LAND ON THE SAMLESBURY ESTATE, NEAR PRESTON, LANCASHIRE

SOILS AND AGRICULTURAL LAND CLASSIFICATION

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SUMMARY

The site has the benefit of a soil map at 1:63,360 scale, published in 1966 by the Soil Survey of England and Wales and the kinds of soils and their distribution have generally been confirmed in 2010 by a site-specific survey. The site consists of about 29.0 hectares (72 acres) of unworked land in the centre and east and an area of former sand and gravel workings in the west (about 21.3 hectares or 52 acres). Well drained, coarse textured soils (Soil Type A) developed in river terrace drift are found at the eastern and western ends of the main unworked area, on slightly higher ground. There is a small area of similar, though generally somewhat sandier soils along part of the northern edge of the area of former sand and gravel workings. On the slightly lower ground on the centre of the main unworked area there are medium textured soils (Soil Type B) which are generally well drained, though the Memoir accompanying the 19966 published soil map suggests that they should show at least some signs of defective natural drainage. There are two minor soil types, a small area of heavy, poorly drained soils (Soil Type C) in a hollow in the centre south and a strip of sandy soils (Soil Type D) on a narrow, lower-lying strip alongside the river on the northern boundary. The area of former sand and gravel working in the west has, as noted above, a small area of unworked land in the north while the rest consists of restored land of variable quality (Soil Type E) and areas of trees, shrubs and wetland.

None of the land can be graded above ALC Grade 2 because of an overall climatic limitation. The wet climate also applies a wetness/workability limitation This restricts even the well drained coarse textured soils of Soil Type A to Grade 2 and the slightly heavier textured soils of Soil Type B to Subgrade 3a. The small area of very heavy and poorly drained soils (Soil Type C) is Grade 4. Summer droughtiness limitations apply only to the sandiest soils, of which the only significant area is a small one in the extreme north, within the area of former sand and gravel workings, which is graded Subgrade 3a. The narrow strip of lower-lying land alongside the river in the north (Soil Type D) is graded Subgrade 3b because of a perceived greater flood risk than the rest of the site where potential flooding is not thought to be a serious issue. The restored sand and gravel working are a mixture of Subgrade 3b and Grade 4, together with wetland and areas of shrubs, shown on the accompanying map as “other land”. A remnant of a soil storage bund on the northern boundary is also shown as “other land”. The areas and proportions of the various ALC grades as discussed above are as follows:-

ALC Grade	Soil Type	Soil Characteristics (drainage and texture)	Area (ha)	%
2	A	Well drained, coarse textured with sandy loam topsoils	17.1	34.0
3a	A	Well drained, coarse textured with loamy sand topsoils	3.6	7.2
3a	B	Well drained, medium textured	13.3	26.4
3b	D	Sandy soils alongside river	1.7	3.4
4	C	Poorly drained, clayey	0.6	1.2
3b	E	Restored sand and gravel workings	4.8	9.5
4	E	Restored sand and gravel workings	1.6	3.2
Other land		Wetland, trees and shrubs	7.6	15.1
Total			50.3	100.0

Soil resources consist of coarse and medium textured topsoils and subsoils from the areas of Soil Types A and B respectively. It is considered that only the coarse textured topsoil is worth conserving from Soil Type D and that none of the topsoil or subsoil from Soil Types C or E is worth conserving.

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1 INTRODUCTION AND METHODOLOGY

1.1 This report describes the soils and Agricultural Land Classification (ALC) of approximately 50.3 hectares (124 acres) of land on the Samlesbury Estate, near Preston which is under investigation as a possible site for the extraction of sand and gravel.

1.2 It is intended to serve as the formal statement of the pre-working physical conditions of the site in the event that planning permission for mineral extraction is forthcoming.

1.3 It is based on a study of published information (see Appendix 1) and a site inspection carried out in October 2010. A total of 51 auger borings was made at the locations shown on SGM 1, on or close to a regular 100m by 100m grid. Two small inspection pits were also dug. Auger boring and pit descriptions are given in Appendix 2.

1.4 Land quality has been assessed using the revised criteria and guidelines for the Agricultural Land Classification system introduced in 1989. A combined soils and ALC map is attached as SGM 2.

1.5 The rest of this report deals in turn with a general description of the site including its location, land use and topography (Section 2), the geology and soils (Section 3) and the detailed Agricultural Land Classification (Section 4). Section 5 discusses the soil resources for restoration.

1.6 Some of the terms used in this report may differ from those used by geologists and so, for the avoidance of doubt, some of these terms are explained in Appendix 3.

2 SITE DESCRIPTION

Location and Land Use

2.1 The site lies in a loop of the River Ribble to the south-east of Preston. It is bounded on the east by the access road to Lower Hall Farm.

2.2 The land in the centre and east, about 29.0 hectares (72 acres) is now all under grass but has formerly been in arable use. In the west there is an area of former sand and gravel workings, about 21.3 hectares (52 acres), which includes some wetland, woodland and some apparently restored and/or unworked land under grass.

Topography

2.3 The unworked land in the centre and east is relatively flat and generally at between about 13 and 15m a.o.d. becoming slightly lower to the south-east where there is a low-lying hollow with a base at about 11m a.o.d. There is a distinct drop-off onto the strip of land alongside the river in the north, which is at about 13m a.o.d.

2.4 The area of former sand and gravel workings in the west has land restored at a markedly lower level. For example in its south-east corner the restored land is as low as 10.5m a.o.d. where the adjacent unworked land is at around 14m a.o.d. There are some similarly low areas close to the areas of wetland. Some of the restored land has a very hummocky micro-topography in contrast to the zone along the northern edge where the apparently unworked land is much more level at between about 13 and 14m a.o.d.

Climate

2.5 The climatic information needed to apply the Agricultural Land Classification system has been obtained from the Met Office's standard 5km grid point data set for a representative point near the middle of the site and is as follows:-

Grid reference:-	SD 591315
Altitude (m):-	14
Average Annual Rainfall AAR (mm):-	957
Accumulated Temperature ATO (day degrees):-	1419
Moisture Deficit for wheat (mm):-	76
Moisture Deficit for potatoes (mm):-	61
Field Capacity Duration (days):-	228

2.6 The site has a fairly typical annual rainfall for lowland parts of North-west England of 958mm (almost 38 inches) and so the climatic moisture deficit which builds up in the summer is low. The period at which the soil is at field capacity, during which excess rainfall has to drain from the profile unless prevented by poor profile drainage, is 228 days which is quite a lengthy period.

2.7 The combination of relatively high rainfall and cool summer temperatures means that the ALC system recognises an overall slight to moderate climatic limitation such that the maximum possible ALC Grade is Grade 2 irrespective of how favourable soil and other environmental circumstances might be.

3 GEOLOGY AND SOILS

Published information

3.1 The site is shown on the 1:50,000 drift geological map (Sheet 75, Preston) as first and second river terrace deposits with a discontinuous fringe of alluvium alongside the river. On the other hand, the published soil map (see below) refers to the parent material of the soils as being Recent (in the geological sense) river alluvium rather than terrace deposits. The accompanying Memoir however, mentions that the flood-plain across which the river meanders shows well developed terrace features.

3.2 The British Geological Survey internet portal shows virtually the whole site as undifferentiated river terrace deposits consisting of sand and gravel with a narrow fringe of alluvium on the lowest land immediately alongside the Ribble.

3.3 The Soil Survey of England and Wales has published a soil map of the Preston area at 1:63,360 scale in 1966, accompanied by a descriptive Memoir. A map such as this shows the distribution of what are referred to as soil series, which are grouping of soils with acceptably similar profiles (see Appendix 3).

3.4 On the Ribble alluvium/terrace areas, including the Samlesbury Estate, the map shows areas of the Douglas Complex. The term complex denotes areas where the pattern of individual soil series is too complicated to show at the scale of mapping employed. However, broad groupings of soils based on their textures have been recognised and these are, to all intents and purposes, soil series or variants thereof.

3.5 Relatively coarse textured soils are shown on the slightly higher areas, above about 14m a.o.d. These typically have loamy sand or sandy loam topsoils and become sandier with depth. It is said that they may have colour mottling denoting periodic waterlogging in the lowest part of the profiles. The Soil Memoir notes, however, that these "have a fairly high fertility, cultivation is easy, and drainage is rarely seriously defective making these the most generally useful soils of those associated with the river flats".

3.6 Medium textured soils are shown as occurring on the slightly lower areas. Textures, while variable, are often in the clay loam to sandy clay loam range. The drainage is described as imperfect to poor and the profiles are generally greyer and more mottled than those of the coarse textured group.

3.7 It was said at the time (1966) that these soils had a tendency to flood and so were more commonly kept in grass though if a satisfactory outfall could be obtained for under-drainage, then they were capable of producing good crops.

3.8 The final variant of the Douglas series is the fine-textured group., consisting of poorly drained silty clays and clays. They are not shown on the 1966 map as occurring on the actual site although they do occur a short distance to the east. Their clayey parent material would be regarded as alluvium rather than river terrace drift since this latter term is usually reserved for light to medium textured materials.

3.9 In general, the results of the geological boreholes drilled in March 2008 match the distribution of soil types described above. Over most of the area shown as the coarse-textured Douglas soils the borehole records describe the upper parts of the profile as sandy, whereas in the medium textured areas, the terminology of sand, silt and clay, i.e. loamy in soil science terminology (see Appendix 3), is used.

3.10 An area shown as alluvium on the geological map along the northern edge of the site is shown on the 1966 soil map as the Ribble series. This was described as a freely draining, very sandy "warp" soil, developed in active river alluvium and liable to more frequent flooding than other parts of the site.

3.11 The western part of the site is shown on the 1966 soil map as un-surveyed former and active sand and gravel workings though, as will be mentioned below, it would appear to contain some unworked areas with soils similar to those on the main part of the site.

3.12 Since the publication of the 1:63,360 soil map in 1966 there has been some rationalisation of the names of various soil series. The generally freely draining, coarse textured Douglas series is now called the Alun series. The medium textured variety would probably be classed as the Trent or Wharfe series depending on drainage status and the most clayey variety as the Fladbury series. The Ribble series developed in active river alluvium has apparently retained its name.

3.13 For the record, the whole site is shown on the 1:250,000 National Soil Map (Sheet 3 Midland and Western England) as the ALUN Association (561c), a more generalised grouping of soils dominated by the Alun series i.e. the coarse textured variant of the Douglas series described above.

3.14 It should also be borne in mind that the soil descriptions given above relate to the whole of the area of the Douglas Complex shown on the 1966 soil map, some 320 hectares (7600 acres) in extent and not specifically to the 45 hectares (110 acres) or so of these soils at Samlesbury. It is for this reason that a site-specific survey is necessary.

Site Inspection

3.15 The site inspection in October 2010 found that the soils of the main part of the site could be divided into two broad groups according to texture i.e. coarse and medium textured and that the distribution of these was broadly similar to that shown on the map produced by the Soil Survey of England and Wales in 1966.

3.16 The Memoir accompanying the 1966 soil map described the medium textured varieties as having imperfect to poor drainage, but this was not substantiated by the investigations in 2010. Although colour mottling indicative of waterlogged conditions is more common than in the lighter textured soils, it is so far from the surface that it indicates no real drainage problem. Thus for all practical purposes all the soils on the river terrace deposits, irrespective of whether they are coarse or medium textured can be regarded as well drained (Wetness Class I).

3.17 As mentioned above, examples of these coarse and medium textured soils are also present on what is apparently unworked land in the north of the area shown on the published map entirely as sand and gravel workings.

3.18 Two minor soil series were also found, but are of very limited occurrence. Poorly drained, heavy textured soils developed in clayey alluvium are present only in a very small area of low-lying land in the south centre of the site. Sandy soils on what is probably the actual active floodplain of the Ribble occur in a thin strip along the northern edge of the site.

3.19 Finally, within the area of former sand and gravel workings there are some poorly restored areas of land under grass with what seems to be just topsoil spread over regraded backfill or waste sands.

3.20 Thus the accompanying map and the following description of the soils recognised five soil types:-

Soil Type A - Well drained, coarse textured soils developed in river terrace drift (Alun series, previously the coarse textured variant of the Douglas series)

Soil Type B - Well drained medium textured, soils developed in river terrace drift (Wharfe series, previously medium textured variant of the Douglas series)

Soil Type C - Heavy textured, poorly drained soils developed in river alluvium (Fladbury series, previously fine textured variant of the Douglas series)

Soil Type D - Sandy soils on the Ribble floodplain (Ribble series)

Soil Type E - Restored sand and gravel workings

Soil Type A - Well drained, coarse textured soils developed in river terrace drift

3.21 This is the typical, coarse textured soil of the slightly higher parts of the river terrace area at Samlesbury and corresponds to what was referred to in the 1966 Soil Survey of England and Wales Memoir as the coarse textured variant of the Douglas series, now classed as the Alun series.

3.22 A typical profile consists of a dark brown, medium sandy loam topsoil over a paler coloured subsoil which is usually of a medium sandy loam texture in its upper part but becomes more sandy, i.e. loamy sand, with depth. In at least some profiles this passes down into medium sand which is best regarded as the top of the mineral deposit rather than part of the soil profile.

3.23 A few profiles have a relatively thin, slightly heavier textured subsoil horizon at depth, typically sandy clay loam, but this is very much the exception.

3.24 There are some distinctly sandier profiles, with loamy medium sand topsoils more or less directly over sand within the area of the former sand and gravel workings at locations 36, 38 and 44. It is believed that these represent unworked examples of Soil Type A rather than land which has been worked and restored.

3.25 Stone content in most of the profiles is either nil or negligible, except for a few which become distinctly stony at depth (e.g. at locations 16, 17, 19, 30 and 33). A few of these are also slightly stony in their upper horizons.

3.26 With the exception of two profiles (at locations 31 and 34), all the profiles are unmottled and so are clearly well drained (Wetness Class I). In even these two, however, the mottling is so faint and so far below the surface that they, too, would be placed in Wetness Class I

3.27 Soil Type A is found mainly on the slightly higher ground at the eastern and western ends of the main unworked area of the site. It is absent between these i.e. along the northern edge where it shown as occurring on the 1966 published soil map i.e. it is somewhat less extensive than this map indicates. This may well be because the 1966 surveyors had fewer actual observation points and were using topography as way of differentiating between the areas of this soil type and the medium textured Soil Type B which tends to occur on slightly lower ground.

3.28 As noted above, there appear to be areas of unworked land with Soil Type A within the area regarded as former sand and gravel workings, often distinctly sandier than others on the site.

Soil Type B - Well drained, medium textured soils developed in river terrace drift

3.29 The 1966 published soil map refers to these as the medium textured variant of the Douglas series which, if showing signs of poor drainage at depth, would now be classed as the Trent series. However, as discussed further below, at Samlesbury they are all well drained and so would now be classed as the Wharfe series.

3.30 A typical profile consists of a dark brown medium clay loam topsoil over a paler coloured subsoil of similar texture. In about half the profiles the texture is the same down to a metre or more from the surface but several become sandier with depth and a few become more clayey. Stone content in all the profiles of Soil Type B is either nil or negligible.

3.31 As with Soil Type A, the coarse textured variant of the soils on the river terrace deposits, most of the profiles of Soil Type B have no colour mottling and so would be classed as well drained (Wetness Class I). A few profiles, notably those which become heavier at depth, do have colour mottling at depth, probably due to the slowly permeable nature of these horizons. As with Soil Type A, however, this mottling is so faint and so far from the surface that it is considered that there is no significant drainage impedance and that these profiles are also in Wetness Class I.

3.32 Soil Type B is found in the centre of the main block of unworked land and tends to occur on slightly lower ground than the areas of Soil Type A to the east and west. It is slightly more extensive in the centre of the site than the 1966 soil map would suggest but, conversely, does not seem to extend as far west as shown on that map. The possible reasons are the same as those cited above for Soil Type A.

Soil Type C - Poorly drained, clayey soils developed in alluvium

3.33 These soils are of only minor importance on the Samlesbury site. Now referred to as the Fladbury series, they correspond to the fine-textured variant of the 1966 Douglas series, developed in clayey alluvium.

3.34 The 1966 soil map does not show any area of them on the actual site, but during the 2010 survey it was thought highly probable that there would be an example in the bottom of the hollow in the south-centre of the site.

3.35 Accordingly auger location 29 was moved into the bottom of the hollow and an example of Soil Type C was duly encountered. It consists of a dark brown, stoneless heavy clay loam topsoil over a stiff, heavy clay loam to clay subsoil of an overall greyish colour and with ochreous and brownish mottling. Such a profile would be placed in Wetness Class IV.

3.36 Standard practice in soil and ALC surveying is to ignore isolated examples of a particular soil or ALC grade unless represented by two or more adjacent auger borings. This is not the case for Soil Type C, which was only encountered at this single location. However, it has been decided specifically to mention it and to show its occurrence on the accompanying map, simply because it completes the sequence of the three variants of the Douglas series from the 1966 soil survey.

Soil Type D - Sandy soils on the Ribble floodplain

3.37 These are the soils found in a narrow fringe of lower lying land close to the river in the north, with a parent material consisting of relatively recently deposited sandy river alluvium.

3.38 Profiles are broadly similar to those of Soil Type A, although somewhat sandier, typically a loamy medium sand topsoil over a loamy medium sand or sand subsoil. They are also somewhat darker and greyer in colour.

3.39 They are mainly worth separating out as a separate soil type, however, because the land where they occur is almost certainly more at risk from flooding than the rest of the site.

3.40 They are not so “immature” as implied by the account of them, as the Ribble series, in the 1966 Soil Memoir which described them as sands with no horizon differentiation. Somewhat surprisingly, they were also said to be calcareous but this has not been found to be the case at Samlesbury.

Soil Type E - Restored sand and gravel workings

3.41 The area shown as former sand and gravel workings in the west consists of areas of apparently unworked land (see Soil Type A above), some areas of wetland and shrubs and a few areas of restored land returned to agricultural use.

3.42 The soils of restored areas range include some which have a reasonable thickness of topsoil spread over what appears to be regraded overburden, quarry wastes or waste sand. These areas of better restoration are at the eastern end, adjacent to the main unworked part of the site.

3.43 At the other extreme are small areas adjacent to the wetland where such "restoration" as has been carried out has resulted in only a thin "skim" of topsoil over an assortment of materials. These poorly- or non-restored areas typically have an irregular, hummocky topography.

4 AGRICULTURAL LAND CLASSIFICATION (ALC)

Published Information

4.1 The published Provisional 1:63,360 ALC map (Sheet 94 Preston), published in 1970, shows the entire site as undifferentiated Grade 3, even including the former sand and gravel workings which are usually shown as "Other land primarily in non-agricultural use" on such maps.

4.2 The accompanying report mentions "alluvial soils along the Ribble Valley but liable to flood risk". It regards them as high in Grade 3 i.e. what would now be Subgrade 3a in the revised ALC system. This may be referring to soils like those on the Samlesbury Estate, but could equally well be referring instead to soils of the Hesketh complex west of Preston, some of which are actually shown on the map as Grade 2.

Revised ALC System

4.3 Since the published ALC maps were produced there has been a fairly drastic revision to the criteria and guidelines for allocating land to particular grades and the following description of the likely ALC grades on the Samlesbury Estate is based on these.

4.4 The main agricultural limitations which have to be considered are the overall climate, winter wetness and associated workability limitations, summer droughtiness and flood risk.

Overall Climate

4.5 As noted above, the combination of a relatively high annual rainfall and cool summer temperatures imposes an overall slight to moderate climatic limitation such that the maximum possible ALC grade for any land on the site is Grade 2 irrespective of how favourable soil and other environmental circumstances might be.

Wetness

4.6 Winter wetness and associated cultivation or workability difficulties are more significant at Samlesbury than droughtiness because of the relatively wet climate.

4.7 A wetness limitation applies in particular to soils with defective drainage e.g. the poorly drained Soil Type C on clayey alluvium, but even the well drained soils (Soil Types A and B) suffer to some extent because of workability limitations.

4.8 The coarse textured topsoils of Soil Type A would require a grading no higher than Grade 2, i.e. the same as imposed by consideration of the overall climate.

4.9 The medium textured soils i.e. Soil Type B, would be classed as Subgrade 3a. It has to be said, however, that the differences in workability between these and Soil Type A are likely to be slight and may not be regarded as any sort of problem by anyone working the land. Nevertheless, strict, objective application of the ALC criteria requires the areas of Soil Type A (other than those with a droughtiness limitation) to be placed in Grade 2 and the areas of Soil Type B in Subgrade 3a.

4.10 The small area of the much heavier textured and poorly drained Soil Type C is, by application of the same ALC wetness criteria, no better than Grade 4.

Droughtiness

4.11 Droughtiness limitations are assessed by comparing the ability of the soils to supply water to crops with the dryness of the climate during the growing season as expressed in the climatic parameter of moisture deficit. The ALC system provides a mathematical methodology for assessing this.

4.12 At Samlesbury the climatic moisture deficits for the two trial crops are relatively low which means that a droughtiness limitation is much less likely than in drier parts of the country, e.g. East Anglia.

4.13 Thus even coarse textured soils such as Soil Type A, which would have moderate to severe droughtiness limitations in a dry climatic area, suffer only slightly at Samlesbury. Indeed calculations of the likely droughtiness indicate that it is only the very sandiest and or stoniest of these which would be affected sufficiently to require downgrading below the Grade 2 already imposed by the overall climatic limitation.

4.14 The auger boring locations of Soil Type A where downgrading to Subgrade 3a because of a summer droughtiness limitation would apply are an isolated, and hence ignored, profile at location 19 and a small area defined by locations 36, 38 and 44 in the extreme north.

Flood Risk

4.15 The gradings applied above because of wetness/workability or droughtiness limitations are on the basis of an insignificant flood risk. If, however, the land flooded frequently or for long periods then downgrading would be required.

4.16 Unfortunately the ALC criteria are based on the frequency and duration of both winter and summer flooding, and data on this is usually not available. The more commonly available flood risk assessments such as “1 year in 20” do not provide sufficiently detailed information to apply the ALC guidelines and so a more pragmatic approach has to be applied.

4.17 Local information, observations made during the site visit and the fact that most of the land has been used in the past for regular arable cropping would suggest that flood-risk is not sufficiently severe to downgrade any areas of Soil Types A, B or C below that which a consideration of overall climate, wetness/workability or droughtiness has already arrived at.

4.18 On the other hand, Soil Type D on the lower land alongside the river is considered to be at sufficient risk of flooding for this strip to be downgraded to Subgrade 3b.

Restored Land

4.19 Assessing the ALC grading for restored land is often done on a subjective basis but bearing in mind the limitations which would apply to undisturbed soils with similar textures.

4.20 On this basis, the better bits of restoration in the east of the area of former sand and gravel workings are classed as of Subgrade 3b quality and the worse examples as Grade 4.

Overall Agricultural Land Classification

4.21 The overall picture which emerges is as follows.

4.22 None of the land can be graded above ALC Grade 2 because of an overall climatic limitation.

4.23 The wet climate also imposes a wetness/workability limitation, restricting even the well drained coarse textured soils of Soil Type A to Grade 2 and the slightly heavier textured soils of Soil Type B to Subgrade 3a. The small area of very heavy and poorly drained Soil Type C is Grade 4.

4.24 Summer droughtiness limitations apply only to the sandiest soils of which the only significant area is a small one in the extreme north, within the area of former sand and gravel workings, which is graded Subgrade 3b.

4.25 The narrow strip of lower-lying land alongside the river in the north (Soil Type D) is graded Subgrade 3b because of a perceived greater flood risk than the rest of the site where potential flooding is not thought to be a serious issue.

4.26 The restored sand and gravel workings are a mixture of Subgrade 3b and Grade 4, together with wetland and areas of shrubs, shown on the accompanying map as "other land". A remnant of a soil storage bund on the northern boundary would also constitute "other land". but is too small to show as a separate entity on the accompanying map.

4.27 The areas and proportions of the various ALC grades as discussed above are as follows:-

ALC Grade	Soil Type	Soil Characteristics (drainage and texture)	Area (ha)	%
2	A	Well drained, coarse textured with sandy loam topsoils	17.1	34.0
3a	A	Well drained, coarse textured with loamy sand topsoils	3.6	7.2
3a	B	Well drained, medium textured	13.3	26.4
3b	D	Sandy soils alongside river	1.7	3.4
4	C	Poorly drained, clayey	0.6	1.2
3b	E	Restored sand and gravel workings	4.8	9.5
4	E	Restored sand and gravel workings	1.6	3.2
Other land		Wetland, trees and shrubs	7.6	15.1
Total			50.3	100.0

5 SOIL RESOURCES FOR RESTORATION

5.1 As with all potential mineral extraction sites, the most valuable soil resource at Samlesbury is the topsoil.

5.2 Given that the difference between the Grade 2 and Subgrade 3a land on the site is because of a difference in topsoil texture, it would seem sensible to strip the coarser textured topsoils from Soil Type A separately from the medium textured topsoils of Soil B.

5.3 It does not seem feasible to try to strip separately the slightly more sandy, i.e. loamy medium sand, topsoils of Soil Type A separately from the much more common medium sandy loam ones. By the same token the loamy medium sand topsoils of Soil Type D could also conveniently be included with them.

5.4 On the other hand, the clayey topsoil from the very small area of Soil Type C is not worth saving and, unless there is a need for absolutely all the available topsoil to be conserved for restoration purposes, the topsoils from the restored land could also be dispensed with.

5.5 Thus the topsoil resources on the site can be summarised as

T1 - Medium sandy loam and, more rarely, loamy medium sand from the areas of Soil Types A and D; average thickness about 30cm

T2 - Clay loam and more rarely sandy clay loam from the areas of Soil Type B; average thickness about 30cm

Other topsoils from Soil Type C and restored land (Soil Type E) are not worth conserving.

5.6 In theory, a restoration profile consisting just of a reasonable thickness, say 30cm, of any of Topsoils T1 or T2 placed over sand would meet the droughtiness requirements for Grade 2. However, it would be much preferable if a layer of subsoil was also present.

5.7 Since the two main soil types differ in their subsoil textures as well as in their topsoil textures it would make sense to differentiate between the two kinds of subsoils in the same way as for the topsoils.

5.8 In Soil Type A, only the medium sandy loam and loamy medium sand material should be stripped and conserved as subsoil and stripping should stop when “pure” sand is reached.

5.9 On the areas of the medium textured soils, i.e. Soil Type B, stripping should continue until distinctly clayey material is reached. In most profiles, however, this is not reached until well below the surface and there would be no harm in incorporating a few centimetres-worth of this with the main bulk of subsoil. An alternative would be to strip slightly more material as subsoil where the clay loams extend below the 120cm normally regarded as the base of the subsoil. By either means it should be possible to obtain an average thickness of medium textured subsoil of around 90cm i.e. 120cm minus the average 30cm thickness of topsoil.

5.10 As with the topsoils, it is considered that subsoils from Soil Type C or the restored areas (Soil Type E) is not worth conserving. Also the subsoil of Soil Type D is generally too sandy for it to be worth conserving.

5.11 Thus the subsoil resources on the site can be summarised as:-

S1 - Medium sandy loam and loamy medium sand from the area of Soil Type A; average thickness about 80 cm after removal of the topsoil and with stripping stopping when "pure" sand is reached

S2 - Clay loam and more rarely sandy clay loam from the area of Soil Type B; average thickness about 90 cm after removal of the topsoil either by including some heavier material at depth or "overstripping" from areas of deeper medium textured material

Other subsoils from Soil Types C, D and restored land (Soil Type E) are not worth conserving.

5.12 In terms of soil types the resources are:-

Soil Type A (coarse textured)	-	topsoil T1 and subsoil S1
Soil Type B (medium textured)	-	topsoil T2 and subsoil S2
Soil Type C (heavy textured)	-	No topsoil or subsoil worth conserving
Soil Type D (Sandy)	-	Only topsoil (T1) worth conserving
Soil Type E (Restored)	-	No topsoil or subsoil worth conserving

5.13 Target restoration profiles should consist of between about 25 and 30cm of topsoil and 50cm of subsoil over a permeable, freely draining substrate made from regraded quarry wastes. Topsoil and subsoil should be used “like on like” i.e. restoration profiles should consist of T1 over S1 or T2 over S2 and not a mixture of textures.

5.14 The detailed restoration proposals reflect the high water table level of the site. There is no planned importation of material. The site is therefore incapable of restoration to agriculture and will be restored to wetland for nature conservation and flood alleviation. Restoration requirements in relation to topsoil and subsoils depths etc will reflect this objective.

APPENDIX 1 - PUBLISHED INFORMATION CONSULTED

British Geological Survey Sheet 75 (Preston) 1:50,000 and internet portal at www.maps.bgs.ac.uk, consulted August 2010.

Soil Survey of England and Wales, Soils of the Preston District of Lancashire (Sheet 75) 1:250,000 and accompanying Memoir.

Soil Survey of England and Wales, National Soil Map Sheet 3 (Midlands and Western England), 1:250,000 and accompanying Regional Bulletin.

Agricultural Land Classification, Sheet 94 (Preston), 1: 63,360 and accompanying Report.

Agricultural Land Classification of England and Wales. *Revised guidelines and criteria for grading the quality of agricultural land*. October 1988. (Introduced in January 1989).

The Met. Office *Climatological data for Agricultural Land Classification*. January 1989.

APPENDIX 2 - AUGER BORING AND SOIL PIT DESCRIPTIONS

Notes

1. All depths are measured in cm. from the surface.

2. Colours are abbreviated:-

    B - Brown
    DB - Dark Brown
    DGB - Dark Greyish Brown
    GB - Greyish Brown
    PB - Pale Brown

3. Textures are abbreviated:-

    c - clay
    cs - coarse sand
    hcl - heavy clay loam
    lcs - loamy coarse sand
    lms - loamy medium sand
    mcl - medium clay loam
    ms- medium sand
    msl - medium sandy loam
    scl - sandy clay loam

Soil Type A - Well drained, coarse textured soils developed in river terrace drift

Pit A - at auger location 24

0 - 28cm Dark brown (Munsell Code 10YR 3/3); medium sandy loam; no stones; moderately developed medium subangular blocky structure but with a considerable amount of unaggregated material; moist; friable; common worms; abundant grass roots. (Topsoil)

28 - 45cm Brown (Munsell Code 7.5YR 5/6); medium sandy loam; no stones; weakly developed coarse angular blocky structure; slightly moist; friable; no worms present, but common earthworm channels; common grass roots. (Subsoil)

45 - 60cm Brown (Munsell Code 7.5YR 5/6); loamy medium sand; no stones; single grain structure; slightly moist; friable to loose; no worms; occasional grass roots. (Subsoil continued)

60+cm (by auger in base of pit) As above, but medium sand; loose (Mineral substrate)

Wetness Class I; ALC Grade 2 (overall climatic limitation)

Soil Type A profiles encountered in auger borings are as follows:-

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
4	0 - 30	DB	msl		
	30 - 80	B	msl		
	80 - 90	B	lms		
	90 +	B	ms	I	2
	At 59300 31580				
8	0 - 26	DB	msl		
	26 - 80	B	msl		
	80 - 100	B	lms		
	100 +	B	ms	I	2
9	0 - 33	DB	msl		
	33 - 85	B	msl		
	85 +	B	lms	I	2
	At 58825 31550				
10	0 - 26	DB	msl		
	26 - 50	B	msl		
	50 - 75	B	lms		
	75 +	B	ms	I	2
11	0 - 27	DB	msl		
	27 - 70	B	msl		
	70 - 75	B	lms		
	75 +	B	ms	I	2

Soil Type A - Well drained, coarse textured soils developed in river terrace drift (continued)

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
12	0 - 28	DB	msl		
	28 - 70	B	msl		
	70 - 75	B	lms		
	75 +	B	ms	I	2
16	0 - 27	DB	msl, occ stones		
	27 - 60	B	msl, slightly stony		
	60 +	Too stony to auger		I	2
	Distinctly stonier than other examples of this soil type				
17	0 - 29	DB	msl		
	29 - 45	B	msl		
	45 - 65	B	scl		
	65 -70	B	scl, gritty, gravelly		
	70 +	Too stony to auger to auger		I	2
	Distinctly stonier at depth than other examples of this soil type				
18	0 - 31	DB	msl		
	31 - 60	B	msl		
	60 - 90	B	scl		
	90 +	B	lms	I	2
19	0 - 26	DB	msl, occ stones		
	26 - 45	B	msl, slightly stony		
	45 +	Too stony to auger		I	3a
	Distinctly stonier than other examples of this soil type				
20	0 - 28	DB	msl		
	28 - 60	B	msl		
	60 +	B	scl	I	2
21	0 - 29	DB	msl		
	29 - 45	B	msl		
	45 - 60	B	lms		
	60 +	B	ms	I	2
30	0 - 30	DB	msl, occ stones		
	30 - 45	B	msl, occ stones		
	45 - 55	B	ms, stony		
	55 +	Too stony to auger		I	2
	Distinctly stonier than other examples of this soil type				
31	0 - 27	DB	msl		
	27 - 65	B	msl		
	65 - 75	B	scl		
	75 +	B with faint mottles	scl	I	2

Soil Type A - Well drained, coarse textured soils developed in river terrace drift (continued)

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
32	0 - 29	DB	msl		
	29 - 65	B	msl		
	65 - 100	B	scl		
	100 +	B	lms	I	2
33	0 - 26	DB	msl, occ stones		
	26 - 40	B	msl, occ stones		
	40 - 45	B	lms, stony		
	45 +	Too stony to auger		I	2
	Distinctly stonier than other examples of this soil type				
34	0 - 26	DB	msl		
	26 - 70	B	msl		
	70 - 95	B with faint mottles	scl		
	95 +	B	ms	I	2
	At 59400 31230				
36	0 - 24	DB	lms		
	24 +	B	ms	I	3a
	Much sandier than other examples of this soil type; believed to be unworked soil within area of former gravel pit				
37	0 - 25	DB	msl		
	25 - 50	B	msl		
	50 - 60	B	lms		
	60 +	B	ms	I	2
	Believed to be unworked soil within area of former gravel pit				
38	0 - 25	DB	lms		
	25 - 35	B	lms		
	35 +	B	ms	I	3a
	Much sandier than other examples of this soil type; believed to be unworked soil within area of former gravel pit; at 58600 31920				
39	0 - 26	DB	msl		
	26 - 90	B	msl		
	90 +	B	scl	I	2
	Believed to be unworked soil within area of former gravel pit				
40	0 - 30	DB	msl		
	30 - 75	B	msl		
	75 +	B	scl	I	2
	Believed to be unworked soil within area of former gravel pit				

Soil Type A - Well drained, coarse textured soils developed in river terrace drift (continued)

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
42	0 - 28	DB	msl		
	28 - 70	B	msl		
	70 +	B	scl	I	2
	Believed to be unworked soil within area of former gravel pit				
43	0 - 27	DB	msl		
	27 - 50	B	msl		
	50 +	B	lms	I	2
	Believed to be unworked soil within area of former gravel pit At 58500 31820				
44	0 - 27	DB	lms		
	27 +	B	ms	I	3a
	Much sandier than other examples of this soil type; believed to be unworked soil within area of former gravel pit				

Soil Type B - Well drained, medium textured soils developed in river terrace drift

Pit B - at auger location 21

0 - 28cm Dark brown (Munsell Code 10YR 3/3); medium clay loam; stoneless; moderately developed fine and medium subangular blocky structure; moist; firm; common worms; abundant grass roots. (Topsoil)

28 - 70cm Brown (Munsell Code 7.5YR 4/4); medium clay loam; stoneless; weakly to moderately developed coarse angular blocky structure; slightly moist; firm; occasional worms and a few earthworm channels; common grass roots (Subsoil)

70 - 80cm Brown (Munsell Code 7.5YR 4/4); (fine) sandy clay loam; stoneless; weakly developed coarse angular blocky structure; slightly moist; firm; no worms; occasional grass roots (Subsoil continued)

80 - 90cm As above but medium sandy loam with single grain structure (Subsoil continued)

90+cm (by auger in base of pit) As above, but loamy medium sand; loose (Subsoil continued)

Wetness Class I; ALC Subgrade 3a (topsoil workability)

Soil Type B - Well drained, medium textured soils developed in river terrace drift (continued)

Soil Type B profiles encountered in auger borings are as follows:-

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
5	0 - 27	DB	mcl		
	27 - 80	B	mcl		
	80 +	B	scl	I	3a
	At 59200 31580				
6	0 - 29	DB	mcl		
	29 +	B	mcl	I	3a
	Medium clay loam subsoil continues to 110+cm				
7	0 - 27	DB	mcl		
	27 - 75	B	mcl		
	75 +	B	scl	I	3a
13	0 - 31	DB	scl		
	31 - 75	B	mcl		
	75 - 85	B	hcl		
	85 +	PB, mottled	hcl	I	3a
	Heavier and more mottled at depth than other examples of this soil type, but still WC I				
14	0 - 31	DB	scl		
	31 - 90	B	scl		
	90 +	B with faint mottles	scl	I	3a
15	0 - 28	DB	mcl		
	28 +	B	mcl	I	3a
	Medium clay loam subsoil continues to 110+cm				
21	0 - 30	DB	mcl		
	30 - 85	B	mcl		
	85 +	B	scl	I	3a
22	0 - 28	DB	mcl		
	28 - 85	B	mcl		
	85 +	B with faint mottles	hcl	I	3a
23	0 - 28	DB	scl		
	28 - 60	B	mcl		
	60 - 75	B with faint mottles	hcl		
	75 +	GB, mottled	c	I	3a
	Heavier and more mottled at depth than other examples of this soil type, but still WC I, just				

Soil Type B - Well drained, medium textured soils developed in river terrace drift (continued)

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
25	0 - 29	DB	mcl		
	29 - 75	B	mcl		
	75 - 80	B	scl		
	80 - 90	B	msl		
	90 +	B	lms	I	3a
26	0 - 27	DB	mcl		
	27 - 85	B	mcl		
	85 +	B with faint mottles	mcl	I	3a
	At 38850 31410				
27	0 - 33	DB	mcl		
	33 - 95	B	mcl		
	95 +	B with faint mottles	mcl	I	3a
28	0 - 32	DB	mcl		
	32 - 80	B	mcl		
	80 - 85	B	scl		
	85 +	B	msl	I	3a
	At 59085 31300				
35	0 - 29	DB	mcl		
	29 - 80	B	mcl		
	80 - 85	B	scl		
	85 +	B with faint mottles	scl	I	3a
	Auger location moved to a relatively low spot at 59065 31220, but even here mottling at depth is only faint and so still WC I				
50	0 - 27	DB	mcl		
	27 - 55	B	mcl		
	55 +	B	mcl	I	3a
	Believed to be unworked soil within area of former sand and gravel pit				
51	0 - 25	DB	mcl		
	25 - 85	B	mcl		
	85 +	B	hcl	I	3a
	Believed to be unworked soil within area of former sand and gravel pit				

Soil Type C - Poorly drained, clayey soils developed in alluvium

No.	Depth	Colour	Texture	Wetness Class	ALC Grade
29	0 - 26	DB	hcl		
	26 - 35	GB, faint mottles	hcl		
	35 - 55	GB, mottled	hcl/c		
	55 +	GB, mottled	c	III	3b
	Auger location moved to 59175 31305 into bottom of hollow and thereby to encounter the only poorly drained clayey soil on the site				

Soil Type D - Sandy soils on the Ribble floodplain

No.	Depth	Colour	Texture	ALC Grade
1	0 - 35	DGB	lms	
	33 +	GB	lms	
	In narrow, low-lying strip adjacent to river with high flood risk			3b
2	0 - 34	DGB	msl	
	34 +	GB	lms	
	In narrow, low-lying strip adjacent to river with high flood risk			3b
3	0 - 33	DGB	lms	
	33 +	GB	ms	
	In narrow, low-lying strip adjacent to river with high flood risk			3b

Soil Type E - Restored sand and gravel workings

No.	Depth	Colour	Texture	ALC Grade
40	0 - 24	DB	lms	
	25 - 50	B	ms	
	50 +	Augering abandoned		3b/4
	Reasonable thickness of topsoil (but very sandy) over waste sand? Uneven surface			
	At 58890 31760			
41	0 - 23	DB	lms	
	23 - 40	B	cs	
	40 - 70	GB, mottled	lcs	
	70 +	Augering stopped by stone		4
	Reasonable thickness of topsoil (but very sandy) over waste sand? Uneven surface			
45	0 - 15	DB	lms	
	15 - 60	GB	ms with included topsoil	
	60 +	Augering abandoned		4
	Thin “skim” of topsoil over regraded overburden? Uneven surface			
	At 58325 31750			

Soil Type E - Restored sand and gravel workings (continued)

No.	Depth	Colour	Texture	ALC Grade
46	0 - 5	DB	lms	
	5 - 40	B	lms with included topsoil	
	40 +	Too stony to auger		4
	Thin "skim" of topsoil over regraded overburden? Uneven surface			
47	0 - 20	DB	lms, stony	
	20 - 30	B	ms/cs, very stony	
	30 +	Too stony to auger		4
	Thin "skim" of topsoil over regraded overburden?			
48	0 - 25	DB	lms	
	25 - 50	B	ms	
	50 +	Augering abandoned		3b
	Reasonable thickness of topsoil (but very sandy) over waste sand?			
49	0 - 30	DB	msl, slightly stony	
	30 - 35	B	lcs, gritty, stony	
	35 +	Too stony to auger		3b
	Reasonable thickness of topsoil (but stony) over regraded overburden			
	At 58760 31530			

APPENDIX 3 - NOMENCLATURE

Some of the terms used in this report may differ from those used by geologists and so, for the avoidance of doubt, some of the terms are explained below

Soil Texture and Stoniness

Soil texture refers to relative proportions of the three major particle sizes, sand (60-2000µm diameter), silt (20-60µm diameter) and clay (<2µm diameter). The sand fraction may be subdivided into fine, medium or coarse depending on whether the predominant size is 60-200µm diameter, 200-600µm diameter or 600-2000µm diameter respectively.

A loam is a more or less equal mixture of sand, silt and clay, and intermediate textures can be described as, for example, clay loam, sandy loam or silt loam. A loamy sand is intermediate between a sandy loam and a "pure" sand.

Generalised terms may be used such as fine- or heavy-textured for soils with a high proportion of clay, coarse- or light-textured for those with a high proportion of sand and medium-textured for those of a more loamy character.

Stones are particles larger than 2000µm diameter which "dilute" the soil and reduce its moisture holding capacity. Stones larger than 2cm or 6cm diameter may have more direct mechanical affects such as causing cultivation difficulties.

Soil Horizons and Profiles

Topsoil refers to the uppermost darker, organic rich material which is usually the product of ploughing either regularly or at some time in the past. The subsoil is the material below this which displays at least some soil-like characteristics and can be exploited by plant roots. The parent material or mineral substrate is the geological material below the subsoil.

The topsoil and subsoil can be referred to as soil horizons and may be further subdivided according to variations in textures, stoniness, etc. The sequence of horizons is referred to as the soil profile.

Soil Drainage

Soils may exhibit signs of having formed under conditions of poor drainage, including greyish colours and colour mottling known as gleying. In extreme cases there may be a surface build-up of organic matter producing either very dark coloured humose or organic horizons, including peat. It should be noted that gleying etc may survive as a relict feature after soil drainage has been improved.

Poor drainage can be caused either by a high water table, a slowly permeable horizon in the subsoil, a very wet climate or a combination of some or all of these. In general the greyer, the more mottled and the nearer the surface these signs appear, the worse the drainage. This was previously described in terms of the drainage category e.g. well-drained, moderately well drained, imperfectly drained, poorly drained or very poorly drained. These terms, while useful in general descriptions, have now been replaced by the concept of the Wetness Class based on the likely duration that various parts of the profile may remain waterlogged. Wetness Classes range from I (well drained) to VI (effectively a swamp).

For the purposes of Agricultural Land Classification it is assumed that if it is feasible to install artificial under-drainage, then this will have been done and the Wetness Class is assessed on the assumed residual situation.

Soil and ALC maps

Soil maps attempt to delineate areas where the soil profiles are generally similar to one another, such groupings being referred to as soil series. These are groupings of soils with similar profiles, within a fairly narrow range, and which are developed in lithologically similar parent materials. They are named after the location where they were first described.

An alternative ad hoc classification into, for example, Soil Type A, Soil Type B, etc can also be used instead of the standard soil series names

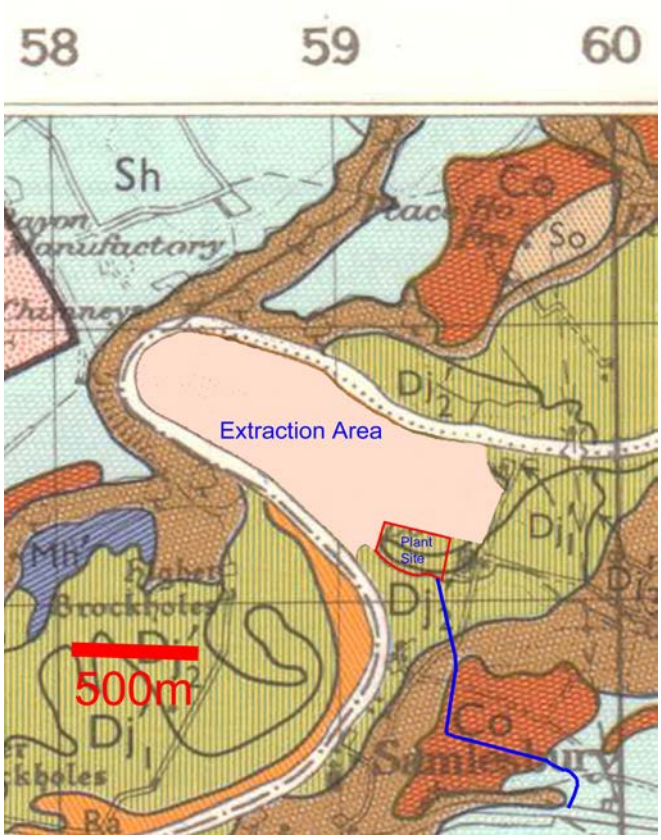
There will inevitably be some variation in the properties used to define various series of soil types but the overall intention is to make groupings of profiles more similar to each other than to other soil series or types.

Depending on the scale of mapping, areas shown on soil maps and corresponding ALC maps as being of a single series, type or grade may include isolated examples of other series, types or grades. By convention, at the scale of mapping used in surveys such as that for the present report i.e. at 100m intervals, at least two adjacent borings of a particular kind of soil or ALC grade are needed to define a discrete area of that soil or grade and isolated observations are ignored.

APPENDIX 4 - PLANT SITE

This description of the soils and ALC of the Plant Site is based on the information obtained during the site survey of the main extraction area, extrapolated using the 1:63,360 scale soil map (Sheet 75, Preston) published by the Soil Survey of England and Wales in 1966.

The plant site is expected to contain what is referred to in the main report as Soil Type B, i.e. well drained, medium textured soils developed in river terrace drift and shown on the published soil map in pale green as part of the so-called Douglas Complex (Dj). These soils qualify for Subgrade 3a in the Agricultural Land Classification system. There is the possibility of some heavier, poorly drained soils (Soil Type C) of only ALC Grade 4 quality in the north-west corner, adjacent to an area of such soils on the extraction area, but their extent is likely to be negligible.



APPENDIX 5 - PROPOSED ACCESS ROUTE

As for the Plant Site, this description of the soils and ALC of the Plant Site is based on the information obtained during the site survey of the main extraction area and the 1:63,360 scale soil map (Sheet 75, Preston) published by the Soil Survey of England and Wales in 1966.

Four soil types are crossed:-

Pale green Dj Douglas Complex (Soil type B of main survey)
Mid brown - Undifferentiated soils on valley sides and associated colluvial deposits
Reddish brown Co(Cottam) Imperfectly drained soils developed in glacial till
Pale blue Sh (Salop) Poorly drained soils developed in glacial till

From the Plant Site, the proposed route round south-westwards across an area almost certainly of the soil type described in the main report as Soil Type B, i.e. well drained, medium textured soils developed in river terrace drift and shown on the published soil map as part of the so-called Douglas Complex (Dj). These soils qualify for Subgrade 3a in the Agricultural Land Classification system.

At the south-east corner of this field the route crosses Potter Lane and turns south through what is understood to have been an old clay pit. This has been included in the assortment of soils described on the published soil map as "Undifferentiated soils on valley sides and associated colluvial deposits" and shown, unannotated in mid brown. This is, in effect, a soil surveyor saying that this is a mixed zone of assorted and usually very variable soils on a variety of different parent materials whose individual distribution is too complicated to work out. This section of the route is of very limited agricultural value, if any, and is probably best classed as Non-agricultural.

About 180m from Potter Lane the route enters a medium sized agricultural field running first southwards across gently sloping land along the western headland, then turning eastwards up the slope along the southern edge of the field. The soils here are the so-called Cottam series (since renamed the Flint series), shown on the published soil map in a reddish brown colour and marked Co. These are soils developed in clayey glacial till but with slightly less clayey, i.e. more loamy, surface horizons. The underlying till is slowly permeable and the drainage impedance caused puts the soils into Wetness Class III on a scale ranging from I (well drained) to VI (effectively a swamp). Given this Wetness Class, the climatic regime of the area and the medium clay loam surface textures, the indicated ALC grade is Subgrade 3b.

These soils and ALC Subgrade 3b continue through most of the next field but on somewhat higher, flatter ground. The final field before the A57, however, has heavier, wetter soils of the Salop series (pale blue with symbol Sh on the published soil map). These are developed more or less entirely in glacial till and because of this are in Wetness Class IV. Because of this and their heavier topsoils of heavy clay loam or clay texture, they give land of Grade 4 quality.

The approximate lengths of the route which pass over the different soils and ALC grades described above are as follows:

240m across Subgrade 3a on Douglas Complex (Soil Type B) in river terrace drift
180m across Non Agricultural through old clay pit and associated hedges and track
630m across Subgrade 3b on imperfectly drained Cottam series developed in glacial till with more loamy surface

150m across Subgrade 4 on poorly drained Salop series developed in clayey glacial till