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MONA OFFSHORE WIND PROJECT

Environmental Statement

Volume 7, Annex 7.1: Published soil and agricultural land classification data technical report

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Image of an offshore wind farm

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Mona Offshore Wind Ltd.

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Glossary

Term	Meaning
Accumulated Temperature	Unit of measurement used to describe the cumulative effect of temperature over time
Maximum Climatic Grade	The highest quality of agricultural land according to an overall climatic limitation
Field Capacity Duration	The amount of rain needed to bring the soil moisture content back to field capacity
Moisture Deficit	The difference between the amount of water in the soil and the amount of water that the soil can hold

Acronyms

Acronym	Description
AAR	Average Annual Rainfall
ALC	Agricultural Land Classification
AOD	Above Ordnance Datum
ATO	Accumulated Temperature
Met Office	Meteorological Office
MHWS	Mean High Water Springs

Units

Unit	Description
mm	Millimetres
m	Metres
km	Kilometres
cm	Centimetres

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1 PUBLISHED SOIL AND AGRICULTURAL LAND CLASSIFICATION DATA TECHNICAL REPORT

1.1 Introduction

1.1.1.1 This technical report provides details of the published Agricultural Land Classification (ALC) and soils data within the Mona Onshore Development Area. This information has been used to inform Volume 3, Chapter 7: Land use and recreation of the Environmental Statement.

1.1.2 Study area

1.1.2.1 The land use and recreation study area comprises all land within the Mona Onshore Development Area, landward of Mean High Water Springs (MHWS). The following aspects of the environment have been considered within the land use and recreation study area:

- Soil types and patterns of soils, including relevant topographic and climatic data
- The quality of agricultural land within the land use and recreation study area, in accordance with the Ministry of Agriculture, Fisheries and Food (MAFF) Agricultural Land Classification (ALC) of England and Wales Revised guidelines and criteria for gradin the quality of agricultural land (MAFF, 1988), including 'best and most versatile' Grade 1, 2 and 3a ALC land.

1.1.2.2 Due to the permanent nature of impacts likely to occur, published ALC and soils data within the area for the Onshore Substation is discussed separately in section 1.5 of this technical report.

1.1.2.3 Baseline data located beyond the land use and recreation study area has also been considered in this technical report, as this provides information that is of relevance to the assessment of soil types and likely ALC grades.

1.1.2.4 The location and geographic extent of the land use and recreation study area is presented in Figure 1.1 to Figure 1.3 of this technical report below.

1.2 Methodology

Desktop study

1.2.1.1 Information on ALC and soils within the land use and recreation study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 1.1 below.

Table 1.1: Summary of key desktop sources.

Title	Source	Year	Author
1:250,000 series Agricultural Land Classification (Wales)	MAFF	1977	MAFF
British Geological Survey Geology Viewer	British Geological Survey	2020	British Geological Survey
Meteorological Office Climatological Data for ALC. Grid point datasets of	The Meteorological Office	1989	The Meteorological Office Soil Survey and Land Research Centre

Title	Source	Year	Author
climatic variables, at 5 km intervals for England and Wales			
Predictive ALC Map 2	DataMapWales	2019	Welsh Government
Sheet 2 (Wales) and accompanying Bulletin 11 of the National Soil Map	Soil Survey of England and Wales	1984	Soil Survey of England and Wales
Soil Survey of Great Britain, The Soils and Land Use of The District around Rhyl & Denbigh, Sheets 95 and 107, 1:63,360 and accompanying Memoir	Soil Survey of Great Britain	1984	Soil Survey of Great Britain

1.3 Published ALC Information

1.3.1 Topography

1.3.1.1 The land use and recreation study area extends south from the intertidal area at Llanndulas over the A55 at a height of about 10 m Above Ordnance Datum (AOD) and rises gently towards the steep escarpment on which Gwrych Castle is situated. Most of the very steep slope is within woodland and the land use and recreation study area emerges from this at a height of about 120 m AOD. Thereafter, the topography can be described as gently undulating reaching a high point of about 180 m AOD near Llys Arwel and a low point of about 80 m AOD, where it crosses a small watercourse near Nant Fawr. Most of the land in this locality (i.e. Llys Arwel to Nant Fawr), however, is at around 100 to 150 m AOD and none of the slopes are so steep as to pose any agricultural limitation.

1.3.1.2 The land use and recreation study area crosses the A548 and B538 near Sirior Goch Farm at a height of about 130 m AOD before turning east. Thereafter the land use and recreation study area pursues an approximate easterly direction mostly at a height of about 120 m to 160 m AOD skirting the north flanks of Moelfre Isaf but reaching the highest point on the land use and recreation study area at about 200 m just south of Letty. Beyond Letty, the land use and recreation study area undulates with gentle slopes and begins to lose overall height falling below 100 m AOD east of Glascoed.

1.3.1.3 The land use and recreation study area continues east for about 1 km, ending on the edge of St Asaph at about 40 m AOD. Other than the steep slopes near Gwrych Castle in the west, most of which are in woodland, there is little if any agricultural land where the slopes pose any limitation.

1.3.2 Climate

1.3.2.1 Climatic data has been obtained from the Met Office's standard 5 km grid point data set for several representative points along the land use and recreation study area, as shown in Table 1.2 below.

Table 1.2: Climatic data.

Reference point	SH 924 780	SH 935 745	SH 959 741	SH 990 738	SJ 008 738	SJ 010 751
Altitude (m)	10	150	190	100	55	20
Accumulated Temperature (ATO) (day degrees)	1,463	1,304	1,281	1,360	1,411	1,451
Average Annual Rainfall (AAR) (millimetres, mm)	738	860	846	781	742	717
Maximum Climatic Grade	1	2	2	1	1	1
Field Capacity Duration (days)	174	196	193	182	176	172
Moisture Deficit for wheat (mm)	104	82	81	92	99	105
Moisture Deficit for potatoes (mm)	94	65	64	79	88	96

1.3.2.2 The data is typical of the mild, maritime climate of North Wales showing the effect of altitude on both the ATO, which falls with increasing altitude, and rainfall, which increases with altitude. These changes are such that, while the overall climate imposes no agricultural limitations at lower altitude, there is a slight limitation at higher altitudes such that the maximum ALC grade is Grade 2 rather than Grade 1. Sample intermediate calculations indicate that, in general terms, the division between Grade 1 and Grade 2 due to the overall climate occurs at approximately 110 to 120 m AOD. This is, however, of relatively little consequence since, as discussed below, there are other factors related to the characteristics of the soils along the land use and recreation study area which determine the ALC grade. It may be noted, however, that the rainfall is relatively low giving a long field capacity duration over the winter and low moisture deficits which build up during the summer.

1.3.3 Geology

1.3.3.1 The underlying bedrock geology consists of various strata of Carboniferous age in the north and east of the area crossed by the land use and recreation study area, notably Carboniferous Limestone forming the steep slopes around Gwrych Castle and Silurian strata, chiefly shales, in the south and west. Other than the narrow outcrop of the Carboniferous Limestone, all the rest of the bedrock is covered in superficial drift in which the soils are formed. The drift is mainly of glacial origin and includes material derived from Silurian, Carboniferous, and Triassic rocks, as described in more detail in section 1.3.4 of this technical report below. Some of the drift, however, will have been locally re-worked, hence the more general term “drift” rather than more specific terms such as “glacial till”.

1.3.4 Agricultural Land Classification

Predictive ALC

1.3.4.1 The Predictive ALC Map (Welsh Government, 2019) uses the best available information to predict the Grade of land on national basis. It has been designed to help Local Planning Authorities, developers, surveyors, and land use managers make informed long-term decisions over the use of land in the planning system and to target survey work to the most appropriate locations.

1.3.4.2 Areas identified as grades 1, 2 or 3a agricultural land by the Predictive ALC Map to be permanently lost during construction of the Mona Offshore Wind Project (e.g. Onshore Substation) have been subject to further soil surveys. These soil surveys were undertaken between October and November 2023 and used to confirm the ALC grade of agricultural land and in what proportion. Further details of the soil surveys undertaken are provided in Volume 7, Annex 7.2: Soil survey data technical report of the Environmental Statement.

Figure 1.1 below illustrates the distribution of predictive ALC grades within the land use and recreation study area. In addition, there have been several detailed ALC surveys undertaken by Welsh Government near the land use and recreation study area as shown in Figure 1.2.

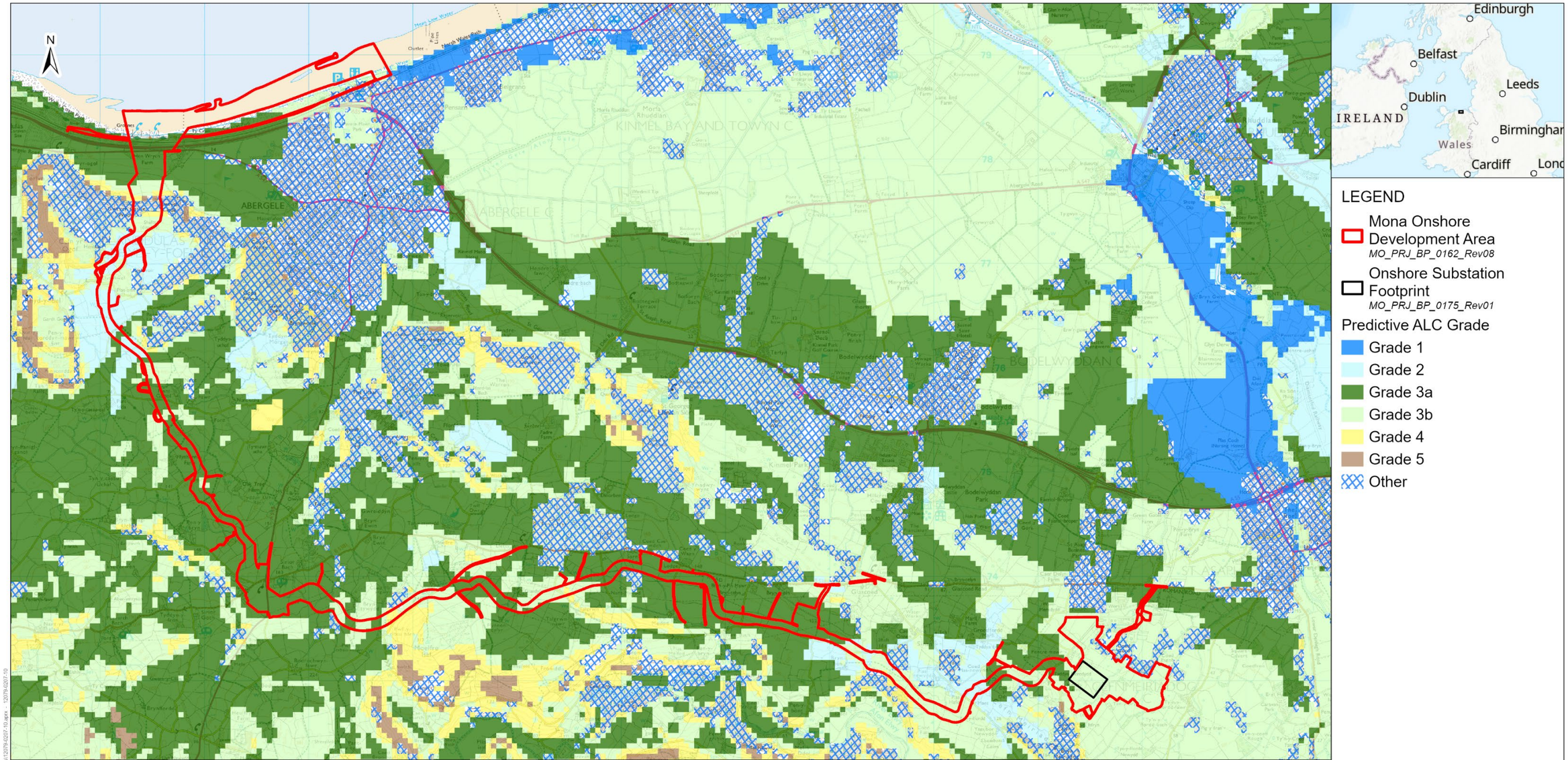
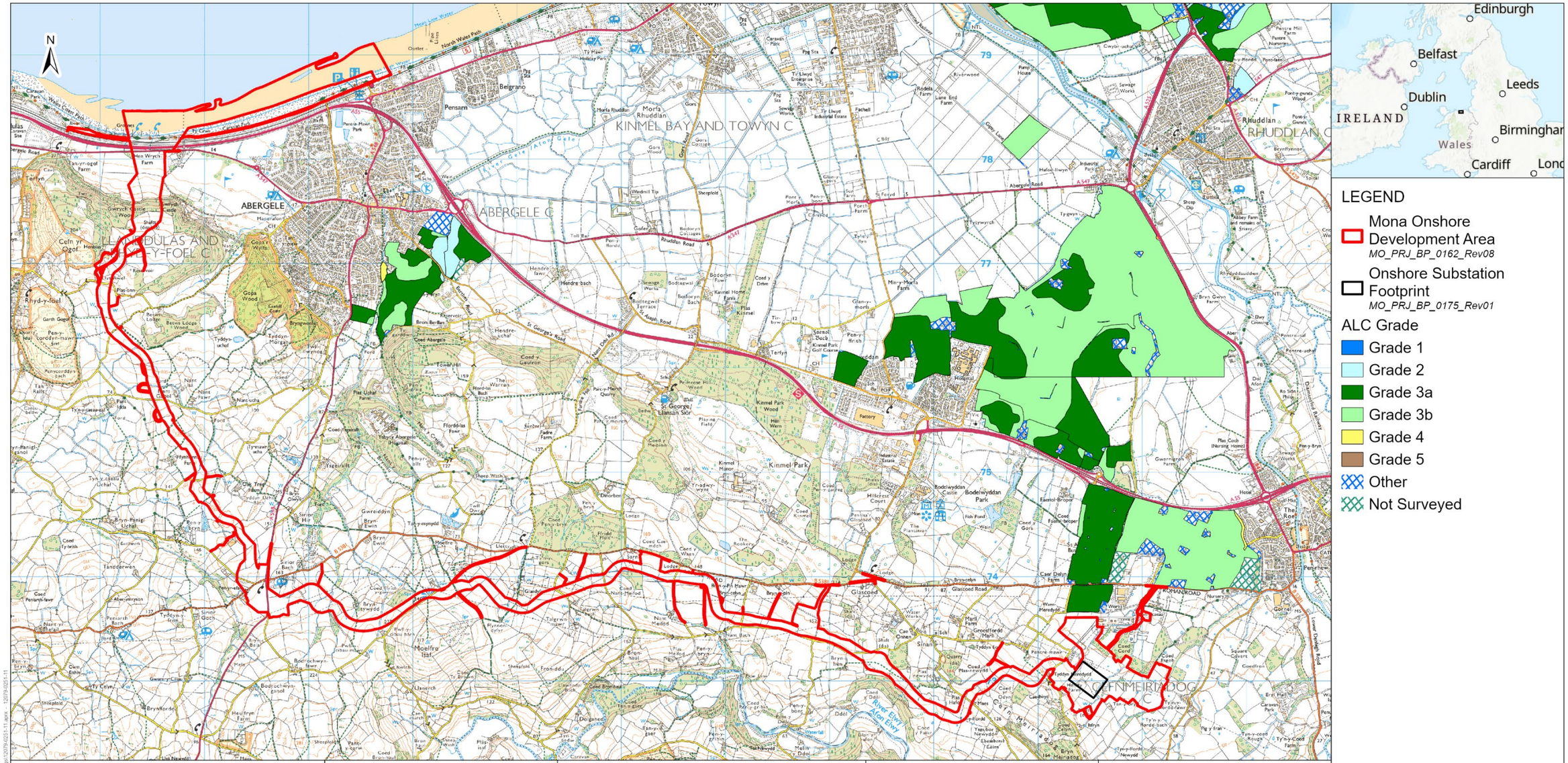


Figure 1.1: Land use and recreation study area and the Predictive ALC.



Service Layer Credits: World Topographic Map: Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS
World Hillshade: Esri, USGS

Data Sources: RPS / bp / EnBwW

Geodetic Information:
Datum: OSGB 1936. Projection: British National Grid.
Scale@ 378.9mm x 214.9 mm:1:40,000

0 0.25 0.5 1 nm
0 0.25 0.5 1 km

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Project Name: MONA OFFSHORE WIND PROJECT

Drawing Title: LAND USE AND RECREATION STUDY AREA AND THE DETAILED ALC

Drawing Number: 12079-0251-11

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Figure 1.2: Land use and recreation study area and the Detailed ALC.

1.3.4.3 Taking this information into account and the soils information as described above, Table 1.3 lists the likely ALC grading for the different soil types identified within the land use and recreation study area.

Table 1.3: ALC grading of soil types within the land use and recreation study area.

Map symbol	Soil series Name	Parent material	Profile drainage	Welsh Government Predictive ALC
Soils in Carboniferous Limestone and associated drift				
Gg	Gower	Carboniferous Limestone	Well drained	3b and 4
Pg	Pentraeth	Drift from Carboniferous Limestone	Well drained	2
Soils in drift from Silurian shales				
Dg	Denbigh	Drift from Silurian shale	Well drained	3a and occasional 3b
Ei	Eriviat	Drift from Silurian shale	Well drained	3b
Sn	Sannan	Drift from Silurian shale	Imperfectly drained	3a occasional 3b
Soils in drift from Triassic rocks				
Fc	Flint	Drift from Triassic rocks	Well drained	3a
Co	Cottam	Drift from Triassic rocks	Imperfectly drained	3b and 3b
Soils in drifts over Triassic till				
Aa	Aber	Drift from Silurian shale over Triassic till	Imperfectly drained	3a
Al	Abergele	Mixed drift over Triassic till	Well drained	3a
Soils in mixed drift				
Gk	Gwaenysgor	Drift from Carboniferous and Triassic rocks	Well drained	2
Lj	LLysfaen	Drift from Silurian shale and Carboniferous sandstone and marl	Well drained	2
Di	Dinorbin	Drift from Silurian shale and Carboniferous Limestone	Well drained	3a

1.3.4.4 The Predicative ALC Map (Welsh Government, 2019) viewer together with the detailed survey work suggests that there are likely to be areas of Subgrades 3a land with smaller areas of lower quality Subgrade 3b land and higher quality Grade 2 within the land use and recreation study area.

1.4 Published soils information

1.4.1.1 The area within the land use and recreation study area was the subject of a soil survey carried out by the Soil Survey of Great Britain, with the results published as two maps (Sheets 95 and 107) at a scale of 1:63,360 and an accompanying Memoir in 1960.

1.4.1.2 Figure 1.3 below illustrates the distribution of the soil series within the land use and recreation study area. These soil series are described in the following sections of this technical report.

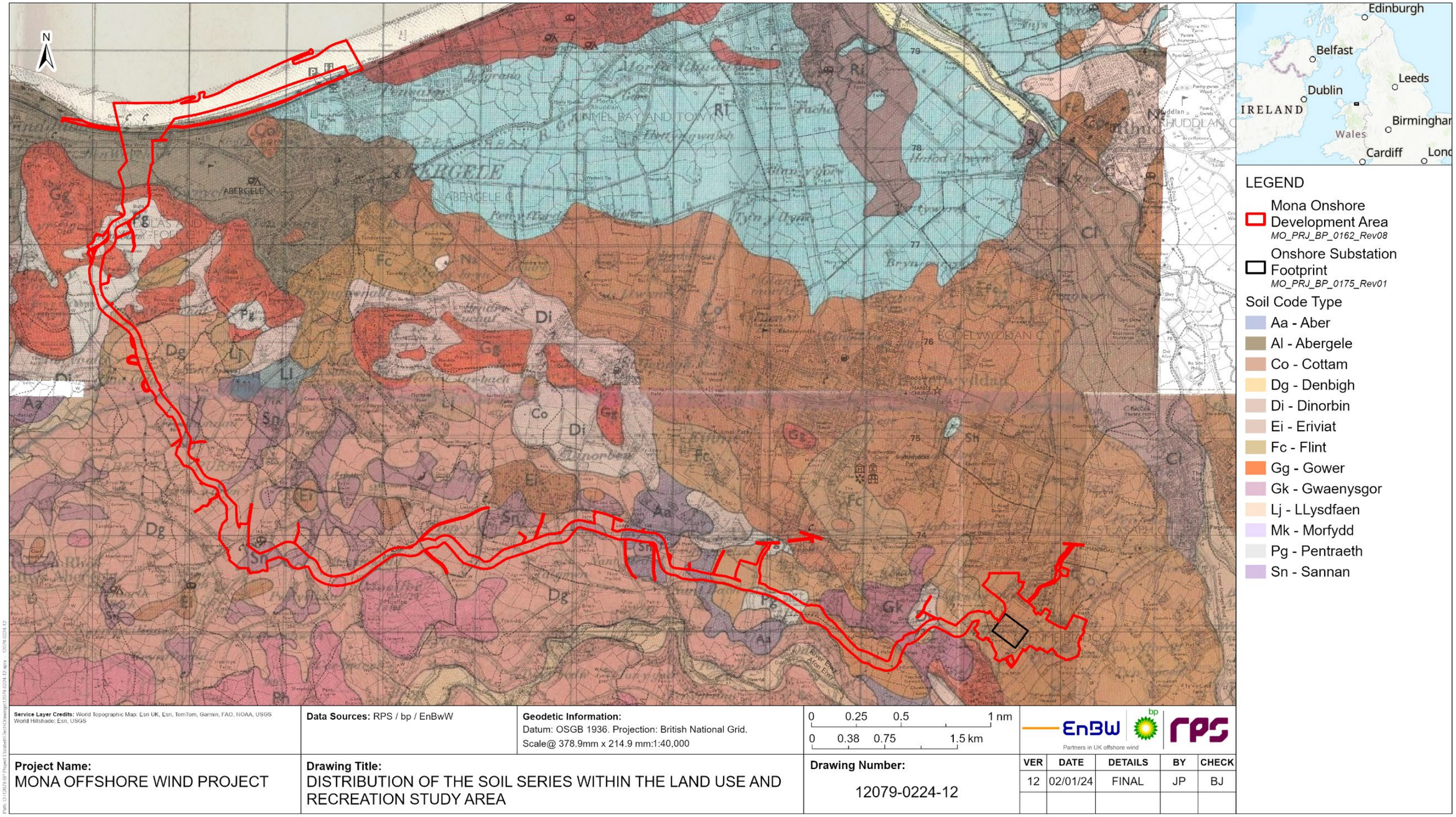


Figure 1.3: Distribution of the soil series within the land use and recreation study area.

1.4.2 Locations of the soil series

1.4.2.1 The following sections of this technical report provide a description of the locations of the different soil series within the land use and recreation study area followed by a description of each of the characteristics of each series.

1.4.2.2 The land use and recreation study area starts by crossing well drained soils of the Abergele series (AI) developed in mixed drift over Triassic till at depth. The land use and recreation study area then encounters various well-drained soils associated with the Carboniferous Limestone ridge, including the shallow Gower series (Gg), the deeper Pentraeth series (Pg) and the Dinorbin series (Di) which has admixed Silurian material.

1.4.2.3 The land use and recreation study area then encounters soils of the well-drained (Wetness Class I) Denbigh series (Dg), its imperfectly drained (Wetness Class II) analogue, the Sannan series (Sn) and one small patch of the well-drained (Wetness Class I) but shallow Eriviat series (Ei) all developed in drift from Silurian shale.

1.4.2.4 Near Nant Back, the influence of Triassic derived material begins, first with a couple of patches of the imperfectly drained (Wetness Class III) Aber series (Aa) developed in drift derived from Silurian shales over Triassic till at depth, then a succession of soils all formed mainly in Triassic material. These include the well-drained (Wetness Class I) Flint series (Fc) and its imperfectly drained (Wetness Class II) analogue the Cottam series (Co). There is an insignificantly small patch of the well-drained (Wetness Class I) Pentraeth series (Pg) where the land use and recreation study area crosses the mainly drift covered outcrop of the Carboniferous Limestone. Also considered to be of insignificant extent is a patch of the well-drained (Wetness Class I) Gwaenysgor series (Gk) on mixed drift.

1.4.3 Descriptions of the soil types

Soils in Carboniferous Limestone and associated drift

Gower series (Gg)

1.4.3.1 This is a shallow, stony, highly calcareous soil developed directly in Carboniferous Limestone but with some superficial drift. A typical profile usually consists of a thin sandy loam topsoil with many limestone fragments directly overlying shattered limestone. The profile is well drained (Wetness Class I in modern nomenclature).

Pentraeth series (Pg)

1.4.3.2 This has more superficial drift than the Gower series resulting in a deeper profile with a distinct subsoil. The topsoil is a non-calcareous sandy silt loam and overlies a browner and slightly sandier subsoil passing down into shattered limestone at between about 60 to 90 cm from the surface. The whole profile is well-drained (Wetness Class I) and has relatively few stones other than occasional limestone fragments.

Soils in drift from Silurian shale

Denbigh series (Dg)

1.4.3.3 This well-drained (Wetness Class I) soil is the most common soil encountered along the land use and recreation study area and is formed in drift material derived mainly from Silurian rocks. This results in a typical profile consisting of a medium clay loam

or silty clay loam, slightly stony topsoil and moderately stony subsoil over solid or shattered rock within about 80 cm of the surface. The depth to rock is, however, variable and without detailed survey information it is difficult to predict how deep the actual profiles are along the land use and recreation study area. Similarly, the number of stones varies and both these factors (i.e. depth to rock and stoniness affect the moisture holding capacity and hence the ALC grading, see below).

Eriviat series (Ei)

1.4.3.4 This is the shallow analogue of the Denbigh series, normally found on the crests of small hummocks where erosion has resulted in a profile no more than about 30 cm thick over compact drift. Although well-drained, the shallowness of the profile gives it a very low moisture holding capacity. It is of negligible importance occurring only in two very small areas on the very edges of the land use and recreation study area.

Sannan series (Sn)

1.4.3.5 This is the imperfectly-drained analogue of the Denbigh series in which the lower subsoil is slowly permeable leading to impeded drainage and the development of greyish colours and mottling, collectively called gleying, below approximately 50 cm from the surface. Some of the wetness may also be due to groundwater seepage related to fault lines in the underlying bedrock. The actual drainage status of the soils is difficult to predict without the benefit of some survey information but is thought to be typically Wetness Class II after drainage installation. The main occurrence of these soils is in the first few kilometres of the land use and recreation study area, where it turns east near Sirior Goch Farm, but there are one or two smaller patches elsewhere.

Soils in drift from Triassic rocks

Flint series (Fc)

1.4.3.6 This soil is developed in drift, probably glacial till, derived from Triassic rocks and consequently has a distinctly reddish brown colour. The drainage status of soils in such parent materials is notoriously difficult to determine since the characteristic greyish colours and mottling (gleying) indicative of waterlogged conditions tend not to develop. Thus, the overall reddish-brown colours of the subsoil and only faint mottling tend to give the impression of free drainage, and this appears to be case in Sheet 95/107 Memoir (Soil Survey of Great Britain, 1984), which reports the Flint as a well-drained soil. It is now generally agreed that the subsoils are slowly permeable and despite the lack of gleying, there is some drainage impedance. Thus, the soils are likely to be only moderately well-drained (Wetness Class II in modern nomenclature). A typical profile consists of a brown, slightly stony medium silty clay loam over a brown slightly stonier subsoil of similar texture passing down into reddish brown, faintly mottled clay at about 60 cm from the surface.

Cottam series (Co)

1.4.3.7 This is the imperfectly drained analogue of the Flint series with somewhat heavier textures (medium to heavy clay loam) and more obvious signs of gleying in the form of paler colours and colour mottling in the subsoil. Thus, they are normally classed as being somewhat less well drained than the Flint series, typically Wetness Class II or III.

Soils in drifts over Triassic till

Aber series (Aa)

1.4.3.8 This soil is developed in a thin covering of loamy drift containing many small shale stones overlying a slowly permeable, reddish brown, heavy clay loam believed to be Triassic glacial till at about 50 cm from the surface. There is a sharp boundary between the two materials. The drainage status is probably Wetness Class III even after drainage. It occurs in the transitional zone between soils formed predominantly in drift derived from Silurian rocks (Denbigh and Sannan series) in the west and those in Triassic derived material (Flint and Cottam series) in the east.

Abergele series (Al)

1.4.3.9 This soil is restricted to the lowland north of the limestone ridge at the west end of the land use and recreation study area. It is very similar to the Aber series (see above) but has more non-Silurian derived material in the surface horizons. A typical profile has a loamy topsoil and subsoil with, as in the Aber series, a sharp boundary to a slowly permeable, reddish brown, heavy clay loam or clay believed to be Triassic glacial till at about 50 cm from the surface. Although described in the Sheet 95/107 memoir (Soil Survey of Great Britain, 1984) as well-drained, the presence of the slowly permeable clay at depth would suggest that the drainage status is very similar to that of the Aber series (i.e. probably Wetness Class III even after drainage).

Soils in mixed drifts

1.4.3.10 The following soil series are encountered along the land use and recreation study area only as very narrow strips or as small patches.

Gwaenysgor series (Gk)

1.4.3.11 This is a well-drained (Wetness Class I) soil developed in drift from Carboniferous and Triassic rocks with a sandy silt loam or sandy loam texture and is only slightly stony. Unlike the Aber and Abergele series there is no sharp boundary to an underlying slowly permeable till.

Dinorbin series (Di)

1.4.3.12 This well-drained (Wetness Class I) soil is found close to the Carboniferous Limestone ridge and its loamy profile includes some limestone fragments. It is broadly similar to the Pentraeth series (see above) but has more Silurian derived material and can be somewhat shallower, with limestone sometimes as near as 45 cm from the surface.

Llysfaen series (Lj)

1.4.3.13 This is a well-drained (Wetness Class I) soil developed in drift from Carboniferous and Triassic rocks which has characteristics similar to the Denbigh series in terms of textures, but deeper, less stony and including stones of Carboniferous origin.

1.5 Onshore Substation

1.5.1 Topography

1.5.1.1 The land within the Onshore Substation slopes very gently from the highest point at about 70 m AOD in the southwest corner to about 55 m AOD at the northeast corner. The slope poses no agricultural limitation.

1.5.2 Climate

1.5.2.1 Climatic data has been obtained from the Met Office's standard 5 km grid point data (Met Office, 1989) set for a representative point at the centre of the Onshore Substation and is presented in Table 1.4 below.

Table 1.4: Climatic data for the Onshore Substation.

Climatic data	Measure
Reference Point	SJ 014 730
Altitude (m)	60
ATO (day degrees)	1,406
AAR (mm)	751
Maximum Climatic Grade	1
Field Capacity Duration (days)	178
Moisture Deficit for wheat (mm)	97
Moisture Deficit for potatoes (mm)	86
Overall climatic limitation.	None

1.5.3 Geology and soils

1.5.3.1 The soil parent material is drift from Triassic rocks and only a single soil series, the Cottam series (Co), is shown on Sheet 107 (Soil Survey of Great Britain, 1984). The whole of the Onshore Substation is similarly shown as just Cottam series (Co).

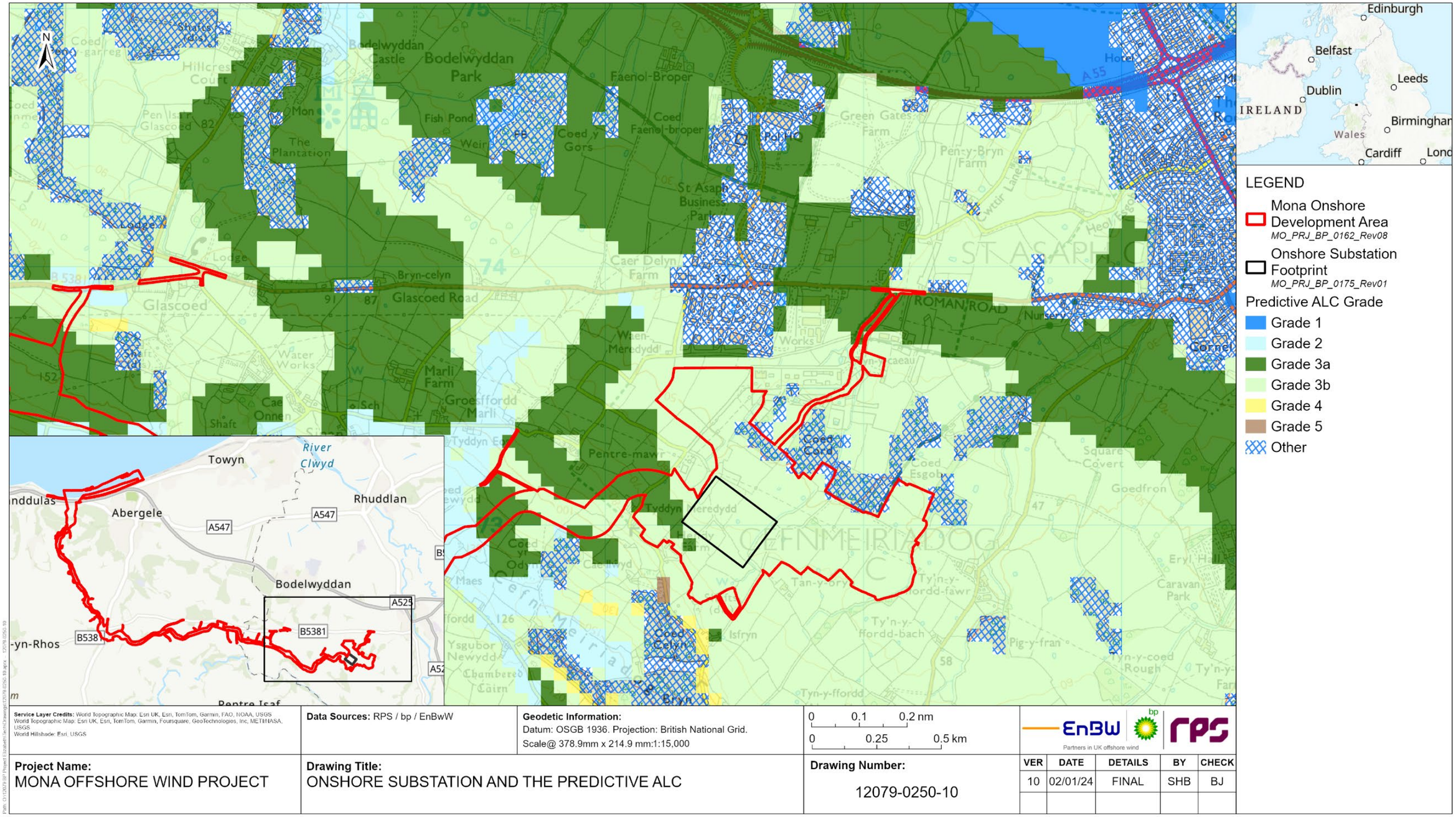
1.5.3.2 The Cottam series (Co) is formed in drift from Triassic rocks has a distinctly reddish-brown colour. The drainage status of soils in such parent materials is notoriously difficult to determine since the characteristic greyish colours and mottling (gleying) indicative of waterlogged conditions tend not to develop. However typical profiles of the Cottam (Co) do have signs of waterlogging in the subsoil in the form of relatively pale colours and colour mottling, collectively called gleying. This is thought to be due to the lower subsoil being only slowly permeable. Thus, a typical profile consists of a dark brown, slightly stony medium silty clay loam over a brown, slightly stonier subsoil of similar texture passing down into reddish brown, faintly mottled clay at about 60 cm from the surface (the slowly permeable layer).

1.5.3.3 It is the depth to the slowly permeable layer, together with the duration of field capacity that is used to determine the Wetness Class. Soils of the Cottam series (Co) are normally classed as being typically in Wetness Class II or III. In the climatic regime of the Onshore Substation with a field capacity duration of 178 days, a profile such as that described above would be in Wetness Class III.

1.5.4 Predictive and detailed ALC

1.5.4.1 The ALC grading for land located within Onshore Substation, according to the Predictive ALC Map (Welsh Government, 2019) is presented in Figure 1.4 of this technical report. The Predictive ALC Map (Welsh Government, 2019) shows that most of Onshore Substation comprises Subgrade 3b land (see Figure 1.4).

1.5.4.2 The ALC grading of land located near the Onshore Substation according to detailed ALC surveys is presented below in Figure 1.5 of this technical report.



Service Layer Credits: World Topographic Map: Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS
World Topographic Map: Esri UK, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS
World Hillshade: Esri, USGS

Data Sources: RPS / bp / EnBwW

Geodetic Information:
Datum: OSGB 1936. Projection: British National Grid.
Scale@ 378.9mm x 214.9 mm:1:15,000

0 0.1 0.2 nm
0 0.25 0.5 km

Project Name:
MONA OFFSHORE WIND PROJECT

Drawing Title:
ONSHORE SUBSTATION AND THE PREDICTIVE ALC

Drawing Number:
12079-0250-10

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Figure 1.4: Onshore Substation and the predictive ALC.

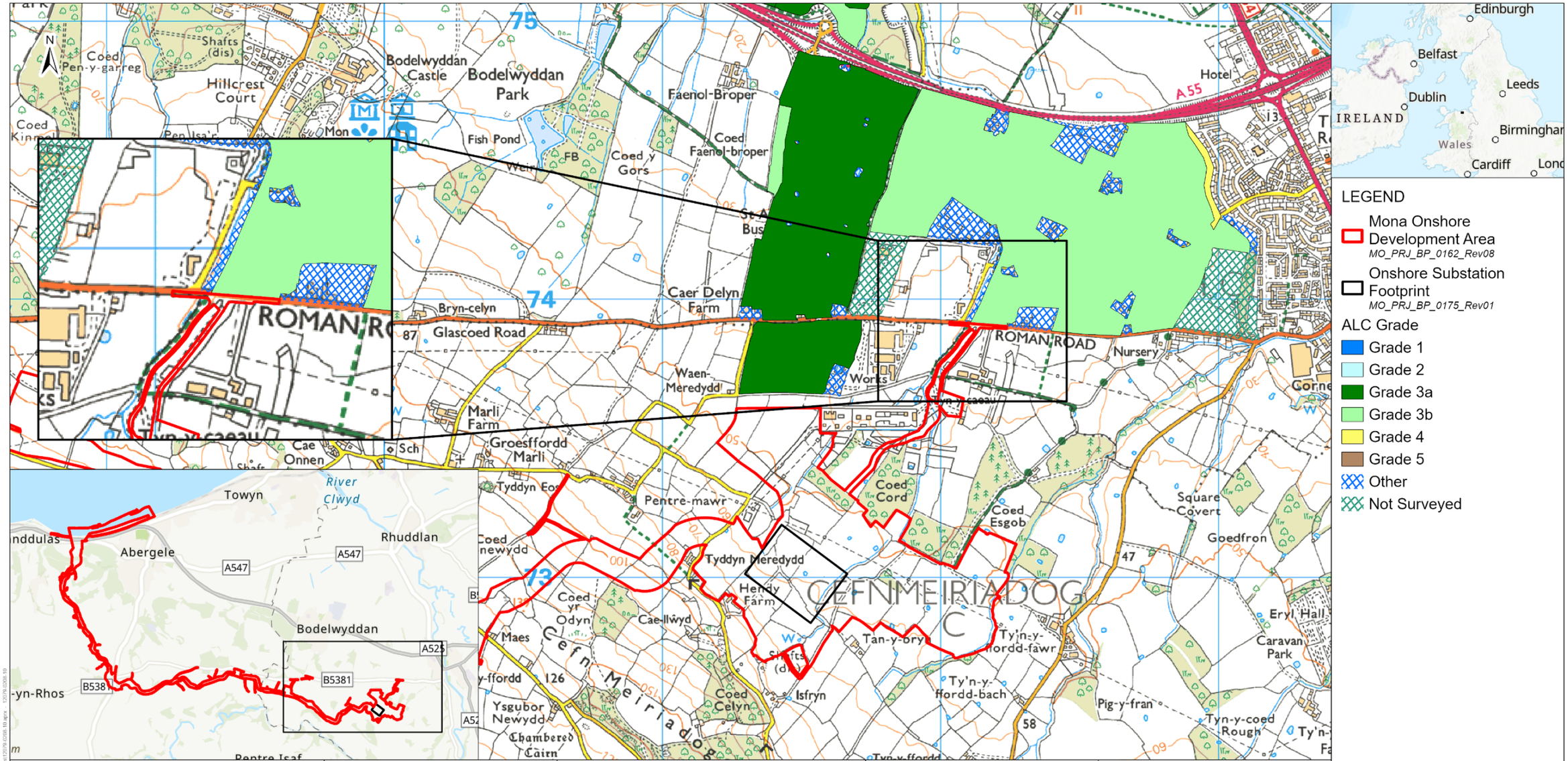

Figure 1.5: Onshore Substation and the detailed ALC.

1.6 References

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