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London Luton Airport Expansion

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5.02 Appendix 6.5 Land at Luton Airport Soil Resource Survey Oct 2018

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5.02 ENVIRONMENTAL STATEMENT APPENDIX 6.5 LAND AT LUTON AIRPORT SOIL RESOURCE SURVEY OCTOBER 2018

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Luton Airport Expansion Project

Soil Resource Survey

Prepared on behalf of:

London Luton Airport Ltd

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1.0 INTRODUCTION

Tim O'Hare Associates LLP was commissioned by Capita Property and Infrastructure Limited to undertake a soil resource survey for the Luton Airport Expansion Project.

The authority to carry out the work is contained in an official Purchase Order from Capita Property and Infrastructure Limited, (Purchase Order 4800326433, dated 18th July 2018).

1.1 Purpose

It is understood that Capita Property and Infrastructure Limited ('Capita') has been appointed to provide Design consultancy services in relation to the expansion of Luton Airport to include a new district park, as well as employment allocated land and associated infrastructure.

It is intended for the district park to be linked to the existing Wigmore Park. Wigmore Park itself is to be updated with a number of landscape improvements.

The majority of the existing site is in use as agricultural land (arable), with the remainder comprising a public park and limited areas of woodland. As such, the site contains large 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.

A scheme of this size will require soils to support the required landscape planting / seeding and the creation of species-rich habitats. Soil provides the foundation to all new landscape and habitat schemes. Its quality, composition and function are intrinsically linked to the health, vigour and establishment of the plants that rely on it for water, mineral and organic reserves, and structural support and therefore not all soils are suitable for landscape and habitat creation purposes.

The purpose of this work was to assess the existing site soils to provide information on their pertinent chemical and physical properties for horticultural re-use. This Soil Resource Survey is intended to guide on-going design and cost analysis by providing information on the existing site soil resources and their potential for re-use for the new development. Subsequently it will inform future soil management activities and support the required Landscape Specifications for this site /soils.

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.

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 and habitat creation on this site.

The survey site is shown on the supplied site plan (*London Luton Airport Ltd* drawing *Luton Airport, Boundaries Plan, for soil survey only. Doc Number: LLADCO-00-OTR-00-00-DR-LS-0004, dated 22/10/2018*) as **Appendix A**.

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:

- *London Luton Airport Ltd* drawing *Luton Airport, Boundaries Plan, for soil survey only. Doc Number: LLADCO-00-CAP-00-00-SK-LD-xxxx;*
- *London Luton Airport Ltd drawing London Luton Airport DCO, Soil Survey Plan. Doc Number CS/089920-03_L_SS date: 25/07/2018*
- *Soil Map of England and Wales (Scale: 1:250,000 – Sheet 6);*
- *British Geological Survey website (Geology of Britain – 1:50,000 Scale);*

The findings of this review are presented below.

2.2 Geology

The *British Geological Survey* website (*Geology of Britain – 1:50,000 Solid and Drift*) describes the geology (Bedrock and Superficial Deposits) as follows with some differences indicated between the *slopes* and *valley bases* on this site:

Slopes

The bedrock for the sloping parts of the site comprise '*Lewes Nodular Chalk Formation and Seaford Formation (undifferentiated) – chalk'*. This consists of Sedimentary Bedrock formed 84 to 94 million years ago in the Cretaceous Period. These rocks were formed in warm chalk seas with little sediment input from land.

Superficial deposits for the sloping portions of the site consist of '*Clay-with-flints Formation - Clay, Silt, Sand and Gravel'*. Superficial Deposits formed up to 5 million years ago in the Quaternary and Neogene Periods. Local environment previously dominated by weathering processes.

Valley Bases

At the base of valleys, the bedrock consisted of '*Holywell Nodular Chalk Formation and New Pit Chalk Formation (undifferentiated) – chalk'*. This is a Sedimentary Bedrock formed approximately 89 to 100 million years ago in the Cretaceous Period. Local environment previously dominated by warm chalk seas.

Superficial deposits at the base of the valleys are shown as '*Head - Clay, Silt, Sand and Gravel'*, formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by subaerial slopes.

2.3 Soil Map of England and Wales

The Soil Map of England and Wales (1:250,000 scale) Sheet 6 indicates the site soils to comprise *Brown Soils*, with some variations represented. The majority of the site falls under the following:

Major Group	*Brown Soils*
Group	*Paleo-argillic brown earths*
Subgroup	*Stagnogleyic paleo-argillic brown earths*

Brown soils have dominantly brownish or reddish subsurface horizons with no prominent mottling or greyish colours above 400mm depth. Paleo-argillic brown earths are loamy or clayey soils with a reddish or reddish mottled, clay-enriched subsoil.

Soil Associations

Further definition places these soils within the following Soil Associations:

BATCOMBE Soil Association, which is described as '*Fine silty over clayey and fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some well-drained clayey soils over chalk. Variably flinty*'.

HORNBEAM 2 Soil Association – '*Deep, fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some well-drained fine loamy and fine silty over clayey and clayey soils. Some soils very flinty*'.

Limited parts of the site may also comprise *Brown calcareous earths* – 'Non-alluvial loamy or clayey soils with a weathered calcareous subsoil', which fall into the following Soil Association:

SWAFFHAM PRIOR Soil Association – '*Well-drained, calcareous coarse and fine loamy soils over chalk rubble. Some similar shallow soils. Deep non-calcareous loamy soils in places. Striped and polygonal soil patterns locally*'.

2.4 Landscape Proposals

The landscape design is at an early stage and is likely to include the following landscape types:

- Tree planting
- Shrub beds
- Native woodland and hedge planting
- Amenity grass
- Species-rich wildflower grassland

3.0 SITE INVESTIGATION

3.1 Site Work

The site work was conducted during August and September 2018 during a period of dry, hot weather.

3.2 The Site

The site was located to the north east of Luton Airport, on the outskirts of Luton, Bedfordshire and was accessed Eaton Green Road / Darley Road. The survey area was comprised of 5 no. distinct areas as indicated on the site plan as **Appendix A**.

With the exception of the land within Wigmore Park (amenity grass with pockets of woodland / trees), the survey site was comprised entirely of existing agricultural land (arable). The fields within the survey areas were bounded by existing native hedgerows and tree lines.

The topography of the arable land consisted of a number of distinct valleys and ridges. The Wigmore Park portion approximately follows the site contours (reasonably level) and is located partway down a wider, off-site slope formation.

Plate 1 : Typical site view: agricultural land (northern portion)

Plate 2 : Typical site view: agricultural land 9northern portion (2)

Plate 3 : Typical site view: agricultural land (southern portion)

Plate 4 : Typical site view: agricultural land (southern portion)

Plate 5 : Wigmore Park

Plate 6 : Wigmore Park (2)

3.3 Soil Conditions

We examined the soils by constructing a total of 57 no. hand-dug trial holes (TH) at representative locations within the survey areas. 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 B**.

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 total of 4 No. distinct soil profiles / types were encountered during the site visit, including:

Soil Profile 1 - Agricultural Soil

Soil Profile 2 - Agricultural Soil (calcareous)

Soil Profile 3 - Parkland Soil

Soil Profile 4 - Woodland Soil

Each of these soil profiles are described below:

Soil Profile 1 – Agricultural Soil

Soil Profile 1 was observed within northern and southern areas of agricultural land at TH7 to TH29, TH42, TH46, TH49, TH51 to TH56.

Topsoil 1 GL – 190/330mm Average depth : 260mm	Dark greyish brown (Munsell Colour 10YR 3/3) dry, slightly compacted, non-calcareous to slightly calcareous MEDIUM CLAY LOAM to HEAVY CLAY LOAM. Upon disturbance, the soil broke into a moderately developed, granular and occasional sub-angular blocky structures. Moderate to moderately high stone contents, comprising common medium to large subrounded to angular flints up to 90mm in size and no observable deleterious materials.
Subsoil 190/330 – 1000mm	Strong brown (Munsell Colour 7.5YR 5/6) dry, brittle non-calcareous HEAVY CLAY LOAM to CLAY, with a moderately developed, subangular blocky structure. Slight to moderately stony. No observable deleterious materials. Ochreous mottling and manganese concretions recorded throughout the subsoil, becoming stronger with depth.
Chalk 250/700 - 800mm	At TH15, TH17, TH20, TH21, TH23 to TH25, the Subsoil became very pale brown (Munsell Colour 10YR 8/3) dry fractured CHALK.

Plate 7 : Soil Profile 1 at TH15 (agricultural soil)

Plate 8 : Topsoil arisings from TH27 (agricultural soil)

Plate 9: Topsoil arisings from TH15 (agricultural soil)

Plate 10: Soil Profile 1 – Sub-angular flints

Soil Profile 2 – Agricultural Soils (Calcareous)

Soil Profile 2 was observed at locations within the central and eastern parts of the site at TH31 to TH37 to TH41, TH47, TH50, and TH52.

Topsoil 2 GL – 180/340mm Average depth : 270mm	Greyish brown (Munsell Colour 10YR 5/2), dry, moderately calcareous to very calcareous MEDIUM CLAY LOAM to CLAY. Upon disturbance, the soil broke into a moderately developed fine to coarse granular and subrounded blocky structure. Moderate to moderately high stone contents (mainly subangular to angular flints) and no observable deleterious materials.
Calcareous Subsoil 180/340 – 190/730mm	Strong brown (Munsell Colour 7.5YR 5/6) dry, friable, very calcareous CLAY to SANDY CLAY, with a moderate to well developed, medium to coarse granular and subrounded blocky structure. Slight to moderately stony (chalk fragments).
Chalk 190/730 - 800mm	Very pale brown (Munsell Colour 10YR 8/3) dry fractured CHALK.

Plate 11 : Soil Profile 2 at TH35 - agricultural soil (calcareous)

Plate 12 : Topsoil 2 arisings - agricultural soil (calcareous)

Plate 13 : Soil Profile 2 – Chalk

Soil Profile 3 – Parkland Soils

Soil Profile 3 was observed at locations within Wigmore Park at TH1 to TH6.

Topsoil 3 GL – 280/320mm Average depth : 310mm	Dark greyish brown (Munsell Colour 10YR 4/2), dry, brittle, compacted, non calcareous HEAVY CLAY LOAM. Upon disturbance, the topsoil broke into a moderate to well developed, granular to subrounded blocky structure. Low to moderate stone contents, with subangular flints up to 75mm in size. No observable deleterious materials.
Subsoil 280/320 – 1000mm	Subsoil described as *Soil Profile 1 Subsoil*

Plate 14 : Soil Profile 3 (Parkland Soil) at TH1

Plate 15 : Soil Profile 3 (Parkland Soil) at TH4

Plate 16 : Soil Profile 3 – topsoil arisings

Plate 17 : Soil Profile 3 showing subangular flints within the topsoil

Soil Profile 4 – Woodland Soils

Soil Profile 4 was observed at several discrete locations at TH43 to TH45, TH48, and TH57.

Litter Layer GL – 50mm Average depth : 50mm	Distinguishable plant remains (mainly leaves or small twigs) overlying unrecognisable plant matter. Described as very dark greyish brown, slightly moist to moist, loose PEATY SAND with a weakly developed granular structure.
Topsoil 4 50 – 270/340mm Average thickness : 220mm	Very dark greyish brown (Munsell Colour 10YR 3/2), dry, friable, non-calcareous HEAVY CLAY LOAM with a well developed, granular structure. Low stone contents, with subangular flints up to 45mm in size. No observable deleterious materials.
Subsoil 280/350mm – 1000mm	Subsoil described as *Soil Profile 1 Subsoil*

Plate 18 : Soil Profile 4 – Woodland Soil

Plate 19 : Soil Profile 4 – Topsoil arisings

3.5 Topsoil Depths

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

TH1 – 310
TH2 – 320
TH3 – 280
TH4 - 310
TH5 – 320
TH6 – 290
TH7 – 320
TH8 – 230
TH9 – 280
TH10 – 260
TH11 – 240
TH12 – 230
TH13 – 230
TH14 –250
TH15 – 280
TH16 – 270
TH17 – 280
TH18 – 250
TH19 – 250
TH20 – 220
TH21 – 300
TH22 – 260
TH23 – 210
TH24 – 330
TH25 – 260
TH26 – 240
TH27 – 200
TH28 – 210
TH29 – 260
TH30 – 270
TH31 – 270
TH32 – 270
TH33 – 310
TH34 – 310
TH35 – 330
TH36 – 340
TH37 – 260
TH38 - 300
TH39 – 280
TH40 – 240
TH41 – 340
TH42 – 290
TH43 – 250
TH44 – 290
TH45 – 220
TH46 – 290
TH47 – 210
TH48 – 180
TH49 – 230
TH50 – 200
TH51 – 190
TH52 – 180
TH53 – 260
TH54 – 270
TH55 – 330
TH56 – 250
TH57 – 140

Overall site average topsoil depth = 270mm

4.0 LABORATORY ANALYSIS

4.1 Analytical Schedule

A total of 42 no. representative samples of topsoil (22 No.) and subsoil (20 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;
- major plant nutrients - N, P, K, Mg (topsoil samples only);
- organic matter content.

The results for topsoil and subsoil are presented on the Certificates of Analyses in **Appendix C**, and **Appendix D** respectively and our interpretation of the results is given below.

4.2 Results of Analysis – Topsoils

Particle Size Analysis

Topsoil 1 Agricultural Soils Topsoil 3 (Parkland Soils) and Topsoil 4 (Woodland Soils)

The samples of *Topsoil 1*, *Topsoil 3* and *Topsoil 4* fell into the MEDIUM CLAY LOAM to HEAVY CLAY LOAM texture classes, and are described as 'moderately heavy' in texture. Such soils usually have good water and nutrient retention capacities, but they are slow-draining and can suffer from seasonal waterlogging following periods of prolonged or heavy rainfall. They are also prone to structural degradation and compaction during handling, and especially when plastic in consistency. Given the moderately high clay content of these topsoils, they can form strong structures when completely dry that may be difficult to break down by mechanical cultivation.

Moderately heavy textured topsoil such as this would be suited to less demanding landscape types only, including for example native hedgerows and woodland, species-rich wildflower grassland and amenity grass establishment (low foot traffic areas), provided species tolerant of heavy moisture retentive soils are selected and provided the soils' physical condition is adequate at planting / seeding. These topsoils are unsuitable for plant species or landscape environments that require or prefer light or free-draining soils. These soils would only be considered acceptable for more demanding landscape types such as hardy shrub planting provided they are at their *optimum* physical condition at planting. Additional measures may be needed to offset other adverse properties of these soils for less robust landscape types (see Section 5.4).

Topsoil 2 (Agricultural Soils – Calcareous)

The sample of *Topsoil 2* was classified as a calcareous MEDIUM CLAY LOAM to CLAY. The highly calcareous nature of *Topsoil 2* helps to mitigate its otherwise clay dominated characteristics, which aids soil structural development and improves its handling properties.

Soils such as these usually have adequate water and nutrient retention capacities, with good drainage and aeration properties. They can be degraded by compaction during soil handling, vehicle tracking or trampling. Once their structure is damaged, these soils are likely to suffer from reduced aeration and drainage rates and once damaged could be prone to waterlogging after periods of prolonged or heavy rainfall.

Topsoils such as these, are typically suitable for many landscape types, including shrub planting, native hedgerows and woodland, species-rich wildflower grassland and amenity grass establishment (low foot traffic areas), provided the structural condition of the soil is satisfactory.

Stone Content

The stone contents recorded within samples of *Topsoil 1, Topsoil 2 Topsoil 3* and *Topsoil 4* were moderate to moderately high and commonly included frequent large stones >50mm in size. Stony soils, such as these contain a lower proportion of fine earth (material less than 2mm) from which water and nutrients may be obtained, and they can be more prone to drought in dry weather. Furthermore, the high proportions of stones observed may affect the establishment, use and maintenance of seeded areas (e.g. amenity grass, species-rich wildflower grasslands). It would therefore be necessary to remove/treat the larger stones by raking, picking, burying or screening, should the soil be used for seeded landscape types. A combination of treatments may be needed to deal with the stones in this instance.

pH and Electrical Conductivity Values

The samples of *Topsoil 1*, *Topsoil 3* and Topsoil 4 (TH48) were acid to alkaline in reaction (pH 5.6 to 7.8) with a pH range that would be ideal for a wide range of plant species commonly used for general landscape purposes.

The samples of *Topsoil 2* were strongly alkaline in reaction (pH 7.7 – 8.0) with pH values which would be suitable for species and landscape types which prefer or demand alkaline and chalky soils only. The pH values recorded are in keeping with the highly calcareous nature of this soil type.

Samples of *Topsoil 4* (TH45) was strongly acid in reaction (pH 4.9), with a pH value that would be suitable for acid-loving species (calcifuges) only. This pH value would not be suitable for species known to specifically require or prefer alkaline soil.

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

All of the topsoil types displayed moderate to moderately high levels of organic matter and total nitrogen and moderate levels of extractable magnesium.

Samples of *Topsoil 1* and *Topsoil 2* typically displayed moderate to moderately high levels of extractable phosphorus and moderately low to low extractable potassium values (deficient).

Samples of *Topsoil 3* and *Topsoil 4* typically contained moderately low to low levels of extractable potassium (deficient).

For landscape types which require fertile soils (e.g. tree and shrub planting, native woodland planting and amenity grass) the topsoils were typically deficient in extractable potassium. *Topsoil 3* and *Topsoil 4* were also generally deficient in extractable phosphorus. As such, where necessary, these deficiencies should be address with a routine fertiliser application at planting or seeding to aid establishment.

With respect to habitat creation purposes, including the establishment of species-rich wildflower grassland, *Topsoil 1* and *Topsoil 2* are considered to be ***fertile*** (typically phosphorus MAFF index 3 to 4) and therefore generally have a low potential for this purpose. Such landscape types require a low fertility soil, particularly in relation to levels of phosphorus to reduce competition form aggressive broad-leaved species and grasses. Phosphorus is relatively immobile in soils and it would therefore be difficult to remove it from the topsoil to reduce the level to a more acceptable level.

Samples of Topsoil 3 and Topsoil 4 would be considered to be infertile to intermediate in relation to habitat creation purposes. As such, the fertility status of these topsoils would confer a moderate potential for the creation of species-rich habitats. However, it would be prudent to provide additional management for such locations (e.g. intensive cutting, spot spraying) to control undesirable species and optimise the diversity of the new sward.

4.3 Results of Analysis – Subsoils

Particle Size Analysis

The samples of subsoil from all parts of the site into the HEAVY CLAY LOAM, CLAY and SILTY CLAY LOAM texture classes, and are described as heavy in texture.

These soils are typically slow-draining and often suffer from seasonal waterlogging following periods of prolonged or heavy rainfall. They are also prone to structural degradation and compaction during handling, and especially when plastic in consistency. As such, they are restricted in terms of their potential for re-use for landscape purposes.

The subsoil at *Soil Profile 1*, *Soil Profile 3* and *Soil Profile 4* would be suitable for less-demanding planting, including native hedgerows and woodland, amenity grass establishment (low foot traffic areas) and species-rich wildflower grassland and provided the structural condition of the soil is satisfactory and provided species tolerant of water retentive soils are selected. These subsoils are unsuitable for plant species or landscape environments that require or prefer light or free-draining soils. Furthermore, there is likely to be a need for improvements to promote a healthy rooting environment, particularly for tree planting and other key locations such as the base of slopes.

At *Soil Profile 2*, the calcareous nature of the subsoil will help to improve its structural development and assist drainage. As such, this subsoil type has potential for re-use for more demanding planting types provided its physical condition is maintained. However, this subsoil will be prone to self-compaction if placed below the weight of a tree root ball and so this subsoil is not considered suitable for use as backfill in tree pits.

Stone Content

The stone contents of the subsoil samples were low to moderate and, as such, stones are unlikely to constitute a significant limitation for general landscape purposes.

pH and Electrical Conductivity Values

The subsoil samples were slightly acid to strongly alkaline in reaction (pH 6.6 – 7.8) with a pH range that is suitable for landscape purposes, provided species selected have a broad pH tolerance.

The samples of *Calcareous Subsoil* were strongly alkaline in reaction (pH 7.9 – 8.2) with pH values which would be suitable for species and landscape types which prefer or demand alkaline and chalky soils only. The pH values recorded are in keeping with the highly calcareous nature of this soil type.

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 Content

Samples of subsoil displayed elevated organic matter contents ab are higher than are normally found in subsoils and increase the risk of the formation anaerobic conditions (oxygen depleted) should they become degraded (compacted).

5.0 DISCUSSION

The purpose of this work was to assess the existing site soils to provide information on their pertinent chemical and physical properties for horticultural re-use.

The landscape design is at an early stage and is likely to include the following landscape types:

- Tree planting
- Shrub beds
- Native woodland and hedge planting
- Amenity grass
- Species-rich wildflower grassland

There is currently little or no information on the horticultural quality, variability and suitability of the site soils for habitat creation and landscape purposes, so the purpose of the investigation was to assess the existing soil conditions, and advise on their potential for re-use. The information collected will be used to support the preparation of the landscape design and a Landscape Specification for this site / soils.

5.1 Summary of Findings

From our investigation, the site contained significant reserves of undisturbed topsoil and subsoil. A total of 4 No. soil profiles were identified, comprising:

Soil Profile 1 - Agricultural Soil
Soil Profile 2 - Agricultural Soil (calcareous)
Soil Profile 3 - Parkland Soil
Soil Profile 4 - Woodland Soil

The depths of topsoil over the site ranged from 140 to 330mm, with an overall site average of 270mm.

Soil Profile 1, Soil Profile 3 and Soil Profile 4

From our site survey and subsequent laboratory analysis, Soil Profile 1, Soil Profile 3 and Soil Profile 4 comprised a respective Topsoil type over reasonably consistent Subsoil. The main characteristics of these soils are summarised below:

Table 5.1.1 Properties of Topsoil 1

Topsoil 1
medium clay loam to heavy clay loam
slightly compacted (breaks to granular and blocky structure)
moderate to high stone contents with common large sized stones (>50mm)
acid to slightly alkaline (non-calcareous)
moderately high levels of organic matter, total nitrogen, extractable phosphorus and extractable magnesium
moderately low levels of extractable potassium
fertile with respect to habitat creation purposes

Table 5.1.2 Properties of Topsoil 3 and Topsoil 4

Topsoil 3 and Topsoil 4
medium clay loam to heavy clay loam
Topsoil 4 (Woodland Soil) granular to subrounded blocky structures
Topsoil 3 (Parkland Soil); compacted
low to moderate stone contents
slightly acid to alkaline (non-calcareous) - *Topsoil 3 and Topsoil 4 (TH48)*
strongly acid (non-calcareous) – *Topsoil 4 (TH45)*
moderately high levels of organic matter, total nitrogen and extractable magnesium
moderately low levels of and extractable phosphorus and extractable potassium
infertile to *intermediate* fertility status with respect to habitat creation

Table 5.1.3 Properties of Subsoil

Subsoil
medium clay loam to silty clay loam
blocky structures
low to moderate stone contents, including occasional large stones
alkaline (non-calcareous)
elevated levels of organic matter

Soil Profile 2

From our site survey and subsequent laboratory analysis, *Soil Profile 2* comprised *Topsoil 2* over *Calcareous Subsoil* and *Chalk*.

Table 5.1.4 Properties of Topsoil 2 and Calcareous Subsoil

Topsoil 2	**Calcareous Subsoil**
medium clay loam to clay (calcareous)	heavy clay loam to clay (calcareous)
breaks on disturbance to granular and blocky structure	blocky structure
moderate to moderately high stone contents	low to moderate stone contents
strongly alkaline (high carbonate content)	strongly alkaline (high carbonate content)
moderately high levels of organic matter, total nitrogen, extractable phosphorus and extractable magnesium	moderately high levels of organic matter
moderately low levels of extractable potassium	
fertile with respect to habitat creation purposes	

5.2 Re-use of the Site Soils

The physical composition of the soils encountered varied in terms of soil texture, carbonate content, pH value and stone contents. *Topsoil 1*, *Topsoil 2* and *Topsoil 3* displaying structural degradation (compaction). The fertility status of *Topsoil 1* and *Topsoil 2* was moderate to moderately high with respect to habitat creation purposes. Topsoil 3 and Topsoil 4 were characterised as infertile to intermediate with respect to habitat creation purposes.

The following sections consider the potential to re-use each of the soils identified for the emerging landscape purposes. The moisture retentive nature of *Soil Profile 1*, *Soil Profile 3* and *Soil Profile 4* limits the potential to re-use these soil types to non-demanding, hardy species and planting types.

For all future uses, it is important that following all landscape construction activities, soil preparation, planting and seeding works that all soils are left in an uncompacted condition with adequate soil structures.

The site soils are all vulnerable to physical degradation (compaction) by intense uses, resulting in a loss of soil aeration and reduced infiltration and drainage and therefore would not be suitable for amenity grass which is expected to support high rates of foot traffic.

Soil Profile 1, Soil Profile 3 and Soil Profile 4

Soil Profile 1, Soil Profile 3 and Soil Profile 4 are characterised by their moderately heavy to heavy soil textures (non-calcareous) with restricted permeability (drainage) characteristics and high stone contents (subrounded to angular flints) including *large stones* up to 90mm in size (*Topsoil 1* and *Topsoil 4*).

In their current condition these soils would be described as 'Imperfectly Drained' and prone to waterlogging for periods of the year.

This type of topsoil has inherent physical properties (e.g. low sand content, clayey nature, moisture retentive, with reduced aeration and drainage performances) which can make it particularly problematic for demanding landscape construction purposes. *Topsoil 1*, and *Topsoil 3* showed signs if structural degradation (compaction) and if left in this condition may display restricted aeration and drainage properties. As such provision for appropriate cultivation should be allowed for as part of the required preparation work for seeding and planting.

Should it be required to subject these soils to intensive earthworks (for example topsoil stripping) this soil type will be particularly susceptible to structural degradation, particularly if it is handled and treated whilst moist and plastic. Additional specific problems envisaged with the use of this type of topsoil could include limited responses to tillage following degradation and a need for multiple cultivations to prepare a suitable tilth. This soil type can be subject to extensive surface cracking.

The moderately high to high stone contents recorded can be problematic for landscape purposes. For seeding purposes, specific action(s) would be warranted to reduce the overall stone content to a suitable level and to remove medium to large stones from the surface (and near surface) soil horizon as part of seed bed preparation.

Soil Profile 1, Soil Profile 3 and *Soil Profile 4* would be best suited to non-demanding landscape environments only, including native woodland and hedgerow planting, amenity grass establishment (low foot traffic areas) provided the soils are suitably prepared for planting/seeding (including decompaction and stone treatment) and the plants selected are tolerant of heavy, moisture retentive soils. Species selected should have a broad pH tolerance. *Soil Profile 4* may be suitable for species which prefer or demand strongly acid soils.

It may be possible to increase the re-use potential of these soils (e.g. shrub planting) by improving its composition and/or the overall functioning of the soil profile (see section 5.3).

Soil Profile 3 (Parkland) is currently compacted within the topsoil horizon and would benefit from decompaction to encourage drainage and aeration. Given the presence of the existing grass sward, this would be best conducted using appropriate 'sports turf management' machinery. *Soil Profile 3* is not suited to intense foot traffic and is likely to be damaged following prolonged periods of heavy usage, particular during wet conditions. Where this soil type is subjected to intense usage, it would be advisable to repair the damage by implementing an appropriate maintenance schedule e.g. vertidrain or Earthquake within any 'kickabout' area.

A light fertiliser application may be necessary at planting and seeding to aid establishment.

Soil Profile 2

Soil Profile 2 is characterised by its calcareous nature, relatively shallow soil depth over fractured chalk at 190/730mm below ground level. *Topsoil 2* is currently compacted which is likely reduce its drainage and aeration properties. Once its physical condition has been restored, this soil should be free draining and, as such, is unlikely to become waterlogged for prolonged periods after rainfall. .

Based on our findings, provided the physical condition of *Soil Profile 2* is improved it is anticipated to provide adequate drainage for moderately demanding planting types such as shrub planting. However the soils at this location are strongly alkaline and highly calcareous and this must be factored into planting selections made for this soil profile. Furthermore, the moderately shallow total soil depth observed at *Soil Profile 2* (<500mm topsoil/subsoil over fractured chalk) may be a limiting factor for certain species demanding on their root morphology. *Soil Profile 2* is not appropriate for more demanding landscape types, such as semi-mature tree planting or those which prefer or demand moisture retentive and/or non-calcareous soils.

Subsoil Organic Matter Contents

The organic matter contents of the subsoil samples (3.3 – 6.7%) were higher than that typically observed in subsoil material (<2%). In this instance, this is likely to be associated with a diffuse boundary between the topsoil and subsoil. Following excavation and reinstatement, the presence of organic matter within subsoil at higher levels may lead to the formation of anaerobic conditions. In this instance, no evidence of anaerobism was observed in these subsoils during our examinations. At present the structure is adequate to allow sufficient drainage of water and gaseous exchange to allow the oxygen demand on the soil to be met. Particular care and good soil management practices should be taken to maintain the physical condition of these subsoils.

Tree Pits for Semi-Mature Trees

The site topsoils are not considered to be of an adequate quality for back-filling tree pits for extra heavy standard trees and semi-mature trees and a suitable free draining sandy, fertile topsoil should be imported for this demanding purpose.

It would be important that appropriate modifications are incorporated into 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 soil structures and the level of soakage following landscape construction. For any locations subject to significant disturbance, consideration should be given to the provision of an appropriate gravel soakaway layer at the base of the tree pits.

The subsoil will be prone to self-compaction if placed below the weight of a tree root ball and so these subsoils are 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.

The shallow and calcareous nature of *Soil Profile 2* should be taken into account at the design stage in terms of species selection and tree pit design.

Species-rich Wildflower Grasslands

Topsoil 1 and *Topsoil 2* have a low potential for species-rich wildflower grassland establishment 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.

Based on the understanding that the soil profiles will all be kept in place, seed mixes should be selected that are compatible with the characteristics of the site soils. As such, *Topsoil 1* and *Topsoil 3* would be classified as 'slightly acid, moisture retentive and fertile', whilst *Topsoil 2* may

be described as 'strongly alkaline, (calcareous), well drained and fertile'. *Topsoil 4* is a woodland soil (strongly 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.

5.3 Summary of Soil Suitability

The suitability of the site soils for re-use for landscape purposes and habitat creation are summarised in the table below:

Table 5.3.1 Summary of Soil Suitability

Landscape Type	*Topsoil 1*	*Topsoil 2*	*Topsoil 3*	*Topsoil 4*	*Subsoil*
Semi-mature tree planting	X	X	X	X	X
Native woodland	✓	✓^	✓	✓*	✓
Native hedges	✓	✓^	✓	✓*	✓
Shrub beds	O[d]	□^	O[d]	O[d]*	O[d]
Amenity grass (low foot traffic)	✓	✓^	✓	✓*	✓
Amenity grass (Intense foot traffic)	X	X	X	X	✓[d]
Species-rich wildflower grassland	w	w	w	w	✓

✓ Suitable for this purpose provided the physical condition of the soil is adequate at planting / seeding and species selected are tolerant of moisture retentive soils (with the exception of calcareous subsoils) and have a broad pH tolerance.

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.

✓[d] May be acceptable for this purpose provided assistance is given to the drainage properties (e.g. by topsoil mounding or installation of an artificial drainage system).

^ Species selected must be tolerant of shallow, strongly alkaline, chalky soils.

* Species selected must be tolerant of strongly acid soils.

w Potentially suitable for this purpose, provided reduced levels of floral diversity are acceptable and seed mixes selected are suited to soil characteristics.

X Not suitable for this purpose due to inappropriate drainage characteristics or fertility status.

5.4 Improvement Options for Poorly Draining Soils

The restricted drainage properties of the site subsoil will limit the re-use potential of *Soil Profile 1*, *Soil Profile 3* and *Soil Profile 4* to the 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 and 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.

It is likely that tree pits and shrub beds within this area will require positive drainage, or at least a soakaway, to remove accumulating water from low points and prevent the tree pits from acting as sumps.

5.5 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 rooting zone.

Topsoil 1 and Topsoil 3 typically displayed damage to its structure. The compaction damage identified is likely to reduce the drainage rate and aeration of these topsoils. 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 and therefore, the physical condition of these soils should be improved as part of the soil preparation works at these locations.

Landscape construction and soil preparation works themselves can be damaging to the structures of heavy, clay based soil such as these, therefore all soil handling operations should ideally be programmed for periods when the soils are friable and non-plastic in consistency.

We would like to thank London Luton Airport Ltd and Capita Property and Infrastructure 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.

Tim White
BSc MSc MISoilSci CSci
Senior Associate

For and on behalf of Tim O'Hare Associates LLP

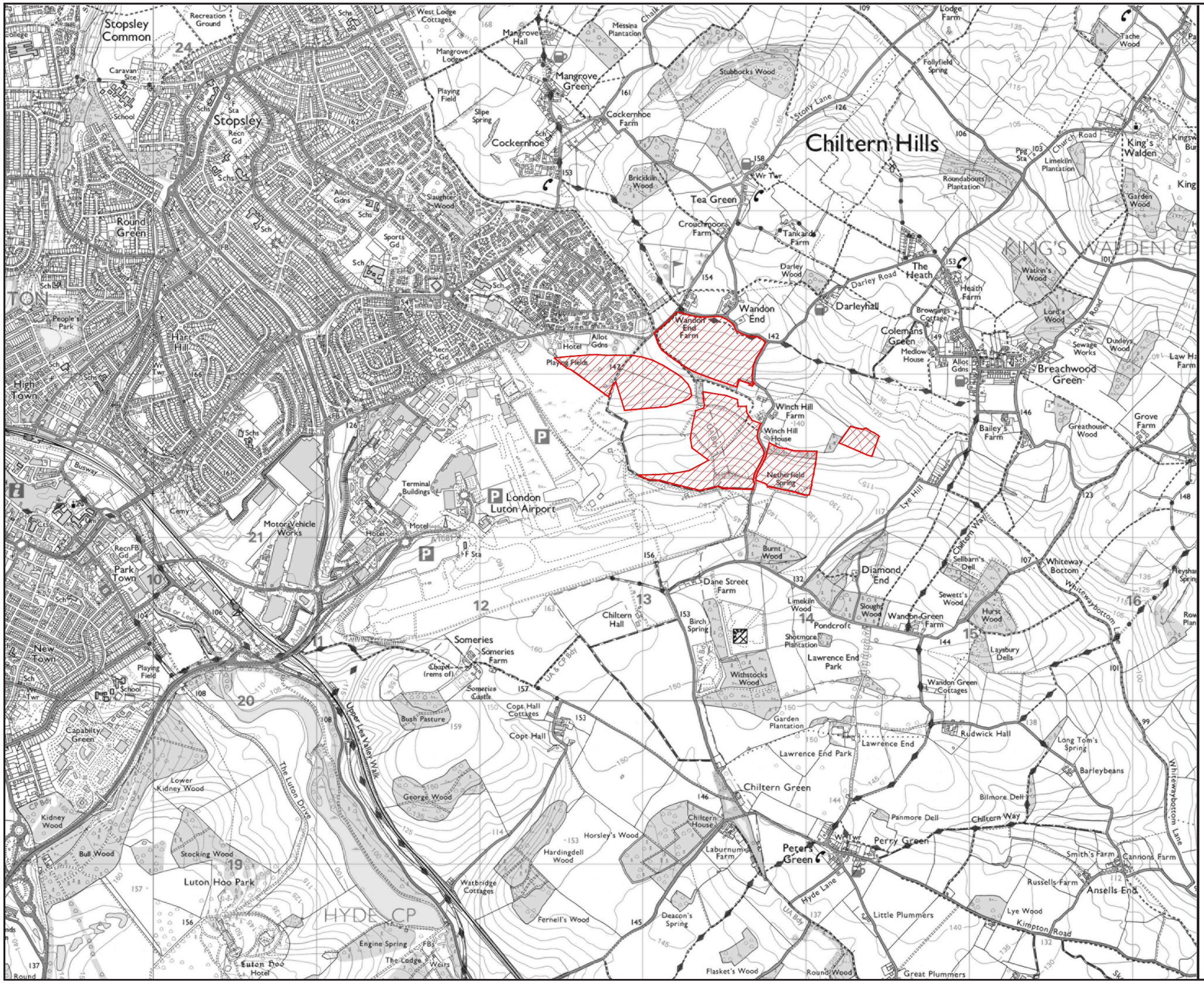
Report Qualifications

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 proposed site of the Luton Airport Expansion Project. 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 Capita Property and Infrastructure 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 A

Site Plan Showing Extent of
Soil Resource Survey



Legend

Soil Survey Boundary

N

SCALE 25 50 100 200 300 400 500

1:7500 @ A0

Notes

Boundaries are captured and maintained to a generalised scale of 1:10,000.

Rev	Date	By	Chkd	Appd
PO1	22/10/2018	YC	SC	PD

London Luton Airport Ltd
A Luton Council company

Registered in England & Wales No. 2020381
Registered address: Hart House Business Centre, Kimpton Road, Luton, LU2 0LA

Project Title

Future LuToN

Document Reference Title

Soil Survey Plan

Discipline

Landscape Survey

Suitability

For Use in Preparation of Soil Surveys

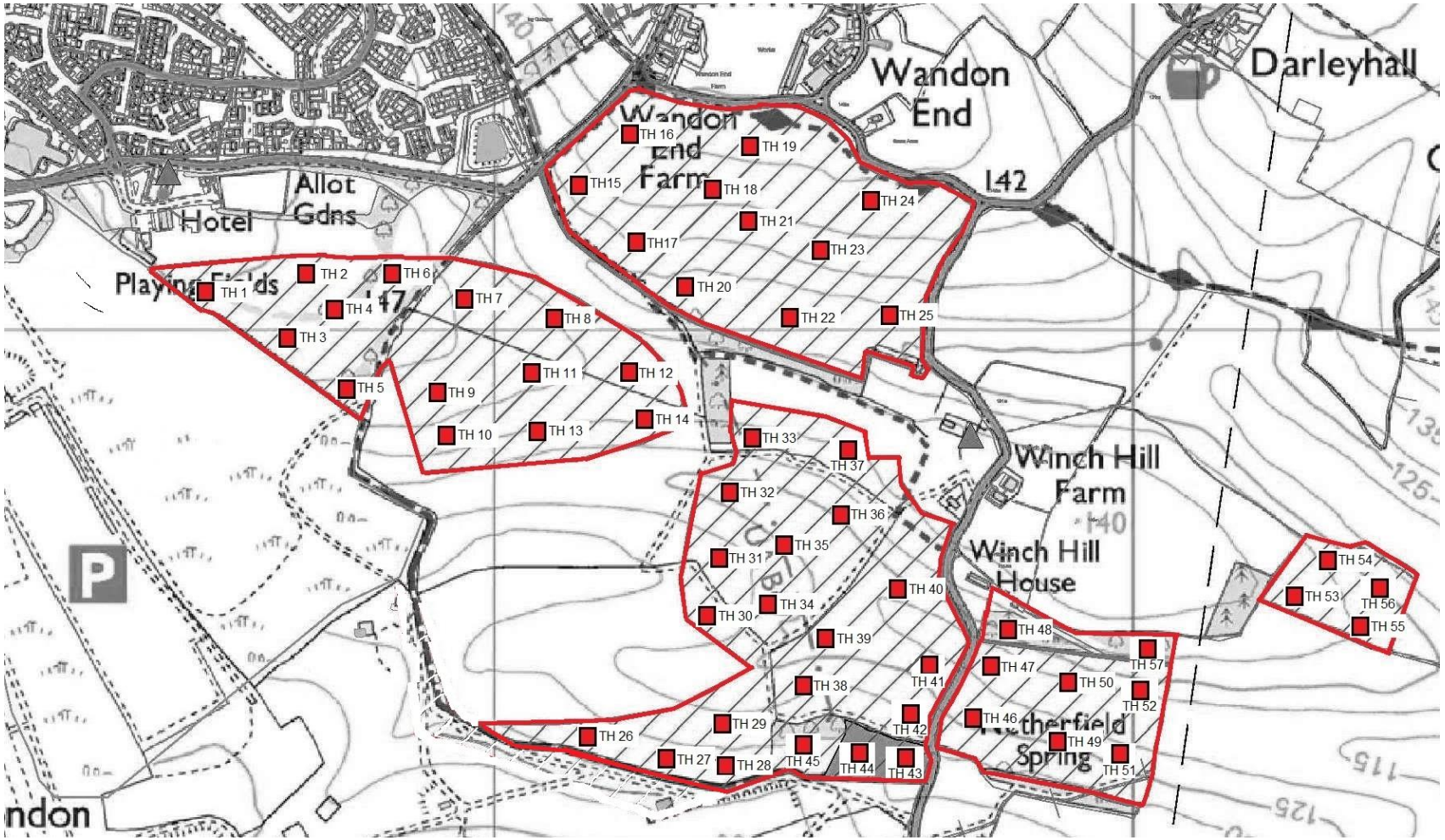
Map Title

Doc Number

LLADCO-00-OTR-00-00-DR-LS-0004

Appendix B

Site Plan Showing Trial Hole Locations



THx

Approximate Trial Hole location

Site boundary

Client:	London Luton Airport Ltd		
Project:	London Luton Airport - DCO		
Job ref no.:	TOHA/18/3139/TW		
Drawing no.:	3139/2		
Drawing title	Soil Resource Survey		
Date:	October '18	Scale:	NTS
Drawn by:	ML	Checked by:	TW

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Appendix C

Laboratory Analysis Results

Topsoil

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**London Luton Airport Ltd**
Project:	**London Luton Airport - DCO**
Job:	**Soil Resource Survey**
Date:	**October 2018**
Job Ref No:	**TOHA/18/3139/TW**

Sample Reference			**TH1**	**TH4**	**TH5**	**TH7**	**TH12**	**TH13**	**TH15**	**TH19**	**TH22**	**TH24**	**TH25**
Soil Type			**Topsoil 3**	**Topsoil 3**	**Topsoil 3**	**Topsoil 1**	**Topsoil 1**	**Topsoil 1**	**Topsoil 1**	**Topsoil 1**	**Topsoil 1**	**Topsoil 1**	**Topsoil 1**
Land Use			**Park**	**Park**	**Park**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**
		Accreditation											
Clay (<0.002mm)	%	UKAS	27	27	28	24	27	25	26	25	21	24	27
Silt (0.002-0.063mm)	%	UKAS	52	51	44	48	41	35	39	52	53	38	48
Sand (0.063-0.2.00mm)	%	UKAS	21	22	28	28	32	40	35	23	26	38	25
Texture Class (UK Classification)	--	UKAS	HCL	HCL	HCL	MCL	HCL	MCL	MCL	MCL	MCL	MCL	HCL
Stones (2-20mm)	% DW	GLP	4	6	7	8	10	3	6	5	7	5	4
Stones (20-50mm)	% DW	GLP	7	16	16	15	8	9	19	15	8	10	8
Stones (>50mm)	% DW	GLP	0	4	4	0	14	10	0	12	4	0	5
pH Value (1:2.5 water extract)	units	UKAS	6.2	5.8	6.6	6.6	6.1	7.6	7.8	5.8	5.6	6.0	7.7
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	93	106	104	101	158	198	209	139	108	131	194
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2000	1989	1999	1973	2062	2033	2021	2048	2074	2091	2023
Exchangeable Sodium Percentage	%	UKAS	0.7	0.9	0.4	0.4	0.5	0.5	0.3	0.8	0.7	0.6	0.3
Organic Matter (LOI)	%	UKAS	6.6	5.5	6.7	5.6	7.3	8.7	7.5	5.5	4.4	6.2	6.1
Total Nitrogen (Dumas)	%	UKAS	0.22	0.17	0.21	0.2	0.26	0.31	0.27	0.19	0.15	0.21	0.24
C : N Ratio	ratio	UKAS	17:1	19:1	19:1	16:1	16:1	16:1	16:1	17:1	17:1	17:1	15:1
Extractable Phosphorus	mg/l	UKAS	6	8	18	13	30	16	39	18	19	18	25
Extractable Potassium	mg/l	UKAS	77	68	71	77	83	124	121	89	93	96	90
Extractable Magnesium	mg/l	UKAS	75	78	76	41	100	123	46	46	35	71	36

MCL = MEDIUM CLAY LOAM
HCL = HEAVY CLAY LOAM
C = CLAY

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

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**London Luton Airport Ltd**
Project:	**London Luton Airport - DCO**
Job:	**Soil Resource Survey**
Date:	**October 2018**
Job Ref No:	**TOHA/18/3139/TW**

Sample Reference			**TH26**	**TH28**	**TH31**	**TH33**	**TH36**	**TH38**	**TH40**	**TH45**	**TH48**	**TH52**	**TH55**
Soil Type			**Topsoil 1**	**Topsoil 1**	**Topsoil 2**	**Topsoil 2**	**Topsoil 2**	**Topsoil 1**	**Topsoil 2**	**Topsoil 4**	**Topsoil 4**	**Topsoil 2**	**Topsoil 1**
Land Use			**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Woodland**	**Woodland**	**Agriculture**	**Agriculture**
		Accreditation											
Clay (<0.002mm)	%	UKAS	22	31	32	24	37	20	40	24	27	28	22
Silt (0.002-0.063mm)	%	UKAS	46	46	38	29	35	49	37	48	39	39	28
Sand (0.063-0.2.00mm)	%	UKAS	32	23	30	47	28	31	23	28	34	33	50
Texture Class (UK Classification)	--	UKAS	MCL	HCL	HCL	MCL	C	MCL	C	MCL	HCL	HCL	MCL
Stones (2-20mm)	% DW	GLP	11	6	5	6	6	8	2	7	3	4	11
Stones (20-50mm)	% DW	GLP	10	12	6	14	9	9	5	8	12	10	8
Stones (>50mm)	% DW	GLP	2	0	0	0	4	0	10	2	10	8	0
pH Value (1:2.5 water extract)	units	UKAS	6.4	6.1	8.1	8.3	8.2	7.2	7.9	4.9	7.9	8.2	6.7
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	113	158	221	222	255	241	265	89	302	220	172
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	1980	2023	2019	2020	2059	2027	2109	1853	2135	2036	1996
Exchangeable Sodium Percentage	%	UKAS	0.7	1.7	0.5	0.3	0.3	0.6	0.4	4.3	0.7	0.5	0.5
Organic Matter (LOI)	%	UKAS	3.8	7.4	6.2	8.0	6.2	3.3	7.0	5.3	15.3	6.7	6.7
Total Nitrogen (Dumas)	%	UKAS	0.13	0.26	0.28	0.36	0.30	0.11	0.35	0.16	0.57	0.27	0.24
C : N Ratio	ratio	UKAS	17	17	13	13	12	17	12	19	16	14	16
Extractable Phosphorus	mg/l	UKAS	7	8	22	23	23	13	48	4	11	17	13
Extractable Potassium	mg/l	UKAS	62	276	87	135	77	42	199	37	129	94	94
Extractable Magnesium	mg/l	UKAS	32	208	63	105	52	62	54	39	160	83	95

MCL = MEDIUM CLAY LOAM
HCL = HEAVY CLAY LOAM
C = CLAY

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

Appendix D

Laboratory Analysis Results

Subsoil

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**London Luton Airport Ltd**
Project:	**London Luton Airport - DCO**
Job:	**Soil Resource Survey**
Date:	**October 2018**
Job Ref No:	**TOHA/18/3139/TW**

Sample Reference			**TH1**	**TH4**	**TH5**	**TH7**	**TH13**	**TH15**	**TH21**	**TH22**	**TH24**	**TH26**
Soil Type			**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**
Land Use			**Park**	**Park**	**Park**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**
		Accreditation										
Clay (<0.002mm)	%	UKAS	31	28	49	29	50	39	59	26	32	27
Silt (0.002-0.063mm)	%	UKAS	37	39	38	47	39	49	34	50	44	46
Sand (0.063-2.0mm)	%	UKAS	32	33	13	24	11	12	7	24	24	27
Texture Class (UK Classification)	--	UKAS	HCL	HCL	C	HCL	C	ZC	C	MCL	HCL	HCL
Stones (2-20mm)	% DW	GLP	1	1	7	8	2	5	4	7	3	7
Stones (20-50mm)	% DW	GLP	0	1	1	13	0	1	0	9	0	3
Stones (>50mm)	% DW	GLP	0	0	0	0	0	0	0	21	0	0
pH Value (1:2.5 water extract)	units	UKAS	7.4	6.8	7.8	6.9	7.3	7.6	7.7	7.6	7.9	6.6
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	84	49	87	54	199	583	100	722	86	107
Organic Matter (LOI)	%	UKAS	4.3	4.0	5.3	3.6	5.4	5.1	5.8	3.3	5.7	3.3

MCL = MEDIUM CLAY LOAM
HCL = HEAVY CLAY LOAM
ZC - SILTY CLAY

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

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**London Luton Airport Ltd**
Project:	**London Luton Airport - DCO**
Job:	**Soil Resource Survey**
Date:	**October 2018**
Job Ref No:	**TOHA/18/3139/TW**

Sample Reference			**TH29**	**TH32**	**TH34**	**TH36**	**TH40**	**TH42**	**TH45**	**TH46**	**TH54**	**TH57**
Soil Type			**Subsoil**	**Calcareous Subsoil**	**Calcareous Subsoil**	**Calcareous Subsoil**	**Calcareous Subsoil**	**Calcareous Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**	**Subsoil**
Land Use			**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Agriculture**	**Woodland**	**Agriculture**	**Agriculture**	**Woodland**
		Accreditation										
Clay (<0.002mm)	%	UKAS	40	42	33	43	48	33	37	28	38	38
Silt (0.002-0.063mm)	%	UKAS	39	44	35	42	42	19	47	45	38	38
Sand (0.063-2.0mm)	%	UKAS	21	14	32	15	10	48	16	27	24	24
Texture Class (UK Classification)	--	UKAS	C	C	HCL	C	C	SC	ZC	HCL	C	C
Stones (2-20mm)	% DW	GLP	9	7	2	6	2	8	1	11	6	6
Stones (20-50mm)	% DW	GLP	0	4	2	19	1	20	0	12	8	8
Stones (>50mm)	% DW	GLP	0	0	0	0	0	0	0	0	0	0
pH Value (1:2.5 water extract)	units	UKAS	7.1	8.0	8.2	8.2	7.9	6.7	4.6	7.3	7.3	8.0
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	152	205	214	235	196	159	152	159	233	218
Organic Matter (LOI)	%	UKAS	4.4	4.2	2.8	4.1	3.7	5.6	4.5	4.0	4.9	6.7

HCL = HEAVY CLAY LOAM
C = CLAY
SC - SANDY CLAY
ZC - SILTY CLAY

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