-5.43	SPT(C)	1.00	2.50	N=50 285 mm	...becoming stiff to very stiff consistency below 5.0 m	5.00			
					Base of Hole				

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	100%	5.00	2.50					
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	0%							
4.00-5.00	100%							

Remarks	Notes
	1. All logging and sampling in accordance with BS 5930:1999+A2:2010 2. The depths to strata change are approximate only 3. Symbols and abbreviations are explained on the accompanying key 4. All linear dimensions are in metres unless otherwise stated 5. Undrained shear strength test value given in kN/m ²



Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Dynamic sampling uk ltd
Unit 8.
Victory park way.
Victory road.
Derby.
DE24 8ZF

Hammer Ref: LR110.50
Test Date: 11/11/2013
Report Date:
File Name: LR110.50.spt
Test Operator: TP

Instrumented Rod Data

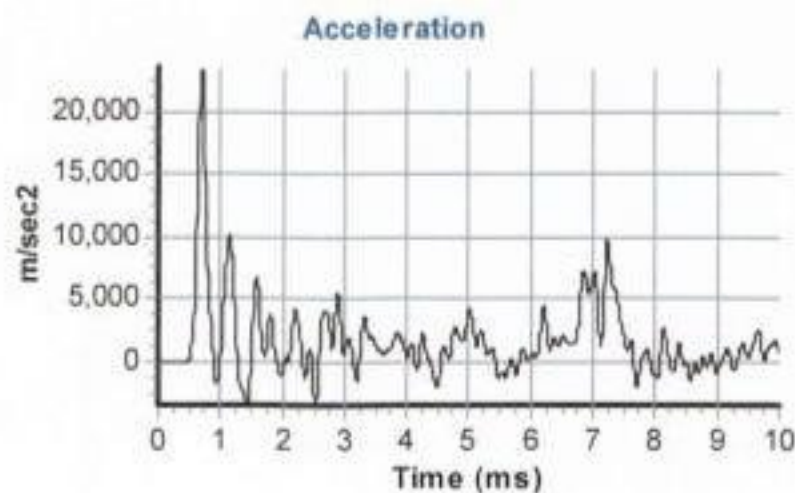
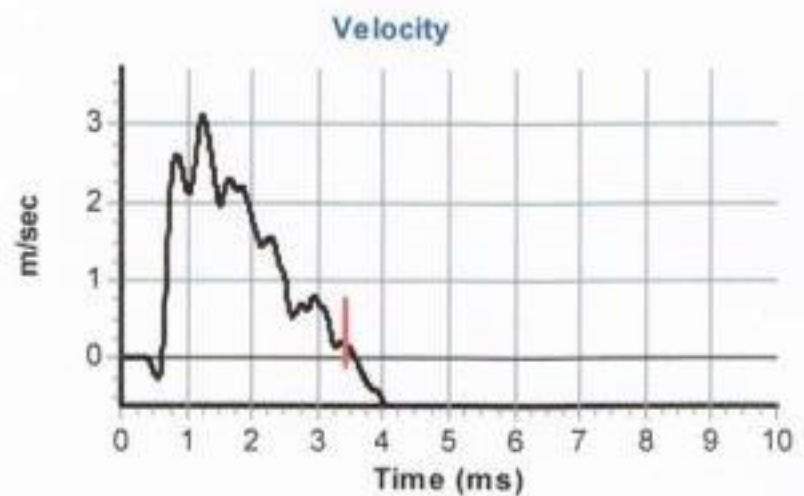
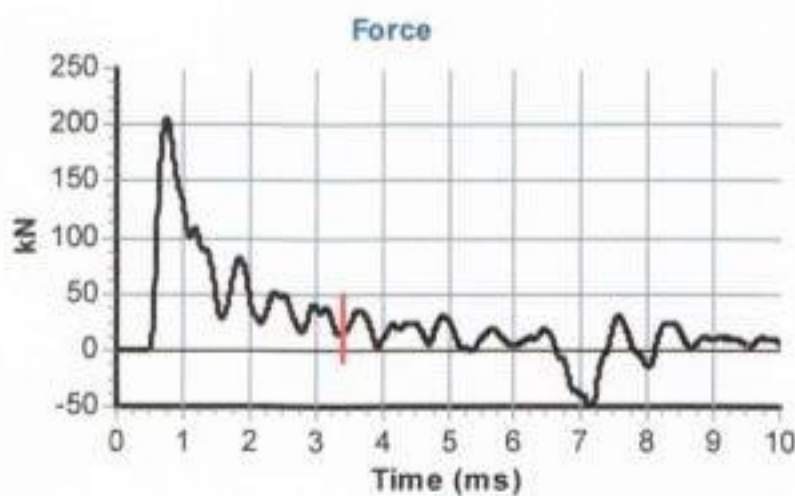
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.9
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 6455
Accelerometer No.2: 6457

Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
String Length L (m): 13.0

Comments / Location

Hammer tested at Dynamic sampling yard.



Calculations

Area of Rod A (mm²): 1021
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 391

Energy Ratio E_r (%): **83**

Signed: T.parker

Title: operations manager

The recommended calibration interval is 12 months

Tom Dewhurst
 Crossfield Consulting Ltd
 The Granary
 White Hall Farm
 Leamington Road
 Long Itchington
 Warwickshire
 CV47 9PU

e: td@crossfield-consulting.co.uk

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

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 14-62062

Project / Site name: 104 - 112 Elm Grove, Hayling Island
 Hampshire

Your job number: CCL02592

Your order number: PO8540

Report Issue Number: 1

Samples Analysed: 9 soil samples

Samples received on: 27/10/2014

Samples instructed on: 27/10/2014

Analysis completed by: 04/11/2014

Report issued on: 05/11/2014

Signed:

Dr Claire Stone
 Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Thurstan Plummer
 Organics Technical Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 - 711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

Excel copies of reports are only valid when accompanied by this PDF certificate.

soils - 4 weeks from reporting
 leachates - 2 weeks from reporting
 waters - 2 weeks from reporting
 asbestos - 6 months from reporting



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Environmental Science

Analytical Report Number: 14-62062

Project / Site name: 104 - 112 Elm Grove, Hayling Island Hampshire

Your Order No: P08540

Lab Sample Number	385737	385738	385739	385740	385741
Sample Reference	WS1	WS1	WS2	WS2	WS2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.10-0.20	0.80-0.90	0.30-0.40	1.30-1.40	2.70-2.80
Date Sampled	22/10/2014	22/10/2014	22/10/2014	22/10/2014	22/10/2014
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	9.7	16
Total mass of sample received	kg	0.001	NONE	0.38	0.78

General Inorganics

pH	pH Units	N/A	MCERTS	7.9	8.0	7.9	8.0	7.2
Total Cyanide	mg/kg	1	MCERTS	< 1	-	< 1	-	-
Total Sulphate as SO ₄	mg/kg	50	ISO 17025	1200	-	530	-	-
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	0.074	0.030	0.16	0.028	0.0098
Water Soluble Sulphate as SO ₄ (2:1)	mg/kg	2.5	MCERTS	74	30	160	28	9.8
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.037	0.015	0.079	0.014	0.0049
Sulphide	mg/kg	1	MCERTS	< 1.0	-	4.2	-	-
Total Sulphur	mg/kg	50	NONE	510	-	350	-	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.1	-	1.0	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.6	-	8.5	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	-	1.5	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.5	-	0.4	-	-
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	-	< 4.0	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	21	-	24	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	65	-	35	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	540	-	180	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	-	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	-	17	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	270	-	160	-	-



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Environmental Science

Analytical Report Number: 14-62062

Project / Site name: 104 - 112 Elm Grove, Hayling Island Hampshire

Your Order No: P08540

Lab Sample Number	385742	385743	385744	385745	
Sample Reference	WS3	WS3	WS4	WS5	
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)	0.50-0.60	3.70-3.80	1.10-1.20	0.90-1.00	
Date Sampled	22/10/2014	22/10/2014	22/10/2014	22/10/2014	
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	16	18
Total mass of sample received	kg	0.001	NONE	0.52	0.35

General Inorganics

pH	pH Units	N/A	MCERTS	7.1	7.2	7.1	7.1
Total Cyanide	mg/kg	1	MCERTS	-	-	-	-
Total Sulphate as SO ₄	mg/kg	50	ISO 17025	-	-	-	-
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	0.037	0.35	0.041	0.043
Water Soluble Sulphate as SO ₄ (2:1)	mg/kg	2.5	MCERTS	37	350	41	43
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.019	0.18	0.020	0.022
Sulphide	mg/kg	1	MCERTS	-	-	-	-
Total Sulphur	mg/kg	50	NONE	-	-	-	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	-	-
Chromium (hexavalent)	mg/kg	4	MCERTS	-	-	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-



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Environmental Science

Analytical Report Number : 14-62062**Project / Site name: 104 - 112 Elm Grove, Hayling Island Hampshire**

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of soil should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
385737	WS1	None Supplied	0.10-0.20	Light brown clay and sand with gravel.
385738	WS1	None Supplied	0.80-0.90	Light brown clay.
385739	WS2	None Supplied	0.30-0.40	Brown clay and sand.
385740	WS2	None Supplied	1.30-1.40	Light brown clay.
385741	WS2	None Supplied	2.70-2.80	Light brown clay and sand.
385742	WS3	None Supplied	0.50-0.60	Light brown clay and sand.
385743	WS3	None Supplied	3.70-3.80	Light grey clay.
385744	WS4	None Supplied	1.10-1.20	Light brown clay.
385745	WS5	None Supplied	0.90-1.00	Light brown clay.



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Environmental Science

Analytical Report Number : 14-62062

Project / Site name: 104 - 112 Elm Grove, Hayling Island Hampshire

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphénylcarbazide followed by colorimetry.	In-house method	L080-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Stones not passing through a 10 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES. Results reported corrected for extraction ratio (soil equivalent) as g/l and mg/kg; and upon the 2:1	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	ISO 17025
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.



Contract Number: 24906

Client's Reference: **CCL02592**

Report Date: **31-10-2014**

Client **Crossfield Consulting**
The Granary
White Hall Farm
Long Itchington
Warwickshire
CV47 9PU

Contract Title: **104 - 112 Elm Grove, Hayling Island, Hampshire**
For the attention of: **Tom Dewhurst**

Date Received: **27-10-2014**
Date Commenced: **27-10-2014**
Date Completed: **31-10-2014**

Test Description	Qty
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	4
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	4

Notes: Observations and Interpretations are outside the UKAS Accreditation
* - denotes test included in laboratory scope of accreditation
- denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Approved Signatories:

Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - D V Edwards (Managing Director)
Emma Williams (Office Manager) - Paul Evans (Quality/Technical Manager)

**Test Report: Method of the Determination of the plastic limit and plasticity index
BS 1377 : Part 2 : 1990 Method 5**

Client ref: CCL02592
Location: 104 - 112 Elm Grove, Hayling Island, Hampshire
Contract Number: 24906-

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
WS2	J	1.30 - 1.40	25	40	20	20	90	CI Intermediate Plasticity
WS3	J	0.50 - 0.60	27	46	22	24	100	CI Intermediate Plasticity
WS3	J	3.70 - 3.80	28	55	23	32	100	CH High Plasticity
WS5	J	0.90 - 1.00	26	43	22	21	100	CI Intermediate Plasticity

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999+A2:2010

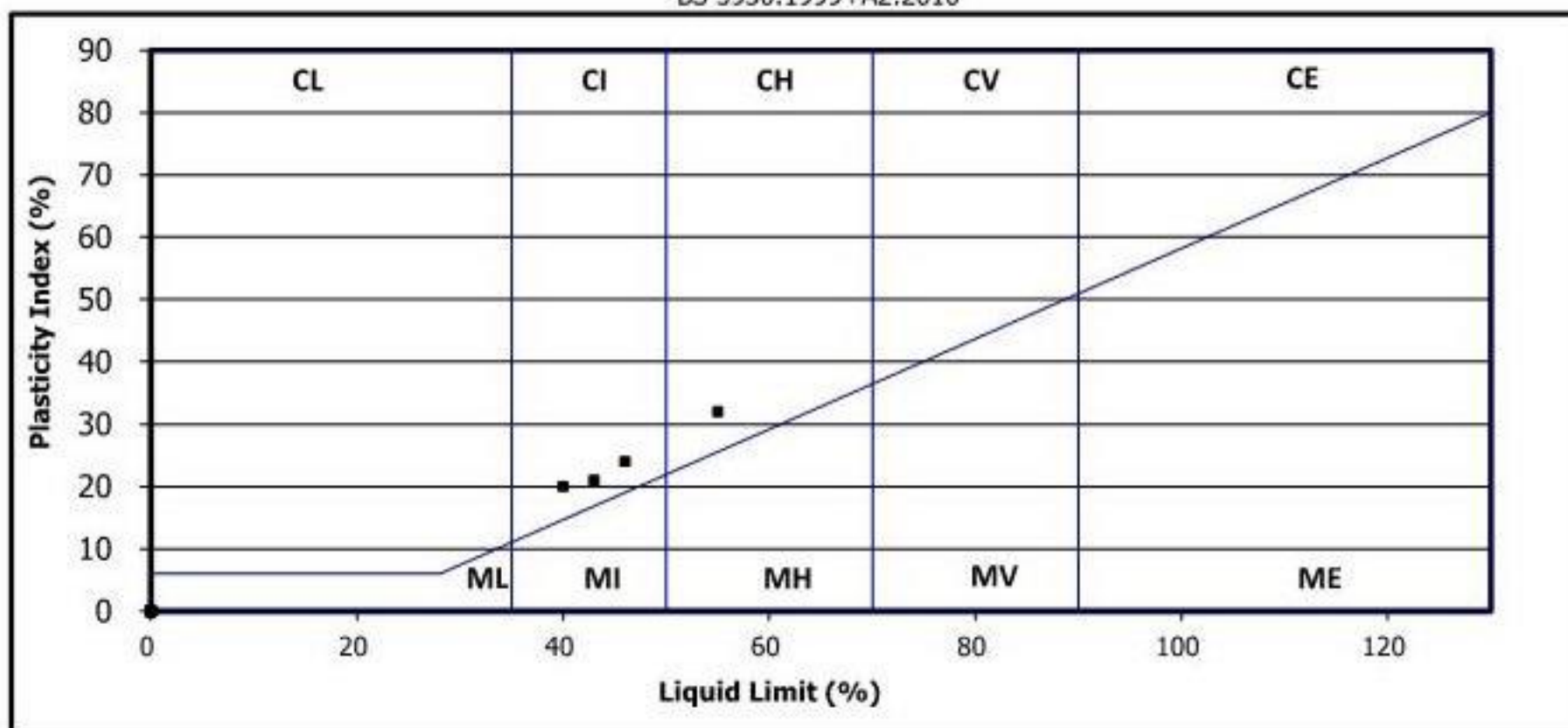
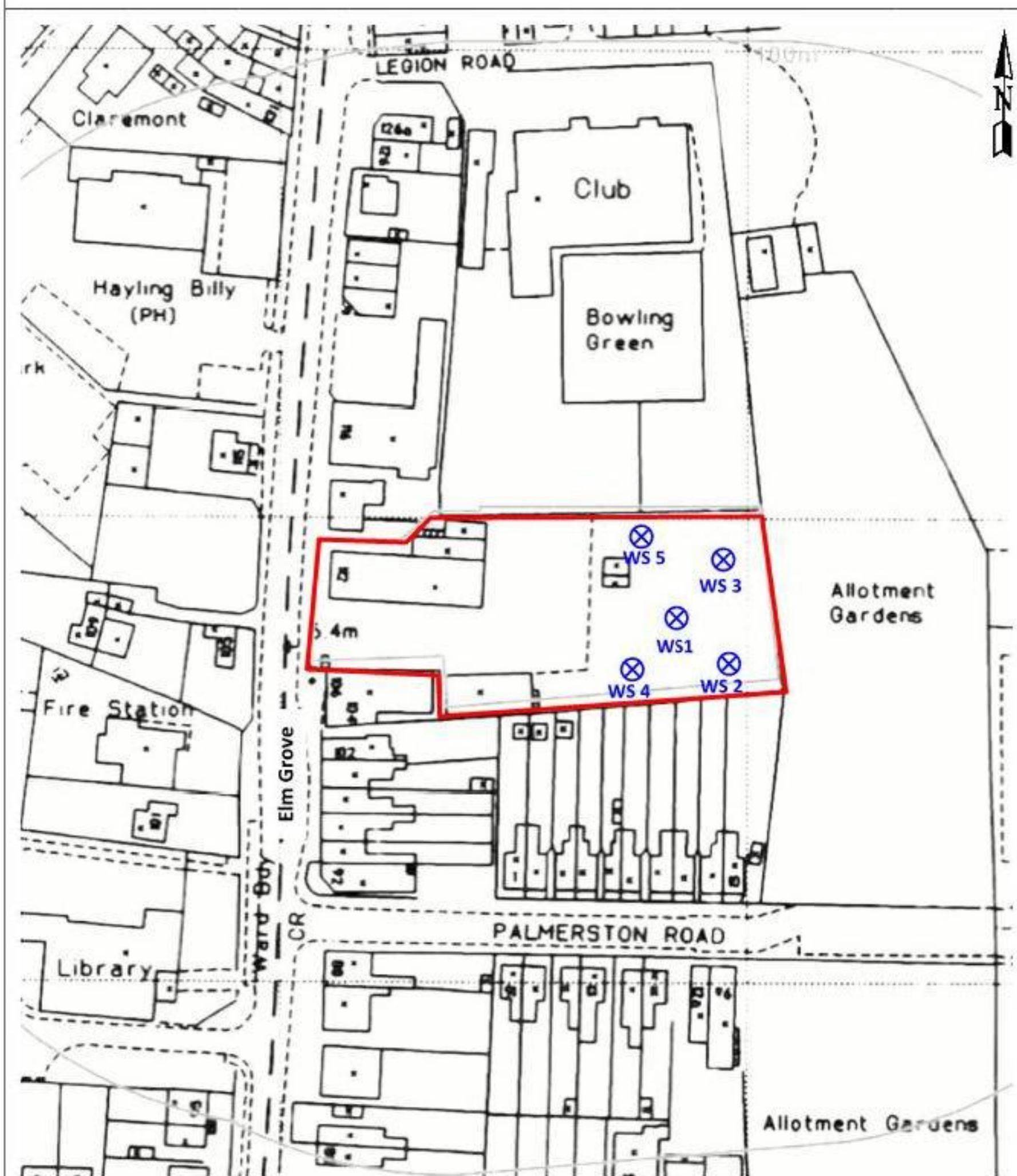


FIGURE I-1



EXPLORATORY HOLE LOCATION PLAN

Scale 1: 1250

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APPENDIX II

APPENDIX II – QUANTITATIVE RISK ASSESSMENT: HUMAN HEALTH

Contaminated Land Exposure Assessment Model v1.06

A site-specific risk assessment, with respect to human health considerations, has been undertaken due to the concentrations of certain inorganic compounds (arsenic) recorded at levels above the generic assessment criteria (GAC).

The model has been set up on the basis that the proposed development comprises apartments, for residents of retirement age. The development will have managed landscaping such that there will be no private gardens and residents will not be permitted to cultivate the ground. The pollutant linkages considered are compatible with the published criteria for a residential development without plant uptake. It is noted that the risk assessment model presumes that the soil associated with the substance will be exposed at the surface following completion of the development. However, as the soft landscaped areas will comprise entirely grassed and mulched ornamental planting areas, which will be tended by landscaping contractors as part of a maintenance agreement, it is considered that there will be no exposure route relating to home grown produce or long-term direct dermal soil contact. The CLEA model has been set up for an age class of 18, which is appropriate for end users of retirement age as the critical risk receptor. The soil organic matter and pH parameters have been determined from average site data.

The model parameters, exposure route analysis and the summary of results for the relevant compounds are presented in this Appendix. The output data are summarised as follows:

Substance	Maximum Concentration (mg/kg)	Concentration Range (mg/kg)	Site Specific Assessment Criteria (SSAC) (mg/kg)	Maximum Concentration Exceeds SSAC? ¹	No. of Samples that Exceed SSAC
Lead	540	180 to 540	943	No	0

Notes

1. Where the maximum concentration does not exceed the SSAC, risks to end users are considered to be negligible and, therefore, no further assessment is required. For compounds with a maximum concentration above the SSAC, further consideration of risks or remediation may be required. See Section 7.
2. The following output data from CLEA v.1.06 support the above summary. Pages with no data are omitted from the output.

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Report generated 05/11/2014

Report title Elm Grove, Hayling Island

Created by Tom Dewhurst at Crossfield Consulting Ltd



BASIC SETTINGS

Land Use Residential without homegrown produce

Building Apartment - Large

Receptor Female (res)

Soil Sandy loam

Start age class 18

End age class 18

Exposure Duration 10 years

Exposure Pathways

Direct soil and dust ingestion	☒
Consumption of homegrown produce	☐
Soil attached to homegrown produce	☐

Dermal contact with indoor dust	☒
Dermal contact with soil	☒

Inhalation of indoor dust	☒
Inhalation of soil dust	☒
Inhalation of indoor vapour	☒
Inhalation of outdoor vapour	☒



Land Use Residential without homegrown produce

Age Class	Exposure Frequencies (days yr ⁻¹)						Occupation Periods (hr day ⁻¹)		Soil to skin adherence factors (mg cm ⁻²)		Direct soil ingestion rate (g day ⁻¹)
	Direct soil ingestion	Consumption of homegrown produce	Dermal contact with indoor dust	Dermal contact with soil	Inhalation of dust and vapour, indoor	Inhalation of dust and vapour, outdoor	Indoors	Outdoors	Indoor	Outdoor	
1	180	0	180	180	365	365	23.0	1.0	0.06	1.00	0.10
2	365	0	365	365	365	365	23.0	1.0	0.06	1.00	0.10
3	365	0	365	365	365	365	23.0	1.0	0.06	1.00	0.10
4	365	0	365	365	365	365	23.0	1.0	0.06	1.00	0.10
5	365	0	365	365	365	365	19.0	1.0	0.06	1.00	0.10
6	365	0	365	365	365	365	19.0	1.0	0.06	1.00	0.10
7	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
8	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
9	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
10	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
11	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
12	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
13	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
14	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
15	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
16	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
17	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00
18	365	0	365	365	365	365	16.0	1.0	0.06	0.30	0.05



Receptor Female (res)

Age Class	Body weight (kg)	Body height (m)	Inhalation rate (m ³ day ⁻¹)	Max exposed skin factor		Total skin area (m ²)	Consumption rates (g FW kg ⁻¹ BW day ⁻¹)					
				Indoor (m ² m ⁻²)	Outdoor (m ² m ⁻²)		Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
1	5.60	0.7	8.5	0.32	0.26	3.43E-01	7.12	10.69	16.03	1.83	2.23	3.82
2	9.80	0.8	13.3	0.33	0.26	4.84E-01	6.85	3.30	5.46	3.96	0.54	11.96
3	12.70	0.9	12.7	0.32	0.25	5.82E-01	6.85	3.30	5.46	3.96	0.54	11.96
4	15.10	0.9	12.2	0.35	0.28	6.36E-01	6.85	3.30	5.46	3.96	0.54	11.96
5	16.90	1.0	12.2	0.35	0.28	7.04E-01	3.74	1.77	3.38	1.85	0.16	4.26
6	19.70	1.1	12.2	0.33	0.26	7.94E-01	3.74	1.77	3.38	1.85	0.16	4.26
7	22.10	1.2	12.4	0.22	0.15	8.73E-01	3.74	1.77	3.38	1.85	0.16	4.26
8	25.30	1.2	12.4	0.22	0.15	9.36E-01	3.74	1.77	3.38	1.85	0.16	4.26
9	27.50	1.3	12.4	0.22	0.15	1.01E+00	3.74	1.77	3.38	1.85	0.16	4.26
10	31.40	1.3	12.4	0.22	0.15	1.08E+00	3.74	1.77	3.38	1.85	0.16	4.26
11	35.70	1.4	12.4	0.22	0.14	1.19E+00	3.74	1.77	3.38	1.85	0.16	4.26
12	41.30	1.4	13.4	0.22	0.14	1.29E+00	3.74	1.77	3.38	1.85	0.16	4.26
13	47.20	1.5	13.4	0.22	0.14	1.42E+00	3.74	1.77	3.38	1.85	0.16	4.26
14	51.20	1.6	13.4	0.22	0.14	1.52E+00	3.74	1.77	3.38	1.85	0.16	4.26
15	56.70	1.6	13.4	0.21	0.14	1.60E+00	3.74	1.77	3.38	1.85	0.16	4.26
16	59.00	1.6	13.4	0.21	0.14	1.63E+00	3.74	1.77	3.38	1.85	0.16	4.26
17	70.00	1.6	14.8	0.33	0.27	1.78E+00	2.94	1.40	1.79	1.61	0.22	2.97
18	70.90	1.6	12.0	0.33	0.27	1.80E+00	2.94	1.40	1.79	1.61	0.22	2.97

**Building Apartment - Large****Soil Sandy loam**

Building footprint (m ²)	8.00E+01
Living space air exchange rate (hr ⁻¹)	5.00E-01
Living space height (above ground, m)	2.50E+00
Living space height (below ground, m)	0.00E+00
Pressure difference (soil to enclosed space, Pa)	3.10E+00
Foundation thickness (m)	1.50E-01
Floor crack area (cm ²)	2.56E+03
Dust loading factor (µg m ⁻³)	5.00E+01

Porosity, Total (cm ³ cm ⁻³)	5.30E-01
Porosity, Air-Filled (cm ³ cm ⁻³)	2.00E-01
Porosity, Water-Filled (cm ³ cm ⁻³)	3.30E-01
Residual soil water content (cm ³ cm ⁻³)	1.20E-01
Saturated hydraulic conductivity (cm s ⁻¹)	3.56E-03
van Genuchten shape parameter <i>m</i> (dimensionless)	3.20E-01
Bulk density (g cm ⁻³)	1.21E+00
Threshold value of wind speed at 10m (m s ⁻¹)	7.20E+00
Empirical function (<i>F_s</i>) for dust model (dimensionless)	1.22E+00
Ambient soil temperature (K)	2.83E+02
Soil pH	7.00E+00
Soil Organic Matter content (%)	1.00E+00
Fraction of organic carbon (g g ⁻¹)	5.80E-03
Effective total fluid saturation (unitless)	5.12E-01
Intrinsic soil permeability (cm ²)	4.75E-08
Relative soil air permeability (unitless)	6.42E-01
Effective air permeability (cm ²)	3.05E-08

**Soil - Vapour Model**

Depth to top of source (no building) (cm)	0
Depth to top of source (beneath building) (cm)	65
Default soil gas ingress rate?	Yes
Soil gas ingress rate ($\text{cm}^3 \text{s}^{-1}$)	2.50E+01
Building ventilation rate ($\text{cm}^3 \text{s}^{-1}$)	2.78E+04
Averaging time surface emissions (yr)	10
Finite vapour source model?	No
Thickness of contaminated layer (cm)	200

Air Dispersion Model

Mean annual windspeed at 10m (m s^{-1})	5.00
Air dispersion factor at height of 0.8m *	2400.00
Air dispersion factor at height of 1.6m *	0.00
Fraction of site cover ($\text{m}^2 \text{m}^{-2}$)	0.75
* Air dispersion factor in $\text{g m}^{-2} \text{s}^{-1}$ per kg m^{-3}	

Soil - Plant Model

	Dry weight conversion factor	Homegrown fraction		Soil loading factor	Preparation correction factor
		Average	High		
	$\text{g DW g}^{-1} \text{FW}$	dimensionless		$\text{g g}^{-1} \text{DW}$	dimensionless
Green vegetables	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	0.103	0.06	0.40	1.00E-03	1.00E+00
Tuber vegetables	0.210	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	0.058	0.06	0.40	1.00E-03	6.00E-01
Shrub fruit	0.166	0.09	0.60	1.00E-03	6.00E-01
Tree fruit	0.157	0.04	0.27	1.00E-03	6.00E-01

Gardener type None

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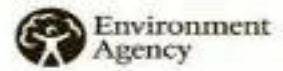
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Created by Tom Dewhurst at Crossfield Consulting Ltd



RESULTS

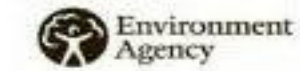
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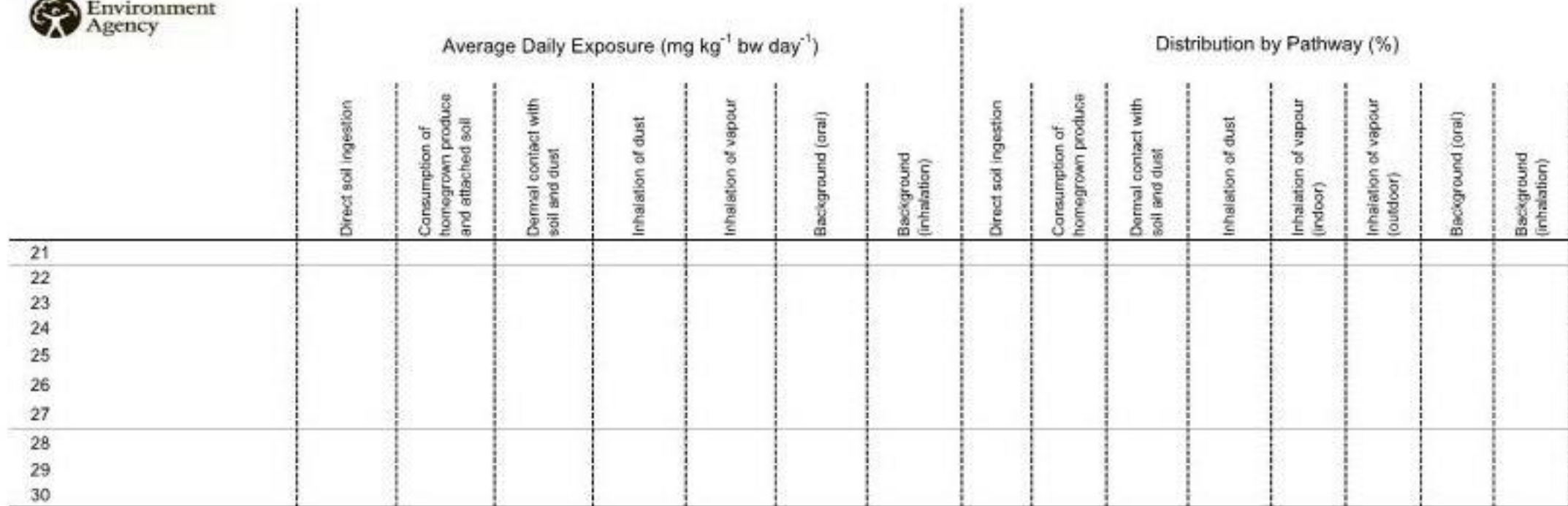
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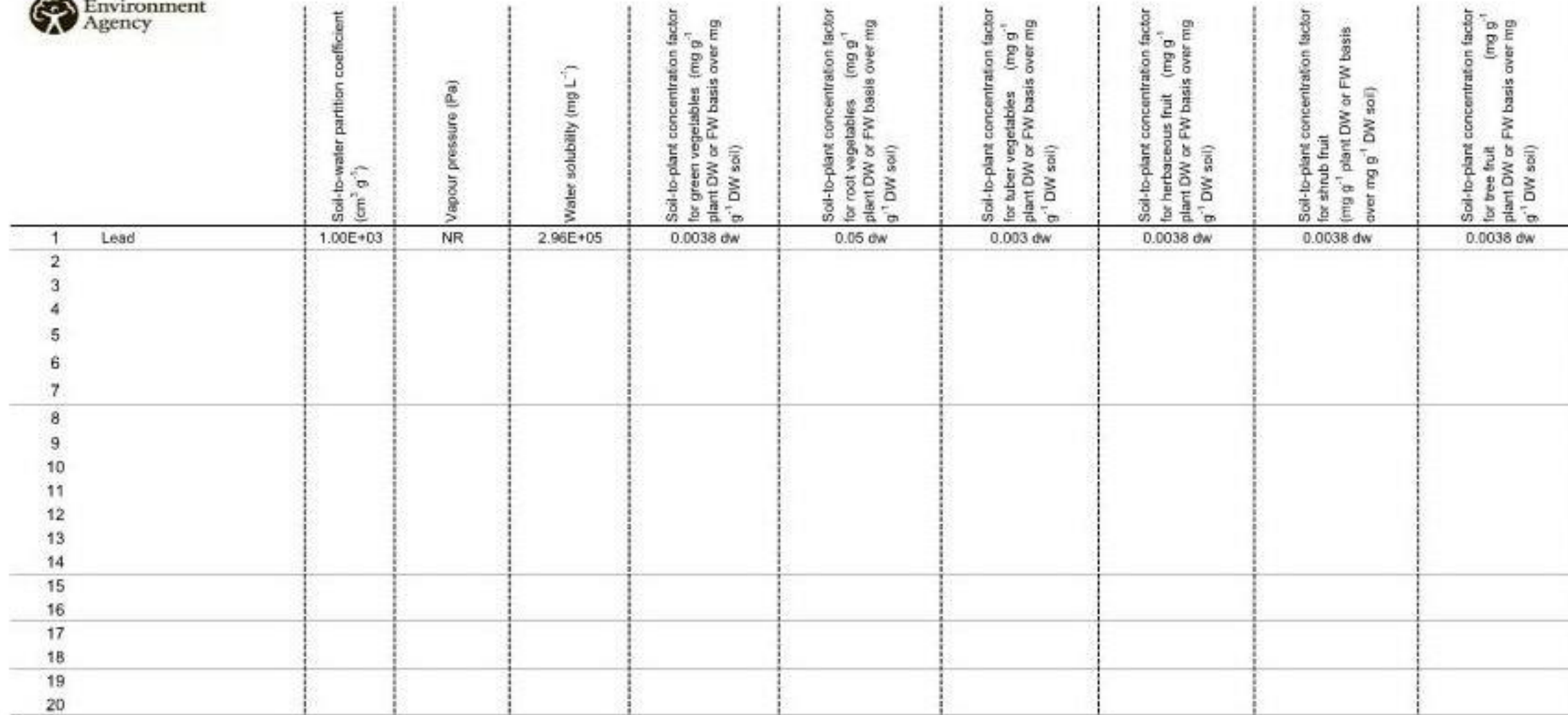
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APPENDIX III

APPENDIX III – BASIS OF GEOTECHNICAL ASSESSMENT FOR FOUNDATIONS

Geotechnical Design Category of Structure: 2

Design Working Life: Standard building structure (50 years)

Design Approach: 1

1. Geotechnical Model

On the basis of the ground investigation data, the following model of the ground conditions is considered appropriate for foundation design purposes:

Depth (m)	General Description of Strata (and classification)	Parameter	Characteristic Value & Units	Remarks
0.00 to 0.20	Made Ground	γ	18 kN/m ³	Based on site observations
0.20 to 2.30	Low to medium strength, soft to firm consistency, silty, slightly gravelly clay (River Terrace/Brickearth Deposits)	N	3	Based on SPT data
		γ	21 kN/m ³	Estimated from site observations
		c_u	30 kN/m ²	Estimated from site observations
		ϕ_u	0°	
2.30 to 4.00	Loose sand (River Terrace/Brickearth Deposits)	Modified PI	23%	Medium volume-change potential NHBC (2014)
		N	6	Based on site data
		γ	20 kN/m ³	Estimated from site observations
		c'	0 kN/m ²	
4.00 to > 6.00	High strength, stiff consistency silty clay (London Clay Formation)	ϕ'	29°	From Peck Hanson & Thornburn (1974)
		PI	n/a	Non-shrinkable – NHBC (2014)
		N	15	Based on SPT data
		γ	21	Estimated from site observations
		c_u	75 kN/m ²	Estimated from SPT data
		ϕ_u	0°	
		Modified PI	32%	Medium volume-change potential NHBC (2014)

Characteristic Depth to Groundwater (or groundwater level): 2.30 m

Reference should be made to Sections 8 – 9 of the report for an assessment of overall ground stability, seismic risk, combined failure of the structure/ground, excessive settlements and potential soil-volume changes (including heave).

2. Imposed Actions from Proposed Structure

The following are generic values, based on the development proposed, as described in the report. In compliance with BS EN 1997-1:2004, final designs should include consideration of the calculated imposed loads.

Imposed Load on Foundations: 190 kN/m run

Serviceability Limit Values (associated with above action)

Maximum Total Settlement: 25 mm

Maximum Deflection (angular distortion value): 1/1000

3. Geometry of Proposed Foundation

Footing Width (assumed for assessment): 0.6 m to 2.0 m

Footing Depth (assumed for assessment): 0.9 m

With reference to the present building layout information, it is envisaged that piles will be located at a spacing of not less than 5 pile diameters. On this basis, and with reference to Tomlinson (1994) and DIN4026 pile group effects are unlikely to influence serviceability criteria. In the event that a closer pile spacing are considered in the detailed pile layout design then, additional consideration of pile group settlements should be undertaken.

4. Ground Treatment

4.1 Vibro-Replacement Ground Treatment

The detailed design of the ground treatment will reflect the specific plant, materials, and process proposed. It is noted that compacted 'stone columns' should extend to the designated bearing strata and designs may consider issues of column/stone stiffness, potential column bulging and end-bearing support.

The reinforced strip footing supported by the vibro-replacement ground treatment should be designed to span between the centres of adjacent 'stone columns' unless an alternative design approach is shown to be acceptable. Reinforced strip footings should include at least minimum area of steel in compliance with the requirements published in BS EN 1992-1-1 (2002) and should include reinforcement in top and bottom faces, designed to resist hogging and sagging moments.

In compliance with the guidance published in NHBC (2014) 4.6, the foundation designer shall confirm (with input from the specialist ground treatment designer) that the design of the foundation, ground treatment and ground conditions are mutually compatible.

4.2 Piled Foundations

In assessing the load capacity of individual piles, a number of methods are used, as outlined below. For each pile type, the appropriate Partial Factors and Model Factors have been obtained from BS EN 1997-1:2004 and the relevant National Annex and these values have been used in the calculations.

It is noted that less onerous Partial Factors and Model Factors may be adopted when completing detailed pile designs based on pile test data or additional data points.

4.2.1 Piles in Fine-grained Soils

For calculating the Ultimate Limit State pile capacity, a conventional total stress approach is adopted, as outlined below:

$$\text{Pile Shaft Resistance} = \frac{1}{\gamma_s \gamma_{Rd}} s \cdot c_{su} \cdot A_s \quad \text{kN}$$

s : Shape factor (unity for vertical pile)
 c_{su} : average pile shaft/clay adhesion
 $c_{su} = \alpha \cdot c_u$ (α : adhesion factor)
 c_u : Characteristic undrained shear strength (mean of bearing strata over pile shaft length)
 A_s : Pile shaft area (within bearing strata)

$$\text{Pile Base Resistance} = \frac{1}{\gamma_b \gamma_{Rd}} N_c \cdot c_{ub} \cdot A_b \quad \text{kN}$$

N_c : Terzaghi bearing capacity factor
 c_{ub} : Characteristic undrained shear at pile base
 γ_s, γ_b : Partial Factors
 γ_{Rd} : Model Factor (or correlation factor)

NOTE: Pile shaft/clay adhesion (c_{su}) limited to a maximum of 100 kN/m²