

McCARTHY & STONE RETIREMENT LIFESTYLES LIMITED

GRFC BOWLS CLUB, CHURCH WALK, GRAVESEND, KENT, DA12 2TU

GROUND INVESTIGATION REPORT

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1. INTRODUCTION

A residential development is proposed at GRFC Bowls Club, Church Walk, Gravesend, Kent. The site is currently occupied by a former bowls club, comprising a bowling green and a pavilion, and part of a sports ground. The proposed development comprises a four storey block of apartments, together with car parking, and managed landscaping areas. Residents of the development will be of retirement age.

Crossfield Consulting Limited prepared a Desk Study Appraisal, as listed in the References, in February 2022 for the proposed development. Subsequent ground investigation work has been designed on the basis of the preliminary assessment provided in the Desk Study Appraisal.

Crossfield Consulting Limited has been commissioned by McCarthy & Stone Retirement Lifestyles Limited 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, recommendations regarding ground stability/support, and recommendations for 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. 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. This report should be read in conjunction with the Desk Study Appraisal Report.

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, and NHBC. The ground investigation to inform the risk assessment of potential contamination, as defined in Environment Agency Land Contamination Risk Management (LCRM) (2023) and BS 10175:2011+A2:2017.

The report also includes a geotechnical assessment and the salient information, assessments and recommendations are presented in Sections 9 to 15 of the report, together with the associated Figures and Appendices.

The report has been prepared under the direction and supervision of a Chartered Geologist and Specialist in Land Condition (SiLC). 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 adjacent to Church Walk, approximately 0.9 km to the southeast of Gravesend town centre, as shown on Figure 1. The National Grid Reference for the site is TQ 6572 7378. The site is bounded by Milton Road to the north, Church Walk to the east, a road identified as Ellerslie on the western boundary and sports ground playing fields on the southern boundary, as shown on Figure 2.

2.2 Site Description

This site description is based on observations made during a ground investigation undertaken in March 2024. A topographical survey is presented as Figure 3.

The overall site is irregular in shape, with an approximate area of 0.85 ha. The topographical survey indicates that the site slopes down gently to the northeast, with a fall of approximately 4 m from the southwestern corner to the northeastern corner, the majority of the change of elevation occurs in the western part of the site.

The majority of the site is occupied by Gravesend Rugby Football Club (GRFC) Bowls Club, which comprises a bowling green with a single-storey, wooden pavilion present to the west of the green and an above-ground water tank and shed to the north. The club is separated from the remainder of the site by a hedge and wooden fence. The rest of the site comprises an open, grassed area with the southern-most area occupied by parts of rugby pitches. Trees are present along the northern site boundary. It is understood that a main sewer runs beneath the site, as shown on Figure 3.

2.3 Site History

A detailed history of the site, including historical map extracts and other pertinent information, is provided in the Desk Study Appraisal Report by Crossfield Consulting Limited. A summary of pertinent historical development at the site and in the surrounding area is provided below.

The site comprised undeveloped land until the early 1930s by which time the bowling green and associated pavilion had been built. No significant changes have occurred on the site since that time to the present day.

3. PUBLISHED GEOLOGY

Geological map data, published by the British Geological Survey (BGS), online and in print, on the 1:50,000 scale Sheet No. 271 (Dartford), and in the related Memoirs indicate that the site is underlain by superficial Head Deposits comprising clay, silt, sand, and gravel. Underlying the superficial deposits, the solid strata beneath the site are indicated to comprise chalk associated with the Lewes Nodular Chalk Formation, Seaford Chalk Formation, and the Newhaven Chalk Formation (Undifferentiated).

4. DESK STUDY ENQUIRIES

Detailed desk study information is presented in the Desk Study Appraisal Report by Crossfield Consulting Limited. A summary of relevant information is provided below.

The Groundsure Environmental Database indicates that there are no active or historical landfills recorded within 250 m of the site. Neither the site nor land in close proximity is designated as contaminated land under Part 2A of the Environmental Protection Act 1990.

Hydrogeological information indicates that the superficial deposits underlying the site are classified as 'Secondary Undifferentiated' aquifer strata. The bedrock strata underlying the site are classified as 'Principal' strata. The site is not located within a groundwater Source Protection Zone.

BRE BR211 (2023) and the associated online maps (based on UK Health Security Agency and British Geological Survey data, updated December 2022) indicate that the site is not 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

No buried obstructions or services were encountered during the investigation. However, services are understood to be present below the site and obstructions should be anticipated associated with current structures. A mains sewer is also understood to run beneath the site.

5.3 Strata Encountered

Topsoil/Made Ground

In the western and southern areas of the site, topsoil was encountered to depths of between 0.3 m and 0.45 m. Elsewhere across the site, Made Ground has been encountered to depths of between 0.3 m and 0.9 m and comprises gravelly sand and clay with man-made inclusions of brick and ash fragments. Some evidence of topsoil-type material is also noted locally within the Made Ground.

Head Deposits/Completely weathered Undifferentiated Upper Chalk

Beneath the Made Ground and topsoil across the site, strata considered to be Head Deposits were encountered to the depths of between 1.0 m and 3.6 m. These comprise variable deposits of soft to firm through to firm to stiff consistency gravelly sandy clays and sandy gravels.

With depth a greater percentage of chalk clast is noted and these deposits may possibly be completely weathered undifferentiated Upper Chalk. These materials were proved to depths of 2.4 m and in excess of 4.0 m.

Standard penetration tests undertaken within these strata recorded variable 'N' values across the site, with values of between 3 and 6 at 1 m, within the eastern area of the site, increasing to 'N' values in excess of 50 at 3 m and 4 m. Elsewhere across the site, 'N' values of between 18 and 27 were recorded to a depth of 2 m.

Undifferentiated Upper Chalk

Chalk has been recorded in three of the five dynamic sampling boreholes at depths of between 2.4 m and 3.5 m and was proven to the maximum depth of the investigation (4.0 m). The strata typically comprise structureless chalk composed of silty sand/sandy gravel with flint and gravelly, silty clay.

Standard Penetration Tests (SPTs) undertaken in the undifferentiated chalk recorded 'N' values (uncorrected) typically between 5 and 11. One test recorded a 'N' value of greater than 50, which is likely to be due to a flint cobble.

5.4 Groundwater

Groundwater was not encountered across the majority of the site but was observed at one location in the southern part of the site at a depth of 3 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

The proposed development, which is shown on Figure 4, includes the following buildings and other features:

- A four storey residential apartment building
- Managed soft landscaping
- Car parking
- A retaining wall (up to 1.75 m retained height) to the west of the proposed building

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) (and subsequent amendments), Environment Agency LCRM (2023), CLEA Model (2004-2009), BS 10175:2011+A2:2017, 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 contaminant 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 contaminant linkages. Where relevant, this included the recovery of representative samples and subsequent analytical laboratory testing. The rationale for the sampling and testing is set out in Appendix I. The results of the analytical testing are presented in Appendix I and summarised in Table 2. On the basis of the conceptual site model and the results of the analytical laboratory testing, an assessment of the identified contaminant linkages is presented in Table 3.

7.2 Potential Sources of Contamination

Based on the available information, the existing former bowls club has been the only development to have occurred on the site.

Made Ground materials may have been imported to form a development platform for the bowls club and such materials may have included demolition and ashy materials, such that the potential presence of toxic and phytotoxic metals, polyaromatic hydrocarbons (PAHs) and asbestos containing materials (ACM) cannot be entirely discounted.

With respect to potential sources of off-site contamination, the surrounding land comprises a sports grounds and typically residential properties. A car dealership/garage is located 34 m to the north of the site on the opposite side of Milton Road. Based on the available information, it appears that the car dealership/garage was constructed in the late 1980s/early 1990s and has not been used as a fuel filling station. Hence, it is considered that the potential for a significant contaminant source is very low. Based on the indicated topography, the garage is at a lower level than the site such that any potential migration pathways associated with the garage should be away from the site.

There are no recorded active or historical landfills within influencing distance of the site. The site is not located within an area requiring radon protection measures. Therefore, the available information has identified no potential sources of ground gases.

Based on the available information, representative soil samples were recovered from the shallow Made Ground materials (as such materials included evidence of man-made inclusions) encountered beneath the site and were tested for the potential contaminants identified above. The test results are summarised in Table 2 and are presented against generic assessment criteria (GAC) and Category 4 Screening Levels (C4SL), relevant to the protection of human health in a residential development with managed landscaping. As can be seen from Table 2, the majority of potential contaminant concentrations are recorded below the GAC (negligible risk to human health) and C4SL (low but acceptable risk to human health) and, therefore, do not represent an unacceptable risk to end users. However, one tested sample includes an arsenic concentration above both the GAC and C4SL. Asbestos containing materials have not been identified in any of the samples tested. The completed testing indicates only a limited potential source (associated with arsenic) in relation to human health but additional comments relevant to human health risk assessment are provided in Section 7.3.1.

Based on appropriate laboratory test data, risks to construction materials are assessed in Section 7.3.2.

No significant concentrations of potentially phytotoxic chemicals have been recorded. Therefore, with respect to plantings in any proposed soft landscaping, there should be no deleterious effects on such plantings associated with the existing ground.

The Conceptual Site Model did not identify a valid contaminant linkage in respect of controlled waters. On the basis of the ground investigation and analytical laboratory testing, no significant sources of mobile contaminants have been identified and, therefore, it is considered that the Conceptual Site Model remains valid and no further risk assessment is required in relation to controlled waters.

No putrescible material has been identified at the site and no significant thicknesses of Made Ground have been recorded. There are no recorded landfills within influencing distance and 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 Contaminant Linkages – Solids and Liquids

Based on the Conceptual Site Model, consideration is given below to identified contaminant 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 contaminants associated with the site history are generally below the relevant GAC values and C4SL (where applicable). However, an exceedance of arsenic has been detected within soils at one location below the site.

With respect to end users, an effective barrier, in the form of the proposed building and hardstanding from road pavements, will be in place across the majority of the site and will remove exposure pathways between end users and the ground across much of the site. However, the proposed development also includes areas of managed soft landscaping. Within those locations, there are potential exposure pathways following development. It is noted that residents will not be permitted to dig or cultivate the managed landscaped areas. However, root activity and earth worm activity could mix the existing ground with topsoil materials, thereby returning impacted soils to the near-surface, if limited thicknesses of topsoil are placed. Therefore, dust exposure pathways may be applicable after development.

The GAC values are considered to be conservative with respect to the proposed development as it considers young children as the critical risk 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 (CLEA) Model (version 1.071), has been undertaken with respect to the elevated concentration of arsenic recorded within the shallow ground. Based on the proposed end use, the CLEA model has been assessed 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 concentration of arsenic is significantly below the site-specific assessment criteria (SSAC) for the proposed development. As the site specific model has only amended the end user group and has not changed chemical parameters or exposure pathways, it is considered that the site SSAC continues to represent minimal risk levels to the end users of retirement age. Therefore, it is considered that end users will not be potentially exposed to unacceptable levels of risk from the localised arsenic within the shallow soils.

It would be prudent to maintain a discovery strategy throughout demolition and development groundworks so that if unexpected, and potentially contaminated, ground conditions are encountered then additional investigation and assessment can be undertaken of those unexpected ground conditions. Based on the site history and current investigation data, it is considered that, if adverse ground conditions are identified under a discovery strategy, then a topsoil/subsoil capping layer is likely to be appropriate to break exposure pathways that may be present in soft landscaping areas. Therefore, it may be prudent to maintain an allowance for such a capping layer in case of localised adverse findings during demolition/groundworks.

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 site 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 (where there may then be a limited risk to neighbours and/or the general public) 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 slightly alkaline 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 (the car dealership/garage is considered to represent too limited a potential source for valid migration to the site, as previously noted). Therefore, the site should 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.

7.4 Recommended Remedial Works

On the basis of the foregoing information and risk assessment, it is evident that there are no valid contaminant linkages such that remediation works should not be necessary for the proposed development. Notwithstanding this, it is recommended that a Discovery Strategy be implemented for the site clearance works and continuing during subsequent groundworks for the proposed development. This provides a straightforward procedure for the site team to report unexpected materials that might be associated with a potential source of contamination, such that those materials are then inspected/investigated and any necessary risk assessment or further works undertaken, with all necessary documentation issued to the local planning authority and, if applicable, NHBC.

7.5 Construction Management/Best Practice

- In view of the ground conditions recorded at the site, it is recommended that 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.
- Groundworkers should wear appropriate PPE.
- If topsoil is imported to site for proposed soft landscaping areas, appropriate documentation should be obtained to confirm that contaminant concentrations in the materials to be imported do not represent an unacceptable risk to end users or the wider environment and that the imported materials could not be classified as a waste material.

7.6 Potential Liabilities

Based on the available data and risk assessment, it is considered that there should be no significant environmental liabilities associated with the ground conditions and site ownership.

8. ASSESSMENT OF MINING, QUARRYING AND OVERALL GROUND STABILITY

The site is not within an area of recorded underground mining or other such mineral extraction, nor are there any quarries recorded at, or in close proximity to, the site. The site is within an area where, based on BGS classification, risks from non-coal mining (such as chalk) are at a very low risk level where the potential for difficult ground conditions are unlikely and would not normally need to be considered. Therefore, it is unlikely that the proposed development would be constrained by ground stability issues associated with mining or quarrying.

The bedrock beneath the site comprises chalk strata. Chalk strata can be dissolved by water and solution features can fill with loose superficial deposits. Such deposits can be susceptible to collapse settlement (if loads are applied) or to inundation settlement (if large volumes of water are introduced to the superficial materials). Furthermore, based on the geological database information, part of the site has been classified as having a 'moderate' hazard rating for ground dissolution of soluble rocks. It would, therefore, be prudent, during ground investigation works or groundworks, to remain vigilant to the presence of potentially anomalous ground conditions that could be indicative of mining or solution features. If anomalous ground conditions are identified during construction works, it is recommended that the advice of a geotechnical engineer be obtained to assess the particular ground conditions.

9. GEOTECHNICAL ASSESSMENT

9.1 Assessment of Foundation Solutions

It is understood that the proposed development will comprise a block of retirement apartments, four storeys in height, together with car parking and areas of managed soft landscaping.

Structural loads associated with a four-storey building are anticipated to be reasonably high. Whilst the exploratory holes progressed at the site refused locally at depths of 3.0 m to 4.0 m, it is considered that the refusals were due to the presence of large flints within the strata rather than typically being high strength/density. SPT 'N' values of less than 10 have been recorded locally at depths of up to 5 m, demonstrating the variable and locally weak nature of the near-surface deposits. On this basis, it is considered that conventional spread foundations will not be suitable to support the proposed four-storey building. It is considered that piles may be the most likely foundation solution and it is recommended that allowance be made for such a foundation solution. Continuous flight auger (CFA) piles are likely to be appropriate, but it will be necessary to progress deeper boreholes to confirm the piling technique and obtain data for pile design.

The Head Deposits/completely weathered chalk strata present at shallow depth are noted to comprise clays at some locations. Laboratory testing indicates that some of the clays may be classified as 'medium' volume change potential, as defined in NHBC Standards (2024). Therefore, within influencing distance of trees, it may be necessary to adopt foundation precautions that are compatible with NHBC Standards (2024).

9.2 Floor Slab Recommendations

Due to potential for disturbance of the shallow ground beneath the site during demolition of existing structures, it is recommended that an allowance be made for suspended ground floor slabs for the proposed new building. Within influencing distance of trees, it may be necessary to include a suitable underfloor void, in accordance with NHBC Standards (2024), due to the presence of 'medium' volume change potential clays.

9.3 Proposed Retaining Wall

Due to the change in ground levels across the site, a retaining wall is proposed to the west of the proposed apartment building, as shown on Figure 4. It is understood that the retained height will be up to approximately 1.75 m.

It is noted that the retaining wall will be located partly within the easement of the main sewer running beneath the site. Consideration should be given to a flexible gabion or crib wall type structure to minimise ground penetration within the main sewer easement.

9.4 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 existing services encountered are carefully and satisfactorily blocked to prevent water seeping through the drains and into any excavations.

The locations of any trial pits undertaken as part of this investigation should be accurately surveyed in order that their precise locations are known and that appropriate precautions can be taken when building over or near to these locations.

10. TEMPORARY WORKS

Conventional plant is considered appropriate for shallow excavation works at the site. However, the use of hydraulic breakers may be required to break up floor slabs, concrete surfacing, foundations and any buried concrete structures.

Shallow excavations may remain stable in the short term where excavations do not encounter groundwater. 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 in compliance with the relevant risk assessment.

Groundwater is, based on current data, expected not to be present to depths of at least 3.0 m below ground level. However, perched water may locally be encountered. If perched water does enter excavations, sump pumping may be required.

11. ASSESSMENT OF SOAKAWAY DRAINAGE

Soakaway testing was undertaken at two locations as part of the ground investigation. The tests extended through different material types, as encountered by the ground investigation. Whilst some infiltration was recorded at both test locations, the outflow of water from the test pits was not sufficient to calculate a soil infiltration rate, in accordance with BRE DG365 (2016). Therefore, the shallow strata beneath the site are indicated to have limited infiltration characteristics and to be of very low permeability, as defined in CIRIA C750 (2016). With reference to the guidance published in BRE DG365 (2016) and CIRIA C753 (2015) and based on the test data, it is considered that the shallow strata beneath the site are not suitable to support a soakaway drainage solution. Notwithstanding the test data, it should be noted that, due to the presence of potentially soluble strata beneath the site, ground support conditions relating to the underlying chalk would also need to be considered when assessing an infiltration drainage solution. Based on the above, it would be prudent to identify an alternative drainage solution at this stage.

12. ROAD PAVEMENTS

Based on the nature of the shallow soils beneath the site a preliminary design equilibrium CBR of 3% may be considered for the design of road pavements. The materials at shallow depth are likely to be regarded as potentially frost susceptible.

13. ASSESSMENT OF MATERIALS FOR WASTE DISPOSAL

There is no requirement to remove soils from site and, therefore, development levels should 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 retained and re-used on site. However, if materials are excess to requirements, they should be taken to an appropriately permitted waste 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 III. It should be noted that additional testing, either for classification purposes or for waste acceptance criteria (WAC) testing to confirm acceptability of the waste may be required.

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

A preliminary assessment of potential waste classification for materials on site has been undertaken in accordance with the Environment Agency's document Guidance on the Classification and Assessment of Waste WM3 (2021). The assessment indicates that the following preliminary waste classification advice would be appropriate.

- 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.
- Made Ground at the site, whilst appearing to include topsoil-type material, generally has a total organic carbon content that is compliant with 'inert' WAC values (and no contaminant concentrations have been recorded that would classify the materials as 'hazardous' waste). Therefore, it may be feasible to take Made Ground to an 'inert' landfill. However, additional testing may be required or requested by waste facilities. It may be prudent to maintain an allowance for Made Ground to be classified as 'non-

hazardous' waste for disposal at landfill due to potential variability in topsoil content and potential difficulty in segregating topsoil and Made Ground that include topsoil materials.

- Natural strata 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 FURTHER GROUND INVESTIGATION

A supplementary phase of ground investigation comprising deep boreholes to confirm the strata at depth beneath the site, and to provide parameters for piled foundation design, should be undertaken when suitable access is available.

It is considered that a supplementary phase of ground investigation is not required in respect of the contaminated land risk assessment provided in this report and the implementation of a discovery strategy during demolition and construction works would mitigate localised residual risks associated with unexpected ground conditions.

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 9.4 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, the following supervision and monitoring is recommended.

- Verification testing required (following pile installation)

16. SUMMARY

A residential development is proposed at GRFC Bowls Club, Church Walk, Gravesend, Kent. The site is currently occupied by a former bowls club, comprising a bowling green and a pavilion, and part of a sports ground. The proposed development comprises a four storey block of apartments, together with car parking, and managed landscaping areas. Residents of the development will be of retirement age.

Ground conditions comprise a limited thickness of Topsoil/Made Ground, typically present to depths of between approximately 0.3 m and 0.9 m. Present beneath the Topsoil/Made Ground are Head Deposits and completely weathered chalk strata. These soils were recorded to depths of between 1.0 m and greater than 4.0 m and comprise typically low and medium strength slightly gravelly, sandy clay and loose through to medium dense sand and gravel. Below the Head Deposits/completely weathered chalk strata, undifferentiated Upper Chalk strata were proved in most investigation locations. The material comprises structureless chalk of orangish brown, white and cream, sandy, gravelly clay (matrix supported, Grade Dm chalk) or sandy, clayey/silty gravel (clast supported, Grade Dc chalk). Groundwater has typically not been identified to the depths investigated. A seepage was noted at one location at 3 m depth.

Based on historical maps and information from regulatory authorities, a conceptual site model has been developed that has identified a number of potential contaminant linkages. A ground investigation was then designed to provide assessment of those contaminant linkages. At this stage, no unacceptable level of risk to human health has been identified in relation to the ground and potential contaminants identified in the Conceptual Site Model. Therefore, it is considered that remediation works should not be required and the proposed development should not be constrained by issues relating to ground gases.

Structural loads associated with a four-storey building are anticipated to be reasonably high. Whilst the exploratory holes progressed at the site refused locally at depths of 3.0 m to 4.0 m, it is considered that the refusals were due to the presence of large flints within the strata rather than typically being high strength/density. SPT 'N' values of less than 10 have been recorded locally at depths of up to 5 m, demonstrating the variable and locally weak/loose nature of the near-surface strata deposits. On this basis, it is considered that conventional spread foundations will not be suitable to support the proposed four-storey building. It is considered that piles may be the most likely foundation solution and it is recommended that allowance be made for such a foundation solution. Continuous flight auger (CFA) piles are likely to be appropriate, but it will be necessary to progress deeper boreholes to confirm the piling technique and obtain data for pile design.

Based on the soakaway testing undertaken at the site and observations of the shallow ground conditions, it is considered that a shallow soakaway drainage solution would not be feasible for the proposed development. An alternative drainage solution should be identified at this stage.

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GENERAL NOTES

1. The report is limited to the site boundaries and is specific to the development proposals as identified by the Client (or Client's advisor) and confirmed within this report. The report should not be used in a different context. Where the report is identified as a site appraisal, further geoenvironmental assessment, and detailed investigations, will be required prior to finalisation of ground related assessment and designs. Other reports may recommend additional investigation or other works that would be considered essential prior to the preparation of final assessments and associated designs.
2. This report has been prepared by Crossfield Consulting Limited with all reasonable skill, care and diligence within the terms of the Appointment/Proposal Terms and Conditions (as applicable) and with the resources agreed with the Client. Responsibility for any matters outside the agreed scope is not accepted.
3. Where any data supplied by the Client or by other external sources, including previous site investigation data, has 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.
4. 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".
5. Any assessments made in this report are based on the ground conditions indicated by the factual records included and/or referenced in the report, namely, trial pits and/or boreholes, together with the results of any field or laboratory testing undertaken and, where appropriate, other relevant site data/desk study information 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 that have not been revealed by the investigation and that have not been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available.
6. Exploratory hole locations provided in the report are generally established by tape measurement (or similar measurement) from existing features or boundaries. Ground levels stated in the report are based on site survey plans as provided. Hole locations are not accurately surveyed and ground levels at these locations are not obtained unless specifically included in the agreed scope of services.
7. Unless stated otherwise, no consultations with regulatory authorities, funders or other third parties have been carried out; hence, definitive assurance that such third parties will accept the findings of this report cannot be provided.
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TABLES

TABLE 1

CONCEPTUAL SITE MODEL

	Potential Contaminant Source	Potential Contaminants	Potential Pathway	Receptors and Assessed Contaminant Linkage
On-Site Solid	Made Ground	Toxic and phytotoxic metals Polyaromatic hydrocarbons (PAHs) Asbestos	Dermal and oral exposure pathways (including air-borne migration) are present during construction phase but will generally not be present following development due to building and hardstanding effective barriers. If limited landscaping areas are proposed, then after development such areas represent possible dust exposure pathways. Release into Liquid Phase Metal solubility generally low at typical soil temperature and pH. Polyaromatic hydrocarbons are typically of low solubility. Therefore, limited potential for release into liquid/aqueous phase. Release into Vapour Phase n/a – no source	Human Health <i>End Users:</i> Possible contaminant linkage <i>Groundworkers:</i> Possible contaminant linkage <i>Neighbouring Properties/General Public:</i> Possible contaminant linkage Buried Structures & Services <i>Buried concrete:</i> No contaminant linkage <i>Potable water pipes:</i> No contaminant linkage <i>Other buried structures:</i> No contaminant linkage Landscape Areas: No contaminant linkage
Off-Site Solid	No evidence of potential source	n/a		
On-Site Liquid	No evidence of potential source	n/a	n/a – no source	
Off-Site Liquid	No evidence of potential source	n/a	Release into Vapour Phase n/a – no source	
On Site Liquid	No evidence of potential source	n/a	n/a – no source	Controlled Waters <i>Groundwater:</i> No contaminant linkage Secondary undifferentiated superficial aquifer strata and Principal bedrock aquifer strata, no groundwater source protection zone: <i>Surface Water:</i> No contaminant linkage
Ground Gases	No historical/active landfills located within 250 m (no source)	n/a	n/a	Human Health <i>End Users:</i> No contaminant linkage
	Not in an area where radon protection measures are required (no significant source)	n/a		
	Made Ground (no evidence to suggest significant thickness of Made Ground or putrescible materials – no source)	n/a		

- NOTES
- The above conceptual model is based on CIRIA C552 (2001) and BS 10175:2011+A2:2017, BS EN ISO 21365:2020 and Environment Agency Land Contamination Risk Management (LCRM) (2023).
 - The Conceptual Site Model is prepared from available desk study information. Where a site walkover or ground investigation identifies information that was not known at the desk study stage, such information is used to modify the Model.
 - Where a contaminant linkage is identified, any subsequent ground investigation is designed to obtain relevant information to assess the contaminant linkage. See Table 3 for a summary of contaminant linkage assessments.

TABLE 2
(Page 1 of 2)

SUMMARY OF ANALYTICAL TEST DATA: SOILS
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	5	5.6	61	40 ¹	1	40 ³	1
Cadmium	mg/kg	5	<0.2	0.5	85 ¹	0	149 ³	0
Chromium (Total) ⁴	mg/kg	5	10	33	910 ¹	0	-	-
Chromium (VI)	mg/kg	5	<1.8	<1.8	6 ¹	0	21 ³	0
Lead	mg/kg	5	3.5	200	-	-	310 ³	0
Inorganic Mercury	mg/kg	5	1.2	39	56 ¹	0	-	-
Nickel	mg/kg	5	11	36	180 ¹	0	-	-
Selenium	mg/kg	5	<1.0	<1.0	430 ¹	0	-	-
Copper	mg/kg	5	18	33	7100 ¹	0	-	-
Zinc	mg/kg	5	17	110	40,000 ¹	0	-	-
Boron	mg/kg	5	0.3	1.9	11,000 ¹	0	-	-
Phenols	mg/kg	5	<1.0	<1.0	690 ¹	0	-	-
pH	-	10	7.4	8.7	-	-	-	-
Total Organic Carbon	%	5	1.1	3	-	-	-	-
Petroleum Hydrocarbons								
Aliphatics C ₅ – C ₆	mg/kg	5	<0.020	<0.020	78 ¹	0	-	-
Aliphatics C ₆ – C ₈	mg/kg	5	<0.020	<0.020	230 ¹	0	-	-
Aliphatics C ₈ – C ₁₀	mg/kg	5	<0.050	<0.050	65 ¹	0	-	-
Aliphatics C ₁₀ – C ₁₂	mg/kg	5	<1.0	<1.0	330 ¹	0	-	-
Aliphatics C ₁₂ – C ₁₆	mg/kg	5	<2.0	<2.0	2400 ¹	0	-	-
Aliphatics C ₁₆ – C ₃₅	mg/kg	5	<8.0	42	92,000 ¹	0	-	-
Aromatics C ₆ – C ₇	mg/kg	5	<0.010	<0.010	690 ¹	0	-	-
Aromatics C ₇ – C ₈	mg/kg	5	<0.010	<0.010	1800 ¹	0	-	-
Aromatics C ₈ – C ₁₀	mg/kg	5	<0.050	<0.050	110 ¹	0	-	-
Aromatics C ₁₀ – C ₁₂	mg/kg	5	<1.0	<1.0	590 ¹	0	-	-
Aromatics C ₁₂ – C ₁₆	mg/kg	5	<2.0	2.7	2300 ¹	0	-	-
Aromatics C ₁₆ – C ₂₁	mg/kg	5	<10	20	1900 ¹	0	-	-
Aromatics C ₂₁ – C ₃₅	mg/kg	5	<10	150	1900 ¹	0	-	-
VOCs								
Benzene	mg/kg	5	<0.005	<0.005	0.70 ¹	0	1.6 ³	0
Toluene	mg/kg	5	<0.005	<0.005	1900 ¹	0	-	-
Ethylbenzene	mg/kg	5	<0.005	<0.005	190 ¹	0	-	-
Xylene	mg/kg	5	<0.005	<0.005	180 ¹	0	-	-
MTBE	mg/kg	5	<0.005	<0.005	120 ²	0	-	-

TABLE 2
(Page 2 of 2)

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
PAHs								
Naphthalene	mg/kg	5	<0.05	<0.05	5.6 ¹	0	-	-
Acenaphthylene	mg/kg	5	<0.05	0.12	4600 ¹	0	-	-
Acenaphthene	mg/kg	5	<0.05	0.05	4700 ¹	0	-	-
Fluorene	mg/kg	5	<0.05	<0.05	1600 ¹	0	-	-
Phenanthrene	mg/kg	5	<0.05	0.87	1500 ¹	0	-	-
Anthracene	mg/kg	5	<0.05	0.13	35,000 ¹	0	-	-
Fluoranthene	mg/kg	5	<0.05	2.8	1600 ¹	0	-	-
Pyrene	mg/kg	5	<0.05	2.5	3800 ¹	0	-	-
Benz(a)anthracene	mg/kg	5	<0.05	1.3	14 ¹	0	-	-
Chrysene	mg/kg	5	<0.05	1.5	31 ¹	0	-	-
Benzo(b)fluoranthene	mg/kg	5	<0.05	2.0	4.0 ¹	0	-	-
Benzo(k)fluoranthene	mg/kg	5	<0.05	1.0	110 ¹	0	-	-
Benzo(a)pyrene	mg/kg	5	<0.05	1.7	3.2 ¹	0	5.3 ³	0
Indeno(123cd)pyrene	mg/kg	5	<0.05	0.88	46 ¹	0	-	-
Dibenzo(ah)anthracene	mg/kg	5	<0.05	<0.05	0.32 ¹	0	-	-
Benzo(ghi)perylene	mg/kg	5	<0.05	0.99	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. Soil GAC for Human Health Risk Assessment produced by CL:AIRE (2010) – Residential Without Plant Uptake. Assumption of 2.5% soil organic matter.
3. Category 4 Screening Level (C4SL), Department for Environment Food and Rural Affairs (March 2014) – calculated for 2.5% SOM using the CLEA Model v1.071
4. 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).

TABLE 3

ASSESSMENT OF CONTAMINANT LINKAGES

NOTES:

- 1. Contaminant linkage validity assessed following qualitative or semi-quantitative risk assessment.
- 2. Contaminant 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)

Contaminant Linkage			Assessment of Contaminant Linkage following Ground Investigation	Contaminant Linkage Valid? ¹	Risk Rating			Quantitative Risk Assessment	Recommended Remediation/Mitigation (See Section 7 for further details)	Recommended Work Verified?	Contaminant Linkage Valid? ²
Source	Pathway	Receptor			C	P	Risk				
Toxic metals Polyaromatic hydrocarbons Asbestos fibres/ACM	Inhalation (dust) Ingestion (dust), Dermal contact (dust)	End users	Concentration of metals generally below GAC and C4SL levels but locally elevated arsenic recorded Concentrations of PAHs all below GAC levels No asbestos detected	Yes No No	Med n/a n/a	LL n/a n/a	Mod/Low n/a n/a	Site specific assessment criteria (SSAC) generated for arsenic using the CLEA Model (v. 1.071). Recorded concentration of arsenic is below the SSAC and, therefore, considered to be of negligible risk to end user health	Not applicable	Not applicable	No
Toxic metals Polyaromatic hydrocarbons Asbestos fibres/ACM	Dermal contact (dust), Ingestion (dust), Inhalation (dust)	Neighbours/general public	Concentration of metals generally below GAC and C4SL levels but locally elevated arsenic recorded Concentrations of PAHs all below GAC levels No asbestos detected	Yes No No	Med n/a n/a	UL n/a n/a	Low n/a n/a	GAC considered to be appropriate for assessing risk to off-site receptors	It is recommended that soil dampening equipment be used to minimise potential for airborne migration of fugitive dust from site.	To be confirmed during construction stage	No
Toxic metals Polyaromatic hydrocarbons Asbestos fibres/ACM	Dermal contact, ingestion and inhalation	Construction workers	All tests below concentrations considered to be a short term (acute) risk. No further assessment required. No asbestos detected	No No	n/a n/a	n/a n/a	n/a n/a	Not applicable	Not required but standard personal protective equipment is recommended as good practice and dust suppression measures should be adopted when undertaking groundworks.	Not applicable	No

FIGURES

FIGURE 1



SITE LOCATION PLAN

Scale 1: 50,000

Reproduced from the 2013 1:50,000 Ordnance Survey map with the permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office, © Crown copyright. Licence No.100014660

FIGURE 2



SITE PLAN

Scale 1: 1250

Reproduced from the 2022 1:1250 Ordnance Survey map with the permission of Ordnance Survey.
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GRFC Bowls Club, Church Walk, Gravesend
CCL03525.CU18
April 2024

FIGURE 4



PROPOSED DEVELOPMENT PLAN

Scale 1: 500

Reproduced from Proposed Site Layout (Ground Floor Plan) by On Architecture, dated August 2022, Dwg No. LSE-2821-03-AC-0010

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+A1:2020, BS EN1997-1:2004(2007) and BS EN1997-2:2007(2007).

The site operations were carried out on 20th and 21st March 2024 under the supervision of a geoenvironmental/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/geotechnical 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.

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

Trial Pits

Two trial pits, denoted as TP1 and TP2, were excavated by a tracked excavator on 20th March. The trial pit records from the investigation are presented in this Appendix and these records include the descriptions and depths of the strata encountered, together with sample depths, groundwater observations and other pertinent comments.

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-Edeco hand vane tester, with extension rods in accordance with the site health and safety method statement. With reference to the guidance published in Serota & Jangle (1972), it is noted that this instrument is calibrated and scaled to provide a direct reading of undrained shear strength, such that application of additional correction factors on the recorded measurements is not necessary. Published correlations with undrained shear strength, as measured by immediate undrained triaxial tests, indicate this hand vane tester provides measurements with a significantly lower scatter in comparison to triaxial tests, with fewer anomalous results. Specific test measurements are listed on the exploratory hole records.

In Situ Soakaway Tests

In situ soakaway tests were performed in trial pits, TP1 and TP2, generally in accordance with the requirements of BRE DG365 (2016) except that they were filled only once. The trial pits were filled with clean water and the fall in water level measured with time. The results of the in situ testing are presented in this Appendix.

Dynamic Sampling

Five dynamic sampling boreholes, denoted as DS1 to DS5, were sunk by LTS Drilling Limited, on 21st March to between 3.0 m and 5.0 m depth. Dynamic/driven open-tube soil sampling/boring was undertaken using an Archway Competitor rig. Using a 1.0 m long thick-walled open-tube sampler (with plastic liner), Category A and B samples were recovered (sample disturbance being influenced by the specific soils encountered). Where appropriate, small disturbed sub-samples were recovered from the materials recovered in the open-tube sampler.

Standard Penetration Tests (SPT) were carried out at regular intervals to provide data on the in situ density of coarse-grained strata and an indication of strength within fine-grained and chalk strata. The SPTs were carried out in accordance with BS EN ISO 22476-3:2005(2007).

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

Soil Samples

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

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

Analytical Laboratory Testing

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

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

- | | |
|-----------------------------------|------------------------------|
| • Arsenic (Total) | • Cadmium (Total) |
| • Chromium (Total and Hexavalent) | • 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 (Fibre & ACM 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:

- Total Petroleum Hydrocarbons – aromatic/aliphatic split and carbon number banding, using GC-FID techniques
- Polyaromatic Hydrocarbons – using GC-MS techniques

Selected samples were submitted for Waste Acceptance Criteria Tests (WAC) to BS EN 12457-3:

Solid Tests

Total Organic Carbon (TOC)	PCB # – Total (7 Congeners)
Loss on Ignition @ 450°C	PAH ^Δ – (Total WAC 17)
Mineral Oil (C ₁₀ -C ₄₀)	Acid Neutralisation Capacity
BTEX * – Total	pH

* BTEX: Total of Benzene, Toluene, Ethylbenzene, Xylenes

PCB: Polychlorinated biphenyl (Total of congener Nos. 28, 52, 101, 118, 138, 153, 180)

^Δ PAH: Polyaromatic Hydrocarbons (Total of 17No. compounds from WAC)

Eluate 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)	Phenols - Total (monohydric)
Mercury (dissolved)	Zinc (dissolved)	Dissolved Organic Carbon (DOC)

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:

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

The analyses were carried out by i2 Analytical and GEO Site & Testing Services Limited (GSTL), UKAS accredited laboratories, 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.

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+A2:2017, BS 5930:2015+A1:2020 and Environment Agency LCRM (2023), the layout of the exploratory holes and sampling regime also considers the Conceptual Site Model and potential contaminant linkages, such that the spatial arrangement of the investigation provides the necessary information to support a risk assessment of the identified potential contaminant linkages.

Exploratory Hole and Technique	Rationale for Hole Location	Depth (m)	Sampling/In Situ Testing and Monitoring
TP1 and TP2	Exploratory hole locations were chosen to provide data in areas of the site where soakaway drainage would be located if ground conditions prove to be suitable.	Up to 2.0	Soil samples were recovered from potential founding strata for geotechnical testing. In situ percolation tests undertaken. Hand vane test undertaken to determine undrained shear strength of fine-grained soils.
DS1 to DS5	All exploratory hole locations were placed near to the proposed building footprint to provide information on the strata profile and to aid in foundation design. The holes also provide coverage of the site to identify if Made Ground/contaminant-impacted natural strata are present.	Up to 5.0 m	Soil samples were recovered from soils at shallow depths for analytical laboratory testing. Soil samples were recovered from potential founding strata for geotechnical testing. Standard Penetration Tests (SPTs) 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 and chalk strata.

Key:

TP X Machine dug trial pit
DS X Dynamic Sample Borehole

TABLE I-2

RATIONALE FOR THE ANALYTICAL TESTING SUITE

Exploratory Hole and Samples	Selection Criteria	Analytical Tests
DS1 – 0.2 m DS2 – 0.2 m DS3 – 0.3 m DS4 – 0.3 m DS5 – 0.3 m	Representative samples of shallow Made Ground tested to assess for inorganic and organic contaminants identified in the Conceptual Site Model and to assist in a preliminary assessment of waste classification.	Screening tests for metals and metalloids, boron, cyanides, phenols (pH and total organic carbon also included to assist with risk assessments) Asbestos identification (and quantification, if applicable) Polyaromatic hydrocarbons (speciated 16 USEPA priority PAHs) Petroleum hydrocarbons (TPH-CWG with aliphatic/aromatic split)
DS1 – 0.2 m DS2 – 0.2 m	Representative Made Ground samples recovered and tested to supplement the waste classification and to provide an assessment of potential disposal routes.	WAC Solid Suite WAC Leachate Suite (BS EN 12457-3)

TABLE I-3

RATIONALE FOR THE GEOTECHNICAL TESTING SUITE

Exploratory Hole and Sample	Selection Criteria	Geotechnical Tests
TP1 – 0.8 m DS1 – 0.8 m DS2 – 1.5 m DS4 – 0.8 m DS5 – 1.5 m	Samples were recovered from potential founding strata to aid concrete classification assessment.	pH Water soluble sulphate Total sulphate Total sulphur
TP2 – 0.6 m DS2 – 0.6 m DS3 – 1.5 m DS4 – 1.4 m	Samples were recovered from the natural strata for classification testing.	Atterberg Limits Moisture content

TRIAL PIT RECORDS

KEY

	J	Disturbed Jar Sample	}	Category B Samples
	G	Soil Sample in Glass Container		
	g	Soil Sample in Glass Vial		
	B	Disturbed Bulk Sample		
	C	"Undisturbed" CBR Mould Sample (denoted Category A: OS-TK/W in BS EN 22475-1:2006)		
	W	Water Sample		
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}^*	Undrained Shear Strength from Hand Vane Shear Strength Test on block sample dug from pit by excavator	

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, 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.

Crossfield CONSULTING GEOTECHNICAL ENVIRONMENTAL			Trial Pit Record Sheet			Hole Ref. TP 1		
			Project GRFC Bowls Club, Church Walk, Gravesend			Sheet 1 of 1		
			Date 20/03/2024			Job No. CCL03525		
Bearing: East			Shoring None used			Ground Level 9.65 m OD		
Plant JCB 50Z-2			Stability Stable during excavation			Co-ordinates		
Trial Pit Plan A B C			Water No groundwater encountered during excavation			Logged by MW Logged on site during excavation		
Checked by								
Depth	Face A			Face B		Face C		Depth
0.30				(1)				0.30
				(2)				
1.00				End of exploratory hole				1.00
Sampling			Strata					
Sample/Test Depth	Type	Strength (kN/m²)	Ref. No.	Strata Depth	Description			
0.30	JGg		1	0.00-0.45	Grass over dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Sand is fine to coarse. Gravel is subangular to subrounded of chalk, flint and quartzite (TOPSOIL/SUBSOIL)			
0.80	J		2	0.45-1.00	White mottled light brown sandy clayey GRAVEL with low cobble content. Sand is fine to coarse. Gravel is subrounded to rounded fine to coarse of predominantly chalk with occasional subangular to subrounded fine to coarse gravel of flint. Cobbles are subangular of flint (HEAD DEPOSITS/COMPLETELY WEATHERED UNDIFFERENTIATED UPPER CHALK)			
1.00	J							
Remarks					Notes			
Percolation test undertaken in base of trial pit					1. All logging and sampling in accordance with BS 5930:2015+A1:2020 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated			

Crossfield CONSULTING GEOTECHNICAL ENVIRONMENTAL			Trial Pit Record Sheet			Hole Ref. TP 2	
			Project GRFC Bowls Club, Church Walk, Gravesend			Sheet 1 of 1	
			Date 20/03/2024			Job No. CCL03525	
Bearing: South			Shoring None used			Ground Level 7.25 m OD	
Plant JCB 50Z-2			Stability Stable during excavation			Co-ordinates	
Trial Pit Plan A → B C			Water No groundwater encountered during excavation			Logged by MW Logged on site during excavation	
Checked by <i>AMH</i>							
Depth	Face A		Face B		Face C		Depth
0.30			(1)				0.30
2.00			(2)				2.00
			End of exploratory hole				
Sampling			Strata				
Sample/Test Depth	Type	Strength (kN/m²)	Ref. No.	Strata Depth	Description		
0.20	JGg		1	0.00-0.30	Grass over brown slightly sandy slightly gravelly CLAY with frequent rootlets and rare roots (<5mm). Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk and flint (TOPSOIL/SUBSOIL)		
0.65	c _{fv}	48,58,68	2	0.30-2.00	Firm consistency light brown slightly gravelly silty CLAY with low cobble content, frequent rootlets and rare roots. Gravel is subangular to subrounded fine to coarse of chalk and flint. Cobbles are subrounded of flint and quartzite (HEAD DEPOSITS)		
0.60	J						
1.20	c _{fv}	60,66,74					
Remarks					Notes		
Percolation test undertaken in base of trial pit					1. All logging and sampling in accordance with BS 5930:2015+A1:2020 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated		

In Situ Percolation Test

Hole Ref. **TP 1**

Project: GRFC Bowls Club, Church Walk, Gravesend

Sheet 1 of 2

Date: 20/03/2024

Job No. CCL03525

Test by: MW

Checked by: *AM*

Trial Pit 1

Test 1

Depth 1.00 m
Length 1.75 m
Width 0.85 m

Depth to water at start of test 0.56 m
Max Effective Depth 0.44 m
75% Effective Depth 0.33 m
25% Effective Depth 0.11 m

Water Level Measurements

Time at Start of Test	Time (Minutes)	Depth to Water (metres)	Effective Depth (m)
	0	0.56	0.44
	0.5	0.56	0.44
	1	0.56	0.44
	2	0.56	0.44
	5	0.56	0.44
	10	0.56	0.44
	15	0.56	0.44
	30	0.59	0.41
	45	0.60	0.40
	60	0.62	0.38
	90	0.68	0.32
	120	0.68	0.32
	150	0.73	0.27
	180	0.74	0.26
	210	0.76	0.24
	240	0.77	0.23

75% Effective Depth - 100 - 0.33
25% Effective Depth -

Outflow Volume

Volume outflowing between 75% & 25% effective depth:

$$V_{p75} = 0.33 \text{ m}^3$$

The mean surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and the base.

$$a_{p50} = 2.63 \text{ m}^2$$

Time for outflow

$$t_p = \text{Not Determined} \text{ mins}$$

$$\text{Soil Infiltration Rate } f = V_{p75} / a_{p50} * t_p$$

as defined in BRE DG365 (2016) $f =$ **Insufficient infiltration of water**

Strata very low permeability

(as defined in CIRIA C750: 2016)

Infiltration rate estimated to be less than 1×10^{-6} m/s

In Situ Percolation Test

Hole Ref. **TP 1**

Project: GRFC Bowls Club, Church Walk, Gravesend

Sheet 2 of 2

Job No. CCL03525

Date: 20/03/2024

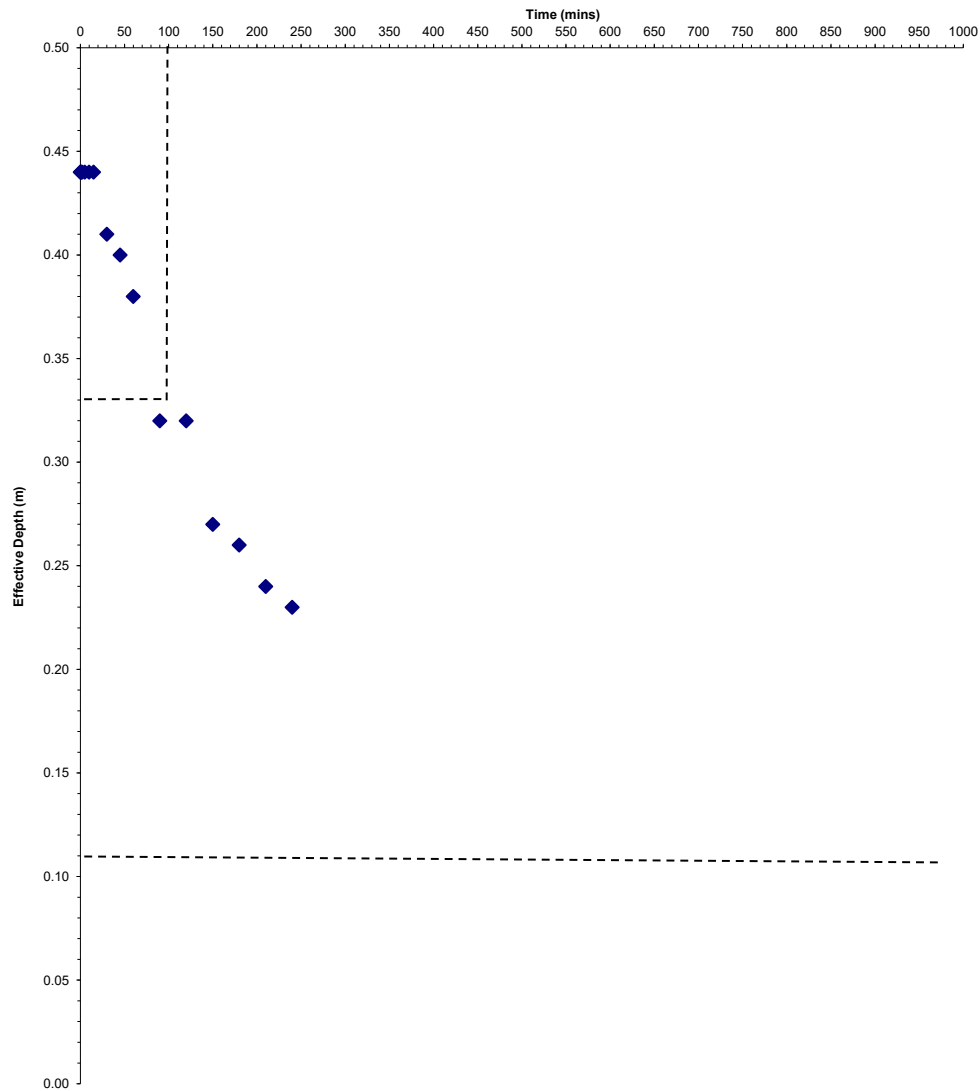
Test by: MW

Checked by: *AM*

Trial Pit 1

Test 1

Infiltration Rate



In Situ Percolation Test

Hole Ref. **TP 2**

Project: GRFC Bowls Club, Church Walk, Gravesend

Sheet 1 of 2

Job No. CCL03525

Date: 20/03/2024

Test by: MW

Checked by: *AM*

Trial Pit 2

Test 1

Depth 2.00 m
Length 3.15 m
Width 0.90 m

Depth to water at start of test 0.34 m
Max Effective Depth 1.66 m
75% Effective Depth 1.25 m
25% Effective Depth 0.42 m

Water Level Measurements

Time at Start of Test	Time (Minutes)	Depth to Water (metres)	Effective Depth (m)
	0	0.34	1.66
	0.5	0.34	1.66
	1	0.34	1.66
	2	0.36	1.64
	5	0.39	1.61
	10	0.41	1.59
	15	0.41	1.59
	30	0.45	1.55
	45	0.50	1.50
	60	0.52	1.48
	90	0.59	1.41
	120	0.70	1.30
	150	0.73	1.27
	180	0.73	1.27
	210	0.75	1.25
	240	0.79	1.21

75% Effective Depth - 210 - 1.25
25% Effective Depth -

Outflow Volume

Volume outflowing between 75% & 25% effective depth:

$$V_{p75} = 2.35 \text{ m}^3$$

The mean surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and the base.

$$a_{p50} = 9.56 \text{ m}^2$$

Time for outflow

$$t_p = \text{Not Determined} \text{ mins}$$

$$\text{Soil Infiltration Rate } f = V_{p75} / a_{p50} * t_p$$

as defined in BRE DG365 (2016) $f =$ **Insufficient infiltration of water**

Strata very low permeability

(as defined in CIRIA C750: 2016)

Infiltration rate estimated to be less than 1×10^{-6} m/s

In Situ Percolation Test

Hole Ref. **TP 2**

Project: GRFC Bowls Club, Church Walk, Gravesend

Sheet 2 of 2

Job No. CCL03525

Date: 20/03/2024

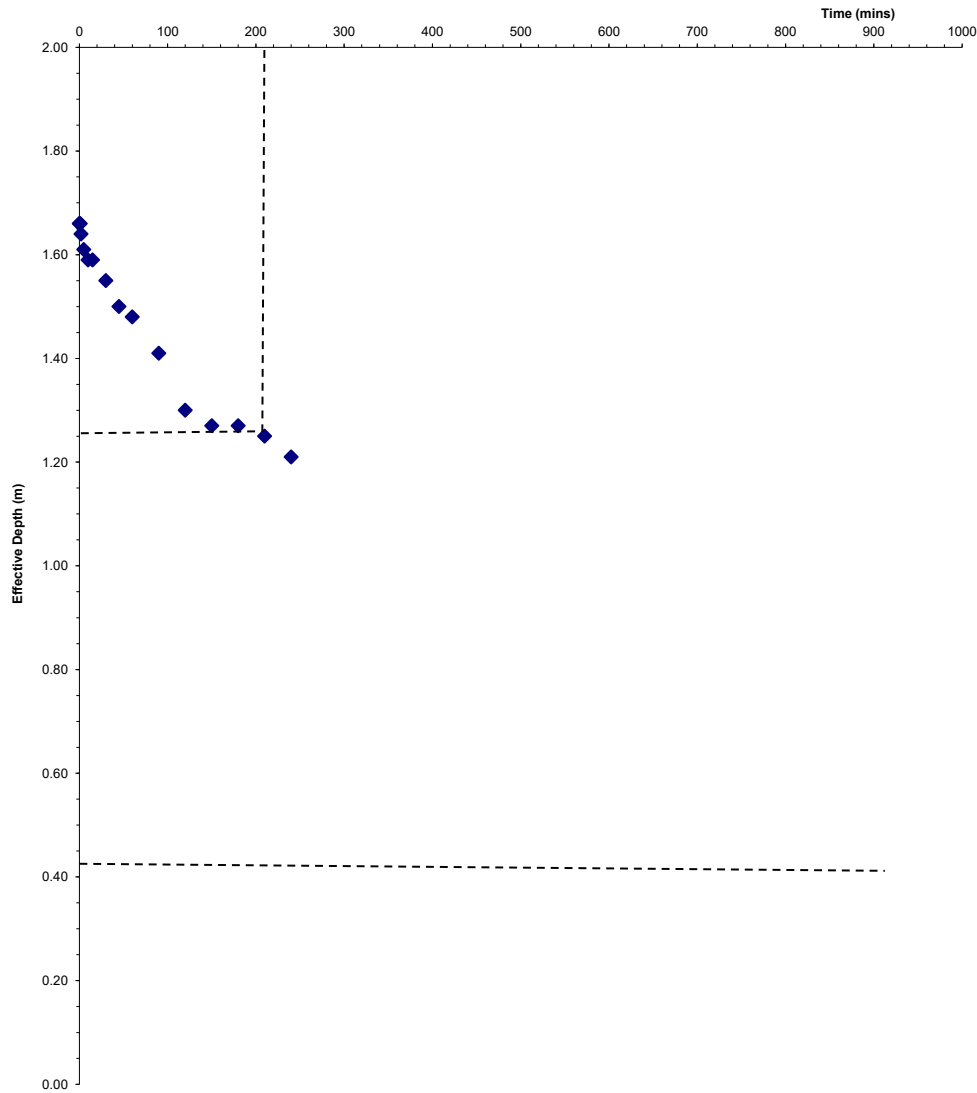
Test by: MW

Checked by: *AM*

Trial Pit 2

Test 1

Infiltration Rate



DYNAMIC 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

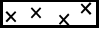
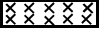
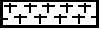
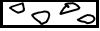
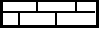
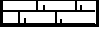
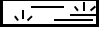
FVT	C_{fv}	Undrained Shear Strength (from hand vane shear vane test)
	C_{rv}	Undrained Remoulded Shear Strength (from hand vane shear vane test)
	C_{fv}^*	Hand Vane Shear Strength Test (on Category A: OS-TK/W soil sample recovered in window sampler)
	S	Standard Penetration Test (SPT: split spoon sampler)
	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:

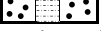
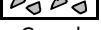
1. All measurement values on record sheets are uncorrected, unless otherwise indicated.
2. For corrected test values, refer to report.
3. Identification and classification of strata is based on the guidance published in the current edition of BS5930 together with BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 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.

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 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.

Crossfield CONSULTING GEOTECHNICAL ENVIRONMENTAL					Dynamic Sample Record Sheet					Hole Ref. DS 1	
					Project: GRFC Bowls Club, Church Walk, Gravesend					Sheet 1 of 1	
					Date: 21/03/2024					Job No. CCL03525	
Contractor LTS Drilling					Equipment Archway Competitor					Ground Level. 7.75 m OD	
Method 0.0 m to 5.0 m dynamic sampling										Co-ordinates	
Boring Diameter 100 mm										Logged by: MW Logged on site during drilling operations	
					Checked by: <i>[Signature]</i>						
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.		
0.20	JGg				Dark brown slightly sandy slightly gravelly clay with occasional black specks. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of brick, chalk and flint (MADE GROUND)	0.30			7.45		
0.80	J				Soft to firm consistency brown becoming orangish brown slightly sandy slightly gravelly silty CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk, flint, quartzite and sandstone (HEAD DEPOSITS)						
1.00-1.45	SPT(C)			N=27	Firm consistency light brown and white sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of flint and predominantly chalk (HEAD DEPOSITS/COMPLETELY WEATHERED UNDIFFERENTIATED UPPER CHALK)	1.00			6.75		
1.30	J										
2.00-2.45	SPT(C)			N=18		2.40			5.35		
2.60	J				Structureless CHALK composed of soft consistency white sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk (UNDIFFERENTIATED UPPER CHALK, GRADE Dm)						
3.00-3.45	SPT(C)			N=7							
4.00-4.45	SPT(C)			N=8							
4.60	J				Structureless CHALK composed of white clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of flint and predominantly chalk (UNDIFFERENTIATED CHALK, GRADE Dc)	4.45			3.30		
5.00-5.45	SPT(C)			N=8	End of exploratory hole	5.00			2.75		
Core Recovery					Groundwater					Additional Tests	
Depth		Recovery		Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value	
0.00-1.00		60%									
1.00-2.00		85%									
2.00-3.00		80%									
3.00-4.00		40%									
4.00-5.00		75%									
Remarks					Notes						
					1. All logging and sampling in accordance with BS 5930:2015+A1:2020						
					2. The depths to strata change are approximate only						
					3. Symbols and abbreviations are explained on the accompanying key						
					4. All linear dimensions are in metres unless otherwise stated						
					5. Undrained shear strength test value given in kN/m ²						

Project:	GRFC Bowls Club, Church Walk, Gravesend
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Sheet 1 of 1

Date: 21/03/2024

Job No.	CCL03525
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Contractor	LTS Drilling
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Equipment	Archway Competitor
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Ground Level.	7.00 m OD
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Method	0.0 m to 3.0 m dynamic sampling
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Co-ordinates

Boring Diameter	100 mm
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Logged by:	MW	Logged on site during drilling operations
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Checked by: *AAH*

Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.20	JGg				Grass over brown fine to coarse sand with frequent rootlets (MADE GROUND)	0.25			6.75
0.35	JGg				...Becomes slightly clayey below 0.10 m.	0.28			6.72
0.60	J				Yellowish brown fine to coarse sand (MADE GROUND)	0.45			6.55
1.00-1.45	SPT(C)			N=3	Black ashy sandy gravel with occasional pockets of soft consistency brown clay. Sand is fine to coarse. Gravel is angular to subangular fine to medium of ash and charcoal (MADE GROUND)				
1.50	J				Soft becoming firm consistency brown slightly sandy slightly gravelly silty CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk, flint, quartzite and sandstone (HEAD DEPOSITS)				
2.00-2.45	SPT(C)			N=10	 Becoming firm to stiff consistency				
2.70	J								
3.00-3.425	SPT(C)			N=50 425 mm		3.00			4.00
					End of exploratory hole				

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	85%							
1.00-2.00	75%							
2.00-3.00	80%							

Remarks

Notes

1. All logging and sampling in accordance with BS 5930:2015+A1:2020
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

Crossfield CONSULTING GEOTECHNICAL ENVIRONMENTAL					Dynamic Sample Record Sheet					Hole Ref. DS 3	
					Project: GRFC Bowls Club, Church Walk, Gravesend					Sheet 1 of 1	
					Date: 21/03/2024					Job No. CCL03525	
Contractor LTS Drilling					Equipment Archway Competitor					Ground Level. 6.95 m OD	
Method 0.0 m to 4.0 m dynamic sampling										Co-ordinates	
Boring Diameter 100 mm										Logged by: MW Logged on site during drilling operations	
					Checked by:						
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.		
0.30	JGg				Grass over brown fine to coarse sand (MADE GROUND)	0.20			6.75		
					...Becomes slightly clayey below 0.10 m	0.23			6.72		
0.60	JGg				Yellowish brown fine to coarse sand (MADE GROUND)	0.43			6.52		
1.00-1.45	SPT(C)			N=6	Black ashy sandy gravel. Sand is fine to coarse. Gravel is subangular fine to medium of ash and charcoal (MADE GROUND)	0.90			6.05		
1.50	J				Soft consistency brown slightly sandy slightly gravelly clay with occasional rootlets. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk, flint and quartzite (MADE GROUND)						
2.00-2.45	SPT(C)			N=4	Soft to firm consistency brown and orangish brown slightly sandy slightly gravelly silty CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk, flint and quartzite (HEAD DEPOSITS)						
2.70	J				...Becomes stiff consistency below 2.50 m						
3.00-3.45	SPT(C)			N=25	Medium dense light brown fine to coarse SAND and fine to medium subangular to rounded GRAVEL of lint and quartzite. (HEAD DEPOSITS)	3.00			3.95		
3.40	J					3.60			3.35		
3.80	J				Orangish brown and white sandy clayey fine to medium subrounded to subangular GRAVEL of flint. Sand is fine to coarse. (HEAD DEPOSITS/COMPLETELY WEATHERED UNDIFFERENTIATED UPPER CHALK)	4.00			2.95		
4.00-4.415	SPT(C)			N=50 415mm	End of exploratory hole						
Core Recovery					Groundwater					Additional Tests	
Depth		Recovery		Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value	
0.00-1.00		80%									
1.00-2.00		75%									
2.00-3.00		50%									
3.00-4.00		60%									
Remarks					Notes						
					1. All logging and sampling in accordance with BS 5930:2015+A1:2020						
					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	LTS Drilling
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Equipment	Archway Competitor
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Ground Level.	7.00 m OD
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Method	0.0 m to 4.0 m dynamic sampling
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Co-ordinates

Boring Diameter	100 mm
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Logged by:	MW	Logged on site during drilling operations
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Checked by: *AAH*

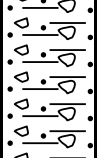
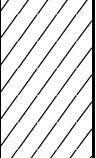
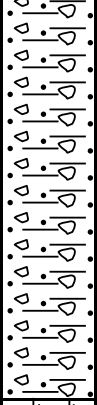
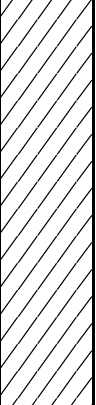
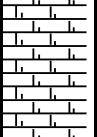
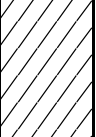
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.
0.10	JGg				Grass over brown fine to coarse sand with frequent rootlets (MADE GROUND)	0.20			6.80
0.23	g				...Becomes slightly clayey below 0.10 m	0.25			6.75
0.30	JGg				Yellowish brown fine to coarse sand (MADE GROUND)	0.45			6.55
0.50	JGg				Black sandy gravel. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of ash and charcoal (MADE GROUND)				
0.80	J				Soft consistency brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk, flint and quartzite (HEAD DEPOSITS)				
1.00-1.45	SPT(C)			N=4					
1.40	J								
2.00-2.45	SPT(C)			N=12					
2.50	J								
2.70	J					2.60			4.40
3.00-3.45	SPT(C)			N=9	Brown and orangish brown sandy slightly clayey fine to coarse subrounded to subangular GRAVEL of flint and chalk. Sand is fine to coarse (HEAD DEPOSITS/COMPLETELY WEATHERED UNDIFFERENTIATED UPPER CHALK)				
3.80	J				Structureless CHALK composed of firm to stiff consistency cream slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of flint and predominantly chalk (UNDIFFERENTIATED UPPER CHALK, GRADE Dm)	3.50			3.50
4.00-4.415	SPT(C)			N=50 415 mm		4.00			3.00
					End of exploratory hole				

Core Recovery		Groundwater				Additional Tests		
Depth	Recovery	Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value
0.00-1.00	85%							
1.00-2.00	76%							
2.00-3.00	55%							
3.00-4.00	50%							

Remarks

Notes

1. All logging and sampling in accordance with BS 5930:2015+A1:2020
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

Crossfield CONSULTING GEOTECHNICAL ENVIRONMENTAL					Dynamic Sample Record Sheet					Hole Ref. DS 5	
					Project: GRFC Bowls Club, Church Walk, Gravesend					Sheet 1 of 1	
					Date: 21/03/2024					Job No. CCL03525	
Contractor LTS Drilling					Equipment Archway Competitor					Ground Level. 7.25 m OD	
Method 0.0 m to 5.0 m dynamic sampling										Co-ordinates	
Boring Diameter 100 mm										Logged by: MW Logged on site during drilling operations	
					Checked by: 						
Sample Depth	Sample or Test	Casing Depth	Water Depth	Test Value	Description	Depth	Legend	Backfill	Level O.D.		
0.30	JGg				Grass over dark brown slightly sandy silty clay with frequent rootlets. Sand is fine to medium (MADE GROUND)	0.25			7.00		
					Soft consistency brown slightly sandy slightly gravelly clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of brick, charcoal, flint and quartzite (MADE GROUND)	0.37			6.88		
1.00-1.45	SPT(C)			N=25	Soft to firm consistency orangish brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk, flint and quartzite (HEAD DEPOSITS)	1.20			6.05		
1.50	J				Soft to firm consistency light brown sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk and flint. Recovered very slightly damp (HEAD DEPOSITS/COMPLETELY WEATHERED UNDIFFERENTIATED UPPER CHALK)						
2.00-2.45	SPT(C)			N=23							
2.90	J				Structureless CHALK composed of white clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk (UNDIFFERENTIATED UPPER CHALK, GRADE Dc)	2.70			4.55		
3.00-3.45	SPT(C)			N=5	Structureless CHALK composed of dark grey slightly gravelly SAND. Sand is fine to coarse. Gravel is subrounded fine to medium flint and chalk. Recovered wet (UNDIFFERENTIATED UPPER CHALK, GRADE Dc)	3.00			4.25		
3.40	J				Structureless CHALK composed of cream, light brown and white sandy very clayey GRAVEL/slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk (UNDIFFERENTIATED UPPER CHALK, GRADE Dm)	3.15			4.10		
4.00-4.45	SPT(C)			N=11		4.00			3.25		
4.50	J				Structureless CHALK composed of soft consistency white and light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of chalk (UNDIFFERENTIATED UPPER CHALK, GRADE Dm)						
5.00-5.45	SPT(C)			N=7	End of exploratory hole	5.00			2.25		
Core Recovery					Groundwater			Additional Tests			
Depth		Recovery		Hole Depth	Strike Depth	Water Depth	Observations	Test type	Test Depth	Test Value	
0.00-1.00		65%		3.00	3.00						
1.00-2.00		85%									
2.00-3.00		80%									
3.00-4.00		80%									
4.00-5.00		55%									
Remarks					Notes						
					1. All logging and sampling in accordance with BS 5930:2015+A1:2020						
					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						

SPT Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: AF01
Test Date: 18/01/2024
Report Date: 18/01/2024
File Name: AF01.spt
Test Operator: JL

Instrumented Rod Data

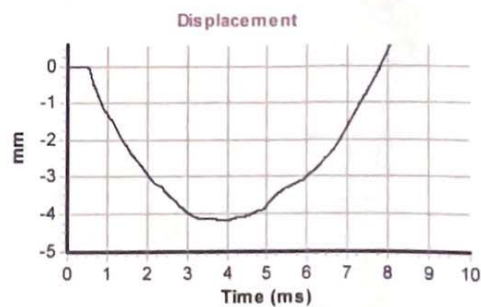
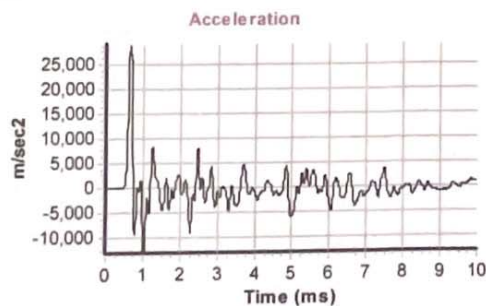
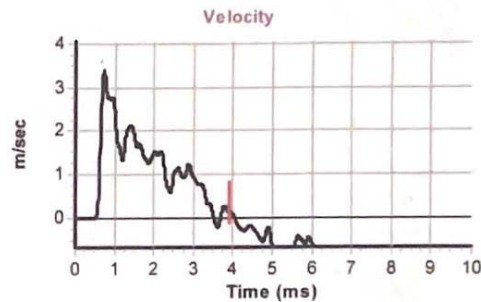
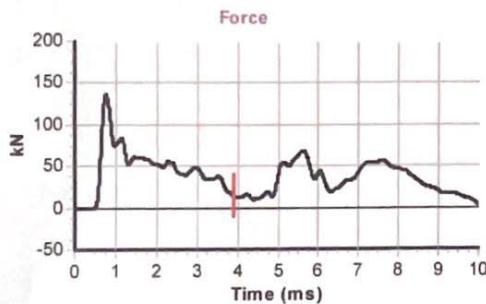
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.6
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 7080
Accelerometer No.2: 11609

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

LTS DRILLING LTD - 88000



Calculations

Area of Rod A (mm^2): 983
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 283

Energy Ratio E_r (%): **60**

Signed: J.LOCK

Title: FITTER

The recommended calibration interval is 12 months



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

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

e: mw@crossfield-consulting.co.uk

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

Analytical Report Number : 24-010711

Project / Site name:	RFC Bowls Club, Church Walk, Gravesend	Samples received on:	22/03/2024
Your job number:	CCL03525	Samples instructed on/ Analysis started on:	22/03/2024
Your order number:	PO13351	Analysis completed by:	02/04/2024
Report Issue Number:	1	Report issued on:	02/04/2024
Samples Analysed:	10 soil samples		

Signed:

Anna Goc
PL Head of Reporting Team
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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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Your Order No: PO13351

Lab Sample Number	153067	153068	153069	153070	153071
Sample Reference	DS1	DS2	DS3	DS4	DS5
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.20	0.20	0.30	0.30	0.30
Date Sampled	Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	14	12	17	12	12
Total mass of sample received	kg	0.1	NONE	0.8	0.8	0.8	0.8	0.8

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	MMI	MMI	MMI	MMI	MMI

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	7.7	7.4	8.3	7.8	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	750	400	510	220	630
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	27	12	13	38	19
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.01355	0.00615	0.00628	0.01886	0.0094
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	13.6	6.15	6.28	18.9	9.4
Water Soluble SO ₄ 16hr extraction (2:1)	mg/l	1.25	MCERTS	-	-	-	-	-
Sulphide	mg/kg	1	MCERTS	< 1.0	13	< 1.0	6.4	< 1.0
Total Sulphur	mg/kg	50	MCERTS	480	270	240	240	320
Organic Matter (automated)	%	0.1	MCERTS	5.2	3.1	1.9	4.4	2.6
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	3	1.8	1.1	2.5	1.5

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.12	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.87	0.21	0.09	< 0.05	0.1
Anthracene	mg/kg	0.05	MCERTS	0.13	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	2.8	0.67	0.23	< 0.05	0.23
Pyrene	mg/kg	0.05	MCERTS	2.5	0.6	0.2	< 0.05	0.2
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.3	0.34	0.13	< 0.05	0.13
Chrysene	mg/kg	0.05	MCERTS	1.5	0.42	0.18	< 0.05	0.14
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	2	0.51	0.21	< 0.05	0.18
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1	0.27	0.09	< 0.05	0.08
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.7	0.45	0.17	< 0.05	0.15
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.88	0.2	0.1	< 0.05	0.06
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.99	0.24	0.12	< 0.05	0.09

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	15.8	3.91	1.52	< 0.80	1.36
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Analytical Report Number: 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Your Order No: PO13351

Lab Sample Number				153067	153068	153069	153070	153071
Sample Reference				DS1	DS2	DS3	DS4	DS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.20	0.30	0.30	0.30
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken				None Supplied	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	61	13	5.6	9.4
Boron (water soluble)	mg/kg	0.2	MCERTS	1.9	0.7	0.4	0.3	0.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	< 0.2	0.5	< 0.2	0.3
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	27	26	33	10	29
Copper (aqua regia extractable)	mg/kg	1	MCERTS	30	18	19	33	20
Lead (aqua regia extractable)	mg/kg	1	MCERTS	110	200	46	3.5	46
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.2	39	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	22	11	27	36	23
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	63	66	17	62

Petroleum Hydrocarbons

TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020 ###	< 0.020 ###	< 0.020 ###	< 0.020 ###	< 0.020 ###
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050 ###	< 0.050 ###	< 0.050 ###	< 0.050 ###	< 0.050 ###
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	42	< 8.0	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	42	< 10	< 10	< 10	< 10

TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	2.7	< 2.0	< 2.0	< 2.0	< 2.0
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	20	< 10	< 10	< 10	< 10
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	150	14	< 10	< 10	< 10
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	170	14	< 10	< 10	< 10

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Your Order No: PO13351

Lab Sample Number				153072	153073	153074	153075	153076
Sample Reference				TP1	DS1	DS2	DS4	DS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	0.80	1.50	0.80	1.50
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	15	16	14	15
Total mass of sample received	kg	0.1	NONE	1	1	1.1	1.1	1

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos Analyst ID	N/A	N/A	N/A	-	-	-	-	-

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	8.7	8.5	8.1	8.4	8.5
Total Cyanide	mg/kg	1	MCERTS	-	-	-	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	540	380	350	310	560
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	22	39	30	30	44
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1)	mg/l	1.25	MCERTS	11.1	19.5	15	14.9	21.8
Sulphide	mg/kg	1	MCERTS	-	-	-	-	-
Total Sulphur	mg/kg	50	MCERTS	230	140	140	130	230
Organic Matter (automated)	%	0.1	MCERTS	-	-	-	-	-
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	-	-	-	-

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	-	-	-	-
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Analytical Report Number: 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Your Order No: PO13351

Lab Sample Number				153072	153073	153074	153075	153076
Sample Reference				TP1	DS1	DS2	DS4	DS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	0.80	1.50	0.80	1.50
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken				None Supplied	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	-	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	-	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	-	-	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	-	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-

Petroleum Hydrocarbons

TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	-	-	-	-	-
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	-	-	-	-	-
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	-	-	-	-	-
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	-	-	-	-	-
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	-	-	-	-	-
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-	-	-	-
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-	-	-	-
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	-	-	-	-	-

TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	-	-	-	-	-
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	-	-	-	-	-
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	-	-	-	-	-
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	-	-	-	-	-
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	-	-	-	-	-
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-	-	-	-
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-	-	-	-
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	-	-	-	-	-

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-	-	-
Benzene	µg/kg	5	MCERTS	-	-	-	-	-
Toluene	µg/kg	5	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-	-	-	-
p & m-Xylene	µg/kg	5	MCERTS	-	-	-	-	-
o-Xylene	µg/kg	5	MCERTS	-	-	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-010711
Project / Site name: RFC Bowls Club, Church Walk, Gravesend

* 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 *
153067	DS1	None Supplied	0.2	Brown clay and loam with gravel and vegetation
153068	DS2	None Supplied	0.2	Brown loam and sand with gravel and vegetation
153069	DS3	None Supplied	0.3	Brown clay and loam with gravel and vegetation
153070	DS4	None Supplied	0.3	Black sand with gravel and clinker
153071	DS5	None Supplied	0.3	Brown clay and loam with gravel and vegetation
153072	TP1	None Supplied	0.8	Beige clay and sand with gravel and chalk
153073	DS1	None Supplied	0.8	Brown clay with vegetation
153074	DS2	None Supplied	1.5	Brown clay and sand
153075	DS4	None Supplied	0.8	Brown clay and sand
153076	DS5	None Supplied	1.5	Beige clay and sand with chalk and vegetation

Analytical Report Number : 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	In-house method	L010	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
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.	L019B	D	NONE
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	L038B	D	MCERTS
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	L038B	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	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	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	L038B	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	MCERTS
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	L080	W	MCERTS

Analytical Report Number : 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

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

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

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

- Quality control parameter failure associated with this result; other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised.

Sample Deviation Report



Analytical Report Number : 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DS1	N/A	S	153067	a	Asbestos identification in Soil	A001B	a
DS1	N/A	S	153067	a	BTEX and/or Volatile organic compounds in soil	L073B	a
DS1	N/A	S	153067	a	Boron, water soluble, in soil	L038B	a
DS1	N/A	S	153067	a	Hexavalent chromium in soil	L080	a
DS1	N/A	S	153067	a	Metals in soil by ICP-OES	L038B	a
DS1	N/A	S	153067	a	Monohydric phenols in soil	L080	a
DS1	N/A	S	153067	a	Organic matter (Automated) in soil	L009B	a
DS1	N/A	S	153067	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS1	N/A	S	153067	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS1	N/A	S	153067	a	Sulphide in soil	L010	a
DS1	N/A	S	153067	a	Total Sulphur in soil	L038B	a
DS1	N/A	S	153067	a	Total cyanide in soil	L080	a
DS1	N/A	S	153067	a	Total organic carbon (Automated) in soil	L009B	a
DS1	N/A	S	153067	a	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088	a
DS1	N/A	S	153067	a	Total sulphate (as SO4 in soil)	L038B	a
DS1	N/A	S	153067	a	pH in soil (automated)	L099	a
DS1	N/A	S	153073	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS1	N/A	S	153073	a	Total Sulphur in soil	L038B	a
DS1	N/A	S	153073	a	Total sulphate (as SO4 in soil)	L038B	a
DS1	N/A	S	153073	a	pH in soil (automated)	L099	a
DS2	N/A	S	153068	a	Asbestos identification in Soil	A001B	a
DS2	N/A	S	153068	a	BTEX and/or Volatile organic compounds in soil	L073B	a
DS2	N/A	S	153068	a	Boron, water soluble, in soil	L038B	a
DS2	N/A	S	153068	a	Hexavalent chromium in soil	L080	a
DS2	N/A	S	153068	a	Metals in soil by ICP-OES	L038B	a
DS2	N/A	S	153068	a	Monohydric phenols in soil	L080	a
DS2	N/A	S	153068	a	Organic matter (Automated) in soil	L009B	a
DS2	N/A	S	153068	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS2	N/A	S	153068	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS2	N/A	S	153068	a	Sulphide in soil	L010	a
DS2	N/A	S	153068	a	Total Sulphur in soil	L038B	a
DS2	N/A	S	153068	a	Total cyanide in soil	L080	a
DS2	N/A	S	153068	a	Total organic carbon (Automated) in soil	L009B	a
DS2	N/A	S	153068	a	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088	a
DS2	N/A	S	153068	a	Total sulphate (as SO4 in soil)	L038B	a
DS2	N/A	S	153068	a	pH in soil (automated)	L099	a
DS2	N/A	S	153074	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS2	N/A	S	153074	a	Total Sulphur in soil	L038B	a
DS2	N/A	S	153074	a	Total sulphate (as SO4 in soil)	L038B	a
DS2	N/A	S	153074	a	pH in soil (automated)	L099	a
DS3	N/A	S	153069	a	Asbestos identification in Soil	A001B	a
DS3	N/A	S	153069	a	BTEX and/or Volatile organic compounds in soil	L073B	a
DS3	N/A	S	153069	a	Boron, water soluble, in soil	L038B	a
DS3	N/A	S	153069	a	Hexavalent chromium in soil	L080	a
DS3	N/A	S	153069	a	Metals in soil by ICP-OES	L038B	a
DS3	N/A	S	153069	a	Monohydric phenols in soil	L080	a
DS3	N/A	S	153069	a	Organic matter (Automated) in soil	L009B	a
DS3	N/A	S	153069	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS3	N/A	S	153069	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS3	N/A	S	153069	a	Sulphide in soil	L010	a
DS3	N/A	S	153069	a	Total Sulphur in soil	L038B	a
DS3	N/A	S	153069	a	Total cyanide in soil	L080	a
DS3	N/A	S	153069	a	Total organic carbon (Automated) in soil	L009B	a
DS3	N/A	S	153069	a	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088	a
DS3	N/A	S	153069	a	Total sulphate (as SO4 in soil)	L038B	a
DS3	N/A	S	153069	a	pH in soil (automated)	L099	a
DS4	N/A	S	153070	a	Asbestos identification in Soil	A001B	a
DS4	N/A	S	153070	a	BTEX and/or Volatile organic compounds in soil	L073B	a

Sample Deviation Report



Analytical Report Number : 24-010711

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DS4	N/A	S	153070	a	Boron, water soluble, in soil	L038B	a
DS4	N/A	S	153070	a	Hexavalent chromium in soil	L080	a
DS4	N/A	S	153070	a	Metals in soil by ICP-OES	L038B	a
DS4	N/A	S	153070	a	Monohydric phenols in soil	L080	a
DS4	N/A	S	153070	a	Organic matter (Automated) in soil	L009B	a
DS4	N/A	S	153070	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS4	N/A	S	153070	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS4	N/A	S	153070	a	Sulphide in soil	L010	a
DS4	N/A	S	153070	a	Total Sulphur in soil	L038B	a
DS4	N/A	S	153070	a	Total cyanide in soil	L080	a
DS4	N/A	S	153070	a	Total organic carbon (Automated) in soil	L009B	a
DS4	N/A	S	153070	a	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088	a
DS4	N/A	S	153070	a	Total sulphate (as SO4 in soil)	L038B	a
DS4	N/A	S	153070	a	pH in soil (automated)	L099	a
DS4	N/A	S	153075	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS4	N/A	S	153075	a	Total Sulphur in soil	L038B	a
DS4	N/A	S	153075	a	Total sulphate (as SO4 in soil)	L038B	a
DS4	N/A	S	153075	a	pH in soil (automated)	L099	a
DS5	N/A	S	153071	a	Asbestos identification in Soil	A001B	a
DS5	N/A	S	153071	a	BTEX and/or Volatile organic compounds in soil	L073B	a
DS5	N/A	S	153071	a	Boron, water soluble, in soil	L038B	a
DS5	N/A	S	153071	a	Hexavalent chromium in soil	L080	a
DS5	N/A	S	153071	a	Metals in soil by ICP-OES	L038B	a
DS5	N/A	S	153071	a	Monohydric phenols in soil	L080	a
DS5	N/A	S	153071	a	Organic matter (Automated) in soil	L009B	a
DS5	N/A	S	153071	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS5	N/A	S	153071	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS5	N/A	S	153071	a	Sulphide in soil	L010	a
DS5	N/A	S	153071	a	Total Sulphur in soil	L038B	a
DS5	N/A	S	153071	a	Total cyanide in soil	L080	a
DS5	N/A	S	153071	a	Total organic carbon (Automated) in soil	L009B	a
DS5	N/A	S	153071	a	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088	a
DS5	N/A	S	153071	a	Total sulphate (as SO4 in soil)	L038B	a
DS5	N/A	S	153071	a	pH in soil (automated)	L099	a
DS5	N/A	S	153076	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
DS5	N/A	S	153076	a	Total Sulphur in soil	L038B	a
DS5	N/A	S	153076	a	Total sulphate (as SO4 in soil)	L038B	a
DS5	N/A	S	153076	a	pH in soil (automated)	L099	a
TP1	N/A	S	153072	a	Sulphate, water soluble, in soil (16hr extraction)	L038B	a
TP1	N/A	S	153072	a	Total Sulphur in soil	L038B	a
TP1	N/A	S	153072	a	Total sulphate (as SO4 in soil)	L038B	a
TP1	N/A	S	153072	a	pH in soil (automated)	L099	a

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Analytical Report Number : 24-012569

Project / Site name:	RFC Bowls Club, Church Walk, Gravesend	Samples received on:	22/03/2024
Your job number:	CCL03525	Samples instructed on/ Analysis started on:	05/04/2024
Your order number:	PO13361	Analysis completed by:	15/04/2024
Report Issue Number:	1	Report issued on:	15/04/2024
Samples Analysed:	2 soil samples - 2 2stage samples		



Signed:

Anna Goc
PL Head of Reporting Team
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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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

i2 Analytical

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Waste Acceptance Criteria Analytical Results							
Report No:	24-012569						
					Client: CROSSFCLTD		
Location	RFC Bowls Club, Church Walk, Gravesend						
Lab Reference (Sample Number)	162881				Landfill Waste Acceptance Criteria		
Sampling Date	/ /				Limits		
Sample ID	DS1				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Depth (m)	0.20						
Solid Waste Analysis							
TOC (%)**	2.9				3%	5%	6%
Loss on Ignition (%) **	5.6				--	--	10%
BTEX (µg/kg)**	< 5.0				6000	--	--
Sum of PCBs (mg/kg)**	< 0.007				1	--	--
Mineral Oil (mg/kg) EH, LD, CU, AL	67				500	--	--
Total PAH (WAC-17) (mg/kg)	18.0				100	--	--
pH (units)**	7.4				--	>6	--
Acid Neutralisation Capacity (mmol / kg)	0.50				--	To be evaluated	To be evaluated
Eluate Analysis		2:1	8:1		Cumulative 10:1	Limit values for compliance leaching test	
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)		mg/l	mg/l		mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)	
Arsenic *	0.0079	0.0070		0.071	0.5	2	25
Barium *	0.027	0.023		0.23	20	100	300
Cadmium *	< 0.00010	< 0.00010		< 0.0010	0.04	1	5
Chromium *	0.0017	0.0048		0.046	0.5	10	70
Copper *	0.059	0.026		0.29	2	50	100
Mercury *	< 0.00070	< 0.0007		< 0.0070	0.01	0.2	2
Molybdenum *	0.0069	0.0042		0.044	0.5	10	30
Nickel *	0.0067	0.0052		0.053	0.4	10	40
Lead *	0.0022	0.0061		0.058	0.5	10	50
Antimony *	0.0027	0.0049		0.047	0.06	0.7	5
Selenium *	< 0.0050	< 0.0050		< 0.050	0.1	0.5	7
Zinc *	0.014	0.013		0.13	4	50	200
Chloride *	20	< 4.0		35	800	15000	25000
Fluoride*	0.37	0.32		3.2	10	150	500
Sulphate *	9.0	2.7		32	1000	20000	50000
TDS*	200	92		1000	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.16	< 0.13		< 0.50	1	-	-
DOC	36.3	39		384	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.8						
Dry Matter (%)	86						
Moisture (%)	14						
Stage 1							
Volume Eluate L2 (litres)	0.324						
Filtered Eluate VE1 (litres)	0.15						
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							
** = UKAS accredited (liquid eluate analysis only)							
** = 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.

i2 Analytical

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Waste Acceptance Criteria Analytical Results							
Report No:	24-012569						
					Client: CROSSFCLTD		
Location	RFC Bowls Club, Church Walk, Gravesend						
Lab Reference (Sample Number)	162882				Landfill Waste Acceptance Criteria		
Sampling Date	/ /				Limits		
Sample ID	DS2				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Depth (m)	0.20						
Solid Waste Analysis							
TOC (%)**	1.6				3%	5%	6%
Loss on Ignition (%) **	3.6				--	--	10%
BTEX (µg/kg)**	< 5.0				6000	--	--
Sum of PCBs (mg/kg)**	< 0.007				1	--	--
Mineral Oil (mg/kg) EH, LD, CU, AL	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	3.86				100	--	--
pH (units)**	7.2				--	>6	--
Acid Neutralisation Capacity (mmol / kg)	0.49				--	To be evaluated	To be evaluated
Eluate Analysis		2:1	8:1		Cumulative 10:1	Limit values for compliance leaching test	
(BS EN 12457 - 3 preparation utilising end over end leaching procedure)		mg/l	mg/l		mg/kg	using BS EN 12457-3 at L/S 10 l/kg (mg/kg)	
Arsenic *	0.0042	0.0035		0.036	0.5	2	25
Barium *	0.025	0.015		0.16	20	100	300
Cadmium *	< 0.00010	< 0.00010		< 0.0010	0.04	1	5
Chromium *	0.0014	0.0014		0.014	0.5	10	70
Copper *	0.024	0.025		0.25	2	50	100
Mercury *	< 0.00070	< 0.0007		< 0.0070	0.01	0.2	2
Molybdenum *	0.0021	< 0.0014		< 0.014	0.5	10	30
Nickel *	0.0022	0.0017		0.018	0.4	10	40
Lead *	0.0030	0.0059		0.056	0.5	10	50
Antimony *	< 0.0020	< 0.0020		< 0.020	0.06	0.7	5
Selenium *	< 0.0050	< 0.0050		< 0.050	0.1	0.5	7
Zinc *	0.0078	0.0059		0.060	4	50	200
Chloride *	< 4.0	< 4.0		25	800	15000	25000
Fluoride*	0.68	0.38		4.1	10	150	500
Sulphate *	8.1	2.5		30	1000	20000	50000
TDS*	120	59		650	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.16	< 0.13		< 0.50	1	-	-
DOC	11.5	11		114	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.8						
Dry Matter (%)	88						
Moisture (%)	12						
Stage 1							
Volume Eluate L2 (litres)	0.326						
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							
** = UKAS accredited (liquid eluate analysis only)							
** = 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.

Analytical Report Number : 24-012569

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

* 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 *
162881	DS1	None Supplied	0.2	Brown clay and loam with gravel and vegetation
162882	DS2	None Supplied	0.2	Brown loam and sand with gravel and vegetation

Analytical Report Number : 24-012569

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
pH at 20°C in soil	Determination of pH in soil by addition of water followed by electrometric measurement	In-house method	L005B	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
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.	L019B	D	NONE
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L023B	D	MCERTS
PCB's By GC-MS in soil	Determination of PCB by extraction with hexane followed by GC-MS	In-house method based on USEPA 8082	L027B	D	MCERTS
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.	L031B	W	ISO 17025
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.	L033B	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.	L037B	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.	L039B	W	ISO 17025
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.	L039B	W	ISO 17025
Preparation WAC leachate		In-house method	L043B	W	NONE
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	L046B	W	NONE
Loss on ignition of soil @ 450°C	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	In-house method	L047	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/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	L080	W	ISO 17025

Analytical Report Number : 24-012569

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

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	L082B	W	ISO 17025

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

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

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

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Analytical Report Number : 24-012569

Project / Site name: RFC Bowls Club, Church Walk, Gravesend

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DS1	N/A	2	162881	a	Chloride in WAC leachate (BS EN 12457-3 Prep)	L082B	a
DS1	N/A	2	162881	a	DOC in WAC leachate (BS EN 12457-3 Prep)	L037B	a
DS1	N/A	2	162881	a	Fluoride in WAC leachate (BS EN 12457-3 Prep)	L033B	a
DS1	N/A	2	162881	a	Metals in WAC leachate (BS EN 12457-3 Prep)	L039B	a
DS1	N/A	2	162881	a	Phenol Index in WAC leachate (BS EN 12457-3 Prep)	L080	a
DS1	N/A	2	162881	a	Preparation WAC leachate	L043B	a
DS1	N/A	2	162881	a	Sulphate in WAC leachate (BS EN 12457-3 Prep)	L039B	a
DS1	N/A	2	162881	a	TDS in WAC leachate (BS EN 12457-3 Prep)	L031B	a
DS1	N/A	S	162881	a	Acid neutralisation capacity of soil	L046B	a
DS1	N/A	S	162881	a	BTEX and/or Volatile organic compounds in soil	L073B	a
DS1	N/A	S	162881	a	Loss on ignition of soil @ 450°C	L047	a
DS1	N/A	S	162881	a	PCB's By GC-MS in soil	L027B	a
DS1	N/A	S	162881	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS1	N/A	S	162881	a	Total organic carbon in soil	L023B	a
DS1	N/A	S	162881	a	Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	L076B/L088	a
DS1	N/A	S	162881	a	pH at 20°C in soil	L005B	a
DS2	N/A	2	162882	a	Chloride in WAC leachate (BS EN 12457-3 Prep)	L082B	a
DS2	N/A	2	162882	a	DOC in WAC leachate (BS EN 12457-3 Prep)	L037B	a
DS2	N/A	2	162882	a	Fluoride in WAC leachate (BS EN 12457-3 Prep)	L033B	a
DS2	N/A	2	162882	a	Metals in WAC leachate (BS EN 12457-3 Prep)	L039B	a
DS2	N/A	2	162882	a	Phenol Index in WAC leachate (BS EN 12457-3 Prep)	L080	a
DS2	N/A	2	162882	a	Preparation WAC leachate	L043B	a
DS2	N/A	2	162882	a	Sulphate in WAC leachate (BS EN 12457-3 Prep)	L039B	a
DS2	N/A	2	162882	a	TDS in WAC leachate (BS EN 12457-3 Prep)	L031B	a
DS2	N/A	S	162882	a	Acid neutralisation capacity of soil	L046B	a
DS2	N/A	S	162882	a	BTEX and/or Volatile organic compounds in soil	L073B	a
DS2	N/A	S	162882	a	Loss on ignition of soil @ 450°C	L047	a
DS2	N/A	S	162882	a	PCB's By GC-MS in soil	L027B	a
DS2	N/A	S	162882	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
DS2	N/A	S	162882	a	Total organic carbon in soil	L023B	a
DS2	N/A	S	162882	a	Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	L076B/L088	a
DS2	N/A	S	162882	a	pH at 20°C in soil	L005B	a



Laboratory Report



Contract Number: 72030

Client Ref: **CCL03525**

Client PO: **13350**

Date Received: **28-03-2024**

Date Completed: **13-04-2024**

Report Date: **13-04-2024**

Client: **Crossfield Consulting**

This report has been checked and approved by:

Contract Title: **RFC Bowls Club, Church Walk, Gravesend**

For the attention of: **Info Email**

Brendan Evans
Office Administrator

Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	4
4 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	4
Disposal of samples for job	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 test report/certificate shall not be reproduced except in full, without the approval of GEO Site & Testing Services Ltd. Any opinions or interpretations stated - within this report/certificate are excluded from the laboratories UKAS accreditation.

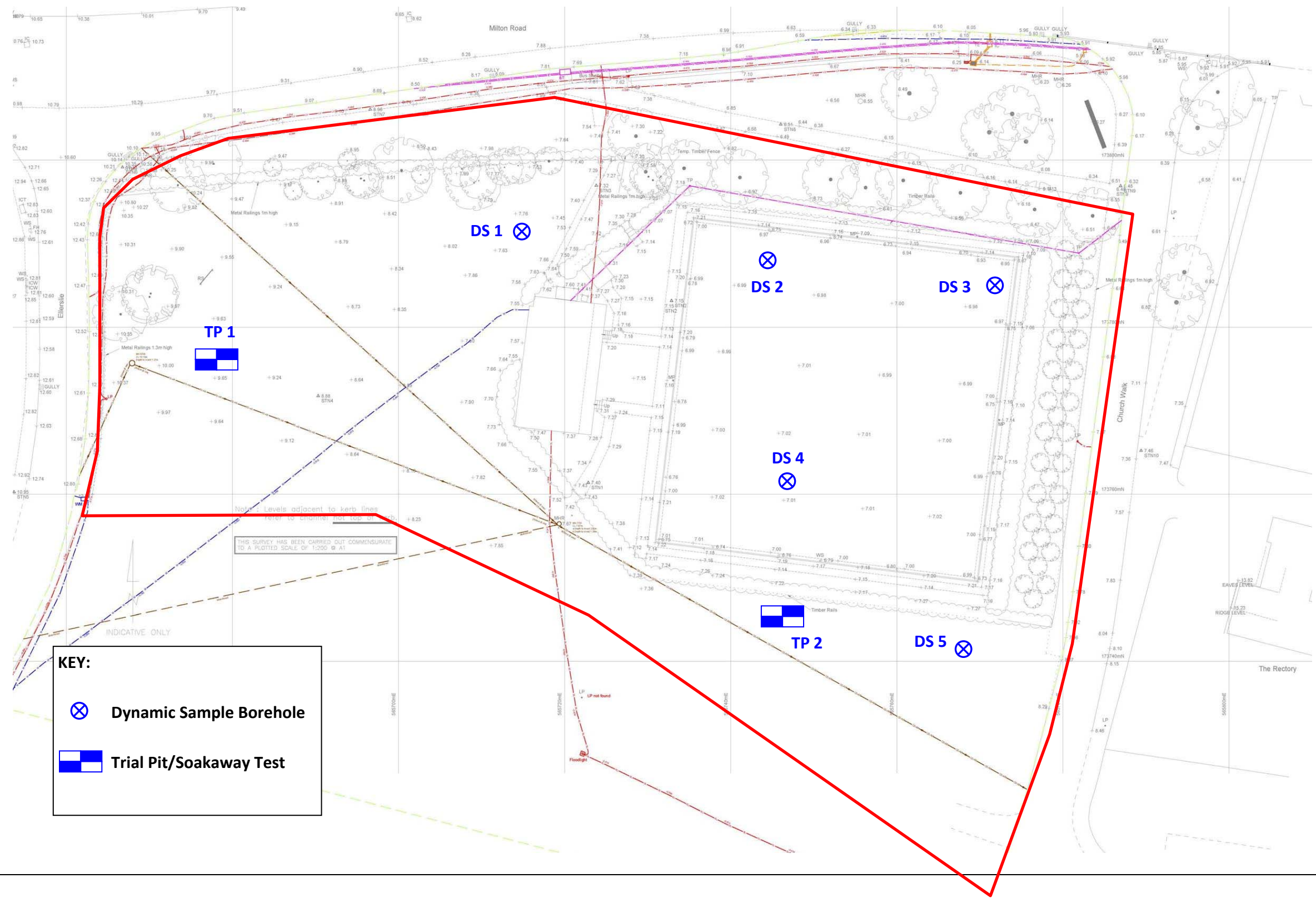
Approved Signatories:

Brendan Evans (Office Administrator) - Darren Bourne (Quality Senior Technician) - Paul Evans (Director)

Richard John (Quality/Technical Manager) - Shaun Jones (Laboratory manager) - Shaun Thomas (Site Manager)

Wayne Honey (HR & HSE Manager)

FIGURE I-1



EXPLORATORY HOLE LOCATION PLAN
Scale 1: 500

Reproduced from Prospaplan Limited Drawing No. PP/4081/GRAVESEND/F1, dated December 2021

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 arsenic recorded at levels above the generic assessment criteria (GAC).

The model has been set up on the basis that the proposed development comprises apartments, for residents of retirement age. The development will have managed landscaping such that there will be no private gardens and residents will not be permitted to cultivate the ground. The contaminant 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
Arsenic	61	5.6 to 61	410	No	0

Notes

1. Where the maximum concentration does not exceed the SSAC, risks to end users are considered to be negligible and, therefore, no further assessment is required. For compounds with a maximum concentration above the SSAC, further consideration of risks or remediation may be required. See Section 7.
2. The SSAC is presented to two significant figures from the value calculated in the CLEA output sheets presented in this Appendix.

CLEA Software Version 1.071

Page 1 of 5

Report generated 16/04/2024

Report title GRFC Bowls Club, Church Walk, Gravesend



Created by GF 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 clay 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)	Max exposed skin factor					
	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		Body weight (kg)	Body height (m)	Inhalation rate (m ³ day ⁻¹)	Indoor (m ² m ⁻²)	Outdoor (m ² m ⁻²)	Total skin area (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



Age Class	Consumption rates (q FW kg^{-1} bodyweight day^{-1}) by Produce Group											
	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**Soil** Sandy clay loam

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

Porosity, Total (cm ³ cm ⁻³)	5.30E-01
Porosity, Air-Filled (cm ³ cm ⁻³)	1.60E-01
Porosity, Water-Filled (cm ³ cm ⁻³)	3.70E-01
Residual soil water content (cm ³ cm ⁻³)	1.50E-01
Saturated hydraulic conductivity (cm s ⁻¹)	2.37E-03
van Genuchten shape parameter <i>m</i> (dimensionless)	3.10E-01
Bulk density (g cm ⁻³)	1.20E+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	7.40E+00
Soil Organic Matter content (%)	3.00E+00
Fraction of organic carbon (g g ⁻¹)	1.74E-02
Effective total fluid saturation (unitless)	5.79E-01
Intrinsic soil permeability (cm ²)	3.16E-08
Relative soil air permeability (unitless)	5.78E-01
Effective air permeability (cm ²)	1.83E-08

Soil - Vapour Model

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

Air Dispersion Model

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

* Air dispersion factor in $\text{g m}^{-2} \text{s}^{-1}$ per kg m^{-3} **Soil - Plant Model**

	Dry weight conversion factor	Homegrown fraction		Soil loading factor	Preparation correction factor
	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

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GRFC Bowls Club, Church Walk, Gravesend

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