

**Additional Ground
Investigation & Risk
Assessment Report**

Project Name: Former Police Station

Location: 133 Windmill Street, Gravesend, DA12 1DB

Client: Churchill Retirement Living

Project ID: J15380

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SUMMARY

The site, which was rectangular in outline and extended to approximately 0.4ha, comprised a former police station that had been partially demolished; leaving the perimeter walls, basements and semi-basements intact. It is proposed to redevelop the site with a complex of retirement flats.

Geological records indicated the site to be underlain by Thanet Formation and Lewes Nodular Chalk. Made Ground was likely to be present.

A desk study was carried out previously, by others, and this indicated that the site has had a history of initial residential use. The site was redeveloped as the police station between 1948 and 1953. Demolition appeared to have commenced circa 2016.

An underground fuel tank was present beneath the site. This UST was found during demolition. It was encased in thick concrete and had not caused any contamination from petroleum hydrocarbons.

An Unexploded Ordnance (UXO) risk assessment was not included in our brief.

A number of intrusive investigation were carried out, including two phases undertaken by others and two phases by STL. There were areas of the site that were inaccessible during the fieldwork phase, such as the ground beneath the floor slabs that covered the entire site area; these have been addressed during demolition. It should not be assumed that the same ground conditions would apply to these inaccessible areas.

The soils encountered comprised thick, heavily reinforced concrete that was up to 0.8m in thickness, in places; underlain by Made Ground, to depths of between 2.0mbgl and 3.9mbgl. This included lean mix concrete to a depth of 1.5mbgl in STL BH1. A thin layer of Head/Thanet Formation was noted to depths of between 4.5mbgl and 6mbgl; with Lewes Nodular Chalk to the full depth of the ground investigation (25mbgl).

Groundwater was encountered at depths of between 17.9mbgl and 18.5mbgl to the lower or northern end of the site; in 2021. The well that was installed in borehole BH102 was monitored on 28/02/2023, with the groundwater level being found at 18.5mbgl. Groundwater was noted at a depth of 21.5mbgl and 22mbgl to the upper or southern end of the site; in 2023. The well that was installed in BH1 by STL was monitored 28/02/2023 and the groundwater level was found to be 21.05mbgl (28/02/2023).

Piled foundations are recommended for this site.

The sulphate content of the fill and natural soil was found to fall within Class DS1. The ACEC classification for the site is AC1.

No significant groundwater conditions requiring de-watering of excavations are anticipated.

Suspended floor slabs are advised.

Detailed information on the proposed development, such as detailed final layout, loadings and serviceability limits was not provided. Accordingly, where geotechnical design advice is provided it is on the prescriptive basis allowed for by Eurocode 7: employing conventional and conservative design rules.

Based upon the thirteen soil samples and two groundwater samples (tested by others) analysed from this site, there is no evidence of soil or groundwater contamination at this site. The presence of contamination may affect the classification of waste soils, or the potential for their re-use.

Groundwater analysis, undertaken by others showed the groundwater to not be impacted by the site. In particular, the results for speciated petroleum hydrocarbons were all noted to be below the laboratory limit of detection.

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

As with any site, areas of contamination not identified during investigation works may come to light during the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to reassess the remedial strategy for the site. The presence of contamination may affect the classification of waste soils, or the potential for their re-use.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

The investigation was conducted and this report has been prepared for the sole internal use and reliance of Churchill Retirement Living and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd. believes are reliable. Nevertheless, Southern Testing Laboratories Ltd. cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The recommendations contained in this report are made in respect of the particular context of the investigation as described in the report and may not be appropriate to alternative development schemes. This report should be considered in its entirety and Southern Testing Laboratories Ltd accepts no responsibility for and excludes liability in respect of any omission or alteration made by others, and any use of the report for any purpose other than that for which it was produced.

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For and on behalf of Southern Testing Laboratories Limited

DOCUMENT HISTORY AND STATUS

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A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a project order document, from Churchill Retirement Living, ref HM-20085GD/0005, dated 25 January 2023.

2 Location

The site is located approximately 0.2km south of the train station in Gravesend, Kent. The approximate National Grid Reference of the site is TQ 6470 7380. The site location is indicated on Figure 1 within Appendix A.

3 Proposed Construction

It is proposed to construct a residential development. The proposed development comprises an apartment block, up to five storeys in height. This is to have areas of soft landscaping and vehicle parking. Residents of the development will be of retirement age.

For the purposes of the contamination risk assessment, the proposed development land use is classified as Residential without consumption of Homegrown Produce CLEA Model Ref [1] / C4SL Report Ref [2].

There are no current UK screening values for the land use as flats to be occupied by people over the age of 55.

The gas sensitivity of the proposed development is rated as Moderate CIRIA C665 Ref [3].

4 Object

This is a walkover sand additional intrusive geotechnical and contamination (risk estimation and evaluation) investigation (Tier 1).

The object of the investigation was to assess foundation bearing conditions and other soil parameters relevant to the proposed development, and to assess the likely nature and extent of soil, groundwater and soil gas contamination on the site.

5 Scope

This report presents our exploratory hole logs and test results and our interpretation of these data.

A UXO risk assessment was not requested within our brief for the investigation.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The ground investigation has been completed with reference to BS 5930 Ref [4] and BS 10175 Ref [5].

Waste Classification of soils has not been included within the brief for the investigation.

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Detailed information on the proposed development, such as detailed final layout, loadings and serviceability limits was not provided. Accordingly, where geotechnical design advice is provided it is on the prescriptive basis allowed for by Eurocode 7: employing conventional and conservative design rules.

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

B DESK STUDY AND WALKOVER SURVEY

6 Desk Study

A desk study has been carried out previously, by others, in 2008. This information was incorporated into report ref: CCL03497.CO72, dated November 2021, Crossfield Consulting. This report detailed an intrusive investigation, comprising four cable percussive boreholes, undertaken to the lower part of the site and six windowless sample boreholes; of which only one was taken to a depth below the concrete slab. The reader is referred to this report for further information.

The site has had a history of use initially as residential, with houses being located to the east and west sides of the site. The police station appeared to have been constructed between 1948 and 1953, with a police office block being added to the southern side by 2003. The site was partially demolished by 2016.

A fuel storage tank may be present beneath the site. A fuel pump was described as being denoted upon a 2010 topographical survey of the site. The actual location of this pump was not stated in the report. The petroleum officer was contacted previously, but had no records. STL would comment that records for the location and status of underground tanks are only obligatory for those that are used to store petroleum. Records do not need to be kept for diesel fuel, engine oil or heating oil.

A fuel spillage was described as having taken place at the site in 2006. The area where this fuel spillage took place is not given in the report.

6.1 Geology

The British Geological Survey Map No 271, indicated that the site geology consisted of Thanet Formation, underlain by Lewes Nodular Chalk.

6.1.1 Thanet Formation

The Thanet Formation is a Palaeocene deposit, consisting of fine-grained pale yellow and grey mottled silty to very silty sand that can be clayey or glauconitic.

The boundary between the Thanet Formation and the underlying Chalk is very irregular and is marked by a bed of green-coated flints and glauconitic sand and clay (Bullhead Beds).

It is not uncommon to find sinkholes in the vicinity of the outcrop of the Thanet Formation particularly where there was a layer of overlying clay. In some areas, there are many old shafts that were dug in order to mine the underlying Chalk.

6.1.2 Lewes Nodular Chalk Formation

The Lewes Nodular Chalk Formation is characterised by bands of orange-stained, hard, medium to very high density chalk interbedded with soft greyer low density chalk. There are some well-developed hardgrounds noted such as the Top Rock and Chalk Rock. A number of persistent marl and flint horizons are included within this formation. Fracturing is variable, although commonly steeply inclined and curvilinear in nature. Horizons of sub-horizontal sheet flints are also present.

The White Chalk outcrop in particular is frequently highly fractured and highly permeable, and usually has good infiltration characteristics. On the other hand, Chalk Head, highly weathered Chalk and Chalk under a low permeability superficial cover may have very poor infiltration characteristics.

Chalk is slightly soluble in water and, while it has excellent bearing properties when unweathered, this solubility can lead to deep weathering and softening, and the upper layers of chalk often have an irregular boundary with overlying strata.

The Chalk may be softened by solutioning to a depth of 5 to 15 metres and bearing capacities and engineering properties generally improve with depth. Where there is an outcrop of impermeable soil overlying the chalk there may be a dramatically increased solution effect due to concentrated surface water flow to the Chalk close to the outcrop boundary.

Solution features are common in the Chalk, and these can present significant difficulties to development on affected sites. Some risk of structural damage due to solution features must be accepted when developing sites on Chalk even where intensive site investigation work has been carried out.

Man has also worked the chalk for flints, and for other purposes, for thousands of years and any signs of old workings should be carefully investigated.

6.2 UXO Risk Management

The agreed scope of work did not allow for either a preliminary or detailed UXO risk assessment.

7 Site Walkover Survey

7.1 General Site Description and Boundaries

The site, which was roughly rectangular in outline and extended to approximately 0.4ha, was surrounded by a high brick built wall and bounded to the north by Woodville Place. Woodville Place had a double gated access, allowing access for vehicles to the site.

Wrotham Road was located to the west. A layby/access road or parking area was noted to the east side of Wrotham Road. Windmill Street, which had a stepped and ramped pedestrian entrance situated to the south east corner was located to the east boundary. Windmill Street had a wide area of pavement. Zion Place was located to the south boundary.

Residential properties comprising either terraced housing or blocks of flats, were located to the east, south and west of the site. Buckland House, a two storey block, which comprised function rooms were noted to the south west corner of the site.

An amenity complex, housing the Civic Centre, the Woodville Theatre, the library and the Gravesham Council offices building were situated to the north.

The River Thames was located approximately 0.8 km to the north of the site.

The site was previously occupied by a purpose built police station. This was constructed from concrete, with a tall and thick perimeter wall, constructed from bricks. It had been partially demolished at the time of this ground investigation. A large above ground tank, constructed from reinforced concrete was noted to the north west side of the site. This tank appeared to have been the header tank for a sprinkler system.

The site had two levels. An access ramp previously connected the upper level to the lower level, but this had been demolished. The area to the south was at the same level as the surrounding roads. There were basements to the centre of this upper level. To the north the land had been lowered to provide an undercroft and open area.

The former police station sub-structure had been left in situ. This appeared to act as a retaining wall to the northern boundaries (Woodville Place) and also to part of Windmill Street to the east and the side road adjacent to Wrotham Road to the west.

The previous report commented that a topographical survey showed a fuel pump island, but did not give a location.

Subsequently, during demolition, the location of this underground fuel storage tank was determined. It was towards the centre of the site, (See Figure 2 in Appendix A). It was at a depth of around four metres from the upper level, which would be around the level of the lower part of the site.

The demolition contractor commented to STL that the UST was around 10000 litres in volume. It was found to be empty, but had not been decommissioned. It was encased in concrete that was around one metre in thickness. There was no odour noted.

7.2 Topography and Drainage

The site was set at two levels. The area to the south was at street level, but also had basements to the centre. To the north the land had been lowered to provide an undercroft and open area.

The site most likely drained via the combined sewerage system.

7.3 Vegetation

The site had previously been overgrown with buddleia. Three large London plane trees were located upon the east site boundary. Eight lime trees, of varying heights and ages, were located to the west boundary, on Wrotham Road.

7.4 Buildings and Land Use on Site and Nearby

A complex housing the Civic Centre, the Woodville Theatre, library and Gravesham Council offices were located to the north side of the site, off Woodville Place. Two storey terraced houses and three to four storey blocks of flats were noted to all other boundaries, on the opposite sides of Windmill Street, Zion Place and Wrotham Road respectively.

7.5 Inaccessible Site Areas

The site was accessible, however there was no lighting within the semi-basement and basement areas, which contained quantities of fly tipped materials.

7.6 Site Photographs

A series of photographs showing the site is included in Appendix G.

C PRELIMINARY SITE MODELS

8 Conceptual Engineering Geological Ground Model

From the desk study information and walkover undertaken at this site the following conceptual ground model has been formulated.

Data Source	Comments
Geology	The recorded soils beneath the site comprise Made Ground, a thin layer of Thanet Formation and Lewes Nodular Chalk. Foundation requirements will be a piled solution, excavations will be unstable.

Data Source	Comments
Former Site Use	There are likely to be old foundations/basements/ cellars, piles and floor slabs present. The police station was set upon piled foundations. During demolition, the location of an underground fuel storage tank was determined. It was towards the centre of the site, (See Figure 2 in Appendix A). It was at a depth of around four metres from the upper level, which would be around the level of the lower part of the site. The demolition contractor commented to STL that the UST was around 10000 litres in volume. It was found to be empty, but had not been decommissioned. It was encased in concrete that was around one metre in thickness. There was no odour noted.
Groundwater	The depth to groundwater appears to be around 18mbgl to 21mbgl. It is unlikely to be encountered during excavation work. The groundwater is within a principal aquifer, comprising the Lewes Nodular Chalk. The site does not lie within a source protection zone, for potable supply of groundwater.
Surface Water	The site is located in an area of potential flooding, described as moderate risk. Flood protection measures will need to be considered in the design process.
Potential Geo-hazards	Cohesive Thanet Formation will exhibit shrinkage/swelling, granular Thanet Formation will run on contact with water. Chalk is known to have solution features. Site lies within an area where sporadic chalk mining took place.
Other Comments	Solution pipe within chalk strata, 276 m to the east of the site. Ice wells located 600m north of the site. Deneholes 700m west of the site

On the basis of the available information the geotechnical categorization for the proposed structure(s) is considered to fall within Geotechnical Category 2 – Conventional structure with no exceptional risk or difficult ground or loading conditions; Eurocode 7 Ref [6].

9 Conceptual Site Model

In the context of this report, the conceptual model summarises the potential pollutant linkages identified for the site and forms the basis of the risk assessment for the site. The preliminary model comprises the potential sources of contamination, receptors that could be harmed and exposure pathways identified from the desk study and walkover survey. These potential linkages form the basis upon which the investigation is designed and reported.

9.1 Potential Sources of Contamination

The site has a history of use as a purpose built police station and is located within an area of mixed uses, including commercial, amenity and residential land uses.

A few potentially contaminative uses have been identified, on site. There were no significant sources noted in the locality.

Potential contaminants associated with these uses have been compiled from our experience of such sites.

9.1.1 On-Site Sources

Potential Source	Potential Contaminants
Made Ground	Metals, non-metals, petroleum hydrocarbons, PAH compounds, asbestos containing materials, soil gas emissions
Potential for underground fuel storage tanks, fuel pipelines and pumps	Petroleum hydrocarbons

Potential Source	Potential Contaminants
Oil spillage in 2006	Petroleum hydrocarbons

The location of the fuel pump and fuel spill are not stated in the previous report.

The location of this underground tank was determined during demolition. It was towards the centre of the site, (See Figure 2 in Appendix A). It was at a depth of around four metres from the upper level, which would be around the level of the lower part of the site.

The demolition contractor commented to STL that the UST was around 10000 litres in volume. It was found to be empty, but had not been decommissioned. It was encased in concrete that was around one metre in thickness. There was no odour noted.

The thickness of the concrete at the site would have impeded any impact from the fuel spillage to the underlying soils.

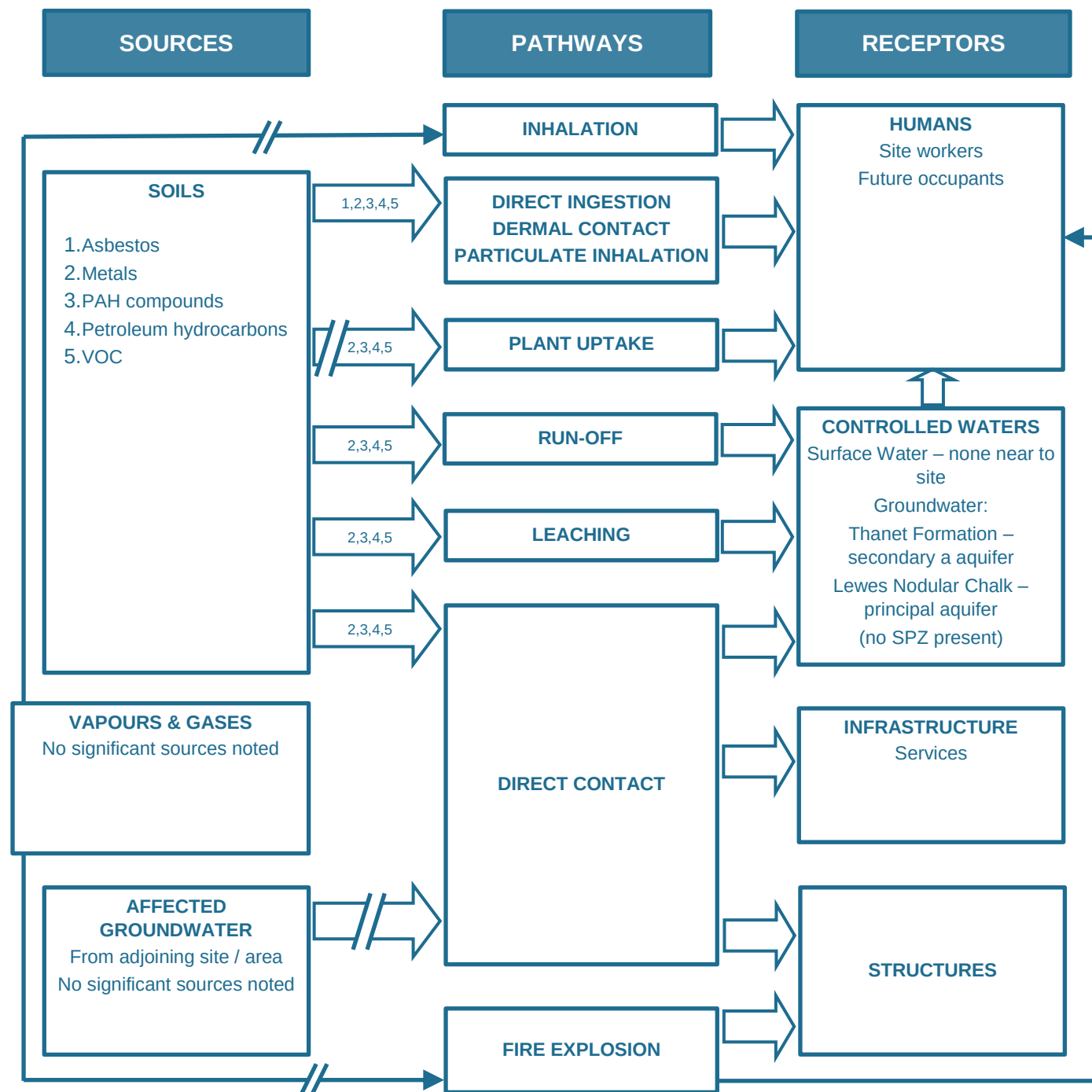
The building on site was of an age where asbestos containing materials would have been used in the construction. No survey of the previous or remaining structures has been made by STL.

9.1.2 Off-Site Sources

The site may be impacted by contamination migrating from beyond the site boundary. No significant off site sources were identified in the previous report.

9.2 Pollutant Linkages and Conceptual Site Model Summary

The following diagram shows the potential pollutant linkages identified for the site and summarises the preliminary conceptual model:



D GROUND INVESTIGATION

10 Strategy and Method

The strategy adopted for this intrusive investigation comprised the following:

Activity / Method	Purpose	Max Depth Range (mbgl)	Installations / Notes
Concrete coring	To create starter holes	0.45-0.85	
BH1-BH2 Cable Percussive	Boreholes to assess deeper ground conditions and allow SPT's and samples for geotechnical testing.	25.0	200mm / 150mm diameter 50mm groundwater monitoring well installed within BH1
TPA -TPD	Hand dug trial pits	1	To take contamination soil samples after removal of concrete slabs (15/03/23)
TPE-TPF	Machine dug trial pits	4-6	Machine dug trial pits to obtain geotechnical samples (27/03/23)

Exploratory hole locations are shown on Figure 2 in Appendix A.

In-situ test and sampling methods descriptions employed are given in Appendix B together with the test results.

SPT Energy Ratio certificates and a Summary Table of SPT N Values is provided within Appendix B.

The presence of the buildings, basements, thick reinforced concrete hardstanding restricted access for the fieldwork.

11 Weather Conditions

The fieldwork was carried out between 15 February 2023 and 27 March 2023; at which time the weather was generally mixed. February 2023 was very dry and March 2023 was wet.

12 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Made Ground, underlain by the Thanet Formation and Chalk. A summary is given below.

Depth (m)	Thickness (m)	Soil Type	Description
GL-0.8/1.5	0.8-1.5	Concrete	Reinforced concrete (heavily reinforced)
0.8/1.5-2.5/2.7	1.2	Made Ground	Dark blackish brown or brown mottled black and brown sandy gravelly CLAY. Sand is coarse. Gravel comprises fine to coarse angular to rounded flint and concrete
2.5/2.7-4.5/6.0	1.8-3.5	Head / Thanet Formation	Silty sandy CLAY or very sandy CLAY
4.5-6.0->25	>25	Lewes Nodular Chalk	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel, occasional flints noted

The soils found are generally in accordance with those anticipated.

Head may have been present but this was really not distinguishable from the Thanet Formation.

12.1 Visual and Olfactory Evidence of Contamination

Evidence of possible contamination in the form of Made Ground was recorded at the location of all trial holes.

These occurrences are discussed in Section E.

13 Groundwater Observations

Groundwater was observed in the exploratory holes as follows:

Hole ID	Water Strike Depth (mbgl)	Comment	Stratum
BH101 (CC)	18.8	Rose to 17mbgl in 20 minutes (09/11/21) borehole installed to lower level of site	Chalk
BH102 (CC)	18.6	Rose to 17.96mbgl in 20 minutes (10/11/21) borehole installed to lower level of site	Chalk
BH1 (STL)	22.0	Rose to 21.65mbgl in 20 minutes (17/02/23) borehole installed to upper level of site	Chalk
BH2 (STL)	21.5	Level did not rise (22/02/23) borehole installed to upper level of site	Chalk

E DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

14 Geotechnical Laboratory Tests

The following geotechnical laboratory testing was carried out on selected samples in order to aid material classification and characterise soil properties. The test method references and results are given in Appendix C.

Laboratory Test	Number of Samples Tested	Stratum
Moisture Content	7	Thanet Formation
Atterberg Limit	7	Thanet Formation
Particle Size Distribution (Wet Sieve)	4	Thanet Formation
BRE SD1 Suite	12	Thanet Formation and Chalk
SMC Chalk	8	Chalk

15 Soil Classification and Properties

15.1 Made Ground

Thick surface hard standing in the form of concrete was encountered at each exploratory hole location.

The made ground materials beneath was found to be generally composed of sandy gravelly clays, and clayey sands. These contained various anthropogenic materials, including brick and concrete.

The made ground should be anticipated to be very variable in both composition and thickness across the site and potentially having a high compressibility. SPT N values ranged between 4 and 6, indicating that the Made Ground was loose.

Obstructions, such as former piled foundations will be encountered.

15.2 Head / Thanet Formation

These deposits were seen to be variable with soils ranging from firm sandy clays to clayey sands. The distribution of individual soil types across the site is not predictable and rapid changes in soil type should be anticipated both vertically and laterally.

The Atterberg limit results for the cohesive Head / Thanet Formation material indicates clays of high plasticity. Liquid Limit results were seen within the range 32% to 64%, Plastic Limit results between 19% to 33% and Plasticity Indices between 5% and 44%, indicating a High Volume Change Potential.

A plot of SPT results against depth within the soils beneath this site has been included within Appendix D, based upon the SPT N values.

The Thanet Formation materials were found to be loose to medium dense in nature, with SPT N values ranging between 9 and 26. The more clayey sandy gravels had lower N values indicating dense or medium dense materials.

The Thanet Formation materials had the following range of particle size distribution results.

Hole ID / Depth (mbgl)	Clay / Silt(%)	Sand (%)	Gravel (%)	Cobbles (%)
BH1 2.7	38	60	1	0
BH1 3.5	33	64	2	0
BH2 3.0	47	52	1	0
BH2 5.0	31	69	0	0

All samples had high fines content and are not likely to be fairly free-draining. However, their observed vertical and lateral distribution may be anticipated to be lenticular or 'channelized'. Other more clayey materials will have substantially lower permeabilities.

The more cohesive soils within are likely to have high to medium compressibility characteristics.

15.3 Lewes Nodular Chalk

The Lewes Nodular Chalk soils at the site were generally recovered as a putty Chalk, with fine to coarse gravel of weathered, possibly low density Chalk lithorelicts, and fine to coarse gravel of flint.

SPT N values in the Chalk were in the range of 4 to 28.

Eight samples of Chalk were subject to saturation moisture content testing. These results indicated bulk densities of between 1.89mg/m³ and 1.94mg/m³, with the saturation moisture contents ranging between 29% and 32%.

It should be noted that the cable percussive drilling technique can destroy most of the structure of the Chalk. Any Chalk recovered may, therefore, be unrepresentatively weaker than the whole chalk mass. It is not usually possible to classify Chalk or log in detail with this technique.

15.4 Summary of Geotechnical Parameters

Soil Type: Head / Thanet Formation

Parameters	Range	Suggested Design Value
SPT (N Value)	9-26	20
Effective Angle of Friction, ϕ' (degrees)	-	32

Soil Type: Lewes Nodular Chalk

Parameters	Range	Suggested Design Value
Plasticity Index (%) (modified value)	Nil	Nil

Parameters	Range	Suggested Design Value
SPT (N Value)	4-28	20
Effective Angle of Friction, ϕ' (degrees)	Not measured	35

16 Groundwater Levels

Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long-term monitoring from boreholes or standpipes is required to assess the ground water regime.

Groundwater was encountered at depths of between 17.9mbgl and 18.8mbgl to the lower part of the site in 2021, and between 22mbgl and 21.5mbgl in 2023 to the upper part of the site.

The wells were monitored in 2021; results ranged between a dry well that was installed to a depth of 4.99mbgl (dry well) and groundwater at a depth of 18mbgl.

The well installed by STL was monitored on 28/02/2023. Groundwater was found to stand at 18.5mbgl in ST BH1.

The two original wells were monitored during this site visit. BH101 was found to be dry. The groundwater level in BH102 was noted to be 18.5mbgl.

Based on the observations to date, allowance should be made for seepages within the Thanet materials, during spells of inclement weather. Where seepages are encountered the soils will soften rapidly.

It is envisaged that seepages above the water table could be controlled within excavations by locally pumping from sumps.

17 Swelling and Shrinkage

Shrinkable soils are subject to changes in volume as their moisture content is altered. Soil moisture contents vary from season to season and can be influenced by a number of factors including the action of roots. The resulting shrinkage or swelling of the soil can cause subsidence or heave damage to foundations, the structures they support and services.

The designer should be aware that precautions regarding swelling and shrinkage are applicable, and in this respect NHBC precautions provide a helpful guide with respect to minimum foundation depths and deepening particularly within the zone of influence of vegetation.

Assessment of foundation depths should take into account trees, hedgerow and shrubs which are to be removed, are to remain or are proposed in any planting scheme; and which may be allowed to reach maturity.

The cohesive Head/ Thanet Formation are of limited thickness and therefore precautions should not be needed.

Full details of protective measures are given in NHBC Standards Ref [7], Chapter 4.2 to which the reader is referred.

18 Soakaways

No soakage testing has been carried out, however, due to the silt/clay nature of the superficial soils on site these are considered unsuitable for soakaway drainage and a positive drainage system should be considered for surface water disposal.

Given the density of the proposed development, which will occupy the site footprint; it is unlikely that soakaways could be used into the Chalk.

On the basis of these test results and given the soil types present, the site is not considered suitable for shallow soakaway drainage. We would therefore recommend a positive drainage system be considered for all surface water disposal.

19 Sulphates and Acidity

Chemical analysis of the underlying soils has been undertaken to establish the aggressive chemical environment for concrete in accordance with the BRE Special Digest 1, Ref [8]. The site category determined is that of a brownfield location that contain pyrites (or potential pyrites), as the underlying soils form part of the Thanet Formation.

The recorded pH values are in the range 4.8 to 11.7.

The Design Sulphate Class is DS1. Groundwater should be assumed to be mobile. The ACEC site classification is AC 1.

20 Foundation and Bearing Capacity

All loadings should be transferred beneath any fill or made ground, soft or disturbed soils and be placed within the underlying natural Chalk soils.

A piled foundation solution is recommended for the proposed development.

21 Piling

As with any piling scheme, discussions should be held with selected piling contractors to discuss the technical and financial merits of their various systems. With respect to overall resources, the equipment available should be appropriate for the soils described and anticipated and be able to achieve the depths and diameters considered with an appropriate safety margin.

Noting that groundwater could be encountered, the specialist contractor should take appropriate measures to ensure that his system caters for the ingress of groundwater.

From the viewpoint of pile type and given the close proximity of adjacent structures, a bored pile solution is considered to be a more appropriate pile type. In terms of bored piles and, noting the presence of potentially unstable soils (clay and Chalk), a continuous flight auger grout injected pile (CFA) or segmented flight auger (SFA) would be best suited to the ground conditions encountered. Careful monitoring during construction of these pile types is however required.

It should be noted that subsurface obstructions could be encountered in the form of old foundations, drain runs etc. accordingly allowances for their removal/breaking out should be made when carrying out piling works and excavations.

Piles on this site will derive the majority of their capacity from the skin friction within the Chalk, base resistance will provide a much smaller contribution. Within the Chalk, the design of piles is typically based on using a plot of SPT results versus depth derived from both SPT results. The plot of results from the boreholes is appended as Figure SPT12 (Appendix D) on which a suggested design line is indicated. The contribution of skin friction within the Thanet Formation utilises a value for the angle of friction (ϕ) derived from the SPT results.

For the purpose of providing preliminary estimates of pile capacities, we have assumed the following crude soil model, which is based on the findings of our borehole.

Depth to base (mbgl)	Soil Type
GL - 3.0	Made Ground – nil skin friction assumed
3.0 – 6	Thanet Formation – Cu 0kPa assumed, due to disturbance of soils during removal of previous piled foundations
7.0 – 25.0	Chalk – profile as plotted in Figure SPT12 Appendix D

A standing water table of around 17mbgl (lower part of site) to 21mbgl (upper part of site) has been assumed at this stage.

It is estimated that a 350mm diameter pile with a toe set at around 19mbgl would have a safe allowable load of 600kN, assuming a factor of safety of 3.0.

The above noted pile capacities are for individually loaded piles. It is anticipated that the final design will be subject to more detailed calculations and structural analysis; as such our preliminary assumed parameters and calculated values should therefore not supersede the Engineer's or specialist piling Contractors final design.

22 Floor Slabs

Allowance should be made for fully suspended ground floor slabs.

23 Settlement

Based on the recommendations given above, settlement for the proposed structure should be within tolerable limits.

24 Excavations and Dewatering

Statutory lateral support will be required in all excavations where personnel must work.

An allowance should be made for breaking out sub-surface obstructions associated with existing and past developments.

The clay materials will be prone to instability in open excavations during wet weather or where seepages are encountered and will soften rapidly if exposed to moisture or the elements.

Where excavation is proposed in close proximity to existing structures care will need to be taken to avoid undermining existing foundations.

Significant inflows of groundwater into excavations would not be anticipated nor would the requirement for specialist de-watering activities.

Seepage of groundwater into excavations should be anticipated, especially from the superficial soils, during spells of inclement weather. However, these should be managed with simple pumping methods/or specialist de-watering system will be required such as well-pointing.

25 Filling

The materials with higher clay / silt contents will be difficult to handle and compact when wet, making them difficult for re-use as structural fill.

Soil testing is currently being carried out, to enable the superficial soils to be replaced in a controlled and engineered fashion, after removal of the existing piled foundations for the previous building had been undertaken. Following replacement a piling mat is to be placed.

26 Pavement Construction

It is anticipated that proposed pavement areas will be formed in the Made Ground or Thanet Formation.

For preliminary design purposes of a CBR value of 1% can be assumed for pavement design. However, given that the soils are likely to be disturbed by construction plant during demolition and construction it may be prudent to reassess the CBR value as construction progresses.

The most important element of any road construction is drainage and attention must be given not only to the drainage of the subsoil but to the various layers of construction. To this end, the formation should be shaped to a camber or crossfall to allow water movement out of the sub-base. Silty soils soften extremely quickly if allowed to become wet or if they are excavated below the water table and this softening can give rise to a very substantial increase in costs.

Sub-base and coarse capping materials tend to segregate during placing operations, particularly when end tipped. On soft clay subgrades this can lead to punching and softening of the formation. The use of a layer of sand or geofabric will minimise the problem.

The formation should be proof rolled and any soft spots found should be excavated and replaced with compacted granular material. The surface of the formation should then be compacted, prior to laying the road sub base.

Construction traffic should be kept off formations and it is often advisable to leave a protective layer of soil above formation level until the last moment before placing the sub-base.

The formation should be considered potentially frost-susceptible.

F DISCUSSION OF GEOENVIRONMENTAL TEST RESULTS AND RECOMMENDATIONS

27 Analytical Framework

There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

The CLEA model Ref [1], provides a methodology for quantitative assessment of the long-term risks posed to human health by exposure to contaminated soils. Toxicological data is used to calculate a Soil Guideline Value (SGV) for an individual contaminant, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.

In the absence of any published SGVs for certain substances, Southern Testing have derived or adopted Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH S4UL's Ref [9] and CL:AIRE Soil Generic Assessment Criteria Ref [10]. In addition, in 2014, DEFRA Ref [11] published the results of a research programme to develop screening values to assist decision making under Part 2A of the Environmental Protection Act. Category 4 screening levels were published for 6 substances, with reference to human health risk only. This guidance includes revisions of the CLEA exposure parameters, presenting parameters for public open space land use scenarios, and also of the toxicological approach. The screening levels represent a low risk scenario, based on a 'Low Level of Toxicological Concern' rather than the 'Minimal Risk' of CLEA, and the analytical results of this investigation may be considered relative to these levels.

Site-specific assessments are undertaken wherever possible and/or applicable.

CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.

The results of any groundwater analyses are compared to relevant quality criteria, e.g. Environmental Quality Standards (EQS) or Drinking Water Standards (DWS).

Ground gases are assessed in accordance with the guidance given in CIRIA C665 Ref [3] and BS8485 Ref [12].

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

28 Site Investigation – Soils

28.1 Sampling Regime

The number of sample locations was limited by significant thickness of concrete hard standing and was intended to provide general coverage.

28.2 Testing

The potential for contamination by Made Ground was identified in the preliminary conceptual model. Therefore, the following tests were selected.

Test Suite	Number of Samples 2021	Number of Samples 2023	Soil Tested
STL Key Contamination Suite	4	9	Made Ground Natural soil
Asbestos Screen	4	9	Made Ground Natural soil

Test Suite	Number of Samples 2021	Number of Samples 2023	Soil Tested
Petroleum hydrocarbon screen	-	6	Made Ground Natural soil
Speciated petroleum hydrocarbons with aliphatic and aromatic split	4	-	Made Ground Natural soil
VOC	4	-	Made Ground Natural soil

The test results are presented in full in Appendix E. A summary and discussion of the significance of the results and identified contamination sources is given below.

28.3 Test Results and Identified Contamination Sources

28.3.1 General Contaminants

The results of the key contaminant tests have been analysed in accordance with the CLEA methodology. The samples have been grouped into one population, comprising all soil samples. For each parameter in each population the sample mean is calculated and compared to a Tier 1 screening value. If the sample mean exceeds the screening value, the soil may be regarded as contaminated and further assessment may be required. If neither the sample mean nor any single value exceeds the screening value, the soil may be regarded as not contaminated, though further confirmatory assessment may be required. Where any single parameter value exceeds the screening value but the sample mean does not, further statistical analysis may be applied to that parameter if the available data is suitable. Such analysis would include an assessment of the Normality of the distribution of the data, consideration of the presence of outliers, and the calculation of a UCL estimate of the mean.

Summary data is presented in the tables below and the laboratory analysis is included in Appendix E. The screening values and source notes are presented in Table 1 "Tier 1 Screening Values" at the front of Appendix E.

Soil Type: all soil samples

Contaminants	Units	No of Samples Tested	Range	Sample Mean	Residential without Home-grown Produce Consumption Tier 1 Screening Values
Arsenic (As)	mg/kg	13	4.7-15	10	40
Cadmium (Cd)	mg/kg	13	<0.2-4	0.5	85
Trivalent Chromium (CrIII)*	mg/kg	13	24-96	40	910
Hexavalent Chromium (CrVI)	mg/kg	13	<1.8-<4	2.5	6
Lead (Pb)	mg/kg	13	6.9	240	310
Mercury (Hg)	mg/kg	13	<0.3-1	0.35	9.2-15
Selenium (Se)	mg/kg	13	<1	1	430
Nickel (Ni)	mg/kg	13	12-34	20	180
Copper (Cu)	mg/kg	13	6.4-130	30	7,100
Zinc (Zn)	mg/kg	13	24-140	73	40,000
Phenol	mg/kg	13	<1	1	440-1200

Contaminants	Units	No of Samples Tested	Range	Sample Mean	Residential without Home-grown Produce Consumption Tier 1 Screening Values
Benzo(a)pyrene (BaP)	mg/kg	13	<0.05-0.83	0.18	2.6
Naphthalene	mg/kg	13	<0.05-0.05	0.04	2.3-13
Total Cyanide (CN)	mg/kg	13	<1	1	-
Acidity (pH values)	-	13	4.8-11.7	9.3	-
Soil Organic Matter	%	13	0.1-1.5	0.66	-

* Assumed as Total Cr minus CrVI

Results have been compared to the STL Tier 1 screening values for a residential land use, without consumption of home grown produce. No results of concern were noted. All results were below the screening values used.

Benzo(a)pyrene is used as a surrogate marker for all genotoxic PAH compounds, in line with HPA guidance Ref [13]. The test data has been compared with the concentration limits reported for the Culp study, as recommended by HPA, and is consistent with this approach. On the basis of the test results, the genotoxic PAH compounds in the samples would not be considered to pose a potential risk to human health.

The measured concentrations of PAH compounds do not exceed the UKWIR threshold(s) for the use of plastic water supply pipes / British Plastics Federation Pipes Group thresholds for drainage and sewage pipes.

28.3.2 Asbestos Containing Materials

No asbestos containing materials were detected in the samples analysed and none were observed in the exploratory holes. However, it should be noted that the exploratory holes are of small size relative to the area investigated and the investigation was constrained by site usage; therefore, the samples obtained may not reflect the full composition of the soils on the site, and there is always the potential for pockets of asbestos or for asbestos containing materials to be present, which have not been detected in the sampling.

It is also our experience that asbestos containing materials are quite often encountered in buried pockets and beneath slabs (sometimes adhering to the concrete) on older sites. It is, therefore, advised that further examination is carried out in trial pits, when suitable access is available.

No assessment of the previous buildings was made by STL.

28.3.3 Organic Contaminants

The following tables summarise the results of the analysis for petroleum hydrocarbons:

Hydrocarbon Substance or Fraction	Measured Concentrations in mg/kg (µg/kg)						
	DS1 @ 0.5m	DS1 @ 1.5m	BH01 @ 1.0m	BH02 @ 1.5m			
BTEX							
Benzene	<1	<1	<1	<1			
Toluene	<1	<1	<1	<1			
Ethylbenzene	<1	<1	<1	<1			
Xylenes	<1	<1	<1	<1			
MTBE	<1	<1	<1	<1			

Hydrocarbon Substance or Fraction	Measured Concentrations in mg/kg ($\mu\text{g/kg}$)						
	DS1 @ 0.5m	DS1 @ 1.5m	BH01 @ 1.0m	BH02 @ 1.5m			
Aliphatics							
EC5-EC6	<0.001	<0.001	<0.001	<0.001			
>EC6-EC8	<0.001	<0.001	<0.001	<0.001			
>EC8-EC10	<0.001	<0.001	<0.001	<0.001			
>EC10-EC12	<1	<1	<1	<1			
>EC12-EC16	<2	<2	<2	<2			
>EC16-EC21	<8	<8	<8	<8			
>EC21-EC35	<8	<8	<8	<8			
Aromatics							
EC5-EC7 (Benzene)	<0.001	<0.001	<0.001	<0.001			
>EC7-EC8 (Toluene)	<0.001	<0.001	<0.001	<0.001			
>EC8-EC10	<0.001	<0.001	<0.001	<0.001			
>EC10-EC12	<1	<1	<1	<1			
>EC12-EC16	<2	<2	<2	<2			
>EC16-EC21	<10	<10	<10	<10			
>EC21-EC35	<10	<10	<10	<10			
Hazard Index	0.025	0.025	0.025	0.025			

Petroleum hydrocarbon mixtures are assessed using the Hazard Index approach. The calculation sheet is included in Appendix E. The calculated Hazard Index values for all samples were less than 1. All recorded results were noted to be below laboratory limit of detection, indicating that the recorded concentrations below above tolerable limits for long term exposure with regards to human health.

Petroleum hydrocarbons screening was undertaken by STL.

Hydrocarbon Substance or Fraction	Measured Concentrations in mg/kg						
	TPA @ 0.9m	TPB @ 0.9m	TPC @ 0.9m	TPD @ 0.9m	BH1 @ 1.5	BH2 @ 1.5	
TPHC6-10	-	-	-	-	<0.1	<0.1	
TPHC10-C40	<10	<10	<10	92	<10	15	

No results of concern were noted.

The measured concentrations of the petroleum hydrocarbon fractions and VOC do not exceed the UKWIR threshold(s) for the use of plastic water supply pipes / British Plastics Federation Pipes Group thresholds for drainage and sewage pipes.

29 Groundwater

Groundwater analysis, undertaken by others in 2021 (Crossfield Consulting) showed the groundwater to not be impacted by the site. In particular, the results for speciated petroleum hydrocarbons and VOC were all noted to be below the laboratory limit of detection.

30 Summary of Identified Contamination

Based upon the soil testing undertaken for this ground investigation, no potential contamination has been identified.

31 Risk Evaluation

The object of the risk evaluation is to assess the pollution linkages for specific contaminant groups considered in the conceptual model, identify any unacceptable risks and, therefore establish whether there is a need for further investigation and/or remedial action.

The risks are considered in the context of the specific development proposals for the site and, therefore, the conclusions may not be appropriate for alternative schemes.

Based upon the soil testing undertaken for this ground investigation, no potential contamination has been identified.

31.1 Revised Conceptual Model

The preliminary site model has been refined in light of the findings of this investigation and is summarised below.

Metals	Petroleum Hydrocarbons	PAH Compounds VOC	Land Gas	Asbestos	Pathways	Receptors
N	N	N	n/a	P	Ingestion/inhalation of contaminated soil & dust	Human Health
N	N	N	n/a	n/a	Dermal contact with contaminated soil & dust	
N	N	N	n/a	n/a	Inhalation of vapours or gases	
n/a	n/a	n/a	n/a	n/a	Uptake into edible fruit and vegetables	
n/a	n/a	n/a	n/a	n/a	Surface water run-off into surface water features	Water Environment
N	N	N	n/a	n/a	Migration through ground into surface water or groundwater	
N	N	N	n/a	n/a	Off-site migration of contaminated groundwater	
n/a	n/a	n/a	n/a	n/a	Vegetation on site growing in contaminated soil	Flora and Fauna
n/a	n/a	n/a	n/a	n/a	Aquatic life in affected waters	
N	N	N	n/a	n/a	Contact with contaminated soils	Building materials / buried services
N	N	N	N	n/a	Fire or explosion	

Key:

- Y Pollutant linkage likely
- N Pollutant linkage not likely
- P Pollutant linkage possible
- n/a Pathway not applicable to contaminant

31.2 Relevant Pollutant Linkages

No Relevant Pollutant Linkages for which remedial action will be required have been identified in the revised conceptual model.

Potential pollutant linkages have also been identified for the presence of asbestos containing materials.

32 Soil Waste Management

Asbestos containing materials may be encountered beneath the existing building floor slabs and areas of hard standing that are still present upon the site. If this is the case, these should be kept separate from other soils.

The presence of contamination may affect the classification of waste soils, or the potential for their re-use.

32.1 Re-use of Soils

It is anticipated that the arisings from groundworks on this site will comprise Made Ground, Thanet Formation and Chalk.

Clean natural arisings from groundworks may be re-used on site without further testing, where there is a definite use for such materials, e.g. raising levels or construction of landscaping layers or bunds as set out in the approved plans for the development.

Treated contaminated soils may be reused on site under an appropriate Materials Management Plan, where certain criteria are met, in accordance with the CL:AIRE Definition of Waste Code of Practice, Ref [14].

32.2 Disposal of Soils

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classifications. As waste producers, the Developer holds responsibilities under the various governing regulations, particularly the Waste Duty of Care Code of Practice under the Environmental Protection Act 1990, Ref [15].

The chemical analyses appended to this report can be used to inform the initial classification of the soils as either Hazardous or Non-Hazardous, and derive the appropriate EWC code, for offsite disposal or transfer. Waste Acceptance Criteria (WAC) testing may be needed for confirmation of the material's classification, and will be required to demonstrate an inert classification.

There are strict requirements in place for the accurate description of wastes using EWC codes and, therefore, it is essential that materials that would be given different descriptions (e.g. blacktop, made ground and natural soils), as well as those with different classifications, are carefully segregated during excavation and storage on site. This will also ensure the most cost effective disposal. Mixing these materials can give rise to significant difficulties in disposal and also substantially increase costs.

Soil arisings may be transferred to other development sites under a Materials Management Plan, where certain criteria are met, in accordance with the CL:AIRE Definition of Waste Code of Practice Ref [14].

All soils leaving site will need to be pre-treated. Waste minimisation by selective excavation is a recognised form of pre-treatment.

33 Discussion and Conclusions

Materials that are to be disposed of off site may require additional testing, such as WAC testing.

The UST was located and removed during demolition, it had not caused any petroleum hydrocarbon impact, because it was encased in extremely thick concrete.

Organic contaminants present in the soils, particularly PAH compounds and petroleum hydrocarbons that may be found in Made Ground, could affect plastic underground service pipes (such as the types used by water and gas supply companies). Guidance should be sought from the relevant companies regarding any proposed plant in the affected area. Many water supply companies now require higher specification pipe on contaminated sites, even following remediation.

As with any site, areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to reassess the remedial strategy for the site.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

The existing monitoring wells on the site should be decommissioned, to prevent the upward migration of gas/downward migration of contamination to the groundwater.

34 General Guidance

Allowance should be made for verification of any remedial works by suitably experienced personnel.

It may be that specific local requirements apply to this site, of which we are not aware at this time.

In general terms, the workforce and general public should be protected from contact with contaminated material. There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

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APPENDIX A

**Site Plans and Exploratory
Hole Logs**





NB: Contains Ordnance Survey Data © Crown copyright and database right 2023.

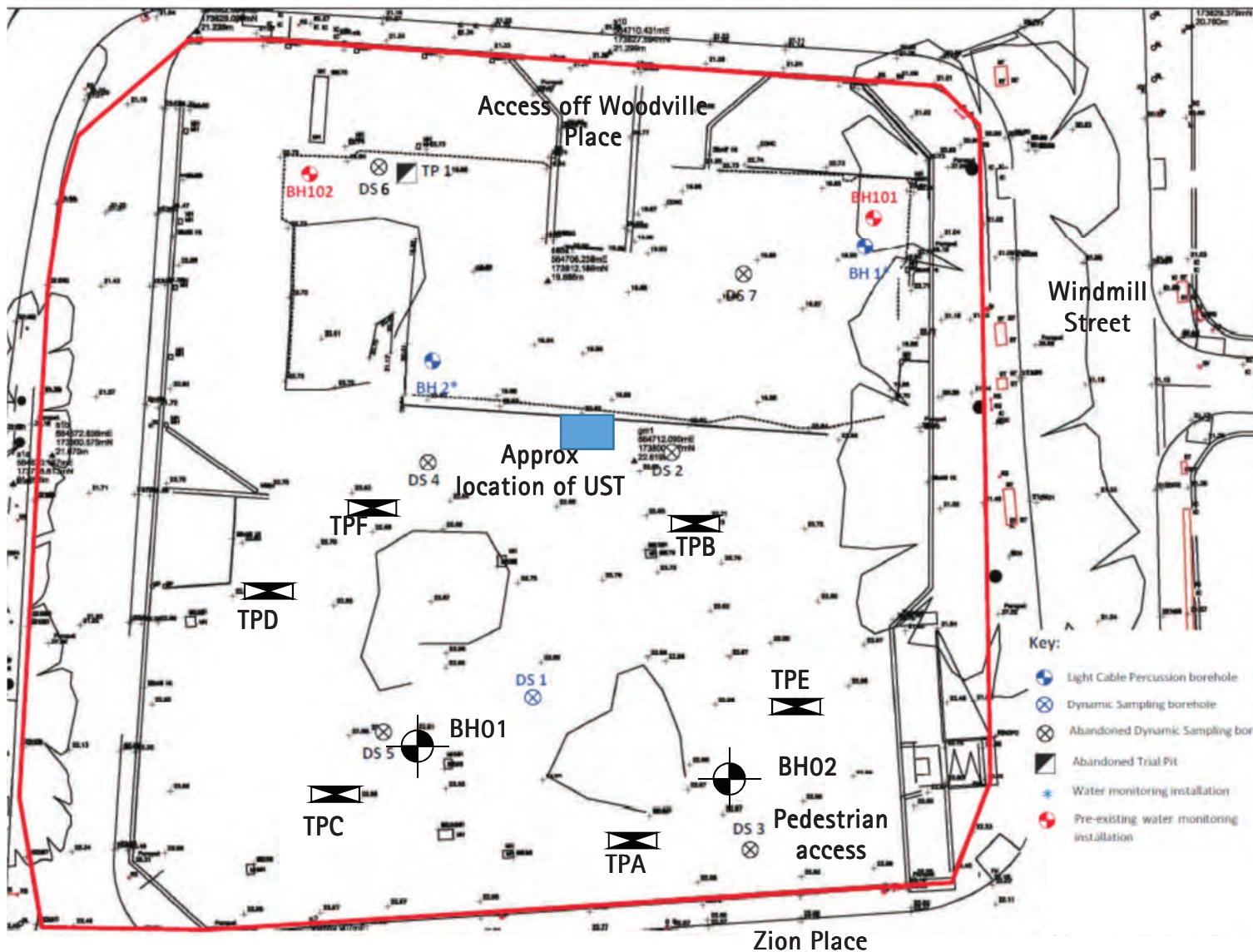
Site: Former Police Station, 133 Windmill Street, Gravesend, DA12 1DB

STL: J15380

Fig No: 1

Date: 4th April 2023

Site Location Plan



NB: Positions are only indicative.

Site: Former Police Station, 133 Windmill Street, Gravesend, DA12 1DB

Date: 4th April 2023

STL: J15380

Fig No: 2

Exploratory Hole Location Plan – Not to Scale

 Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN

 ST Consult

Key to Exploratory Hole Logs, Plans and Sections

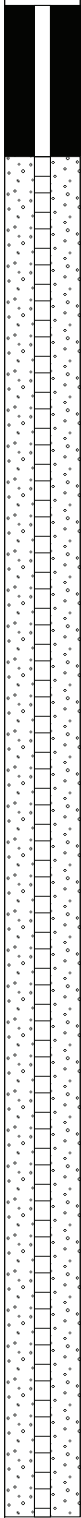
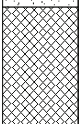
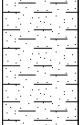
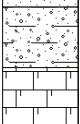
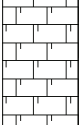
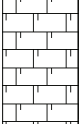
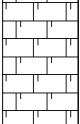
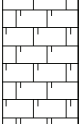
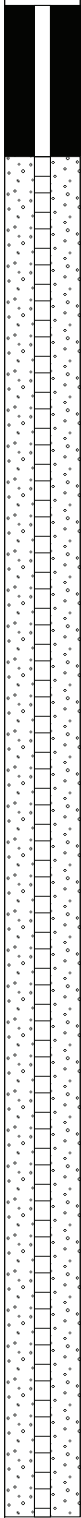
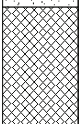
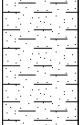
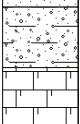
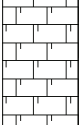
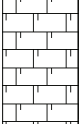
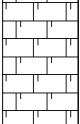
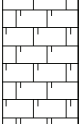
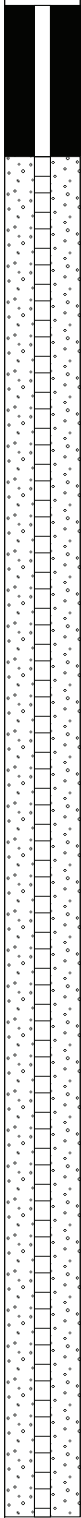
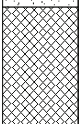
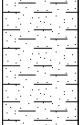
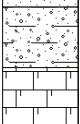
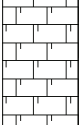
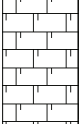
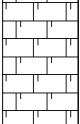
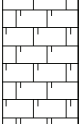
Backfill Symbols		Pipe Symbols		Principal Soil Types		Principal Rock Types		Drilling Records	
Arisings		Plain Pipe		Topsoil		Mudstone		Water Strike	
Concrete		Slotted Pipe		Made Ground		Claystone		Depth Water Rose	
Blacktop		Piezometer		Clay		Siltstone		Total Core Recovery (%) [TCR]	
Bentonite		Piezometer Tip		Silt		Sandstone		Solid Core Recovery (%) [SCR]	
Gravel Filter		Filter Tip		Sand		Limestone		Rock Quality Index (%) RQD]	
Sand Filter		Extensometer		Gravel		Chalk		Fracture Index (fractures / m) [FI]	
		Inclinometers		Peat					

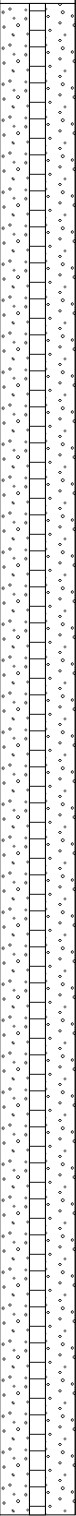
All soil and rock descriptions are in general accordance with BS5930 2015, BS EN ISO 14688-1:2002+A1:2013 and BS EN ISO 14689-1:2003. Chalk descriptions are also based on CIRIA C574 and "Logging the Chalk – R.N. Mortimer 2015". The Geology Code is only provided where a positive identification of the sample strata has been made.

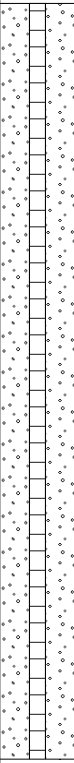
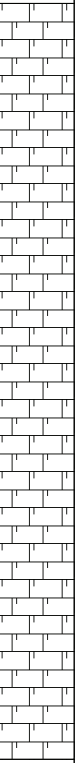
Location / Method Identifiers		In-situ Test Location / Method	
BH	Borehole (undefined)	DP	Dynamic Probe
CP	Cable Percussive	CPT	Cone Penetration Test
RC	Rotary Core	CBR	In-situ CBR Test
RO	Rotary Open Hole	DCP	CBR using Dynamic Cone Penetrometer
ODC	Rotary Odex/Symmetrix drilling cased	CBRT	CBR using TRL Probe
CP+RC	Cable Percussive to Rotary Core	PB	Plate Bearing Test
SNC	Sonic	SPT (S)	Standard Penetration Test (Split Barrel Sampler)
CFA	Continuous Flight Auger	SPT (C)	Standard Penetration Test (Solid Cone)
FA	Flight Auger	N	SPT Result
VC	Vibro Core	-/-	Blows/Penetration (mm) after seating drive
WLS+RC	Windowless (Dynamic) Sampler to Rotary Core	-*/-	Total Blows / Penetration (mm)
WLS	Windowless Sampler	()	Extrapolated Value
WS	Window Sampler	PPT	Perth Penetration (In-House Method - Equivalent N Value)
HA	Hand Auger	HP / UCS	Strength from Hand Penetrometer (kN/m ²)
C	Road / Pavement Core	IVN	Strength from Hand Vane ((kN/m ²) P = peak, R = residual
IP	Inspection Pit (Hand Excavation)	PID	Photo Ionisation Detector (ppm)
TP	Trial Pit (Machine Excavated)	MEXE	Mexi-Cone CBR (%)
OP	Observation Pit (Supported Excavation Hand or Machine)		

Samples / Test Type	
B	Bulk Sample
BLK	Block Sample
C	Core Sample
CBRS	CBR Mould Sample
D	Small Disturbed Sample
ES	Environmental Sample (Soil)
EW	Environmental Sample (Water)
GS	Environmental Sample (Gas)

Samples / Test Type	
SPTLS	Standard Penetration Test Split Barrel Sample
TW	Thin Wall Push In Sample (e.g. Shelby Sampler)
U	Undisturbed Open Drive Sample (blows to take)
UT	Thin Wall Undisturbed Open Drive Sample (blows to take)
W	Water Sample (Geotechnical)
SP	Sample from Stockpile
P	Piston Sample
AMAL	Amalgamated Sample

				Start - End Date:		Project ID:	Hole Type:	BH1																																																																																																																										
				15/02/2023 - 20/02/2023		J15380	CP	Sheet 1 of 3																																																																																																																										
Client:		Churchill Retirement Living				Co-ordinates:		Level (m AOD)	Logger:																																																																																																																									
Project Name:		Windmill Street				Location:		133 Windmill Street, Gravesend, DA12 1DB																																																																																																																										
<table><tr><td rowspan="2">Well</td><td rowspan="2">Water Strikes</td><td colspan="3">Samples and Insitu Testing</td><td rowspan="2">Level (m AOD)</td><td rowspan="2">Thickness (m)</td><td rowspan="2">Legend</td><td rowspan="2">Depth (m bgl)</td><td rowspan="2">Stratum Description</td><td rowspan="2"></td></tr><tr><td>Depth (m bgl)</td><td>Type</td><td>Results</td></tr><tr><td rowspan="18"></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Concrete</td><td>1</td></tr><tr><td>1.50</td><td>D</td><td rowspan="3">N=5 (1,0/1,1,2,1)</td><td rowspan="3">(1.20)</td><td rowspan="3"></td><td rowspan="3">1.50</td><td rowspan="3">Dark blackish brown mottled black and brown sandy gravelly CLAY. Sand is coarse. Gravel comprises fine to coarse angular to rounded flint and concrete. MADE GROUND <i>2.0m: 50mm dia. 5mm metal rod. Possible reinforcing bar.</i></td><td rowspan="3">2</td></tr><tr><td>1.50 - 2.00</td><td>B</td></tr><tr><td>1.50</td><td>SPT (C)</td></tr><tr><td>2.00 - 2.50</td><td>B</td><td rowspan="3">N=6 (1,1/1,1,2,2)</td><td rowspan="3">(1.40)</td><td rowspan="3"></td><td rowspan="3">2.70</td><td rowspan="3">Friable bluish grey/yellowish brown very sandy CLAY with rare fine chalk gravel. Sand is fine to medium.</td><td rowspan="3">3</td></tr><tr><td>2.00</td><td>SPT (C)</td></tr><tr><td>2.50</td><td>D</td></tr><tr><td>2.70</td><td>D</td><td rowspan="3">N=26 (3,4/5,6,7,8)</td><td rowspan="3">(0.40)</td><td rowspan="3"></td><td rowspan="3">4.10</td><td rowspan="3">Recovered as greenish brown speckled white clayey slightly sandy GRAVEL. Sand is fine to coarse. Gravel comprises fine to coarse angular extremely weak chalk with occasional iron staining and rare coarse subangular flint.</td><td rowspan="3">4</td></tr><tr><td>3.00</td><td>SPT (S)</td></tr><tr><td>3.50</td><td>D</td></tr><tr><td>3.00 - 3.50</td><td>B</td><td rowspan="3">N=9 (1,1/2,2,2,3)</td><td rowspan="3">(3.00)</td><td rowspan="3"></td><td rowspan="3">4.50</td><td rowspan="3">Structureless CHALK recovered as yellowish brown/cream silty slightly gravelly CLAY. Gravel consists of fine extremely weak chalk. (putty chalk) <i>5.5m: Increased chalk gravel content with rare coarse subangular flint gravel.</i></td><td rowspan="3">5</td></tr><tr><td>3.00</td><td>SPT (S)</td></tr><tr><td>4.00</td><td>SPTL S</td></tr><tr><td>4.00 - 4.50</td><td>B</td><td rowspan="3">N=25 (13,7/7,6,5,7)</td><td rowspan="3">(4.00)</td><td rowspan="3"></td><td rowspan="3">7.50</td><td rowspan="3">Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i></td><td rowspan="3">8</td></tr><tr><td>4.00</td><td>SPT (S)</td></tr><tr><td>4.50</td><td>D</td></tr><tr><td>5.00</td><td>SPTL S</td><td rowspan="3">N=18 (2,3/4,4,5,5)</td><td rowspan="3">(4.00)</td><td rowspan="3"></td><td rowspan="3">7.50</td><td rowspan="3">Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i></td><td rowspan="3">9</td></tr><tr><td>5.50</td><td>D</td></tr><tr><td>6.50</td><td>D</td></tr><tr><td>6.50 - 6.95</td><td>U</td><td rowspan="3">N=18 (2,3/4,4,5,5)</td><td rowspan="3">(4.00)</td><td rowspan="3"></td><td rowspan="3">7.50</td><td rowspan="3">Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i></td><td rowspan="3">10</td></tr><tr><td>7.50</td><td>D</td></tr><tr><td>8.00</td><td>SPTL S</td></tr><tr><td>8.00</td><td>SPT (S)</td><td rowspan="3">N=18 (2,3/4,4,5,5)</td><td rowspan="3">(4.00)</td><td rowspan="3"></td><td rowspan="3">7.50</td><td rowspan="3">Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. 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Gravel comprises fine to coarse angular extremely weak chalk with occasional iron staining and rare coarse subangular flint.	4	3.00	SPT (S)	3.50	D	3.00 - 3.50	B	N=9 (1,1/2,2,2,3)	(3.00)		4.50	Structureless CHALK recovered as yellowish brown/cream silty slightly gravelly CLAY. Gravel consists of fine extremely weak chalk. (putty chalk) <i>5.5m: Increased chalk gravel content with rare coarse subangular flint gravel.</i>	5	3.00	SPT (S)	4.00	SPTL S	4.00 - 4.50	B	N=25 (13,7/7,6,5,7)	(4.00)		7.50	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i>	8	4.00	SPT (S)	4.50	D	5.00	SPTL S	N=18 (2,3/4,4,5,5)	(4.00)		7.50	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i>	9	5.50	D	6.50	D	6.50 - 6.95	U	N=18 (2,3/4,4,5,5)	(4.00)		7.50	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i>	10	7.50	D	8.00	SPTL S	8.00	SPT (S)	N=18 (2,3/4,4,5,5)	(4.00)		7.50	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>8.5m: Rare coarse tabular flint.</i>	10	8.50	D	9.50	SPTL S
Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description																																																																																																																									
		Depth (m bgl)	Type	Results																																																																																																																														
									Concrete	1																																																																																																																								
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Status:		DRAFT		Log Print Date and Time:		07/03/2023 03:27		Log Approved By:																																																																																																																										

Southern Testing ST Consult				Start - End Date: 15/02/2023 - 20/02/2023		Project ID: J15380	Hole Type: CP	BH1 Sheet 2 of 3			
Client: Churchill Retirement Living		Co-ordinates:			Level (m AOD)		Logger: GD				
Project Name: Windmill Street		Location: 133 Windmill Street, Gravesend, DA12 1DB									
Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description		
		Depth (m bgl)	Type	Results							
		10.50	SPT (S) D	N=21 (2,3/5,5,5,6)		(1.00)			Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed. <i>10.5m: Rare fine angular flint.</i>	11	
		11.00 - 11.45	U								
		11.50	D					11.50	Structureless CHALK recovered as off-white slightly clayey GRAVEL. Gravel comprises fine to coarse angular extremely weak chalk with iron staining. 60x30x20mm sized gravel. No flint observed.	12	
		12.50	D SPTL S					12.50	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed.	13	
		13.50	SPT (S) D	N=20 (2,3/4,5,5,6)		(3.50)					
		14.00	SPTL S								14
		14.50	D SPT (S)	N=22 (3,4/5,5,6,6)					<i>14.5m: Nodular flint cobble</i>	15	
		15.50	D						<i>15.5m: Rare fine angular flint.</i>		
		15.50 - 15.95	U								
		16.00	D			(1.50)		16.00	Structureless CHALK recovered as off-white slightly clayey GRAVEL. Gravel comprises fine to coarse angular to subangular extremely weak to weak chalk. 60x60x20mm sized gravel. <i>16.5m: Increased clay content</i>	16	
		16.50	D								
		17.00	SPTL S								17
		17.50	SPT (S) D	N=20 (2,3/4,5,5,6)				17.50	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk. 50x30x20mm size gravel. No flint observed.	18	
		18.50	D			(0.50)					
		18.50 - 18.95	U							Structureless CHALK recovered as off-white slightly clayey GRAVEL. Gravel comprises fine to coarse angular to subangular extremely weak to weak chalk. 60x60x20mm sized gravel.	19
		19.00	D					19.00	Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk and occasional fine angular flint. 50x30x20mm size chalk gravel.		
	19.50	D					19.50		20		
Remarks:											
Status:		DRAFT		Log Print Date and Time:		07/03/2023 03:27		Log Approved By:			

Southern Testing ST Consult				Start - End Date: 15/02/2023 - 20/02/2023		Project ID: J15380	Hole Type: CP	BH1 Sheet 3 of 3				
Client: Churchill Retirement Living		Co-ordinates:			Level (m AOD)		Logger: GD					
Project Name: Windmill Street		Location: 133 Windmill Street, Gravesend, DA12 1DB										
Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description			
		Depth (m bgl)	Type	Results								
		20.00	SPTL S SPT (S) D	N=20 (2,3/4,5,5,6)					Structureless CHALK recovered as off-white silty gravelly CLAY. Gravel comprises fine to coarse angular to subangular chalk and occasional fine angular flint. 50x30x20mm size chalk gravel.	21		
		20.50										
	▼	21.50	D SPTL S SPT (S) D	N=17 (2,2/3,4,5,5)	(5.50)					21.5m: With fine to coarse angular flint gravel	22	
	▽	22.50								22.5m: Wet with abundant fine to coarse fine to coarse angular flint gravel.	23	
		23.00	SPTL S SPT (S) D	N=23 (4,4/4,5,6,8)						23.5m - 24.5m: Wet with occasional fine to medium angular flint.	24	
		23.50										
	24.50	D SPTL S SPT (S)	N=28 (3,4/4,12,5,7)									
							25.00	End of Borehole at 25.00m	25			
										26		
										27		
										28		
										29		
										30		
Remarks:												
Status:		DRAFT		Log Print Date and Time:		07/03/2023 03:27		Log Approved By:				

	Start - End Date:	Project ID:	Hole Type:	BH1
	15/02/2023 - 20/02/2023	J15380	CP	Sheet 1 of 1

Depth Related Hole Information									
Top Depth (m)	Base Depth (m)	Hole Type	Start Date	End Date	Crew	Plant Used	Contractor	Logged By	Remarks
0.00	25.00	CP			KF Drilling			GD	

Hole Diameter			Casing Diameter		
Hole Diameter (mm)	Depth to Base (m)	Remarks	Casing Diameter (mm)	Depth to Base (m)	Remarks
			150	4.00	

Project Specific Time Related Remarks				Drilling Progress by Time				
Date Time Start	Date Time End	Duration	Remarks	Date Time	Depth (m)	Casing Depth (m)	Water Depth (m)	Remarks

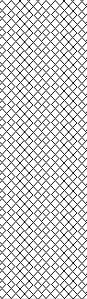
SPT								
Top Depth (m)	Test Type	Casing Depth (m)	Water Depth (m)	Self Weight Penetration (mm)	Reported Result (N Value)	Hammer Serial No.	Energy Ratio %	Remarks
1.50	C	1.50			N=5 (1,0/1,1,2,1)			
2.00	C	1.50			N=6 (1,1/1,1,2,2)			
3.00	S	2.50			N=26 (3,4/5,6,7,8)			
4.00	S	2.50			N=9 (1,1/2,2,2,3)			
5.00	S	4.00			N=25 (13,7/7,6,5,7)			
8.00	S	4.00			N=18 (2,3/4,4,5,5)			
9.50	S	4.00			N=21 (2,3/5,5,5,6)			
12.50	S	4.00			N=20 (2,3/4,5,5,6)			
14.50	S	4.00			N=22 (3,4/5,5,6,6)			
17.00	S	4.00			N=20 (2,3/4,5,5,6)			
20.00	S	4.00			N=20 (2,3/4,5,5,6)			
21.50	S	4.00			N=17 (2,2/3,4,5,5)			
23.00	S	4.00	21.50		N=23 (4,4/4,5,6,8)			
24.50	S	4.00	21.50		N=28 (3,4/4,12,5,7)			

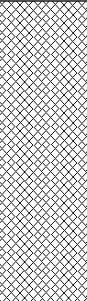
Water Strikes and Details							
Depth Strike (m)	Date Time	Depth Casing (m)	Depth Sealed (m)	Remarks	Time Elapsed (mins)	Water Depth (m)	Remarks
22.00	17/02/2023 14:00:00	4.00			10 5 20	21.50 21.65 21.50	

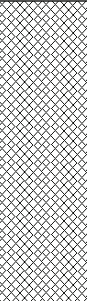
Backfill Details				Chiselling Details				
Depth Top (m)	Depth Base (m)	Material	Remarks	From (m)	To (m)	Start (Date / Time)	Duration (hh:mm)	Remarks
0.00 1.00	1.00 25.00	Bentonite Gravel Backfill		0.40	1.50	16/02/2023 10:00:00	02:00	

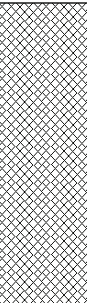
Installation Details						Pipe Construction				
Distance	Point Ref.	Type	Top of Response Zone (m)	Base of Response Zone (m)	Pipe Ref.	Pipe Reference	Depth Top (m)	Depth Base (m)	Diameter (mm)	Pipe Type
25.00	1	SP			1	1 1	0.00 1.00	1.00 25.00	50 50	PLAIN SLOTTED

Status:	DRAFT	Log Print Date and Time:	07/03/2023 03:27	Log Approved By:	
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Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date:		Project ID:		Machine Type:		TPA		
						J15380		hand		Sheet 1 of 1		
Project Name: Windmill Street				Remarks:		Co-ordinates:		Level (m AOD):		Logger:		
										er		
Location: 133 Windmill Street, Gravesend, DA12 1DB												
Client: Churchill Retirement Living												
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description					
Depth (m)	Type	Results										
0.90	ES			(0.80)		0.80	Concrete, heavily reinforced, now removed					1
							Firm fine sandy silty CLAY occasional gravel of brick, chalk flint, concrete Made Ground					
							Pit terminated at 1.00m.					
				(0.20)		1.00						2
												3
												4
Pit Dimension (m)			Pit Stability:					Water Strikes:				
Width:		0.50										
Length:		0.50										
Depth:		1.00										

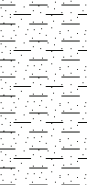
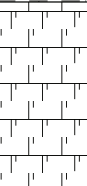
Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date:		Project ID:		Machine Type:		TPB	
						J15380				Sheet 1 of 1	
Project Name: Windmill Street				Remarks:		Co-ordinates:		Level (m AOD):		Logger:	
Location: 133 Windmill Street, Gravesend, DA12 1DB											
Client: Churchill Retirement Living											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.90	ES			(0.80)		0.80	Concrete, heavily reinforced, now removed				1
							Firm fine sandy silty CLAY occasional gravel of brick, chalk flint, concrete Made Ground				
							Pit terminated at 1.00m.				
				(0.20)		1.00					2
											3
											4
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:											
Length:											
Depth:		1.00									

Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date:		Project ID:		Machine Type:		TPC		
						J15380		hand		Sheet 1 of 1		
Project Name: Windmill Street				Remarks:		Co-ordinates:		Level (m AOD):		Logger:		
										er		
Location: 133 Windmill Street, Gravesend, DA12 1DB												
Client: Churchill Retirement Living												
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description					
Depth (m)	Type	Results										
0.90	ES			(0.80)		0.80	concrete, heavily reinforced, now removed					1
							Firm fine sandy silty CLAY occasional to some gravel of brick, chalk flint, concrete Made Ground					
							Pit terminated at 1.00m.					
				(0.20)		1.00						2
												3
												4
Pit Dimension (m)			Pit Stability:				Water Strikes:					
Width:												
Length:												
Depth:												

Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date:		Project ID:		Machine Type:		TPD	
				J15380				Sheet 1 of 1			
Project Name: Windmill Street				Remarks:		Co-ordinates:		Level (m AOD):		Logger:	
Location: 133 Windmill Street, Gravesend, DA12 1DB											
Client: Churchill Retirement Living											
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m)	Type	Results									
0.90	ES			(0.80)		0.80	Concrete, heavily reinforced, now removed				1
							Firm fine sandy silty CLAY occasional gravel of brick, chalk flint, concrete Made Ground				
							Pit terminated at 1.00m.				
				(0.20)		1.00					2
											3
											4
Pit Dimension (m)			Pit Stability:				Water Strikes:				
Width:											
Length:											
Depth:											

[illegible]

Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date:		Project ID:	Machine Type:	TPE	
				J15380			Sheet 2 of 2		
Project Name:		Windmill Street		Remarks:	Co-ordinates:		Level (m AOD):	Logger:	
Location:		133 Windmill Street, Gravesend, DA12 1DB							
Client:		Churchill Retirement Living							
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description		
Depth (m)	Type	Results							
				(3.50)			Brown very sandy CLAY		
						6.50	Pit terminated at 6.50m.		
Pit Dimension (m)			Pit Stability:			Water Strikes:			
Width:									
Length:									
Depth:	6.50								

Southern Testing ST Consult www.southerntesting.co.uk tel:01342 333100 www.stconsult.co.uk tel:01604 500020				Start - End Date:		Project ID:	Machine Type:	TPF	
				J15380	tracked	Sheet 2 of 2			
Project Name:		Windmill Street		Remarks:	Co-ordinates:		Level (m AOD):	Logger:	
								er	
Location:		133 Windmill Street, Gravesend, DA12 1DB							
Client:		Churchill Retirement Living							
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description		
Depth (m)	Type	Results							
				(0.50)		4.50	Brown very sandy CLAY		
						5.00	off white putty CHALK		
							Pit terminated at 5.00m.		
							5		
							6		
							7		
							8		
Pit Dimension (m)			Pit Stability:			Water Strikes:			
Width:			unstable						
Length:									
Depth:	5.00								



Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

APPENDIX B

Field Sampling and In-Situ
Test Methods and Results



B

Soil and Rock Descriptions

All soil and rock descriptions are in general accordance with BS5930 Ref [4].

Anthropogenic soils ('made ground' or 'fill') describe materials which have been placed by man and can be divided into those composed of reworked natural soils and those composed of or containing man-made materials. 'Fill' is used to describe material placed in a controlled manner and 'made ground' is used to describe materials placed without strict engineering control.

The classification of materials such as topsoil is based on visual description only and should not be interpreted to mean that the material complies with criteria used in BS 3882 Ref [16].

Chalk descriptions are based on CIRIA C574 Ref [17] and Mortimore Ref [18].

The geology code is only provided on logs where a positive identification of the sample strata has been made.

Inspection Pit

Inspection pits are hand excavated from the surface (maximum depth 1.2 – 1.5m) using appropriate tools to locate and avoid existing buried services at exploratory hole positions. They are also regularly used as part of investigations on existing structures to expose and determine foundation detail.

Trial Pits and Trenches

Trial pits and trenches are unsupported excavations, mechanically excavated by machine to the required depth to enable visual examination, in situ testing and sampling as required from outside the excavation.

Pavement Cores

Pavement coring was completed using a trailer mounted 'Neptune Excalibur', diesel-powered rig. The rig can be fitted with core barrels up to 300mm (12") for use in confirming pavement layer thicknesses or composition. The rig is fitted with hydraulic outriggers to allow fast, accurate levelling when setting up to core.

All cores are logged and photographed on completion and retained for laboratory analysis.

Standard Penetration Test (SPT)

The Standard Penetration Test (SPT) is specified in BS EN ISO 22476-3 Ref [19]. In this test, an open-ended tube is driven into the ground by blows from a free-falling hammer (with specified sizes, weights and distances).

The tube is seated by driving to a penetration of 150mm, or by 25 blows, whichever occurs first. It is then driven for a maximum of a further 300mm and the number of blows is termed the penetration resistance (N). If 300mm penetration cannot be achieved in 50 blows, the test drive is terminated and penetration depth is recorded.

When testing in gravels, a conical end piece is attached to the tube. The test is then called an SPT(C).

A classification of relative density descriptions as used on borehole logs, based upon uncorrected SPT N values, is given within BS5930 Ref [4] and set out as follows:

Classification based on uncorrected SPT N Value	Term
0 - 4	Very Loose
4 - 10	Loose
10 – 30	Medium Dense
30 – 50	Dense
Over 50	Very Dense

Hand Penetrometer Test

The handheld soil penetrometer consists of a spring loaded and calibrated plunger which is forced into cohesive soil. A reading of unconfined compression strength (equal to twice cohesion) is given on a calibrated scale. The average of a set of three readings shall be recorded.

In common with other hand methods of strength assessment it does not give an accurate indication of bearing capacity in stiff or fissured soils, because of the small test area.

Disturbed Samples

Disturbed samples were taken from exploratory holes in general accordance with BS 5930 [4] and BS EN ISO 22475-1 Ref [20] as required and stored in appropriately labelled containers. Details of the type, size and depth of sample will be recorded within the exploratory hole record. Such samples can be regarded as being between Class 5 up to Class 3 quality depending upon their method of sampling.

Open-tube Samples

Open-tube samples were taken within cohesive soils in general accordance with BS 5930 [4] and BS EN ISO 22475-1 Ref [20]. Details of the type, size and depth of sample will be recorded within the exploratory hole record. The open-tube samples were sealed with wax and had end caps fitted before transport from site. Open tube samples are typically of Class 2 or Class 1 quality depending upon the soil type, sampling technique and sampler used.

Environmental Samples

Environmental samples were taken from the boreholes at regular intervals in the made ground and natural soils as indicated on the exploratory hole logs. The sampling strategy was in general accordance with BS10175 Ref [5] and BS ISO 18400 Refs [21], [22], [23], [24] & [25].

These samples were collected and stored in glass jars or plastic pots and transferred to the laboratory in cool boxes as appropriate to the proposed laboratory testing.

Monitoring Well

A groundwater and/or ground gas monitoring well consists of a perforated pipe, which is installed in the ground. The standpipe is typically 50mm nominal in diameter and is installed in a lined borehole. It is perforated from the base with a sand/gravel surround through the soil horizon of interest to an appropriate depth below ground level. Above this there is a bentonite seal with solid pipework and is provided with an end cap or a gas valve at the top as appropriate.

Gas monitoring is carried out via the gas tap. Water sampling/purging can be undertaken by removing the gas tap and bung.

The well is usually completed at the surface with a flush cast iron cover or raised lockable cover.

Groundwater Monitoring – Dip Meter

The dip meter is used to measure standing water levels within boreholes. The probe is lowered into the borehole until the meter detects the groundwater with an audible 'beep'. The level is then read from the tape.

Project Name: Windmill Street

Location: 133 Windmill Street, Gravesend, DA12 1DB

Client: Churchill Retirement Living

Project Number: J15380

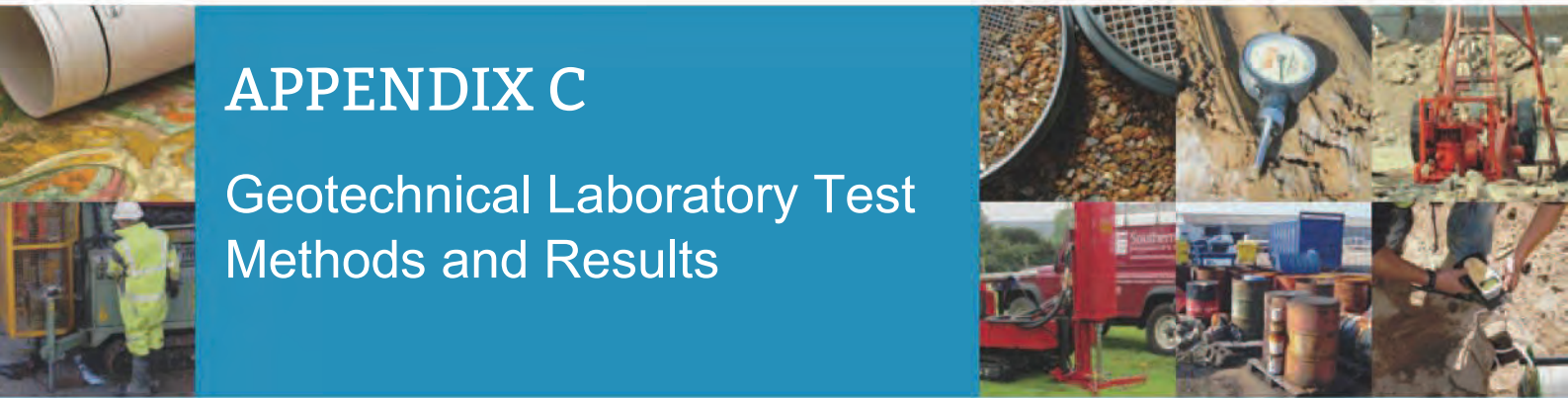
Engineer: ER

STANDARD PENETRATION TEST RESULTS

Location ID	Test Depth (m bgl)	Test Type	Seating Blows/Penetration				Main Test Blows/Penetration								N Value	Reported Result
			SB1	SP1	SB2	SP2	MB1	MP1	MB2	MP2	MB3	MP3	MB4	MP4		
BH1	1.5	C	1	75	0	75	1	75	1	75	2	75	1	75	5	N=5 (1,0/1,1,2,1)
BH1	2	C	1	75	1	75	1	75	1	75	2	75	2	75	6	N=6 (1,1/1,1,2,2)
BH1	3	S	3	75	4	75	5	75	6	75	7	75	8	75	26	N=26 (3,4/5,6,7,8)
BH1	4	S	1	75	1	75	2	75	2	75	2	75	3	75	9	N=9 (1,1/2,2,2,3)
BH1	5	S	13	75	7	75	7	75	6	75	5	75	7	75	25	N=25 (13,7/7,6,5,7)
BH1	8	S	2	75	3	75	4	75	4	75	5	75	5	75	18	N=18 (2,3/4,4,5,5)
BH1	9.5	S	2	75	3	75	5	75	5	75	5	75	6	75	21	N=21 (2,3/5,5,5,6)
BH1	12.5	S	2	75	3	75	4	75	5	75	5	75	6	75	20	N=20 (2,3/4,5,5,6)
BH1	14.5	S	3	75	4	75	5	75	5	75	6	75	6	75	22	N=22 (3,4/5,5,6,6)
BH1	17	S	2	75	3	75	4	75	5	75	5	75	6	75	20	N=20 (2,3/4,5,5,6)
BH1	20	S	2	75	3	75	4	75	5	75	5	75	6	75	20	N=20 (2,3/4,5,5,6)
BH1	21.5	S	2	75	2	75	3	75	4	75	5	75	5	75	17	N=17 (2,2/3,4,5,5)
BH1	23	S	4	75	4	75	4	75	5	75	6	75	8	75	23	N=23 (4,4/4,5,6,8)
BH1	24.5	S	3	75	4	75	4	75	12	75	5	75	7	75	28	N=28 (3,4/4,12,5,7)
BH2	1.5	C	1	75	0	75	1	75	1	75	0	75	2	75	4	N=4 (1,0/1,1,0,2)
BH2	2	C	2	75	4	75	7	75	10	75	3	75	5	75	25	N=25 (2,4/7,10,3,5)
BH2	3	S	2	75	3	75	4	75	5	75	5	75	5	75	19	N=19 (2,3/4,5,5,5)
BH2	4	S	2	75	4	75	4	75	5	75	6	75	7	75	22	N=22 (2,4/4,5,6,7)
BH2	5	S	1	75	3	75	5	75	5	75	7	75	7	75	24	N=24 (1,3/5,5,7,7)
BH2	8	S	1	75	1	75	0	75	1	75	2	75	1	75	4	N=4 (1,1/0,1,2,1)
BH2	9.5	S	1	75	1	75	1	75	1	75	2	75	2	75	6	N=6 (1,1/1,1,2,2)
BH2	11	S	2	75	2	75	3	75	3	75	4	75	3	75	13	N=13 (2,2/3,3,4,3)
BH2	14.5	S	4	75	4	75	5	75	4	75	4	75	4	75	17	N=17 (4,4/5,4,4,4)
BH2	15.5	S	3	75	4	75	5	75	5	75	6	75	4	75	20	N=20 (3,4/5,5,6,4)
BH2	17	S	3	75	3	75	5	75	6	75	5	75	5	75	21	N=21 (3,3/5,6,5,5)
BH2	18.5	S	4	75	4	75	5	75	7	75	5	75	8	75	25	N=25 (4,4/5,7,5,8)
BH2	21.5	S	4	75	5	75	5	75	7	75	6	75	7	75	25	N=25 (4,5/5,7,6,7)
BH2	23	S	3	75	4	75	5	75	6	75	7	75	8	75	26	N=26 (3,4/5,6,7,8)
BH2	24.5	S	4	75	4	75	5	75	7	75	7	75	9	75	28	N=28 (4,4/5,7,7,9)

APPENDIX C

Geotechnical Laboratory Test Methods and Results



Atterberg and Moisture Content Summary

BS1377-2 cl.3.2, 3.3, 4.2, 4.3 & BS EN ISO 17892-1

Project Name		133 Windmill Street, Gravesend					Project Number		J15380	
Client		Churchill Retirement Living				PE	ER	Date Issued		04-Apr-23
Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Liquid Limit %	Plastic Limit %	Plasticity Index	Classi- fication	Passing 425 micron %
BH1	3.00	B	Dark yellow grey very sandy CLAY.		32	54	22	32	CH	99
BH1	4.00	B	Soft yellow grey patched off white slightly sandy slightly gravelly calcareous CLAY. Gravel consists of medium subangular chalk.		32	37	20	17	CI	98
BH1	5.50	D	Very soft off white slightly gravelly calcareous CLAY. Gravel consists of fine and medium subrounded chalk.		30	32	27	5	ML	90
BH2	2.50	D	Stiff fissured yellow grey sandy slightly gravelly CLAY. Gravel consists of medium subangular flint.		24	62	19	43	CH	98
BH2	3.50	D	Stiff yellow grey patched pale grey sandy CLAY.		35	64	20	44	CH	100
BH2	4.50	D	Stiff dark yellow slightly sandy CLAY.		29	52	22	30	CH	100
BH2	5.50	D	Very stiff orange brown patched grey slightly sandy CLAY.		34	57	33	24	MH	100

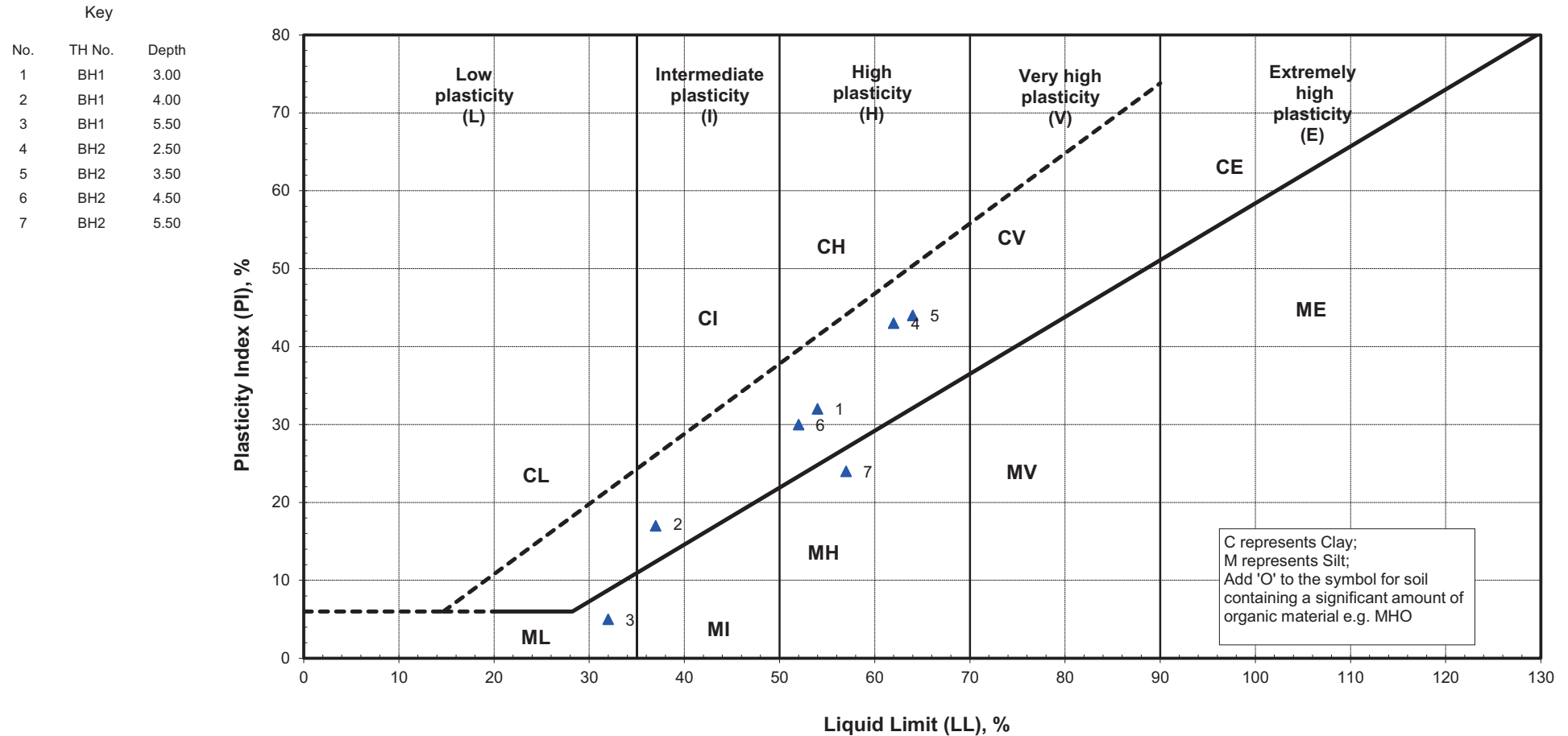
Registered office Southern Testing Laboratories Ltd, Keeble House, Stuart Way, East Grinstead RH19 4QA. Testing carried out at Units 20A & B, Durkins Road, East Grinstead RH19 2RW. BSI Ref: FS29280 under BS EN ISO 9001.

Jun 13

Plasticity Chart for Atterberg Limit Tests



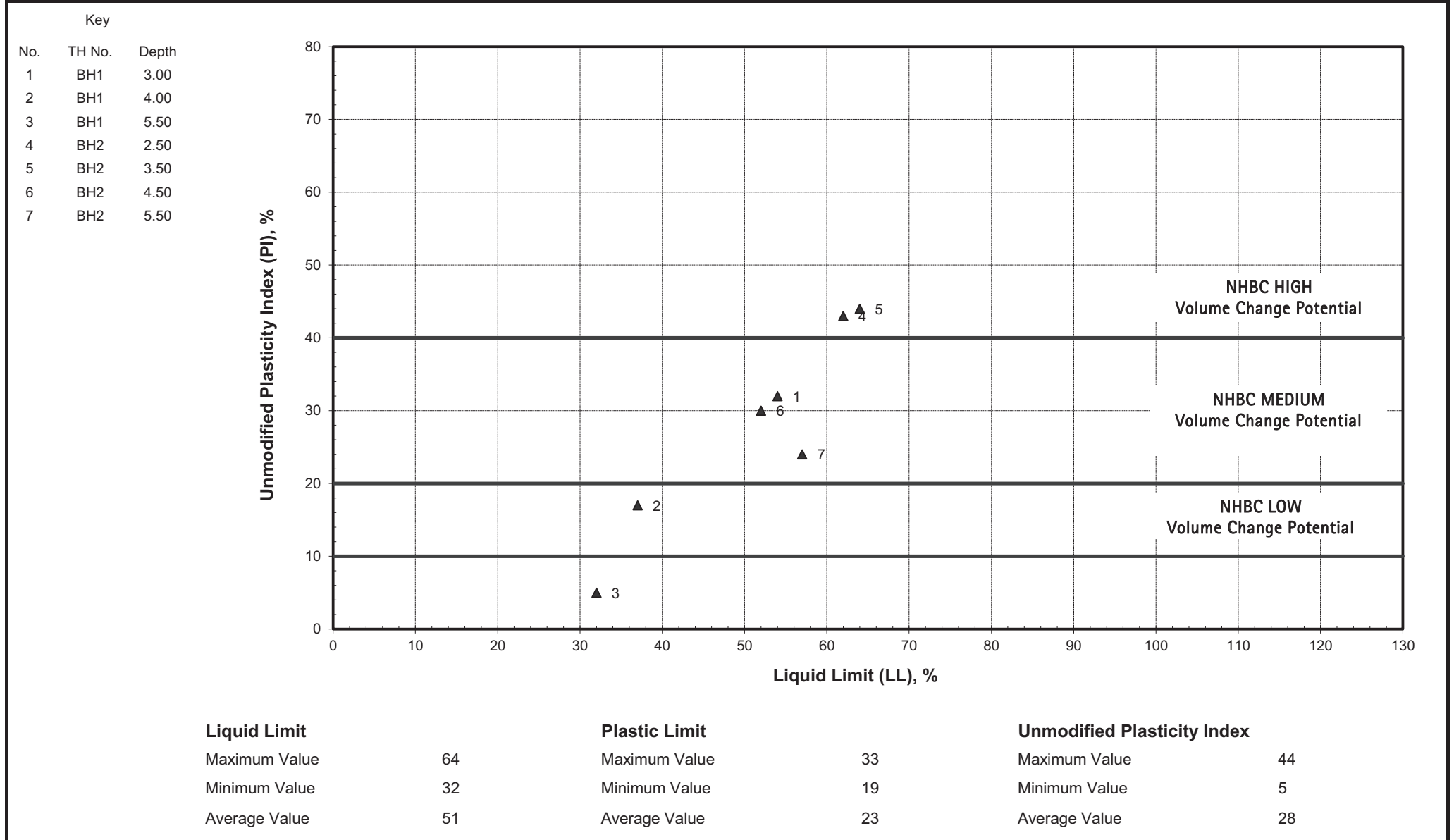
Project Name	133 Windmill Street, Gravesend			Project Number	J15380
Client Name	Churchill Retirement Living	PE	ER	Date Issued	04-Apr-23



NHBC Classification for Volume Change Potential



Project Name	133 Windmill Street, Gravesend			Project Number	J15380
Client Name	Churchill Retirement Living	PE	ER	Date Issued	04-Apr-23

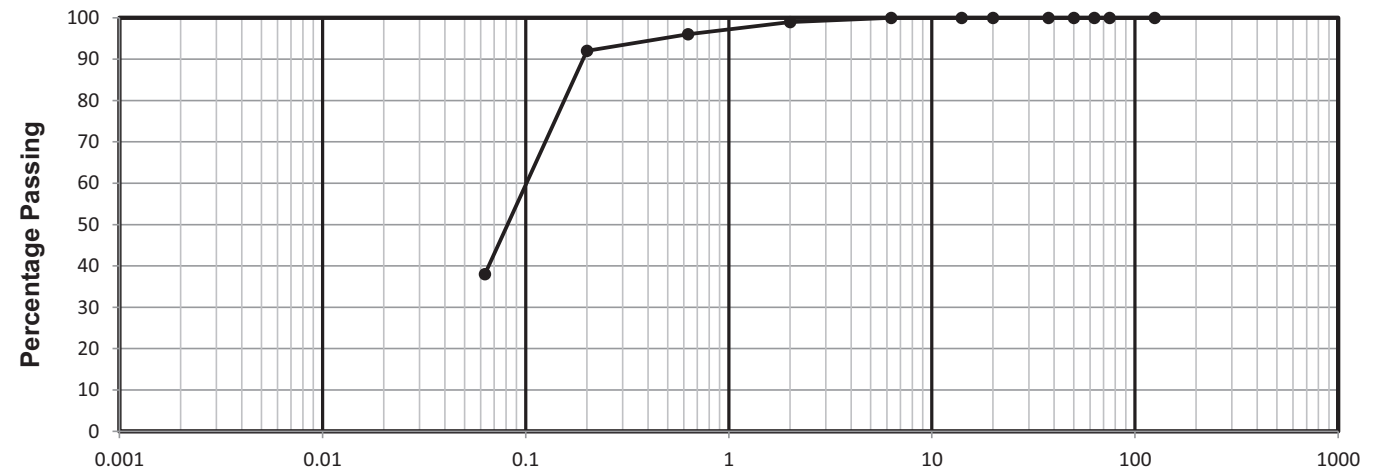


PARTICLE SIZE DISTRIBUTION REPORT

To BS1377-2 cl. 9.2-9.5

Project Name	133 Windmill Street, Gravesend			Project Number	J15380
Client Name	Churchill Retirement Living	PE	ER	Date Issued	24-Mar-23

Particle Size Distribution Chart



Particle Size	% Passing
125mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
20mm	100
14mm	100
6.3mm	100
2mm	99
630µm	96
200µm	92
63µm	38

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
38				60			1			0

Visual Description of Sample:

Dark yellow grey sandy calcareous CLAY.

Particle Density Mg/m³

Coefficient of Uniformity

N/A

Test Methods:

Wet & Dry Grading BS1377-2
 cl.9.2 & 9.3 & BS EN ISO 17892-4

Location

BH1

Depth (m)

2.70

Sample Type

D

Tested By

STL Lab

Checked By

Timon

Comments:

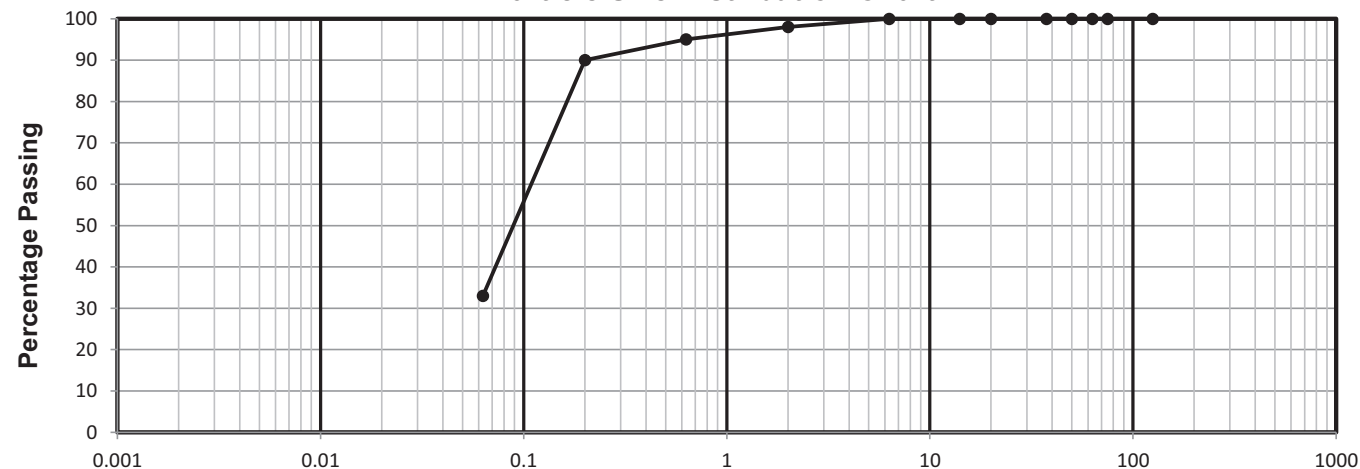
PARTICLE SIZE DISTRIBUTION REPORT

To BS1377-2 cl. 9.2-9.5



Project Name	133 Windmill Street, Gravesend			Project Number	J15380
Client Name	Churchill Retirement Living	PE	ER	Date Issued	24-Mar-23

Particle Size Distribution Chart



Particle Size	% Passing
125mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
20mm	100
14mm	100
6.3mm	100
2mm	98
630µm	95
200µm	90
63µm	33

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
33			64			2			0	

Visual Description of Sample:

Firm yellow grey speckled dark yellow sandy CLAY.

Particle Density Mg/m³

Coefficient of Uniformity

N/A

Test Methods:

Wet & Dry Grading BS1377-2
cl.9.2 & 9.3 & BS EN ISO 17892-4

Location

BH1

Depth (m)

3.50

Sample Type

D

Tested By

STL Lab

Checked By

Timon

Comments:

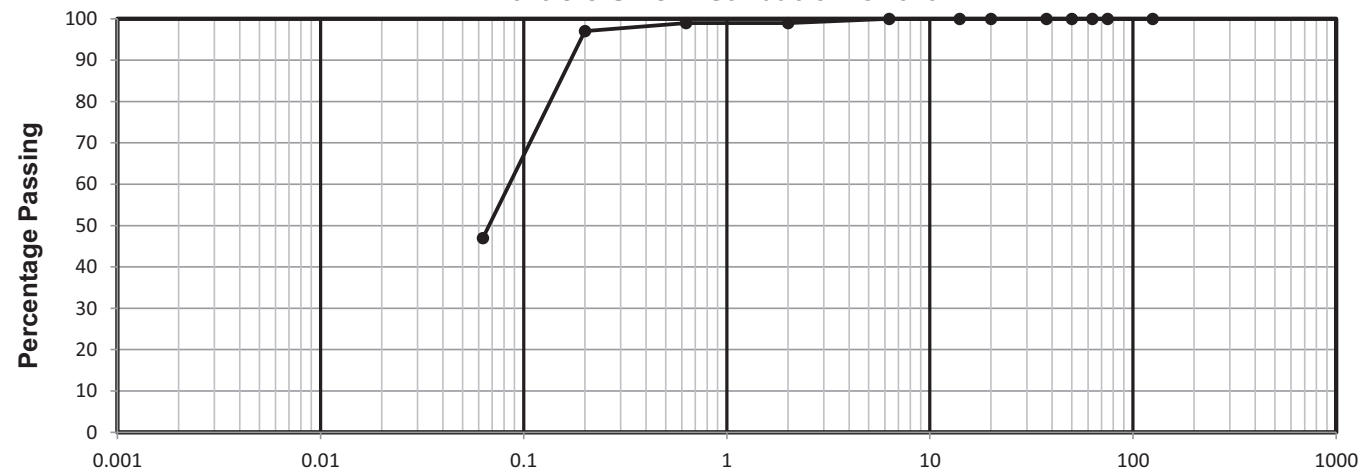
PARTICLE SIZE DISTRIBUTION REPORT

To BS1377-2 cl. 9.2-9.5

Project Name	133 Windmill Street, Gravesend			Project Number	J15380
Client Name	Churchill Retirement Living	PE	ER	Date Issued	31-Mar-23

Particle Size Distribution Chart

Particle Size	% Passing
125mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
20mm	100
14mm	100
6.3mm	100
2mm	99
630µm	99
200µm	97
63µm	47



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
47			52			1			0	

Visual Description of Sample:

Brown sandy CLAY.

Particle Density Mg/m³

Coefficient of Uniformity

N/A

Test Methods:

Wet & Dry Grading BS1377-2
cl.9.2 & 9.3 & BS EN ISO 17892-4

Location

BH2

Depth (m)

3.00

Sample Type

B

Tested By

STL Lab

Checked By

Timon

Comments:

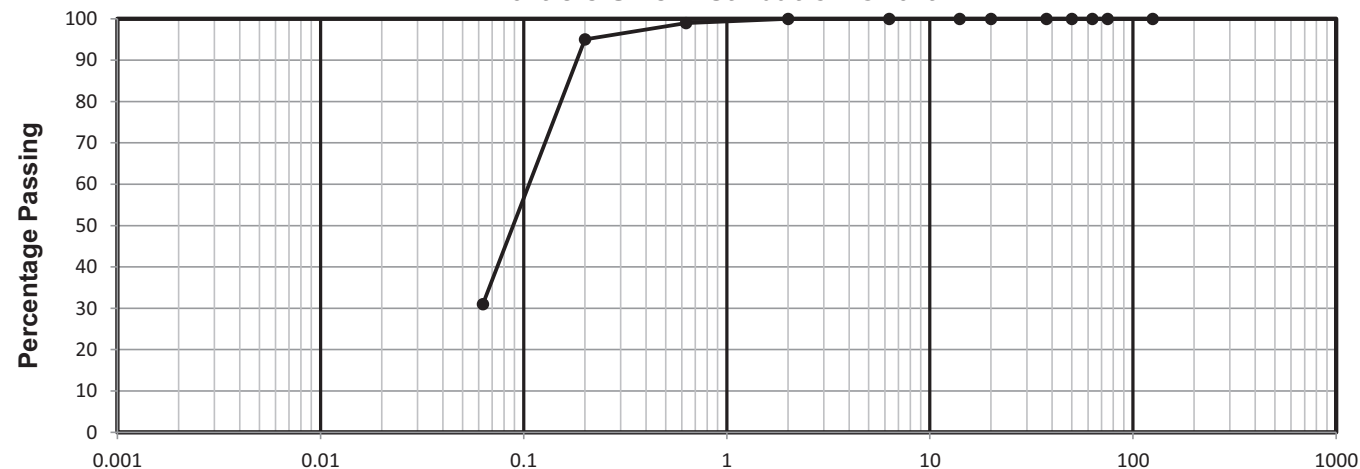
PARTICLE SIZE DISTRIBUTION REPORT

To BS1377-2 cl. 9.2-9.5



Project Name	133 Windmill Street, Gravesend			Project Number	J15380
Client Name	Churchill Retirement Living	PE	ER	Date Issued	31-Mar-23

Particle Size Distribution Chart



Particle Size	% Passing
125mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
20mm	100
14mm	100
6.3mm	100
2mm	100
630µm	99
200µm	95
63µm	31

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			
31				69			0			0

Visual Description of Sample:

Mid grey patched orange brown very sandy SILT.

Particle Density Mg/m³

Coefficient of Uniformity

N/A

Test Methods:

Wet & Dry Grading BS1377-2
 cl.9.2 & 9.3 & BS EN ISO 17892-4

Location

BH2

Depth (m)

5.00

Sample Type

B

Tested By

STL Lab

Checked By

Timon

Comments:

Classification Summary

BS1377-2 cl. 3.2, 3.3, 8.3 & BS1377-9 cl. 2.4 & BS EN ISO 17892-1, 2 & 3

Project Name		133 Windmill Street, Gravesend				Project Number		J15380	
Client		Churchill Retirement Living			PE	ER	Date Issued		31-Mar-23
Location	Depth m	Sample Type	Visual Description	Comments	Natural MC %	Particle Density Mg/m ³	Bulk Density Mg/m ³	Dry Density Mg/m ³	Saturation MC %
BH1	13.50	D	Off white slightly sandy gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		32		1.92	1.45	32
BH1	16.00	D	Off white clayey/silty slightly sandy calcareous fine to coarse subangular subrounded chalk GRAVEL.		30		1.91	1.47	31
BH1	18.50	U	Off white slightly sandy slightly gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		30		1.94	1.49	30
BH1	23.50	D	Off white slightly sandy slightly gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		30		1.95	1.50	30
BH2	12.50	D	Cream slightly sandy slightly gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		32		1.89	1.44	33
BH2	14.50	D	Cream slightly sandy slightly gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		32		1.93	1.46	31
BH2	16.50	D	Cream slightly sandy slightly gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		32		1.94	1.47	31
BH2	24.50	D	Cream slightly sandy gravelly calcareous CLAY. Gravel consists of fine to coarse subangular chalk.		30		1.96	1.51	29

Notes: Saturation Moisture Content of chalk test is carried out on intact fragments selected from the supplied sample. Particle density of chalk is assumed to be 2.7Mg/m³ unless otherwise stated above.

Southern Testing Laboratories Limited, East Grinstead is registered under BS EN ISO 9001 BSI ref: FS29280

Oct 14



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Analytical Report Number : 23-22246

Project / Site name:	133 Windmill Street Gravesend	Samples received on:	10/03/2023
Your job number:	J15380	Samples instructed on/ Analysis started on:	10/03/2023
Your order number:	J15380 2	Analysis completed by:	16/03/2023
Report Issue Number:	1	Report issued on:	20/03/2023
Samples Analysed:	4 soil samples		

Signed:

Anna Goc
Junior Reporting Specialist
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: 23-22246
 Project / Site name: 133 Windmill Street Gravesend
 Your Order No: J15380 2

Lab Sample Number				2612370	2612371	2612372	2612373
Sample Reference				BH1	BH1	BH1	BH1
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	2.50	3.00	6.50
Date Sampled				16/02/2023	16/02/2023	16/02/2023	16/02/2023
Time Taken				1200	1200	1200	1200
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	18	19	22	22
Total mass of sample received	kg	0.001	NONE	1.6	1.6	1.6	1.6

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.6	8.2	7.8	8.5
Total Sulphate as SO ₄	%	0.005	MCERTS	0.048	0.046	0.043	0.042
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.2	0.22	0.26	0.1
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	198	216	264	101
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	7.4	6	-	-
Total Sulphur	%	0.005	MCERTS	0.027	0.022	0.02	0.024
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	2.3	< 2.0	-	-

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	< 5.0	< 5.0	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	< 2.5	< 2.5	-	-

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



Analytical Report Number : 23-22246

Project / Site name: 133 Windmill Street 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 *
2612370	BH1	None Supplied	1.5	Brown clay and sand.
2612371	BH1	None Supplied	2.5	Brown clay and sand.
2612372	BH1	None Supplied	3	Brown sandy clay.
2612373	BH1	None Supplied	6.5	Beige clay and sand with chalk.

Analytical Report Number : 23-22246
Project / Site name: 133 Windmill Street 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
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	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 30oC

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.



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Analytical Report Number : 23-22690

Project / Site name:	133 Windmill Street, Gravesend	Samples received on:	14/03/2023
Your job number:	J15380	Samples instructed on/ Analysis started on:	14/03/2023
Your order number:	J15380 5	Analysis completed by:	20/03/2023
Report Issue Number:	1	Report issued on:	21/03/2023
Samples Analysed:	8 soil samples		

Signed:

Dominika Warjan
Junior Reporting Specialist
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: 23-22690
 Project / Site name: 133 Windmill Street, Gravesend
 Your Order No: J15380 5

Lab Sample Number				2615329	2615330	2615331	2615332	2615333
Sample Reference				BH1	BH2	BH2	BH2	BH2
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.00-2.50	1.50	3.00	5.00	7.50
Date Sampled				16/02/2023	20/02/2023	20/02/2023	21/02/2023	21/02/2023
Time Taken				1200	1200	1200	1200	1200
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	17	14	19	20	23
Total mass of sample received	kg	0.001	NONE	2	0.9	0.9	0.9	0.9

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	9.6	7.8	7.1	6.3	8.3
Total Sulphate as SO ₄	%	0.005	MCERTS	0.105	0.074	0.304	0.077	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.17	0.11	0.11	0.24	0.06
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	171	109	115	244	59.5
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	22	4.1	4.6	5.9	-
Total Sulphur	%	0.005	MCERTS	0.06	0.046	0.138	0.043	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	5	21	18	14	-

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	< 5.0	7.2	13	29	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	< 2.5	3.6	6.4	14	-

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

Analytical Report Number: 23-22690

Project / Site name: 133 Windmill Street, Gravesend

Your Order No: J15380 5

Lab Sample Number				2615334	2615335	2615336
Sample Reference				BH2	BH2	BH2
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				11.50	15.50	22.50
Date Sampled				21/02/2023	21/02/2023	22/02/2023
Time Taken				1200	1200	1200
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	20	21	18
Total mass of sample received	kg	0.001	NONE	0.9	0.9	0.9

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.8	8.6	8.4
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.018	0.11	0.05
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	18.4	113	50.3
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	-
Total Sulphur	%	0.005	MCERTS	-	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	-	-

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	-	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	-	-

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



Analytical Report Number : 23-22690

Project / Site name: 133 Windmill Street, 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 *
2615329	BH1	None Supplied	2.00-2.50	Brown clay and sand.
2615330	BH2	None Supplied	1.5	Brown clay and sand with gravel and brick.
2615331	BH2	None Supplied	3	Brown sandy clay.
2615332	BH2	None Supplied	5	Brown sandy clay.
2615333	BH2	None Supplied	7.5	Beige clay with gravel and chalk.
2615334	BH2	None Supplied	11.5	Beige chalk.**
2615335	BH2	None Supplied	15.5	Beige chalk.**
2615336	BH2	None Supplied	22.5	Beige chalk with glass.**

Analytical Report Number : 23-22690
Project / Site name: 133 Windmill Street, 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
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	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 30oC

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.

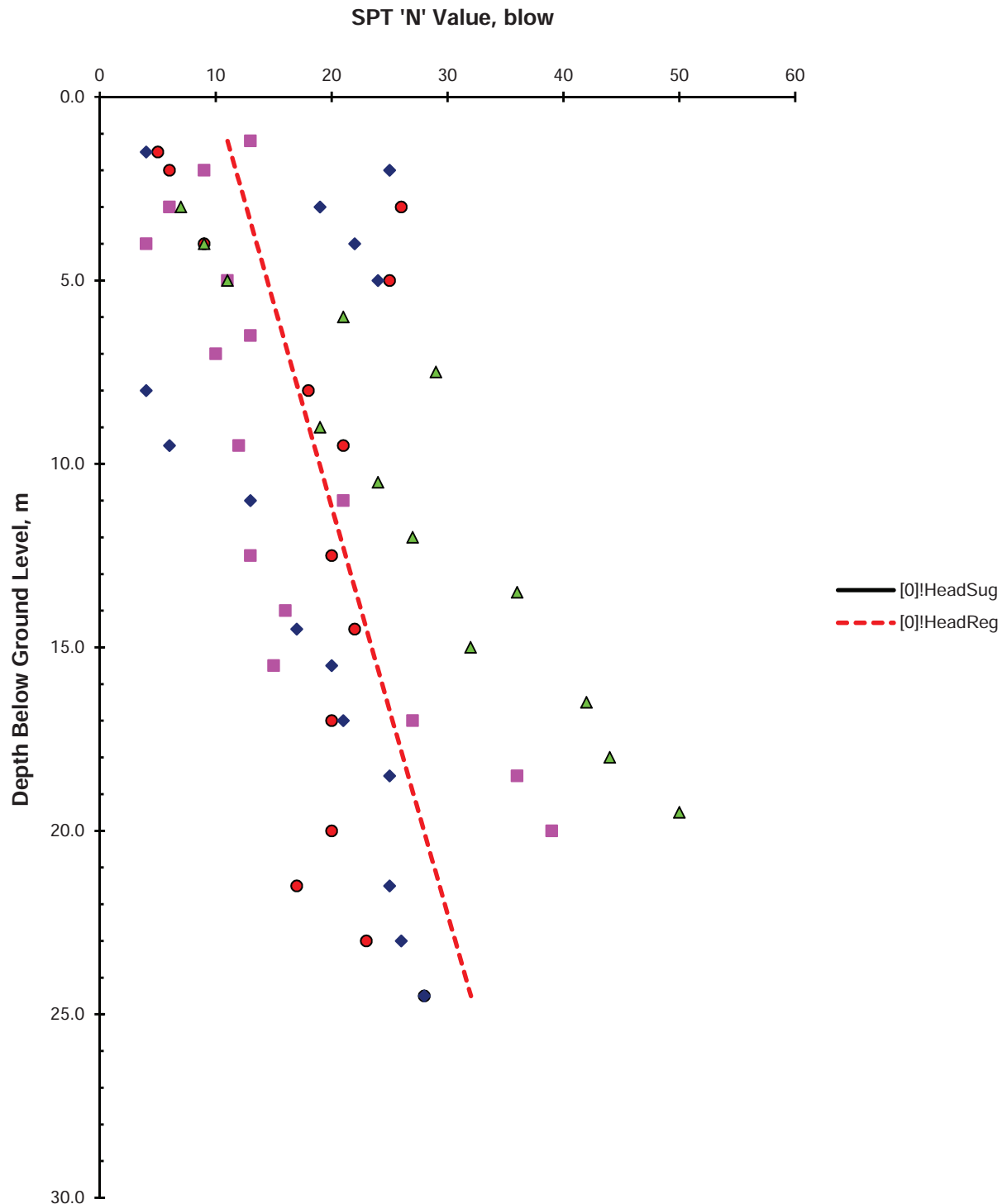
****UNACCREDITED SAMPLE MATRIX**

APPENDIX D

**Geotechnical Figures and
Tables**



SPT 'N' Value vs Depth Below Ground Level



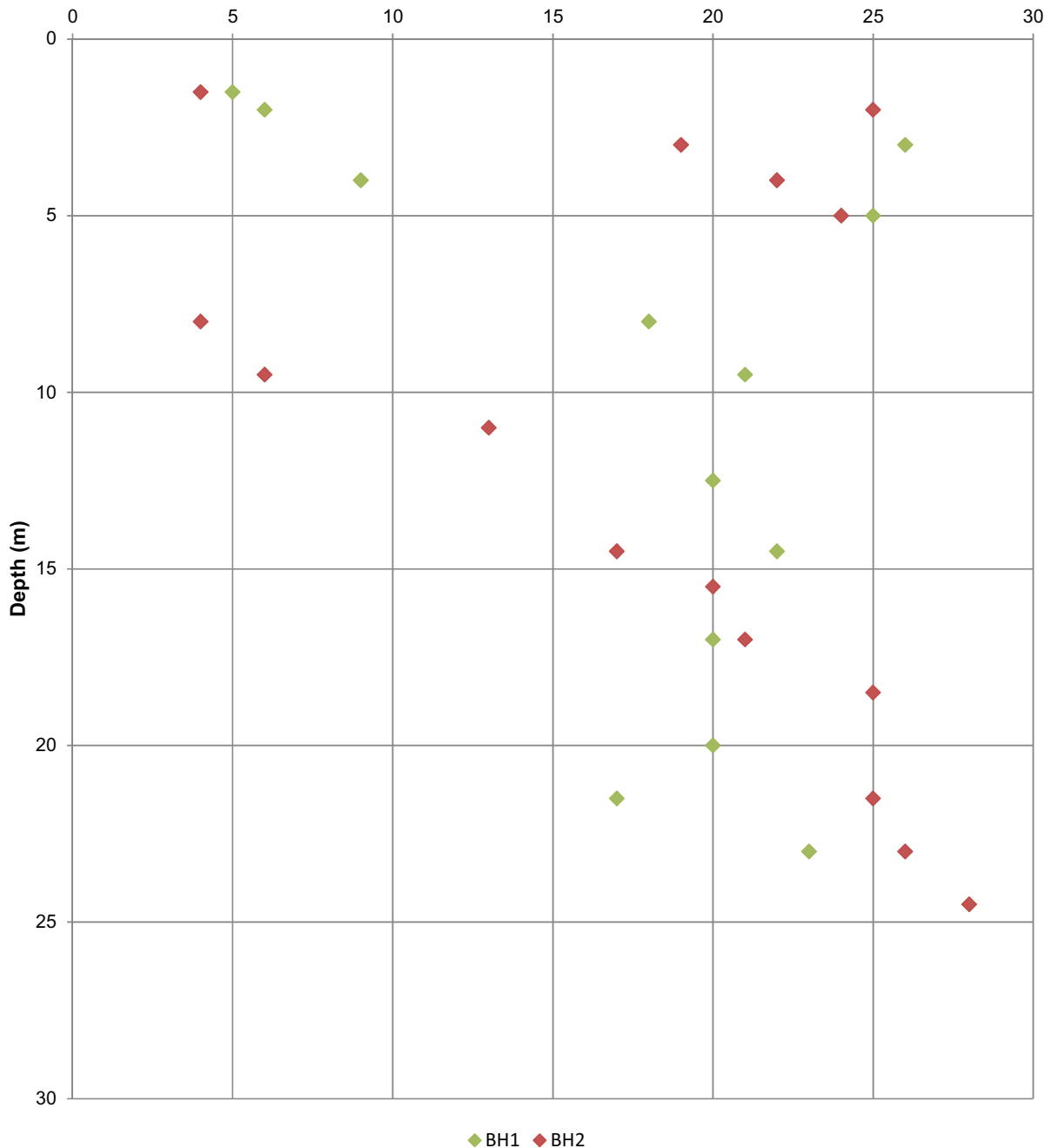
Linear Regression of the Test Results : Slope = 0.90 blow/m, Zero intercept = 10 blow
Suggested Line for Pile Design : As shown above

Client:	Churchill Retirement Living	Site:	Former Police Station, 133 Windmill Street, Gra	
Job No:	J15380	Date:	30/03/2023	Figure I SPT12



Project ID:	J15380	Project Title:	Windmill Street
Client:	Churchill Retirement Living	Location:	133 Windmill Street, Gravesend, DA12 1DB

SPT N Value vs Depth Summary



APPENDIX E

Contamination Laboratory Test Methods and Results



These screening values are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

Table 1 – Tier 1 Screening Values

Contaminant	Units	Proposed Land Use					
		Residential with home grown produce consumption	Residential without home grown produce consumption	Open Space * (Residential)	Open Space * (Park)	Allotments	Commercial / Industrial
Arsenic (As) [2]	mg/kg	37	40	79	170	43	640
Cadmium (Cd) [2]	mg/kg	11	85	120	555	1.9	190
Trivalent Chromium (CrIII) [2]	mg/kg	910	910	1,500	33,000	18,000	8600
Hexavalent Chromium (CrVI) [2]	mg/kg	6	6	7.7	220	1.8	33
Lead (Pb) [3]	mg/kg	200	310	630	1300	80	2330
Mercury (Hg) [1,2,7]	mg/kg	7.6-11	9.2-15	40	68-71	6.0	29-320
Selenium (Se) [2]	mg/kg	250	430	1,100	1,800	88	12,000
Nickel (Ni) [2,4]	mg/kg	130	180	230	800	53	980
Copper (Cu) [2,4]	mg/kg	2,400	7,100	12,000	44,000	520	68,000
Zinc (Zn) [2,4]	mg/kg	3,700	40,000	81,000	170,000	620	730,000
Phenol [1,2]	mg/kg	120-380	440-1200	440-1300	440-1300	23-83	440-1300
Benzo[a]pyrene [1,5]	mg/kg	1.7-2.4	2.6	4.9	10	0.67-2.7	36
Naphthalene [1,2]	mg/kg	2.3-13	2.3-13	77-430*	77-430*	4.1-24	77-430*
Total Cyanide (CN) [6]	mg/kg	/	/	/	/	/	/
Free Cyanide [6]	mg/kg	/	/	/	/	/	/
Complex Cyanides [6]	mg/kg	/	/	/	/	/	/
Thiocyanate [6]	mg/kg	/	/	/	/	/	/

Notes:

* Open Space levels calculated on the basis of the exposure modelling developed in the C4SL research.

+ Screening values constrained to saturation limit. Higher values may be acceptable on a site specific basis.

[1] Where ranges of values are given for organic contaminants the screening value is dependent on the Soil +Organic Matter.

[2] LQM/CIEH S4UL (2014). Copyright Land Quality Management Ltd. reproduced with permission; Publication Number S4UL 3116. All rights reserved.

[3] C4SL (DEFRA 2014).

[4] Copper, Zinc and Nickel may have phototoxic effects at the given concentrations. Alternative criteria should be adopted for importation of Topsoil or other soils for cultivation. BS3882:2015 and BS8601:2013 suggest values of 200 to 300mg/kg for Zn, 100 to 200mg/kg for Cu, and 60 to 110mg/kg for Ni, for topsoil and subsoil, depending on pH.

[5] Based on the Surrogate Marker approach and modelled using the modified exposure parameters of C4SL but retaining 'minimal risk' HCV.

[6] Screening criteria derived on a site specific basis if test results indicate.

[7] S4UL for Methyl Mercury, higher concentrations may be tolerable if inorganic mercury is the only species present. Lower concentrations apply for elemental Mercury.

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Analytical Report Number : 23-22245

Project / Site name:	133 Windmill Street, Gravesend	Samples received on:	10/03/2023
Your job number:	J15380	Samples instructed on/ Analysis started on:	10/03/2023
Your order number:	J15380-3	Analysis completed by:	21/03/2023
Report Issue Number:	1	Report issued on:	21/03/2023
Samples Analysed:	5 soil samples		

Signed:

Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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: 23-22245

Project / Site name: 133 Windmill Street, Gravesend

Your Order No: J15380-3

Lab Sample Number				2612365	2612366	2612367	2612368	2612369
Sample Reference				BH1	BH1	BH1	BH2	BH2
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	2.50	3.50	1.50	2.50
Date Sampled				08/03/2023	08/03/2023	08/03/2023	08/03/2023	08/03/2023
Time Taken				1500	1500	1500	1500	1500
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	15	16	20	14	18
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.4	0.4	0.4

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	9.7	9.7	8	9.1	4.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.19	0.2	0.26	0.19	0.2
Sulphide	mg/kg	1	MCERTS	11	4.7	< 1.0	2.5	3.4
Organic Matter (automated)	%	0.1	MCERTS	0.7	0.6	0.2	1.5	0.2

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	< 0.05	< 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	< 0.05	< 0.05	< 0.05	0.16	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.06	< 0.05	< 0.05	0.66	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.05	< 0.05	< 0.05	0.7	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.44	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.42	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	0.65	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	0.18	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.49	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.31	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.07	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.38	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	< 0.80	< 0.80	4.46	< 0.80
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Analytical Report Number: 23-22245

Project / Site name: 133 Windmill Street, Gravesend

Your Order No: J15380-3

Lab Sample Number				2612365	2612366	2612367	2612368	2612369
Sample Reference				BH1	BH1	BH1	BH2	BH2
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.50	2.50	3.50	1.50	2.50
Date Sampled				08/03/2023	08/03/2023	08/03/2023	08/03/2023	08/03/2023
Time Taken				1500	1500	1500	1500	1500
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.5	9.8	8.4	13	4.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
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	32	32	69	24	24
Copper (aqua regia extractable)	mg/kg	1	MCERTS	23	19	18	47	6.4
Lead (aqua regia extractable)	mg/kg	1	MCERTS	60	65	6.9	230	11
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	0.4	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	17	34	19	12
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	51	52	83	79	24

Petroleum Hydrocarbons

TPH C10 - C40 EH_CU_ID_TOTAL	mg/kg	10	MCERTS	< 10	-	-	15	-
TPH2 (C6 - C10) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	-	-	< 0.1	-
TPH C6 - C40 EH_CU+HS_CU_ID_TOTAL	mg/kg	10	NONE	< 10	-	-	15	-

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



Analytical Report Number : 23-22245
Project / Site name: 133 Windmill Street, 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 *
2612365	BH1	None Supplied	1.5	Brown loam and clay.
2612366	BH1	None Supplied	2.5	Brown clay and sand.
2612367	BH1	None Supplied	3.5	Brown sandy clay.
2612368	BH2	None Supplied	1.5	Brown loam and clay with gravel.
2612369	BH2	None Supplied	2.5	Brown sandy clay.

Analytical Report Number : 23-22245

Project / Site name: 133 Windmill Street, 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
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TPH2 (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS

Analytical Report Number : 23-22245

Project / Site name: 133 Windmill Street, 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
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-PL	W	MCERTS
TPH C6 - C40 (soil)	Determination of TPH bands by HS-GC-MS/GC-FID	TPH > C10 Dry soil n-house method with silica gel split/clean up. TPH < C10 by Wet by HS-GC-MS	L088/L076		NONE

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 30oC.

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

**Eliza Richardson**

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Analytical Report Number : 23-23136

Project / Site name:	Former Police Station, Windmill Street, Gravesend	Samples received on:	16/03/2023
Your job number:		Samples instructed on/ Analysis started on:	16/03/2023
Your order number:	315380	Analysis completed by:	24/03/2023
Report Issue Number:	1	Report issued on:	24/03/2023
Samples Analysed:	4 soil samples		

Signed:

Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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: 23-23136

Project / Site name: Former Police Station, Windmill Street, Gravesend

Your Order No: J15380

Lab Sample Number				2618043	2618044	2618045	2618046
Sample Reference				TPA	TPB	TPC	TPD
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.90	0.90	0.90	0.90
Date Sampled				15/03/2023	15/03/2023	15/03/2023	15/03/2023
Time Taken				1000	1000	1000	1000
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	13	19	19	14
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.4	0.4

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	10.2	8.3	9.8	10.2
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.3	0.078	0.13	0.2
Sulphide	mg/kg	1	MCERTS	< 1.0	3.4	7.5	5.3
Organic Matter (automated)	%	0.1	MCERTS	1	1.1	0.7	0.9

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 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
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	1	0.12	0.4	0.42
Anthracene	mg/kg	0.05	MCERTS	0.17	< 0.05	0.12	0.08
Fluoranthene	mg/kg	0.05	MCERTS	2.1	0.3	1.2	0.63
Pyrene	mg/kg	0.05	MCERTS	1.8	0.28	1.1	0.56
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.89	0.14	0.68	0.3
Chrysene	mg/kg	0.05	MCERTS	0.93	0.16	0.63	0.28
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	1.1	0.21	0.69	0.39
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.37	0.11	0.27	0.14
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.83	0.16	0.55	0.28
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.55	0.1	0.29	0.18
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.1	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.59	0.14	0.32	0.18

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	10.5	1.72	6.28	3.44
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Analytical Report Number: 23-23136

Project / Site name: Former Police Station, Windmill Street, Gravesend

Your Order No: J15380

Lab Sample Number				2618043	2618044	2618045	2618046
Sample Reference				TPA	TPB	TPC	TPD
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.90	0.90	0.90	0.90
Date Sampled				15/03/2023	15/03/2023	15/03/2023	15/03/2023
Time Taken				1000	1000	1000	1000
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status	

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.2	13	15	11
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	31	59	38
Copper (aqua regia extractable)	mg/kg	1	MCERTS	14	20	130	28
Lead (aqua regia extractable)	mg/kg	1	MCERTS	70	150	130	89
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	16	19	27	20
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	61	140	76	81

Petroleum Hydrocarbons

TPH C10 - C40 _{EH_CU_10_TOTAL}	mg/kg	10	MCERTS	< 10	< 10	< 10	92
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U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



Analytical Report Number : 23-23136

Project / Site name: Former Police Station, Windmill Street, 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 *
2618043	TPA	None Supplied	0.9	Brown loam and clay with gravel and concrete.
2618044	TPB	None Supplied	0.9	Brown loam and clay with gravel.
2618045	TPC	None Supplied	0.9	Brown loam and sand with gravel.
2618046	TPD	None Supplied	0.9	Brown loam and sand with gravel and chalk.

Analytical Report Number : 23-23136

Project / Site name: Former Police Station, Windmill Street, 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
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS



Analytical Report Number : 23-23136

Project / Site name: Former Police Station, Windmill Street, 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
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-PL	W	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.

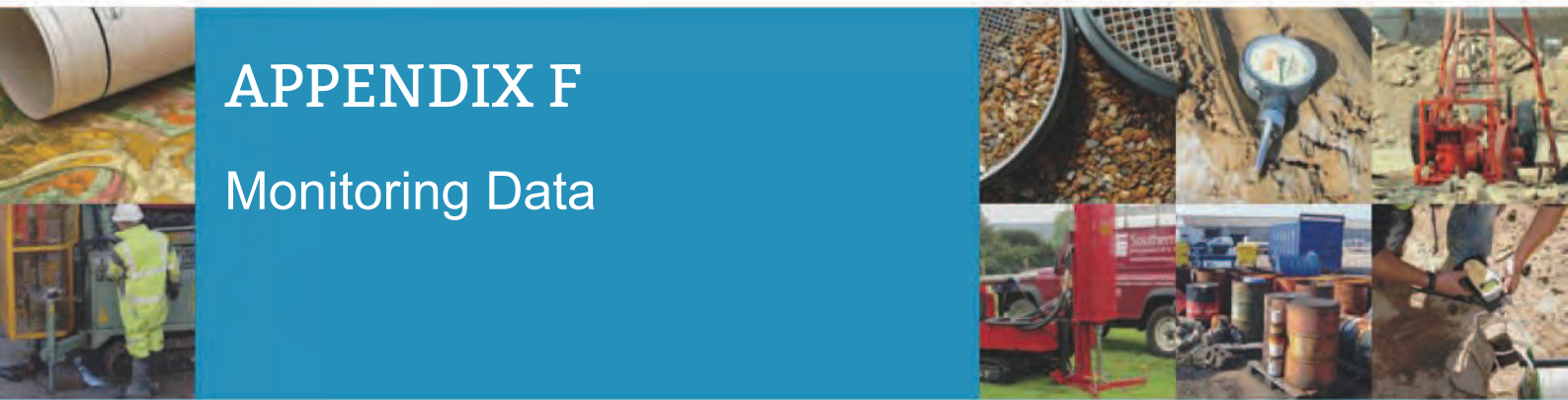
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

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



APPENDIX F

Monitoring Data





SOIL GAS AND GROUND WATER DAILY RECORD SHEET

Project Name:	Former Police Station, 133 Windmill Street, Gravesend, DA12 1DB	Project Engineer:	ER	Date:	28-Feb-23	Project No:	
Client:	Churchill Retirement Living	Operative:	er	Day of the week:	Tuesday	Project No:	J15380

Land Gas Data											Groundwater Data			Remarks		
Well / TH No.	Atmospheric Pressure (mb) and Ambient Temperature	PID	BH pressure	Flow Rate		CH ₄	CO ₂	O ₂	CO	H ₂ S	Depth to base of well	Water level	Height of Cover	Details of water samples (colour, clarity, odour etc)	Ground Conditions (soft, wet/dry, frozen etc) & Weather Conditions	General Remarks
		ppm	Pa	l/hr		%	%	%	ppm	ppm	m below top of cover	m below top of cover	m above GL			
BH101	6.0	P				P					22.80	18.50		bailer in well, water was clear	hard surfaced site, dry, cold, windy demolition has started	50mm diameter pipe
		S				S										
		Time Of Readings:			Time Of Readings:					Time Of Readings:						
											10.00					
BH102	6.0	P				P					3.90	dry			hard surfaced site, dry, cold, windy demolition has started	50mm well pipe
		S				S										
		Time Of Readings:			Time Of Readings:					Time Of Readings:						
											10.15					
BH1	6.0	P				P					25.00	21.05			hard surfaced site, dry, cold, windy, surface around borehole extremely broken up	well will not survive much longer
		S				S										
		Time Of Readings:			Time Of Readings:					Time Of Readings:						
											10.30					
		P				P										
		S				S										
		Time Of Readings:			Time Of Readings:					Time Of Readings:						
		P				P										
		S				S										
		Time Of Readings:			Time Of Readings:					Time Of Readings:						
		P				P										
		S				S										
		Time Of Readings:			Time Of Readings:					Time Of Readings:						

P = Peak Reading, S = Steady reading	Equipment Used: Interface Meter, MiniRAE 2000, GFM435 Gas Analyser	Checked By	
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Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical

APPENDIX G

Photographs



G

Former Police Station, 133 Windmill Street, Gravesend



Plate 1: Access to north.



Plate 2: Access looking south.



Plate 3: Access looking south east.

Former Police Station, 133 Windmill Street, Gravesend



Plate 1: North.



Plate 2: Lower level of site.



Plate 3: Lower level of site.



Plate 4: Access ramp.



Plate 5: North east corner.



Plate 6: Tank for sprinkler system to north west corner.

Former Police Station, 133 Windmill Street, Gravesend



Plate 7: BH1.



Plate 8: Core from BH1.



Plate 9: Core from BH1.



Plate 10: BH1 core lower section.



Plate 11: Access ramp to Woodville Street, north.



Plate 12: Retaining wall.

Former Police Station, 133 Windmill Street, Gravesend



Plate 13: West lower part of site.



Plate 14: BH2 core.



Plate 15: BH2 core.



Plate 16: BH2 core.



Plate 17: BH2 core.



Plate 18: BH2 core.

Former Police Station, 133 Windmill Street, Gravesend



Plate 19: Pedestrian access off Windmill Street to east.



Plate 20: Pedestrian access off Windmill Street to east.



Plate 21: Windmill Street.

Former Police Station, 133 Windmill Street, Gravesend



Plate 1: Demolition of perimeter wall.



Plate 2: East.



Plate 3: Site surface with concrete removed.



Plate 4: Site surface with concrete removed.



Plate 5: Site surface with concrete removed.



Plate 6: Site surface with concrete removed.

Former Police Station, 133 Windmill Street, Gravesend



Plate 7: Site surface with concrete removed.



Plate 8: Site surface with concrete removed.

Former Police Station, 133 Windmill Street, Gravesend



Plate 1: Pile removal west.



Plate 2: North west.



Plate 3: South.



Plate 4: South east.



Plate 5: Pile removal.



Plate 6: West.

Former Police Station, 133 Windmill Street, Gravesend



Plate 7: South west.



Plate 8: South.



Plate 9: South.

Former Police Station, 133 Windmill Street, Gravesend



Plate 1: North east.



Plate 2: East site surface.



Plate 3: South east site surface.



Plate 4: Depth of concrete removed.



Plate 5: Depth of concrete removed.



Plate 6: Depth of concrete removed.

Former Police Station, 133 Windmill Street, Gravesend



Plate 7: Site surface.



Plate 8: Site surface north.



Plate 9: East.



Plate 10: West.



Plate 11: Site surface.



Plate 12: Site surface.

Former Police Station, 133 Windmill Street, Gravesend



Plate 13: North.



Plate 14: North.



Plate 15: East.



Plate 16: East.



Plate 17: Excavation of Made Ground.



Plate 18: North.

Former Police Station, 133 Windmill Street, Gravesend



Plate 19: Site surface north.



Plate 20: Site surface east.



Plate 21: North.



Plate 22: East.

Former Police Station, 133 Windmill Street, Gravesend



Plate 1: Reduced level dig and area where UST was found.



Plate 2: Reduced level dig.



Plate 3: Reduced level dig and stockpile of Made Ground.



Plate 4: Stockpile of Made Ground and retaining wall exposed.



Plate 5: Remains of housing to east side of site.



Plate 6: Reduced level dig / TPE.

Former Police Station, 133 Windmill Street, Gravesend



Plate 7: Reduced level dig.



Plate 8: Remains of housing to east side of site.



Plate 9: Remains of housing to east side of site.



Plate 10: Remains of housing to east side of site.



Plate 11: Retaining wall.

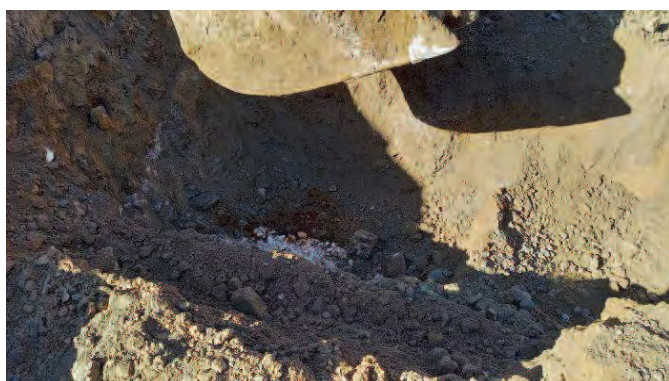


Plate 12: TPE.

Former Police Station, 133 Windmill Street, Gravesend



Plate 13: TPE.



Plate 14: Remains of housing to east side of site.



Plate 15: Remains of housing to east side of site.



Plate 16: Remains of housing to east side of site.

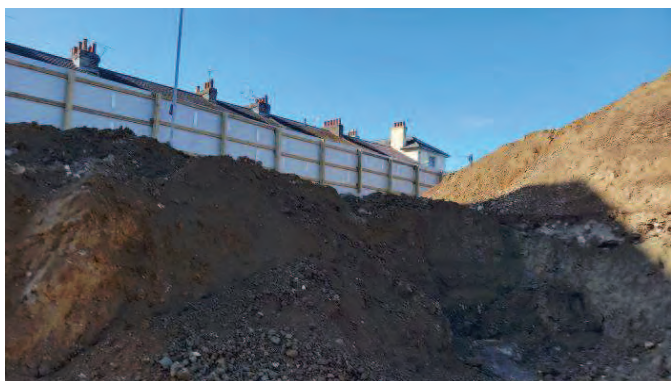


Plate 17: Stockpile of Made Ground soils.



Plate 18: Stockpile of Made Ground soils.

Former Police Station, 133 Windmill Street, Gravesend



Plate 19: Retaining wall.



Plate 20: TPF.



Plate 21: Stockpile.



Plate 22: Side of stockpile.



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