Hendre Lakes

Soil Management Plan

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Submitted to:

Rowena Ekermawi, ARUP, 4 Pierhead Street, Cardiff, CF10 4QP

Prepared by:

Rosemary Peel, RSK ADAS Ltd, Gleadthorpe, Meden Vale, Mansfield, Nottinghamshire, NG20 9PD

Tel: 01623 844331

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Quality Assurance

Version	Date	Author (s)	Checked	Approved
Draft 01	*December 2019*	*Rosemary Peel* *BSc (Hons); Dip Env.Pro* *BASISs S&W, FACTS*	*John Grylls* *Soil Scientist*	*D Ingram* MIAgrE, MISoilSci
Final 01	*May 2020*	*Rosemary Peel* *BSc (Hons); Dip Env.Pro* *BASISs S&W, FACTS*	*D Ingram* MIAgrE, MISoilSci	*D Ingram* MIAgrE, MISoilSci

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1 Executive Summary

Land to the south east of Cardiff is proposed for the development of an industrial and transport hub. This development will involve the stripping, storing and reuse of the soils on site. ADAS was commissioned to undertake a soil survey to inform decisions on soil management during the site working and to determine land quality. The soil resources on the Hendre Lakes development hub, were assessed by ADAS in November 2019. In the north the site will be developed whilst in the south the land will be used for flood alleviation and the translocation of Marshfield SINC soils.

The site is almost level to very gently sloping. At the time of the survey, the site supported cereal stubbles and pasture which was grazed by cattle and sheep.

The solid geology is overlain by Tidal Flats deposits over most of the site and by Till in the west; the soils were mainly poorly drained and fields were separated by wide ditches across most of the site.

A Soil Management Plan has been developed which takes account of the soils on site and the proposed end use of the soils, to provide a suitable soil handling strategy which will preserve the soils, during and after site works. This is to be achieved either by using them on site or burying them below a clean fill material where ground levels have to be raised above the flood plain. Soils from the Marshfield SINC will be translocated to land south of the railway.

The fieldwork undertaken for this report indicates that the site has two soil types which should be managed separately and these areas have been delimited on the Soil Resource Plan.

Agricultural land quality is low and the site is mapped as Grade 4 and Non-agricultural.

2 Introduction

Land to the south east of Cardiff is proposed for the development as an industrial and transport hub. This development will involve the stripping, storing and reuse of some of the soils on site and ADAS was commissioned to undertake a soil survey to inform decisions on soil management during the site working and to determine land quality. The soil resources on the Hendre Lakes development hub, were assessed by ADAS in November 2019. In the north the site will be developed whilst in the south the land will be used for flood alleviation and the translocation of Marshfield SINC soils. Areas of the flood plain which are to be used for development will be raised by importing inert fill material and this has been considered in this Soil Management Plan (SMP).

3 Methodology

Desk Study

A desk study of soils and climatic information was undertaken using reference material available to ADAS, including information on geology, soils, flood risk and climate. The following sources were considered:

https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en
British Geological Society 2018; Map Viewer at http://www.bgs.ac.uk/data/mapViewers/
SSEW 1983 Soils of Wales.
The Met Office: Climatological Data for Agricultural Land Classification.

Fieldwork

Fieldwork was undertaken with a hand held 50mm diameter "Dutch" auger and/or spade to a depth of up to 1.0m.

A total of 100 auger borings were examined to determine the soil types and the land was divided into soil units which have similar characteristics. A map of soil resources is shown at ***Appendix 1***. A brief description of the soil pits and auger profiles are given in ***Appendix 2,*** the results of laboratory tests for soil texture, organic matter and major nutrients from the pits are shown at ***Appendix 3.***

The fieldwork was carried out on 25-27th November 2019 when the ground was at or above field capacity, with patchy areas of surface water.

4 Geology, Soils and Present Land Use

Present Land Use

At the time of survey in November 2019, the agricultural land supported cereal stubbles and pastures which were being grazed by cattle and sheep.

Site

Slope:

The site is part of a larger system of tidal flats and therefore almost level; only in the west where a small area of Till occurs does the land have a discernible gradient. The lack of gradient will not affect soil handling directly but will make the soils wetter because water cannot easily flow off site after periods of rainfall, leading to a build-up of surface water in slight depressions.

Flooding:

The site is offered some protection from flood by flood defences and lies in a mainly low risk area[1] (< 1% chance of flooding each year), but has small areas of medium risk ground (between 1-3.3% chance of flooding each year) within it. For planning purposes the area is classified as Flood Zone C1 (an area within the extreme flood boundary).

Geology

The geology map[2] shows the site to the north of the railway to be underlain by Maughans Formation deposits, which are argillaceous rocks and sandstone laid down 393 - 419 million years ago by rivers during the Devonian Period. To the south of the railway the area is underlain by Mercia Mudstone laid down 201 – 252 million years ago during the Triassic Period. Overlying the solid geology are superficial Tidal Flat deposits which were laid down two million years ago in the Quaternary Period. The resulting soils are mapped on the soil maps[3] of the area as Newchurch Association, which typically includes slowly permeable and seasonally wet clay soils. Till occurs in the south west of the site on slightly higher ground and here soils of the Salwick Association occur.

[1] https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en
[2] British Geological Society 2018; Map Viewer at http://www.bgs.ac.uk/data/mapViewers/
[3] SSEW 1983 Soils of Northern England

Soils Present

Soils were found to be uniform across the site and for the purposes of soil stripping, storage and reinstatement can be considered as two main soil units. Details of individual auger borings are listed in Appendix 2 and the position of each investigation point is shown at Appendix 1.

Unit 1

This unit was mapped to include uniform, heavy textured soils formed on tidal flats. Soils typically had dark grey brown silty clay topsoils over grey silty clay to clay subsoils. Topsoils ranged in thickness from 30 – 310mm, with a typical topsoil thickness of 250mm in arable fields and 150-200mm in grassland fields. To the north of the railway close to the western boundary (borings 51, 52, 61, 62 & 72) there was an area of very shallow topsoil typically only 50mm deep. In areas of pasture the topsoil was more organic than in the arable fields. The grassland had rusty root mottles in the topsoil but the arable fields were generally not mottled within cultivation depth.

The topsoil contained few stones or manmade materials but occasional piles of rubbish were noted on site including a pile of potentially asbestos containing material, in the corner of the field close to auger point 26.

The subsoils were typically clay to silty clay throughout and can be stripped as one horizon where required. The subsoil showed signs of impeded drainage immediately below the topsoil. The soils were poorly drained and will become very sticky in wet conditions due to their high silt and clay content and lack of gradient. Water management will be particularly important on this site.

Unit 2

This unit is mapped to include unused land in the west of the site where medium textured soils have formed in glacial Till. They typically had dark red brown medium clay loam topsoils over heavy clay loam to clay subsoils. Topsoils ranged in thickness from 100 – 300mm, with a typical thickness of 200mm. The soils were slightly stony and became stonier with depth.

The subsoils were typically red brown clay loam to clay and contained platy stones. The subsoil showed signs of impeded drainage extending into the topsoil. The soils were poorly drained and will become very sticky in wet conditions due to their high clay content and very gentle gradients. Much of this soil unit was saturated, especially against the river and water will have to be controlled before soil stripping can commence.

Unit 3

This unit is mapped around the edges of the site and over the railway to included areas of the site where there was no soil at the surface. It includes roads, and buildings as well as the railway embankments. There will be little recoverable topsoil in this unit.

Table 1: Summary of soils on site

Typical Bottom Depth of Horizon (mm)	Texture	Drainage	Stones	Area (ha)	Potential maximum volume of topsoil m^3
Unit 1					
250 arable 150 - 200 grassland range 30 – 310	Dark grey brown silty clay	Ochreous common in grass fields	Few	89.64	224100
310 - 1000+	Grey brown silty clay	Ochreous mottles abundant	Few		
A shallow variant of this soil type occurs in the vicinity of borings 51, 52, 61, 62 & 72 and in this area topsoil should only be stripped to 50mm					
Unit 2					
200 Range 100 - 300	Dark red brown medium clay loam	-	Few	7.57	15140
200 - 350	Red brown medium clay loam	Ochreous mottles many	Slightly – platy sandstone and shale		
250 - 1000+	heavy clay loam - clay, with some sandy patches	Ochreous mottles abundant	Slightly – platy sandstone and shale		
Unit 3					
No soil at the surface				4.84	0

Soil nutrients

Based on results from soil collected from around the soil pits prior to the start of works the soils had a pH which was slightly acidic pH 5.6-6.2 in the farmed areas and pH 5.4 on the unused land. Phosphorus levels were deficient to low (Index 0-1) but potassium was at target (Index 2-) levels. Magnesium was at moderate to high levels (Index 3-6). The full set of laboratory analysis is presented at Appendix 3.

5 Land Quality

The Agricultural Land Classification (ALC) provides a framework for classifying land according to the extent to which its physical characterises impose long term limitations on the use of the land and an ALC grade has been assigned to the site based on guidance contained in the publication:

> *Defra: Agricultural Land Classification of England and Wales – revised guidelines and criteria for grading the quality of agricultural land.*

Supporting climatic data and the critical cut-offs used in the assessment of land quality are shown at Appendix 4 along with a plan showing the ALC of the site. Grade 1 land is excellent quality land whilst Grade 5 land is very poor quality land.

The major overriding limitation to the classification of this site is a combination of soil wetness coupled with heavy topsoil textures), which limit the land to ALC Grade 4. The silty clay loam to clay topsoil's are gleyed and mottled within 400mm of the surface and are slowly permeable within 550mm; which in an area of high field capacity days (205days) makes the soils WC4 and so precludes the soils from a higher grade.

Non-agricultural land has been mapped in the west were scrub and brambles dominate the fields and the land is not farmed. If the land was brought back into production by clearing and draining the soil, it would be mapped as Grade 3b.

Table 2: Agricultural Land Classification Measurements

Grade	Total Area (ha)	Agricultural Land Area (ha)	% of Total Area
1	-	-	-
2	-	-	-
3a	-	-	-
3b	-	-	-
4	63.22	63.22	83.57
5	-	-	-
Other land	16.95	-	16.43
Total	**80.17**	**63.22**	**100.00**

6 Soil Management

Based on the findings of the survey described above a soil management plan has been devised to guide soil handling during site construction and restoration. The lack of gradient and high number of full ditches means that this site will have to be managed very sympathetically to ensure the soils are sufficiently dry to handle during site working. Soils should be managed according to their end use; of particular concern on this site is the requirement to translocate soils from Marshfield SINC to a prepared site in the flood alleviation area south of the railway and the need to raise ground levels on parts of the site to bring the ground level above the floodplain. Soil management requirements are therefore given for the site generally, for soil translocation and for land raising.

Aim of the Soil Management Plan

The aims of this Soil Management Plan are to:

Identify the different soil resources on site which will require separate handling.

Devise a working method designed for protection and conservation of soil resources on site.

Maintain the physical and chemical properties of the soils on site.

Retain soil function during and after restoration.

Provide suitable mitigation measures appropriate to the soil types on site.

Provide on-site reference on soil management for site operators.

Site Preparation

The Site will be constructed with the aim of keeping the soils in store for as short a time as possible, whilst minimising damage to the soil or site. Some adjustment to the working method may be required if the soils remain close to field capacity and above their plastic limit.

- The site will be cleared of all deposited rubbish ahead of soil stripping and all collected material will be treated as waste and managed under a Materials Management Plan,
- Existing utilities will be clearly signed and protected by 'no dig' areas.
- Any vegetative growth higher than 100 mm should be cut and removed from site prior to topsoil stripping. Species of invasive vegetation such as Japanese Knotweed should be treated according to the particular requirements for that species.
- Haul routes and the surface of the construction areas and compounds will be stripped of topsoil except in areas where there is a requirement to cover over the topsoil to raise ground levels.
- Areas of landscaping should be left undisturbed wherever possible and should be fenced off from the construction areas to preserve soil quality.
- Any land drains located during soil stripping will be recorded and diverted to a new perimeter ditch to prevent the site becoming waterlogged during construction.
- Dust control measures – haul roads will be sprayed with water when required during dry weather conditions to reduce dust.

Soil Stripping

It is recommended that soil stripping is designed to keep topsoil and subsoil separate at all times. 360^{o} excavators with a toothed bucket and dump trucks will be used to move soils to store. Topsoil depths are typically 150-200mm on the grassland and 250mm in arable fields. Soils from the 150/250 – 1000mm layer will be treated as subsoil and stripped as necessary for utility installation and to provide storage for overburden mounds. Any soils from below 1000mm will be treated as overburden and kept separate from the subsoil.

The Marshfield SINC will be stripped to preserve the seed bank and any bulbs and the stripped topsoil reinstated to the south of the railway in an area from which the topsoil has been stripped. The soils from the SINC fields only should not be placed in store, but directly reinstated on the prepared receptor site to help preserve the seed bank. The receptor site will be stripped of the same amount of topsoil to remove any excess nutrients and to maintain surface levels.

Soils surrounding areas of invasive species should be kept separate at all times to prevent contamination of the main soil bunds.

In all other areas from which the topsoil is to be stripped the following system will be adopted, if ground conditions permit, to preserve a much topsoil as possible:

- Topsoil stripping will only occur when the soils are as dry as reasonably practicable, normally when they are below the plastic limit and not within 24 hrs of significant rainfall (i.e. >10 mm in 24 hrs). The soil will be tested on site by attempting to form a worm of soil 3mm in diameter by rolling it out on a flat non-porous surface. If the soil 'worm' will not form or is cracked the soil is sufficiently dry to handle.
- Soil will be stripped when in a dry state where ever possible, but if the soils are at or above their plastic limit when stripped they will be deposited into windrows prior to lifting them into their final bund once they have dried out sufficiently.
- Topsoils from the majority of the site should be stripped as deep as the base of the darker topsoil layer which is typically to a depth of between 150/250mm (as shown in Table 3).
- Topsoils from the SINC will be divided into cells of a known size and stripped in turfs to a depth of 100-200mm to preserve the seed and any bulbs and roots known to be present. The turfs will be transferred immediately to the receptor site. Turfs should not be cut if conditions on either the donor or receptor site are unsuitable for immediate translocation.
- The stripped topsoil (excluding the turfs) will be stored in designated bunds at locations to be agreed, normally close to their final destination ready for use in the restoration of the landscape areas.
- Topsoil mounds will not exceed 3m, unless required to be higher for landscaping and should be set back from the stripped area by at least 0.5m to prevent the loss of topsoil into the excavation. Bunds should be fenced off from the rest of the site to prevent materials being stored on the sides of the mounds.
- Topsoil will be stored on topsoil from which any excess vegetation has been removed.
- Any subsoil which needs to be stripped will be stored separately from the topsoil and should be clearly labelled as subsoil. Subsoil will be stripped to a maximum depth of 1000mm with any deeper soils treated as overburden and stored in an area from which the topsoil has been removed.
- Sufficient subsoil will be retained on site for landscaping purposes and to fill any planting holes to within 300mm of the final surface.

Table 3: Recommended Average Topsoil Stripping Depth

Unit Number	Average Topsoil Depth (mm)	Predominant Topsoil Texture	Stripping Depth (mm)
Unit 1 arable	250	Silty clay	250
Unit 1 pasture	150-200	Silty clay	150/200
Unit 1 shallow topsoil	50	Silty clay	50
Unit 1 Marshfield SINC soils	250-300	Silty clay	100-200
Unit 2	200	Medium clay loam	200

Management of areas from which topsoil is not stripped

A large proportion of the southern end of the site needs to be raised to permit the development, due to a risk of flooding. On the areas requiring raising the engineers report that the topsoil will not be stripped. The aim of their proposed methodology is to reduce silt production and to reduce the risk of vehicles becoming bogged down in unstable soils. The engineers consider that the current 'soil crust' and grass cover will provide a reasonable surface for initial traffic movements on the site and help control the amount of silts released that could impact surface waters. Also they indicate that leaving the material in place will reduce the quantity of fill material that needs to be imported to site. With the engineering requirements in mind it is recommended that the following work is required on areas which are not to be stripped of topsoil:

- Keep the affected area as small as possible, consistent with the needs of the project, to preserve as much topsoil as possible for use on this or other sites.
- Vegetation growth higher than 100 mm should be cut and removed just before the placement of additional suitable clean materials, to raise ground level to the required height.
- To help prevent environmental harm material placement work should be carried out when the site and soils are as dry as reasonably practicable, normally when they are below the plastic limit and not within 24 hrs of significant rainfall (i.e. >10 mm in 24 hrs). Such conditions are most likely between mid-April and the end of October. The unstripped soil should be tested on site by attempting to form a worm of soil 3 mm in diameter by rolling it

out on a flat non-porous surface. If the soil 'worm' will not form or is cracked the soil is sufficiently dry to accept placement of the imported materials.

- Water courses should be maintained in good working order to keep the site dry.
- Water should be protected by silt barriers in areas of runoff.
- The fill materials should be deposited at the entrance to the site and progressively bulldozed out across the site in a layer sufficiently thick to prevent machinery breaking through it and compacted as required for the proposed development. Machinery should remain on the waste materials at all times.
- The buried topsoil is likely to become anaerobic and compacted and this should be taken into account when deciding on the future use of the area.
- Burying the topsoil is a loss of topsoil resource for future on or off site use and the area affected should be kept as small as possible, consistent with the requirements of the project.
- Landscaping areas within the raised ground should be filled with subsoil to within 300mm of the surface and completed with 300mm of stored topsoil.

Drainage and Utilities

It is recommended that prior to commencement of soil stripping the current drainage condition of the site should be improved as much as is possible by cleaning out main ditches and grips to ensure water is drained off site as quickly as possible. A record of ground conditions during construction works will be kept and any unmarked utilities located during the work will be recorded and protected.

- A track sheet should record any existing drainage features located during soil stripping, including their type, depth, size, angle and condition. This detail will then be available to aid a review of the requirements for water management.
- Any existing field drains which are cut off/damaged by the works should be diverted into local drainage ditches through silt traps, to minimise sediment release.
- Due to the heavy soil textures and high rainfall surface water management will be particularly important on this site.

Soil Storage

It is recommended that soil stores be placed in defined areas for screening and final restoration of the landscaped areas. Sufficient topsoil will be retained on site to ensure that there is 300mm of topsoil available over all landscaped areas (150mm for amenity grass areas). Surplus topsoil should

be put to a beneficial use off site to ensure its many soil functions such as a carbon and water storage are retained.

- Soil stores should be set back by more than 0.5m from the excavation to prevent soils slumping into the cut. All bunds should be labelled with their volume and soil type (e.g. ***m^3; Unit 1 topsoil). Topsoil should be stored on topsoil and subsoil should be stored on subsoil.
- Soils should be moved to store along defined haul roads to prevent trafficking of the majority of the soil surface and soil should be placed into store by tracked equipment where possible, in a loose condition and bunds lightly firmed to consolidate the surface.
- A low maintenance grass mix should be sown on bunds that will be in place for more than six months at a rate of 5g/m^2. The grass should be kept weed free by mowing or spraying weeds before they set seed.
- The soils from Marshfield SINC will be directly placed into measured cells within the flood alleviation area to the south of the railway and will not be placed in store. The cells will be of the same size as those on the donor sites. The receptor site will be cultivated with forward facing tines to a depth of 200mm to remove any compaction and to prepare the ground for the turfs.

Table 4: Soil Bund Heights

Soil Type	Bund	Height (up to**m)
Unit 1 -Topsoil	Bund A	2-3m
Unit 1 - Subsoil where stripped to install services/foundations	Bund B	3m or higher for screening
Unit 2 - Topsoil	Bund C	2-3m
Unit 2 - Subsoil	Bund D	3m or higher for screening
Overburden from any soil unit	Bund E	as required

Soil Reinstatement

It is recommended that the parts of the site which provide green space and landscape planting should be restored using soils from the site. Topsoil for landscaping should be well drained and aerated and hold sufficient water, nutrients, organic matter and soil biology to enable healthy, sustained growth by plants. Soil is most likely to be restored in this condition if it is only handled in a dry and friable condition.

Ideally the soil should only be reinstated between mid-April and the end of October when they are at their driest. Soil replacement should only take place when the soils are below their plastic limit and not within 24hrs of significant rainfall (i.e. >10mm in 24hrs) so that the soils have a full day of drying before work recommences.

Once construction is completed and the compounds have been closed, all green spaces and landscaping areas should be restored as follows:

- All buildings, construction materials, services and temporary surfaces should be lifted and removed from site.
- Validation soil samples should be collected from the ground surface of the cleared compounds, targeting high risk areas and tested for potentially toxic substances. If soils are considered to be unsuitable due to contamination impacts, remediation may be required, and advice should be sought from contamination specialists.
- The site will be litter picked to remove any remaining construction waste and stones larger than 100mm diameter and inspected to ensure that the site is in a state fit to receive the topsoil.
- Stored subsoil will be used to infill any hollows created during the removal of the hardstanding and service trenches, or from trafficking along the haul roads; with the remainder spread evenly over the stripped area to provide a subsoil surface up to 300mm below ground level (too allow room for topsoil placement).
- 10 days prior to soil reinstatement soil stores will be sprayed off if vegetated.
- The surface of the in-situ subsoil will be inspected to ensure that all construction material has been removed and that the site is in a fit state to receive the topsoil.
- Subsoil compaction will be removed prior to replacing the topsoil, by subsoiling with a winged tine subsoiler set 20mm below the bottom depth of the compact layer (typically 350mm), but only outside 'no dig' areas to protect utilities. If compaction is less than 200mm deep a cultivator will be used in preference to a subsoiler.
- Soils will be replaced with minimum vehicular movements to avoid re-compacting the loosened surface. Restoration should start at the furthest point from the exit to ensure that soils once deposited are not run on by earth moving machinery.
- Particular care should be taken to minimise re-compaction of the subsoil by carefully controlling traffic movement along defined routes and working only in dry conditions.

- The depth of soil to be replaced will be determined by the proposed end use of the area. As a rule of thumb[4], topsoil and subsoil depths for different planting types should as a minimum be as follows: -
    - Trees – 300mm topsoil over 600mm subsoil.
    - Shrubs – 300mm topsoil over 300mm subsoil.
    - Amenity grassland – 150mm topsoil over 150mm subsoil.
- Loosen the soils to a depth of up to 400mm (depth permitting) to tie the topsoil and subsoil together, but only in dry conditions and special care will be taken to avoid damage to services and any shallow drains.
- Soil loosening will be carried, at an angle to the line of any drains and, where possible, extended into the undisturbed soil on either side of the working area. The depth of working and the type of equipment used will be determined by the depth of compaction.
- The site will be litter picked to remove any remaining construction waste and large stones brought up by subsoiling, prior to landscape planting.
- The flood alleviation site which lies to the south of the railway will have topsoil from Marshfield SINC direct placed onto the topsoil stripped surface after remediation of any compaction. The soils will be spread out evenly over the area and the surface contoured to replicate some of the original ditches and drainage depressions.

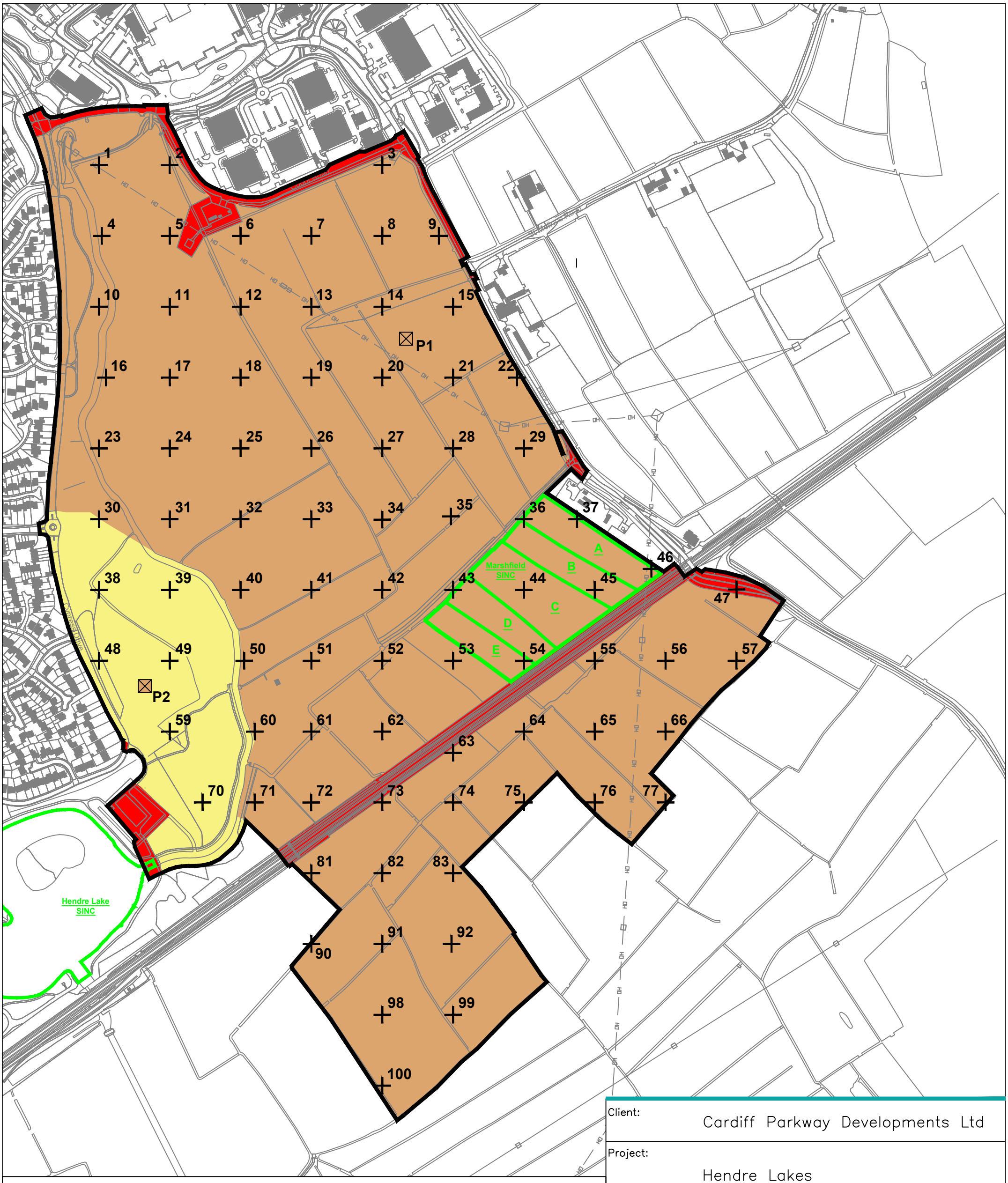
[4] Draft Soils and Development Technical Guidance Note June 2017; Cardiff Green Infrastructure SPG: Soils and Development Technical Guidance Note; Consultation Draft, June 2017

7 Topsoil Quality

Soil samples collected from the pits indicate that the soils would not pass the full BS 3882:2015 Topsoil Specification due to heavy topsoil textures (47-50% clay) and low levels of phosphorus. However both of these limitations can be overcome by digging sand and organic matter into the topsoil during planting to lighten the soil texture of the landscaping areas. Phosphorus levels could also be improved by the addition of a phosphate fertiliser or phosphate rich organic matter. The soils are considered to be suitable for use in the restoration of the landscaping areas with minor modification. A full BS Topsoil Specification should be undertaken before the soils come out of store to confirm fertiliser and organic matter requirements.

Appendix 1: Soil Resource Plan

(See following page)



Unit

1

2

3

** Auger survey location.

Soil pit location.

Outline Planning Application Boundary

Client: Cardiff Parkway Developments Ltd

Project: Hendre Lakes

Drawing Title: Soil Resource Plan

Drawing No: aru0002(1)/srp01

Scale: 1/5000 @A3

Drawn by: Tommy Farr Date: 15.6.20

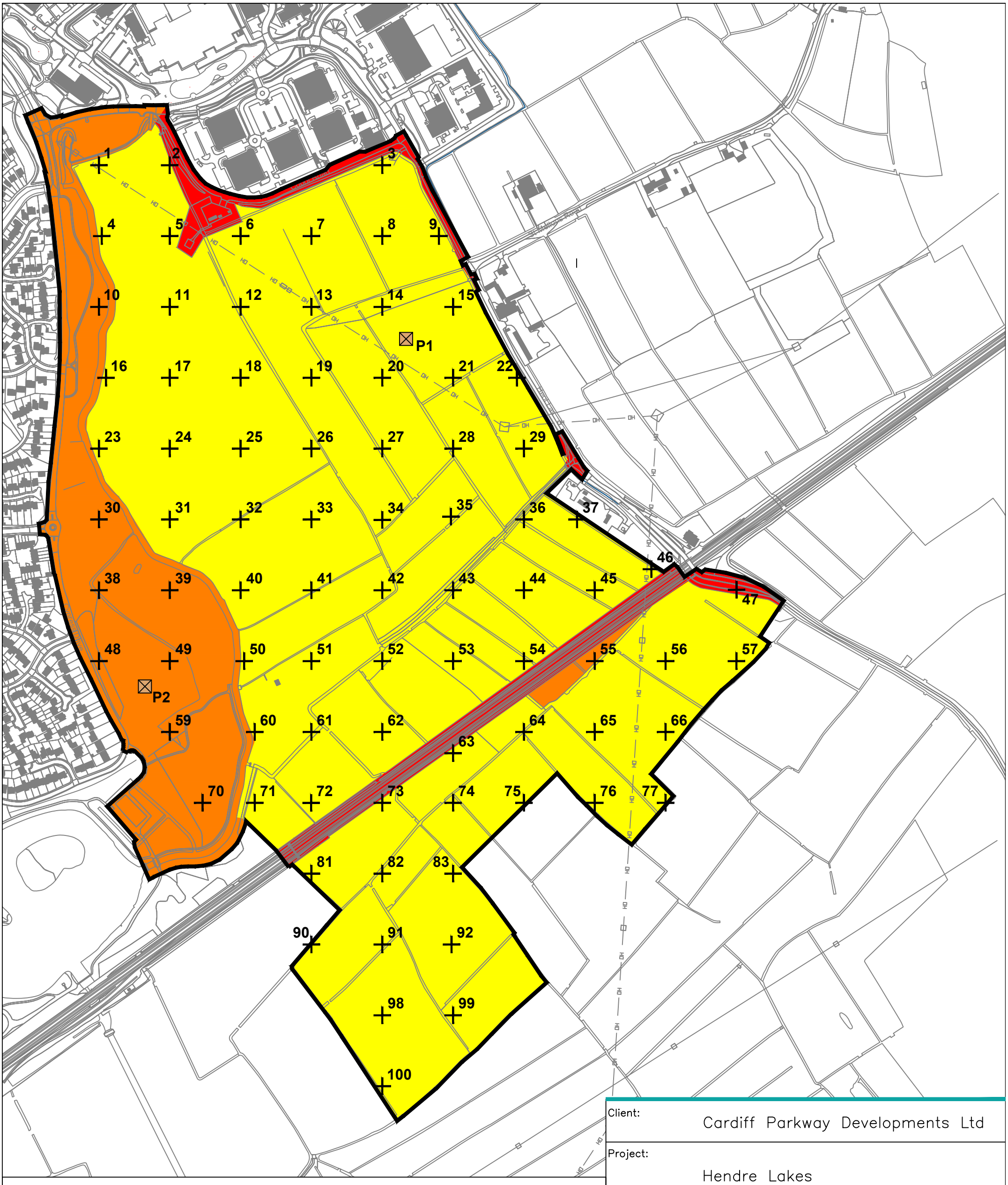
Checked by: Rosemary Peel Date: 15.6.20

RSK ADAS Ltd., Rosemaund, Preston Wynne,
Hereford, HR1 3PG.
Tel. 01432 820444.

ADAS

ALC Plan

(See following page)



ALC Grade

- 1
- 2
- 3a
- 3b
- 4
- 5
- Urban / Farm buildings
- Non Agric / Woodland

** Auger survey location.

Outline Planning Application Boundary

Soil pit location.

Client: Cardiff Parkway Developments Ltd

Project: Hendre Lakes

Drawing Title: ALC Grade Plan

Drawing No: aru0002(1)/alc01

Scale: 1/5000 @A3

Drawn by: Tommy Farr Date: 15.6.2020

Checked by: Rosemary Peel Date: 15.6.2020

RSK ADAS Ltd., Rosemaund, Preston Wynne,
Hereford, HR1 3PG.
Tel. 01432 820444.

ADAS

Appendix 2: Soil Descriptions

Key to soil description

Texture Key

S = sand	F = fine
Z = silt	M = medium
C = clay	C = coarse
L(y) = loam(y)	Pt(y) = peat(y)

Structure Key

(V)Wk = (very)weak	M = moderate	S = strong
F = fine	M = medium	C = coarse
SG = single grain	GR = Granular	SAB = subangular blocky
AB = angular blocky	PR = prismatic	Fri =friable
Fm = firm		

Colour key

Br = brown	Bl = black	Yl = yellow
Rd = red	Or = orange	pl = pale
Ol = olive	Gr = grey	

Main Limitation

DR = Drought	WE = Wetness	CL = Climate
GR = Gradient	MR = Microrelief	TX = Texture

Land use

Wht = wheat	perm past = permanent pasture	Osr = oil seed rape
WC = winter cereals	Ley = grass ley	WBC = wild bird cover
Bar = barley	r&f = ridge and furrow	fal = fallow

Others abbreviations

ab = abundant	cons = concretions	imp = impenetrable
MB = moisture balance	Mn = manganese	mot = mottles
occ = occasional/ly	och = ochreous	pok = pockets
pot = potatoes	sat = saturated	
SPL = slowly permeable layer	na = not applicable	CBC = chalky boulder clay
OM = organic matter	Rrm = rusty root mottles	

Site: Cardiff Parkway
PIT DESCRIPTIONS

Pit	Depth (mm)	Colour	Texture	Structure	Drainage /Porosity (0.5% pores)	Total Stone %
1	0-120	10yr 4/1	ZC , sl org	S M SAB	Rrm/>	<1
	120-300	10yr 5/2	ZC	M C Pr braking to SAB	Ab och />	<1
	320-1000	10yr 5/1	ZC	Augered below 600	Och ab/<	<1
	Gleyed at: 150	SPL at: 320	Wetness class: 4	Wetness grade: **4**	Comments: wet rush pasture	
		MB wheat: - MB pot:-	DR Grade: -	Main limitation. **WE**		ALC grade **4**

Pit	Depth (mm)	Colour	Texture/	Structure	Drainage /Porosity (0.5% pores)	Total Stone %
2	0-90	DK Gr Br	MCL (org)	M M SAB	-	-
	90-220	Gr Br	MCL	Wk C SAB to M/M SAB	Ab och	<5
	220-380	Li Gr Br + St Br	MCL	Wk C PR breaking to M/M SAB	Many och mot	<5
	380 -500+	Rd br	C	C PR	Many och mot	<10
	Gleyed at: 90	SPL at: 380	Wetness class: 4	Wetness grade: **3b potential**	Comments: Currently non agricultural. Drainage required to reach potential	
		MB wheat: - MB pot: -	DR Grade: -	Main limitation. **WE**		ALC grade **Non ag**

Auger Boring Table								
No / land use/ gradient	Bottom Depth of horizon	Texture	Colour	Gleyed / spl	% Stone >2cm /total	Wetness Class	Main Limit-ation	Grade
1 arable	250	ZC	Dk rd gr		-			
	900	ZC	Rd gr	Och many	-			
	1050	ZC		Och many	-	4	We	4
Non ag in field to north								
2 arable	250	ZC	Dk gr br	-	-			
	1000	ZC	Gr br	Och many	-	4	We	4
3 arable	290	ZC	Dk gr br					
	980	ZC	Gr	Och many		4	We	4
4 arable	270	ZC	Dk gr br	Rrm + och few	-			
	650	ZC	Gr	Och many	-			
	900	Pty L	Dk br		-			
	1000+	SCL	Pl br	Och many	-	4	We	4
5 arable	250	ZC	Dk rd gr					
	490	ZC	Dk rd gr	Och many				
	1100	ZC	Pl gr	Och many		4	We	4
6 arable	270	ZC	Dk gr br	-	-			
	1000	C/ZC	Gr br, more gr with depth	Och many	-	4	We	4
7 arable	280	ZC	Dk gr br					
	850+	ZC	Br gr	Och many		4	We	4
8 arable	270	ZC	Dk gr br	-	-			
	1000	C/ZC	Gr br, more gr with depth	Och many	-	4	We	4
9 arable	270	ZC	Dk gr br	-	-			
	1000	C/ZC	Gr br, more gr with depth	Och many	-	4	We	4
10 non aghricultural								
11 arable	250	ZC	Dk gr br	-	-			
	1000	ZC	Gr br	Och many	-	4	We	4

12 arable	310	HZCL	Dk gr br		-			
	960+	C/ZC	Gr br	Och many	-	4	We	4
13 arable	240	HZCL/ZC	Dk gr br		-			
	900+	C/ZC	Br gr & Br	Och many	-	4	We	4
14 rush pasture	290	ZC	Dk gr br		-			
	1000	ZL	Gr	Och many	-	4	We	4
15 rush pasture	260	ZC	Dk gr br & Rd br		-			
	990+	ZC	Gr	Och many	-	4	We	4
16 arable	240	ZC	Dk gr br	-	-			
	450	C/ ZC	Gr br	Och many	-			
	700	C/ ZC	Gr	Och many	-			
	800	MZCL	Pl gr	Few och mottles	-			
	900	HZCL calc	Pl gr	Och many	-			
	1000+	ZC calc	Or br mixed with pl gr	Few och mot	-	4	We	4
17	260	ZC	Gr					
	930+	ZC	Gr br	Och many		4	We	4
18 arable	250	ZC	Dk gr br	-	-			
	1000	ZC	Gr br	Och many	-	4	We	4
19 arable	270	ZC	Dk gr br	-	-			
	1000	C/ZC	Gr br, more gr with depth	Och many, ab by 700	-	4	We	4
20 rush pasture	130	ZC, sl org	Dk gr br	-	-			
	1050	C	Gr br, more gr with depth	Och & br ab	-	4	We	4
21	220	ZC	Dk gr br & Br					
	930+	C/ZC	Dk gr & Br	Och many		4	We	4

22 rush pasture	230	ZC	Dk gr br	Rrm + och few	-			
	350	C/ZC	Gr br	Faint och motts	-			
	700+	C/ZC	Gr	Och many	-	4	We	4
23 arable	250	MCL	Dk br		-			
	350	HCL	Gr br	Och many	-			
	800	SCL (sat. at base)	Rd br & gr br mix	Och many	5%	4	We	3b
	800	Impen. (Stone or rock)			-			
24	170	ZC	Br gr					
	700+	ZC	Br gr	Och many		4	We	4
25 arable	250	ZC	Dk gr br	-	-			
	1000	ZC	Gr br	Och many	-	4	We	4
26 arable	270	ZC	Dk gr br	-	-			
	1000	ZC	Gr br more gr with depth	Och many	-	4	We	4
Potential asbestos in field corner								
28 rush pasture	200	ZC	V dk gr br	Och few	-			
	320	ZC	V dk gr, mixed with rd br CL	Och many	-			
	1000+	C/ZC	Gr	Och many	-	4	We	4
29 Rush Pasture	270	ZC	V Dk gr br	Och Many	-	4	We	4
	1000	C/ZC	V Dk gr br	Och Many	-	4	We	4
30	100	SCL (organic)	Rd br		-			
	230	SCL	Rd br	Och many	-			
	330	C	Rd	Och few	-			
	430+	ZCL	Gr			4	We	Non ag
31	230	ZC	Gr br		-			
	820+	ZC	Gr br	Och many	-	4	We	4

32 arable	340	ZC	Dk gr br	Och com by 200	-			
	1000	ZC	Gr br more gr with depth	Och many	-	4	We	4
33 arable	270	ZC	Dk gr br	-	-			
	1000	C/ZC	Gr br, more gr with depth	Och many	-	4	We	4
34 arable	270	ZC	Dk gr br	-	-			
	1000	C/ZC	Gr br, more gr with depth	Och many	-	4	We	4
35 rush pasture	200	HCL	Dk gr br	Och few	-			
	330	C	Gr br	Och many	-			
	1000+	C/ZC	Gr	Och many	-	4	We	4
35A rush pasture	250	ZC	Gr with some admix of rd br ZCL	Och few	-			
	350	ZC	Grey	Och many	-			
	1000+	C/ZC	Dk gr/ Gr	Och many	-	4	We	4
36 rush pasture	30	ZC	Dk gr br	Och Many	-	4	We	4
	1000	HZC	V dk gr br	Och Many	-	4	We	4
37 Rush Pasture	250	ZC	Dk Br	Och Few	-	4	We	4
	40	ZC	Dk Brown Gr	Och Many	-	4	We	4
	1000	C	Gr	Och Many	-			
38 scrub	280	MCL (organic)	Dk gr br		-			
	420	HCL	Pl br & Br	Och many	-			
	920+	C	Rd & Yl br	Och many	-	4	We	Non ag
39 scrub	100	MCL	Dk gr br	Rrm				
	360	MCL	Gr br	Och many	Occ sst			
	1000	C	Gr br, darker gr with depth	Och com	Occ sst	4	We	Non ag

40 arable	270	HZCL	Dk gr br		-			
	820+	C/ZC	Gr	Och many	-	4	We	4
42 rush pasture	190	ZC	Dk gr br	Rrm + och com	-			
	800+	C/ZC	Gr	Och many	-	4	We	4
43 rush pasture	280	ZC	Dk gr br	Few mottles	-	4	We	4
	900+	ZC	Gr	Och many	-			
44 Rush Pasture	260	ZCL	DK gr br	Och Many	1%	4	We	4
	420	ZC	V Dk gr Br	Och Many	-	4	We	4
	900+	C/ZC	VVDk Gr	Och Many	-	4	we	4
45 Rush Pasture	260	ZC	Dk Gr Br	Och Many	-	4	We	4
	400	ZC	Dk Gr Br	Och Many	-			
	800+	C/ZC	Gr	Och Many	-			
46 Rush Pasture	28	ZCL	Dk Gr Br	RRM	-	4	We	4
	55	ZC	Gr Br	Och Many	-			
	850+	C/ZC	Gr Br	Och Many	-			
47 Rush Pasture	30	ZC	Dk Gr Br	Rrm	-	4	We	4
	600	ZC	D Gr Br	Och Many	-			
	850+	C/ZC	Gr	Och Many	-			
48 Scrub and rough grass	150	MCL	Dk gr br	Och com	-			
	350	MCL	Br	Och many	Occ sst			
	1000	ZC	Rd br	Och com	Occ sst	4	We	Non ag
Wet flushes across field								

49 Scrub and rough grass	**100**	**MCL (organic)**	**Dk gr br**		**-**			
	420	**MCL**	**Yl br**	**Och many**	**-**			
	650	**HCL**	**Pl rd**	**Och many**	**-**			
	850+	**C**	**Dk rd**			**4**	**We**	**Non ag**
50 rush pasture	**250**	**ZC/C**	**Dk gr br**	**Och com**	**-**			
	400	**ZC**	**Gr br**	**Och many + Mn**	**-**			
	1000+	**ZC**	**Gr**	**Och many + Mn**	**-**	**4**	**We**	**4**
51 rush pasture	**50**	**C**	**Gr**	**Och many**	**-**			
	1000+	**C**	**Gr**	**Och many**	**-**	**4**	**We**	**4**
Virtually no topsoil - stripped off in the past?								
52 Rush Pasture	**30**	**ZC**	**Dk Gr**	**Rrm**	**-**	**4**	**We**	**4**
	500	**ZC**	**V Dk Gr**	**Och Mott Many**	**-**			
	900+	**C**	**Gr**	**Och Many**	**-**			
53 Rush Pasture	**280**	**ZC**	**Dk Gr**	**Och Many**	**-**	**4**	**We**	**4**
	500	**ZC**	**Dk Gr**	**Och Many**	**-**			
	950+	**C**	**Gr**	**Och Many**	**-**			
54 Rush Pasture	**320**	**ZC**	**Dk Gr**		**-**	**4**	**We**	**4**
	550	**ZC**	**Dk Gr**	**Och Mott Many**	**-**			
	800+	**C**	**Gr**					
55 Rush Pasture	**310**	**ZC**	**Dk Gr Br**	**Och Many**	**1%**	**4**	**We**	**4**
	550	**ZC**	**Gr**	**Och many**				
	900+	**ZC**	**Gr**	**Och Many**				
56 Rush Pasture	**250**	**ZC**	**Dk Br Gr**	**Rrm**	**-**	**4**	**We**	**4**
	430	**ZC**	**Gr**					
	900+	**C**	**Gr**		**-**			

57 Rush Pasture	250	ZC	Dk Gr Br	RRM	-	4	We	$
	400	ZC	Gr	Och Many	-			
	850+	C	Gr	Och Many	-			
58	Number not used							
59 scrub	300	MCL	Dk gr br		10-20			
	520+	SCL	Rd	Och many	10-20	4	We	Non ag
60 rush pasture	150	C	Gr br/Gr	Och many	-			
	800+	C	Gr	Och many	-	4	We	4
61 rush pasture	50	ZC	Gr	Och many	-			
	800+	ZC	Gr	Och many	-	4	We	4
Virtually no topsoil - stripped off in the past?								
62 rush pasture & scrub	50	C	Gr br	Och few	-			
	900+	C	Gr	Och many	-	4	We	4
Virtually no topsoil - stripped off in the past?								
63 rush pasture	300	ZC	Dk Gr Br	RM	1%	4	We	4
	900+	ZC	Gr	Och Many	-			
64 Grazing	300	ZC	Dk Br Gr	RRM	2%	4	We	4
	610	ZC	Gr	Och Many	<2%			
	850+	C	Gr	Och Many	<2%			
65 Grazing	280	ZC	DK br Gr	Och Many	-	4	We	4
	500	ZC	Gr Br	Och Many	-			
	900+	C	Gr	Och Many	-			
66 Grazing	280	HZC	Dk Gr br	Rrm	-	4	We	4
	550	ZC	Dk Gr	Och Many	-			
	850+	C	Gr	Och Many	-			
67 - 69	Numbers not used							

70								**Non ag**
71 grass, rushes, small alders (scrub)	**120**	**C (sat.)**	**Gr br**	**Och com**	**-**			
	1000+	**C/ZC**	**Gr**	**Och many + Mn**	**-**	**4**	**We**	**4**
72 grass, rushes, small alders (scrub)	**30**	**C**	**Gr/ Gr br**	**Och com**	**-**			
	800+	**C**	**Gr + mix of pl rd br**	**Och many**	**-**	**4**	**We**	**4**
Virtually no topsoil - stripped off in the past?								
73 rush pasture & scrub	**200**	**ZC**	**Dk gr br**	**Och few**	**-**			
	1000+	**C**	**Gr**	**Och many**	**-**	**4**	**We**	**4**
74	**230**	**ZC**	**Gr br & Br**					
	1000+	**ZC**	**Gr & Br**	**Och many**		**4**	**We**	**4**
75 grass & rushes	**170**	**ZC**	**Dk gr br**	**Och few**	**-**			
	1000+	**ZC**	**Gr**	**Och many**	**-**	**4**	**We**	**4**
76 rush pasture	**200**	**ZC**	**Dk gr br**	**Och few**	**-**			
	1000+	**C/ZC**	**Gr**	**Och many**	**-**	**4**	**We**	**4**
77 Rough grazing	**260**	**ZC**	**Dk Gr Br**	**Och Few Rrm**	**-**	**4**	**We**	**4**
	1000+	**Clay**	**Gr**	**Och Many**	**-**			
78 – 80 Number not used								
81 rush pasture & scrub	**200**	**ZC**	**Dk gr br**	**Occ och mot**	**-**			
	1000+	**C**	**Gr**	**Och many**	**-**	**4**	**We**	**4**
82 Rush Pasture	**240**	**ZC**	**DK Br**	**Och few**	**-**	**4**	**We**	**4**
	900+	**C**	**Gr**	**Och many**	**-**			

83 Rush Pasture	**250**	**ZC**	**Dk Br**	**RRM**	**-**	**4**	**We**	**4**
	900+	**Clay**	**Clay**	**Och Many**	**-**			
84 - 89 Number not used								
90 Rush Pasture	**290**	**ZC**	**Dk Gr br**	**Rrm**	**-**	**4**	**We**	**4**
	520	**ZC**	**Gr**	**Och Mott**	**-**			
	900+	**C**	**Gr**	**Och Mott**	**-**			
91 Rush Pasture	**240**	**ZC**	**Dk Br gr**	**Och Many**	**-**	**4**	**We**	**4**
	850+	**C**	**Gr**	**Och Many**	**-**			
92 Rush Pasture	**220**	**Org ZC**	**Dk Dk Br Gr**	**Rrm**	**-**	**4**	**We**	**4**
	400	**ZC**	**Gr**	**Och Many**	**-**			
	900	**C**	**Gr**	**Och Many**	**-**			
93 – 97 Number not used								
98 Rush Pasture	**270**	**ZC**	**Dk gr br & Br**					
	850+	**ZC**	**Gr**			**4**	**We**	**4**
99 Rush pasture	**100**	**Org ZC**	**Br**	**Och few**	**-**			
	300	**ZC**	**Gr br**	**Och many**	**-**			
	1000	**ZC**	**Gr br**	**Och many**	**-**	**4**	**We**	**4**
100 Rush pasture	**150**	**Org ZC**	**Br**	**Och few**	**-**			
	300	**ZC**	**Gr br**	**Och many**	**-**			
	1000	**ZC**	**Gr br**	**Och many**	**-**	**4**	**We**	**4**

Appendix 3: Laboratory Analysis - nutrients

ANALYTICAL REPORT

Report Number	**79881-19**	**X922**	**ROSEMARY PEEL**	**Client**	**CARDIFF PARKWAY**
Date Received	**03-DEC-2019**		**RSK ADAS LTD**		**1010514**
Date Reported	**10-DEC-2019**		**PARKFIELD COTTAGE**		**27 11 19**
Project	**1010514 27 11 19**		**POLLARDS LANE**		
Reference	**CARDIFF PARKWAY**		**SOUTHWELL**		
Order Number			**NOTTS NG25 0TL**		

Laboratory Reference		**SOIL464434**	**SOIL464435**	**SOIL464436**
Sample Reference		**PIT 1**	**PIT 2**	**PIT 3**
Determinand	**Unit**	**SOIL**	**SOIL**	**SOIL**
pH water [1:2.5]		6.2	5.4	5.6
Available Phosphorus (Index)	mg/l	3.6 (0)	9.6 (1)	5.4 (0)
Available Potassium (Index)	mg/l	127 (2-)	125 (2-)	150 (2-)
Available Magnesium (Index)	mg/l	463 (6)	127 (3)	362 (6)
Sand 2.00-0.063mm	% w/w	2	30	1
Silt 0.063-0.002mm	% w/w	51	46	49
Clay <0.002mm	% w/w	47	24	50
Organic Carbon by DUMAS	%	3.4	2.5	3.2
Organic Matter [calculation]	%	5.8	4.3	5.5
Textural Class **		ZC	MCL	ZC

Notes

Analysis Notes

The sample submitted was of adequate size to complete all analysis requested.
The results as reported relate only to the item(s) submitted for testing.
The results are presented on a dry matter basis unless otherwise stipulated.

Document Control

** Please see the attached document for the definition of textural classes.

Reported by

Myles Nicholson

Natural Resource Management, a trading division of Cawood Scientific Ltd.
Coopers Bridge, Braziers Lane, Bracknell, Berkshire, RG42 6NS
Tel: 01344 886338
Fax: 01344 890972
email: enquiries@nrm.uk.com

Appendix 4: Site Data for Agricultural Land Classification

Site specific climatic data

North

Grid Ref	Altitude	AAR	AT0	FCD	MDW	MDP	Climate
6 figure	*m AOD*	*mm*	*day ℃*		*mm*	*mm*	*grade limit*
ST249812	5	**993**	**1548**	**205**	**92**	**82**	**1**

South

Grid Ref	Altitude	AAR	AT0	FCD	MDW	MDP	Climate
6 figure	*m AOD*	*mm*	*day ℃*		*mm*	*mm*	*grade limit*
ST252805	5	**978**	**1548**	**202**	**93**	**83**	**1**

Critical cut-offs

Gleyed at less than 400mm - Cut off between Wetness Classes 3 and 4 is 550mm.

Gleyed below 400mm - Cut off between Wetness Classes 3 and 2 is 740mm