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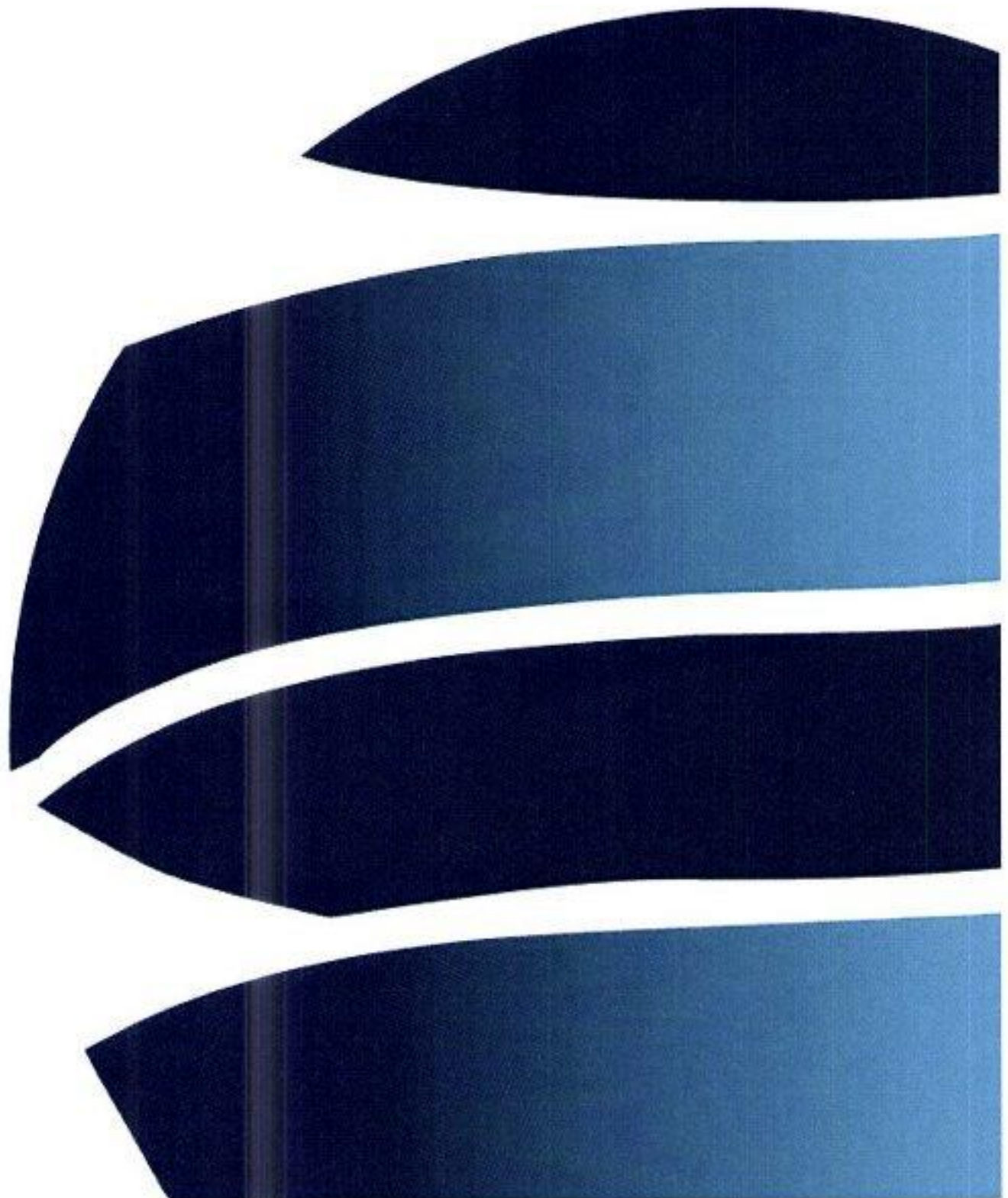
REMEDIATION METHOD STATEMENT

for the land at

BARTONS ROAD, HAVANT PO9 5NA

on behalf of

LINDEN HOMES SOUTH





Remediation Method Statement

Report:	REMEDIATION METHOD STATEMENT
Site:	BARTONS ROAD, HAVANT PO9 5NA
Client:	LINDEN HOMES SOUTH
Date:	27/09/2016
Reference:	GE15735-RMS-SEP16
Version:	1.1
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AMENDMENT RECORD

Revision ref.	Date	Reasons for amendment	Author's initials
1.0	12/07/2016	First issue	GR
1.1	24/09/2016	Amendments following supplementary investigation and LPA/EHO consultation	GR

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1.0 INTRODUCTION

1.1 General

Geo-Environmental Services Limited ('Geo-Environmental') was appointed by Linden Homes South, to formulate a remediation strategy in relation to the proposed residential development on land at Bartons Road, Havant PO9 5NA herein referred to as 'the site' (Figure 1).

The site has been the subject of a Phase I desk study and Phase II intrusive investigation undertaken and reported by Geo-Environmental (ref. GE15054/GIR/NOV15). Other phases of intrusive investigation have also been undertaken by Geo-Environmental on the subject site to inform geotechnical and structural design strategies of the development.

Following submission of the original draft of the Remediation Method Statement (RMS), ref. GE15735-RMS-JUL16, and comments received from the Environmental Control Officer (ECO) at the Local Planning Authority, a supplementary investigation was undertaken to target areas where soil contamination had previously been identified and assessed as isolated occurrences. The supplementary investigation targeted each of these locations and also an area of proposed 'cut', i.e. ground level reduction. The findings of the supplementary investigation, as presented in a letter report ref. GE15735/JT01/160729, have been incorporated into this updated RMS following further consultation with the ECO.

The investigations referred to above identified the presence of potential hazards and through a risk assessment process a series of pollutant linkages were identified which require action to mitigate or otherwise reduce the risk.

The remedial strategy has been developed to reflect the findings from all phases of the assessments undertaken on this site.

1.2 Objectives

The RMS sets out the proposed remedial works to be undertaken on the subject site to support its development for a residential end use.

1.3 Planning Permission

The following planning conditions relating to contamination, or which could impact on remediation proposals, have been imposed on the planning permission granted (ref. APP/14/00863) for the site:

24. Prior to the commencement of any specific phase of development approved by this planning permission (or such other date or stage in development as may be agreed in writing with the Local Planning Authority), a scheme to deal with the risks associated with the possible contamination shall be submitted to and approved in writing by the Local Planning Authority. That scheme shall include all of the following elements unless specifically excluded, in writing, by the Local Planning Authority.

1. A desk study &/or site walkover survey identifying:

- All previous uses,*
- potential contaminants associated with those uses,*
- a conceptual model of the site indicating sources, pathways and receptors, and;*
- a summary of potentially unacceptable risks arising from contamination at the site.*



2. A site investigation scheme based on (1), to provide sufficient information for an appropriate assessment of the risks to all receptors that may be affected, including those off site.
3. The results of the site investigation and risk assessment (2) and if appropriate, an options appraisal and remediation strategy based on these results giving full details of the remediation measures required and how they are to be undertaken.
4. A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in the remediation strategy in (3) are complete, identifying any requirements for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action.

All elements shall be adhered to unless agreed in writing by the Local Planning Authority.

Reason: Having due regard to policies and proposals E1 of the Hampshire County Structure plan 1996-2011 (Review), and DM10 of the Havant Borough Adopted Core Strategy (2011); Contamination may be present at the site as a result of both previous & current landuses (&/or activities) at the site that could pose a risk to future site occupiers.

25. If, during development, contamination not previously identified on site is found to be present, no further development (unless otherwise agreed in writing by the Local Planning Authority) shall be undertaken until a report has been submitted to and approved by the Local Planning Authority that details how that contamination is to be dealt with. Unless otherwise agreed in writing with the Local Planning Authority, all works outlined in the submitted report shall be adhered to.

Reason: Having due regard to policies and proposals E1 of the Hampshire County Structure plan 1996-2011 (Review), and DM10 of the Havant Borough Adopted Core Strategy (2011); Contamination may be present at the site as a result of both previous & current landuses (&/or activities) at the site that could pose a risk to future site occupiers.

26. No occupation of any part of the permitted development shall take place until a verification report has been submitted to and approved in writing by the Local Planning Authority.
The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan, and must demonstrate that site remediation criteria have been met. It shall also include any plan identified as being necessary for longer-term monitoring of pollutant linkages (a "long-term monitoring and maintenance plan"), including provision for maintenance and contingency action. The long-term monitoring and maintenance plan shall be implemented as approved."

Reason: Having due regard to policies and proposals E1 of the Hampshire County Structure plan 1996-2011 (Review), and DM10 of the Havant Borough Adopted Core Strategy (2011); Contamination may be present at the site as a result of both previous & current landuses (&/or activities) at the site that could pose a risk to future site occupiers.

It is understood from correspondence between the Contaminated Land Officer and Planning Officer that a partial discharge of Condition 24, i.e. relating to Clauses 1 and 2, was considered acceptable. This Remediation Method Statement sets out the strategy to facilitate the discharge, in due course, of the remainder of Condition 24 and also Conditions 25 and 26.

2.0 BACKGROUND

This RMS has been developed from the findings of the various phases of assessment. In addition, the remedial



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strategy has wherever feasible taken into account the Client's objective to retain and re-use site won materials where feasible as part of a general waste minimisation strategy. As such, this document should be read in conjunction with the Materials Management Plan (GE15735-MMP-JUL16).

A brief overview of salient findings of the reports is presented below. For further information, the individual reports should be referred to directly.

2.1 Overview

The site comprised an approximately rectangular parcel of land which had been the subject of several and consecutive uses including a lawn mower repair shop, houses, dog grooming/hydrotherapy pool, dog kennels and fields/paddocks.

The ground conditions beneath the site comprised a mantle of Made Ground and/or Topsoil overlying a succession of gravelly clay soils (Head Deposits) and predominantly clay soils of the London Clay Formation.

Investigation and testing of soils on site identified localised contaminant concentrations of concern within the Made Ground that were indicated to be unsuitable for re-use within residential gardens and associated soft landscaping. The assessment presented in GE15054/GIR/NOV15 and GE157.5/JT01/160729, included a statistical assessment of the full dataset of analytical results which led to the identification of WS2 as a localised area requiring further action. In addition, whilst individual determinant concentrations were below respective screening levels, the Made Ground soils from WS3 and WS5 were considered to be of generally poor quality. The recent review and revision of the soil contamination assessment is summarised in Section 4 of this report.

The intrusive investigation also identified the presence of asbestos within Made Ground sampled from WS5.

The investigations undertaken also considered and assessed ground gas and controlled waters contamination. In neither case was a requirement for remedial action identified to protect human health, the development, controlled waters or other receptors.

2.2 Proposed Site Use

The proposed development comprises the construction of a residential estate comprising detached and semi-detached residential dwellings with private gardens, access roads, parking, communal soft landscaping and associated infrastructure.

The site is located on sloping ground (falling towards the west and north-west) and in order to achieve the required development levels, it will be necessary to reduce ground levels in some areas whilst raising ground levels in others. As stated in Section 2.0, wherever possible and feasible, it was the developer's intention to retain and re-use site won materials, subject to suitability.

2.2 Conceptual Site model

Remediation works are proposed to break the identified plausible pollutant linkages associated with contaminants of concern above respective threshold levels within proposed gardens and residential soft landscaping areas thereby mitigating the associated risk of harm to human health. This would be achieved by undertaking a reduced dig, where required on site to achieve site development levels and/or the installation of a capping system where levels on site require raising to achieve development levels. These works would be monitored through observations and records providing a documentary evidence trail of the materials if removed from site. Validation works would be undertaken upon completion of the remediation works to demonstrate the thicknesses of reduce dig undertaken and or composition and thickness of the capping layer installed.



The aim of the remediation is not to remove all contamination identified on site but to reduce the identified risk to an acceptable level with respect to human health, the built environment and controlled waters.

3.0 GROUND GAS AND VAPOURS

The ground gas assessment undertaken did not identify any specific requirement for ground gas protection.

4.0 SOILS

The ground conditions on site have been established through several phases of intrusive investigation. In previously developed areas of the site, encountered soils comprised a mantle of Made Ground overlying gravelly clay of the Head Deposits overlying medium to high strength clay soils of the London Clay Formation. In areas not previously developed, Made Ground was not encountered and mantle of Topsoil was present overlying the natural subsoil.

Investigation and assessment of the site has identified areas of soil contamination which could require remedial action to protect key receptor groups.

4.1 Site Workers

It is the responsibility of the Principal Contractor and their appointed sub-contractors to implement and manage safe systems of work, prepare their own risk assessments in accordance with Health and Safety legislation in order to protect persons in their employ, as well as mitigate the risk of harm to others due to works in their control. Special consideration should be given to the provisions of the Construction (Design & Management) Regulations 2015, Health and Safety at Work Act and the Control of Substances Hazardous to Human Health regulations to protect the safety of persons in their employment. Additional guidance can be sought from the CIRIA publications entitled "A Guide for Safe Working on Contaminated Sites" and "Environmental Good Practice on site guide (fourth edition)".

In addition to the safe systems of works to be implemented alongside appropriate risk assessments and method statements, all site personnel shall benefit from on-site hygiene facilities including wash area, toilets and drying room.

Separate canteen area and welfare facilities should be provided. All eating and drinking should be restricted to the canteen area and only once site personnel have removed outer PPE and washed exposed skin.

In the event of dry spells, or where the exposed surface becomes dry, regular damping down of the surface of the site will be required to prevent the release of soil dust which could impact on site operatives or migrate off-site, thereby mitigating both off-site exposure and nuisance for neighbours.

4.2 End Users

This section should be read in conjunction with Figure 3 which indicates areas where specific remedial action or materials management are proposed.

Subsequent to the issue of the above referenced report, comments received from the Contaminated Land Officer have resulted in a revised assessment which considered the analytical results from Made Ground soils as a separate dataset (and averaging area) from natural soils. The results of the revised statistical assessment on Made Ground soils are presented in Appendix A. The revised assessment still indicated that the Made Ground at WS2 contained concentrations of several PAH compounds which were outliers compared with the remaining dataset.



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With reference to the relevant exploratory hole log, it would appear that the elevated PAH compounds could be due to the presence of bituminous fragments entrained within the Made Ground at this location. As such, the outcome of the update assessment was that the Made Ground around WS2 would be considered separately to the remainder of the site.

The statistical assessment of the remaining dataset, i.e. following the removal of outlier concentrations from WS2, indicated that the upper confidence limit concentrations were below the respective assessment criteria and that the 'null hypothesis' could be rejected in each case, i.e. the evidence level for each determinant exceeded 95%.

Cross reference of the exploratory hole locations with the development layout indicated that WS2 was located beneath the building footprints of Plots 7-8 and thus the presence of permanent hard cover serves to break the potential pollutant linkage associated with the reported PAH compound concentrations. However, recommendations were presented in the Ground Investigation Report for localised removal of Made Ground soils from the garden areas of Plots 7-8, validation sampling of exposed soils following the reduced dig and placement of suitable subsoil and Topsoil to achieve the required garden level.

With reference to the proposed development layout and post demolition topographic survey, a reduced dig of approximately 0.3m (average) is required in the garden areas to Plots 7-8 in order to achieve the proposed finished garden level. Finished garden levels on these plots are in the range 28.75-29.70m AOD. The base of the Made Ground encountered within WS2 was approximately 29.5m AOD and thus it would appear that the reduced dig required to achieve the finished garden levels would remove the majority of the Made Ground soils. Thus the remedial strategy for the gardens to Plots 7-8 is to extend the reduce dig to remove Made Ground soils from the lower/main garden areas and place suitable Topsoil or paving slabs on to the exposed subsoil. The exception on these plots would relate to the raised patio areas immediately to the rear of the houses which comprise a hard cover end use and where ground levels will be raised to 29.85 – 30.30m AOD, i.e. c. 1.0 – 1.4m above existing level, and thus the thickness of cover (uncontaminated bulk fill or structural fill) and presence of hard cover serve to break any potential exposure scenario.

Asbestos fibres (chrysotile and amosite) were identified within one location (WS5 at 0.2m and 0.5m bgl). With reference to the development layout, WS5 was located beneath the footprint of the house/garage on Plot 15 and thus the construction of permanent hard cover would serve to break any plausible exposure route thereby mitigating a risk of harm to human health. Nonetheless, if Made Ground was present within the garden area of Plot 15 and adjacent plots there is a potential exposure to soil and plausible potential risk of harm. However, in this area of the site, ground levels are to be raised and with reference to the post demolition topographic survey, the current ground level within the garden to Plot 15 varies from c.29.2m AOD to 29.8m AOD and the proposed finished garden level is in the range 30.15m AOD to 30.9m AOD. Considering individual locations within the proposed garden, ground levels are due to be raised by approximately 0.9-1.0m from the post demolition level and as such there is scope to consider the placement of a soil cover system in the garden of Plot 15 and adjacent plots in order to protect end users from coming into contact with the Made Ground soils.

Where Made Ground soils remain in-situ beneath a soil cover, the formation should be covered by a geotextile separator to prevent mixing of soil types and overlain by a high visibility geogrid mesh to inhibit excavation. An example of the recommended cover system for the garden areas underlain by Made Ground soils is shown below:



Schematic 1 Topsoil and subsoil cover system where Made Ground is present beneath gardens

No concentrations of concern were identified within the Topsoil or naturally occurring subsoil and thus no specific remedial measures are considered to be warranted in relation to these soil types.

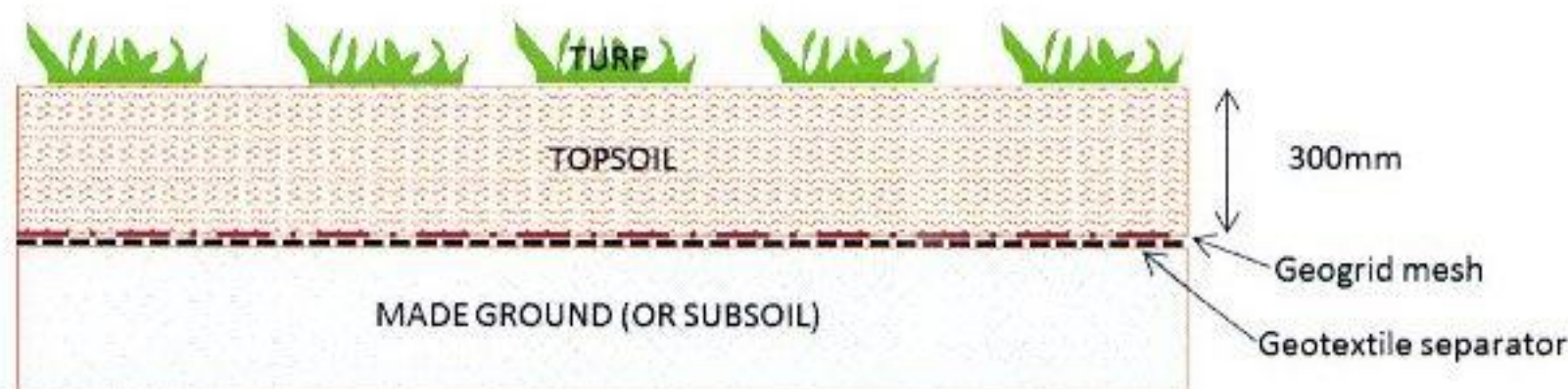
During demolition and site clearance, sporadic cement sheet fragments were encountered bonded within concrete slabs on the former kennel area and also sporadic/rare loose fragments of cement sheet were present immediately beneath the slabs. The concrete from this portion of the site was segregated and removed from site under appropriate duty of care. Where these soils were located beneath proposed building footprints or external hard cover there was no plausible pollutant linkage and thus no remedial action was considered to be required. However, where present within proposed garden areas, a risk of harm due to soil exposure was considered potentially to arise even though any fibres would have been bonded with a cementitious matrix and thus not readily mobile or capable of airborne release. Notwithstanding this, in order to achieve the required development levels in this portion of the site, ground levels in the proposed gardens were required to be reduced. Following initial inspection of the ground conditions, the reduced dig exercise would remove the Made Ground soils from the main garden areas. An inspection of the reduced dig in this portion of the site would be undertaken as part of the remediation verification measures.

It should be noted that the eastern boundary of the development includes no-dig zones associated with tree protection orders and these portions of gardens are to be separated from the main garden areas by a retaining wall. In these no-dig zones, there is no scope to undertake a reduced dig to remove any Made Ground soils, if present, and as such it is proposed to install a geogrid mesh and separate geotextile separator fabric on the existing ground surface and place a cover of Topsoil over the mesh. A target cover thickness of 300mm of Topsoil would be generally be required but this is subject to such a cover thickness being achievable within the fixed development level limits and not adversely affecting the protected vegetation. The 'no-dig' restriction would continue to apply for the occupation phase of the development and thus the provision of a clean cover, geogrid mesh barrier and geotextile separator are considered to prevent end users coming into contact with soils beneath this cover. The no-dig zone extends to the north of Plot 37 (north-eastern corner of the site) and this will comprise open space. Here again, where there is no scope to undertake a reduced dig due to tree protection and the no-dig zone, a soil cover system comprising a minimum of 300mm of Topsoil overlaying a geogrid mesh shall be laid to form the final landscape profile. In the event that ground levels are to be raised in this open space area by greater than 300mm, the levels would be achieved by the placement of site won subsoil prior to laying the geogrid mesh and Topsoil.

An example of the recommended cover system for use in no-dig areas is provided below:



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Schematic 2 Soil cover system in tree protection 'No-dig' zone

The depth of any soil cover system will vary from plot to plot due to the variation in both existing and proposed final development levels. Table 4.1 summarises the level variation by plot and anticipated remedial solution.

Plot	Level change (m)	Remediation strategy
1-6	-0.1 to -0.3	Amenity soft landscaping only. Install separator and geogrid mesh over formation and Topsoil cover.
7	-0.7 to -0.4	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
8	-0.4 to 0	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
9	-0.5	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
10	+0.6 to +0.8	Install soil cover system as per Schematic 1 if Made Ground is present.
11	+0.7	Install soil cover system as per Schematic 1 if Made Ground is present.
12	+0.6 to +0.4	Install soil cover system as per Schematic 1 if Made Ground is present.
13	+0.5 to +1.0	Install soil cover system as per Schematic 1 if Made Ground is present.
14	+0.5	Install soil cover system as per Schematic 1 if Made Ground is present.
15	+0.9 to +1.0	Install soil cover system as per Schematic 1 if Made Ground is present.
16	+0.7	Install soil cover system as per Schematic 1 if Made Ground is present.
17	-0.5 to -0.7	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
18	-0.5 to -0.9	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
19	-0.2	Reduced dig and install soil cover system as per Schematic 1 if Made Ground is present at/beneath the exposed formation.
20	-0.2 to -0.4	Reduced dig and install soil cover system as per Schematic 1 if Made Ground is present at/beneath the exposed formation.
21	-0.5 to -0.1	Reduced dig and install soil cover system as per Schematic 1 if Made Ground is present at/beneath the exposed formation.
22	-0.2 to -0.3	Reduced dig and install soil cover system as per Schematic 1 if Made Ground is present at/beneath the exposed formation.
23	-0.1 to -0.4	Reduced dig and install soil cover system as per Schematic 1 if Made Ground is present at/beneath the exposed formation.
24	-0.4	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
25	-0.4 to -0.5	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
26	-1.0	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.



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Plot	Level change (m)	Remediation strategy
27	-0.7 to -1.0	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
28	-0.1 to -0.8	Reduced dig to remove Made Ground. Place subsoil (if required) and Topsoil to achieve development level.
29	+0.3 to +0.5	Install soil cover system as per Schematic 1 if Made Ground is present.
30-37	Variable	Reduced dig to remove Made Ground from main garden areas. Place subsoil (if required) and Topsoil to achieve development level. Apply Schematic 2 soil cover in any 'no-dig' zone.
38-55	Variable	In previously undeveloped area where Made Ground is not anticipated. Watching brief and discovery strategy to remain in place.

Table 4.1 Summary of ground level variations by plot (from existing to finished development level)

In areas where no remedial action is required, or where Topsoil is to be placed directly on to subsoil, a minimum thickness of 150mm of suitable Topsoil is recommended.

Prior to placement of Topsoil, any compacted subsoil should be broken up, e.g. by rotovation, to aid root establishment and drainage.

In line with the proposal to retain and re-use site won soils wherever possible, the Made Ground soils would be retained for re-use in raising ground levels solely and specifically in areas of permanent hard cover, as also set out in the Materials Management Plan. As such, Made Ground soils would be retained for re-use in achieving the construction levels for sections of site roads and as general fill beneath permanent hard cover only. This would require the recording of materials movement within the site from the source to point of deposition and should be verified independently of the Contractor through observation and/or inspection. Mass balance estimates are presented in Appendix B.

4.3 Validation

Verification of remediation measures shall be required through regular inspection at key stages of the works in order to verify reduced dig levels and the installed soil cover/capping system where required. Details of these works would be presented within a verification report for the site.

4.4 Built Environment

Buried plastics laid in contact with contaminated soils may be susceptible to attack by aggressive chemicals; therefore, potable water supplies may potentially become contaminated or tainted. Where potable water supply pipes are to be placed at depth within the 'uncontaminated' natural soils, it is possible that potable water supply pipes would not need to be protected. Where they are to be placed within the Made Ground barrier pipe should be considered to be required for potable water supplies. The results of the laboratory analysis should be forwarded to the appropriate water supply company for confirmation of this assessment.

As a matter of good practice and to maximise the protection to maintenance workers, clean, granular backfill should be used in service runs and marker tapes for all buried services.

5.0 CONTROLLED WATERS

In the absence of a continuous shallow groundwater body and given that no significant concentrations of potentially mobile contamination have been identified from investigation works undertaken on the site. It is considered that no significant risk to controlled waters exists on the site as such specific remedial measures with respect to controlled waters are not required.



6.0 WASTE

6.1 Waste Classification and Segregation

Waste may be defined as any substance or object in Annex 1 of the Waste Framework Directive which the holder discards, intends to discard, or is required to discard. The holder of waste is anyone in possession of waste or generates it and therefore both the contractor and ultimately the developer are responsible for safe disposal of waste.

The following information is provided for preliminary guidance purposes, as different facilities or operators may have differing acceptance criteria and further Waste Acceptance Criteria (WAC) analysis may be required to confirm the exact classification.

Based on the results of the testing undertaken it is considered that any surplus natural soil arisings on site are likely to be classified as Inert Waste, suitable for disposal at an inert landfill site. The results of the chemical analysis should be provided to the proposed landfill site for confirmation.

Similarly, Made Ground soils are likely, based on previous testing, to be classified as inert waste if they were to be disposed of from site. However, should asbestos concentrations within the surplus soils exceed 0.1% by weight (of any asbestos containing fragment as opposed to the mass of the load in which it was contained), the soils would be deemed hazardous waste.

In the event of dry spells, or where the exposed surface becomes dry, it is recommended that the surface of the site is regularly damped down to prevent the release of soil dust which could migrate off-site and thereby mitigate both off-site exposure and nuisance for neighbours.

As stated in Section 2.0, the development proposal includes for the re-use of site won materials where suitable and feasible. As such, this Remediation Method Statement would be supported by a Materials Management Plan developed for the construction works on this site. This should include contingency plans in any unexpected contamination is encountered during the development.

In accordance with CL:AIRE Code of Practice (2011) materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded by the holder'. Current guidance recommends the retention and re-use of site won soils where there is a need for the materials and where the risk is acceptable.

The Code of Practice therefore allows soils to be reused on site where the following criteria are met:

- Pollution of the environment and harm to human health is prevented in reusing the excavated materials;
- The material are suitable for use (without any further processing);
- There is certainty of use; and
- The quantity that is absolutely necessary (and no more) is used.

In order to comply with the Code of Practice, a Material Management Plan (MMP) that confirms the above criteria are met will be prepared. The MMP will be reviewed by a 'Qualified Person' (QP) who will issue a declaration to the Environment Agency. The MMP and QP role will be provided by Geo-Environmental albeit that the QP shall not have had any previous involvement with the site, as required under the Code of Practice.

Where materials do not meet the required criteria, it may be possible to treat them under an environmental permit so that they may be re-used on site.



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Where material is required and reused under the Definition of Waste Code of Practice, the reuse of the material will be documented and included within the Verification Report produced on completion of the works.

7.0 EXCAVATION AND STOCKPILING OF MATERIAL

7.1 Excavation Process

Where Made Ground materials are to be excavated on site as part of a reduced dig, wherever possible these material should be excavated and transported directly to the required deposition/disposal location. In the event that this does not fit with other elements of the earthworks programme then it may be necessary to excavate the bund and transport the soils to a stockpile location for temporary storage prior to deposition/disposal.

Excavations would be limited where it is not reasonably practicable to do so in a safe manner, such as:

- Instability adjacent to roadways, railway line, live infrastructure, buildings, walls or site boundaries;
- Close proximity of adjacent services, particularly foul sewers and high voltage cables.
- Ingress of water that cannot be dealt with by normal pumping equipment.

7.2 Stockpiling of Soils

All stockpiles of contaminated soil, where required shall be constructed no larger than 250m³ and no higher than 1.8m. Stockpiles shall be placed on stable and level ground, with a perimeter bund overlain by a polythene liner for run-off control. The liner will extend across the full base area of the stockpile. The stockpile shall either be covered by a second polythene (or similar) sheet, or otherwise sealed to prevent the ingress of rainfall into the stockpile. This upper sheet shall be weighted down or otherwise secured to the stockpile.

Prior to placement of material the stockpile bund will be inspected to ensure that it is impermeable and as such will be sufficient to retain surface runoff during the period of storage. Should water be noted to be building up within the bund it will be pumped out of the bund and disposed of under the appropriate duty of care.

On completion of on-site remediation works and removal of the stockpiles, the bund and liner materials will be removed to enable development of this portion of the site to continue. At this stage, the exposed ground will be inspected to confirm/validate that no leakage occurred from the stockpile. Any such new impact would be dealt with under the Discovery Strategy set out in Section 8 of this report.

Subsoil and Topsoil shall not be imported to site without prior acceptance of provenance and chemical suitability. Import suitability criteria are presented in Appendix C. Where materials are to be imported on to the site for use as subsoil and Topsoil, these shall be derived from one of two sources, i.e. natural or processed. Where natural sourcing is proposed, the provenance of the material shall be determined by confirmation of the source site's history to confirm no previous potentially contaminative use, coupled with analysis of soils at a minimum rate of 3No. samples per source site (up to 250m³) and 1 sample per 250m³ thereafter. Where Topsoil or subsoil are derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50 m³. With regard to physical and nutritional composition and minimum testing regime of 1 sample per 250 m³ is recommended for either source.

8.0 DISCOVERY STRATEGY

Whilst the site has been the subject of several phases of investigation and assessment, it remains possible that previously unexpected soil conditions may be encountered during the process of site preparation and construction.



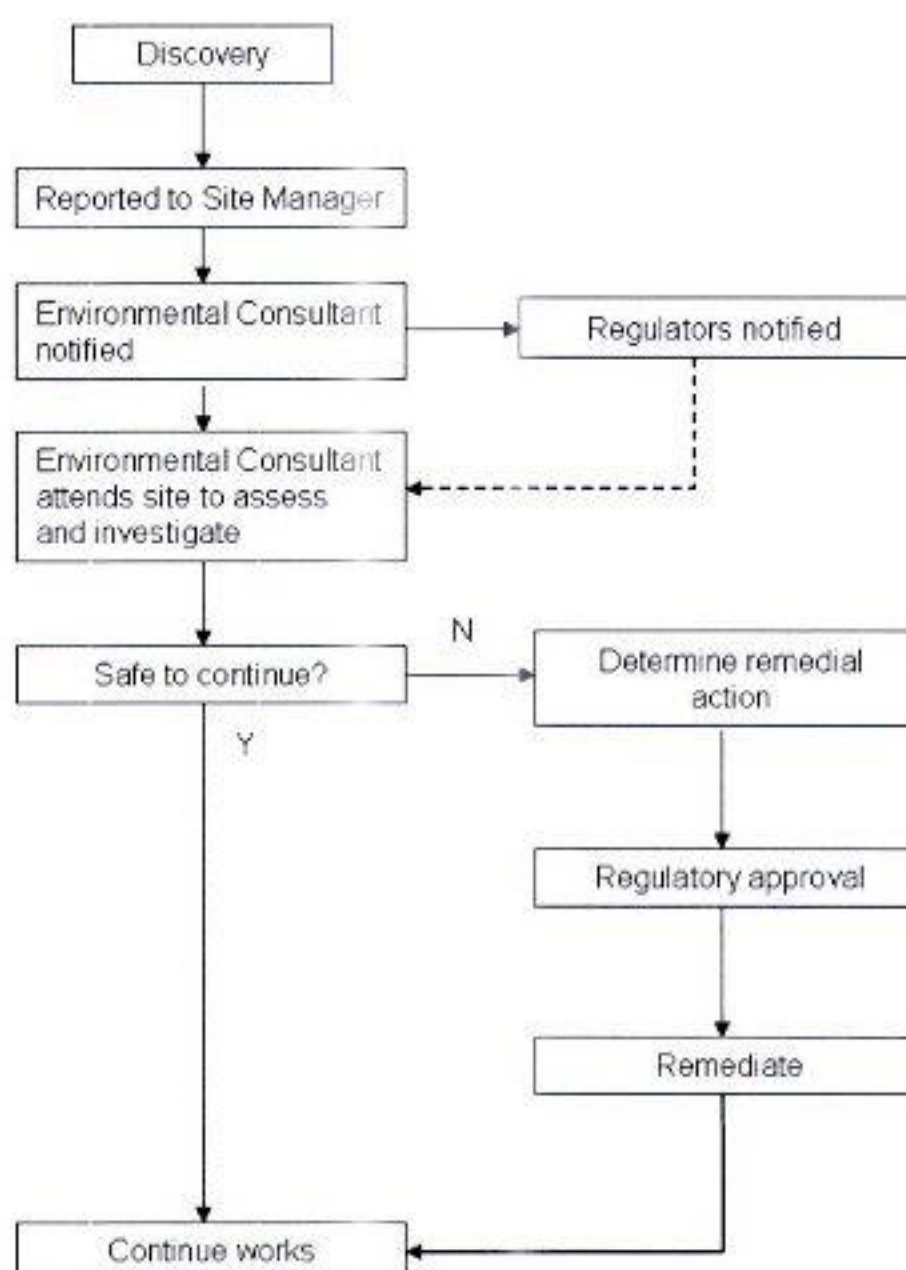
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Examples may include oily pockets within the soil, pockets of cement boarding or fibrous materials within the soil, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former structures or brickwork.

Should previously undiscovered contamination be encountered during the demolition/construction of the new buildings the following course of action should be adhered to:

- Works in the area of the suspected contamination should cease immediately. The ground workers should report any suspected contamination immediately to the Client's site supervisor. The supervisor should contact the Environmental Consultant, who should visit the site to assess the extent of the 'contamination'.
- The Environmental Consultant shall make records of their inspection, and pass details of these to the Local Authority.
- Where the conditions revealed differ from those previously anticipated, the Environmental Consultant shall take samples as deemed appropriate to be dispatched for appropriate chemical testing.
- Depending on the results of the testing either: 1) no further work will be required; 2) a further detailed risk assessment will be required; and/or 3) localised specific remedial measures will be necessary. Appraisal criteria will vary depending on the nature of the assessment.
- The results of any such testing will be sent to the Regulatory Authority for consultation. If further remediation is required, the Regulatory Authority will be informed of the date and time of the proposed works.
- Any further remediation will be undertaken in accordance with a method statement submitted to the Local Authority for approval. The works shall be supervised by the Environmental Consultant who shall provide a Verification Report for the Local Authorities purposes.

The process is summarised overleaf:



A copy of this strategy should be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious or contaminated materials they may encounter.

9.0 VERIFICATION

Verification is required to be undertaken throughout the course of the remediation works. The Verification Report will be submitted to the Client, NHBC and Local Authority for formal approval.

The Verification Report will refer to the works as set out within this RMS and as required by relevant planning conditions. The Report will include relevant site based information such as records from site inspections, locations where the Made Ground was excavated and deposited/disposed of within the context of the final scheme, details of capping system installation and validation of thicknesses. Photographs of specific remedial or waste handling measures and an audit trail for imported any subsoil and Topsoil, including source, provenance, analytical results, placement location and thickness (should subsoil and/or Topsoil be imported).

The remedial works will be inspected and validated by the Environmental Consultant (Geo-Environmental).

A verification plan is set out below and should be referred to facilitate tracking and recording progress of all stages of the remediation process.



Remediation Method Statement

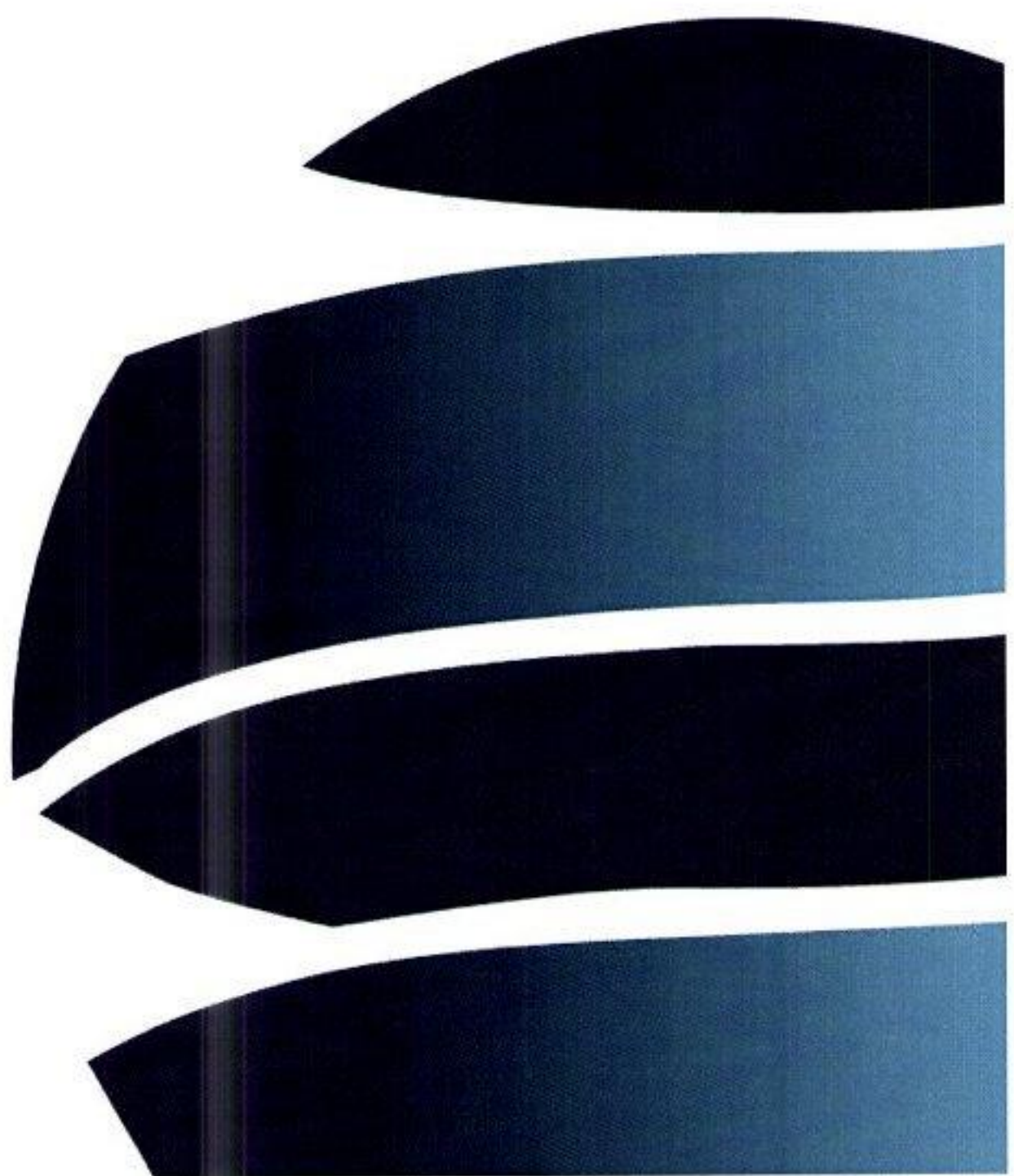
Reference	Principal requirements	Design or construction related	Site visit required by qualified geo-environmental engineer?	Supporting documentation
1.0 General principles	The proposed development will comprise low-rise residential housing with associated parking, utilities and areas of soft landscaping. The site remediation requirements are as follows: - Reduced dig exercise to some plots to achieve development level and thereby remove Made Ground - Installation of soil cover systems on plots where Made Ground is to remain beneath gardens - Protection of underground services from contact with residual contaminants in the near surface soils on site are required. - Importation of chemically and physically suitable Topsoil within soft landscaped areas. [It is anticipated that sufficient Topsoil and subsoil should be available from the uncontaminated areas of the development to mitigate any requirement for importation]	Design & construction	YES As detailed below.	Details of construction programme to be provided by client/contractor.
2.0 Compliance with legislation	The construction and remediation activities on the site will be undertaken in accordance with all current health and safety and environmental legislation.	Construction	-	-
3.0 Health and Safety requirements	This verification plan does not specifically cover health and safety requirements. This will be addressed in the Contractor's Health and Safety Plan.	Design & Construction	-	-
4.0 New services	Correspondence with the appropriate utility company has taken place – the correct pipe shall be installed. The installation of barrier pipes will require validation including in situ photographic evidence.	Design & Construction	YES To validate that the recommended pipework has been installed.	Proof of the water authority's recommended pipework for the site (to be supplied). Site visit reports including photographs.

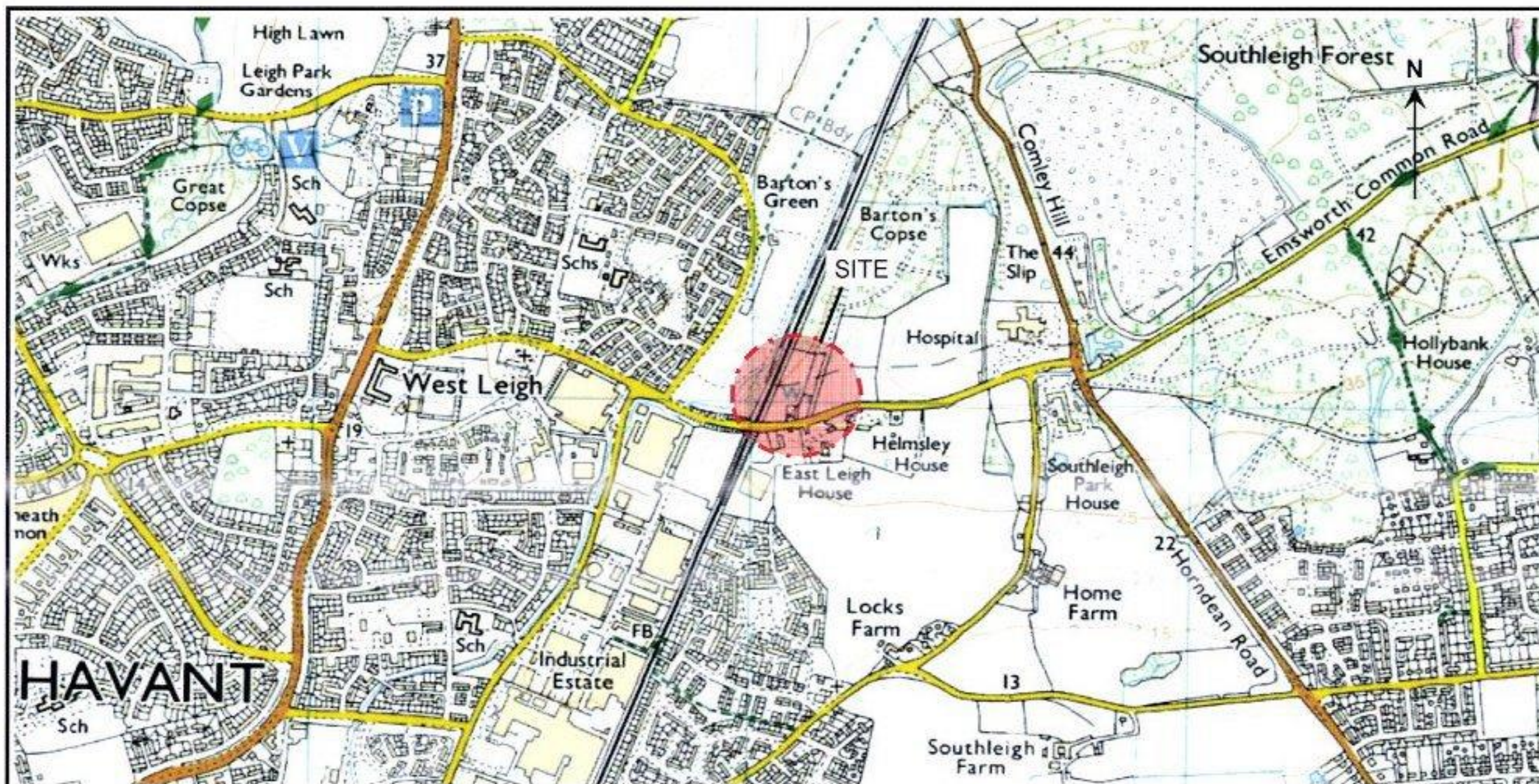


Remediation Method Statement

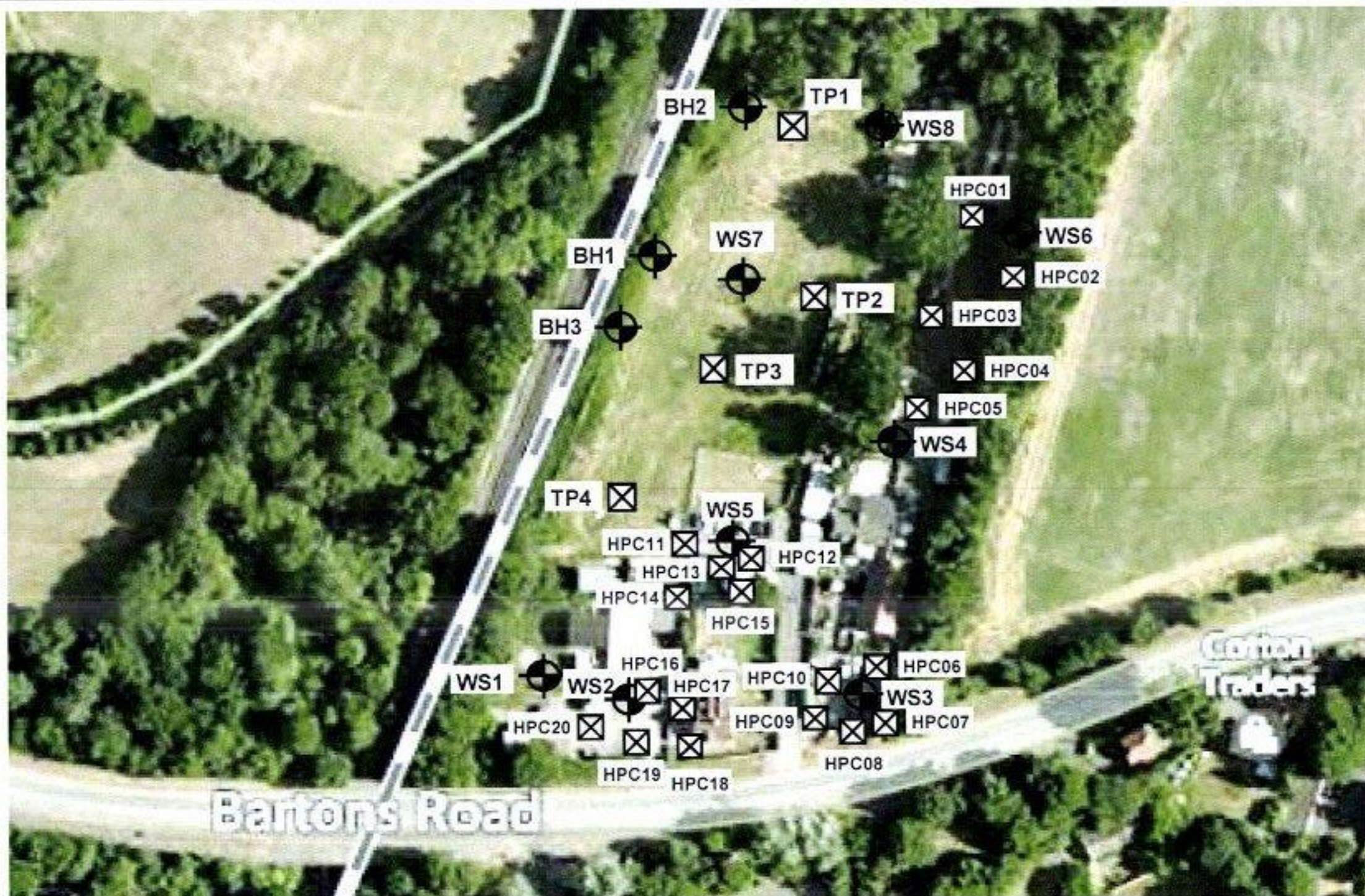
Reference	Principal requirements	Design or construction related	Site visit required by qualified geo-environmental engineer?	Supporting documentation
5.0 Topsoil Importation [if required]	Chemical certification of any proposed imported Topsoil should be submitted prior to importing materials onto site to confirm its suitability for use. The date of certification should be within one month of the materials importation on to site. Where certificates of suitability cannot be supplied for the imported materials, or if the physical quality of the soils is deemed to be sub-standard (i.e. through the presence of brick, concrete, etc.) based on a visual inspection, then samples should be taken for laboratory analysis.	Design & Construction	YES To visually inspect the physical quality of the imported in situ Topsoil (<i>and take appropriate samples for laboratory analysis if necessary</i>).	Laboratory certificates to be supplied by Client/Contractor. Site visit reports including photographs.
6.0 Unexpected contamination	A watching brief is to be put in place on site. Should unexpected areas of contamination be encountered during construction works a qualified geo-environmental engineer is to be informed to conduct a site visit, take additional samples and assess the risk. The Local Authority should also be notified. For full details, reference should be made to the Section 8 (Discovery Strategy) of the Remediation Method Statement.	Construction	YES <i>Only in the event of unexpected contamination.</i> To assess the extent of any unexpected contamination.	<i>In the event of unexpected contamination:</i> Site visit reports including photographs. Chemical test results. <i>Revised risk assessment.</i>

FIGURES





Project:	Bartons Road, Havant			Title	Site Location Plan	
Client:	Linden Homes South			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE15735	Revision:	1.1			
Drawn:	GR	Date:	27/09/2016			
Figure:	1	Scale:	Not To Scale			



NOTE:

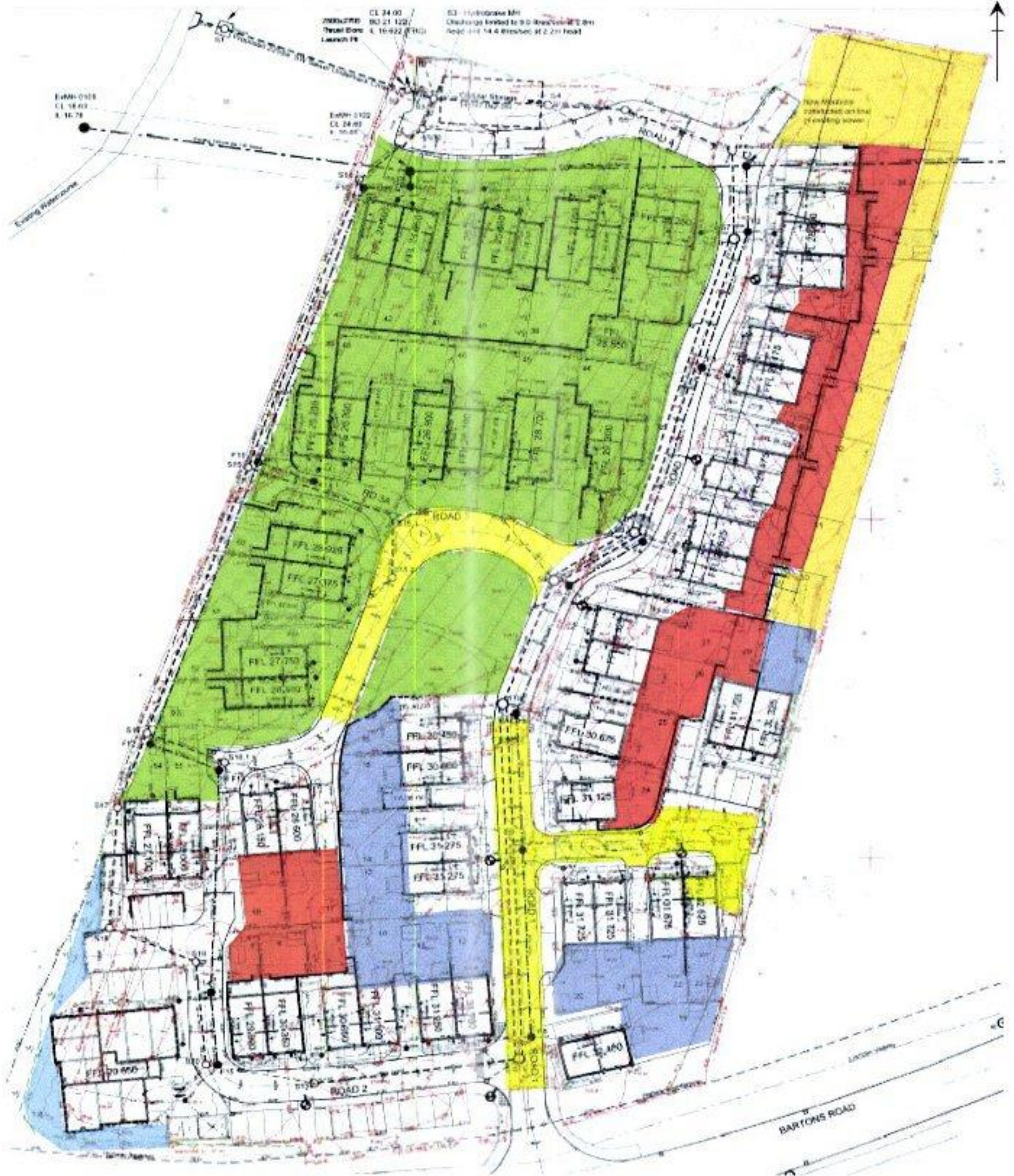
TP1-TP4
undertaken for
soakage tests
GE9323

BH1-BH3
undertaken for
foundation
design GE9451

WS1-WS8
undertaken as
part of
investigation
GE15054

Project:	Bartons Road, Havant			Title	Exploratory Hole Location Plan	
Client:	Linden Homes South			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE15735	Revision:	1.1			
Drawn:	GR	Date:	27/09/2016			
Figure:	2	Scale:	Not To Scale			

N



- | | | | |
|---|--|---|---|
|  | Soil cover to amenity soft landscaping |  | Soil cover to 'tree protection' 'no-dig' zone |
|  | No remedial action anticipated |  | Reduced dig to remove Made Ground |
|  | Re-use of Made Ground soils beneath permanent hard cover |  | Soil cover system over Made Ground |

NTS

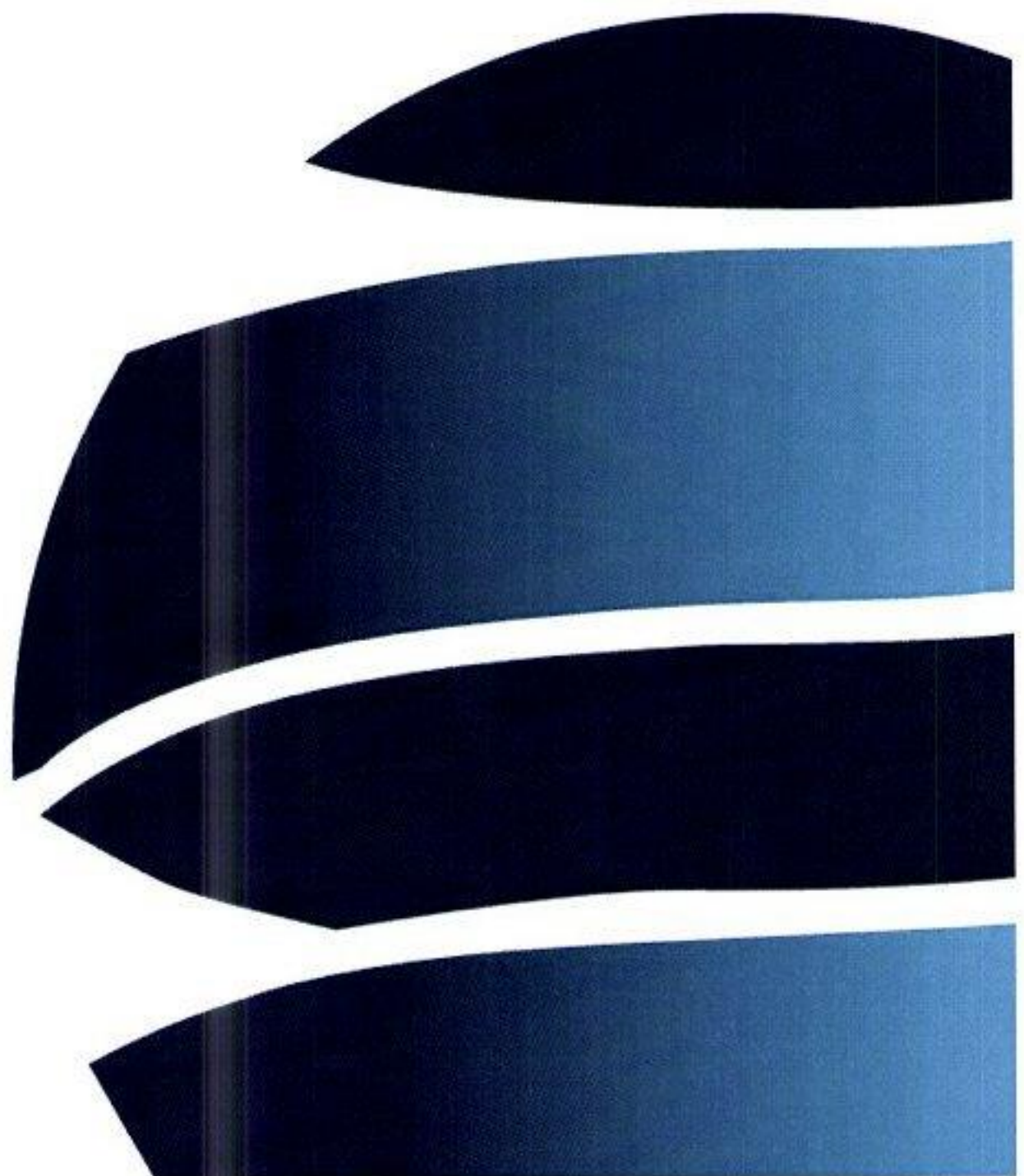
Project:	Bartons Road, Havant			Title	Remediation areas
Client:	Linden Homes South			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	 Geo-Environmental
Ref No:	GE15735	Revision:	1.1		
Drawn:	GR	Date:	27/09/2016		
Figure:	3	Scale:	Not To Scale		



Geo-Environmental

APPENDIX A

Revised statistical assessment of Made Ground soils



Client ref: 15739 Project ref: 0215739 Site ref: Gortons Road, Havant Data description: Made Ground soils Combined dataset Contaminants: PAHs Test scenario: Planning Date: 28 July 2016	Naphthalene (mg/kg)	Acenaphthylene (mg/kg)	Acenaphthene (mg/kg)	Fluorene (mg/kg)	Phenanthrene (mg/kg)	Anthracene (mg/kg)	Fluoranthene (mg/kg)	Pyrene (mg/kg)	Benzo(a)anthracene (mg/kg)	Chrysene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Benzo(a)pyrene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)
Critical concentration, C _c	1.5	138	169	133	75.1	1850	217	474	2.9	5.6	5.3	8.2	5	3	0.7	43.2
Notes																
Full dataset size	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Outliers present?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of outliers temporarily excluded													0			
Number removed by filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample size, n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Sample mean, $\bar{x}$	0.15833333	0.30833333	0.18333333	0.13333333	1.9	0.75	3.90833333	3.45	2.36666667	2.76666667	3.11666667	2.99166667	3.36666667	2.85	0.31666667	2.88333333
Standard deviation, s	0.26536139	0.63278485	0.26012817	0.18073922	4.08387071	1.54951605	8.41673432	7.50366577	5.08891131	5.97232506	6.78083082	6.3123226	7.24221421	6.22059128	1.46821888	6.21189719
Number of non-detects	5	5	4	4	4	4	3	4	4	4	4	3	2	4	4	4
Ref non-detect values for	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Distribution	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal
Statistical approach	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev
Test scenario	Planning: is true mean lower than critical concentration $\mu < C_c$?															
Evidence level	Evidence level requested: 95%															
Test statistic, t_c (or z_c)	-12.38461538	-533	-1588.657487	-1800.89125	-43.90507481	-2923.312022	-62.01524626	-153.8059086	-0.256814882	-1.182063495	-0.788701671	-2.021087938	-0.552432327	-0.069054732	0.027805683	-15.89778174
Upper confidence limit (or true mean concentration, μ)	0.83054739	1.43438223	0.64623461	0.45496114	9.1673012	3.50738403	18.8880218	18.8028711	11.4188917	13.394497	15.1832436	14.2245271	16.2542813	13.9198013	3.3293813	13.9374854
Evidence level	99%	100%	100%	100%	100%	100%	100%	100%	6%	57%	38%	80%	23%	0%	0%	100%
Size decision on	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu \geq C_c$	$\mu \geq C_c$	$\mu \geq C_c$	$\mu \geq C_c$	$\mu \geq C_c$	$\mu \geq C_c$	$\mu \geq C_c$	$\mu < C_c$
Select dataset	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Client/Ref: 02151738 Project ref: 02151738 Site ref: Barton Road, Havant Data description: Made Ground soils. Combined dataset Contaminant(s): PAH with outlier for W52 removed Test scenario: Planning Date: 29 July 2022	Naphthalene (mg/kg)	Acenaphthylene (mg/kg)	Acenaphthene (mg/kg)	Fluorene (mg/kg)	Phenanthrene (mg/kg)	Anthracene (mg/kg)	Fluoranthene (mg/kg)	Pyrene (mg/kg)	Benzo(a)anthracene (mg/kg)	Chrysene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Benzo(a)pyrene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Benzo[a,h,i]perylene (mg/kg)
Critical concentration, C _c	1.5	138	169	133	75.1	1850	217	474	2.9	5.6	5.3	8.2	5	3	0.7	43.2
Notes																
Full dataset size	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Outliers present?	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of outliers temporarily excluded													0			
Number removed by filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample size, n	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Sample mean, $\bar{x}$	0.05	0.05	0.08	0.06	0.24	0.12	0.49	0.4	0.3	0.34	0.36	0.43	0.42	0.32	0.12	0.36
Standard deviation, s	0	0	0.06708204	0.02236068	0.42485292	0.15652476	0.95616421	0.78262379	0.55901699	0.64845971	0.69318107	0.76860263	0.66389005	0.60373835	0.15652476	0.69318107
Number of non-detects	5	5	4	4	4	4	3	4	4	4	4	3	2	4	4	4
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Distribution	Single value	Single value	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal
Statistical approach	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev	Auto-Chebyshev
Test scenario	Planning: is true mean lower than critical concentration $\mu < C_c$?															
Calculated t ₀ for t ₀₁	N/A	N/A	-5830.88887	-13294	-384	-26426.85714	-506.3252698	-1353.142857	-10.4	-18.13793103	-15.93548367	-22.80496149	-15.42603526	-9.825921926	-8.285714286	-138.1935464
Upper confidence limit (on true mean concentration, μ)	0.05	0.05	0.21075697	0.10358899	1.0681908	0.42512293	2.35390719	1.92561463	1.38972474	1.60408069	1.71125867	1.92828235	1.71415996	1.49690271	0.42512293	1.71125867
Evidence level	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	99%	99%	100%
Base decision of:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$
Select dataset	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Client ref: 02/15735
 Project ref: 02/15735
 Site ref: Barton Road, Havant
 Data description: MADE GROUND soils only
 Combined Dataset
 Contaminant(s): Metals
 Test scenario: Planning
 Date: 28 July 2016
 User: J. Smith, J. Smith

	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Hexavalent Chromium (mg/kg)	Water Soluble Boron (mg/kg)
Critical concentration, C _c	37	1330	41.2	26	3010	2300	200	169	127	350	107	3700	21	290
Notes														
Full dataset size	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Outliers present?	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Number of outliers temporarily excluded				0										
Number removed by filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample size, n	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Sample mean, $\bar{x}$	8.77083333	120.054167	0.5	0.40208333	23.4958333	31.3791667	83.8666667	0.25	14.9666667	0.5	28.9333333	167.804167	0.4	1
Standard deviation, s	2.13143739	55.8888881	0	0.21542636	4.47577821	14.647035	51.780529	0	3.24072813	0	6.10976885	109.597042	1.1341E-16	0.67340795
Number of non-detects	0	0	24	16	0	0	0	24	0	24	0	0	24	4
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Distribution	Normal	Normal	Single value	Non-normal	Normal	Normal	Normal	Single value	Normal	Single value	Normal	Normal	Non-normal	Non-normal
Statistical approach	Auto One-sample t	Auto One-sample t	Auto Chebyshev	Auto Chebyshev	Auto One-sample t	Auto One-sample t	Auto One-sample t	Auto Chebyshev	Auto One-sample t	Auto Chebyshev	Auto One-sample t	Auto One-sample t	Auto Chebyshev	Auto Chebyshev
Test scenario	Planning: is true mean lower than critical concentration $\mu < C_c$?													
Test statistic, t_{obs}	-64.88302627	-106.0586464	N/A	-582.1185088	-3288.88911	-758.783394	-10.98742757	N/A	-169.3597793	N/A	-62.5959849	-157.8588858	-8.89858E+17	-2102.447827
Upper confidence limit (at true mean concentration μ)	9.51650085	139.606478	0.5	0.59376034	25.061651	36.5033229	101.9817	0.25	16.1004113	0.5	31.0707905	206.145877	0.4	1.59916911
Evidence level	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Base decision rule	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$
Select dataset	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Client ref: Project ref: 0815/06 Site ref: Barlons Road, Horant Data description: Made Ground Combined Dataset Contaminant(s): Hydrocarbons Test scenario: Planning Date: 20 July 2016 Test facility: Geochem Centre	>C5-C8 Aliphatic (mg/kg)	>C6-C8 Aliphatic (mg/kg)	>C8-C10 Aliphatic (mg/kg)	>C10-C12 Aliphatic (mg/kg)	>C12-C16 Aliphatic (mg/kg)	>C16-C21 Aliphatic (mg/kg)	>C21-C35 Aliphatic (mg/kg)	>C35-C40 Aliphatic (mg/kg)	>C5-C7 Aromatic (mg/kg)	>C7-C8 Aromatic (mg/kg)	>C8-C10 Aromatic (mg/kg)	>C10-C12 Aromatic (mg/kg)	>C12-C16 Aromatic (mg/kg)	>C16-C21 Aromatic (mg/kg)	>C21-C35 Aromatic (mg/kg)	>C35-C40 Aromatic (mg/kg)
Critical concentration, C _c	78.9	190	48.9	240	1750	88400	88400	88400	76.3	121	38.1	62.4	114	207	822	822
Notes																
Full dataset size	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Outliers present?	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes
Number of outliers temporarily excluded																0
Number removed by filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample size, n	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Sample mean, $\bar{x}$	0.005	0.005	0.5	0.59230769	1.86153846	4.9	59.6864615	17.7615385	0.005	0.005	0.5	0.5	1.4	6.66923077	109.511538	40.8615385
Standard deviation, s	8.8454E-19	8.8454E-19	0	0.47067872	5.41974737	11.3745881	178.974596	80.7703225	8.8454E-19	8.8454E-19	0	0	3.66867824	12.414178	226.608309	77.9224234
Number of non-detects	26	26	26	25	22	16	2	7	26	26	26	26	23	6	0	3
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Distribution	Non-normal	Non-normal	Single value	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Non-normal	Single value	Single value	Non-normal	Non-normal	Non-normal	Non-normal
Statistical approach	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev
Test scenario	Partially > four times lower than critical concentration ($\mu < C_c$)															
Testable, $\mu < C_c$	Evidence level required: 95%															
Upper confidence limit for true mean concentration, μ	-4.54798E+20	-1.0625E+21	N/A	-2593.58333	-1644.687754	-39525.97392	-2516.831905	-8670.469795	-4.39811E+20	-8.97489E+20	N/A	N/A	-156.5003961	-82.28418358	-16.03203598	-51.11545672
Upper confidence limit for true mean concentration, μ	0.005	0.005	0.5	0.99466759	6.49461174	14.6235543	212.684969	61.1625698	0.005	0.005	0.5	0.5	4.53617111	17.281496	303.227746	107.473554
Estimator level	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$
Subset dataset	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Client ref: 0515736 Project ref: 0515736 Site ref: Barons Road, Havant Data description: Made Ground Area around WS3 Contaminant(s): Hydrocarbons Test scenario: Planning Date: 20 July 2016	>C3-C8 Aliphatic (mg/kg)	>C6-C8 Aliphatic (mg/kg)	>C8-C10 Aliphatic (mg/kg)	>C10-C12 Aliphatic (mg/kg)	>C12-C16 Aliphatic (mg/kg)	>C16-C21 Aliphatic (mg/kg)	>C21-C35 Aliphatic (mg/kg)	>C35-C40 Aliphatic (mg/kg)	>C5-C7 Aromatic (mg/kg)	>C7-C8 Aromatic (mg/kg)	>C8-C10 Aromatic (mg/kg)	>C10-C12 Aromatic (mg/kg)	>C12-C16 Aromatic (mg/kg)	>C16-C21 Aromatic (mg/kg)	>C21-C35 Aromatic (mg/kg)	>C35-C40 Aromatic (mg/kg)
Critical concentration, C _c	78.9	190	48.9	240	1750	88400	88400	88400	78.3	121	38.1	62.4	114	207	822	822
Notes																
Full dataset size	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Outliers present?	No	No	No	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	No	No
Number of outliers temporarily excluded															0	
Number removed by filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample size, n	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Sample mean, $\bar{x}$	0.005	0.005	0.5	0.71818182	3.33636364	5.55454545	13.4181818	2.61818182	0.005	0.005	0.5	0.5	2.23636364	7.38181818	54.2727273	16.5
Standard deviation, s	9.097E-19	9.097E-19	0	0.72362723	8.22438724	12.3394784	11.8360313	2.64906217	9.097E-19	9.097E-19	0	0	5.53069123	11.6017945	47.1454365	16.3970729
Number of non-detects	11	11	11	10	8	6	1	5	11	11	11	11	9	1	0	3
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Distribution	Non-normal	Non-normal	Single value	Non-normal	Non-normal	Non-normal	Normal	Non-normal	Non-normal	Non-normal	Non-normal	Single value	Single value	Non-normal	Non-normal	Normal
Statistical approach	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto One-sample t	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto Chebyshev	Auto One-sample t	Auto One-sample t
Test scenario:	Planning, is true mean less than critical concentration (p < C _c)?			Evidence level required:			95%	Use Normal distribution to test for outliers								
t-value(s), t _c (or k)	-2.8764E+20	-6.90695E+20	N/A	-1096.708333	-704.3718782	-23758.80078	-24767.18095	-110672.6514	-2.78151E+20	-4.41131E+20	N/A	N/A	-67.02201077	-57.0551901	-54.00809086	-162.9276374
Upper confidence limit (or true value concentration, μ)	0.005	0.005	0.5	1.66921431	14.1453261	21.7717973	19.8963077	6.09975788	0.005	0.005	0.5	0.5	9.50511596	22.6295634	80.0366518	25.4606329
Evidence level	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Make decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$	$\mu < C_c$
Is test dataset	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



APPENDIX B

Mass balance estimation





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Project Bartons Road, Havant PO9 5NA		Sheet No 1
Client Linden Homes South		Prepared by GR
Project Ref GE15735	Date 08/07/2016	Checked by JT

Mass balance cut:fill estimation

Reduced dig zone through the rear gardens of plots 30-37 (see enclosed site plan on Sheet 2)

dimensions:

reduced dig zone length	=	80	m
reduced dig zone width	=	15	m
average reduced dig depth	=	0.3	m
reduced dig volume	=	360	m³

Road and permanent hard cover areas requiring increase in levels (see enclosed site plan on Sheet 2)

Zone 1

length	=	13	m
width	=	9	m
depth of fill required	=	0.5	m
	=	58.5	m³

Zone 2

length	=	16	m
width	=	3.6	m
depth of fill required	=	0.5	m
	=	28.8	m³

Zone 3

length	=	56	m
width	=	4.8	m
depth of fill required	=	0.5	m
	=	134.4	m³

Zone 4

length	=	46	m
width	=	4.5	m
depth of fill required	=	0.5	m
	=	103.5	m³

Total volume of fill required for Areas 1-4

$$= \underline{\underline{325.2}} \text{ m}^3$$

$$\text{Volume of fill from reduced dig} = 360 \text{ m}^3$$

$$\text{Volume of fill required} = 325.2 \text{ m}^3$$

Mass balance calculations indicate that sufficient fill would be produced from the required reduced dig through Plots 30-37 to provide general bulk fill for placement beneath roads and permanent hard cover areas where ground levels require raising to achieve the development levels.

All volumes assume 1:1 bulking:compaction



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Project		Sheet No
Bartons Road, Havant PO9 5NA		3
Client		Prepared by
Linden Homes South		GR
Project Ref	Date	Checked by
GE15735	08/07/2016	JT

Mass balance cut:fill estimation

Uncontaminated Topsoil and subsoil for retention and re-use in achieving development levels and soil cover systems in gardens

Approximate dimensions:

Topsoil

length	=	80	m
width	=	40	m
average thickness	=	0.3	m
	=	<u>960</u>	<u>m³</u>

estimated from site plans

estimated from site plans

average from ground investigation information

Approximate dimensions:

Subsoil

length	=	50	m
width	=	10	m
average thickness*	=	0.5	m
	=	<u>250</u>	<u>m³</u>

combined estimate from development plans and RMS

combined estimate from development plans and RMS

approximate average thickness from development levels and RMS



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Project

Sheet No

Client

Prepared by

Project Ref

Date

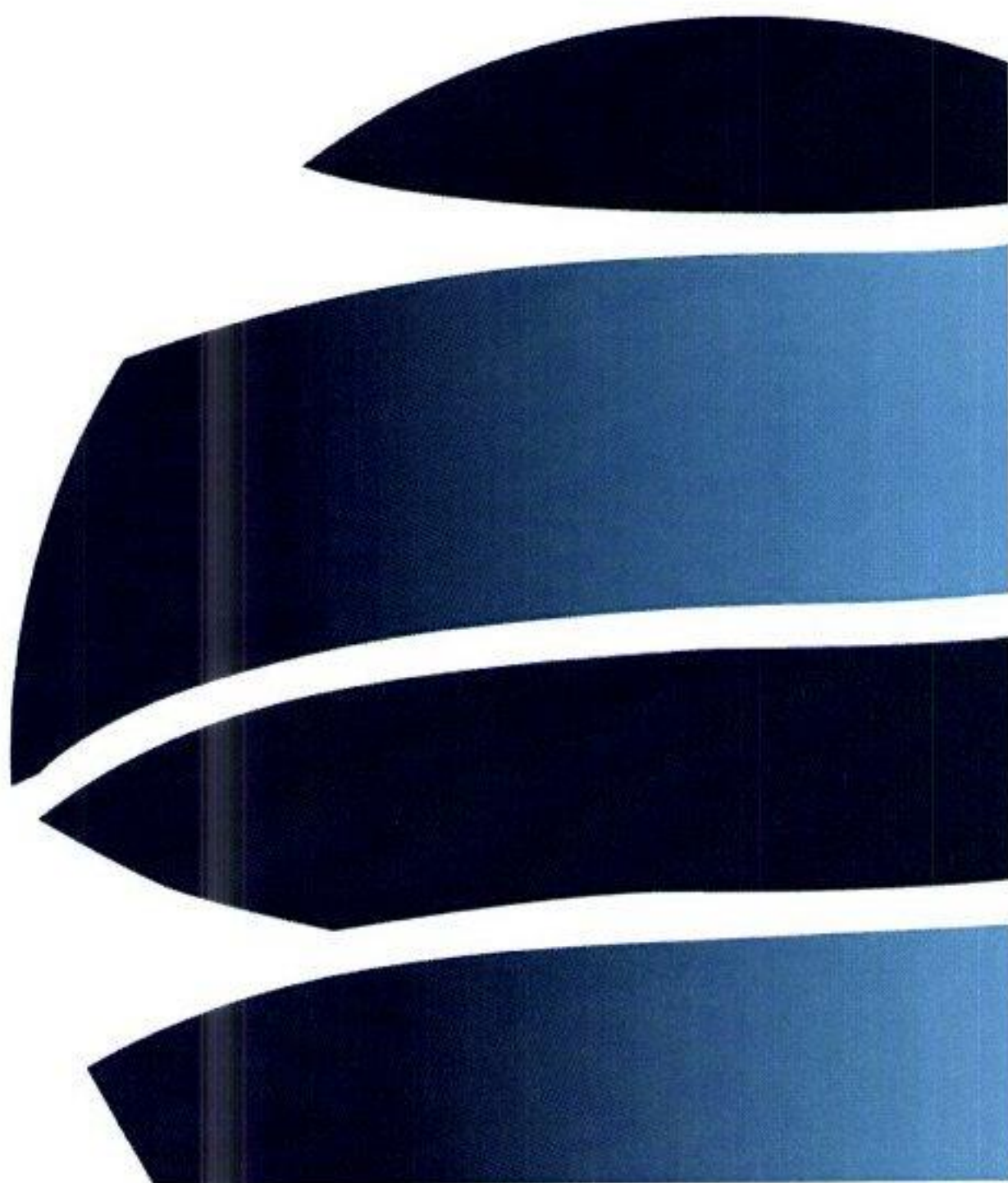
Checked by



Geo-Environmental

APPENDIX C

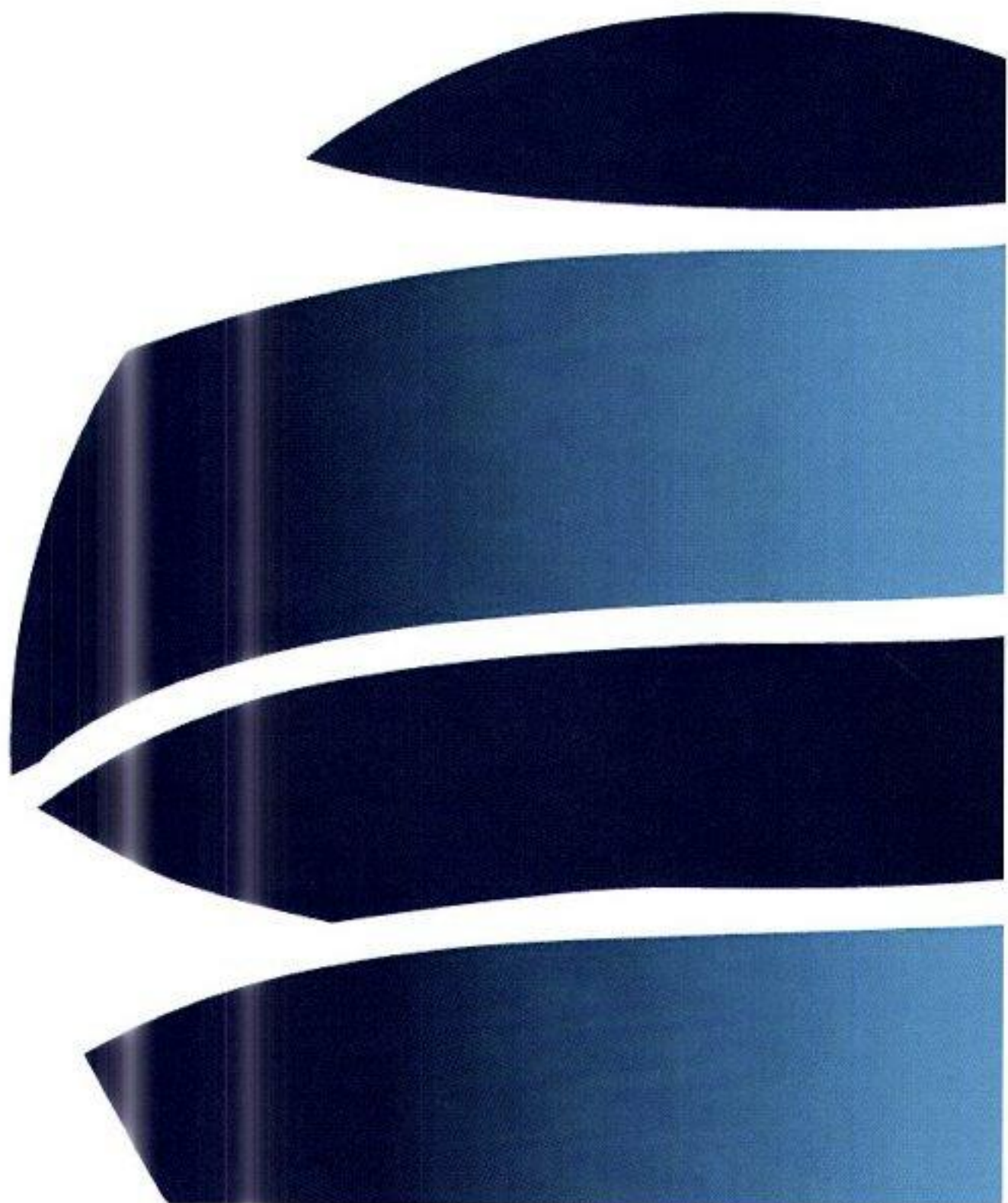
Soil Import Criteria





Geo-Environmental

IMPORTED SOIL SPECIFICATION
for the site at
BARTONS ROAD, HAVANT PO9 5NA
on behalf of
LINDEN HOMES





CONTENTS

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3.0	Nutritional Composition	5
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1.0 Introduction

This document sets out the requirements for imported subsoil and Topsoil materials for any project undergoing redevelopment or other works where capping work is required.

Within the specification reference has been made to topsoil and subsoil. Topsoil relates to the top layer of natural soil that can support healthy vegetation growth. Subsoil relates to the layer of soil immediately below the topsoil to the depth of the underlying broken rock or geological parent material.

The specification considers the chemical, nutritional and physical properties of soils that are to be imported onto site, in order to ensure materials used are suitable for their intended use and do not introduce any new hazard or pollutant linkage on to the site.

Where there is any discrepancy between this specification and BS3882:2015 or BS8601:2013, the latter documents shall take precedence unless otherwise formally confirmed by the relevant regulator.

2.0 Chemical Composition

The chemical criteria listed below are based on published CLEA Soil Guideline Values (SGVs), generic assessment criteria calculated using UK policy compliant software or by reference to current guidance and best practice. From time to time these values may change in line with regulatory or UK policy changes. Such changes will require revision and re-issue of this document.

At the time of preparation, where SGVs have not been published, generic assessment criteria (GAC) have been generated using the Contaminated Land Exposure Assessment (CLEA) model v1.06 published by the Environment Agency, or reference has been made to the relevant Suitable for Use Level (S4UL) published by LQM, or the Category 4 Screening Levels (C4SLs) published by DEFRA have been used. Although the C4SLs were released for Part 2A use, the associated policy companion document for the C4SLs indicated that they may also be used for planning. Although the C4SLs represent a marginally higher risk level than the SSACs (low risk rather than minimal risk) it is considered that the risk levels remain very low. Therefore, the final C4SLs are considered to be suitable to assess soils under the planning regime. Where SGVs or GAC are published for a range of Soil Organic Matter (SOM) values, these ranges and their respective SOM values have been presented and would be considered when assessing compliance with this Specification.

2.1 Method of Analysis

Samples should be analysed using UKAS or MCERTS accredited laboratories. For TPH analysis sample preparation must not include air drying.

2.1.1 Poly Aromatic Hydrocarbon (PAH)

The PAH analysis must include the EPA priority 16.

2.1.2 Total Petroleum Hydrocarbons (TPH)

The analysis for TPH should be undertaken on the 'as received' sample and not be subject to any pre-treatment and include aliphatic and aromatic carbon banding split.

2.2 Topsoil (0-300mm depth)

Table 1 provides a list of the maximum acceptable concentrations for imported topsoil.



Parameter	Maximum concentration (mg/kg)
Inorganic	
Arsenic (total)	<32
Boron (water soluble)	<291
Cadmium (total)	10 (SOM=6%)
Chromium (total)	<130
Copper (total)	<2330
Cyanide (total)	<250
Lead (total)	<200
Mercury (total inorganic)	<8
Nickel (total)	<130 (SOM=6%)
pH	5.5 – 7.8
Selenium (total)	<350 (SOM=6%)
Sulphate (total)	<2000
Zinc (total)	<3750
Asbestos	Absent
Organic	
Soil Organic Matter (SOM)	
Phenols (total)	<420 (SOM=6%)
Poly Aromatic Hydrocarbon (speciated)	See Table 1a
Total Petroleum Hydrocarbon (speciated)	See Table 1b

Table 1 Chemical Specification for Topsoil

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	5% SOM
Acenaphthene	210	480	1000
Acenaphthylene	170	400	850
Anthracene	2300	4900	9200
Benz(a)anthracene *	3.1	4.7	5.9
Benzo(a)pyrene	0.83	0.94	1.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(ghi)perylene	44	46	47
Benzo(k)fluoranthene	8.5	9.6	10
Chrysene	6.0	8.0	9.3
Dibenz(ah)anthracene *	0.24	0.28	0.30
Fluoranthene	260	460	670
Fluorene	160	380	780
Indeno(1,2,3CD)pyrene	3.2	3.9	4.2
Naphthalene	1.5	3.7	8.7
Phenanthrene	92	200	380
Pyrene	560	1000	1600
Total PAH	1910	3950	7285

NOTE: * - S4UL concentration at 6% SOM

Table 1a Topsoil Specification for Speciated PAH

As set out at the bottom of Table 1a, the total permissible PAH concentration for any given sample shall not exceed 50% of the sum of the individual maximum concentrations.



Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	5% SOM
Aliphatic			
EC 5-6	30	55	110
EC >6-8	73	160	370
EC >8-10	19	46	110
EC >10-12	93	230	540
EC >12-16	740	1700	3000
EC >16-35	45000	64000	76000
EC >35-44	45000	64000	76000
Aromatic			
EC 5-7 (benzene)	65	130	280
EC >7-8 (toluene)	120	270	611
EC >8-10	27	65	151
EC >10-12	69	160	346
EC >12-16	140	310	593
EC >16-21	250	480	770
EC >21-35	890	1100	1230
EC >35-44	890	1100	1230
Aliphatic and Aromatic			
EC >44-70	1200	1300	1300

Table 1b Topsoil Specification for Speciated TPH

Determinant	Phytotoxicity GAC (mg/kg)		
	pH <6.0	pH 6.0-7.0	pH >7.0
Zinc	200	200	300
Copper	100	135	200
Nickel	60	75	110

Table 1c Topsoil Specification for phytotoxicity

2.3 Subsoil (300-1000mm depth)

Table 2 provides a list of the maximum acceptable concentrations for imported subsoil.

Parameter	Maximum concentration (mg/kg)
Inorganic	
Arsenic (total)	<32
Boron (water soluble)	<291
Cadmium (total)	10 (SOM=6%)
Chromium (total)	<130
Copper (total)	<2330
Cyanide (total)	<250
Lead (total)	<200
Mercury (total inorganic)	<8
Nickel (total)	<130 (SOM=6%)
pH	5.5 – 7.8
Selenium (total)	<350 (SOM=6%)
Sulphate (total)	<2000



Parameter	Maximum concentration (mg/kg)
Inorganic	
Zinc (total)	<3750
Asbestos	Absent
Organic	
Soil Organic Matter (SOM)	
Phenols (total)	<420 (SOM=6%)
Poly Aromatic Hydrocarbon (speciated)	See Table 2a
Total Petroleum Hydrocarbon (speciated)	See Table 2b

Table 2 Chemical Specification for Subsoil

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	5% SOM
Acenaphthene	210	480	1000
Acenaphthylene	170	400	850
Anthracene	2300	4900	9200
Benz(a)anthracene *	3.1	4.7	5.9
Benzo(a)pyrene	0.83	0.94	1.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(ghi)perylene	44	46	47
Benzo(k)fluoranthene	8.5	9.6	10
Chrysene	6.0	8.0	9.3
Dibenz(ah)anthracene *	0.24	0.28	0.30
Fluoranthene	260	460	670
Fluorene	160	380	780
Indeno(1,2,3CD)pyrene	3.2	3.9	4.2
Naphthalene	1.5	3.7	8.7
Phenanthrene	92	200	380
Pyrene	560	1000	1600
Total PAH	1910	3950	7285

NOTE: * - S4UL concentration at 6% SOM

Table 2a Subsoil Specification for Speciated PAH

As set out at the bottom of Table 2a, the total permissible PAH concentration for any given sample shall not exceed 50% of the sum of the individual maximum concentrations.

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	5% SOM
Aliphatic			
EC 5-6	30	55	110
EC >6-8	73	160	370
EC >8-10	19	46	110
EC >10-12	93	230	540
EC >12-16	740	1700	3000
EC >16-35	45000	64000	76000
EC >35-44	45000	64000	76000
Aromatic			



Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	5% SOM
EC 5-7 (benzene)	65	130	280
EC >7-8 (toluene)	120	270	611
EC >8-10	27	65	151
EC >10-12	69	160	346
EC >12-16	140	310	593
EC >16-21	250	480	770
EC >21-35	890	1100	1230
EC >35-44	890	1100	1230
Aliphatic and Aromatic			
EC >44-70	1200	1300	1300

Table 2b Subsoil Specification for Speciated TPH

Determinant	Phytotoxicity GAC (mg/kg)		
	pH <6.0	pH 6.0-7.0	pH >7.0
Zinc	200	200	300
Copper	100	135	200
Nickel	60	75	110

Table 2c Subsoil Specification for phytotoxicity

3.0 Nutritional Composition

The nutritional criteria listed below are based on BS3882:2015 for topsoil and BS8601:2013 for subsoil. In the absence of published criteria, current guidance and best practice has been applied to derive appropriate criteria.

3.1 Topsoil & Subsoil

Table 3 details the minimum acceptable concentrations for imported topsoil and subsoil.

Topsoil/Subsoil	Parameter	Concentration
Topsoil	Phosphorous	16 – 140 mg/l
	Potassium	121 – 1500 mg/l
	Magnesium	51 – 600 mg/l
	Nitrogen	0.15 % m/m
	Carbon:nitrogen ratio	<20:1
Subsoil	Phosphorous	16 mg/l
	Potassium	121 mg/l
	Magnesium	51 mg/l
	Nitrogen	0.15 %
	Carbon:nitrogen ratio	<20:1

Table 3 Nutritional Specification for Topsoil and Subsoil

4.0 Physical Composition

The physical criteria listed below are based on BS 3882:1994 Specification for Topsoil. In the absence of published criteria, current guidance and best practice has been applied to derive appropriate criteria.



4.1 Topsoil

Table 4 details requirements for imported topsoil and subsoil.

Topsoil/Subsoil	Parameter	Specification requirements
Topsoil	Textural Classification	Sandy clay loam, sandy loam, loamy sand, sandy silt loam (as defined in BS 3882, Figure 1)
	Loss on Ignition	3 - 20% (for 5-20% clay soil) 5 - 20% (for 20-35% clay soil)
	Maximum Stone content:	>2mm = 30% >20mm = 10% >50mm = 0%
Subsoil	Textural Classification	Refer to BS8601 Figure 1
	Loss on Ignition	2%
	Maximum Stone content:	>2mm = 40% >20mm = 20% >75mm = 0%

NB: Topsoil and Subsoil must be free from glass, brick fragments, asbestos and other deleterious materials.

Table 4 Physical Specification for Topsoil & Subsoil

5.0 Source Requirements

5.1 Topsoil and Subsoil

The following will be provided with all soils imported to site:

- Location of site which is clean and has no history of potentially contaminative uses.
- A site plan detailing the location and address of the source site.

5.2 Manufactured soils

Where natural soils are unavailable manufactured soils may be utilised the following should be provided:

- Details of the soil manufacturing process, including criteria for received soils, quality control procedure and validation protocol.
- Soils should be tested at a minimum ratio of one sample per 50m³.

6.0 Testing Rates and Compliance

Sampling shall be undertaken in accordance with BS3882:2015 and BS8601:2013.

6.1 Topsoil

Where natural sourcing is proposed, the provenance of the material shall be determined by confirmation of the source site's history to confirm no previous potentially contaminative use, coupled with analysis of soils at a minimum rate of 3No. samples per source site (up to 250m³) and 1 sample per 250m³ thereafter.

Where Topsoil is derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50m³.



With regards to physical and nutritional composition and minimum testing regime of 1 sample per 250m³ is recommended for either source.

6.2 Subsoil

Where the source of the material is known and a due diligence review has established no previous contaminative use associated with the proposed subsoil, validation sampling should be undertaken at a minimum rate of 3 sample per source (up to 250m³) and 1 sample per 250m³ thereafter.

Where the source of the material is not known the validation sampling should be undertaken at a minimum of 1 sample per 50m³.

6.3 Manufactured soils

Soils should be tested at a minimum ratio of one sample per 50m³.

6.4 Sample failure

In the event that a sample fails to meet the specified criteria for any parameter the Environmental Consultant should be contacted for advice on the suitability of the materials.

Further testing may be required to provide reassurance that the exceedances are not representative of the soil.

6.5 Timing

Sampling and analysis undertaken by a manufactured topsoil supplier shall be no earlier than two weeks from the date of import, any results which are older than two weeks will be deemed not to be representative of the soils to be imported and rejected. Results showing consistency of batching shall may be requested.

Imported soil suppliers and groundworks contractors are required to take reasonably practicable measures to ensure that compliance with this Specification does not hinder formal completion of individual plots or developments.

6.6 General Compliance

All analytical suites shall correspond with the chemical and nutritional compliance criteria (as set out in Tables 1 to 3). The soil supplier shall ensure that the analytical limits of detection are equal or lower than the compliance values presented within this Specification. Where either testing suites or limits of detection do not comply with this Specification, the entire set of results shall be rejected.