Water Eaton

PR6a : Land East of Oxford Road

Environmental Statement Appendix 3.1: Soils Management Plan

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WATER EATON

SOIL MANAGEMENT PLAN

Report 1385/3

17th January, 2023

Land Research ASSOCIATES

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WATER EATON

SOIL MANAGEMENT PLAN

L Thomas, MSc, MISoilSci

Report 1385/3
Land Research Associates Ltd
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17th January, 2023

1.0 Introduction

1.1 This report provides information on the soils of agricultural land which will form the site of the Water Eaton development.

1.2 As part of the soils strategy, soil resources have been assessed for suitability for reuse in a variety of landscaping and gardens within the development including:

- Tree planting (standards, transplants)
- Ornamental shrubs and hedges
- Wildflower grassland
- Amenity grass

1.3 Soil resources have been surveyed in detail and are fully described in a previous report (report 1385/1).

2.0 Soils investigation

SITE ENVIRONMENT

2.1 The site was revisited in November 2021. The site was divided into field/land management units, and representative topsoil samples (0-150 mm) collected from each (see Map 1). Samples were submitted for nutrient analysis at an UKAS accredited laboratory.

2.2 Previous soil survey (see report 1385/1) has shown the soils to vary in texture and drainage properties, as described below.

HEAVY SLOWLY PERMEABLE SOILS

2.3 These are the dominant soils of the site and typically comprise heavy clay loam topsoil directly overlying dense, slowly permeable clay subsoil. The subsoils are greyish or pale with ochreous mottles (evidence of seasonal waterlogging) to shallow depth. The land is poorly-draining (Soil Wetness Class IV).

PERMEABLE LOAMY SOILS

2.4 These soils occur in a small area in the south of the site and typically comprise heavy clay loam or sandy clay loam topsoil, over subsoil of the same texture. The subsoils show evidence seasonal waterlogging, but are moderately well structured and permeable. This land is moderately freely-draining (Soil Wetness Class II).

3.0 Laboratory analysis

TOPSOILS

3.1. The topsoils are of neutral pH with the exception of TS4, which is slightly acidic. The land has been intensively managed for agriculture in the past and as a result most of the topsoils have moderately high available phosphate status. TS1 is the exception, having very low phosphate concentrations.

3.2. Summarised nutrient analyses are shown in Table 3.1 below and sample areas are shown by Map 1. Full laboratory testing certificates are appended to this report.

Table 3.1: Soil nutrient status

Sample ID	pH	mg/l (MAFF indices in brackets)			Organic matter (LOI) %
		P	K	Mg	
TS1	6.9	5.8 (0)	176 (2-)	69 (2)	5.0
TS2	7.1	13.2 (1)	182 (2+)	61 (2)	4.5
TS3	7.0	39.6 (3)	419 (4)	92 (2)	5.9
TS4	5.5	25.4 (2)	114 (1)	57 (2)	5.1
TS5	6.2	18.0 (2)	137 (2-)	80 (2)	4.9
TS6	6.8	15.6 (2)	118 (1)	86 (2)	4.8

4.0 Available soil resources

4.1. The distribution of soil resources is shown on Map 2 in the appendix to this report. One topsoil and one subsoil resources have been identified. The available resources are described below.

TOPSOIL

TOPSOIL A The topsoils across the site are predominantly heavy clay loam in texture, with minor areas of sandy clay loam which could not be effectively separated. The topsoils have moderate nutrient content and are well structured. The soils are of moderate quality for reuse as a landscaping resource; due to their relatively high clay content, they are difficult to handle with machinery and susceptible to compaction damage when wet.

It is advised that the high nutrient topsoils across the site be stripped as one resource to an average thickness of **300 mm** depth.

Estimated maximum yield: 93,900 m^3

TOPSOIL B The topsoil in sample area TS1 has low nutrient levels and should be stripped and stockpiled separately to TSA.

It is advised that the low nutrient topsoils across the site be stripped as one resource to an average thickness of **300 mm** depth.

Estimated maximum yield: 34,890 m^3

SUBSOIL

SS1 The permeable loamy subsoils in the south of the site are a moderate to high quality resource, occuring to a thickness of 900 mm and should be stripped and stockpiled separately to other resources.

Estimated maximum yield: 48,600 m^3

The dense clays across the majority of the site are hard to handle with machinery and likely to be too poorly-structured to support landscaping use once excavated. They are best reserved for engineering uses (embankments etc.) or as a liner for wetland areas**.**

5.0 Soil suitability assessment

5.1. The suitability of the identified on-site resources has been evaluated against the proposed landscaping uses. General suitability assessment is summarised in Table 5.1.

Table 5.1: soil suitability assessment

After use	Soil resource		
	TSA	TSB	SS1
Tree standards	✓	✓[5]	✓[1,4]
Tree transplants	✓	✓[5]	✓[1,4]
Shrubs and hedges	✓	✓[5]	✓[1,4]
Wildflower grassland	✗[2]	✓	✓[1,3,4]
Amenity grassland	✓	✓[5]	✓[1,4]
Wetland planting	✗	✗	✗

✓ well suited ✓ moderately suitable ✗ not suitable

[1]High clay content makes soil handling difficult. Soils used for this purposes must be maintained in good structural condition and carefully replaced without compaction.

[2]High nutrient availability may introduce excess weed competition, management required.

[3]Used as topsoil

[4]Limited resource availability

[5] Low nutrient availability may lead to slow growth

TREE STANDARDS

5.1. Areas of subsoil around proposed planting pits of 10*10 m should be de-compacted. 900 mm planting pits should be backfilled with 600 mm of subsoil (SS1) or suitable imported subsoil meeting British Standards 8601:2013 if insufficient/unsuitable site-won materials available) and 300 mm of topsoil (TSA/B).

TREE TRANSPLANTS

5.2. In-situ soils should be retained in undisturbed areas. Elsewhere subsoil de-compaction should take place prior to planting. Planting should involve a 300 mm deep trench, backfilled with topsoil (TSA/B).

SHRUBS/HEDGE PLANTING

5.3. In-situ soils should be retained in undisturbed areas. Elsewhere subsoil de-compaction will take place prior to planting. Planting will involve a 300 mm deep trench, backfilled with topsoil (TSA/B).

WILDFLOWER GRASSLAND

5.4. The topsoils within most of the site have moderately high nutrient content which makes them unsuitable for use in wildflower grassland without management (TSA).

5.5. Wildflower grassland would be best created on *in situ* subsoils in the south of the site. The topsoils in this area should be stripped to 300 mm depth and removed. The exposed subsoil should then be harrowed and sown with the required seed mix for wildflower grassland. The subsoil is best suited as it will have no weed burden and have low nutrient content.

5.6. If this is not possible, topsoil resource TSB has low nutrient availability according to present testing. Provided these levels remain and no fertiliser is applied before the land is stripped, these soils would be well suited to the creation of wildflower grassland. A thin layer of 150 mm of TSB should be laid over ripped in situ subsoil and sown with an appropriate seed mix.

AMENITY GRASSLAND

5.7. This planting has low demands and can use any excess topsoil resources. Emplacement to a minimum depth of 300 mm will reduce surface wetness. Subsoil de-compaction should take place on previously trafficked areas before topsoil is emplaced.

WETLAND AREAS

5.8. Topsoil should be removed from wetland areas/SUDs and within 1 m of their margin as the moderately high nutrient levels are likely to affect water quality through run off. The permeability of the base may be reduced by smearing with an excavator bucket. Reed plugs and rhizomes can be planted directly into the clay subsoil. Topsoil should not be used in aquatic planting schemes although where they are positioned on higher ground transitional to grassland, a thin topsoil (*c*. 150 mm of TSA/B) can be used.

6.0 Soil handling

6.1 The majority of the soils within the site a have high clay content and are susceptible to damage and compaction through machine handling.

6.2 Soil handling should be undertaken when the soils are dry and friable, between late May and early October. Soil handling should not take place when soils are in a plastic state. This can be assessed with a simple field test to establish whether the soil can be rolled into a thread 3 mm in diameter. If this is the case, soils should not be handled with machinery and drier conditions should be awaited before repeating the test. The clay subsoils to be used to form the core of embankments need not be subject to this condition.

6.3 The location of stockpiles of different resources (i.e. TSA; TSB; SS) should be recorded and retained to avoid mixing or loss during extended construction works.

TOPSOILS

6.4 Topsoils should be stripped and stockpiled from designated roadways prior to the commencement of groundworks. Vehicle traffic should be kept to designated roadways as far as possible to avoid damage to soil resources.

6.5 Topsoil should be stripped from areas to be used for subsoil stockpiles.

6.6 Topsoils and subsoils should be stripped and stored separately according to resources Map 2 in the appendix to this report. Care should be taken to ensure that the soils are stripped to the correct depth to prevent dilution with underlying subsoil. Average topsoil resource thicknesses are indicated in section 4.0 of this report, but in all cases stripping depth should be checked carefully (e.g. by a banksman).

6.7 Topsoil resource TSA and TSB should be stockpiled in windrows no more than 3 m in height to minimise settling damage to structure and to facilitate drying prior to reinstatement. Stockpiles to be left in-situ for greater than six months should be seeded with grass to increase stability.

SUBSOILS

6.8 Subsoil resource SS1 occurs in a small area in the south of the site and quickly grades to dense clay outside the marked area. Stripping should be checked carefully (e.g. by a banksman).

6.9 In-situ upper subsoils compacted during construction should be loosened/ripped prior to topsoil reinstatement to improve drainage and aeration.

7.0 Summary and conclusions

7.1 The site has soils with moderate to high clay content which are highly susceptible to damage if handled when wet. In the past the site has been in intensive agricultural management and most of topsoils are therefore of moderately high nutrient status with the exception of one field in the north of the site which was found to have low nutrient content at the time of survey.

7.2 There are limited subsoil resources for reuse across the site. The permeable soils form a small area in the south and where these soils can be excavated they are of moderate quality for reuse. The dense clay subsoils across most of the site, are unsuitable for use in general landscaping once excavated and should be reserved for use in bunds and as liners for wet areas.

7.3 Overall the existing topsoils on site are of sufficient quality and volume for all landscaping requirements.

SUMMARY OF RECOMMENDATIONS

After use	Recommended soil resources	Recommendations
Tree pit planting (standards and heavy standards)	**TSA/TSA SS1**	There are limited subsoil resources for use in landscaping within the site. SS1 should preferentially be used to backfill tree pits if available in sufficient volume, otherwise subsoil meeting BS 8601:2013 should be imported. TSA/B are suitable for use as topsoil in the tree pits but care should be taken when handling the soils to avoid compaction through handling damage. Pits need to be relatively large, with the margins broken, to avoid filling with water.
Transplants	**TSA/TSB**	Planted by hand on undisturbed land/in trenches, transplants may be backfilled with the in-situ topsoil (TS1/2).
Shrubs/Hedges	**TSA/TSB**	Planted by hand on undisturbed land/in trenches, shrubs may be backfilled with the in-situ topsoil (TS1/2).
Wildflower grassland	**TSA/SS**	Wildflower planting would be best carried out on in-situ subsoils in the south of the site: strip the topsoil layer and reseed with desired seed mix in summer or early autumn. Or with a thin (150 mm) layer of TSB spread over ripped/de-compacted subsoil.

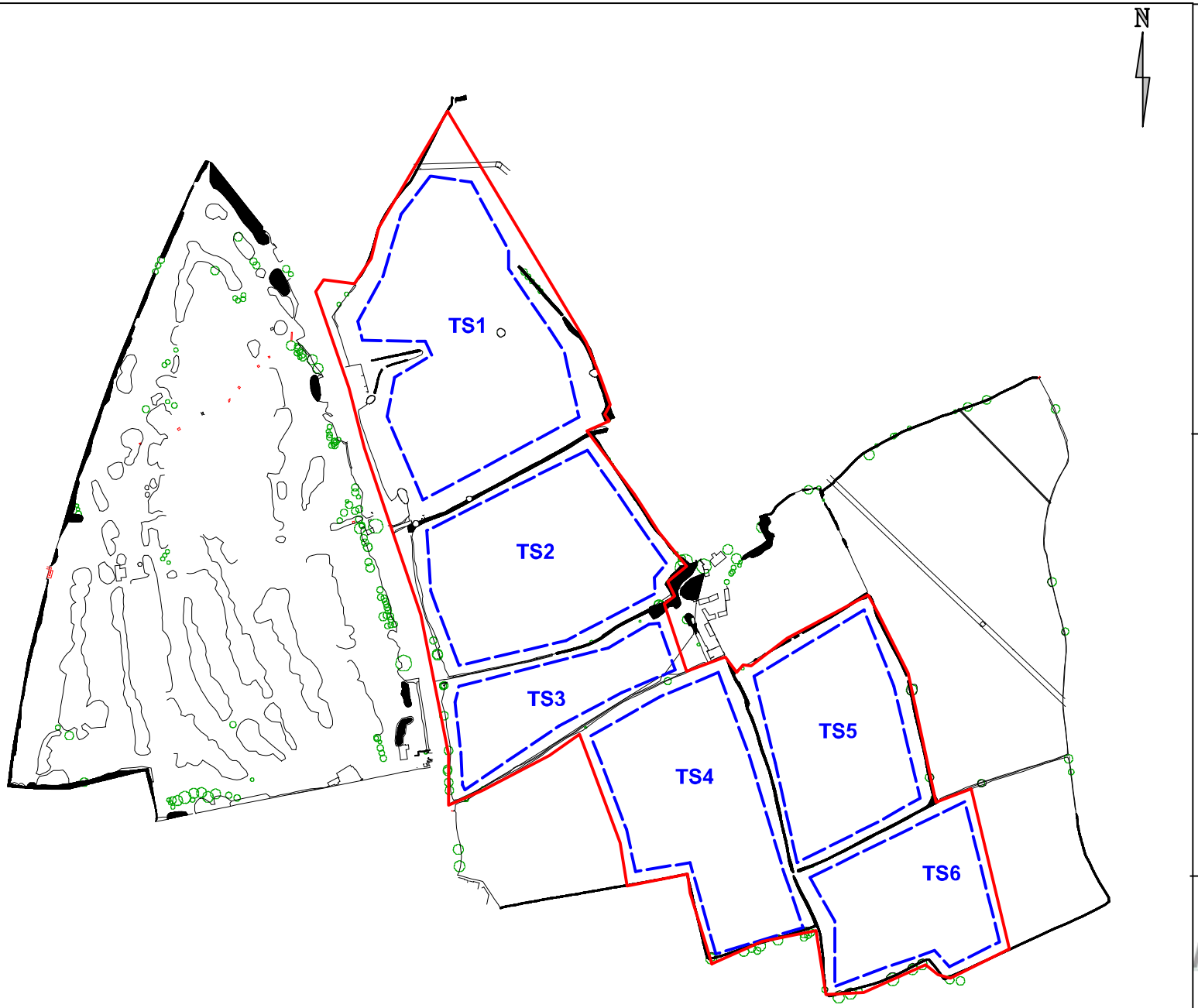
After use	Recommended soil resources	Recommendations
Open water / wetland	**N/A**	Scrape away topsoil within 1 m of the margin. The permeability of the base may be reduced by smearing with an excavator bucket. Reed plugs and rhizomes can be planted directly into the clay subsoil. Topsoil should not be used in aquatic planting schemes.
Amenity grassland	**TSA/TSB**	This planting has low demands and can use any excess topsoil resources. Emplacement to a minimum of 300 mm will reduce surface wetness.

APPENDIX

SAMPLE AREAS

RESOURCE AREAS

LABORATORY ANALYSIS



KEY

Sample areas

Application site

Site:

Water Eaton

Map title:

Map 1
Sample areas

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Lockington Hall
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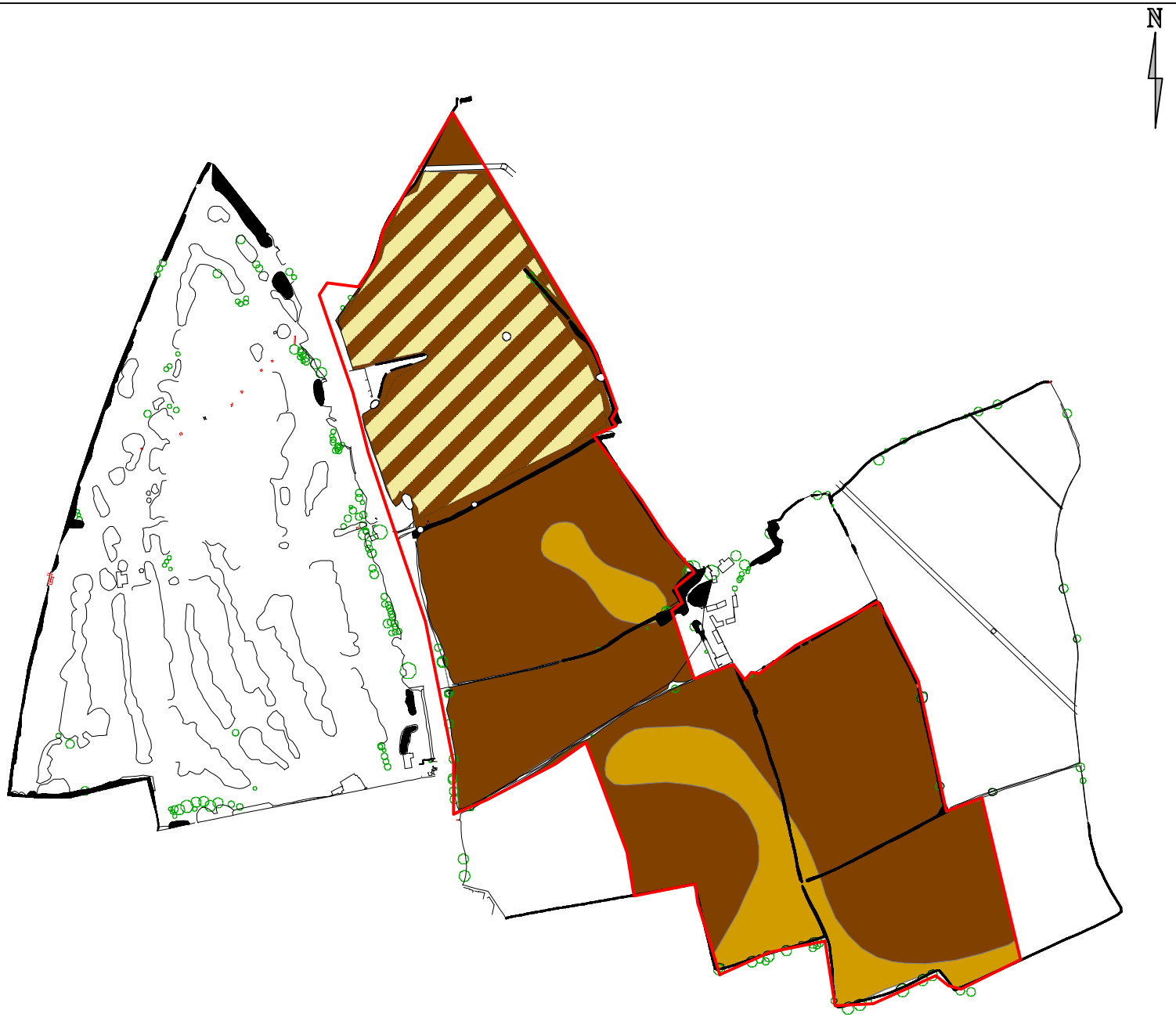
01509 670570

Scale: 1:8,000

Date: 17/01/2023



KEY

- Low nutrient heavy slowly permeable soils TSB
- High nutrient heavy slowly permeable soils TSA
- Deep loamy soils TSA/SS
- Application site

Site:

Water Eaton

Map title:

Map 2
Soil resources

Land Research Associates
Lockington Hall
Lockington
Derby DE74 2RH
01509 670570

Scale: 1:8,000

Date: 17/01/2023

ANALYSIS REPORT

Contact : MR MIKE PALMER
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H579

Please quote the above code for all enquiries

Client : NORTH OXFORD TRIANGLE

Local Rep : LAURA THOMAS

Telephone : 07545 584568

Sample Matrix : Agricultural Soil

Laboratory Reference
Card Number 81119/21

Date Received 30-Nov-21
Date Reported 08-Dec-21

SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
547373/21	1	**TS1** *No cropping details given*	**6.9**	**0**	**2-**	**2**	**5.8**	**176**	**69**
547374/21	2	**TS2** *No cropping details given*	**7.1**	**1**	**2+**	**2**	**13.2**	**182**	**61**
547375/21	3	**TS3** *No cropping details given*	**7.0**	**3**	**4**	**2**	**39.6**	**419**	**92**
547376/21	4	**TS4** *No cropping details given*	**5.5**	**2**	**1**	**2**	**25.4**	**114**	**57**
547377/21	5	**TS5** *No cropping details given*	**6.2**	**2**	**2-**	**2**	**18.0**	**137**	**80**
547378/21	6	**TS6** *No cropping details given*	**6.8**	**2**	**1**	**2**	**15.6**	**118**	**86**

If general fertiliser and lime recommendations have been requested, these are given on the following sheets.
The analytical methods used are as described in DEFRA Reference Book 427
The index values are determined from the AHDB Fertiliser Recommendations RB209 9th Edition.

Released by Sandy Cameron On behalf of NRM Date 08/12/21

MICRO NUTRIENT REPORT

DATE **8th December 2021**

SAMPLES FROM **NORTH OXFORD TRIANGLE**

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Reference: **81119/547373/21** Field Name: **TS1**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Organic matter (LOI) %	5.0	**1**	*OM level data not available for this crop*				

Reference: **81119/547374/21** Field Name: **TS2**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Organic matter (LOI) %	4.5	**1**	*OM level data not available for this crop*				

Reference: **81119/547375/21** Field Name: **TS3**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Organic matter (LOI) %	5.9	**1**	*OM level data not available for this crop*				

Reference: **81119/547376/21** Field Name: **TS4**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Organic matter (LOI) %	5.1	**1**	*OM level data not available for this crop*				

Reference: **81119/547377/21** Field Name: **TS5**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Organic matter (LOI) %	4.9	**1**	*OM level data not available for this crop*				

Reference: **81119/547378/21** Field Name: **TS6**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Organic matter (LOI) %	4.8	**1**	*OM level data not available for this crop*				

Notes (*)

(1) NRM considers Organic soils to contain between 10-20% organic material with Peaty soils containing over 20% . The optimum ranges for Organic Matter which have been set are dependent on the soil type and the cropping but these must be viewed as guidance values only.

ANALYSIS REPORT

DATE	8th December 2021
SAMPLES FROM	NORTH OXFORD TRIANGLE
SAMPLED BY	LAURA THOMAS
Report reference	81119/21

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Fertiliser Recommendations

The phosphate and potash recommendations shown below, are those required to replace the offtake and maintain target soil indices. The larger recommended applications for soils below target index will allow the soil to build up to this target index over a number of years. Not applying fertiliser to soils which are above target index will allow the soil to run down over a number of years to the target index.
The recommendation should be increased or decreased where yields are substantially more or less than that specified. The amount to apply can be calculated using the expected yield and values for the offtake of phosphate and potash per tonne of yield given in the RB209 9th edition.
All recommendations are given for the mid-point of each Index.
Where a soil analysis value (as given by the laboratory) is close to the range of an adjacent Index, the recommendation may be reduced or increased slightly taking account of the recommendation given for the adjacent Index. Small adjustments of less than 10 kg/ha are generally not justified.
Efficient use of P and K is most likely to be achieved on soils that are well structured and enable good rooting.
For visual evaluation of soil structure (VESS), a score on 1 or 2 would be considered adequate.
Don't forget to deduct nutrients applied as organic manures.
For Nitrogen recommendations please refer to the RB209 9th edition or seek advice from an FACTS qualified adviser.
Target Indices:
Arable, Forage, Grassland and Potato Crops: P Index 2, K Index 2-
(In rotations where most crops are Autumn-sown, soils are in good condition and P is applied annually, high index 1 can be an adequate target.)
Vegetables and Bulbs: P Index 3, K Index 2+
(If vegetables are only grown occasionally as part of an arable rotation, it would be most economic to target index 2 for arable and forage crops.)
Fruit Vines and Hops: P Index 2, K Index 2, Mg Index 2
(Note: Cider apples respond to K Index 3, Mg Index 3)
A lime recommendation is usually for a 20cm depth of cultivated soil or a 15cm depth of grassland soil. Where soil is acid below 20 cm and soils are ploughed for arable crops, a proportionately larger quantity of lime should be applied. However, if more than 10 t/ha is needed, half should be deeply cultivated into the soil and ploughed down, with the remainder applied to the surface and worked in.
For established grassland or other situations where there is no, or only minimal soil cultivation, no more than 7.5 t/ha of lime should be applied in one application.
In these situations, applications of lime change the pH below the surface very slowly. Consequently, the underlying soil should not be allowed to become too acidic because this will affect the root growth and thus limit nutrient and water uptake, which will adversely affect yield.

Field Name / Ref / Soil Type	*Last Crop / Next Crop*		*P2O5*	*K2O*	*MgO*		*Lime (Arable)*	*(Grass)*
TS1	**Not Given / Not Given**	*Units/Acre*				*T/Ac*	**0**	**0**
547373 /		*Kg/Ha*				*Te/Ha*	**0**	**0**
Field Name / Ref / Soil Type	*Last Crop / Next Crop*		*P2O5*	*K2O*	*MgO*		*Lime (Arable)*	*(Grass)*
TS2	**Not Given / Not Given**	*Units/Acre*				*T/Ac*	**0**	**0**
547374 /		*Kg/Ha*				*Te/Ha*	**0**	**0**
Field Name / Ref / Soil Type	*Last Crop / Next Crop*		*P2O5*	*K2O*	*MgO*		*Lime (Arable)*	*(Grass)*
TS3	**Not Given / Not Given**	*Units/Acre*				*T/Ac*	**0**	**0**
547375 /		*Kg/Ha*				*Te/Ha*	**0**	**0**
Field Name / Ref / Soil Type	*Last Crop / Next Crop*		*P2O5*	*K2O*	*MgO*		*Lime (Arable)*	*(Grass)*
TS4	**Not Given / Not Given**	*Units/Acre*				*T/Ac*	**3.4**	**1.5**
547376 /		*Kg/Ha*				*Te/Ha*	**8.4**	**3.7**
Field Name / Ref / Soil Type	*Last Crop / Next Crop*		*P2O5*	*K2O*	*MgO*		*Lime (Arable)*	*(Grass)*
TS5	**Not Given / Not Given**	*Units/Acre*				*T/Ac*	**1.4**	**0**
547377 /		*Kg/Ha*				*Te/Ha*	**3.5**	**0**

Fertiliser recommendations are based on **AHDB RB209 (Ninth Edition).** If a nutrient is deficient and no recommendation is given, either no recommendation is given in RB209 or we have insufficient data to give a recommendation. Apply Lime to the nearest half Ton / Tonne.
NRM is a UKAS accredited laboratory to ISO/IEC 17025

Report continued.....

ANALYSIS REPORT

DATE	8th December 2021
SAMPLES FROM	NORTH OXFORD TRIANGLE
SAMPLED BY	LAURA THOMAS
Report reference	81119/21

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Fertiliser Recommendations

Field Name / Ref / Soil Type	*Last Crop / Next Crop*		*P2O5*	*K2O*	*MgO*	*Lime (Arable)*	*(Grass)*
TS6	**Not Given / Not Given**	*Units/Acre*				*T/Ac* **0**	**0**
547378 /		*Kg/Ha*				*Te/Ha* **0**	**0**

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