Appendix 8.3 Soils and Agricultural Land Desk Study

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KEYLAND DEVELOPMENTS LTD

North Bierley

Soils and Agricultural Land – Desk Study

November 2015

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wardell armstrong

Wardell Armstrong
City Quadrant, 11 Waterloo Square, Newcastle upon Tyne, NE1 4DP, United Kingdom
Telephone: +44 (0)191 232 0943 Facsimile: +44 (0)191 261 1572 www.wardell-armstrong.com

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PREPARED BY:

Jakub Olewski Senior Soil Scientist

APPROVED BY:

Dave Brignall Technical Director

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CONTENTS

1 INTRODUCTION

1.1 Background

1.1.1 The purpose of this report is to use available published data sources and previous geotechnical survey data to assess the soil type and agricultural land quality of the site, and to comment on the potential impacts of the proposed redevelopment of the land for mixed residential and commercial uses.

1.2 Site description

1.2.1 The site is located approximately 6.0km south of Bradford city centre, adjacent to the junction of the M606 and M62 motorways (see Drawing No. SH10534-001 (1:50,000) and Drawing No. SH10534-002 (1:2,500)). The total area of the proposed development is 13.23ha, it comprises, now disused, North Bierley Waste Water Treatment Works (WWTW), covering approximately 10ha and including areas of grass and scrub. The total area of agricultural land within the site boundary is approximately 12ha (as estimated from satellite imagery) and it is used as a permanent grassland. The site is bounded by the M606 motorway to the west, Hunsworth Beck to the east, the M62 motorway to the south and agricultural fields to the north.

1.3 Definitions

Agricultural Land Classification

1.3.1 The Agricultural Land Classification (ALC) is a standardised method for classifying agricultural land according to its versatility, productivity and workability, based upon inter-related parameters including climate, relief, soil characteristics and drainage. These factors form the basis for classifying agricultural land into one of five grades (with Grade 3 land divided into Subgrades 3a and 3b), ranked from excellent (Grade 1) to very poor (Grade 5). ALC is determined using MAFF's 'Agricultural Land Classification of England and Wales: Revised guidelines and criteria for grading the quality of agricultural land, 1988'.

Best and most versatile (BMV) agricultural land

1.3.2 The National Planning Policy Framework (Department for Communities and Local Government, 2012) defines best and most versatile (BMV) land as land of excellent (ALC Grade 1), very good (Grade 2) and good (Grade 3a) agricultural quality. BMV land is afforded a degree of protection against development within planning policy.

Moderate, poor and very poor quality land is designated subgrade 3b or Grades 4 and 5 respectively, and is restricted to a narrower range of agricultural uses.

Soil series

1.3.3 Soil series is the lower categorical level of the soil classification used in England and Wales. "*Soil series are defined using a combination of three main properties, the broad type of parent material present (substrate type), the texture of the soil material (textural grouping) and the presence or absence of material with a distinctive mineralogy*." (Soil Survey of England and Wales 1984). Higher categories are: major soil group, soil group, and soil subgroup, which are not explicitly used in this report.

Soil association

1.3.4 Soil associations is a geographic grouping of soils identified by the name of the most frequently occurring soil series and by the combination of ancillary soil series.

Gleying

1.3.5 Gleying is the process of iron reduction (opposite to oxidation) in soils from ferric (reddish in colour) to ferrous compounds (grey or colourless), by microorganisms or by-products of decomposing organic matter. Gleying occurs in areas devoid of oxygen when the soil is waterlogged. The resulting mottling (spots or blotches of colour) can therefore be used to identify occurrence of temporary excessive soil wetness.

2 METHODOLOGY

2.1 Published data research

2.1.1 A desk study was carried out using published data sources to determine the general soil characteristics of the site (Soil Survey of England & Wales, 1984) and identify the overall Agricultural Land Classification (ALC) in the region (MAFF, 1993).

2.2 Data from Phase II Environmental Assessment

2.2.1 Results of the geotechnical site investigation (as presented in Phase II Geo-Environmental Site Investigation report, RPT-001B) were used together with the published data to determine the likely characteristics of the soil on site and potential agricultural quality of the land. No additional soil surveys have been carried out.

2.3 Agricultural Land Classification

2.3.1 ALC grading is assigned by investigating the physical properties of the soil resources and interrelated factors such as topography and climate, and assessing how they limit

a site's suitability for agricultural use. These factors are called limitations and the quality of the land is determined by the most serious limitation(s) present. The limitations to ALC grading are assessed as follows:

2.3.2 The overall climatic limitation is assessed using the average annual rainfall and accumulated temperature. It reflects the direct effects of water supply and the energy available for photosynthesis on plant growth.

2.3.3 Gradient has a significant effect on mechanised farm operations since most conventional agricultural machinery performs best on level ground. The safe and efficient use of machinery on sloping land depends very much on the type and design of the machine and on the nature of the slope being farmed. Microrelief involves complex changes in slope angle and direction over short distances, or the presence of boulders or rock outcrops; all of which can impact upon the use agricultural machinery.

2.3.4 Flooding can affect choice of crops to be grown, because it may have negative influence on the yield of some crops and restricts soil cultivation. The main factor determining the risk of flooding is topography. Local conditions can be assessed based on local knowledge and information from the water authorities. Floods which occur in summer are generally more damaging than winter floods because the growing roots of the crops are more sensitive to waterlogging. The flood limitation is therefore assessed separately for a 'winter' and a longer 'summer' periods (the latter including spring sowing and autumn cultivation).

2.3.5 Soil depth is important when determining available water capacity. Shallowness can affect cropping in a number of ways, such as restricting the range of cultivation methods available, restricting nutrient uptake and root growth.

2.3.6 Stones act as an impediment to cultivation, harvesting and crop growth. A high stone content reduces the potential for certain agricultural crop management, can cause wear and tear to agricultural implements and tyres, and can reduce the quality of crops (i.e. bruising potatoes during harvesting).

2.3.7 The physical limitations resulting from the interactions between climate, site and soil characteristics are soil wetness and droughtiness. Soil wetness limitations adversely affect plant growth or agricultural management (e.g. grazing, machine operation, poaching by livestock, smearing by machinery). Droughtiness is most likely to be a significant limitation to crop growth in areas with low rainfall and high evapotranspiration, or where the soil profile holds only small reserves of moisture.

2.3.8 For ALC purposes the soil wetness assessment takes account of duration of the period of time when soil moisture is at field capacity, and soil susceptibility to waterlogging based on the following soil profile characteristics: depth to slowly permeable layer, depth to gleying features (indicating intermittent waterlogging), and topsoil texture.

2.3.9 Droughtiness is assessed based on average drought risk of two reference crops, winter wheat and potatoes. The method uses rooting depth and foliar characteristics of the reference crops to estimate soil moisture balance at a given location.

2.3.10 A secondary factor, accompanying other more critical limitations such as slope or droughtiness, is erosion related to wind or water action. Soils can be at risk of a loss of topsoil, seeds, seedlings and fertiliser, as well as damage from abrasion to plants, due to wind erosion.

3 POLICY FRAMEWORK

3.1 National level

National Planning Policy Framework (NPPF)

3.1.1 Paragraphs 111 and 112 of The National Planning Policy Framework (Department for Communities and Local Government, 2012) promote the sustainable management and protection of soils and agricultural land consistent with the economic, social and environmental needs of England. These paragraphs state:

3.1.2 "Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value. Local planning authorities may continue to consider the case for setting a locally appropriate target for the use of brownfield land. Local planning authorities should take into account the economic and other benefits of the best and most versatile agricultural land. Where significant development on agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of a higher quality."

3.1.3 Consequently, impacts to the soil resources and best and most versatile (BMV) agricultural land are to be considered and the resources protected against development, where their importance overrides the economic benefits of the development itself.

Soil Strategy for England

3.1.4 The National Strategy for England; Safeguarding our Soils (DEFRA, 2009a), provides a long-term guide to direct policy regarding the protection of soils in England. The strategy highlights the importance of the protection of soils, especially in agricultural landscapes and during development. Protecting soils ensures the protection of their related ecosystem services, the mitigation of climate change, and prevention of contamination.

3.1.5 In particular, Chapter 1 of this document ensures soils are sustainably managed and degradation threats are successfully dealt with, whilst Chapter 2 puts this into the context of agricultural landscapes. Chapter 6 ensures effective soil protection during development and construction, with a focus on the protection of soil-related ecosystem services. Furthermore, in response to this DEFRA has constructed a series of best practice guidelines for the handling and storage of soil resources during development, which are referred to later within this report.

Desk study results

3.2 Soils – published information

3.2.1 Data from the Soil Survey of England and Wales, 1984, shows the soils on the site belong to the Dale (712a) association. The underlying geology of this association comprises Carboniferous mudstones and shales. The Dale association can be found mainly throughout the Pennine foothills; in the coalfields around Bristol; and over similar rocks of Jurassic age in and around the North York Moors. There are three dominant soil series within the Dale association, all of which are surface-water gley soils (typically slowly permeable and seasonally waterlogged): Dale, Ticknall and Bardsey.

3.2.2 The Dale series are pelo-stagnogley soils, found where there is no Head, often on convex slopes. This series is characterised by dark greyish brown, slightly mottled, stoneless clay or clay loam topsoil. The upper subsoil (20 to 50cm) is strong brown and mottled in colour, stoneless clay with strong, coarse prismatic structure. The lower subsoil (50 to 100cm) is grey in colour with many ochreous mottles, stoneless clay with strong coarse prismatic structure.

3.2.3 The cambic stagnogley soils of the Ticknall series occur where thin shale beds alternate with siltstones and sandstones. The topsoil of this series is a very dark greyish brown, slightly stony silty clay loam. The upper subsoil (20 to 50cm) is light brownish grey and

mottled in colour, and has moderate coarse angular blocky structure. The lower subsoil (50 to 100cm) is brown and mottled in colour, slightly stony silty clay loam, with moderate coarse prismatic structure and high packing density.

3.2.4 The cambic stagnogley soils of the Bardsey series are found where Head is present below sandstone outcrops or on lower slopes. The topsoil is very dark greyish brown in colour, stoneless or slightly stony clay loam or sandy clay loam. The upper subsoil (20 to 45cm) is grey in colour with many ochreous mottles, slightly stony clay or silty clay and has a strong coarse prismatic or angular blocky structure.

3.2.5 The main soils in the Dale association are all seasonally waterlogged (Wetness Class IV), if land conditions allow for drainage to be installed Wetness Class III can be achieved for Bardsey and Ticknall soils.

3.2.6 Where the land is cropped to grass soils can be droughty in drier regions (such as South Yorkshire), but tend to be slightly less droughty in the Leeds district where the site is located. Where the land is cropped to cereals in an average year it tends to be slightly droughty in both localities.

3.3 Soils – geotechnical investigation

3.3.1 The geotechnical site investigation found that made ground (restored or disturbed soil) was found at the majority of borehole, window sample and trial pit locations within the site. The exceptions were boreholes locations BH1 and BH3; window sample location WS110; and trial pit locations TP108, TP112, TP113, TP114 and TP116 (see Phase II Geo-Environmental Site Investigation report for details). The texture of the subsoil in those undisturbed profiles was classed as clay, which matches the description of the Dale series. The texture of made ground was also generally clay, which indicates that the original soils were also Dale series.

3.3.2 However, topsoil textures were sandy in many places, which does not match any of the soil series descriptions for the Dale association. This may be due to the importation of material to site, which is likely given the extent of disturbance which the site has been subject to. Disturbance has included the construction of motorways and junctions, coal extraction and the construction and operation of the WWTW.

3.4 Drainage

3.4.1 In general, the site slopes very gently to the east. The elevation of the site ranges from approximately 110m AOD in the north to approximately 95m AOD in the south. The geotechnical site investigation did not report presence of underdrainage in any of the

19 trial pits across the site. It is assumed that any surface water flow drains to the Hunsworth Beck which forms the eastern boundary of the site.

3.5 Agricultural Land Classification

3.5.1 The provisional 1:250,000 ALC mapping (MAFF, 1993) indicates that the agricultural land within the site is classed as ALC Grade 3 (good and moderate quality agricultural land). However, it does not provide distinction between Subgrades 3a and 3b (good and moderate); and the scale of the mapping cannot be used to identify the ALC grade of the land at field scale.

3.5.2 This desk study is based on published data; and limited soil profile information from the geotechnical site investigation, which indicates that the soils at the site belong to the Dale series. Therefore, it is assumed that soil at the entire site has their characteristics and that the restored (made ground) profiles have similar properties.

Agroclimatic data

3.5.3 The agroclimatic data of a site influences the ALC in terms of growing conditions, and the soil reaction in terms of wetness and droughtiness. The Meteorological Office publishes agroclimatic data for England and Wales on a five kilometre grid basis for use in the calculation of ALC grading.

3.5.4 Agroclimatic data for the site was taken from the nearest meteorological stations and interpolated between these stations to produce site specific values (Table 1). This was then used to establish whether the agricultural land quality of the site is limited by climate and, in conjunction with soil profile characteristics, soil wetness and droughtiness.

Table 1: Agroclimatic data for the site, UK grid reference: SE 179 274	
Average annual Rainfall (mm)	773
Accumulated Temperature (°C)	1310
Field Capacity Duration (days)	195
Moisture Deficit Wheat (mm)	91
Moisture Deficit Potatoes (mm)	77

3.5.5 Table 1 highlights that the site has an average annual rainfall of 773 mm, with an accumulated temperature of 1310°C. The climatic conditions result in 195 field capacity days per annum, defined as days when the soil is saturated with water and any water from rainfall would infiltrate quickly under the force of gravity or create waterlogging.

Direct ALC limitations

3.5.6 The combination of average annual rainfall and accumulated temperature (Table 1), indicates that climate limits the quality of agricultural land at the site to Grade 2 (very good quality).

3.5.7 The gradient over the site does not exhibit slopes of greater than 7°, therefore does not pose a limitation to agriculture at the site.

3.5.8 Soil depth is consistently deep across the site (more than 60 cm), and therefore does not pose a limitation to agriculture at the site.

3.5.9 The topsoil is stoneless or slightly stony, therefore topsoil stoniness does not pose a limitation to agriculture at the site.

3.5.10 Topsoil at the site has textures which do not limit the quality of the land.

Interactive ALC limitations

3.5.11 Due to high annual rainfall and deep soils, droughtiness does not limit the quality of agricultural land at the site.

3.5.12 According to the Soil Survey of England and Wales (1984) the Dale series belong to Wetness Class IV. The combination of Wetness Class IV, the climatic conditions (195 field capacity days) and the topsoil texture, results in the agricultural quality of the land being limited to at least Subgrade 3b (where topsoil has sand to medium clay loam textures) or Grade 4 (where topsoil has heavy clay loam to clay textures).

3.5.13 Overall, the desk study shows that wetness is the most limiting factor to the quality of agricultural land at the site, limiting the quality of the land to a maximum of Subgrade 3b (moderate quality agricultural land).

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Agricultural land

4.1.1 The desk study indicates that the land at the site is unlikely to be of BMV quality due to wetness limitation. Given the relatively small area of agricultural land within the site (approximately 12ha) such loss is considered to be insignificant for the locality.

4.2 Soil resources

4.2.1 The redevelopment of the site would result in disturbance to soil resources. The activities undertaken during the construction phase which have an impact upon soil resources include earthworks, such as:

- Stripping and stockpiling of topsoil and subsoil, storage and reinstatement;
- Ground excavation;
- Stockpiling materials;
- Levelling ground;
- Trenching;
- Road construction; and
- Vehicle movements on site.

4.2.2 The adverse effects of such operations on soil resources include:

- Damage to the structure and compaction;
- Loss of nutrients (e.g. nitrogen);
- Loss of soil biota (e.g. bacteria, fungi, earthworms) and reduction of its activity; and
- Mixing of soil horizons (especially topsoil with subsoil) reducing their potential for reuse.

4.2.3 The soil resources present on the site are of moderate quality due to the nature of the original soils present and high levels of historic disturbance over the majority of the site, therefore it is considered that the development would not result in high risk of soil degradation provided that appropriate good practice guidelines are followed.

4.2.4 The stripping, stockpiling, handling, transportation and reuse of soil resources has the potential to damage soil in terms of its structure, nutrient content, carbon content and soil organism activity, and lead to increased risk of soil erosion, if not carried out in an appropriate manner. Soil resources would be protected against damage by the adoption of appropriate up to date guidance measures. The current guidelines (Defra, 2009b) for typical working methods and techniques used to protect topsoil resources include the following:

- The handling of soil resources only when sufficiently dry, generally limiting soil operations to the months April to September (although this period may be extended during dry periods). This is especially important given the clayey texture of the majority of soils on the site;
- The stripping, handling, storage and transportation of topsoil separately from subsoil movements;

- Appropriate seeding of soil storage mounds if required for a period longer than six months, to prevent erosion and to maintain soil structure, nutrient content and biological activity; and
- Minimising the number of machine movements across topsoil to minimise compaction and retain soil structure.

4.2.5 The majority of soil resources stripped to allow the permanent built development to take place would be retained on site for reuse upon to create areas such as public greenspaces and private gardens. Soil resources which cannot be reused on site would be put to beneficial use elsewhere in the locale. Appropriate Environmental Agency permits will be required to export surplus soil from the site as it would be classed as waste.

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wardell-armstrong.com

STOKE-ON-TRENT
Sir Henry Doulton House
Forge Lane
Etruria
Stoke-on-Trent
ST1 5BD
Tel: +44 (0)845 111 7777

CARDIFF
22 Windsor Place
Cardiff
CF10 3BY
Tel: +44 (0)29 2072 9191

EDINBURGH
Suite 2/3, Great Michael House
14 Links Place
Edinburgh
EH6 7EZ
Tel: +44 (0)131 555 3311

GREATER MANCHESTER
2 The Avenue
Leigh
Greater Manchester
WN7 1ES
Tel: +44 (0)1942 260101

LONDON
Third Floor
46 Chancery Lane
London
WC2A 1JE
Tel: +44 (0)20 7242 3243

NEWCASTLE UPON TYNE
City Quadrant
11 Waterloo Square
Newcastle upon Tyne
NE1 4DP
Tel: +44 (0)191 232 0943

PENRYN
Tremough Innovation Centre
Tremough Campus
Penryn
Cornwall
TR10 9TA
Tel: +44 (0)1872 560738

SHEFFIELD
Unit 5
Newton Business Centre
Newton Chambers Road
Thorncliffe Park
Chapeltown
Sheffield
S35 2PH
Tel: +44 (0)114 245 6244

TRURO
Wheal Jane
Baldhu
Truro
Cornwall
TR3 6EH
Tel: +44 (0)1872 560738

WEST BROMWICH
Thynne Court
Thynne Street
West Bromwich
West Midlands
B70 6PH
Tel: +44 (0)121 580 0909

International offices:

ALMATY
29/6 Satpaev Avenue
Rakhat Palace Hotel
Office Tower, 7th Floor
Almaty
050040
Kazakhstan
Tel : +7-727-3341310

MOSCOW
Suite 2, Block 10,
Letnikovskaya St.
Moscow, Russia
115114
Tel: +7(495) 980 07 67

Wardell Armstrong Archaeology:

CUMBRIA
Cocklakes Yard
Carlisle
Cumbria
CA4 0BQ
Tel: +44 (0)1228 564820

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