

BDW South Wales

**Land at St Cyres School,
Dinas Powys**

**Agricultural Land Classification
and
Soil Resources**

March 2017



Reading Agricultural Consultants Ltd

www.readingagricultural.co.uk

1. Introduction

- 1.1.1. Reading Agricultural Consultants Ltd (RAC) is instructed by BDW South Wales to investigate the Agricultural Land Classification (ALC) and soil resources of land at St Cyres School, Dinas Powys, by means of a detailed survey of soil and site characteristics.
- 1.1.2. Guidance for assessing the quality of agricultural land in England and Wales is set out in the Ministry of Agriculture, Fisheries and Food (MAFF) revised guidelines and criteria for grading the quality of agricultural land (1988¹).
- 1.1.3. Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. The principal physical factors influencing grading are climate, site and soil which, together with interactions between them, form the basis for classifying land into one of the five grades.
 - 1.1.1. Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use, and Grade 5 is very poor quality land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land). Land which is classified as Grades 1, 2 and 3a in the ALC system is defined as best and most versatile agricultural land.
 - 1.1.2. The whole of England and Wales was mapped from reconnaissance field surveys in the late 1960s and early 1970s, to provide general strategic guidance on agricultural land quality for planners. This Provisional Series of maps was published on an Ordnance Survey base at a scale of One Inch to One Mile (1:63,360). The Provisional ALC map (sheet 107) shows the site as undifferentiated Grade 3 land, which is good to moderate quality agricultural land defined as:

"Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where more demanding crops are grown, yields are generally lower or more variable than on land in Grades 1 and 2."

- 1.1.3. However, paragraph 6.2.4 of Technical Advice Note 6² explains that:

"This map is produced for use in strategic planning and provides only a generalised indication of the distribution of land quality. The map is not suitable for use in evaluating individual sites. In such cases a resurvey at a larger scale is necessary to obtain a definitive grade."

¹ **MAFF (1988)**. *Agricultural Land Classification of England and Wales. Revised guidelines and criteria for grading the quality of agricultural land*. MAFF Publications.

² **Welsh Assembly Government (2010)**. *Planning for Sustainable Rural Communities*. Technical Advice Note No. 6

- 1.1.6 A detailed re-survey has been undertaken according to the published guidelines, at an observation density of one boring per hectare. This survey follows the detailed methodology set out in the MAFF guidelines.

2. Site and Climatic Conditions

2.1. General Features, Land Form and Drainage

- 2.1.1. The site extends to around 12 hectares (ha) in total, of which 7ha is agricultural land. Part of the site to the east formerly comprised a school with associated playing fields in the centre, whilst the west of the site is agricultural grassland. The school buildings have since been demolished. Other non-agricultural land at the site comprises woodland and mature trees.
- 2.1.2. The site is bounded to the north and north-west by the settlement of Dinas Powys, to the east and south by other agricultural land, and to the south-west by woodland.
- 2.1.3. Much of the site is gently sloping, with a level area roughly in the centre. The slopes down to the east are shallow, falling from around 40m to 35m above Ordnance Datum (AOD) toward a drainage ditch, whilst the slopes to the west fall to around 30m AOD.

2.2. Agro-climatic Conditions

- 2.2.1. Agro-climatic data for the site have been interpolated from the Meteorological Office's standard 5km grid point data set at a representative altitude of 40m AOD, and are given in Table 1. The site is warm and very wet with moderate to moderately small crop moisture deficits. The Field Capacity Day (FCD) regime is relatively long and is unfavourable for providing opportunities for agricultural field work.

Table 1: Local agro-climatic conditions

Average Annual Rainfall	1,015mm
Accumulated Temperatures >0°C	1,514 day°
Field Capacity Days	204 days
Average Moisture Deficit, wheat	86mm
Average Moisture Deficit, potatoes	73mm

2.3. Soil Parent Material and Soil Type

- 2.3.1. The underlying geology across most of the site as mapped by the British Geological Survey³ comprises interbedded mudstone and limestone of the Mary's Well Bay Member. Around the western, northern and eastern periphery of this unit, the similar Penarth Group is mapped, including grey to black mudstones, with subordinate limestones and sandstones. On the western slopes of the site, silty mudstones and siltstones of the Blue Anchor Formation are mapped. There are no superficial deposits mapped.
- 2.3.2. The Soil Survey of England and Wales soil association mapping⁴ (1:250,000 scale) shows soils of the Worcester association to be present across the site. Worcester soils are characterised by variably calcareous clayey profiles over mudstone. The profiles are typically seasonally waterlogged and of Wetness Class (WC) III⁵.

3. Agricultural Land Quality

3.1. Soil Survey Methods

- 3.1.1. Ten soil profiles were examined across the site using an Edelman (Dutch) auger at an observation density of more than one per hectare. One pit was also excavated with a spade to examine subsoil structures. The locations of observations are indicated on Figure RAC7597-1. The following characteristics were assessed for each observable soil horizon up to a maximum of 120cm or any impenetrable layer:
- soil texture;
 - significant stoniness;
 - colour (including local gley and mottle colours);
 - consistency;
 - structural condition;
 - free carbonate; and
 - depth.
- 3.1.2. One topsoil sample was submitted for laboratory determination of particle size distribution, pH, organic matter content and nutrient contents (P, K, Mg). Results are given in Appendix 1.

³ **British Geological Survey (2017)**. *Geology of Britain viewer*, <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

⁴ **Soil Survey of England and Wales (1984)**. *1:250,000 scale soil association mapping, Sheet 2 – Soils of Wales*

⁵ **Rudolf et al (1984)**. *Soil and Their Use in Wales*. Soil Survey of England and Wales Bulletin No. 11

- 3.1.3. Soil Wetness Class (WC) was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling and/or poorly permeable subsoil layers at least 15cm thick, in relation to the number of Field Capacity Days at the location.
- 3.1.4. Soil droughtiness was investigated by the calculation of moisture balance equations (given in Appendix 2). Crop-adjusted Available Profile Water (AP) is estimated from texture, stoniness and depth, and then compared to a calculated moisture deficit (MD) for the standard crops wheat and potatoes. The MD is a function of potential evapotranspiration and rainfall. Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs.

3.2. Agricultural Land Classification and Site Limitations

- 3.2.1. Assessment of quality has been carried out according to the MAFF revised guidelines (1988¹). Soil profiles have been described according to Hodgson (1997⁶) which is the recognised source for describing soil profiles and characteristics according to the MAFF revised ALC guidelines.
- 3.2.2. Agricultural land quality at this site is affected mostly by soil wetness and workability and is limited severely to Grade 4 or moderately to Subgrade 3b.
- 3.2.3. Topsoil is predominantly of clay with some silty clay loam textures in the centre and west. The topsoil has an average depth of 24cm and ranges in colour from very dark grey to brown (including 10YR3/1, 3/2, 4/1, 4/2 and 4/3 in the Munsell soil colour charts⁷). The structure is moderately well developed with fine and medium subangular blocky peds, though some firmer clods are also present. Pores and fissures are common. Fine roots are common in the topsoil, which is also stoneless across the site and non-calcareous.
- 3.2.4. Upper subsoil is of clay which is grey, greyish brown or light olive brown (10YR5/1, 5,2 or 2.5Y5/3). Across most of the site, the clay is mottled with ochreous stains and is gleyed. The structure is moderately developed with coarse angular and subangular blocky peds and is slowly permeable in most areas. Stone content is mostly slight at around 5%, however in the centre of the site at Observations 4, 5 and 9, the stone content is much higher. Pit 1 excavated at Observation 4 (photographs shown in Appendix 3) shows a stone content of around 45%, comprising many large slabs of stone. The upper subsoils are variably calcareous, those which are being found mostly in the centre of the site.
- 3.2.5. Lower subsoil layers are also of clay which varies in colour, including greyish brown (10YR5/2), light olive brown (2.5Y5/3), light brownish grey (2.5Y6/2), greenish grey (10Y5/1), very dark grey and grey (N3, N5). The clay exposed by the pit has a weak, very coarse platy and medium angular blocky structure and many prominent ochreous mottles. The lower subsoil is also gleyed and slowly permeable.

⁶ Hodgson, J. M. (Ed.) (1997). *Soil survey field handbook*. Soil Survey Technical Monograph No. 5, Silsoe.

⁷ Munsell Color (2009). *Munsell Soil Color Book*, Grand Rapids, MI, USA

- 3.2.6. A majority of the soil profiles are poorly drained, of WC IV. Under the climatic conditions of the site, with 204 FCDs, soils of WC IV with clay or heavy silty clay loam topsoils are limited by wetness and workability to Grade 4.
- 3.2.7. One profile of WC IV has a lighter textured topsoil and is of Subgrade 3b. In the west of the site, the clay subsoil layers were found to be calcareous and had a friable, crumbly consistency at the time of survey. The applicable profile is of WC II due to gleying from 40cm, although the clay topsoil results in a limitation to Subgrade 3b. An adjacent profile that was not able to be observed to depth due to obstruction by stone is considered likely to also be of this type due to comparable topsoil and upper subsoil characteristics.
- 3.2.8. The areas of each ALC grade are given in Table 2 and are mapped in Figure RAC7597-2.

Grade	Description	Area (ha)	% of agric. land
3b	Moderate quality	1.6	23
4	Poor quality	5.4	77
	Total Agricultural	7.0	100

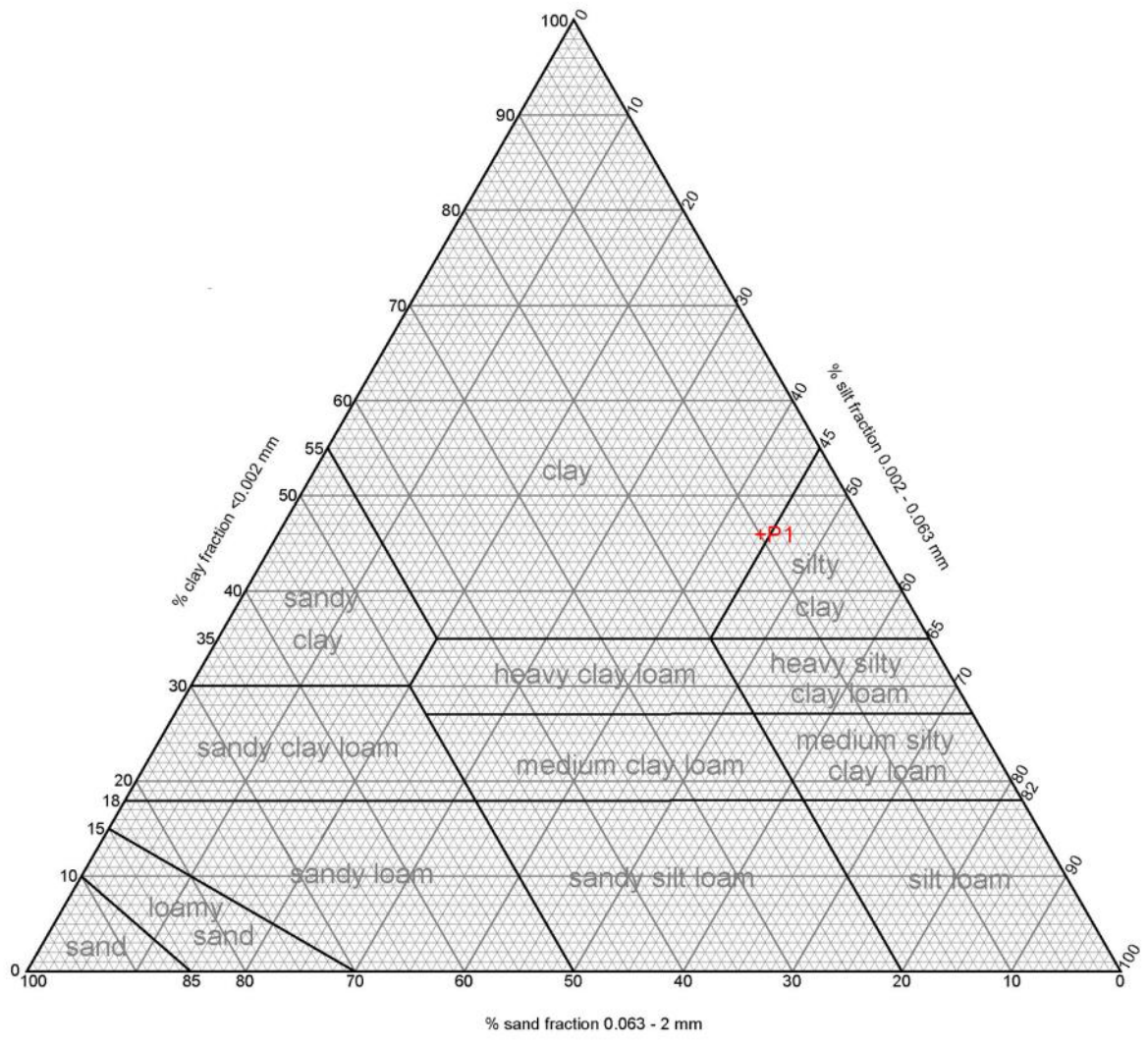
Appendix 1: Laboratory Data

Determinand	Pit 1	Units
Sand 2.00-0.063 mm	10	% w/w
Silt 0.063-0.002 mm	44	%w/w
Clay <0.002 mm	46	% w/w
Organic Matter WB	7.7	% w/w
Texture	Clay	% w/w

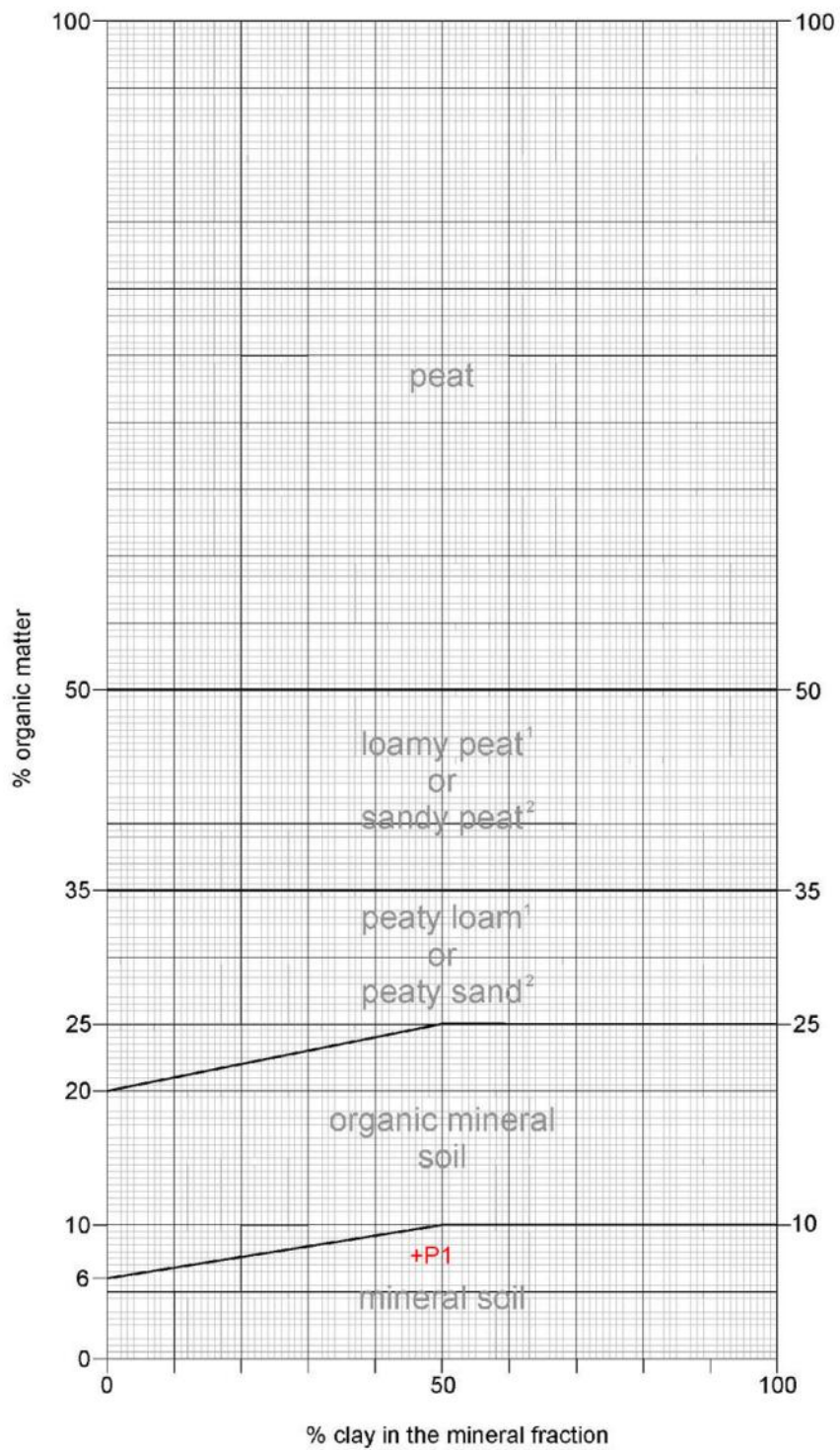
Determinand	Pit 1	Units
Soil pH	7.6	
Phosphorus (P)	5.0	mg/l (av)
Potassium (K)	157	mg/l (av)
Magnesium (Mg)	84.7	mg/l (av)

Determinand	Pit 1	Units
Phosphorus (P)	0	ADAS Index
Potassium (K)	2-	ADAS Index
Magnesium (Mg)	2	ADAS Index

Soil Texture by Particle Size Distribution



Organic Matter Class



¹ Less than 50% sand in the mineral fraction

² 50% sand or more in the mineral fraction

Appendix 2: Soil Profile Summaries and Droughtiness Calculations

Wetness / workability limitations are determined according to the methodology given in Appendix 3 of the ALC guidelines, MAFF 1988

Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988.

Grades are shown for drought, wetness and any other soil or site factors which are relevant. The overall Grade is set by the most limiting factor and shown on the right.

Stone types		
%	TAv	Eav
hard	1	0.5

Climate Data	
MDwheat	86
MDpotato	73
FCD	204

Wetness Class Guidelines	II	III	IV	V
SPL within 80cm, gleying within 40cm		>55m	<55cm	
SPL within 80cm, gleying at 40-70cm	>75cm	<75cm		
No SPL but gleying within 40cm	coarse subsoil	II	other cases	III
No SPL but gleying within 40-70cm	coarse subsoil	I	other cases	II

Maximum depth of auger penetration is underlined

hard flint & pebble

Site No.	Depth cm	Texture	CaCO ₃	Colour	Mottle colour	abundance	stone% hard	stone%	Structure	APwheat mm	AP potato mm	Gley	SPL	WC	Wetness grade WE	Final Grade	Limiting Factor(s)	
1	T 0 30	C		10YR3/1			0			51	51	n	n	IV	4	4	W	
	30 60	C		10YR5/1	och	mff-d	0	poor	33	39	y	y						
	60 120	C		10Y5/1	och	cff	0	poor	42	13	y	y						
	Total									126	103							
	MD									40	30							
Droughtiness grade(DR)										1	1							
2	T 0 28	hZCL		10YR3/2			0	-	53	53	n	n	IV	4	4	W		
	28 60	C		2.5Y5/3	och	cff	5	poor	34	40	y	y						
	<u>60</u> 120	C		2.5Y5/3	och	mfd	15	poor	36	11	y	y						
	Total									123	104							
	MD									37	31							
Droughtiness grade(DR)										1	1							
3	T 0 25	mZCL		10YR3/2			0	-	48	48	n	n	IV	3b	3b	W		
	25 65	C	slight	2.5Y5/3	och	cff	5	poor	41	50	y	y						
	65 100	C	mod	2.5Y6/2	och	cf	15		24	7	y	n						
	<u>100</u> 120	C	mod	2.5Y6/2	och	cf	40		10	0	y	n						
	Droughtiness grade(DR)										1	1						

														Total	123	104				
														MD	37	31				
														Droughtiness grade(DR)		1	1			
4/P1	T	0	30	C		10YR3/2			0	-	51	51	n	n	IV	4	4	W		
		30	43	C	slight	2.5Y5/3	och	cff	45	poor	10	10	y	y						
		43	60	C	mod	N5	och	mcp	2	poor	16	22	y	y						
		<u>60</u>	120	C	mod	N5	och	mcp	2	poor	41	13	y	y						
														Total	118	95				
														MD	32	22				
														Droughtiness grade(DR)		1	1			
5	T	0	20	C		10YR3/2			0	-	51	51	n	n	IV	4	4	W		
		20	30	C	slight	2.5Y5/3	och	cff	45	poor	10	10	y	y						
		<u>30</u>	60	C	mod	N5	och	cf	2	poor	16	22	y	y						
		60	120	C	mod	N5	och	cf	2	poor	41	13	y	y						
														Total	118	95				
														MD	32	22				
														Droughtiness grade(DR)		1	1			
6	T	0	25	C		10YR4/1			0	-	43	43	n	n	IV	4	4	W		
		25	55	C	slight	2.5Y5/3	och	cff	5	poor	34	37	y	y						
		55	65	C	mod	2.5Y6/2	och	cf	15	poor	6	11	y	y						
		<u>65</u>	120	C	mod	2.5Y6/2	och	cf	15	poor	33	6	y	y						
														Total	116	97				
														MD	30	24				
														Droughtiness grade(DR)		1	1			
7	T	0	20	hZCL		10YR4/2			0	-	38	38	n	n	IV	4	4	W		
		20	70	C		2.5Y5/3	och	cff	5	poor	51	62	y	y						
		70	100	C		2.5Y5/3			2		24	0	n	n						
		<u>100</u>	120	C		2.5Y5/3			2		16	0	n	n						
														Total	128	100				

									MD	42	27								
									Droughtiness grade(DR)		1	1							
8	T	0	20	hZCL		10YR4/2		0	-	38	38	n	n	IV	4	4			W
		20	55	C	slight	2.5Y5/3	och	cff	5	poor	41	43	y	y					
		55	70	C	slight	5Y6/2	och	cf	5	poor	10	19	y	y					
		70	120	C		N3	och	cff	0	poor	35	0	y	y					
									Total	124	100								
									MD	38	27								
									Droughtiness grade(DR)		1	1							
9	T	0	25	C		10YR4/3		0	-	43	43	n	n	I	3b	3b			W
		25	32	C		10YR5/2		40		7	7	n	n						
		<u>32</u>	70	C		10YR5/2		40		28	38	n	n						
		70	120	C		10YR5/2		40		25	0	n	n						
									Total	102	88								
									MD	16	15								
									Droughtiness grade(DR)		2	1							
10	T	0	20	C		10YR4/3		0	-	34	34	n	n	II	3b	3b			W
		20	40	C		10YR5/2		10		29	29	n	n						
		40	120	C		2.5Y6/2	och	cf	40		45	30	y	n					
									Total	108	93								
									MD	22	20								
									Droughtiness grade(DR)		2	1							

Appendix 3: Site Photographs



Exposed pit



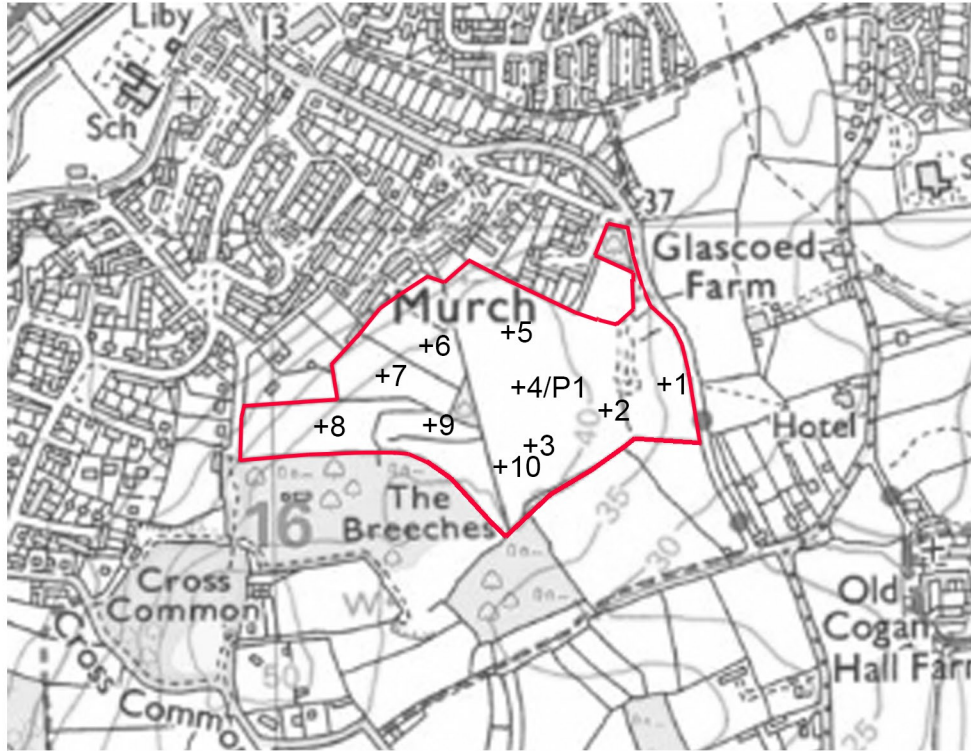
Topsoil



Subsoil



Clay lower subsoil



- Survey Area
- .1 Auger Observation
- .P1 Pit Observation



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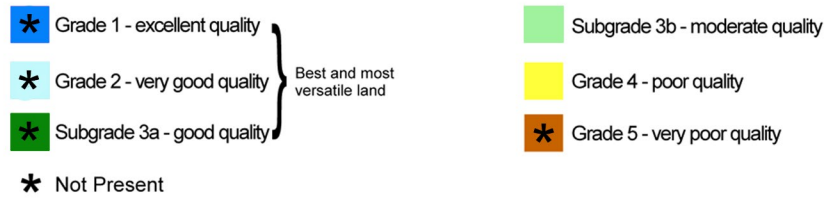
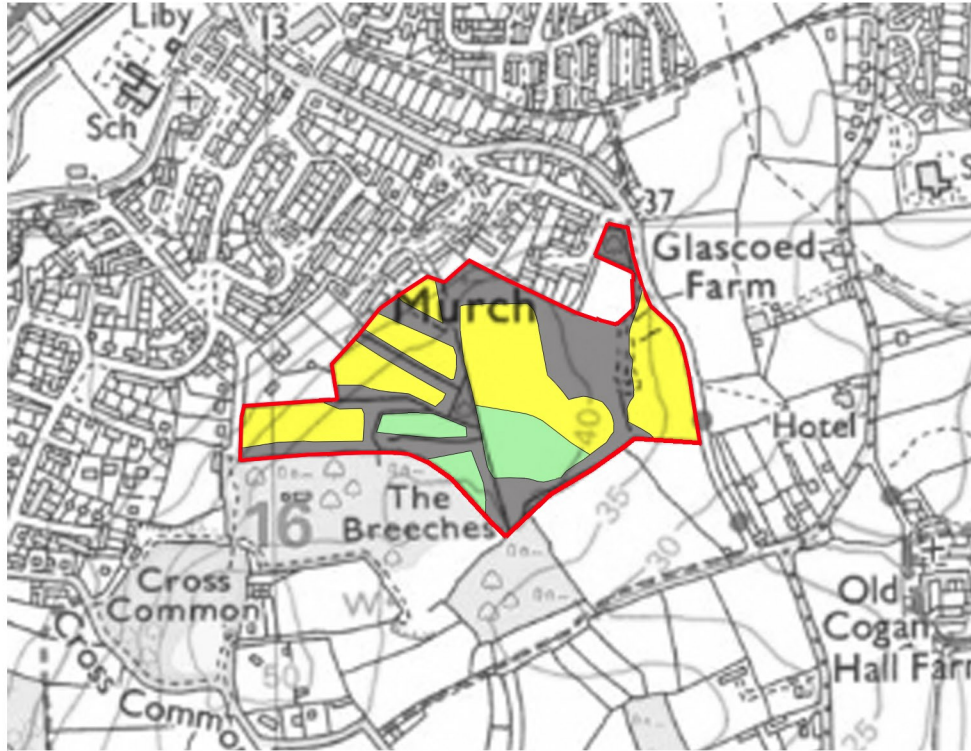
Figure RAC7597-1: Observations

Site: Land at St Cyres School, Dinas Powys

Client: BDW South Wales



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Figure RAC7597-2: Agricultural Land Classification

Site: Land at St Cyres School, Dinas Powys

Client: BDW South Wales

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