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**Elizabeth Huggins Cottages
Cross Lane West
Gravesend
Kent
DA11 7LD**

Phase 2 Geo-Environmental Investigation

On behalf of Elizabeth Huggins Trust



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February 2021

air quality assessment contaminated land ecology environmental audits noise assessment
environmental impact assessments flood risk assessments geotechnical engineering ground investigation
hydrogeology noxious weeds remediation design risk assessments waste management

**Site: Elizabeth Huggins Cottages, Cross Lane West, Gravesend,
Kent, DA11 7LD**

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1 INTRODUCTION

Ground and Environmental Services Ltd (GES) was commissioned by Stonechart Developments Ltd on behalf of the Elizabeth Huggins Trust (The Client) to undertake a Phase 2 Geo-Environmental Investigation at a proposed development site at Elizabeth Huggins Cottages, Cross Lane West, Gravesend, Kent, DA11 7LD.

It was understood that the proposed development is to comprise the construction of four blocks of flats and houses together with associated access roads, car parking and soft landscaped areas which will include private gardens.

The purpose of the ground investigation was to determine the ground profile and to provide guideline recommendations for the design of foundations for new structures on the site, together with floor slab, pavement and soakage design.

In addition, contamination testing and a soil gas survey were carried out to provide a preliminary assessment of contamination issues based on current Contaminated Land Legislation.

2 SITE LOCATION AND LAYOUT

The site is situated in an urban setting to the south of Cross Lane West, approximately 1km south of Gravesend town centre. The site is located at approximate Grid Reference TQ 645 727, with the following features immediately bounding the site:

- North, the site is bound by Cross Lane West beyond which residential properties;
- East, the site is bound by rear gardens to residential properties that front Alfred Road
- South, beyond a steel palisade fence was a row of private garages. Behind the garages were residential properties that front onto Hillingdon Road
- West; the site is bound by the A227 Wrotham Road beyond which were residential properties.

The site occupies an area of approximately 1.0 Ha and was accessed from the north west corner at the junction between Wrotham Road and Cross Lane West.

The Elizabeth Huggins Cottages complex comprises a total of 10 bungalows. Eight bungalows (Numbers 1 to 8) are located around a cul de sac which runs from the north west to the south east into a turning head and communal garden area. The remaining two bungalows are accessed from Cross Lane West (Number 9) or Wrotham Road (Number 10). The properties are single storey dwellings which are understood to have been constructed in 1930's. All properties have private garden areas which are given over to lawn with planted borders. Small trees are located across the site with clusters of large mature trees, some pollarded, located along the site access road and in the rear gardens to bungalows 6, 7 and 10. Further large mature trees were located around the communal garden area located towards the front of bungalows 3, 4 5, and 6.

3 ENVIRONMENTAL SETTING

3.1 GEOLOGY

Reference to the British Geological Survey online geological map of the area indicates that the site is underlain by a bedrock geology comprising Thanet Formation over the north eastern part of the site and the underlying Lewes Nodular Chalk Formation over the south western part of the site. No superficial deposits were shown on the site however Head Deposits were shown to the immediate west.

The geological memoir for the area described these strata as follows:

Head Deposits – Clay and Silt

Head is poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. Solifluction is the slow viscous downslope flow of waterlogged soil and other unsorted and unsaturated superficial deposits. The term gelifluction is restricted to the slow flow of fluidized superficial deposits during the thawing of seasonally frozen ground. The flow is initiated by meltwater from thawing ice lenses. Polymict deposit: comprises gravel, sand and clay depending on upslope source and distance from source. Locally with lenses of silt, clay or peat and organic material.

Thanet Formation

Glauconite-coated, nodular flint at base, overlain by pale yellow-brown, fine-grained sand that can be clayey and glauconitic. Rare calcareous or siliceous sandstones.

Lewes Nodular Chalk Formation

Comprises Chalk with flints, with discrete marl seems, nodular chalk, sponge rich and flint seems throughout.

Upper Boundary – Unconformable with the overlying Paleogene/Quaternary deposits in this area i.e. Clay with Flints.

Lower Boundary – Is conformable with the underlying Grey Chalk Supergroup. Placed at the lowest bed in the Plenus Marls Member at the base of the Hollywell Nodular Chalk Formation (Southern Province) and the base of the same member in the Welton Chalk Formation (Northern Province).

3.2 GROUNDWATER

Reference to the British Geological Survey 1:50,000 scale Aquifer Designation Dataset, shows the site to be set upon Unproductive strata within the superficial Head Deposits, with the bedrock chalk being designated as a Principal Aquifer.

Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The site is also situated within an Environment Agency designated Groundwater Source Protection Zone II – Outer Zone.

3.3 RADON

A Radon Report for the site was obtained for UK Radon. This showed the site to be set with a Radon Affected Area, with a 1-3% probability of the levels on site being above the action level of 200 Bq/m³. However, no special measures are required to be incorporated into any new buildings on site. The Radon report is included in Appendix 1.

4 INTRUSIVE INVESTIGATION

4.1 FIELDWORK

The site works were carried out between the 15th December 2020 and the 27th January 2021 and comprised the following:

- Window Sampling;
- Falling Head Testing;
- Dynamic Cone Penetrometer Testing;
- Soil Gas and Groundwater Monitoring.

The positions of the above works on the site are indicated on Figure 1, Exploratory Hole Location Plan.

When considering the sampling strategy for this supplementary investigation, GES consulted current guidance as stipulated within British Standard BS10175 – ‘Investigation of Potentially Contaminated Sites – Code of Practice’.

Window Sample Holes

Thirteen window sample holes (WS1 to WS13) were excavated using a Premier 110 window sampling rig to depths ranging between 4.0m and 5.0m.

The soils and materials encountered in the holes were logged and representative samples recovered for laboratory analysis. Standard Penetration tests were also carried out at regular intervals using either the split spoon or solid cone attachment as appropriate to the ground conditions encountered.

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Upon completion of window sample holes WS1, WS4, WS8 and WS10, 35mm diameter dual purpose soil gas and groundwater monitoring standpipes were installed.

Window sample hole logs and installation details are presented in Appendix 2.

Falling Head Testing

Falling head testing was undertaken in the standpipes installed in WS4, WS8 and WS10. The test involved recording the drop in water level with respect to time.

The field test data is summarised below in Section 7.4 below and the results presented in Appendix 3.

Dynamic Cone Penetrometer Testing

Ten dynamic cone penetrometer (DCP1 to DCP10) tests were undertaken in the approximate areas proposed for access roads/hardstanding. The dynamic cone penetrometer (DCP) uses an 8 kg hammer dropping through a height of 575 mm and a 60° cone having a maximum diameter of 20 mm. Penetration depth is recorded after every blow. The DCP is a Penetrometer device used to provide a measure of in situ CBR. Blow count readings were converted to an equivalent CBR, which is displayed in the results tables presented in Appendix 4.

The TRRL equation was used to calculate the equivalent CBR value from the DCP results.

Soil Gas Survey

A soil vapour survey was undertaken across the site and comprised the monitoring of the atmosphere within the window sample hole standpipes installed at the site. Portable gas monitoring equipment (GA 5000) was used to monitor the standpipes for concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂).

The gas monitoring results are presented in Appendix 5.

4.2 GROUNDWATER

Groundwater was not recorded as part of this investigation either during the fieldwork or the subsequent post-fieldwork monitoring.

It should be noted that groundwater levels may vary due to seasonal fluctuations in rainfall, but in the shorter term, can be affected by antecedent weather conditions or other causes.

5 LABORATORY TESTING

5.1 GENERAL

During the intrusive investigation, excavated soils were subjected to PID screening techniques in order to determine the presence of Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) which is considered an appropriate screen for organic contamination.

Confirmatory soil samples were taken from all thirteen window sample holes. Headspace analysis to determine VOC concentrations was carried out using a PID on all soil samples retrieved as part of this investigation. The results of the screening indicated that VOC concentrations were below the detection limit of 10 ppm in all samples.

Therefore, no significantly elevated VOCs or SVOCs were encountered and therefore the on-site soil elsewhere on site was deemed to not have been impacted by any potential VOC and SVOC contaminants. These soils would not be deemed to pose any significant risk of significant harm to human health as a result of the presence of volatile hydrocarbons. This is discussed in greater detail later in the report.

5.2 GEOTECHNICAL TESTING

The following range of laboratory tests were scheduled and the results are presented in Appendix 6.

- i. Moisture Content Determination (11 No.).
- ii. Atterberg Limit Determination (11 No.).
- iii. Determination of Saturation Moisture Content and Density of Chalk (2 No.).
- iv. Determination of pH (16 No.). – See Appendix 7.
- v. Determination of water-soluble sulphate (16 No.). – See Appendix 7.

5.3 ANALYTICAL TESTING

Nine soil samples were selected and scheduled for chemical analysis which was undertaken by DETS Ltd. All soil samples were analysed for a general screening suite of contaminants considered appropriate to the current usage and past history of the site and surrounding area.

Toxic Metals		Phytotoxic Metals	Inorganic Compounds	Organic Compounds
Arsenic	Lead	Water Soluble	Water Soluble	Total Polyaromatic
Barium	Mercury	Boron	Sulphate	Hydrocarbons (PAH)
Beryllium	Nickel	Copper	pH	Mineral oils
Cadmium	Selenium	Nickel	Asbestos	Total Petroleum
Chromium	Vanadium	Zinc		Hydrocarbons (TPH)

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Two samples were further analysed for the presence of phenols for the purpose of assessing risks to water supply pipes.

In addition, two composite samples were prepared and submitted for testing in accordance with the Environment Agency's waste acceptance criteria.

Soil samples were stored in appropriate containers as specified within BS10175. The containers comprised of 1 kg capacity plastic containers with fitted lids.

Where organic compounds were to be determined, inert containers, which prevent loss by absorption, or volatilization, i.e. wide-mouthed amber glass containers, were used.

Samples were stored in appropriately cooled cool boxes and were transported to the laboratory as quickly as possible in order to minimize any potential for chemical and biological changes to take place.

The results of the analytical testing are presented in Appendix 7.

6 GROUND CONDITIONS

6.1 GROUND PROFILE

The ground investigation found soils typical of Head Deposits beneath a relatively thin layer of Made Ground/Topsoil. Chalk of the Lewes Nodular Chalk Formation was found beneath the Head Deposits at varying depths across the site.

Made Ground/Topsoil

The surface layer comprised a sandy clayey silt with fragments of carbon, flint and brick. The Made Ground was found to depths ranging between 0.35m and 0.5m.

Head Deposits

Beneath the Made ground were soils typical of Head Deposits. The Head Deposits were to depths ranging between 1.3m and 3.3m with thickness ranging between 0.9m and 2.9m. The Head Deposits soils comprised a sequence of silty sandy clays, slightly gravelly silty sands, very sandy silts and sandy gravelly silts.

The more cohesive horizon of silty sandy clays was found towards the top of the Head Deposits soil sequence and was found to depths ranging between 0.55m and 2.1m. The increasing gravel component that was noted with depth comprised primarily of flint with subordinate chalk fragments.

Lewes Nodular Chalk Formation

Underlying the Head Deposits at all test locations was a white with light brown chalk which was recovered as a fine to coarse gravel within a variable silt matrix. The chalk was proven to the base of all intrusive locations (maximum depth 5.0m). Within the chalk materials, in varying quantities, was fine to coarse flint gravel.

The chalk materials found in the window sample holes was classified as Grade Dm and Grade Dc materials with reference to CIRIA Report C574 'Engineering in Chalk'.

It should be noted that both the Dm and Dc gradings are considered conservative for the materials found in the window sample holes which were significantly disturbed through the sampling process.

6.2 ENGINEERING PROPERTIES

The engineering properties of the principal strata, as discussed above, can be assessed based upon a combination of in situ observations and laboratory test results.

A summary of the engineering properties is given below.

Head Deposits

In situ SPT results indicated that the soils were very soft to firm with blow counts in the range 2 to 14 blows although the majority of results were in the range 7 to 12 blows indicating firm soils (see Figure 2). Figure 3 provides a plot of corrected N60 values against depth. The N60 value taking into account an energy ratio (Er) of 77% for the test equipment used. Tactile observations made at the time of the investigation classified the soil as soft to firm becoming firm with depth.

Classification tests on the predominantly cohesive soils found towards the top of the soil sequence indicated the Head Deposits to be clay of low, intermediate and high plasticity with plasticity indices in the range 9 to 28%. NHBC guidance indicates these soils to be of low to medium shrink/swell potential with the majority in the low shrink/swell classification.

Particle size distribution tests on the more granular materials found towards the base of the soil sequence recorded slightly sandy clayey silt, slightly clayey sand, gravelly sandy silt and slightly clayey sandy silt with fine fractions (Silt/clay) in the range 31.0% to 89.6%. Hydrometer analysis to further assess the fine fraction on selected samples recorded silt fractions ranging between 42.1 and 54.2% and clay fractions ranging between 17.8% and 27.8%

For preliminary foundation design purposes the following parameters may be used for consideration of shallow foundations within the Head Deposits stratum.

Undrained Shear Strength S_u = 40 kN/m² (firm)

Coefficient of compressibility = 0.3 m²/MN (Moderate) – typical value

Shrinkage Potential = Low

Lewes Nodular Chalk Formation

Standard penetration tests carried out throughout the chalk generally recorded N values in the range 5 to 30 indicating very weak to weak chalk although the majority of results were between 5 and 15 indicating very weak chalk. No discernible trend of relative density with depth was observed – see Figures 2 and 3.

Laboratory testing found that the chalk was of low density with dry densities ranging between 1.38 and 1.44 Mg/m³ and saturation moisture contents in the range 32 to 35% measured.

7 ENGINEERING DESIGN

7.1 FOUNDATION DESIGN

It was understood that the proposed redevelopment of the site would comprise the construction of four blocks of flats and low-rise housing units.

At the time of reporting, applied structural loads from the proposed development were unknown. However, for preliminary foundation design purposes, a line load of 80kN/m run has been adopted for the housing units.

In deliberation of suitable foundation options consideration was given to the geotechnical hazards and risks as presented below:

Geotechnical Hazard	Qualitative Risk & Consequences	Possible Risk Reduction Measures
Existing underground structures such as footings and service runs.	Very high Implication for foundation depth and economic feasibility of shallow foundations.	New foundations to be constructed in undisturbed ground or alternatively disturbed ground to be removed and replaced with suitable engineering fill.
Shrinkage/swelling of foundation soils due to action of tree roots.	Low to Medium Foundation movement and cracking of brickwork.	Comply with NHBC recommendations to Low shrinkability soils.
Variations in stiffness of ground below foundation depth that could give rise to unacceptable total and differential settlement.	Medium Large span buildings such as terraced blocks would be particularly sensitive to differential settlement. Would result in cracking of superstructure if conventional brickwork or brick cladding is used.	Calculate likely magnitude of settlement and determine if within acceptable tolerances. Make foundations act as reinforced beams. Consider ground treatment to improve ground conditions or adopt deep foundation.

Based upon the findings of the ground investigation, for preliminary design purposes consideration has been given to founding the proposed new structures on conventional shallow strip foundations founding in either the Head Deposits or Chalk stratum.

7.1.1 Shallow Foundations – Head Deposits

Minimum Foundation Depth

A minimum foundation depth of 1.2m is recommended for the new structures. Foundation depths should also comply with the minimum foundations depths as governed by the NHBC guidance on building near trees. For preliminary design purposes recommendations for low shrink/swell potential soils are recommended. Foundations depths should be extended in depth a minimum of 0.3 m below the depth of live roots found.

Allowable Bearing Pressure

Based on field observations and laboratory test results a maximum allowable bearing of 100 kN/m² is recommended for foundations placed within the Head Deposits stratum at 1.2m. For a typical line load of 80 kN/m run the recommended minimum foundation width would be 0.8m.

Settlement

Preliminary settlement calculations for a typical line load of 60kN/m run indicated that total settlement would be in the order of 36mm. Given the material types encountered immediate settlement would be approximate 10% of the total with the remainder long term consolidation settlement.

7.1.2 Shallow Foundations - Chalk

The guidance provided for foundation design in Chalk is principally related to determining the density of Chalk and then sub-divisions based upon Chalk Grade indicate limiting values of applied stress that can be used. The general guidance for allowable bearing pressure on Chalk for shallow footings that will limit total settlement to 25 mm is as follows:

Medium/High Density (Grades A, B, C, Dc)	300 kN/m ²
Low Density (Grades A, B, C)	240 kN/m ²
Low Density (Grade Dc)	225 kN/m ²

Site-specific plate loading tests are typically required for proposed foundations on Grade Dm Chalk. Chalk of Grade Dm and Grade Dc was found during this ground investigation. For preliminary design purposes an allowable bearing pressure of 150kN/m² can be adopted. For a line load of 80kN/m run it is recommended that a minimum foundation width of 0.55m be adopted.

Settlements of the foundations under a ground loading equivalent to 150kN/m² would be less than 10mm.

Based on the evidence gained from this ground investigation it is considered that the risk of solution features affecting the development is low. However, should evidence of solution features be found during the foundation construction works redesign and reinforcement of foundations would most likely be required.

7.1.3 Summary of Foundation Options

It is considered that shallow foundations founding within either the Head Deposits or Lewes Nodular Chalk Formation are feasible however where both stratum are encountered in foundation trenches the introduction of reinforcement is recommended to mitigate the potential for differential settlement. The alternative to reinforcement would be to increase foundation depths into the Chalk stratum.

7.2 GROUND FLOORS

NHBC guidance advises that suspended ground floors should be adopted when the plasticity index (PI) of the founding soils is greater than 10%. In addition, where the depth of fill would be greater than 600 mm within a self-contained area, the floor construction over the whole of that area is required to be self-supporting and independent of the fill.

Based upon the results of this ground investigation it is recommended that suspended ground floor slabs should be adopted.

7.3 TEMPORARY WORKS

Excavations in excess of 1.2 m depth will be required in connection with the proposed development on this site. If there is a requirement for personnel to enter into excavations, then the need for trench side support should be considered for any depth of excavation and, therefore, appropriate equipment should be available on site prior to excavation proceeding. A site specific risk assessment should be carried out where man entry into excavations is required.

The base of foundation excavations should be inspected and any soft loose, organic or otherwise deleterious material at foundation level removed and replaced with lean mix concrete. The soils encountered will be liable to softening/loosening when exposed to surface water infiltration. In order to avoid deterioration of the prepared formation the base of foundations should be blinded with concrete as soon as practical after excavation and particularly if there is delay before placing foundation concrete.

7.4 ROADS/HARDSTANDING

The results of in situ DCP tests indicated CBR values in the range 1 to 32% although generally in the range 2 to 6% below a typical formation level of 0.45m.

For preliminary design purposes a CBR value of 2% should be adopted. The soils encountered during this ground investigation are considered frost susceptible therefore road construction should have a minimum of thickness of 450 mm.

7.5 SOAKAWAYS

The results of the falling head tests recorded a very high infiltration potential with rates ranging between 1.39×10^{-3} m/s and 5.2×10^{-4} m/s recorded in WS4 and WS8 respectively. Due to the very high infiltration rate in WS10 it was not possible to raise the head to quantify the infiltration rate.

Based upon these results the use of soakaways discharging into the Lewes Nodular Chalk Formation would be a viable option for disposal of surface water. It is recommended that additional DG365 testing be undertaken at enabling stage to confirm final design parameters.



Should soakaways be considered as part of the development then irrespective of other considerations they should be sited at least 10m away from any foundations. The Environment Agency and Local Authority must be consulted when planning soakaway installations.

7.6 CHEMICAL ATTACK ON BURIED CONCRETE

The results of the chemical testing indicated a concentration of water-soluble sulphate in the near surface soils in the range between <10 and 15 mg/l as SO₄. pH values were slightly alkaline to neutral with a range between 7.9 and 8.4 pH units.

In accordance with BRE Special Digest 1 (SD1:2005) entitled 'Concrete in Aggressive Ground' a design sulphate class for the site of DS-1 is recommended. Using SD1 an ACEC (Aggressive Chemical Environment for Concrete) class of AC-1 is recommended.

8 GROUND CONTAMINATION ASSESSMENT

The current guidelines used for this contamination assessment are presented within Appendix 8.

The contaminant concentrations encountered as part of this investigation have been compared against either Land Quality Management Generic Assessment Criteria (LQM GAC) for a residential development, the Chartered Institute of Environmental Health's (CIEH) Suitable for Use Levels (S4USL), or where available against newly published Category 4 Screening Levels (C4SLs) for a Residential (with home-grown produce) end use. Where neither guidelines have limit values, Contaminated Land Exposure Assessment (CLEA) framework guideline limit values have been assessed.

Category 4 Screening Levels (C4SLs) have currently been published for six substances as per the table below.

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37	40	49	640	79	170
Benzene	0.87	3.3	0.18	98	140	230
Benzo(a)Pyrene	5.0	5.3	5.7	77	10	21
Cadmium	22	150	3.9	410	220	880
Chromium VI	21	21	170	49	21	250
Lead	200	310	80	2300	630	1300

All concentrations expressed in mg/kg

This table should be read in conjunction with the Final C4SL R&D Report

8.1 SOIL QUALITY

In terms of any proposed redevelopment of the site, the results of the analysis of the selected soil samples recovered during the site investigation indicated that the concentrations of *metals and metalloids* considered to be potentially toxic to humans were below the respective guideline values in all samples tested with the exception of slightly elevated concentrations of lead in some of the near surface samples.

Organic contamination across the site was low and concentrations which may be considered to pose an unacceptable risk to human health should any viable pathway exist were not encountered.

Asbestos contamination was not encountered within any of the soil samples.

A comprehensive description of the soil quality as measured as part of the intrusive site investigation is given below.

8.1.1 Toxic Metals

Concentrations of toxic metals arsenic, barium, beryllium, cadmium, copper, chromium, mercury, nickel, selenium, vanadium and zinc were all below their respective soil guidance values for either a residential development under the CLEA/LQM GAC guidelines and the C4SL/S4USL guideline values for residential (with home-grown produce) where appropriate in all samples tested.

Very slightly elevated lead concentrations of 319 mg/kg, 300 mg/kg and 424 mg/kg were encountered within the near surface soil samples retrieved from WS1 (0.3m), WS7 (0.3m) and WS12 (0.3m) which was in excess of the 200 mg/kg Category 4 Screening Level.

All other samples had contaminant concentrations of below their relevant guideline values.

8.1.2 Phytotoxic Metals

Concentrations of phytotoxic metals copper, zinc and nickel were compared against the maximum permissible concentration in the Sewage Sludge (Use in Agriculture) Regulations 1989.

Concentrations of all three metals were found to be below the maximum permissible concentration for the relevant pH level in all of the analysed soil samples.

8.1.3 Organic Compounds

Polycyclic Aromatic Hydrocarbons (PAH)

Concentrations of PAH were generally very low and were found to be below the inert waste acceptance criteria of 100 mg/kg, as detailed in the EC Landfill Directive 1999/31/EC as applied under the Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (SI 2019/39) and as defined by the council decision establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC(2003/33/EC), in all of the samples tested.

Benzo(a)pyrene (B(a)P)

All B(a)P concentrations were below the C4SL guideline limit value of 5mg/kg for a residential (with home-grown produce) end use.

Total Petroleum Hydrocarbons

Concentrations of TPH were well below the inert waste acceptance criteria of 500 mg/kg as detailed within the EC Landfill Directive 1999/31/EC as applied under the

Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (SI 2019/39) and as defined by the council decision establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC(2003/33/EC), and also within the UK Water Industry Research (UKWIR) in all soil samples tested.

Generic Assessment Criteria (GAC) for total petroleum hydrocarbons according to both their molecular weight and chemical structure and also for a range of soil organic matter (SOM) content values have been derived using CLEA software. The LQM CIEH GACs are presented according to their soil organic matter content and proposed end use of the land.

Comparison of the measured TPH data with the worst-case scenario constituent compounds and their GAC limit values was made to provide a conservative assessment of the organic contamination. The maximum TPH concentration recorded on site during the site investigation was 50 mg/kg within WS10 comprising predominantly of 33 mg/kg within the C21-C35 range which is significantly below the absolute worst-case relevant GAC limit of C21-C35 aromatic compounds of 1100 mg/kg for a residential with plant uptake end use.

The TPH concentrations recorded on site were therefore below the relevant GAC limit for their respective range and would therefore not be considered to pose a significant risk of significant harm to human health.

8.1.4 Inorganic Compounds

Concentrations of water-soluble sulphate ranged from below the analytical detection limit of 10 mg/l to 15 mg/l (as SO₄). The pH values were generally slightly alkaline with values of 7.9 to 8.4 units.

8.1.5 Asbestos

Asbestos contamination was not encountered within any of the soil samples.

8.2 SOIL GAS

Three gas monitoring visits were undertaken between the 13th and the 27th January 2021.

On each of the visits, a soil vapour survey was undertaken across the site and comprised the monitoring of the atmosphere within the installed Window Sample Hole standpipes. Portable gas monitoring equipment (GA 5000) was used to monitor the standpipes for concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂)

For determining the gas protection measures which may be required in low rise buildings with a beam and block floor there is published guidance from the NHBC for use on

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residential developments which utilises a traffic light system of classification. For larger buildings the guidance in CIRIA 665 and BS8485 is used.

Reference has also been made to the British Standard Code of Practice BS8485:2015, *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* and regard has been given to the recommendations presented therein. The processes set out in BS8485 represent good practice and is based on the CIRIA C665 document.

In addition, CIRIA document C735, *Good practice on the testing and verification of protection systems for buildings against hazardous ground gases* has also been referenced.

The results obtained from the short-term soil gas monitoring undertaken indicated that significantly elevated carbon-dioxide and methane concentrations were not detected during the short-term monitoring programme. The soil gas results are attached at Appendix 5.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. The maximum gas flow rate measured on site was <0.1 l/hr.

9 CONTAMINATION RISK ASSESSMENT

This risk assessment has been undertaken with due regard to the advice relating to groundwater as provided in the Environment Agency's "Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources", the advice provided in the Contaminated Land (England) Regulations 2000, and the associated statutory guidance. The guidance defines contaminated land as any land that is in such a condition that by reason of substances in, on or under the land:

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- pollution of controlled water is being, or is likely to be caused.

This definition is based on the principles of risk assessment defined as a combination of the probability (or frequency) of occurrence of a defined hazard and the magnitude (including the seriousness) of the consequences. Central to the risk assessment process is the concept of pollutant linkage, that is a linkage between a contaminant and a receptor by means of a pathway.

Statutory definitions relating to pollution linkage.	
Contaminant	"a substance which is in, on or under the land and which has the potential to cause harm or to cause pollution of controlled waters."
Receptor	"a living organism, a group of living organisms, and ecological system or a piece of property" which meets given criteria. "controlled waters which are, or could be, polluted by a contaminant".
Pathway	"one or more routes or means by, or through, which a receptor: • is being exposed to, or affected by, a contaminant, or • could be so exposed or affected".

The relationship between these components is discussed below in order to identify the existence of any source-pathway-receptor linkage on the site, and hence the potential risks associated with any contamination.

This risk assessment is based on the proposed redevelopment of the site for the construction of a residential development comprising four blocks of flats and low rise housing with associated access roads, parking and soft landscaped areas including private gardens.

The significance of the risks to the receptors/targets identified is based on an evaluation of the potential pathways between the contaminant source and receptors based on the most sensitive end use, i.e. a residential with plant uptake end use.

Potential receptors/targets at the site and in the area in which the site is located include:

- future occupants and the general public;
- construction/maintenance workers;
- groundwater resources;
- underground services in and around the site;
- plants in proposed private gardens and landscaped areas.

9.1 CONTAMINANT SOURCES

The site walkover did not identify any obvious potential sources of significant contamination on site.

Similarly, no visual or olfactory evidence of organic contamination was noted during the intrusive investigations or noted in the detailed soil sampling logs. The analytical testing of soils retrieved as part of the intrusive investigation did not reveal any significantly elevated organic contaminant concentrations present above their respective guideline values. The risks associated with the contaminants encountered are discussed below.

9.2 RISK TO HUMAN HEALTH

Toxic Metals

Concentrations of toxic metals arsenic, barium, beryllium, cadmium, chromium, copper, mercury, nickel, selenium, vanadium and zinc were all below their respective soil guidance values for a residential with plant uptake end use in all samples tested in this site investigation, therefore the risks to human health from these contaminants is considered to be low.

Three out of the nine soil samples tested contained lead concentrations above the C4SL guidance level of 200 mg/kg.

The test results have been assessed following the CLAIRE/CIEH (2008) guidance for statistical testing of a data set for planning purposes involving the calculation of the sample mean and sample standard deviation, investigation of the normality of the data distribution and investigation of outliers and the calculation of 95th UCL values. The measured concentrations on site have been statistically analysed using the ESI statistics calculator as described above. The 95th UCL of the test results have been used for subsequent comparison with the CLEA SGVs or CIEH GAC values as appropriate.

The application of the above statistical test was run for the lead dataset. The lead dataset showed that the sample mean exceeds the critical concentration of 200 mg/kg therefore the soil on site, in terms of lead, would be considered to pose a significant risk of significant harm to human health. The test results sheet for all the datasets have been attached to this report at Appendix 9.

Organic Compounds

Concentrations of PAH and TPH were below their respective soil guidance values in all samples tested. Therefore, the risks posed to human health from these contaminants are considered to be low.

Inorganic Compounds

Asbestos was not detected in any of the near surface made ground/topsoil samples.

In the event that ACM is encountered during the site enabling works then the extent of such will be delineated under the supervision of a suitably competent consultant/engineer and the material will be removed from site in accordance with the hazardous waste regulations. Should any such material be encountered it is considered likely that a single dedicated skip provided by a suitably licensed asbestos handling company would prove sufficient. If further asbestos-containing material is found on site, then all the documentation regarding its remediation including duty of care and waste transfer notes would be forwarded to the appropriate authorities.

On the balance of the toxicological risks posed by the ground contamination encountered as part of the intrusive investigation undertaken by GES, it is considered that the potential risks to site workers and future occupants could be adequately controlled as follows:

Site Workers

- Provision of appropriate personal protective equipment and hygiene facilities.
- Good working practice in line with current legislation when safely handling and disposing of any asbestos material.
- Provision of appropriate dust suppression, to minimise the generation of potentially contaminated suspended particulates during site works.

Future Occupants

Elevated levels of contaminants which could potentially pose a health risk to future occupants of the site were generally not identified during the intrusive investigation.

Slightly elevated lead contamination was encountered within near surface Made Ground soils found in WS1, WS7 and WS12. Such impacted made ground is likely to be removed as part of the site preparatory works, being at such shallow depths.

Following the enabling works in the proposed garden areas on site material will be excavated and certified clean sub soils and topsoil imported for the garden areas. BRE cover system modelling has been carried out which confirms the thickness of clean soil

required and the model results spreadsheet is attached at Appendix 10. Reference to the BRE 465 'Cover Systems for Land Regeneration, Thickness of Cover Systems for Contaminated Land' 2004 document shows that such a cover could reduce the risk of exposure.

The modelling results indicates that a simple cover system of approximately 360 mm soils would be required to sever the linkage of pollutants in the soil below in the proposed soft landscaped areas based on the worst-case contamination recorded on site. It should be noted that this would be considered a conservative approach since most of the contaminated Made Ground indicated in this area will be removed as part of the site enabling works. Typically, 150 mm topsoil over 210 mm clean free draining subsoils would generally be considered sufficient. Where deep rooting shrubs / trees are proposed in any landscaping it may be necessary to locally deepen the clean cover to accommodate a healthy root bowl. No such clean cover has been laid on site yet and will not be brought to site and placed until the construction phase is completed to avoid over compaction by site plant.

In areas which are to be covered by either buildings or hard standing, no such clean cover layer is required to sever the contain source to receptor pathway.

Following implementation of the aforementioned remedial measures the site would not be considered to pose a potential risk of significant harm to human health in the context of Part 2A.

9.3 RISKS TO WATER RESOURCES

The site is underlain by Head Deposits and soils belonging to the Lewes Nodular Chalk Formation which are designated as unproductive strata and a principal aquifer respectively. The site is located within a groundwater Source Protection Zone however there are no potable water abstractions within 1km of the site.

However, significant levels of potentially soluble and therefore mobile organic contaminant sources were not measured on site within the samples tested. It is therefore considered risks to groundwater resources are considered to be classed as low.

9.4 RISKS TO PLANTS

The concentrations of potentially phytotoxic metals copper, zinc and nickel were all below their respective maximum permissible concentrations used in the Sewage Sludge (Use in Agriculture) Regulations 1989 for their relevant soil pH and therefore the existing on-site soils would not be considered to pose any significant risks to plants.

Given that current development proposals include private gardens, and small areas of communal soft landscaping and planting, the importation of clean suitable topsoil may therefore be necessary to these areas. As mentioned in Section 9.2, a cover thickness of 360 mm, comprising 150 mm topsoil and 210 mm subsoils would be sufficient to sever

any pathway in terms of contamination, and would provide suitable growth material. Where deep rooting shrubs / trees are proposed in any landscaping it may be necessary to locally deepen the clean cover to accommodate a healthy root bowl.

Any material imported to site for use in any proposed garden and soft landscaped areas would require chemical testing to confirm its suitability for use.

This action would also ensure any residual contamination is isolated below the rooting zone of plants, and therefore unavailable for uptake, thus ensuring any source receptor pathways are severed. The risk to plant health posed by the contaminants identified would be considered to be low following implementation of the remedial strategy.

9.5 RISKS TO BUILDINGS & SERVICES

Based on organic contaminant concentrations encountered as part of this investigation within natural soils from likely depths of proposed service runs and within the majority of near surface made ground soils, the risks to buried services from organic contamination such as TPH, which can degrade/permeate plastics and other polymer materials used to supply potable water is considered to be low.

Based on current guidance, the need to protect incoming water supplies, e.g. by the use of barrier pipes, is unlikely given the contaminant levels encountered as part of this investigation however it is always advisable that confirmation from utility suppliers should be sought.

9.6 GAS RISK ASSESSMENT

The levels of soil gas underlying the site have been monitored as part of a short-term soil gas monitoring programme carried out across the site during January 2021. The results obtained from the soil gas survey indicate that elevated levels of soil gas, which may require gas protection measures to be incorporated into the development, are not present on site. No elevated gas flow rates were recorded during the monitoring which included periods of low and falling atmospheric pressure. Furthermore, significant biodegradable material was not encountered in any of the holes excavated at the site.

The highest carbon dioxide concentration encountered on site during this current investigation was measured in WS1 at 2.5% which does not exceed the relevant guideline limits of 5%. Similarly, no elevated methane concentrations were recorded across the site.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. The maximum gas flow rate measured on site was below 0.1 l/hr which was measured using the GA5000 built-in flow meter. In order to allow for a worst-case scenario, a gas flow rate across the site of 1.5 l/h has been applied in the following calculations.

Elizabeth Huggins Cottages, Gravesend, DA11 7LD Phase 2 Geo-Environmental Investigation



Based on BS 8485:2015, we have assessed the site based on the gas monitoring undertaken as part of the site investigation in order to calculate a Characteristic Gas Situation (CS).

Based on the worst case gas characteristic situation, the worst case implied CS derived by combining the maximum observed concentrations from different gas monitoring standpipes during any monitoring event and a worst case flow rate of 1.5 l/h are as follows.

Flow Rate (l/h)	CH4 (%)	CO2 (%)	GSV – CH4 (l/h)	GSV – CO2 (l/h)	Implied CH4 CS	Implied CO2 CS
1.5	0.0	2.5	0.000	0.038	1	1

On the basis of the measurements in the table above, the GSV is taken to be 0.038 l/h, which is the worst case for methane and carbon dioxide. A GSV of 0.038 l/h lies within the GSV values for **CS1** (<0.07 l/h) which has a very low hazard potential.

BS 8485:2015 enables the minimum level gas protection (score) for the site or zones to be determined based on the determined CS and the type of proposed building. Given the proposed end use of the site, a High risk Type A building has been used for calculating the appropriate gas protection score.

Given that the site has an implied CS1, the minimum gas protection score required for a Type A building is 0, which means that no gas protection measures would be required as part of the proposed development based on current gas concentrations.

9.7 WASTE DISPOSAL

Should an excess volume of soil be required to be disposed of off-site then a waste classification may be required.

For a waste classification to be undertaken, materials may need to be subjected to chemical testing which would give an indication to the contaminants present and, therefore those most toxic to the environment in the waste. Following the assessment of the waste as hazardous or non-hazardous waste acceptance criteria leachate testing allows the appropriate disposal pathway to a suitably licensed disposal facility to be further determined.

Waste acceptance criteria (WAC) leachate testing was carried out on two composite soil samples from across the site. The results are attached at Appendix 7 and show that levels in excess of the inert limit values were not noted within the samples.

As a preliminary waste assessment and based on the results of materials tested to date, it is considered that the majority of any surplus soils requiring off-site disposal would be classified as EWC 17 05 04 non-hazardous and likely to be acceptable at a waste facility licenced to accept inert material.



10 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a system diagram identifying contaminant sources, routes of exposure (pathways), and which receptors are affected by contaminants moving along those pathways.

The model is produced to identify the zones of the site with different potential contaminations characteristics (e.g. whether contaminants in the soil are likely to be on the surface or at depth, distributed over an entire area or in localised 'hot spots').

The conceptual site model presented in the table below is based on the findings of the site investigation undertaken.

Elizabeth Huggins Cottages, Gravesend, DA11 7LD
Phase 2 Geo-Environmental Investigation



Source	Pollutant	Pathway	Hazard	Receptor	Observations/ Recommendations	Assessed Risk
Contaminated ground	Metals, organic (hydrocarbons) could be present	Direct contact, ingestion, inhalation.	Health risks including skin irritation.	Humans: site workers	Normal health and safety precautions. No significantly elevated contaminant concentrations encountered other than certain elevated lead concentration within near surface Made Ground soils which are likely to be removed during site clearance.	Low following site clearance and importation of clean topsoil to proposed gardens and soft landscaped areas.
		Surface run off.	Lateral movement to surface watercourses.	Aquatic resources, ecology and subsequent users including humans.	Significant contamination not encountered on site and there are no surface water courses in immediate vicinity of the site.	Low
		Leaching/ Dispersion.	Downward migration to groundwater.	Aquatic resources – Groundwater, abstraction wells) / surface waters.	Significant mobile contamination not encountered in soils.	Low
		Uptake by plants.	Phytotoxic effects.	Soft landscaped areas / plants.	Significant contamination generally not present in soils. However, the importation of certified clean topsoil will be required across proposed gardens and soft landscaped parts of the site.	Low
		Direct contact	Aggressive chemical attack	Building structures and services	It is considered that protection of services is unlikely to be required on this site however confirmation advice should be sought from Statutory Providers.	Low

Elizabeth Huggins Cottages, Gravesend, DA11 7LD
Phase 2 Geo-Environmental Investigation



Source	Pollutant	Pathway	Hazard	Receptor	Observations/ Recommendations	Assessed Risk
Liquid contaminant sources	Diesel, Petrol and Oils.	→ Direct contact; ingestion, inhalation.	Health risks including skin irritation. Lateral and vertical migration of contaminants.	→ Humans: site workers. Groundwater and surface water.	Significant mobile contamination not encountered on site.	Low
Asbestos	Asbestos fibres within made ground and waste on site	→ Inhalation.	Health risks including asbestosis, mesothelioma, and lung cancer.	→ Humans: site workers and future occupants.	Asbestos was not detected in any of the samples retrieved from site. Appropriate PPE should be worn.	Low
Landfill, made ground,	Ground Gases (CO ₂ , CH ₄)	Inhalation and ingress into buildings	Asphyxiation and explosions	Buildings/humans/ future site users	Significantly elevated ground gases have not been noted on site.	Low
Redundant Waste, Demolition Waste		Dermal Contact/ingestion. Potential for migration via surface water run-off	Health Risks	Humans: Site workers	Any unwanted waste on site is to be removed from site during site preparatory works and disposed of in accordance with current legislation. Normal health and safety precautions.	Low

11 CONCLUSIONS AND RECOMMENDATIONS

Based on the site investigation, intrusive works and subsequent data assessment, the following conclusions and recommendations have been drawn in respect of the Elizabeth Huggins Cottages site located off Cross Lane West, Gravesend, Kent.

Geotechnical

- The ground investigation found Head Deposits underlain by chalk of the Lewes Nodular Chalk Formation.
- At the time of reporting, applied structural loads from the proposed development of the site were unknown. However for preliminary foundation design purposes a line load of 80kN/m run was adopted for the proposed housing units.
- The feasibility of founding within either the Head Deposits or Lewes Nodular Chalk Formation was investigated.
- For foundations in the Head Deposits a maximum allowable bearing of 100kN/m² was recommended for foundations placed at a minimum depth of 1.2m. For a typical line load of 80kN/m a minimum foundation width of 0.8m was recommended.
- Preliminary settlement calculations indicated that total settlement would be in the order of 36mm, approximately 10% of which would be immediate settlement.
- An allowable bearing pressure of 150kN/m² was recommended for foundations placed in the Lewes Nodular Chalk Formation. Settlements would be less than 10mm.
- Should both stratum be encountered in foundation trenches reinforcement of foundations is recommended.
- Suspended ground floor slabs are recommended.
- For preliminary design purposes a CBR value of 2% was recommended.
- The use of shallow chamber type soakaways discharging into the chalk was considered feasible although additional testing would be required at enabling stage to confirm final design parameters. Soakaways would require siting a minimum of 10m from any foundations.
- A design sulphate class of DS-1 and an ACEC class of AC-1 was recommended.

Environmental

- The site is underlain by Head Deposits and soils belonging to the Lewes Nodular Chalk Formation which are designated as unproductive strata and a principal aquifer respectively. The site is located within a groundwater Source

Protection Zone however there are no potable water abstractions within 1km of the site.

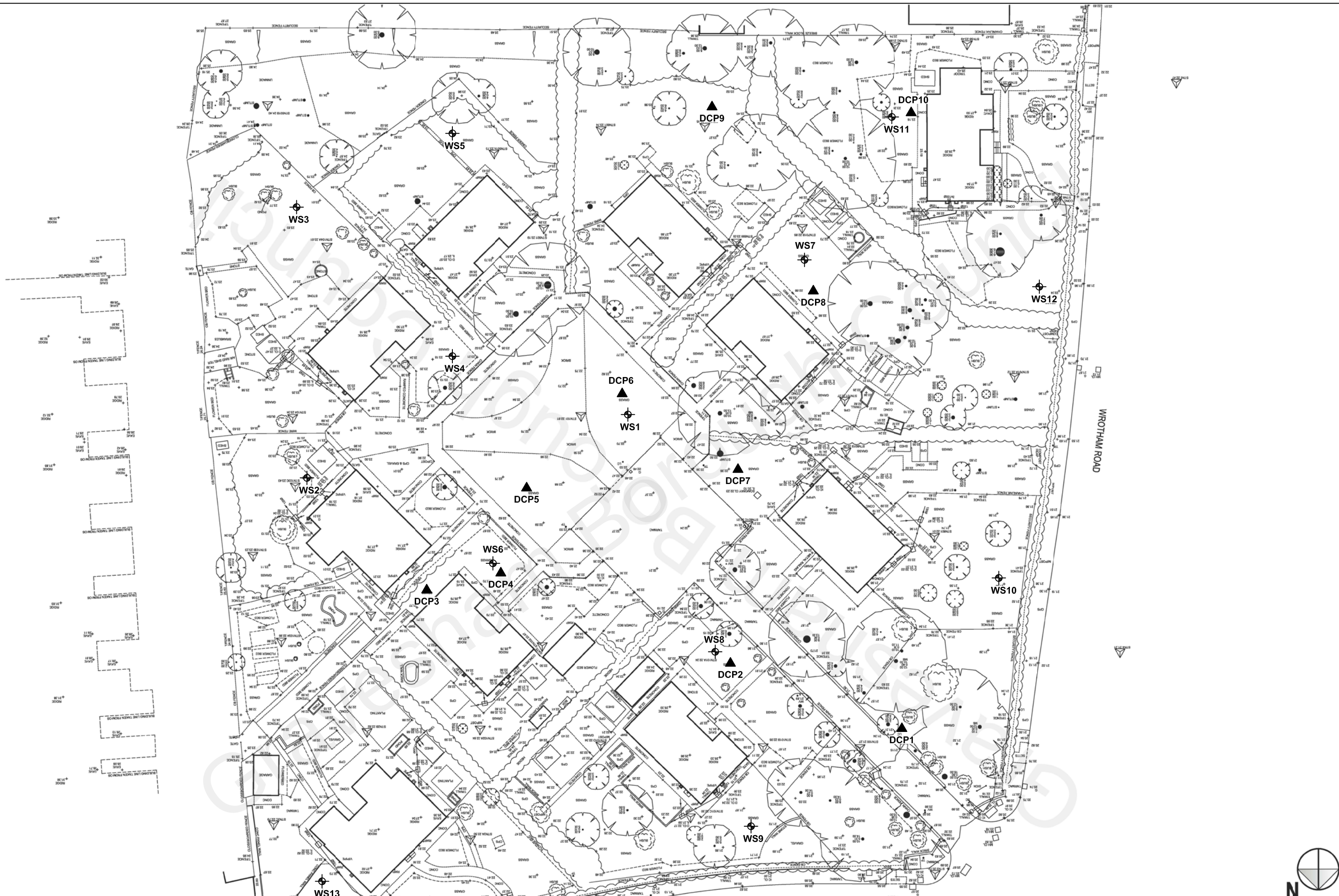
- Concentrations of toxic metals were below their respective soil guideline values and are therefore not considered to pose a significant risk of significant harm to human health, except for lead, which would not be considered to pose a risk to human health as was encountered within very near surface Made Ground soils which are likely to be removed from site as part of the site preparatory works.
- Similarly, organic hydrocarbon concentrations were generally not significantly elevated and are therefore not considered to pose a significant risk of significant harm to human health.
- Concentrations of TPH were generally low across the site and would therefore not be considered to pose a significant risk of significant harm to human health.
- The risk to flora on site is considered to be low given the absence of phytotoxic contamination however in the absence of a suitable growth media on site, it is recommended that certified clean topsoil would need to be imported into private gardens and soft landscaped areas. This will also serve to isolate any residual contamination not identified during the site investigation.
- The modelling results indicates that a simple cover system of approximately 360 mm soils would be required to sever the linkage of pollutants in the soil below in the proposed soft landscaped areas based on the worst-case contamination recorded on site.
- The risks posed to workers involved in any future redevelopment of the site are not considered significant providing standard health and hygiene practices are adopted.
- The risk to flora on site is considered to be low, particularly following the importation of the proposed clean growth media.
- Based on low concentrations of organic contaminants found across the site, it is unlikely that any new services, in particular potable water, will require protection, however it is advisable to seek service provider confirmation of this.
- Based on gas monitoring results, the site has been given a classification of CS1 which has a very low hazard potential and therefore no gas protection measures need be incorporated into any new buildings constructed on the site.
- The risks to groundwater in the underlying Principal Aquifer are generally considered to be low due to the lack of any significant mobile organic contamination encountered within soil samples from the site.
- The majority of any surplus soil material to be removed off site is likely to be classified as non-hazardous and may be acceptable at a facility licensed to accept inert waste.
- It is recommended that a watching brief is implemented on this site during enabling works and should any contamination or potentially contaminative

Elizabeth Huggins Cottages, Gravesend, DA11 7LD
Phase 2 Geo-Environmental Investigation



sources be discovered all site works would cease and suitably competent consultants/engineers will attend site.

Based on the principles and definitions outlined under section 57 of the Environment Act 1995, the site would not be considered to be "Contaminated Land" based on its proposed residential redevelopment.



EXISTING SITE PLAN, 1:200@A0

- | | |
|-------------------------------------|-------------------------------|
| WS - Window Sample | DP - Dynamic Probe |
| BH - Borehole | GM - Gas Monitoring Standpipe |
| TP - Trial Pit | SP - Soakage Pit |
| HDTP - Hand Dug Trial Pit | PT - Percolation Test |
| DCP - Dynamic Cone Penetration Test | S - Sample Location |
| HA - Hand Auger | |

Site: Elizabeth Huggins Cottages, Gravesend

Client: Stonechart Developments

Drawn: PJ

Rev.:

Title: Figure 1 Exploratory Hole Location Plan

Project: 12545

Date: 12/2020

Scale:



Unit 2 Montpelier
Business Park,
Dencora Way,
Ashford,
Kent TN23 4FG
Tel: 01233 646 237

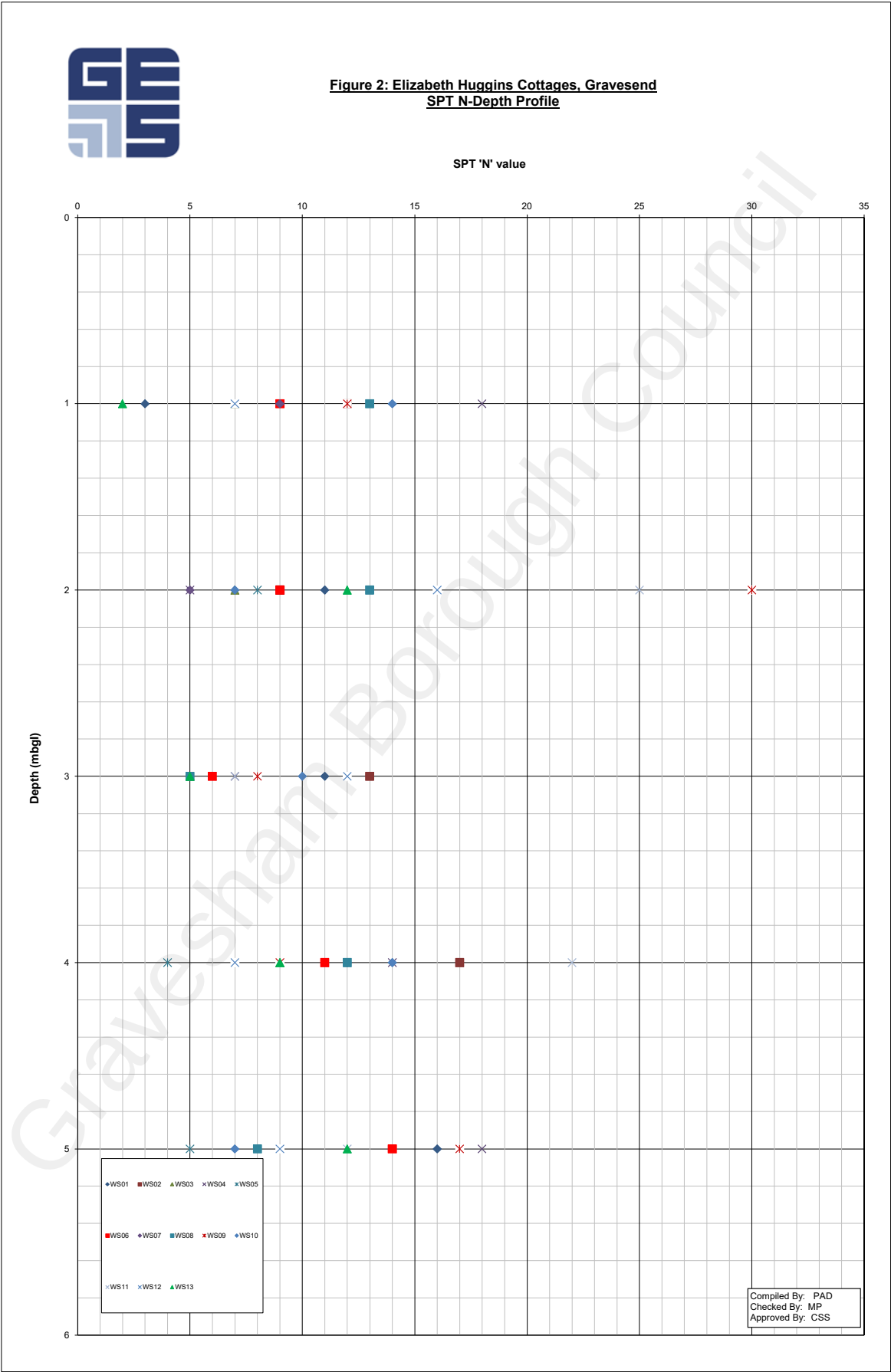
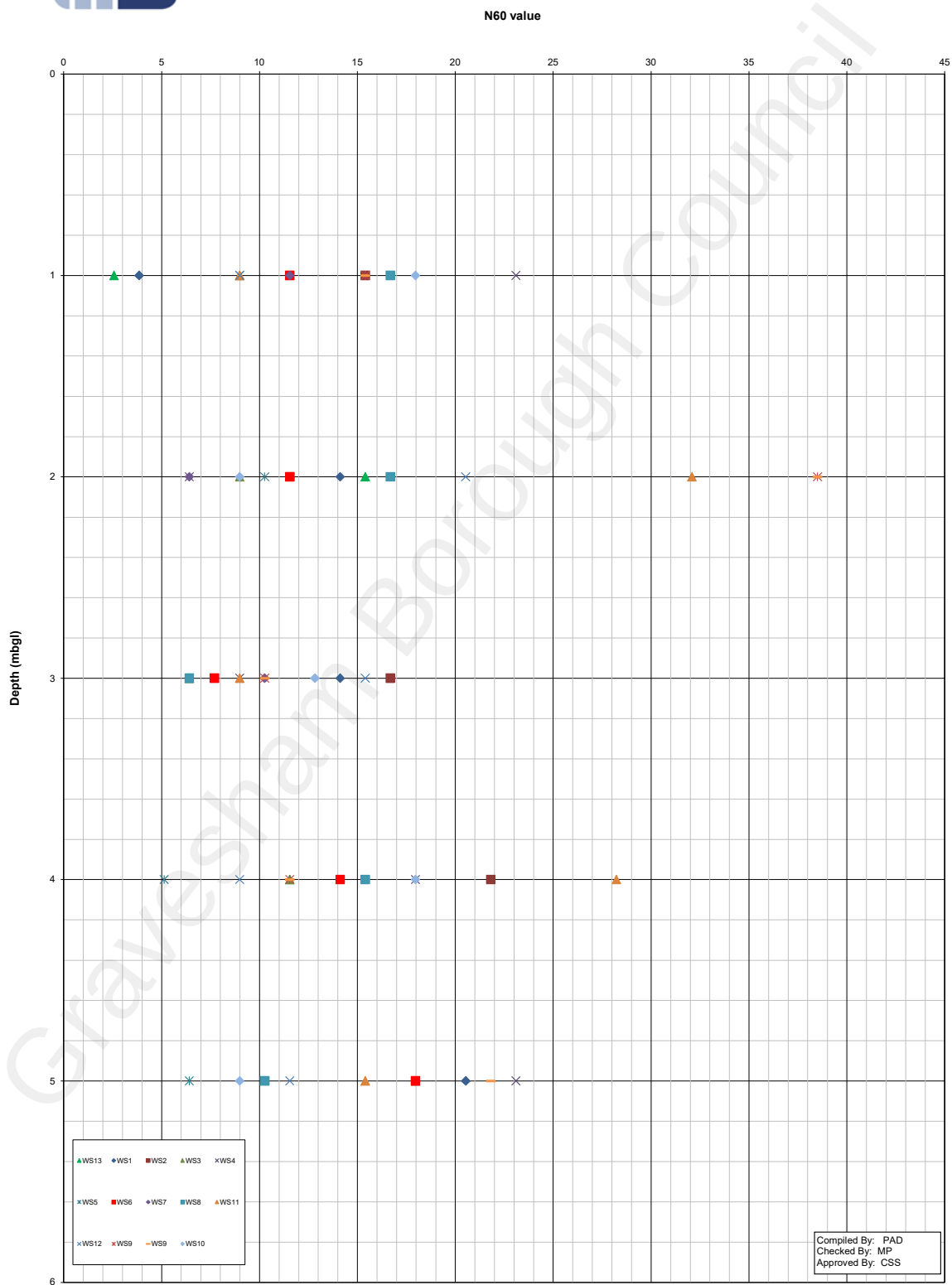




Figure 3: Elizabeth Huggins Cottages, Gravesend
N60-Depth Profile





APPENDIX 1
UK RADON REPORT



Radon Risk Report for addresses in England and Wales

Issued by Public Health England and British Geological Survey. This is Based upon Crown Copyright and is reproduced, where applicable, with the permission of Land & Property Services under delegated authority from the Controller of Her Majesty's Stationery Office, © Crown copyright and database right 2014MOU512.

Address searched: 7 Elizabeth Huggins Cottages, Cross Lane West, Gravesend, DA11 7LD

Date of report: 3 February 2021

Guidance for existing properties

Is this property in a radon Affected Area? - Yes

A radon Affected Area is defined as where the radon level in at least one property in every hundred is estimated to exceed the Action Level.

The estimated probability of the property being above the Action Level for radon is: 1-3%

The result may not be valid for buildings larger than 25 metres.

If this site is for redevelopment, you should undertake a GeoReport provided by the British Geological Survey.

This report informs you of the estimated probability that this particular property is above the Action Level for radon. This does not necessarily mean there is a radon problem in the property; the only way to find out whether it is above or below the Action Level is to carry out a radon measurement in an existing property.

Radon Affected Areas are designated by the Public Health England. PHE advises that radon gas should be measured in all properties within Radon Affected Areas.

If you are buying a currently occupied property in a Radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were above the Radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and the results of re-testing confirmed the effectiveness of the measures.

Further information is available from PHE or <https://www.ukradon.org>

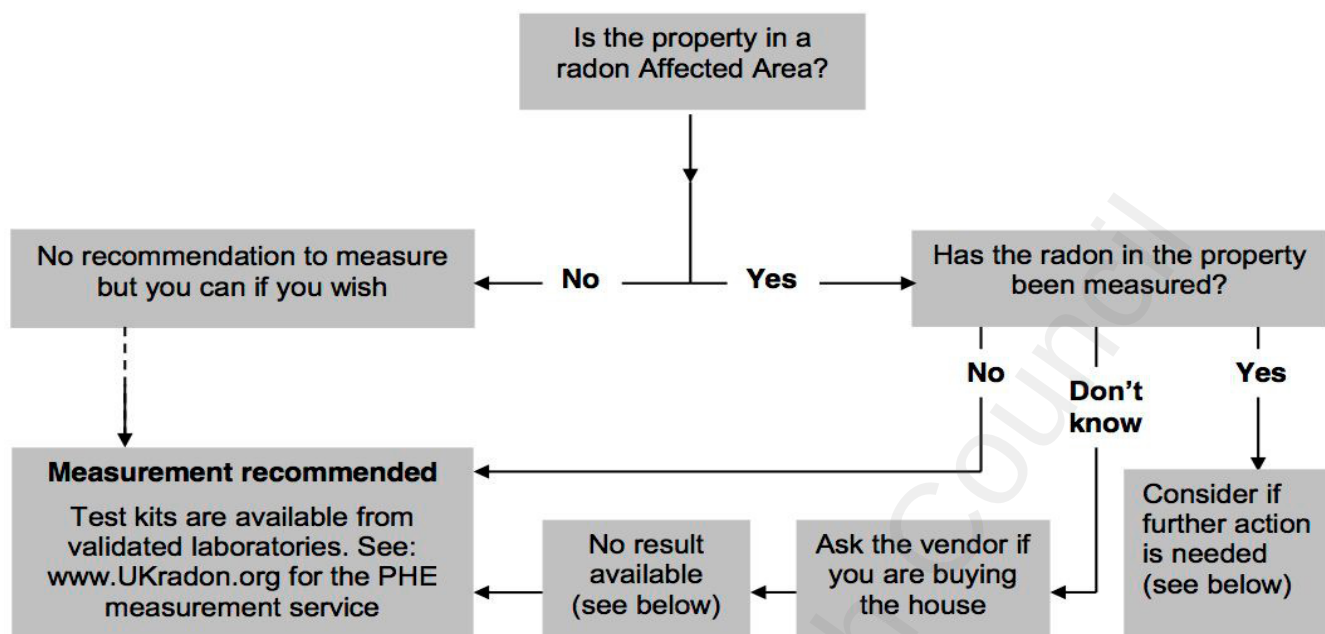
Guidance for new buildings and extensions to existing properties

What is the requirement under Building Regulations for radon protection in new buildings and extensions at the property location? - None

If you are buying a new property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

See the Radon and Building Regulations for more details.

PHE guidance for occupiers and prospective purchases



Existing radon test results: There is no public record of individual radon measurements. Results of previous tests can only be obtained from the seller. Radon levels can be significantly affected by changes to the building or its use, particularly by alterations to the heating and ventilation which can also be affected by changes in occupier. If in doubt, test again for reassurance.

Radon Bond: This is simply a retained fund, the terms of which are negotiated between the purchaser and the vendor. It allows the conveyance of the property to proceed without undue delay. The purchaser is protected against the possible cost of radon reduction work and the seller does not lose sale proceeds if the result is low. Make sure the agreement allows enough time to complete the test, get the result and arrange the work if needed.

High Results: Exposure to high levels of radon increases the risk of developing lung cancer. If a test in a home gives a result at or above the Action Level of 200 Becquerels per cubic metre of air (Bq/m³), formal advice will be given to lower the level. Radon reduction will also be recommended if the occupants include smokers or ex-smokers when the radon level is at or above the Target Level of 100 Bq/m³; these groups have a higher risk. Information on health risks and radon reduction work is available from PHE. Guidance about radon reduction work is also available from some Local Authorities, the Building Research Establishment and specialist contractors.

PHE designated radon website:

<https://www.ukradon.org>

Building Research Establishment:

<http://www.bre.co.uk/page.jsp?id=3137>



APPENDIX 2

WINDOW SAMPLE LOGS AND INSTALLATION DETAILS



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

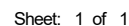
Tel: 01233 646237

Window

Sampler Log No. WS01

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: 35mm Standpipe Installation				Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545		
Co-ordinates: E: N:				Ground Level (m):		Date Started:16/12/2020 Date Completed:16/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Grass cover. occasional brick and flint fragments			(0.45)
0.60		D			Soft brown very silty CLAY, Occasional roots up to 3mm diameter to 0.6m. occasional fine chalk fragments (Head)	-0.45		0.45 (0.25)
0.90- 1.00		D			Soft becoming firm greyish brown with white slightly gravelly sandy SILT, Friable. gravel is fine to medium chalk. (Head)	-0.70		0.70
1.00- 1.45		SPTLS	SN=3	1,1/1,1,0,1				
1.50- 1.60		D			...from 1.30 becoming gravelly. gravel is chalk ...from 1.50 cobble of flint pushed down in cutting shoe			(2.30)
2.00- 2.45		SPTLS	SN=11	1,1/2,2,2,5				
2.60- 2.70		D						
3.00- 3.45		SPTLS	SN=11	1,1/2,2,2,5	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix (Lewes Nodular Chalk Formation)	-3.00		3.00
3.50- 3.90		D						(2.00)
4.00- 4.45		SPTLS	SN=12	2,3/3,3,3,3				
4.60- 4.90		D			...from 4.80 flint gravel			
5.00- 5.45		SPTLS	SN=16	4,5/4,4,4,4				5.00
						-5.00	End of W/S 5.00 m (Thickness of basal layer not proven)	
Remarks:						Logged By:		Checked By:
						CS		
						Scale: 1:30		Approved By:
						FIG No.		
Notes: For explanation of symbols and abbreviations, see Key Sheet.								



Project Name: Elizabeth Huggins Cottages
Project Location: Cross Lane West, Gravesend DA11 7LD
Client: Elizabeth Huggins Trust

Job No:
12545

Co-ordinates:
E:
N:

Ground Level (m):

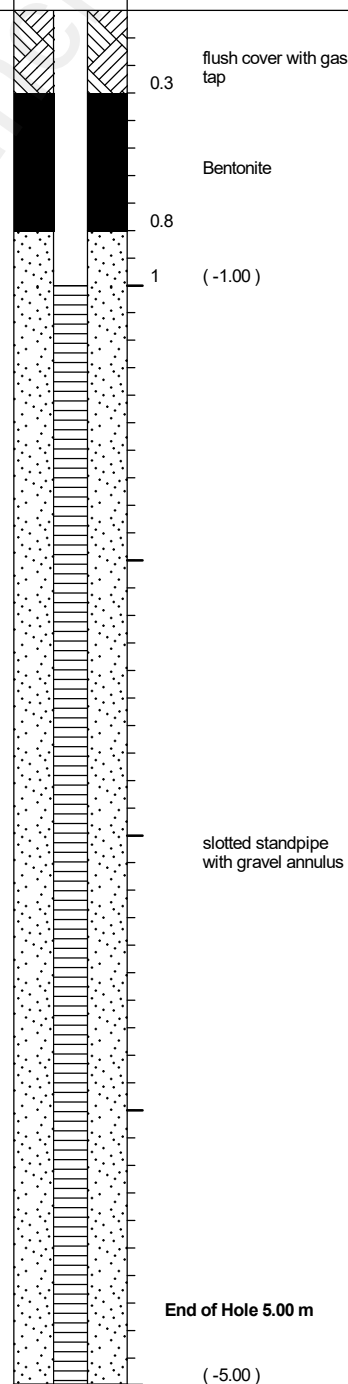
Date Started:16/12/2020

Date Completed:16/12/2020

Installation Date : 17/12/2020 Depth to TOP Response Zone : 1 (m)
Installation Type : SP Depth to BASE Response Zone : 5 (m)

Installation Diagram

Depth Related
Remarks
(Elevation)



Compiled By: CS	Checked By:
Scale:	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

GSG PIEZO/STANDPIPE LOG LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 5/2/21



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS02

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust			Job No: 12545		
Co-ordinates: E: N:					Ground Level (m):			Date Started:16/12/2020 Date Completed:16/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional chalk and flint fragments. frequent roots			(0.40)		
0.50- 0.60		D			Firm orangeish brown gravelly very sandy CLAY, Gravel is fine to medium sub rounded flint (Head)	-0.40		0.40		
0.90- 1.00		D			Soft to firm greenish brown and orange silty very sandy CLAY, Sand is fine to medium (Head)	-0.80		0.80		
1.00- 1.45		SPTLS	SN=12	1,1/1,3,3,5		-1.30		1.30		
1.50- 1.60		D			White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)					
2.00- 2.45		SPTLS	SN=9	1,2/2,2,2,3						
2.50- 2.70		D			...from 2.50 flint gravel			(2.70)		
3.00- 3.45		SPTLS	SN=13	1,2/4,3,3,3						
3.70- 3.90		D								
4.00- 4.45		SPTLS	SN=17	2,3/4,3,5,5						
						-4.00		4.00		
						End of W/S 4.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:		
						CS				
						Scale: 1:30		Approved By:		
						FIG No.				
Notes: For explanation of symbols and abbreviations, see Key Sheet.										

 Ground and Environmental Services Limited Unit 2 Montpelier Business Park Dencora Way, Ashford Kent TN23 4FG Tel: 01233 646237					Window Sampler Log No. WS03 Sheet: 1 of 1						
Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust					Job No: 12545	
Co-ordinates: E: N:					Ground Level (m):		Date Started: 16/12/2020 Date Completed: 16/12/2020				
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)			
Depth (m)	No.	Type	Result								
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional carbon fragments. frequent roots			(0.40)			
0.50- 0.60		D			Soft to firm orangeish brown very sandy CLAY, Rare gravel of fine to medium sub rounded flint. occasional fine roots up to 1m diameter tom (Head)	-0.40		0.40			
0.90- 1.00		D						(1.10)			
1.00- 1.45		SPTLS	SN=7	1,1/2,1,2,2							
1.50- 1.60		D			Firm (medium strength) light greyish brown and gravelly sandy SILT, Gravel is flint and chalk (Head)	-1.50		1.50			
						-1.90		1.90			
2.00- 2.45		SPTLS	SN=7	2,2/2,1,2,2	White and light orangeish brown distinctly weathered CHALK, Chalk is fine to medium gravel in a silt matrix. Grade Dm. (Lewes Nodular Chalk Formation)			(1.20)			
2.70- 2.90		D									
3.00- 3.45		SPTLS	SN=5	1,1/1,1,2,1	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)	-3.10		3.10			
3.70- 3.90		D						(1.90)			
4.00- 4.45		SPTLS	SN=9	1,2/2,2,2,3							
4.70- 4.90		D									
5.00- 5.45		SPTLS	SN=14	2,4/4,3,3,4		-5.00		5.00			
					End of W/S 5.00 m (Thickness of basal layer not proven)						
Remarks:						Logged By: CS		Checked By:			
						Scale: 1:30		Approved By:			
						FIG No.					
Notes: For explanation of symbols and abbreviations, see Key Sheet.											



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS04

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: 35mm Standpipe Installation				Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545				
Co-ordinates: E: N:				Ground Level (m):		Date Started:16/12/2020 Date Completed:16/12/2020				
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional carbon fragments. frequent roots			(0.35)		
0.60- 0.70		D			Soft to firm orangeish brown very sandy CLAY (Head)	-0.35		0.35 (0.20)		
1.10- 1.20 1.00- 1.45		D SPTLS	SN=18	2,2/3,3,5,7	Firm light greyish brown and gravelly sandy SILT, Gravel is flint and chalk (Head) ...from 1.10 to 1.30 clayey ...from 1.40 to 1.50 greenish brown gravelly sand. gravel is coarse flint	-0.55		0.55 (0.95)		
1.90- 2.00					White and light orangeish brown distinctly weathered CHALK, Chalk is fine to medium gravel in a silt matrix. Grade Dm. (Lewes Nodular Chalk Formation)	-1.50		1.50		
2.00- 2.45		SPTLS	SN=5	1,2/1,1,2,1				(1.40)		
2.80- 3.00		D				-2.90		2.90		
3.00- 3.45		SPTLS	SN=7	2,1/2,1,2,2	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)					
3.70- 3.90		D						(2.10)		
4.00- 4.45		SPTLS	SN=14	2,3/3,3,3,5						
4.70- 4.90		D								
5.00- 5.45		SPTLS	SN=18	4,5/4,4,4,6		-5.00		5.00		
Remarks:						End of W/S 5.00 m (Thickness of basal layer not proven)				
						Logged By: CS			Checked By:	
						Scale: 1:30			Approved By:	
Notes: For explanation of symbols and abbreviations, see Key Sheet.						FIG No.				



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

T: 01233 646237

Hole ID. WS04

Installation Details & Readings

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used: None Backfill: 35mm Standpipe Installation		Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545	
Co-ordinates: E: N:		Ground Level (m):		Date Started: 16/12/2020 Date Completed: 16/12/2020	
Installation Date : 17/12/2020 Installation Type : SP				Depth to TOP Response Zone : 1 (m) Depth to BASE Response Zone : 5 (m)	
				Installation Diagram	
				Depth Related Remarks (Elevation)	
				flush cover with gas tap 0.3	
				Bentonite 0.8	
				1 (-1.00)	
				End of Hole 5.00 m (-5.00)	
				Compiled By: CS	
				Checked By:	
				Scale:	
				Approved By:	
				FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

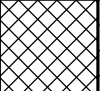
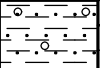
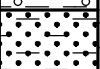
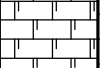
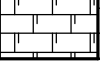
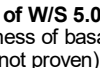
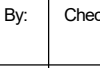
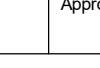
Tel: 01233 646237

Window

Sampler Log No. WS05

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust			Job No: 12545		
Co-ordinates: E: N:					Ground Level (m):			Date Started:16/12/2020 Date Completed:16/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional carbon fragments. rare fine brick fragments. frequent roots			(0.40)		
0.50- 0.60		D			Soft orangeish brown very silty CLAY (Head)	-0.40		0.40		
1.10- 1.20 1.00- 1.45		D SPTLS	SN=7	1,1/1,2,2,2	Soft to firm orangeish brown silty very sandy CLAY, Sand is fine. roots up to 1mm diameter to 1,5m. random fine rounded flint gravel (Head)	-0.90		0.90		
1.70- 1.90		D			Loose to medium dense light greyish brown and gravelly silty SAND, Gravel is flint and chalk (Head)	-1.60		1.60		
2.00- 2.45		SPTLS	SN=8	2,2/2,3,1,2	White and light orangeish brown distinctly weathered CHALK, Chalk is fine to medium gravel in a silt matrix. Grade Dm. (Lewes Nodular Chalk Formation) ...from 2.30 flints	-2.10		2.10		
2.60- 2.80		D						(0.80)		
3.00- 3.45		SPTLS	SN=6	1,1/1,1,2,2	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)	-2.90		2.90		
3.70- 3.90		D						(2.10)		
4.00- 4.45		SPTLS	SN=4	1,0/1,0,1,2						
4.70- 4.90		D								
5.00- 5.45		SPTLS	SN=5	1,1/1,1,1,2		-5.00		5.00		
						End of W/S 5.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:		
						CS				
						Scale: 1:30		Approved By:		
						FIG No.				
Notes: For explanation of symbols and abbreviations, see Key Sheet.										

 Ground and Environmental Services Limited Unit 2 Montpelier Business Park Dencora Way, Ashford Kent TN23 4FG Tel: 01233 646237					Window Sampler Log No. WS06 Sheet: 1 of 1						
Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust					Job No: 12545	
Co-ordinates: E: N:					Ground Level (m):		Date Started: 16/12/2020 Date Completed: 16/12/2020				
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)			
Depth (m)	No.	Type	Result								
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional chalk and flint fragments. frequent roots			(0.40)			
0.50- 0.60		D			Firm orangeish brown gravelly sandy CLAY, Gravel is fine to medium sub rounded to angular flint (Head)	-0.40		0.40 (0.35)			
0.90- 1.00		D			Loose orangeish brown slightly clayey SAND, Sand is fine to medium (Head)	-0.75		0.75 (0.25)			
1.00- 1.45		SPTLS	SN=9	1,1/2,2,2,3	Firm greenish brown and orange silty very sandy CLAY, Sand is fine to medium (Head)	-1.00		1.00 (0.30)			
1.50- 1.60		D			Firm greenish grey with orange very sandy SILT, Sand is fine. friable. fine roots to 1.7m (Head)	-1.30		1.30 (0.60)			
2.00- 2.45		SPTLS	SN=9	1,2/2,2,2,3	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)	-1.90		1.90			
2.50- 2.70		D			...from 2.50 flint gravel						
3.00- 3.45		SPTLS	SN=6	1,1/1,2,1,2							
3.70- 3.90		D									
4.00- 4.45		SPTLS	SN=11	1,2/2,3,3,3							
4.70- 4.90											
			CN=14	2,3/3,4,3,4							
											
											
											
											
											
											
											
											
											
Remarks:						Logged By: CS		Checked By:			
						Scale: 1:30		Approved By:			
						FIG No.					
Notes: For explanation of symbols and abbreviations, see Key Sheet.											



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS07

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust			Job No: 12545		
Co-ordinates: E: N:					Ground Level (m):			Date Started:16/12/2020 Date Completed:16/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional chalk and flint fragments. rare brick fragments. frequent roots			(0.40)		
0.60- 0.70		D			Firm orangeish brown silty sandy CLAY, Occasional gravel of fine to medium sub rounded to angular flint (Head)	-0.40		0.40		
1.00- 1.45		SPTLS	SN=9	1,1/2,2,2,3	...from 1.10 much rounded flint gravel	-1.20		1.20		
1.30- 1.40		D			Stiff light brown with white gravelly sandy SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint (Head)	-1.75		(0.55)		
1.90- 2.00		D			White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)			1.75		
2.00- 2.45		SPTLS	SN=5	1,1/1,1,2,1						
2.50- 2.70		D						(2.25)		
3.00- 3.45		SPTLS	SN=8	1,1/2,2,2,2						
3.70- 3.90		D								
4.00- 4.45		SPTLS	SN=12	2,2/2,3,3,4						
						-4.00		4.00		
						End of W/S 4.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:		
						CS				
						Scale: 1:30		Approved By:		
						FIG No.				
Notes: For explanation of symbols and abbreviations, see Key Sheet.										



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS08

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: 35mm Standpipe Installation					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust			Job No: 12545		
Co-ordinates: E: N:					Ground Level (m):			Date Started:17/12/2020 Date Completed:17/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional flint fragments. rare carbon and brick fragments. frequent roots	-0.45		(0.45)		
0.60- 0.70		D			Firm orangeish brown silty sandy CLAY, Occasional gravel of fine to medium sub rounded to angular flint. roots up to 20mm diameter to 0.6m. fine roots upto 1mm diameter to 1.2m (Head)	-1.30		0.45 (0.85)		
1.00- 1.45		SPTLS	SN=13	1,1/2,3,4,4		-1.30		1.30		
1.40- 1.50		D			Stiff light brown with white gravelly sandy SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint (Head)	-2.10		(0.80)		
2.00- 2.45		SPTLS	SN=13	4,6/5,3,2,3	...from 1.95 to 2.10 much flint gravel	-2.10		2.10		
2.50- 2.70		D			White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)					
3.00- 3.45		SPTLS	SN=5	1,1/1,1,2,1				(2.90)		
3.60- 3.80		D								
4.00- 4.45		SPTLS	SN=12	2,2/2,3,3,4						
4.70- 4.90		D								
			CN=8	1,2/2,2,2,2		-5.00		5.00		
						End of W/S 5.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:		
						CS				
						Scale: 1:30		Approved By:		
						FIG No.				
Notes: For explanation of symbols and abbreviations, see Key Sheet.										



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

T: 01233 646237

Hole ID. WS08

Installation Details & Readings

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used: None Backfill: 35mm Standpipe Installation		Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545	
Co-ordinates: E: N:		Ground Level (m):		Date Started: 17/12/2020 Date Completed: 17/12/2020	
Installation Date : 17/12/2020 Installation Type : SP				Depth to TOP Response Zone : 1 (m) Depth to BASE Response Zone : 5 (m)	
				Installation Diagram	
				Depth Related Remarks (Elevation)	
				flush cover with gas tap 0.3	
				Bentonite 0.8	
				1 (-1.00)	
				slotted standpipe with gravel annulus	
				End of Hole 5.00 m (-5.00)	
				Compiled By: CS	
				Checked By:	
				Scale:	
				Approved By:	
				FIG No.	

GSG PIEZO/STANDPIPE LOG LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 5/2/21

Notes: For explanation of symbols and abbreviations, see Key Sheet.



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS09

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings				Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545		
Co-ordinates: E: N:				Ground Level (m):		Date Started:17/12/2020 Date Completed:17/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional flint fragments. rare carbon fragments. frequent roots			(0.50)
0.50- 0.60		D			Firm orangeish brown silty sandy CLAY, Rare gravel of fine to medium sub rounded to angular flint. fine roots upto 1mm diameter to 1.1m (Head)	-0.50		0.50
1.10- 1.20 1.00- 1.45		D SPTLS	SN=12	1,1/1,2,4,5	Stiff light brown with white gravelly sandy SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint (Head)	-1.30		1.30
1.70- 1.80		D			...from 1.90 to 2.00 abundant flints			(0.80)
2.00- 2.45		SPTLS	SN=30	4,6/8,9,7,6	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)	-2.10		2.10
2.60- 2.80		D						
3.00- 3.45		SPTLS	SN=8	1,2/2,2,2,2				
3.60- 3.80		D						(2.90)
4.00- 4.45		SPTLS	SN=9	1,2/2,2,2,3				
4.70- 4.90		D						
			CN=17	2,2/3,7,4,3		-5.00		5.00
						End of W/S 5.00 m (Thickness of basal layer not proven)		
Remarks:						Logged By:		Checked By:
						CS		
						Scale: 1:30		Approved By:
						FIG No.		
Notes: For explanation of symbols and abbreviations, see Key Sheet.								



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS10

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: 35mm Standpipe Installation				Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545		
Co-ordinates: E: N:				Ground Level (m):		Date Started:17/12/2020 Date Completed:17/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional flint fragments. frequent carbon fragments. frequent roots			(0.35)
0.50		D			Firm orangeish brown silty sandy CLAY (Head)	-0.35		0.35
					Firm light brown with white gravelly clayey SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint. frequent roots up to 1m diameter to 1.0m (Head)	-0.60		0.60
1.10- 1.20 1.00- 1.45		D SPTLS	SN=14	3,3/4,3,4,3	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)	-1.20		1.20
1.70- 1.80		D						
2.00- 2.45		SPTLS	SN=7	1,2/1,2,2,2				
2.60- 2.80		D			...from 2.60 to 2.80 orange mottling on fracture surfaces			
3.00- 3.45		SPTLS	SN=10	1,2/3,2,3,2				(3.80)
3.60- 3.80		D						
4.00- 4.45		SPTLS	SN=14	2,2/3,4,3,4				
4.70- 4.90		D						
			CN=7	1,1/2,1,2,2				
						-5.00		5.00
						End of W/S 5.00 m (Thickness of basal layer not proven)		
Remarks:						Logged By:		Checked By:
						CS		
						Scale: 1:30		Approved By:
						FIG No.		
Notes: For explanation of symbols and abbreviations, see Key Sheet.								



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

T: 01233 646237

Hole ID. WS10

Installation Details & Readings

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used: None Backfill: 35mm Standpipe Installation		Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust		Job No: 12545	
Co-ordinates: E: N:		Ground Level (m):		Date Started: 17/12/2020 Date Completed: 17/12/2020	
Installation Date : 17/12/2020 Installation Type : SP				Depth to TOP Response Zone : 1 (m) Depth to BASE Response Zone : 5 (m)	
				Installation Diagram	
				Depth Related Remarks (Elevation)	
				flush cover with gas tap 0.3	
				Bentonite 0.8	
				1 (-1.00)	
				End of Hole 5.00 m (-5.00)	
				Compiled By: CS	
				Checked By:	
				Scale:	
				Approved By:	
				FIG No.	

GSG PIEZO/STANDPIPE LOG LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 5/2/21

Notes: For explanation of symbols and abbreviations, see Key Sheet.



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS11

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust			Job No: 12545		
Co-ordinates: E: N:					Ground Level (m):			Date Started:17/12/2020 Date Completed:17/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional flint fragments. rare carbon and brick fragments. frequent roots			(0.45)		
0.60- 0.70		D			Firm orangeish brown silty very sandy CLAY, Rare fine gravel of flint. fine roots upto 1mm diameter to 0.9m (Head)	-0.45		0.45		
1.00- 1.45		SPTLS	SN=7	1,1/2,2,1,2	...from 1.00 clayey sand			(1.35)		
1.40- 1.50		D								
2.00- 2.45		SPTLS	SN=25	2,3/4,7,7,7	Meidum dense orangeish brown silty slightly gravelly SAND, Sand is fine. gravel is fine to medium rounded flint (Head)	-1.80		1.80		
2.50- 2.70		D			Medium dense orangeish brown and whiteish grey sandy very silty GRAVEL, Gravel is fine to coarse flint and fine to medium chalk (Head)	-2.00		(0.20)		
					Stiff light brown with white gravelly sandy SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint (Head)	-2.30		(0.30)		
					...from 2.70 flint gravel	-2.75		(0.45)		
3.00- 3.45		SPTLS	SN=7	1,2/2,2,1,2	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)			2.75		
3.60- 3.80		D						(2.25)		
4.00- 4.45		SPTLS	SN=22	1,2/2,2,3,15	...from 4.30 flint in cutting shoe - poor recovery					
			CN=12	4,6/3,3,3,3		-5.00		5.00		
						End of W/S 5.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:		
						CS				
						Scale: 1:30		Approved By:		
						FIG No.				
Notes: For explanation of symbols and abbreviations, see Key Sheet.										

 Ground and Environmental Services Limited Unit 2 Montpelier Business Park Dencora Way, Ashford Kent TN23 4FG Tel: 01233 646237					Window Sampler Log No. WS12 Sheet: 1 of 1						
Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust					Job No: 12545	
Co-ordinates: E: N:					Ground Level (m):			Date Started:17/12/2020 Date Completed:17/12/2020			
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)			
Depth (m)	No.	Type	Result								
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional flint fragments. rare carbon and brick fragments. frequent roots			(0.40)			
0.60- 0.70		D			Firm orangeish brown silty very sandy CLAY, Rare fine gravel of flint. occasional roots up to my diameter to 0.6m. fine roots up to 1mm diameter to 1.4m (Head)	-0.40		0.40			
1.10- 1.30 1.00- 1.45		D SPTLS	SN=7	1,1/1,2,2,2	...from 1.00 to 1.30 slightly clayey silty sand.	-1.30		1.30			
1.80- 1.90		D			Loose orangeish brown very silty SAND, Sand is fine. (Head)			(0.90)			
2.00- 2.45		SPTLS	SN=16	2,3/2,2,4,8	...from 2.00 to 2.20 becoming clayey	-2.20		2.20			
2.50- 2.70		D			Stiff light brown with white gravelly sandy SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint (Head)			(1.10)			
3.00- 3.45		SPTLS	SN=12	3,4/4,3,2,3		-3.30		3.30			
3.60- 3.80		D			White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc (Lewes Nodular Chalk Formation)						
4.00- 4.45		SPTLS	SN=7	1,1/1,2,2,2				(1.70)			
4.70- 4.90		D				-5.00		5.00			
			CN=9	1,2/2,2,2,3			End of W/S 5.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:			
						CS					
						Scale: 1:30		Approved By:			
						FIG No.					
Notes: For explanation of symbols and abbreviations, see Key Sheet.											



Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG

Tel: 01233 646237

Window

Sampler Log No. WS13

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact Support Used:None Backfill: Arisings					Project Name: Elizabeth Huggins Cottages Project Location: Cross Lane West, Gravesend DA11 7LD Client: Elizabeth Huggins Trust			Job No: 12545		
Co-ordinates: E: N:					Ground Level (m):			Date Started:17/12/2020 Date Completed:17/12/2020		
Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)		
Depth (m)	No.	Type	Result							
0.30		TUB			MADE GROUND: dark brown sandy clayey silt, Occasional flint fragments. rare carbon and brick fragments. frequent roots	-0.35		(0.35)		
0.60- 0.70		D			Soft to firm orangeish brown silty very sandy CLAY, Rare fine gravel of flint.			0.35		
1.00- 1.45 1.20- 1.30		SPTLS D	SN=2	0,0/0,1,0,1	...from 1.40 becoming firm			(1.75)		
1.90- 2.00		D				-2.10		2.10		
2.00- 2.45		SPTLS	SN=12	1,2/2,3,3,4	Stiff light brown with white gravelly sandy SILT, Sand is fine. friable. gravel is fine to medium chalk and occasional flint			(0.70)		
2.50- 2.70		D			...from 2.70 coarse flint gravel	-2.80		2.80		
3.00- 3.45		SPTLS	SN=5	1,1/1,2,1,1	White with orangeish white partially weathered CHALK, Chalk recovered as structureless melange comprising fine to medium gravel in a silt matrix grade Dc					
3.60- 3.80		D						(2.20)		
4.00- 4.45		SPTLS	SN=9	1,2/2,2,2,3						
4.70- 4.90		D								
			CN=12	1,2/3,3,3,3		-5.00		5.00		
						End of W/S 5.00 m (Thickness of basal layer not proven)				
Remarks:						Logged By:		Checked By:		
						CS				
						Scale: 1:30		Approved By:		
						FIG No.				
Notes: For explanation of symbols and abbreviations, see Key Sheet.										



APPENDIX 3
FALLING HEAD TEST RESULTS

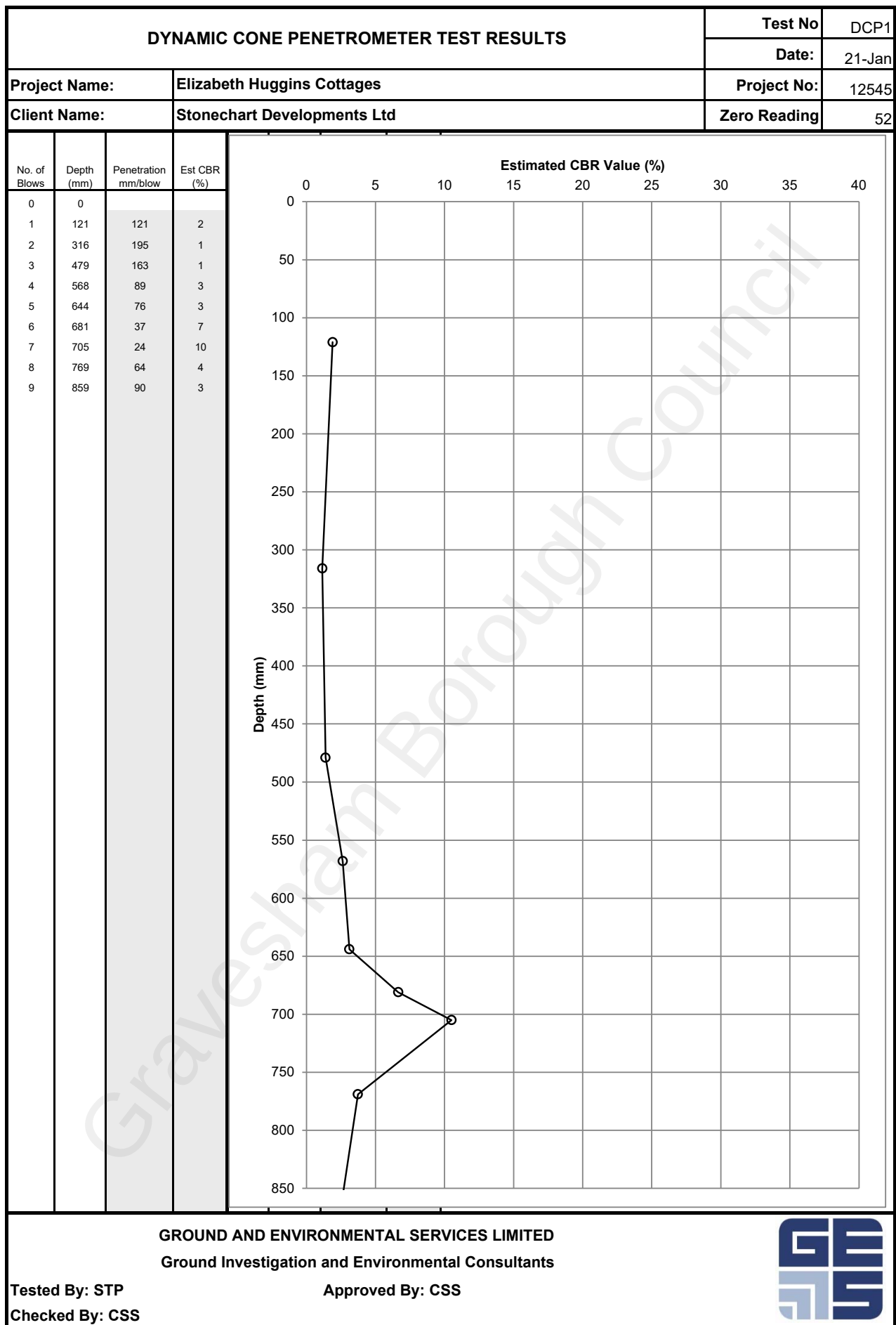
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[illegible]

[illegible]



APPENDIX 4
DCP TEST RESULTS



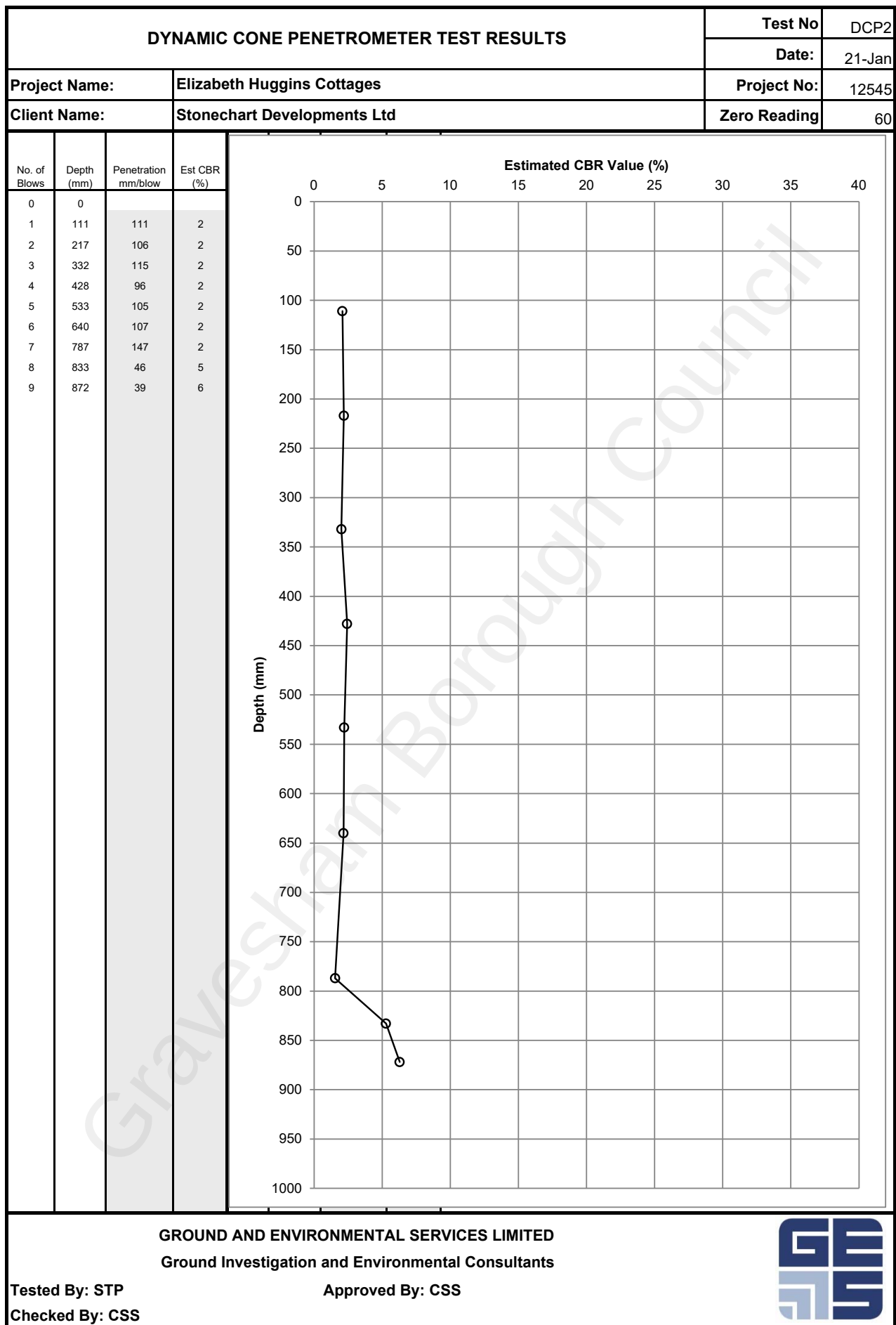
GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

Tested By: STP

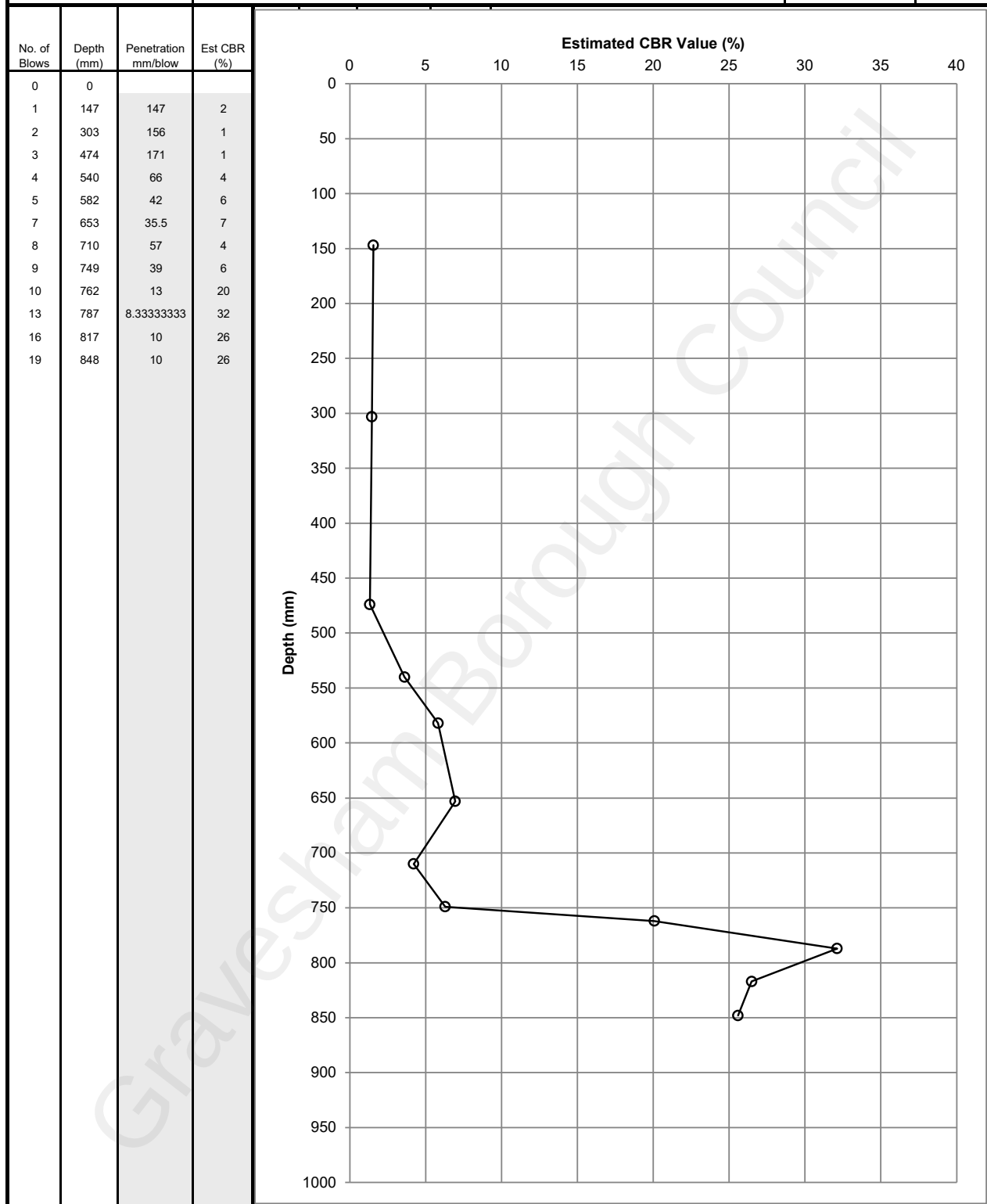
Approved By: CSS

Checked By: CSS





DYNAMIC CONE PENETROMETER TEST RESULTS		Test No	DCP3
		Date:	21-Jan
Project Name:	Elizabeth Huggins Cottages	Project No:	12545
Client Name:	Stonechart Developments Ltd	Zero Reading	50



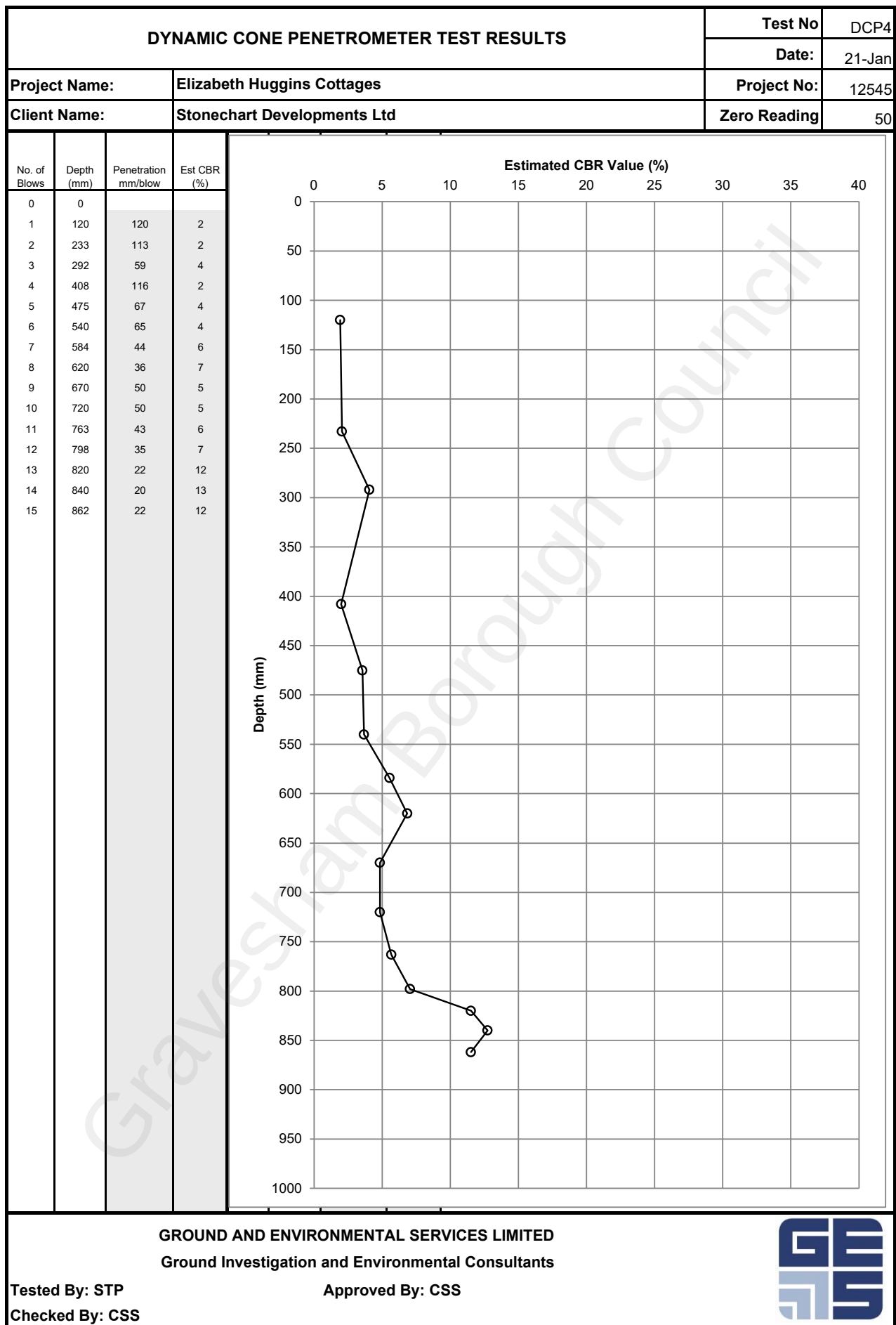
GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

Tested By: STP

Approved By: CSS

Checked By: CSS





GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

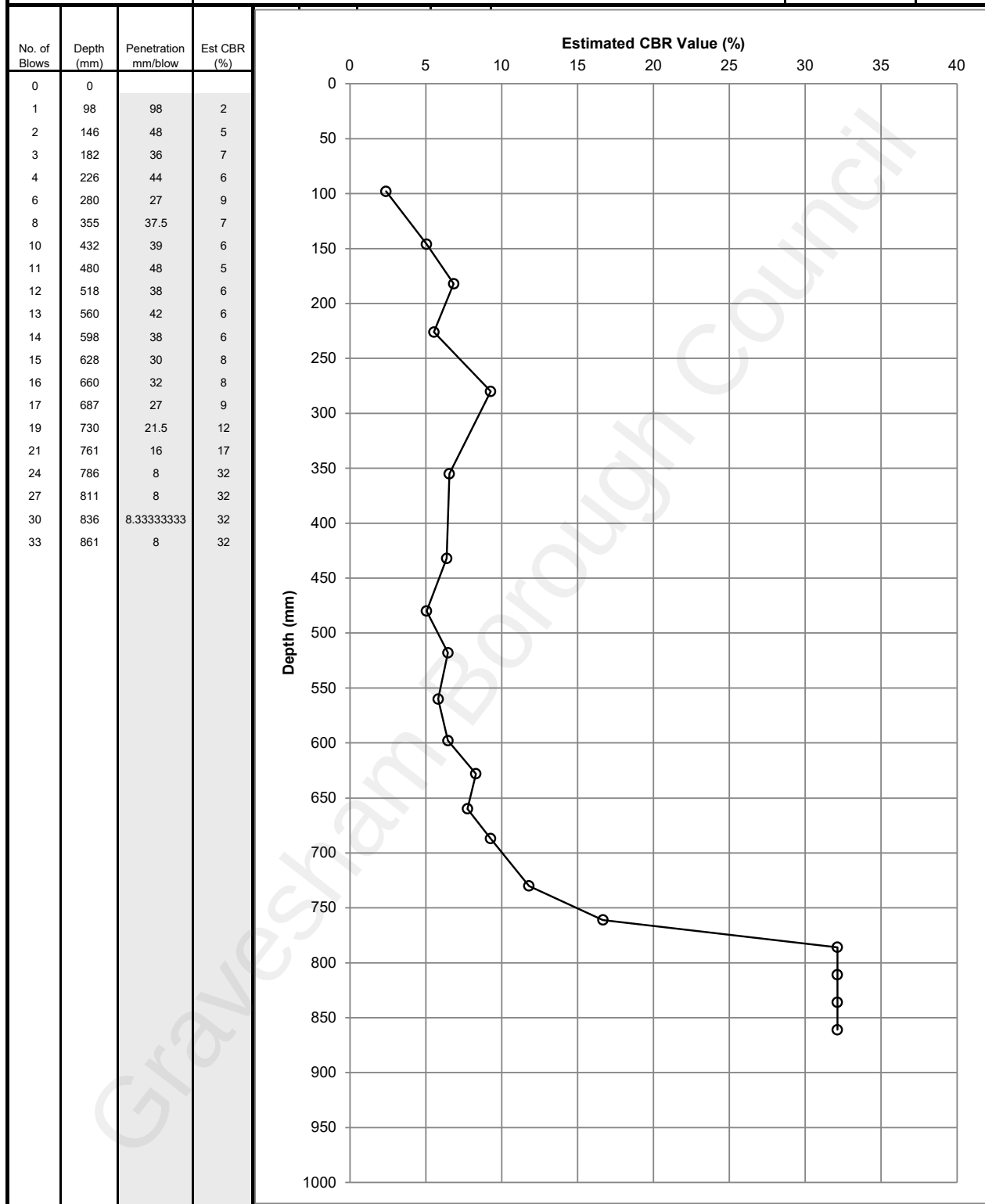
Tested By: STP

Approved By: CSS

Checked By: CSS



DYNAMIC CONE PENETROMETER TEST RESULTS		Test No	DCP5
		Date:	21-Jan
Project Name:	Elizabeth Huggins Cottages	Project No:	12545
Client Name:	Stonechart Developments Ltd	Zero Reading	50



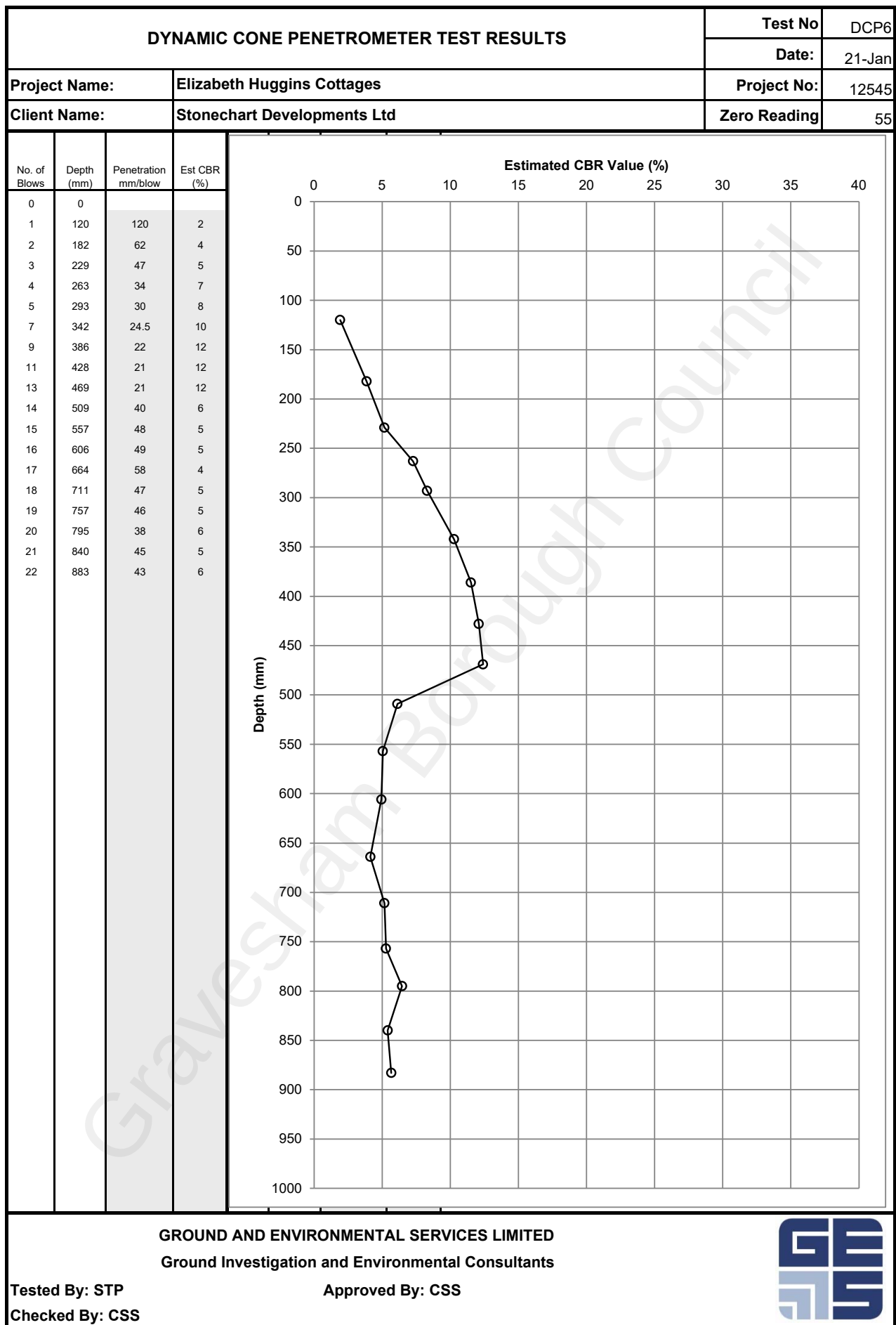
GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

Tested By: STP

Approved By: CSS

Checked By: CSS





GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

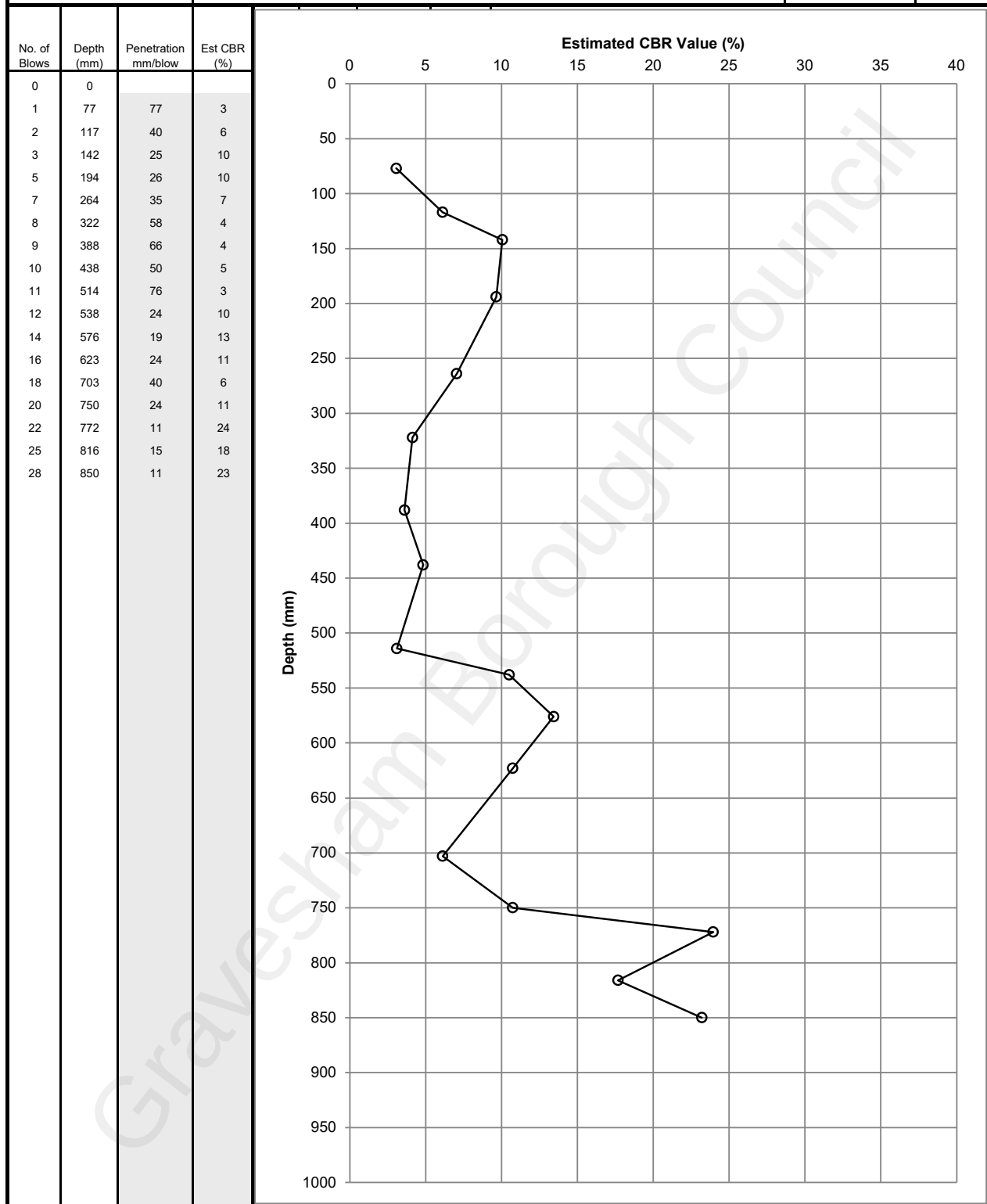
Tested By: STP

Approved By: CSS

Checked By: CSS



DYNAMIC CONE PENETROMETER TEST RESULTS		Test No	DCP7
		Date:	21-Jan
Project Name:	Elizabeth Huggins Cottages	Project No:	12545
Client Name:	Stonechart Developments Ltd	Zero Reading	50

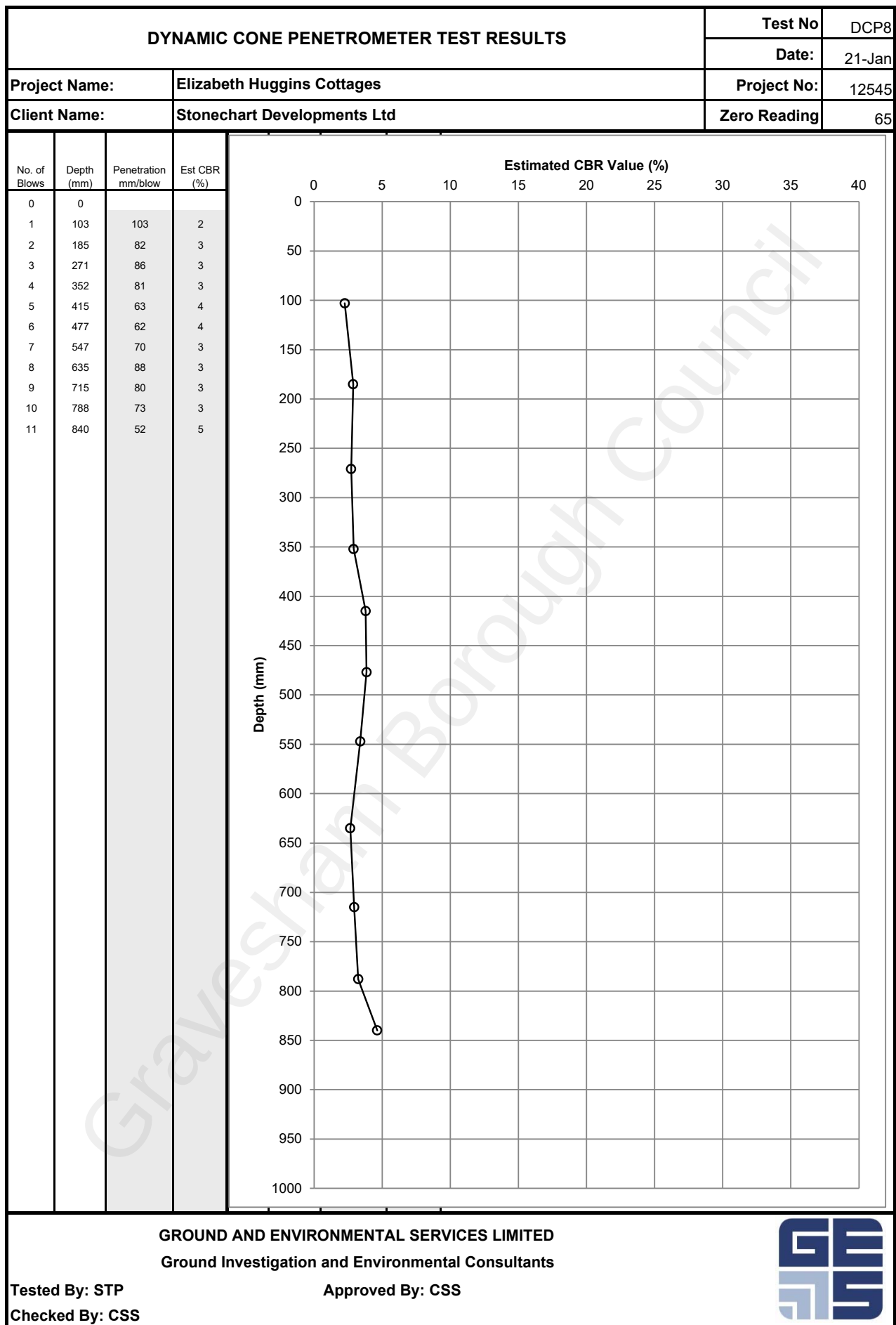


GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

Tested By: STP
Checked By: CSS

Approved By: CSS





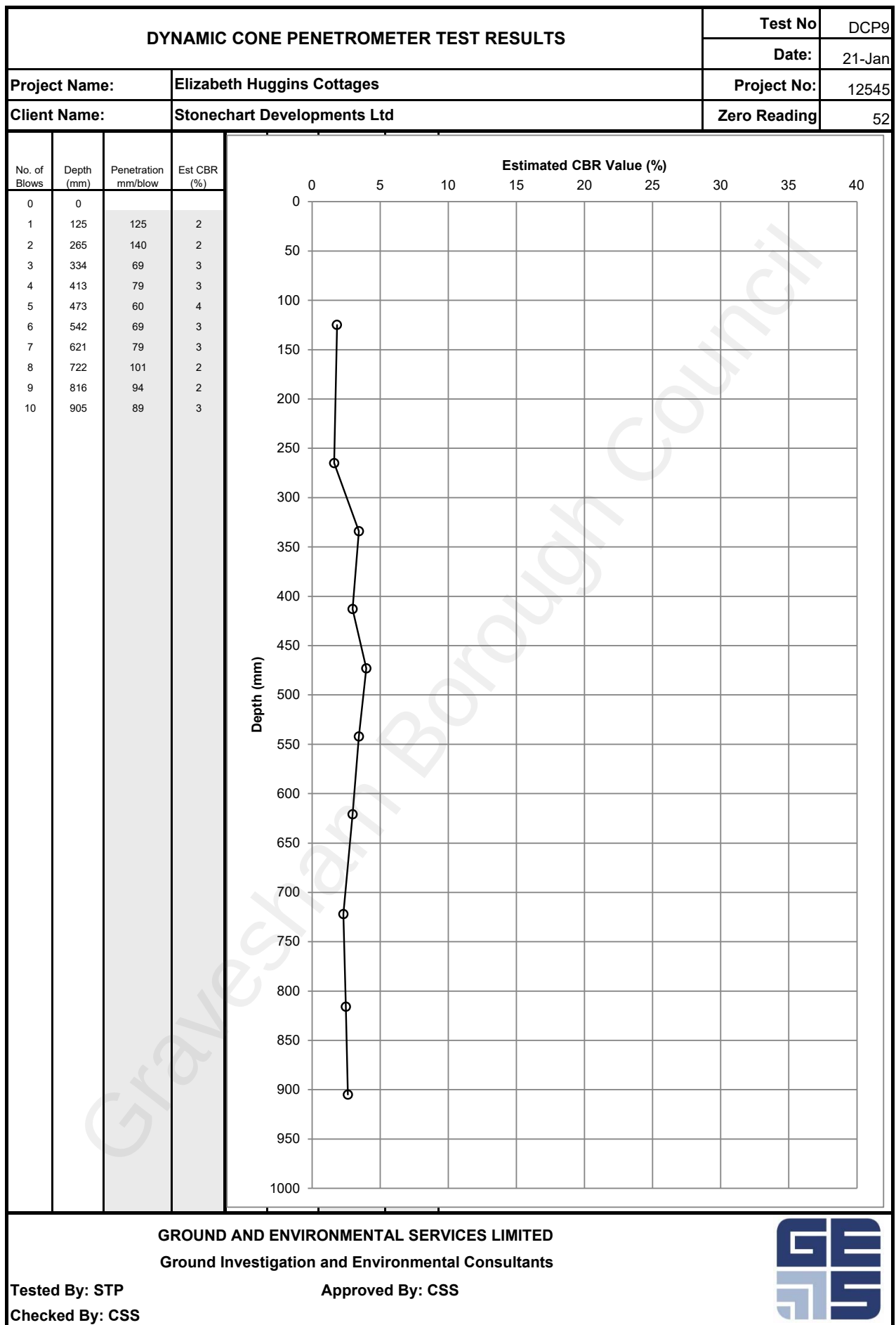
GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

Tested By: STP

Approved By: CSS

Checked By: CSS





GROUND AND ENVIRONMENTAL SERVICES LIMITED
Ground Investigation and Environmental Consultants

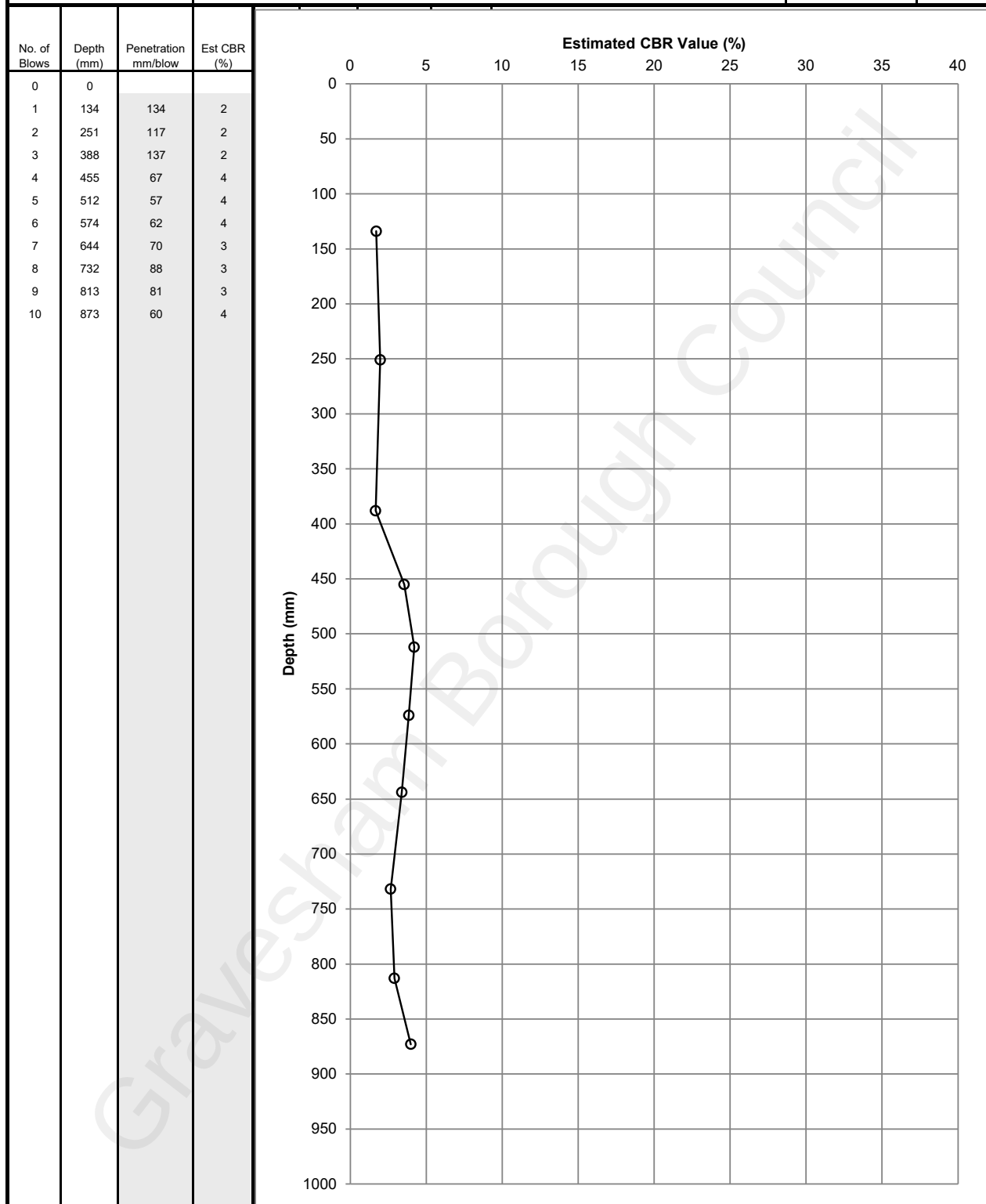
Tested By: STP

Approved By: CSS

Checked By: CSS



DYNAMIC CONE PENETROMETER TEST RESULTS		Test No	DCP10
		Date:	21-Jan
Project Name:	Elizabeth Huggins Cottages	Project No:	12545
Client Name:	Stonechart Developments Ltd	Zero Reading	60





APPENDIX 5
SOIL GAS MONITORING RESULTS



Ground and Environmental Services Limited

Notes:
CH ₄ : methane in percent volume per volume (% v/v)
CO ₂ : carbon dioxide in %v/v
O ₂ : oxygen in % v/v
H ₂ S: hydrogen sulphide in part per million (ppm)
CO: carbon monoxide in ppm
B.P.: Barometric pressure in mBar
Flow: Gas flow in litre per hour (l/h)



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[illegible]



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[illegible]



APPENDIX 6
LABORATORY TEST RESULTS



Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG

www.genvs.com
E: info@genvs.com
T: 01233 646237

Client: Elizabeth Huggins Trust

Project No: 12545

Site: Elizabeth Huggins Cottages

Date: 05/01/2021

Date Received: 17/12/2020

Date Tested: 04/01/2021

Test Results

Location ID	Depth (m)	MC (%)	LL (%)	PL (%)	PI (%)	% passing 425 µm sieve	Classification	Sample type
WS 1	0.6	19	30	19	11	98	CL	D
WS 2	0.9-1.0	25	53	25	28	98	CH	D
WS 5	1.1-1.2	18	40	19	21	98	CI	D
WS 8	0.6-0.7	23	28	19	9	98	CL	D
WS 9	1.1-1.2	19	37	19	18	98	CI	D
WS 11	1.3-1.4	19	38	19	19	98	CI	D
WS 13	1.2-1.3	22	27	19	8	98	CL	D

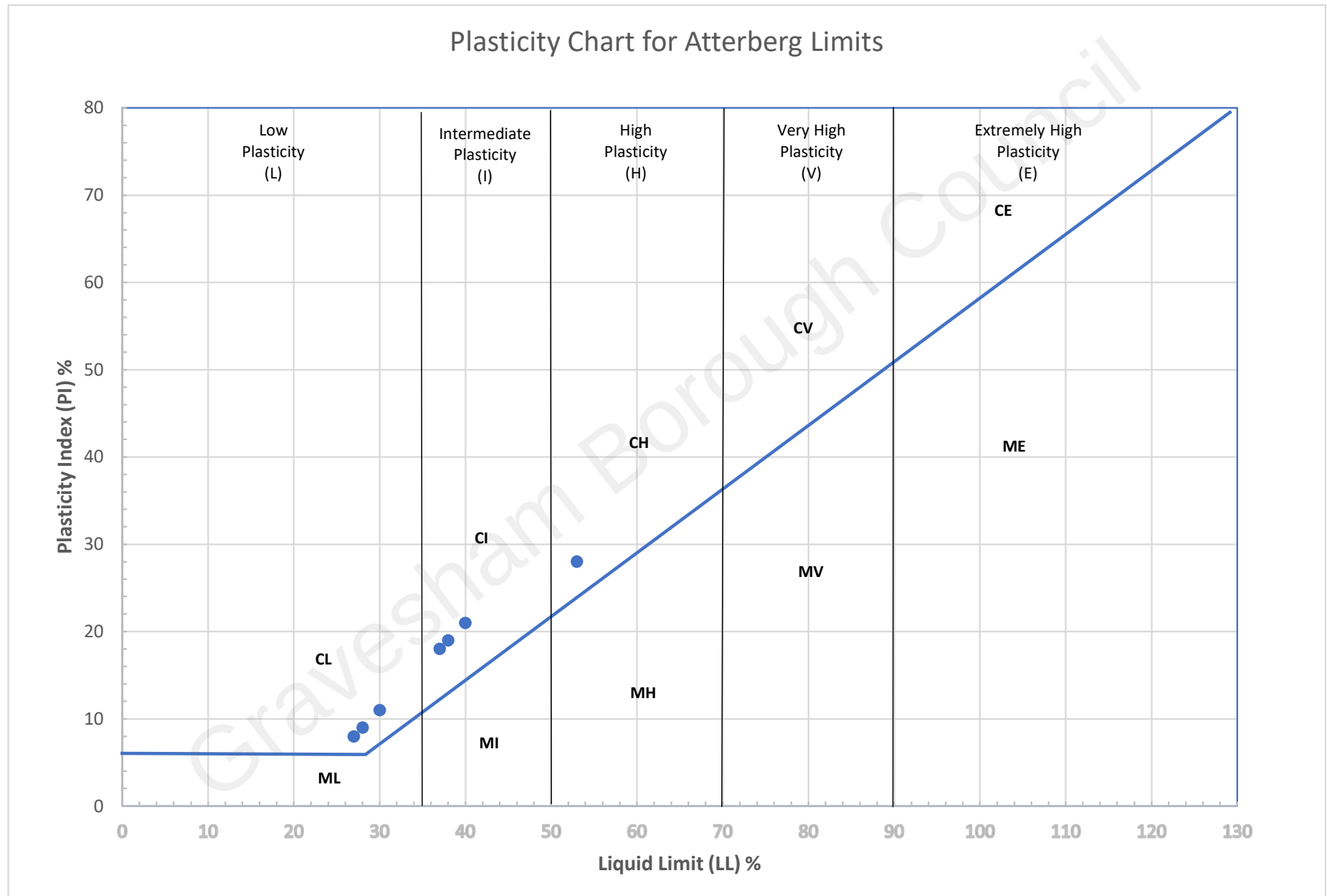
Visual Descriptions

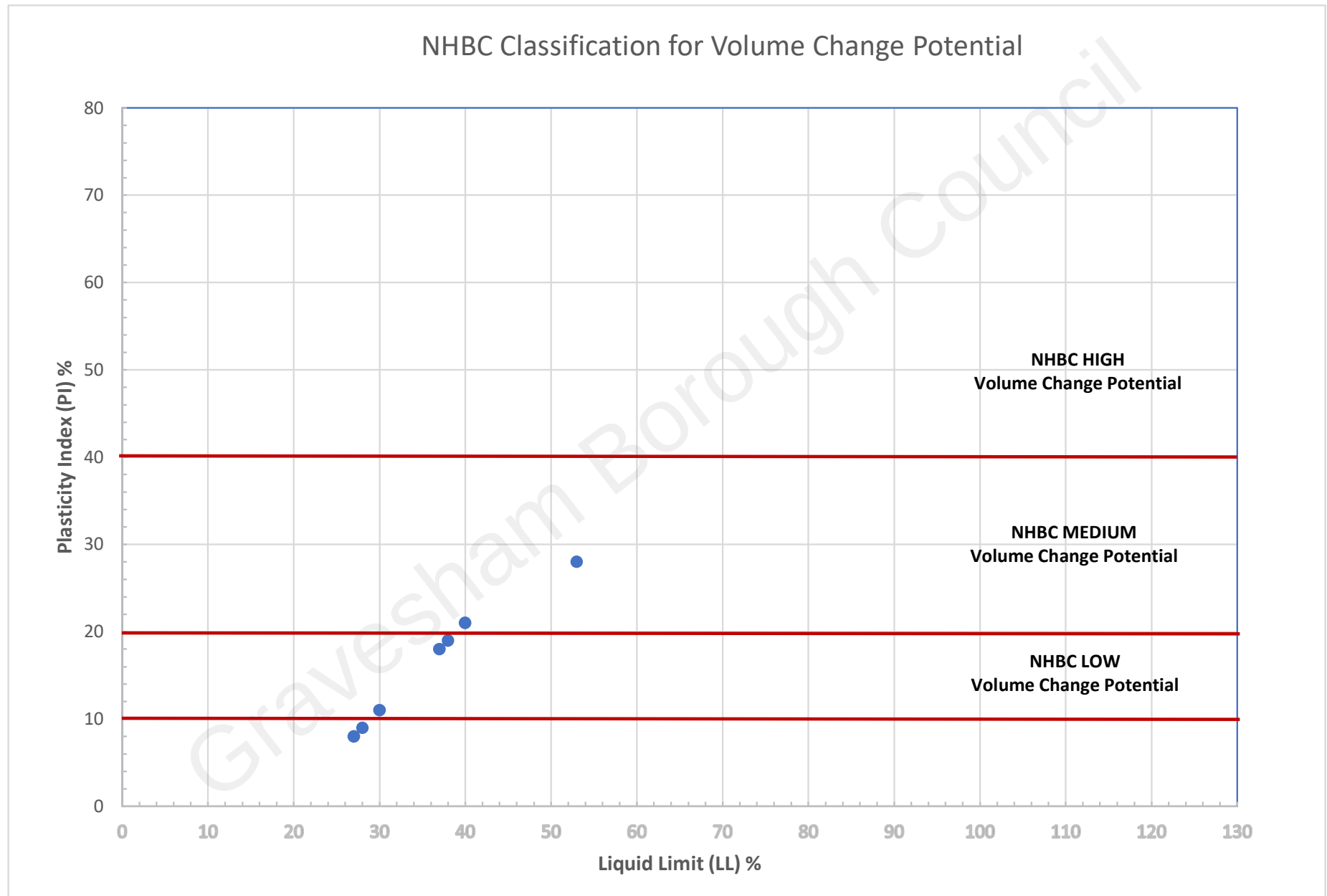
Location ID	Depth	Description
WS 1	0.6	Brown very silty CLAY
WS 2	0.9-1.0	Greenish brown and orange silty sandy CLAY
WS 5	1.1-1.2	Orangeish brown silty very sandy CLAY
WS 8	0.6-0.7	Orangeish brown very silty CLAY
WS 9	1.1-1.2	Orangeish brown very silty CLAY
WS 11	1.3-1.4	Orangeish brown very silty CLAY
WS 13	1.2-1.3	Orangeish brown very silty CLAY

Tested by: STP

Checked by: CSS

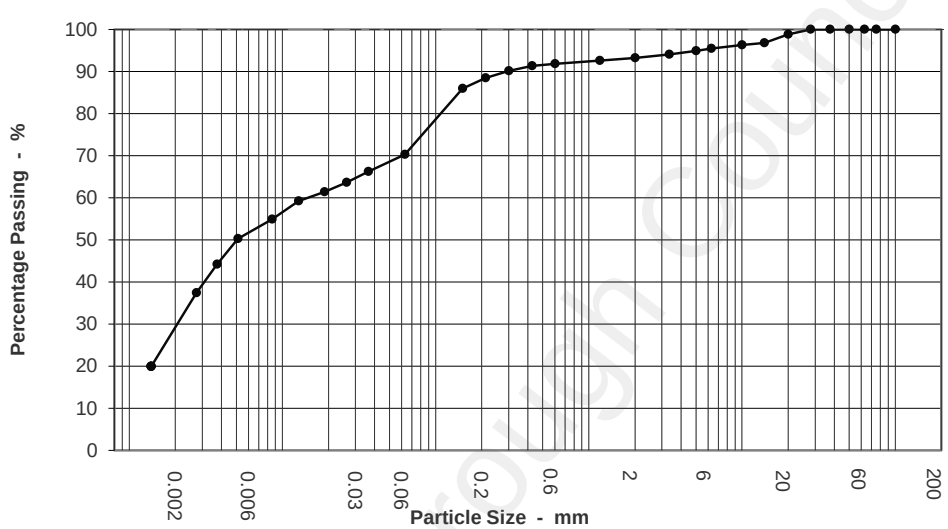
Approved by: CSS





	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9		Job Ref	12545
			Borehole / Pit No	WS 4
Project	Elizabeth Huggins Cottages		Sample No	
Soil Description			Depth	1.1-1.2 m
	Whiteish brown slightly sandy clayey SILT with rare fine to medium gravel		Sample type	D

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100	0.036	66
63	100	0.026	64
50	100	0.019	61
37.5	100	0.013	59
28	100	0.009	55
20	99	0.005	50
14	97	0.004	44
10	96	0.003	37
6.3	95	0.001	20
5	95		
3.35	94		
2	93		
1.18	93		
0.6	92		
0.425	91		
0.3	90		
0.212	88		
0.15	86		
0.063	70		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

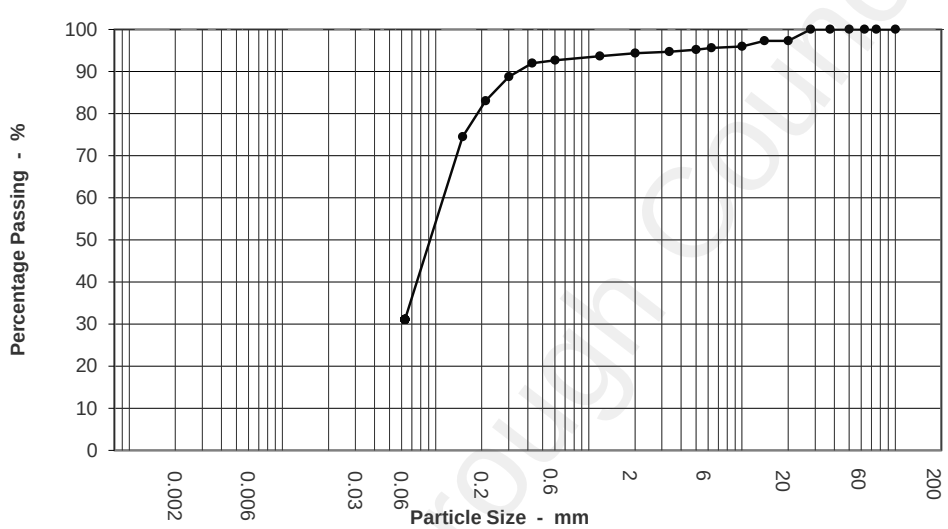
Sample Proportions	
Cobbles	0.0
Gravel	6.7
Sand	23.4
Silt	42.1
Clay	27.8

Grading Analysis	
D100	28.0
D60	0.015
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9		Job Ref	12545
			Borehole / Pit No	WS 6
Project	Elizabeth Huggins Cottages		Sample No	
Soil Description			Depth	0.9-1.0 m
	Mid brown slightly clayey silty fine to coarse SAND with rare fine to medium gravel		Sample type	D

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	97		
14	97		
10	96		
6.3	96		
5	95		
3.35	95		
2	94		
1.18	94		
0.6	93		
0.425	92		
0.3	89		
0.212	83		
0.15	74		
0.063	31		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

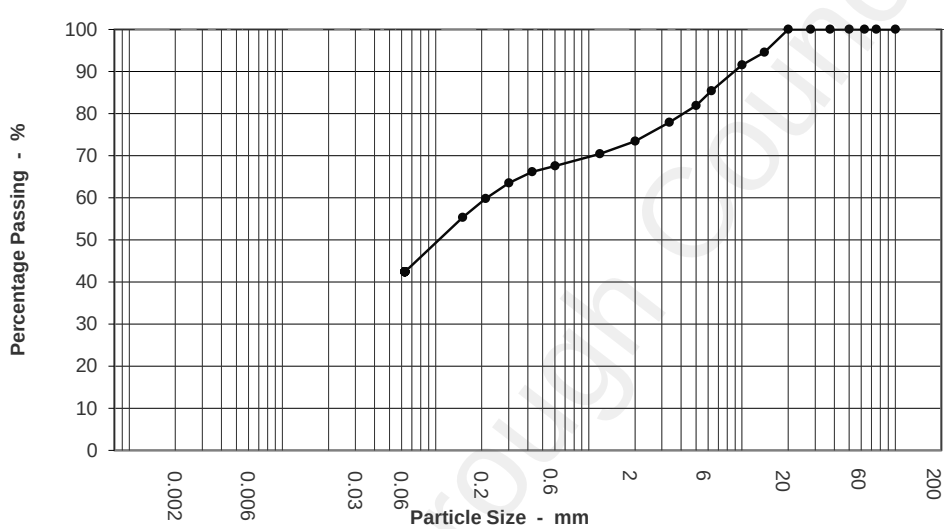
Sample Proportions	
Cobbles	0.0
Gravel	5.6
Sand	63.3
Silt & Clay	31.0

Grading Analysis	
D100	28.0
D60	0.121
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9		Job Ref	12545
			Borehole / Pit No	WS 9
Project	Elizabeth Huggins Cottages		Sample No	
Soil Description	Whiteish brown gravelly sandy SILT with some clay content		Depth	1.7-1.8 m
			Sample type	D

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			



Percentage Passing - %

Particle Size - mm

Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	95		
10	92		
6.3	85		
5	82		
3.35	78		
2	73		
1.18	70		
0.6	68		
0.425	66		
0.3	64		
0.212	60		
0.15	55		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

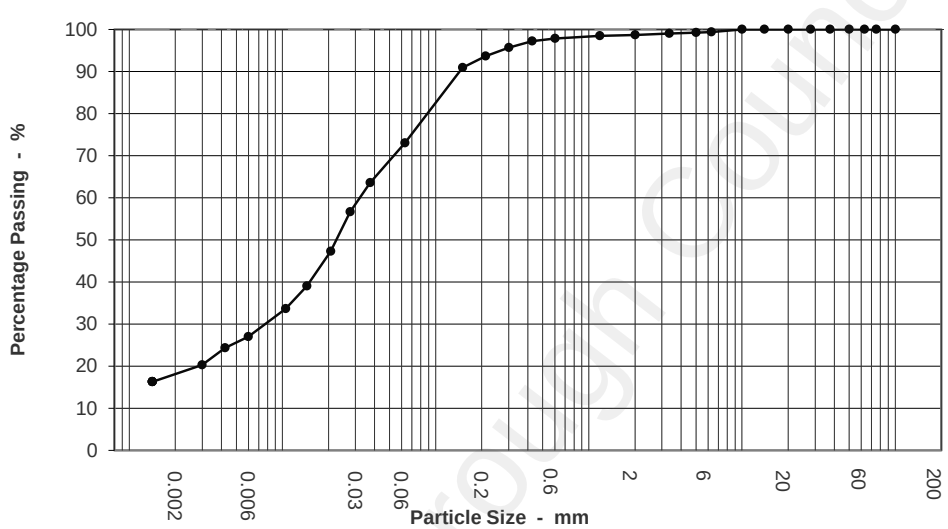
Sample Proportions	
Cobbles	0.0
Gravel	26.5
Sand	31.0
Silt & Clay	42.4

Grading Analysis	
D100	20.0
D60	0.217
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9		Job Ref	12545
			Borehole / Pit No	WS 12
Project	Elizabeth Huggins Cottages		Sample No	
Soil Description	Brown slightly clayey sandy SILT		Depth	1.1-1.3 m
			Sample type	D

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100	0.037	64
63	100	0.028	57
50	100	0.021	47
37.5	100	0.014	39
28	100	0.010	34
20	100	0.006	27
14	100	0.004	24
10	100	0.003	20
6.3	99	0.001	16
5	99		
3.35	99		
2	99		
1.18	98		
0.6	98		
0.425	97		
0.3	96		
0.212	94		
0.15	91		
0.063	73		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

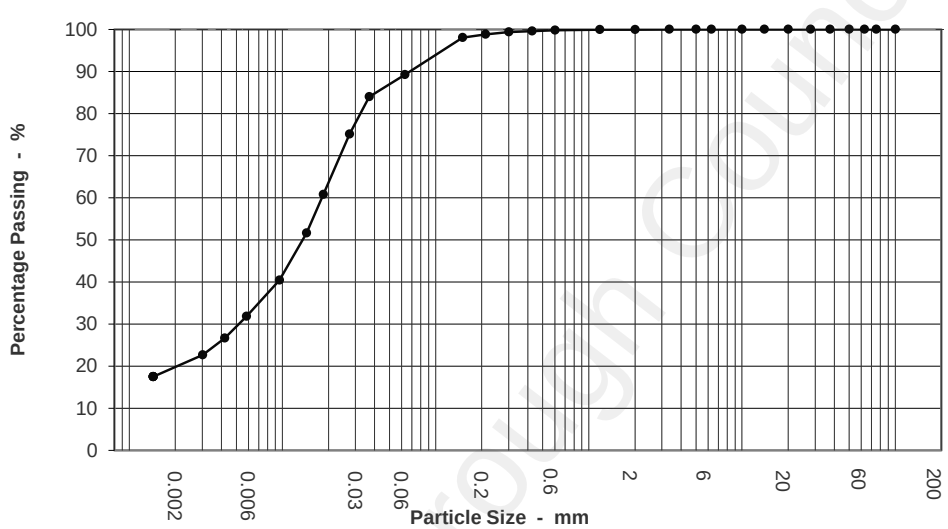
Sample Proportions	
Cobbles	0.0
Gravel	1.3
Sand	26.8
Silt	54.2
Clay	17.8

Grading Analysis	
D100	10.0
D60	0.032
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks	
STP	CSS	CSS		

	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9		Job Ref	12545
			Borehole / Pit No	WS 12
Project	Elizabeth Huggins Cottages		Sample No	
Soil Description	Brown slightly csandy clayey SILT		Depth	1.8-1.9 m
			Sample type	D

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100	0.037	84
63	100	0.027	75
50	100	0.018	61
37.5	100	0.014	52
28	100	0.010	40
20	100	0.006	32
14	100	0.004	27
10	100	0.003	23
6.3	100	0.001	17
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	99		
0.15	98		
0.063	89		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	11.3
Silt	69.3
Clay	19.3

Grading Analysis	
D100	0.425
D60	0.018
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks
STP	CSS	CSS	



Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG

www.genvs.com
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T: 01233 646237

Client: Stonechart Developments Ltd

Project No: 12545

Site: Elizabeth Huggins Cottages

Date: 05/01/2021

Date Received: 17/12/2020

Date Tested: 04/01/2021

Test Results

Location ID	Depth (m)	Saturation Moisture Content SMC (%)	Bulk Density (mg/m ³)	Dry Density (mg/m ³)	Sample type
WS 2	1.5	32	1.90	1.44	D
WS 5	2.6	34	1.86	1.40	D
WS 7	1.9	34	1.87	1.41	D
WS 8	2.5	35	1.85	1.4	D
WS 10	1.7	35	1.82	1.38	D

Visual Descriptions

Location ID	Depth	Description
WS 2	1.5	Off white gravel of CHALK
WS 5	2.6	Off white gravel of CHALK
WS 7	1.9	Off white gravel of CHALK
WS 8	2.5	Off white gravel of CHALK
WS 10	1.7	Off white gravel of CHALK

Tested by: STP

Checked by: CSS

Approved by: CSS



APPENDIX 7
ANALYTICAL TEST RESULTS



Craig Spanton
Ground & Environmental Services Ltd
Unit 2
Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 20-15070

Site Reference: Elizabeth Huggins Cottages, Gravesend

Project / Job Ref: 12545

Order No: GES/4178.12545

Sample Receipt Date: 21/12/2020

Sample Scheduled Date: 21/12/2020

Report Issue Number: 1

Reporting Date: 05/01/2021

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
DETS Report No: 20-15070	Date Sampled	16/12/20	16/12/20	16/12/20	16/12/20	16/12/20
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS1	WS1	WS2	WS3	WS4
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/4178.12545	Depth (m)	0.30	0.90 - 1.00	0.30	0.60 - 0.70	0.30
Reporting Date: 05/01/2021	DETS Sample No	517494	517495	517496	517497	517498

Determinand	Unit	RL	Accreditation					
Stone Content	%	< 0.1	NONE	< 0.1		< 0.1		< 0.1
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected		Not Detected		Not Detected
pH	pH Units	N/a	MCERTS	8.4	8.4	7.9	8.3	8.1
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	15	< 10	10	< 10	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.02	< 0.01	0.01	< 0.01	< 0.01
Organic Matter	%	< 0.1	MCERTS	2.2		3.1		2.1
Arsenic (As)	mg/kg	< 2	MCERTS	15		14		11
Barium (Ba)	mg/kg	< 2.5	MCERTS	135		217		97
Beryllium (Be)	mg/kg	< 0.5	MCERTS	1.1		1		0.9
W/S Boron	mg/kg	< 1	NONE	< 1		< 1		< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE	0.5		0.5		0.4
Chromium (Cr)	mg/kg	< 2	MCERTS	22		31		23
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2		< 2		< 2
Copper (Cu)	mg/kg	< 4	MCERTS	60		45		34
Lead (Pb)	mg/kg	< 3	MCERTS	319		191		195
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1		< 1		< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	17		21		16
Selenium (Se)	mg/kg	< 2	MCERTS	< 3		< 3		< 3
Vanadium (V)	mg/kg	< 1	MCERTS	38		41		35
Zinc (Zn)	mg/kg	< 3	MCERTS	196		202		96
Total Phenols (monohydric)	mg/kg	< 2	NONE					
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS	< 10		< 10		< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate						
DETS Report No: 20-15070	Date Sampled	16/12/20	16/12/20	16/12/20	16/12/20	16/12/20
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS4	WS5	WS6	WS6	WS7
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/4178.12545	Depth (m)	0.60 - 0.70	0.50 - 0.60	0.30	0.90 - 1.00	0.30
Reporting Date: 05/01/2021	DETS Sample No	517499	517500	517501	517502	517503

Determinand	Unit	RL	Accreditation					
Stone Content	%	< 0.1	NONE			< 0.1		< 0.1
Asbestos Screen ^(S)	N/a	N/a	ISO17025			Not Detected		Not Detected
pH	pH Units	N/a	MCERTS	8.3	8.3	8.1	8.2	8.3
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Organic Matter	%	< 0.1	MCERTS			2.2		2
Arsenic (As)	mg/kg	< 2	MCERTS			11		10
Barium (Ba)	mg/kg	< 2.5	MCERTS			92		83
Beryllium (Be)	mg/kg	< 0.5	MCERTS			0.9		0.9
W/S Boron	mg/kg	< 1	NONE			< 1		< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE			0.4		0.4
Chromium (Cr)	mg/kg	< 2	MCERTS			24		23
Chromium (hexavalent)	mg/kg	< 2	NONE			< 2		< 2
Copper (Cu)	mg/kg	< 4	MCERTS			41		30
Lead (Pb)	mg/kg	< 3	MCERTS			185		300
Mercury (Hg)	mg/kg	< 1	MCERTS			< 1		< 1
Nickel (Ni)	mg/kg	< 3	MCERTS			18		15
Selenium (Se)	mg/kg	< 2	MCERTS			< 3		< 3
Vanadium (V)	mg/kg	< 1	MCERTS			36		34
Zinc (Zn)	mg/kg	< 3	MCERTS			81		71
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2				
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS			< 10		< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate						
DETS Report No: 20-15070	Date Sampled	16/12/20	17/12/20	17/12/20	17/12/20	17/12/20
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS7	WS8	WS8	WS9	WS9
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/4178.12545	Depth (m)	0.60 - 0.70	1.40 - 1.50	0.30	0.30	1.10 - 1.20
Reporting Date: 05/01/2021	DETS Sample No	517504	517505	517506	517507	517508

Determinand	Unit	RL	Accreditation				
Stone Content	%	< 0.1	NONE			35.7	< 0.1
Asbestos Screen ^(S)	N/a	N/a	ISO17025			Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	8.3		8.2	8.2
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	12		< 10	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.01		< 0.01	< 0.01
Organic Matter	%	< 0.1	MCERTS			1.7	1.8
Arsenic (As)	mg/kg	< 2	MCERTS			7	8
Barium (Ba)	mg/kg	< 2.5	MCERTS			67	75
Beryllium (Be)	mg/kg	< 0.5	MCERTS			0.6	0.7
W/S Boron	mg/kg	< 1	NONE			< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE			0.3	0.4
Chromium (Cr)	mg/kg	< 2	MCERTS			15	21
Chromium (hexavalent)	mg/kg	< 2	NONE			< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS			21	25
Lead (Pb)	mg/kg	< 3	MCERTS			159	168
Mercury (Hg)	mg/kg	< 1	MCERTS			< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS			12	14
Selenium (Se)	mg/kg	< 2	MCERTS			< 3	< 3
Vanadium (V)	mg/kg	< 1	MCERTS			23	30
Zinc (Zn)	mg/kg	< 3	MCERTS			55	67
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2			
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS			< 10	< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate						
DETS Report No: 20-15070	Date Sampled	17/12/20	17/12/20			
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS10	WS12			
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied			
Order No: GES/4178.12545	Depth (m)	0.30	0.30			
Reporting Date: 05/01/2021	DETS Sample No	517509	517510			

Determinand	Unit	RL	Accreditation				
Stone Content	%	< 0.1	NONE	< 0.1	< 0.1		
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	8.1	8.1		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	< 10	< 10		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	< 0.01	< 0.01		
Organic Matter	%	< 0.1	MCERTS	2.1	3.2		
Arsenic (As)	mg/kg	< 2	MCERTS	11	14		
Barium (Ba)	mg/kg	< 2.5	MCERTS	164	210		
Beryllium (Be)	mg/kg	< 0.5	MCERTS	1	1.4		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	NONE	0.5	0.6		
Chromium (Cr)	mg/kg	< 2	MCERTS	27	27		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	40	47		
Lead (Pb)	mg/kg	< 3	MCERTS	289	424		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	18	24		
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3		
Vanadium (V)	mg/kg	< 1	MCERTS	37	47		
Zinc (Zn)	mg/kg	< 3	MCERTS	125	145		
Total Phenols (monohydric)	mg/kg	< 2	NONE				
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS	< 10	< 10		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 20-15070	Date Sampled	16/12/20	16/12/20	16/12/20	16/12/20	16/12/20
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS1	WS2	WS4	WS6	WS7
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/4178.12545	Depth (m)	0.30	0.30	0.30	0.30	0.30
Reporting Date: 05/01/2021	DETS Sample No	517494	517496	517498	517501	517503

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.53	0.37	1.40	0.77	0.88
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.18	< 0.1	0.13
Fluoranthene	mg/kg	< 0.1	MCERTS	1.55	1.04	2.99	2.07	1.92
Pyrene	mg/kg	< 0.1	MCERTS	1.36	0.93	2.58	1.82	1.72
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.78	0.52	1.18	0.92	0.81
Chrysene	mg/kg	< 0.1	MCERTS	0.77	0.53	1.18	0.93	0.71
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.93	0.63	1.31	1.10	0.80
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.37	0.30	0.52	0.38	0.28
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.73	0.46	1.05	0.75	0.61
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.48	0.31	0.54	0.41	0.32
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.38	0.25	0.49	0.40	0.28
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	7.9	5.3	13.4	9.5	8.5



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 20-15070	Date Sampled	17/12/20	17/12/20	17/12/20	17/12/20	
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS8	WS9	WS10	WS12	
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: GES/4178.12545	Depth (m)	0.30	0.30	0.30	0.30	
Reporting Date: 05/01/2021	DETS Sample No	517506	517507	517509	517510	

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.62	0.18	1.64	1.52
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.19	0.15
Fluoranthene	mg/kg	< 0.1	MCERTS	2.03	0.53	4.63	4.31
Pyrene	mg/kg	< 0.1	MCERTS	1.83	0.46	3.99	3.58
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.98	0.29	1.99	1.75
Chrysene	mg/kg	< 0.1	MCERTS	0.91	0.30	1.91	1.74
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	1.01	0.42	2.35	2.05
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.37	0.13	0.89	0.77
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.78	0.29	1.84	1.54
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.39	0.18	0.94	0.81
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.21	0.19
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.38	0.18	0.90	0.73
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	9.3	2.9	21.5	19.2



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Soil Analysis Certificate - EPH Banded (Type D)						
DETS Report No: 20-15070	Date Sampled	16/12/20	16/12/20	16/12/20	16/12/20	16/12/20
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS1	WS2	WS4	WS6	WS7
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/4178.12545	Depth (m)	0.30	0.30	0.30	0.30	0.30
Reporting Date: 05/01/2021	DETS Sample No	517494	517496	517498	517501	517503

Determinand	Unit	RL	Accreditation					
EPH (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C12 - C16)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C16 - C21)	mg/kg	< 1	MCERTS	5	3	11	7	7
EPH (>C21 - C35)	mg/kg	< 6	NONE	14	12	21	17	13
EPH (C8 - C35)	mg/kg	< 6	NONE	20	15	32	24	20



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Soil Analysis Certificate - EPH Banded (Type D)						
DETS Report No: 20-15070	Date Sampled	17/12/20	17/12/20	17/12/20	17/12/20	
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Elizabeth Huggins Cottages, Gravesend	TP / BH No	WS8	WS9	WS10	WS12	
Project / Job Ref: 12545	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: GES/4178.12545	Depth (m)	0.30	0.30	0.30	0.30	
Reporting Date: 05/01/2021	DETS Sample No	517506	517507	517509	517510	

Determinand	Unit	RL	Accreditation					
EPH (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	
EPH (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	
EPH (>C12 - C16)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	
EPH (>C16 - C21)	mg/kg	< 1	MCERTS	7	< 1	16	14	
EPH (>C21 - C35)	mg/kg	< 6	NONE	15	< 6	33	30	
EPH (C8 - C35)	mg/kg	< 6	NONE	23	< 6	50	45	

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

DETS Report No: 20-15070		Date Sampled	17/12/20			Landfill Waste Acceptance Criteria Limits		
Ground & Environmental Services Ltd		Time Sampled	None Supplied					
Site Reference: Elizabeth Huggins Cottages, Gravesend		TP / BH No	WAC Composite 1					
Project / Job Ref: 12545		Additional Refs	None Supplied					
Order No: GES/4178.12545		Depth (m)	None Supplied					
Reporting Date: 05/01/2021		DETS Sample No	517512					
Determinand	Unit	MDL				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
TOC ^{MU}	%	< 0.1	0.6			3%	5%	6%
Loss on Ignition	%	< 0.01	1.90			--	--	10%
BTEX ^{MU}	mg/kg	< 0.05	< 0.05			6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1			1	--	--
Mineral Oil ^{MU}	mg/kg	< 10	< 10			500	--	--
Total PAH ^{MU}	mg/kg	< 1.7	< 1.7			100	--	--
pH ^{MU}	pH Units	N/a	8.1			--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	3.2			--	To be evaluated	To be evaluated
Eluate Analysis			2:1 mg/l	8:1 mg/l	Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic ^U		< 0.01	< 0.01		< 0.2	0.5	2	25
Barium ^U		< 0.02	< 0.02		0.2	20	100	300
Cadmium ^U		< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium ^U		< 0.005	< 0.005		< 0.20	0.5	10	70
Copper ^U		0.02	0.02		< 0.5	2	50	100
Mercury ^U		< 0.0005	< 0.0005		< 0.005	0.01	0.2	2
Molybdenum ^U		0.008	0.004		< 0.1	0.5	10	30
Nickel ^U		< 0.007	< 0.007		< 0.2	0.4	10	40
Lead ^U		0.018	< 0.005		< 0.2	0.5	10	50
Antimony ^U		< 0.005	< 0.005		< 0.05	0.06	0.7	5
Selenium ^U		< 0.005	< 0.005		< 0.05	0.1	0.5	7
Zinc ^U		0.008	< 0.005		< 0.2	4	50	200
Chloride ^U		5	9			800	15000	25000
Fluoride ^U		< 0.5	< 0.5		< 1	10	150	500
Sulphate ^U		5	7		71	1000	20000	50000
TDS		115	124		1229	4000	60000	100000
Phenol Index		< 0.01	< 0.01		< 0.5	1	-	-
DOC		11.1	14.3		139	500	800	1000
Leach Test Information								
Sample Mass (kg)			0.20					
Dry Matter (%)			89.5					
Moisture (%)			11.8					
Stage 1								
Volume Eluate L2 (litres)			0.33					
Filtered Eluate VE1 (litres)			0.21					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
 Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepancies with current legislation
 M Denotes MCERTS accredited test
 U Denotes ISO17025 accredited test

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

DETS Report No: 20-15070		Date Sampled	17/12/20			Landfill Waste Acceptance Criteria Limits		
Ground & Environmental Services Ltd		Time Sampled	None Supplied					
Site Reference: Elizabeth Huggins Cottages, Gravesend		TP / BH No	WAC Composite 2					
Project / Job Ref: 12545		Additional Refs	None Supplied					
Order No: GES/4178.12545		Depth (m)	None Supplied					
Reporting Date: 05/01/2021		DETS Sample No	517513					
Determinand	Unit	MDL				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
TOC ^{MU}	%	< 0.1	0.6			3%	5%	6%
Loss on Ignition	%	< 0.01	1.40			--	--	10%
BTEX ^{MU}	mg/kg	< 0.05	< 0.05			6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1			1	--	--
Mineral Oil ^{MU}	mg/kg	< 10	< 10			500	--	--
Total PAH ^{MU}	mg/kg	< 1.7	< 1.7			100	--	--
pH ^{MU}	pH Units	N/a	8.2			--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1			--	To be evaluated	To be evaluated
Eluate Analysis			2:1 mg/l	8:1 mg/l	Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic ^U		< 0.01	< 0.01		< 0.2	0.5	2	25
Barium ^U		< 0.02	< 0.02		< 0.1	20	100	300
Cadmium ^U		< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium ^U		< 0.005	< 0.005		< 0.20	0.5	10	70
Copper ^U		0.01	0.02		< 0.5	2	50	100
Mercury ^U		< 0.0005	< 0.0005		< 0.005	0.01	0.2	2
Molybdenum ^U		0.020	0.008		< 0.1	0.5	10	30
Nickel ^U		< 0.007	< 0.007		< 0.2	0.4	10	40
Lead ^U		< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony ^U		< 0.005	< 0.005		< 0.05	0.06	0.7	5
Selenium ^U		< 0.005	< 0.005		< 0.05	0.1	0.5	7
Zinc ^U		0.006	< 0.005		< 0.2	4	50	200
Chloride ^U		3	8		77	800	15000	25000
Fluoride ^U		< 0.5	< 0.5		< 1	10	150	500
Sulphate ^U		6	7		72	1000	20000	50000
TDS		91	97		964	4000	60000	100000
Phenol Index		< 0.01	< 0.01		< 0.5	1	-	-
DOC		9.2	13.5		131	500	800	1000
Leach Test Information								
Sample Mass (kg)			0.20					
Dry Matter (%)			88.3					
Moisture (%)			13.4					
Stage 1								
Volume Eluate L2 (litres)			0.33					
Filtered Eluate VE1 (litres)			0.18					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
 Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepancies with current legislation
 M Denotes MCERTS accredited test
 U Denotes ISO17025 accredited test



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 20-15070
Ground & Environmental Services Ltd
Site Reference: Elizabeth Huggins Cottages, Gravesend
Project / Job Ref: 12545
Order No: GES/4178.12545
Reporting Date: 05/01/2021

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
517494	WS1	None Supplied	0.30	12.8	Brown sandy clay with vegetation and stones
517495	WS1	None Supplied	0.90 - 1.00	13.9	Brown clayey sand with gravel and stones
517496	WS2	None Supplied	0.30	12.8	Brown sandy clay with vegetation and gravel
517497	WS3	None Supplied	0.60 - 0.70	12.4	Brown clay with vegetation
517498	WS4	None Supplied	0.30	15.1	Brown sandy clay with vegetation
517499	WS4	None Supplied	0.60 - 0.70	8.6	Brown sandy clay with vegetation and stones
517500	WS5	None Supplied	0.50 - 0.60	10.7	Brown sandy clay
517501	WS6	None Supplied	0.30	15.2	Brown sandy clay with vegetation and stones
517502	WS6	None Supplied	0.90 - 1.00	13.9	Brown sandy clay
517503	WS7	None Supplied	0.30	14.9	Brown sandy clay with vegetation
517504	WS7	None Supplied	0.60 - 0.70	15.6	Brown sandy clay
517505	WS8	None Supplied	1.40 - 1.50	9.4	Brown sandy clay with stones
517506	WS8	None Supplied	0.30	13.9	Brown sandy clay with vegetation
517507	WS9	None Supplied	0.30	14.4	Brown sandy clay with vegetation
517508	WS9	None Supplied	1.10 - 1.20	12.4	Brown sandy clay
517509	WS10	None Supplied	0.30	14.2	Brown sandy clay with gravel
517510	WS12	None Supplied	0.30	15.6	Brown sandy clay with gravel
517512	WAC Composite 1	None Supplied	None Supplied	10.5	Brown sandy clay with gravel and vegetation
517513	WAC Composite 2	None Supplied	None Supplied	11.8	Brown sandy clay with gravel

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{1/5}

Unsuitable Sample ^{1/5}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 20-15070

Ground & Environmental Services Ltd

Site Reference: Elizabeth Huggins Cottages, Gravesend

Project / Job Ref: 12545

Order No: GES/4178.12545

Reporting Date: 05/01/2021

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Parameter	Matrix Type	Suite Reference	Expanded Uncertainty Measurement	Unit
TOC	Soil	BS EN 12457	13.49	%
Loss on Ignition	Soil	BS EN 12457	17	%
BTEX	Soil	BS EN 12457	14	%
Sum of PCBs	Soil	BS EN 12457	23	%
Mineral Oil	Soil	BS EN 12457	9	%
Total PAH	Soil	BS EN 12457	20	%
pH	Soil	BS EN 12457	0.399	Units
Acid Neutralisation Capacity	Soil	BS EN 12457	18	%
Arsenic	Leachate	BS EN 12457	16.63	%
Barium	Leachate	BS EN 12457	14.29	%
Cadmium	Leachate	BS EN 12457	14.44	%
Chromium	Leachate	BS EN 12457	18.06	%
Copper	Leachate	BS EN 12457	21.27	%
Mercury	Leachate	BS EN 12457	24.13	%
Molybdenum	Leachate	BS EN 12457	12.55	%
Nickel	Leachate	BS EN 12457	20.08	%
Lead	Leachate	BS EN 12457	13.43	%
Antimony	Leachate	BS EN 12457	18.85	%
Selenium	Leachate	BS EN 12457	18.91	%
Zinc	Leachate	BS EN 12457	13.71	%
Chloride	Leachate	BS EN 12457	16	%
Fluoride	Leachate	BS EN 12457	19.4	%
Sulphate	Leachate	BS EN 12457	19.63	%
TDS	Leachate	BS EN 12457	12	%
Phenol Index	Leachate	BS EN 12457	14	%
DOC	Leachate	BS EN 12457	10	%
Clay Content	Soil	BS 3882: 2015	15	%
Silt Content	Soil	BS 3882: 2015	14	%
Sand Content	Soil	BS 3882: 2015	13	%
Loss on Ignition	Soil	BS 3882: 2015	17	%
pH	Soil	BS 3882: 2015	0.399	Units
Carbonate	Soil	BS 3882: 2015	16	%
Total Nitrogen	Soil	BS 3882: 2015	12	%
Phosphorus (Extractable)	Soil	BS 3882: 2015	24	%
Potassium (Extractable)	Soil	BS 3882: 2015	20	%
Magnesium (Extractable)	Soil	BS 3882: 2015	26	%
Zinc	Soil	BS 3882: 2015	14.9	%
Copper	Soil	BS 3882: 2015	16	%
Nickel	Soil	BS 3882: 2015	17.7	%
Available Sodium	Soil	BS 3882: 2015	23	%
Available Calcium	Soil	BS 3882: 2015	23	%
Electrical Conductivity	Soil	BS 3882: 2015	10	%



APPENDIX 8
GUIDELINES ON CONTAMINANT LEVELS

Guidelines on Contamination Levels.

Human Health

CLEA Soil Guideline values (SGV)

The UK's primary contaminated land guidance is contained within the Contaminated Land Exposure Assessment (CLEA) framework. Within this framework a number of Soil Guideline Values (SGVs) were published for key contaminants along with toxicological guideline values relating to intake thresholds. The soil guideline values provided by the CLEA model represent intervention values for end uses based upon potential human exposure and soil concentrations of a contaminant above these values might represent an unacceptable risk to the health of the site users. The Environment Agency had an ongoing programme of SGV publication with associated toxicological information for key contaminants. Where SGVs are available then they should be used as the basis for any human health risk assessment.

All CLEA SGVs were withdrawn for use by the Environment Agency in 2008 whilst they are under review and pending the availability of new toxicological data. To date, new SGV values have been set for benzene, toluene, ethylbenzene and xylene and mercury and selenium. In the absence of the new SGVs and toxicological report data, GES have used appropriate screening tools or Generic Assessment Criteria Levels as assessment criteria guidelines for those determinands not currently assigned SGVs. It should be noted that the former SGVs for metals were in general agreement with those site specific levels generated by RBCA and other similar computer model based risk assessment tools.

The GES screening assessment of contaminants within samples has been carried out using these model generated values in the absence of any other values or guidelines. The version of the CLEA model, v1.06, was used. The published SGVs are shown below. Nickel SGV has been withdrawn (2015) pending an assessment of the toxicological data used in the model for nickel. Published SGV values.

Land use	Soil Guideline Value (mg kg ⁻¹)		
	Residential	Allotment	Commercial
Inorganic arsenic	32	43	640
Nickel	130	230	1,800
Cadmium	10	1.8	230
Phenol	420	280	3200
Elemental Hg	1	26	26
Inorganic Hg	170	80	3600
Methyl Hg	11	8	410
Selenium	350	120	13,000
Benzene	0.33	0.07	95
Toluene	610	120	4400
Ethylbenzene	350	90	2800
o-Xylene	250	160	2600
r-Xylene	240	180	3500
m-Xylene	230	160	3200

Based on a sandy loam soil as defined in Environment Agency (2009b) and 6% SOM.



Guidelines on Contamination Levels.

DEFRA Category four screening level (C4SL)

In addition to the SGVs, guideline screening values proposed in the DEFRA document SP1010- Development of Category 4 Screening Levels for Assessment of Land affected by Contamination Final Project Report (C4SL) are considered along with the suitable for use levels (S4USL) derived by the Chartered Institute of Environmental Health (CIEH) in partnership with the Land Quality Management Organization (LQM). The screening levels are given for residential, commercial, allotment or public open space end uses.

PARAMETER	Residential		Commercial	Allotment	Public open Space near residential POS _{resi}	Public park land POS _{park}	Sources
	With Plant uptake	Without Plant uptake					
Inorganics - mg/kg unless stated							
Arsenic (inorganic)	37	40	640	49	79	170	DEFRA C4SL
Beryllium	1.7	1.7	12	35	2.2	63	LQM/S4USL
Boron	290	11,000	240,000	45	21,000	46,000	LQM/CIEH
Cadmium	22	150	410	3.9	220	880	LQM/S4USL
Chromium III	910	910	8,600	18,000	1,500	33,000	LQM/CIEH
Chromium VI	21	21	49	170	21	250	LQM/S4USL
Copper	2,400	7,100	68,000	520	12,000	44,000	LQM/CIEH
lead	200	310	2,300	80	630	1,300	DEFRA C4SL
Mercury (Inorganic)	40	56	1,100	19	120	240	LQM/CIEH
Nickel	180	180	980	230	230	3,400	LQM/CIEH
Selenium	250	430	12,000	88	1,100	1,800	LQM/CIEH
Vanadium	410	1,200	9,000	91	2,000	5,000	LQM/CIEH
Zinc	3,700	40,000	730,000	620	81,000	170,000	LQM/CIEH
Total sulphate	2400	2400	2400	2400	2400	2400	BRE (2005)
Water-soluble sulphate (g/l)	0.5	0.5	0.5	0.5	0.5	0.5	BRE (2005)
pH	<5	<5	<5	<5	<5	<5	-

CLEA does not currently provide guidance for total Polycyclic Aromatic Hydrocarbons (PAHs). A standalone Defra C4SL for benzo(a)pyrene has been assigned and is shown below. In addition, the Chartered Institute of Environmental Health (CIEH) in partnership with the Land Quality Management Organization (LQM) used CLEA software to derive Generic Assessment Criteria (GAC) and Assessment Sub Criteria (ASC) for the following PAH compounds:



Guidelines on Contamination Levels.

PARAMETER	Residential												PO S resi	PO S park	Source
	With Plant uptake			Without Plant uptake											
	SOM %	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5			
Organics - mg/kg unless stated															
Acenaphthene	200	490	1080	2000	3600	5200	75000	92000	100000	34	85	202			CLEA/LQM CIEH
Acenaphthylene	170	400	900	2000	3600	5200	76000	92000	100000	28	68	163			CLEA/LQM CIEH
Anthracene	2300	5400	10700	30000	34000	36000	520000	530000	540000	380	947	2230			CLEA/LQM CIEH
Benzo(a)anthracene	7.5	11	13	12	14	15	170	170	180	2.9	6.5	13			CLEA/LQM CIEH
Benzo(a)pyrene C4SL			5			5.3			77			5.7	10	21	DEFRA C4SL
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	44	45	45	1	2.2	3.9			CLEA/LQM CIEH
Benzo(g,h,i)perylene	315	340	350	360	360	360	3900	4000	4000	290	480	646			CLEA/LQM CIEH
Benzo(k)fluoranthene	77	93	100	110	110	110	1200	1200	1200	37	76	129			CLEA/LQM CIEH
Chrysene	15	22	27	30	31	32	350	350	350	4.1	9.5	19			CLEA/LQM CIEH
Dibenzo(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	3.5	3.6	3.6	0.14	0.27	0.44			CLEA/LQM CIEH
Fluoranthene	280	560	890	1500	1600	1600	23000	23000	23000	52	127	288			CLEA/LQM CIEH
Fluorene	165	390	850	2200	3400	4200	60000	67000	70000	27	67	158			CLEA/LQM CIEH
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	500	510	510	9.5	21	40			CLEA/LQM CIEH
Naphthalene	1	2.3	5.5	1	2.4	6	100	260	600	4	9.8	23			CLEA/LQM CIEH
Phenanthrene	95	220	440	1300	1400	1500	22000	22000	23000	15	38	90			CLEA/LQM CIEH
Pyrene	620	1200	2000	3700	3800	3800	54000	54000	55000	11	271	620			CLEA/LQM CIEH

Petroleum Hydrocarbons represent a complex situation being a mixture of a range of compounds, the relative concentrations of which may change over time.

As discussed above, Generic Assessment Criteria (GAC) for total petroleum hydrocarbons according to both their molecular weight and chemical structure and also for a range of soil organic matter (SOM) content values have been derived using CLEA software.

The LQM CIEH GACs are again presented according to their soil organic matter content and proposed end use of the land. The generic assessment criteria for a 1%, 2.5% and 6% SOM content are tabulated below and presented according to the proposed end use.



Guidelines on Contamination Levels.

SOM %	LQM CIEH Generic Assessment Criteria (mg/kg dry weight soil)											
	Residential						Allotment Land Use			Commercial Land Use		
	With Plant Uptake			Without Plant Uptake								
	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6
Aliphatic												
EC 5 – 6	24	40	80	24	40	80	752	1730	3900	2400	4000	8000
EC > 6 – 8	52	110	250	52	110	250	2304	5580	13000	5200	11000	25000
EC > 8 – 10	13	30	70	13	30	70	321	770	1700	1300	3000	7000
EC > 10 – 12	60	150	360	60	150	360	2153	4300	7150	6000	15000	32000
EC > 12 – 16	500	1200	2600	500	1200	2600	10800	12400	13200	42000	72000	90000
EC > 16 – 35	4100 0	6900 0	94000	41000	6900 0	9400 0	240000	260000	260000	140000	160000	180000
EC > 35 – 44	4100 0	6900 0	94000	41000	6900 0	9400 0	240000	260000	260000	140000	160000	180000
Aromatic												
EC 5 – 7 (benzene)	50	110	240	155	300	630	12	25	57	15000	28000	55000
EC > 7 – 8 (toluene)	100	240	550	370	800	1800	21	50	117	33000	68000	130000
EC > 8 – 10	20	50	110	20	53	125	8.6	21	50	2000	5000	120000
EC > 10 – 12	63	150	340	120	280	650	12.5	31	74	11000	22000	31000
EC > 12 – 16	140	320	660	1100	1900	2300	23	57	134	35000	37000	38000
EC > 16 – 21	260	540	930	1800	1900	1900	47	112	260	28000	28000	28000
EC > 21 – 35	1100	1400	1700	1900	1900	1900	370	820	1500	28000	28000	28000
EC > 35 – 44	1100	1400	1700	1900	1900	1900	370	820	1500	28000	28000	28000
											POS _{re} si	POS _p ark
Benzene DEFRA C4SL	0.06	0.13	0.3 (0.87)	0.16	0.3	0.64 (3.3)	0.016	0.033	0.073 (0.18)	15	28	57 (98)
Toluene	104	240	550	370	830	1800	22	50	117	33000	68000	130000
Ethylbenzene	30	62	150	34	81	190	16	38	91	3200	7000	16000
o-xylene	30	70	170	40	90	200	28	67	160	3700	8000	19000
m-xylene	30	70	160	34	80	190	30	74	170	3400	8000	18000
p-xylene	30	70	160	33	80	180	28	69	160	3200	8000	17000

TPH values calculated using CLEA v1.06 with parameter changes in accord with DEFRA (2014) C4SL and LQM/CIEH (2015)

Inert Material

The limit values for inert waste are given in the EC Landfill Directive 1999/31/EC as applied under the Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (SI 2019/39) and as defined by the council decision establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC(2003/33/EC).

The regulations and associated guidance provide waste acceptance criteria, which set the limits of contaminants permitted in various waste categories going to landfill. These criteria are of particular use where CLEA guidance or DEFRA Screening values has not yet been provided.



Guidelines on Contamination Levels.

Inert waste is defined as waste which contains insignificant potential for pollution and does not endanger the quality of surface water or groundwater. The Landfill Directive states that inert waste will not adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health.

For risk assessment purposes we would consider that any materials (soils) containing concentrations of potential contaminants that would result in them being classified as inert would be considered as uncontaminated and therefore representing a low risk to human health.

Similarly, such material would not be considered to represent a significant risk to water resources.

Where CLEA or Defra screening values exist, these would always be used in preference to inert waste values when assessing risks to human health.

Selected inert waste acceptance criteria as given in Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills for the Landfill Directive are given below.

Landfill acceptance criteria for inert waste (mg/kg)	
Total organic carbon (TOC)	30,000
BTEX compounds	6
Mineral oils (C10 – C40)	500
PCBs	1
PAH	100

Risks to Plants

The CLEA framework does not provide a method for the assessment of phytotoxic risks to plants. However maximum permissible concentrations have been published in the Sludge (Use in Agriculture) Regulations 1989 (SI 1989, No. 1263). This legislation enforces the provisions of the EC Directive 86/278/EEC for potentially toxic elements (PTEs) on soils for agricultural use where sewage sludge has been applied (see table below). These limits relate to the potential risk to plants and not human health for which CLEA is the overriding risk assessment model.

Maximum permissible concentration in agricultural soils following sewage sludge application (mg/kg).				
	pH 5.0<5.5	pH 5.5<6.0	pH 6.0-7.0	pH >7.0
Zinc	200	250	300	450
Copper	80	100	135	200
Nickel	50	60	75	110



Guidelines on Contamination Levels.

Risks to buried concrete

The potential risks to buried concrete can be assessed by reference to the BRE Special Digest 1 (SD1) entitled 'Concrete in Aggressive Ground'. This document provides a methodology for the specification of concrete based on the ground conditions encountered and is based upon chemical analysis and associated factors (e.g. groundwater). The guidance provides a Design Sulphate Class (DS) based upon the ground conditions and it is considered that a low concentration of sulphate and pH (i.e. DS – 1 and DS – 2) is considered to represent a low risk to buildings.

Risks to buried services

In addition, where water is supplied in plastic pipes which could come into contact with contaminated ground then this can lead to premature failures, resulting in leakage and loss of water quality. Risks to water supply pipes are assessed using guidance published by the UK Water Industry Research (UKWIR) entitled '*Guidance for the Selection of Water Pipes to be used in Brownfield Sites*' (Report Ref. No. 10/WM/03/21). This is known as the UKWIR guidance.

Previous guidance from WRAS has been withdrawn but may still be in use by certain water supply companies. In general water companies have adopted a common set of guidelines as given in the ***Contaminated Land Assessment Guidance from January 2014***.

Additional threshold values for determining pipe material have also been published by certain water supply companies. If these threshold values are exceeded then consideration should be given to the selection of pipe material or to the use of barrier pipes. The UKWIR threshold values, together with those of certain water supply companies are presented in the table below for a range of potential hazards.

Guidelines on Contamination Levels.

Substance ⁽¹⁾	Water UK Guidance	Thames Water
Total VOC	0.5	-
Total BTEX & MTBE	0.1	0.1 or either
Total SVOC	2	-
EC5-EC10 aliphatic and aromatic hydrocarbons	2	-
EC5-EC12 aliphatic hydrocarbons		0.5
EC5-EC12 aromatic hydrocarbons		0.5
EC10-EC16 aliphatic and aromatic hydrocarbons	10	-
EC12-EC21 aliphatic hydrocarbons		10
EC12-EC21 aromatic hydrocarbons		10
EC16-EC40 aliphatic and aromatic hydrocarbons	500	-
EC21-EC35 aliphatic hydrocarbons		500
EC21-EC35 aromatic hydrocarbons		500
Phenols	2	5*
Cresols and chlorinated phenols	2	2
Naphthalene	-	5
Ethers	0.5	-
Nitrobenzene	0.5	-
Ketones	0.5	-
Aldehydes	0.5	-
Amines	0	-
Corrosives pH and EC	#	
	##	

All units mg kg⁻¹ in soil;

pH <7 for wrapped steel, pH <5 wrapped ductile iron and copper and ##EC >400μS/cm;

*Phenol limit at 2mg/kg in presence of BTEX.



APPENDIX 9

STATISTICS CALCULATOR DATA TEST RESULT SHEET

Test Results

Lead

Client/client ref: Stonechart Dev Site ref: Elizabeth Huggins Cottages, Gravesend

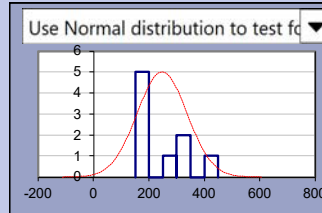
Date: 03-Feb-2021

Project ref: 12545

Data description:

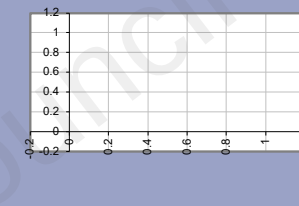
User details: PAD

Dataset:	Lead	
Sample mean	$\bar{X}$	247.78
Sample standard deviation, s		89.965
Sample size, n		9
Critical concentration, Cc		200



Outliers & non-detects

Outliers present?	No
Significance level	5%
Outliers excluded	0
Non-detects	0

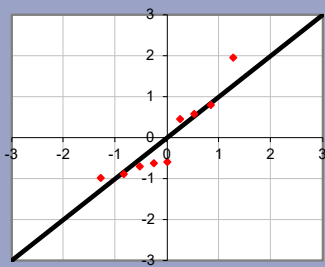


Normality test

Significance level: 5%

Normal distribution

Use: Auto: One-sample t-test

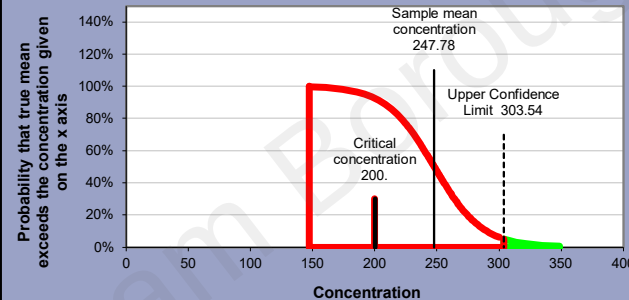


Test scenario:

Planning: is true mean lower than critical concentration ($\mu < C_c$)?

Null hypothesis: The true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$

Alternative hypothesis: The true mean concentration is less than the critical concentration: $\mu < C_c$



Evidence against Null hypothesis:

7%

Base decision on: evidence level

Evidence level required: 95%

Balance of probability? N/A

Reject Null Hypothesis? No

$\mu \geq C_c$

Back to data

Back to summary

Go to outlier test

Go to normality test



APPENDIX 10

BRE COVER SYSTEM SPREADSHEET

600	mm
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[illegible]

Summary		
	Res with PU	RwPU
Number of contaminants	17	17
Number of contaminants with no thickness calculation	16	16
Breakdown - Number for which no TV specified	16	16
Breakdown - Number for which no soil specified	16	16
Breakdown - Number for which no cover specified	16	16
Breakdown - Number for which cover > TV	0	0
Number of contaminants with thickness calculation	1	1
Breakdown - Number for which no cover required	0	0
Breakdown - Number for which cover required	1	1
Overall thickness of cover required	359	562

Design Chart

- $C_c = 0.00 - 0.25 \times \text{Trigger levels}$
- $C_c = 0.25 - 0.50 \times \text{Trigger levels}$
- $C_c = 0.50 - 0.75 \times \text{Trigger levels}$
- $C_c = 0.75 - 1.00 \times \text{Trigger levels}$
- ▲ RwPU
- ▲ Res with PU

If site specific data for consideration should be given to the applicability of using a cover system

