
LAND OFF GREVATT'S LANE WEST

SOIL RESOURCE SURVEY

Prepared on behalf of:

LANDLINK ESTATES LTD

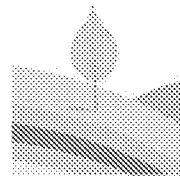
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1.0 INTRODUCTION

Tim O'Hare Associates LLP was commissioned by Landlink Estates Limited to undertake a soil resource survey at the Grevatt's Lane West site.

Permission to carry out the work is provided by the Landlink Estates Limited Purchase Order (PO No. 3000517) dated 12/07/2019.

1.1 Introduction

It is understood the site is to be developed to construct the proposed Central Arun Crematorium to include a number of soft landscape areas, including feature trees, native tree lines, ornamental planting, native planting belts, native hedge, wildflower meadow, amenity grass and swales. As part of the development strategy, it is intended that the site topsoil will be stripped and stored in temporary stockpiles before it is re-used for landscape purposes.

The existing site was formally under agricultural usage (vegetable production) and, as such, contains significant reserves of topsoil and subsoil. However, there is currently no information available on the horticultural quality, variability and suitability of the soils for landscape purposes for this development.

With reference to the supplied brief, *Soil Consultancy Services* are required to assist with the requirements under Item e and Item g of *Policy SO DM1*:

e. Site appraisal documents submitted by the applicant must demonstrate that consideration has been given to DEFRA's Soil Strategy for England (34);

g. The applicant has submitted a comprehensive soil resources plan for the development site which demonstrates that care will be taken to preserve the soil resource, such that it can be incorporated into a Productive Green Environment following development.

Item 'e' cites 'DEFRA's Soil Strategy for England' – this was issued in 2009 under the title of *Safeguarding our soils – A strategy for England (2009)*. The document refers to the DEFRA *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (CoP)*. The CoP aims to improve the use and management of soils through all stages of the construction process including re-using or recycling topsoil where appropriate. In terms of 'site appraisal', the *Pre-construction Planning* section of the CoP describes the need for a *Soil Resource Survey* in order to identify the site topsoil and subsoil resources - to be carried out on the site by a suitably qualified and experienced soil scientist or practitioner and prior to any earthworks operations.

The *Soil Resource Survey* will inform the production of the *Soil Resources Plan* for the development (item g).

1.2 Actions

Tim O'Hare Associates LLP (TOHA) has evaluated the quality and suitability of the soils by assessing a number of key chemical and physical soil properties, through desk study review, on-site investigation and laboratory analysis. The survey covered the main development area only and excluded the new access road (currently Grevatt's Lane West).

This report issues the findings of the desk study review and soil investigation, including site observations and soil descriptions, results and interpretation of all analyses, discussion on soil quality and implications for landscape construction on this site.

2.0 DESK STUDY REVIEW

2.1 Documents Reviewed

Prior to commencing the site investigation work, the following documents were reviewed as part of a Desk Study Review:

- *Soil Map of England and Wales (Scale: 1:250,000 – Sheet 6);*
- *British Geological Survey website (Geology of Britain – 1:50,000 Scale);*
- *Haverstock LLP, Existing Site Boundary Plan, Ref. 1176 1001- shown as Appendix 1.*
- *Plincke Landscape Limited, Design and Access Statement, Arun Crematorium (Plincke Ref: 1176_D001 - Design and Access Statement 21.12.2018);*
- *Plincke Landscape Limited, Proposed Site Plan, Arun Crematorium (Plincke Ref: 0524-DR-100).*

The findings of this review are presented below.

2.2 Geology and Soils

The British Geological Survey 1:50,000 Solid and Drift map indicates that the site is underlain by *Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation And Portsdown Chalk Formation (undifferentiated) - Chalk*, which is comprised of sedimentary bedrock formed approximately 72 to 94 million years ago in the Cretaceous Period under an environment previously dominated under an by warm chalk seas. Superficial deposits of *River Terrace Deposits (undifferentiated) - Sand, Silt And Clay* were also recorded across the site.

The Soil Map of England and Wales (1:250,000 scale) Sheet 6 indicates one soil type is present at this site, as outlined below:

Major Group	<i>Brown Soils</i>
Group	<i>Argillic Brown Earths</i>
Subgroup	<i>Typical Argillic Brown Earths</i>
Series	<i>571z Hamble 2</i>

Brown Soils have dominantly brownish or reddish subsurface horizons with no prominent mottling or greyish colours above 400mm. *Argillic brown earths* are loamy or loamy over clayey soils with subsurface horizons showing significant clay enrichment.

The *Hamble 2* series are 'Aeolian silty drift, deep stoneless well drained and similar soils affected by ground water, over gravel locally. Usually flat land'.

2.3 Landscape Proposals

From the supplied Plincke Landscape Limited, *Design and Access Statement* drawings, the new landscape within the Central Arun Crematorium site will include feature trees, native tree lines, ornamental planting, native planting belts, native hedge, wildflower meadow, amenity grass and swales.

These landscape environments will require different soil conditions, varying in terms of drainage characteristics and fertility status in order to meet their demands. The soil requirements of each landscape type are considered below.

Feature Trees, Native Tree Lines

The most demanding of the proposed planting environments are extra heavy standard and semi-mature pit planted trees. Trees of this size and age have grown accustomed to optimum growing conditions in the nursery, and these need to be replicated when the rootballed or containerised tree is planted in the pit. In particular, aeration and drainage around the rootball to a depth of between 0.5m to 1.0m are critical. Without these properties, trees will very quickly suffer and possibly die during their first few growing seasons after planting.

Ornamental Planting

Ornamental planting beds require shallower soil depths compared to mature trees. However, many shrubs and herbaceous perennials are not typically tolerant of adverse soil conditions and normally require soils which are fertile, well drained and aerated.

Native Planting Belts, Native Hedges

Native planting belts and native hedges comprise indigenous woodland plant species, typically planted as whips and transplant trees. These are less demanding planting types, for which a broad range of soil types is often considered acceptable.

Wildflower Meadow

Wildflower meadows require low-nutrient soils, and in particular low phosphorus levels, so that aggressive weeds and grasses such as dandelion, nettle and rye-grass cannot dominate the sward.

Amenity Grass

Amenity grass can typically be established on a wide range of soil types and on relatively shallow soil depths. Special consideration may need to be given to areas expected to receive high levels of footfall. Soils with low stone contents without medium or large-sized stones are normally required for seeded amenity grass.

Swale

Swale habitat planting may be comprised of several planting types which normally vary according to the predominant water level, typically consisting of mainly marginal plants, as well as submergent and emergent types. Appropriate soils are needed for these purposes, which normally have a relatively low fertility status to avoid impact on water quality by *eutrophication*. Inert soil with low organic matter content is normally required to be placed below a *permanent* water line (if/where present).

3.0 SITE INVESTIGATION

3.1 Site Visit

The site work was conducted on the 9th July 2019 during a period of warm, dry weather. The site was located to the east of Bognor Regis, West Sussex, north of Dover, immediately south east of Burndell. The site was accessed directly from Grevatt's Lane West.

3.2 Site Observations

The site was roughly rectangular in shape, reasonably level, without noticeable micro-topography or built structures. Boundaries consisted of hedges to the north, east and south, whilst the western edge was unbounded. Vegetation consisted of moderately dense colonisation by a variety of annual and perennial weeds.

No evidence of soil disturbance was recorded other than from normal agricultural activities. Surface shrinkage cracks and subangular flints (up to 90mm in diameter) were present over the entire site.

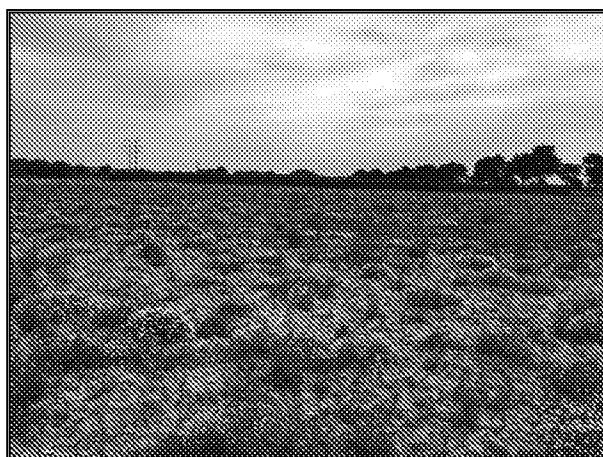


Plate 1: View of the site to the north



Plate 2: Example of soil shrinkage cracking

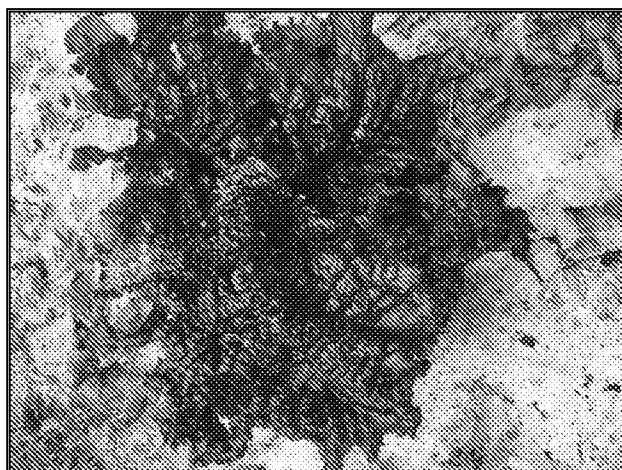


Plate 3: Example of vegetable from previous land use

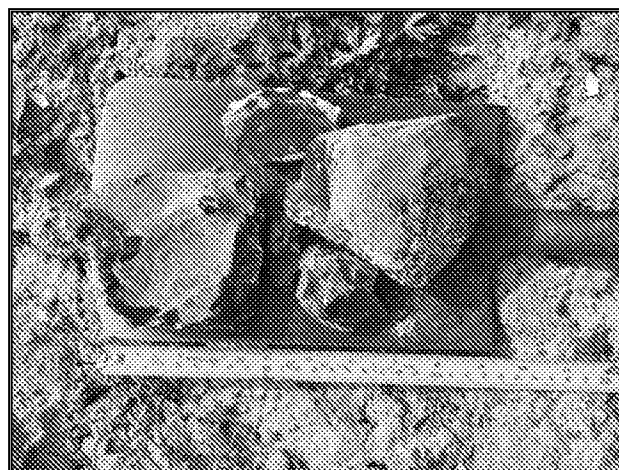


Plate 4: Larger stones observed on the soil surface

3.3 Soil Conditions

We examined the soils by constructing a total of 12 No. hand-dug trial holes (TH) at representative locations within the survey area. Trial holes were dug to a maximum depth of 1000mm where possible. The locations of our trial holes are indicated on the site plan in **Appendix 1**.

At each trial hole, the soils were examined with reference to the Soil Survey Field Handbook. Important physical soil characteristics were recorded, including texture, structure, compaction, waterlogging, anaerobism, topsoil depths, stone content and the presence of deleterious materials. At the same time, representative soil samples were taken for laboratory analysis.

3.4 Soil Descriptions

A single soil profile was encountered during the site visit which was described as below:

Topsoil

GL – 290/330mm

Average depth:
320mm

Brown (Munsell Colour 10YR 4/3), dry to slightly moist, friable, non-calcareous SILTY CLAY LOAM to CLAY LOAM with a poor to moderately developed structure. Upon disturbance, the soil broke into a weak fine to coarse granular to subangular blocky structure.

Slightly stony including occasional sub-angular flints up to 90mm in length. No observable deleterious materials.

Subsoil

290/330 – 1000mm

Yellowish brown to light brownish grey (Munsell Colour 10YR 5/6 – 6/2), slightly moist, slightly plastic SILTY CLAY LOAM with a moderately developed, sub-angular blocky structure. Virtually stone-free to slightly stony and no observable deleterious materials. Ochreous mottling and manganese concretions throughout and becoming stronger with depth.



Plate 5: Typical soil profile (TH1)

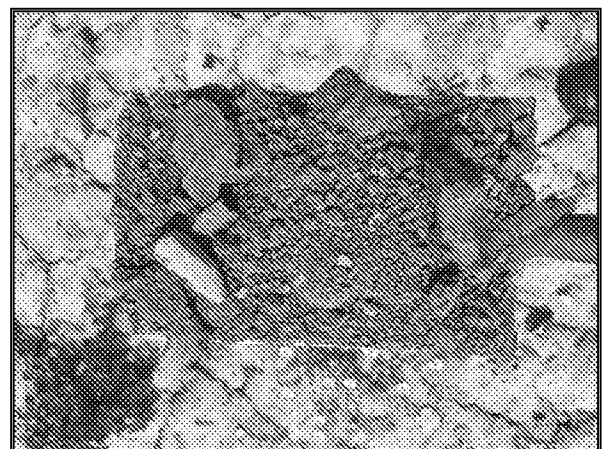


Plate 6: Topsoil arisings

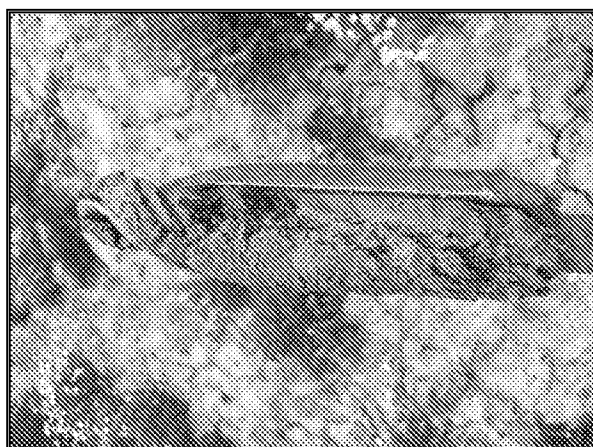


Plate 7: Subsoil arisings

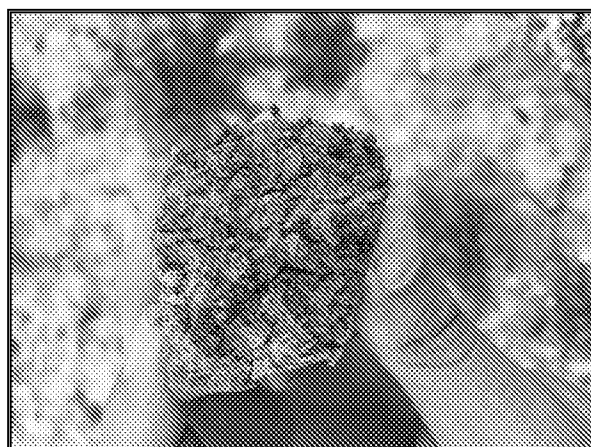


Plate 8: Subsoil arisings showing distinct mottling

3.5 Topsoil Depths

The following topsoil depths (mm) were recorded during our survey:

Trial Hole	Topsoil Depth	Trial Hole	Topsoil Depth
TH1	330	TH7	330
TH2	320	TH8	320
TH3	320	TH9	330
TH4	320	TH10	330
TH5	320	TH11	290
TH6	310	TH12	290

Average topsoil depth: 320mm

3.6 Soil Sampling

3 No. composite samples of Topsoil and 2 No. composite samples of Subsoil were collected from site. The following table details the locations of the sub-samples for each of the 5 No. composite samples.

Composite Sample	Sub-Sample Trial Hole Locations
<u>Topsoil</u>	
Sample 1	TH1, 2, 3, 4
Sample 2	TH5, 6, 7, 8
Sample 3	TH9, 10, 11, 12
<u>Subsoil</u>	
Sample 1	TH1, 2, 3, 4, 5, 6
Sample 2	TH7, 8, 9, 10, 11, 12

The trial hole locations can be viewed on the site plan located within **Appendix 1**.

4.0 LABORATORY ANALYSIS

4.1 Analytical Schedule

A total of 5 No. representative samples of Topsoil (3 No.) and Subsoil (2 No.) were submitted to the laboratory for analysis.

The samples were analysed in accordance with the following schedule:

- particle size analysis;
- stone content;
- pH and electrical conductivity values;
- exchangeable sodium percentage (Topsoil only);
- major plant nutrients - N, P, K, Mg (Topsoil only);
- organic matter content;
- carbon to nitrogen ratio (Topsoil only).

The results are presented on the Certificates of Analyses in **Appendix 2** and our interpretation of the results is given below.

4.2 Results of Analysis

Particle Size Analysis

The topsoil and subsoil samples fell into the SILTY CLAY LOAM to MEDIUM CLAY LOAM texture classes. Silty soils, such as these, typically have low structural strength and are therefore prone to structural degradation and self-compaction when handled intensively, (e.g. topsoil stripping, storage and respreding). In addition, unlike clay soils, silty soils do not possess the same ability to 'self-repair' by the *shrink and swell* mechanism (an important soil structure forming process), and they usually do not respond well to mechanical cultivation. As a consequence, once structurally damaged, it can be difficult to improve the physical condition of silty soils, particularly in the short-term, to a level fit for landscaping.

Where these soils are used for landscape purposes, they would be best suited to hardy plant species tolerant of moisture retentive soil and only if the soils' physical condition is adequate. In addition, smaller plant stock, such as whips and transplants, would be more suited than containerised or rootballed stock, as they tend to be more tolerant of adverse soil conditions. The soils would not be suitable for use for plants / planting environments that require light or free-draining soil.

The potentially restricted drainage properties of the soils, particularly following disturbance and reinstatement, would need to be overcome to promote a healthy rooting environment, particularly for demanding planting types such as tree pits. This may include the installation of land drains, profiling the landscape areas to shed water, sand amelioration of the topsoil, or even the use of alternative soils.

Stone Content

The topsoil samples were slightly stony, including low proportions of stones >50mm diameter. Whilst the overall stone content may not affect tree or shrub planting, it would be prudent to reduce the proportion of the larger stones from the topsoil prior to planting by intensive mechanical raking or picking.

The presence of large stones may affect the establishment and maintenance of grass areas. Therefore, it would be prudent to reduce the proportion of the larger stones by mechanical raking, picking or screening prior to seeding or turfing.

The subsoil samples were virtually stone-free to slightly stony, and would be considered suitable for the proposed landscape scheme.

pH and Electrical Conductivity

The topsoil samples were slightly acid in reaction (pH 6.6 – 6.8), with a pH range that would be considered ideal for general landscape purposes.

The subsoil samples were slightly alkaline in reaction (pH 7.4), with a pH range that would be considered ideal for general landscape purposes.

The electrical conductivity (salinity) values were all low, indicating that soluble salts were not present at levels that would be harmful to plants.

Organic Matter and Nutrient Status

The below table indicates the organic matter and nutrient status of the topsoil samples for the proposed landscape types which require fertile soils (e.g. tree, shrub and herbaceous planting, native hedgerow planting and amenity grass).

Parameter	Sample 1	Sample 2	Sample 3
Organic Matter	O	O	O
Total Nitrogen	O	O	O
Extractable Phosphorus	✓✓	✓✓	✓✓
Extractable Potassium	✓	x	x
Extractable Magnesium	✓	✓	✓

✓✓ - well supplied; ✓ - adequately supplied; O - slightly deficient; x - deficient; xx - very deficient

The topsoil contained a moderately high level of extractable phosphorus and a moderate level of extractable magnesium. The organic matter, total nitrogen and extractable potassium were slightly low. A routine application of bulky organic matter or fertiliser would be required in order to address the deficiencies identified above.

Plant available phosphorus is the key nutrient when considering the fertility status of soil in relation to habitat creation purposes, including the establishment of species-rich wildflower grassland. The topsoil samples would be considered to be 'High' with respect to phosphorus (MAFF index 4) and therefore have a low potential for this proposed landscape type.

The subsoil samples displayed low levels of organic matter which would be considered acceptable for a landscape subsoil.

5.0 DISCUSSION

The proposed Central Arun Crematorium includes the provision of a number of soft landscape areas, including feature trees, native tree lines, ornamental planting, native planting belts, native hedge, wildflower meadow, amenity grass and swales. As part of the development strategy, it is intended that the site topsoil will be stripped and stored in temporary stockpiles before it is re-used for landscape purposes.

The aim of this investigation was to ascertain the type and quality of the soil resource present and its suitability for the proposed landscape scheme. Recommendations are provided for the management of the soils through the earthworks phases and any improvement where necessary.

5.1 Summary of Findings

From our site visit and subsequent laboratory analysis, the topsoil and subsoil were found to be reasonably consistent in composition across the site. The topsoil was described as slightly acid, non-saline, non-calcareous SILTY CLAY LOAM to MEDIUM CLAY LOAM with a moderate to well-developed structure of weak strength, and low stone content with occasional stones up to 90mm in length. The topsoil contained a moderately high level of extractable phosphorus and a moderate level of extractable magnesium. The organic matter, total nitrogen and extractable potassium were slightly low. The depths of topsoil over the site ranged from 290 to 330mm, with an overall site average of 320mm.

The subsoil was described as a slightly alkaline, non-saline, non-calcareous SILTY CLAY LOAM and was virtually stone free. The organic matter content was low and consistent with that of natural subsoil.

5.2 Re-use of the Site Soils

The silty character of these soils (moisture retentive, with weak soil structures and tendency to self-compact) makes them particularly problematic and of a low quality for re-use for landscape uses. Soil such as this has little capability for self-repair, unlike those with high clay contents which tend to form deep cracks when dry. The moisture retentive character of the topsoil and its vulnerability to physical degradation following disturbance by soil stripping limits the potential to re-use these soil types to non-demanding, hardy species and planting types.

The development strategy to strip the topsoil results in a loss of soil structure and so further reduces its quality as a 'landscape soil'. This damage has been taken into account with respect to its re-use for landscape purposes, and it will be essential that it is minimised and repaired following resspreading.

Following disturbance, the soils will be suitable for non-demanding landscape environments only, including native planting belts, native hedge and amenity grass (low foot traffic), provided the soils are suitably prepared for planting / seeding and the plants selected are tolerant of moisture retentive soils. In addition, the topsoil was slightly deficient in organic matter, total nitrogen and extractable potassium. These deficiencies must be addressed for landscape purposes.

Given the limitations presented by the site soils, the following sections provide further comments in relation to the proposed landscape types.

5.3 Tree Planting

Tree Pits for Semi-Mature Trees

Tree pits for semi-mature trees should include appropriate modifications to their design so that they do not act as sumps for surface draining water. The level of modification required would depend on the extent of any disturbance and degradation caused to the soils' structure and the level of soakage following landscape construction. Ideally, all tree pits for semi-mature trees should be constructed with positive drainage or as a bare minimum include a gravel soakaway layer at the base.

The site subsoil will be prone to self-compaction if placed below the weight of a tree root ball and so it is not considered suitable for use as backfill in tree pits for semi-mature trees. It is recommended that an appropriate free-draining sand or sandy subsoil is used as subsoil in all tree pits. Topsoil 'mounding' should also be considered in order to improve soil aeration and exposure of the rootball to waterlogging.

Planting Smaller Rootballed Trees

As with larger trees, the aim when planting smaller rootballed trees (say up to heavy standards) is to ensure the rooting zone is well aerated and free from waterlogging, particularly during the growing season. This may be achieved for smaller trees by firstly ensuring the subsoils have adequate soil structures to allow soakage from beneath the rootball. Where the subsoil has been compacted by earthwork activities it should be loosened with suitable tillage equipment. The planting holes should be dug to accommodate the rootballs only and a shallow layer of sand, with a minimum of disturbance to the surrounding soils. The holes should not be 'over-dug' and should leave the subsoil in place. Improvement to the aerations and drainage functions of the soil profile may also be necessary – see section 5.3.

5.4 Ornamental Planting

Planting beds for ornamental plants (e.g. shrubs, herbaceous perennials) should be well aerated and free from waterlogging. As such the subsoil should be thoroughly decompacted as part of the landscape construction phases and following planting additional loosening of the topsoil surface would also be advisable. Improvement to the aerations and drainage functions of the soil profile may also be necessary – see section 5.3.

5.5 Swales

In order for a swale to function correctly, a sand-based soil with rapid drainage is normally required. In this instance, we are not aware as to the function and purpose of this swale design. Based on our findings, the silty nature of the soils is likely to result in a moisture retentive environment, and therefore if a 'free-draining' medium is required, these soils will probably not function as required.

5.6 Wildflower Meadow

The topsoil has a low potential for the establishment of the proposed *Wildflower Meadow* (species-rich wildflower grassland) due to their elevated fertility status and existing weed seed bank, and, as such, would be expected to be particularly prone to colonisation by aggressive species and grasses.

If this topsoil is to be used for this purpose a seed mix should be selected that are compatible with the characteristics of the site topsoil (i.e. slightly acid, moisture retentive and *fertile*). The sward produced is unlikely to achieve high levels of floral diversity, and is likely to become increasingly colonised by grasses. Appropriate management of the sward will be necessary to maximise the numbers of species produced and prevent the domination by aggressive species such as nettle and dock.

As an alternative, it may be sensible to use the site subsoil for this purpose which has the advantages of having lower levels of soil fertility and a negligible weed seed bank. Use of the subsoil is likely to result in slower rates of establishment and so should be considered in relation to the programme and desired site aesthetics. The establishment of the new sward could be accelerated by a light application of green compost.

5.7 Amenity Grass

The topsoil has is prone to settlement and compaction from intense uses and therefore has a low potential for re-use area s of amenity grass anticipated to receive 'high levels' of pedestrian foot traffic (e.g. desire lines).

Where it is desired to re-use this topsoil for high foot traffic areas, it may be advisable to carry out 'sand amelioration' to improve its resistance to compaction. Such areas should also be maintained with a suitable lawn maintenance schedule, including mowing, aeration, decompaction, scarification, fertilisers, herbicide application (if necessary).

5.8 Summary of Soil Suitability

The suitability of the site soils for re-use for the proposed landscape scheme are summarised in the table below:

Landscape Type	Topsoil	Subsoil
Extra Heavy Standard Trees, Semi-mature Trees	X	X
Standard Trees, Heavy Standard Trees	O	O s
Ornamental Planting	O	O
Native Planting Belts	✓	✓
Native Hedgerows	✓	✓
Wildflower Grassland	LP	✓
Swale	II	II
Amenity Grass (low foot traffic)	✓*	✓
Amenity grass (high foot traffic)	O * <	O

- ✓ Suitable for this purpose provided the physical condition of the soil is adequate at planting / seeding and hardy species selected are tolerant of moisture retentive soils. Nutrient deficiencies should be remedied.
- O Possibly suitable for this purpose provided the physical condition of the soil is at its optimum. Species selected must be tolerant of moisture retentive soils. Improvement to aeration and drainage functions of the soil profile may also be necessary.
- * Appropriate stone treatment to remove large stones from the surface by burying or picking would be required.
- s Use in conjunction with a shallow layer of sand to support the rootball.
- < Sand amelioration recommended for this purpose.
- LP Low Potential for this purpose based on high level of soil fertility.
- X Not suitable for this purpose due to inappropriate physical characteristics.
- II Insufficient Information is available to comment on the suitability of this soil.

5.9 Improvement options for poorly draining soils

The restricted drainage properties of the site soil will limit the re-use potential of these soils to more hardy planting types only. Any damage caused to the soils during landscape works and any intense handling is likely to reduce its quality. For more demanding purposes, such as tree planting up to 18 cm girth / 2.4m height and specimen shrub planting, it would be necessary to improve the physical aspects of these soils in order to broaden their re-use potential, including:

Installation of artificial drainage. Drainage may be installed at key locations or specifically for particularly vulnerable planting types. The type, design and depth of the drainage should be suitable to the proposed application. Drainage can be expensive and is reliant on the availability of a suitable outfall / discharge point.

Localised mounding of topsoil. The topsoil may be mounded locally for vulnerable species. This effectively 'lifts' the plants, and reduces the risk of harm from waterlogging and improves aeration within the rooting zone. This approach can be extremely cost effective and is not reliant on an outfall. Mounding can be done on an individual tree basis or larger mounds provided for clusters of trees.

Species-selection. There may be scope to revise the species selection and stock sizes for this landscape scheme to those which are tolerant of heavy moisture retentive soils.

It is likely that a combination of the measures above would be needed to ensure suitable soil conditions are provided for successful landscape construction on this site.

5.10 Soil Structure & Physical Degradation

It is essential to provide a structured, uncompacted topsoil for the successful establishment and subsequent growth of plants and grass. Adequate soil structure is a key element for healthy plant growth to ensure aeration and drainage within the rootzone. Where the site's development programme requires the soils to be disturbed by activities such as excavation, storage and respreading, soil structure can easily be destroyed by compaction. Any damage to soil structure will reduce the drainage rate of this topsoil.

Almost all soils are physically degraded during intensive handling and the potential quality and the ultimate suitability of the topsoil for re-use will depend on how well its soil structure is preserved during the earthworks phase. This silty topsoil is particularly prone to structural damage if handled and moved when wet. In this situation, the larger (air containing) soil pores are destroyed and replaced by smaller (water retentive) pores. This will restrict gaseous exchange with the atmosphere and cause the topsoil to become anaerobic (oxygen depleted). In addition, the lack of larger pores prevents effective drainage and results in an increased risk of waterlogging.

Waterlogged and anaerobic conditions, if they persist, can be severely detrimental to plants in two main ways. Firstly, aerobic bacteria are replaced by anaerobic bacteria that produce ammonia and methane gases which are harmful to plants. Secondly, without oxygen plant roots are unable to take up water and nutrients.

5.11 Topsoil Handling & Programming

If the site topsoil is to be re-used successfully, structural degradation must be kept to a minimum. In order to achieve this, it is considered best practice to only handle the topsoil when it is reasonably dry and friable in consistency.

The most appropriate time to carry out the topsoil strip will therefore be during the summer months (May/June to September/October), and then only when the topsoil is dry. If the topsoil is dry when it goes into the temporary stockpile, it can be kept dry until it is respread.

At the time of the site visit, the topsoil was suitably dry and friable for safe handling and therefore conditions were at their optimum for the topsoil strip and storage phases. If the development's programme requires the topsoil to be further handled when moist/wet and plastic, it is inevitable that significant damage is likely to occur to its structure. This damage will be potentially irreparable (particularly in the short to medium term), and planning the programme of earthworks should therefore be carefully considered by the project team at the earliest stage.

Should the topsoil become damaged through wet handling, it may still be possible to repair the damage provided there is sufficient time and dry weather. It will therefore be essential that the *Topsoil Respreading Phase* take place during a summer season, to allow enough time for the soil to dry out effectively and be thoroughly cultivated before soil cultivation and planting / seeding / turfing takes place in autumn (grass seeding) and winter (planting).

If the project's programme results in wet topsoil being respread for planting / seeding in the wetter / colder winter or following spring months, there is unlikely to be any opportunity to recondition and prepare the topsoil to address the structural degradation caused by the stripping / stockpiling process. Planting into such adverse conditions is likely to result in poor establishment rates and possibly plant failures.

6.0 OUTLINE RECOMMENDATIONS

The following recommendations are provided based on the findings of this Soil Resource Survey.

6.1 Soil Handling

It is important to maintain the physical condition of the soils (topsoil and subsoil) and preferably avoid, and if not minimise, structural degradation during all phases of soil handling (e.g. stripping, storage, resspreading and planting). As a consequence, soil handling operations should be carried out when soil is reasonably dry and non-plastic (friable) in consistency. In particular, it is important to ensure that the soil is not unnecessarily compacted by trampling or trafficking by site machinery. In addition, topsoil handling should be stopped during and after heavy rainfall, and not continued until the soil is again non-plastic in consistency.

If, during the course of the earthworks, the soils are compacted or structurally damaged, they should be suitably cultivated and/or ripped to relieve the compaction and restore the structure prior to any planting or seeding.

6.2 Vegetation Treatment

The site was vegetated with various weeds. It is good practice to reduce the quantity of the vegetation that is stripped with the topsoil and placed in the storage stockpile. This will involve removing as much of the existing vegetation as is practical.

6.3 Soil Ameliorants

The fertility status of the topsoil should be raised for most landscape purposes by applying suitable slow release fertiliser for planting and a pre-seeding fertiliser for areas of amenity grass. No fertiliser should be applied to areas of species-rich wildflower grassland seeding. A light application of green compost would be advisable where the subsoil is to be re-used for the areas of Wildflower Meadow.

For areas of amenity grass (high levels of foot traffic) it would be advisable to carry out sand amelioration using a suitable lawn sand.

6.4 Soil Resource Plan

Sensitive management of topsoil and subsoil is an important aspect for the sustainable use of soils as such, a Soil Resource Plan should be prepared for this site to include the following:

1. Treatment of existing vegetation.
2. Methods for stripping and stockpiling soils.
3. Appropriate topsoil depths.
4. Methods for respreading soils.
5. Soil treatment techniques to ensure a well structured, uncompacted rooting zone is provided for future landscape construction.
6. Soil amelioration measures including options to improve the quality of the soils by adding fertiliser, compost or sand etc.

Once completed, the Soil Resource Plan would cover the relevant requirements from the *Code of Practice for the Sustainable Use of Soils on Construction Sites*, for a *Soil Resource Plan*.

We would like to thank Landlink Estates Limited for entrusting our practice with this commission. We trust this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned if we can be of further assistance.

Matthew Lowry
BSc MSc
Graduate Soil Scientist

Tim White
BSc MSc MScSoilSci CSci
Senior Associate

For and on behalf of Tim O'Hare Associates LLP

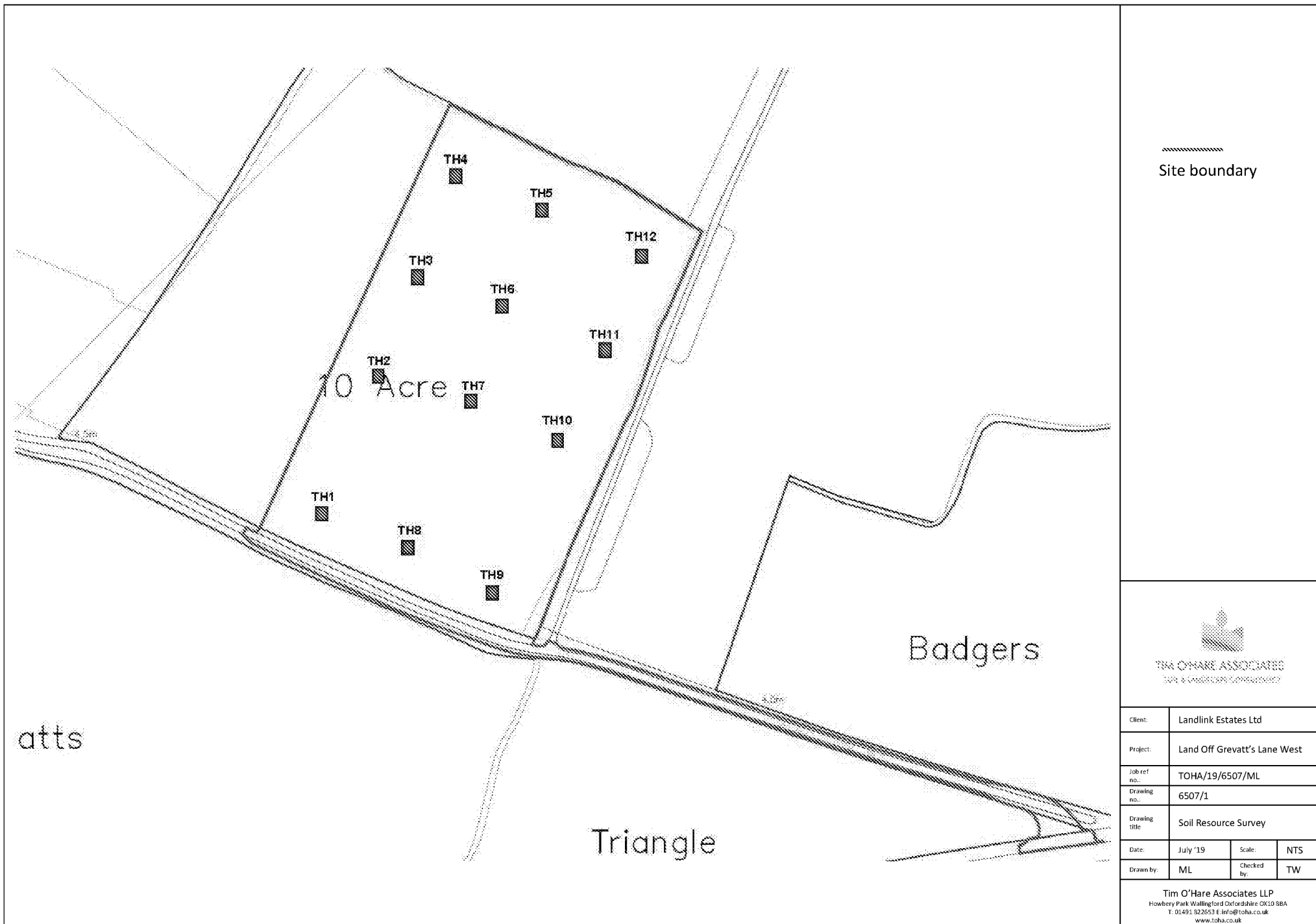
Report Qualifications

Our interpretation of the soil conditions is based on observations made during our site investigation and the results of laboratory tests. This report presents our site observations and test results and our interpretation of those observations and results. On any site, there may be variations in soil conditions between these exploratory positions. We can therefore not accept any responsibility for soil conditions that have not been exposed by this investigation.

This investigation considers the re-use of the soils for landscaping works within the Grevatt's Lane West site. It should not therefore be relied on for alternative end-uses or for other schemes. This report has been prepared solely for the benefit of our client Landlink Estates Limited. No warranty is provided to any third party and no responsibility or liability will be accepted for any loss or damage in the event that this report is relied upon by a third party or is used in circumstances for which it was not originally intended.

Appendix 1

Site Plan – Survey Area and Trial Hole Locations



Site boundary



Client:	Landlink Estates Ltd		
Project:	Land Off Grevatt's Lane West		
Job ref no.:	TOHA/19/6507/ML		
Drawing no.:	6507/1		
Drawing title:	Soil Resource Survey		
Date:	July '19	Scale:	NTS
Drawn by:	ML	Checked by:	TW

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Appendix 2

Laboratory Analysis



TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	Landlink Estates Limited
Project:	Grevatt's Lane West
Job:	Soil Resource Survey
Date:	July 2019
Job Ref No:	TOHA/19/6507/ML

Sample Reference		Accreditation
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.063mm)	%	UKAS
Sand (0.063-2.0mm)	%	UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	GLP
Stones (20-50mm)	% DW	GLP
Stones (>50mm)	% DW	GLP

pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS
Electrical Conductivity (1:2 CaSO ₄ extract)	uS/cm	UKAS
Exchangeable Sodium Percentage	%	UKAS

Organic Matter (LOI)	%	UKAS
Total Nitrogen (Dumas)	%	UKAS
C : N Ratio	ratio	UKAS
Extractable Phosphorus	mg/l	UKAS
Extractable Potassium	mg/l	UKAS
Extractable Magnesium	mg/l	UKAS

Topsoil 1

19
62
19
ZCL
1
7
2

Topsoil 2

19
62
19
ZCL
0
2
3

Topsoil 3

19
60
21
CL
1
3
5

6.8
149
2115
1.2

6.6
141
2105
1.1

6.6
141
2128
1.3

3.5
0.16
13
53
160
123

3.4
0.15
13
57
103
123

3.4
0.14
14
35
101
134

ZCL = SILTY CLAY LOAM
CL = CLAY LOAM

BSc MSc
Graduate Soil Scientist

Results of analysis should be read in conjunction with the report they were issued with

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TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	Landlink Estates Limited
Project:	Grevatt's Lane West
Job:	Soil Resource Survey
Date:	July 2019
Job Ref No:	TOHA/19/6507/ML

Sample Reference		Accreditation
Clay (<0.002mm)	%	UKAS
Silt (0.002-0.05mm)	%	UKAS
Sand (0.05-2.0mm)	%	UKAS
Texture Class (UK Classification)	--	UKAS
Stones (2-20mm)	% DW	GLP
Stones (20-50mm)	% DW	GLP
Stones (>50mm)	% DW	GLP

pH Value (1:2.5 water extract)	units	UKAS
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS

Organic Matter (LOI)	%	UKAS
----------------------	---	------

Subsoil 1

24
66
10
ZCL
0
0
0

7.4
132

2.3

Subsoil 2

24
64
12
ZCL
0
0
0

7.4
142

2.0

ZC = SILTY CLAY LOAM



Matthew Lowry
BSc MSc
Graduate Soil Scientist

Results of analysis should be read in conjunction with the report they were issued with

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