

CHURCHILL RETIREMENT LIVING LIMITED

**38 & 40 EAST STREET & 35 FITZALAN ROAD, LITTLEHAMPTON, WEST SUSSEX,
BN17 6AN**

GROUND INVESTIGATION REPORT

The Granary
White Hall Farm
Long Itchington
Warwickshire
CV47 9PU

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www.crossfield-consulting.co.uk

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1. INTRODUCTION

Churchill Retirement Living Limited proposes to redevelop a site at 38 & 40 East Street and 35 Fitzalan Road, Littlehampton for residential purposes. The development site is presently occupied by three houses and associated grounds. It is understood that the proposed development is to include a three storey block of apartments with associated car parking facilities and managed soft landscaping. The occupants will be of retirement age.

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 ground investigation. Reference should also be made to the Desk Study Appraisal Report. 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, Arun District Council and 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 9 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 to the south of East Street and the west of Fitzalan Road, and on the eastern edge of Littlehampton town centre, as shown on Figure 1. The National Grid Reference for the site is TQ 3193 2291. A site plan is provided as Figure 2. The plan indicates that the site is bounded by East Street to the north, Fitzalan Road to the east, a commercial property (possibly associated with a telephone exchange) to the south and an apartment block referred to as Winterton Lodge to the west.

2.2 Site Description

The site description is based on observations made at the time of the ground investigation in February 2017 and a topographical survey of the site, provided as Figure 3.

The site comprises a roughly rectangular plot of land with an area of approximately 0.31 ha. The site slopes down to the north of the site with an approximate drop in elevation of 1.5 m across the site. There is further drop in elevation of approximately 1.0 m from the site to East Street to the north.

The site comprises two, single-storey houses (No. 40 East Street and No. 35 Fitzalan Road) and one, two-storey house (No. 38 East Street), and their associated outbuildings and grounds. The grounds include gardens comprising lawns, planting and patio areas. Garages with concrete and tarmac surfaced driveways are present to the front of No. 38 and No. 40 East Street properties. Mature trees are present within the site and around the site boundaries. From observations made at the time of the site investigation, it appears that these two trees have been removed since January 2016. Hedges are also present along the boundaries separating the individual properties.

2.3 Site History

A detailed site history is presented in Desk Study Appraisal, and reference should be made to the historical map extracts in that report. In summary, the maps indicate that by the late nineteenth century, the western part of the site comprised gardens associated with a neighbouring property and the eastern part of the site comprised part of the field. East Street is shown immediately to the north of the site. The site then remained undeveloped for many years.

By the 1950s, the No.38 East Street property is shown in the south of the site. A general increase in residential development is noted within the surrounding area. The No. 40 East Street property is shown by the mid to late 1980s. Fitzalan Road is also present by this time. By the mid 1990s, the No. 35 Fitzalan Road property is shown in the south of the site. No significant changes have occurred in site or in the general area since the mid 1990s.

3. PUBLISHED GEOLOGY

The 1:50,000 Scale Solid and Drift Geology map of Chichester and Bognor (Sheet 317/332), together with the digital map published by the British Geological Survey, indicates that the superficial deposits beneath the site comprise River Terrace Deposits which consist of sand, silt and clay. Formerly, these deposits were classified as brickearth.

The underlying solid geology comprises the Cretaceous Upper Chalk including Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk and the Culver Chalk Formation. This strata comprise chalk, but may include weathered strata at shallow depth.

4. DESK STUDY ENQUIRIES

Detailed desk study information is presented in the Desk Study Appraisal, as referenced, and a summary of relevant issues is given below.

There are no recorded operational or historical landfills within 250 m of the site.

Hydrogeological information indicates that the superficial deposits are shown to be designated as a Secondary (A) Aquifer. The solid geology is classified as a 'Principal Aquifer'. There are no groundwater Source Protection Zones or licensed groundwater abstractions listed within the general area.

Non-coal mining has been assessed by the British Geological Survey as being 'rare' (the lowest risk category). There are no historical underground workings recorded within 1 km of the site.

Natural ground subsidence information indicates that the site is classed as 'very low risk' for ground dissolution of soluble rocks. There are no natural cavities recorded within 1 km of the site.

With reference to the Building Research Establishment Document BR211 (2015) *Radon: Guidance on Protective Measures for New Buildings* indicates that the site does not lie within an area where radon precautions are required in new buildings.

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. The investigation has identified the presence of the following, below the site.

5.2 Buried Foundations and Services

The investigation did not identify the presence of any buried obstructions. Based on the history of the site, it is unlikely that buried structures are present outside of the footprint of the current buildings. Underground services are present beneath the site.

5.3 Strata Encountered

Made Ground

Made Ground was encountered across the site and generally extends down to a depth of 0.5 m. The Made Ground generally comprises clayey strata with fragments of brick with occasional coal, ceramic and glass fragments. The Made Ground was noted to be ashy in some areas.

Brickearth Deposits

Brickearth Deposits were encountered below the Made Ground and are generally recorded to extend down to depths of approximately 1.0 m. However, in one location in the north of the site, Brickearth Deposits were encountered to a depth of 1.7 m. The Brickearth Deposits are generally described as soft to firm consistency, brown slightly gravelly silty clay. The deposits are noted as becoming firm consistency (estimated medium strength) at a depth of approximately 0.8 m.

River Terrace Deposits

River Terrace Deposits were encountered below the Brickearth Deposits and are generally present to depths of between 2.4 m and 3.1 m. Deeper River Terrace Deposits were encountered in the central part of the site, extending to depths of between 4.7 m to in excess of 5.0 m (the maximum depth of the investigation). The deposits were generally described as firm to stiff consistency, medium to high strength sandy gravelly clays and medium dense sands.

Standard Penetration Tests (SPT) undertaken in the River Terrace Deposits recorded 'N' values between 7 and 24.

Lewes Nodular Chalk Formation

Chalk strata were encountered below the River Earth Deposits in all locations except one location in the centre of the site. The deposits comprise structureless chalk comprising gravelly clayey silt (Grade Dm).

Standard Penetration Tests undertaken in the Lewes Nodular Chalk Formation recorded 'N' values between 5 and 34.

5.4 Groundwater

Groundwater was encountered in all exploratory holes except WS3 and seepages were observed at depths of between 4.0 m and 4.9 m.

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

It is understood that the proposed development comprises the following structures and features. An indicative development layout is provided on Figure 4.

- A three storey apartment block of load-bearing brick construction
- Hardstanding access road and car parking
- Soft landscaping to form amenity areas and decorative planting

The proposed development will be for residents of retirement age. No private gardens are proposed and residents will not be permitted to cultivate the soft landscaping.

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+A1:2013, 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) significant pollution of controlled waters is being caused or there is significant possibility of such pollution being 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 (together with any quantitative risk assessment, as presented in Appendix II), an assessment of the identified pollutant linkages is presented in Table 3.

7.2 Potential Sources of Contamination

The site appears to have been largely undeveloped until the 1950s. From that time, the residential properties now on site were progressively constructed. It is considered that the only potential source of contaminants associated with the site's usage would be very small volumes of ashy materials associated with domestic fires/ bonfires. Ashy materials, if present may contain heavy metals and polycyclic aromatic hydrocarbons (PAHs).

With respect to potential sources of off-site contamination, desk study information indicates that the surrounding land use is predominantly residential. Such developments are not considered to be associated with a potential off-site source of contamination. In addition, there are no other features identified by the desk study information that are considered to be within influencing distance of the site. Therefore, it is considered that there are no potential off-site sources of contamination that could impact the site development.

Based on the desk study information and observations made during the ground investigation, representative soil samples were recovered for analysis of the potential substances noted above. The results of soil testing have been summarised in Table 2. The laboratory results are presented against generic assessment criteria (GAC) relevant to the protection of human health in residential development with managed landscaping and Category 4 Screening Levels (C4SL) that represent low but acceptable risk to human health. As can be seen from Table 2, the majority of the test results are below the GAC (minimal risk to human health) and, therefore, do not represent an unacceptable risk to end users. However, a localised exceedance of lead and the polycyclic aromatic hydrocarbons, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene have been recorded above the GAC and C4SL (where applicable). No asbestos containing materials have been identified within the ground. The possible risks to end users and other relevant human receptors are discussed further in Section 7.3.1.

The risk and implications to buried concrete and potable water supply pipe materials are discussed in Section 7.3.2.

Phytotoxic metals have not been recorded in the shallow ground at concentrations that may be a risk to plant health (for example, see BS 3882:2015 Specification for topsoil). Recommendations in regards to plantings within proposed landscaping areas are discussed in Section 7.3.3.

No putrescible material has been identified at the site and there are no recorded landfills within influencing distance. Although Made Ground is present at the site, it is evident that the material has negligible organic content, hence, would not be able to be associated with a potential source of harmful ground gases. The site is not within an area where precautions against the ingress of radon gas are required in new dwellings. 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

Potential substances associated with the site history are generally below the relevant GAC values. However concentrations of lead and the polyaromatic hydrocarbons; benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene have been recorded above the GAC and C4SL (where applicable) and are likely to be associated with traces of ash.

With respect to end users, an effective barrier, in the form of the proposed building and hardstanding from road pavements and car parking areas, will be in place across the site. These areas will provide a barrier between end users and the ground across the majority of the site. However, the proposed development also includes areas of soft landscaping. Within these areas, there are potential exposure pathways following development. It is understood that residents will not be permitted to dig or cultivate the managed landscaping areas. However, root activity and earthworm activity could mix the existing ground with topsoil materials, thereby returning impacted soils to the near surface, if a limited thickness of topsoil is placed.

The GAC values are conservative with respect to the proposed development as they consider young children as the critical receptor. Such a receptor is not applicable to this development as the long-term receptor will be people of retirement age. On this basis, a site specific risk assessment, using the Contaminated Land Exposure Assessment (CLEA) Model, has been undertaken with respect to the elevated concentration of substances.

Based on the proposed end use, the CLEA model has been assessed using dust-related oral, dermal and inhalation pathways for residents of retirement age. The full CLEA results and parameters used are presented in Appendix II.

With respect to the relevant exposure pathways, the maximum recorded concentrations of lead and the polyaromatic hydrocarbons; benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene are below the site specific assessment criteria (SSAC) for the proposed development. It is therefore considered that the end users should not be exposed to unacceptable levels from potential contaminants within the shallow soils and hence no remedial works are considered necessary.

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

Groundworkers involved in the construction of the new development are unlikely to be exposed to short-term (acute) risks. However, in line with good practice, it is recommended that appropriate personal protective equipment (PPE) be worn and high levels of personal hygiene be maintained by groundworkers. To minimise soils at the site becoming airborne and moving beyond the site boundaries during earth moving operations, it is recommended that appropriate soil dampening equipment be maintained on site during dry periods to minimise dust generation.

7.3.2 Durability of Buried Structures and Services

In view of the low soluble sulphate content and near-neutral soil conditions, there are no special precautions required for the protection of good quality buried foundation concrete. 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.

The site has not been associated with past fuel and/or chemical storage and there are no such storage facilities in close proximity. Therefore, the site would not be considered to be 'brownfield' under the definition provided by UKWIR (2010) with respect to the assessment of ground for water supply pipes. Based on the guidance provided by UKWIR, conventional plastic materials can be used for potable water supply pipes without any requirements for specific testing.

It should be noted that individual water companies may have in-house requirements for the assessment of ground conditions for potable water supply pipes and these requirements may be in addition to, or may contradict, the guidance provided by UKWIR. Therefore, it is recommended that the relevant water supply company be consulted prior to finalising the potable water supply design.

7.3.3 Landscape and Garden Areas

Concentrations of phytotoxic metals have been recorded below the guideline values given in BS 3882:2015 and hence no special precautions should be required with respect to landscape areas.

If additional topsoil is imported, the materials should be verified (with documentation/ laboratory test reports) as suitable for use within a residential development and in compliance with the usual requirements of NHBC and the local planning authority.

7.3.4 Controlled Waters

The River Terrace Deposits present beneath the site are classified as a Secondary (A) Aquifer and the underlying Lewes Nodular Chalk Formation are classified as a Principal aquifer. The site is not located within a Groundwater Source Protection Zone and there are no groundwater abstraction licences listed within the general area.

The potential contaminants identified at the site (metals and PAHs associated with traces of ash) are generally of low solubility and, hence, mobility. As such, it is considered that there is no valid source of substance that may impact groundwater. In addition, the proposed buildings and hardstanding will act as effective barriers to rainwater infiltration, such that there will be a reduced permeable surface area on completion of the development. Therefore, it is considered that there is no valid pollutant linkage in relation to Controlled Waters.

On this basis of the available information, it is considered that there is no significant risk to controlled waters indicated at the site.

7.6 Recommended Remedial Works

On the basis of the findings of the investigation, it is considered that there is no requirement for remedial works to be undertaken in the context of the proposed development.

In compliance with good practice, the following construction-related works are recommended:

- Soils should be kept damp during groundworks undertaken in dry weather to minimise the potential of aerial migration of dust to neighbouring properties and public.

As the above work is not required to address specific risks to human health or controlled waters, it is considered that there should be no requirement to prepare a Remediation Implementation Plan for the development.

7.7 Potential Liabilities

Based on the available data, and as outlined above, it is considered that there should be no environmental liabilities associated with ownership of the site and this should not change following development.

8. ASSESSMENT OF MINING, QUARRYING AND OVERALL GROUND STABILITY

The site is in an area where chalk mining has been classified as 'Rare' (lowest risk category), according to the BGS hazard rating, in relation to local small scale mining. The solid strata beneath the site has a ground dissolution hazard rating of 'Very Low'. No solution features are indicated in the general area. On this basis, it is considered that risks of poor ground stability are very low to negligible and the proposed development should not be constrained in this regard.

Chalk strata can be associated with natural solution features that can collapse or become filled with loose materials that can be subject to adverse settlements. However, on the basis of the ground conditions observed at the site, it is considered unlikely that the proposed development would be affected by solution features. In the unlikely event that anomalous ground conditions or features indicative of solution features are encountered during groundworks, they should be reported by site staff and a geotechnical inspection and assessment should be undertaken.

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 (three-storey building)

Serviceability Limit Values (associated with above action)

Maximum Total Settlement: 25 mm (shallow foundations) or 10 mm (piles)

Maximum Differential Settlement: 1/1000 (shallow foundations) 5 mm (piles)

9.3 Geotechnical Category of Proposed Structures

In view of the nature of the proposed structure, comprising a three-storey block of apartments, 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.

The proposed structure could be founded on the medium to high strength sandy gravelly clays or medium dense sands of the River Terrace Deposits. Foundations should extend through the Made Ground and localised loose or low strength strata. Strip/ trench fill foundations are considered suitable for the proposed development. Alternatively, piled foundations may be considered. Foundation precautions within the influence zones of trees will be required as outlined in Section 9.5.

9.4.1 Recommended Foundation Design Parameters: Trench Fill Footings

On the basis of the foregoing assessment and the details presented in Appendix III, it is considered that conventional trench-fill foundations provides a possible foundation solution for the proposed structure. On the basis of the ground conditions and structures described in the report, the recommended parameters for the foundation design are as follows:

<i>Foundation Strata :</i>	Firm to stiff consistency, medium to high strength sandy gravelly clays and/ or Medium dense sands (River Terrace Deposits)
<i>Foundation Depth :</i>	Minimum 0.75 m, deepened within influence of trees, or through Made Ground as required.
<i>Foundation Width/Size:</i>	2.0 m (maximum)
<i>Nett Allowable Bearing Pressure:</i>	125 kN/m ²

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.

It is noted that the depths of the River Terrace Deposits may vary across the site and that the nature of the strata may also vary. Hence, it is recommended that a supplementary ground investigation be carried out (as outlined in Section 14) in order to provide additional confidence in the use of strip or trench-fill footings and clarify likely foundation depths (i.e. depths to suitable bearing strata)

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.

9.4.2 Piled Foundations

It is considered that piled foundations provide an alternative appropriate foundation solution for the proposed development. Piles should extend into competent chalk strata at depth. Due to the nature of the adjacent residential land uses, continuous flight auger (CFA) piles are likely to be required for the proposed development. The use of driven piles is likely to be constrained by noise/ vibration issues. It will be necessary to undertake an additional investigation (with deep boreholes), to obtain relevant data for the pile design purposes (if piles are required), as recommended in Section 14.

Should piled foundations be chosen as a foundation solution, it will be necessary to provide a working platform in accordance with the requirements of the Federation of Piling Specialists prior to the commencement of piling operations.

9.5 Building Near Trees

Laboratory testing results indicate that the clayey horizons beneath the site are classified as having a “low volume change” potential, as defined in NHBC Standards (2016). It is noted that two mature trees formerly located in the south of the site, were positioned both within and in close proximity to the proposed building footprint. Within the influence zones of former, existing and proposed trees, suitable foundation precautions should be adopted, as outlined in NHBC Standards (2016), and there will be a requirement to deepen footings locally in relevant areas of the site.

9.6 Floor Slab Recommendations

Due to the presence of potentially shrinkable clay, it is recommended that an allowance be made for a suspended floor slab for the new building. A minimum under floor void of 200 mm should be provided in accordance with NHBC Standards (2016).

9.7 General Construction Advice

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.

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.

Generally, all formations should be placed wholly within the same material type, unless specific geotechnical inspection and assessment have been undertaken.

Care should be taken to ensure that any field 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 excavation works at this site. However the use of hydraulic breakers may be required to break up any remaining foundations following demolition of existing structures.

Shallow excavations may remain stable in the short term, However instability may occur in excavations left open for extended periods of time, Support should be provided, or the sides battered back, in any excavations requiring man entry.

Groundwater is expected not to be encountered within shallow excavations. Should shallow perched water be encountered during groundworks, the resultant seepages should be controlled by conventional sump pumping.

If a piled foundation solution is chosen, a stable working platform must be designed by 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

Based on the high proportion of fines encountered within the River Terrace Deposits, conventional soakaway drainage is unlikely to be feasible. The Lewes Nodular Chalk Formation deposits encountered beneath the site are recorded as being weathered to a gravelly clayey silt and are unlikely to be suitable for soakaway drainage. At this stage, it would be prudent to identify an alternative drainage solution.

12. ROAD PAVEMENTS

Based on the examination of the soils present at the site and the guidance of IAN73/06 TRRL and Report LR1132, it is considered that an equilibrium design CBR value of 4% may be used for road pavement design. It is considered that the material at shallow depth should be regarded as frost susceptible.

13. ASSESSMENT OF MATERIALS FOR WASTE DISPOSAL

There is no requirement to remove soils from the site and, therefore, it is recommended that development levels be set such that soils can be retained and reused on site where possible. Providing development levels are set to accommodate soil arisings (for example from foundation excavations), such materials would not be classified as waste if required and re-used on site. However, if materials are excess to requirements, they should be taken to an appropriately permitted facility.

If material is identified for removal to a waste facility, it will be necessary to provide a description of the material and laboratory test data to the receiving facility. This information is included in Appendix I.

The available analytical test data have been used to provide preliminary waste disposal advice. It should be noted that these tests results may not be specifically related to materials that are, or will be, scheduled for removal from site. However, the results are appropriate for preliminary guidance and costing purposes.

HazWasteOnline™ has been used to assess materials on site in accordance with the Environment Agency's document Guidance on the Classification and Assessment of Waste WM3 (2015). Additional assessment is made by direct reference to WM3. The assessment indicates that the following preliminary waste classification advice would be appropriate:

- Tarmac surfacing associated with existing driveways should be taken to recycling facility. Such materials identified are unlikely to meet WAC for disposal at landfill.
- Topsoil is likely to be classified as "non-hazardous" waste if taken to a landfill due to the organic content of such materials. Alternatively, these materials could be taken to a recycling facility.
- The majority of Made Ground materials are likely to be classified "inert". However, some Made Ground may be classified as "non-hazardous" waste.
- The natural strata at the site would be classified as "inert" waste without any requirement for laboratory testing.

Waste requires pre-treatment prior to disposal at landfill and this may take the form of physical or chemical treatment to reduce hazards and/or waste volumes. The segregation and screening of waste soils into separate, and appropriately classified, waste streams would satisfy the pre-treatment criteria by ensuring that volumes of each waste category are minimised. Segregation of waste streams is also important to prevent materials being classified within a worse-case category and, therefore, incurring higher disposal costs. Mixing of different waste streams to dilute hazardous properties is not permitted.

It should be noted that the above assessment is provided in accordance with current waste disposal and environmental permitting legislation and guidance documents. However, individual landfills and other waste disposal facilities may have variances in their permit that differs from standard guidance. Waste facilities may also make decisions with respect to accepting waste on a commercial basis. Therefore, landfills or other waste facilities should be approached to confirm that they will accept waste materials prior to finalising waste disposal proposals.

14. RECOMMENDATIONS FOR SUPPLEMENTARY GROUND INVESTIGATIONS

Due to the access restrictions at the time of the ground investigation, it is recommended that, when access is available, an additional phase of ground investigation be undertaken. The additional investigation should comprise trial pits and/ or additional windowless sample holes to assess the shallow strata in areas previously inaccessible and to confirm foundation depths.

If piled foundations are proposed, boreholes are recommended, which should extend to suitable depths into chalk strata to provide the necessary data for design.

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(s) and ground floor slab recommendations in Section 9.6, the following supervision and monitoring is recommended.

- Inspections of formation strata in excavations for shallow strip/trench-fill footings (if applicable)
- Verification testing required – in situ testing following pile installation (if a piled solution is chosen)

16. SUMMARY

Churchill Retirement Living Limited proposes to redevelop a site at 38 & 40 East Street and 35 Fitzalan Road, Littlehampton for residential purposes. The development site is presently occupied by three houses and associated gardens. It is understood that the proposed development is to include a three storey block of apartments with associated car parking facilities and managed soft landscaping. The occupants will be of retirement age.

Ground conditions at the site comprise a limited thickness of Made Ground, generally extending down to a depth of 0.6 m. The Made Ground generally comprise clayey strata with fragments of brick and was noted to be ashy in some areas. Brickearth Deposits, generally comprising slightly gravelly silty clays have been recorded below the Made Ground and generally extend down to depths of less than 1.0 m. However, Brickearth Deposits extending down to a depth of 1.7 m are recorded in the north of the site. These deposits are underlain by River Terrace Deposits generally comprising firm to stiff consistency, medium to high strength sandy gravelly clays and medium dense sands. Lewes Nodular Chalk Formation were encountered below the River Terrace Deposits. The chalk deposits generally comprise gravelly clayey silt. Groundwater was recorded at depths of between 4.0 m and 4.9 m.

The ground investigation has not identified concentrations of substances in the ground that are considered harmful to end users of the proposed development type. Soils should be kept damp during groundworks undertaken in dry weather conditions to minimise the potential for dust in compliance with usual good practice. It is considered that there should be no unacceptable risks to controlled waters associated with the ground conditions at the site. The proposed development should not be constrained by issues relating to hazardous ground gases. It is noted that no remediation works are considered necessary for the proposed development.

Based on the recorded ground conditions, conventional strip/ trench-fill footings should be appropriate for the proposed development. However, an alternative solution is provided by piled foundations. Where access is available, a supplementary investigation, using trial pits and/or windowless sampling is recommended to allow further assessment of foundation depths. If piled are proposed then boreholes would also be necessary.

A suspended ground floor slab with an under slab void is recommended.

Shallow soakaway drainage is noted to be incompatible with the recorded low permeability ground conditions and is unlikely to be feasible.

REFERENCES

Site Specific References

Crossfield Consulting Limited (January 2016) *Desk Study Appraisal* Report No. CCL02814.CA27

Technical References

- BRE (2005) *Special Digest 1 – Concrete in aggressive ground*, CRC Ltd
- BRE (2015) *BR211 – Radon: Guidance on protective measures for new buildings* BRE Press
- BSI (2015) *BS 5930:2015 Code of Practice for Ground Investigations* British Standards Institution
- BSI (2013) *BS 10175:2011+A1:2013 Code of Practice for Investigation of Potentially Contaminated Sites* British Standards Institution
- BSI (2004) *BS EN1997-1:2004 Eurocode 7: Geotechnical Design – Part 1: General Rules* British Standards Institution
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- CIRIA (2001) *CIRIA C552 – Contaminated Land Risk Assessment: A Guide to Good Practice* Construction Industry Research Association
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- Department for Communities and Local Government (2012) *National Planning Policy Framework*
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- Environment Agency (2009) *Updated Technical Background to the CLEA Model Science Report SC050021/SR3* EA
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- Highways Agency (2009) *Interim Advice Note 73/06 Revision 1 – Design Guidance for Road Pavements (Draft HD25)* HA
- LQM/CIEH (2015) *The LQM/CIEH S4ULs for Human Health Risk Assessment* Land Quality Press, Nottingham
- NHBC (2016) *Standards* National House Building Council
- 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

Water UK (2014) Contaminated Land Assessment Guidance Water UK & Home Buildings Federation

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 2
(Page 1 of 2)

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

Determinand	Units	No of Tests	Concentration (mg/kg)		Generic Assessment Criteria (mg/kg) Residential Without Plant Uptake		Category 4 Screening Level (mg/kg) Residential Without Plant Uptake	
			Min	Max	Value	No>GAC	Value	No>C4SL
Arsenic	mg/kg	4	14	22	40 ¹	0	40 ⁴	0
Cadmium	mg/kg	4	<0.2	0.6	85 ¹	0	149 ⁴	0
Chromium (Total) ⁵	mg/kg	4	16	22	910 ¹	0	-	-
Chromium (VI)	mg/kg	4	<4.0	<4.0	6 ¹	0	21 ⁴	0
Lead	mg/kg	4	110	390	140 ²	3	310 ⁴	1
Inorganic Mercury	mg/kg	4	<0.3	<0.3	56 ¹	0	-	-
Nickel	mg/kg	4	16	20	180 ¹	0	-	-
Selenium	mg/kg	4	<1.0	<1.0	430 ¹	0	-	-
Copper	mg/kg	4	29	80	7100 ¹	0	-	-
Zinc	mg/kg	4	83	190	40,000 ¹	0	-	-
Boron	mg/kg	2	0.9	1.5	11,000 ¹	0	-	-
Phenols	mg/kg	2	<1.0	<1.0	440 ¹	0	-	-
pH	-	7	6.6	7.7	-	-	-	-
Total Organic Carbon	%	2	1.0	1.2	-	-	-	-
Petroleum Hydrocarbons								
PRO C ₆ – C ₁₀	mg/kg	2	<0.1	<0.1	65 ⁶	0	-	-
DRO C ₁₀ – C ₂₅	mg/kg	2	10	25	330 ⁶	0	-	-
MRO C ₂₅ – C ₄₀	mg/kg	2	<10	< 10	1900 ⁶	0	-	-
VOCs								
Benzene	mg/kg	2	<1.0	<1.0	0.70 ¹	0	3.3 ⁴	0
Toluene	mg/kg	2	<1.0	<1.0	1900 ¹	0	-	-
Ethylbenzene	mg/kg	2	<1.0	<1.0	190 ¹	0	-	-
Xylene	mg/kg	2	<1.0	<1.0	180 ¹	0	-	-
MTBE	mg/kg	2	<1.0	<1.0	120 ³	0	-	-

TABLE 2
(Page 2 of 2)

Determinand	Units	No of Tests ⁶	Concentration (mg/kg)		Generic Assessment Criteria (mg/kg) Residential Without Plant Uptake		Category 4 Screening Level (mg/kg) Residential Without Plant Uptake	
			Min	Max	Value	No>GAC	Value	No>C4SL
PAHs								
Naphthalene	mg/kg	4	<0.05	0.24	5.6 ¹	0	-	-
Acenaphthylene	mg/kg	4	<0.10	0.64	4600 ¹	0	-	-
Acenaphthene	mg/kg	4	<0.10	<0.10	4700 ¹	0	-	-
Fluorene	mg/kg	4	<0.10	0.17	1600 ¹	0	-	-
Phenanthrene	mg/kg	4	0.20	3.8	1500 ¹	0	-	-
Anthracene	mg/kg	4	<0.10	0.94	35,000 ¹	0	-	-
Fluoranthene	mg/kg	4	0.56	13	1600 ¹	0	-	-
Pyrene	mg/kg	4	0.49	11	3800 ¹	0	-	-
Benz(a)anthracene	mg/kg	4	0.28	7.9	14 ¹	0	-	-
Chrysene	mg/kg	4	0.28	6.6	31 ¹	0	-	-
Benzo(b)fluoranthene	mg/kg	4	0.28	6.3	4.0 ¹	1	-	-
Benzo(k)fluoranthene	mg/kg	4	0.26	5.9	110 ¹	0	-	-
Benzo(a)pyrene	mg/kg	4	0.24	7.0	3.2 ¹	1	5.3 ⁴	1
Indeno(123cd)pyrene	mg/kg	4	0.20	4.0	46 ¹	0	-	-
Dibenzo(ah)anthracene	mg/kg	4	<0.10	1.5	0.32 ¹	1	-	-
Benzo(ghi)perylene	mg/kg	4	0.21	4.5	360 ¹	0	-	-

NOTES

1. Suitable for Use Level (S4UL) published by LQM/CIEH, 2015 – Residential Without Plant Uptake landuse. S4UL assumptions comprise 2.5% soil organic matter, soil pH of 7 and sandy loam soil type. S4ULs are copyright © Land Quality Management Limited reproduced with permission; Publication Number S4UL3133.
2. Generic assessment criteria (GAC) for lead calculated using CLEA Software version 1.06 (Environment Agency, 2009) with a lead intake based on a target blood level of 3.5 µg/dL. Other model assumptions comprise 2.5% soil organic matter, soil pH of 7 and sandy loam soil type.
3. Soil GAC for Human Health Risk Assessment produced by CL:AIRE (2010) – Residential Without Plant Uptake. Assumption of 2.5% soil organic matter.
4. Category 4 Screening Level (C4SL), Department for Environment Food and Rural Affairs (March 2014)
5. 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 confirmed by laboratory testing), total chromium concentrations have been compared to the GAC for chromium (III).
6. PRO: petrol range organics. DRO: diesel range organics. MRO: mineral oil range organics. GAC presented against these organic ranges is the lowest of the aromatic or aliphatic GAC relevant to that organic range. Aromatic and aliphatic fraction GAC values are presented for reference.
7. For determinands that exceed the GAC and C4SL, site specific assessment criteria are derived in Appendix II.

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
Probability (P)	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
	Unlikely (UL)	Moderate/Low Risk	Low Risk	Very 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				
Heavy metals PAHs	Dermal contact (dust), Ingestion (dust), Inhalation (dust and vapours)	End Users	Lead identified above the GAC and C4SL. Benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene above GAC and C4SL (where applicable) All other potential contaminants are below GAC	Yes Yes	Med Med	LL LL	Mod/Low Mod/Low	Yes, site specific criteria prepared using CLEA v1.071. All concentrations of lead, Benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene are below the Site Specific Assessment Criteria (SSAC)	Not applicable	Not applicable	No
Asbestos	Inhalation of fibres		No asbestos identified	No	n/a	n/a	n/a	Not applicable			
Heavy metals PAHs	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	Standard personal protective equipment is recommended as good practice. Conventional dust control and soil dampening to be used during construction	To be confirmed during construction phase	No
Asbestos	Inhalation of fibres		No asbestos identified	No	n/a	n/a	n/a				
Heavy metals PAHs	Dermal contact (dust), Ingestion (dust), Inhalation (dust and vapours)	Neighbours/ general public	Lead identified above the GAC and C4SL. Benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene above GAC and C4SL (where applicable) All other potential contaminants are below GAC	Yes No	Med n/a	UL n/a	Low n/a	Not applicable	Dust-suppression and soil dampening measures to be provided during construction works to mitigate potential airborne migration of dust from site	To be confirmed during construction	No
Asbestos	Inhalation of fibres		No asbestos identified	No	n/a	n/a	n/a	Not applicable			
Phytotoxic Metals	Plant Uptake	Landscaped Plantings	No phytotoxic metals identified at concentrations that may be a risk to plant growth based on BS 3882:2015	No	n/a	n/a	n/a	Not applicable	Not applicable	Not applicable	No

FIGURES

FIGURE 1



SITE LOCATION PLAN

Scale 1: 50,000

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FIGURE 2

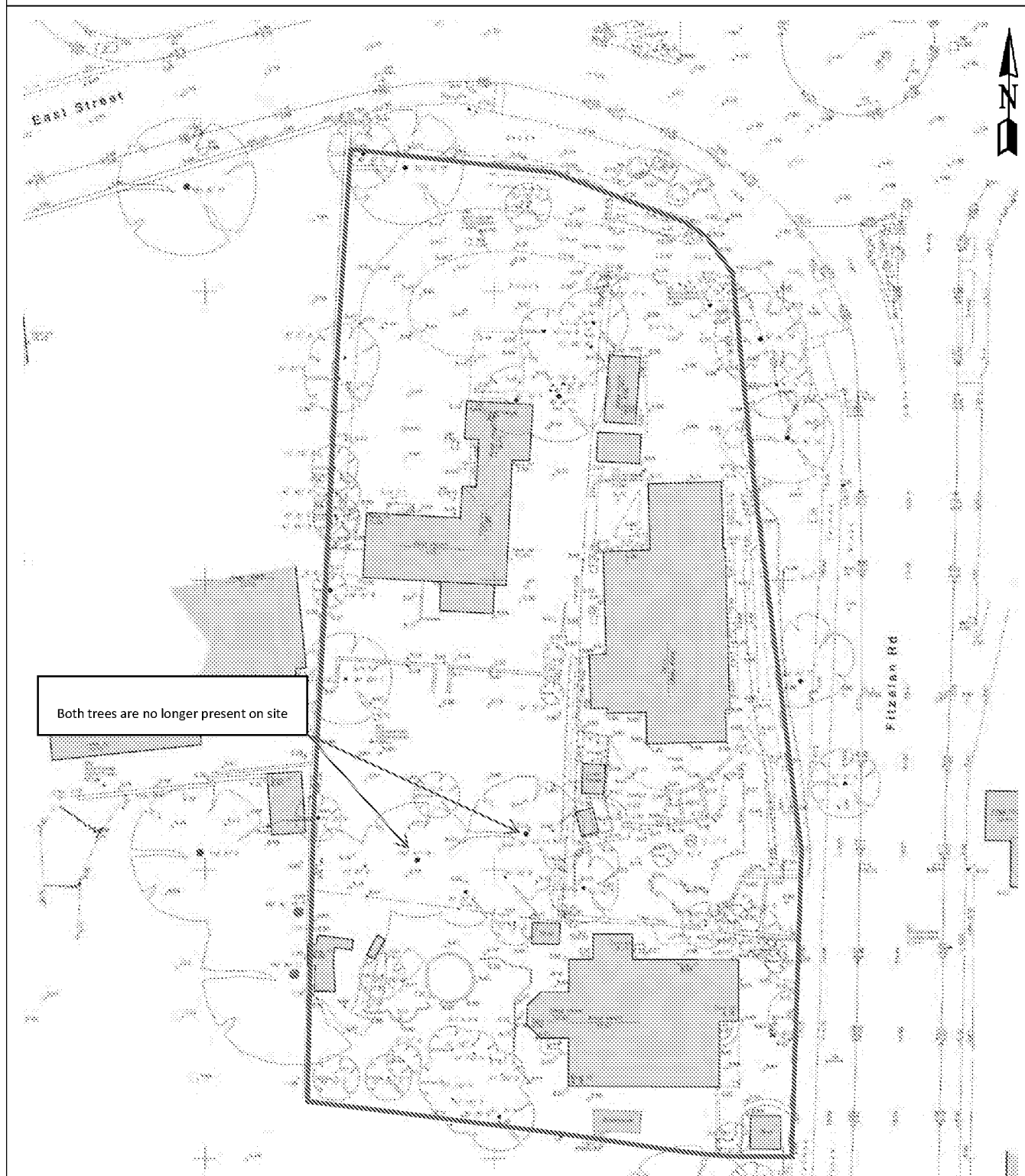


SITE PLAN

Scale 1:1250

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FIGURE 3

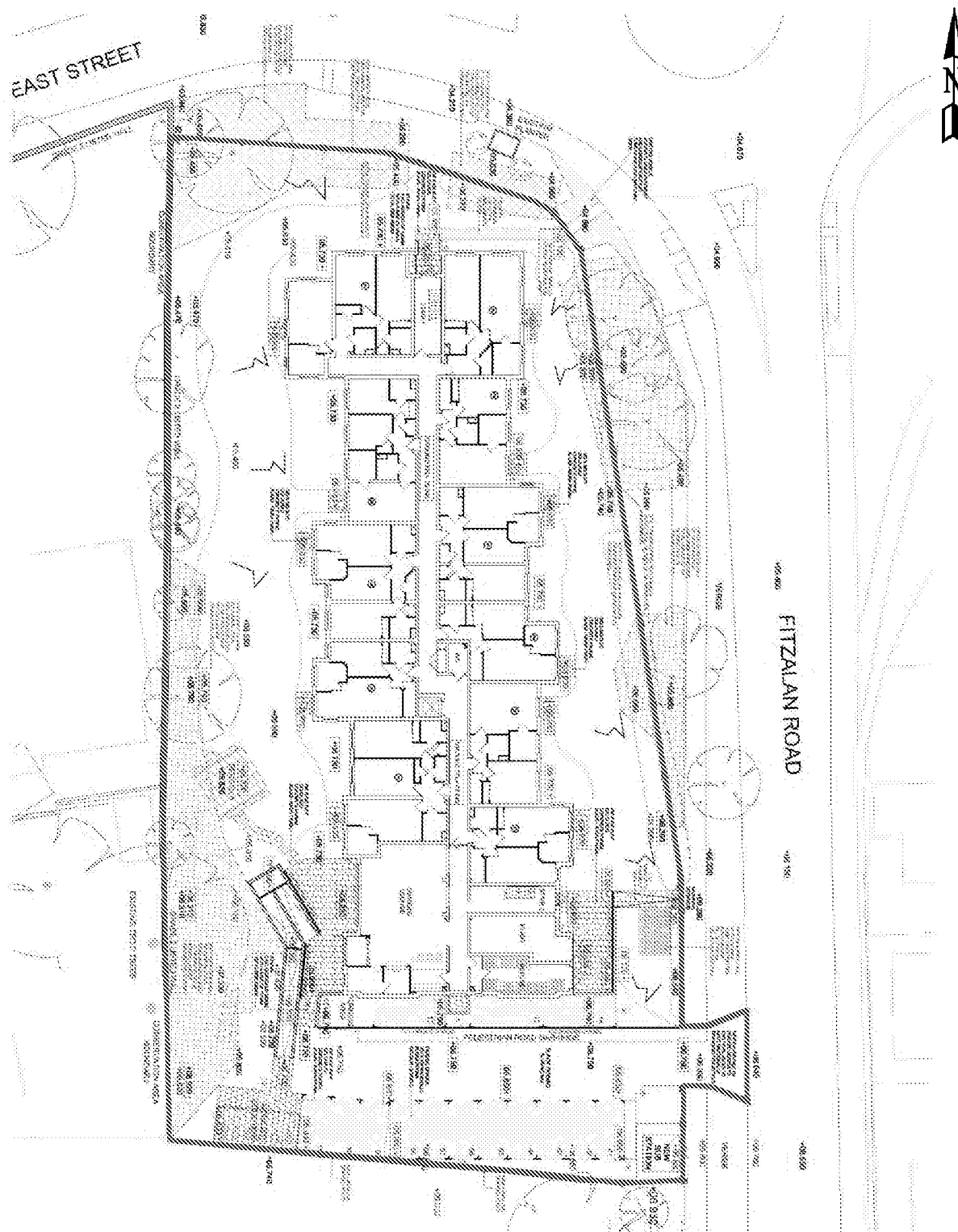


TOPOGRAPHICAL SURVEY PLAN

Scale 1:500

Reproduced from the January 2016 1:200 scale Drawing No. SU-01 produced by D&H Surveys

FIGURE 4



PROPOSED DEVELOPMENT PLAN

Scale 1:500

Reproduced from the November 2016 1:200 scale Drawing No. 200651 H:206 produced by planning issues

APPENDIX I

APPENDIX I – GROUND INVESTIGATION

Introduction

This Appendix, together with Sections 2 to 5 of the report, forms the Ground Investigation Report for the development described in the report, in compliance with the requirements of BS 5930:2015, BS EN1997-1:2004(2007) and BS EN1997-2:2007(2007).

The site operations were carried out on Wednesday 15th February 2017 under the supervision of a geotechnical engineer from Crossfield Consulting Limited. 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 geoenvironmental 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 and the data are summarised on Figure I-1. 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-2.

Windowless Sampling

Five windowless sampling boreholes, denoted as WS1 to WS5, were sunk by Dynamic Sampling UK Limited on Wednesday 15th February 2017 to a depth of 5 m. 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.

In situ hand vane tests were carried out on fine-grained soils, where appropriate, to provide undrained shear strength data representative of the tested horizon. The tests were carried out using Pilcon hand vane test equipment (with extension rods, where necessary).

Standard Penetration Tests (SPT) were carried out at regular intervals to provide data on the in situ density of coarse-grained strata and an indication of strength within fine-grained 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).

Dynamic probing tests were carried out in locations WS1 and WS3 to provide data on the in situ density of coarse-grained strata and an indication of strength within fine-grained strata. The probing complied with the “super heavy” specification (DPSH), as defined in BS EN ISO 22476-2:2005. The probing test results are presented in this Appendix.

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.

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 |
| • Asbestos (ACM and Fibre Screen) | |

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

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

- Polyaromatic Hydrocarbons – using GC-MS techniques

The analyses were carried out by i2 Analytical Limited, 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).

Selected samples of the soils encountered were submitted for Waste Acceptance Criteria Tests (WAC) and waste classification tests:

Arsenic (dissolved)	Molybdenum (dissolved)	Chloride
Barium (dissolved)	Nickel (dissolved)	Fluoride
Cadmium (dissolved)	Lead (dissolved)	Sulphate as SO ₄
Chromium (dissolved)	Antimony (dissolved)	Dissolved Solids
Copper (dissolved)	Selenium (dissolved)	Phenol Index (monohydric)
Mercury (dissolved)	Zinc (dissolved)	Dissolved Organic Carbon
Arsenic (Total)	Copper (Total)	TPH bands (C ₆ -C ₁₀ /C ₁₀ -C ₂₅ /C ₂₅ -C ₄₀)
Cadmium (Total)	Nickel (Total)	BTEX *
Lead (Total)	Zinc (Total)	PCB # - Total (7 Congeners)
Chromium (Total)	Cyanide (total)	PAH - (WAC 17) ^Δ
Mercury (Total)	Total Organic Carbon (TOC)	Acid Neutralisation Capacity
Selenium (Total)	Loss on Ignition @ 450°C	pH

- * BTEX: Benzene, Ethylbenzene, Toluene, Xylenes and Methyl tertiary-butyl ether (MTBE)
- # PCB: Polychlorinated biphenyl (congener Nos. 28, 52, 101, 118, 138, 153, 180)
- Δ PAH: Polyaromatic Hydrocarbons (17No. compounds from WAC criteria)

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 GEO Site & Testing Services, a UKAS accredited laboratory, and the results are presented in this Appendix.

TABLE I-1

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 the investigation works were constrained by access restrictions, particularly within the No. 35 Fitzalan Road property.

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+A1:2013 and BS 5930:2015, 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 – WS5	Exploratory holes located within or close to the proximity of the footprint of the proposed building to provide information on foundations, assess potential contamination to soils and provide information of groundwater levels.	5.0 m	Representative Made Ground samples recovered for analytical testing Samples of potential founding strata recovered for geotechnical testing Standard Penetration Tests undertaken at selected depth intervals In-situ hand shear vane tests were undertaken to provide undrained shear strength data of fine grained strata
DP1 & DP3	Dynamic Probing was carried out at the base of WS1 & WS3 to provide additional data on the in situ density of coarse-grained strata and an indication of strength within fine-grained strata	7.0 m	In situ measurements of sand relative density using DPSH method

Key

WS X	Windowless Sample Borehole
DP X	Dynamic Probe

TABLE I-2

RATIONALE FOR THE ANALYTICAL TESTING SUITE

Exploratory Hole and Samples	Selection Criteria	Analytical Tests
WS3 0.05 - 0.40 m WS5 0.10 - 0.60 m	Representative samples of shallow Made Ground to assess for potential contaminants that may be present on site based on desk study information and ground investigation observations.	Metals (total): As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, Cyanide (total), cyanide (total), pH, phenol, sulphate (water soluble and total), sulphide, total organic carbon Asbestos (ACM & Fibre Screen) Polyaromatic Hydrocarbons (PAHs)
WS1 0.05 - 0.50 m WS4 0.30 - 0.60 m	Samples were recovered from the near-surface soils to assess the presence of any potential contaminants. Scheduled testing permits possible waste to be classified and landfill acceptance to be determined.	Two-stage Eluate test: (BS EN 12457-3) Dissolved As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn, Cl, F, SO ₄ , Dissolved Solids, Phenols (monhydric), total organic carbon Solid suite: Metals (total): As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, Cyanide (total), Petroleum Hydrocarbons (3 band, C6-C10-C25-C40), pH, Loss on Ignition, total organic carbon, PCBs (total), BTEX (total), ANC, PAH WAC 17 speciated Asbestos (ACM & Fibre Screen)

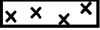
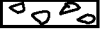
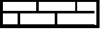
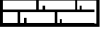
TABLE I-3

RATIONALE FOR THE GEOTECHNICAL TESTING SUITE

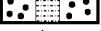
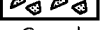
Exploratory Hole and Sample	Selection Criteria	Geotechnical Tests
WS1 1.80 - 2.00 m WS2 1.30 - 1.65 m WS5 1.70 - 1.90 m	Representative samples of potential founding strata recovered to undertake testing to aid concrete design classification	pH Water soluble sulphate
WS1 1.80 - 2.00 m WS2 1.30 - 1.65 m WS3 1.50 - 1.70 m WS4 1.00 - 1.45 m WS5 1.70 - 1.90 m	Representative samples of potential founding strata recovered to undertake testing to aid foundation design	Moisture content Atterberg Limits

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 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)
	$\frac{x}{y}$	x Blows per y Driving Distance (for non-standard SPT or DP driving distance)
	y mm	
	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.

					Windowless Sample Record Sheet					Hole Ref. WS1	
					Project: East Street/ Fitzalan Road, Littlehampton					Sheet 1 of 1	
					Date: 15/02/2017					Job No. CCL02814	
Contractor Dynamic Sampling Ltd			Equipment Premier Compact 110			Ground Level. 5.45 m OD					
Method 0.0 m to 5.0 m windowless sampling								Co-ordinates			
Boring Diameter 100 mm								Logged by: TW Logged on site during drilling operations Checked by: <i>JH</i>			
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.		
0.05 - 0.50	Gg JJ				Brown slightly gravelly sandy silty clay with rootlets. Rare brick fragments and ash (MADE GROUND)	0.30			5.15		
0.90	C _{iv} * / J			35 kPa	Soft to firm consistency brown slightly gravelly slightly sandy clay. Rare ash, glass and ceramic fragments (MADE GROUND)	0.50			4.95		
1.00 - 1.45	S	-	Dry	N = 4	Soft to firm consistency brown slightly gravelly very silty CLAY. Rare sand. Gravel is fine to coarse grained flint (BRICEARTH) ... becomes firm consistency below 0.9 m	1.70			3.75		
1.80 - 2.00	J				Firm to stiff consistency orangish yellowish brown mottled sandy gravelly CLAY. Frequent fine to medium grained sand pockets. Gravel is fine to coarse grained flint.	3.00			2.45		
2.00 - 2.45	S	-	Dry	N = 16	(RIVER TERRACE DEPOSITS)						
3.00 - 3.45	S	-	Dry	N = 12							
3.60 - 4.00	J				Structureless CHALK composed of cream gravelly clay. Clasts are very weak low density (LEWES NODULAR CHALK FORMATION) (Grade Dm)						
4.00 - 4.45	S	-	4.20	N = 5							
					End of windowless sample	5.00			0.45		
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%			4.20 m						
1.00-2.00		100%									
2.00-3.00		100%									
3.00-4.00		100%									
4.00-5.00		100%									
Remarks						Notes					
Ground levels estimated from Drawing No. SU-01 by D&H Solutions						1. All logging and sampling in accordance with BS 5930:2015					
Dynamic probing from 5.00 m to 7.00 m						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	
Contractor Dynamic Sampling Ltd Equipment Premier Compact 110 Method 0.0 m to 5.0 m windowless sampling Boring Diameter 100 mm						Project: East Street/ Fitzalan Road, Littlehampton Date: 15/02/2017		Sheet 1 of 1 Job No. CCL02814	
						Ground Level. 5.60 m OD Co-ordinates Logged by: TW Logged on site during drilling operations Checked by: <i>DM</i>			
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.05 - 0.40	Gg JJ				Brown slightly sandy gravelly silty clay with rootlets brick and coal fragments and ash (MADE GROUND)				
						0.50			5.10
1.00 - 1.45	S	-	Dry	N = 9	Soft to firm consistency brown slightly gravelly CLAY. Gravel comprises fine to coarse grained angular flint with rootlets (BRICEARTH)	0.80			4.80
1.30 - 1.50	J				Firm consistency light brown mottled orange sandy CLAY (RIVER TERRACE DEPOSITS) ... becomes firm to stiff consistency with rare flint gravel below 1.0 m	1.30			4.30
2.00 - 2.45	S	-	Dry	N = 15	Stiff consistency yellowish orangish brown mottled slightly gravelly sandy CLAY (RIVER TERRACE DEPOSITS)	2.70			2.90
3.00 - 3.45	S	-	Dry	N = 12	Medium dense yellowish orangish brown fine to medium grained SAND (RIVER TERRACE DEPOSITS) ... becomes greyish yellowish brown below 3.0 m	3.90			1.70
4.00 - 4.45	S	-	Dry	N = 24	Medium dense yellowish light brown sandy gravelly CLAY. Gravel of sandstone and chalk (RIVER TERRACE DEPOSITS)				
5.00 - 5.45	S	-	4.50	N = 20	End of windowless sample	5.00			0.60
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%			4.50 m					
1.00-2.00	100%								
2.00-3.00	100%								
3.00-4.00	100%								
4.00-5.00	100%								
Remarks						Notes			
Ground levels estimated from Drawing No. SU-01 by D&H Solutions						1. All logging and sampling in accordance with BS 5930:2015 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	
Contractor Dynamic Sampling Ltd Equipment Premier Compact 110 Method 0.0 m to 5.0 m windowless sampling Boring Diameter 100 mm						Project: East Street/ Fitzalan Road, Littlehampton Date: 15/02/2017			Sheet 1 of 1 Job No. CCL02814	
						Ground Level. 6.00 m OD Co-ordinates Logged by: TW Logged on site during drilling operations Checked by: <i>JH</i>				
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.	
0.05 - 0.40	Gg JJ				Brown slightly gravelly slightly sandy silty clay with rootlets. Slightly ashy (MADE GROUND)	0.40			5.60	
					Soft to firm consistency slightly gravelly silty CLAY. Gravel comprises fine to coarse grained angular flint (BRICEARTH)	0.70			5.30	
1.00 - 1.45	S	-	-	N = 7	 becomes firm consistency below 0.6 m Firm consistency greyish orangish brown mottled silty CLAY (BRICEARTH)	1.00			5.00	
1.50 - 1.70	J				Firm consistency greyish orangish brown sandy gravelly CLAY. Gravel comprises fine to coarse grained sub rounded to angular flint gravel (RIVER TERRACE DEPOSITS)					
1.70 - 1.80	J				... becomes stiff consistency below 1.5 m	1.70			4.30	
2.00 - 2.45	S	-	-	N = 9	Stiff consistency organish brown slightly gravelly very sandy CLAY. Gravel comprises fine to coarse grained flint (RIVER TERRACE DEPOSITS)	2.40			3.60	
3.00 - 3.45	S	-		N = 26	Structureless CHALK composed of cream gravelly clayey silt. Clasts are very weak low density (LEWES NODULAR CHALK FORMATION) (Grade Dm)					
4.00 - 4.45	S	-	-	N = 34	... becomes yellowish brown below 4.0 m					
4.50 - 4.70	J				... becomes creamish light brown below 4.5 m					
End of windowless sample						5.00			1.00	
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%					Dry			
1.00-2.00		100%								
2.00-3.00		100%								
3.00-4.00		100%								
4.00-5.00		100%								
Remarks						Notes				
Ground levels estimated from Drawing No. SU-01 by D&H Solutions Dynamic probing from 5.00 m to 7.00 m						1. All logging and sampling in accordance with BS 5930:2015 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				

Contractor	Dynamic Sampling Ltd	Equipment	Premier Compact 110
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Ground Level.	5.75 m OD
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Method	0.0 m to 5.0 m windowless sampling
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Co-ordinates

Boring Diameter 100 mm

Logged by:	TW	Logged on site during
		drilling operations

Checked by: *DL*

Checked by: DL drilling operations

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.30 - 0.60	Gg JJ				CONCRETE	0.15			5.60
					Greyish brown sandy fine to coarse grained angular flint gravel (MADE GROUND)	0.30			5.45
					Soft consistency brown slightly gravelly slightly sandy silty clay. Rare ash and glass fragments (MADE GROUND)	0.60			5.15
					Soft to firm consistency brown silty CLAY (BRICKEARTH)	0.80			4.95
1.00 - 1.45	S	-	Dry	N = 10	Firm consistency orangish yellowish brown very sandy CLAY (RIVER TERRACE DEPOSITS)	1.00			4.75
					Stiff consistency greyish orangish brown slightly gravelly sandy CLAY. Gravel comprises fine to medium grained angular flint (RIVER TERRACE DEPOSITS)				
2.00 - 2.45	S	-	-	N = 19	... becomes thinly laminated below 1.7 m				
3.00 - 3.45	S	-	-	N = 17	Medium dense orangish brown fine to medium grained SAND (RIVER TERRACE DEPOSITS)	2.60			3.15
					... becomes greyish yellowish brown below 2.8 m				
4.00 - 4.45	S	-	4.00	N = 14	Structureless CHALK composed of cream gravelly clayey silt. Clasts are weak low density (LEWES NODULAR CHALK FORMATION) (Grade Dm)	3.10			2.65
4.50 - 5.00	J				... becomes yellowish light brown with flint gravel between 4.40 m and 4.70 m				
5.00 - 5.45	S	-	4.00	N = 17	End of windowless sample	5.00			0.75

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%		4.00 m					
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	100%							
4.00-5.00	100%							

Remarks
Ground levels estimated from Drawing No. SU-01 by D&H Solutions

Notes
1. All logging and sampling in accordance with BS 5930:2015
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

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.10 - 0.50	Gg J				Dark brown slightly gravelly slightly sandy silty clay with rootlets. Rare ash and brick fragments (MADE GROUND)				
0.90	C _{IV} *					0.50			5.90
1.00 - 1.45	S	-	Dry	55 kPa N = 7	Firm consistency brown slightly gravelly silty CLAY. Gravel comprises fine to medium angular flint (BRICKEARTH) ... becomes firm consistency below 0.8 m	1.00			5.40
					Firm consistency orangish yellowish brown very sandy CLAY. Rare flint gravel (RIVER TERRACE DEPOSITS) ... becomes stiff consistency below 1.3 m	1.50			4.90
1.70 - 1.90	J								
1.80	C _{IV} *			100 kPa	Stiff consistency slightly gravelly sandy CLAY. Gravel is fine to coarse grained angular to rounded flint (RIVER TERRACE DEPOSITS)	2.00			4.40
1.90	C _{IV} *			110 kPa					
2.00 - 2.45	S	-	Dry	N = 17	Very stiff consistency orangish yellowish brown very sandy CLAY. Rare flint gravel (RIVER TERRACE DEPOSITS)				
3.00 - 3.45	S	-	Dry	N = 15		3.55			
4.00 - 4.45	S	-	Dry	N = 11	Medium dense yellowish orangish light brown slightly clayey slightly gravelly SAND (RIVER TERRACE DEPOSITS)	4.70			1.70
5.00 - 5.45	S	-	Dry	N = 10	Structureless CHALK composed of cream gravelly sandy silt. Clasts are very weak low density (LEWES NODULAR CHALK FORMATION) (Grade Dm) End of windowless sample	5.00			1.40

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%		4.90 m					
1.00-2.00	100%							
2.00-3.00	100%							
3.00-4.00	100%							
4.00-5.00	100%							

Remarks	Notes
Ground levels estimated from Drawing No. SU-01 by D&H Solutions	1. All logging and sampling in accordance with BS 5930:2015 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

Dynamic Probe Record Sheet

Hole Ref.	DP1
Sheet:	2 of 2
Job No.	CCL02814
5.45 m OD	
Co-ordinates:	
Plotted by:	TW
Checked by:	<i>DL</i>

Contractor:	Dynamic Sampling UK Limited	Equipment:	Premier Compact 110
Method:	Dynamic Probing		
Probing Specification:	DPSH-B		

Depth (m)	Blow Count	Blow Count Plot					Depth	Legend	Level O.D.
5.0-5.1	1								
5.1-5.2	1								
5.2-5.3	2								
5.3-5.4	2								
5.4-5.5	2								
5.5-5.6	1								
5.6-5.7	3								
5.7-5.8	1								
5.8-5.9	1								
5.9-6.0	1								
6.0-6.1	4								
6.1-6.2	3								
6.2-6.3	1								
6.3-6.4	2								
6.4-6.5	1								
6.5-6.6	2								
6.6-6.7	1								
6.7-6.8	2								
6.8-6.9	2								
6.9-7.0	3								
7.0-7.1									
7.1-7.2									
7.2-7.3									
7.3-7.4									
7.4-7.5									
7.5-7.6									
7.6-7.7									
7.7-7.8									
7.8-7.9									
7.9-8.0									
8.0-8.1									
8.1-8.2									
8.2-8.3									
8.3-8.4									
8.4-8.5									
8.5-8.6									
8.6-8.7									
8.7-8.8									
8.8-8.9									
8.9-9.0									
9.0-9.1									
9.1-9.2									
9.2-9.3									
9.3-9.4									
9.4-9.5									
9.5-9.6									
9.6-9.7									
9.7-9.8									
9.8-9.9									
9.9-10.0									

Remarks

Dynamic probing continued from base of windowless sampling hole in WS1
Ground levels estimated from Drawing No. SU-01 by D&H Solutions

Notes

1. Strata interpretations and depths to strata change are approximate only and are based on correlation with borehole records for the site
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated

Dynamic probing undertaken in accordance with BS EN 22476-2:2005

Dynamic Probe Record Sheet

Hole Ref.	DP3
Sheet:	2 of 2
Job No.	CCL02814
6.00 m OD	
Co-ordinates:	
Plotted by:	TW
Checked by:	<i>DL</i>

Contractor:	Dynamic Sampling UK Limited	Equipment:	Premier Compact 110
Method:	Dynamic Probing		
Probing Specification:	DPSH-B		

Depth (m)	Blow Count	Blow Count Plot					Depth	Legend	Level O.D.
5.0-5.1	3								
5.1-5.2	8								
5.2-5.3	7								
5.3-5.4	6								
5.4-5.5	5								
5.5-5.6	6								
5.6-5.7	6								
5.7-5.8	4								
5.8-5.9	4								
5.9-6.0	4								
6.0-6.1	4								
6.1-6.2	4								
6.2-6.3	4								
6.3-6.4	3								
6.4-6.5	3								
6.5-6.6	4								
6.6-6.7	2								
6.7-6.8	2								
6.8-6.9	3								
6.9-7.0	3								
7.0-7.1									
7.1-7.2									
7.2-7.3									
7.3-7.4									
7.4-7.5									
7.5-7.6									
7.6-7.7									
7.7-7.8									
7.8-7.9									
7.9-8.0									
8.0-8.1									
8.1-8.2									
8.2-8.3									
8.3-8.4									
8.4-8.5									
8.5-8.6									
8.6-8.7									
8.7-8.8									
8.8-8.9									
8.9-9.0									
9.0-9.1									
9.1-9.2									
9.2-9.3									
9.3-9.4									
9.4-9.5									
9.5-9.6									
9.6-9.7									
9.7-9.8									
9.8-9.9									
9.9-10.0									

Remarks

Dynamic probing continued from base of windowless sampling hole in WS3

Ground levels estimated from Drawing No. SU-01 by D&H Solutions

Notes

1. Strata interpretations and depths to strata change are approximate only and are based on correlation with borehole records for the site
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated

Dynamic probing undertaken in accordance with BS EN 22476-2:2005



Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

Dynamic sampling uk ltd
6-8 victory parkway
victory road
Derby
DE24 8ZF

Hammer Ref: 110.45.LT
Test Date: 27/06/2016
Report Date:
File Name: 110.45.LT.spt
Test Operator: TP

Instrumented Rod Data

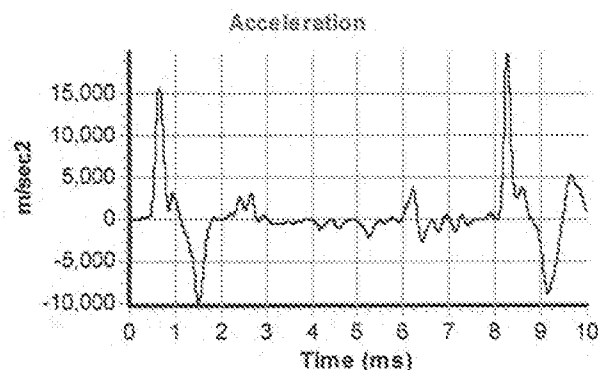
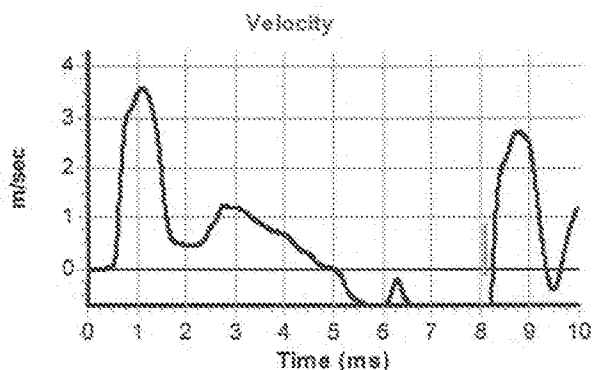
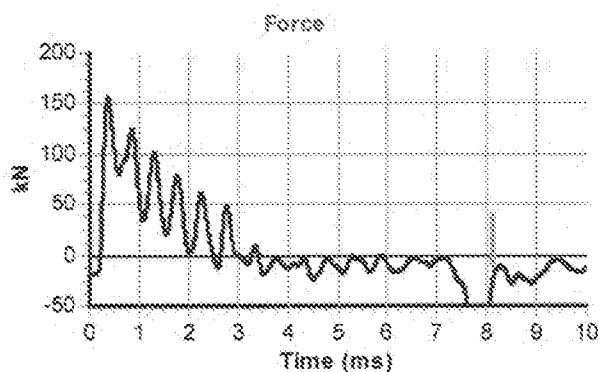
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.9
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 6455
Accelerometer No.2: 6457

Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
String Length L (m): 15.0

Comments / Location

Hammer tested at Dynamic samplings yard.



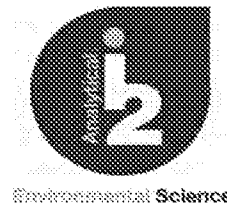
Calculations

Area of Rod A (mm^2): 1021
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 346

Energy Ratio E_r (%): **73**

Signed: A.parker
Title: Manager

The recommended calibration interval is 12 months

**Thomas Warley**

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

e: TW@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 : 17-40593

Project / Site name:	38 and 40 East Street and 35 Fitzalan Road, Littlehampton	Samples received on:	16/02/2017
Your job number:	CCL02814	Samples instructed on:	20/02/2017
Your order number:	PO9925	Analysis completed by:	01/03/2017
Report Issue Number:	1	Report issued on:	01/03/2017
Samples Analysed:	4 soil samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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

Analytical Report Number: 17-40593

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

Your Order No: PO9925

Lab Sample Number				706045	706046	706047	706048	
Sample Reference				WS1	WS3	WS4	WS5	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.05-0.50	0.05-0.40	0.30-0.60	0.10-0.50	
Date Sampled				15/02/2017	15/02/2017	15/02/2017	15/02/2017	
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	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	17	17	16	15	
Total mass of sample received	kg	0.001	NONE	2.0	1.7	2.0	2.0	

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	
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General Inorganics

pH - Manual	pH Units	N/A	MCERTS	6.6	-	7.2	-	
pH - Automated	pH Units	N/A	MCERTS	-	6.6	-	7.1	
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	320	-	280	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	0.015	-	0.0051	
Sulphide	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	
Total Sulphur	mg/kg	50	MCERTS	-	210	-	190	
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.1	1.2	1.0	1.2	
Loss on Ignition @ 450°C	%	0.2	MCERTS	4.5	-	4.2	-	
Acid Neutralisation Capacity	+/- mol/kg	-999	NONE	-2.0	-	1.2	-	

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.24	
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	0.64	
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	
Fluorene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	0.17	
Phenanthrene	mg/kg	0.1	MCERTS	0.58	0.20	0.49	3.8	
Anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	0.94	
Fluoranthene	mg/kg	0.1	MCERTS	1.4	0.56	1.2	13	
Pyrene	mg/kg	0.1	MCERTS	1.5	0.49	1.0	11	
Benzo(a)anthracene	mg/kg	0.1	MCERTS	0.81	0.28	0.58	7.9	
Chrysene	mg/kg	0.05	MCERTS	0.72	0.28	0.55	6.6	
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.67	0.28	0.55	6.3	
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	0.64	0.26	0.41	5.9	
Benzo(a)pyrene	mg/kg	0.1	MCERTS	0.84	0.24	0.49	7.0	
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	0.48	0.20	0.31	4.0	
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	1.5	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.62	0.21	0.38	4.5	
Coronene	mg/kg	0.05	NONE	< 0.05	-	< 0.05	-	

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	-	3.00	-	73.8	
Total WAC-17 PAHs	mg/kg	1.6	NONE	8.3	-	6.0	-	

Analytical Report Number: 17-40593

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

Your Order No: PO9925

Lab Sample Number				706045	706046	706047	706048	
Sample Reference				WS1	WS3	WS4	WS5	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.05-0.50	0.05-0.40	0.30-0.60	0.10-0.50	
Date Sampled				15/02/2017	15/02/2017	15/02/2017	15/02/2017	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	20	22	14	
Boron (water soluble)	mg/kg	0.2	MCERTS	-	0.9	-	1.5	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.6	< 0.2	
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	19	18	22	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	29	80	34	36	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	110	150	390	200	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	16	20	20	17	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	96	83	190	140	

Monoaromatics

Benzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Toluene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
p & m-xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
o-xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	

Petroleum Hydrocarbons

Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	< 0.1	-	< 0.1	-	
TPH (C10 - C25)	mg/kg	10	MCERTS	10	-	25	-	
TPH (C25 - C40)	mg/kg	10	NONE	< 10	-	< 10	-	

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	< 0.007	-	< 0.007	-	
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Analytical Report Number : 17-40593

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

* 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 loam (MCERTS) soil types. Data for unaccredited types of solid 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 *
706045	WS1	None Supplied	0.05-0.50	Brown loam and clay with gravel.
706046	WS3	None Supplied	0.05-0.40	Brown loam and clay with gravel and vegetation.
706047	WS4	None Supplied	0.30-0.60	Brown loam and clay with gravel.
706048	WS5	None Supplied	0.10-0.50	Brown loam and clay with gravel.

Analytical Report Number : 17-40593

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

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
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance"	L046-UK	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
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
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L047-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 2, 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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	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
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
PRO (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS

Iss No 17-40593-1 38 and 40 East Street and 35 Fitzalan Road, Littlehampton CCL02814



Analytical Report Number : 17-40593

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

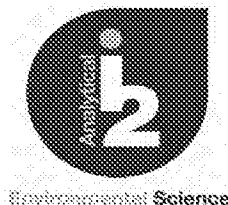
Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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	MCERTS
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	MCERTS
TPH Oils (Soils)	Determination of extractable hydrocarbons in soil by GC-MS/FID.	In-house method	L076-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 30oC.



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

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

e: TW@crossfield-consulting.co.uk

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

Analytical Report Number : 17-40597

Project / Site name:	38 and 40 East Street and 35 Fitzalan Road, Littlehampton	Samples received on:	16/02/2017
Your job number:	CCL02814	Samples instructed on:	20/02/2017
Your order number:	PO9925	Analysis completed by:	01/03/2017
Report Issue Number:	1	Report issued on:	01/03/2017
Samples Analysed:	2 wac multi samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

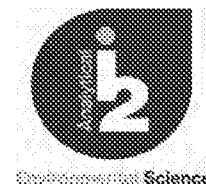
Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

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

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

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i2 Analytical

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

Telephone: 01923 225404

Fax: 01923 237404

email:reception@i2analytical.com

Waste Acceptance Criteria Analytical Results

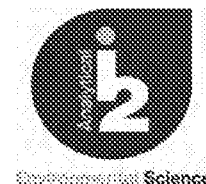
Report No:	17-40597						
					Client: CROSSFCLTD		
Location	38 and 40 East Street and 35 Fitzalan Road, Littlehampton						
Lab Reference (Sample Number)	706067			Landfill Waste Acceptance Criteria			
Sampling Date	15/02/2017			Limits			
Sample ID	WS1			Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	
Depth (m)	0.05-0.50						
Solid Waste Analysis							
TOC (%)**	-			3%	5%	6%	
Loss on Ignition (%) **	-			--	--	10%	
BTEX (µg/kg) **	-			6000	--	--	
Sum of PCBs (mg/kg) **	-			1	--	--	
Mineral Oil (mg/kg) #	-			500	--	--	
Total PAH (WAC-17) (mg/kg)	-			100	--	--	
pH (units)**	-			--	>6	--	
Acid Neutralisation Capacity (mol / kg)	-			--	To be evaluated	To be evaluated	
Eluate Analysis							
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)	2:1	8:1		Cumulative 10:1	Limit values for compliance leaching test		
	mg/l	mg/l		mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.010	< 0.010		< 0.050	0.5	2	25
Barium *	0.013	< 0.0050		< 0.020	20	100	300
Cadmium *	< 0.0005	< 0.0005		< 0.0020	0.04	1	5
Chromium *	0.0038	< 0.0010		0.0060	0.5	10	70
Copper *	0.046	0.011		0.15	2	50	100
Mercury *	< 0.0015	< 0.0015		< 0.010	0.01	0.2	2
Molybdenum *	< 0.0030	< 0.0030		< 0.020	0.5	10	30
Nickel *	0.0052	< 0.0010		0.010	0.4	10	40
Lead *	0.011	< 0.0050		< 0.020	0.5	10	50
Antimony *	0.014	0.0098		0.10	0.06	0.7	5
Selenium *	< 0.010	< 0.010		< 0.040	0.1	0.5	7
Zinc *	0.023	0.0042		0.059	4	50	200
Chloride *	< 4.0	< 4.0		17	800	4000	25000
Fluoride	0.42	0.31		3.2	10	150	500
Sulphate *	3.3	1.7		18	1000	20000	50000
TDS	18	9.9		110	4000	60000	100000
Phenol Index (Monhydric Phenols) *	< 0.13	< 0.13		< 0.50	1	-	-
DOC	9.7	7.3		75	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	82						
Moisture (%)	18						
Stage 1							
Volume Eluate L2 (litres)	0.31						
Filtered Eluate VE1 (litres)	0.16						
Results are expressed on a dry weight basis, after correction for moisture content where applicable.							
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation				** = MCERTS accredited			

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Iss No 17-40597-1 38 and 40 East Street and 35 Fitzalan Road, Littlehampton CCL02814

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The results included within the report are representative of the samples submitted for analysis.



i2 Analytical

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

Telephone: 01923 225404

Fax: 01923 237404

email:reception@i2analytical.com

Waste Acceptance Criteria Analytical Results

Report No:	17-40597			
				Client: CROSSFCLTD
Location	38 and 40 East Street and 35 Fitzalan Road, Littlehampton			
Lab Reference (Sample Number)	706068			Landfill Waste Acceptance Criteria
Sampling Date	15/02/2017			Limits
Sample ID	WS4			
Depth (m)	0.30-0.60			
			Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill
				Hazardous Waste Landfill
Solid Waste Analysis				
TOC (%)**	-			3% 5% 6%
Loss on Ignition (%) **	-			-- -- 10%
BTEX (µg/kg) **	-			6000 -- --
Sum of PCBs (mg/kg) **	-			1 -- --
Mineral Oil (mg/kg) #	-			500 -- --
Total PAH (WAC-17) (mg/kg)	-			100 -- --
pH (units)**	-			-- >6 --
Acid Neutralisation Capacity (mol / kg)	-			-- To be evaluated To be evaluated
Eluate Analysis				
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)	2:1	8:1	Cumulative 10:1	Limit values for compliance leaching test
	mg/l	mg/l	mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)
Arsenic *	< 0.010	< 0.010	< 0.050	0.5 2 25
Barium *	< 0.0050	< 0.0050	< 0.020	20 100 300
Cadmium *	< 0.0005	< 0.0005	< 0.0020	0.04 1 5
Chromium *	< 0.0010	< 0.0010	< 0.0050	0.5 10 70
Copper *	0.026	0.017	0.18	2 50 100
Mercury *	< 0.0015	< 0.0015	< 0.010	0.01 0.2 2
Molybdenum *	0.0057	0.0030	0.033	0.5 10 30
Nickel *	< 0.0010	< 0.0010	0.0069	0.4 10 40
Lead *	< 0.0050	< 0.0050	< 0.020	0.5 10 50
Antimony *	< 0.0050	< 0.0050	< 0.020	0.06 0.7 5
Selenium *	< 0.010	< 0.010	0.081	0.1 0.5 7
Zinc *	0.0035	0.0012	< 0.020	4 50 200
Chloride *	6.7	< 4.0	20	800 4000 25000
Fluoride	0.42	0.28	2.9	10 150 500
Sulphate *	22	3.9	53	1000 20000 50000
TDS	85	25	300	4000 60000 100000
Phenol Index (Monhydric Phenols) *	< 0.13	< 0.13	< 0.50	1 - -
DOC	6.1	4.5	46	500 800 1000
Leach Test Information				
Stone Content (%)	< 0.1			
Sample Mass (kg)	2.0			
Dry Matter (%)	85			
Moisture (%)	15			
Stage 1				
Volume Eluate L2 (litres)	0.32			
Filtered Eluate VE1 (litres)	0.14			
Results are expressed on a dry weight basis, after correction for moisture content where applicable. * = UKAS accredited (liquid eluate analysis only)				
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation ** = MCERTS accredited				

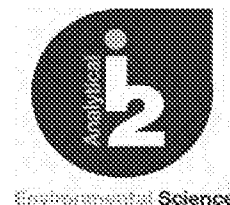
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This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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The results included within the report are representative of the samples submitted for analysis.

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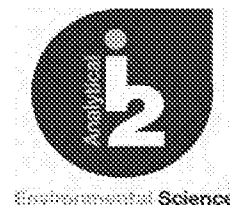
Analytical Report Number : 17-40597

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

* 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 loam (MCERTS) soil types. Data for unaccredited types of solid 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 *
706067	WS1	None Supplied	0.05-0.50	Brown loam and clay with gravel.
706068	WS4	None Supplied	0.30-0.60	Brown loam and clay with gravel.



Analytical Report Number : 17-40597

Project / Site name: 38 and 40 East Street and 35 Fitzalan Road, Littlehampton

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
Chloride in WAC leachate (BS EN 12457-3 Prep)	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
DOC in WAC leachate (BS EN 12457-3 Prep)	Determination of dissolved organic carbon in leachate by TOC/DOC NDIR analyser.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L037-PL	W	NONE
Fluoride in WAC leachate (BS EN 12457-3 Prep)	Determination of fluoride in leachate by 1:1 ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L033-PL	W	NONE
Metals in WAC leachate (BS EN 12457-3 Prep)	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L039-PL	W	ISO 17025
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Phenol Index in WAC leachate (BS EN 12457-3 Prep)	Determination of monohydric phenols in leachate by continuous flow analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate in WAC leachate (BS EN 12457-3 Prep)	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L039-PL	W	ISO 17025
TDS in WAC leachate (BS EN 12457-3 Prep)	Determination of total dissolved solids in leachate by electrometric measurement.	In-house method based on Standard Methods for the Examination of Water and Waste Water, 21st Ed.	L031-PL	W	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 30oC.



Laboratory Report



Contract Number: 34264

Client's Reference: **CCL 02814 PO 9927**Report Date: **07-03-2017**

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

Contract Title: **38 & 40 East Street & 35 Fitzalan Road, Littlehampton**
For the attention of: **Tom Warley**

Date Received: **21-02-2017**
Date Commenced: **21-02-2017**
Date Completed: **07-03-2017**

Test Description	Qty
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	5
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	5
Determination of the water soluble chloride 1377 : 1990 BRE Dependant Options - @ Non Accredited Test	3
pH Value of Soil... 1377 : 1990 Part 3 : 9 - @ Non Accredited Test	3
Disposal of Samples on Project	1

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 except in full, without the prior written approval of the laboratory.

Approved Signatories:

Alex Wynn (Associate Director) - Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager) - Vaughan Edwards (Managing Director)

GEO Site & Testing Services Ltd

Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN

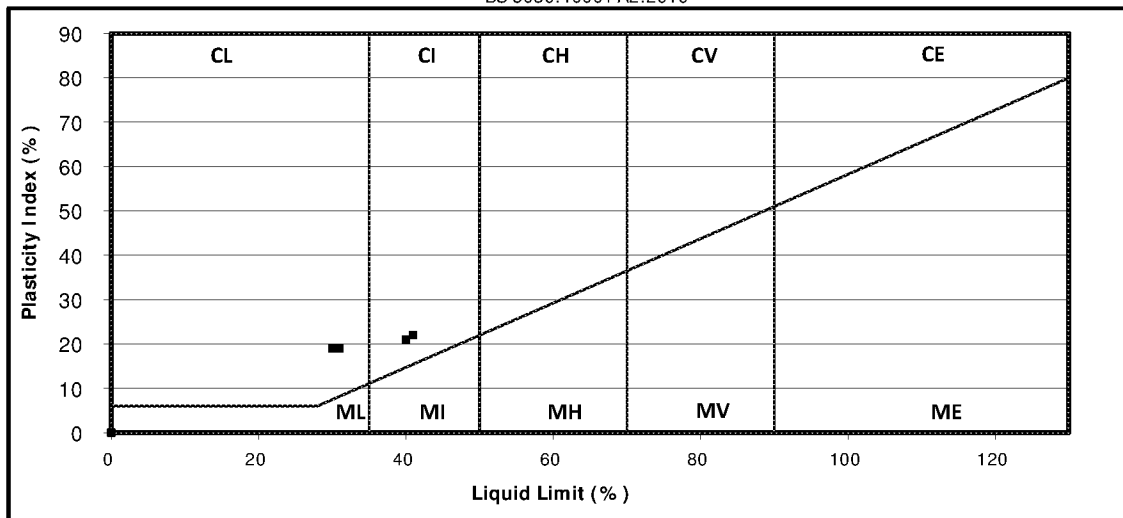
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

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

Client ref: CCL02814
Location: 38 & 40 East Street & 35 Fitzalan Road, Littlehampton
Contract Number: 34264-

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
WS1	J	1.80 - 2.00	14	30	11	19	86	CL Low Plasticity
WS2	J	1.30 - 1.50	17	40	19	21	88	CI Intermediate Plasticity
WS3	J	1.50 - 1.70	16	41	19	22	87	CI Intermediate Plasticity
WS4	J	1.00 - 1.45	16	31	12	19	93	CL Low Plasticity
WS5	J	1.70 - 1.90	15	31	12	19	87	CL Low Plasticity

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.
BS 5930:1999+ A2:2010



For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Sharp (Office Manager)
Date: **7.3.17**





Unit 4
Heol Aur
Dafen Ind Estate
Dafen
Carmarthenshire
SA14 8QN
Tel: 01554 784040
01554 750752
Fax: 01554 770529
01554 784041
Web: www.geo.uk.com

Certificate of Analysis

Date: 06-03-17

Client: Crossfield Consulting

Our Reference: 34264-

Client Reference: CCL02814

Contract Title: 38+40 East Street + 35 Fitzalan Road, Littlehampton

Description: (Total Samples) 3

Date Received:

Date Started: 03-03-17

Date Completed: 06-03-17

Test Procedures: (B.S. 1377 : PART 3 : 1990)

Notes:

Solid samples will be disposed 1 month and liquids 2 weeks

Approved By:

Authorised Signatories:

Emma Sharp
Laboratory Office Manager

Ben Sharp
Contracts Manager

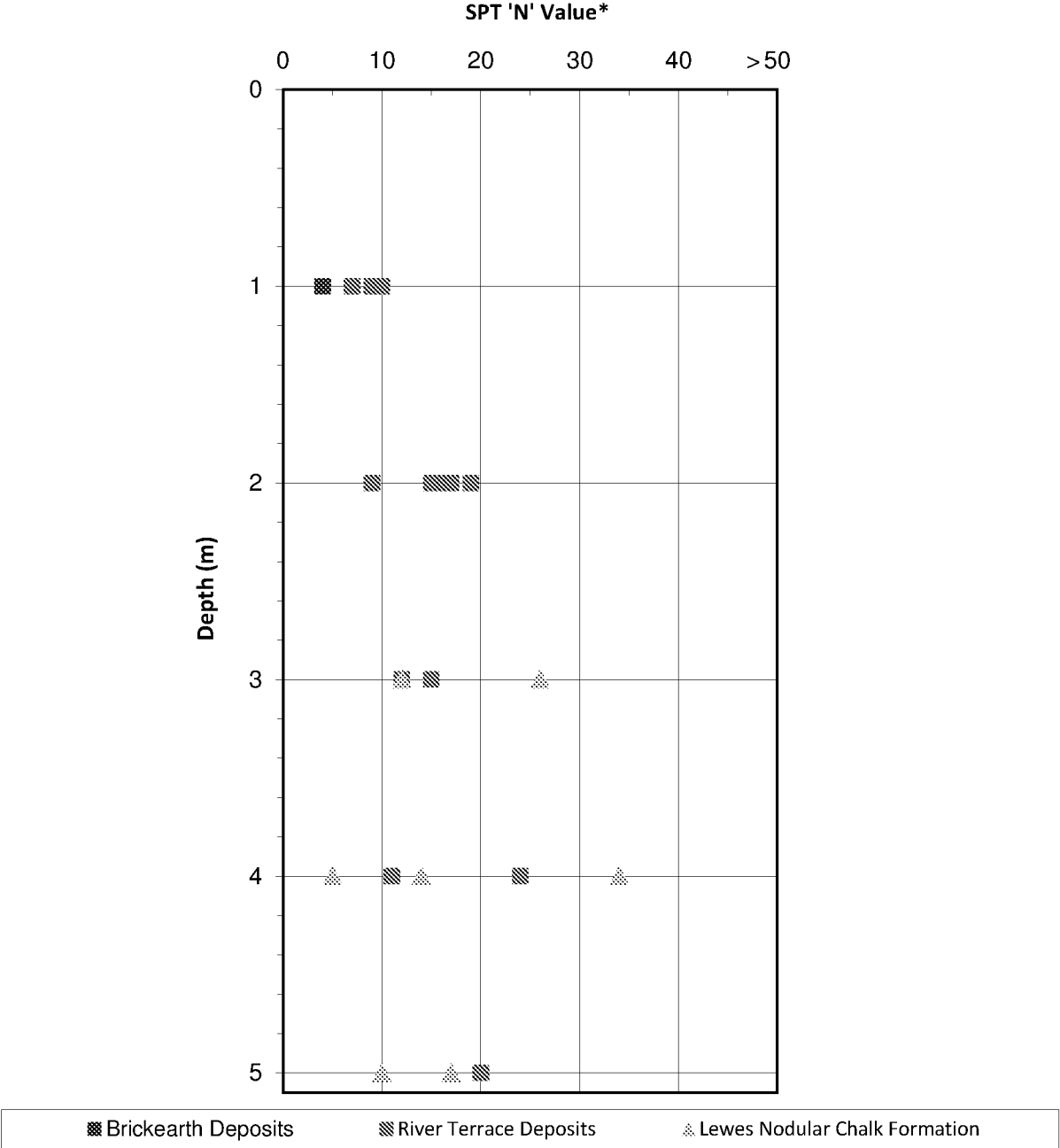
Paul Evans
Quality Manager

Date: 06-03-2017

(B.S. 1377 : PART 3 : 1990)

NCP - No Chloride present

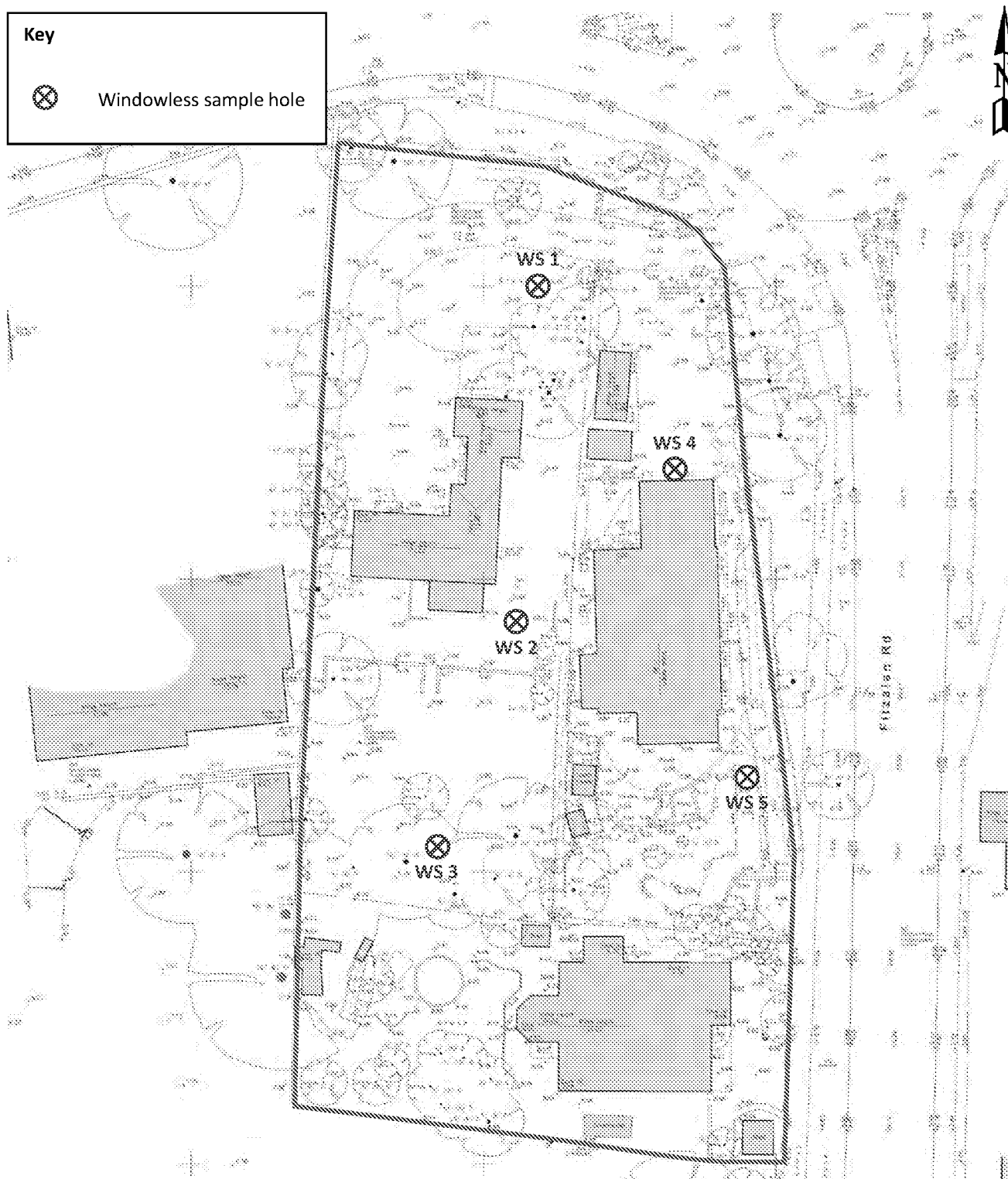
FIGURE I-1



*SPT 'N' values are uncorrected

SPT 'N' VALUE PROFILE

FIGURE I-2



EXPLORATORY HOLE LOCATION PLAN

Scale 1:500

Reproduced from the January 2016 1:200 scale Drawing No. SU-01 produced by D&H Surveys

APPENDIX II

APPENDIX II – QUANTITATIVE RISK ASSESSMENT: HUMAN HEALTH

Contaminated Land Exposure Assessment Model v1.071

A site-specific risk assessment, with respect to human health considerations, has been undertaken due to the concentrations of lead and the polyaromatic hydrocarbons; benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene recorded at levels above the generic assessment criteria (GAC) and Category 4 Screening Levels (where appropriate).

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	390	110 to 390	760	No	0
Benzo(b)fluoranthene	6.3	0.28 to 6.3	30	No	0
Benzo(a)pyrene	7.0	0.24 to 7.0	24	No	0
Dibenz(ah)anthracene	1.5	<0.10 to 1.5	2.4	No	0

Notes

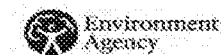
1. Where the maximum concentration does not exceed the SSAC, risks to end users are considered to be negligible and, therefore, no further assessment is required. For compounds with a maximum concentration above the SSAC, further consideration of risks or remediation may be required. See Section 7.
2. SSAC values as two significant figures from the calculated model

CLEA Software Version 1.071

Page 1 of 5

Report generated 01/03/2017

Report title East Street/Fitzalan Road, Littlehampton



Created by TW - Crossfield Consulting Ltd at Crossfield Consulting Limited

BASIC SETTINGS

Land Use Residential without produce

Building Apartment - Large

Receptor Female (res)

Start age class 18

End age class 18

Exposure Duration 10 years

Soil Sandy loam

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

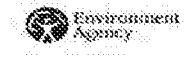


Inhalation of indoor vapour



Inhalation of outdoor vapour



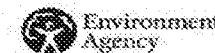


Land Use Residential without produce

Receptor Female (res)

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)	Body weight (kg)	Body height (m)	Inhalation rate (m ³ day ⁻¹)	Max exposed skin factor		Total skin area (m ²)
	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					Indoor (m ² m ⁻²)	Outdoor (m ² m ⁻²)	
1	180	0	180	180	365	365	23.0	1.0	0.06	1.00	0.10	5.60	0.7	8.5	0.32	0.26	3.43E-01
2	365	0	365	365	365	365	23.0	1.0	0.06	1.00	0.10	9.80	0.8	13.3	0.33	0.26	4.84E-01
3	365	0	365	365	365	365	23.0	1.0	0.06	1.00	0.10	12.70	0.9	12.7	0.32	0.25	5.82E-01
4	365	0	365	365	365	365	23.0	1.0	0.06	1.00	0.10	15.10	0.9	12.2	0.35	0.28	6.36E-01
5	365	0	365	365	365	365	19.0	1.0	0.06	1.00	0.10	16.90	1.0	12.2	0.35	0.28	7.04E-01
6	365	0	365	365	365	365	19.0	1.0	0.06	1.00	0.10	19.70	1.1	12.2	0.33	0.26	7.94E-01
7	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	22.10	1.2	12.4	0.22	0.15	8.73E-01
8	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	25.30	1.2	12.4	0.22	0.15	9.36E-01
9	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	27.50	1.3	12.4	0.22	0.15	1.01E+00
10	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	31.40	1.3	12.4	0.22	0.15	1.08E+00
11	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	35.70	1.4	12.4	0.22	0.14	1.19E+00
12	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	41.30	1.4	13.4	0.22	0.14	1.29E+00
13	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	47.20	1.5	13.4	0.22	0.14	1.42E+00
14	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	51.20	1.6	13.4	0.22	0.14	1.52E+00
15	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	56.70	1.6	13.4	0.21	0.14	1.60E+00
16	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	59.00	1.6	13.4	0.21	0.14	1.63E+00
17	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	70.00	1.6	14.8	0.33	0.27	1.78E+00
18	365	365	365	170	365	365	16.0	1.0	0.06	0.30	0.05	70.90	1.6	17.4	0.33	0.27	1.80E+00

Consumption Rates

Consumption rates (α FW kg^{-1} bodyweight day^{-1}) by Produce Group

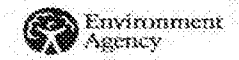
Age Class	MEAN RATES						90TH PERCENTILE RATES					
	Green veg	Root veg	Tuber veg	Herb. Fruit	Shrub fruit	Tree fruit	Green veg	Root veg	Tuber veg	Herb. Fruit	Shrub fruit	Tree fruit
1							7.12E+00	1.07E+01	1.60E+01	1.83E+00	2.23E+00	3.82E+00
2							6.85E+00	3.30E+00	5.46E+00	3.96E+00	5.40E-01	1.20E+01
3							6.85E+00	3.30E+00	5.46E+00	3.96E+00	5.40E-01	1.20E+01
4							6.85E+00	3.30E+00	5.46E+00	3.96E+00	5.40E-01	1.20E+01
5							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
6							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
7							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
8							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
9							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
10							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
11							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
12							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
13							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
14							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
15							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
16							3.74E+00	1.77E+00	3.38E+00	1.85E+00	1.60E-01	4.26E+00
17							2.94E+00	1.40E+00	1.79E+00	1.61E+00	2.20E-01	2.97E+00
18							2.94E+00	1.40E+00	1.79E+00	1.61E+00	2.20E-01	2.97E+00

Top 2 applied? No

Where top 2 method is applied, two produce categories use 90th percentile rates, while the remainder use the mean. Produce categories vary on a chemical-by-chemical basis. Where top 2 method is not used, all produce categories for all chemicals assume 90th percentile rates.

Building Apartment - Large

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

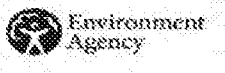
Soil Sandy loam

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 (F _x) for dust model (dimensionless)	1.22E+00
Ambient soil temperature (K)	2.83E+02
Soil pH	7.00E+00
Soil Organic Matter content (%)	2.00E+00
Fraction of organic carbon (g g ⁻¹)	1.16E-02
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 (cm ³ s ⁻¹)	2.50E+01
Building ventilation rate (cm ³ 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 (m ² m ⁻²)	0.75

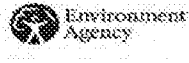
* Air dispersion factor in g m⁻² s⁻¹ per kg m⁻³

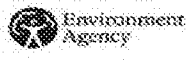
Soil - Plant Model

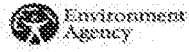
	Dry weight conversion factor	Homegrown fraction		Soil loading factor	Preparation correction factor
	g DW g ⁻¹ FW	Average	High		
		dimensionless		g g ⁻¹ DW	dimensionless
Green vegetables	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	0.103	0.06	0.40	1.00E-03	1.00E+00
Tuber vegetables	0.210	0.02	0.13	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

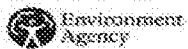
CLEA Software Version 1.071		Page 1 of 11
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Report title	East Street/Fitzalan Road, Littlehampton	
Created by	TW - Crossfield Consulting Ltd at Crossfield Consulting Limited	
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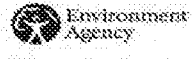
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	Average Daily Exposure ($\text{mg kg}^{-1} \text{ bw day}^{-1}$)	Distribution by Pathway (%)
	Direct soil ingestion Consumption of homegrown produce and attached soil Dermal contact with soil and dust Inhalation of dust Inhalation of vapour Background (oral) Background (inhalation)	Direct soil ingestion Consumption of homegrown produce and attached soil Dermal contact with soil and dust Inhalation of dust Inhalation of vapour (indoor) Inhalation of vapour (outdoor) Background (oral) Background (inhalation)
1 Lead (CCL - Adult)	5.36E-04 0.00E+00 1.91E-06 3.16E-06 0.00E+00 8.46E-05 4.23E-06	85.09 0.00 0.30 0.50 0.00 0.00 13.43 0.67
2 Benzo(b)fluoranthene (S4UL)	2.14E-05 0.00E+00 3.31E-06 1.27E-07 1.23E-08 0.00E+00 0.00E+00	86.16 0.00 13.28 0.51 0.05 0.00 0.00 0.00
3 Benzo(a)pyrene (S4UL)	1.71E-05 0.00E+00 2.64E-06 1.01E-07 7.60E-09 0.00E+00 0.00E+00	86.17 0.00 13.28 0.51 0.04 0.00 0.00 0.00
4 Dibenzo(ah)anthracene (S4UL)	1.70E-06 0.00E+00 2.63E-07 1.00E-08 9.31E-10 0.00E+00 0.00E+00	86.16 0.00 13.28 0.51 0.05 0.00 0.00 0.00
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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 0.50	Made Ground	γ	18 kN/m ³	
0.50 to 1.00	Firm consistency slightly gravelly silty CLAY (BRICEARTH DEPOSITS)	γ c_u ϕ_u Modified PI	19 kN/m ³ 50 kN/m ² 0° 16 %	Based on site observations Estimated from site data Low volume change potential NHBC (2016)
1.00 to 3.00 (Northern and southern parts of the site)	Firm to stiff consistency medium strength brown sandy gravelly CLAY (RIVER TERRACE DEPOSITS)	N γ c_u ϕ_u Modified PI	10 20 kN/m ³ 75 kN/m ² 0° 19 %	SPT data Based on site observations Estimated from site data Low volume-change potential NHBC (2016)
1.00 to >5.00 (Central part of the site)	Medium dense SAND (RIVER TERRACE DEPOSITS)	N γ c' ϕ'	12 20 kN/m ³ 0 kN/m ² 31°	SPT data Based on site observations From Peck Hanson & Thornburn (1974)
3.00 to > 5.00 (Southern part of the site)	Structureless Chalk (LEWES NODULAR CHALK FORMATION – Grade Dm)	N γ	10 20 kN/m ³	SPT data Based on site observations
4.70 to >5.00 (Central part of the site)		N γ	10 20 kN/m ³	SPT data Based on site observations
3.00 to > 5.00 (Northern part of the site)		N γ	5 to 20 20 kN/m ³	SPT data Based on site observations

Characteristic Depth to Groundwater (or groundwater level): 4.5 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 (shallow foundations) or 10 mm (piles)

Maximum Differential Settlement: 1/1000 (shallow foundations) 5 mm (piles)

3. Geometry of Proposed Foundation

3.1 Strip/ trench-fill foundations

Footing Width (assumed for assessment): 2.0 m max

Footing Depth (assumed for assessment): 0.75 m

3.2 Piled Foundations

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. Shallow Foundations

In assessing the allowable bearing pressures below structural foundations, a number of methods are used, as outlined below.

4.1. Fine Grained Soils

Where the foundations are to be placed on these soils, the ultimate bearing capacity has been estimated using the method proposed by Terzaghi (1943) using total stress parameters. Partial factors have been considered in this assessment, in accordance with BS EN 1997-1:2004 and the relevant National Annex.

The recommended *Nett Allowable Bearing Pressure* is based on a value less than 0.3 times the ultimate bearing capacity and, therefore, the serviceability limit state will be satisfied where imposed serviceability loading is not greater than this value.

4.2. Coarse Grained Soils

Where foundations are to be placed on these soils, the allowable bearing pressure is estimated using the method of Terzaghi and Peck, as modified by Meyerhof (1965). Using this method, total settlements are assumed to be not greater than 25 mm (and a detailed serviceability limit calculation is not necessary).