highways england

A14
Cambridge to Huntingdon improvement scheme

Development Consent Order Application

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Technical Annex to the Soil Management Strategy

Environmental Statement Appendix 12.2

September 2015

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A14 Cambridge to Huntingdon improvement scheme

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1 Objective of the technical annex

1.1 Purpose and scope

1.1.1 This technical annex is to be read in conjunction with A14 Improvement Scheme Environmental Statement Appendix 12.2 (Soil Management Strategy), December 2014.

1.1.2 The technical annex provides clarification for the contractor on matters such as preconstruction survey sampling and testing, reference to codes of practices and good practice guidance, and updates to the summary table of the Soil Management Strategy.

1.1.3 The technical annex may be subject to refinement as necessary as the detailed design develops. Any adjustments made within the technical annex following the grant of the DCO will be consulted upon with the relevant stakeholders as appropriate.

2 Pre-construction surveys

2.1 The need for pre-construction surveys

2.1.1 It is currently estimated in the Environmental Statement Appendix 12.2 at Table 2.1 that there would be a surplus of topsoil of 944,000m^3. Pre-construction survey of the on-site soil resources within the Development Consent Order boundary would inform and refine the calculations contained within the SMS. Additionally, it would provide additional information on the nature of the soil resources that could be used within the scheme and sustainably used off the site.

2.1.2 Mitigation relating to bio-security is also committed to in the ES (paragraph 16.5.6 of Volume 6.1) and this will include protection of the bio-security of soil resources. Pre-construction sampling for soil pests and diseases would inform the implementation of bio-security actions seeking to restore agricultural land free from soil pests and diseases.

2.2 Soil Resources Survey

2.2.1 A soil resources survey would be carried out by a suitably qualified and experienced soil scientist or practitioner prior to any earthworks operations and would be commissioned by the appointed Highways England contractors consulting soil scientist and who shall also be suitably qualified and experienced.

2.2.2 The soil resources survey would comprise two components: characterisation of the physical soil resources (including assessment of the Agricultural Land Classification (ALC)); and representative sampling for physiochemical analysis. The aims of the soil resources survey are to describe the characteristics of the soils impacted by the development, discuss the suitability of materials for re-use and make detailed recommendations for the handling and storage of the identified soil materials in order to protect their functions during construction.

2.2.3 The ALC information will provide further data on the presence of Best and Most Versatile (BMV) land to facilitate its protection.

2.2.4 The physiochemical analysis will facilitate protection of the physical and chemical character of disturbed soils during the stripping, storage and reinstatement processes.

Physical Soil Resources Survey

2.2.5 The requirements of the Physical Soil Resources survey are:

- Complete survey at a density of at least one investigation per hectare comprising auger borings and representative soil pits (as appropriate);
- Provide a geological description for the soil profile;
- Characterise each soil (topsoil and subsoil) layer to a depth of 1.2m to include depth, colour, texture, $CaCO_3$, stoniness, identifiable organic matter content, structural and drainage characteristics, and evidence of compaction; and
- Determine slope.

2.2.6 This would be supplemented by a desk based assessment of flood risk from published sources. For agricultural land, the information above would also be used to identify the ALC in accordance with the Agricultural Land Classification guidelines (MAFF 1988). This includes identification of Best and Most Versatile (BMV) Land comprising Grade 1, Grade 2 and Grade 3a land. Non-BMV land is Grade 3b, Grade 4 and Grade 5 land.

2.2.7 A Physical Soil Resources Survey within the extents of the DCO boundary has already been undertaken as part of the A14 Ellington to Fen Ditton scheme investigations in 2009. This included identification of ALC grade where land was in agricultural use. This included off-line sections and further Defra commissioned surveys between Girton to Lolworth. These data are therefore available to inform part of the soil resources survey for the A14 Cambridge to Huntingdon Improvement Scheme.

2.2.8 The 2009 ALC assessment was undertaken in accordance with the revised guidelines and criteria (MAFF 1988) for agricultural land classification with point source soil samples taken at 100m intervals along the proposed southern bypass main alignment. A desk exercise was completed for the on-line sections of the scheme, as Defra had previously carried out detailed surveys between Girton and Lolworth, including the offline section around Bar Hill.

2.2.9 The detailed survey carried out on the offline section is reported in Appendix F, Annex 5 of the A14 Ellington to Fen Ditton ES and can be accessed at:

http://iprojects.costain.com/a14_public_area/Public/VOL%203B/v3b%20Appendix%20F%20Annex%205%20-%20Investigation%20Site%20Data.pdf

2.2.10 The associated Figures 12.2.1 to 12.2.3 can be accessed at:

http://iprojects.costain.com/a14_public_area/Public/VOL%202/chapter%2012%20-%20land%20use/12.2.1-12.2.6.pdf

2.2.11 The environmental assessment for the A14 Cambridge to Huntingdon improvement scheme was based on the published ALC soils map (MAFF, 1988) Additional ALC surveys were not commissioned as it was conservatively assumed for the ES that all soil mapped at ALC Grade 3 fell into the ALC Grade 3a BMV land category, thus adopting a worst case for assessment purposes. This is explained further at paragraph 16.2.26 of the ES, Volume 6.1 and is illustrated in ES Figure 16.1.

2.2.12 The location of the 2009 ALC survey data covers much of the route of the A14 Cambridge to Huntingdon Improvement Scheme, particularly the southern bypass main alignment. However, it does not cover ancillary areas such as borrow pits and soil storage areas. The extent of the 2009 ALC survey is illustrated in Figure 1 appended to this report. The drawing shows the published ALC soils map information as used in the ES along with the 2009 ALC data extracted from Annex 5 Investigation Site Data contained in Appendix F – Land Use of the A14 Ellington to Fen Ditton ES.

2.2.13 The data collected in 2009 were used to undertake a comparative analysis with the current scheme which demonstrated that the assumptions in the ES relating to the extent of BMV land (99.5% of all affected agricultural land) is very similar to the proportion of samples identified as being BMV (94.9% of all samples on agricultural land.

2.2.14 Consequently, the conclusions on the significance of impact based on the provisional ALC mapping as presented in the ES remain valid and are considered to be robust. Natural England have confirmed to Highways England that they agree that consideration of the Atkins 2009 data included in the A14 Ellington to Fen Ditton ES does not materially change the conclusions relating to the amount of BMV land lost. This point is noted in the Statement of Common Ground with Natural England.

2.2.15 The new element of the Physical Soil Resources Survey, would exclude resurvey of land surveyed in 2009 and instead would fill gaps in the existing physical soil resources and ALC data set. The new and old datasets would be combined to make recommendations for the sustainable use of soil for the whole scheme. This would include land required for borrow pits 5 and 6, construction compounds, soil storage areas and haul roads.

2.2.16 The appointed Highways England contractors consulting soil scientist would be responsible for identifying the extents of the Physical Soil Resources Survey and the ALC component and ensuring that Natural England are consulted on the proposed survey extents.

Physiochemical Soil Resources Survey

2.2.17 In addition to the Physical Soil Resources Survey requirements above, a Physiochemical Soil Resources Survey will be undertaken. This will include land identified within the extents of the Physical Soil Resources Survey and all additional land that will be disturbed and stripped as a consequence of the proposed scheme. The Physiochemical Soil Resources Survey shall include appropriate analysis of representative soil samples from all land that is to be stripped. A minimum of one analysis per 4ha is recommended in the sampling protocol outlined in Appendix A. To assist with the characterisation of different soil materials the analysis should include:

- pH
- Salinity
- Particle size analysis
- Nutrients including phosphate, potassium and magnesium;
- Organic matter; and
- Potential contaminants.

2.2.18 The appointed Highways England contractors' consulting soil scientist would be responsible for identifying the extents of the Physiochemical Soil Resources Survey and the number of analysis to be completed. They will also ensure that Natural England is consulted on the proposed survey extents and associated soil analyses.

Reporting of the Soil Resources Survey

2.2.19 The results of the Physical and Physiochemical Soil Resources Surveys and associated analysis along with the 2009 ALC data shall be presented in one interpretive report of the soil resources survey results and include separate maps showing the location and extent of contrasting soils, ALC grade and sampling locations. In addition, the report shall:

- identify the suitability of different topsoil and subsoil materials for reuse;
- make recommendations for the handling and storage of identified topsoil and subsoil materials that would protect soil functions during site working;
- identify haul routes;
- include a topsoil and subsoil budget to augment that already provided in the SMS and an associated storage plan that ensures topsoils and subsoils are stripped, stored and replaced separately;
- make recommendations on what subsoils and topsoils are to be used for on-site landscape use or habitat creation and, if appropriate, how the soils can be improved for use for such purposes;
- make recommendations on what donor subsoils and topsoils are to be used for restoration of agricultural land;
- include recommendations on the suitability of any surplus topsoil and subsoil for off-site use; and
- supervision processes.

2.2.20 The interpretive report shall also identify how topsoil for agricultural re-use (including donor topsoil) and any subsoil used for agricultural re-use (including donor subsoil) is to be stored and managed separately from topsoil and subsoil to be used for other purposes (for example landscaping) in order to protect their integrity. It shall also assess the opportunities for direct movement from donor to receptor sites where practically possible.

2.2.21 Through the combination of both the 2009 ALC survey work and the proposed soil resources survey, BMV land would be identified ahead of construction and would include land temporarily possessed that would ultimately be restored to agricultural use. It would also provide analytical information which would inform storage and restoration methods for all disturbed topsoils and subsoils.

2.2.22 The appointed Highways England contractors will be expected to ensure that the land temporarily possessed is restored to an equivalent agricultural land quality as much as possible, so that BMV land is safeguarded and that Article 30 of the DCO is complied with.

2.3 Soil Biosecurity

2.3.1 There are several plant pests and diseases which, if they were to be transferred to soils free from pests and diseases, could cause serious damage to agricultural or horticultural crops with consequent economic loss.

2.3.2 Three significant and more prevalent crop diseases that may affect crops within the study area are Potato Cyst Nematode (PCN), Clubroot and Rhizomania. In managing soil resources, it is important that disease free soils are not contaminated with any of these diseases. Consequently, pre-construction soil resources surveys should include assessment of the presence of these diseases where the topsoils are ultimately intended for agricultural re-use. This would include topsoils in areas temporarily possessed and that are to be returned to agricultural use as well as any areas identified as donor topsoil.

2.3.3 Soil analysis tests for PCN and Clubroot are available and should be sampled for in-field before the land is disturbed. Sampling shall be completed in accordance with good practice (sampling protocol outlined at Appendix B) and analysed in an accredited laboratory. There is no soil test for Rhizomania and instead the landowners shall be engaged with to determine as far as possible whether Rhizomania is known to be present.

2.3.4 The results of the analysis shall be presented in the interpretive report referred to above, including maps to show the location and extent of pest/disease free soils and where soil pests/diseases are present. This would be used to inform management of soils on site, in particular the suitability of the topsoil as donor topsoil. Only topsoil free of diseases shall be used to restore land to agriculture.

3 Reference to guidance and good practice

3.1.1 Soil is a finite resource that fulfils a number of functions and services which are central to sustainability. It is a living layer, taking over 500 years to form a 2cm thickness. It provides anchorage and oxygen for plant roots, slowly releases nutrients and in conjunction with the underlying subsoil, retains moisture to sustain plant growth during dry periods. Careful management is required for its beneficial reuse on or off-site so that this essential non-renewable resource can be sustained.

3.1.2 The overarching guidance for the sustainable use of soils is contained within the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra 2009). The Highways England appointed contractor will be required to comply with all aspects of this code of practice that are relevant to the scheme.

3.1.3 This code draws on related legislation and guidance and is covered in full in section 2 (Related Legislation) and Section 3 (Related Guidance) of the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. Whilst all of the legislation and guidance is important, in the context of this SMS and as it relates to the nature of the proposed A14 Cambridge to Huntingdon improvement scheme, two guidance documents are worthy of particular attention.

Good Practice Guide for Handling Soils (MAFF, 2000)

3.1.4 The aim of this guide, (which takes the form of 19 sheets), is to provide comprehensive advice on soil handling to operators, soil moving contractors and others with soil handling and management. Each sheet provides detailed information on best practice methods for soil stripping, soil stockpiling, excavation from storage mounds, soil replacement, decompaction and cultivation using different machinery combinations.

3.1.5 The Highways England appointed contractor will be required to follow good practice methods contained within these sheets and this would be overseen by the consulting soil scientist. Whilst all should be considered and followed where appropriate, the nature of the proposed works make the following particularly relevant:

- Sheet 1: Soil stripping with excavators and dump trucks;
- Sheet 2: Building soil storage mounds with excavators and dump trucks;
- Sheet 3: Excavation of soil storage mounds with excavators and dump trucks; and
- Sheet 4: Soil replacement with excavators and dump trucks.

3.1.6 Where practically possible, opportunities for direct movement of donor topsoil and subsoils for agricultural re-use to receptor sites would be identified, planned and actioned. This would be completed in accordance with the guidance contained in Sheet 1 and Sheet 4.

3.1.7 In situations where topsoils and subsoils have to be stockpiled before restoration, the guidance contained in Sheet 2 and Sheet 3 would be followed and the loose tipping method will be adopted. Topsoils and subsoils would be stripped and stored separately.

3.1.8 In the case of topsoil handlings, topsoil will only be handled when it is below its plastic limit. This will be determined by the Highways England appointed contractors' consulting soil scientist. Topsoil handling shall be required to be timed to suit weather conditions and industry best practice as set out in Table 5-1 that follows. Topsoil, whether in topsoil stores or where restored, will not be left unvegetated during the winter months.

3.1.9 Topsoil will be required to be replaced through the loose tipping method and replaced to a thickness that relates to the anticipated rooting depth of the plants to be established and the quality of the underlying subsoil. In the case of amenity grass for landscaping it shall be to a depth of at least 150mm and not greater than 300mm. In the case of trees and shrubs for landscaping it shall be at least 300mm and no greater than 400mm. In the case of agricultural soils, it shall be at least 250mm and no greater than 400mm.

Guidance for Successful Reclamation of Mineral and Waste Sites (Defra 2004)

3.1.10 This guidance draws on the technical knowledge and experience of MAFF, Farming and Rural Conservation Agency (FRCA), Rural Development Service (RDS) and representatives involved in the minerals and waste industry on the agricultural aspects of mineral and waste development. The guidance is extensive covering application, site working, restoration and aftercare.

3.1.11 The Highways England appointed contractor will be required to follow this good practice guidance in addition to the Good Practice Guides for Handling Soils (particularly sheets 1-4) for sites where minerals have been extracted within borrow pits and the land is intended to be restored to agricultural use. It is intended that Borrow Pit 5 is largely restored to agricultural use and Borrow Pit 6 will be partially restored to agricultural use. Full details are provided in appendix 3.3 of the ES Volume 6.3.

3.1.12 The ALC component of the soil resources survey will identify the agricultural land classification of Borrow Pits 5 and 6 and these will be restored to at least the same ALC Grade (including BMV land) as that which subsisted before the scheme where restoration is to pre-existing ground levels and thus safeguarding BMV land. The depth of restored topsoil shall in part be determined by the topsoil depth originally identified in the soil resources survey. It is anticipated that the restored topsoil depth shall be of the order of 250mm to 300mm and in any event no greater than 400mm.

3.1.13 Minerals Planning Practice Guidance relating to restoration and aftercare of mineral sites (paragraphs 036-046) shall be complied with.

4 Implementation of the Soil Management Strategy

4.1.1 Implementation of the soil management strategy would be overseen by the Highways England appointed contractors' suitably qualified and experienced consulting soil scientist. They would ensure that:

- the soils resources survey is undertaken by a suitably qualified and experienced soil scientist or practitioner;
- the soil resources survey scope includes identification of ALC grade for any significant areas of agricultural land impacted that is not covered by the 2009 ALC survey;
- representative topsoil samples for analytical analysis are taken from all topsoil that will be stripped;
- soil biosecurity sampling is undertaken on topsoil identified for agricultural use to confirm its suitability;
- comprehensive interpretive report(s) is prepared following completion of the soil resources survey works that support the sustainable re-use of topsoils and subsoils and ensure BMV land is protected; and
- appropriate guidance is followed during soil stripping, storage and restoration processes.

4.1.2 After each area of agricultural land is re-instated, a condition report would be prepared by the contractors consulting soil scientist and remedial actions would be agreed and implemented as required to ensure that Article 30 of the DCO (restoration of land temporarily possessed to the reasonable satisfaction of the owners of the land and payment of compensation for any loss or damage suffered) is complied with and Best and Most Versatile land is protected.

5 Review of summary table and mitigation

5.1.1 Table 5.1 below replaces Table 3.1 of the SMS and includes mitigation measures by contractors proposed in this technical annex.

Table 5-1: Summary of potential impacts on soil resources and proposed mitigation measures

Construction activity	Potential impact	Proposed mitigation	Management action
General management of the soil resources			
Pre-construction planning	Loss of soil resources or contamination of soils	• Highways England appointed contractor to engage a consulting soil scientist to oversee physical and physiochemical soil resources surveys and stripping, storage and restoration processes. • Physical soil resources survey to characterise the soil types and where agricultural land, determine the Agricultural Land Classification if not already identified within the Atkins (2009) data. • Physiochemical soil resources survey to include physiochemical analysis of topsoils that will be re-used for agriculture and landscaping. • Soil resources survey of soils that will be re-used for agriculture to include soil biosecurity analysis. • Preparation of an interpretive report of the soil resources survey results, including accompanying maps and soil data.	*CoCP*

Construction activity	Potential impact	Proposed mitigation	Management action
Storage of soil	Unnecessary off-site exportation of soil	• Ensure that there is sufficient space on site to stockpile all soil resources to be used. Different soil types as well as topsoil/subsoil to be stored separately.	*CoCP*
Excavation of surplus soil	Loss of surplus soil	• Investigate beneficial off-site uses for all soil materials that are surplus to requirements.	*CoCP*
Handling soil	Compaction, and other problems due to wet conditions	• Plan site works so that soil stripping and replacement occurs in favourable/dry weather conditions, when topsoil below plastic limit and in accordance with other best practice.	*CoCP*
Vehicle movements	Vehicular movements off designated haul routes	• Mark out haul routes. Topsoil to be stripped from haul routes.	*CoCP*
Handling soil	Cross-contamination of different soil types	• Avoid stripping topsoil too deeply so that subsoil becomes incorporated.	*CoCP*
Excavation and stripping of soil			
Stripping soil	Loss of soil resources or contamination of soils	• Compliance with Good Practice Guide for Handling Soils Sheet 1 (MAFF, 2000).	Stripping Plan *CoCP*
Excavating soil from borrow pits	Sterilisation of soil from agricultural use	• Strip soil from areas that would be sterilised by the scheme or construction works.	Stripping Plan
Stripping soil	Contaminating soil type	• Avoid stripping topsoil too deeply so that subsoil becomes incorporated • Segregate stockpiles by type (topsoil and subsoil), character (soil type) and intended use (landscaping and agriculture).	Stripping Plan
Handling soil	Damaging soil by handling whilst they are wet	• Undertake stripping in favourable/dry weather conditions and when topsoil below plastic limit.	Stripping Plan

Construction activity	Potential impact	Proposed mitigation	Management action
Excavating soil from borrow pits	Surplus topsoil	• Find alternative use for the surplus topsoil with local landowners	Consultation Plan
Storage of soil			
Building of storage mounds	Loss of soil resources, contamination of soils, or damage to the biological condition of the soil	• Compliance with Good Practice Guide for Handling Soils Sheet 2 (MAFF, 2000). • Materials should be stored like upon like, so that topsoil is stripped from beneath subsoil stockpiles and subsoil from beneath stockpiles of non-soil materials.	*CoCP*
Excessive height of stockpiles and prolonged storage of soil	Damage to the biological condition of the soil due to anaerobism	• Ensure length of storage of soils in stockpiles is minimised in accordance with best practice. • Limit height of soil stockpiles. • Ensure soils are dry and friable when storing. • Manage long-term soil stores by seeding and cutting vegetation. • Reuse/export excess soil once it is clear it is not required for the scheme.	Stripping Plan *CoCP*
Excessive height of stockpiles and prolonged storage of soil	Damage to the chemical condition of the soil	• Ensure length of storage of soils in stockpiles is minimised in accordance with best practice. • Limit height of soil stockpiles. • Ensure soils are dry and friable when storing. • Manage long-term soil stores by seeding and cutting vegetation. • Reuse/export excess soil once it is clear it is not required on the scheme.	*CoCP*

Construction activity	Potential impact	Proposed mitigation	Management action
Excessive height of stockpiles and prolonged storage of soil	Damage to the physical condition of the soil	• Limit the height of the stockpiles to prevent self-compaction. • Limit topsoil stores to maximum 2m high when storage period in excess of 12 months. Where storage duration is less than 12 months, limit stockpile height as far as practically possible within storage space limitations to a maximum height of 4m.	*CoCP*
Handling of soil	Damage to the physical condition of the soil	• Reduce handling of soil. • Investigate and action opportunities for direct placement. • Avoid handling soil in adverse weather conditions. • Ensure soils are dry and friable when handling.	*CoCP*
Not segregating soil of different types/sources.	Contamination of the stockpiles	• Segregate stockpiles by topsoil/subsoil and use (landscaping and agriculture). • Ensure the stockpiles are clearly defined.	Preparation of handling method statement *CoCP*
Leaving the stockpiles unprotected from the elements	Erosion of soil	• Reduce the footprint of stockpiles in areas susceptible to flooding. • Bund stockpiles to allow soil in runoff to be recovered. • Vegetate stockpiles where to be kept in place longer than 6 months.	*CoCP*
Compaction			
Leaving soil in situ on haul routes and working areas	Compaction	• Ensure that all working areas and haul routes are stripped prior to use.	Stripping Plan *CoCP* Works Information
Not restoring areas of compacted soil	Reduction in agricultural output	• Loosen all areas of compacted soil during the restoration phase at the end of the construction phase.	Restoration Plan Planting scheme Works Information

Construction activity	Potential impact	Proposed mitigation	Management action
Restoration			
Excavation of soil storage mounds and replacement of soils	Loss of soil resources or contamination of soils	• Compliance with Good Practice Guide for Handling Soils Sheets 3 and 4 (MAFF, 2000).	*CoCP*
Restoration of Borrow Pits	Loss of soil resources or contamination of soils	• Compliance with Good Practice Guide for Handling Soils Sheets 3 and 4 (MAFF, 2000). • Compliance with Guidance for Successful Reclamation of Mineral and Waste Sites (Defra, 2004). • Compliance with Minerals Planning Practice Guidance relating to restoration and aftercare of mineral sites (paragraphs 036-046).	*CoCP*
Placement of soil	Compaction	• Implement the loose tipping method. • Avoid mechanical compaction of the soil.	Restoration Plan *CoCP* Works Information
Placement of soil	Anaerobic conditions	• Avoid the placement of topsoil exceeding 400mm in depth.	Restoration Plan *CoCP* Landscaping strategy Works Information
Placement of soil	Damaging chemical/ biological/ physical properties	• Do not handle soil during or after adverse weather conditions. • Handle topsoils when below plastic limit.	*CoCP*
Placement of soil	Clumping of soil	• Avoid placing wet soil. • Do not undertake activities during or after adverse weather conditions.	Restoration Plan *CoCP*
Vehicle movements	Compaction	• Prevent vehicles from access to the restored areas. • Implement the loose tipping method.	Restoration Plan *CoCP*

Construction activity	Potential impact	Proposed mitigation	Management action
Ineffective drainage	Waterlogging	• Ensure the receiving surface is loosened/subsoiled. • Consider whether remedial piped under-drainage or other drainage treatment is required.	Restoration Plan *CoCP* Works information

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APPENDIX A: Physiochemical Analysis Sampling Protocol

Time of sampling: Samples should not be taken within two months of the land having received compound fertilizer, organic manure or more than 50 kg/ha nitrogen.

Sampling area: The sampling area should be sub-divided into a maximum of 4 ha (10 acre) units and sampled separately. Separate samples should also be taken from areas which have been manured differently, or which have different soil types or topography, even if there is only one crop. Avoid sampling headlands, near gates, in areas where lime or manure has been previously been dumped and in areas where livestock congregate.

Draw a map of the field: Submit a field plan to show any subdivisions, using features such as gates and trees as reference points.

Sample size and pattern: Take enough samples randomly on a "W" configuration to provide about 500g soil from 20 samples.

Sampling tools and sampling depth: The best sampling tool is either a soil auger or corer. Permanent grassland should be sampled to 10 cm (4 in) and arable land (including short-term rotation grass) to plough depth 20 cm (8 in). When an auger is used, it should be twisted into the soil to sampling depth and pulled out. All the soil adhering to it should form part of the sample. Further cores should be taken from different parts of the field, until about 20 have been collected and the total sample size is at least 500g.

Sample bagging and labelling: Place soil from each sampling unit into a heavy gauge polythene bag; secure bag with tie to prevent cross contamination. Record details relevant to the sample in and on the bag. Written details should not be put on paper with wet soil.

APPENDIX B: Biological Analysis Sampling Protocol

Clubroot Sampling Protocol

Time of sampling: Fields in which brassicas are to be sown or planted may be sampled at any time of the year, but samples are most conveniently taken when the soil is soft and any growing crop is small.

Sampling area: Samples should be limited to a maximum area of five hectares.

Draw a map of the field: Split the sampling area into blocks which are a maximum of 5 hectares using features such as gates and trees as reference points. Sample each 5 hectare block separately. Gateways and wet hollows should be sampled separately as these areas are most likely to be heavily contaminated and could give a false clubroot rating to the main sampling area.

Sample size and pattern: Fifty cores should be taken from each sampling area to give a soil sample of 4.5 lb (2 Kg). The cores should be collected at regular intervals as the sampling areas are traversed in a "W" or multi "W" pattern.

Sampling tools and sampling depth: A narrow bladed fern trowel or auger should be used and the cores should be taken to a depth of 6-8" (15-20 cm). An auger will be essential where the soil is compacted. Remove excess soil from the sampling tools between different sampling sites.

Sample bagging and labelling: All samples should be collected in heavy gauge polythene bags. Each bag should be tied as soon as it has been filled to prevent contamination. Label each bag separately giving the name of the farm and field or part-field name or number.

Free Living Nematode and Potato Cyst Nematode Sampling Protocol

Time of sampling: Best results are obtained by sampling soils from October until March (inclusive).

Sampling area: Subdivide sampling area into units no greater than 4 ha; subdivision may also be necessary to take account of differences in soil type and previous cropping history.

Draw a map of the field: Submit a field plan to show any sub divisions, using features such as gates and trees as reference points.

Sample size and pattern: Take enough samples randomly on a "W" configuration to provide about 1 kg soil. Clean the sampling tool between sampling different fields or parts of fields.

Sampling tools and sampling depth: Use a narrow -bladed fern trowel or "cheese-corer", take samples at least 1" (2.5 cm) across and 8-10" (20-25 cm) deep, the sampling tool should be driven vertically downwards into the soil to obtain the sample.

Sample bagging and labelling: Place soil from each sampling unit into a heavy gauge polythene bag; secure bag with a tie to prevent cross-contamination. Record details relevant to sample on the bag. Some of these nematodes are very fragile; rough handling of soil during sampling and transportation may jeopardise the results of the test.

FIGURE 1: Agricultural Land Classification Data