Eco-hydrological Guidelines for Upland Peatlands and Associated Habitats

Phase 3 Report

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Report details

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Executive summary

Upland bogs cover a substantial proportion of England and Wales, are valued for their role in providing a range of ecosystem services and for the quantity of carbon they hold, and are vulnerable to ongoing environmental degradation. Developing eco-hydrological guidelines for upland peatlands is an important part of increasing their resilience to environmental change.

The approach to upland bogs has often been to view them as a single ‘type’, overlooking what can be significant differences in their characteristics. This has implications for assessments of site value, condition monitoring, restoration opportunities, and auditing carbon volumes. This report aims to improve understanding of the different types of upland bog habitat and their mechanisms of water supply and drainage, and to provide guidance on how to recognise and categorise them. It builds on earlier work to characterise lowland wetland habitats (the Wetland Framework), and a pilot study to characterise upland bog habitats (Phase 1 and Phase 2 of this project), and it has used field data and published studies from all major peatland regions of England and Wales. Remote sensing data (LiDAR) were used to evaluate sites and prepare for fieldwork, which involved collecting data from different survey areas using ranked scores for a range of surface variables. Multivariate analyses of the data helped to distinguish the main types of upland bog habitat in terms of their surface features, including vegetation types.

Two series of categories were identified: WETMECs, which are units of water supply and drainage that relate mainly to the state of the bog surfaces; and BOGCATs, which are much broader topographical units based on the overall shape of the peat body. WETMECs were the main focus of the investigation and provide the most clearly defined units. BOGCATs are more informal and provide context for the WETMECs. Data were also summarised for a range of reference sites, comprising maps, aerial images, schematic drawings, illustrative photos, and descriptions. These assisted with the development of WETMECs and BOGCATs, and serve as illustrations of the variations in surface conditions, peat depths, vegetation, and topographic features that can be seen in upland peatlands across England and Wales.

Six broad WETMECs were identified: Hill Peat, Ombrotrophic Crowns, Ombrotrophic Aprons, Ombrotrophic Bottoms, Ombrotrophic Flows, and Water Flow Tracks.
Some of these can be sub-divided: Hill Peat Slopes, and Hill Peat Slackenings and Crests.
Ombrotrophic Crowns can be split into Radial Crowns, Partial Crowns, and Hump Crowns.
There are also eroded sub-types: Hill Slope Gullies, Eroded Slackenings and Crests, and Eroded Crowns. Water Flow Tracks can be divided into Ombrotrophic and Minerotrophic forms.

BOGCATs comprise two broad types: Topogenous Bogs and Hill Bogs. Topogenous Bogs can be divided into three types: Mounded Bogs, Trough Bogs, and Sump Bogs. Within Mounded Bogs it is possible to recognise Regular, Irregular, Humped, and Ridge-Mounded Bogs.

The characteristics of each WETMEC and BOGCAT are summarised in this report and described in full detail in a separate annexe to this report, which also provides a comprehensive and valuable summary of much of the literature relating to upland bogs in England and Wales.

The ways that this project links to the lowland Wetland Framework are discussed, as are its compatibility with existing habitat assessment protocols. Streamlined field- and desk-based procedures are proposed, in order to make this approach accessible to other workers.

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1 Introduction

Peatlands cover roughly 5% of the land surface area of England, 4% of Wales, around 25% of Scotland, and 18% of Northern Ireland (IUCN, 2026), much of which occur as part of an extensive upland blanket mire landscape. Upland mires are not covered by existing eco-hydrological guidelines, and in recent years there has been a move away from target setting to an increased emphasis on restoration of natural hydrological functioning of mires in the landscape.

The approach to upland bogs has often been to view them as a single ‘type’, overlooking what can be significant differences in their characteristics. This has implications for assessments of site value, condition monitoring, restoration opportunities, and auditing peat volumes.

The development of eco-hydrological guidelines for upland peatlands is seen as an important element of any strategy that aims to restore and increase the resilience of upland peatland habitats to environmental change, and the guidelines are required to underpin the Peatland Standards for peatland restoration that are being developed by Defra.

This is a multi-year project which has been initiated by the UK Technical Advisory Group (UKTAG) Wetland Task team and led by the Environment Agency, in partnership with Scottish Environmental Protection Agency, Natural Resources Wales, Natural England, DAERA-Northern Ireland and NatureScot. Adoption of these guidelines by Arm’s Length Bodies (ALBs) will help raise the profile of the water environment within peatland restoration strategy, monitoring, and delivery.

Development of these guidelines follows the same approach as the Wetland Framework for Impact Assessment (Wheeler, Shaw, and Tanner, 2009). This phase of the project encompasses England and Wales, but there is the potential to extend the scope of the project in future to Scotland and Northern Ireland.

1.1 Aims

To improve understanding of the different types of upland bog habitat and their mechanisms of water supply and drainage, and to provide guidance on how to recognise and categorise them with regard to characteristics of vegetation, peat, and hydrology.

1.2 Objectives

- Develop and describe Wetland Water Supply Mechanisms (WETMECs) for upland bog habitats in England and Wales.
- Relate the new upland WETMECs to existing lowland WETMECs and improve accessibility of the Wetland Framework Approach to practitioners.
- Evaluate upland bog vegetation types in relation to new and existing WETMECs.
- Compare the new WETMECs and broad bog habitat categories (BOGCATs) with existing bog classification systems and tools.
- Plan the development of a User Guide and Field Protocol aimed at practitioners.

2 Approach

This phase of the project has built upon the findings and outputs of previous phases. Phase 1, carried out in 2020, was a scoping study aimed at reviewing available information that could be used to characterise the water supply mechanisms of upland mires, and relating these to the vegetation types of blanket mire landscapes (Wheeler, and others, 2020).

The second phase was a pilot study that gathered and analysed field data from a limited number of survey sites across central and northern Wales, the Southern Pennines, Forest of Bowland, and the Roman Wall Country of Northumberland and Cumbria (Wheeler, and others, 2023). Those datasets were used to begin to develop a typology of upland mire habitats by identifying their WETMECs and bog configuration types.

The current Phase 3 of this project has extended this work to encompass all major peatland regions in England and Wales, gathering additional data from Dartmoor, southern, central and north Wales, Cumbria, the North York Moors, the North Pennines, and Northumberland. Contact was made with staff from a range of organisations to evaluate existing knowledge, and a streamlined survey protocol was developed. Survey visits, where possible with staff from other organisations, were also used to test the preliminary assignment of WETMECs and BOGCATs in the field.

Data analysis has involved an iterative approach to multivariate analysis in order to modify existing WETMECs, to recognise new ones where appropriate, and to examine relationships between WETMECs, vegetation types, and existing classification schemes. To assist with this process, site survey data have been summarised to produce vegetation maps, peat depth section profiles, 3D oblique site images, and drawings to link vegetation, topography, and WETMECs. New ombrotrophic WETMECs have been described in detail with illustrative conceptual drawings.

Desk-based and field-based data-gathering approaches have been refined and used to begin the process of preparing a succinct User Guide and Field Protocol, which once developed would be available for use by interested practitioners.

In this report the Background to the project is provided in Section 3; Methods are summarised in Section 4; Results of the Vegetation Survey of blanket bogs and associated habitats in England and Wales are described in Section 5; Section 6 provides introduces the concept of Ombrotrophy (rain-fed wetland habitats); and Section 7 introduces the Classification of Ombrotrophic Habitats using WETMECs and BOGCATs, which are explained in greater detail in Sections 8 and 9.

The Discussion in Section 10 relates ombrotrophic WETMECs to other habitat assessment protocols; describes how this work links to the lowland Wetland Framework; considers the possibility of using GIS tools to predict occurrence of WETMECs; and suggests ways to streamline the survey methods and protocols for use by practitioners in future.

3 Background

Two main types of Ombrotrophic Bog have traditionally been recognised in Britain – *raised bogs* and *blanket bogs.* The term 'raised bog' came to be used as a direct translation of the German *Hochmoor*, a term used by continental ecologists, and along with 'blanket bog' became part of a peatland terminology that was "hammered out" by Tansley, Osvald and Godwin in 1935 (Godwin, 1981), and have since become widely-used (*e.g.* Ratcliffe, 1977), if not well defined. Pearsall considered that blanket bog was "a conveniently vague term for peat-forming vegetation" in moorland locations (Pearsall, 1950, *p.* 152).

In broad-brush terms, a raised bog was considered to be a feature of flattish surfaces in the lowlands, formed as a discrete, or isolated, deposit of ombrotrophic peat mounded automorphically a few metres above the level of the surrounding landscape, whilst a blanket bog was seen as a generally thinner deposit of ombrotrophic peat that sprawled across large areas of the uplands, and which both blanketed and reflected a considerable amount of variation in the sub-peat topography. This distinction was illustrated in the early approaches of the British Geological Survey, which had then only a superficial interest in peat and recognised two main categories – 'hill peat' and 'basin peat'. Of these, hill peat corresponded broadly with blanket peat, but basin peat was not specific to ombrotrophic deposits and also included much minerotrophic material.

This duopoly of types was changed in Britain by Moore & Bellamy (1974), who recognised a third type of bog as 'ridge raised mires', a concept based on examples described from the Pripet Marshes, on the border of Belarus and Ukraine, by Kulzynski (1949), in which a mound of ombrotrophic peat had coalesced across a ridge from nearby basins. An example sometimes given for this is Coom Rigg Moss (Chapman, 1964a & b; 1991) in the Roman Wall Country, but as Hall, Wells & Huckerby (1995) pointed out, it also applies equally to some of the large, drained, ombrotrophic bogs that include Chat Moss and other mosses along the west Lancashire coastal plain, which have traditionally been called raised bogs.

There has generally been little consideration of the possibility that raised bogs and blanket bogs could occur in close-juxtaposition, one sometimes embedded within the other. An exception to this was Johnson & Dunham (1963) at Moor House, who referred to areas of deeper 'basin peat' that were embedded within a wider expanse of shallower 'blanket peat'.

Some workers have favoured a geographically-based distinction of the two types. For example, Ellis & Tallis (2000) commented that: "Although sometimes regarded as a raised mire (Ratcliffe 1977; Goode 1997), Kentra Moss nevertheless occupies a situation which, topographically and climatically, is optimal for the development of an active oceanic blanket mire (Godwin 1941; Lindsay and others, 1988)", and they seem to have regarded it as such. But the outcome of this sort of approach can be circular, such that a peatland is called a blanket mire because it occupies a blanket mire climate, whilst a blanket mire climate gets defined by the presence of blanket mires.

Pearsall (1950) recognised that there were differences between some of the ombrotrophic peatlands allocated to the category of blanket bog, but he considered that there was little point in distinguishing them, and that blanket bog was a “conveniently vague” portmanteau term. However, for some purposes, such as setting conservation assessment targets, restoration objectives, or even dating the start of blanket bog formation, it is inconveniently vague, for these can vary between the different types. It took a Swedish ecologist, who made a series of pre-war visits to British mires, to state the obvious: “In some districts of the British Isles there is a gradual transition from the raised to the blanket bog, and flat areas of the latter type often have a more or less obvious dome. On these flat areas the vegetation is very similar to that of the raised bogs, but on the more sloping parts the vegetation is usually more uniform…” (Osvald, 1949).

Moore, Merryfield & Price (1984) subsequently considered that “blanket mire cannot be regarded as a single, simple vegetation type, but should be looked upon as a mire complex in which a variety of mire types become inextricably linked in an interdependent, but floristically and hydrologically diverse, series.”

However, these blanket mire types are not inextricably linked, and there are good reasons for wanting to recognize their subdivisions, not least because in upland landscapes it is often the smaller embedded types that form the biodiversity hotspots and the centres of greatest peat formation. The notion of a mire complex is not new, nor is it confined to blanket mires – many minerotrophic mires are composed of several distinctive elements, and it was to identify these in fens that the Wetland Framework project (Wheeler, Shaw and Tanner, 2009) was originally formulated.

It is thus in the spirit of Osvald’s observations that the present project has attempted to recognise and characterise different types of ombrotrophic peatland, based on their most important characteristics rather than on their apparent discreteness or geographical location. To help this process it has considered the characteristics of some lowland ombrotrophic mires as well as those examined in the uplands.

4 Methods

A summary of the methods used during the project is provided in this section. Further details are given in Annex 2.

4.1 Deskwork and preparation

4.1.1 Choice of sites

Work done during the first two phases of this project was continued, with the aim of developing a list of potential survey sites that would encompass the major upland peatland areas of England and Wales. These included known exemplar sites that had been studied in detail by other researchers, with available datasets or published information that was readily accessible. A list of potential survey locations was drawn up, and from this a short list of the most suitable sites was produced.

Survey sites had to be relatively easy to access, to ensure that each site could be visited in a single day. In addition to geographic coverage, it was necessary to include survey locations that provided a range of topographic situations and surface types, ideally with varying conditions across a single site, for example, encompassing flat ground to sloping ground, concave to convex slopes, with and without signs of erosion.

Due to time constraints, it was important that access agreements were not difficult to obtain, and consequently many survey sites were chosen because they are owned or managed by country agencies or conservation organizations. Some difficulties were encountered when trying to obtain access permission from sporting estates.

In total, 62 sites were visited during field visits from 2022–2025, and several additional sites were considered in desk-based assessments. The locations of these study sites are shown in Figure 1. Sites that were visited are shown with black circles, and those not visited but where published data were used are shown as white circles with labels.

A full list of all study sites with summary environmental and climatic data associated with them are presented in Annexe 1.

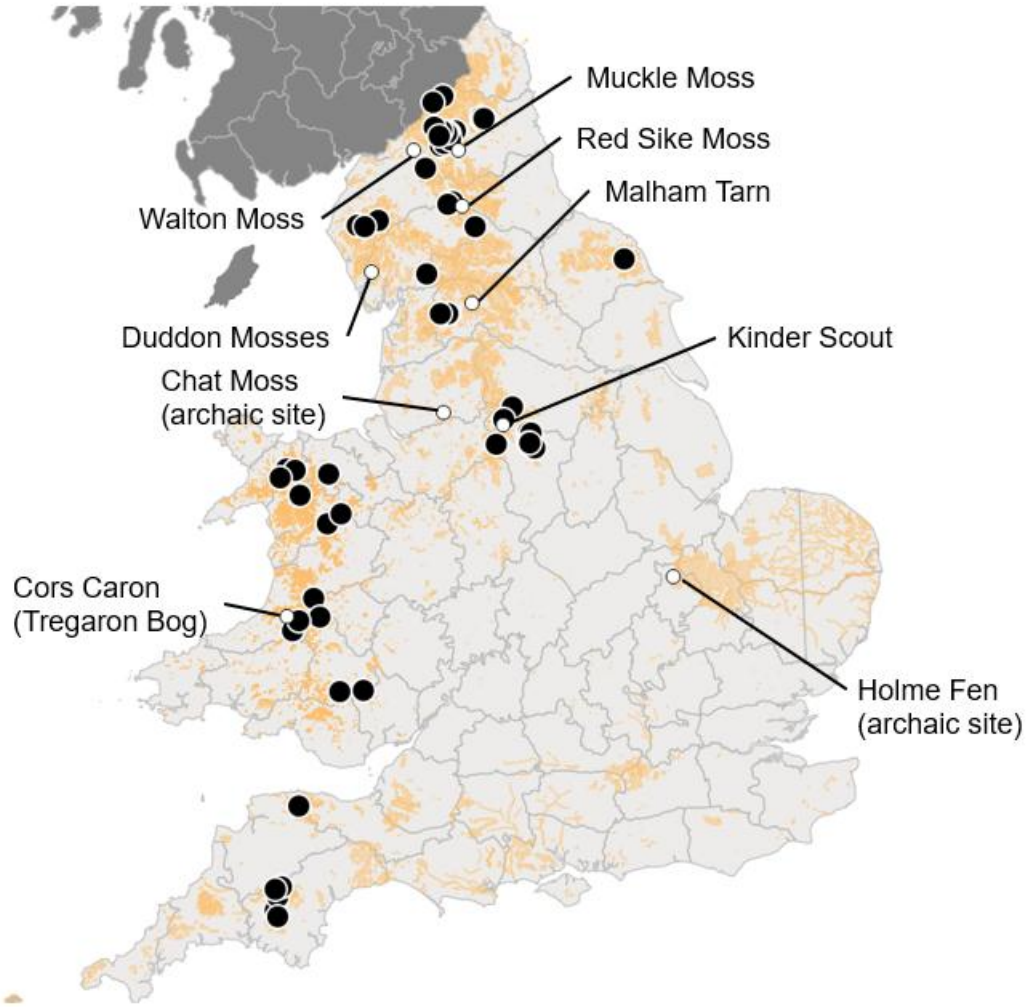


Figure 1. Study sites of the blanket bog eco-hydrological guidelines project 2022–2025.

Note: the background map shows vice-county boundaries and regions of peaty soils. Peat data are derived from the England Peat Map © Natural England 2025, and from the Peatlands of Wales Map © Welsh Government 2022, licensed under the Open Government Licence v3.0.

Sites that were visited are shown with black circles, and those not visited but where published data were used are shown as white circles with labels

4.1.2 Preparation for site visits

For each survey location, deskwork prior to field visits comprised the following actions (additional details are provided in Annexe 2).

Where available, a digital terrain model (DTM) was downloaded from national datasets. The survey area and its immediate surroundings were clipped out using GIS tools to reduce processing time, and the DTM was used to project a hillshade model and surface contour lines at 1m intervals. Any available vegetation survey data or peat depth data were also projected on the GIS.

An additional visual aid was the 3D terrain imagery tool in Google Earth Pro, which was used to produce oblique 3D images of each site.

Other existing site information from published journal articles and previous site reports, such as site descriptions, vegetation descriptions, and peat stratigraphic profiles, was used to provide context.

These resources were used to identify variations in topography and areas of potential interest, and to decide on possible transect routes across the survey site. Information gathered along a transect can be used to produce profile drawings, which are particularly informative in illustrating changing surface conditions and peat depths. Transects are best placed so as to include a range of likely conditions and features, and can be changed if necessary when in the field, if it becomes clear that a different route would provide more information. The value of transect-based surveys is usually much increased if a second transect can be followed that is orthogonal to the first transect (that is, roughly at 90 degrees to it). Sometimes several shorter transects were followed on especially varied sites.

Prior to undertaking the fieldwork, GIS layers were loaded onto a tablet to aid mapping in the field. A route was planned to allow for the most efficient survey, minimising effort required to reach the site from the nearest access point; this was particularly important for some remote locations.

4.2 Fieldwork

Analyses undertaken of the Phase 2 field data showed that a subset of the fieldwork variables provided the most useful information to describe component habitats. As a consequence, the fieldwork survey methodology was revised to streamline the data-gathering process and make the method more accessible. The survey variables recorded at each sample point are listed in Table 1; greater detail is provided in Annexe 3.

Site visits used the prepared GIS maps and proposed transect lines to devise an efficient route across each site, aiming to take in obvious differences in surface characteristics. However, where necessary the proposed transect lines and sample points were modified in the field to ensure the best coverage of the site.

At each sample point the survey parameters were recorded on a spreadsheet. Most of the parameters comprise a ranked score and are fairly rapid to complete. To assess vegetation type, a quadrat was recorded with Domin scores[1] for all vascular plants and bryophytes. The nomenclature for higher plants follows Stace (2019), and Atherton and others (2010) for bryophytes.

A handheld pH meter was used to record the pH of surface water where it was available. In addition, notes were recorded to describe each location so as to provide additional information, and representative digital photographs were taken for a visual reminder of the site in general.

It was also important to gather data from some locations not on the transects, so as to provide site context and to facilitate mapping of vegetation types and WETMEC units. Sometimes, due to limitations of time, the additional sample points were restricted to evaluating vegetation type and peat depth, particularly where other conditions appeared similar to nearby sample points.

Table 1. Survey variables and scoring systems used during the bog surveys.

Variable	Recording details
Peat depth (m)	Using peat probes
Surface configuration	Rank score 1 to 6 (water shedding to collecting)
Slope	Rank score 1 to 5 (flat to steep) estimated in field; verified using GIS to provide % and ratio (e.g. 1 in 50)
Water pH & electrical conductivity	Used handheld meter where free water is present
Vegetation type	Quadrat record, plants & bryophytes, Domin score
Surface wetness	Rank score 1 to 9 (very dry to deep swamp)
Surface softness	Rank score 1 to 6 (solid to floating)
Sphagnum abundance	Rank score 0 to 4 (absent to abundant)
Heather abundance	Rank score 0 to 4 (absent to abundant)
Surface patterning	Rank score 0 to 5 (absent to strong features)
Hummock diversity	Types T1 to T4 (small low to very tall hummocks), each with frequency score 0 to 4 (absent to abundant)
Pool diversity	Types A1 to A5 (wet hollows to very deep pools), each with frequency score 0 to 4 (absent to abundant)
Tussock diversity	Types U2 to U4 (low tussocks to very tall tussocks), each with frequency score 0 to 4 (absent to abundant)
Water flow within stand	Rank score 0 to 5 (absent to streaming)
Erosion features	Rank score 0 to 5 (absent to deep active erosion)

[1] Domin cover values: **1:** <4% cover, with few individuals. **2:** <4% cover, with several individuals. **3:** <4% cover, with many individuals. **4:** 4-10% cover. **5:** 11-25% cover. **6:** 26-33% cover. **7:** 34-50% cover. **8:** 51-75% cover. **9:** 76-90% cover. **10:** 91-100% cover

Variable	Recording details
Erosion amplitude	Types E1 to E5 (small features to deep gullies with mineral ground exposed), each with frequency score 0 to 4 (absent to abundant)
Restoration activity	Presence or absence, plus notes
Proximity to gullies or ditches	Rank score 0 to 5 (absent to adjoining)
Level above gully or ditch	Rank score 0 to 5 (absent to >2m above gully base)
Peat stratigraphy	Using peat auger, top 1m split into upper 30cm and lower 70cm, macro-fossil description & von Post score. Only selected samples recorded.
Peat permeability	Rank score 1 to 7 (stiff silt to loose rhizomes)
Basal substratum permeability	Rank score 1 to 7 (clay/bedrock to coarse gravel)

4.3 Data collation and analysis

Spreadsheet data for each site surveyed during 2025 were quality assured and collated onto a single spreadsheet. The results from previous surveys in 2022 and 2023 were added to this dataset, and sub-sets of data were used in various analyses (Table 2).

Vegetation quadrat sample data were sorted, quality assured, and collated separately from the other surface characteristics. Vegetation data were analysed using the MATCH software (Malloch, 1992) to aid with their classification and checked against the published National Vegetation Classification (NVC) community descriptions (Rodwell, 1991) and other published accounts (Wheeler, Shaw & Tanner, 2009; Mountford, 2011).

Many stands were not well aligned with published NVC units, and in cases where the published descriptions and field experience of the surveyor conflicted with the MATCH outputs, surveyor experience usually outweighed the MATCH outputs when choosing the most appropriate vegetation type. Where unusual vegetation types were encountered that could not be easily assigned to a single NVC community, these have either been described as intermediate between two or more types, or have been compared with vegetation types described by other workers as falling beyond the current scope of the published NVC accounts (see Mountford 2011). The vegetation dataset was also compared to the Irish Vegetation Classification (IVC, 2015) using the ERICA classification tool.

The collated vegetation sample dataset (353 quadrat samples) was also analysed using multivariate Detrended Correspondence Analysis (DCA), and the surface characteristics of a subset of 300 samples representative of the range of habitats sampled across the regions were also subjected to multivariate analysis using DCA and Clustering Analysis techniques, using the computer programmes CANOCO and CLUSTAN.

The approximate altitude of each sample was derived from LiDAR. Modelled Rainfall and Potential Evapotranspiration (PET) data were provided for each sample by the Environment Agency (based on Met Office data and modelled data, Hollis and others

2018, Tanguy and others 2019); annual averages over 65 years (January 1961 – December 2025) were calculated for each sample.

Table 2. Dataset outputs and their use in data analyses.

File name	Brief description	Number of samples	notes
BogEco_Veg_22May2026	Vegetation dataset – quadrats	355	Samples from 2022, 2023 and 2025 surveys Used in vegetation DCA analysis
BogEco_Samples_All_22May2026	Eco-hydrological samples full collated dataset	473	Includes climate data supplied by EA Includes summary information for sites.
BogEco_Samples_Sub_22May2026	Eco-hydrological samples dataset sub-set	300	Sub-set of 300 samples used in WETMEC DCA and cluster analysis

4.4 Use of reference sites

Summaries of the data gathered were produced for a range of reference sites across the main peatland areas of England and Wales, comprising site maps, aerial images, schematic section drawings, illustrative photos, and summary descriptions. These qualitative data were used in conjunction with multivariate analyses of the dataset to assist with the development of the WETMECs and BOGCATs. Reference site studies also provide helpful illustrations of the variations in surface conditions, peat depths, topographic characteristics, and the identified WETMECs and BOGCATs across the regions that were studied.

Data for a selection of reference sites is provided in Annexe 5.

5 Vegetation of blanket bog and associated habitats in England and Wales

Quadrat data recorded in 2022, 2023 and 2025 for 353 samples from 62 sites in England and Wales formed the basis of the vegetation analysis. A vegetation type (NVC community or related type) was assigned to 472 samples recorded in the full WETMEC dataset.

Most stands of vegetation (habitat patches) are distinctive and can be allocated to one NVC community, but some types of vegetation are species-poor, share a similar suite of species and intergrade, so it can be difficult to allocate these to a specific NVC community.

NVC sub-communities described in the published accounts (Rodwell, 1991) do not always represent the most obvious patterns of floristic and ecological variation observed in the field, particularly where vegetation has been much modified (Averis and others, 2004). Various workers have described variants that they have encountered frequently and from locations that were not included in the original NVC dataset (Averis and others, 2004; O'Reilly, 2011; Turner, 2010 and 2017; Mountford, 2011). In some vegetation types structural variation is sometimes more striking than floristic variation (Lindsay, 2010 and 2025; Fernandez and others, 2012) so the present project distinguishes some distinctive sub-types of NVC communities based on field observations, which may relate more clearly to ecological conditions than sub-communities. These include *Sphagnum*-rich (_S), *Molinia*-rich (_M), and species-poor (_P) sub-types, and two basal communities dominated by heather (Heath D) or purple moor-grass (Molinia D).

In the present project, most samples could be allocated to an NVC community fairly easily but there were some exceptions. Several samples had clear affinities to more than one NVC community, in particular there were a large number of samples which could not be clearly allocated to either M18 or M19 mire types, or their sub-communities. This transitional type is distinctive in the field and occurs alongside clear examples of M18 and M19. Samples from this type of vegetation were labelled M18/M19, with the intention of encouraging practitioners to record this type of transitional vegetation more consistently.

Some samples were very species poor and dominated by a few species which are common to several different plant communities of heaths and grasslands. These species-poor vegetation types were regarded as basal vegetation (Rodwell and others, 2000) and were labelled according to the dominant type: *Molinia* D (dominated by purple moor grass) and Heath D (dominated by heath species, mainly heather but sometimes bilberry).

The vegetation types recorded are briefly described in Table 3 and prototype synoptic accounts for M17, M18, and M19 (the main vegetation types found on intact ombrotrophic peatlands) are presented in Annex 6. The geographical distribution of M17, M18 and M19 in the vegetation dataset is shown in Figure 2 as well as records of M18 from England and Wales inventory data. Figure 3 shows the results of the multivariate DCA analysis for 353 samples of vegetation associated with blanket bog landscapes in England and Wales, and

a summary of the relationships between vegetation types, environmental conditions and variables recorded in the field is presented in Table 4 and Table 5.

Table 3. Summary descriptions of the vegetation types frequently encountered in blanket bog landscapes in England and Wales.

NVC	Vegetation type NVC plant community / sub-type
Code	**Brief description**
M1	***Sphagnum denticulatum* community**
Mixtures of *Sphagnum denticulatum* and *S. cuspidatum* in pools and water flow tracks. Can have sparse bog bean, bladderworts and bog pondweed. White beak sedge frequently forms a marginal fringe. Often embedded within more extensive bog habitats.	
M2	***Sphagnum cuspidatum* community**
Sphagnum cuspidatum and/or *S. fallax* forming extensive carpets in hollows and pools. White beak sedge frequently forms a marginal fringe. Frequently occurs with M18, in hummock–hollow complexes.	
M3	**Common cottongrass (*Eriophorum angustifolium*) community**
Patchy common cottongrass. Bryophytes sometimes form sparse patches – mainly *Drepanocladus fluitans*, or tufts of *Sphagnum cuspidatum*. Often found recolonising eroded peat. Bryophytes are often completely absent.	
M15	**Deergrass (*Trichophorum germanicum*) – cross leaved heath (*Erica tetralix*) community**
Variable vegetation with mixtures of deergrass, purple moor grass, cross-leaved heath, heather, with sedges and grasses and rushes over a ground layer with patchy bryophytes, often including scattered *Sphagnum capillifolium*. Generally on marginal areas on shallow peat.	
M17	**Deergrass (*Trichophorum germanicum*) – cottongrass (*Eriophorum* spp.) community**
Mixed sward of deergrass, common cotton-grass, hare's tail cottongrass (often at low cover), purple moor grass, heather, cross-leaved heath, bog asphodel; over ground layer with *Sphagnum* (mainly *S. papillosum* and *S. capillifolium*). *Sphagnum medium (*former name *S. magellanicum)* is distinctive in some flat, wet areas with pools. Round-leaved sundew, tormentil and milkwort are frequent. Hummocks of the moss *Racomitrum lanuginosum* are distinctive in some locations. White-beaked sedge often occurs in wet areas around pools and hollows. Star sedge, common sedge, carnation sedge and devil's bit scabious are sometimes present in marginal areas and transitions to wet heath and acid grassland. Heath rush can also be prominent at higher altitudes and in transitions to wet heath and acid grasslands.	
M17_S	This sub-type has pronounced microtopography with hummocks, hollows and a soft wet substratum dominated by *Sphagnum* in hollows, around pools and in low hummocks. Pleurocarpous mosses are also abundant. Often embedded in more uniform types of M17.
M17_M	*Molinia*-rich form has a taller sward with abundant purple moor-grass, but not usually forming tussocks, and a sparser representation of M17 species, with *Sphagnum* only occasional or localised.
M18	**Cross-leaved heath (*Erica tetralix*) – *Sphagnum papillosum* community**
Mixed, often quite open, vegetation made up of heather, cross-leaved heath and cottongrasses over a ground layer dominated by *Sphagnum* – typically *Sphagnum papillosum* but often accompanied by a range of other species including *S. capillifolium, S. cuspidatum, S. fallax*, and *S. tenellum.* *S. medium* is a distinctive species characteristic of this vegetation and is often abundant; bog rosemary is also strongly associated with this type of vegetation, within its range. Cranberry, deergrass, bog asphodel, and purple moor-grass can be frequent. White beak sedge sometimes occurs locally In wetter areas around the edges of soakways and pools. Bushy lichens can be prominent on hummocks.	

NVC	Vegetation type NVC plant community / sub-type
Code	**Brief description**
M18_S	*Sphagnum*-rich form with spongy more or less continuous ground layer of *Sphagnum*. Bog rosemary and/or *Sphagnum medium* often present and abundant but may be absent.
M18_M	*Molinia*-rich form; purple moor-grass is often tussocky.
M18/M19	**M18/M19 vegetation transitional between M18 and M19 communities**
Vegetation is a mixture of heather (which can be abundant), cross-leaved heath, tussocks of hare's tail cottongrass, deergrass and common cottongrass. Other dwarf shrubs (crowberry and bilberry) are more scattered, and patches of bog asphodel may be locally abundant. The ground layer is a mixture of pleurocarpous mosses and *Sphagnum* patches. Cranberry often occurs straggling over the bryophyte layer and there are sometimes patches of bushy lichens. Bog rosemary and *Sphagnum medium* may or may not be present.	
M19	**Heather (*Calluna vulgaris*) – cottongrass (*Eriophorum vaginatum*) community**
Vegetation is dominated by mixtures of heather and hare's tail cottongrass with a very variable range of associates including bilberry, crowberry, cowberry, common cottongrass and wavy hair grass. Cloudberry is distinctive but does not occur in all stands. Pleurocarpous mosses are often abundant with *Hypnum jutlandicum* and *Pleurozium schreberi* most prominent. *Sphagnum capillifolium* is usually present and sometimes abundant, forming large hummocks (see M19_S sub-type). Scattered patches of a wide range of *Sphagnum* species are often present (including *S. fallax, S. fimbriatum, S. papillosum, S. subnitens*).	
M19_S	*Sphagnum*-rich form with large hummocks of *Sphagnum capillifolium*, often with bushy lichens (*Cladonia* spp.). Other *Sphagnum* species may be present but at lower cover.
M19_P	Species-poor heather and hare's-tail cottongrass-dominated vegetation, with few other species at very low cover. Moss layer generally poorly developed and generally with no *Sphagnum*, or only very rare patches.
M19_M	*Molinia*-rich form – tends to be rather species-poor.
M20	**Hare's-tail cottongrass (*Eriophorum vaginatum*) community**
Vegetation dominated by hare's-tail cottongrass (usually tussocky).	
M20_S	Tussocky hare's tail cottongrass (sometimes with purple moor-grass), with *Sphagnum cuspidatum, S. fallax, Polytrichum commune*, sometimes with abundant cranberry. Widespread and typically occurs in lagg zones, soakways and wet areas.
Heath D	**Heather (*Calluna vulgaris*) dominated basal community**
Dominated by heather and heathland species with few other species (e.g. scattered tufts of cottongrasses and pleurocarpous mosses); vegetation is similar to NVC communities H9 and H12 but occurs on deep peat. Often very species-poor. Usually has a dry surface, damaged by repeated burning and drainage.	
Molinia D	**Purple moor grass (*Molinia caerulea*) dominated basal community**
Very tussocky and species-poor purple moor-grass vegetation on deep peat (more than 0.3m, occasionally up to 5m deep) that on careful searching shows occasional examples of the commonest bog species, such as cross-leaved heath, cottongrasses, deergrass, bog asphodel, tormentil, scattered *Sphagnum*.	
M21	**Bog asphodel (*Narthecium ossifragum*) – *Sphagnum papillosum* community**
Similar to M18: a sparse sward over abundant *Sphagnum* ground layer; but with deergrass and hare's tail cottongrass absent (or low cover) and lacks bog rosemary. Occurrence of many-stalked spike rush and *Sphagnum denticulatum* may help to differentiate from M18. Occurs in troughs and valleyhead situations.	
M4	**Bottle sedge (*Carex rostrata*) – *Sphagnum fallax* community**
Usually small patches dominated by bottle sedge mixed with *Sphagnum fallax;* sometimes *Polytrichum commune, Sphagnum denticulatum* or *Sphagnum cuspidatum;* can be mixed with other species such as common cottongrass, lesser spearwort, soft rush, purple moor-grass. Occurs in soakways or in lagg zones. Some examples may be irrigated by base-poor groundwater seepage.	

NVC	Vegetation type NVC plant community / sub-type
Code	**Brief description**
M6	**Star sedge (*Carex echinata*) – *Sphagnum denticulatum/fallax* communities**
Variable vegetation with mixtures of sedges and rushes over a wet layer of *Sphagnum* (typically including much *Sphagnum fallax*, *S. palustre*, and/or *S. denticulatum),* often with *Polytrichum commune*, around springs, seepages and water flow tracks. Usually has some minerotrophic input. Sometimes associated with patches of greater tussock sedge (see S3 *Carex paniculata* swamp). Low growing sub-communities (M6a and M6b) have an open sward of short sedges, common cottongrass and small rushes over *Sphagnum fallax*, *S. palustre*, and/or *Sphagnum denticulatum* Sub-communities dominated by taller rushes (*Juncus effusus* and *J. acutiflorus*; M6c and M6d) over a wet layer of *S. fallax* usually with much *Polytrichum commune*. Bottle sedge can also be quite prominent in wetter areas so this community can sometimes be transitional to M4.	
Neutral flush	**Common sedge (*Carex nigra*) – lesser spearwort (*Ranunculus flammula*) community**
Similar to M6 but lacking *Sphagnum*, with a short sward made up of small sedges and rushes (for example flea sedge, star sedge, common sedge) accompanied by herbs such as marsh violet and marsh pennywort, over a mossy ground layer (*Calliergonella cuspidata* and *Brachythecium* spp.).	
M14	**Black bog rush (*Schoenus nigricans*) – bog asphodel (*Narthecium ossifragum*) community**
Soakways with slender sedges and spike rushes over *Sphagnum* and golden-brown mosses indicating more base-rich conditions. Very localised at the margins of bogs or in soakways with wet heath or M21.	
M23	**Sharp flowered rush / soft rush (*Juncus acutiflorus / effusus*) – marsh bedstraw (*Galium palustre*) community**
Vegetation dominated by soft rush and /or sharp flowered rush accompanied by a range of herbs. Bryophytes generally quite sparse and *Sphagnum* only patchy. Widespread around streams and flow tracks where they grade into grasslands / pastures. Can form intricate mosaic with patches of M6c or M6d.	
M25	**Purple moor grass (*Molinia caerulea*) – tormentil (*Potentilla erecta*) community**
Species-poor purple moor-grass dominated vegetation occurring on bogs has often been labelled as M25 but may be better described as a basal community (*Molinia* D) associated with a particular habitat (linked to environmental factors such as peat depth). M25a (*Erica tetralix* sub-community) is a type of vegetation with mixtures of purple moor-grass, rushes, dwarf shrubs, sedges and herbs which occurs on the margins of wetter areas, usually on fairly thin peaty soils where there is some minerotrophic input of base-poor water.	
M29	**Marsh St John's-wort (*Hypericum elodes*) – bog pondweed (*Potamogeton polygonifolius*) community**
Very wet channels with marsh St John's-wort (in geographical regions where it occurs), bog pondweed, many-stalked spike rush and a range of associates, including many sedges and rushes also present in M6. Occurs in water flow tracks, often flanked by M21 vegetation.	
M37	***Palustriella commutata / falcata* community**
Springs and flushes, usually very localised with distinctive golden-brown mosses – *Palustriella commutata* and/or *Palustriella falcata*. Found around outflows from calcareous seepages associated with limestone outcrops embedded in blanket bog. May form tufa.	
S3	**Greater tussock sedge (*Carex paniculata*) community**
Greater tussock sedge is sometimes present as small patches in wet areas associated with M4 and M6 vegetation, also occasionally with M21 mire; but it is very distinctive and has not generally been described as part of these communities, so it tends to be allocated to S3.	

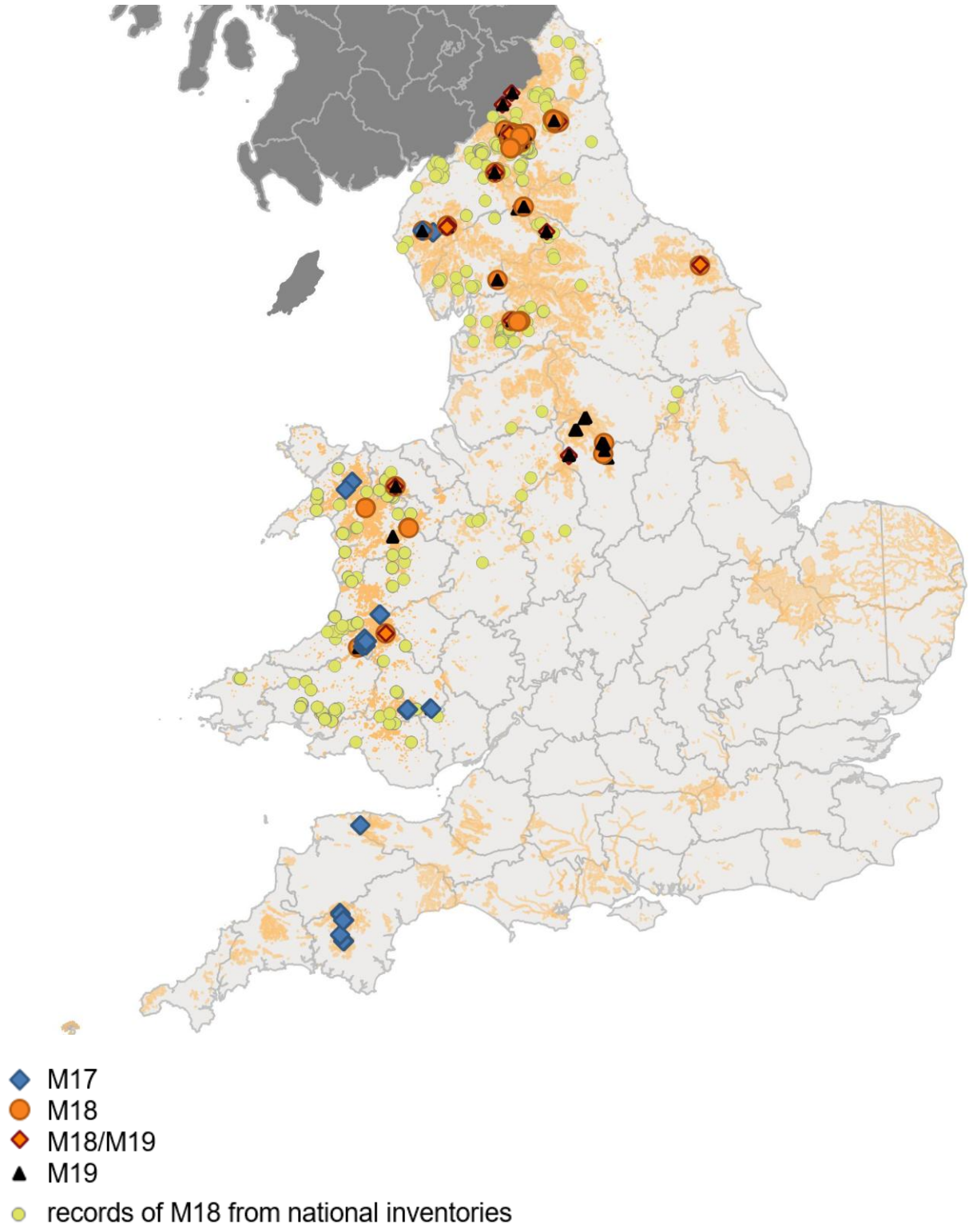


Figure 2. Distribution of M17, M18, M19 communities in vegetation dataset; and records of M18 from England and Wales inventory data.

Note: the background map shows vice-county boundaries and regions of peaty soils. Peat data are derived from the England Peat Map © Natural England 2025, and from the Peatlands of Wales Map © Welsh Government 2022, licensed under the Open Government Licence v3.0.

Multivariate analysis shows the close and intergrading relationships between many of the vegetation types found in the samples recorded from ombrotrophic bog (Figure 3), with a clear gap between samples from extensive peatland surfaces (M17, M18, M19) on the left hand side of the plot, with water flow tracks supporting much bottle sedge and soft rush (M4 and M6), on the right hand side. Between these are M1, M20, M21 and purple moor-grass-dominated vegetation. The arrangement of the samples in the diagram suggests that the horizontal axis represents a gradient from predominantly rain-fed (ombrotrophic) habitats on the left-hand side to habitats irrigated by more mineral rich water on the right-hand side. The vertical axis suggests wetter habitats towards the top and drier towards the bottom.

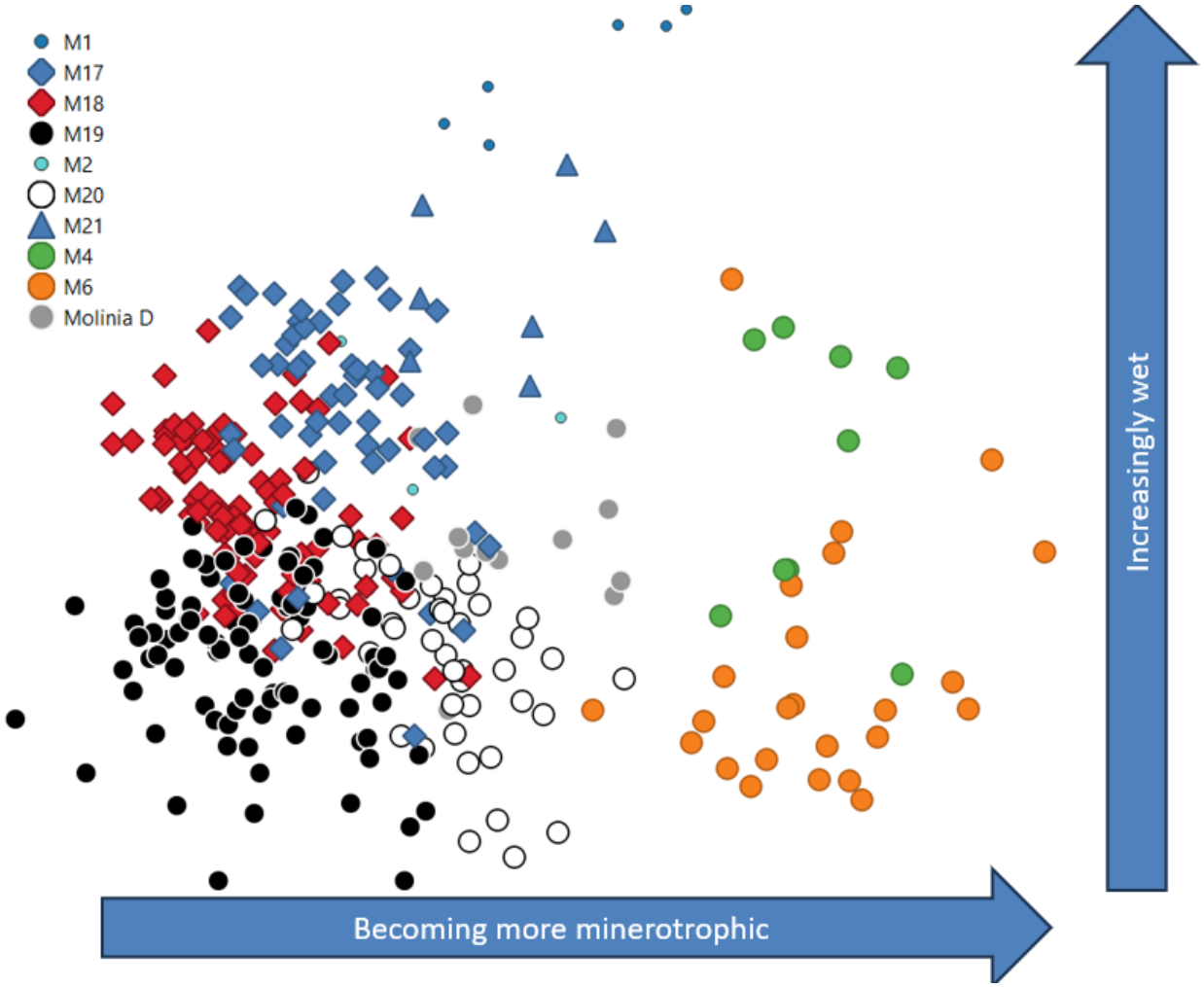


Figure 3. DCA plot of 353 samples of vegetation associated with blanket bog landscapes in England and Wales (recorded in 2022, 2023 and 2025).

Table 4. Summary of mean variable scores associated with vegetation types recorded in 472 samples from blanket bog landscapes in England and Wales.

Details of variables are given in Note 1, below Table 5.

NVC com	n	slope %	Peat depth (m)	Sphagnum	Heather	Wetness	Softness	Hum Hol	Tuss	Flow	Altitude (m aOD)	Rain (mm)	PET (mm)	pH	EC
M17	55	3.5	2.97	3.1	0.7	4.4	2.6	3.6	1.3	0.4	469	2199	475	4.0	54
M18	93	1.3	4.37	3.7	1.4	4.7	3.1	6.1	0.4	0.5	325	1310	485	4.1	65
M18/M19	40	2.1	3.55	3.4	2.1	4.2	2.6	4.2	0.8	0.4	370	1331	479	3.9	72
M19	94	5.0	2.35	1.9	2.3	3.7	2.2	3.0	1.1	0.5	431	1486	478	4.0	73
M20	57	3.1	1.89	2.5	0.5	4.3	2.4	1.6	3.3	0.7	332	1254	489	3.9	80
M21	10	2.7	3.03	3.8	0.4	5.2	4.4	2.2	1.0	2.2	405	1766	479	4.3	50
M1	5	0.9	4.08	4.0	0.0	5.3	3.8	5.3	0.0	2.3	447	1878	470	4.2	40
M2	5	0.6	4.96	4.0	0.8	6.0	4.4	3.8	0.6	0.8	375	1383	494	3.9	56
M4	16	3.3	2.02	3.7	0.1	5.3	3.4	1.4	0.0	2.1	377	1685	482	4.4	49
M6	52	4.7	1.04	3.0	0.1	5.0	3.2	1.3	0.8	2.3	350	1433	490	4.5	73
Heath D	11	8.2	2.05	0.0	3.6	2.3	1.7	0.8	0.0	0.6	407	1364	488	4.1	90
Molinia D	18	5.2	1.43	1.2	0.4	3.9	2.2	0.3	3.9	1.3	381	1590	494	4.1	64
S3	2	–	3.10	0.0	0.0	5.0	5.0	3.0	4.0	2.0	348	1468	514	5.6	90
S27	1	–	1.00	0.0	0.0	5.0	5.0	0.0	0.0	2.0	186	1507	514	6.5	90
M14	1	1.4	2.40	4.0	0.0	5.0	3.0	3.0	0.0	2.0	185	1507	514	6.2	100
M22	1	–	1.20	2.0	0.0	4.0	2.0	0.0	0.0	0.0	184	1507	514	6.0	110
M23	4	2.8	0.76	0.0	0.0	4.3	1.8	0.0	0.5	1.0	287	1054	528	4.8	90
M29	7	2.6	1.39	–	–	–	–	–	–	–	309	1715	497	5.5	88

Table 5. Summary of mean variable scores associated with ombrotrophic vegetation sub-types recorded in 327 samples from blanket bog landscapes in England and Wales.

Veg type	n	slope %	Peat depth (m)	Sphagnum	Heather	Wetness	Softness	Hum Hol	Tuss	Flow	Altitude (m aOD)	Rain (mm)	PET (mm)	pH	EC
M17	28	4.1	2.65	3.3	0.8	4.4	2.6	3.0	1.3	0.5	459	2358	472	3.8	59
M17_M	14	4.2	2.08	1.8	0.4	3.9	2.1	0.7	2.1	0.2	464	2056	481	–	–
M17_S	13	1.4	4.72	3.9	0.9	5.0	3.3	8.1	0.3	0.6	497	2008	475	4.3	45
M18	24	1.8	3.83	3.4	1.5	4.5	2.7	5.8	0.7	0.5	349	1474	483	4.2	70
M18_S	58	1.1	4.93	4.0	1.5	4.8	3.3	6.6	0.1	0.5	315	1226	485	4.0	63
M18_M	5	3.0	2.80	2.4	0.6	4.2	2.2	2.8	3.4	0.6	303	1354	500	4.4	53
M18/M19	46	2.1	3.46	3.4	2.1	4.3	2.7	4.5	0.7	0.5	359	1323	482	4.0	71
M19	41	7.4	1.97	1.6	2.3	3.6	2.1	2.2	1.1	0.4	434	1513	470	3.9	82
M19_S	24	3.4	2.66	3.1	2.5	4.0	2.4	4.6	0.7	0.6	452	1565	470	3.9	68
M19_P	17	3.8	2.33	0.7	2.2	3.9	1.9	2.7	0.7	0.3	450	1381	495	4.0	76
M20	16	4.2	1.50	1.8	0.6	4.1	2.1	1.9	3.6	0.5	376	1382	482	3.9	88
M20_M	11	3.5	1.92	1.7	0.1	4.0	2.0	1.7	3.5	0.6	269	1106	499	4.2	48
M20_S	30	2.5	2.09	3.2	0.6	4.5	2.6	1.4	3.1	0.8	332	1240	489	3.9	84

Note 1. Variables recorded for each sample (see Annexe 3 for details):

- Gradient of slope (%)
- Peat depth (m) (total depth, not thickness of ombrotrophic peat)
- *Sphagnum* abundance (rank 0–4, absent to abundant)
- Heather abundance (rank 0–4, absent to abundant)
- Surface wetness (rank 1–9, dry to deep swamp)
- Surface softness (rank 1–6, firm to quaking)
- Hummock–Hollow index (sum of abundance scores of hummocks, hollows and pools)
- Tussock index (sum of abundance score of tussock types)
- Water flow (rank 0–5, no visible flow to streaming)
- Erosion (sum of abundance score of erosion features)
- Drain/ditch/gully proximity (rank 0–5, none to adjoining/within)
- Surface configuration (rank 1–6, water shedding to water collecting)
- Altitude estimated from LiDAR;
- Rainfall annual averages (mm) from Environment Agency data.
- PET (Potential Evapotranspiration) annual averages (mm) from Environment Agency data.

6 Ombrotrophic bogs

This report covers the characteristics, characterisation and occurrence of ombrotrophic bogs in the uplands of England and Wales, based on field survey and literature sources.

Ombrotrophic bogs are important features of the landscape in parts of England and Wales, both in the uplands and some of the lowlands. They are peat-based wetlands in which the upper layers of peat and the peat surface (but sometimes the entire deposit) have formed under the direct and more-or-less exclusive influence of precipitation. This separates them from other peatlands (often referred to as fens) in which telluric[2] water sources also contribute to surface conditions. The two broad categories of bog and fen have been very widely recognised but are not always easy to distinguish (Table 6; Box 1; for a more detailed discussion, see Annexe 7).

Because of their dependence on cool, wet climates, ombrotrophic bogs are important and extensive features of the British landscape. Ombrotrophic peats are of variable depth. There is no clear point of separation between such peats (which are often designated as 'organic soils') and mineral soils with a strongly organic surface, as found in some peaty gleys and peaty podsols. The maximum peat depth measured during this project was about 10 m, but not all of this was ombrotrophic.

Ombrotrophic peats are generally of low fertility and highly acidic. Their particularly high acidity (often pH 4 or less) appears partly to be a product of 'acid rain', but as it is also a feature of bogs in parts of the world where the rainfall pH is sub-neutral (around 5.5), it is thought to be largely a consequence of cation-exchange with the water (proton donation) by plants of *Sphagnum.* "Most species of *Sphagnum* flourish only in places where they are entirely dependent on precipitation which they would, naturally, make about as acid as acid rain" (Clymo, Kramer & Hammerton, 1984), although this cause of acidic surface conditions is not applicable to the large areas of acidic peatland which nowadays support only small amounts of *Sphagnum.*

Ombrotrophic peatlands occur over a surprisingly wide bioclimatic range in lowland England and Wales, including the driest and warmest zones as mapped by Bendelow and Hartnup (1980). In the uplands they are associated with areas of high rainfall and low evapotranspiration, because this is the nature of upland climates. Attempts to specify their climatic limits are generally based on the conditions thought to be present at the locations where they now occur, rather than on a more fundamental assessment of their eco-hydrological requirements. Annexe 1 lists the climatic conditions associated with the ombrotrophic peatland sites studied in this project, several of which lie beyond the suggested thresholds required for the formation of blanket peat (Tallis, 1998).

[2] Water that has been in contact with the mineral ground; includes groundwater and surface water.

6.1 The concept of ombrotrophy

6.1.1 Peatland categories and ombrotrophy

Peatlands in England and Wales, both in the uplands and lowlands, have developed primarily in locations that are (or once were) persistently wet. The causes of their wetness are normally either because of impeded drainage of water in their location, or as a consequence of high and consistent rates of water supply, or both. The water that helps to provide these conditions at the surface may be more-or-less exclusively meteoric (precipitation) or meteoric mixed in varying proportions with telluric water (of variable hydrochemical character). This simple categorisation of peatlands can be related to some terms widely used by telmatologists[3], that is, *topogenous* ('topography made'), *ombrogenous* ('rain made') and *soligenous* ('soil made'). These terms are not always used with exactly the same compass by different workers (especially in the case of soligenous), but a simple rationalisation of their meaning and use is suggested in Table 6.

Table 6. Main categories of peatland in relation to the principal reasons for the wetness of their sites or surfaces.

Reason for wetness	Telluric and meteoric water supply (Minerotrophic) FEN	More-or-less exclusively meteoric water supply (Ombrotrophic) BOG
Wetness due considerably to topographical impedance of drainage	**Topogenous Fen** Lakesides, basins, floodplains, and so on	**Topogenous Bog** Accumulations of ombrotrophic peats in basins and so on, often autonomously mounded and frequently developed from Topogenous Fen
Impeded drainage together with significant and consistent water flow	**Rheo-Topogenous Fen** Basins, Troughs, Valleyheads	
Wetness due mainly to high and consistent rates of water supply (flow). Often sloping.	**Soligenous Fen** Seepages, minerotrophic flushes and flow tracks, and so on	**Hill Bog** Ombrotrophic peat surfaces and flow tracks on hillsides, and so on

The categories of topogenous and soligenous fen to some extent intergrade with regard to their water supply and retention characteristics, both in concept and in the field, as do also those of topogenous bog and hill bog. There is generally considered to be a sharp conceptual distinction between ombrotrophic peats and those peats that are irrigated with telluric water as well as by rainfall. Some see this in terms of exclusivity, as a binary split – a peatland surface is either exclusively fed by precipitation or it isn't – whereas others are content with a fuzzier subdivision. In either case, however sharp the conceptual distinction may be, the point of distinction between minerotrophic and ombrotrophic surfaces in the field can be difficult to detect. In addition, various related terms have been used to refer to the state of ombrotrophy, each with rather different – though not always universally

[3] Telmatology is the study of semi-terrestrial wetlands (marshes, swamps, fens and bogs).

recognised – nuances of meaning (Table 7). In this report the term **ombrotrophic** is used to refer to bog surfaces which are considered to be dependent on rainfall for their formation and water supply.

Table 7. Some terms related to ombrotrophy

Ombrogenous Greek. 'rain-made'	Peat formed under the ± exclusive influence of precipitation. Always ombrotrophic.
Ombrotrophic Greek. 'rain-nourished'	Peat fed ± exclusively by precipitation, mostly but not always ombrogenous. Includes some fen peat surfaces where the telluric water supply has been disturbed (by drainage *etc.*) In the Wetland Framework these were designated as 'ombrotrophic legacy telluric'
Ombrophilous Greek. 'rain-loving'	Used by some authors to refer to either of the above categories. Used here to include apparent ombrotrophic surfaces that potentially have some weakly-minerotrophic influence.
Oxyphilous Greek 'acid-loving' *Syn*: acidophilous (Latin + Greek)	Occasionally used, mostly to refer to local acidic areas within a more base-rich mire, often associated with the leached tops of hummocks or tumps. Includes circumstances where acidity is a consequence of a base-poor (possibly leached) mineral soil, rather than just precipitation supply, for example acidic ridges between more base-rich channels.
Endotelmic-ombrotrophic, Indirect-ombrotrophic	Refers to a supply of precipitation-sourced water that has flowed only through or across ombrotrophic peat.
Occult-minerotrophic	Apparently ombrotrophic surfaces in locations with some potential or suspected telluric water supply (often assessed topographically), but where any impact of this is not evident in the vegetation or simple hydrochemical measurements.

6.1.2 The recognition of ombrotrophy

In some instances, the occurrence of ombrotrophic surfaces may appear to be obvious, on the simple topographical grounds, for example where the surface is above any obvious telluric influence; but even in such cases some consideration of the possibility of groundwater outflows may be needed. In others the boundary is far from obvious, and distinction of the two types can be difficult even with the use of detailed hydrological and hydrochemical studies (Box 1).

The main reason for this difficulty relates to the eco-hydrological position of the ombrotrophic-minerotrophic split. Whilst this is widely considered to represent a fundamental subdivision of mires based on their water source, the point at which there is no influence by telluric water (the 'mineral soil water limit') does not represent the most significant subdivision based on hydrochemistry and vegetation composition. This seems to be set at around pH 5.5 and it splits mires into the broad categories of base poor and base rich, with an intermediate category of sub-neutral (Damman, 1996; Wheeler &

Proctor, 2000). A consequence of this is that some fen vegetation of weakly minerotrophic conditions can be very similar to an adjoining area of ombrotrophic bog. They may have similar species compositions, and the composition of the water from ombrotrophic areas, although typically acidic and low in plant nutrients, can vary and overlap with that of weakly minerotrophic mires.

Box 1. Fundamental subdivisions of peatlands – a brief review

In the first main publication on British vegetation, Tansley (1911) distinguished between 'Fens' and 'Moors'. His Fens were developed in base-rich conditions, his Moors in more acidic circumstances. These latter included conditions that would now be regarded as ombrotrophic, but they also included base-poor minerotrophic mires, such as those of the New Forest. This distinction was perpetuated in his later, more comprehensive, publication (Tansley, 1949) except that 'Moor' was replaced by the 'Bog' or 'Moss', labels which were used as synonyms for 'wet acid peat vegetation'.

Elsewhere in Europe, and particularly in Sweden, a rather different approach developed, and Du Rietz (1949, 1954) suggested that the primary division of 'the main formation of boreal mires' was between those that were ombrotrophic (*mosse*) and those that were minerotrophic (*kärr*). These primary categories were separated by the 'mineral soil water limit', so that ombrotrophic mires were fed directly and exclusively by precipitation whilst minerotrophic surfaces were fed also to some extent by telluric water. This work provided a much-needed clarification of some aspects of mire terms and concepts and was broadly welcomed. In English, the two main categories were designated 'bogs' and 'fens', respectively.

Du Rietz's approach had the great benefit of being conceptually clear – a mire surface was either fed exclusively by precipitation or it wasn't. What was much less clear was how this could be determined. In the approach of Du Rietz, the *practical* split between ombrotrophic and minerotrophic surfaces was determined floristically, based on the *mineralbodenwasser* ***zeiger****grenze* ('mineral soil water ***indicator*** limit') – that is, the presence or absence of plants thought to indicate minerotrophic conditions. This approach involves a good deal of circularity of argument and is also hostage to the fact that the apparent indicator value of plants for minerotrophy varies geographically across Europe, possibly in response to variations in the solute content of rainfall. Moreover, it appears that all of the species that grow regularly in ombrotrophic conditions can also grow in minerotrophic circumstances.

In Britain, analysis of sample data from a large number of mires led Wheeler and Proctor (2000) to recognise that whilst the ombrotrophic–minerotrophic split might represent a fundamental difference in their water source, it did not coincide with the primary subdivision of either their vegetation or hydrochemistry. The main floristic and hydrochemical subdivisions they identified essentially divided mires into those that were base poor and those that were base rich, with a diffuse separating point at about pH 5.5 in the mire water. This view agreed with a global assessment made by Damman (1996) and was broadly supportive of the original subdivision made by Tansley (1911).

In the view of Wheeler & Proctor, whilst the subdivision of mires into bog *versus* fen reflects "a major difference in water *source*, it represents neither a basic edaphic distinction, nor a fundamental split of floristics (on which it was ostensibly based)". A corollary of this is that, in a habitat where *any* subdivision of floristics and hydrochemistry is likely to be fuzzy, Du Rietz's split between bog and fen is likely to be particularly difficult to identify.

6.1.2.1 Plant species as indicators of Ombrotrophy

Recognising the difficulties of identifying the 'mineral soil water limit', Du Rietz (1949, 1954) adopted a practical solution based on the indicator value of plants for minerotrophy (that is, the 'mineral soil water *indicator* limit'). This was based on the absence of 'fen' species from bogs, because no plant species appears to be confined to bogs. Distinctions made on the basis of species that do not occur can be unsatisfactory, not least because there may be several reasons for absenteeism. Also, if circular reasoning is to be avoided, the initial recognition of species that do not grow in bogs requires some independent identification of ombrotrophic conditions. Some species, such as purple moor-grass, can form dense, dominant swards in both ombrotrophic and minerotrophic situations, and this can help to obscure the affinities of the peatlands. This is especially the case in some of the upland mires in Wales. In addition, a number of plant species show considerable geographical variation in their fidelity to the minerotrophic habitat, both across the British Isles and on a pan-European scale. For example, *Sphagnum medium* is regarded as an important 'bog building' species in many ombrotrophic mires in Britain but is considered to be a 'fen species' across much of Scandinavia. A further difficulty is provided by variations in water flow rate within ombrotrophic mires, whereby certain species (such as hare's-tail cottongrass and bog myrtle) that occur widely in bogs and fens, can become particularly prominent in water flow tracks in bogs, together sometimes with species normally confined to fens, probably because of a slightly greater supply of nutrients and better aeration.

Plant species which can grow regularly in weakly minerotrophic conditions but which do not normally grow in nearby ombrotrophic ones (in England and Wales) include star sedge, white sedge, carnation sedge, bottle sedge, sharp-flowered rush, bog-bean, bog pondweed, lousewort, devil's-bit scabious, and the mosses *Sphagnum denticulatum, S. inundatum, Sphagnum squarrosum* and *S. fimbriatum*.

6.1.2.2 Plant communities as indicators of Ombrotrophy

Plant communities are vegetation units based on aggregations of species that recurrently grow together. In terms of their indicator value for ombrotrophy, they show some of the limitations identified for individual species, with the additional constraint of being variable in their species composition and sometimes difficult to distinguish from one another. On the other hand, some appear to provide a positive association with ombrotrophic conditions, and they also appear to show less regional shift than some individual species (Table 8).

Table 8. Value of selected mire plant communities as indicators of ombrotrophic conditions in England and Wales.

NVC community*	Usefulness as indicator of ombrotrophic conditions
M17: deergrass (*Trichophorum germanicum*) – cottongrass (*Eriophorum* spp.) community	**Ombrotrophic.** Sometimes potentially influenced by runoff from adjoining mineral slopes or nearby water flow tracks and can be occult-minerotrophic. Widespread in upland peatland habitats in south-west England and in some parts of Wales and north-west England. M17 sometimes occurs on firm peat 'flats' between pools and soakways (M1 and M2 which may be weakly minerotrophic). Grades into wet heath (M15), acid grassland (U5, U6) and *Molinia* dominated vegetation on thinner soils.

NVC community*	Usefulness as indicator of ombrotrophic conditions
M18: cross-leaved heath (*Erica tetralix*) – *Sphagnum papillosum* community	**Ombrotrophic**, occurring in bog habitats in the lowlands and uplands in England and Wales. Hummock–hollow–pool complexes are found in the wettest and most intact examples of this plant community. May be replaced by M18/M19 and M19 in some drier, often part-drained, examples. Sometimes occurs in revegetating ombrotrophic turf ponds, and as isolated ombrotrophic nuclei embedded in other wetland surfaces (fens).
M19 Heather (*Calluna vulgaris*) – hare's tail cottongrass (*Eriophorum vaginatum*) community	**Ombrotrophic.** Sometimes potentially influenced by runoff from adjoining mineral slopes and therefore occult-minerotrophic. Mainly in upland peatlands in northern areas (North Wales, Pennines, Northumberland).
M20: Common cottongrass (*Eriophorum vaginatum*) community	**Often ombrotrophic**. Community defined by dominance of hare's-tail cottongrass and occurs on damaged peatland surfaces, especially in upland areas. Similar vegetation, often very tussocky with abundant *Sphagnum fallax* and *Molinia* (M20_S), also occupies water flow tracks in various circumstances, often ombrotrophic but sometimes weakly minerotrophic, particularly as 'lagg' zones at the margins of peatlands where they adjoin mineral ground.
M21 bog asphodel (*Narthecium ossifragum*) – *Sphagnum papillosum* community	Not known to be ombrotrophic, but associated with base-poor, typically rheotrophic, circumstances. Often occurs flanking water flow tracks (M14 and M29), pools and soakways (M1 and M2) in base-poor, minerotrophic situations, and has strong floristic similarities with M17 and M18. Grades into wet heath on thinner peat (M15 and M16)
M25 Purple moor grass (*Molinia caerulea*) – tormentil (*Potentilla erecta*) community	The community itself is poorly-defined because purple moor-grass is a distinctive species that is present in a range of plant communities, occurring widely both in ombrotrophic and minerotrophic situations, probably as different, but ill-defined variants, so it is not a good indicator.
M1 *Sphagnum denticulatum* community	May be ombrotrophic, in pools and soakways embedded in more extensive bog habitats in hummock–hollow–pool complexes), but often likely to be weakly minerotrophic.
M2 *Sphagnum cuspidatum* community	Typically ombrotrophic when embedded within a more extensive bog habitat in hummock–hollow–pool complexes (often within M18), but weakly minerotrophic examples occur elsewhere.
M3 common cotton-grass community	Ombrotrophic when embedded within a more extensive bog habitat as a usually fairly small feature of shallow hollows on damaged peatlands that are recolonising with common cottongrass. May be embedded in M17, M18, and M19 elsewhere, and minerotrophic examples also occur.
M4 bottle sedge (*Carex rostrata*) – *Sphagnum fallax* community	**Minerotrophic**, associated with the margins of ombrotrophic deposits or sometimes in and around water flow tracks passing through them. Often associated with M6.
M6 star sedge (*Carex echinata*) – *Sphagnum denticulatum / S. fallax* community	**Minerotrophic**, irrigated by base-poor water supply. Can also occur around more localised calcareous outflows that are typically marked out by distinctive bryophytes (M37)
M23 sharp flowered rush / soft rush (*Juncus acutiflorus / effusus*) – marsh bedstraw (*Galium palustre*) community	**Minerotrophic** vegetation sometimes associated with the margins of ombrotrophic peatlands. Vegetation typically dominated by tall rushes.
M29 Marsh St. John's-wort (*Hypericum elodes*) – bog pondweed (*Potamogeton polygonifolius*) community	**Minerotrophic**, base-poor water flow tracks with bog pondweed, *Sphagnum denticulatum* and sometimes marsh St John's-wort. Sometimes found in water flow tracks through ombrotrophic peatlands, suggesting potential occult-minerotrophy in these.

* Note: See Table 3 for more details about vegetation types and NVC communities.

7 Classification and characterisation of ombrotrophic habitats

7.1 Overview

A categorisation of the main types of ombrotrophic peatlands (‘bogs’) in England and Wales is presented in this report, based on field investigations and literature sources. Two series of categories are identified: WETMECs, which are quasi-objective units of water supply and drainage that relate mainly to the state of the bog surfaces; and BOGCATs, which are much broader topographical units based on the overall shape of the peat body. WETMECs were the main focus of the investigation and provide the most clearly defined and applicable units. BOGCATs are more informal units that are useful because they provide broad topographical contexts within which the WETMECs can be located and their inter-relationships considered. BOGCATs are ‘top-down’ categories that have been developed using a combination of field data (peat depths), supplemented by some published material, and LiDAR-derived contours. In contrast, WETMECs are ‘bottom-up’ categories based on the characterisation of different patches of peatlands using their intrinsic properties as measured in the field using a series of ranked variables. There are links between WETMECs and BOGCATs, but they are largely independent of each other, and an individual WETMEC can occur in several BOGCATs.

This work is an extension of an earlier report (Wheeler and others, 2023) on ombrotrophicpeatlands in the uplands. It is also a development from the Wetland Framework (WF) project (Wheeler, Shaw and Tanner, 2009), which was primarily concerned with lowland minerotrophic mires (‘fens’). The same approach, and field and analytical procedures, have been used in the present project, partly to ensure backward-compatibility with the earlier work. This work has focussed upon ombrotrophic peatlands, but some information was collected from minerotrophic locations where present in the sites examined.

In the WF project, WETMECs were seen as a hydrological component of a framework intended to help identify ‘habitats’ in the wetlands concerned. Other main components of the framework were base-status and soil fertility categories, which formed independent layers that could be combined with WETMECs to generate a composite habitat unit. In ombrotrophic peatlands the framework is simpler, because all examples are acidic and of low fertility. Also, the water source is mostly precipitation, so the ombrotrophic WETMECs generally reflect constraints on drainage patterns rather than water supply.

In an important contribution to eco-hydrology, Ingram (1978) championed the idea that ombrotrophic peatlands could be regarded as *diplotelmic* systems, in which a relatively permeable and partially unsaturated top-most peat formed a thin layer (the *acrotelm*), over a thicker, and much less permeable, body of peat (the *catotelm*). The catotelm normally forms the bulk of the deposit and largely determines its shape, so that the BOGCATs

proposed here essentially refer to the conformation, or overall shape, of the catotelm. In some situations, this is automorphic ('self-shaping'), determined mainly by the pattern of drainage within the accumulating mound of peat.

Surface conditions on ombrotrophic bogs, particularly their wetness, are partly determined by hydraulic gradients resulting from the shape of the low-permeability catotelm, and by the accompanying lateral flow of water through the acrotelm, but they can also be determined by self-regulation properties of the acrotelm. As this layer also provides the surface for plant growth, it determines in large measure the habitat conditions on the bog surface. The hydro-regulatory capacity provided by the acrotelm is essentially one of varying transmissivity in response to variation in precipitation inputs. A consequence of this is that measurements of its hydraulic conductivity can vary with time, precipitation and the thickness of the acrotelm. The WETMECs recognised here essentially relate to the functional character and properties of the acrotelm.

In recent decades, the label 'acrotelm' has been used informally by practitioners in a different sense, one that emphasises its supposed self-regulatory capabilities, and equating it with a 'spongy *Sphagnum* surface'. Other workers appear to use a stratigraphical[4] definition, based on the level of humification[5] in the peat profile (Schouten, 2002), with low-humification peat forming the definition of the acrotelm. As a consequence, this 'stratigraphical acrotelm' is thickest in the wettest, flattest part of an ombrotrophic peatland and thinnest on, or absent from, its steeper, better-drained slopes. Here we use the term acrotelm more-or-less in its original sense, to refer to a partially saturated surface layer, whilst recognising that empirical data on field water conditions are sparse.

7.2 Data analysis

Analysis and interpretation of the field data was made using quasi-objective multivariate clustering and ordination procedures, in conjunction with schematic sections produced for each site visited, and for selected sites from the published literature. Two main multivariate procedures were used: Detrended Correspondence Analysis (DCA), and an agglomerative clustering procedure (Ward's Method), following the approach outlined in the Wetland Framework (Wheeler, Shaw and Tanner, 2009).

The analyses were based on the following ranked estimates of variables recorded in field samples. This has been an iterative process, with earlier analyses leading to re-examination of the source data to determine the most appropriate assignment of samples to the emerging WETMEC types.

[4] Stratigraphy: a description of the layering within peat based on the composition and character of the peat and mineral content.

[5] The degree of decomposition of peat, involving the production of humus from the decay of organic matter by microbial action.

- Gradient of slope (%)
- Peat depth (m) (total depth, not thickness of ombrotrophic peat)
- *Sphagnum* abundance (rank 0–4, absent to abundant)
- Heather abundance (rank 0–4, absent to abundant)
- Surface wetness (rank 1–9, dry to deep swamp)
- Surface softness (rank 1–6, firm to quaking)
- Hummock–Hollow index (sum of abundance scores of hummocks, hollows & pools)
- Tussock index (sum of abundance score of tussock types)
- Water flow (rank 0–5, no visible flow to streaming)
- Erosion (sum of abundance score of erosion features)
- Drain/ditch/gully proximity (rank 0–5, none to adjoining)
- Surface configuration (rank 1–6, water shedding to water collecting)

7.2.1 Clustering analysis

A cluster analysis of the dataset was performed to evaluate how closely the divisions relate to the evolving WETMEC types (using the CLUSTAN programme). During the clustering analysis, the 10-cluster stage was selected for examination of the results, and these are displayed in Figure 4.

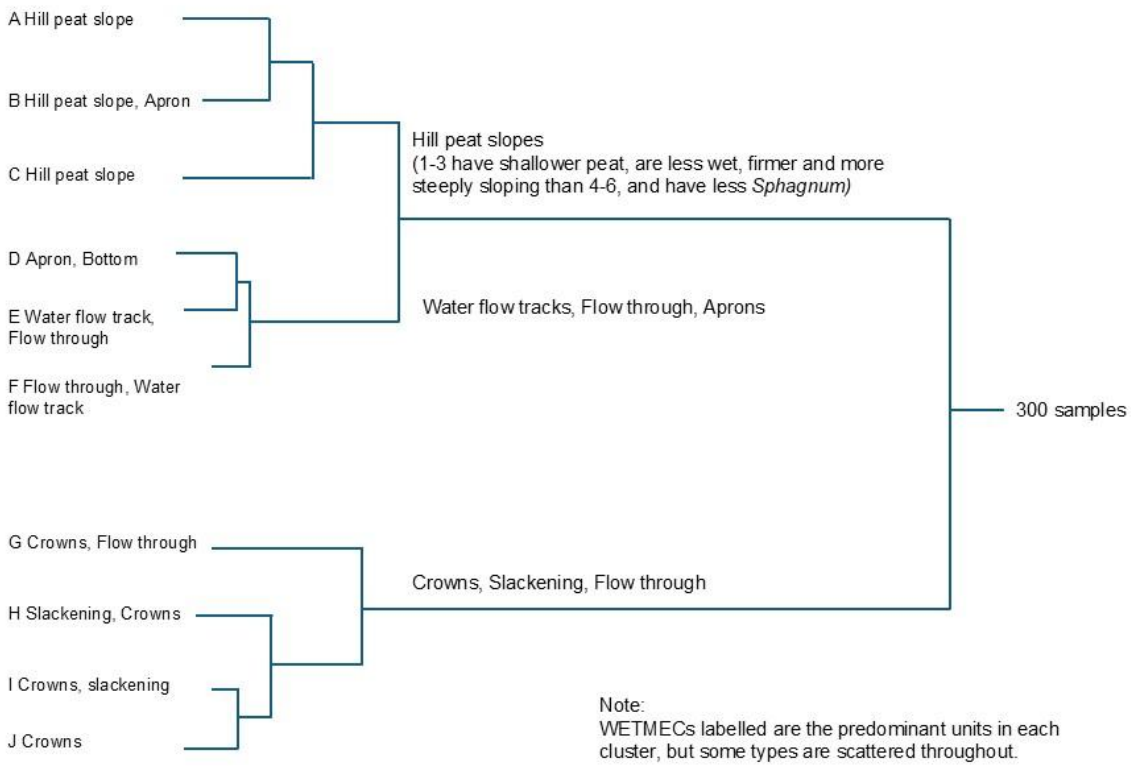


Figure 4. A cluster analysis of the bog dataset for England and Wales, illustrating divisions between WETMECs, and some overlaps.

7.2.2 Detrended Correspondence Analysis (DCA)

Detrended Correspondence Analysis (DCA) is a multivariate statistical technique used to find the main factors or gradients in large data matrices. DCA was used here to explore the relationships between the variables recorded for all samples; and separately, the relationships of both samples and variables to the recorded vegetation types.

Figure 5 shows the results of an ordination of 300 upland ombrotrophic peat samples, with their distributions coded by WETMEC type and sub-type (see Section 9).

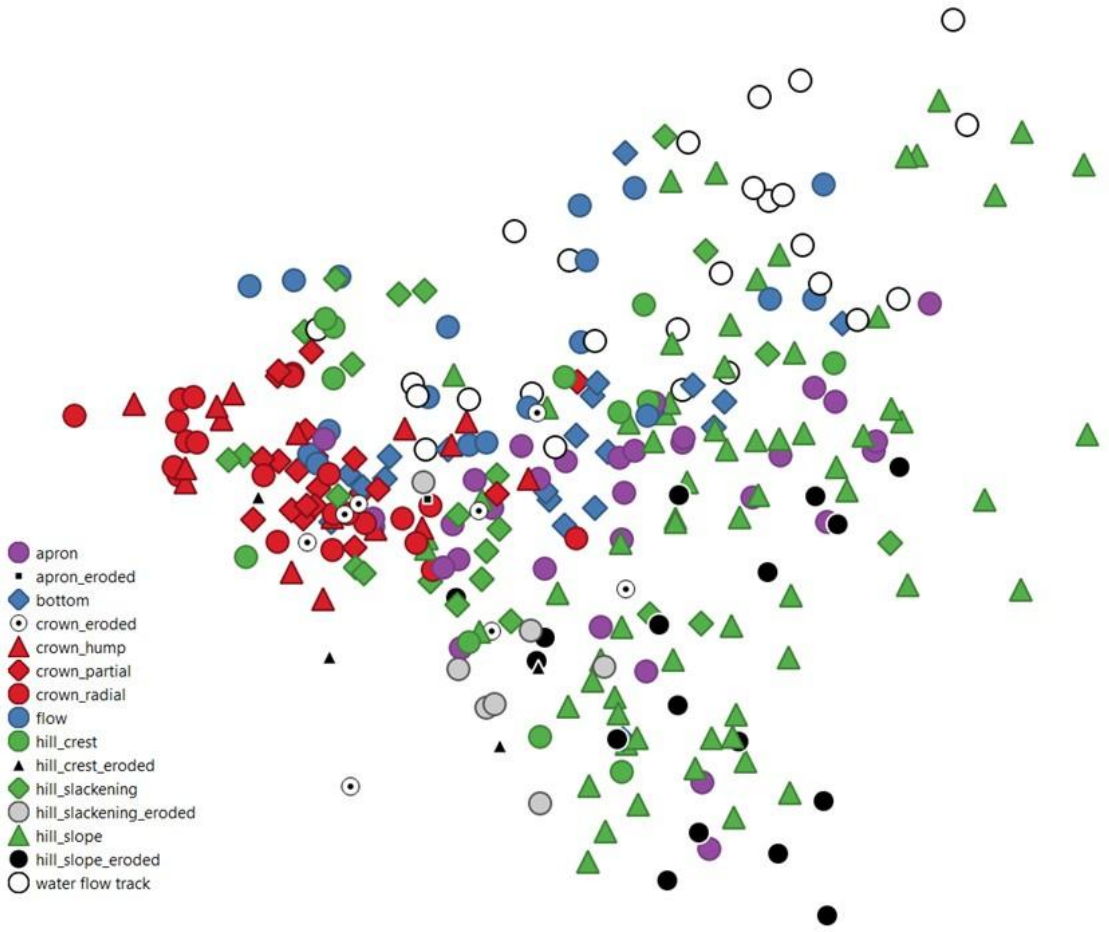


Figure 5. An ordination of 300 upland ombrotrophic peat samples, with their distributions coded by WETMEC type and sub-type.

Figure 6 (below) shows the same data as in Figure 5, as a DCA plot overlaid with the distribution of the variables used in the analysis, to indicate broad relationships between the identified WETMEC types (see Section 9) and sub-types and specific variables.

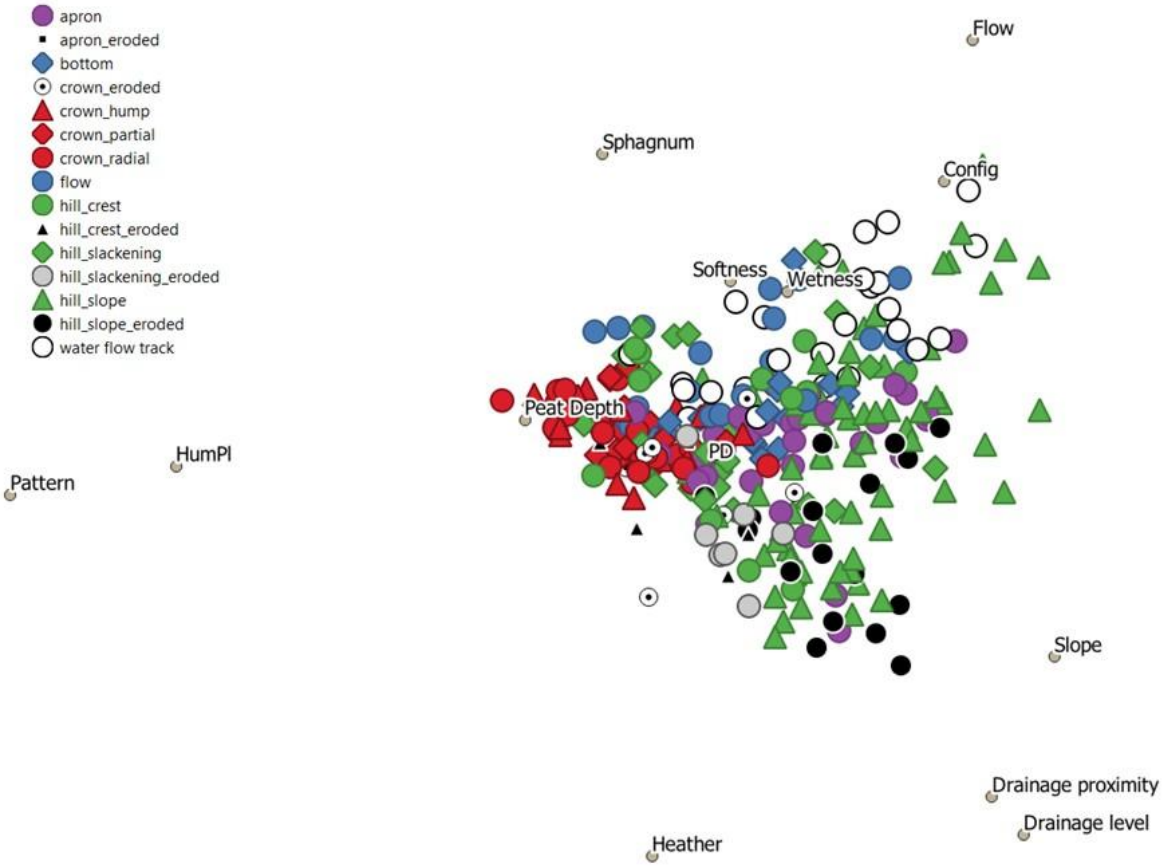


Figure 6. A DCA plot of 300 bog samples (axes 1 and 2) overlaid with the distribution of variables, coded by WETMEC type and sub-type.

Within the cluster of points there is evidence for several trends which can be related to the variables. For example, hummock–pool diversity, surface patterning, and peat depth are increasingly important in samples further to the left along Axis 1. Steeper slopes and greater tussock diversity are more important further to the right along Axis 1. Axis 2 broadly relates to trends in wetness and water flow: lower down the axis, samples tend to be associated with abundant heather, drainage, erosion, and steeper slopes. Higher up Axis 2 samples are associated with wetter, softer surfaces, more abundant *Sphagnum*, and greater water flow.

Figure 7 shows the WETMECs plotted onto the DCA ordination. This suggests that Axis 1 consists of a gradient from Crowns and Slackenings on the left, to Hill Peat Slopes and Aprons on the right. Variation along Axis 2 corresponds particularly to eroded surfaces of various WETMECs lower down the axis, and to Ombrotrophic Flows and Water Flow Tracks higher up the axis. The rather non-descript category of Ombrotrophic Bottom is located suitably near the centre of the ordination, in a position related to none of the main trends of variation.

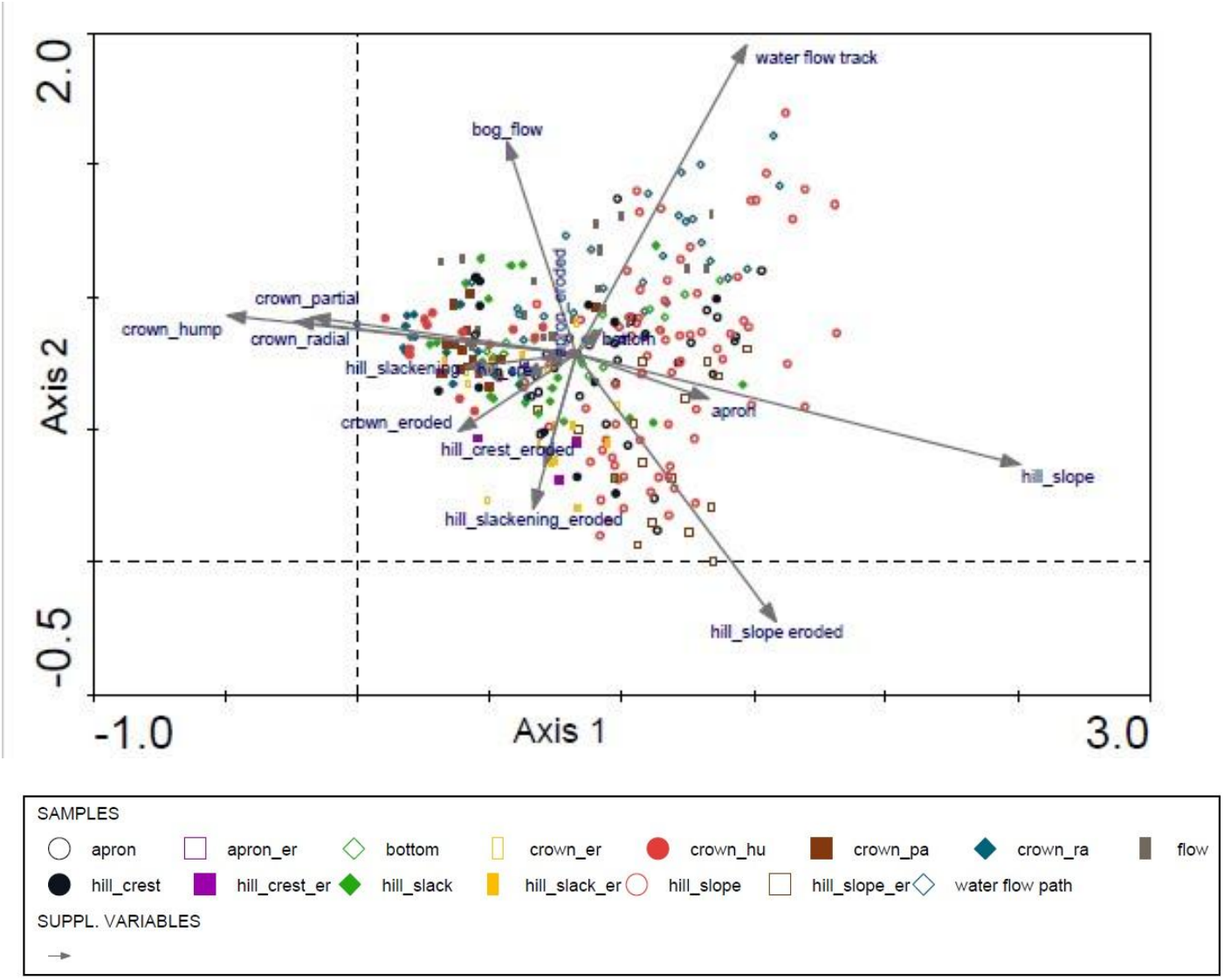


Figure 7. A DCA plot of 300 bog samples (axes 1 and 2) overlaid with the broad trends for each of the WETMEC types and subtypes.

7.3 WETMECs and BOGCATs: names and relationships

A small number of new ombrotrophic WETMECs have been recognised in this report, and some of those already identified (Wheeler and others, 2023) have been refined; these are listed below and described in more detail in subsequent sections of this report.

The proposed BOGCAT units are also listed below. A summary of the relationships of WETMECs to BOGCATs is provided in Table 12.

Detailed descriptions of WETMECs and BOGCATs are given in subsequent sections.

WETMECs

Hill Peat

Hill Peat Slopes

Hill Slope Gullies

Slackenings and Crests

Eroded Slackenings and Crests

Ombrotrophic Crown

Radial Crown

Partial Crown

Hump Crown

Eroded Crown

Ombrotrophic Apron

Ombrotrophic Bottom

Ombrotrophic Flow

Water Flow Tracks

BOGCATs

Hill Bogs – landscape components can be informally split into:

Summits; Slopes; Shallow slopes; Cols, troughs, and small valley bottoms

Topogenous Bogs – these can be split into:

Mounded Bogs

Trough Bogs

Sump Bogs

Within the Mounded Bogs it is possible to recognize the following:

Regularly, Irregularly, Humped, and Ridge-Mounded Bogs

7.4 Summary of field variables and vegetation in relation to WETMECs

Data gathered from the 438 samples that were recorded as part of this project have been summarised to provide mean values for the most important variables in relation to each WETMEC of ombrotrophic habitats (Table 9). It should be noted that this includes samples from eroded WETMEC sub-types; however, small amounts of erosion are often widespread, and very small areas of bare peat may be present in samples that have been assigned to non-eroded sub-types.

Where eroded WETMEC sub-types have been separated from other WETMECs, it is important to note that erosion modifies the surface variables scores, resulting in higher values that relate to the presence of small hollows and channelled flow. Eroded samples are generally less wet and less soft than more intact / less eroded samples. Microtopographical variation is also often higher in some eroded areas, but this is usually because of the presence of small pools in the erosion hollows.

The relationship between WETMECs and vegetation types has been explored and tabulated in Table 10. For each vegetation type, the most frequent WETMEC is shaded green, the second-most frequent is shaded brown.

Table 11 similarly shows the distribution of sub-units of ombrotrophic NVC plant communities with a particularly spongy *Sphagnum*-rich surface layer.

Table 9. Summary mean values of field variables from 438 samples, in relation to WETMECs of ombrotrophic habitats*

WETMEC	n	Slope %	Peat depth (m)	Sphag-num	Heather	Wet-ness	Soft-ness	Hum / Holl	Tuss	Flow	Ero-sion	Drain prox	Config	Alt m aOD	Rainfall (mm)	PET (mm)
Hill peat slope	106	7.4	1.2	1.6	1.5	3.6	1.9	1.6	1.9	0.4	0.7	2.6	2.0	431	1683	474
Slackening	43	2.0	2.3	2.8	1.6	4.1	2.5	4.5	0.6	0.5	0.8	2.5	2.3	447	1766	481
Crest	9	1.8	1.9	3.2	2.0	4.1	2.3	5.6	1.1	0.0	0.3	0.8	1.2	510	1783	471
Crown partial	40	0.8	4.6	3.5	1.5	4.5	3.0	6.1	0.6	0.4	0.5	2.5	1.7	327	1342	489
Crown radial	29	0.6	5.3	3.6	1.6	4.7	3.0	7.2	0.1	0.5	0.1	1.3	1.4	305	1176	494
Crown hump	20	0.9	5.3	3.5	1.6	4.6	3.1	6.2	0.7	0.3	0.3	1.6	2.5	414	1584	479
Apron	51	2.8	3.7	2.6	1.8	4.1	2.4	2.7	1.7	0.7	0.3	2.9	2.2	334	1386	485
Bottom	25	1.7	4.1	3.2	1.5	4.5	2.7	2.4	1.3	0.3	0.1	2.8	2.8	347	1326	484
Flow	22	1.6	3.9	3.8	0.6	5.1	3.9	4.7	1.3	1.7	0.2	1.7	5.1	397	1598	473
Water flow track	93	3.3	1.7	3.1	0.4	4.9	3.1	1.7	1.8	2.0	0.2	1.8	4.3	360	1482	490

* **Note:** Variables were recorded for each sample as follows:

- Gradient of slope (%)
- Peat depth (m) (total depth, not thickness of ombrotrophic peat)
- *Sphagnum* abundance (rank 0–4, absent to abundant)
- Heather abundance (rank 0–4, absent to abundant)
- Surface wetness (rank 1–9, dry to deep swamp)
- Surface softness (rank 1–6, firm to quaking)
- Hummock–Hollow index (sum of abundance scores of hummocks, hollows & pools)
- Tussock index (sum of abundance score of tussock types)
- Water flow (rank 0–5, no visible flow to streaming)
- Erosion (sum of abundance score of erosion features)
- Drain/ditch/gully proximity (rank 0–5, none to adjoining/within)
- Surface configuration (rank 1–6, water shedding to water collecting)
- Altitude estimated from LiDAR
- Rainfall annual averages (mm) from Environment Agency data
- PET (Potential evapotranspiration) – annual averages (mm) from Environment Agency data

Table 10. Distribution of vegetation types across the WETMECs of ombrotrophic habitats, as a percentage of sample size (n).

NVC community	n	Hill Peat Slope	Slack-ening	Hill Peat Crest	Crown radial	Crown partial	Crown hump	Apron	Bottom	Flow	Water Flow Track
M1	5					40				20	40
M2	4					25	25			25	25
M17	55	33	18	7	2	4	9	16	5	5	
M18	88	3	6	1	23	25	13	13	6	8	3
M18/M19	39	5	28		13	18	3	18	10	3	3
M19	93	49	15	4	3	3	2	17	5		
M20	53	38	4			4		9	8	6	32
M21	8								13	50	38
M4	12									8	92
M6	39									3	97
Heath D	11	55	9					27	9		
Molinia D	18	61							6		33

Table 11. Distribution of vegetation sub-units with a spongy *Sphagnum* layer across the WETMECs of ombrotrophic habitats.

Sphagnum rich sub-type	n	Hill Peat Slope	Slack-ening	Hill Peat Crest	Crown radial	Crown partial	Crown hump	Apron	Bottom	Flow	Water Flow Track
M17_S	14		14	7	7	14	29	7		21	
M18_S	57		2		26	30	14	11	7	9	2
M19_S	24	29	25	13	4			17	13		
M20_S	28	29				4			11	7	50

For each vegetation type, the most frequent WETMEC is shaded green, the second-most frequent is shaded brown.

8 BOGCATs (Bog Configuration Categories)

It has long been recognised that some broad and intergrading topographical categories of bog can be recognised based on the shape of the ombrotrophic peat deposits, if only as “conveniently vague” units (Pearsall, 1950). Here an attempt has been made to identify more robust units (BOGCATs), based mainly on the surface profiles and stratigraphical sections of the sites considered. Table 12 summarises the BOGCAT types and their relationship to associated WETMECs, which have been described in detail in Section 8.

Two main categories of Ombrotrophic Bogs are recognised here – Topogenous Bogs, which essentially represent ombrotrophic examples of the ‘basin peat’ that was described by the British Geological Society (BGS, 2008), and Hill Bogs, which are broadly equivalent to the ‘hill peat’ described by the BGS (except for the Topogenous Bog areas embedded within them). The Topogenous Bogs are sub-divided into Mounded Bogs, Trough Bogs, and Sump Bogs.

8.1 Hill Bogs

In England and Wales Hill Bogs are primarily associated with upland landscapes. They represent relatively thin accumulations of mostly ombrotrophic peat, most typically on sloping ground. Their surface roughly reflects the shape of the underlying mineral ground, thickening somewhat across shallow depressions or where the slope decreases, and thinning where the slope steepens, thereby partly ironing out minor irregularities in the sub-peat surface. This category has traditionally been regarded as ‘blanket bog’, but as defined here is less broad than that because where the slope slackens, the Hill Bog surface can become transitional into topogenous bog deposits.

In the sites examined here it has not been possible to distinguish different broad topographical types of Hill Bog, perhaps because broadly similar Hill Bog surfaces cover a wide range of topographical features. However, these can be identified as underlying topographical components: Plateaux, Crests, Slopes, Benches, Steps, Cols and valley bottoms. These vary in the topographical impedance they provide to down-slope water flow, and this is reflected in the WETMECs identified for Hill Bogs.

8.2 Topogenous Bogs

Topogenous bogs are considerably more widespread, though not more extensive, than hill bogs and occur both in upland and lowland landscapes. In upland situations, topogenous bogs occur particularly in basins and troughs, and in other locations where drainage is impeded topographically, often embedded within tracts of Hill Bog. Three main types of Topogenous Bogs have been distinguished: Mounded Bogs, Trough Bogs, and Sump Bogs. These three sub-types are the most important to recognise, and it is not essential to go further, although Mounded Bogs can, if required, be sub-divided into four informal categories

8.2.1 Mounded Bogs

Mounded Bogs form distinct mounds of ombrotrophic peat, raised above the level of the underlying mineral ground. They are largely automorphic (self-shaping), regulated mainly by constraints on, and drainage patterns of, precipitation. Four informal categories of Mounded Bogs can be recognised, based on the topography of the peat deposits: **Ridge-Mounded Bogs, Regularly-Mounded Bogs, Irregularly-Mounded Bogs** (Tilted or Bulging Bogs) and **Humped Bogs**.

8.2.2 Trough Bogs

Trough Bogs are rarely mounded above the level of the underlying mineral ground, are mostly confined within topographical troughs, have an axially-sloping surface (that is, in one direction only) and associated water flow, and may be susceptible to water inflows from their surroundings. Trough Bogs appear to be fairly common in upland areas.

8.2.3 Sump Bogs

Sump Bogs are closely related to Trough Bogs, but are characteristic of smallish hollows or basins, have negligible surface water flow, and may also be susceptible to water inflows from their surroundings. Sump Bogs appear mainly to be features of lowland areas.

Table 12. Summary of the relationships between WETMECs and BOGCATs.

BOGCAT	WETMEC
Broad position and shape of the peat deposit. 'Shape' refers to the surface of the peat deposit, not to the topography of the landscape, though sometimes the two are more-or-less the same.	In principle, any WETMEC can occur in any BOGCAT. In practice they are preferentially partitioned. ***Bold type***: most important. *Indented*: WETMEC sub-type
HILL BOGS Developed over hills in the uplands. Peat surface conforms broadly with the underlying landscape topography It has not been possible to distinguish different generic *peat* topographical types as has been done for Topogenous Bogs, but it is possible to recognise *landscape* topographical components:	Only the typical WETMECs are listed
Hill Bog Landscape Components: ***Summits*** ***Slopes*** Free-ish downslope drainage ***Shallow Slopes*** Some impedance to downslope drainage, often associated with thicker peat and wetter conditions. ***Cols, Troughs and small Valley Bottoms*** Water collecting areas that do not support mounded topogenous units (but are conceptually transitional to these). ***Margins*** Thin peat, often on steep slopes, forming the margins of Hill Bogs.	**Hill Peat** **Sloping Hill Peat** Hill Slope Gullies **Crests and Slackenings** Eroded Crests and Slackenings May also contain embedded TOPOGENOUS BOG units (such as Ombrotrophic Crowns or Ombrotrophic Flows) or other WETMECs, or may be transitional to these.

BOGCAT	WETMEC
TOPOGENOUS BOGS Developed where there are significant topographical constraints on drainage, typically in topographical basins and troughs, or over irregular or 'flat' surfaces.	
MOUNDED BOGS Ombrotrophic peat mounded above the landscape topography, as automorphic or partly automorphic deposits.	
Regularly-Mounded Bogs Largely automorphic ombrotrophic mounds draining in multiple directions, typically on flattish surfaces. Surface plan reflects topographical context. Examples can form radially or bilaterally symmetrical domes, but asymmetric doming is also prevalent, sometimes associated with an underlying topographical slope. Often referred to as 'raised bogs'.	**Ombrotrophic Crown** **Radial Crown** **Ombrotrophic Apron** Bouyant Ombrotrophic Quag (BOQ) May form small patches in re-flooded excavations, particularly evident in drained sites.) Eroded Crown (Especially in high level examples) Sloping Hill Peat (If present, often only a tenuous link to Crown) Drained Ombrotrophic Surfaces (Particularly in lowland examples) May adjoin (typically marginal) Flow-track Units
Irregularly-Mounded Bogs (Tilted / Bulging Bogs) Particularly associated with some asymmetric basins, these are effectively tilted examples of Regularly-Mounded Bogs, sometimes with a restricted development of a crown and a drainage pattern that is not fully radial. May adjoin hill slopes, sometimes embedded within an area of Hill Bog.	**Ombrotrophic Crown** **Radial Crown** **Partial Crown** **Ombrotrophic Apron** **Hill Peat Slope** (Especially (upper and lower) margins) **Eroded Crown** (Especially in high level examples) May adjoin (typically marginal) Flow-track Units

BOGCAT	WETMEC
Hump-Mounded Bogs Within these can be recognised two variants: Humped Bog Mounds (largely automorphic) Hump-backed Bog Mounds (partly automorphic) Usually in topogenous troughs, often over cols. Drainage axial, little cross-trough mounding (usually 'flat' or sloping to one side). Flanked by slopes of mineral ground or Hill Peat, which can contribute to an apparent convex cross-trough profile.	**Ombrotrophic Crown** **Hump Crown** **Ombrotrophic Apron** **Hill Peat Slopes** (Often present on rising flanks of mound) **Eroded Crown** Ombrotrophic Flow
Ridge-Mounded Bogs Sprawling mounds of ombrotrophic peat, partly and variably automorphic, draped across irregular terrain (ridges and hollows). Constitutes 'ridge-raised mires' but also includes many of the large lowland bogs of NW England that are informally called 'raised bogs', many now drained and converted.	**Ombrotrophic Crown** **Radial Crown** **Partial Crown** **Ombrotrophic Apron** Hill Peat Slopes May adjoin Sump Bog unit Drained Ombrotrophic Surfaces (Particularly in lowland examples)
TROUGH BOGS Peat is not obviously mounded. Gently-sloping ombrotrophic peat infill, usually in a topographical trough, often deepest (and surface highest) at upslope (usually closed) end, but may have deep hollows in downslope parts of the trough. Surface may slope across the bog but is not significantly mounded across the trough. Transitional conceptually, and sometimes spatially into Humped or Hump-Backed Mounds.	**Ombrotrophic Bottom** **Ombrotrophic Flow**
SUMP BOGS **'**Flat' ombrotrophic surface, typically in small, ± circular basins such as kettle holes or moraine-dammed hollows. Very slightly mounded (< 0.5 m) above any marginal minerotrophic 'lagg'.	**Buoyant Ombrotrophic Quag (BOQ)** (Also a feature of re-flooded peat workings) **Ombrotrophic Bottom** Drained Ombrotrophic Surfaces Often adjoined or surrounded by Flow-track Units.

9 WETMEC summary descriptions

WETMECs are peatland units of water supply and drainage. They are based on the characterisation of different patches of peatlands, using their intrinsic properties (which may relate directly or indirectly to their hydrodynamics), and are not based on variables external to them, such as landscape topography, altitude, exposure, or precipitation. WETMECs are generally smaller and better-defined units than the broad peatland types identified as BOGCATs. In principle, WETMECs are independent of the type of BOGCAT in which they occur, but in practise some WETMECs occur preferentially within certain BOGCATs, and not in others.

Detailed accounts for each WETMEC, in the style of the Wetland Framework (Wheeler and others, 2009) are provided in a separate document (Annexe 7).

9.1 Hill Peat Slopes

The category of ‘Hill Peat Slopes’ corresponds with many informal conceptions of ‘blanket bog’: large tracts of relatively shallow, sloping, ombrotrophic peat that covers large parts of upland Britain, broadly following the topography of the underlying mineral ground, but often filling small irregularities within this, such as shallow hollows.

At their upper limit, Hill Peat Slopes may cover the summits of the hills across which they are developed (Figure 8 and Figure 9, which show both Hill Peat Slopes and embedded Slackenings). Where these summits are flatter, they can be replaced by a separate WETMEC (Hill Peat Slackenings and Crests). In landscapes of more rugged terrain they may extend up or down hillslopes until these become too steep for peat formation. Downslope, Slackenings and Crests can occupy areas of gentler slope such as benches that are embedded within steeper Hill Peat Slopes. The lower limit of Hill Peat Slopes may occur where the peat gradually thins, to be replaced downslope by mineral soils, or it may grade into foot-slopes formed from other peatland units.

On average, the Hill Peat Slope category has the thinnest of all the ombrotrophic peats of the uplands (mean depth: 1.23 m) and occupies the steeper slopes (mean slope: 7.4%). Although it grades into them, it can be distinguished from the similar, but somewhat thicker ombrotrophic peats of shallower slopes or benches (Slackenings and Crests). Hill Peat Slopes have the smallest amount of surface *Sphagnum*, which can be absent from the steepest slopes and shallowest peats. They also have the lowest development of hummock–hollow patterning, the highest development of tussockiness, and the lowest mean estimates of surface wetness and surface softness, most typically being recorded as having a firm, damp or moderately wet surface. The vegetation is broadly dominated by species such as heather, bilberry, cottongrasses, deer-grass, purple moor-grass, and pleurocarpous mosses, with sparse or scattered *Sphagnum* mosses. Hill Peat Slopes are typically acidic and have low soil fertility.

Hill Peat Slopes are associated with peat that often appears to be dark and strongly humified, and is frequently referred to as an *Eriophorum – Calluna – Sphagnum* peat and categorised as a Winter Hill Soil (Burton & Hodgson, 1987). Of those top-layers examined in the current work, 33% were categorised as amorphous, with 29% as *Sphagnum–Eriophorum* and 10% as *Sphagnum* peat. Various workers (for example Tallis, 1964) have shown that the top parts of the deeper peats are generally less humified and more *Sphagnum*-rich than are the lower layers. They may also be banded into different layers that are either dominated by *Sphagnum* or cottongrass remains, possibly in response to changes in surface wetness, which may have been caused by past climate change.

Hill Peat Slopes are mostly kept wet by precipitation and down-slope, often rather flashy, flows of ombrotrophic water. Where they occupy summits they are irrigated more-or-less exclusively by direct precipitation, but below these water flow on the slopes increases with the increasing catchment area. Much water flow in intact examples is thought to be by overland flow and near-surface flow through the top layer of peat. Whilst these surfaces have an upper partially unsaturated zone (the acrotelm), typically to around 0.3 m thick, it appears that the hydrologically active part of the acrotelm is very thin (Holden & Burt (2003). As a consequence, rainfall is rapidly released as runoff, and baseflows are very low because of very efficient transfer of water through the near surface peat.

Downslope surface flows tend to become concentrated into ephemeral soakways, water tracks, and small streams, which may sometimes run dry, reflecting rapid rates of water discharge following precipitation events. Concentrated water flow has resulted in the development of erosional gully systems on many Hill Peat Slopes, although their development and naturalness are not fully understood. In some instances, Hill Peat Slopes may receive a minor input of weakly minerotrophic water, from flanking mineral slopes or from pipes formed within the peat, which can have contact with basal mineral ground. Peat pipes appear to be widespread, but their form and hydrological function is not well known (for example Baird and Low 2022). In addition, groundwater outflows can occur within some areas of Hill Peat Slopes, but these are considered to be a separate minerotrophic WETMEC. However, it is possible that groundwater outflows may have a supporting role in the water balance of some Hill Peat Slopes where situated over water-bearing rocks.

M17 deergrass – cottongrass community is typically found in western regions (south-west and north-west England and Wales), with the M19 heather-cottongrass community further north and east (in Wales, north and south Pennines, Northumberland, and North Yorkshire). In many areas the M19 vegetation is managed to create a patchwork of heather age classes to support grouse management. M20 hare's-tail cottongrass community occurs on Hill Peat Slopes as an impoverished form of M19, and in places where eroded areas have re-colonised, often over quite thin peat. *Sphagnum*-rich M19_S vegetation with large hummocks, typically of *Sphagnum capillifolium*, is distinctive on some Hill Peat Slopes, particularly in undisturbed areas. Where Hill Peat Slopes have been modified by drainage, peat cutting, burning or forestry, they often support heathy vegetation (Heath D) or tussocky purple moor-grass dominated vegetation (*Molinia* D).

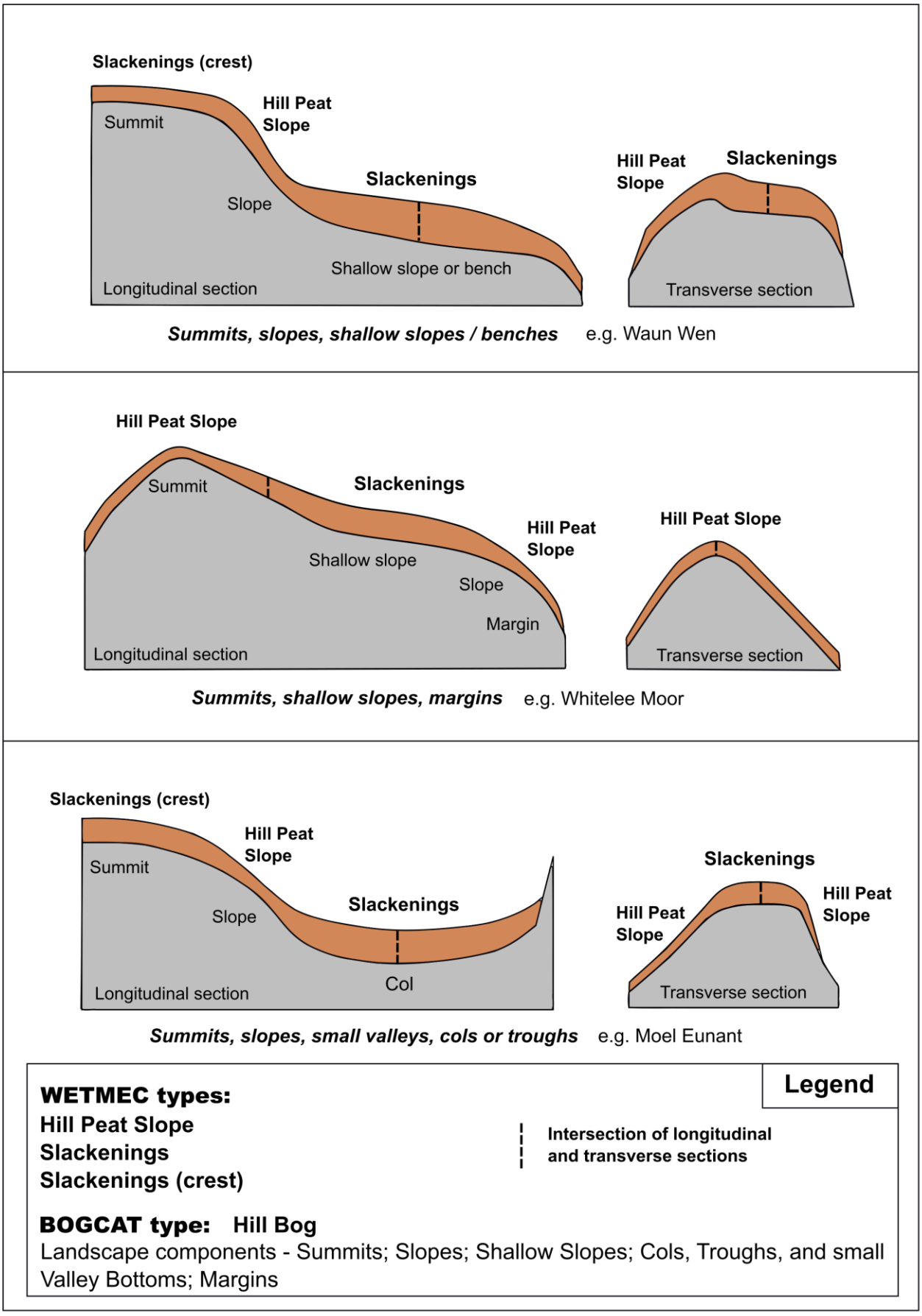


Figure 8. WETMEC conceptual profiles: Hill Peat Slopes (and Slackenings & Crests)

There is limited information regarding water table regimes on Hill Peat Slopes. However, the crude ‘wetness’ index of this study showed that Hill Peat Slopes were the least wet of any of the Bog WETMEC types, while the Cluster Analysis distinguished two categories of Hill Bog, one having an association with steeper slopes and drier conditions, the other with gentler slopes and wetter conditions.

Hill Peat Slopes form the main constituent WETMEC of Hill Bog landscapes and are found throughout their distribution. They can also occur as a minor, marginal component of some Topogenous Bog sites, especially draped on slopes around some Mounded Bogs. The Hill Peat Slope WETMEC is generally a distinctive unit, forming an irregular surface across many upland peat landscapes. It is usually quite easily distinguished from the other main ombrotrophic unit of Hill Bogs, namely Slackenings and Crests, by its more strongly sloping character, lower surface wetness and softness, and lower Hummock–Pool diversity (‘surface patterning’). The most difficult distinction is from Aprons (Section 9.4), which are superficially similar, but have deeper peat and generally gentler slopes. Aprons are primarily a feature of the marginal ‘ramparts’ of Crowns in Mounded Bogs, rather than of Hill Bogs, but peat surfaces that have the characteristics of Aprons can occur on the lower slopes of some Hill Bogs.

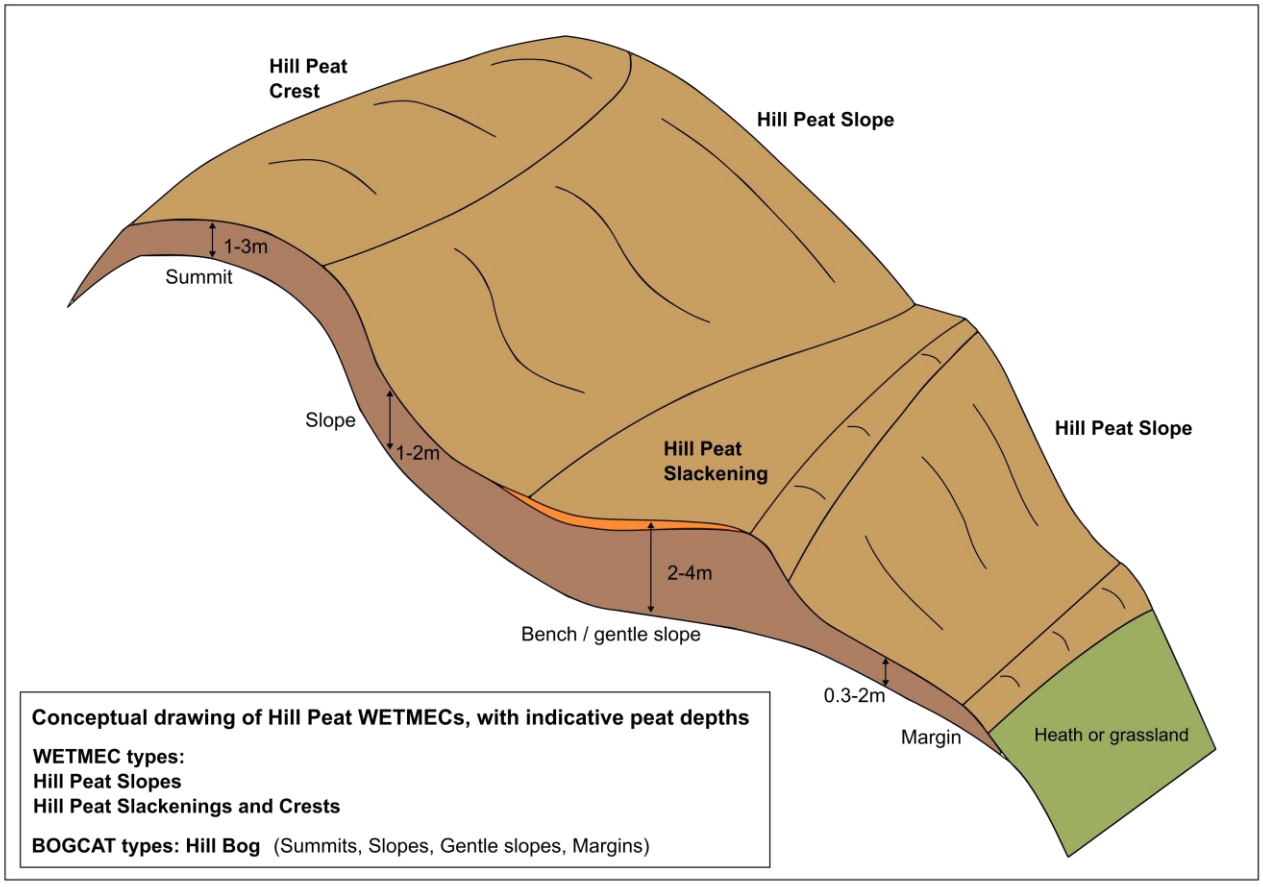


Figure 9. Conceptual drawing of Hill Peat WETMECs.

A summary of the variables recorded for Hill Peat Slopes is provided in Table 13.

Table 13. Numerical and ranked variables recorded for Hill Peat Slopes.

Variable (n = 106)	mean	min	max
Peat Depth (m)	1.23	0.05	3.20
Altitude (m aOD)	431	216	721
Slope %	7.4	1.0	25.0
Rainfall (mm / year)	1683	966	3425
Potential evapotranspiration (mm / year)	474	385	543
Water pH	3.8	3.2	4.2
Conductivity (µS cm^{-1})	74	40	120
Wetness (rank 1 to 9)	3.6	1.0	5.0
Softness (rank 1 to 6)	1.9	1.0	4.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	1.6	0.0	8.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	1.9	0.0	8.0

9.1.1 Erosion sub-type: Hill Slope Gullies

Areas of sloping hill bog are particularly prone to erosion in the form of gully systems. These are often more-or-less linear, sub-parallel features (in some studies these have been referred to as 'Type 2 erosion', for example Bower, 1961; Tallis, 1985) that can extend from close to the summit of a hill to the lower margins of the peat body (Figure 10 and Figure 11). Depending on the intensity of erosion that has been experienced, gullies may be relatively shallow and separated laterally by large expanses of relatively intact peat surface, or they may be deep, often reaching to the sub-peat mineral ground, and may have branching tributaries that dissect the intervening peat into narrow strips. Where gullies are actively eroding, the gully sides often comprise bare peat slopes and a bare mineral base, with small seasonal streams in the gully bottom, and often with minerotrophic vegetation on the base and flanking the streams. Elsewhere gullies may be partly or wholly revegetated (either naturally or as a consequence of restoration work), usually with cottongrasses and heather stabilising the peat of the gully sides, and often with redeposited peat on the gully floor. The peat baulks between the gullies are typically edged by dry vegetation, usually heather, bilberry, crowberry, and pleurocarpous mosses; and, depending on the extent of the baulk, further from the gully edge there may be wetter bog vegetation with cottongrasses and scattered *Sphagnum* hummocks. Allott and others, (2009) found the typical draw-down zone of individual gullies to be around 2 m wide.

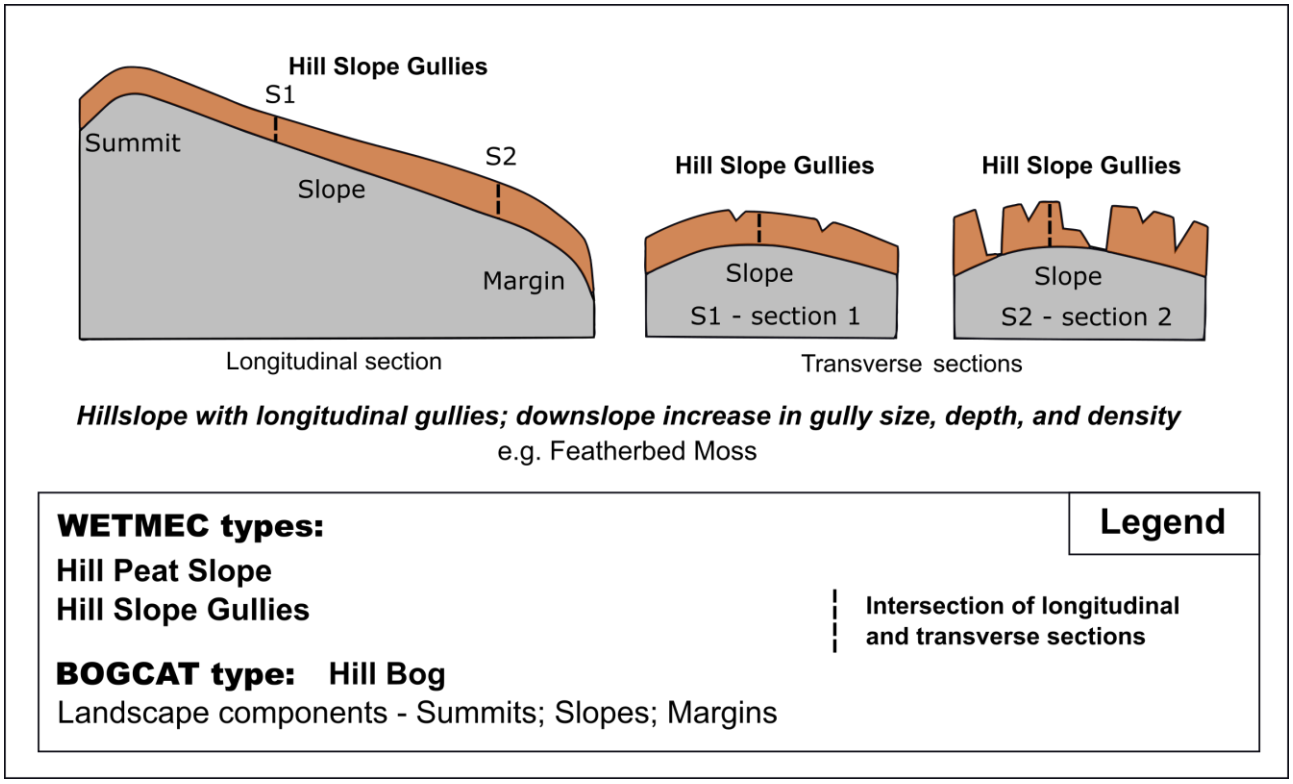


Figure 10. WETMEC conceptual profiles: Hill Slope Gullies.

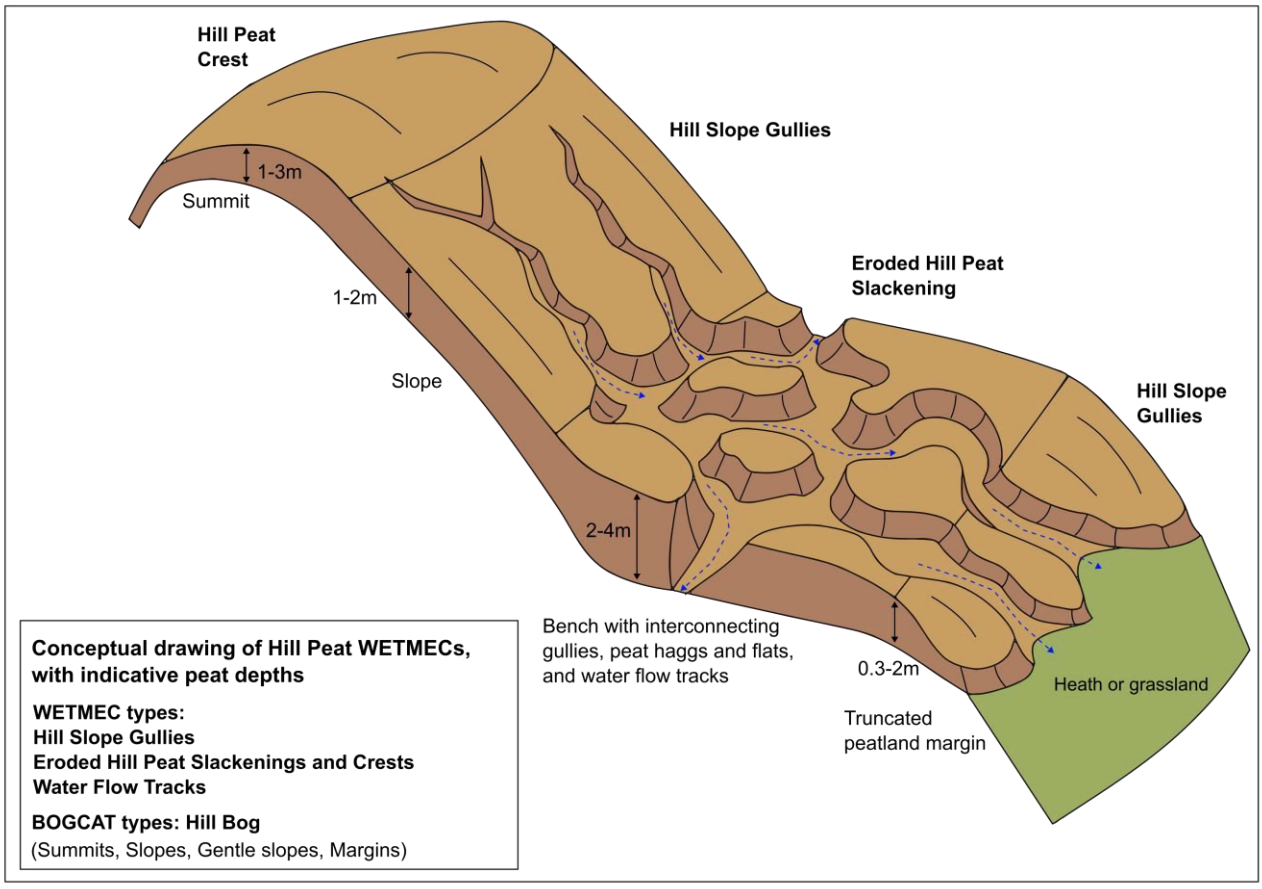


Figure 11. Conceptual drawing of Eroded Hill Peat WETMECs.

Gully formation and / or extension may be related to the development of large macropores within the peat body itself ('peat pipes'), which may collapse to create surface channels in the peat (Pearsall, 1950; Gilman and Newson, 1980), although this has mostly been inferred from similar effects in mineral soils rather than demonstrated in peatlands. Gully formation is a gradual process, and some may be features of some antiquity (e.g. several centuries or more, Tallis 1998), whilst others are likely to be of more recent origin, possibly influenced by the effects of managed moorland burning.

The surface of the intervening areas of 'intact' Hill Peat Slopes may receive some surface water flow from upslope areas of intact peat, and where peat pipes emerge, their outflows may result in some irrigation of slopes below them (Johnson & Dunham, 1963).

9.2 Hill Peat Slackenings & Crests

Like Hill Peat Slopes, Slackenings and Crests typically form part of many informal conceptions of blanket bog, that is, large tracts of relatively shallow, often sloping, ombrotrophic peat that cover large parts of upland Britain, and often they are not distinguished from Hill Peat Slopes. Slackenings and Crests form an important ombrotrophic constituent of Hill Bog landscapes and are found throughout their distribution, though generally they are not as extensive as are Hill Peat slopes.

Crests occupy the ridges of some hill summits or spurs, where these are suitably broad and gently sloping. Narrower and steeper ridges do not generally support Crests, being replaced by Hill Peat Slopes. Slackenings refer to gentle parts of hill slopes, such as provided by benches or steps in a hillside, and to other hollows or flattening of slopes such as small cols, some troughs, and some broader valley bottoms (see Figure 9 and Figure 12, which show Slackenings embedded in Hill Peat Slopes).

The distinguishing features of Slackenings and Crests are that, compared with Hill Peat Slopes, they have a gentler slope (typically around 2%), generally somewhat thicker, but still relatively shallow, peat (typically around 2–3 m), and greater surface patterning of hummocks, hollows and occasional shallow pools. The surface also tends to be somewhat wetter, softer and supports more *Sphagnum* than does that of most Hill Peat Slopes. However, some microtopographical variation may be due to natural re-vegetation of previously eroded surfaces. Slackening and Crest surfaces are typically acidic and have low soil fertility.

Slackenings and Crests are kept wet mainly by precipitation and to some degree by down-slope surface flows of ombrotrophic water, although they may also receive some weakly minerotrophic water from flanking mineral slopes. Surface water flow appears to be particularly important for water supply to Slackenings, but may also irrigate some Crests except where they occupy a summit location. Crests typically merge downslope into Hill Peat Slopes, whilst Hill Slope Slackenings generally occupy locations embedded in Hill Peat Slopes (with Hill Peat Slopes both upslope and downslope of them).

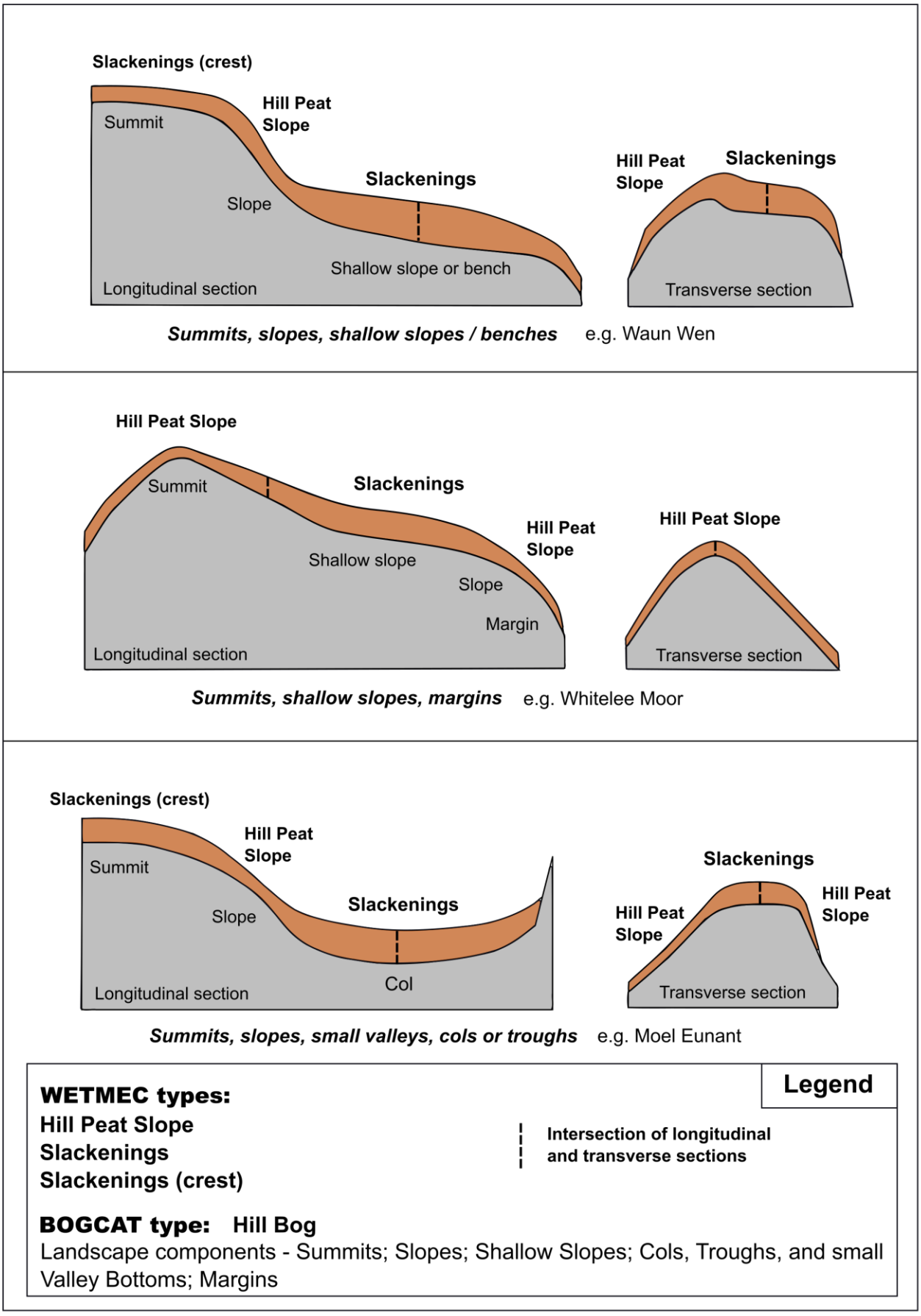


Figure 12. WETMEC conceptual profiles: Hill Peat Slackenings & Crests, embedded in Hill Peat Slopes.

There were slight differences in the variables recorded for Slackenings compared to Crests, though the sample size for crests was very small (see Table 14 and Table 15). Essentially, Slackenings typically had slightly deeper peat, greater slope, slightly reduced surface patterning, and provided more of a water-collecting location. Crests generally occurred at higher altitudes and functioned more as water-shedding locations. These are closely related sub-types, and it is not always possible (or necessary) to separate them.

Data analyses showed that Slackenings and Crests have stronger affinities to Ombrotrophic Crowns than to Hill Peat Slopes, and where they occur in large cols it can be difficult to distinguish them from Hump Crowns, since the two types intergrade. Where mounded peat occurs in depressions, small hollows, basins, or cols, these are considered to be some form of Crown rather than Hill Peat. Often the surface topography of Slackenings and Crests is confused by extensive erosion, which usually forms an interconnecting network of gullies (see Section 9.2.1).

The vegetation of Slackenings and Crests is often transitional between the NVC communities M18 and M19, typically with abundant heather mixed with cross-leaved heath and cottongrasses over patches of *Sphagnum* (usually *S. capillifolium* and *S. papillosum*), often with some cranberry and bog asphodel, and occasionally *S. medium*. *Sphagnum*-rich M19_S with *Sphagnum capillifolium* hummocks is also often found in these habitats. In western areas, Slackenings may support *Sphagnum*-rich M17_S vegetation with hollows and pools, some which are interconnected, embedded in more extensive and less *Sphagnum*-rich M17.

Table 14. Numerical and ranked variables recorded for Slackenings.

Variable (n = 43)	mean	min	max
Peat Depth (m)	2.32	0.40	4.30
Altitude (m aOD)	447	285	552
Slope %	2.0	0.0	6.0
Rainfall (mm per year)	1766	966	3425
Potential evapotranspiration (mm / year)	481	427	523
Water pH	3.9	3.4	4.8
Conductivity (µS cm^{-1})	72	45	110
Wetness (rank 1 to 9)	4.0	3.0	5.0
Softness (rank 1 to 6)	2.5	1.0	4.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	4.5	0.0	12.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	0.6	0.0	4.0

Table 15. Numerical and ranked variables recorded for Crests.

Variable (n = 9)	mean	min	max
Peat Depth (m)	1.88	0.90	2.90
Altitude (m aOD)	511	420	591
Slope %	1.8	0.0	3.3
Rainfall (mm per year)	1783	1383	2116
Potential evapotranspiration (mm / year)	472	421	502
Water pH	3.9	3.6	4.3
Conductivity (µS cm^{-1})	77	50	90
Wetness (rank 1 to 9)	4.1	3.0	5.0
Softness (rank 1 to 6)	2.3	2.0	3.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	5.6	2.0	9.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	1.1	0.0	3.0

9.2.1 WETMEC sub-type: Eroded Hill Peat Slackenings & Crests

Hill Peat Slackenings and Crests can also become eroded, often forming a reticulated or net-like pattern of gullies that separate residual peat mounds, which are often referred to as ‘haggs’. This type of erosion has also been referred to as “Type 1 erosion” (Bower, 1961). The depth of erosion can vary from shallow depressions 20–30 cm deep to very deep gullies that can reach the sub-peat mineral ground, though where peat depth is greater than about 2 m there may remain a considerable depth of peat beneath the surface of the erosion channel or hollow (Figure 11 and Figure 13).

In some cases, the eroded base of bare peat may have small pools, sometimes with thick carpets of *Sphagnum* mosses and cottongrasses revegetating the wetter peat. Where the intervening residual peat baulks are quite extensive, they can retain moderately rich bog vegetation with localised *Sphagnum* hummocks, but the smaller baulks tend to have drier surfaces that are dominated by dwarf shrubs, cottongrasses, deer-grass, and pleurocarpous mosses; here there is often evidence of peat wastage and a reduction of surface height. Where erosion has cut down to the sub-peat mineral ground there may be extensive areas of bare rock or sand and gravel, with patches of acidic grassland, and there may also be tracts of re-deposited eroded peat.

It is not clear whether this type of erosion has formed by hill slope gullies extending upslope onto flatter ground to meet the headwaters of other gully systems; or whether they are the remnants of a former hummock–hollow–pool microtopography, whereby former pools or hollows have become inter-connected, ultimately forming an erosive flow track system; or perhaps a combination of these processes (Tallis, 1998).

Due to their location on flatter ground than the sloping peat gullies, it is more likely that the surfaces of the peat baulks are isolated from down-slope flow of surface water (or from

peat pipes), and are only irrigated by direct precipitation. Hence, they may be more prone to water table drawdown, and have drier surface peat layers, than some peat haggs on gullied slopes. Allott and others (2009) showed that erosion gullies could cause water drawdown in the adjoining haggs, extending to about 2 m into the haggs, but they also considered that there was a more pervasive lowering of the water table in the haggs, which was not directly a consequence of gully drawdown, instead it was possibly related to the diversion of hillslope water flow into gully channels.

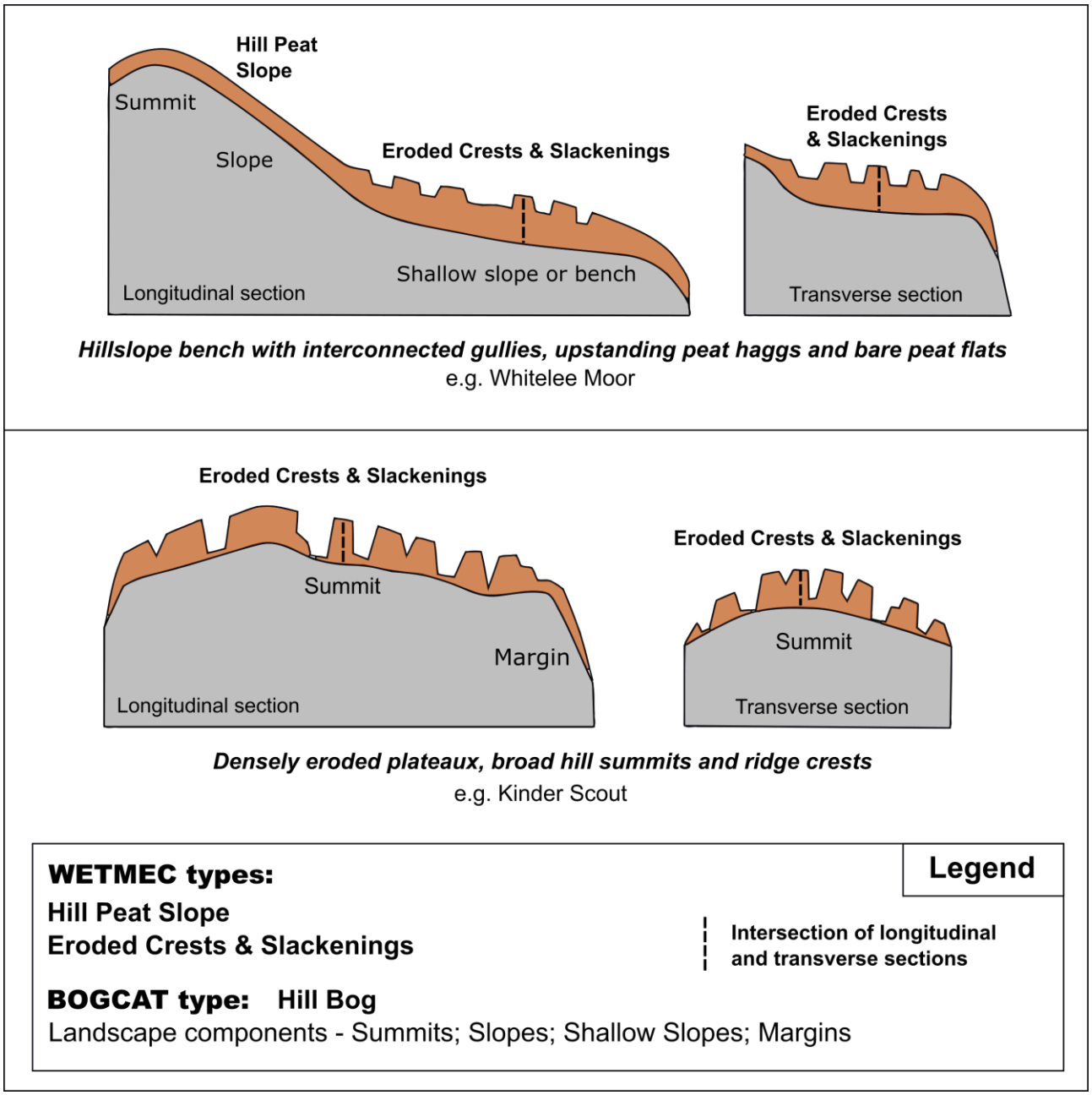


Figure 13. WETMEC conceptual profiles: Eroded Crests & Slackenings

9.3 Ombrotrophic Crowns

Ombrotrophic Crowns are shallow domes of ombrotrophic peat that form a cap on the tops of Mounded or Trough Bogs. They are particularly a feature of Mounded Bogs where they are usually surrounded by a circlet of steeper and often somewhat drier ombrotrophic peat, referred to here as an Ombrotrophic Apron, which can include features sometimes known as ‘rands’. Both Crown and Apron are usually part of a single hydrological unit that have developed in tandem, and they are often considered together as a single unit (such as a raised bog); they are distinguished here because their surfaces are different, and because they can occur independently of each other in some bogs.

Ombrotrophic Crowns typically occupy the highest, flattest, least well-drained and wettest parts of Mounded Bogs, and water from precipitation drains through them into the surrounding Apron and, where present, into a surrounding lagg channel. Their position may be more-or-less concentric or markedly eccentric, and their shape and size vary, usually depending on the shape of the peat mound as a whole. That appears to be determined by drainage patterns, which are influenced by the topography of the landscape in which the mound has developed. They may form much of the surface of a Mounded Bog, except for any steeper marginal Aprons. In many Irregularly-mounded Bogs the Crown is proportionately smaller, and much of the bog surface consists of a sloping Apron (see Figure 15, Figure 17, and Figure 19).

Overall, Ombrotrophic Crowns are amongst the wettest of all of the ombrotrophic WETMECs. They often have well developed surface patterning and have the greatest hummock–pool diversity, usually with well-developed hummocks, lawns, hollows and pools, although there is much variation in this. Crowns typically have a wet, soft or spongy surface (up to about 0.5m deep), usually with much *Sphagnum*, over firmer and more humified peat that can reach to 10m in depth, though typical depths are between 4–6m. Most of the upper part of the peat (± the ‘acrotelm’) appears to be of quite high permeability and is likely to have some capacity for hydrological self-regulation. Some Crowns may have drier and firmer surfaces, dominated particularly by heather and cottongrasses, which is often (but not always) in response to damage from burning or partial drainage. Crowns are typically acidic and of low fertility.

Three types of Ombrotrophic Crowns have been distinguished: Radial Crowns, Partial Crowns and Hump Crowns. The surface conditions of these are very similar, with high values of surface patterning, high hummock–pool diversities, and deep peat. The differences between them relate primarily to different shapes of the catotelm peat, which are related to drainage patterns and to the topographical context in which the peat has accumulated. Summary variables are presented in Table 16, Table 17, and Table 18.

Radial Crowns: ‘Complete Crowns’ which drain in more-or-less all directions. Particularly associated with Regularly-mounded Bogs, but also in some Irregularly-mounded Bogs.

Partial Crowns: Crowns that are attached to an adjoining rising hillslope by a strip of peat; the hillside may be of mineral ground or covered by Hill Peat Slopes; they drain only in

directions away from the hillslope, from which they may receive some water flow. Particularly, but not exclusively, associated with Irregularly-mounded Bogs.

Hump Crowns: Occur in trough-like landscape features, particularly some cols, and form a Crown that is humped and drains mainly along the axis of the trough. The peat of the hump tends to be flat across the trough, and when it merges with flanking Hill Peat Slopes it can have a concave profile. Hump Crowns may receive significant water flow from the flanking slopes. They are particularly a feature of Humped Bogs, but sometimes occur in Trough Bogs, and can grade into certain types of Hill Peat Slackenings.

Ombrotrophic Crowns were once widespread in the lowlands, but only a fairly small number of recognisable examples remain, particularly in the north-west of England, and in the western lowlands of Wales. Some Crowns are found in the uplands of south-western England, and there is a particular concentration in the Roman Wall Country of northern England. Most upland Crowns are associated with Mounded Bogs, but in some regions, such as the Roman Wall Country, Crowns occur within Trough Bogs, but usually without much of an associated Apron. Some examples are known from hollows embedded within Hill Bogs, again with limited development of an Apron. In more lowland situations, Crowns have often been truncated by peat cutting, particularly for horticultural peat, or have been modified by drainage and cultivation. In these examples, the Crown is often the main part of a Mounded Bog to persist, though usually in a highly modified form, as upstanding massifs of peat that have been cut away around their margins (for example, Wreaks Moss, Duddon Mosses; see Figure 14).

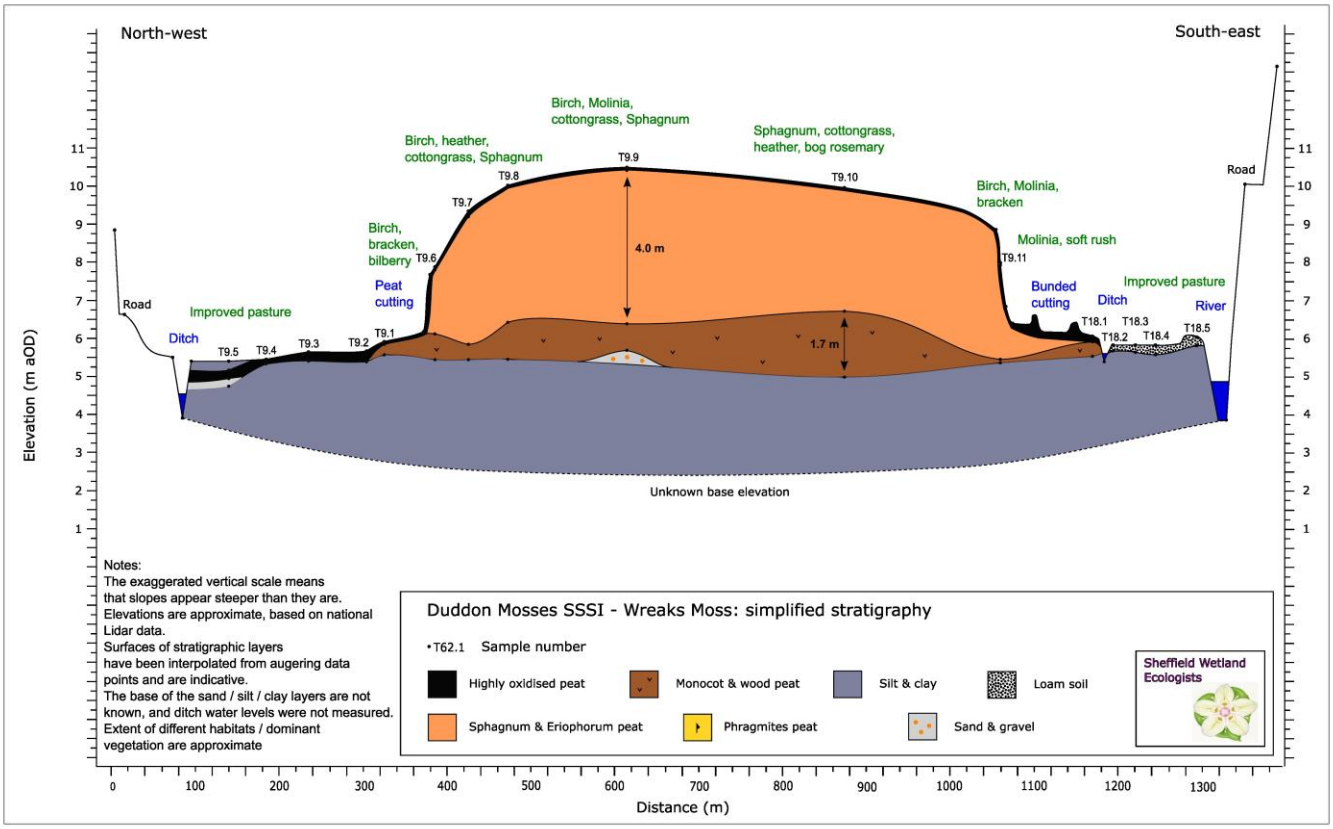


Figure 14. Simplified stratigraphy of Wreaks Moss, Duddon Mosses SSSI.

Crowns support the wettest forms of the NVC communities M17 and M18, on the softest surfaces, where the vegetation occupies an intimate mosaic of low hummocks and hollows with aquatic *Sphagnum* species (*S. cuspidatum* / *S. denticulatum*). Hummock–hollow microtopography is particularly distinctive in M18_S where there is a more or less continuous layer of spongy *Sphagnum* (usually *S. papillosum* often with *S. magellanicum*). M17_S tends to be less hummocky with firmer 'flats' and elongated hollows. Larger pools (M1 and M2) are often associated with M17 and M18 vegetation on Crowns. Drained or disturbed areas support vegetation typical of drier and firmer surfaces: M18/M19 and M17.

9.3.1 Radial Crown

Radial Crowns potentially drain in all, or most, directions. They form the highest and wettest parts of Mounded Bogs, and near their apex are more-or-less exclusively rain fed, supplemented further from the apex by surface flows from the higher areas. Radial Crowns may be more-or-less concentric, or they may be eccentric in shape (Figure 15 and Figure 16), the latter seeming to develop when drainage from the Crown to one margin is less than to other margins. This may relate to distance from the main drainage outlet, or the influence of water from adjoining hill slopes, or to the slope of the mineral ground beneath the peat. Eccentric Radial Crowns are common in asymmetric basins: there the Crown is typically located towards the higher back wall of the hollow, closest to flows from adjoining slopes, but separated from these by a lower surface or channel, which may contain a marginal 'lagg-like' water flow track. In this situation, drainage from the hill slope may have a supporting influence upon the Crown, by helping to keep it wet, without directly affecting its surface. In some situations, an extensive Apron has formed below the Crown, usually on the outlet side of the basin (for example, Scald Law in Northumberland).

Table 16. Numerical and ranked variables recorded for Radial Crowns.

Variable (n = 29)	mean	min	max
Peat Depth (m)	5.26	2.40	10.00
Altitude (m aOD)	305	187	568
Slope %	0.6	0.0	2.4
Rainfall (mm per year)	1176	956	1690
Potential evapotranspiration (mm / year)	494	476	523
Water pH	4.3	3.8	4.9
Conductivity (µS cm^{-1})	61	30	90
Wetness (rank 1 to 9)	4.7	3.0	5.0
Softness (rank 1 to 6)	3.0	2.0	4.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	7.2	2.0	16.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	0.1	0.0	4.0

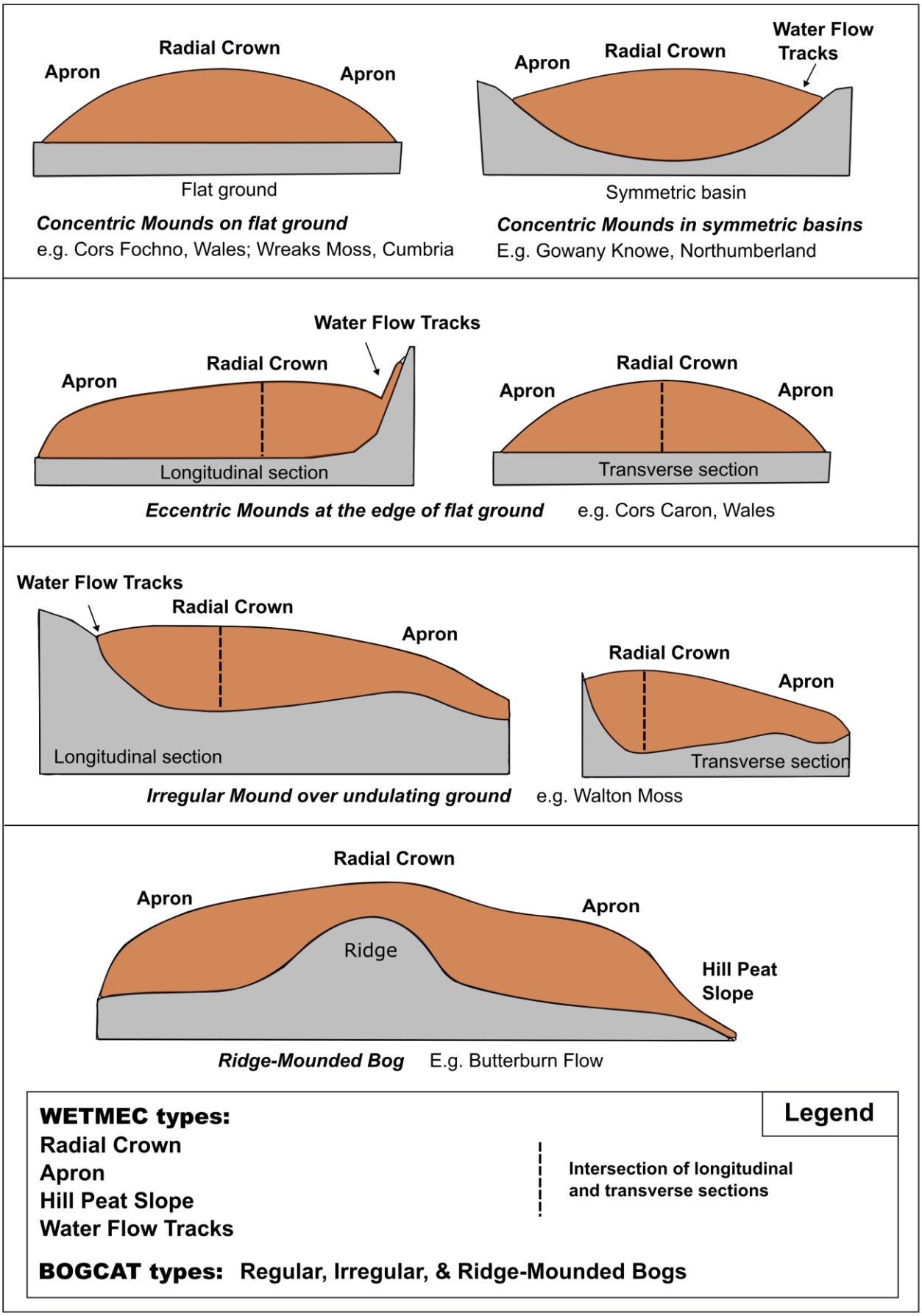


Figure 15. WETMEC conceptual profiles: Radial Crowns.

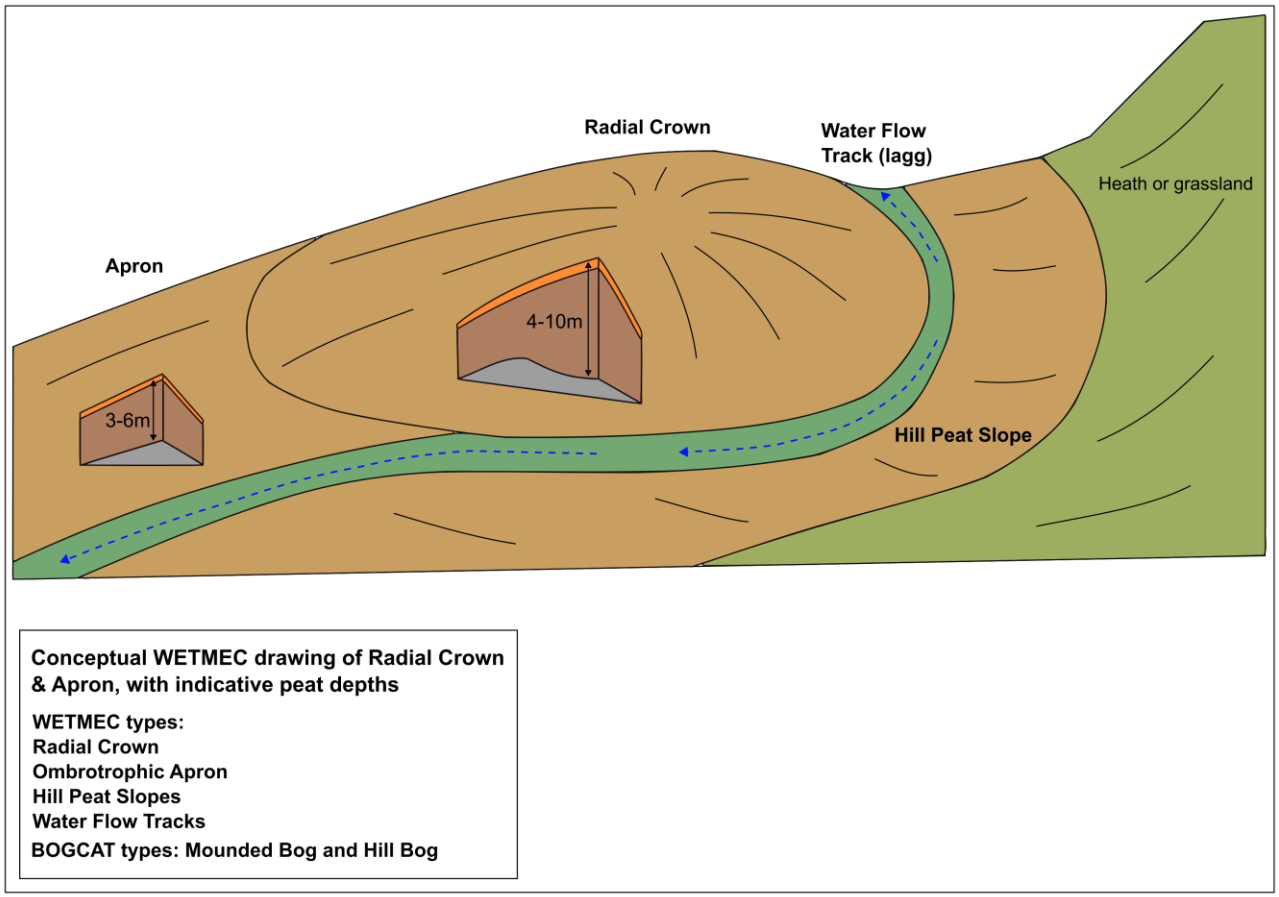


Figure 16. Conceptual WETMEC drawing of a Radial Crown and Apron.

9.3.2 Partial Crown

Partial Crowns are partly attached to an adjoining slope, which may be either mineral ground or peat covered. They are particularly characteristic of some Irregularly-mounded Bogs. In some instances, the Partial Crown is connected to the hillslope by a narrow strip of peat, on either side of which is a shallow channel with a soakway or 'lagg' stream. In other cases, the Partial Crown is essentially 'half-a-crown', with most of its upslope margin connected to the adjoining hillslope, so that its radius of drainage is around 180° or less (see Figure 17 and Figure 18).

Partial Crowns potentially receive surface water from the adjoining hillside, which could be either ombrotrophic or weakly minerotrophic, depending on its source and on the surface of the hillslope. The magnitude and degree of penetration of these surfaces flows is difficult to estimate, but available evidence suggests it is unlikely to be strongly minerotrophic.

As Partial Crowns steepen downslope, they are often replaced by Ombrotrophic Aprons which may be extensive. However, a few examples of Partial Crowns (for example, The Wou, Gors Lwyd) represent shallow domes of ombrotrophic peat that protrude into Trough

Bogs from their upland margins, and these may have little or no development of an associated Apron.

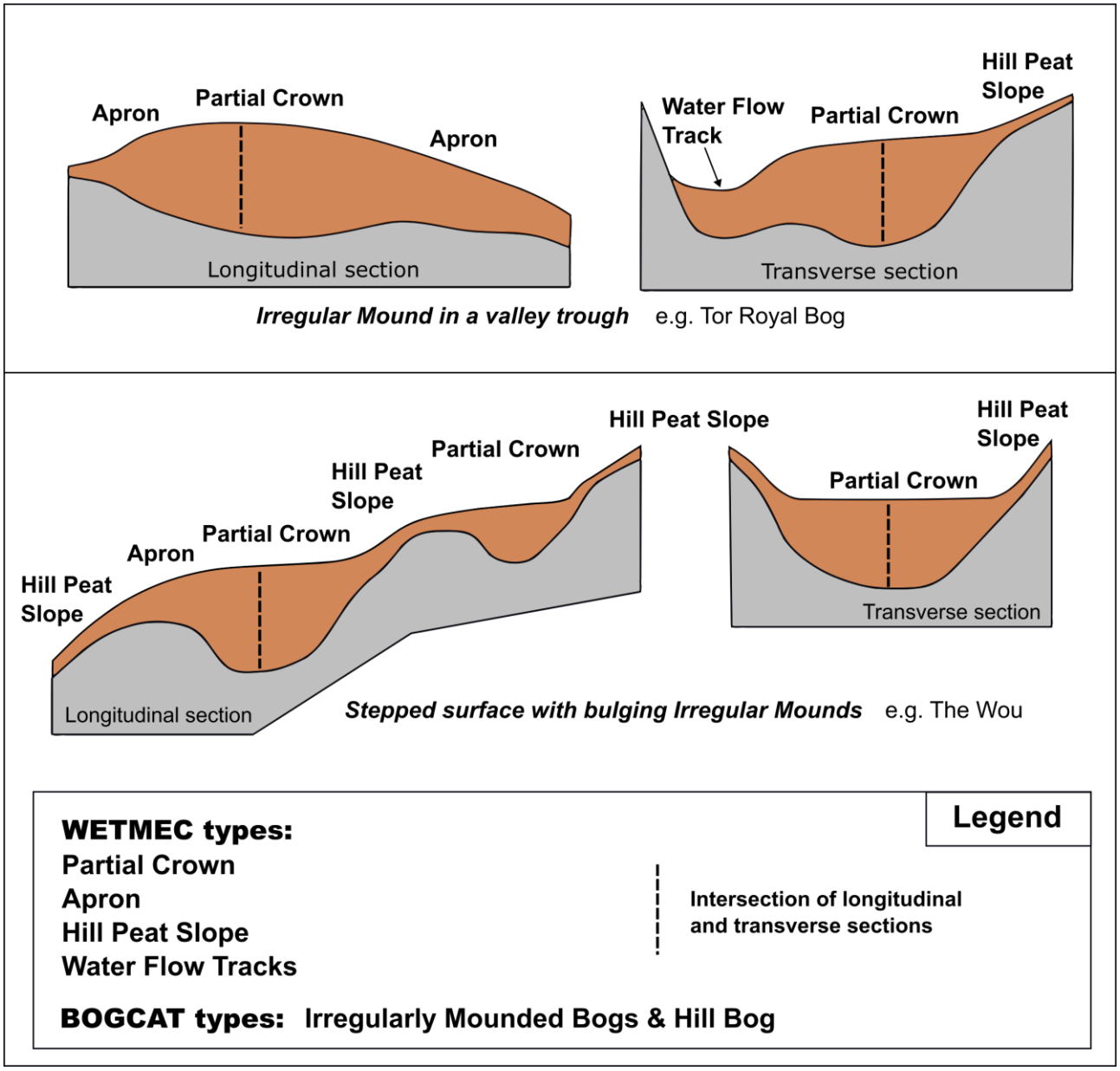


Figure 17. WETMEC conceptual profiles: Partial Crowns.

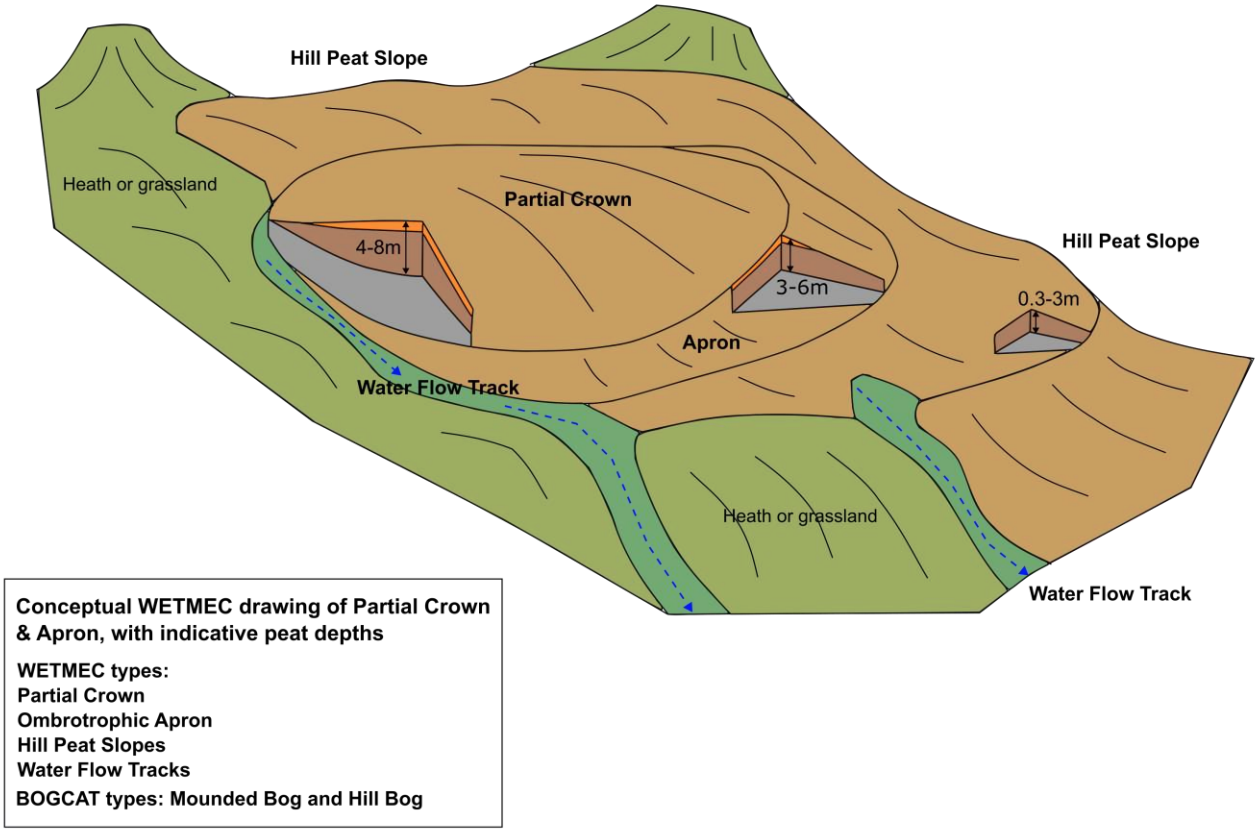


Figure 18. Conceptual WETMEC drawing of a Partial Crown and Apron.

Table 17. Numerical and ranked variables recorded for Partial Crowns.

Variable (n = 40)	mean	min	max
Peat Depth (m)	4.56	1.40	8.00
Altitude (m aOD)	327	187	580
Slope %	0.8	0.0	3.3
Rainfall (mm per year)	1342	934	2323
Potential evapotranspiration (mm / year)	489	421	549
Water pH	3.9	3.4	4.6
Conductivity (µS cm^{-1})	68	20	120
Wetness (rank 1 to 9)	4.5	2.0	5.0
Softness (rank 1 to 6)	3.0	2.0	4.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	6.1	0.0	14.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	0.6	0.0	5.0

9.3.3 Hump Crown

Hump Crowns are associated with Humped and Hump-backed forms of Mounded Bog, and they drain primarily just along the axes of these, in either one or both directions depending on the topographical formation of the Hump. They are mostly found in cols, within which they are often associated with flat surfaces or shallow basins rather than with a convex mineral surface (Figure 19 and Figure 20).

Their location in cols means that Hump Crowns are particularly likely to receive water flow from the flanking hill slopes, either of ombrotrophic or weakly minerotrophic origin. This is especially likely when the Crown is not separated from the slopes by any sort of marginal water flow track, and when the slopes are peat-covered the Crown will often merge into adjoining Hill Peat.

The Crown is usually only mounded axially, not across the Hump, though it may sometimes slope to one side or the other. Where it merges with flanking Hill Peat Slopes, it may have a concave shape across the hump, whilst remaining humped axially. The surface of Hump Crowns appears typically to be ombrotrophic, with little floristic evidence for minerotrophic enrichment from surface water flow from the adjacent slopes. The Crown may grade into an Ombrotrophic Apron as the slope steepens.

Table 18. Numerical and ranked variables recorded for Hump Crowns.

Variable (n = 20)	mean	min	max
Peat Depth (m)	5.31	2.80	9.00
Altitude (m aOD)	414	292	561
Slope %	0.9	0.0	2.0
Rainfall (mm per year)	1584	966	2457
Potential evapotranspiration (mm / year)	480	432	534
Water pH	3.9	3.3	4.7
Conductivity (µS cm^{-1})	64	30	110
Wetness (rank 1 to 9)	4.6	3.0	6.0
Softness (rank 1 to 6)	3.1	2.0	5.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	6.2	0.0	11.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	0.7	0.0	4.0

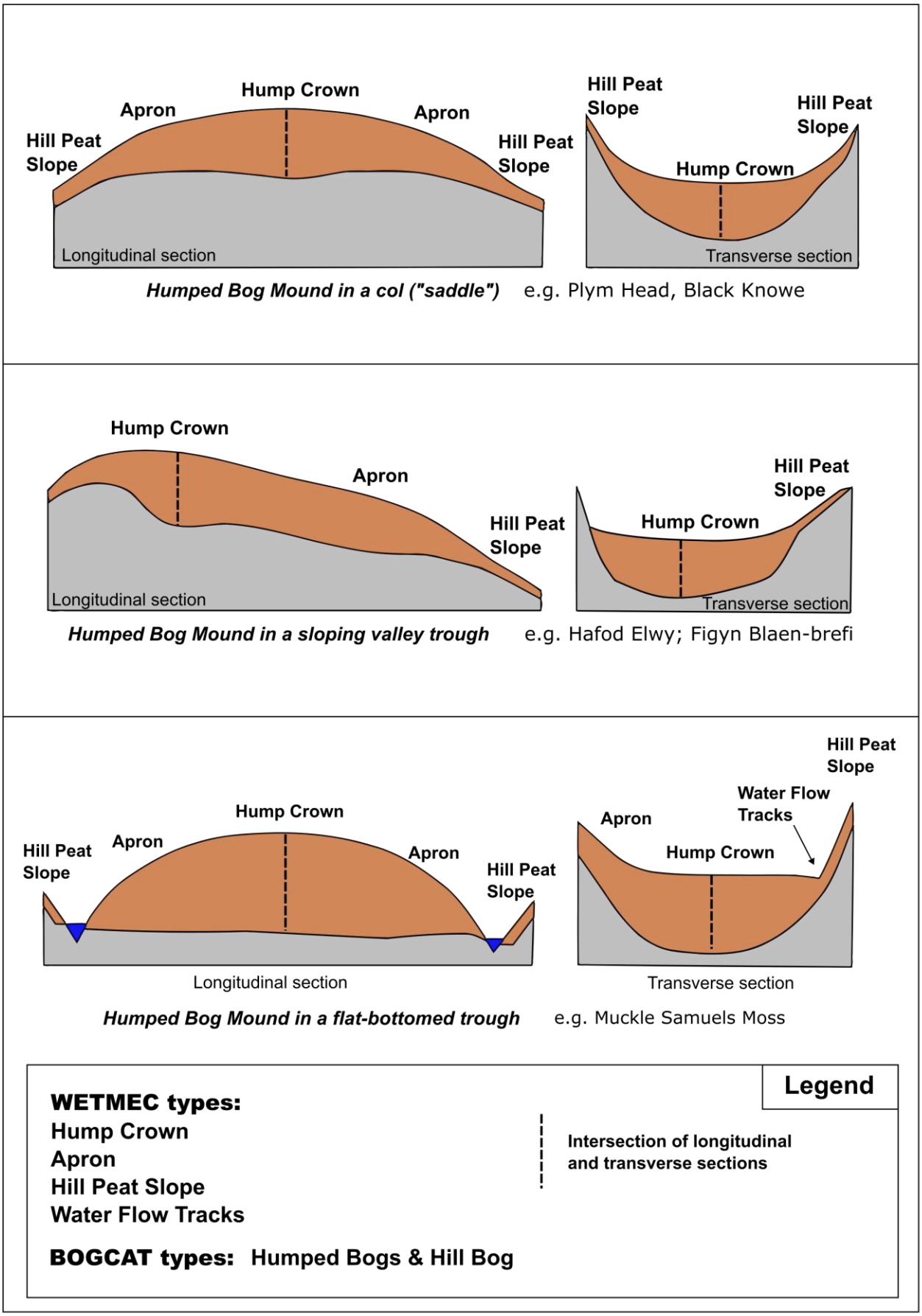


Figure 19. WETMEC conceptual profiles: Hump Crowns.

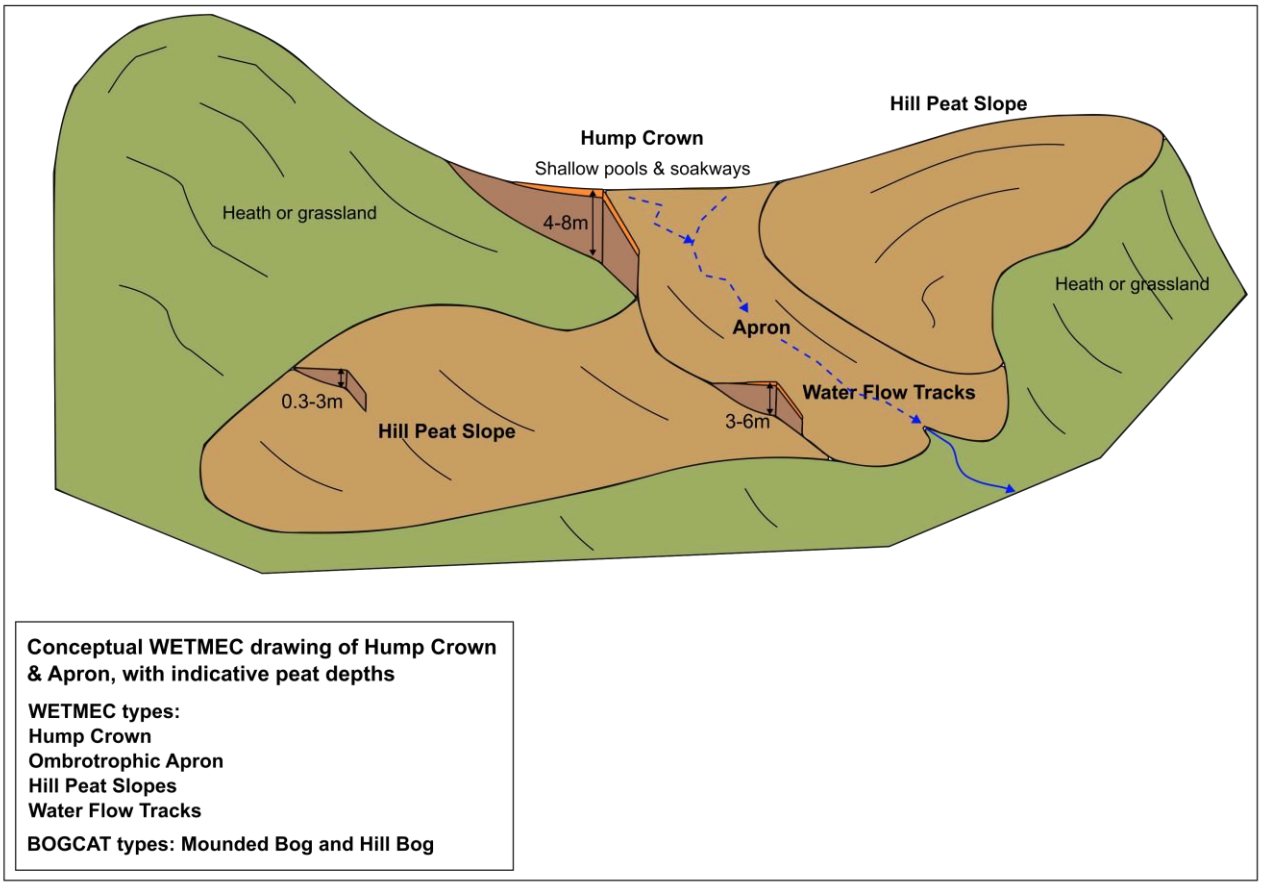


Figure 20. Conceptual WETMEC drawing of Hump Crown and Apron.

9.3.4 Eroded Crown

Features that are thought to be the eroded remains of former Crowns have been identified in several locations in different parts of England and Wales during the current project (e.g. Gors Goch and Gors Lwyd in the Elan Valley of mid-Wales; various parts of the Migneint in northern Wales; several locations close to Trout Beck in Moorhouse, northern Pennines). Most of these comprise areas of very deep peat (up to about 6 m) that have developed in hollows or basins embedded in larger expanses of Hill Peat Slopes, though sometimes in Trough Bogs in valley bottoms, and they may be flanked by areas of Ombrotrophic Apron or Ombrotrophic Bottoms.

They appear to have many similarities to the Eroded Slackenings and Crests, though depending on their situation they may not be associated with gullying on adjacent ground (e.g. Gors Lwyd), suggesting the severe erosion areas may be a particular feature of the former Crowns. In addition, the examples observed as part of this study do not appear to have been eroded down to the mineral base, presumably because of the greater depth of peat (Figure 21 and Figure 22).

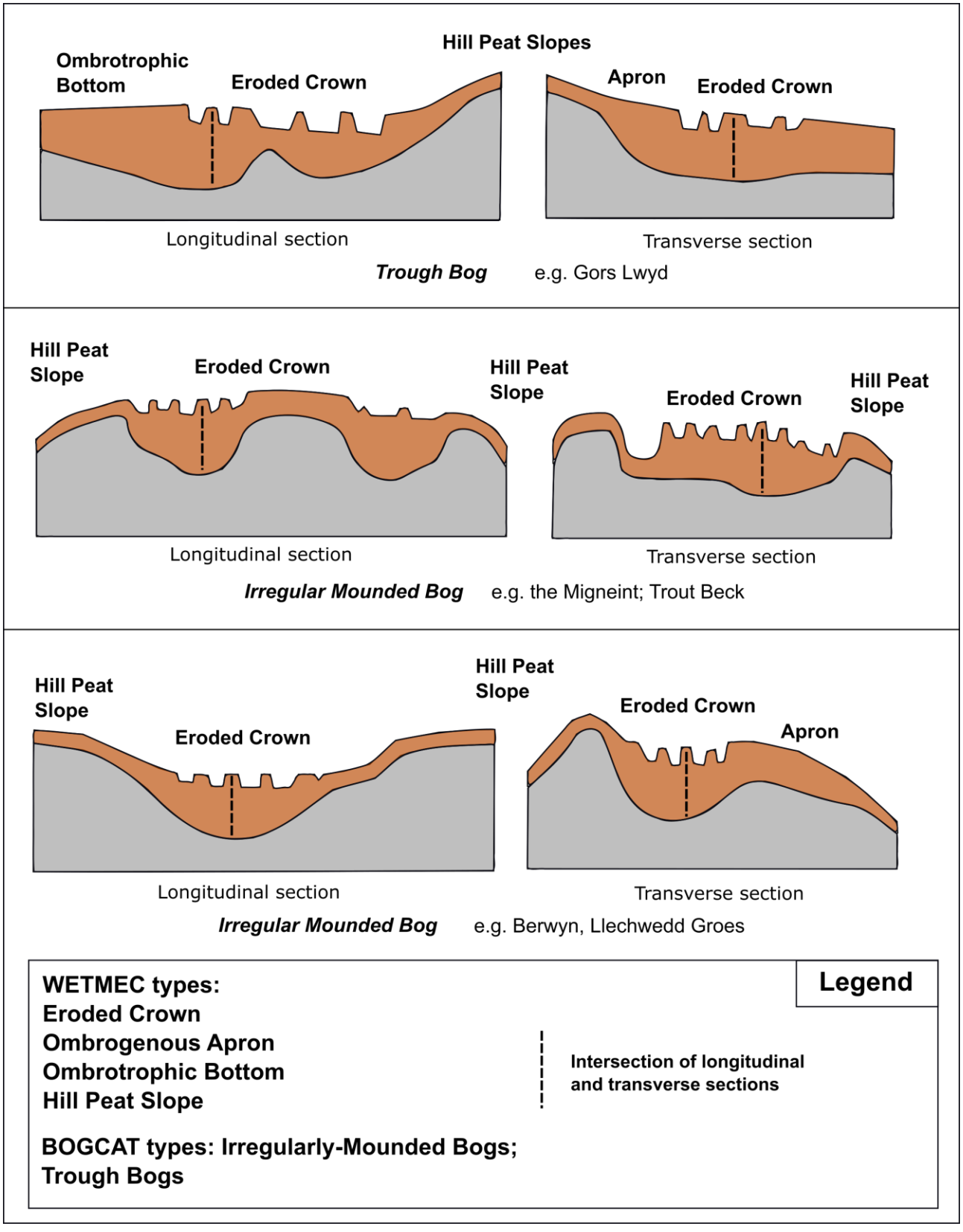


Figure 21. WETMEC conceptual profiles: Eroded Crowns.

Like Eroded Slackenings and Crests, eroded Crowns can range from examples with a few small, upraised haggs of peat surrounded by expanses of bare peat, to situations with abundant peat haggs surrounded by a complex network of channels that may be dry, partly water-filled, or have revegetating carpets of *Sphagnum* mosses and cottongrasses.

The difference in elevation between the surface remnants and channels appears to range from about 50–100 cm. As with Eroded Slackenings, where the upraised areas are quite extensive, they can support a remnant bog flora that is quite species-rich, but the smaller haggs tend to have a firm dry surface that is dominated by dwarf shrubs, cottongrasses, deer-grass, and pleurocarpous mosses.

Similarly to Eroded Slackenings, because of their isolation from surrounding slopes it is likely that the surfaces of the peat haggs do not receive surface water (or peat pipe) irrigation from adjacent ground, instead being wetted only by precipitation. Hence, they may be more prone to water table drawdown, and have drier surface peat layers, than the peat haggs on gullied slopes.

Despite their highly eroded character, the examples examined here had similar values to those of the three Crown sub-types for many variables. The main differences observed were more tussocky surfaces, and a greater capacity for collecting water (compared with the normally water-shedding Crowns). This is partly a consequence of hollows and channels created by erosion, which can help to create a water-retaining environment, and these features are likely to facilitate the restoration of such areas. It seems that former Crowns have been particularly prone to erosion, possibly on account of their wetness, their soft *Sphagnum*-rich peat and possibly their surface patterning.

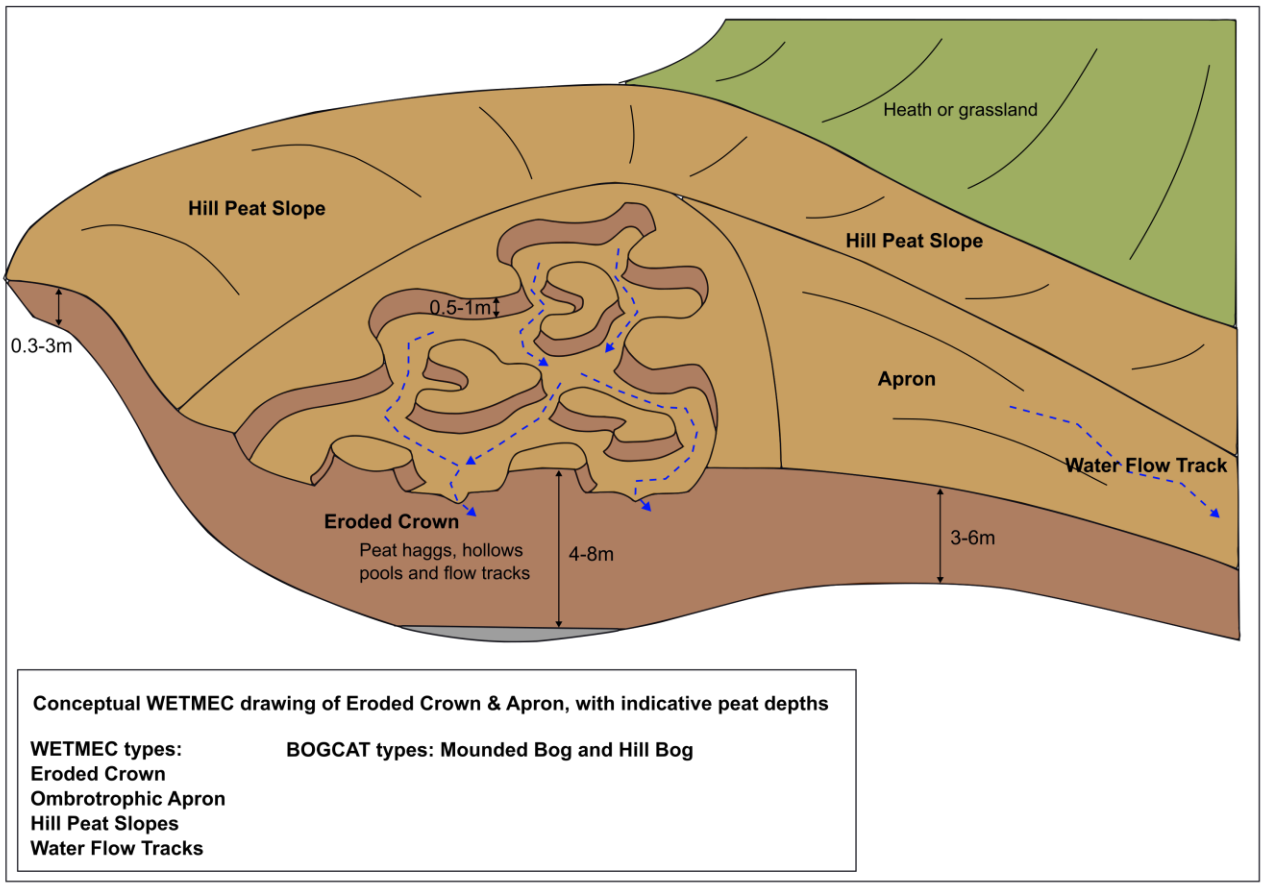


Figure 22. Conceptual WETMEC drawing of Eroded Crown and Apron.

9.4 Ombrotrophic Aprons

Ombrotrophic Aprons are sloping habitats of fairly deep peat (slope mean: 2.8%; mean depth: 3.7 m; see Table 19) and are intermediate in many ways between Ombrotrophic Crowns and Hill Peat Slopes. On average they are more strongly sloping than Crowns, of similar mean slope to Hill Peat Slackenings, but much less than Hill Peat Slopes. Their average peat depth is less than that of Crowns but considerably greater than that of Hill Peat Slackenings and Hill Peat Slopes. They have somewhat lower estimates of surface wetness and softness than Crowns, and much lower Hummock–Pool diversity and *Sphagnum* cover. Heather cover on Aprons is generally greater than both Crowns and Hill Peat Slopes, with a tendency for it to dominate on the steeper slopes.

Ombrotrophic Aprons occupy rain-fed slopes over deep peat, with a range of *Sphagnum* abundance. Aprons are irrigated by a combination of direct precipitation and ombrotrophic flow tracks from higher up the slope. Whilst there may occasionally be the potential for inflow from adjacent hillsides, this appears at most to be weakly minerotrophic. Bog pools are generally not a feature of Aprons. The surfaces of Ombrotrophic Aprons are typically acidic and of low fertility.

Ombrotrophic Aprons are comprised of a variable depth of ombrotrophic peat, usually overlaying minerotrophic (most typically wood) peat. Observations made in the present investigation indicated that Aprons have more mixed *Sphagnum–Eriophorum* peat and less *Sphagnum* peat in the top layer compared with Crowns. An amorphous top layer of peat was also more frequent in Aprons compared to Crowns.

Aprons have been recorded from two distinct topographical contexts, one associated with the Crowns of Mounded Bogs, the other associated with Hill Bogs and Trough Bogs (Figure 23; also Figure 16, Figure 18, and Figure 20). Some Aprons also occur as more-or-less separate peatland units.

Bog Mound Aprons occupy the steeper, more peripheral parts of Mounded Bogs. In Regularly-mounded Bogs they can form a circlet around the Crown. This is sometimes referred to as a ‘rand’ and, when present, is a distinctive feature, but it often forms just a narrow zone around the bog mound. In many lowland Regularly-mounded Bogs the natural Apron has been removed by drainage, cultivation or turbary (see Figure 14), and its former character is not known. Aprons are often developed much more prominently below the Crowns of Irregularly-mounded Bogs and Hump Bogs, where they can form quite long slopes draining the Crown.

Hill Slope Aprons occupy the lower slopes of some upland bogs, sometimes in shallow channels or sloping hollows. They can also occur as a downslope continuation of Bog Mound Aprons. Other examples are not associated with a Crown and largely represent slopes of deep peat that can be isolated from other peatland units (*e.g.* Ringinglow Bog, south Pennines). Elsewhere they may occur over lower hill slopes, often close to the margin of a Trough Bog, which they may protrude into (for example, Gors Lwyd and Gors Goch, Cwmystwyth Uplands of Wales).

Along with Ombrotrophic Crowns, Aprons form an integral component of most Mounded Bogs, and their occurrence reflects the distribution of these, except in lowland examples where the Apron has been destroyed. They are also prominent features of some Irregularly-mounded Bogs, and many examples though drained and forested, may not have been destroyed.

The extent of Aprons varies considerably from site to site. They can be absent from some small Mounded Bogs, or embedded within some Trough Bogs, whilst elsewhere the Apron can occupy most of the mire below a relatively small Crown. The spatial distinction of such slopes from Ombrotrophic Crowns is usually fuzzy and sometimes difficult to determine.

Where they adjoin Crowns with *Sphagnum*-rich M18_S vegetation, Aprons can support the M18 bog vegetation type (though this is absent from the steeper slopes), but the majority are occupied by M18/M19 or M19 vegetation. Where they are associated with Crowns that have *Sphagnum*-rich M17_S vegetation (for example, in Dartmoor and parts of Wales), Aprons often support more uniform M17 vegetation. Some Aprons have been modified by human activity, and where they are affected by forestry furrows and marginal drains, they often support tussocky cottongrass vegetation (M20). Almost a quarter of examples, mostly on the steepest slopes, were dominated by heathy vegetation (Heath D).

In Mounded Bogs in northern England, the location and extent of Ombrotrophic Aprons can often be visible as a zone of M19 vegetation surrounding the M18 of the Crown. However, in some sites, including examples that have been ditched for forestry such as Muckle Samuel's Moss, or at Ringinglow Bog (which is thought to have been much damaged by past industrial pollution; Conway, 1949), this distinction can be confused by the Crown also supporting M19 vegetation. In much of Wales and south-western England where M17 is prevalent, the floristic distinction between Crowns and Aprons can be subtle.

Table 19. Numerical and ranked variables recorded for Ombrotrophic Aprons.

Variable (n = 51)	mean	min	max
Peat Depth (m)	3.7	0.90	6.80
Altitude (m aOD)	335	185	548
Slope %	2.8	0.9	6.7
Rainfall (mm per year)	1386	950	2457
Potential evapotranspiration (mm / year)	485	459	523
Water pH	4.0	2.9	4.9
Conductivity (µS cm^{-1})	68	40	160
Wetness (rank 1 to 9)	4.1	2.0	6.0
Softness (rank 1 to 6)	2.4	1.0	4.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	2.7	0.0	10.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	1.6	0.0	7.0

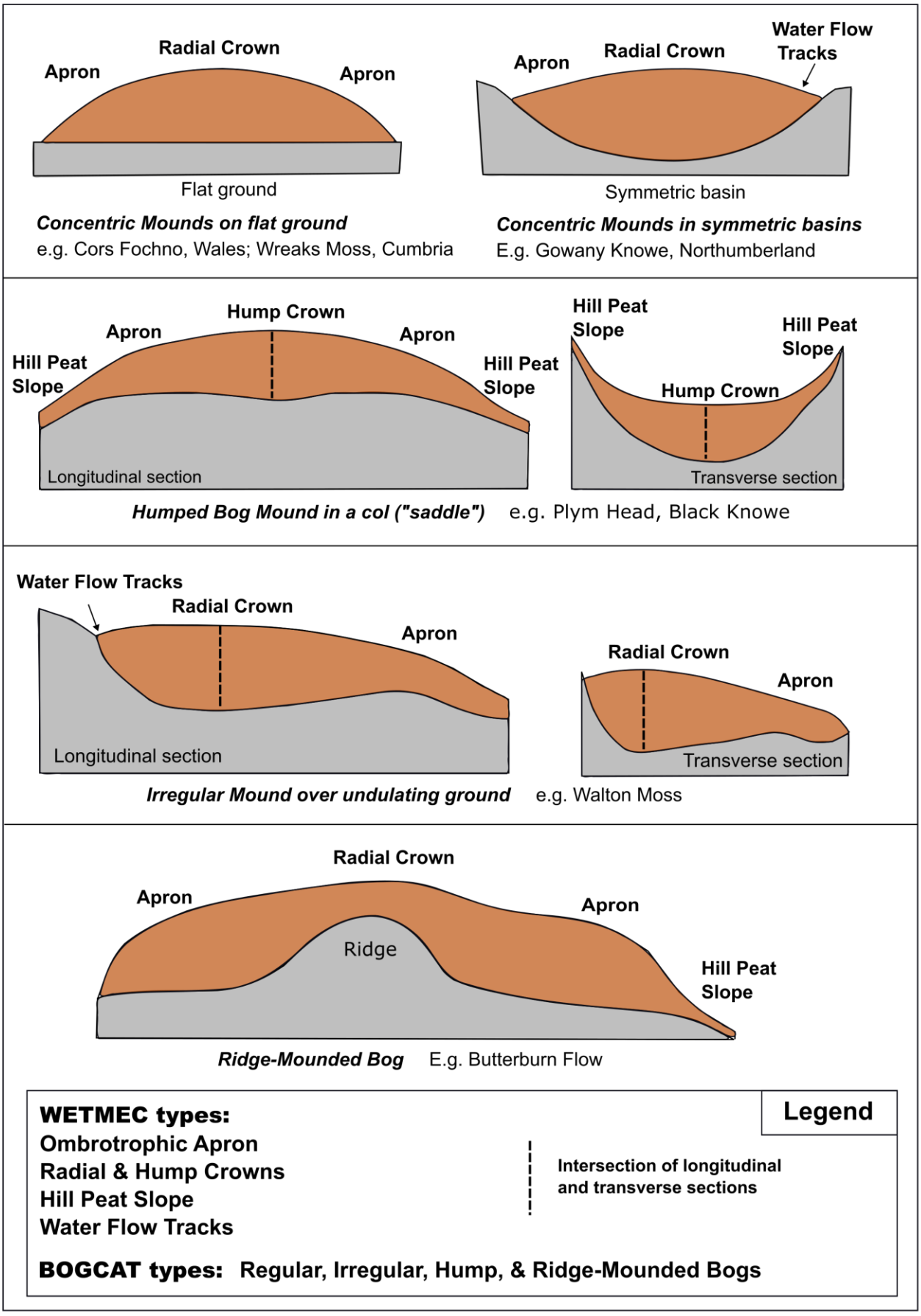


Figure 23. WETMEC conceptual profiles: Ombrotrophic Aprons.

9.5 Ombrotrophic Bottoms

Ombrotrophic Bottoms are perhaps the most nondescript of all the ombrotrophic WETMECs, in that they are essentially defined negatively: they are not mounded, not very sloping, not buoyant, with little evidence of water flow and with a wide range of wetness conditions and vegetation types. They are most similar to Ombrotrophic Aprons, but are less strongly-sloping, wetter, and more *Sphagnum* rich. In general, the flattish, non-mounded character of Ombrotrophic Bottoms makes them distinctive (see Figure 24 and Figure 25). Ombrotrophic Flows are similar but are wetter and more quaking (see Section 9.6). Ombrotrophic Bottoms are essentially a feature of Trough Bogs and Sump Bogs (the latter is mostly a lowland feature) but can sometimes form a zone below shallow Ombrotrophic Crowns. Table 20 provides a summary of surface variables for Ombrotrophic Bottoms.

In the uplands, Ombrotrophic Bottoms are usually quite extensive, more-or-less flat or very gently sloping, are often quite heathery (though they may be dominated by purple moor-grass), with slight surface patterning of low *Sphagnum* hummocks and lawns, occasional hollows, and few or no pools. The surface is usually moderately wet, but firm with some softer hollows. They are mostly irrigated by direct precipitation with some downslope flow of ombrotrophic soakways, occasionally with weakly minerotrophic surface flows from adjacent hillslopes, although marginal flow tracks often separate them from flanking hill slopes. Those examples found in Trough Bogs typically slope very gently axially down the trough and in some instances may slope very gently across the trough as well. Ombrotrophic Bottoms associated with Sump Bogs in the lowlands are usually quite small with almost flat ombrotrophic surfaces that are elevated slightly above an encircling lagg-like feature. The surfaces of Ombrotrophic Bottoms are typically acidic and of low fertility.

Ombrotrophic Bottoms are mostly characterised by a firm ombrotrophic surface over more humified ombrotrophic peat, replaced at depth by minerotrophic peat that in some cases has developed over late-Devensian lake sediments. Peat depths range from about 1 to 6.5 m, with a mean of 3.8m depth. Some examples in Trough Bogs have been partly drained and may once have been examples of the wetter Ombrotrophic Flow WETMEC.

Upland examples of Ombrotrophic Bottoms in Trough Bogs that were studied during the present survey were mostly found in Northumberland (for example Blackdown Flow) and in parts of Wales (Gors Lwyd). No examples in upland Sump Bogs were encountered in the present survey, but they are known from Traeth Mawr (Illtydd Pools, Brecon) at 325 m aOD, and in parts of South Wales. In the lowlands, examples are more variable in character, but are largely associated with Sump Bogs, and their distribution reflects the distribution of the glacial features with which they are often associated (particularly kettle holes and moraine dammed hollows).

The relatively firm peat surfaces of Ombrotrophic Bottoms support a range of vegetation types including M17, M18, M18/M19, and M19_S. There is typically a canopy of heather and dwarf shrubs with cottongrasses over *Sphagnum capillifolium* and *S. papillosum*, forming patchy hummocks. Areas modified by human activities (drainage, forestry,

burning, heavy grazing) support vegetation types with tussocky cottongrass (M20) and purple moor-grass (such as M17_M).

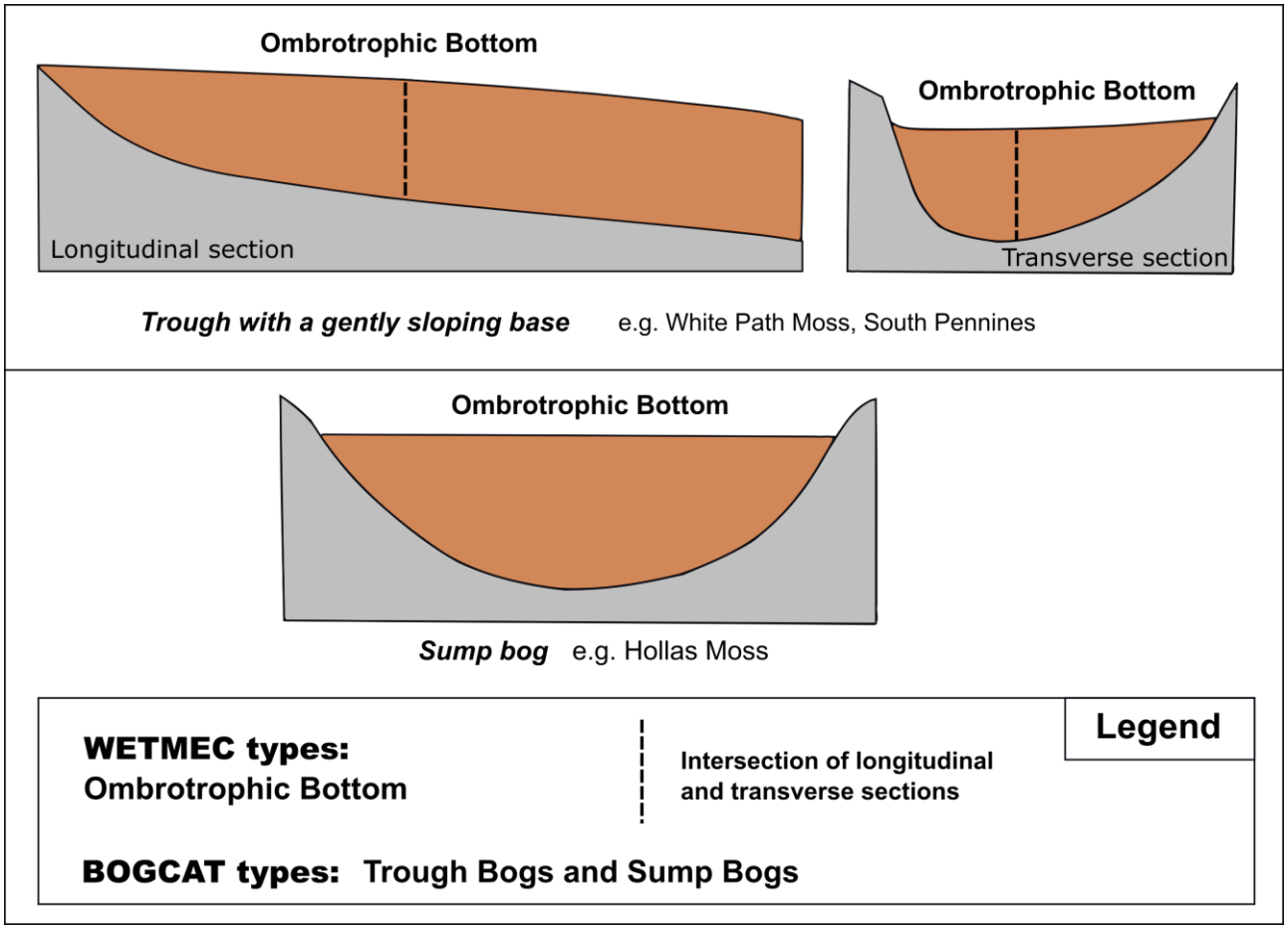


Figure 24. WETMEC conceptual profiles: Ombrotrophic Bottoms.

Table 20. Numerical and ranked variables recorded for Ombrotrophic Bottoms.

Variable (n=23)	mean	min	max
Peat Depth (m)	3.75	1.00	6.40
Altitude (m aOD)	356	255	552
Slope %	1.7	0.5	3.3
Rainfall (mm per year)	1236	942	1970
Potential evapotranspiration (mm / year)	481	437	530
Water pH	4.0	3.7	4.2
Conductivity (µS cm^{-1})	64	40	100
Wetness (rank 1 to 9)	4.5	3.0	5.0
Softness (rank 1 to 6)	2.7	2.0	4.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	2.4	0.0	6.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	1.3	0.0	6.0

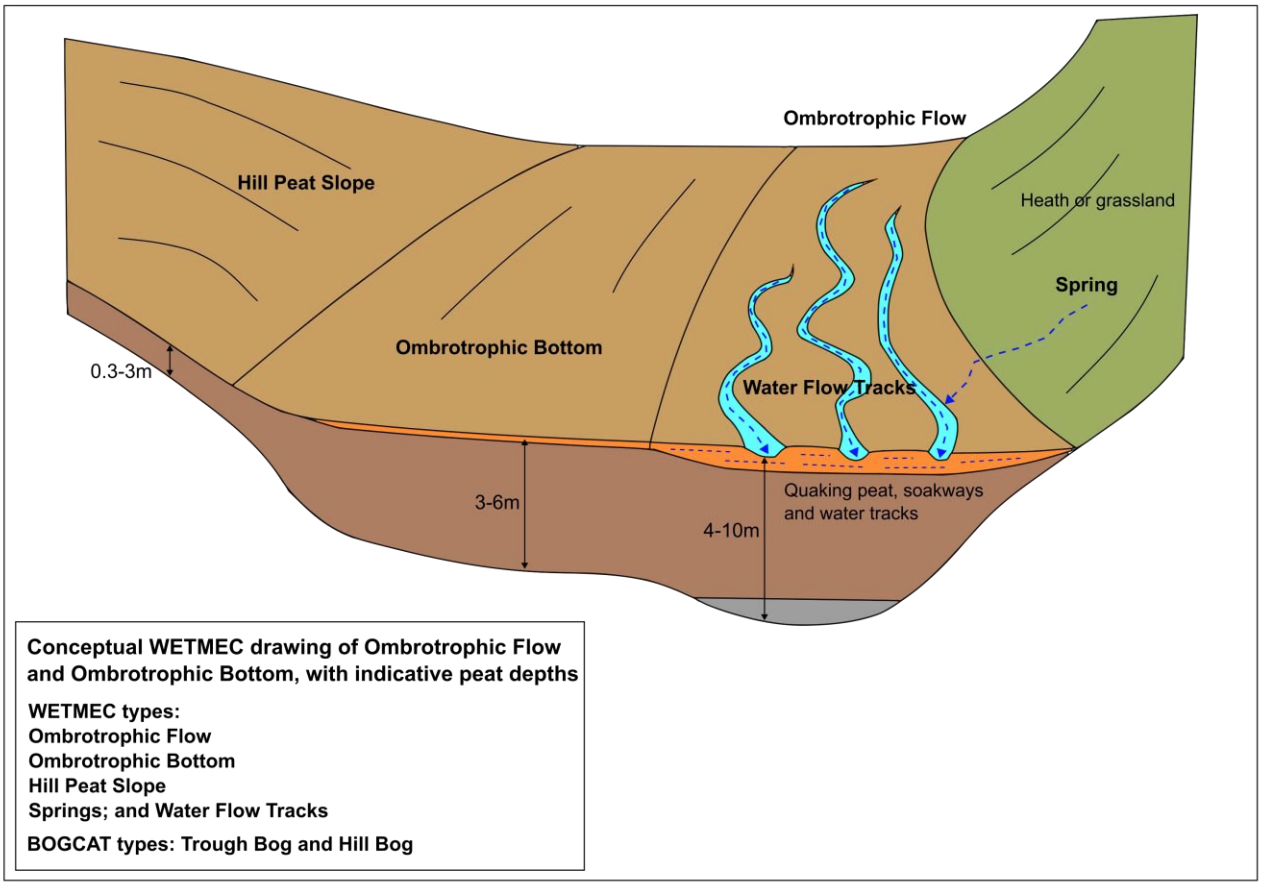


Figure 25. Conceptual WETMEC drawing of Ombrotrophic Bottoms & Flows.

9.6 Ombrotrophic Flows

Ombrotrophic Flows are an uncommon type of peatland habitat, mainly upland but with some examples below 300m aOD. They are usually quite extensive and occupy more-or-less flat or very gently sloping locations in Trough Bogs, sloping axially down the trough, and sometimes with a slight slope from one side to the other across the trough (see Figure 25 and Figure 26).

Flows often have a more-or-less continuous carpet of *Sphagnum* but are sometimes quite heather-rich. They have only slight surface patterning (Table 21), including *Sphagnum* lawns and often treacherous pools and soakways, with stunted heather and cross-leaved heath growing on low hummocks. There are usually abundant water flow tracks, which can be marginal or axial, or both, and in some cases much of the trough can be dominated by large, braided flow tracks with flanking patches of Ombrotrophic Flow surfaces.

Water levels are typically very close to the surface, and water flow may occur through the spongy or quaking surface layer of peat, as well as the water flow tracks. Ombrotrophic Flows are the wettest of all the peatland habitats considered here, with the softest and most quaking surfaces, comparable only to the lowland Buoyant Bogs (see Section 9.8.1).

The water supply of Ombrotrophic Flows is dominated by precipitation, with much down-trough flow of ombrotrophic surface water, which may be supplemented by weakly minerotrophic surface-water from the flanking hillslopes, though this may sometimes be intercepted by a marginal flow track. In some places there are marginal springs (sometimes beneath the peat) which can provide additional input of minerotrophic water to the Ombrotrophic Flow, typically visible as small soakways marked by trails of bottle sedge. However, the buoyant quaking character of many of the Flow surfaces may keep much of the surface more-or-less isolated from the effects of minerotrophic influence. Beneath the spongy or quaking ombrotrophic top layer, which may be up to 1m thick, there is a more consolidated ombrotrophic peat; total depth can exceed 10m (mean 3.9m).

Most examples of Ombrotrophic Flows seem to have developed over hollows or shallow basins within a valley trough, which may represent former post-glacial lakes that have become terrestrialised. At both Muckle Moss and The Lakes (in the Roman Wall Country of Northumberland), the overall thickness of peat decreases irregularly down-trough because of these hollows and basins, with the shallowest peat close to the drainage outlet, suggesting some drainage-based control on peat accumulation, as for Mounded Bogs.

The distribution of Ombrotrophic Flows is not well known, but it appears to be an uncommon peatland type, recorded mostly from Trough Bogs of the Roman Wall Country of Northumberland, and the Cwmystwyth Uplands of mid-Wales. The best documented example is Muckle Moss in Northumberland, which was not examined in the present study. Other well-developed examples include Chesters Burn Moss, also in Northumberland.

Ombrotrophic Flows are acidic and infertile, and generally support *Sphagnum*-rich vegetation such as M17_S and M18_S. In addition, M1, M2, M20_S, M4, M21, and vegetation with affinities to M6 have also been recorded in these habitats, where diffuse soakways and firmer vegetation are often closely juxtaposed and difficult to separate.

Table 21. Numerical and ranked variables recorded for Ombrotrophic Flows.

Variable (n = 22)	mean	min	max
Peat Depth (m)	3.90	0.70	10.00
Altitude (m aOD)	397	212	551
Slope %	1.5	0.1	3.3
Rainfall (mm per year)	1598	1045	2767
Potential evapotranspiration (mm / year)	473	437	543
Water pH	4.2	3.2	5.2
Conductivity (µS cm^{-1})	58	40	80
Wetness (rank 1 to 9)	5.1	4.0	6.0
Softness (rank 1 to 6)	3.9	3.0	5.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	4.7	0.0	13.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	1.3	0.0	8.0

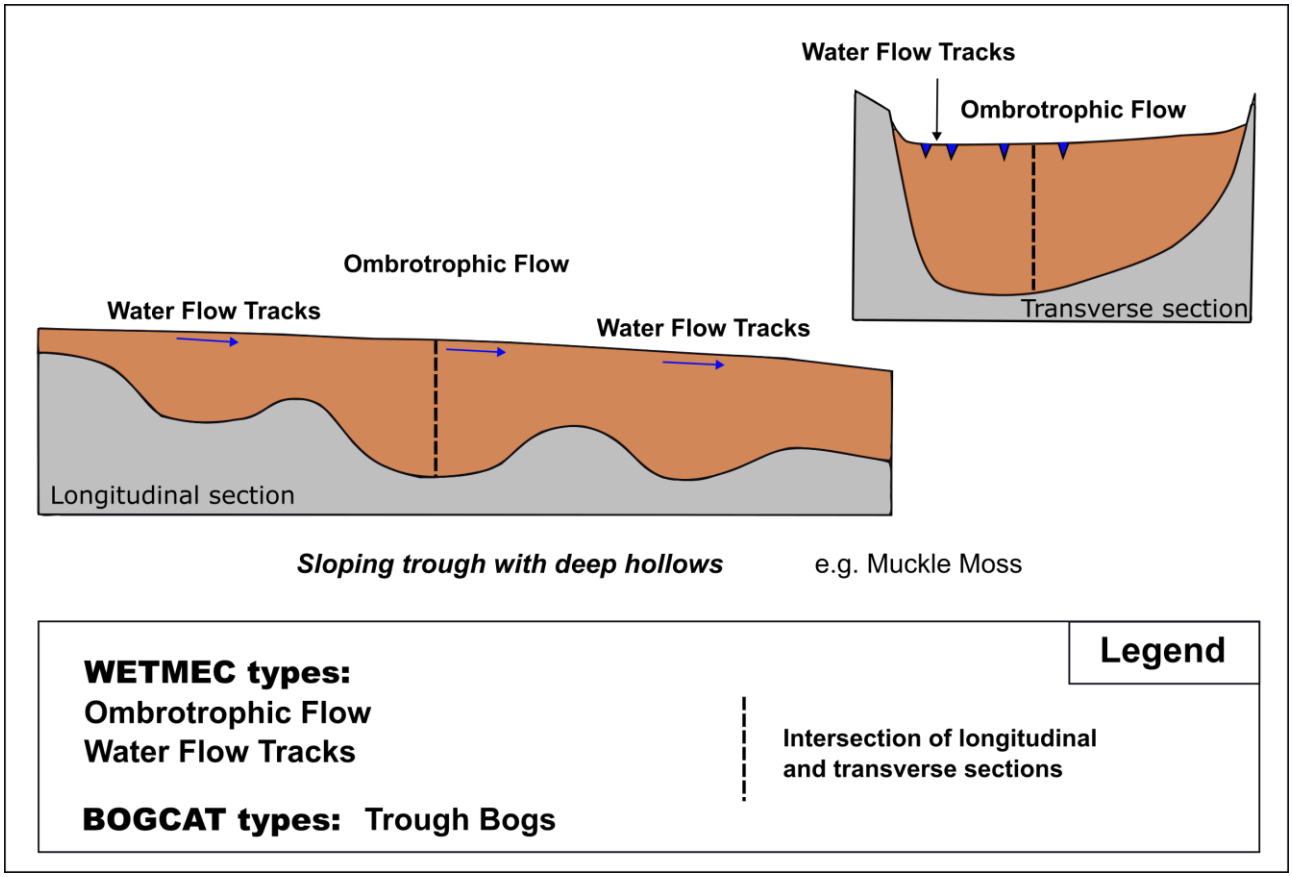


Figure 26. WETMEC conceptual profiles: Ombrotrophic Flows.

9.7 Water Flow Tracks

Water Flow Tracks are more-or-less linear units of focussed water flow, most typically embedded in, or around, bog units. The bog flow may be sourced from within the peatland (endotelmic) or from outside the peatland (exotelmic).

Endotelmic flow is sourced solely from surface runoff of rainfall (and so is essentially ombrotrophic), although in some situations it may be supplemented by submerged seepages of groundwater (an exotelmic water source), which may be difficult to see, but can usually be identified by the presence of certain plant species. Sub-peat or marginal seepages in upland areas are typically base poor and give rise to weakly minerotrophic Water Flow Tracks, but sometimes they may be base rich, giving rise to localised areas of more strongly minerotrophic features. Other exotelmic examples may correspond to inflows of surface-water runoff or small streams that originate on the adjacent slopes. These are mainly weakly minerotrophic, but again there are occasional examples of more strongly base-rich inflows.

Water Flow Tracks may form features around or along the margins of bogs, or they can form more-or-less axial features that flow through the bog. Marginal water flow tracks are sometimes described as lagg streams.

Water Flow Tracks mostly occupy the lowest surfaces of a bog system and provide natural drainage for flanking peatland surfaces. Their water level can help to regulate the surface wetness of adjoining bog, sometimes forming a localised water source for the bog surface, though this function usually changes further downslope.

The depth of peat beneath Water Flow Tracks can vary greatly, and while many marginal examples have quite shallow peat over mineral ground, examples that flow through the main body of a peatland can be associated with very deep peat. Some examples occur within eroded areas of peat and may be actively contributing to their erosion.

Water Flow Tracks in bog habitats can be informally split into soakways and water tracks.
Soakways are zones of diffuse water flow that are almost completely vegetated and with little obvious surface water, except perhaps on close inspection, or after heavy rainfall. The flow is often not easily visible, particularly in drier summer conditions.
Water Tracks are particularly wet flow tracks, sometimes like small streams, which can be distinguished from soakways by a having a high proportion of surface water, sometimes with visible flow, and can be distinguished from streams by having patches or tussocks of mire vegetation across some of their width.

The Water Flow Track WETMEC shows a range of sub-types that can be broadly recognised through a combination of features, mainly their surface characteristics, possible water source, and vegetation. However, identification of these variants may not always be possible, and should not be seen as an essential requisite for characterising water flow features within a bog site. A summary of variables aggregated for all Water Flow Tracks is provided in Table 22.

The following six broad sub-types can be recognised: Mire Expanse Soakways; Marginal Soakways; Exotelmic Water Flow Tracks; Seepage Flow Tracks; Quaking Axial Flow Tracks; and Erosion Flow Tracks, which can be split into Ombrotrophic and Minerotrophic types. Of these six sub-types, two are ombrotrophic – Mire Expanse Soakways and Ombrotrophic Erosion Flow Tracks, while the others are minerotrophic, even in very weakly.

9.7.1 Mire Expanse Soakways

Examples of this type are usually rather diffuse zones of channelled endotelmic flow forming soakways, but they can sometimes form more distinct water tracks after heavy rainfall, which can form connections between small pools where they are present. They are typically marked by cottongrass-dominated or purple moor-grass-dominated vegetation (M20, and purple moor-grass-rich versions of M17, M18, and M19) but can form water tracks that are *Sphagnum*-rich, sometimes with white-beaked sedge. Mire Expanse Soakways may also occupy shallow grips or revegetated shallow erosion features on flattish bog surfaces, which have become totally occluded with *Sphagnum*.



Photo 1. Mire Expanse Soakways on M18 bog at Sweethope Moss, Northumberland.

Mire Expanse Soakways are typically embedded in firm, soft, or spongy, very gently sloping peat surfaces that may be examples of Hill Peat Slopes, Aprons, Ombrotrophic Bottoms, and Crowns. Peat depths can range from shallow to very deep.

Examples observed during the current project include those seen at Pundershaw Moss, Hummel Knowe, Whitelee Moor, and Black Knowe in Northumberland; May Moss in the North York Moors; Ringinglow Bog in the South Pennines; Plym Head, Tor Royal, and Winney's Down in Dartmoor; and Mynydd Llangatwc in South Wales.

9.7.2 Marginal Soakways

This type of flow track is often similar in character to many Mire Expanse Soakways. It can be recognised as a moat-like soakway of tussocky vegetation dominated by hare's-tail cottongrass and / or purple moor-grass (M20, M20_S), situated around the edges of topogenous bogs, often with no visible water or water flow; these are often described as 'laggs'. Marginal Soakways typically form a belt of variable width (from 1 to 20 m) between a topogenous bog and adjacent slopes of mineral ground or shallow Hill Peat Slopes. The base of the soakway is usually slightly lower than the adjacent mire expanse, and the water source is likely to be a combination of surface runoff from the mire and from the adjacent slopes; consequently it is likely to be weakly minerotrophic. Because of their position at the edges of topogenous bogs, peat depths are usually fairly shallow.



Photo 2. Cottongrass-dominated Marginal Soakway separating M18 bog to the right, dry heath to the left, at Blackdown Flow, Northumberland.

Examples from this project include the margins of many of the topogenous bogs of the Roman Wall Country of Northumberland and eastern Cumbria, and the Ottercops region of Northumberland; also May Moss of the North York Moors, and Ringinglow Bog, Lucas Moss and Totley Moss of the South Pennines.

9.7.3 Exotelmic Water Flow Tracks

These flow tracks take the form of soakways, water tracks, or small streams flowing across or flanking a bog surface and are partly sourced by exotelmic water entering from the adjacent slopes. The water source may be from rain-generated runoff, from springs or seepages of groundwater, outflows from higher level bogs, or a combination of these; often it is difficult to distinguish the water sources. This type of flow track is often marked by soft-rushes (M6c vegetation), sometimes with patches of bottle sedge (M4) or strips of hare's-

tail cottongrass (M20 and M20_S vegetation). Peat depths are often relatively shallow, but can be deep where they cross topogenous bogs (from 0.5 to 5 m).



Photo 3. Surface-water flow track at Moorhouse Valley Bog, North Pennines.

In some situations, this type of flow track may enter a marginal channel and be diverted away from the bog surface. In others, a flow track entering the bog may spread out and partially irrigate the surface, before coalescing into soakways and small channels further downslope. Consequently, an exotelmic water flow track may irrigate the bog surface with weakly minerotrophic water in the upper part of the bog, whilst having a drainage function with little or no direct impact upon the bog surface lower down the bog slope.

These flow tracks may be found on Hill Peat Slopes, Slackenings, some kinds of Ombrotrophic Aprons, Ombrotrophic Bottoms, and potentially Ombrotrophic Flows.

Examples are present on the Buttermere Fells, Whiteoak Moss, and Stone Park in Cumbria; some of the Ottercop mires in Northumberland; Moor House in the North Pennines; and in North Wales at Cwm Dyli, Cwm Gwern Gof, and the Migneint.

9.7.4 Seepage Flow Tracks

These water flow tracks usually appear to originate within the mire expanse, but support vegetation that suggests that they are likely to be partly irrigated by sub-surface or marginal springs or seepages. Most appear to be weakly minerotrophic and base poor, but some examples are clearly influenced by more base-rich upwellings of groundwater.

Base-poor Seepage Flow Tracks often have species-poor vegetation that can be assigned to communities such as M29 and M1, with semi-aquatic plants such as bog pondweed and bog-bean. Sometimes presumed sub-peat springs may be marked by quaking clumps of greater tussock sedge, or strips of bottle sedge (S3 and M4 vegetation respectively), linked by soakways or water tracks embedded in broad tracts of apparently ombrotrophic bog vegetation. Other base-poor flow tracks may be visible by the presence of small-sedge and soft rush vegetation (M4, M6a/b and M6c). Some very weakly minerotrophic flow tracks may lose any indication of base-enrichment a short distance from the presumed springs, becoming lost in the surface of the bog.



Photo 4. Seepage-fed flow tracks across an M17 trough bog in central Wales.

Further downslope the flow tracks may coalesce to form larger channels or may join a marginal or axial stream channel. Examples of this type of water flow track have been found at Gors Goch, Gors Lwyd, and other locations in the Cwmystwyth Uplands of central Wales; the Migneint in north Wales; also at May Moss in the North York Moors and Low Moss, Castlerigg Fell, in Cumbria. Peat depths can be deep (from 2 to 6m).

In some situations, base-rich seepages and springs are present at or just above the margin of a bog, typically supporting vegetation such as the M10 mire community, or species-rich fen vegetation. Water from these may flow into a marginal soakway and be directed around the edge of the bog, having little or no effect upon it (for example on the eastern edge of Whaup Moss, Northumberland). Alternatively, there may be some ingress

of base-rich water onto and across the bog surface, giving rise to localised soakways of base-rich vegetation, such as M15a, though the influence of these generally dissipates a short distance into the bog (for example on the north-eastern margin of Blackdown Flow, in Northumberland). A very distinctive example is found at the limestone spring-fed margins of Malham Tarn Moss, in the Yorkshire Dales, which has led to the development of extensive areas of very species-rich fen meadow flanking the mounded bog.

9.7.5 Quaking Axial Flow Tracks

This is a distinctive sub-type that is characterised by water flow associated with quaking surfaces, sometimes treacherously so. Typically, there is a very gentle downslope flow of water over or through a mire surface that comprises a floating mat of roots and rhizomes over fluid peat, often with abundant bottle sedge, sharp-flowered rush, bog bean, bog pondweed, or other weakly minerotrophic bog vegetation. These flow tracks are mostly found in broad trough-like valley bottoms, they may flank small streams and can be embedded in or marginal to topogenous peat deposits. Presumably the fluid substratum and quaking surface are related to large volumes of water flowing off a relatively large surface water catchment, sometimes combined with groundwater outflows. Occasionally, examples of quaking flow tracks may be found within smaller valleyhead sites and are likely to be related to the presence of vigorous sub-peat springs at the peat margins. Some examples may also occur in marginal areas where there has been peat cutting for fuel.



Photo 5. A quaking flow track in the Cwmystwyth Uplands of mid-Wales.

Vegetation types associated with this type of water flow track include M1, M4, M6d, M21, and M29.

Quaking Flow Tracks can be embedded in Ombrotrophic Flows and Bottoms. Examples have been observed at Gors Lwyd, Gors Goch, and other upland sites in the Cwmystwyth Uplands of central Wales; Buttermere Moss and Castlerigg Fell in north-west Cumbria;

Hasgill Fell and Crutchember Fell in the Forest of Bowland; and at The Lakes and The Wou in the Roman Wall Country of Northumberland.

9.7.6 Erosion Flow Tracks

These are found where water flows across or through erosion features on bog surfaces, including eroded and gullied Hill Peat Slopes, eroded Crests and Slackenings, Eroded Crowns, and also as part of smaller erosion features that can be present within other bog WETMECs, for example within the damaged lagg zones and Aprons of lowland mounded bogs.

Within Erosion Flow Tracks can be recognised two sub-types: Ombrotrophic and Minerotrophic Erosion Flow Tracks.

9.7.6.1 Ombrotrophic Erosion Flow Tracks

These occur as water tracks where erosion has cut into the upper layers of peat, but mineral ground has not been exposed. Some examples may be ditched, and water flow is often visible, except on very flat surfaces. The peat surface within a flow track may be bare, or it may have a revegetating surface of cottongrasses (M20) or more *Sphagnum*-rich vegetation with affinities to M17, M18, M19, M20, or M2 pool vegetation on flatter surfaces. They may grade into, and be indistinguishable from, shallow erosion features that have become totally revegetated by *Sphagnum*-rich bog vegetation (that is, some Mire Expanse Soakways).

Examples during the present survey were observed at Cwm Dyli, the Migneint, and Waun Wen in Wales; at Whitelee Moor and Deadwater Fell in Northumberland; and Featherbed Moss and Langsett Moors in the South Pennines.



Photo 6. Water flow tracks in gullied deep peat, Migneint, north Wales.

9.7.6.2 Minerotrophic Erosion Flow Tracks

These are found where severe erosion has exposed the mineral ground beneath the peat, and water flows over a surface of sand, gravel, and rocks, usually as water tracks or small streams. The surface may be bare or may have a partial or total cover of soft rushes and bryophytes such as *Polytrichum commune* and *Sphagnum fallax* (M6c mire). Alternatively, the surface may be partially covered by re-deposited peat, with a patchy growth of cottongrass (with affinities to M20 mire).

Examples of this type have been observed at Combs Moss, Kinder Scout, and Featherbed Moss in the South Pennines; Cross of Greet in the Forest of Bowland; Whitelee Moor in Northumberland; and the Migneint and Waun Wen in Wales.



Photo 7. Water flow in deeply eroded bog, Kinder Scout, South Pennines.

Table 22. Numerical and ranked variables recorded for Water Flow Tracks.

Variable (n = 93)	mean	min	max
Peat Depth (m)	1.65	0.05	6.30
Altitude (m aOD)	361	185	550
Slope %	3.3	0.1	25.0
Rainfall (mm per year)	1482	934	3425
Potential evapotranspiration (mm / year)	491	408	549
Water pH	4.4	3.0	6.6
Conductivity (µS cm^{-1})	70	20	360
Wetness (rank 1 to 9)	4.9	3.0	7.0
Softness (rank 1 to 6)	3.1	1.0	6.0
Hummock_Pool diversity (sum of ranks, higher = more diverse)	1.7	0.0	9.0
Tussockiness (sum of ranks, higher = more and larger tussocks)	1.8	0.0	7.0

9.8 Associated WETMECs from the Wetland Framework

Several WETMECs that were identified as part of the Wetland Framework (Wheeler, Shaw and Tanner, 2009) are relevant to this project, either because they are known to occur within or close to upland bogs, or because they have close conceptual links and may be present in some upland bogs, but have not yet been identified in them. Three such WETMECs are described briefly in this section: Buoyant Bogs; Drained Ombrotrophic Surfaces; and Springs and Seepages.

9.8.1 Buoyant Bog

Buoyant Bog comprises more-or-less flat, strongly quaking, often buoyant, peat surfaces that have developed under the exclusive influence of precipitation. It is particularly characteristic of some lowland Sump Bogs where it is sometimes referred to as schwingmoor (see Figure 27).

Very often the quaking surface consists of a rather thin layer of ombrotrophic peat that is only slightly (at most 0.5m) above the regional water table or adjoining water sources, either because the surface is relatively young and so is naturally thin, or it may have subsided (for example at Chartley Moss and Wybunbury Moss), or some may have been removed by peat cutting. The buoyancy of the surface can help to keep Buoyant Bog surfaces vertically isolated from underlying, more base-rich, water. The buoyant ombrotrophic surface is often surrounded by a well-developed, and frequently very treacherous, lagg-like feature.

The surface of Buoyant Bogs may have locally well-developed microtopography of shallow pools, lawns, and low hummocks, but often the surface is dominated by low carpets of *Sphagnum*, and there are frequently young trees of birch and pine. The vegetation of Buoyant Bogs typically comprises abundant *Sphagnum cuspidatum,* with a sparse canopy of vascular plants, usually with common cottongrass, and sometimes with hare's-tail cottongrass and bog rosemary on more stable areas. Plant communities are typically M18 and M18_S, and pools with affinity to M2 and M18_S.

The greatest practical difficulty in identifying Buoyant Bog surfaces in basins is in separating them from buoyant, weakly minerotrophic surfaces, which often occur in close juxtaposition, and which may be a precursor to Buoyant Bog. In principle the defining difference is clear – the presence or absence of an ombrotrophic surface – but in practice ombrotrophy is difficult to identify without detailed measurements. Floristic composition can often be taken as a useful proxy guide to their status, and simple measurements of pH and conductivity can also be informative, though confusion may occur near the point of contact of the two types.

Examples of basin versions of Buoyant Bog are mostly from discrete basins, typically kettle holes or moraine-dammed hollows, and they are mostly small and nearly circular. Many basins are closed, or have just a weak outflow, but a few have strong outflows.

Buoyant BogS are widespread in lowland parts of England, especially the Meres and Mosses area of the West Midlands, and sites in north-west England. Only one example from Wales has been examined (Cors y Llyn), but it may be more widespread there.

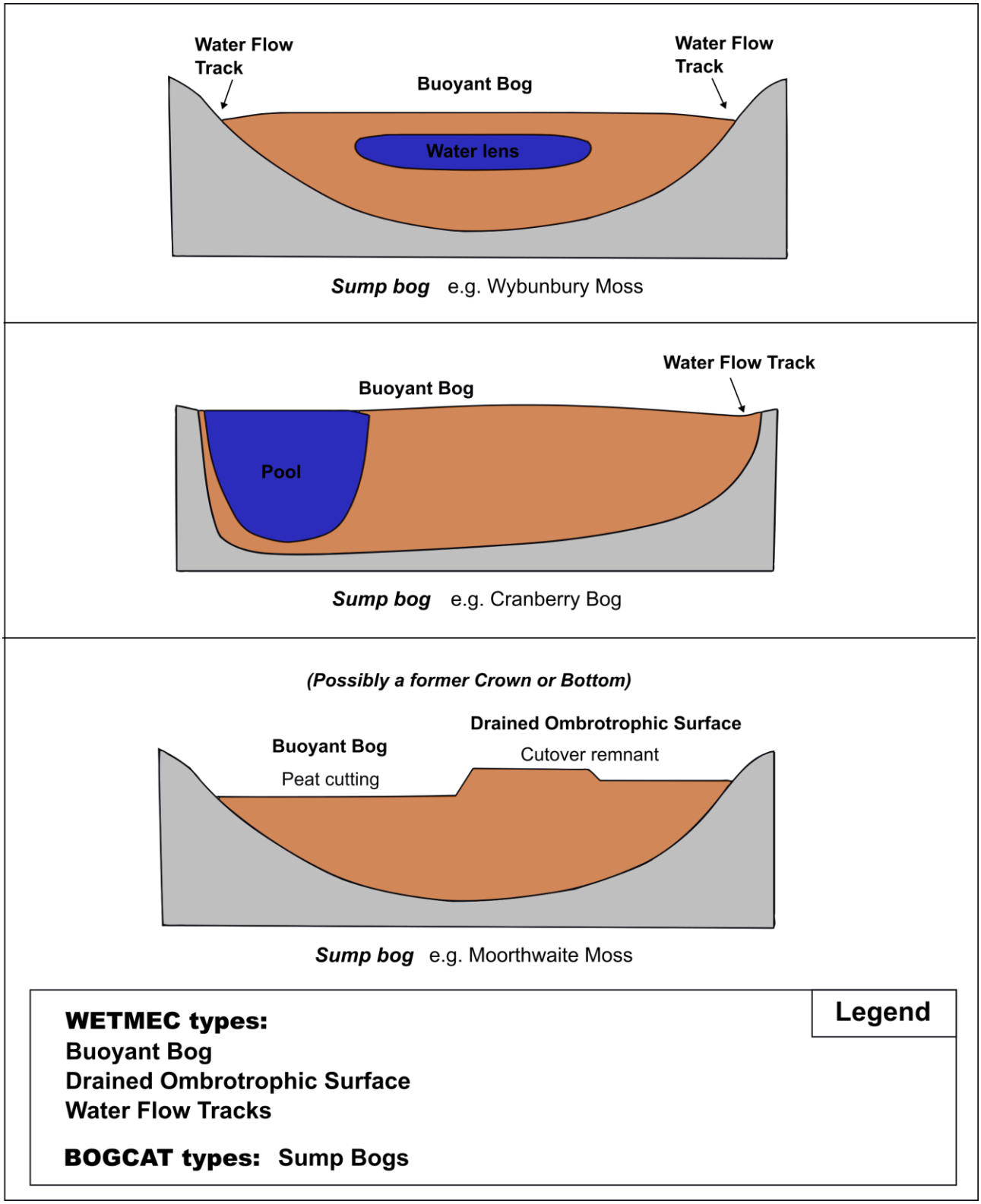


Figure 27. WETMEC conceptual profiles: Buoyant Bogs and Drained Ombrotrophic Surfaces.

9.8.2 Drained Ombrotrophic Surfaces

As described in the Wetland Framework (Wheeler, Shaw and Tanner, 2009), Drained Ombrotrophic Surfaces are widespread in the lowlands of England and parts of Anglesey, and are mostly found in topogenous situations; many are in Sump Bogs. They are essentially peatland sites that have been artificially drained but retain remnants of wetland habitats. They have ombrotrophic surfaces that are currently only irrigated by rainfall; in many cases this is because drainage has disrupted the natural water supply mechanisms that would once have supplied the surface with telluric water. However, other examples would originally have had ombrotrophic surfaces, though these have been much altered and disturbed by drainage and sometimes peat extraction (for example, Moorthwaite Moss, in Cumbria; Figure 27).

Their surfaces are usually fairly flat, but with some undulations caused by drainage and peat removal. Across some parts of these surfaces, deep excavations, where wet enough, may have led to the development of localized Buoyant Bog surfaces. Most of the surfaces have a deep summer water table, and a strongly decomposed and humified surface of peat, beneath which deeper layers of peat may be less humified, but are often also highly humified, or replaced by lake deposits.

Where the surface peat is ombrotrophic it often comprises a mixture of *Sphagnum*, cottongrass, and ericaceous remains. Alternatively, peat removal may have exposed fen peat composed of brushwood, saw-sedge, or reedswamp remains.

The peat surface is typically very dry, particularly in summer, and often supports birch and pine scrub, with only a few remnants of bog vegetation. Former bog surfaces are generally acidic and infertile, while former fen surfaces may still be quite base rich, although with a tendency towards acidification.

9.8.3 Springs and Seepages

Groundwater-fed springs and seepages were identified in the Wetland Framework as two separate but closely related WETMECs: Permanent Seepage Slopes, and Intermittent and Part-drained Seepages. They are considered here as a single unit because, although they often occur in close proximity to some upland bogs, it is not always easy or possible to ascertain their permanence, and it may not be of critical importance to do so. Their features and potential relevance to upland bogs are outlined here, but it should be noted that the WF dealt more-or-less entirely with lowland examples.

Springs and seepages are widespread throughout England and Wales, are typically small, and usually found on sloping ground, though they also occur at the edge of peat-filled basins and troughs (Figure 28). They are typically irrigated by groundwater from semi-confined or unconfined bedrock or drift aquifers, with water outflows often visible, or oozing underfoot.

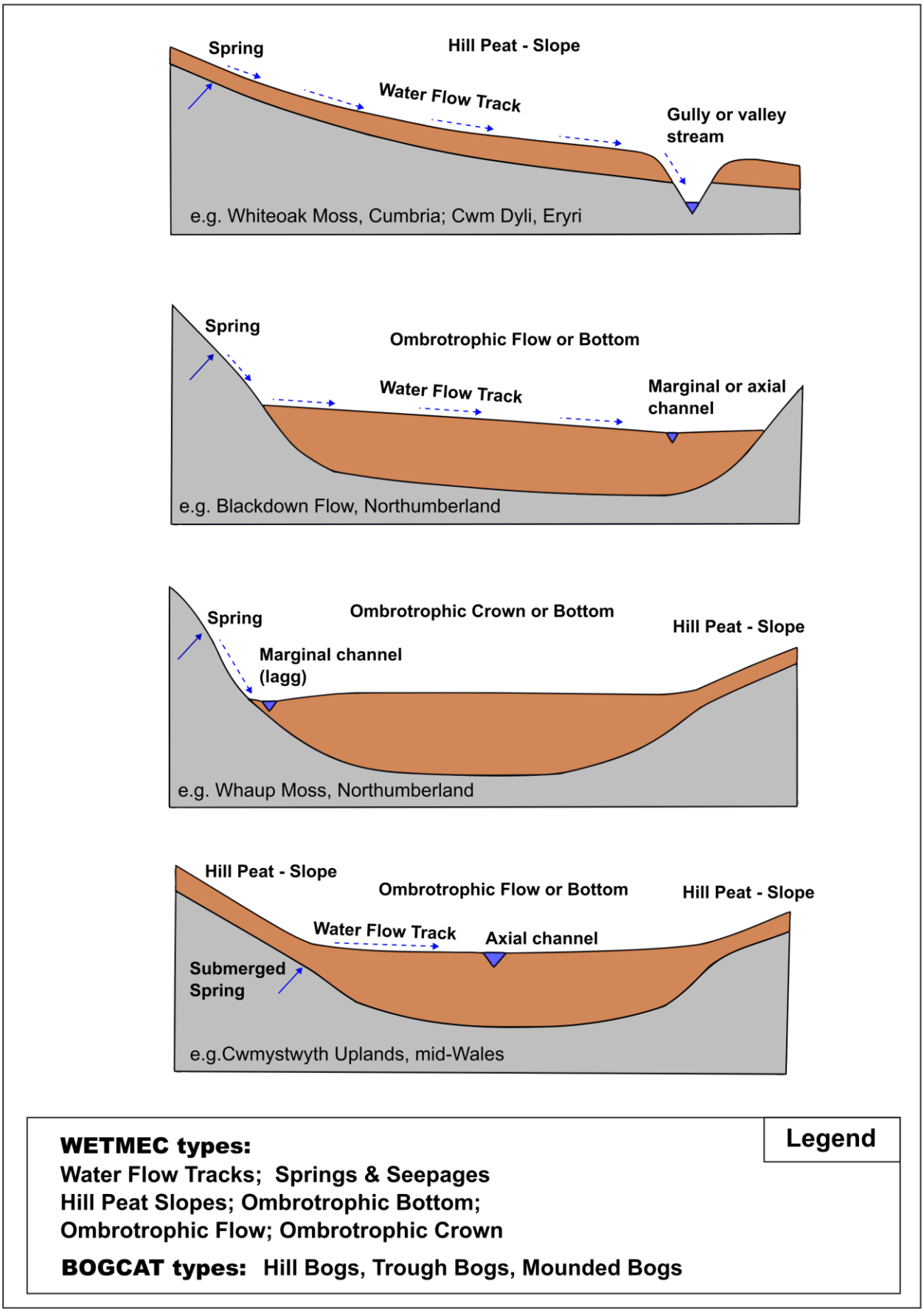


Figure 28. WETMEC conceptual profiles: Springs and Seepages.

In upland situations, springs or seepages may be visible on flanking slopes above the bog surface, usually noticeable because of a change in vegetation type (for example, a patch or strip of soft rushes embedded in either bog vegetation, acidic grassland, heathland, or other), and the flowing down the hillside as Water Flow Tracks (see Section 9.7). Elsewhere, springs may emerge just above the edge of the bog margin (for example, at Blackdown Flow, Northumberland) and partially irrigate the edge of the bog, or the water may be intercepted by a marginal channel. In other locations, sub-peat springs are suspected because of the presence of strips of swampy vegetation (typically bottle sedge, sometimes greater tussock sedge) in the bog surface, often becoming channelled into soakways or water tracks (for example several sites in the Cwmystwyth Uplands of mid-Wales).

Springs on hillsides above Trough Bogs or embedded in Hill Bogs are typically in shallow peat or organic mineral soils, or may issue from sand and gravel layers. Springs and seepages are often base-poor, acidic and nutrient-poor in the uplands, but some examples may be base rich. Base-poor springs are often associated with relatively species-poor vegetation, such as M4 or M6, but base-rich examples often support small patches of very species-rich M10 or M37 mire vegetation. Where acidic springs flow into or across upland bogs the influence upon the bog vegetation may be negligible, but base-rich spring flow may result in patches of quite diverse fen vegetation at the edge of the bog, sometimes extending a short distance across the peatland surface before becoming confined to narrow flow tracks or becoming captured by an axial channel, and the base-rich influence diluted and lost. These situations are described further in Section 9.7.

Discussion

9.9 Compatibility with existing habitat assessment protocols

WETMECs are eco-hydrological units based on the recorded character of the present-day peatland surface and its interactions with topography and water supply. This concept, and the methods that have been developed to carry out eco-hydrological assessments and to record and map WETMECs, are compatible with other approaches to habitat assessment.

WETMEC survey data can usually add context and detail to complement other approaches. For example, recording the Wetness and Softness of peatland surfaces and additional microtopographical elements would add detail to the Yorkshire Peat Partnership Field Survey Protocol, and the recording of NVC community type or sub-type would add context to the Peat Bog Condition Matrix (Lindsay, 2025).

Sampling along transects helps to demonstrate the relationships between component habitats within extensive landscapes. Aerial imagery, LIDAR datasets and GIS tools are widely available and are routinely used to plan and prepare for field surveys (Lindsay 2025, Peatland Code 2022, and so on). Extracting altitude information and combining with peat depth surveys allows the configuration of the peat deposit to be described and visualised.

Vegetation survey and reporting is based on standard methods and allocation of NVC community as the main descriptor of vegetation type. Quadrat data in upland habitats can usually be recorded fairly rapidly. In this project NVC sub-communities have not been used, but some simplified sub-types of NVC communities have been described, based on types frequently encountered during field surveys. *Sphagnum* presence and abundance is generally regarded as an important ecological variable to record, preferably to species level to align with NVC survey, as well as the Peat Bog Condition Matrix and Peat Partnership surveys.

Similar approaches are used in Ireland to record surface features (softness, wetness, and microtopographical variation on ombrotrophic peatlands (Fernandez and others 2014, Flynn and others 2021, Mackin and others 2024), although their surveying of vegetation community does not appear to relate to Irish Vegetation Classification (IVC, 2015) communities, perhaps because the IVC is still a relatively new approach.

The focus of many surveys is to identify areas of damaged and eroded peatland which would benefit from restoration actions, particularly to reduce carbon emissions (Peatland Code 2022, MoorLIFE 2020). Broad condition classes are used to categorise areas as ‘near-natural’, modified, drained, and eroding. The near-natural and modified categories encompass the vegetation types that are extensive on typical ombrotrophic peatland surfaces (M17, M18, M19, M20), which are generally regarded as ‘active’ – that is, vegetation that is normally peat forming (JNCC 2026, Tallis 1998). Areas of deep peat where the vegetation is overwhelmingly dominated by purple moor-grass, heather, or other

heathland species (for example bilberry), with few other typical bog species present, are separated in the MoorLIFE 2020 factsheet, which describes six ‘bog states’. Similar types are also recognised in this project as being heavily modified forms (*Molinia* D and Heath D), usually resulting from historical damage, such as peat cutting, extensive drainage, frequent burning, or heavy grazing.

This project has used the term ‘intact’ (rather than active, near-natural or modified) to describe extensive areas supporting typical bog vegetation (M17, M18, M19, M20) (following Flynn and others 2021, Luscombe and others 2017); and known or visible damage and erosion features have also been recorded. If required, future WETMEC surveys could be used to allocate areas to pre-restoration condition categories or Annex 1 habitats.

9.10 Links to the Wetland Framework

The Wetland Framework (Wheeler and others, 2009) provides a comprehensive eco-hydrological classification of lowland wetland habitats (fens and bogs). This was based on analyses of habitat data from England and Wales, including detailed stratigraphical and hydro-geological information. Twenty WETMEC categories were described and detailed accounts of important plant communities were provided. WETMECs as a concept have been widely adopted by practitioners but some of the detail and perceived complexity has been a barrier to the application of eco-hydrological principles in habitat surveys. In practice this means that habitat surveys are mainly focussed on vegetation sampling and mapping, and observations relating to water supply and regime, substratum, drainage and so on are often not routinely made, even though they are crucial to understanding how a wetland works.

The current upland eco-hydrological guidelines project followed a similar approach to the Wetland Framework, with the over-arching aim of producing a more accessible classification and field protocol based on surface characteristics that can be observed fairly rapidly in the field, alongside use of LiDAR and GIS tools to better understand site topography and peat configuration.

Some of the WETMEC categories in the Wetland Framework are analogous to the WETMEC categories in the blanket bog eco-hydrological guidelines, others are closely related (Table 23).

The Wetland Framework included a useful analysis of habitat conditions associated with characteristic plant communities. Some vegetation types that are widespread in upland peatland habitats were not included in those accounts, because they are not characteristic of lowland habitats. The accounts should be revised to include upland settings (for example M10, M18) and expanded to include important vegetation types which are widespread and distinctive, including M17, M19, M20, M15 (in marginal areas), M6, M37 and ‘neutral flush’ (associated with springs, seepages and flushes).

Work to streamline the upland and lowland WETMECs into a unified and simplified eco-hydrological classification is in progress.

Table 23. Relationships between original and new upland WETMEC classifications.

WETMEC (upland habitats) (blanket bog eco-hydrological guidelines 2026)	Original (lowland) WETMEC (Wetland Framework 2009)	Relationship and rationalisation
Hill Peat Slope	No equivalent	New – extensive in upland habitats
Slackening and Crests	No equivalent	New– embedded in Hill Peat Slopes
Crowns (radial, partial, hump)	WETMEC 1 Domed Ombrogenous Surfaces ('raised bog')	New categories incorporate original WETMEC
Buoyant Bog	WETMEC 2 Buoyant Ombrogenous Surfaces	Equivalent
Haggs in erosion complexes; baulks in peat cuttings.	WETMEC 4 Drained Ombrotrophic Surfaces	Equivalent
Apron	No equivalent	New
Ombrotrophic Bottom	No equivalent	New Related to existing types of minerotrophic bottom, which require rationalisation
Ombrotrophic Flow	No equivalent Ombrotrophic version related to WETMEC 14 Seepage Percolation Troughs WETMEC 18 Percolation Troughs	New Related to existing minerotrophic types which require rationalisation.
Water Flow Track (ombrotrophic)	No equivalent	New
Water Flow Track (minerotrophic)	Related to: WETMEC 15 Seepage Flow Tracks WETMEC 19 Flow Tracks	Related to existing minerotrophic types which require rationalisation.
Springs, Seepages and Flushes	WETMEC 10 Permanent Seepage Slopes WETMEC 11 Intermittent and Part-drained Seepages WETMEC 17 Groundwater Flushed Slopes	Equivalent but water supply often base poor / only weakly minerotrophic in upland habitats.

9.11 Using GIS tools to map and predict occurrence of WETMECs

Aerial imagery and LIDAR have been successfully used to identify and map areas of damaged and eroded peatland, as well as intact ombrotrophic surfaces (for example Carless and others, 2019; Luscombe and others, 2017), and to estimate peat depth (Gatis and others, 2019; Natural England, 2025).

GIS based models have been successfully developed and applied to identify and map areas with conditions (particularly hydrological regime) that are likely to support particular habitats (also known as ecotopes) on ombrotrophic peatlands in Ireland, based on calculating MFAC (Modified Flow Accumulation Capacity) within upland catchments from LiDAR data (Mackin and others, 2017; Regen and others, 2020). Even where the locations identified by the model do not strongly relate to ecological conditions on the surface, this approach can be used to identify areas which require further, more targeted eco-hydrological investigations (Mackin and others, 2024).

In England and Wales, almost complete LIDAR coverage is freely available, so there is huge potential to apply the MFAC approach, but it does require significant technical skill to prepare and process the LiDAR data, as well as considerable computer processing power. A specific project would be required to test this approach in a small number of exemplar catchments.

LiDAR is particularly useful for visualising topography through the extraction of contours at close intervals (1 or 0.5 m), the production of hill-shading models, and the creation of schematic surface profiles – these are activities that are accessible to most peatland practitioners with basic GIS skills.

A very limited project to look at the scope for using widely available datasets and GIS tools found that the current dataset is too small to be used with predictive modelling tools, but that some of the processing tools available through the freeware QGIS (for example Geomorphon) have the potential to help practitioners visualise topography to help plan surveys (Tratt, Eades and Parnell, 2026).

9.12 Desk and field survey methods

The desk and field survey methods used during this project have been reviewed and streamlined for future use by practitioners to identify upland ombrotrophic habitats. The most critical variables have been retained, with the aim of making it as straightforward as possible to evaluate the WETMECs (and BOGCATs) likely to be present in a survey area, without omitting essential information.

A subset of additional variables has been suggested for more detailed studies, should practitioners have sufficient time, funding, expertise, or a specific need to gather more information.

In the event of a survey site being revisited at a later date, perhaps as part of statutory monitoring (such as site condition assessment monitoring), a slightly reduced subset of the

most important variables is proposed for use during repeat monitoring, with the aim of only re-recording those variables that are likely to have changed over the intervening years (for example, surface wetness could increase or decrease, but slope is unlikely to have changed).

9.12.1 Deskwork

The following actions all provide valuable insights into the character of a survey area and make it easier to carry out a targeted investigation. They assume a certain basic knowledge of GIS (or access to GIS assistance from an in-house team). More detailed descriptions of deskwork methodology are provided in Annexe 2.

1) Download LiDAR data.
2) Clip the area of interest, e.g. the land-holding boundary or SSSI unit.
3) Use the GIS tool to create contour lines (1 m interval is usually sufficient).
4) Use the GIS tool to create a hill-shade model.
5) Use Google Earth to examine or create a 3D oblique view of the survey area.
6) Gather existing site information (such as maps of vegetation types, peat depth data, existing published or unpublished studies).
7) Choose the survey limits.
8) Determine the priority survey area if time or budget are limited.
9) Plan possible transect lines (ideally 2 orthogonal lines), create as a GIS layer.
10) Plan possible sample points, create as a GIS layer.
11) Import GIS transect lines, sample points, and contours to a tablet recording app.
12) Slopes of sample locations can be calculated using GIS once fieldwork is completed.

Possible additional actions, if there is available GIS skill / time / budget:

- Use Geomorphon to help identify the flattest areas that may be a focus for survey in regions of difficult topography (for example, in afforested areas where mires may have been hidden by mature conifer plantations).

9.12.2 Fieldwork

The fieldwork components listed below comprise a subset of the most essential variables to be recorded. It is assumed that surveyors have a basic level of survey experience, that site access has been agreed, and that best practice safety procedures are followed. Variables, their rank scores and descriptions, are presented in Annex 3.

1) Mark the sample location using a GIS field recording app.
2) Measure peat depth with a peat probe[6].

[6] Electricians' rods can be used as a light and cost-effective peat probe. Sets of 10 x 1m length, 5mm diameter rods can be bought online fairly cheaply.

3) Use a handheld probe to record pH and electrical conductivity (EC) of free water (reserve for a subset of samples if necessary, but include water flow tracks as they can show higher values if there are sub-surface or marginal springs).
4) Record a vegetation quadrat (if vegetation type is not already known), including bryophytes, using Domin scores or % cover, with appropriate quadrat size.
5) Estimate surface wetness (rank score).
6) Estimate surface softness (rank score).
7) Estimate *Sphagnum* abundance (rank score).
8) Record water flow within immediate area of sample (rank score).
9) Estimate the slope of the surface or calculate using GIS.
10) Record micro-topographic diversity (presence and size or depth of pools, hummocks, tussocks).
11) Record the presence, type, and extent of erosion features.
12) Record presence/absence of restoration measures and other management activities, and a brief description.
13) Write a brief description of the sample location, surface features, vegetation, restoration features – these serve as useful reminders of the sample and site.

Possible additional actions if there is available budget / need for additional information:

- Record surface configuration type (rank score).
- Evaluate degree of surface patterning (rank score)
- Estimate proximity to grips / drains / gullies (rank score).
- Auger the top 1m of peat and examine the basic stratigraphy to identify plant macrofossils (for example *Sphagnum*, cottongrasses, heathers) and estimate degree of decomposition (for example using the von Post score – see Annexe 4).
- Estimate the permeability of the top 30cm of peat and lower 30–100cm (rank score).

For repeat survey or condition monitoring, at each sample point record:

- Vegetation quadrat.
- Surface wetness.
- Surface softness.
- Erosion features.
- Restoration activity.
- Water flow within sample area.
- Brief description.

9.13 Further work

There are a number of possibilities for future work that could be undertaken to further the outcomes of this project, including:

a) Publicise the broad findings of this project to as wide an audience as possible and ascertain the level of interest.
b) To assist with this process, develop a succinct user guide and survey methodology.
c) Field test this approach as training days with interested parties.
d) Enter into dialogue with practitioners and policy makers in Northern Ireland and Scotland to evaluate the potential applicability of this approach to those countries.
e) If there is interest, encourage practitioners to test this approach themselves at survey sites known to them.

10 Summary

Two main types of Ombrotrophic Bog have traditionally been recognised in Britain – *raised bogs* and *blanket bogs.* Raised bogs were seen to be features of flat ground in the lowlands, forming isolated mounds of ombrotrophic peat raised a few metres above the surrounding landscape. Blanket bogs were seen as a thinner layer of ombrotrophic peat covering large parts of the uplands. However, little consideration was given to the possibility that both raised bogs and blanket bogs could occur close to each other, and sometimes be embedded within one another.

Some workers favoured a geographical distinction of the two types, but that can lead to a circular approach, where a peatland is called a blanket bog because it occupies a blanket mire climate, whilst a blanket mire climate becomes defined by the presence of blanket bogs. Other workers recognised that there were differences within what was known as blanket bog, but had the view that there was little point in bothering to distinguish between them unless there was some specific need, and so blanket bog came to be used as a conveniently vague term for peatlands in upland locations. Yet other workers, while recognising that blanket bog does not comprise a single, simple vegetation type, regarded it as such a complex habitat that the constituent mire types were inextricably linked.

However, there are good reasons for wanting to disentangle these mire types and to recognise the subdivisions of upland bogs. Critically, only some types seem to form biodiversity hotspots, and perhaps most importantly, restoration may be more successful in particular types. Linked to this, the need for setting conservation assessment targets and restoration objectives, and for more academic purposes such as dating the start of blanket bog formation, requires some understanding of the key variations between different kinds of upland bog.

For this reason, the present project has attempted to recognise and characterise different types of upland ombrotrophic peatland, based on their most important characteristics rather than on their apparent discreteness or geographical location. To aid this process it has considered the characteristics of some lowland ombrotrophic mires as well as those examined in the uplands.

Two different groupings of the main types of ombrotrophic peatlands examined in England and Wales are presented in this report: WETMECs, which are units of water supply and drainage that relate particularly to the state of the bog surfaces; and BOGCATs, which are topographical units based on the overall shape of the ombrotrophic peat bodies. WETMECs were the main focus of the investigation and provide the most clearly defined units. BOGCATs are more informal units that are useful because they provide contexts within which the WETMECs can be considered. There are some links between BOGCATs and WETMECs, but they are largely independent of each other, and one BOGCAT may support several WETMECs, while an individual WETMEC can occur in several BOGCATs.

The WETMECs identified and described here are a development from the Wetland Framework project (Wheeler and others, 2009), which was mostly concerned with lowland fens, and used the same approach. In the Wetland Framework, WETMECs were the

hydrological component of a framework whose aim was to identify habitats in lowland wetlands; other components included base-status and soil fertility. In ombrotrophic peatlands the framework is simpler, because all examples are acidic and of low fertility. Furthermore, in upland bogs the water source is mainly rainfall, so that the ombrotrophic WETMECs presented here generally reflect drainage patterns and constraints on this, rather than differences in supply. Some WETMECs of lowland fens were identified in association with upland bogs.

Two main categories of BOGCATs were identified– Topogenous Bogs, typically comprising deep peat in basins and troughs whose surface does not follow the contours of the underlying mineral ground; and Hill Bogs, comprising thinner layers of peat on sloping ground, whose surface roughly reflects the shape of the underlying mineral ground. Topogenous Bogs are sub-divided into Mounded Bogs, Trough Bogs, and Sump Bogs.

A summary of the surface features and characteristic vegetation of each WETMEC is provided in Table 24. Detailed WETMEC and BOGCAT accounts are provided in Annexe 7, as a separate document.

Table 24. Summary of upland bog WETMEC physical characteristics and vegetation.

WETMEC	Characteristics
Hill Peat Slope	**Physical characteristics:** Slopes, gentle to steep. Water level sub-surface, in dry conditions water cannot usually be squeezed out. Surface generally firm. Peat depth moderate to deep. Microtopography usually very subdued, with only scattered low hummocks of *Sphagnum* and low tussocks of cottongrass (sometimes deergrass). In some areas high hummocks comprising *Sphagnum capillifolium* and heather are distinctive. Pools are absent, except in erosion areas. **Characteristic vegetation:** Dominated by dwarf shrubs and cottongrasses, *Sphagnum capillifolium* sometimes abundant beneath these (M19 heather – cottongrass community); M19_S in areas with frequent tall *Sphagnum* hummocks. Cloudberry (*Rubus chamaermorus*) is distinctive in M19. Pleurocarpous mosses are usually abundant. In western areas uniform tracts of M17 deergrass – cottongrass community replace M19. *Sphagnum* can be abundant beneath the sward.
Hill Peat Slackening and Crest	**Physical characteristics:** Slopes very gentle. Water level sub-surface, but water can usually be squeezed out. Surface ranges from firm to soft, with some very soft areas in hollows. Peat depth is moderate to deep. Microtopography: flat areas with more uniform vegetation and low hummocks of *Sphagnum*, interspersed with irregular hollows and pools, which may be un-vegetated or have patchy bog asphodel, deergrass, *Sphagnum cuspidatum* or *Warnstorfia fluitans*. Some microtopographical variation may be due to natural re-vegetation of previously eroded surfaces. **Characteristic vegetation:** Vegetation can be transitional between NVC communities M18 and M19 with abundant heather mixed with cross-leaved heath and cottongrasses, over patches of *Sphagnum* (usually *S. capillifolium* and *S. papillosum*), often with some cranberry and bog asphodel. M19_S with *Sphagnum capillifolium* hummocks is also found in these habitats. In western areas, *Sphagnum*-rich hollows and pools, some of which are interconnected, are embedded in M17.

WETMEC	Characteristics
Ombrotrophic Crown	**Physical characteristics:** Slopes flat to very gentle. Very wet, water level at or locally above surface and readily oozes from footprints or forms pools. Peat mounded over mineral ground, and usually very deep. Surface generally soft to very soft: either a spongy layer of *Sphagnum* forming an intricate hummock–hollow–pool complex, or a mosaic of firmer areas with softer hollows and pools (shallow to deep) which are sometimes interconnected. Tussocks only scattered. Examples that have been ditched may have a slightly firmer and less wet surface, depending on the effectiveness of the drainage. **Characteristic vegetation:** Crowns support the most *Sphagnum*-rich forms of NVC communities M17 and M18 where the vegetation is an intimate mosaic of low hummocks and hollows, with aquatic *Sphagnum* (*S. cuspidatum* or *S. denticulatum*) in the hollows. Hummock–hollow microtopography is particularly distinctive in M18_S, where there is a more-or-less continuous layer of spongy *Sphagnum* (usually *Sphagnum papillosum*, often with *Sphagnum medium*). M17_S tends to be less hummocky with 'flats' interspersed with elongated hollows. Larger pools and soakways (M1 and M2) are often embedded. Drained or disturbed areas support vegetation which is typical of drier and firmer surfaces: M18/M19 and M17.
Ombrotrophic Apron	**Physical characteristics:** Slopes very gentle to moderate. Surface is moderately wet with the water level close to the surface, water can usually be squeezed out and there are occasionally wetter hollows. Surface is generally firm with some softer hollows. Peat depth variable, but usually deep, becoming shallow towards the base of slope. Variable microtopography, generally rather subdued but occasional low hummocks and hollows with *Sphagnum*. Localised erosion on steeper slopes can give rise to erosion channels and small pools. **Characteristic vegetation:** In suitable regions Aprons tend to support M18, M18/M19 and M19 vegetation, often with some deergrass and *Molinia*. In western areas with M17 Aprons typically support more uniform M17.
Ombrotrophic Bottom	**Physical characteristics:** Slopes almost flat to very gentle. Water level sub-surface or near surface, water can usually be easily squeezed out. Surface firm with some softer hollows. Peat usually deep and can be very deep. Microtopography generally quite subdued but some *Sphagnum* hummocks and hollows amongst vascular plants. Where surfaces have been ditched, these may formerly have been the Ombrotrophic Flow WETMEC. **Characteristic vegetation:** The firm peat surfaces of Bottoms support a range of vegetation types including vegetation dominated by heather and cottongrasses, often with abundant *Sphagnum capillifolium* and S. *papillosum* below the canopy (M18, M18/M19, M19_S). Some areas support quite tussocky vegetation with abundant purple moor-grass.

WETMEC	Characteristics
Ombrotrophic Flow	**Physical characteristics:** Slopes flat to very gentle. Water level at or locally above surface, readily fills boot prints and can be much deeper. Peat depth fairly deep to very deep. Surface very soft and often quaking. Microtopography: *Sphagnum* lawns, and mosaics of soakways and pools, which can be deep. Where artificially drained these may become the Ombrotrophic Bottom WETMEC. **Characteristic vegetation:** Mosaics of firmer patches of vegetation (which often flank networks of soakways and pools) with abundant *Sphagnum* forming lawns and low hummocks in a spongy layer, usually *Sphagnum papillosum* often with *Sphagnum medium*). Vascular plants form an open canopy, usually including common cottongrass, hare's tail cottongrass, cross-leaved heath, stunted heather, sometimes with bottle sedge. M17_S and M18_S, with embedded *Sphagnum denticulatum* or *S. cuspidatum* pools and soakways (M1 and M2), often with white-beaked sedge.
Water Flow Tracks (Ombrotrophic)	**Physical characteristics:** Slopes gentle to steep. Water level at or above surface, flow often not visible in dry conditions, may appear as a series of wet hollows between hummocks or tussocks. Peat depth variable – can be on shallow or on deeper peat. Microtopography: usually tussocks of cottongrasses and/or purple moor-grass with *Sphagnum* lawns in hollows between. Water flow usually endotelmic (sourced within the peatland). **Characteristic vegetation:** Often tussocky hare's-tail cottongrass and/or purple moor-grass (M20) with *Sphagnum fallax* and *Polytrichum commune*. Flow tracks on crowns or aprons may support much *Sphagnum papillosum, S. cuspidatum,* with cottongrasses and white-beaked sedge.
Water Flow Tracks (Minerotrophic)	**Physical characteristics:** Slopes gentle to steep. Peat depth very variable, depending on position within wider peatland unit. Water level often at or above surface, flow sometimes (but often not) visible. Water can be sourced from springs and seepages at mineral margins or from surface-water flow, and is exotelmic (sourced from outside the peatland). Minerotrophic water flow tracks flowing through ombrotrophic bog vegetation can produce interesting zonations of habitats. At the margins of ombrotrophic peatlands, where the peatland adjoins mineral ground, minerotrophic water flow tracks are often referred to as lagg zones. These areas can be very variable depending on the nature of the adjoining mineral slopes. **Characteristic vegetation:** Tussocky hare's-tail cottongrass and purple moor-grass with *Sphagnum fallax* and *Polytrichum commune* (M20_S), sometimes with patchy soft rush (M6c), are typical in weakly minerotrophic situations in lagg zones and surface-water flows from acidic, base-poor mineral slopes. Wetter and more strongly minerotrophic water flow tracks can support bottle sedge, bog pondweed, marsh St John's wort (within its range), sharp-flowered rush, lesser spearwort, *Sphagnum denticulatum* (in NVC communities M1, M4, M6, M29). In some situations, they occur in mosaics with extensive lawns of *Sphagnum papillosum* (M21). Occasionally base-rich springs give rise to species-rich vegetation including M15a and some types of fen meadow in marginal areas.

WETMEC	Characteristics
Eroded Hill Peat Slopes	**Physical characteristics:** Linear erosion channels ('Type 2' erosion) flowing downslope result in drier surfaces dissected by steep-sided gullies, which can be eroded down to the mineral material beneath the peat (Peat depth usually thin to fairly deep). These have a drawdown effect on the water table within 2m of the peat edge. **Characteristic vegetation:** in gully channels often similar to Water Flow Tracks: tussocky cottongrass (M20), purple moor-grass and soft rush (M6c). Gully edges (haggs) often support drier versions of precursor vegetation (typically M19 or purple moor-grass-rich M17) and can be heathy in the driest situations. Common cottongrass is often the initial coloniser of bare peat (M3).
Eroded Slackenings and Crests	**Physical characteristics:** Networks of erosion channels ('Type 1' erosion) result in a mosaic of hagged peat mounds with a relatively dry surface close to the eroding edges, and bare peat in eroded hollows and channels on lower ground closer to the water table. Peat depth variable, usually thin to fairly deep. **Characteristic vegetation:** If stabilised (either naturally or through restoration) these often re-colonise with vegetation similar to the precursor type (M17, M18/M19, M19) or with tussocky vegetation (M20 or purple moor-grass dominated vegetation) resulting in uneven ground supporting a fragmented mosaic of vegetation types. Common cottongrass is often the initial coloniser of bare peat (M3).
Eroded Crowns	**Physical characteristics:** Networks of erosion channels ('Type 1' erosion) result in uneven ground which is a mosaic of firm dry peat islands (haggs), and peaty slopes and hollows, some with bare peat and some re-colonising, with shallow pools on the lowest ground where the water table is higher. Peat often very deep to very deep even below the eroded surface. **Characteristic vegetation:** The wettest areas can support fragments of vegetation similar to that of un-eroded crowns (M17_S, M18_S, M18/M19). Bare peat is often initially colonised by common cottongrass (M3).

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12 Glossary

These definitions relate to the usage of terms in this document and are not necessarily general definitions. Words underlined are defined elsewhere in the glossary.

Term	Definition
Acidic	here used for wetlands with water strongly dominated by H^+ (and usually SO_4) (pH < 4.5)
Acrotelm	the uppermost, 'active layer' of a peat deposit, most often used with regard to an undamaged raised bog, comprising the living plant cover passing downwards into recently-dead plant material and thence to fresh peat. It forms the largely oxygenated surface layer with high hydraulic conductivity, within which the water level fluctuates and the main water movement occurs (cf. catotelm).
Allogenic	Induced by external factors.
Autogenic	'self-made' [caused by reactions of organisms themselves]
Automorphic	'self-formed'.
Blanket mire landscape	where the land surface is covered ('blanketed') to a large extent by mire habitat, including a mixture of ombrotrophic bog and minerotrophic fen habitat. The term 'blanket bog landscape' is often used as a synonym. The Flow Country of Scotland is a classic example of a blanket mire landscape.
Catotelm	the lower, so-called 'inert' layer of a peatland. The catotelm underlies the acrotelm, and is permanently saturated, mainly anoxic and usually of lower hydraulic conductivity and storage capacity than the acrotelm
Diplotelmic	literally 'two marshed' (*Greek*), *i.e.* 'two layers of mire'. In raised bogs, this refers to the typical occurrence of an uppermost 'active layer' (the acrotelm) and a lower so-called 'inert' layer (the catotelm).
Endotelmic flow	flow of water sourced from within the wetland itself (rather than from external sources).
Eutrophic	nutrient-enriched (not necessarily also base rich, but often so).
Evapotranspiration	loss of water from the soil by evaporation from the surface and by transpiration from the plants growing thereon; the volume of water lost in this way.
Fen	often used as a generic term for all minerotrophic mires; can include mires on peat and normally-wet mineral deposits (tufa *etc.*).
Floristic	relating to the distribution, number, types and relationships of plant species in an area or areas. (www.dictionary.com)

Term	Definition
Flow track	used as a generic term for distinct, linear zones of focussed surface or near-surface water flow within wetlands, and includes runnels, soakways and water tracks.
Groundwater	used primarily to refer to water in, or sourced from, a bedrock or drift aquifer; although peat may form a local aquifer, in this report 'groundwater' is not normally used for the water within wetland substrata, to avoid possible confusion with regard to peat deposits which are groundwater-fed and those that are not.
Humification (von Post scale)	degree of decomposition (of peat) [production of humus from the decay of organic matter as a result of microbial action].
Hummocks	elevated mounds created by the growth of bryophytes, especially *Sphagnum* species.
Hydraulic conductivity [K; K_{sat}]	the rate at which water moves through a material. K_{sat} denotes saturated hydraulic conductivity – *i.e.* the rate at which water moves through a saturated material.
Hydraulic gradient	the change in hydraulic head or water surface elevation over a given distance.
Lagg	a moat-like strip of fen around the margins of some raised bogs; normally used to refer to a distinctive (often wet) structure rather than just the minerotrophic fringe which normally occurs where any ombrotrophic deposit contacts adjoining mineral ground or minerotrophic peat.
Lawn	noticeably even (level) surfaces on flat or sloping ground
Lowland	an ill-defined term, in the UK often considered to correspond to land that is either below about 300 m in altitude, or below the boundary of enclosure.
Macrofossils	plant or animal remains preserved in peat which can be identified without the use of a high-powered microscope (*e.g.* stems, leaves and roots but not pollen grains).
Macrotope	mire macrotope; large-scale units, consisting of complexes in which peat bodies originating as different hydrological units have become either closely juxtaposed or merged together, *e.g.* the Silver Flowe in Galloway. *(from Bog SSSI Guidelines, based on Lindsay et al. 1988; Lindsay 1995)*
Mesotope	mire mesotope; in which a peat body can be identified as a single hydrological entity (though, in the case of blanket bog mesotopes, these may have hydrological links with other mesotopes), *e.g.* Cors Fochno (Borth Bog) in central Wales or Brishie Bog in the Silver Flowe. The lagg fen around a raised bog is a distinct mesotope, with its own hydrological requirements, so a complete raised bog system, with its lagg fen, should be classed as a macrotope. *(from Bog SSSI Guidelines, based on Lindsay* and others, *1988; Lindsay, 2025)*

Term	Definition
Meteoric water	precipitation
Microform	mire microform; relating to single surface feature, such as pool or hummock. (See Lindsay et al. 1988, pp. 23–24) *(from Bog SSSI Guidelines, based on Lindsay* and others,*1988)*
Microtope	mire microtope; relating to the arrangement of surface features, especially into a pattern which alternates aquatic and terrestrial elements, *e.g.* pool and hummock, or terrestrial features alone, *e.g.* hollow and ridge (*Lindsay* and others, *1988)*
Minerotrophic	fed by telluric water.
Minerotrophic mire	mire whose surface is irrigated both by precipitation and telluric water.
Mire	a general term for habitats with consistently high, but rarely above-surface, water tables; it is sometimes applied specifically to peat-producing ecosystems but here used more broadly as a synonym for 'permanent telmatic wetlands'
Moorland	moorland is a term often used in the UK to describe open habitat that is generally characterised by acidic, low nutrient, often waterlogged soils, supporting a mixture of acidic grassland, heathland (both dry and wet), and bog vegetation. Moors are generally upland, but some lowland areas are also called 'moors'.
Oligotrophic	low fertility, nutrient poor (not necessarily also base poor).
Ombrogenous	wetland developed under the exclusive influence of precipitation
Ombrotrophic	wetland surface that obtains nutrients and water directly and exclusively from the atmosphere (rain, snow, fog *etc*.).
Ombrotrophic bog	bog with surface irrigated more-or-less exclusively by precipitation inputs.
Ontogeny / ontogenesis	history of development.
Paludification (paludosere/paludology)	the development of wetland directly over formerly dry ground through impeded drainage or an increase in water supply.
Pedogenic	Processes relating to soil formation.
Percolation	used to refer to diffuse water flow through a (usually topogenous) wetland deposit.
Permeability	the capacity of a porous medium for transmitting water.
Precipitation	deposition of water on the earth's surface by rain, snow, mist, frost, condensation *etc*.; the quantity of water so deposited.
Raised bog/raised moss	name given to a dome or domes of ombrogenous peat formed above the regional groundwater table, mainly in basins and floodplains; dome may be bordered by a rand and lagg

Term	Definition
Rand	a ‘rim, margin, or border’. Following Swedish telmatologists, ‘rand’ is used here specifically to refer to the rather dry, and often steeply-sloping margin of a raised bog, which often directly adjoins a peripheral lagg
Rheo-topogenous*	Topogenous surfaces with significant lateral water movement (percolation)
Runnel	small lines of water flow on fairly steep slopes and often on a skeletal substratum.
Seepage	groundwater ‘seepage’ is considered to be groundwater outflow from a mineral aquifer to the surface of a wetland (cf. flush).
Soakway	water flow tracks within wetlands which can be detected by the contrast in their vegetation and wetness relative to the flanking mire; distinguished from a water track by having little or no obvious surface water.
Soligenous	literally ‘made by soil’; here used to refer to wetness induced primarily by moving supply of telluric water sourced from mineral deposits adjoining a wetland (such as seepage slopes).
Soligenous wetlands	wetlands primarily kept wet by supply of telluric water with little impedance to outflow; most typical of relatively steep slopes where groundwater or run-off input produces surface-wet conditions – wetlands on ± flat surfaces are not usually classified here unless characterised by rates of water through-flow comparable to that on the steeper slopes; often have thin deposits of peat and water movement is often more by surface flow than percolation through the peat.
Spring	Used to refer to a discrete focus of groundwater outflow from a mineral aquifer onto the ground surface, usually with visible water flow into a stream, runnel(s) or soakway; may occur as an area of enhanced outflow within a more diffuse seepage system
Stand	a relatively uniform patch of vegetation of distinctive species composition and appearance; can vary in size from very small (*e.g.* 2m^2) to very large (*e.g.* 1 ha). The internal uniformity can sometimes encompass small scale, repeated heterogeneity, such as is created by a microtopographical mosaic.
Stratigraphy (peat)	description of the layering within a peat deposit based on the composition and character of the peat and mineral content
Sub-neutral	wetlands with pH range c. 5.5–6.5.
Surface run-off	water that reaches (or leaves) a mire either by overland flow or percolation through the upper layers of the adjoining substratum (due to gravity).
Surface water	water from pools and lakes, water courses, land-drainage, surface run-off, and so on (contrast with groundwater).

Term	Definition
Swamp	wetlands with emergent vegetation in shallow standing water (summer water table typically more than about 25 cm above ground level); note that in North American terminology, swamp is more often used to refer to forested wetlands.
Telluric water	a generic term for water that has been in contact with the mineral ground, as opposed to direct precipitation inputs (*meteoric water*); includes both groundwater and surface water.
Telmatic wetland	wet, semi-terrestrial wetlands (*i.e.* not aquatic wetlands), subdivided into 'permanent', 'seasonal' and 'fluctuating' types; derived from the Greek *telma* (telma), meaning 'pond, marsh, swamp'; 'paludal' and 'paludic' are Latin-derived equivalents.
Telmatology, telmatologist	the study of, or one who studies, telmatic wetlands, derived from the Greek telma, meaning 'pond, marsh, swamp', and ολογία. Some workers prefer these terms to 'paludology' (*etc*) because the latter is of mixed Latin and Greek derivation.
Terrestrialisation	the transition of open water to 'dry', 'solid' ground by the process of hydroseral succession, which occurs by gradual infilling with accumulating organic (± mineral) material, or sometimes by the initial formation of a floating raft of vegetation.
Topogenous	wetness induced by topography and poor drainage of telluric water (such as hollows)
Topogenous wetlands	telluric wetlands in which high water level is maintained by impeded drainage (detention) of water inputs.
Trough	the unqualified term 'trough' is used to refer to elongate, mostly valley-bottom contexts which are neither valleyheads nor floodplains.
Turbary	The cutting and removal of turf or peat for fuel.
Tussocks	elevated mounds created by the growth of caespitose vascular plants, such as *Molinia caerulea* or *Eriophorum vaginatum*; tussocks can sometimes coalesce to form elevated platforms.
Upland	an ill-defined term, in the UK often considered to correspond to land that is either above about 300 m in altitude, or above the boundary of enclosure. In northern and western areas, particularly in Scotland, Wales and Ireland, unenclosed land often descends close to sea-level, and the upland–lowland dichotomy becomes meaningless.
Valleyhead wetland/fen	wetlands associated with the headwaters and upper reaches of valleys; mainly soligenous (*e.g.* New Forest valley mires).
Water level	a generic term for water surface and water table.

Term	Definition
Water mound	refers to the water mound developed within a raised bog as a result of impeded drainage and storage of water derived solely from precipitation (*i.e.* perched above the level of regional groundwater levels).
Water table	below-ground free water surface
Water track	trackways of preferential water movement through wetlands; distinguished from a soakway by having more open water.

13 Annexe 1. Summary of study sites and their environmental conditions

Table 25 provides a summary of environmental conditions on ombrotrophic peatland sites in England and Wales (62 locations were visited during 2022–2025; additional sites, highlighted grey, were considered in desk-based assessments). Values highlighted in yellow indicate where average climate conditions lie beyond the thresholds regarded as typical for supporting formation of blanket peat (see bullet points below; summarised in Tallis 1998):

- rainfall >1200 mm per year;
- wet days (with >1mm of rainfall) at least 160;
- Q2 and Q3 (April–September) rainfall minus potential evaporation > 200

Rainfall and evapotranspiration potential (PET) are based on Met Office data and modelled data (Ross and others, 2018; Tanguy and others, 2019). Values are means of daily totals over 65 years (January 1961– December 2025).

Table 25. Summary of environmental and climatic conditions ombrotrophic peatland study sites in England and Wales.

Site Name	East	North	Region	altitude m aOD	Rainfall mm	Days >1mm rainfall/yr	Q2–3 rain-PET	PET mm
Berwyns-Llechwedd Groes	303558	330179	Wales	600	1819	188	349	453
Black Knowe	364223	581419	Northumberland	470	1497	188	298	432
Blackdown Flow	396056	586026	Northumberland	280	950	154	59	482
Butterburn Flow	367300	575800	Northumberland	280	1195	175	138	490
Buttermere Fells	319125	516712	NW England	470	2767	199	728	448
Central Wales	275848	260586	Wales	480	1832	193	348	455
Chester's Burn	396833	587554	Northumberland	290	966	154	67	476
Combs Moss	404600	375900	South Pennines	470	1446	176	206	502
Coom Rigg Moss	369150	579480	Northumberland	325	1313	178	200	476
Cors Geuallt	273481	358510	Wales	255	2363	196	462	523
Cotherstone	390800	517100	North Pennines	430	1179	168	109	485
Cranester Bog	395461	586761	Northumberland	265	942	154	59	476
Cross of Greet	368232	460871	NW England	430	1901	187	376	473
Crutchember Fell	373032	460532	NW England	400	1713	183	305	484
Cwm Dyli	264042	354161	Wales	315	3425	212	974	516
Cwm Gwern Gof	268130	359263	Wales	550	2736	208	723	408
Dawes Moss	398135	586309	Northumberland	238	934	151	46	491
Deadwater Fell	363269	597851	Northumberland	515	1532	182	293	427
East Dart Head	260499	86173	SW England	560	1690	170	204	492
Exmoor_Chains	276451	140781	SW England	486	1841	181	308	500

Site Name	East	North	Region	altitude m aOD	Rainfall mm	Days >1mm rainfall/yr	Q2–3 rain-PET	PET mm
Featherbed Moss	409110	392085	South Pennines	540	1518	182	255	479
Felecia Moss	372126	577660	Northumberland	315	1236	176	157	482
Figyn Blaen-brefi	271750	254600	Wales	425	1701	193	306	479
Geltsdale	358300	554779	North Pennines	383	1366	177	266	459
Gidleigh Common	265062	88373	SW England	400	1690	170	204	492
Gors Goch	289758	263364	Wales	435	1787	185	281	485
Gors Lwyd	285838	275313	Wales	420	1970	198	378	479
Gowany Knowe	373050	578750	Northumberland	283	1173	173	120	490
Grain Heads Moss	374550	573700	Northumberland	285	1109	173	101	498
Hafod Elwy	295300	356100	Wales	420	1454	184	196	492
Halstead Fell	374036	460847	NW England	360	1646	181	272	492
Hasgill Fell	372452	460268	NW England	400	1827	185	351	479
Hummel Knowe	370300	571400	Northumberland	240	1129	175	102	508
Langsett Moors	414900	399770	South Pennines	490	1557	180	241	492
Leash Fen	429620	373600	South Pennines	283	966	146	-8	549
Low Moss – Castlerigg Fell	327883	521031	NW England	370	1825	181	332	499
Lucas Moss	426360	376700	South Pennines	345	1066	153	42	534
May Moss	487369	495770	NE Yorkshire	350	956	143	20	523
Migneint	276622	342702	Wales	475	2323	205	571	463
Moel Eunant	295000	323800	Wales	540	2173	198	451	470
Moorhouse Knock Fell	372800	531700	North Pennines	700	1711	196	448	385
Moorhouse Trout Beck	374714	533168	North Pennines	580	1950	201	449	421
Moorhouse Valley Bog	376296	533144	North Pennines	550	1908	199	402	437
Muckl Samuels Moss	367850	579010	Northumberland	305	1302	179	193	478
Mynydd Llangatwg	318090	215450	Wales	500	1649	171	208	523
Plym Head	262466	68668	SW England	465	2176	183	438	465
Pundershaw	377500	579150	Northumberland	245	1063	164	67	500
Ringinglow Bog	426850	383364	South Pennines	410	1121	157	73	518
Sandyford Brook	426961	374756	South Pennines	285	1027	150	21	534
Scald Law	394637	588252	Northumberland	310	975	155	68	470
Stoke Flats	425547	376510	South Pennines	290	1045	152	25	543
Stone Park	359688	486733	NW England	185	1507	177	255	514
The Lakes	373850	577350	Northumberland	295	1176	174	126	486
The Wou	368296	569959	Northumberland	220	1094	172	88	513
Tor Royal Bog	260459	72773	SW England	390	1997	184	370	489
Totley Moss	427193	378964	South Pennines	365	1003	151	24	530
Waun Wen	302818	214835	Wales	480	2116	188	423	485

Site Name	East	North	Region	altitude m aOD	Rainfall mm	Days >1mm rainfall/yr	Q2–3 rain-PET	PET mm
Whaup Moss	395257	587607	Northumberland	280	961	155	64	476
White Oak Moss	314116	517640	NW England	365	1870	183	318	493
White Path Moss	425620	383525	South Pennines	410	1121	157	73	518
Whitelee Moor	370087	601786	Northumberland	560	1383	181	227	437
Winneys Down	262466	81921	SW England	520	2457	190	505	471
Reference Sites (not surveyed)								
Chat Moss (archaic)	370457	396631	NW England	24	870	152	–63	609
Cors Caron (Tregaron Bog)	268228	263535	Wales	167	1280	174	103	545
Duddon Mosses	323489	487619	Cumbria	10	1540	175	197	553
Holme Fen (archaic)	519950	289510	East Anglia	–3	563	108	–203	630
Kinder Scout	409345	388169	South Pennines	630	1685	184	368	437
Malham Tarn	389024	467087	Yorkshire Dales	380	1596	178	301	463
Muckle Moss	380053	567049	Northumberland	214	863	155	–16	543
Red Sike Moss	382508	529999	North Pennines	498	1503	182	235	447
Walton Moss	350643	566725	NW England	101	966	155	37	541

14 Annexe 2. Deskwork methodology details

Note that these methods were accurate in May 2026. However, locations of publicly available datasets may change, and procedures may need to be modified with later versions of GIS software. The details provided for use of LiDAR data are for the open-source software QGIS (version 3.34.11-Prizren) and assume a certain basic level of proficiency with it.

14.1 Downloading and manipulating Lidar data (QGIS)

14.1.1 Wales LiDAR DTM layer (2020–22 surveys at 1m resolution)

This is a quick 'how-to' for accessing in QGIS the Lidar dataset for Wales as a DTM file without having to download the data (it comes as a single tileset that would take days to download).

1. Go to the 'DataMapWales' site – https://datamap.gov.wales/maps/lidar-viewer/

2. Scroll down the page to where there is a list of DTM cog file links and choose the 32-bit one – or copy this link:

https://dmwproductionblob.blob.core.windows.net/cogs/lidar/wales_dtm_32bit_cog.tif

3. Just above the DTM list there is a blue highlighted link to ‘Read more about COGs’. Following this link will take you to an explanation about what COGs are, and a tutorial in the ‘Tools' section that tells you how to link to the data using QGIS. Alternatively:

4. In QGIS click 'Layer' and then 'Data Source Manager'. Choose the 'Raster' dialogue button and to the right where it says 'Source Type' choose 'Protocol: HTTP(S), cloud, etc'.

5. In the Protocol dialogue, select the Type 'HTTP/HTTPS/FTP', then paste the url from 2) above into the URI dialogue line (below 'Type'), ensuring there are no spaces before the link. Then click 'Add' at the bottom of the window and close the Data Source Manager. It may take a few moments to load, but there should be a dtm for the whole of Wales on the screen.

14.1.2 England LiDAR DTM tiles

Currently LiDAR tiles are available for much of England from the Defra website:

https://environment.data.gov.uk/survey

The process involves zooming into the target area on the displayed map of the UK, drawing a polygon to select the desired tile(s), and then clicking the green button ‘Get available tiles’. This will bring up a list of available lidar composite DTM tiles. Click the

required tile link and wait for it to download. Save the zip file to a suitable location and then unzip it. It will now be ready to load into QGIS.

Alternatively, a coarser DTM 10m layer is available for most of the English uplands and gives good results.

14.1.3 Using DTM to Create Hillshade Models and Contours

Once the LiDAR tiles (for England) or the Welsh DTM are loaded into QGIS, it is possible to extract and manipulate the data in various ways. It is usually a good idea to create a copy of the relevant area of the DTM (to encompass your site and its immediate surroundings) to reduce processing time when creating hillshade models and contour lines. This can be done as follows:

1. Create a separate polygon layer which can be used to draw a polygon that encompasses the area of interest. If using this for multiple sites then remember to highlight just the polygon(s) of interest, prior to extracting/creating the hillshade or contours.

2. In the 'Layers' list at the left of the map screen, highlight the relevant DTM layer (e.g. ‘wales_dtm_32bit_cog’, or the individual tile), then click on the 'Raster' menu, and choose 'Extraction', then 'Clip Raster by Mask Layer'. The correct input layer should already be highlighted, then click the 'Mask layer' and choose the layer that has the polygon showing the site of interest. Check the box 'selected features only', and press 'Run'.

3. In the 'Layers' list at the left of the map screen, find the DTM of the site that has just been created (usually at the top of the list, and will be called 'Clipped (mask)'). If you want to keep this then save it (as a GeoTiff), otherwise it will be lost when closing QGIS.

14.1.3.1 Creating a Hillshade Model

Highlight the DTM layer that has just been created, then click on the 'Raster' menu, and choose 'Analysis' and then 'Hillshade'. The correct input layer should already be highlighted, so click 'Run'. Save the hillshade layer as a GeoTiff.

14.1.3.2 Creating contour layers

Contour lines overlaid on the hillshade model can be very informative. The contour interval should be chosen depending on the scale of the site, but note that the smaller the interval, the larger the resulting file and processing time. To reduce this effect it is possible to create two identical contour layers that are offset from each other, to produce the desired interval.

1. In the layers list highlight the DTM that has just been created for your site. Click on the 'Raster' menu, then 'Extraction', then 'Contour'.

2. In the 'Interval between contour lines' dialogue, type "1" (or whatever interval is appropriate), and click 'Run'. The resulting set of contour lines will appear on screen.

3. With the 'Raster Extraction – Contour' screen still open, click the 'Change Parameters' button at the bottom. In the 'Offset from zero ....' dialogue, type "0.5" (or whatever is half of the chosen contour interval), then click 'Run'. The offset contour lines will appear on screen. Close the 'Raster Extraction – Contour' screen.

4. The contour layers will be at the top of the layers list. These will need to be saved as shapefiles. They can then be modified (colour, elevation labels, etc) so that they project well – a suggested combination of colour, size, label frequency is as follows:

5. Double click on the contour layer. Choose 'Symbology', then simple line, width 0.15. (e.g. dark brown for one of the contour line layers, and mid brown for the second). Then choose 'Labels', 'Single labels', 'Value' – choose 'elevation'; 'Text' – regular, size 7, dark brown; 'Rendering' – 'Feature options' – 'Suppress labelling of features smaller than' - type in "15". Click 'OK'.

14.2 Use of Google Earth 3D terrain imagery

The use of oblique views of Google Earth 3D terrain imagery can be a very useful adjunct to viewing images and contour data on GIS, as it provides a user-friendly way to alter the direction and angle of viewing, and different quality aerial images can be accessed using the historical imagery function.

The following is a brief description of how to use Google Earth Pro to view and save 3D oblique images of survey areas.

1) Zoom into the area of interest.
2) Click ‘Tools’ then ‘Options’, and choose the 3D View tab.
3) In the Terrain section ensure the check boxes for ‘Use high quality terrain…’ and ‘Use 3D imagery…’ are ticked.
4) If the survey area has quite subdued terrain (gently sloping hill, shallow valleys), the ‘Elevation exaggeration…’ can be increased to a maximum of 3. The click OK.
5) Click the ‘Show historical imagery’ button (looks like a clock face with a green anti-clockwise arrow) at the top of the screen, use the slider to show different image dates, and choose the best image for your purpose.
6) Use the compass in the top right of the screen to tilt the image, to provide an oblique view: using the mouse pointer press and hold the up arrow just below the N symbol, this will tilt the screen. You will need to navigate back to the survey area using the mouse to grab and drag the screen. Zoom in as required to see the survey area.
7) Rotate the view to see the survey area from different directions, by using the mouse pointer to grab and rotate the outer circle of the compass in the top right corner of the screen. Pressing the N will automatically return the view to northwards.
8) Import GIS layers: proposed survey transects, points, or polygons can be imported assist with survey planning. Select ‘File’ and ‘Import’, and in the window that opens chose ‘ESRI Shape’ from the dropdown menu in the bottom right, before navigating to the required file and clicking Open. There is a fairly limited facility to modify the

colour of the points, lines and polygons, and whether to see outlines or filled shapes.

9) To save the view that has been created, choose ‘File’, ‘Save’, and ‘Save image’. If required, give the image a title and description, and modify or omit the legend, then click ‘Save image’ at the top of the screen.

15 Annexe 3. Survey variables and descriptors

Table 26 lists the variables that are considered the most critical for describing habitat conditions during eco-hydrological surveys in upland peatlands of England and Wales, and includes descriptions, rank scores, and relevant measurements. These are a subset of the variables that were used during the pilot study (Phase 2), and are considered to be the simplest to use. Variables have been greyed out where they are unlikely to be encountered in upland bog habitats.

Note that the Hummock-Hollow Index scores mentioned in Sections 5 and 7 refer to the sum of frequency scores for microtopographic features. These comprise Hummocks, ranging from slight undulations to very tall hummocks (Peat Bog Matrix codes T1 to T4); and Hollows/Pools, ranging from wet hollows to very deep pools (Peat Bog Matrix codes A1 to A5). Frequency scores comprised: Absent (0); Rare (1); Occasional (2); Frequent (3); Abundant (4). For example, if a sample was recorded in a location with frequent shallow pools and abundant low hummocks, the Hummock-Hollow Index score would be 3 + 4 = 7. Typically, the greater the range of sizes of features, the higher the score, and the greater the degree of surface patterning.

An additional *Sphagnum* abundance score of 5 has been included, to distinguish situations where *Sphagnum* forms an almost complete layer.

Peat depth: 5mm electrical cabling rods were used as peat probes. Sometimes, if the types of peat and other wetland infill layers are quite complex, it can be difficult to determine when the peat probe has passed into a different material. However, the probes usually pass quite freely through bog peat, and can be removed quite easily, unless the peat is very firm and desiccated. There can be one or more layers of wood peat, which may feel very firm but can usually be pushed through with some effort, and these may mark a transition to underlying fen peat (if present). If there is a layer of clay beneath the peat then it often manifests as a gradual change to a firmer, sticky material, though the transition can be quite sharp. A rock or gravel base may have a crunchy or grinding sensation, or the probe may come to a sharp halt. If a very firm or impervious wood layer is suspected, it is recommended to repeat the probing exercise 50-100 cm away from the initial location.

Table 27 contains some additional variables that were also used during the pilot study, and which are more difficult and time-consuming to record, but may provide useful information for workers with specific interests or larger budgets.

Table 26. Upland bog habitat variables and descriptors, with rank scores where they are used as part of bog eco-hydrological surveys.

Note: variables have been greyed out where they are unlikely to be encountered in upland bog habitats.

Physical Characteristic descriptors	Rank score with measure / cross-reference
Peat depth	**Depth (m) below ground level**
Very thin	1 < 0.2 m
Thin	2 < 0.5 m
Moderate	3 0.5 – 1.5 m
Fairly deep	4 1.5 – 3.0 m
Deep	5 3.0 – 5.0 m
Very deep	6 > 5.0 m
Wetness	**Likely water level in relation to ground level (cm)**
Very dry – no dampness even when sitting down (except after rain)	1 Water extremely deeply sub-surface (–75cm)
Dry – no dampness even when sitting down (except after rain)	2 Water very deeply sub-surface (–75 to –40cm)
Damp – moisture cannot easily be squeezed out by foot or hand pressure	3 Water deeply sub-surface (–40 to –18cm)
Moderately wet – water does not readily ooze into boot-prints, but can be easily squeezed out	4 Water sub-surface (–18 to –5cm)
Wet – water readily fills boot-prints	5 Water near surface (–5 to +1cm)
Very wet – shallow pools present	6 Water above surface (+1 to +10cm)
Shallow swamp – may fill wellies	7 Water above surface (+10 to +25cm)
Swamp – may fill thigh waders	8 Water above surface (+25 to +50cm)
Deep swamp – may end up swimming!	9 Water above surface (>+50cm)
Surface stability / softness	**Qualitative description**
Solid	1 Mineral ground.
Firm	2 Ground does not sink underfoot.
Soft	3 Ground sinks slightly underfoot.
Very soft	4 Feet sink into surface (up to ankle deep) but surface readily rebounds if vegetated. In bare peat, may leave footprints.
Quaking	5 Ground quakes underfoot and feet sink into the surface (up to shins).
Floating	6 Thin mat of roots and rhizomes, likely to sink rapidly through into deep water or fluid peat.
Sphagnum abundance	**Frequency estimate**
Absent	0 *Sphagnum* species absent from the vegetation generally.
Rare	1 Only a few *Sphagnum* patches present in the vegetation.
Occasional	2 Scattered small patches of *Sphagnum* but not generally contributing to the ground cover.
Frequent	3 *Sphagnum* patches found regularly throughout the vegetation and making a modest contribution to cover.
Abundant	4 *Sphagnum* patches found regularly throughout the vegetation and contributing significantly to the cover
Dominant	5 *Sphagnum* can form an almost continuous layer beneath taller plants

Physical Characteristic descriptors	Rank score with measure / cross-reference
Water flow in the stand	**Qualitative description**
No flow	0 No signs of water flow
Possible flow	1 Flow likely but no visible evidence
Intermittent flow	2 Flow lines of distinctive vegetation, no visible surface flow
Visible summer flow	3 Visible surface flow in summer
Strong summer flow	4 Strong surface flow in summer
Streaming flow	5 Vigorous water flow tracks or small streams
Slopes	**Approximate % (and ratio)**
1 More or less flat	1 Greater than 1 in 60 (0 to about 2%)
2 Very gentle	2 1 in 60 to 1 in 20 (about 2% to 5%)
3 Slight	3 1 in 20 to 1 in 10 (about 5% to 12%)
4 Moderate	4 1 in 10 to 1 in 5 (about 12% to 18%)
5 Steep	5 Less than 1 in 5 (more than about 18%)
Microtopography	**Microtopographical feature types and vertical heights of features in relation to ground level (cm)**
Subdued microtopography	Uniform structure with no hummock–hollow–tussock features, or only scattered.
Hummock–hollow–pool complexes	Mixtures of microtopographical features (may be regular or irregular pattern).
Flats	Areas of uniform vegetation between hollow and pool features.
Wet hollows	≤10cm deep: Peat bog matrix A1
Shallow pools	10cm to ≤20cm deep: Peat bog matrix A2
Moderate pools	20cm to ≤40cm deep: Peat bog matrix A3
Deep pools	40cm to ≥100cm deep: Peat bog matrix A4
Very deep pools	1m to 400cm+ deep: Peat bog matrix A5
Slight undulations - often with *Sphagnum* lawns (*S. fallax, S. medium, S. papillosum*)	0cm to ≤15cm high: Peat bog matrix T1
Low hummocks - (*Sphagnum/Polytrichum* ± *Eriophorum*/ericaceous spp)	15cm to ≤25cm high: Peat bog matrix T2
Tall hummocks - (*Sphagnum/Polytrichum* ± *Eriophorum*/ericaceous spp)	25cm to ≤50cm high: Peat bog matrix T3
Very tall hummocks - (*Sphagnum/Polytrichum* ± cottongrass / dwarf shrubs)	50cm to ≤100cm high: Peat bog matrix T4
Low tussocks - (*Molinia* / deergrass / cottongrass)	15cm to ≤25cm high: Peat bog matrix Tk
Tall tussocks (*Molinia*)	25cm to ≤50cm high: Peat bog matrix Tk
Very tall tussocks (*Molinia*)	50cm to ≤100cm high: Peat bog matrix Tk
Frequency of Microtopographic features	**Frequency score**
Absent	0
Rare	1
Occasional	2
Frequent	3
Abundant	4
Erosion features	
No visible erosion features	
Haggs	Upstanding islands of peat with steep sides.
Peat pans / peat flats	Flat areas of bare peat (estimate area).

Physical Characteristic descriptors	Rank score with measure / cross-reference
Gullies	Steep sided channels in peat – can be a range of sizes and can cut into the mineral ground beneath the peat.
Pools	Some shallow pools can result from erosion; dammed gullies can result in deeper pools.
Revegetated former haggs, peat flats, shallow gullies, forestry furrows	Equivalent to: Peat bog matrix E1 revegetating gully
Scattered small areas of bare peat (≤4m^2)	Equivalent to: Peat bog matrix Em micro-erosion
Eroded ditches, shallow gullies, narrow strips of eroded peatland edges	
Large areas of bare peat and upstanding haggs – actively eroding	
Numerous deep, actively eroding gullies	Equivalent to: Peat bog matrix E2 eroding gully
Restoration activity	
Restoration actions: drain or gully blocks; re-profiled drains or gullies; peat dams and pools; plug planting; nurse crop or brash.	Presence or absence Description of restoration features
Management activity	
Grazing (livestock, wild animals) Heather management (burning or cutting) Drainage Vehicle tracks Game rearing / shooting Other	Description of management activities
Damage	
Peat cutting Trampling Wildfire Other	Description, note whether recent or historic
Water supply	**pH**
Ombrotrophic	More or less exclusively irrigated by precipitation. Acidic (pH < 4.0).
Minerotrophic	Irrigated by water which has been in contact with mineral ground. Very variable, can be base-rich (pH 6.5 – 8.0), sub-neutral (pH5.5 – 6.5), base-poor (pH 4.0 – 5.5) or acidic (pH < 4.0). In areas with high rainfall, many minerotrophic wetland habitat features are only weakly minerotrophic (acidic or base-poor).
Endotelmic	Flow of water is sourced from within the wetland itself, rather than from external sources.
Exotelmic	Flow of water is at least partly sourced from outside the wetland.

Table 27. Additional variables that can be used as part of more detailed eco-hydrological investigations.

Note: variables have been greyed out where they are unlikely to be encountered in upland bog habitats.

Physical Characteristic descriptors	Rank score with measure / cross-reference	
Surface configuration		
Water shedding	1	Crown, ridge or hill top
Water shedding and receiving	2	Downslope flow, receiving water from above
Water collecting on a slope	3	Flat areas within a larger slope – benches, steps, terraces
Flat, unconfined	4	Plateau, plain, or other more-or-less flat ground
Axial trough	5	Small trough or 'lagg'-like marginal channel
Water collecting	6	Discrete hollow or basin
Surface patterning		
None	0	No obvious pools / hollows / hummocks
Weak	1	Occasional pools / hollows / hummocks
+/– circular	2	Frequent pools / hollows / hummocks, mostly +/– round rather than linear or crescent-shaped
Mixed	3	A mixture of +/– round and some linear (across slope) pools and hummocks
Strongly linear	4	Strongly linear (across slope) pools and hummocks
Crescent	5	Crescent-shaped (across slope) pools and hummocks
Proximity to drains and gullies	**Description**	
None	0	None
Far distant	1	More than 100m distance
Distant	2	30–100m distance
Close	3	10–30m distance
Very close	4	3–10m distance
Adjoining	5	Adjoining or within
Peat permeability	**Qualitative description**	
Almost totally impermeable	1	Stiff clay or silt
Extremely poorly transmissive	2	Dense, solid, highly-decomposed peat
Very poorly transmissive	3	Well-decomposed, firm peat (much catotelm peat in bogs)
Poorly transmissive	4	Firm, moderately decomposed peat (typically moss/herbaceous)
Moderately transmissive	5	Fresh or slightly decomposed moss or herbaceous peat
Highly transmissive	6	Loose plant material / semi-floating mat
Extremely transmissive	7	Very loose plant material e.g. at edge of water bodies
Basal substratum permeability	**Qualitative description**	
Almost totally impermeable	1	Heavy silt or clay, or low-permeability bedrock
Extremely poorly transmissive	2	Silt or clay loam
Very poorly transmissive	3	Sandy clays or silts
Poorly transmissive	4	Sandy clay / silt loam
Moderately transmissive	5	Sandy loam
Highly transmissive	6	Sand or gravel or high-permeability bedrock
Extremely transmissive	7	Coarse gravel

16 Annexe 4. The von Post scale for assessing peat decomposition

The von Post field-test procedure is used to estimate the degree of decomposition or the humification value (H) for peat samples. The lower the score the less decomposed the peat is; a score of H10 implies total decomposition of the peat into an amorphous ooze-like substance. Lower scores are usually associated with younger material that has been totally waterlogged and anaerobic, whilst higher scores are related to material that has not been permanently waterlogged, or is much older (some bacterial decomposition can occur at very slow rates in anaerobic environments).

The method described here is adapted from Verry and others (2011).

Use saturated peat or add water if the peat is dry. Place enough peat to fill the hand when the fingers are gently curved against the palm. Gently bounce it until it just fits your hand. Squeeze the sample as hard as you can. In the other hand catch the amorphous material and / or water squeezed between the fingers. Note the colour and turbidity of the free water (water that is separate from any amorphous material). Thinning the water by opening the second hand facilitates the examination of colour and turbidity. Use the fingers of the second hand to scrape amorphous material from between the closed, squeezed fingers of the first hand and consolidate the amorphous material in the second hand. Consolidate the material in both hands by gently bouncing the material. Open both hands and compare the relative volume of the fibrous material that remains in the squeezed hand with the amorphous material in the second hand. The relative volume of the amorphous material that has been extruded from the first hand is used to assign the von Post H value, in conjunction with water colour and turbidity, and the nature of the plant residues in the squeezed hand.

It should be noted that the von Post scale was originally developed for describing peats dominated by *Sphagnum* mosses, and the scoring may not be entirely accurate when used to assess the degree of decomposition in peats with a large proportion of higher plant material, such as fen peats, or peat dominated by cottongrasses and ericaceous remains.

Table 28. The von Post scale of humification (decomposition).

Von Post H value	Nature of squeezed liquid	Proportion of peat extruded	Nature of plant residues	Description
H1	Clear, colourless	None	Plant structure unaltered Fibrous, elastic	Undecomposed
H2	Almost clear, yellow-brown	None	Plant structure distinct, almost unaltered	Almost undecomposed
H3	Slightly turbid, brown	None	Plant structure, most remains easily identifiable	Very weakly decomposed
H4	Strongly turbid, brown	None	Plant structure distinct, most remains identifiable	Weakly decomposed
H5	Strongly turbid, contains a little peat in suspension	Very little	Plant structure clear but indistinct and difficult to identify	Moderately decomposed
H6	Muddy, much peat in suspension	One third	Plant structure indistinct	Well decomposed
H7	Strongly muddy	One half	Plant structure indistinct	Strongly decomposed
H8	Thick mud, little free water	Two thirds	Plant structure very indistinct – only resistant material such as roots	Very strongly decomposed
H9	No free water	Nearly all	Plant structure almost unrecognizable	Almost completely decomposed
H10	No free water	All	Plant structure not recognizable, amorphous	Completely decomposed

17 Annexe 5. Selected reference site data

Each reference site summary comprises a brief description, site maps, aerial images, schematic section drawings, and illustrative photos where these were available.

Oblique aerial images have been overlaid with the approximate extent of each identified WETMEC and BOGCAT unit. Site maps in plan view showing surface contours and hill-shading (derived from national LiDAR data) have also been overlaid with the approximate extent of WETMEC and BOGCAT units, plus survey sample numbers, transect lines, and dataset sample points (e.g. WAGL03). Separately, a plan view site map also shows approximate extent of wetland vegetation types, survey sample numbers, transect lines, and dataset sample points.

Cross-section profiles have been produced along each transect line, labelled with peat depths, sample points, dataset sample IDs, vegetation type, descriptions of surface features, and WETMEC and BOGCAT units. Surface descriptions also provide a score for Hummock/Pool diversity, which is based on the sum of frequency scores for microtopographical features (e.g. shallow hollows, deep pools, low hummocks, tall hummocks, and so on) – see Section 15 for more details.

17.1 Gors Lwyd, Elan Valley, central Wales

Gors Lwyd Site Summary

Gors Lwyd is situated at SN 85730 75280, at the watershed between two rivers, the Elan and the Ystwyth, in the Cwmystwyth Uplands of central Wales. The landscape in this area comprises a broad north-south trending valley floor at 385 m aOD, surrounded by large, steep-sided hills that reach a maximum height of 500 m aOD. A deep topogenous mire fills much of the valley floor, while thinner peat covers large sections of the surrounding hillsides; other habitats mainly comprise acidic grassland.

The valley bottom mire has previously been studied in some detail in the early 1970s (Moore, 1970; Slater, 1975), which showed that the deepest peat areas (reaching 5.5 m depth) have developed over two former shallow basins in the floor of the valley, one at the northern end and one at the southern end. Those areas have suffered widespread erosion and now consist of a mosaic of upstanding firm peat mounds with drier bog vegetation of purple moor-grass, heather, deergrass, cross-leaved heath, and bushy *Cladonia* lichens (species-poor M17 bog vegetation), surrounded by peat flats, hollows, and pools; bare peat is particularly extensive in the larger southern area, but there are also large patches of very wet and *Sphagnum*-rich bog vegetation developing in the wetter hollows, with white-beaked sedge, common cottongrass, sundews, and abundant *Sphagnum papillosum, S. denticulatum* and *S. cuspidatum* (M1 bog pool vegetation, grading into M17_S vegetation).

The eroded parts of the valley floor are embedded in deep peat (4-5 m depth) with a more-or-less intact, firm surface, with a sub-surface water table, that is mostly dominated by purple moor-grass mixed with deer-grass, cross-leaved heath, bog asphodel, some hare's-tail and common cottongrasses, and rarely *Sphagnum papillosum* and *S. fallax* (M17-*Molinia*-dominated bog vegetation).

Along the eastern side of the valley bottom there is a broad expanse of treacherously quaking bog vegetation over deep peat (to about 4 m depth), with large base-poor water flow tracks flowing to the south, that partly issue from one or more submerged springs at the watershed of the valley floor.

Gors Lwyd Site Summary (continued)

The flow tracks support a mixture of bog bean, creeping St-John's wort, slender sedge, water horsetail, bog pondweed, bulbous rush, common cotton-grass, star sedge, and *Sphagnum denticulatum* (M29 soakway vegetation), with rarely some common reed. Quaking ground with a very wet surface flanking the flow tracks has locally abundant white beaked sedge, common cotton grass, purple moor-grass, cross leaved heath, sundews, tormentil, bog asphodel, deer grass, and both *Sphagnum denticulatum* and *Sphagnum papillosum* (M21 mire vegetation).

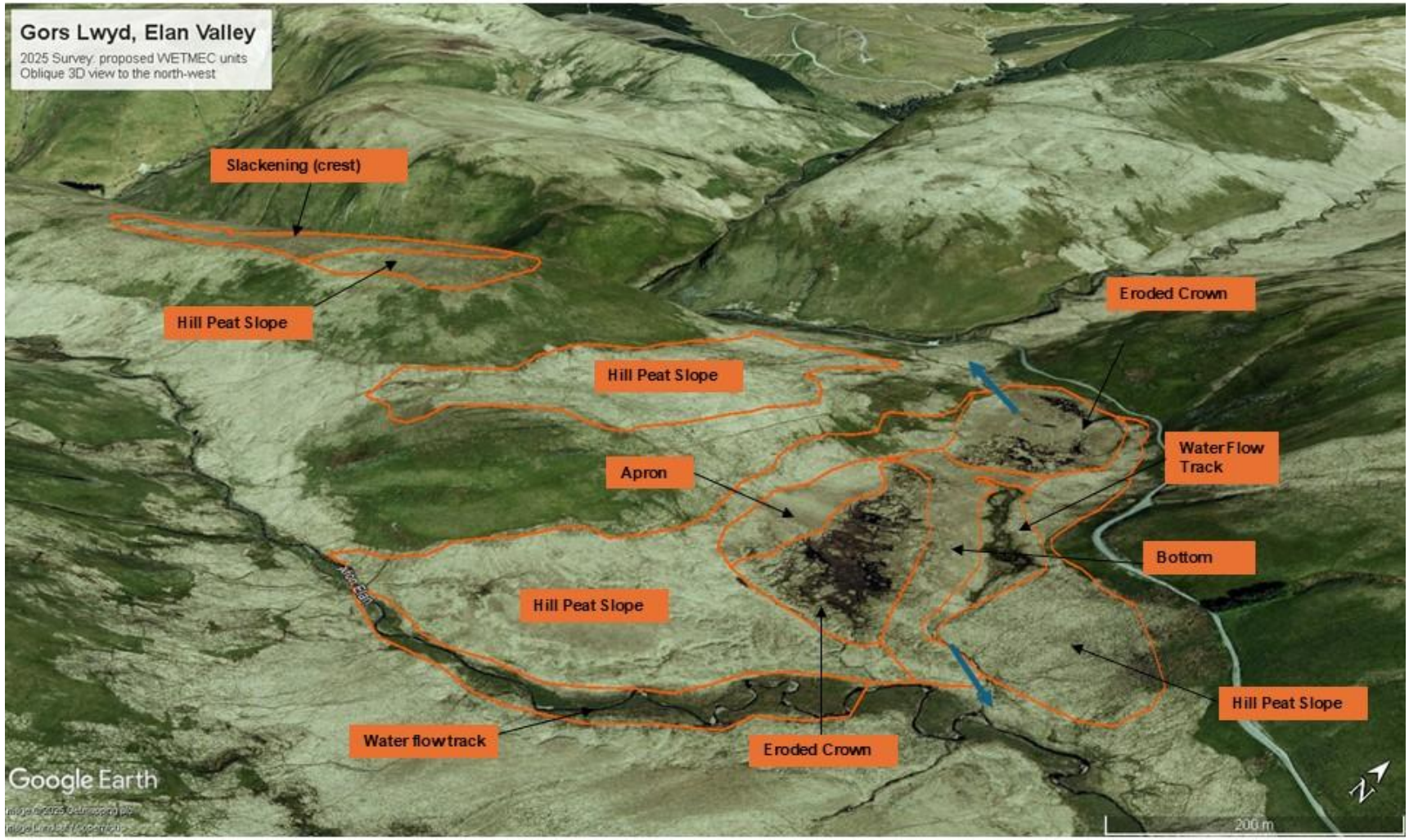
The more gently sloping parts of the hillslopes that surround the valley bottom have much shallower peat that is at most about 2.5 m deep, but is generally between 0.5 m and 1.5 m deep. These areas have a firm surface with a sub-surface water table, and are dominated by purple moor-grass, with occasional cross-leaved heath, bilberry, deer-grass, hare's-tail and common cottongrasses, bog asphodel, some pleurocarpous mosses including the distinctive *Racomitrium lanuginosum*, and rarely scattered tufts of Sphagnum mosses. This type of species-poor M17-*Molinia*-dominated bog vegetation is present on all but the steepest parts of the hillslopes, where it is replaced by short acidic grassland, or purple moor-grass dominated grassland. However, some of the broadest and flattest parts of the ridge-tops are much more diverse and support patches of *Sphagnum*-rich M17 bog.

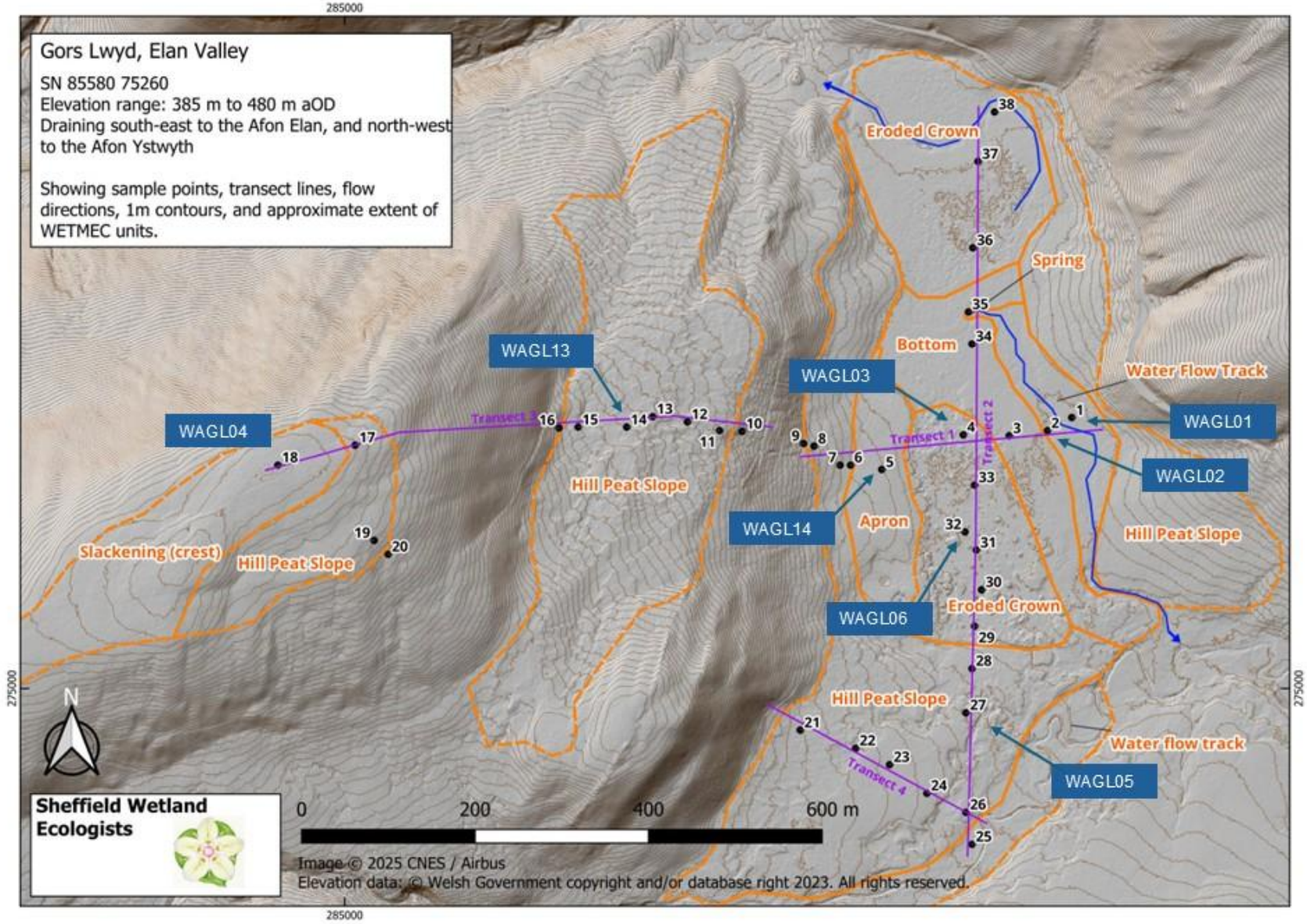
BOGCATs:

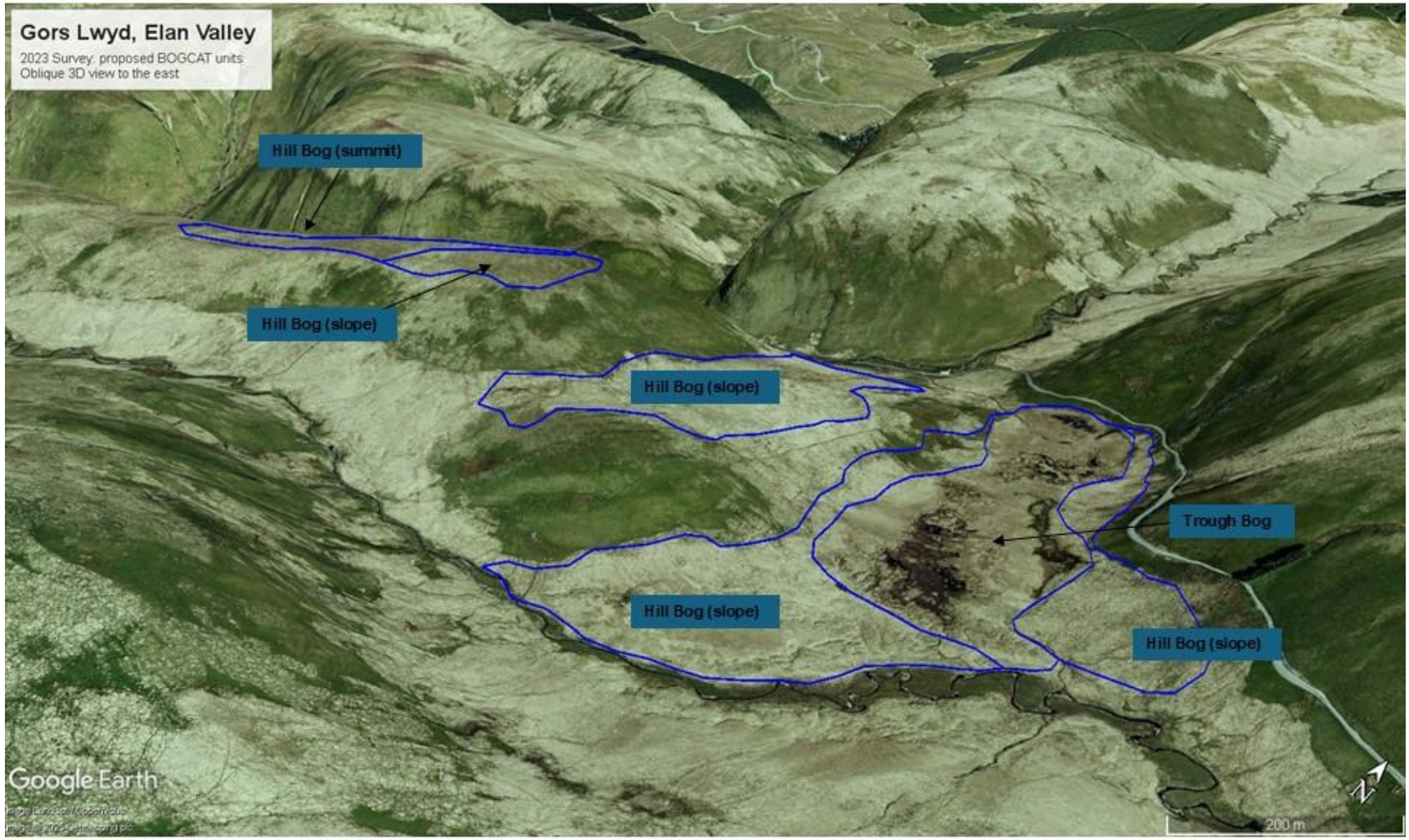
In terms of BOGCAT types, the valley bottom comprises a Trough Bog, whilst the hillsides and hilltop support Hill Bog.

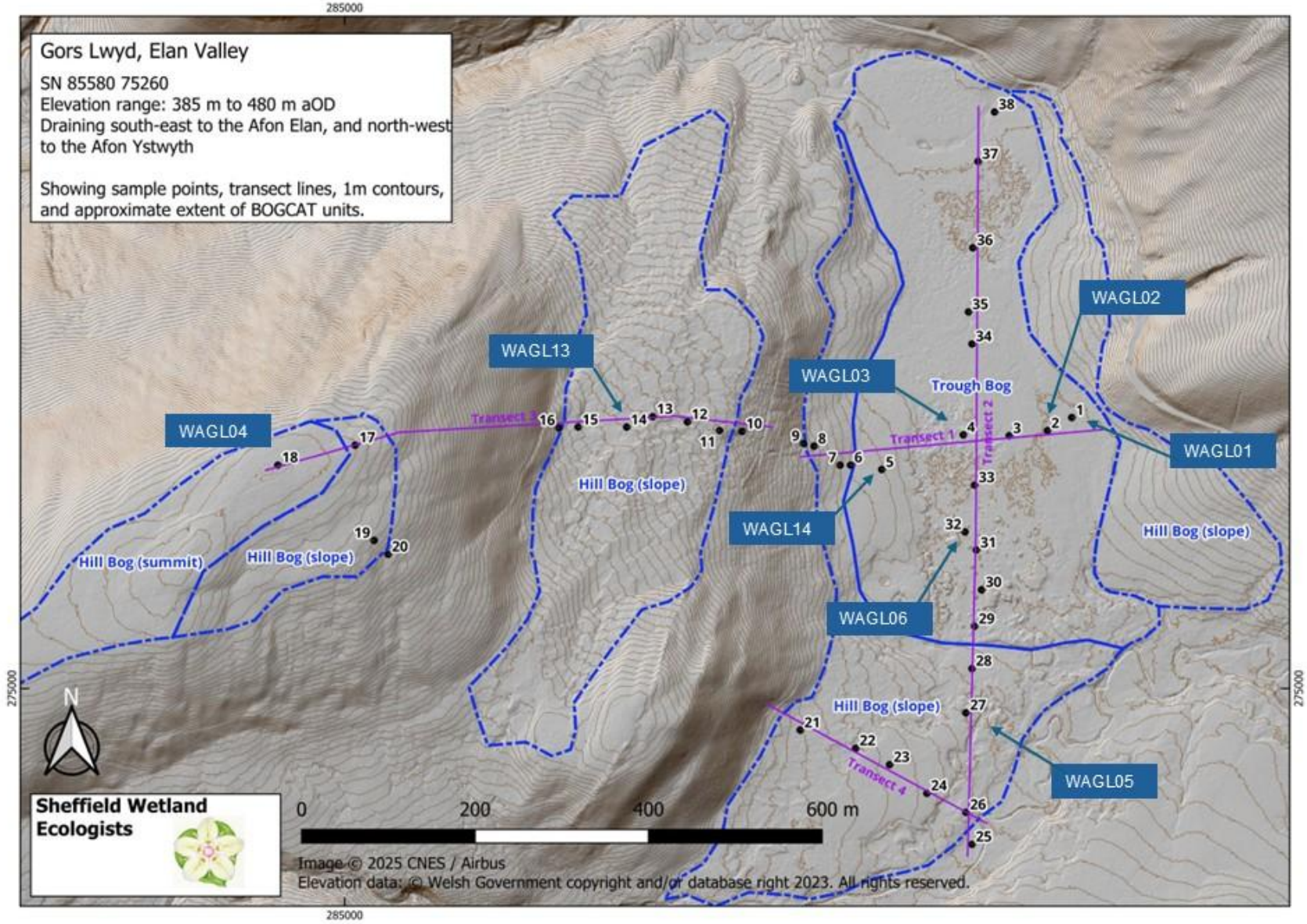
WETMECs:

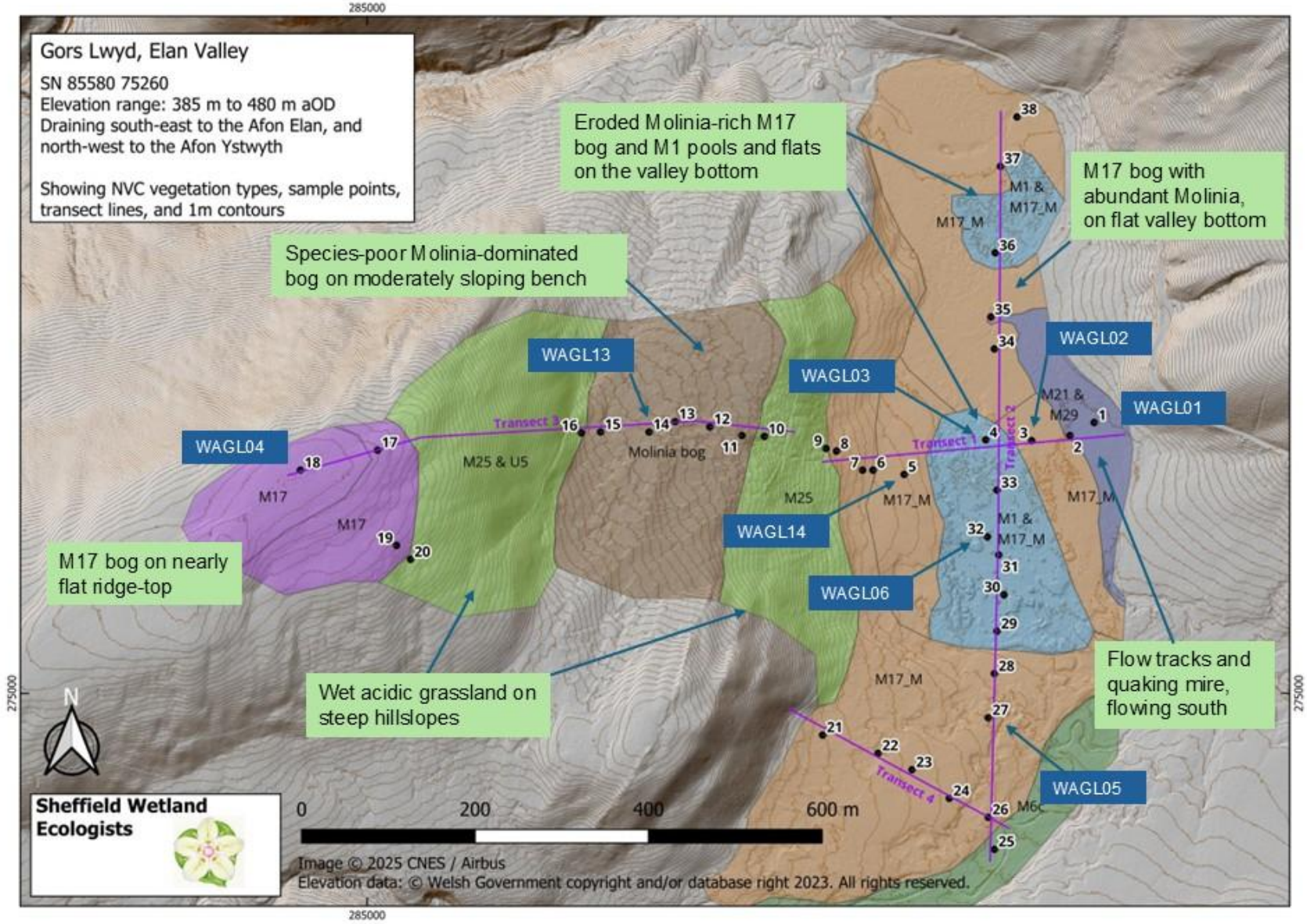
The valley floor mire consists of two areas of Eroded Crown at the northern and southern ends of the valley bottom. A strip of Ombrogenous Apron slopes down from the lower hillside to the southern Eroded Crown, while to the east of the Crown is a strip of Ombrotrophic Bottom, and then at the eastern edge of the valley floor is a broad strip of Water Flow Tracks. The hillside bogs mostly have Hill Peat Slope WETMECs, with a Slackening forming the crest of the hill to the west.

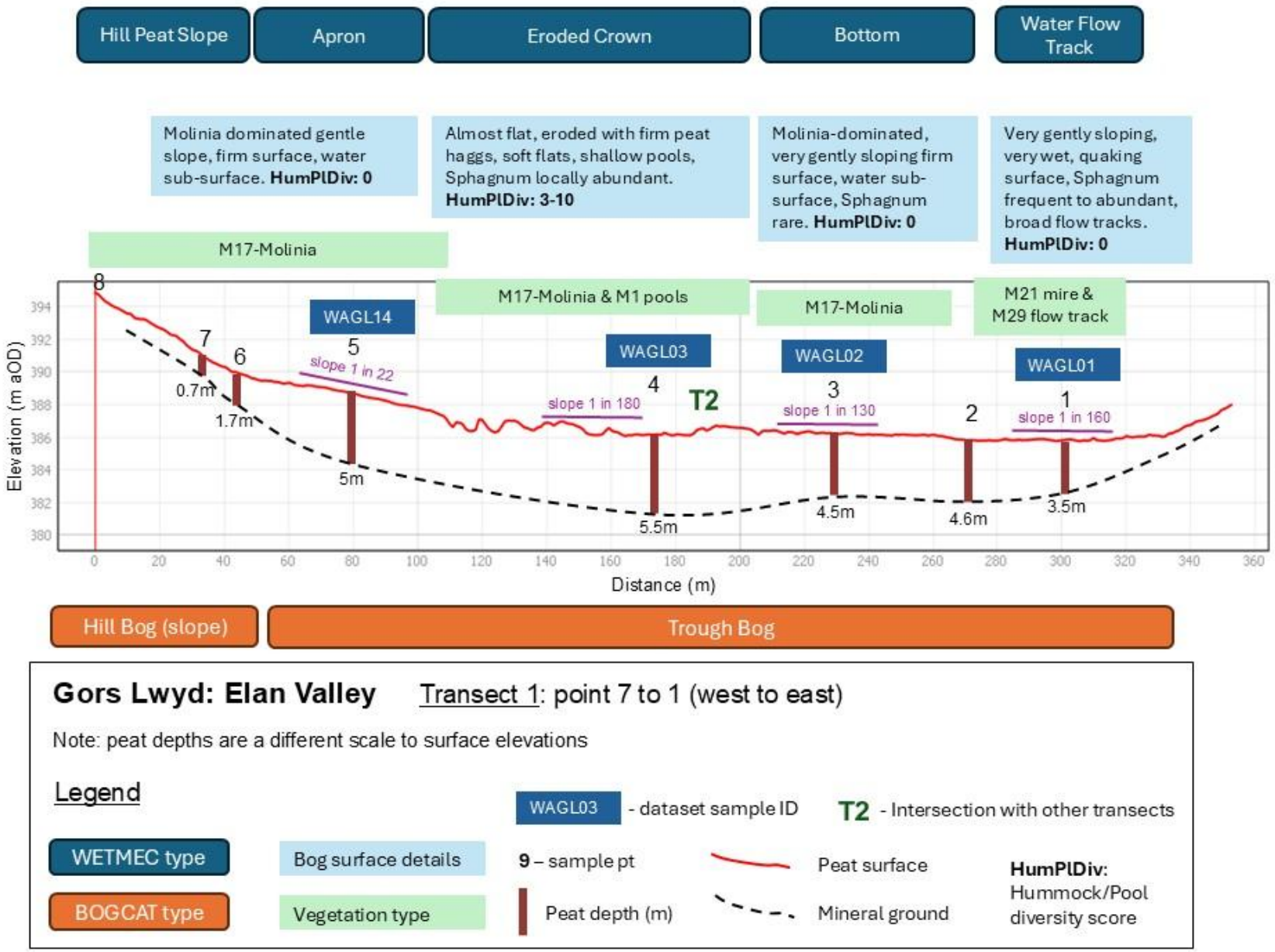

Gors Lwyd, Elan Valley
2025 Survey: proposed WETMEC units
Oblique 3D view to the north-west
Slackening (crest)
Hill Peat Slope
Hill Peat Slope
Eroded Crown
Water Flow Track
Apron
Bottom
Hill Peat Slope
Hill Peat Slope
Water flow track
Eroded Crown
Google Earth
200 m

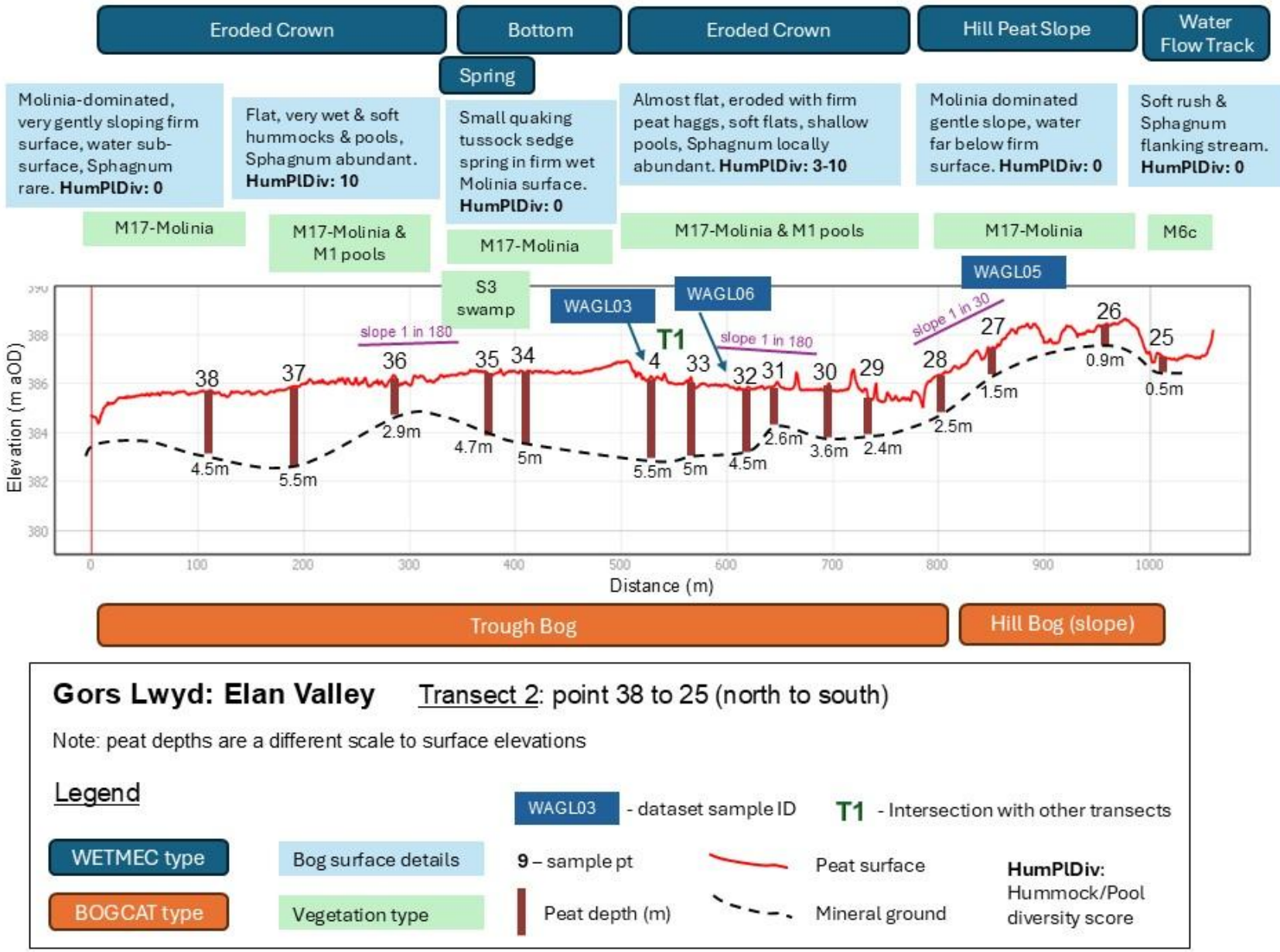

Gors Lwyd, Elan Valley
SN 85580 75260
Elevation range: 385 m to 480 m aOD
Draining south-east to the Afon Elan, and north-west to the Afon Ystwyth
Showing sample points, transect lines, flow directions, 1m contours, and approximate extent of WETMEC units.
285000
275000
N
WAGL13
WAGL04
WAGL03
WAGL01
WAGL02
WAGL14
WAGL06
WAGL05
Transect 3
Transect 1
Transect 2
Transect 4
Eroded Crown
Spring
Bottom
Water Flow Track
Hill Peat Slope
Apron
Slackening (crest)
Water flow track
Sheffield Wetland Ecologists
0
200
400
600 m
Image © 2025 CNES / Airbus
Elevation data: © Welsh Government copyright and/or database right 2023. All rights reserved.

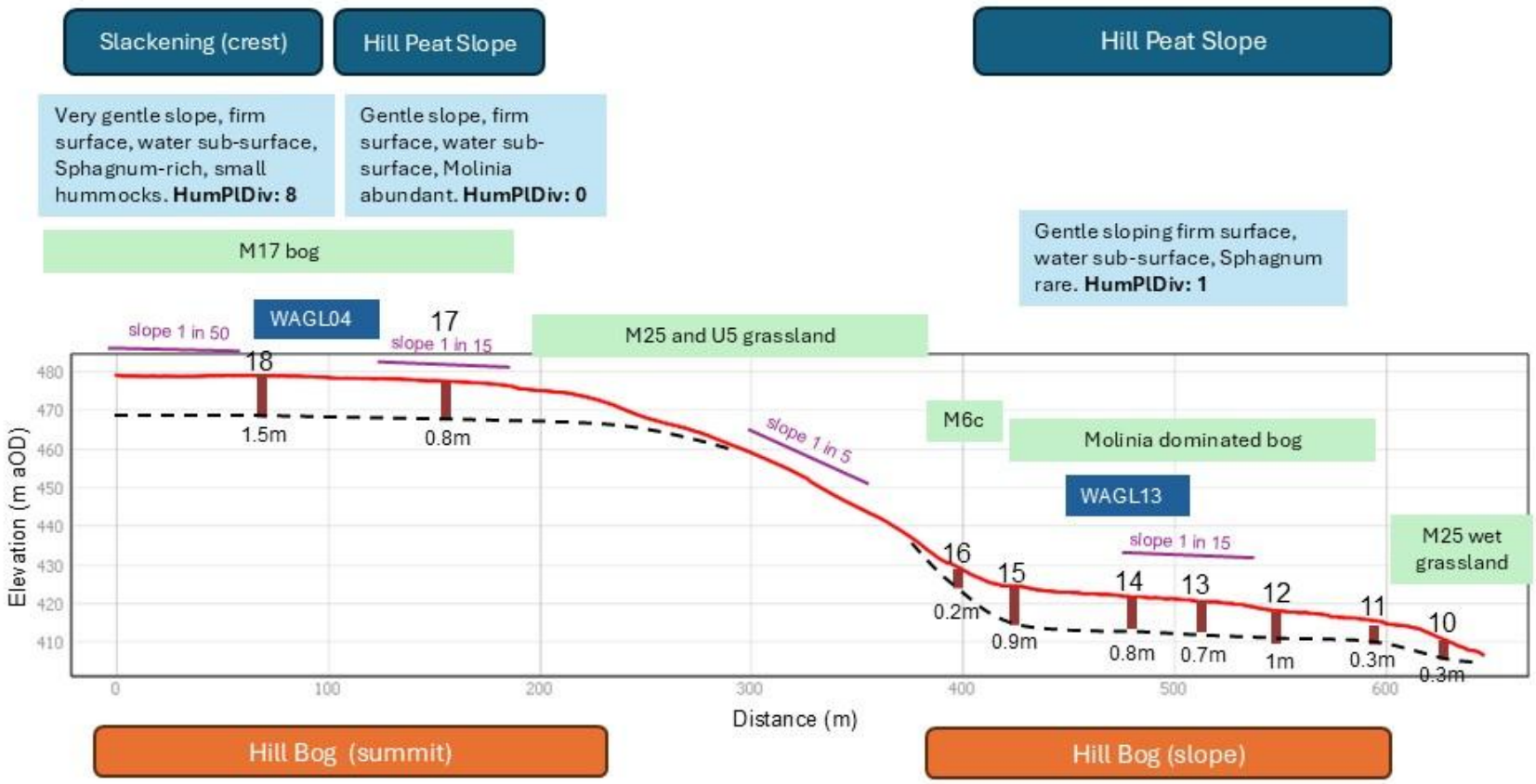

Gors Lwyd, Elan Valley
2023 Survey: proposed BOGCAT units
Oblique 3D view to the east
Hill Bog (summit)
Hill Bog (slope)
Hill Bog (slope)
Trough Bog
Hill Bog (slope)
Hill Bog (slope)
Google Earth
200 m


Gors Lwyd, Elan Valley
SN 85580 75260
Elevation range: 385 m to 480 m aOD
Draining south-east to the Afon Elan, and north-west to the Afon Ystwyth
Showing sample points, transect lines, 1m contours, and approximate extent of BOGCAT units.
285000
275000
WAGL01
WAGL02
WAGL03
WAGL04
WAGL05
WAGL06
WAGL13
WAGL14
Trough Bog
Transect 1
Transect 2
Transect 3
Transect 4
Hill Bog (slope)
Hill Bog (summit)
N
0
200
400
600 m
Sheffield Wetland Ecologists
Image © 2025 CNES / Airbus
Elevation data: © Welsh Government copyright and/or database right 2023. All rights reserved.


Gors Lwyd, Elan Valley
SN 85580 75260
Elevation range: 385 m to 480 m aOD
Draining south-east to the Afon Elan, and north-west to the Afon Ystwyth
Showing NVC vegetation types, sample points, transect lines, and 1m contours
Eroded Molinia-rich M17 bog and M1 pools and flats on the valley bottom
M17 bog with abundant Molinia, on flat valley bottom
Species-poor Molinia-dominated bog on moderately sloping bench
WAGL13
WAGL03
WAGL02
WAGL01
WAGL04
WAGL14
WAGL06
WAGL05
M17 bog on nearly flat ridge-top
Wet acidic grassland on steep hillslopes
Flow tracks and quaking mire, flowing south
Transect 1
Transect 2
Transect 3
Transect 4
Molinia bog
M25 & U5
M25
M17
M17_M
M1 & M17_M
M21 & M29
M6c
285000
275000
N
0
200
400
600 m
Sheffield Wetland Ecologists
Image © 2025 CNES / Airbus
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Hill Peat Slope
Apron
Eroded Crown
Bottom
Water Flow Track
Molinia dominated gentle slope, firm surface, water sub-surface. HumPlDiv: 0
Almost flat, eroded with firm peat haggs, soft flats, shallow pools, Sphagnum locally abundant. HumPlDiv: 3-10
Molinia-dominated, very gently sloping firm surface, water sub-surface, Sphagnum rare. HumPlDiv: 0
Very gently sloping, very wet, quaking surface, Sphagnum frequent to abundant, broad flow tracks. HumPlDiv: 0
M17-Molinia
M17-Molinia & M1 pools
M17-Molinia
M21 mire & M29 flow track
WAGL14
WAGL03
WAGL02
WAGL01
T2
slope 1 in 22
slope 1 in 180
slope 1 in 130
slope 1 in 160
0.7m
1.7m
5m
5.5m
4.5m
4.6m
3.5m
Elevation (m aOD)
Distance (m)
Hill Bog (slope)
Trough Bog
Gors Lwyd: Elan Valley
Transect 1: point 7 to 1 (west to east)
Note: peat depths are a different scale to surface elevations
Legend
WAGL03 - dataset sample ID
T2 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground


Eroded Crown
Bottom
Spring
Eroded Crown
Hill Peat Slope
Water Flow Track
Molinia-dominated, very gently sloping firm surface, water sub-surface, Sphagnum rare. HumPlDiv: 0
Flat, very wet & soft hummocks & pools, Sphagnum abundant. HumPlDiv: 10
Small quaking tussock sedge spring in firm wet Molinia surface. HumPlDiv: 0
Almost flat, eroded with firm peat haggs, soft flats, shallow pools, Sphagnum locally abundant. HumPlDiv: 3-10
Molinia dominated gentle slope, water far below firm surface. HumPlDiv: 0
Soft rush & Sphagnum flanking stream. HumPlDiv: 0
M17-Molinia
M17-Molinia & M1 pools
M17-Molinia
M17-Molinia & M1 pools
M17-Molinia
M6c
S3 swamp
WAGL03
WAGL06
WAGL05
T1
slope 1 in 180
slope 1 in 180
slope 1 in 30
38
37
36
35
34
4
33
32
31
30
29
28
27
26
25
4.5m
5.5m
2.9m
4.7m
5m
5.5m
5m
4.5m
2.6m
3.6m
2.4m
2.5m
1.5m
0.9m
0.5m
Elevation (m aOD)
Distance (m)
Trough Bog
Hill Bog (slope)
Gors Lwyd: Elan Valley
Transect 2: point 38 to 25 (north to south)
Note: peat depths are a different scale to surface elevations
Legend
WAGL03 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground



Gors Lwyd: Elan Valley Transect 3: point 18 to 10 (west to east)

Note: peat depths are a different scale to surface elevations

Legend

WAGL03 - dataset sample ID

T1 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

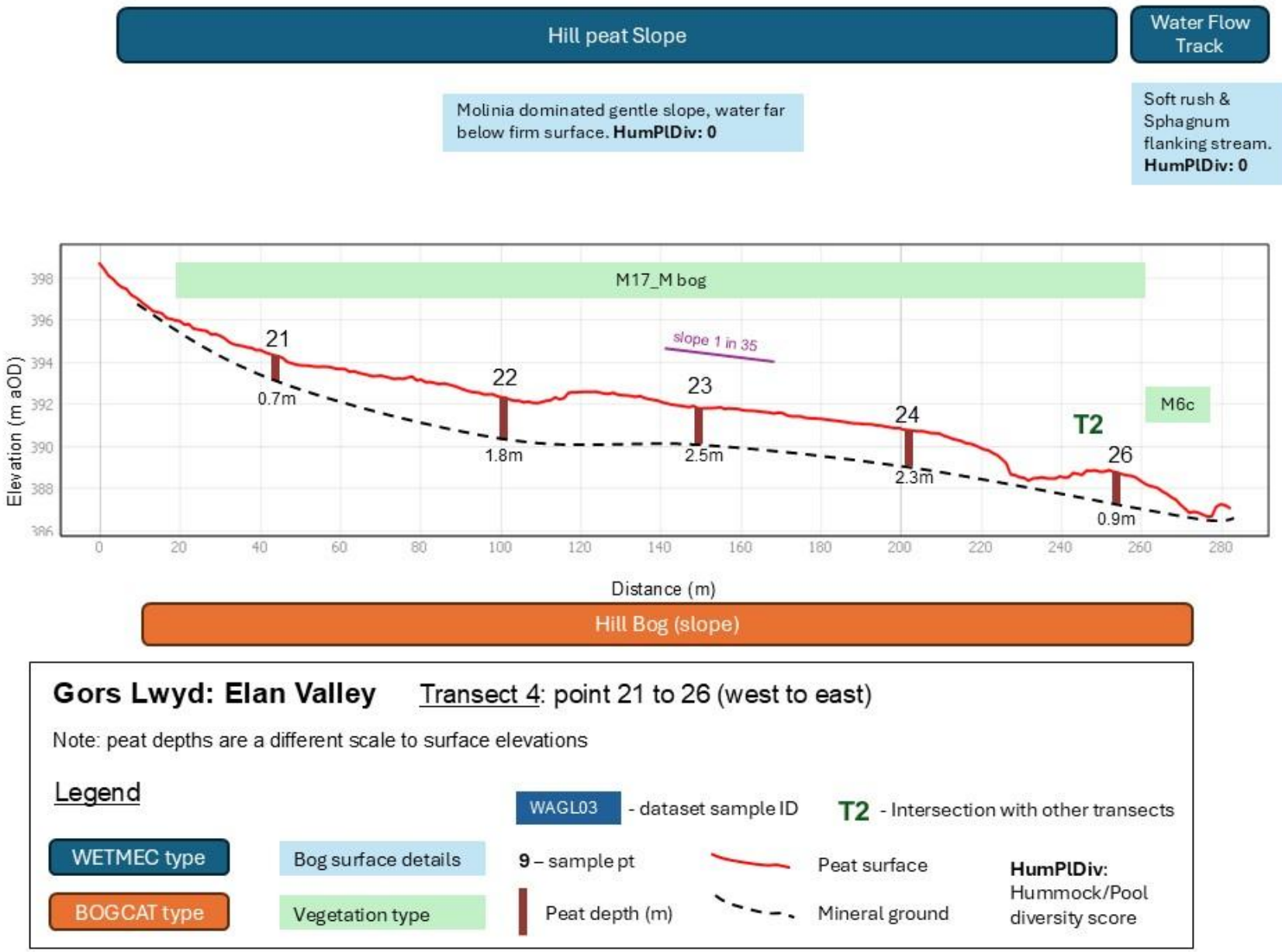
9 – sample pt

Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score


Hill peat Slope
Water Flow Track
Molinia dominated gentle slope, water far below firm surface. HumPlDiv: 0
Soft rush & Sphagnum flanking stream. HumPlDiv: 0
M17_M bog
slope 1 in 35
21
22
23
24
T2
26
0.7m
1.8m
2.5m
2.3m
0.9m
M6c
Elevation (m aOD)
Distance (m)
Hill Bog (slope)
Gors Lwyd: Elan Valley
Transect 4: point 21 to 26 (west to east)
Note: peat depths are a different scale to surface elevations
Legend
WAGL03 - dataset sample ID
T2 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground

17.2 Mynydd Llangatwc, Bannau Brycheiniog, South Wales

Mynydd Llangatwg Site Summary

The survey area is situated at SO 17880 15580, and comprises part of a broad, gently undulating plateau about 14 km to the north-east of Merthyr Tydfil, in the Bannau Brycheiniog (Brecon Beacons) National Park. The plateau supports a range of vegetation types: much of the flattest ground supports bog, with dry acidic grassland and fragments of dry heath on better drained low rocky ridges and small hills, strips of wet heath at the base of these slopes, and patches of acidic flushes following small watercourses. There are also several large solution hollows, some within areas of bog. The highest point within the survey area is in the north-west at about 510 m aOD, dropping to about 490 m aOD at the southern end. The area currently appears to be lightly grazed by sheep and ponies, with some evidence of recent burning.

In the north-western corner the bog is shallow (generally between 0.4 and 1 m deep), supporting species-poor purple moor-grass-dominated vegetation (Molinia-M17), with hare's-tail cottongrass, bilberry, crowberry, cross-leaved heath, and scattered *Sphagnum fallax, S. fimbriatum,* and *S. palustre*. The peat surface here is firm and rather dry, and the surface gradient is about 1 in 55 (<2%).

The bog surface slopes gently down to the south-east, and the bog expanse broadens to the north-east and south-west. The peat gradually deepens to about 5 m, and the vegetation becomes less dominated by purple moor-grass, changing to a fairly species-poor form of the M17 bog community, with large patches of bog asphodel, frequent cross-leaved heath, hare's-tail cottongrass, and deer-grass, and scattered Sphagnum. There are also a few narrow ditches that have been cut roughly north to south, feeding into a large gully along the south-western edge of the survey area. The peat surface is firm, the water table just sub-surface, and surface gradient is reduced to about 1 in 135 (<1%).

The bog surface flattens in the centre of the survey area and is marked by a series of shallow soakways that flow to the south-west and the north-east: in this part of the site the peat body forms a mound of deep peat about 400 m across, sloping to the south-west and to the north-east, situated over a small hollow in the underlying mineral ground. At the south-eastern edge of this is a small dome about 100 m across, which slopes down to a small lake (Pwll Gwy-rhoc) at the far eastern end of the survey area. Much of the bog in this part of the site has been burned in the past few years, with charcoal remains and frequent small patches of bare peat, but shows no sign of significant erosion, and the vegetation remains a form of M17. The peat surface is firm, the water table just sub-surface, and at its deepest the peat reaches 6.2 m.

Mynydd Llangatwg Site Summary (continued)

The bog surface slopes gently down to the lake, which is edged by a 20 m-wide band of hare's-tail cottongrass with purple moor-grass, *Sphagnum cuspidatum*, and *Polytrichum commune* (M20-S). The peat remains deep right to the edge of the lake (4.7 m), and is presumed to extend beneath it, as peat blocks were visible in the water. It is possible that this marks a solution hollow in the limestone beneath the peat, that has caused the peat surface to subside and form a shallow lake.

The mounded part of the bog slopes north-eastwards down to the edge of a very deep, rocky-sided solution hollow, and soakways flow into it, marked by narrow strips of soft rushes (M6c). Another prominent rocky solution hollow is embedded in the south-western side of the bog. At the time of survey, the latter (about 100m across) comprised a bare stony base with a small stream flowing into it, but aerial images show it sometimes to be filled with water.

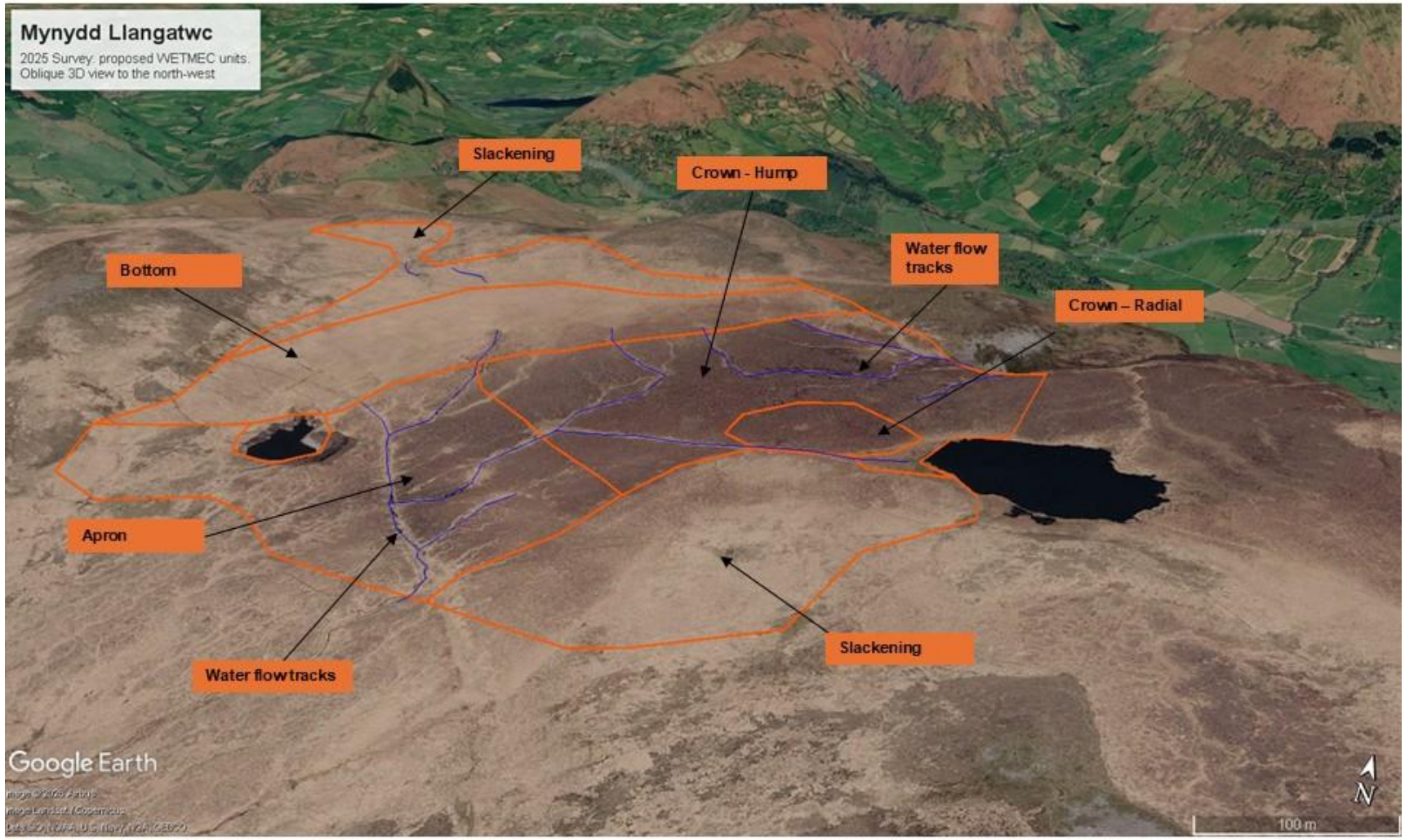
The south-western side of the peat mound slopes gently towards a broad erosion gully, into which soakways and ditches flow. The vegetation of the sloping peat is a species-poor form of M17, with a firm surface and sub-surface water table, a gradient of about 1 in 85 (just over 1%), and peat about 3.8 m deep. To the south-east the vegetation becomes purple moor-grass dominated, and it is presumed that it has a shallower layer of peat over more steeply sloping ground, though this was not examined. The gully itself (which may have been artificially straightened), along the south-western edge of the bog, is about 10 m wide and 2 m deep, with adjacent low haggs of bare peat about 0.5 m high along the edges, though these are mostly revegetated with M17 bog vegetation. The base of the gully has peat around 1.7m deep, and the surface has been colonised by purple moor-grass with frequent soft rush, *Sphagnum cuspidatum* and common cotton grass.

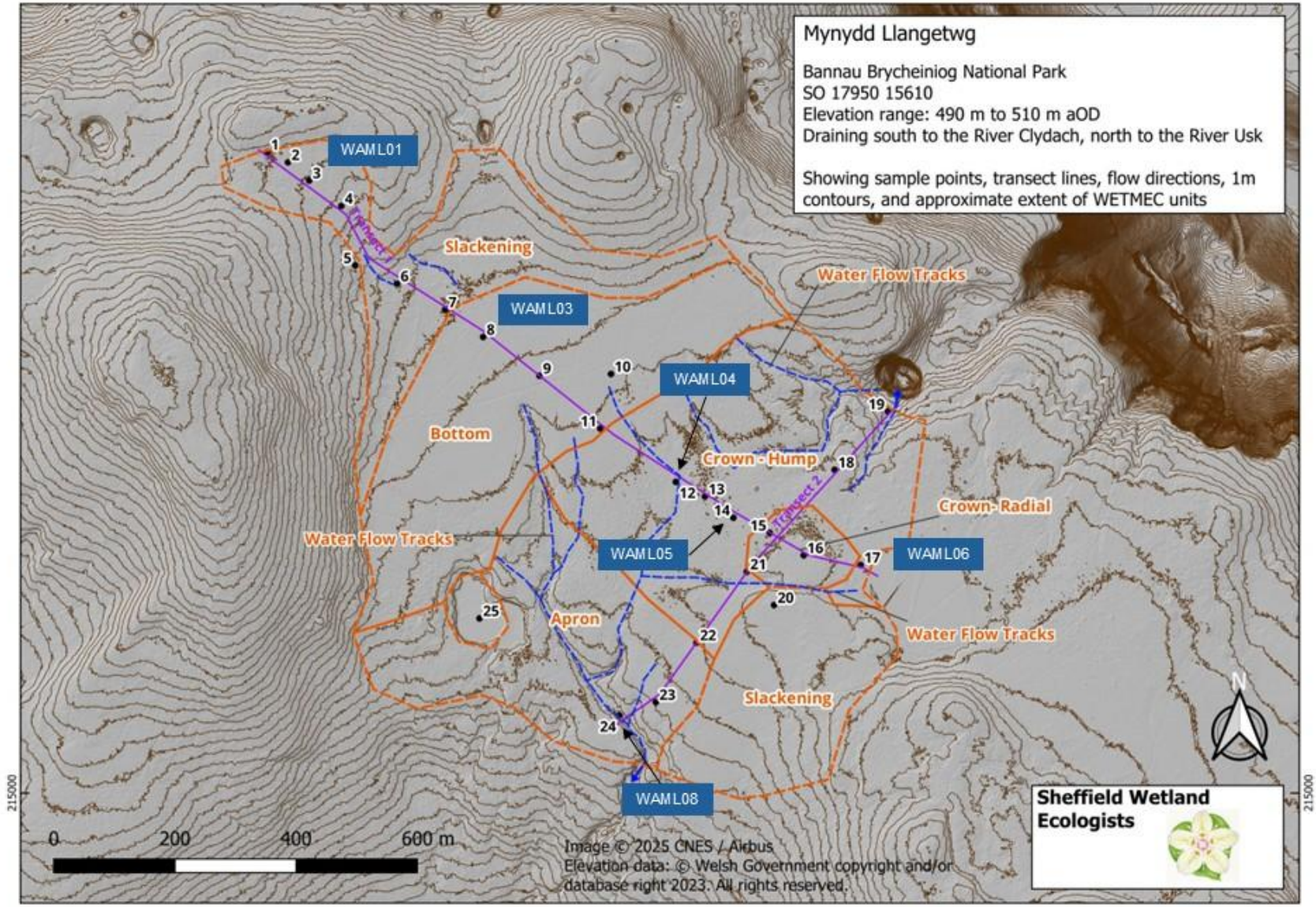
BOGCATs:

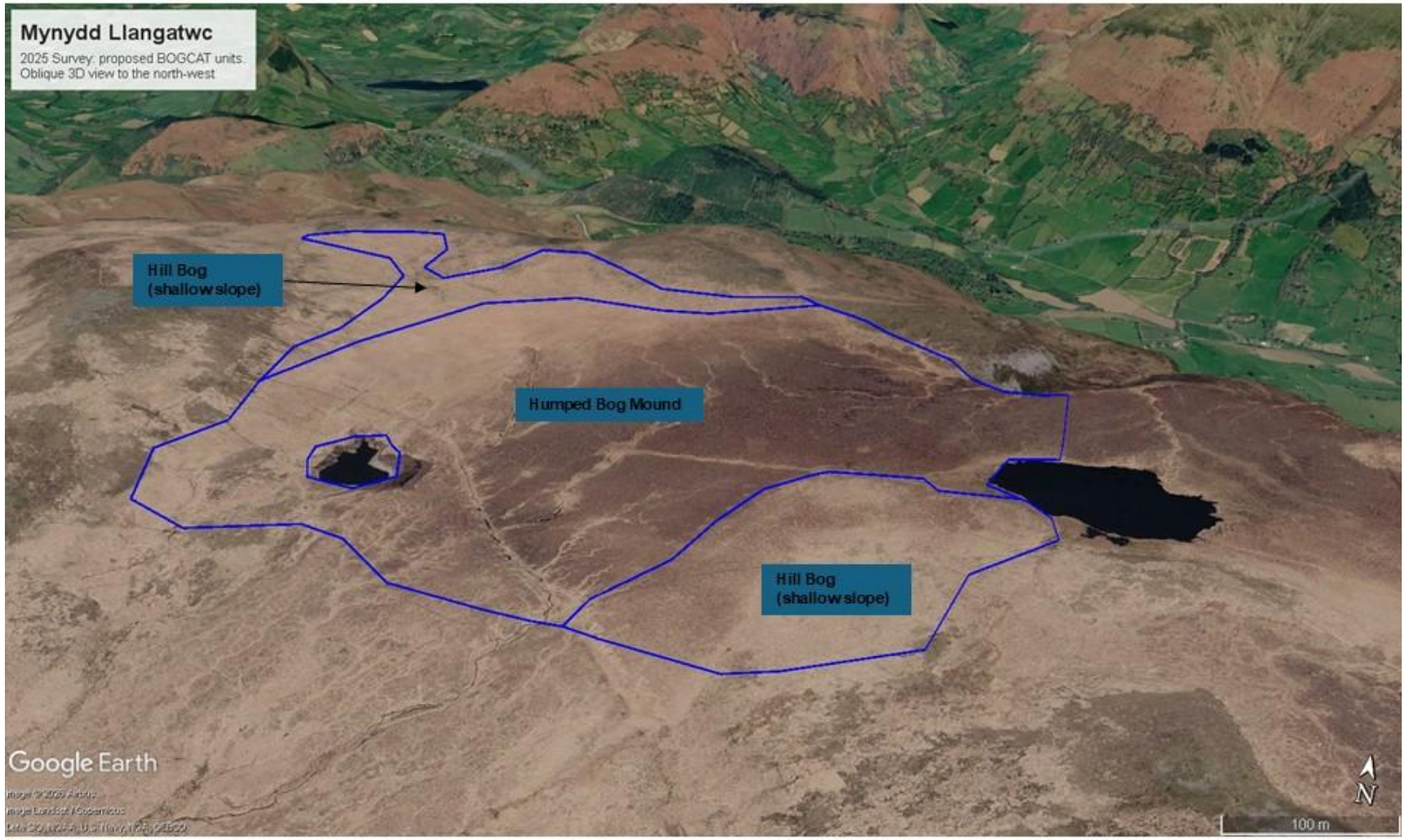
In terms of BOGCAT types, the main part of the survey area comprises a Humped Bog Mound, with flanking regions of Hill Bog on shallow slopes.

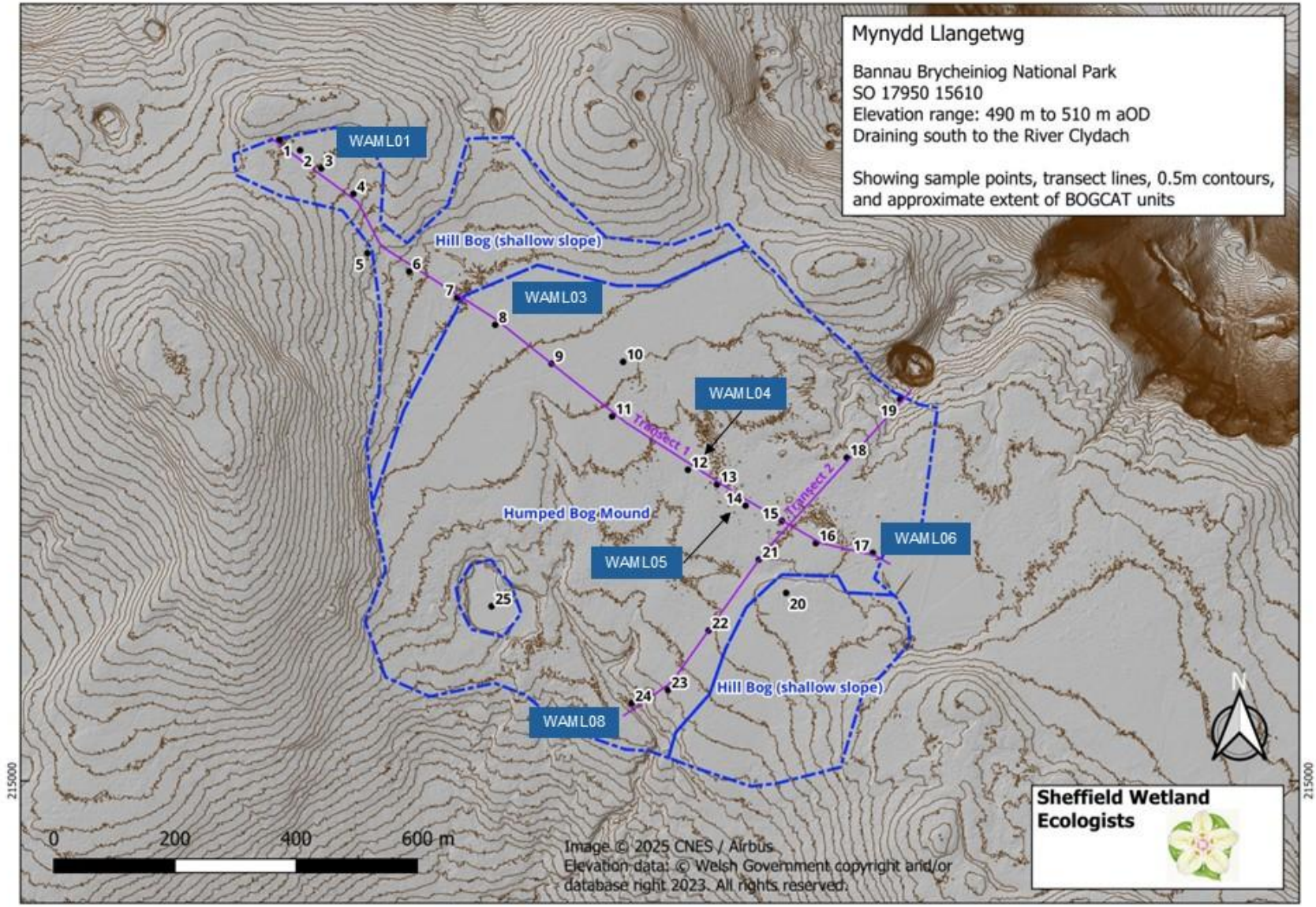
WETMECs:

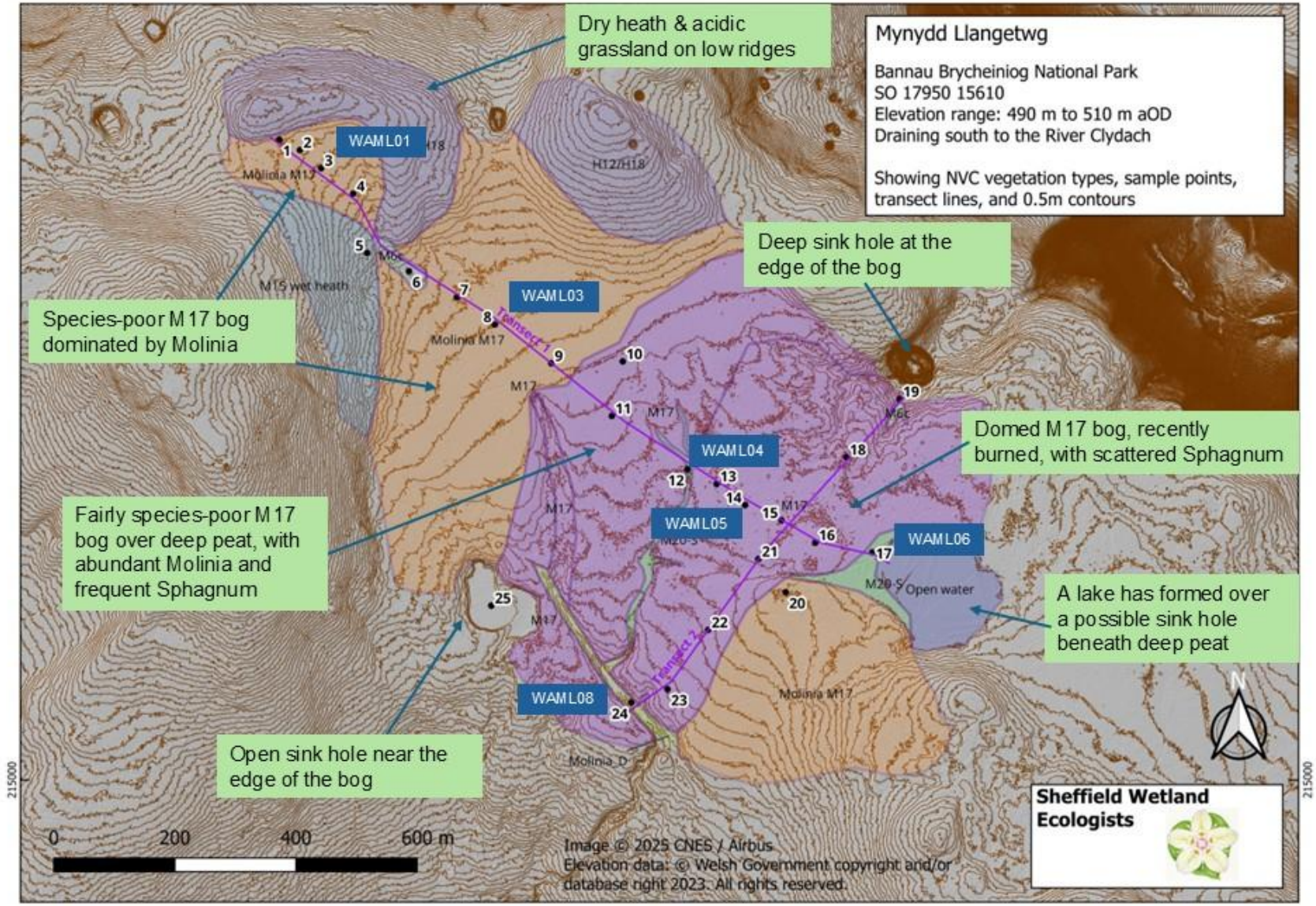
Much of the central part of the bog consists of a Hump Crown, with a small region of Radial Crown adjacent to the small lake. The long deep peat slope to the south-west of the Hump Crown is an Apron. The shallow peat slope to the north-west is a Slackening (also present to the south-east of the Hump Crown). Between the north-western Slackening and the Hump Crown, a very gentle slope of deep peat forms a Bottom.

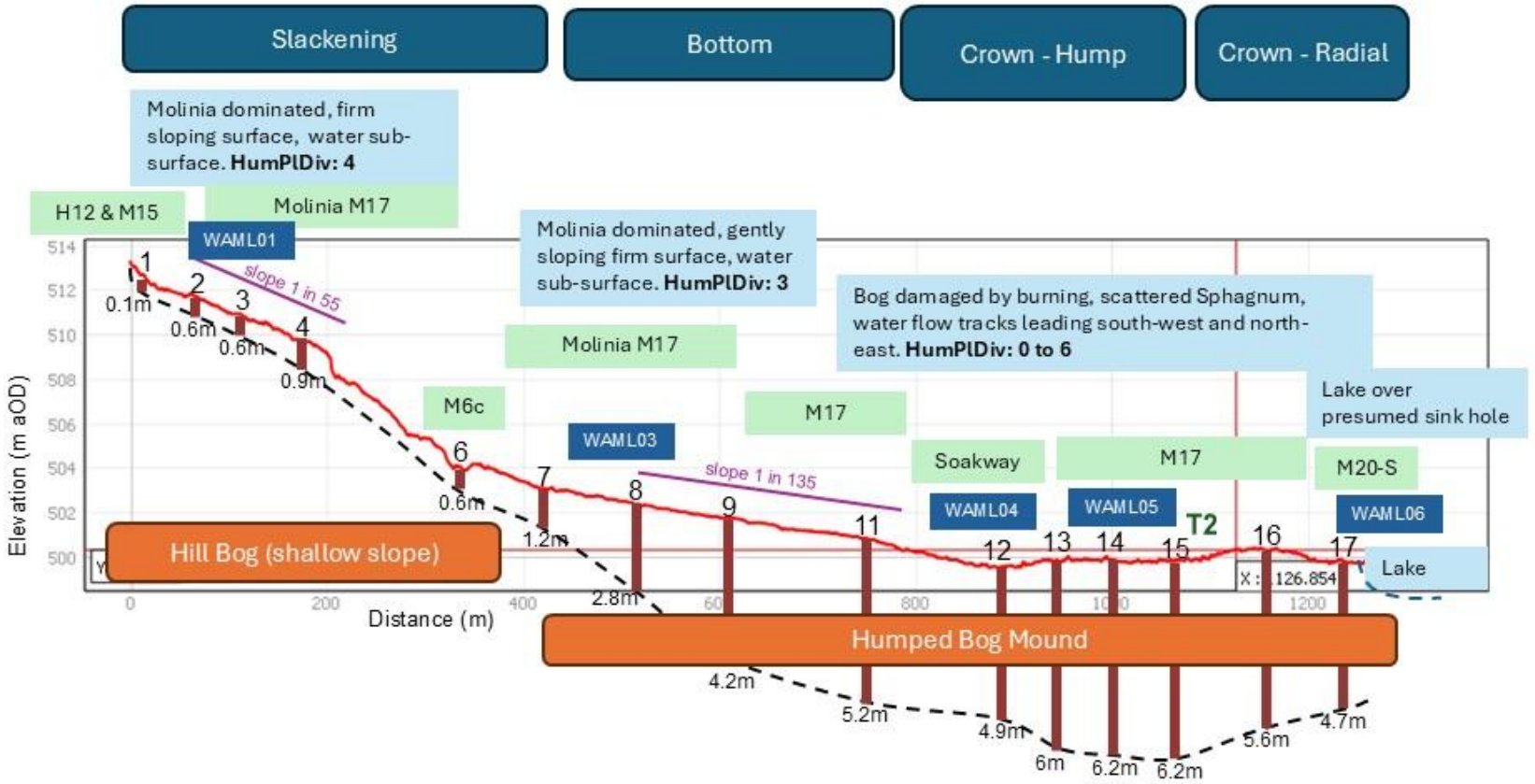

Mynydd Llangatwc
2025 Survey: proposed WETMEC units.
Oblique 3D view to the north-west
Slackening
Crown - Hump
Water flow tracks
Bottom
Crown – Radial
Apron
Slackening
Water flow tracks
Google Earth
N
100 m


Mynydd Llangetwg
Bannau Brycheiniog National Park
SO 17950 15610
Elevation range: 490 m to 510 m aOD
Draining south to the River Clydach, north to the River Usk
Showing sample points, transect lines, flow directions, 1m contours, and approximate extent of WETMEC units
WAML01
WAML03
WAML04
WAML05
WAML06
WAML08
Transect 1
Transect 2
Slackening
Water Flow Tracks
Bottom
Crown - Hump
Crown - Radial
Apron
Water Flow Tracks
Water Flow Tracks
Slackening
N
0
200
400
600 m
Image © 2025 CNES / Airbus
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Sheffield Wetland Ecologists
215000
215000


Mynydd Llangatwc
2025 Survey: proposed BOGCAT units.
Oblique 3D view to the north-west
Hill Bog
(shallow slope)
Humped Bog Mound
Hill Bog
(shallow slope)
Google Earth
N
100 m


Mynydd Llangetwg
Bannau Brycheiniog National Park
SO 17950 15610
Elevation range: 490 m to 510 m aOD
Draining south to the River Clydach
Showing sample points, transect lines, 0.5m contours, and approximate extent of BOGCAT units
WAML01
WAML03
WAML04
WAML05
WAML06
WAML08
Hill Bog (shallow slope)
Humped Bog Mound
Transect 1
Transect 2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
N
0
200
400
600 m
215000
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Dry heath & acidic grassland on low ridges
Mynydd Llangetwg
Bannau Brycheiniog National Park
SO 17950 15610
Elevation range: 490 m to 510 m aOD
Draining south to the River Clydach
Showing NVC vegetation types, sample points, transect lines, and 0.5m contours
Deep sink hole at the edge of the bog
Species-poor M17 bog dominated by Molinia
Domed M17 bog, recently burned, with scattered Sphagnum
Fairly species-poor M17 bog over deep peat, with abundant Molinia and frequent Sphagnum
A lake has formed over a possible sink hole beneath deep peat
Open sink hole near the edge of the bog
WAML01
WAML03
WAML04
WAML05
WAML06
WAML08
Transect 1
Transect 2
Molinia M17
M17
M15 wet heath
M20 S
Open water
Molinia D
H12/H18
215000
0
200
400
600 m
N
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Mynydd Llangatwg: Bannau Brycheiniog National Park

Transect 1: point 1 to 17 (north-west to south-east)

Note: peat depths are a different scale to surface elevations

Legend

SPRB03 - dataset sample ID

T2 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

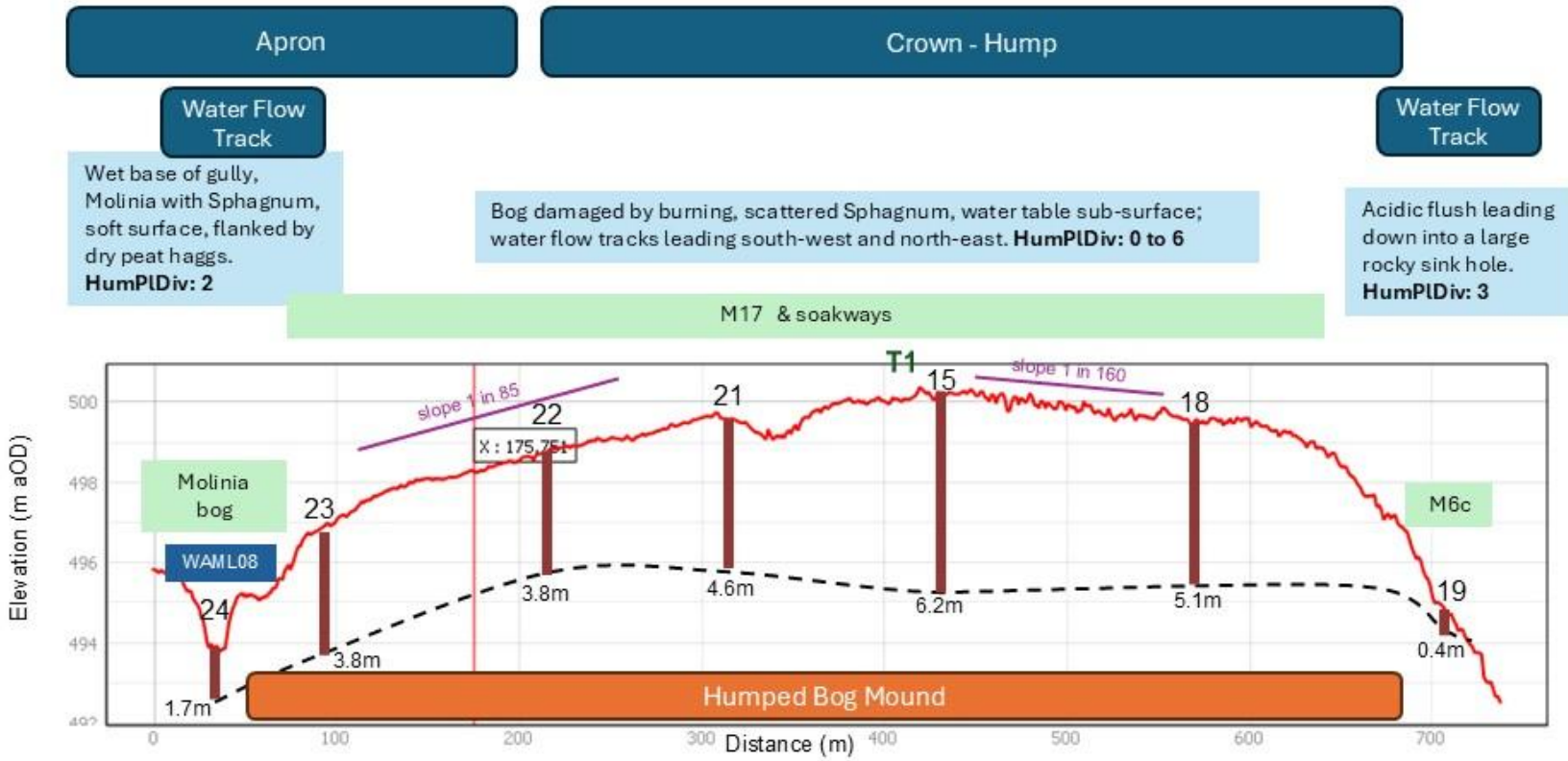
9 – sample pt

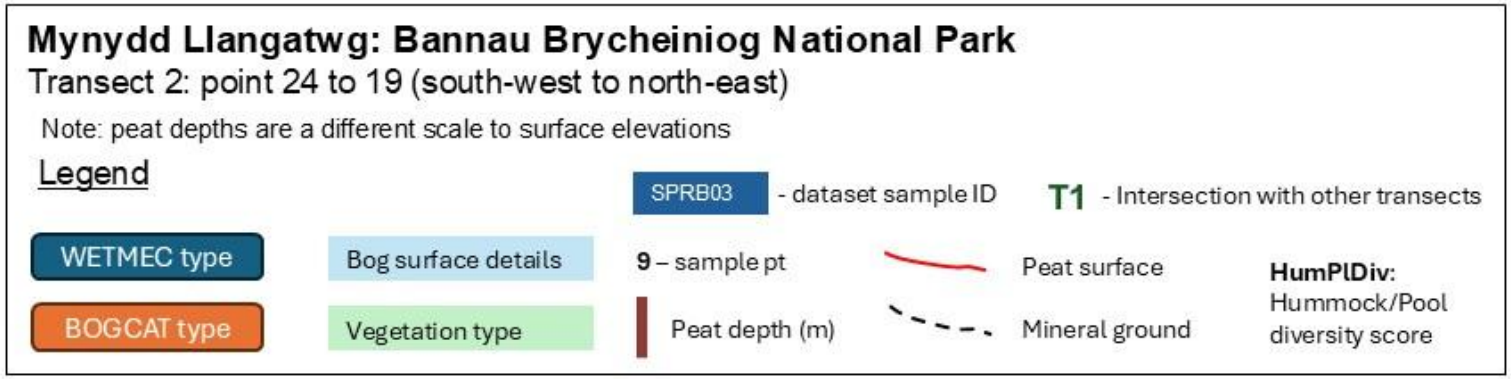
Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score


Apron
Crown - Hump
Water Flow Track
Water Flow Track
Wet base of gully, Molinia with Sphagnum, soft surface, flanked by dry peat haggs. HumPlDiv: 2
Bog damaged by burning, scattered Sphagnum, water table sub-surface; water flow tracks leading south-west and north-east. HumPlDiv: 0 to 6
Acidic flush leading down into a large rocky sink hole. HumPlDiv: 3
M17 & soakways
Elevation (m aOD)
500
498
496
494
slope 1 in 85
slope 1 in 160
T1
15
21
22
18
X : 175,751
Molinia bog
23
M6c
WAML08
24
19
3.8m
4.6m
6.2m
5.1m
0.4m
1.7m
3.8m
Humped Bog Mound
0
100
200
300
Distance (m)
400
500
600
700

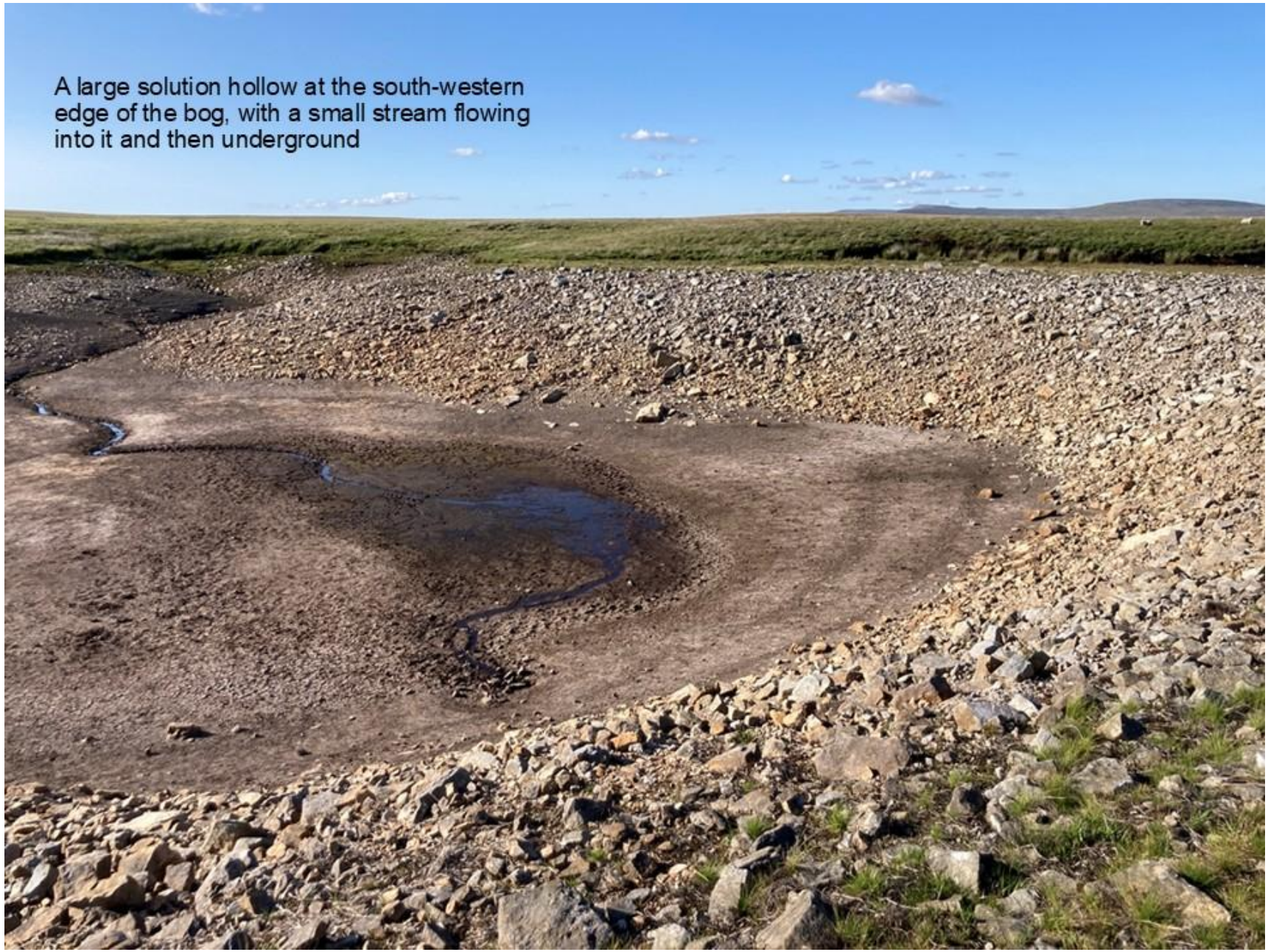

Mynydd Llangatwg: Bannau Brycheiniog National Park
Transect 2: point 24 to 19 (south-west to north-east)
Note: peat depths are a different scale to surface elevations
Legend
SPRB03 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground



View across the purple moor-grass-dominated bog plateau from dry heath slopes in the west, with the Pwll Gwy-rhoc lake in the background


A small Radial Crown over deep peat (6.2m), with
M17 vegetation that has recently been burned


A wet 'lagg' zone alongside the lake, presumed
to have formed over a solution hollow


A large solution hollow at the south-western edge of the bog, with a small stream flowing into it and then underground

17.3 Waun Wen, Bannau Brycheiniog, South Wales

Waun Wen Site Summary

Waun Wen is situated at SO 02860 14800 in the Bannau Brecheiniog (Brecon Beacons) National Park, and consists of a broad, gently sloping western spur of a long ridge that runs from the summit, Pen y Fan, 6 km to the north, to the town of Merthyr Tudfil, 6 km to the south. Streams that drain from the spur flow south-west into the Afon Taf Fawr, which flows southwards to discharge to the sea at Penarth. The spur of Waun Wen is mainly covered with bog habitat, with smaller areas of wet grassland on steeper ground, occasional patches of acidic flush, and a conifer plantation on the lower south-western slopes. The highest point of the spur, on the top of the ridge to the north-east, is at 528 m aOD, dropping to about 415 m aOD at the boundary of the conifer plantation in the south-west. The site is grazed by sheep, and has suffered widespread erosion, with deep gullies on steeper slopes, shallow gullies and channels on flatter ground. Some areas of eroded bog have been subject to recent restoration works, with smaller erosion channels blocked by wooden dams, larger ones with peat dams.

Peat on the upper slopes ranges from about 1 m deep on steeper ground, where there is very species-poor purple moor-grass-dominated bog (gradient 1 in 14, 7%), to about 2.6 m on gentler slopes (gradient 1 in 65, 1.5%), where the vegetation is slightly richer (M17-Molinia). In the richer areas amongst the purple moor-grass there is also much deer-grass, hare's-tail cottongrass, bilberry, cross-leaved heath, some heather, and scattered *Sphagnum cuspidatum*, *S. papillosum*, and *S. subnitens*. The peat surface is firm and rather dry, with neither tussocks nor hummocks or hollows, and the water table is sub-surface.

The spur slopes down to the south-west with a series of small steps or benches. These have flatter ground that supports richer M17 bog vegetation with reduced abundance of purple moor-grass and a good mix of typical species including heather, cross leaved heath, deer grass, hare's-tail cottongrass, common cotton grass, abundant *Sphagnum subnitens*, locally abundant *Sphagnum cuspidatum*, scattered *Sphagnum papillosum*, locally abundant sundews, and patchy *Hypnum jutlandicum*. Most of these flatter areas have peat depths of between 2 and 3 m depth, very gentle gradients (between 1 in 60 and 1 in 85, 1.2%), frequent low Sphagnum hummocks and small tussocks of deergrass and cottongrasses and generally have firm surfaces with water tables sub-surface.

Waun Wen Site Summary (continued)

A much larger bench is situated more-or-less in the centre of the spur, measuring about 400 m across. It is visible as a darker area of vegetation, partly because of its much-reduced cover of purple moor-grass, which is only present as low scattered tufts, and also the presence of some bare peat. Otherwise, it supports typical M17 vegetation. However, it differs from the other areas of flatter ground in that it has much deeper peat (>4 m) and has suffered quite severe erosion. The surface comprises a convoluted series of shallow erosion channels with bare peat, all of which have been recently blocked using wooden dams; consequently, the channels are now water-filled with colonising Sphagnum mosses and cottongrasses. The intervening ground is mostly covered with bog vegetation, with scattered low Sphagnum hummocks and small tussocks; the surface is firm, the water table sub-surface, and the slope is around 1 in 85 (1.2%). The channels join to form larger gullies at the edges of the bench, flowing out to the south, south-west, and south-east.

The more steeply sloping flanks of the spur mostly support dense Molinia bog on peat between 0.4 and 1.5 m deep, with gradients of between 1 in 10 and 1 in 20, firm and rather dry surfaces, and just a few scattered plants of deer-grass, hare's-tail cottongrass, bilberry, cross-leaved heath, and occasional patches of *Sphagnum fimbriatum* and *S. subnitens*. Although the purple moor-grass is usually dominant, it is rarely densely tussocky. The slopes are cut by many deep gullies (1 to 2 m deep) with total cover of purple moor-grass, which can be tussocky. In a few places the gully bottoms have patches of soft rushes (M6c), while some of the steepest slopes have wet acidic grassland (U6).

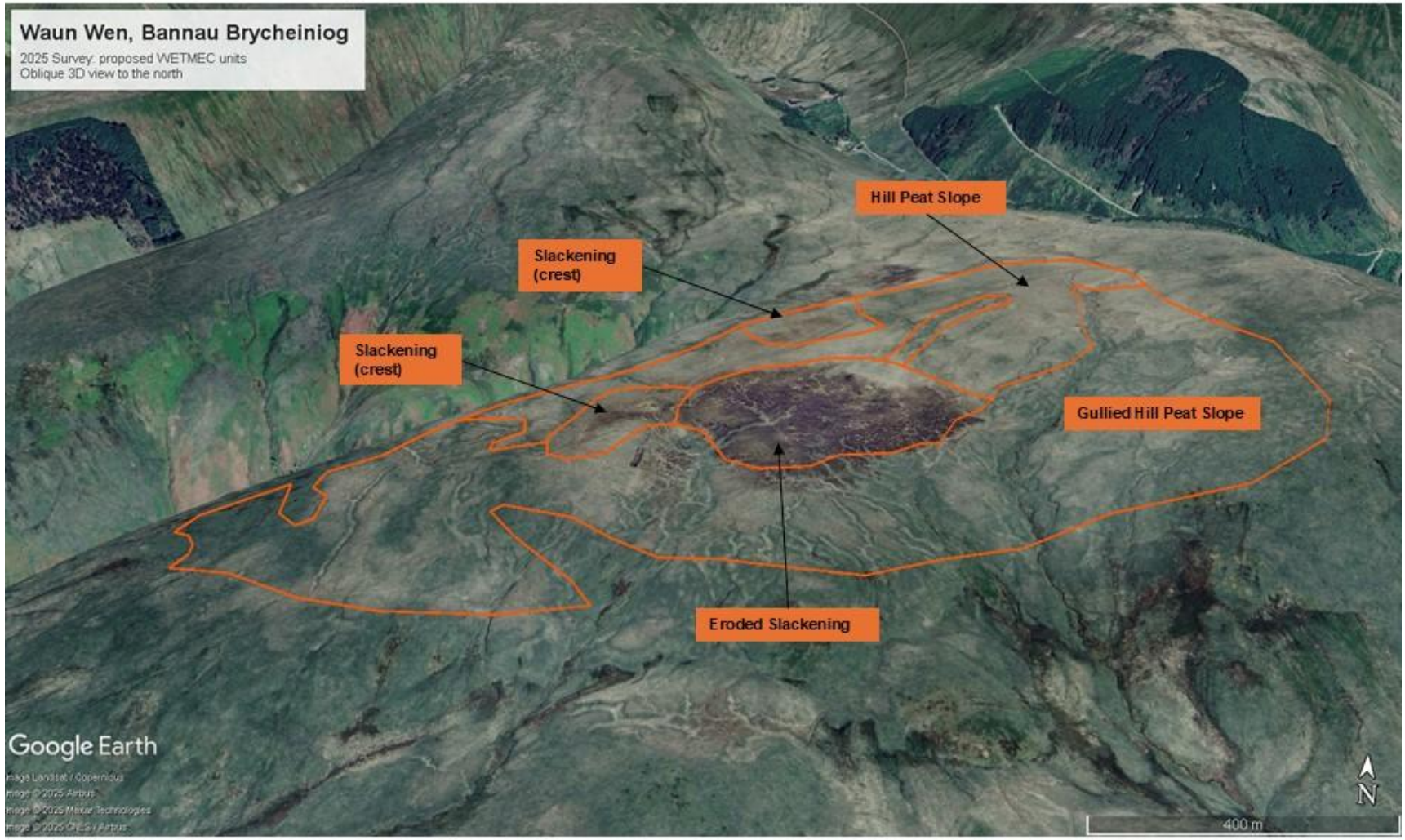
On the lower slopes the peat depths become much shallower (0.2 to 0.5 m) and the vegetation is a mixture of dense purple moor-grass and dense soft rushes, sloping down to a conifer plantation in the south-west.

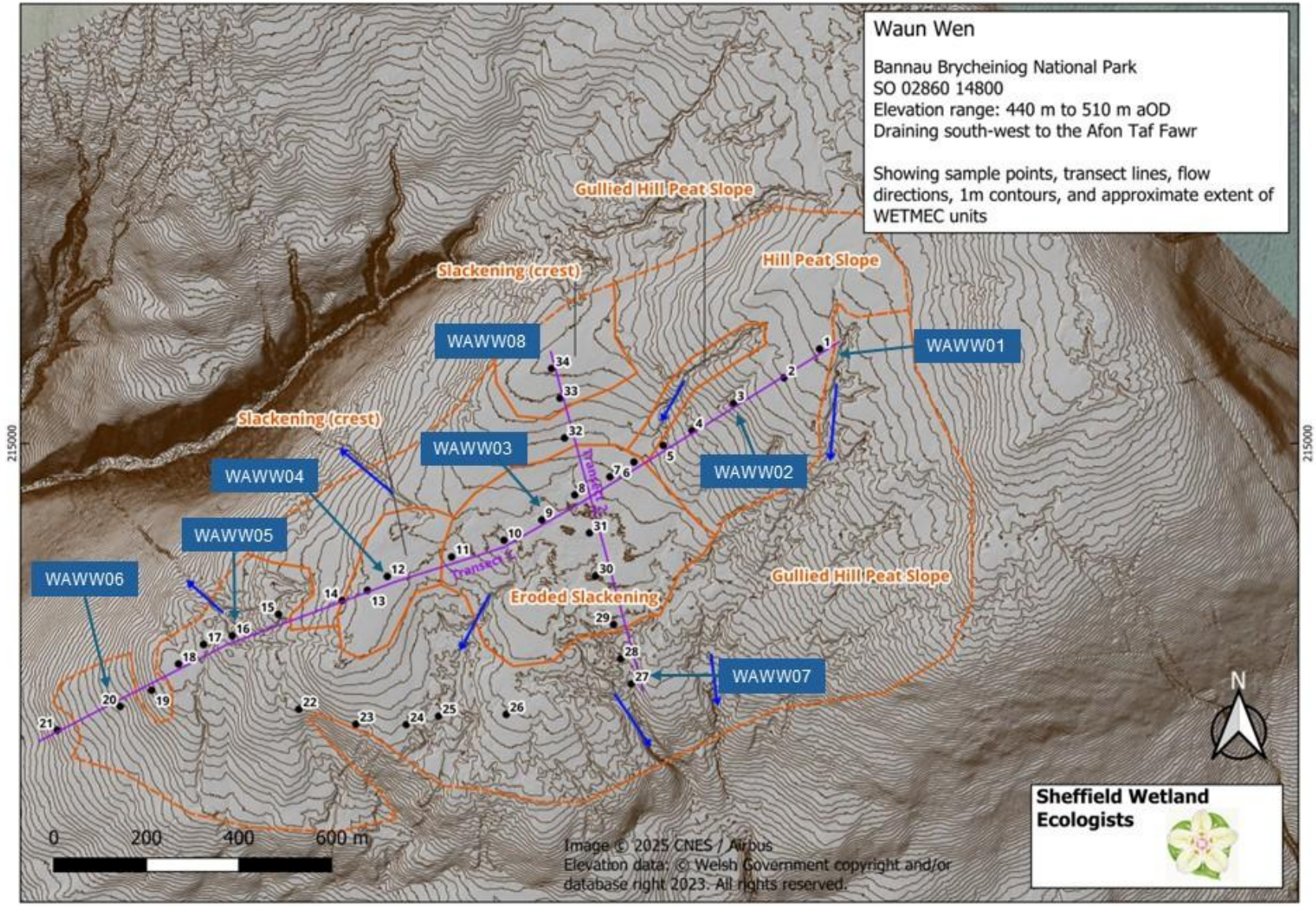
BOGCATs:

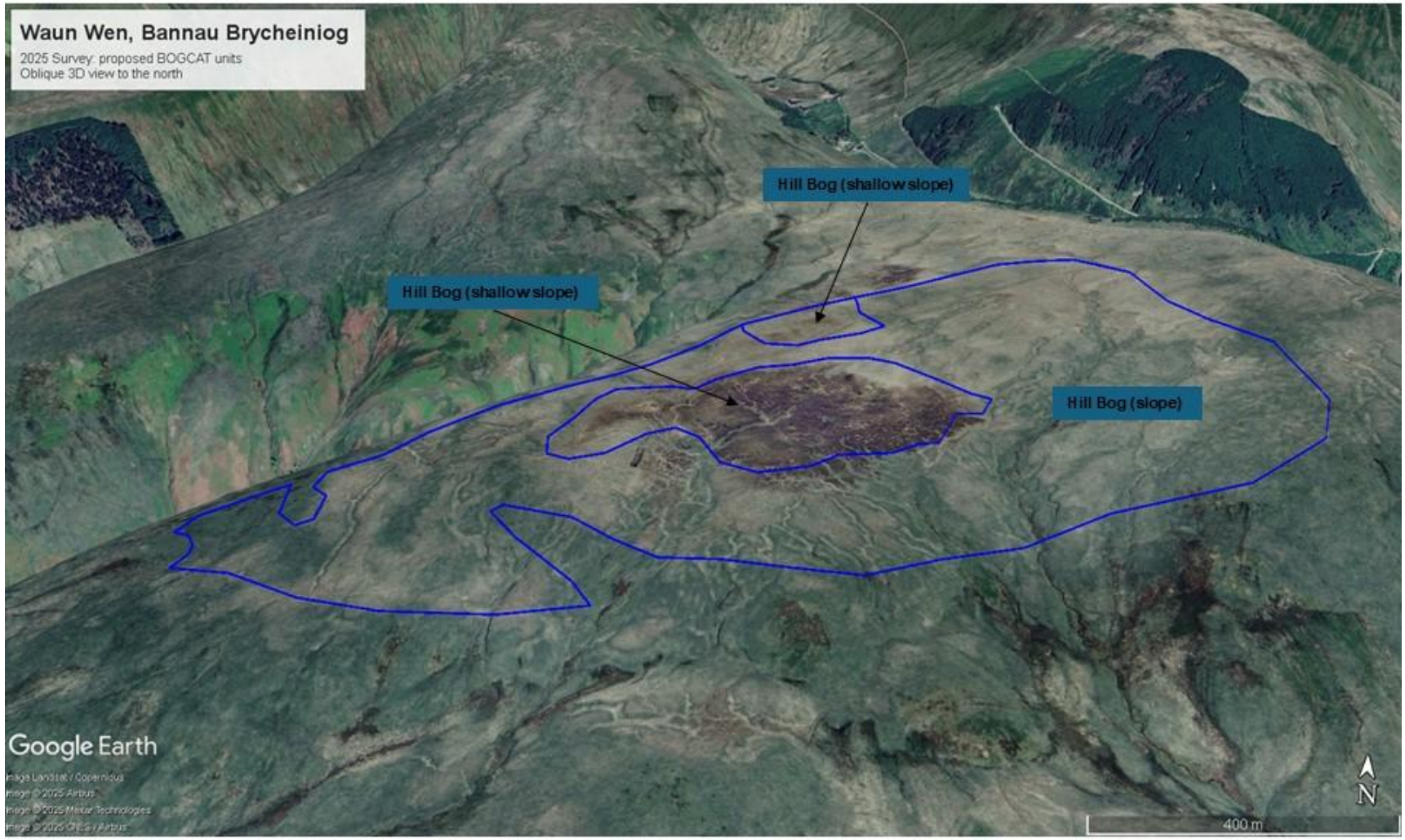
In terms of BOGCAT types, Waun Wen mostly consists of sloping Hill Bog, with several areas of shallow sloping Hill Bog.

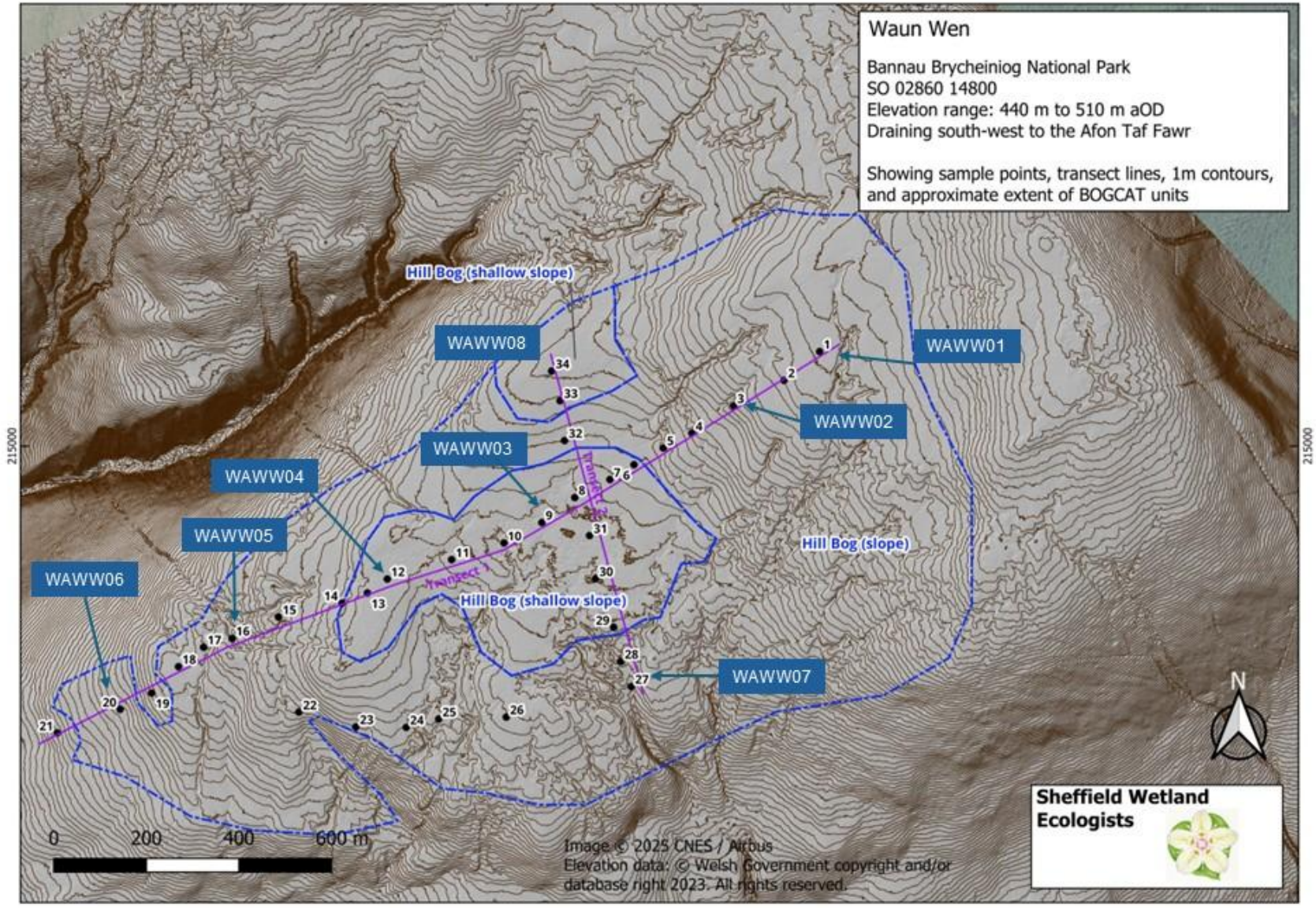
WETMECs:

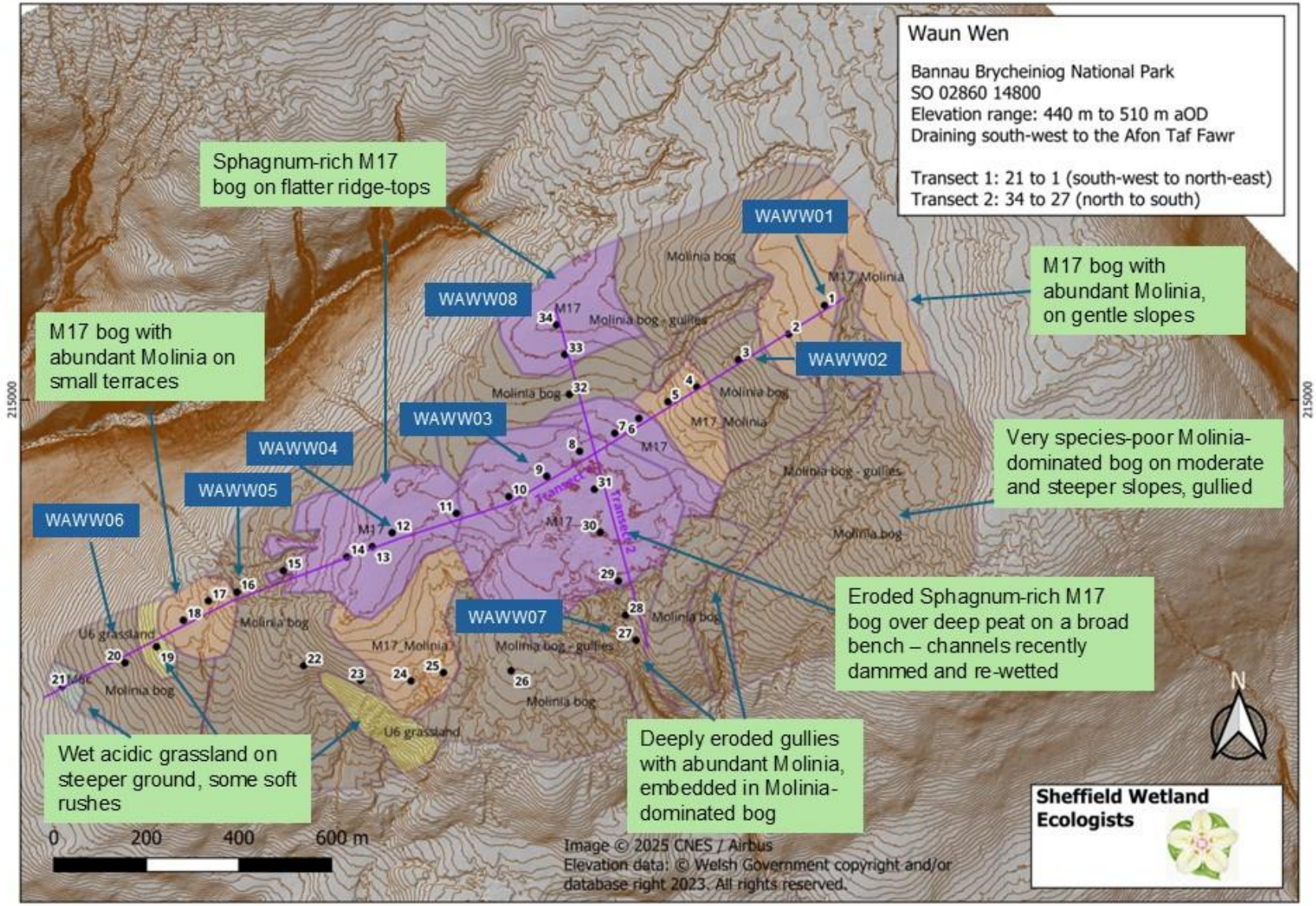
Much of Waun Wen comprises gullied Hill Peat Slopes, with small Slackenings, and a large area of eroded Slackening.

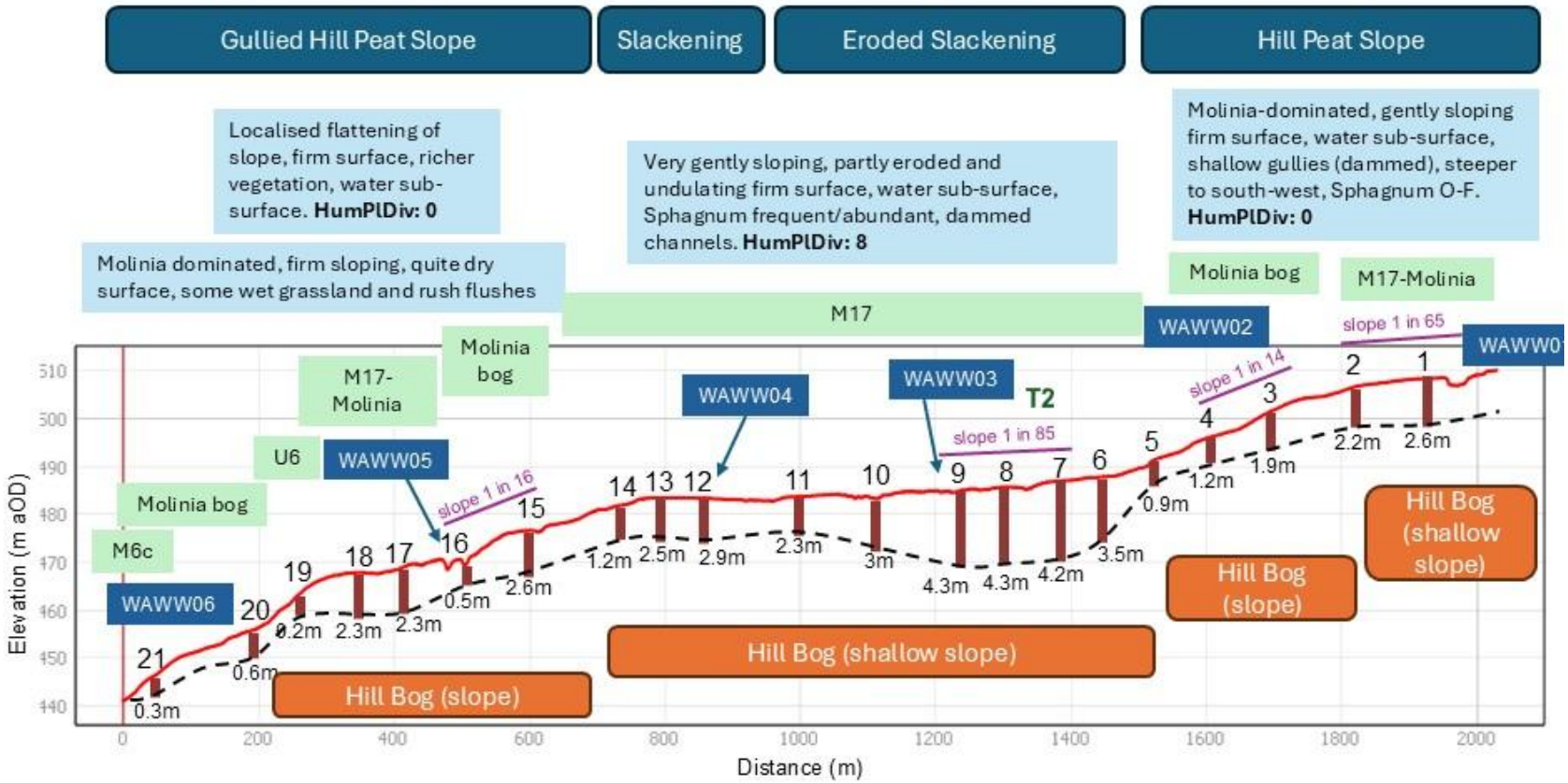

Waun Wen, Bannau Brycheiniog
2025 Survey: proposed WETMEC units
Oblique 3D view to the north
Hill Peat Slope
Slackening (crest)
Slackening (crest)
Gullied Hill Peat Slope
Eroded Slackening
Google Earth
400 m
N


Waun Wen
Bannau Brycheiniog National Park
SO 02860 14800
Elevation range: 440 m to 510 m aOD
Draining south-west to the Afon Taf Fawr
Showing sample points, transect lines, flow directions, 1m contours, and approximate extent of WETMEC units
Gullied Hill Peat Slope
Slackening (crest)
Hill Peat Slope
WAWW08
WAWW01
Slackening (crest)
WAWW03
WAWW04
WAWW02
WAWW05
WAWW06
Transect 1
Transect 2
Eroded Slackening
Gullied Hill Peat Slope
WAWW07
N
0
200
400
600 m
Image © 2025 CNES / Airbus
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215000
215000


Waun Wen, Bannau Brycheiniog
2025 Survey: proposed BOGCAT units
Oblique 3D view to the north
Hill Bog (shallow slope)
Hill Bog (shallow slope)
Hill Bog (slope)
Google Earth
400 m
N


Waun Wen
Bannau Brycheiniog National Park
SO 02860 14800
Elevation range: 440 m to 510 m aOD
Draining south-west to the Afon Taf Fawr
Showing sample points, transect lines, 1m contours, and approximate extent of BOGCAT units
Hill Bog (shallow slope)
WAWW08
WAWW01
WAWW02
WAWW03
WAWW04
WAWW05
WAWW06
WAWW07
Hill Bog (slope)
Hill Bog (shallow slope)
Transect 1
Transect 2
215000
215000
N
0
200
400
600 m
Image © 2025 CNES / Airbus
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Waun Wen
Bannau Brycheiniog National Park
SO 02860 14800
Elevation range: 440 m to 510 m aOD
Draining south-west to the Afon Taf Fawr
Transect 1: 21 to 1 (south-west to north-east)
Transect 2: 34 to 27 (north to south)
Sphagnum-rich M17 bog on flatter ridge-tops
M17 bog with abundant Molinia on small terraces
M17 bog with abundant Molinia, on gentle slopes
Very species-poor Molinia-dominated bog on moderate and steeper slopes, gullied
Eroded Sphagnum-rich M17 bog over deep peat on a broad bench – channels recently dammed and re-wetted
Deeply eroded gullies with abundant Molinia, embedded in Molinia-dominated bog
Wet acidic grassland on steeper ground, some soft rushes
WAWW01
WAWW02
WAWW03
WAWW04
WAWW05
WAWW06
WAWW07
WAWW08
Transect 1
Transect 2
M17
M17_Molinia
Molinia bog
Molinia bog - gullies
U6 grassland
215000
N
0
200
400
600 m
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Waun Wen: Bannau Brycheiniog Transect 1: point 21 to 1(SW to NE)

Note: peat depths are a different scale to surface elevations

Legend

WAGL03 - dataset sample ID

T2 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

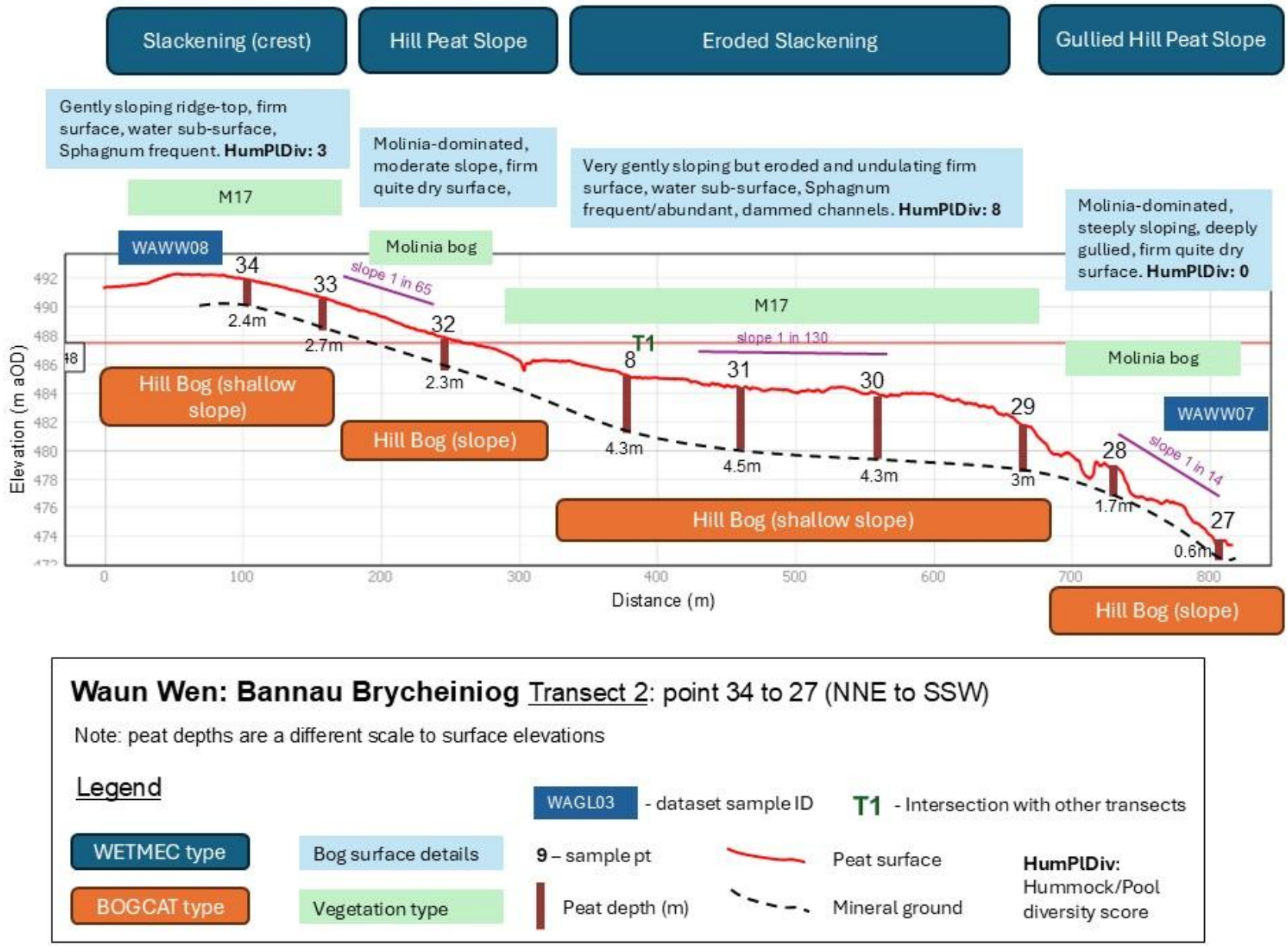
9 – sample pt

Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score



Waun Wen: Bannau Brycheiniog Transect 2: point 34 to 27 (NNE to SSW)

Note: peat depths are a different scale to surface elevations

Legend

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

WAGL03 - dataset sample ID

9 – sample pt

Peat depth (m)

T1 - Intersection with other transects

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score

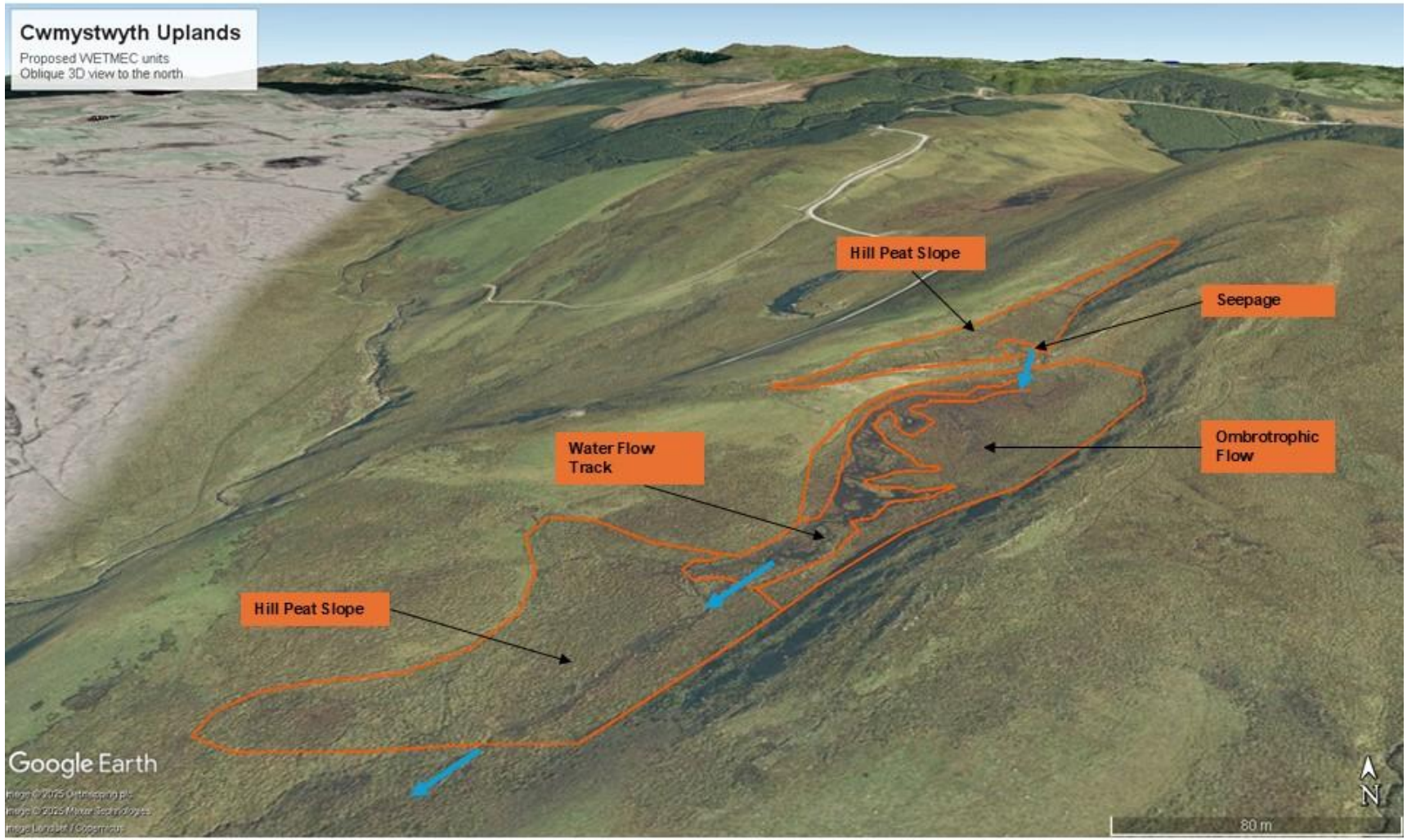

A broad, shallow gully near Point 1 (looking S) at the top of the slope has recently been blocked with peat dams. Peat is around 2m deep, purple moor-grass is dominant

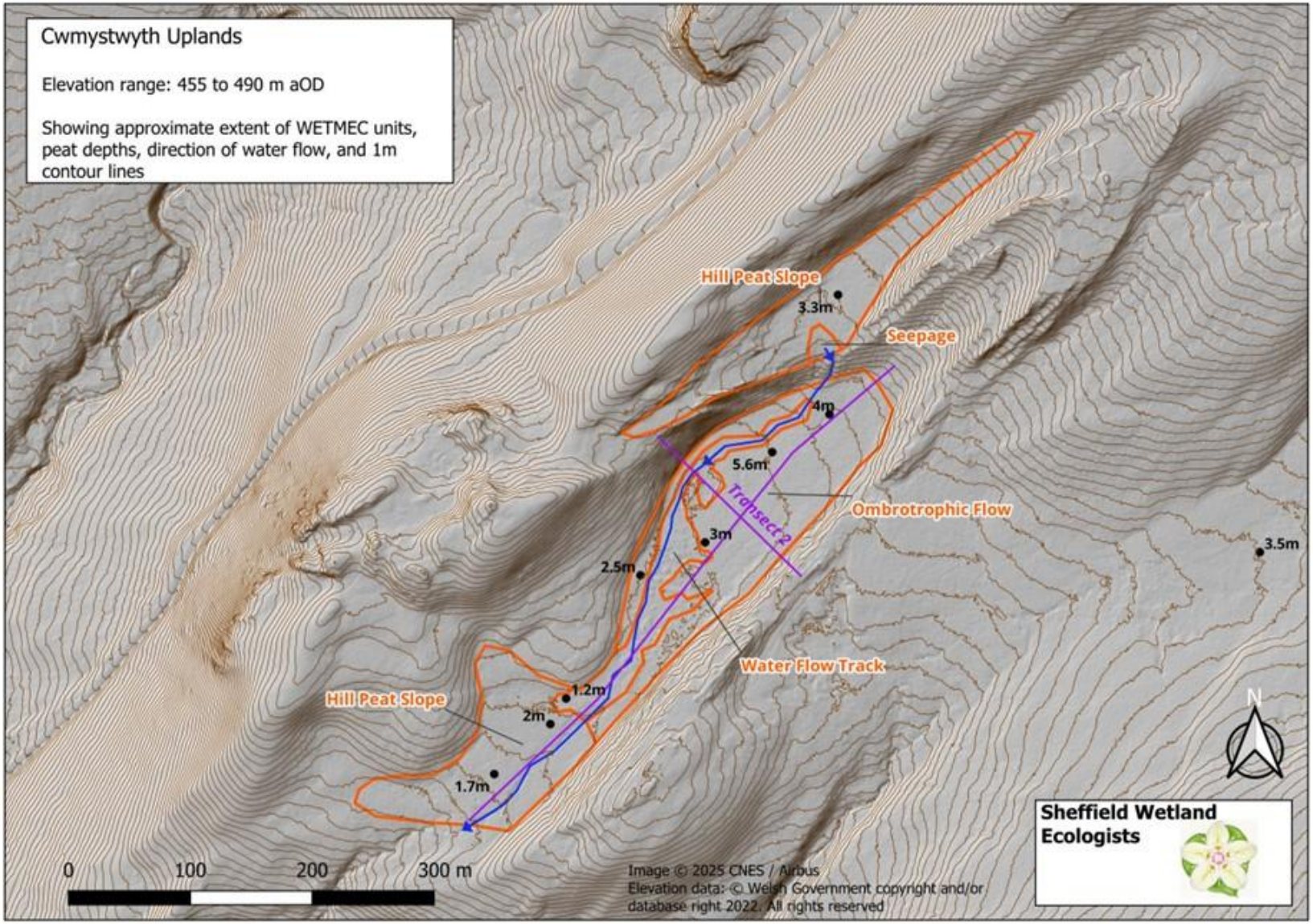

Near to Point 6, looking upslope (NE) towards Point 7: purple moor-grass-dominated M17 on deep peat (3.5m); gullies and purple moor-grass bog in the background

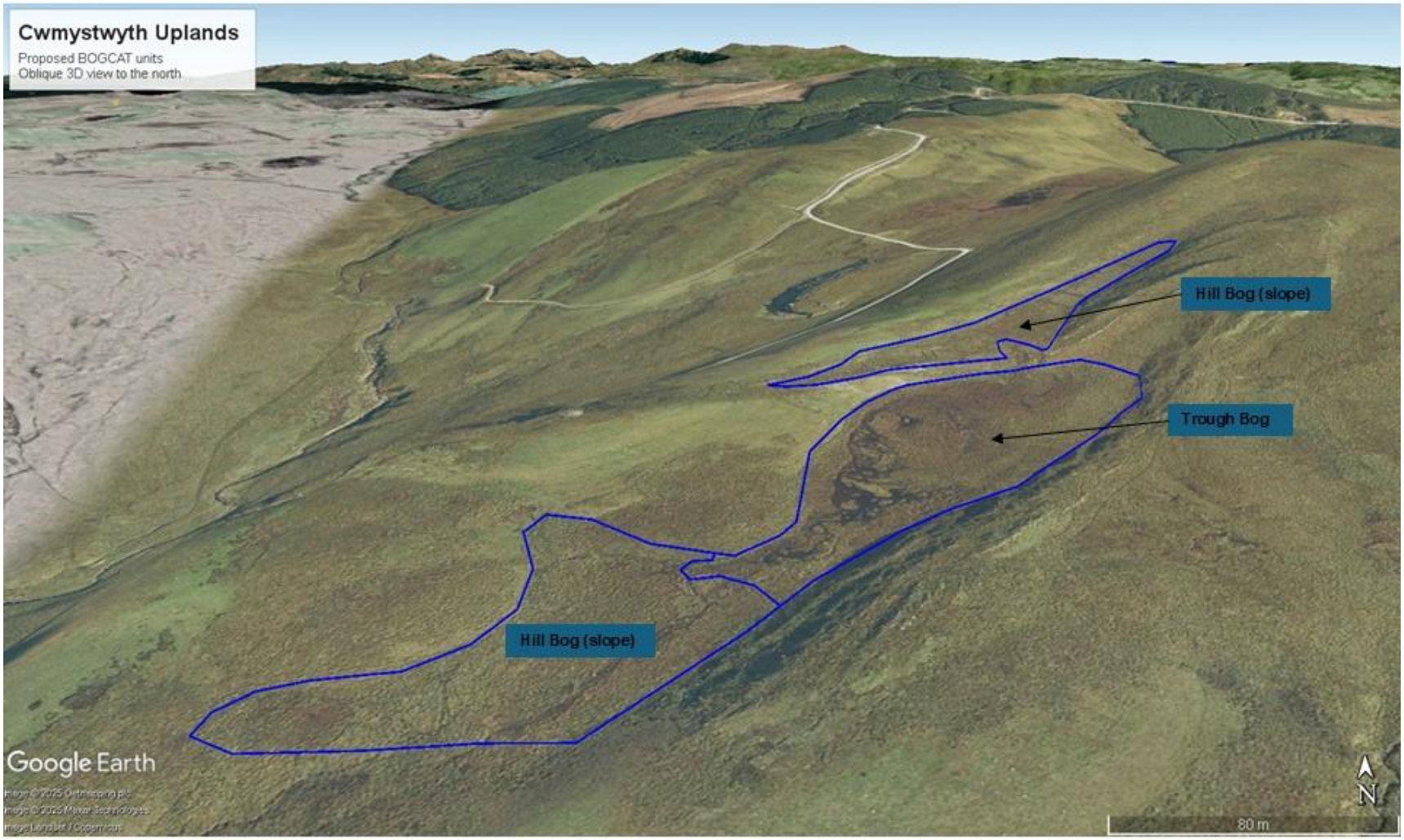

Near to Point 9: almost flat, eroded bog with
M17 vegetation on deep peat (4.3m) on a
broad bench. Shallow erosion channels have
recently been blocked with dams

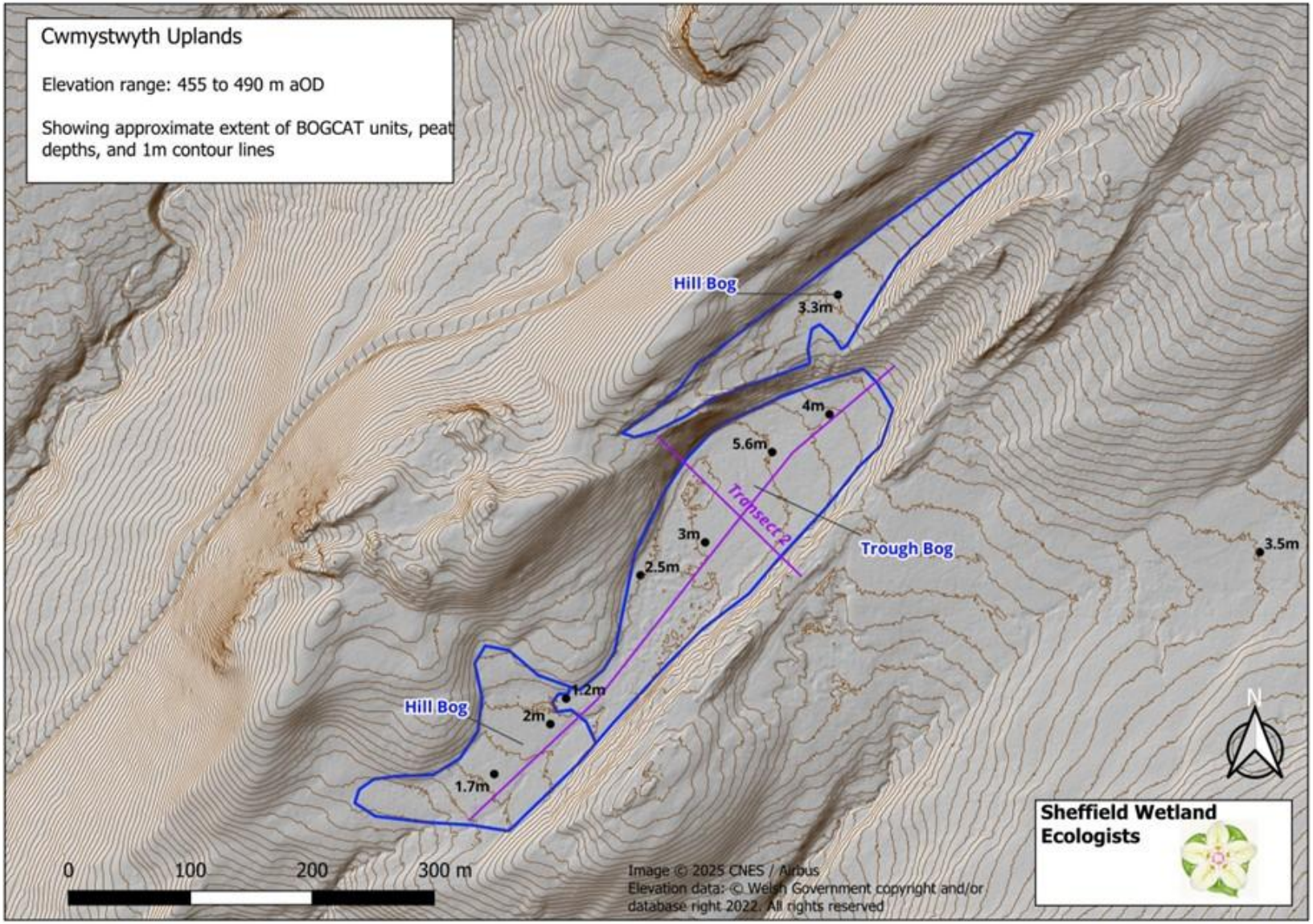

Point 16: purple moor-grass-dominated gullies on
the lower slopes of the ridge, flowing off the slope
to the north-west, 0.5m of peat at their base,
1.5m deep on intervening mounds

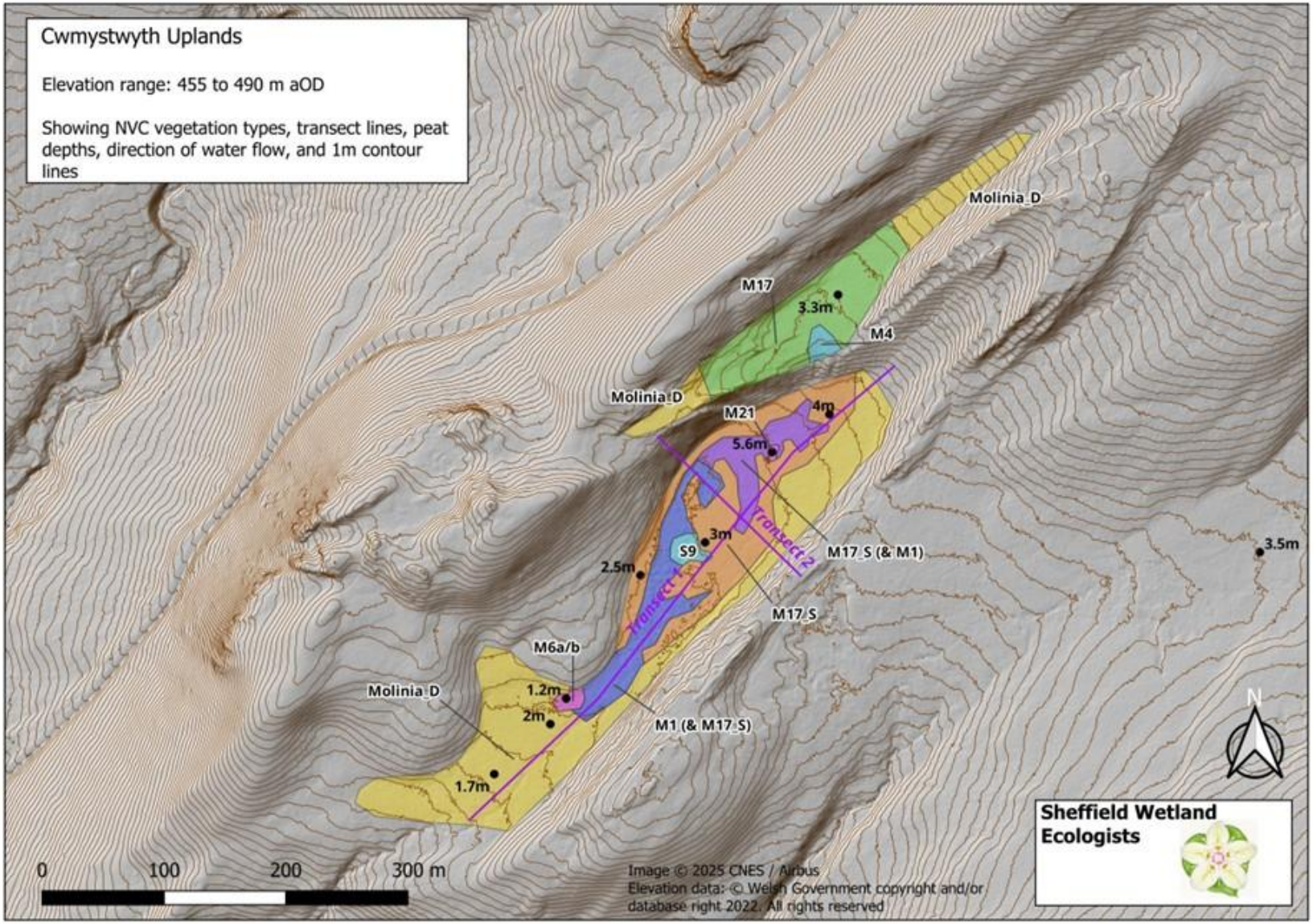
17.4 Cwmystwyth Uplands, central Wales

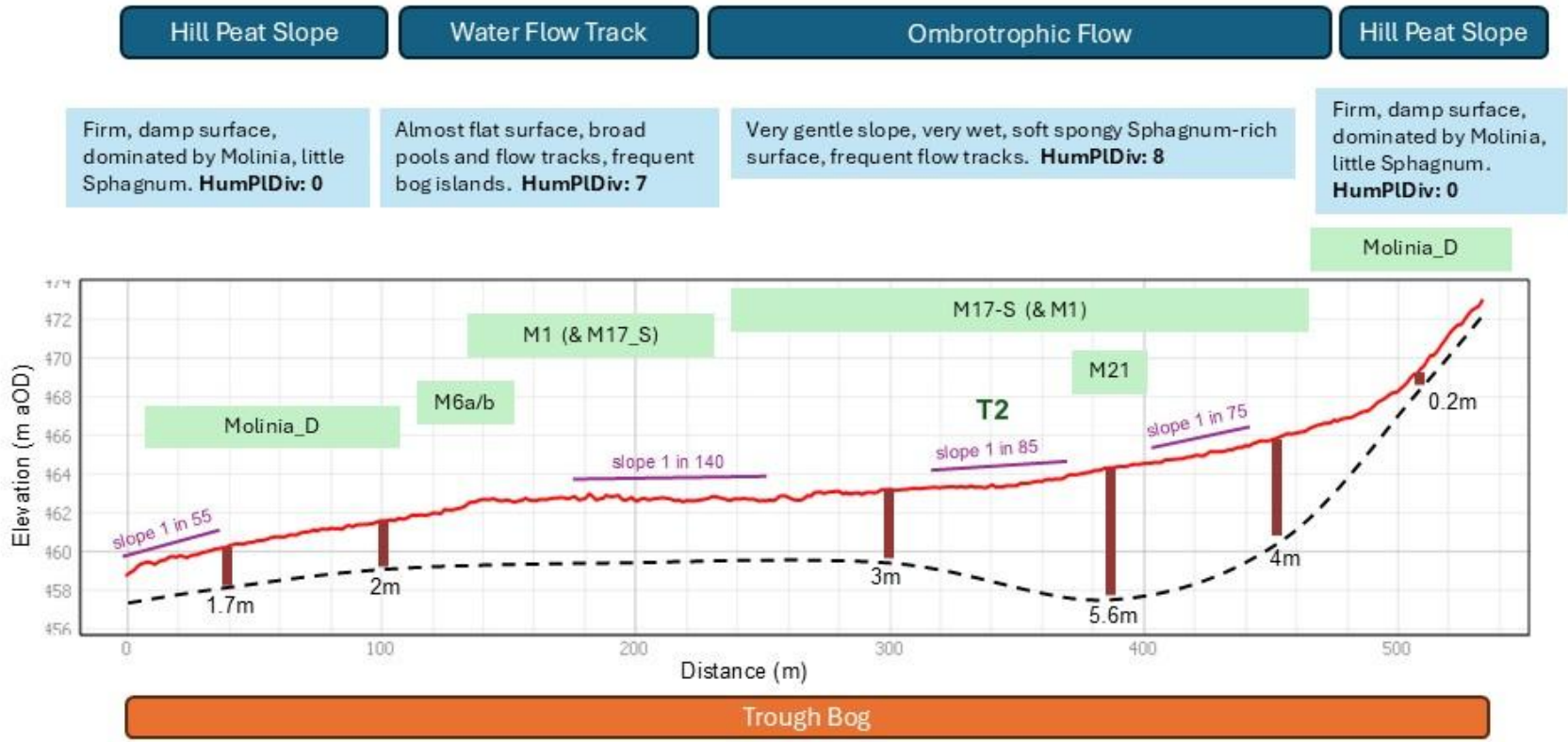

Cwmystwyth Uplands
Proposed WETMEC units
Oblique 3D view to the north
Hill Peat Slope
Seepage
Ombrotrophic Flow
Water Flow Track
Hill Peat Slope
Google Earth
N
80 m


Cwmystwyth Uplands
Elevation range: 455 to 490 m aOD
Showing approximate extent of WETMEC units, peat depths, direction of water flow, and 1m contour lines
Hill Peat Slope
3.3m
Seepage
4m
5.6m
Transect 2
Ombrotrophic Flow
3m
2.5m
3.5m
Water Flow Track
1.2m
Hill Peat Slope
2m
1.7m
N
0
100
200
300 m
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Cwmystwyth Uplands
Proposed BOGCAT units
Oblique 3D view to the north
Hill Bog (slope)
Trough Bog
Hill Bog (slope)
Google Earth
N
80 m


Cwmystwyth Uplands
Elevation range: 455 to 490 m aOD
Showing approximate extent of BOGCAT units, peat depths, and 1m contour lines
Hill Bog
3.3m
4m
5.6m
Transect 2
Trough Bog
3.5m
3m
2.5m
Hill Bog
1.2m
2m
1.7m
N
0
100
200
300 m
Image © 2025 CNES / Airbus
Elevation data: © Welsh Government copyright and/or database right 2022. All rights reserved
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Cwmystwyth Uplands
Elevation range: 455 to 490 m aOD
Showing NVC vegetation types, transect lines, peat depths, direction of water flow, and 1m contour lines
Molinia D
M17
3.3m
M4
Molinia D
M21
4m
5.6m
Transect 2
3m
S9
M17 S (& M1)
3.5m
2.5m
Transect 1
M17 S
M6a/b
Molinia D
1.2m
2m
M1 (& M17 S)
1.7m
N
0
100
200
300 m
Image © 2025 CNES / Airbus
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Cwmystwyth Uplands Transect 1: south-west to north-east

Note: peat depths are a different scale to surface elevations

Legend

T2 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

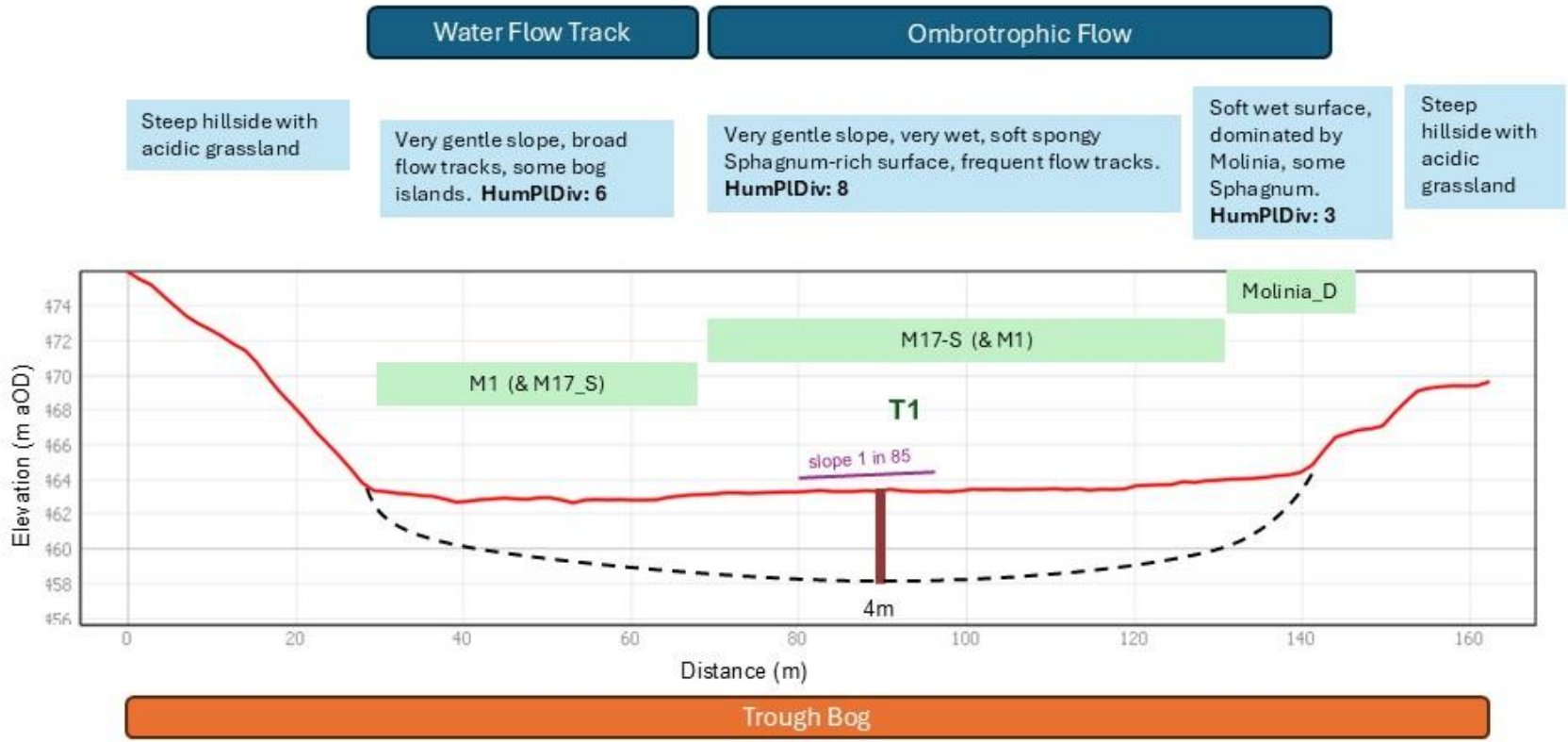
5 – sample pt

Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score



Cwmystwyth Uplands Transect 2: north-west to south-east

Note: peat depths are a different scale to surface elevations

Legend

T1 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

5 – sample pt

Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score


View of the south-western end of the trough bog
with pools, water flow tracks, and bog islands


View towards the north-eastern end of the bog,
with a Sphagnum-rich bog surface and network
of small flow tracks


At the northern end of the bog, looking towards
the western edge

17.5 Blackdown Flow, Northumberland

Blackdown Flow Site Summary

Blackdown Flow is located 10 km south-east of Otterburn in Northumberland, about 60 km south of The Cheviot and the Scottish border. It is situated in an undulating landscape of low ridges and shallow valleys, many of which are occupied by peatland with bog and fen habitat, at an elevation of between 260 and 310 m aOD. It occupies a broad trough-like valley, oriented south-west to north-east, that is about 1500 m long and is flanked by low but steep ridges that support dry heath and acidic grassland, with a conifer plantation on the south-eastern side. Most of the valley slopes gently down to the main north-eastern outflow that joins Hart Burn further to the east, whilst smaller outflows at the southern and western sides join the Ray Burn and Lisles Burn respectively.

The peat surface has been intensively gripped with shallow ditches that are mostly about 60 cm deep by 50 cm wide but can reach 1 m deep and 2 m wide where they are actively eroding. The adjacent ridges support heathland that is managed by burning, and small conifer plantations. The area is lightly grazed by sheep, and several wind turbines are present on the hill slopes to the north and west.

The deepest peat is found in the broadest parts of the valley (generally between 3 and 6 m deep), becoming much shallower in the narrower southern, western and north-eastern limbs of the valley. Peat depths are fairly uniform across the valley, though with shallow hollows along the valley bottom beneath the peat, which is in places underlain by stiff sandy clay. Most of the survey area comprises Topogenous Bog that has formed over these broad, gently sloping hollows in the mineral ground, and can be assigned to the BOGCAT type Trough Bog. There are a few marginal areas of Hill Bog, and small areas of fen at the outflows where there are springs.

The flattest parts of the bog surface (gradient ranging from about 1 in 120 to 1 in 250), over the deepest peat, typically support very *Sphagnum*-rich M18_S vegetation with abundant heather, cross-leaved heath, hare's-tail cottongrass, with frequent but small hummocks of *Sphagnum papillosum*, *Sphagnum capillifolium*, and *Sphagnum medium;* less frequently there is bog asphodel, deergrass, common cottongrass, and cranberry. The bog surface here is typically wet and soft, sometimes spongy, and is an example of the Partial Crown WETMEC, sloping slightly at the edges into narrow lagg-like Water Flow Tracks.

Blackdown Flow Summary (continued)

Near the north-western outflow there is a small region of the Crown-Hump WETMEC with M19a bog vegetation dominated by heather with locally abundant cross-leaved heath and a less diverse bryophyte layer (abundant *Sphagnum fallax* and *Sphagnum capillifolium / rubellum*, *Polytrichum commune*, and pleurocarpous mosses), grading downslope into M20-S vegetation dominated by hare's-tail cottongrass with some stunted heather and cross-leaved heath, and abundant *Sphagnum fallax*, and a few other bryophytes.

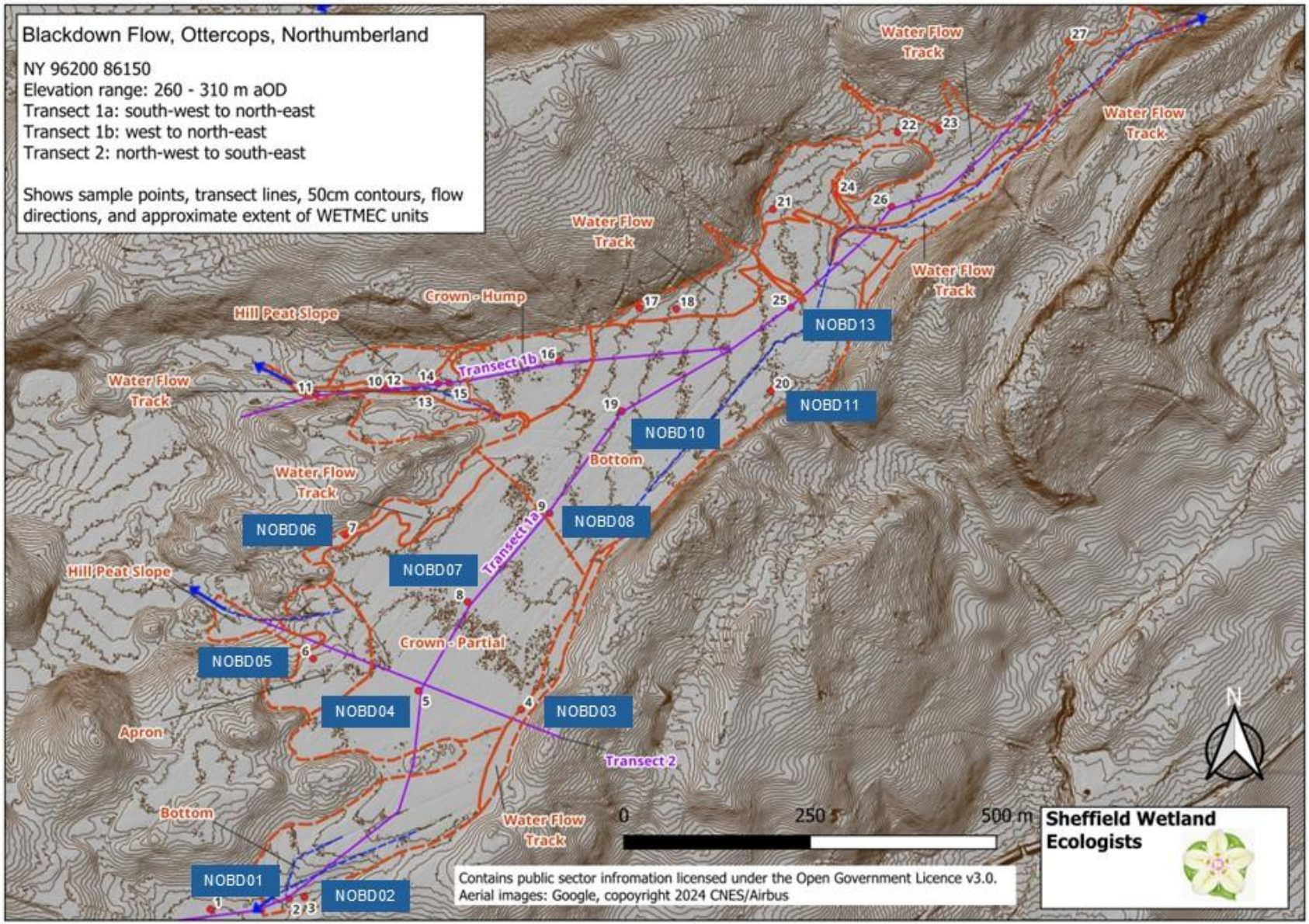
Much of the rest of the valley to the north-east supports *Sphagnum*-rich M18a bog vegetation but with a firmer surface and a slightly steeper slope (about 1 in 120) to the north-east: this is considered to be an example of the Bottom WETMEC. The peat remains deep here (ranging from 4 to 6 m), with a sub-surface water table.

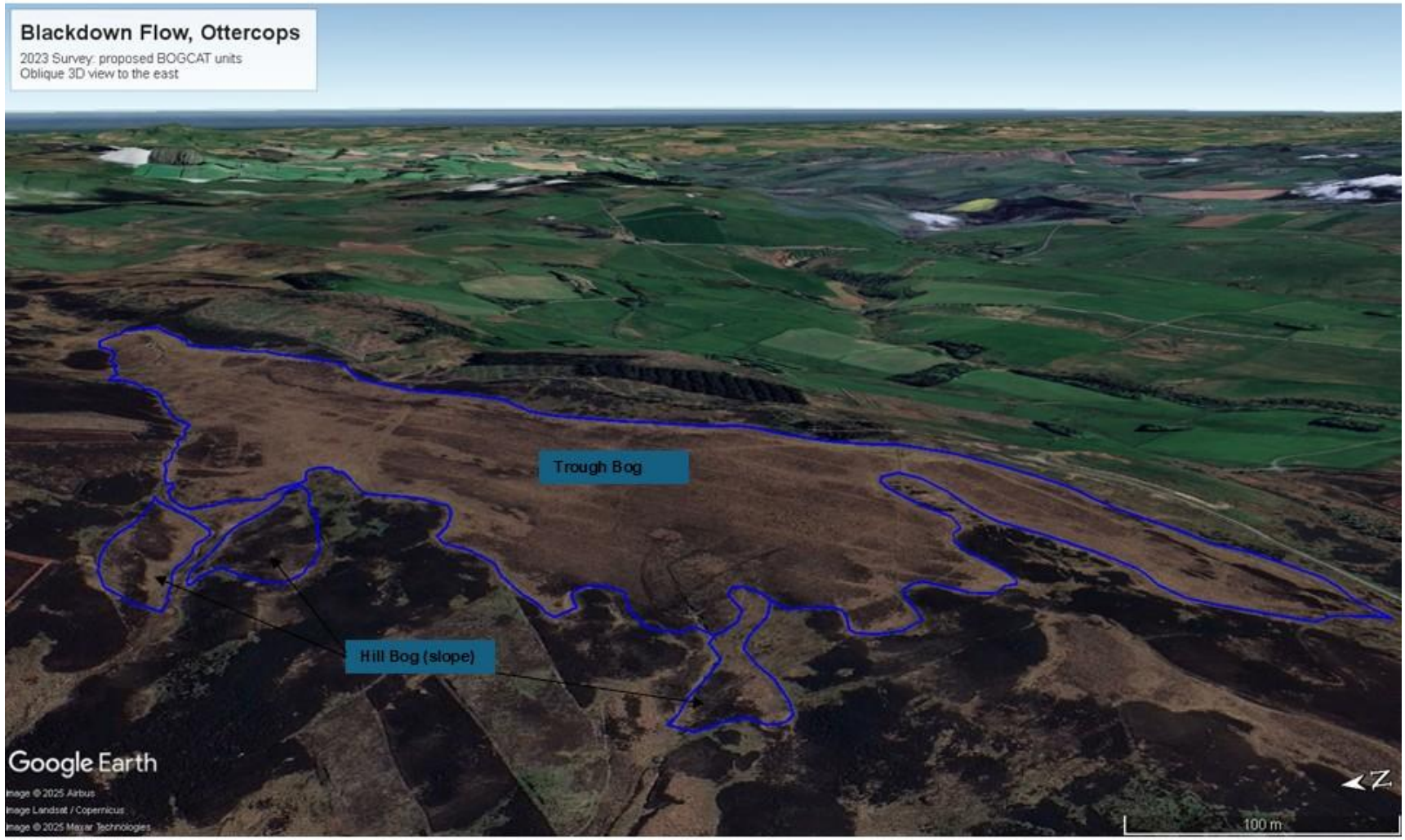
A smaller region of Bottom forms the southern outflow of the site (with a mixture of M19a, M19, and M20-S vegetation), whilst a small area of the Apron WETMEC forms a western edge to the Partial Crown, with a steeper gradient (1 in 25), firm surface, and sub-surface water table.

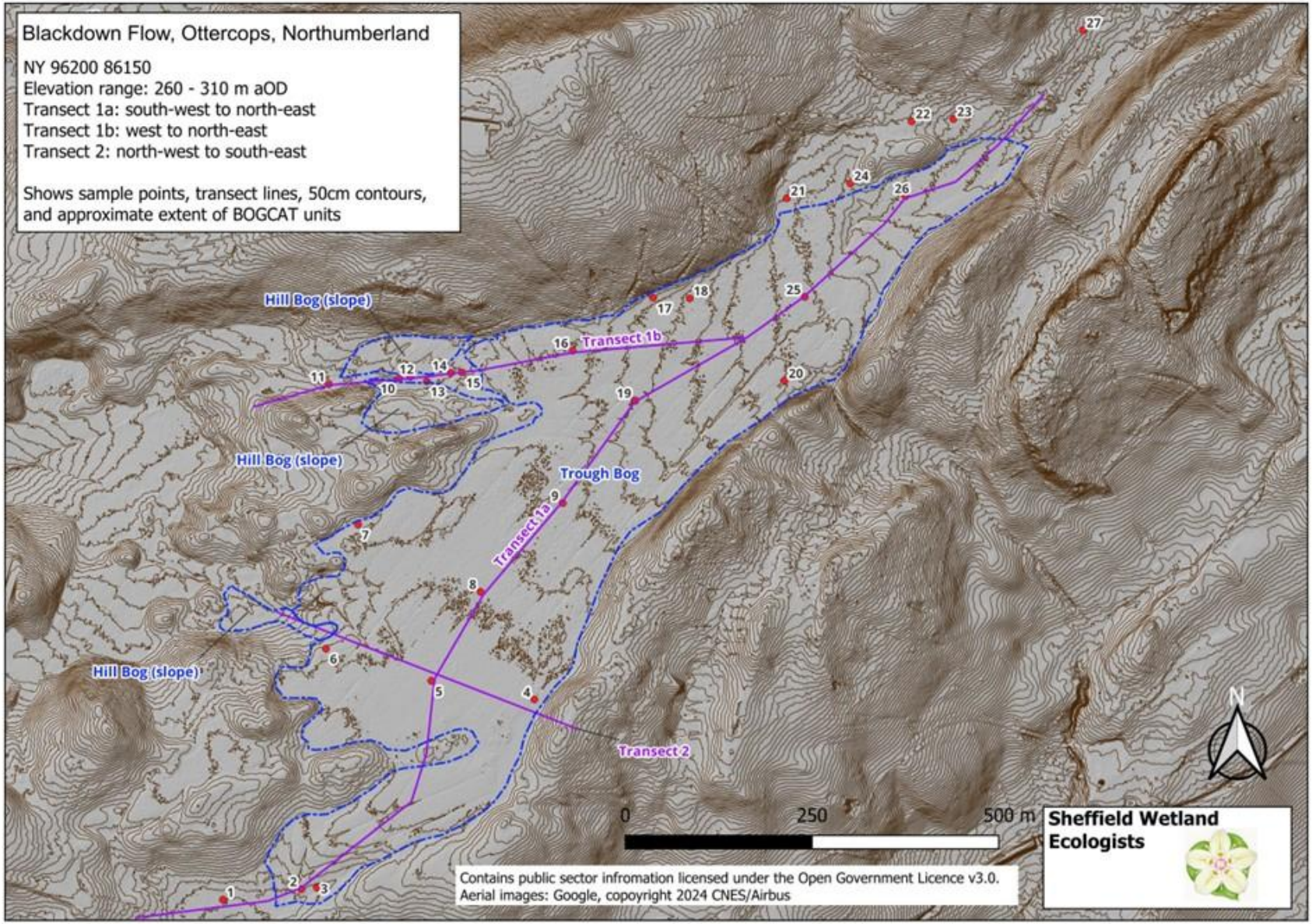
Narrow strips of bog along parts of the margins also support M20-S; these are ditched 'lagg-like' regions with soft and wet surfaces and slightly lower surface elevations than the adjacent bog. Their surface gradients are very slight, but any water flow is likely to be along the margins rather than into the adjacent bog. They are considered to be examples of Water Flow Track WETMEC.

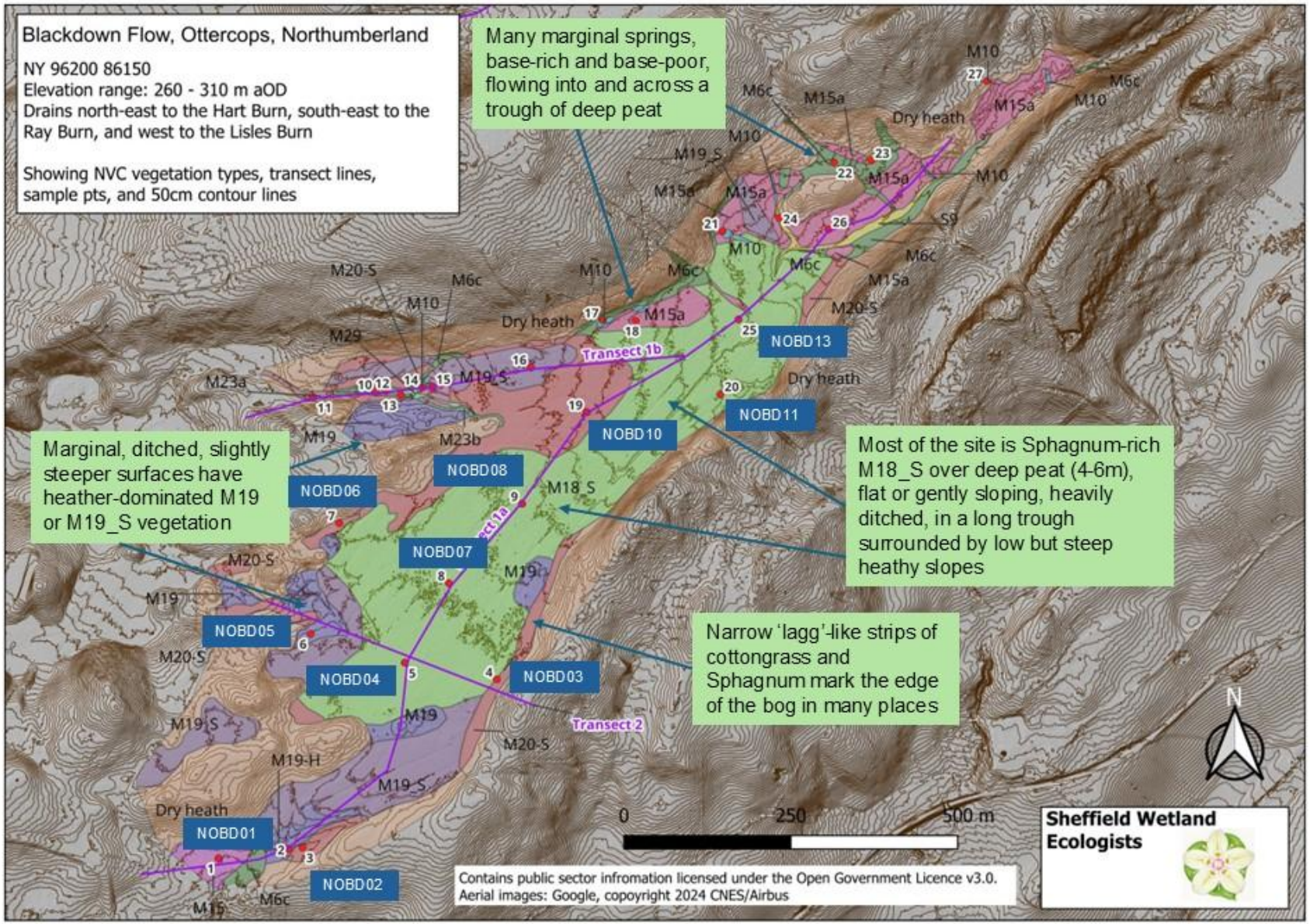
Small springs and flushes are present at the western and north-eastern outflows, and also along parts of the northern margin of the bog, typically on fairly shallow, sloping Fen Peat (0.5 to 1.6 m deep). Many of these are base-rich and support very species-rich M10a mire vegetation, characterised by a very diverse open-growing sward of small sedges, small rushes, brown mosses (e.g. *Palustriella falcata*, and *Scorpidium cossonnii*), and other small forbs such as bog pimpernel, fairy flax, creeping willow, and marsh arrow-grass. They are mingled with patches of wet heath M15a, M29 water flow tracks, S9 swamp, and base-poor M6c and d flushes. These comprise a combination of the WETMECs Permanent Seepage Slopes, Seepage Percolation Trough, and Seepage Flow Track.

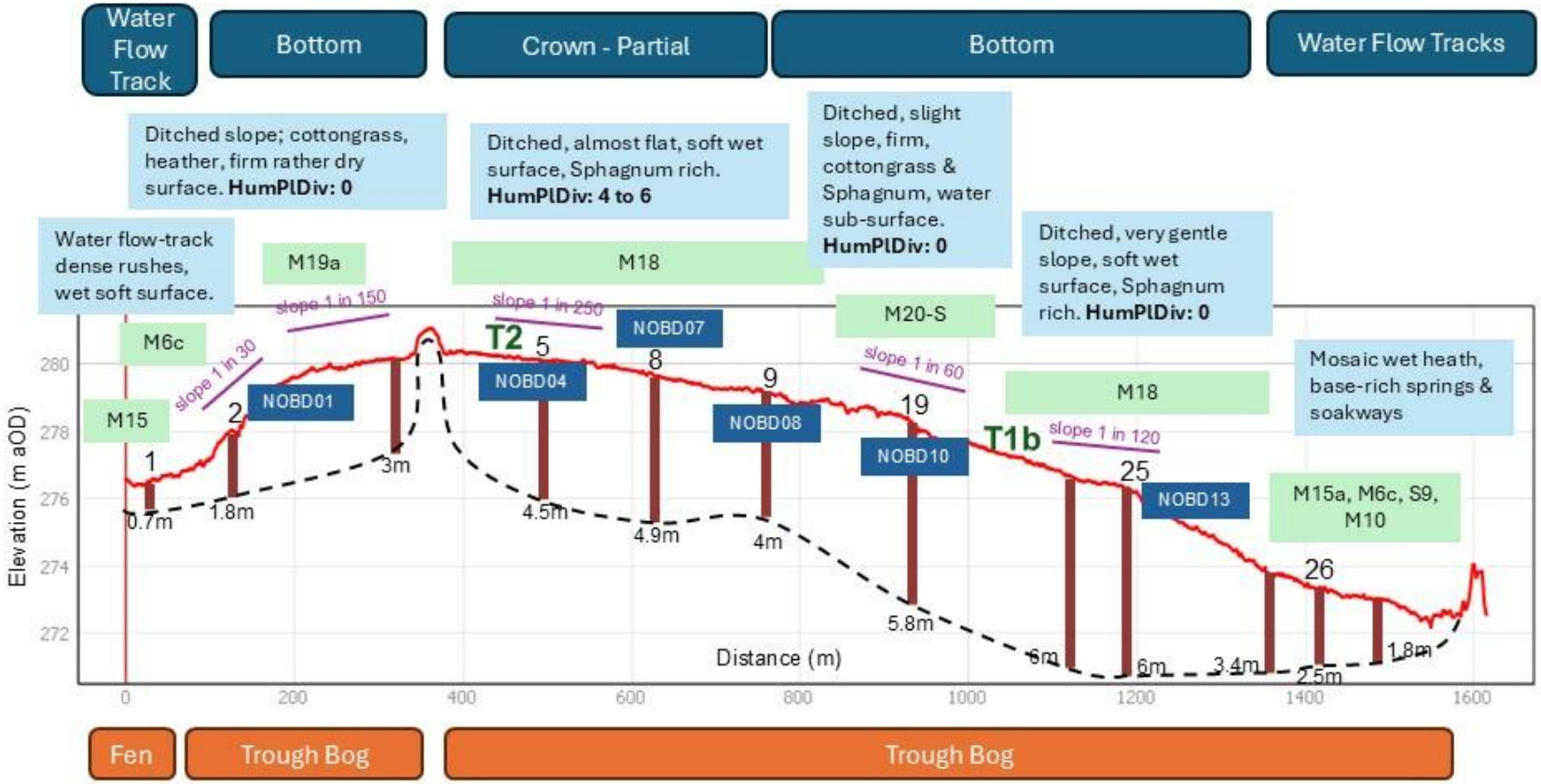

Blackdown Flow, Ottercops
2023 Survey: proposed WETMEC units
Oblique 3D view to the east
Water flowtrack
Bottom
Water flowtrack
Crown – Hump
Crown – partial
Bottom
Hill peat - slope
Water flowtrack
Apron
Hill peat - slope
Google Earth
100 m


Blackdown Flow, Ottercops, Northumberland
NY 96200 86150
Elevation range: 260 - 310 m aOD
Transect 1a: south-west to north-east
Transect 1b: west to north-east
Transect 2: north-west to south-east
Shows sample points, transect lines, 50cm contours, flow directions, and approximate extent of WETMEC units
Water Flow Track
Hill Peat Slope
Crown - Hump
Crown - Partial
Bottom
Apron
Transect 1a
Transect 1b
Transect 2
NOBD01
NOBD02
NOBD03
NOBD04
NOBD05
NOBD06
NOBD07
NOBD08
NOBD10
NOBD11
NOBD13
N
0
250
500 m
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Blackdown Flow, Ottercops
2023 Survey: proposed BOGCAT units
Oblique 3D view to the east
Trough Bog
Hill Bog (slope)
Google Earth
100 m


Blackdown Flow, Ottercops, Northumberland
NY 96200 86150
Elevation range: 260 - 310 m aOD
Transect 1a: south-west to north-east
Transect 1b: west to north-east
Transect 2: north-west to south-east
Shows sample points, transect lines, 50cm contours, and approximate extent of BOGCAT units
Hill Bog (slope)
Hill Bog (slope)
Hill Bog (slope)
Trough Bog
Transect 1a
Transect 1b
Transect 2
0
250
500 m
N
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Blackdown Flow, Ottercops, Northumberland
NY 96200 86150
Elevation range: 260 - 310 m aOD
Drains north-east to the Hart Burn, south-east to the Ray Burn, and west to the Lisles Burn
Showing NVC vegetation types, transect lines, sample pts, and 50cm contour lines
Many marginal springs, base-rich and base-poor, flowing into and across a trough of deep peat
Marginal, ditched, slightly steeper surfaces have heather-dominated M19 or M19_S vegetation
Most of the site is Sphagnum-rich M18_S over deep peat (4-6m), flat or gently sloping, heavily ditched, in a long trough surrounded by low but steep heathy slopes
Narrow 'lagg'-like strips of cottongrass and Sphagnum mark the edge of the bog in many places
NOBD01
NOBD02
NOBD03
NOBD04
NOBD05
NOBD06
NOBD07
NOBD08
NOBD10
NOBD11
NOBD13
Transect 1b
Transect 2
M10
M6c
M15a
M20-S
M19_S
M19
M18_S
M23a
M23b
M29
M19-H
Dry heath
M15
0
250
500 m
N
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Blackdown Flow, Ottercops, Northumberland

Transect 1a: T1 to Q26 (south-western outflow to north-eastern outflow)

Note: peat depths are a different scale to surface elevations

Legend

NOBD10 - dataset sample ID

T2 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

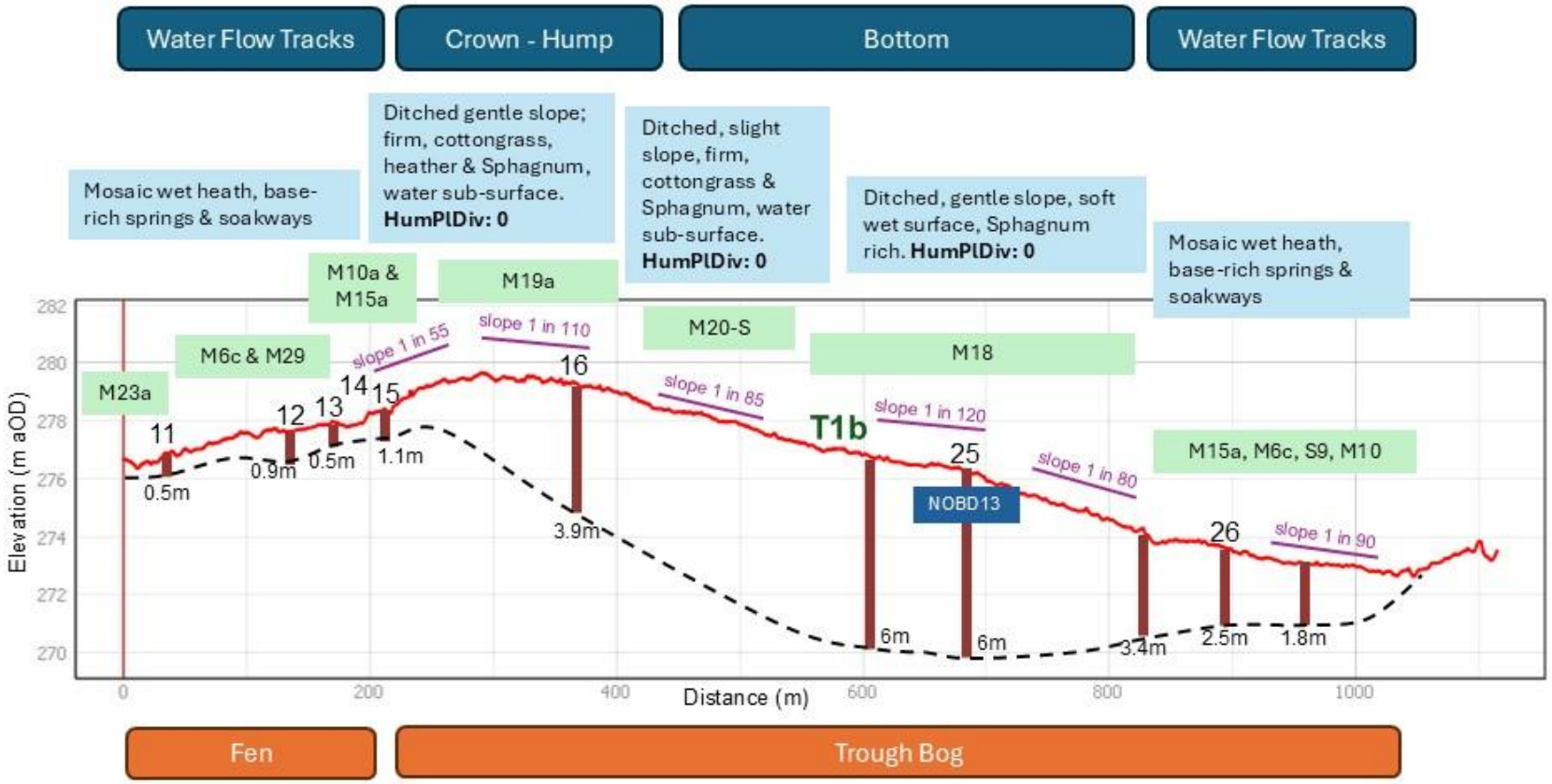
9 – sample pt

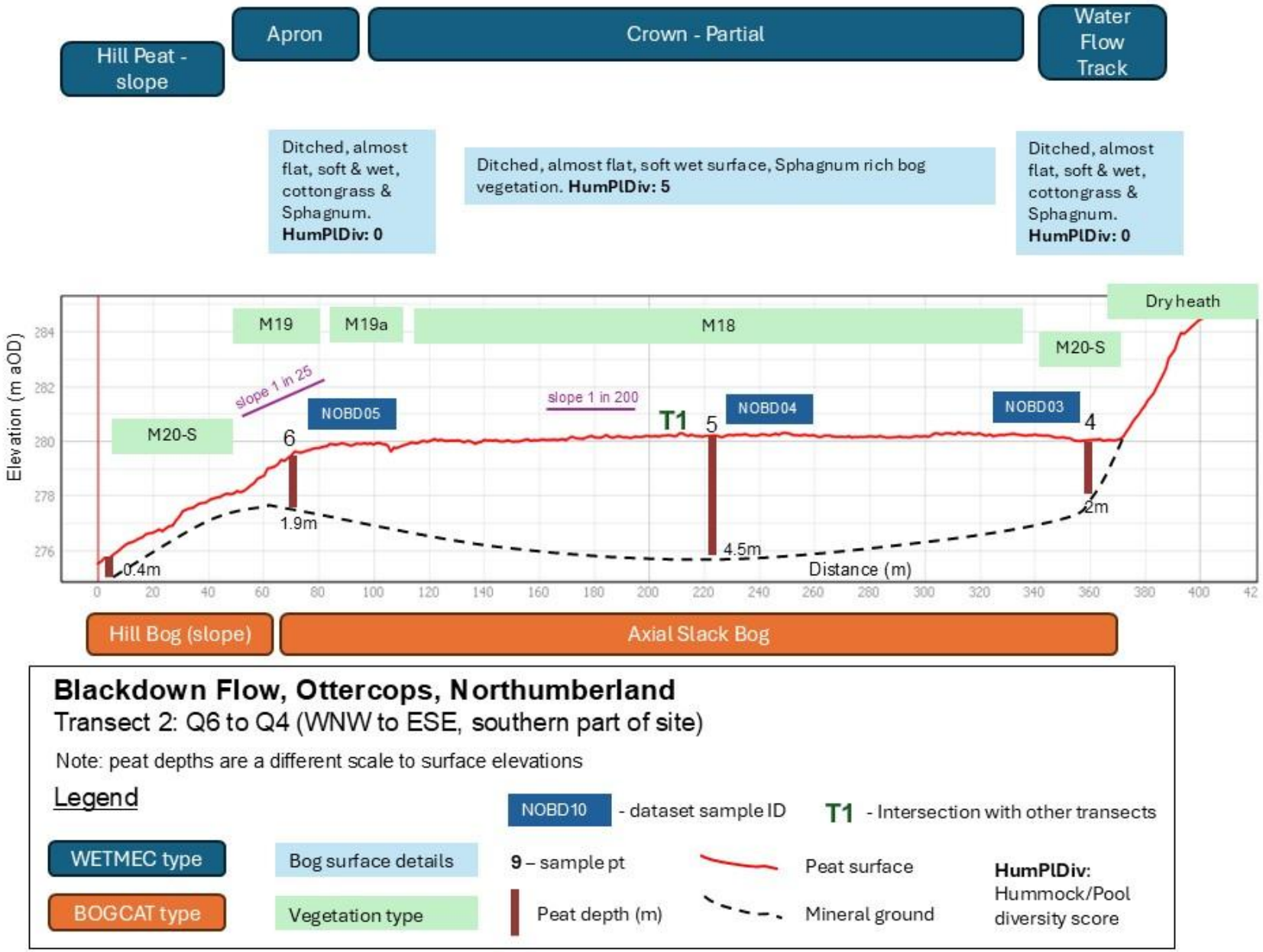
Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score


Water Flow Tracks
Crown - Hump
Bottom
Water Flow Tracks
Mosaic wet heath, base-rich springs & soakways
Ditched gentle slope; firm, cottongrass, heather & Sphagnum, water sub-surface. HumPlDiv: 0
Ditched, slight slope, firm, cottongrass & Sphagnum, water sub-surface. HumPlDiv: 0
Ditched, gentle slope, soft wet surface, Sphagnum rich. HumPlDiv: 0
Mosaic wet heath, base-rich springs & soakways
M10a & M15a
M19a
M20-S
M18
M6c & M29
M23a
M15a, M6c, S9, M10
slope 1 in 55
slope 1 in 110
slope 1 in 85
slope 1 in 120
slope 1 in 80
slope 1 in 90
T1b
NOBD13
11
12
13
14
15
16
25
26
0.5m
0.9m
0.5m
1.1m
3.9m
6m
6m
3.4m
2.5m
1.8m
Elevation (m aOD)
282
280
278
276
274
272
270
0
200
400
600
800
1000
Distance (m)
Fen
Trough Bog
Blackdown Flow, Ottercops, Northumberland
Transect 1b: Q11 to Q27 (western outflow to north-eastern outflow)
Note: peat depths are a different scale to surface elevations
Legend
NOBD10 - dataset sample ID
T2 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground


Hill Peat - slope
Apron
Crown - Partial
Water Flow Track
Ditched, almost flat, soft & wet, cottongrass & Sphagnum. HumPlDiv: 0
Ditched, almost flat, soft wet surface, Sphagnum rich bog vegetation. HumPlDiv: 5
Ditched, almost flat, soft & wet, cottongrass & Sphagnum. HumPlDiv: 0
Dry heath
M19
M19a
M18
M20-S
M20-S
slope 1 in 25
slope 1 in 200
NOBD05
NOBD04
NOBD03
T1
6
5
4
1.9m
4.5m
2m
0.4m
Elevation (m aOD)
Distance (m)
Hill Bog (slope)
Axial Slack Bog
Blackdown Flow, Ottercops, Northumberland
Transect 2: Q6 to Q4 (WNW to ESE, southern part of site)
Note: peat depths are a different scale to surface elevations
Legend
NOBD10 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
BOGCAT type
Bog surface details
Vegetation type
9 – sample pt
Peat depth (m)
Peat surface
Mineral ground
HumPlDiv: Hummock/Pool diversity score


Looking north-east from the south-
eastern ridge, across ditched M18_S
bog over deep peat to 6 m depth.


A deep, overgrown but actively flowing ditch is situated close to the eastern edge of the bog. Ditches in this area are quite large (to 1m deep, 2m wide).


Deep peat at the centre of the highest and broadest southern part of the valley, with ditched but still quite rich M18_S bog vegetation


A broad lagg-like strip of hare's-tail cottongrass at the western edge of the bog, below a low mineral ridge to the left, with M19_S bog to the right.



Base-rich fen, wet heath, and a water flow track at the western outflow of the bog. A recent burn on the heathy ridge is visible in the background.



Water flow track from base-poor springs at the north-eastern end of the site. A partially harvested conifer plantation is visible on the ridge.

17.6 Chesters Burn Moss, Northumberland

Chesters Burn Moss Site Summary

Chesters Burn Moss is situated at NY 96350 87050 on the Ray Estate at Ottercops, in Northumberland. Land use in the wider area comprises a mixture of grazing (mainly sheep with some hardy cattle), burning management for game birds, small conifer plantations, and a recently constructed wind turbine array, and the area is dissected by farm tracks and wind turbine access tracks. Broadly speaking the surface topography of the wider area is characterized by a series of low ridges, hollows, and broad shallow valleys, many of which have become infilled with peat.

Chesters Burn Moss is approximately 1400 m long and comprises a curved shallow valley trending from north-east to south-west, at an elevation of between about 280 to 292 m. It is enclosed by low mineral slopes that become larger toward the south-western end. The site drains generally to the south-west but has smaller outflows to the southeast and north, and it is broadest in the bowl-like centre of the bog, narrowing upslope to the north-east and downslope to the south-west. The entire site has been gripped with shallow ditches, and these are deeper and wider close to the main south-western outflow.

The valley has infilled with peat, with the deepest peat in the broadest central and south-western part of the valley, reaching 9 m of peat in the centre, which appears to correspond with a hollow in the mineral ground below the peat. The north-eastern arm of the bog is narrower and shallower, with a maximum of about 4.5 m of peat. Peat depths shallow rapidly into the western and south-eastern outflows (generally about 1 to 2 m).

Most of the bog surface is fairly wet (though no pools were visible), and supports frequent or abundant *Sphagnum*, often forming large hummocks to about 40 cm tall, mixed with cottongrasses, heather and cross leaved heath. The deepest and flattest part of the site has the wettest surface, with ditches almost completely occluded with Sphagnum, and this area notably supports abundant bog rosemary. Much of the surface supports scattered young spruce saplings 0.5-2m tall. The surrounding slopes support dry heath, damp acid grassland, and patches of bog vegetation.

Chesters Burn Moss Site Summary (continued)

Most of Chesters Burn Moss supports M18 vegetation, which was characterized by abundant heather, cross-leaved heath, hare's-tail cottongrass, cranberry, scattered common cottongrass and Sphagnum mosses, typically with abundant *Sphagnum medium*, *Sphagnum papillosum*, *Sphagnum rubellum*, and *Sphagnum tenellum*, and locally abundant *Sphagnum cuspidatum*, *Sphagnum fallax*, and *Sphagnum capillifolium*.

The broad southern part of the site, with the deepest peat and wettest surface, is more species-rich (M18_S), with a more continuous carpet of *Sphagnum*. Here there was abundant bog rosemary and locally abundant bog asphodel and deergrass, and frequent sundew, the leafy liverwort *Odontoschisma sphagni*, and the bushy lichen *Cladonia portentosa*. At its sloping western edge this vegetation rapidly grades out into drier and less *Sphagnum*-rich bog vegetation at the south-western outflow.

Close to the south-western outflow and along parts of the northern margins of the bog, there were several areas of very dry and species-poor M19 bog vegetation, dominated by heather, and mixed with locally abundant hare's-tail cottongrass and common cottongrass, typically over a dense carpet of pleurocarpous mosses.

Large areas of shallower peat supported less diverse M20_S vegetation, dominated by hare's-tail cottongrass, *Sphagnum fallax*, and *Polytrichum commune*, with scattered tunted heather and cross-leaved heath, frequent cranberry, patchy purple moor-grass, occasional wavy hair grass and deergrass.

There are a few areas of base-poor water flow tracks, typically with dense soft rushes (M6c) forming narrow marginal lagg zones. Elsewhere, at the south-eastern outflow, there are small base-rich seepages associated with very diverse M10 vegetation with small sedges and brown mosses.

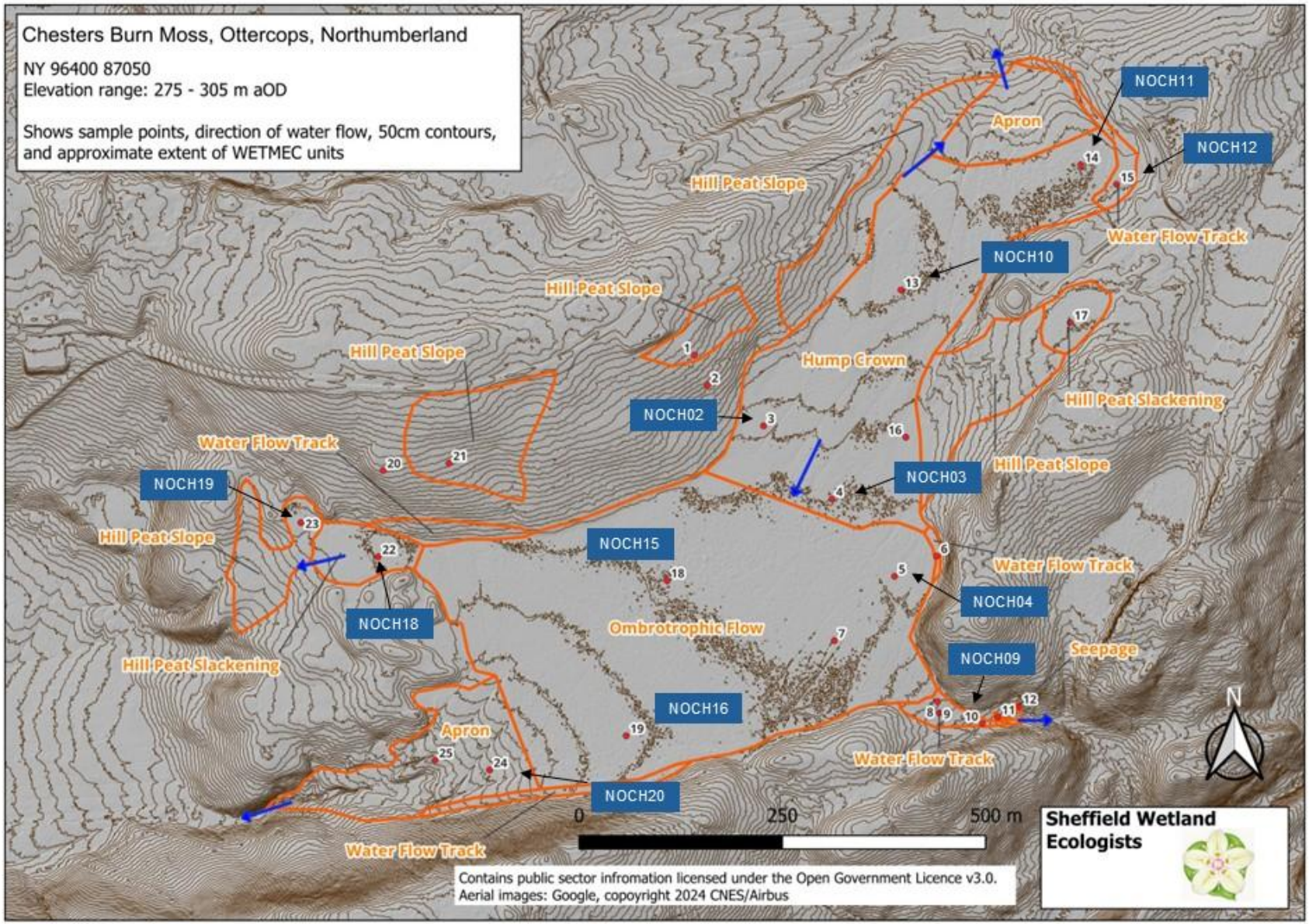
BOGCATs:

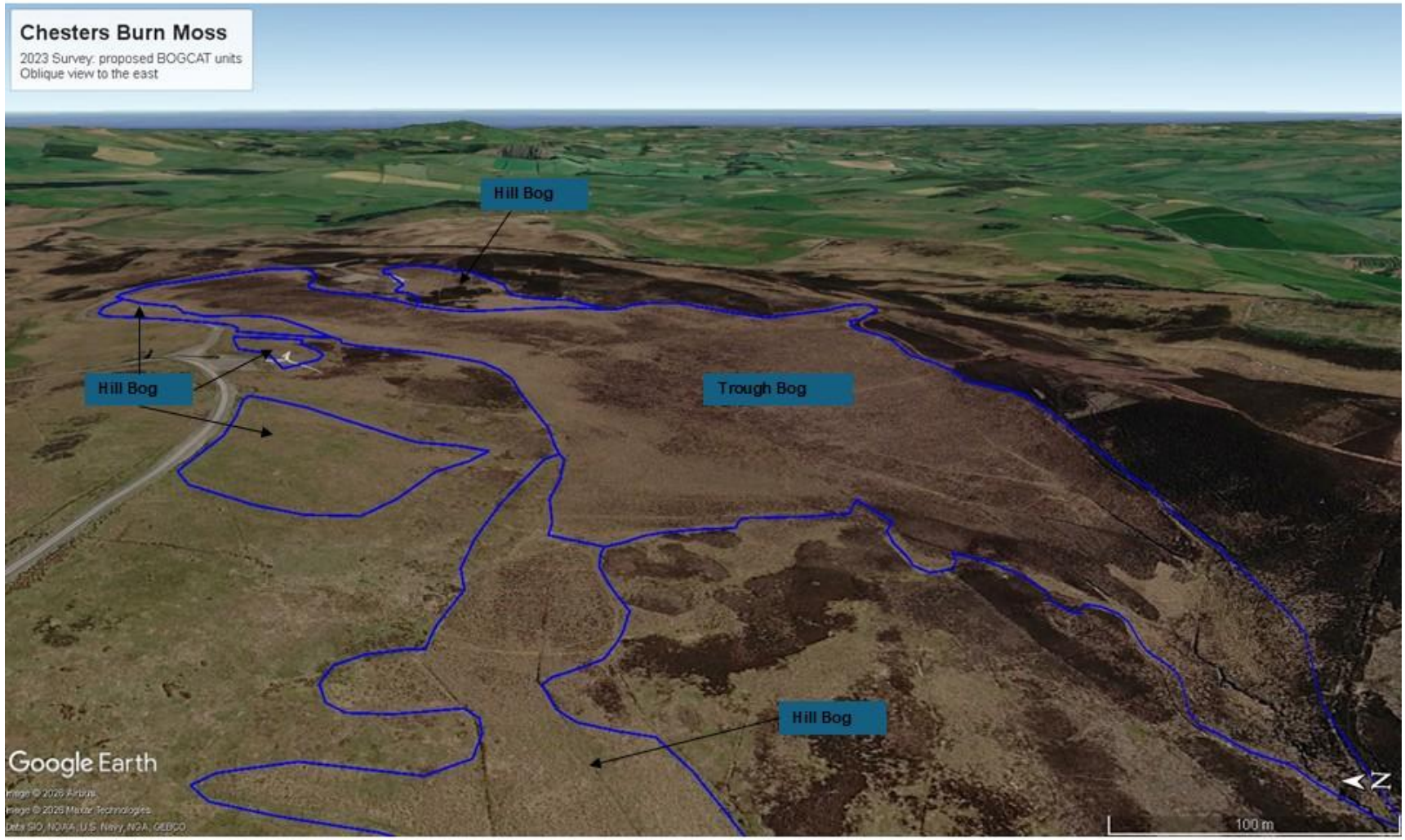
The valley is an example of a large Trough Bog with small patches of Hill Bog on the flanking mineral slopes.

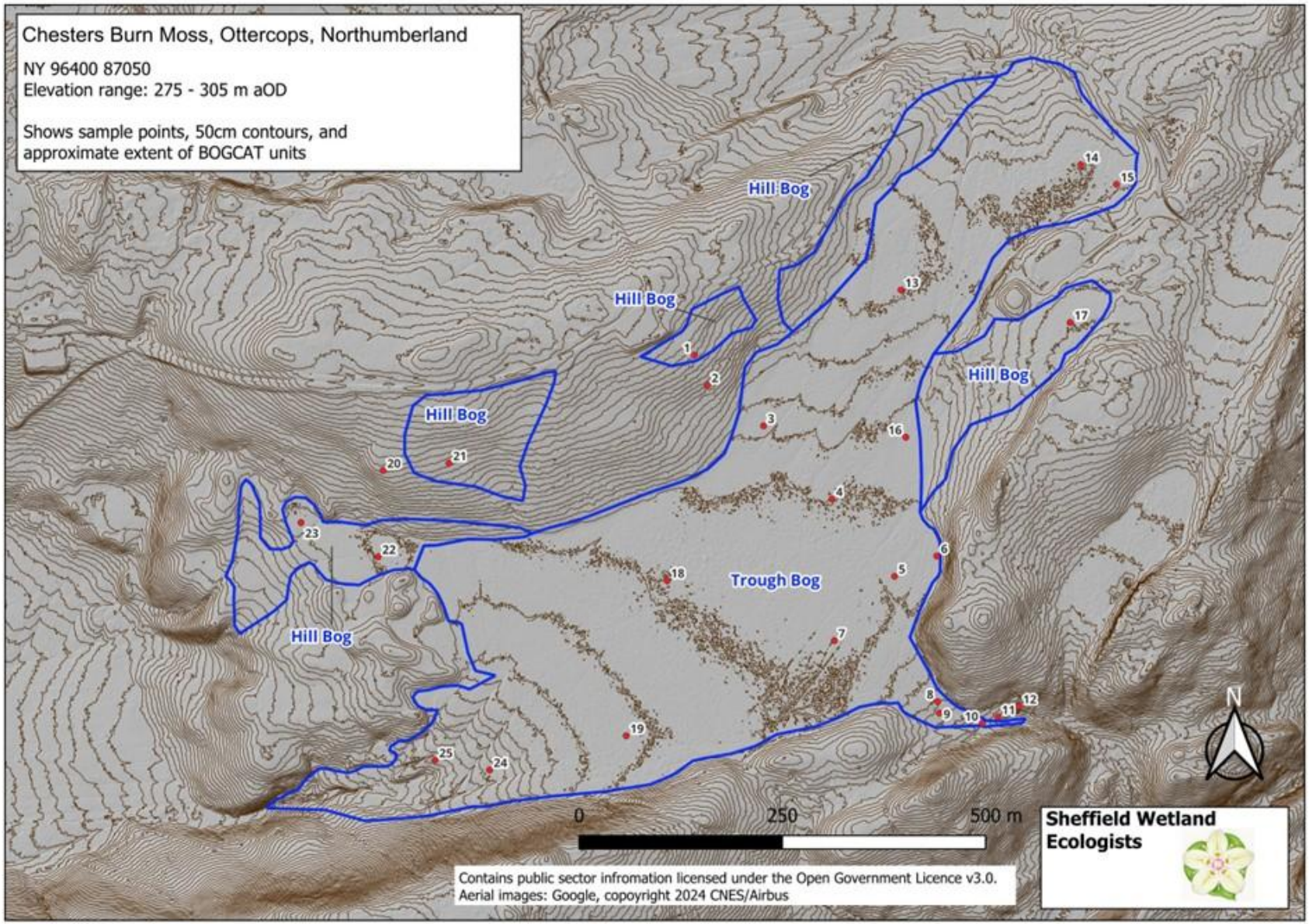
WETMECs:

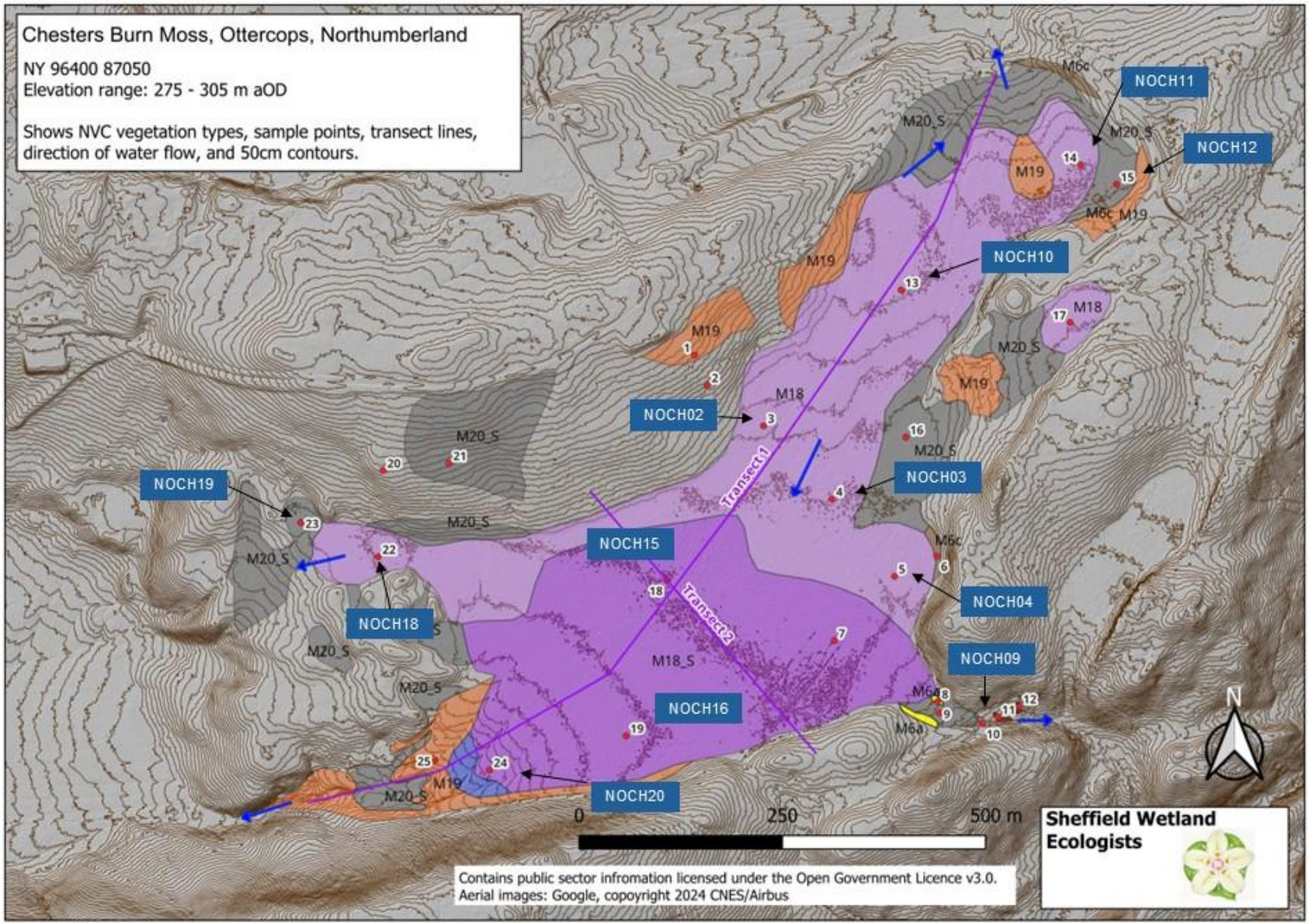
The north-eastern part of the survey area comprises a Hump Crown, with a small Apron at its northern end, and marginal Water Flow Tracks. The broader southern part of the valley is an Ombrotrophic Flow, with marginal Water Flow Tracks, and narrows into an Apron at the south-western outflow. Water Flow Tracks and Springs occupy the south-eastern outflow. Sloping Hill Peat occupies parts of the flanking mineral ridges, with two small areas of Slackening in the north-east and south-west of the valley.


Chesters Burn Moss
2023 Survey: proposed WETMEC units
Oblique view to the east
Apron
Hump Crown
Hill Peat Slopes
Water Flow Track
Ombrotrophic Flow
Hill Peat Slopes
Water Flow Track
Hill Peat Slackening
Apron
Google Earth
100 m
N

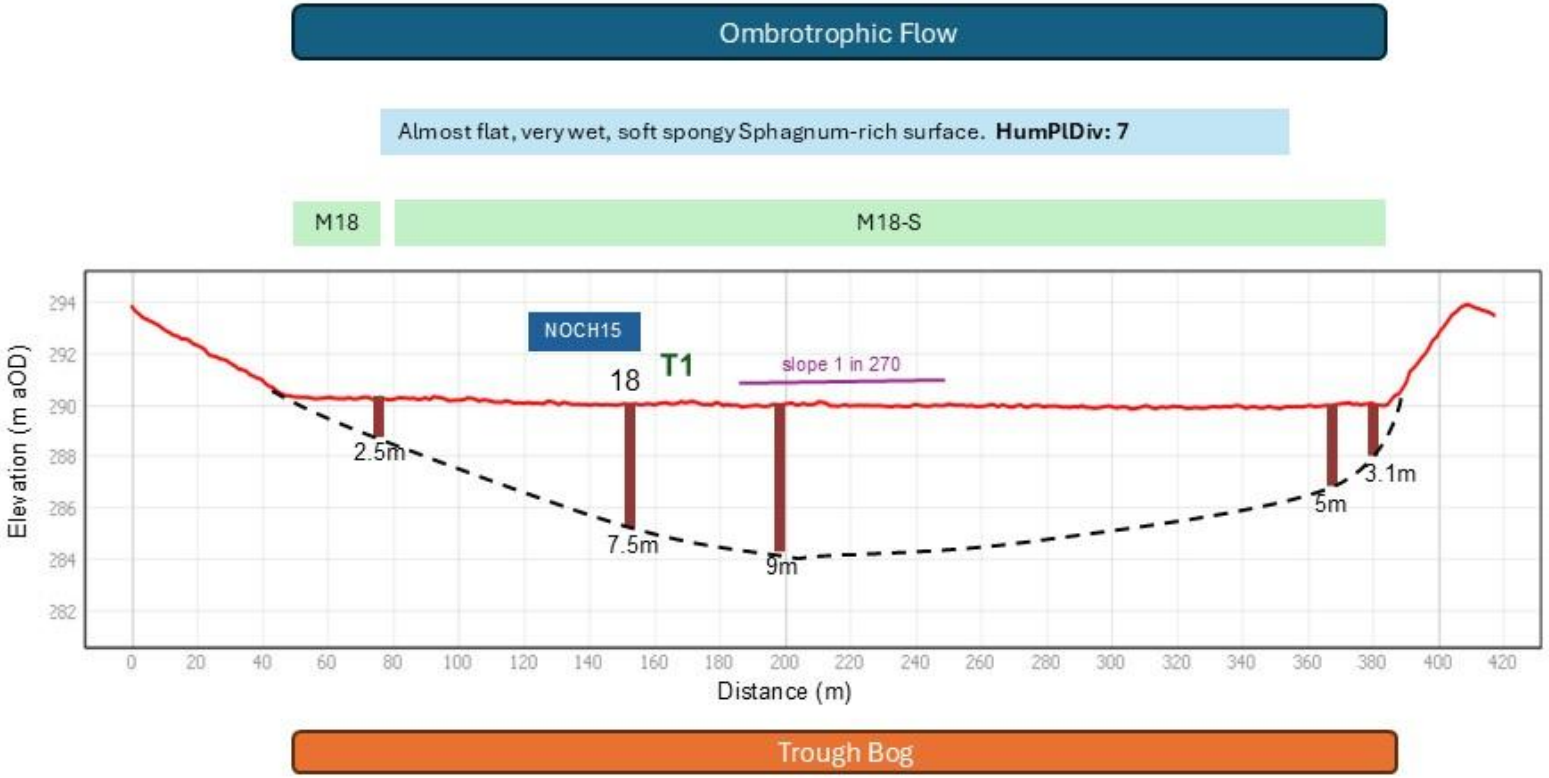

Chesters Burn Moss, Ottercops, Northumberland
NY 96400 87050
Elevation range: 275 - 305 m aOD
Shows sample points, direction of water flow, 50cm contours, and approximate extent of WETMEC units
NOCH11
NOCH12
NOCH10
NOCH02
NOCH03
NOCH19
NOCH15
NOCH18
NOCH04
NOCH09
NOCH16
NOCH20
Apron
Hill Peat Slope
Water Flow Track
Hump Crown
Hill Peat Slackening
Ombrotrophic Flow
Seepage
N
0
250
500 m
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Chesters Burn Moss
2023 Survey: proposed BOGCAT units
Oblique view to the east
Hill Bog
Hill Bog
Trough Bog
Hill Bog
Google Earth
100 m
N


Chesters Burn Moss, Ottercops, Northumberland
NY 96400 87050
Elevation range: 275 - 305 m aOD
Shows sample points, 50cm contours, and approximate extent of BOGCAT units
Hill Bog
Hill Bog
Hill Bog
Hill Bog
Hill Bog
Trough Bog
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
N
0
250
500 m
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Chesters Burn Moss, Ottercops, Northumberland
NY 96400 87050
Elevation range: 275 - 305 m aOD
Shows NVC vegetation types, sample points, transect lines, direction of water flow, and 50cm contours.
NOCH11
NOCH12
NOCH10
NOCH02
NOCH03
NOCH04
NOCH09
NOCH15
NOCH16
NOCH18
NOCH19
NOCH20
Transect 1
Transect 2
M6c
M19
M20_S
M18
M18_S
M6a
N
0
250
500 m
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Apron
Ombrotrophic Flow
Hump Crown
Apron
Steep nose of the bog (main outflow). Firm, dry surface, heather dominated, Little Sphagnum. HumPlDiv: 0
Almost flat, very wet, soft spongy Sphagnum-rich surface. HumPlDiv: 7
Gentle slope, wet, soft Sphagnum-rich surface. HumPlDiv: 5
Steep edge of the bog. Water mostly sub-surface. Surface firm, frequent Sphagnum. HumPlDiv: 0
M18
M18-S
M20-S
M19_S
M19 & M20_S
NOCH10
NOCH15
NOCH16
NOCH20
T2
slope 1 in 150
slope 1 in 270
slope 1 in 25
slope 1 in 25
13
18
19
24
25
3m
4.3m
2.6m
0.3m
7.5m
9m
7m
4.3m
2.3m
1.5m
Elevation (m aOD)
292
290
288
286
284
282
280
278
276
0
200
400
600
800
1000
1200
Distance (m)
Trough Bog
Chesters Burn Moss Transect 1: point 25 to 13 (south-west to north-east)
Note: peat depths are a different scale to surface elevations
Legend
NOCH20 - dataset sample ID
T2 - Intersection with other transects
WETMEC type
Bog surface details
5 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground



Chesters Burn Moss Transect 2: point 18 (north-west to south-east)

Note: peat depths are a different scale to surface elevations

Legend

NOCH15 - dataset sample ID

T1 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

5 – sample pt

Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score


Very wet surface, soft and spongy, very
Sphagnum-rich with bog rosemary, shallow
ditches are completely occluded


A boundary fence crossing the wet surface has sunk / has been overgrown by bog plants


Burned mineral ground on the
western margin of the bog

17.7 Scald Law, Northumberland

Scald Law Site Summary

Scald Law is situated at NY 94500 88270 on the Ray Estate at Ottercops, in Northumberland. Land use in the wider area comprises a mixture of grazing (mainly sheep with some hardy cattle), burning management for game birds, small conifer plantations, and a recently constructed wind turbine array, and the area is dissected by farm tracks and wind turbine access tracks. Broadly speaking the surface topography of the wider area is characterized by a series of low ridges, hollows, and broad shallow valleys, many of which have become infilled with peat.

Scald Law itself is a small bog near the top of a broad hill, in a tilted basin about 300 m across and at an elevation of about 308 m aOD. Mineral slopes rise up from it to the north and west to about 313 m aOD, whilst gently sloping mineral ground and shallow peat fall to the east into a small col at about 298 m aOD. The bog basin shows a very slight eccentric dome across its centre, highest at the north-western corner.

Peat depth measurements show the deepest peat (5.5 m) to be in the western part of the basin, beneath the eccentric dome, shallowing rapidly near to the base of the surrounding slopes, which have only about 30 cm of peat. To the south the ground drops steeply, and ditched outflows from the bog follows this route. The gentle eastern slope has shallow peat up to 1 m depth, leading down to the small col, which reaches 1.5 m depth, and where there are clear signs of former peat cutting. The bog basin has been drained by a series of shallow grips about 0.5 m wide and 0.5 m deep, the majority of which have recently been blocked.

Most of the deep peat supports diverse and very *Sphagnum*-rich M18-S bog vegetation with frequent large hummocks and shallow pools. There is abundant but stunted heather and cross-leaved heath, much hare's-tail cottongrass, and a rich sward of Sphagnum mosses: *Sphagnum medium*, *Sphagnum papillosum*, *Sphagnum rubellum*, and *Sphagnum capillifolium*, with frequent *Sphagnum cuspidatum* and *Sphagnum tenellum*. Other species include sundew, bog asphodel, deergrass, and cranberry.

Surrounding this and occupying the shallower peat margins of the bog basin is a broad belt of M19-S bog vegetation, which is slightly less Sphagnum-rich, with more pleurocarpous mosses, lacks bog asphodel, deergrass, and *Sphagnum medium*, and has a more robust cover of heather and cross-leaved heath. The eastern col also has this type of vegetation.

Scald Law Site Summary (continued)

At the western edge of the bog basin is a narrow lagg-like fringe of cottongrass-dominated vegetation; similar vegetation is found on the gentler parts of the slopes that surround much of the basin, and on the slightly deeper peat that slopes down to the eastern col. This is **M20-S** bog vegetation and is dominated by hare's-tail cottongrass, with abundant *Sphagnum fallax*, wavy hair-grass, and the bryophytes *Polytrichum commune*, and *Pleurozium schreberi.* There is also frequent cranberry, and a few other bryophytes: *Aulacomnium palustre, Sphagnum fimbriatum, Sphagnum palustre*, and *Sphagnum rubellum.*

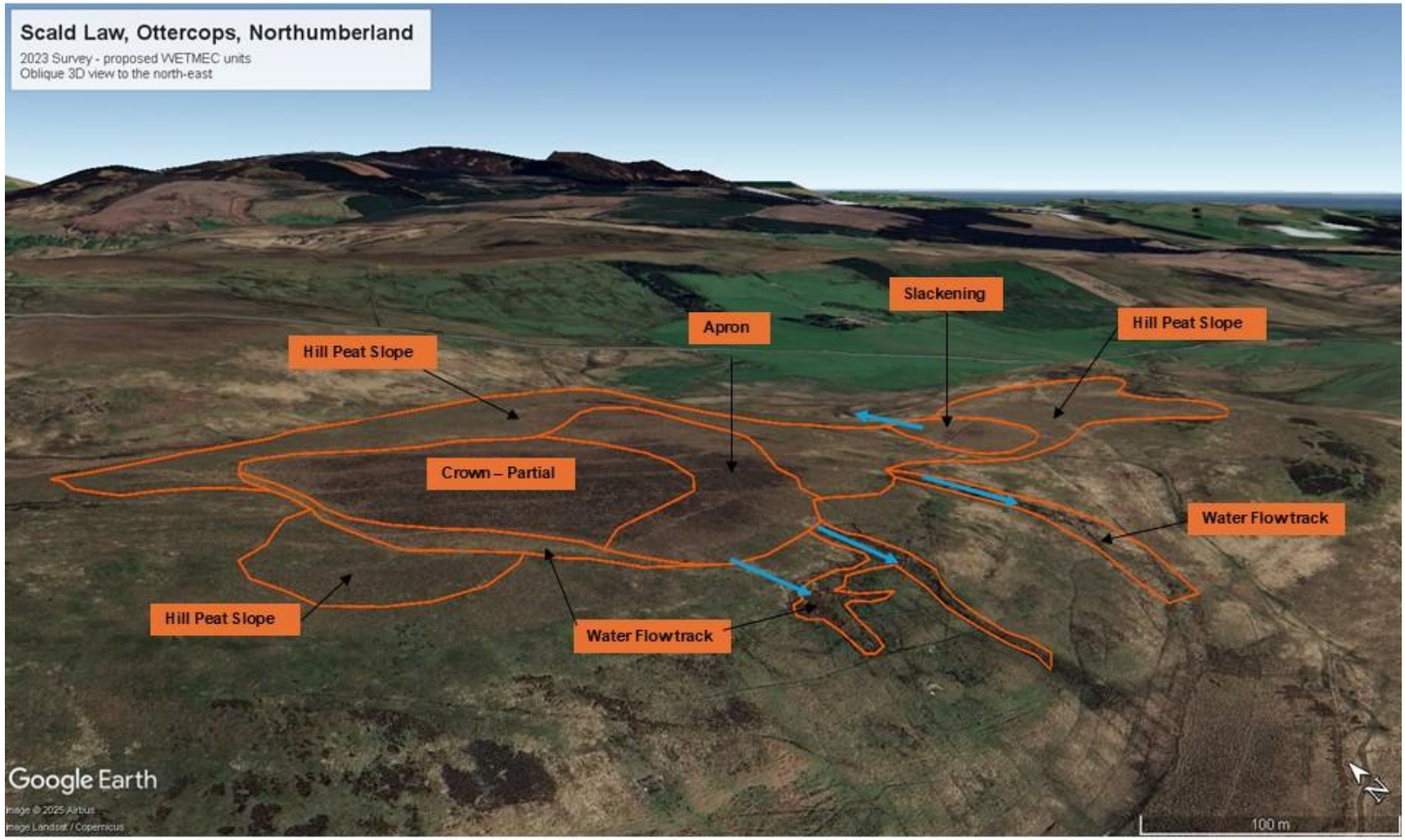
Base-poor water flow tracks on the southern side of the bog basin flow away down a steep slope. These are examples of **M6c mire** and are extremely species-poor, dominated by soft rush with abundant *Sphagnum fallax*, *Sphagnum palustre,* and *Polytrichum commune.*

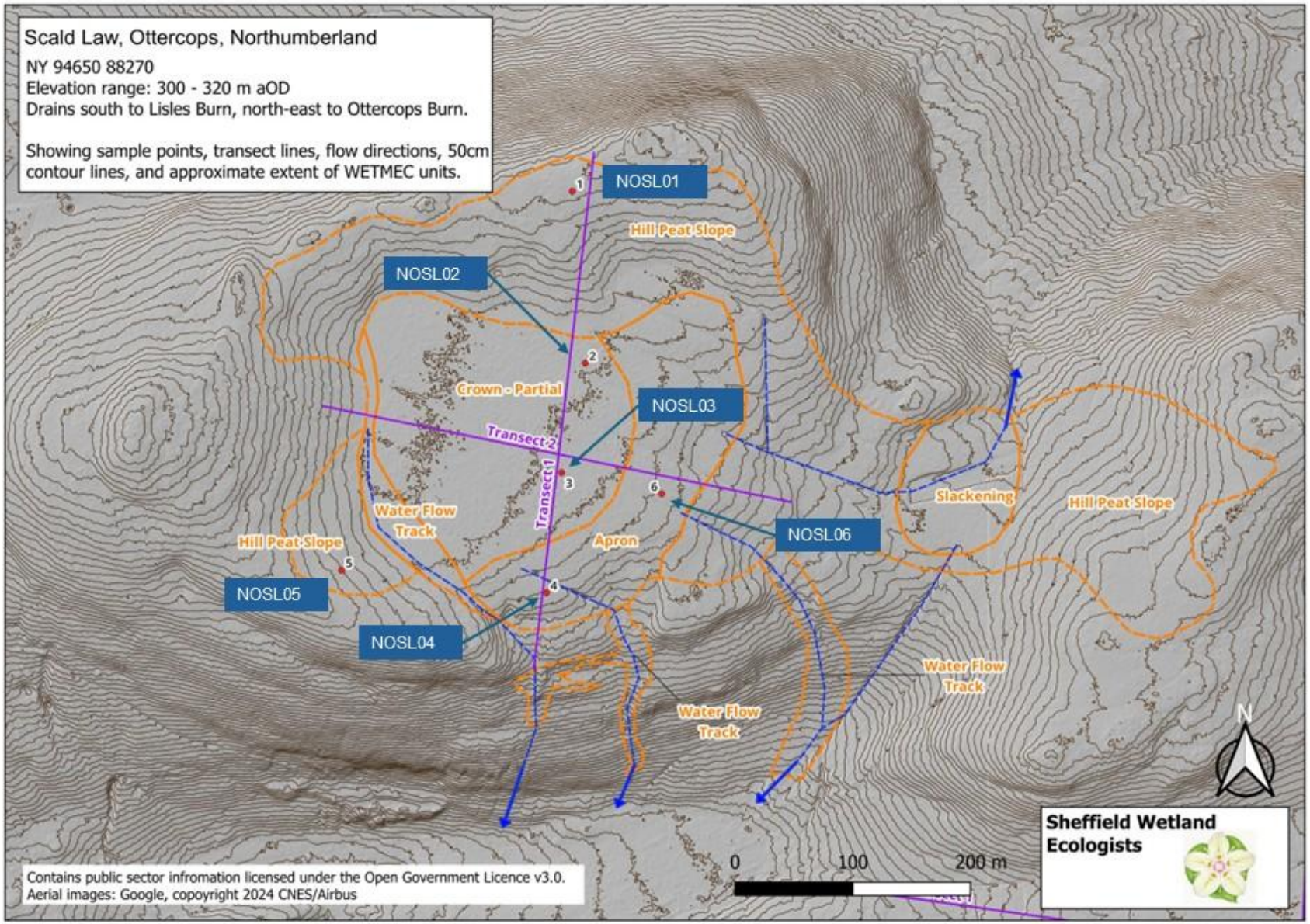
BOGCATs:

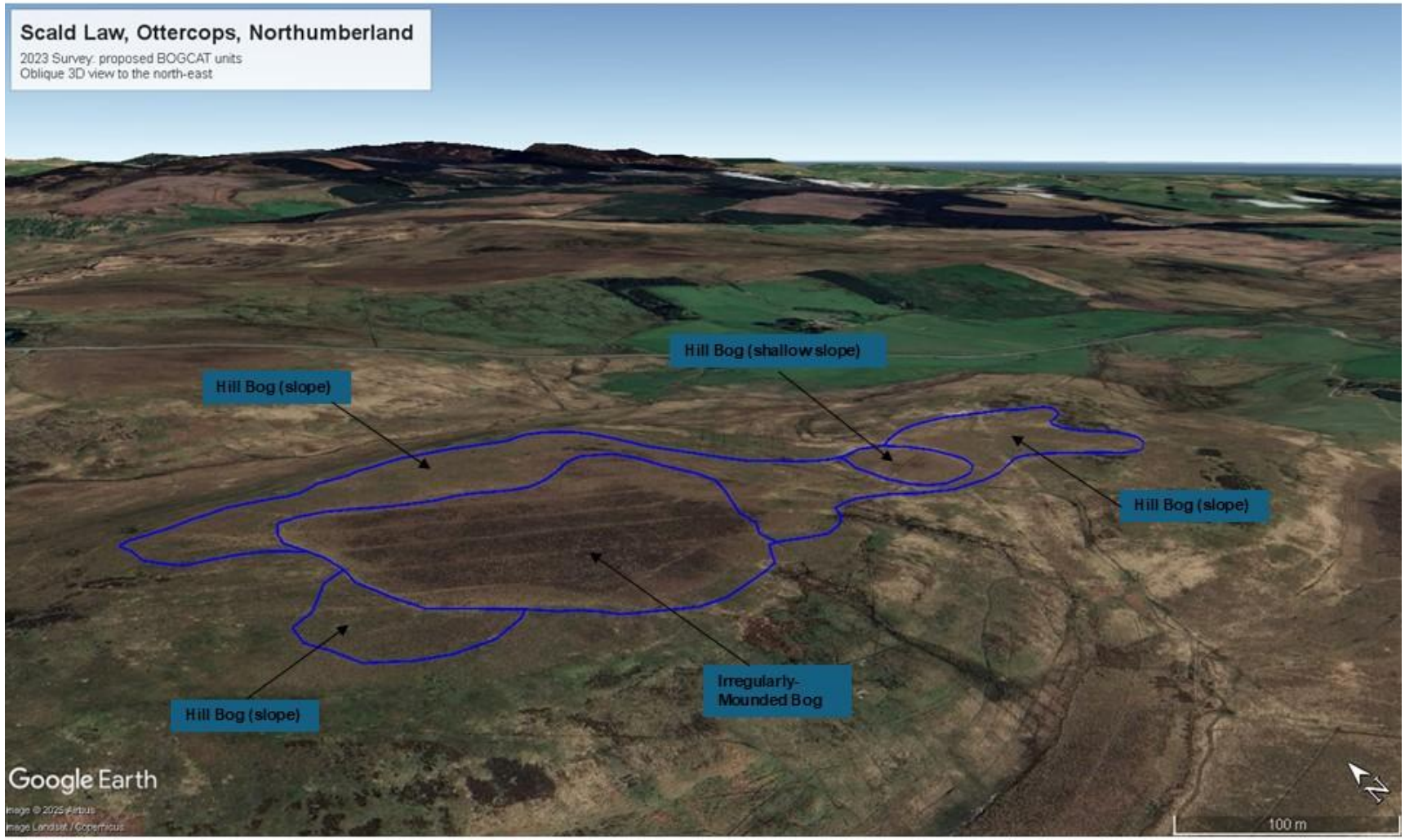
In terms of BOGCAT types, the main bog basin is an example of an Irregularly-Mounded Bog that is surrounded by sloping Hill Bog, while the small eastern col is Hill Bog on a shallow slope.

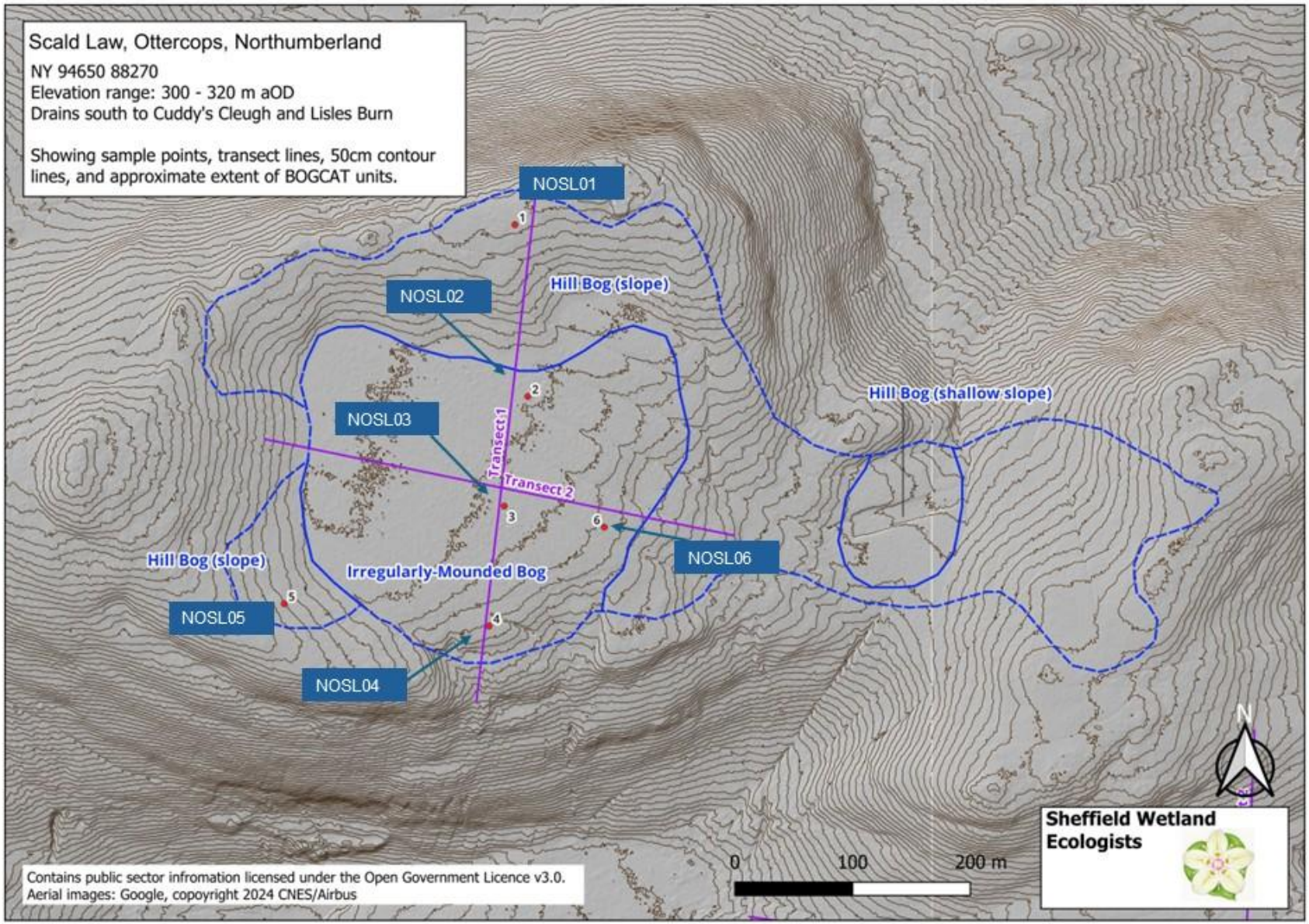
WETMECs:

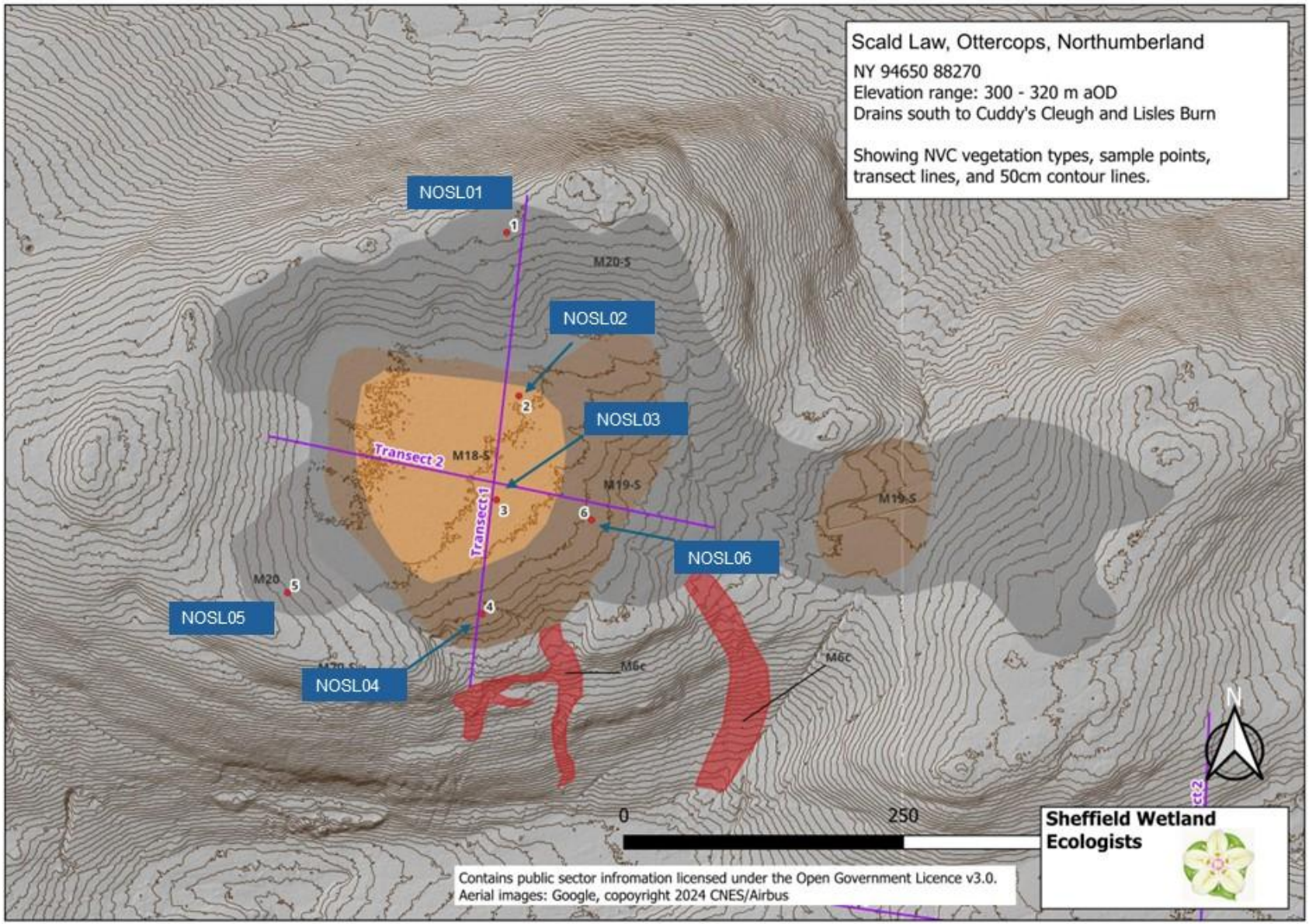
Much of the survey area comprises the Sloping Hill Peat WETMEC, with a small Slackening occupying the eastern col. The bog basin consists of a Partial Crown that slopes to the east and south, forming an Apron. A Water Flow Track forms a partial lagg zone along the western edge of the bog basin, outflowing to the south, and other Water Flow Tracks also flow off the bog to the south.

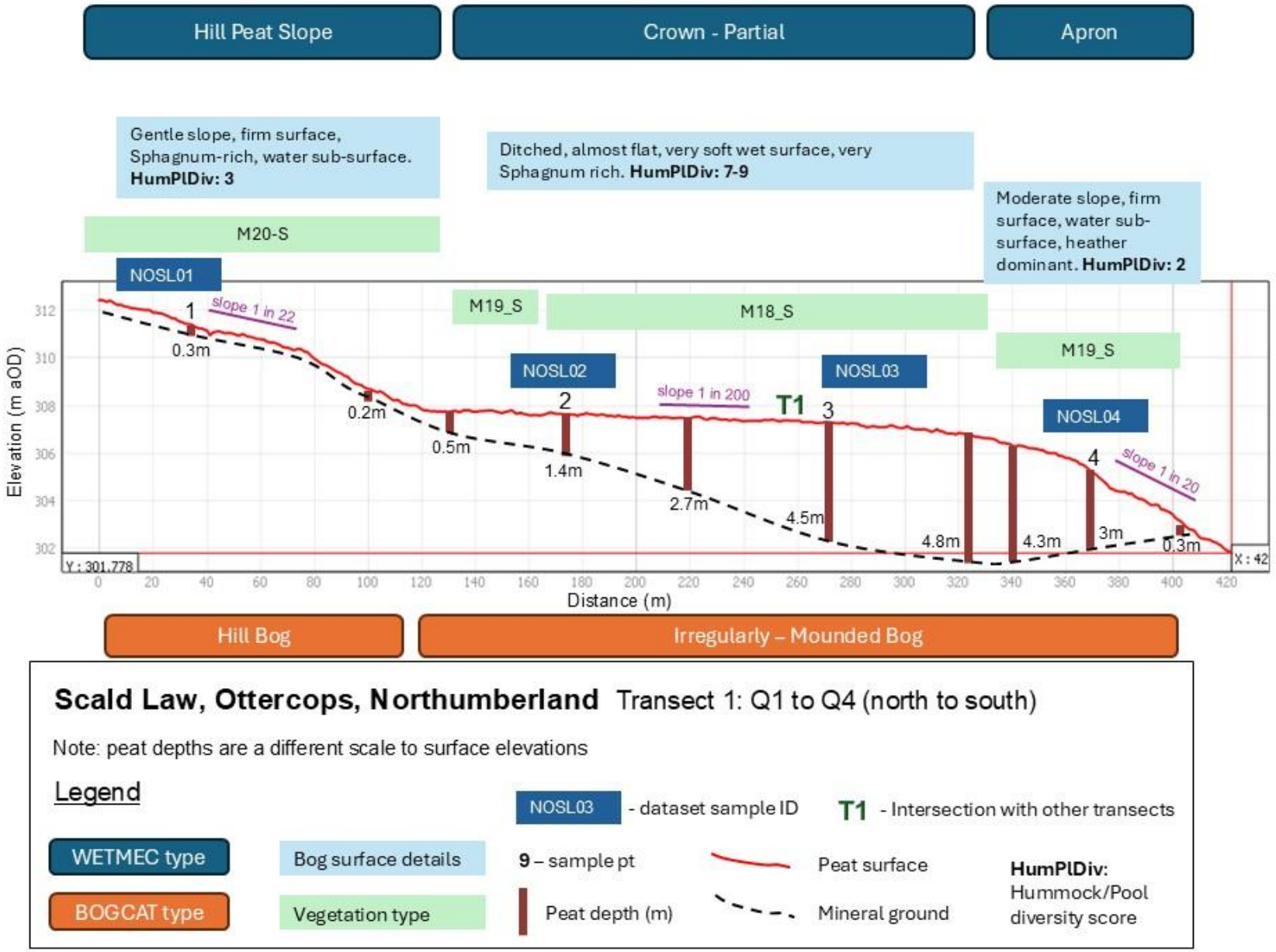

Scald Law, Ottercops, Northumberland
2023 Survey - proposed WETMEC units
Oblique 3D view to the north-east
Slackening
Apron
Hill Peat Slope
Hill Peat Slope
Crown – Partial
Water Flowtrack
Hill Peat Slope
Water Flowtrack
Google Earth
100 m

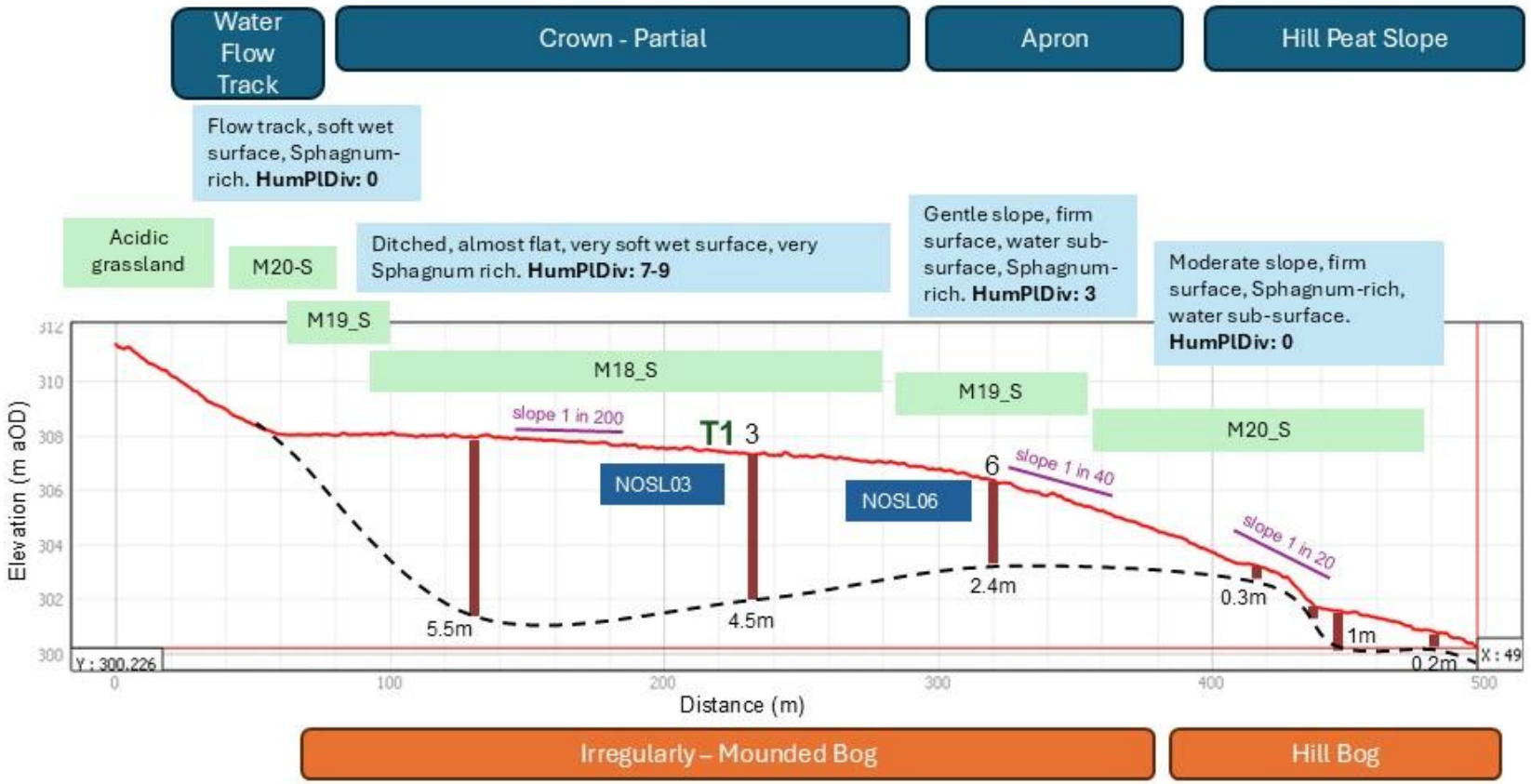

Scald Law, Ottercops, Northumberland
NY 94650 88270
Elevation range: 300 - 320 m aOD
Drains south to Lisles Burn, north-east to Ottercops Burn.
Showing sample points, transect lines, flow directions, 50cm contour lines, and approximate extent of WETMEC units.
NOSL01
NOSL02
NOSL03
NOSL04
NOSL05
NOSL06
Hill Peat Slope
Crown - Partial
Transect 2
Transect 1
Water Flow Track
Apron
Slackening
Hill Peat Slope
Hill Peat Slope
Water Flow Track
Water Flow Track
1
2
3
4
5
6
N
0
100
200 m
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Scald Law, Ottercops, Northumberland
2023 Survey: proposed BOGCAT units
Oblique 3D view to the north-east
Hill Bog (shallow slope)
Hill Bog (slope)
Hill Bog (slope)
Irregularly-Mounded Bog
Hill Bog (slope)
Google Earth
100 m


Scald Law, Ottercops, Northumberland
NY 94650 88270
Elevation range: 300 - 320 m aOD
Drains south to Cuddy's Cleugh and Lisles Burn
Showing sample points, transect lines, 50cm contour lines, and approximate extent of BOGCAT units.
NOSL01
NOSL02
NOSL03
NOSL04
NOSL05
NOSL06
Hill Bog (slope)
Hill Bog (shallow slope)
Irregularly-Mounded Bog
Transect 1
Transect 2
1
2
3
4
5
6
N
0
100
200 m
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Aerial images: Google, copoyright 2024 CNES/Airbus


Scald Law, Ottercops, Northumberland
NY 94650 88270
Elevation range: 300 - 320 m aOD
Drains south to Cuddy's Cleugh and Lisles Burn
Showing NVC vegetation types, sample points, transect lines, and 50cm contour lines.
NOSL01
NOSL02
NOSL03
NOSL04
NOSL05
NOSL06
Transect 1
Transect 2
M18-S
M19-S
M20-S
M20
M6c
N
0
250
Sheffield Wetland Ecologists
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Aerial images: Google, copoyright 2024 CNES/Airbus


Hill Peat Slope
Crown - Partial
Apron
Gentle slope, firm surface, Sphagnum-rich, water sub-surface. HumPlDiv: 3
Ditched, almost flat, very soft wet surface, very Sphagnum rich. HumPlDiv: 7-9
Moderate slope, firm surface, water sub-surface, heather dominant. HumPlDiv: 2
M20-S
M19_S
M18_S
M19_S
NOSL01
NOSL02
NOSL03
NOSL04
1
2
3
4
T1
slope 1 in 22
slope 1 in 200
slope 1 in 20
0.3m
0.2m
0.5m
1.4m
2.7m
4.5m
4.8m
4.3m
3m
0.3m
Elevation (m aOD)
Distance (m)
Y : 301.778
X : 42
Hill Bog
Irregularly – Mounded Bog
Scald Law, Ottercops, Northumberland Transect 1: Q1 to Q4 (north to south)
Note: peat depths are a different scale to surface elevations
Legend
NOSL03 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
BOGCAT type
Bog surface details
Vegetation type
9 – sample pt
Peat depth (m)
Peat surface
Mineral ground
HumPlDiv: Hummock/Pool diversity score


Water Flow Track
Crown - Partial
Apron
Hill Peat Slope
Flow track, soft wet surface, Sphagnum-rich. HumPlDiv: 0
Acidic grassland
M20-S
Ditched, almost flat, very soft wet surface, very Sphagnum rich. HumPlDiv: 7-9
Gentle slope, firm surface, water sub-surface, Sphagnum-rich. HumPlDiv: 3
Moderate slope, firm surface, Sphagnum-rich, water sub-surface. HumPlDiv: 0
M19_S
M18_S
M19_S
M20_S
slope 1 in 200
slope 1 in 40
slope 1 in 20
T1 3
6
NOSL03
NOSL06
5.5m
4.5m
2.4m
0.3m
1m
0.2m
Elevation (m aOD)
Distance (m)
Irregularly – Mounded Bog
Hill Bog
Scald Law, Ottercops, Northumberland Transect 2: Q3 to Q6 (west to east)
Note: peat depths are a different scale to surface elevations
Legend
NOSL03 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground


View across the centre of the bog from
the northern edge, with M18-S
vegetation in the distance, and M19-S
in the foreground.



View from the western slopes supporting tussocky hare's-tail cottongrass (M20-S vegetation). In the far left the bog basin with M18-S vegetation is visible as a darker region.

17.8 Whitelee Moor, Northumberland

Whitelee Moor NNR, Northumberland

The survey area at Whitelee Moor is situated at NT 68600 05320 and comprises a long, gently sloping ridge trending north-east to south-west that marks the border between Scotland and England. The lower flanks of the ridge support conifer plantations, the gentle upper slopes have bog, grading into acidic grassland on steeper slopes. The highest point of the ridge is at 579 m aOD. There were no signs of livestock grazing.

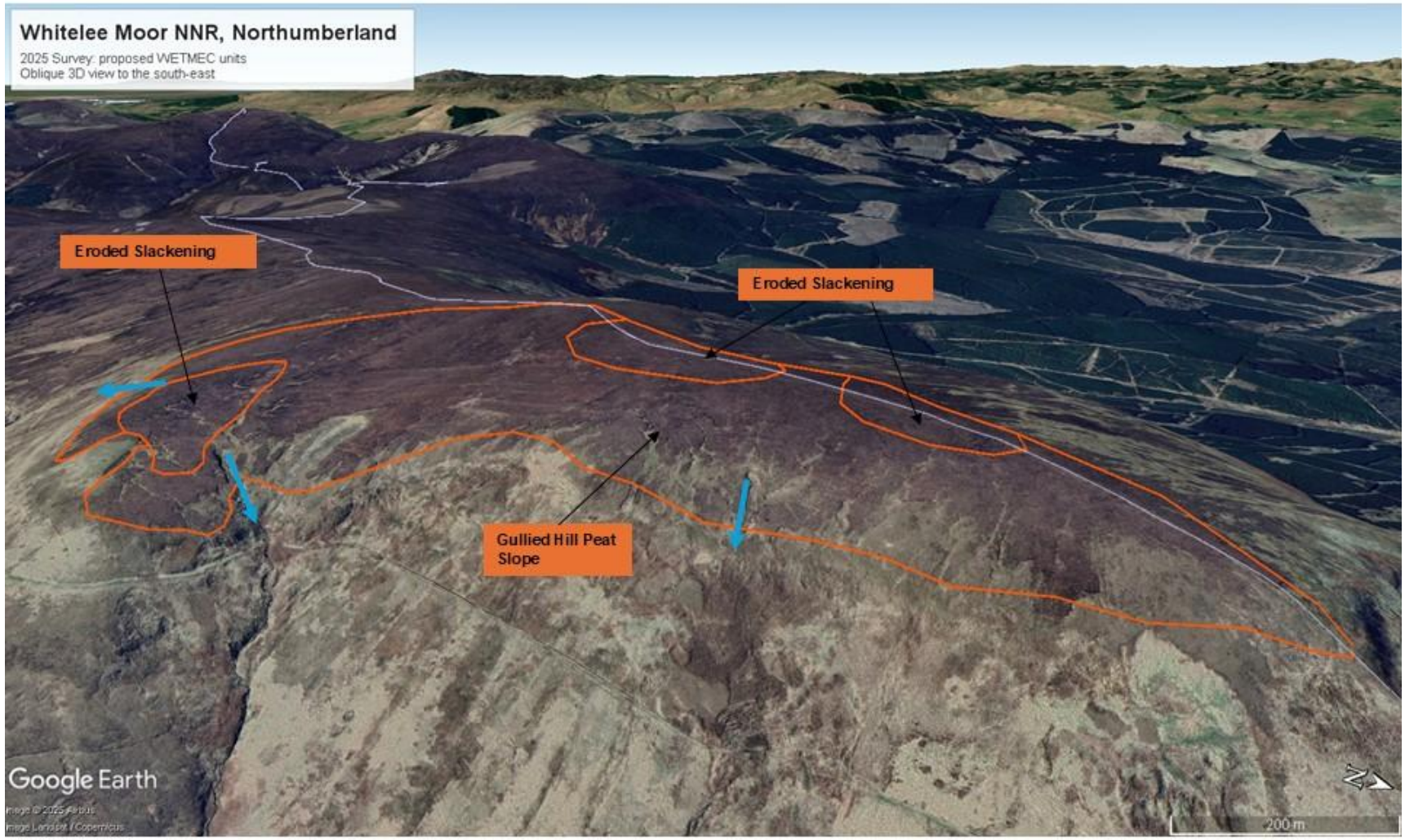
The flanks of the ridge have peat between 1 and 2m in depth, and support quite species-poor heather-cottongrass bog (M19) with some bilberry, deergrass, pleurocarpous mosses, and rare to occasional patches of *Sphagnum capillifolium*. In many places these show signs of past erosion, with small gullies that have been blocked with plastic dams. The steepest slopes reach about 1 in 5 gradient (20%).

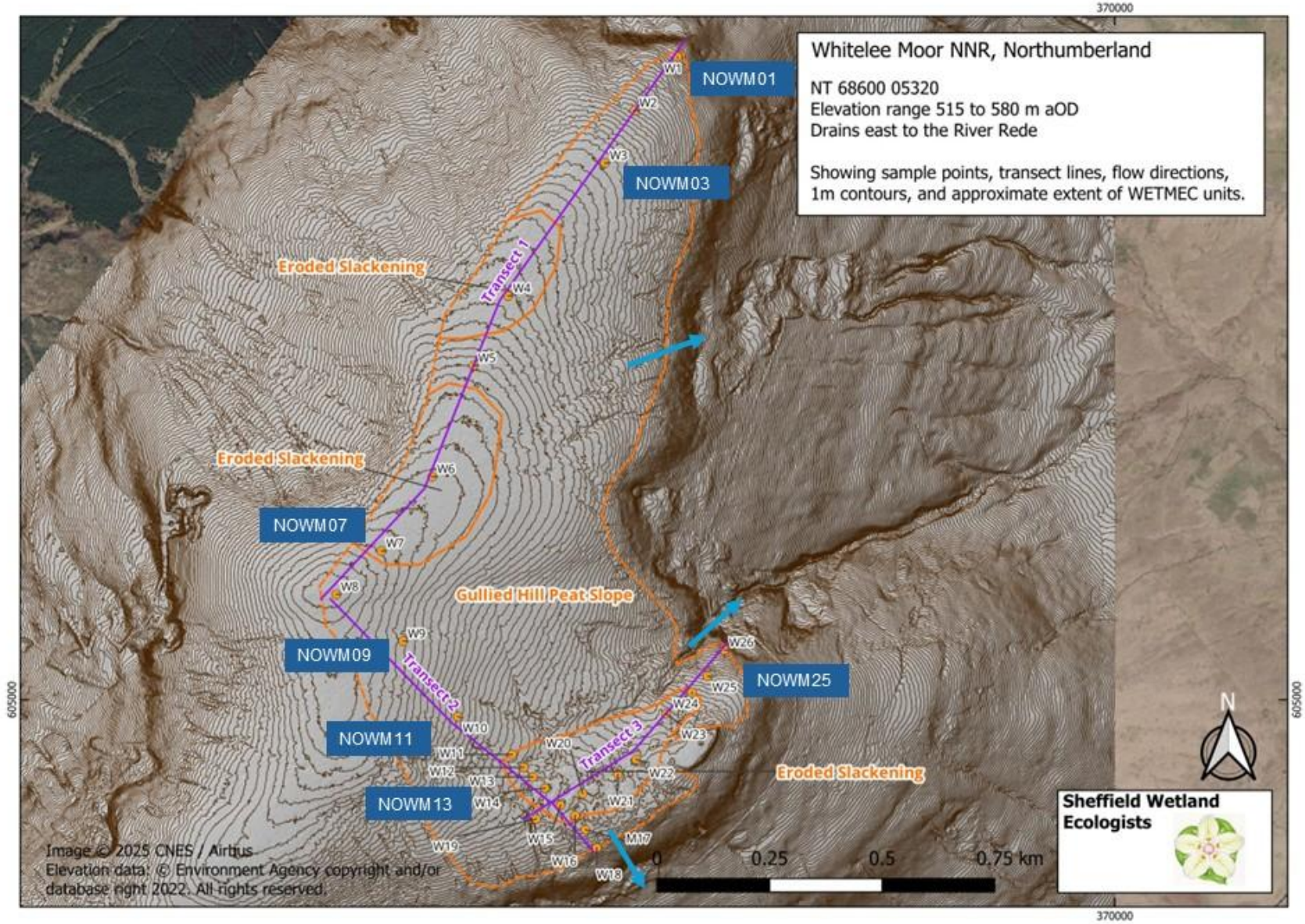
Along the top of the ridge, much gentler slopes lead up towards the crest, with gradients as low as 1 in 80 (about 1.2%). In places there is deeper peat to about 2.8m in depth, and more Sphagnum-rich M19-S vegetation, with abundant *Sphagnum papillosum, S. subnitens,* and *S. capillifolium*, beneath hare's-tail cottongrass and heather. Frequent shallow erosion gullies have been dammed with coir rolls, which are holding back water in shallow pools.

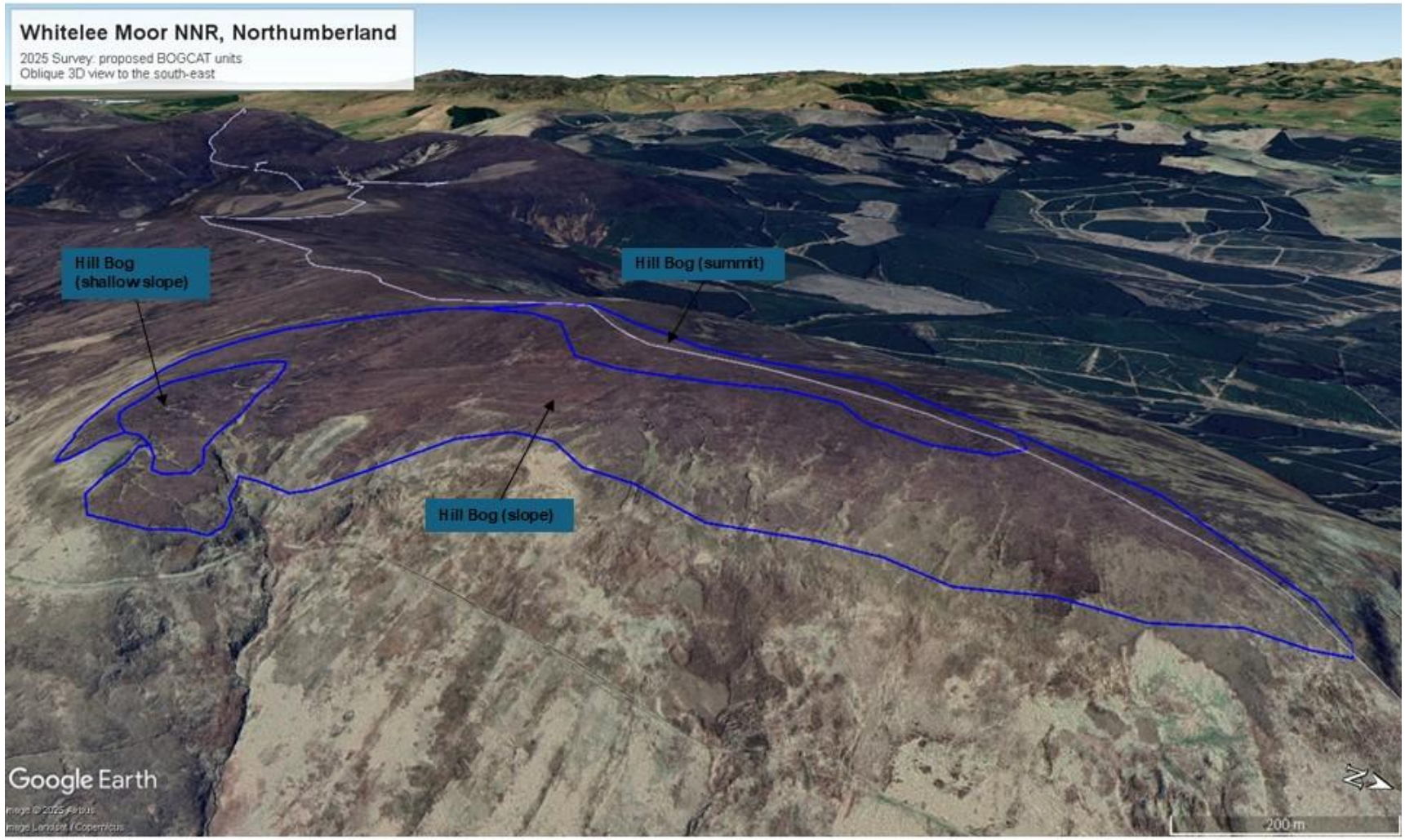
On the south-eastern flank of the ridge a moderate slope of M19 bog vegetation leads down to a small spur that forms a gently sloping bog-covered bench, before dropping down steeply into the valley below, onto grass- and bracken-covered slopes. The bench itself has gradients of around 1 in 40 (2.5%), and has been intensively eroded, with a dense network of varying depth gullies and hollows that have been blocked with plastic dams and coir rolls. The gullies are now completely revegetated with abundant Sphagnum mosses (mainly *Sphagnum papillosum* and *S. medium*) and cotton grass, and the adjacent low haggs are also quite diverse with heather, deer grass, bog asphodel, cotton grasses, *Cladonia* lichens and the moss *Racomitrium lanuginosum*, and a range of Sphagnum species. The vegetation is a form of M18/M19.

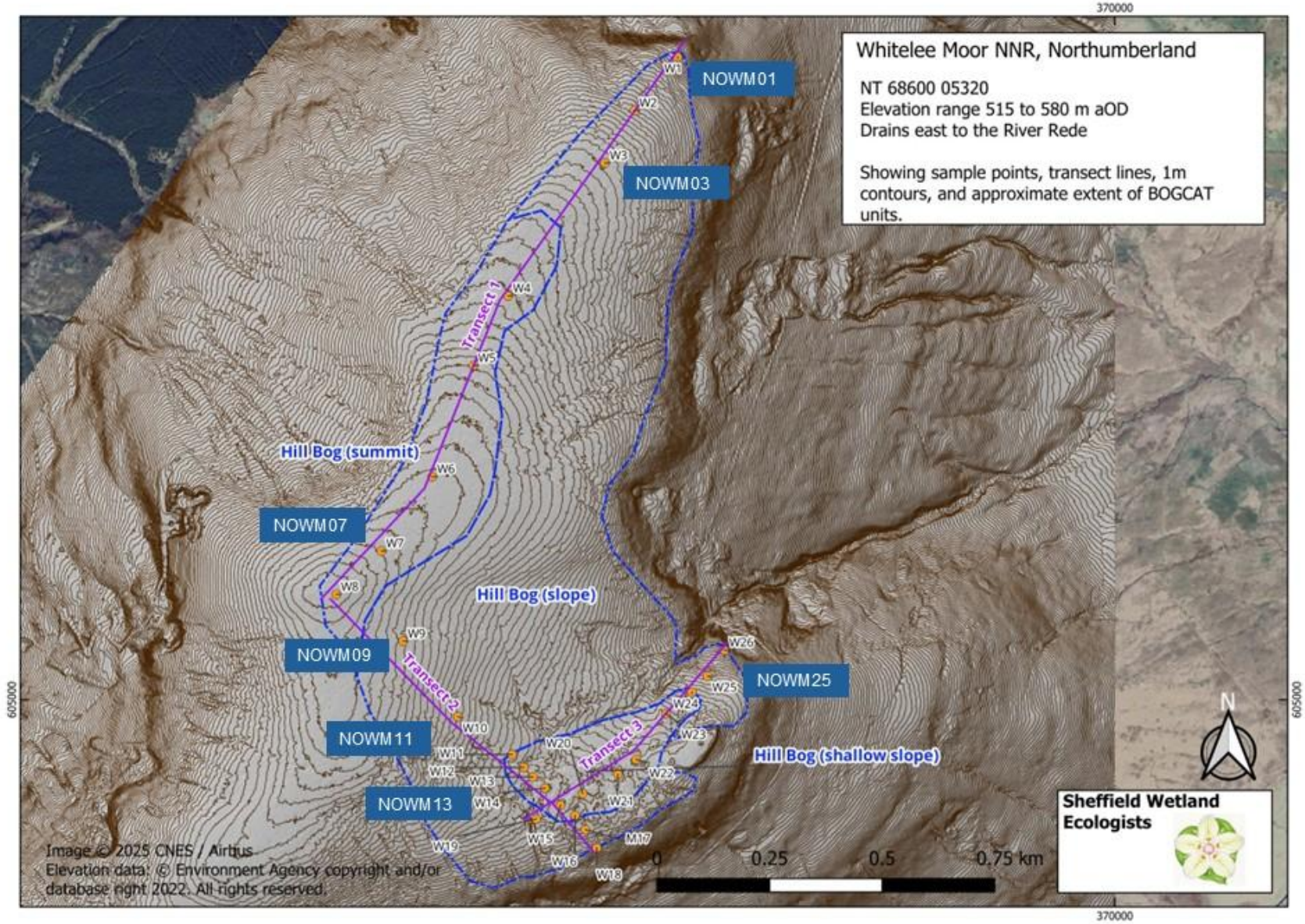
BOGCATs comprise Hill Bog, within which can be recognised areas of summit, slope, and shallow slope.

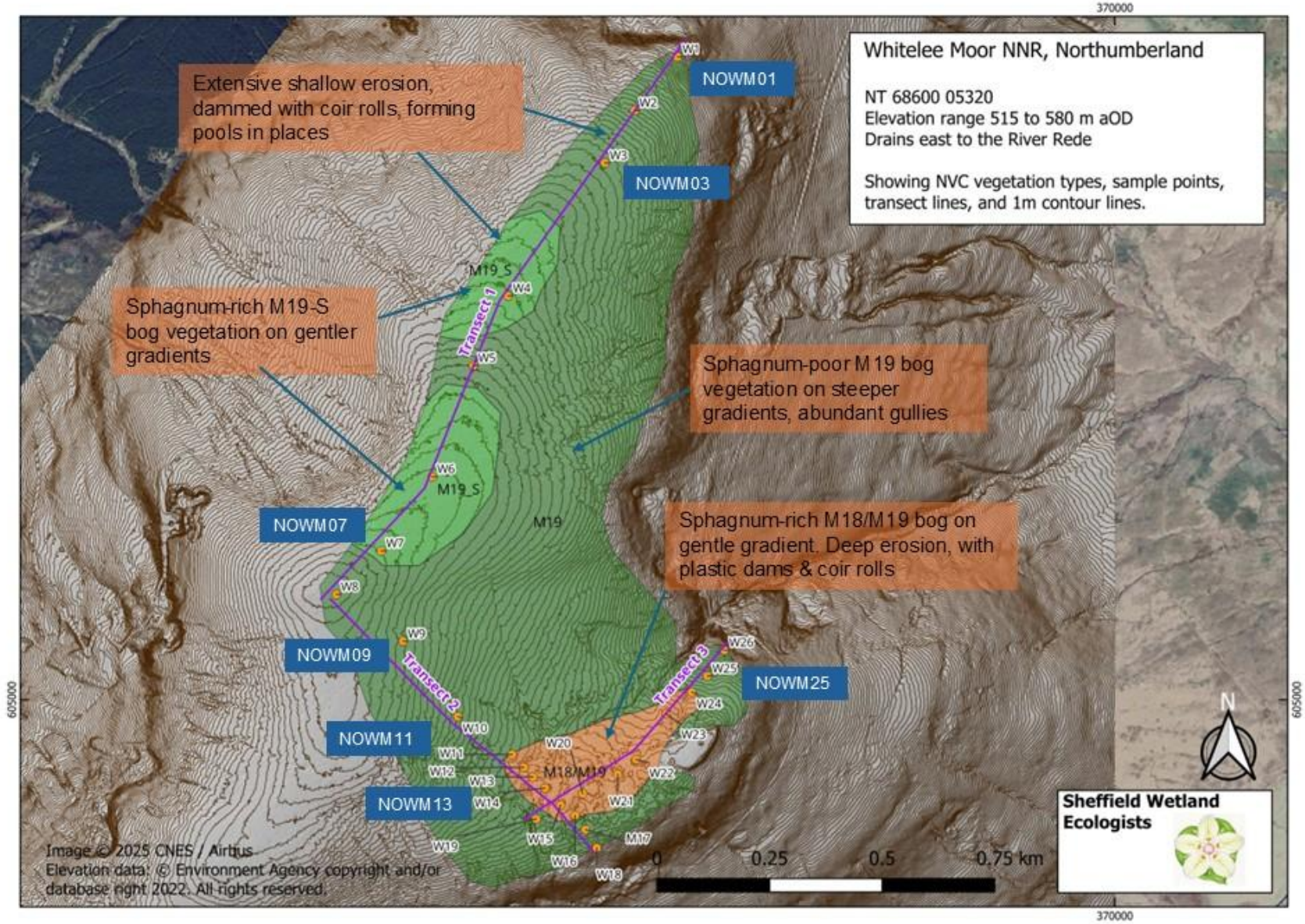
WETMECs consist of mostly Gullied Hill Peat Slope, with several areas of Eroded Slackenings on the ridge top and also on the bench area.

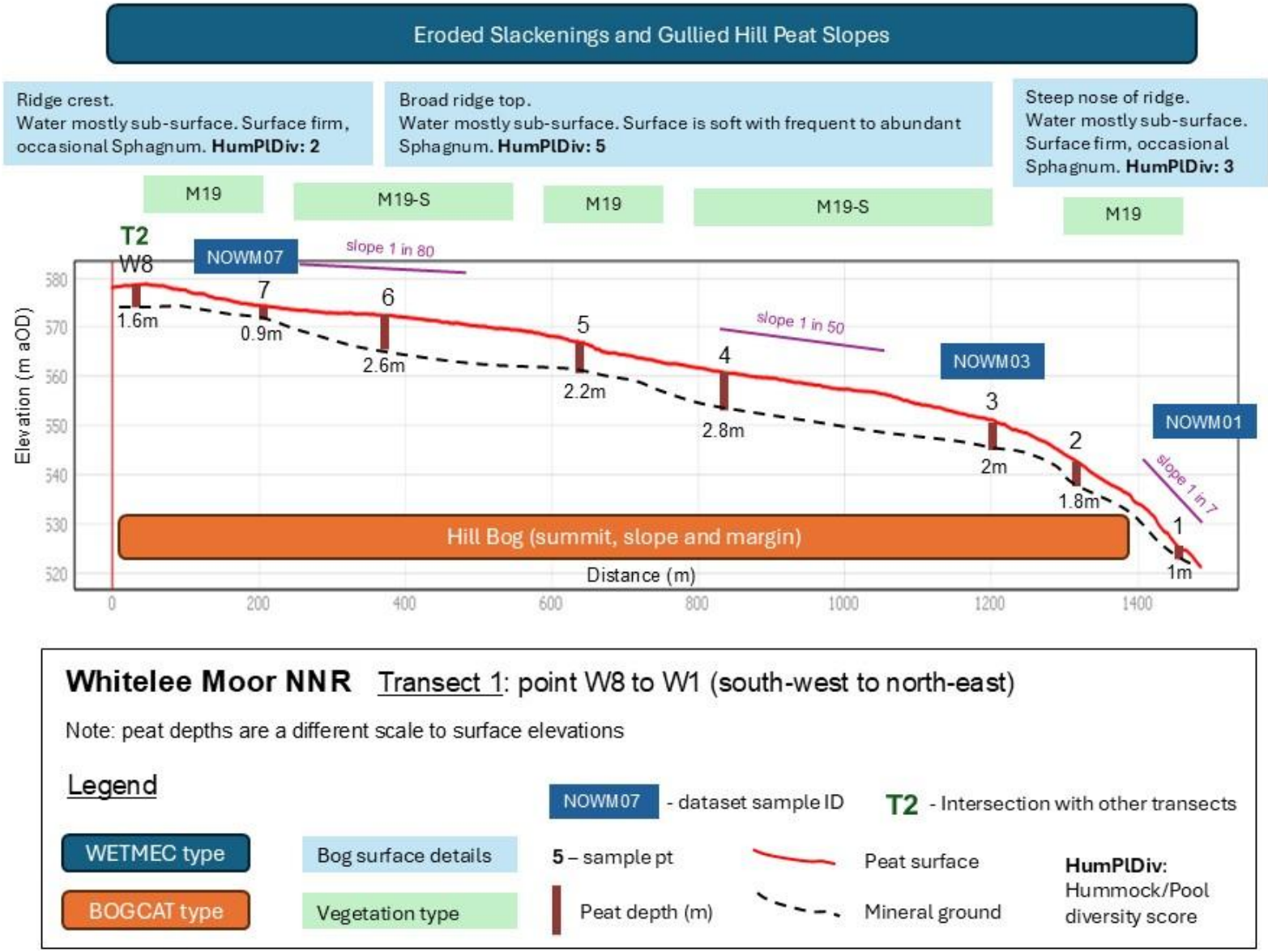

Whitelee Moor NNR, Northumberland
2025 Survey: proposed WETMEC units
Oblique 3D view to the south-east
Eroded Slackening
Eroded Slackening
Gullied Hill Peat Slope
Google Earth
200 m

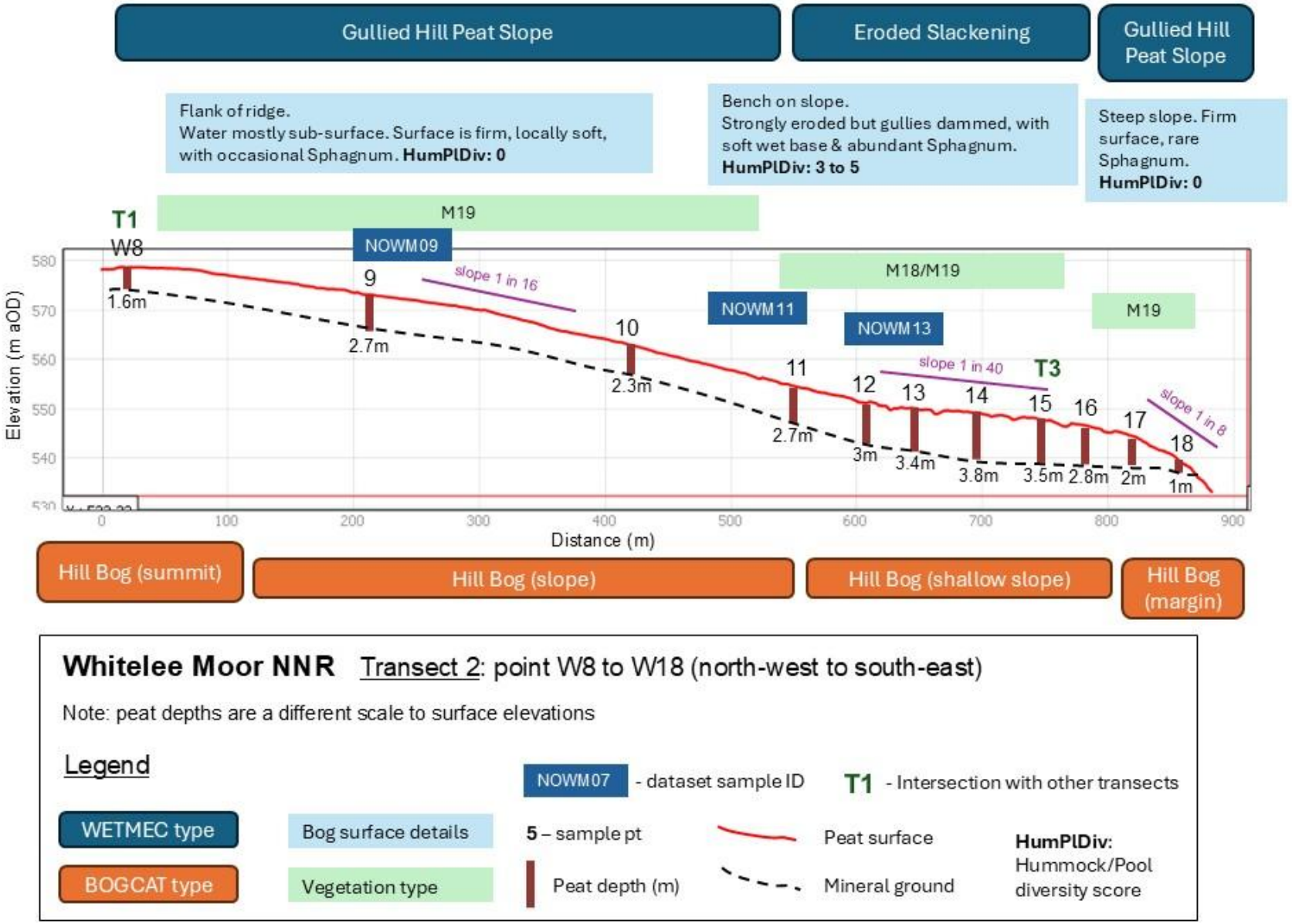

Whitelee Moor NNR, Northumberland
NT 68600 05320
Elevation range 515 to 580 m aOD
Drains east to the River Rede
Showing sample points, transect lines, flow directions, 1m contours, and approximate extent of WETMEC units.
NOWM01
NOWM03
NOWM07
NOWM09
NOWM11
NOWM13
NOWM25
Eroded Slackening
Eroded Slackening
Eroded Slackening
Gullied Hill Peat Slope
Transect 1
Transect 2
Transect 3
W1
W2
W3
W4
W5
W6
W7
W8
W9
W10
W11
W12
W13
W14
W15
W16
W17
W18
W19
W20
W21
W22
W23
W24
W25
W26
370000
605000
N
0
0.25
0.5
0.75 km
Sheffield Wetland Ecologists
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Whitelee Moor NNR, Northumberland
2025 Survey: proposed BOGCAT units
Oblique 3D view to the south-east
Hill Bog (shallow slope)
Hill Bog (summit)
Hill Bog (slope)
Google Earth
200 m


Whitelee Moor NNR, Northumberland
NT 68600 05320
Elevation range 515 to 580 m aOD
Drains east to the River Rede
Showing sample points, transect lines, 1m contours, and approximate extent of BOGCAT units.
NOWM01
NOWM03
NOWM07
NOWM09
NOWM11
NOWM13
NOWM25
Hill Bog (summit)
Hill Bog (slope)
Hill Bog (shallow slope)
Transect 1
Transect 2
Transect 3
W1
W2
W3
W4
W5
W6
W7
W8
W9
W10
W11
W12
W13
W14
W15
W16
W17
W18
W19
W20
W21
W22
W23
W24
W25
W26
370000
605000
N
0
0.25
0.5
0.75 km
Sheffield Wetland Ecologists
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Whitelee Moor NNR, Northumberland
NT 68600 05320
Elevation range 515 to 580 m aOD
Drains east to the River Rede
Showing NVC vegetation types, sample points, transect lines, and 1m contour lines.
Extensive shallow erosion, dammed with coir rolls, forming pools in places
Sphagnum-rich M19-S bog vegetation on gentler gradients
Sphagnum-poor M19 bog vegetation on steeper gradients, abundant gullies
Sphagnum-rich M18/M19 bog on gentle gradient. Deep erosion, with plastic dams & coir rolls
NOWM01
NOWM03
NOWM07
NOWM09
NOWM11
NOWM13
NOWM25
Transect 1
Transect 2
Transect 3
M19_S
M19
M18/M19
370000
605000
N
0
0.25
0.5
0.75 km
Sheffield Wetland Ecologists
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Eroded Slackenings and Gullied Hill Peat Slopes
Ridge crest.
Water mostly sub-surface. Surface firm, occasional Sphagnum. HumPlDiv: 2
Broad ridge top.
Water mostly sub-surface. Surface is soft with frequent to abundant Sphagnum. HumPlDiv: 5
Steep nose of ridge.
Water mostly sub-surface.
Surface firm, occasional Sphagnum. HumPlDiv: 3
M19
M19-S
M19
M19-S
M19
T2
W8
NOWM07
slope 1 in 80
slope 1 in 50
NOWM03
NOWM01
slope 1 in 7
7
6
5
4
3
2
1
1.6m
0.9m
2.6m
2.2m
2.8m
2m
1.8m
1m
Hill Bog (summit, slope and margin)
Elevation (m aOD)
Distance (m)
380
370
360
350
340
330
320
0
200
400
600
800
1000
1200
1400
Whitelee Moor NNR Transect 1: point W8 to W1 (south-west to north-east)
Note: peat depths are a different scale to surface elevations
Legend
NOWM07 - dataset sample ID
T2 - Intersection with other transects
WETMEC type
BOGCAT type
Bog surface details
Vegetation type
5 – sample pt
Peat depth (m)
Peat surface
Mineral ground
HumPlDiv: Hummock/Pool diversity score


Gullied Hill Peat Slope
Eroded Slackening
Gullied Hill Peat Slope
Flank of ridge.
Water mostly sub-surface. Surface is firm, locally soft, with occasional Sphagnum. HumPlDiv: 0
Bench on slope.
Strongly eroded but gullies dammed, with soft wet base & abundant Sphagnum.
HumPlDiv: 3 to 5
Steep slope. Firm surface, rare Sphagnum.
HumPlDiv: 0
M19
T1
W8
NOWM09
M18/M19
NOWM11
NOWM13
M19
T3
slope 1 in 16
slope 1 in 40
slope 1 in 8
1.6m
2.7m
2.3m
2.7m
3m
3.4m
3.8m
3.5m
2.8m
2m
1m
Elevation (m aOD)
Distance (m)
Hill Bog (summit)
Hill Bog (slope)
Hill Bog (shallow slope)
Hill Bog (margin)
Whitelee Moor NNR Transect 2: point W8 to W18 (north-west to south-east)
Note: peat depths are a different scale to surface elevations
Legend
NOWM07 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
BOGCAT type
Bog surface details
Vegetation type
5 – sample pt
Peat depth (m)
Peat surface
Mineral ground
HumPlDiv: Hummock/Pool diversity score



Whitelee Moor NNR Transect 3: point 19 to W26 (south-west to north-east)

Note: peat depths are a different scale to surface elevations

Legend

NOWM07 - dataset sample ID

T2 - Intersection with other transects

WETMEC type

BOGCAT type

Bog surface details

Vegetation type

5 – sample pt

Peat depth (m)

Peat surface

Mineral ground

HumPlDiv: Hummock/Pool diversity score

Whitelee Moor NNR, Northumberland

The survey area at Whitelee Moor is situated at NT 68600 05320 and comprises a long, gently sloping ridge trending north-east to south-west that marks the border between Scotland and England. The lower flanks of the ridge support conifer plantations, the gentle upper slopes have bog, grading into acidic grassland on steeper slopes. The highest point of the ridge is at 579 m aOD. There were no signs of livestock grazing.

The flanks of the ridge have peat between 1 and 2m in depth, and support quite species-poor heather-cottongrass bog (M19) with some bilberry, deergrass, pleurocarpous mosses, and rare to occasional patches of *Sphagnum capillifolium*. In many places these show signs of past erosion, with small gullies that have been blocked with plastic dams. The steepest slopes reach about 1 in 5 gradient (20%).

Along the top of the ridge, much gentler slopes lead up towards the crest, with gradients as low as 1 in 80 (about 1.2%). In places there is deeper peat to about 2.8m in depth, and more Sphagnum-rich M19-S vegetation, with abundant *Sphagnum papillosum, S. subnitens,* and *S. capillifolium*, beneath hare's-tail cottongrass and heather. Frequent shallow erosion gullies have been dammed with coir rolls, which are holding back water in shallow pools.

On the south-eastern flank of the ridge a moderate slope of M19 bog vegetation leads down to a small spur that forms a gently sloping bog-covered bench, before dropping down steeply into the valley below, onto grass- and bracken-covered slopes. The bench itself has gradients of around 1 in 40 (2.5%), and has been intensively eroded, with a dense network of varying depth gullies and hollows that have been blocked with plastic dams and coir rolls. The gullies are now completely revegetated with abundant Sphagnum mosses (mainly *Sphagnum papillosum* and *S. medium*) and cotton grass, and the adjacent low haggs are also quite diverse with heather, deer grass, bog asphodel, cotton grasses, *Cladonia* lichens and the moss *Racomitrium lanuginosum*, and a range of Sphagnum species. The vegetation is a form of M18/M19.

BOGCATs comprise Hill Bog, within which can be recognised areas of summit, slope, and shallow slope.

WETMECs consist of mostly Gullied Hill Peat Slope, with several areas of Eroded Slackenings on the ridge top and also on the bench area.


Eroded Sphagnum-rich M19
bog vegetation with coir dams
and shallow pools


Broad, gently sloping ridge
top with heather, cottongrass,
patchy Sphagnum mosses


Eroded deep peat (now dammed) on a bench part way down the gently sloping hillside, with abundant bog asphodel and Sphagnum mosses


On the broad, eroded bench on the hillside, gullies have been effectively blocked with plastic dams, with abundant Sphagnum colonising the flooded gully bottoms


A large gully at the southern edge of the
bench area, its base has been partly
blocked with stone dams to catch sediment.
Some bare peat remains on the gully sides.

17.9 Plym Head, Dartmoor

Plym Head Site Summary

Plym Head is situated at SX 62500 68700 in southern Dartmoor. Land use in the wider area currently comprises relatively light grazing by sheep, cattle, and ponies. Evidence of more intensive activities in the past include peat cutting for fuel, and mining for tin. The landscape consists of large, rounded hills and broad valleys, supporting habitats that are dominated by bogs and acidic grassland, with some base-poor fens, and acidic flushed ground.

The survey area at Plym Head occupies the watershed between three river systems: the Plym to the west, the Erme to the south, and the Swincombe to the north. The highest part of the survey area is Crane Hill (471 m aOD), dropping to 453 m aOD in Blacklane Brook, which forms the headwater of the Erme.

Much of the survey area comprises peat that blankets the hill slopes and hollows between them; most of the peat ranges from about 0.4 to 2.5 m in depth, but much deeper peat occupies a col between Crane Hill and another low rise to the south. Here the peat reaches 7 m in depth and forms a humped mound of peat stretching from the headwater stream of the Plym in the west, eastwards to the Blacklane Brook. Other areas of deep peat are found occupying hollows on the eastern side of Blacklane Brook, reaching 5 m depth.

The survey area was mentioned in the Nature Conservation Review as an important site (Ratcliffe, 1977). It was also surveyed by the BES Mires Research Group in 1988, at which time a few patches of the rare *Sphagnum imbricatum* (now *S. austinii*) were recorded in an area of abundant Sphagnum and pools over deep peat (around point P19). Based on their reported vegetation descriptions and quadrat records, little has changed since then, although *Sphagnum austinii* was not relocated during the present survey.

Plym Head Site Summary (continued)

The deepest peat areas appear to be intact, whereas there are signs of peat cuttings in all the surrounding shallower peat areas, which have uneven surfaces and a series of baulks and hollows that tend to support vegetation with abundant purple moor-grass, which is tussocky in places.

There is some erosion with low hagged peat mounds on the steep slopes around the upper part of Blacklane Brook, where it connects to Black Lane (a wet track between Crane Hill and Caters Beam, near a marker post to the north). This channel appears to cut into a very deep peat area and may have been dug out and deepened to drain the peat. Remnants of tin workings and peat cuttings are abundant in the local area.

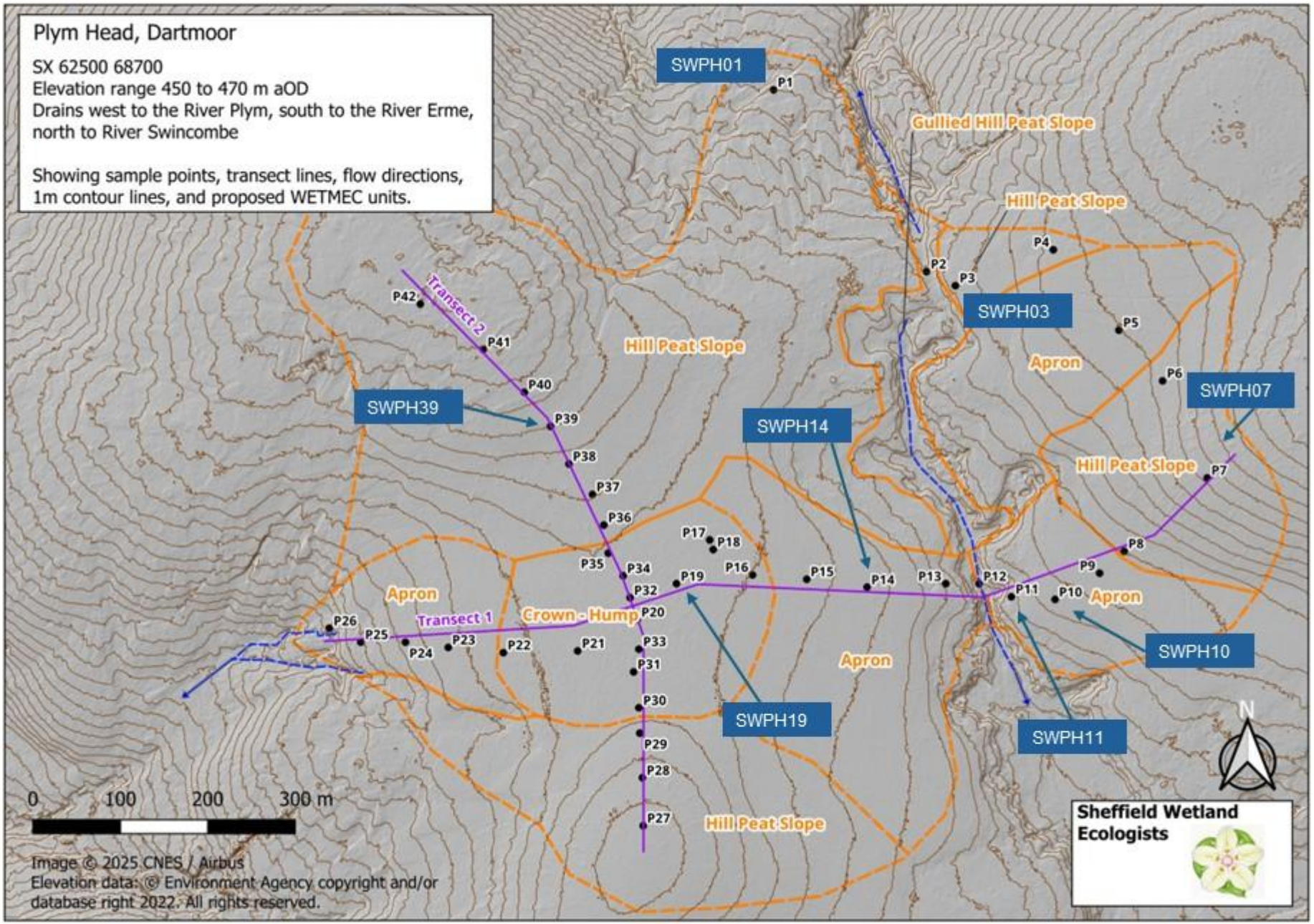
Much of the vegetation of the survey area comprises uniform M17 bog, with a firm, moderately wet surface, and supports a mixture of deer-grass, heather, bilberry, common cottongrass, hare's-tail cottongrass, purple moor-grass, bog asphodel, tormentil, heath milkwort, and a range of Sphagnum bog-mosses, in particular *Sphagnum capillifolium, Sphagnum rubellum,* and *Sphagnum papillosum*. Large areas of the thinner peat on the hill slopes is dominated by purple moor-grass, with deer-grass and a scattering of the other species, and just a few hummocks of *Sphagnum capillifolium*. In contrast, the area of deepest peat at the top of the col is very wet and spongy, with small pools and interconnecting soakways, and abundant Sphagnum, including *Sphagnum medium,* also sundews, and in places patches of white-beaked sedge.

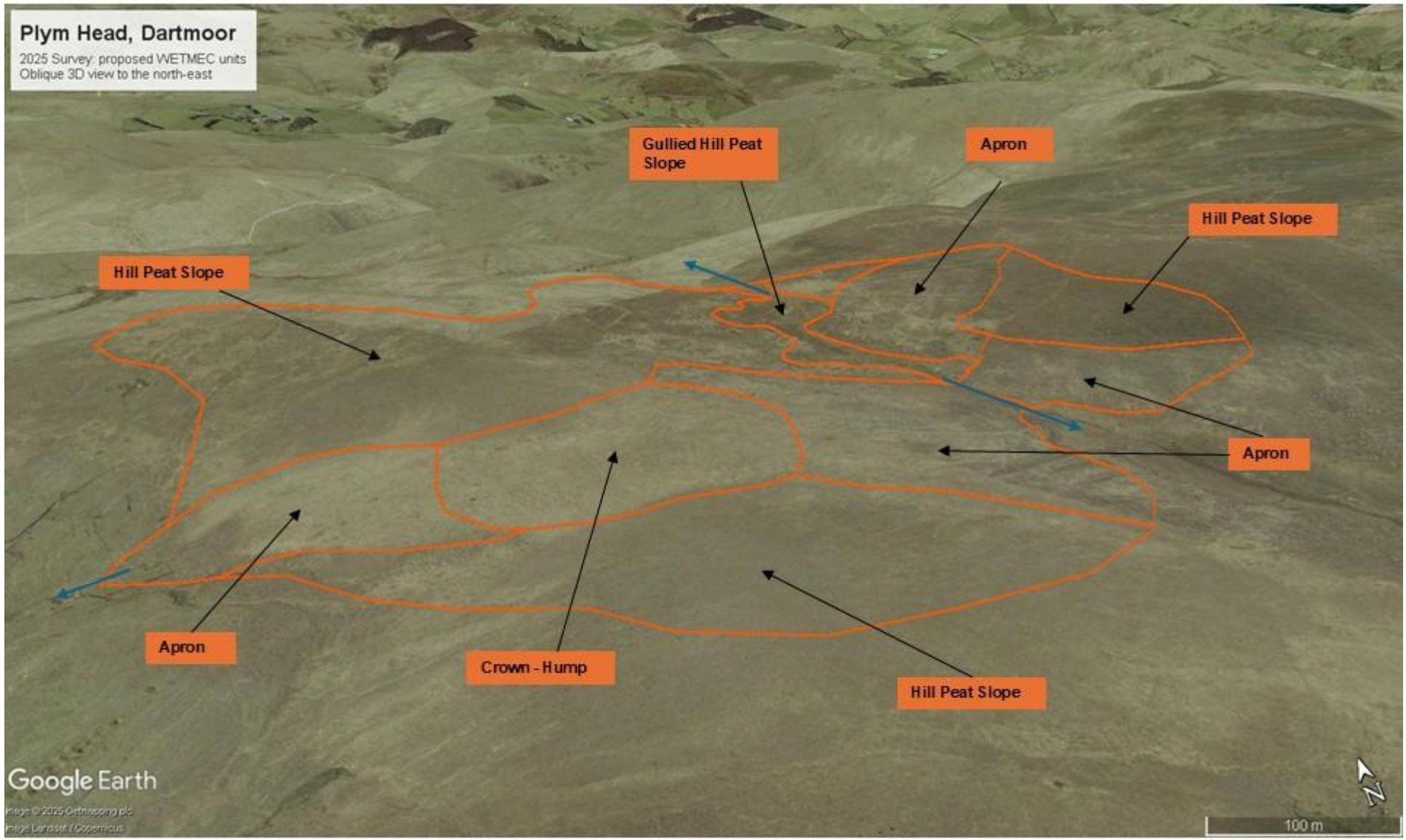
BOGCATs:

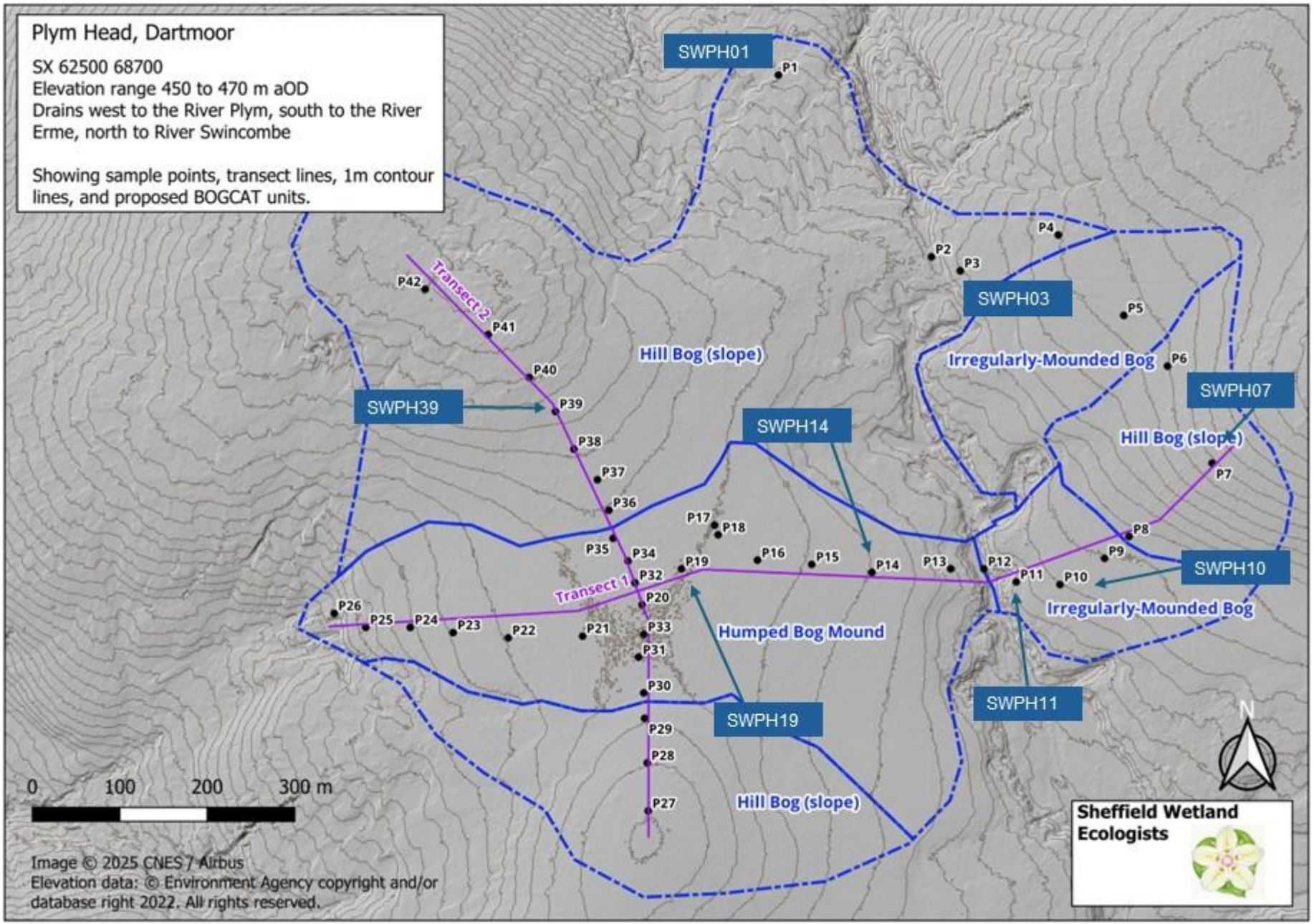
A Humped Bog Mound occupies the col, whilst Hill Bog covers most of the rest of the area; in two locations Irregularly-Mounded Bogs are found in hollows between the hills.

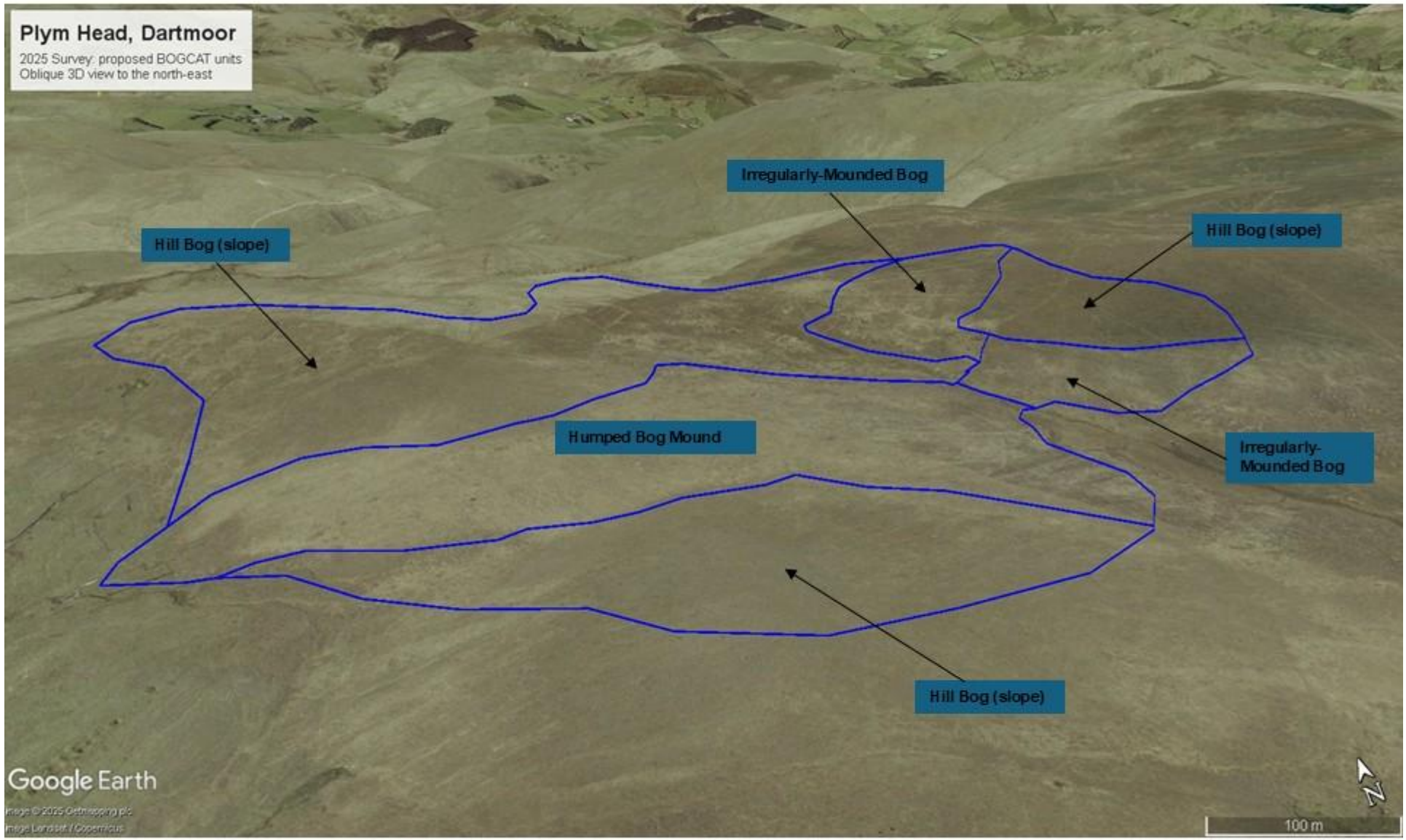
WETMECs:

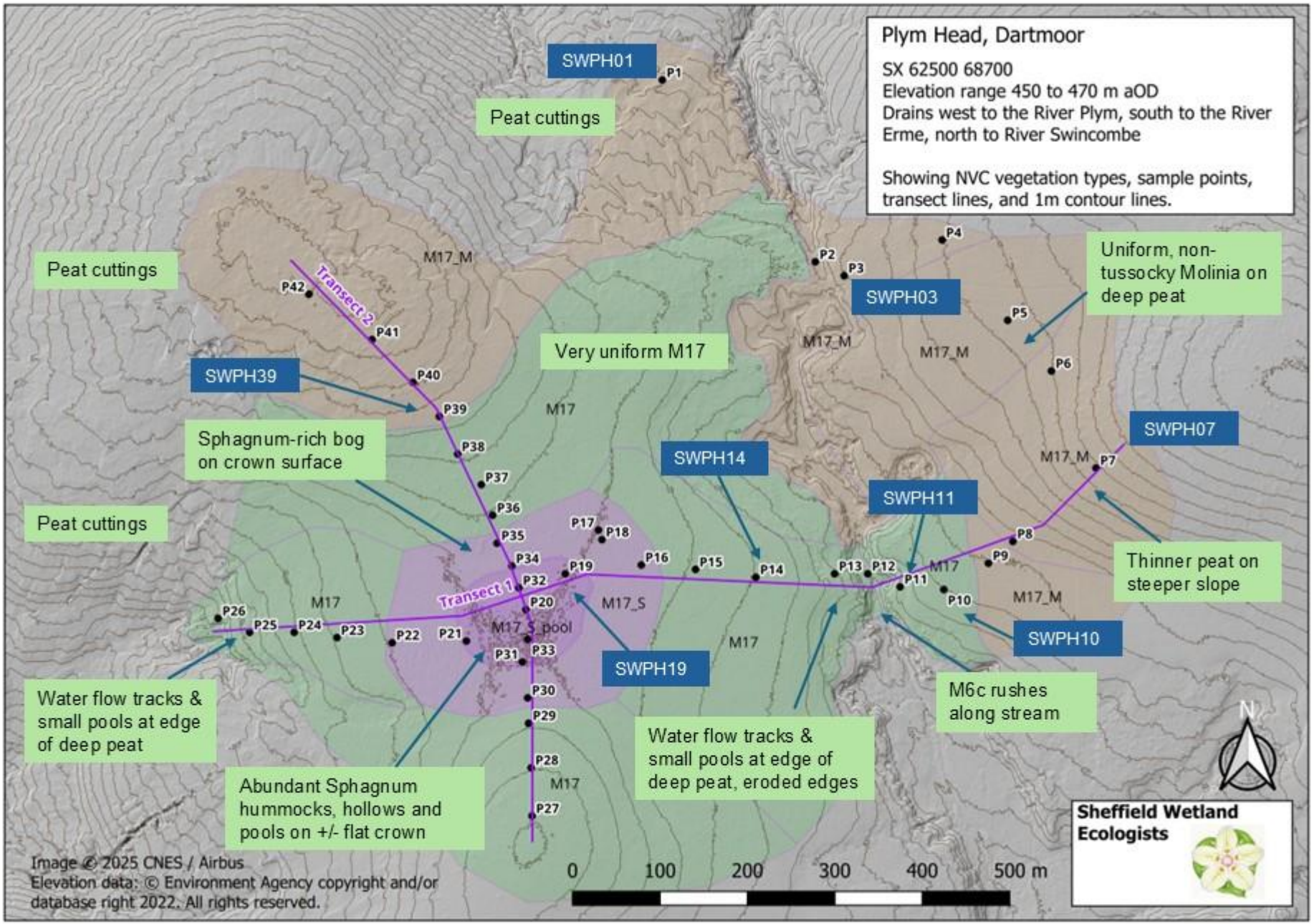
Most of the survey area comprises Sloping Hill Peat, with a Humped Crown forming the centre of the col, and Aprons sloping away from the crown to west and east. Two further Aprons are found on deep peat slopes on the eastern side of the Blacklane Brook. Where the brook has cut northwards, this comprises Gullied Hill Peat.

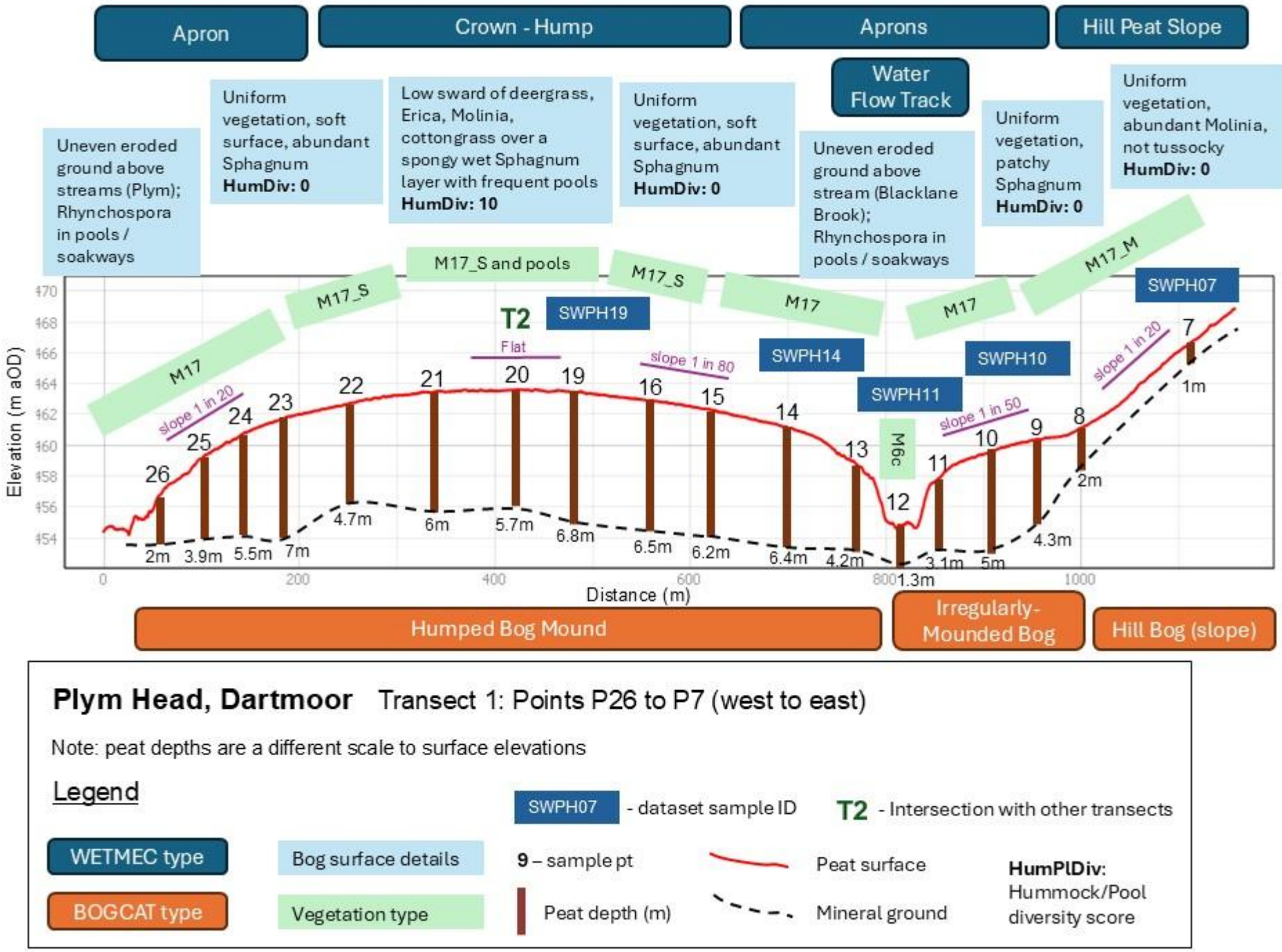

Plym Head, Dartmoor
SX 62500 68700
Elevation range 450 to 470 m aOD
Drains west to the River Plym, south to the River Erme, north to River Swincombe
Showing sample points, transect lines, flow directions, 1m contour lines, and proposed WETMEC units.
SWPH01
SWPH03
SWPH07
SWPH10
SWPH11
SWPH14
SWPH19
SWPH39
Gullied Hill Peat Slope
Hill Peat Slope
Apron
Crown - Hump
Transect 1
Transect 2
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
P21
P22
P23
P24
P25
P26
P27
P28
P29
P30
P31
P32
P33
P34
P35
P36
P37
P38
P39
P40
P41
P42
N
0
100
200
300 m
Sheffield Wetland Ecologists
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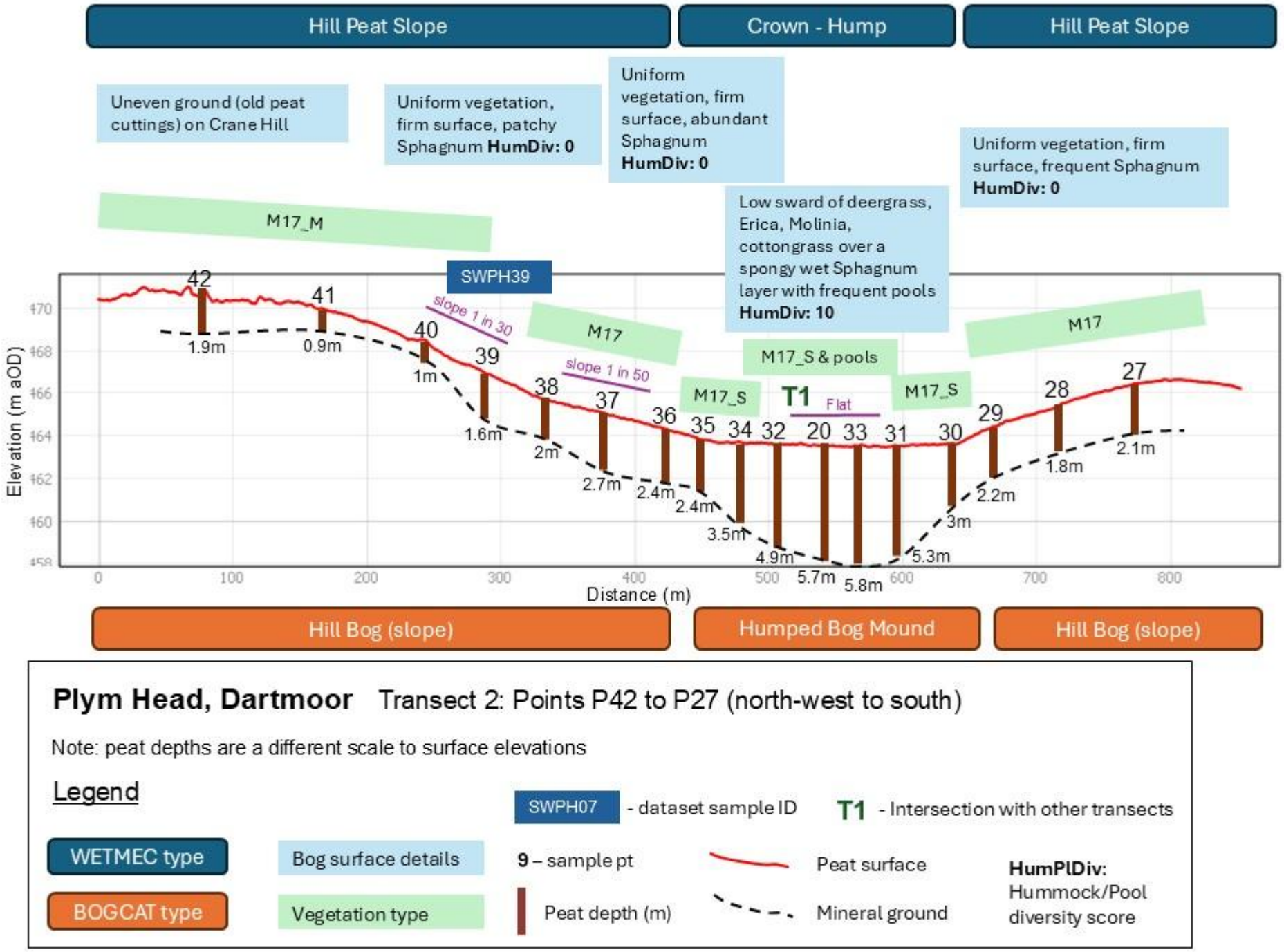

Plym Head, Dartmoor
2025 Survey: proposed WETMEC units
Oblique 3D view to the north-east
Gullied Hill Peat Slope
Apron
Hill Peat Slope
Hill Peat Slope
Apron
Apron
Crown - Hump
Hill Peat Slope
Google Earth
100 m
N


Plym Head, Dartmoor
SX 62500 68700
Elevation range 450 to 470 m aOD
Drains west to the River Plym, south to the River Erme, north to River Swincombe
Showing sample points, transect lines, 1m contour lines, and proposed BOGCAT units.
SWPH01
SWPH03
SWPH07
SWPH10
SWPH11
SWPH14
SWPH19
SWPH39
Transect 1
Transect 2
Hill Bog (slope)
Irregularly-Mounded Bog
Humped Bog Mound
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
P21
P22
P23
P24
P25
P26
P27
P28
P29
P30
P31
P32
P33
P34
P35
P36
P37
P38
P39
P40
P41
P42
0
100
200
300 m
N
Sheffield Wetland Ecologists
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Plym Head, Dartmoor
2025 Survey: proposed BOGCAT units
Oblique 3D view to the north-east
Irregularly-Mounded Bog
Hill Bog (slope)
Hill Bog (slope)
Humped Bog Mound
Irregularly-Mounded Bog
Hill Bog (slope)
Google Earth
100 m
N


Plym Head, Dartmoor
SX 62500 68700
Elevation range 450 to 470 m aOD
Drains west to the River Plym, south to the River Erme, north to River Swincombe
Showing NVC vegetation types, sample points, transect lines, and 1m contour lines.
SWPH01
Peat cuttings
Peat cuttings
Peat cuttings
SWPH39
Sphagnum-rich bog on crown surface
Very uniform M17
SWPH03
Uniform, non-tussocky Molinia on deep peat
SWPH14
SWPH11
SWPH07
Thinner peat on steeper slope
SWPH10
SWPH19
Water flow tracks & small pools at edge of deep peat
Abundant Sphagnum hummocks, hollows and pools on +/- flat crown
Water flow tracks & small pools at edge of deep peat, eroded edges
M6c rushes along stream
Transect 1
Transect 2
M17
M17_M
M17_S
M17_S pool
N
Sheffield Wetland Ecologists
0 100 200 300 400 500 m
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Apron
Crown - Hump
Aprons
Hill Peat Slope
Water Flow Track
Uneven eroded ground above streams (Plym); Rhynchospora in pools / soakways
Uniform vegetation, soft surface, abundant Sphagnum HumDiv: 0
Low sward of deergrass, Erica, Molinia, cottongrass over a spongy wet Sphagnum layer with frequent pools HumDiv: 10
Uniform vegetation, soft surface, abundant Sphagnum HumDiv: 0
Uneven eroded ground above stream (Blacklane Brook); Rhynchospora in pools / soakways
Uniform vegetation, patchy Sphagnum HumDiv: 0
Uniform vegetation, abundant Molinia, not tussocky HumDiv: 0
M17
M17_S
M17_S and pools
M17_S
M17
M17
M17_M
T2
SWPH19
SWPH14
SWPH11
SWPH10
SWPH07
Flat
slope 1 in 20
slope 1 in 80
slope 1 in 50
slope 1 in 20
M6c
Elevation (m aOD)
Distance (m)
Humped Bog Mound
Irregularly-Mounded Bog
Hill Bog (slope)
Plym Head, Dartmoor Transect 1: Points P26 to P7 (west to east)
Note: peat depths are a different scale to surface elevations
Legend
SWPH07 - dataset sample ID
T2 - Intersection with other transects
WETMEC type
BOGCAT type
Bog surface details
Vegetation type
9 – sample pt
Peat depth (m)
Peat surface
Mineral ground
HumPlDiv: Hummock/Pool diversity score


Hill Peat Slope
Crown - Hump
Hill Peat Slope
Uneven ground (old peat cuttings) on Crane Hill
Uniform vegetation, firm surface, patchy Sphagnum HumDiv: 0
Uniform vegetation, firm surface, abundant Sphagnum HumDiv: 0
Low sward of deergrass, Erica, Molinia, cottongrass over a spongy wet Sphagnum layer with frequent pools HumDiv: 10
Uniform vegetation, firm surface, frequent Sphagnum HumDiv: 0
M17_M
M17
M17_S & pools
M17
M17_S
M17_S
T1
Flat
SWPH39
slope 1 in 30
slope 1 in 50
42
41
40
39
38
37
36
35
34
32
20
33
31
30
29
28
27
1.9m
0.9m
1m
1.6m
2m
2.7m
2.4m
2.4m
3.5m
4.9m
5.7m
5.8m
5.3m
3m
2.2m
1.8m
2.1m
Elevation (m aOD)
470
468
466
464
462
460
458
0
100
200
300
400
500
600
700
800
Distance (m)
Hill Bog (slope)
Humped Bog Mound
Hill Bog (slope)
Plym Head, Dartmoor Transect 2: Points P42 to P27 (north-west to south)
Note: peat depths are a different scale to surface elevations
Legend
SWPH07 - dataset sample ID
T1 - Intersection with other transects
WETMEC type
Bog surface details
9 – sample pt
Peat surface
HumPlDiv: Hummock/Pool diversity score
BOGCAT type
Vegetation type
Peat depth (m)
Mineral ground



P4, P5, P6 (eastern side of survey area) Purple moor-grass dominated M17 vegetation with a uniform structure. Shallower Hill Peat 1-2m (P4 & P6) is less diverse; a deeper Apron (P5, around 4m) tends to have more open vegetation with more Sphagnum.



Uneven ground around P11 at the edge of the Apron where it drops down into the eroded headwaters of Blacklane Brook. Has connected pools / water flow tracks on the eroded slope with white-beaked sedge and patchy *Sphagnum medium*.




P20: M17_S with pools on top of the
Crown - Hump in the col at Plym Head

P24 and P25: Uneven ground and connected pools / flow tracks on eroding slopes above Plym River headwaters (west side of survey area)





18 Annexe 6. Vegetation synoptic accounts

Three accounts are shown for NVC communities M17, M18 and M19 which encompass the most distinctive and widespread vegetation types found in upland ombrotrophic peatland habitats in England and Wales.

The format is based on the synoptic accounts produced for the Irish Vegetation Classification (IVC, 2015) which are designed to be informative, accessible and straightforward to update.

18.1 M17 mire community synopsis

England and Wales wetland vegetation classification – community synopsis

Scientific name	*Trichophorum germanicum – Eriophorum* spp. *community*
Common name	Deergrass – Cottongrass community
Community code	M17

Vegetation description

Mixed sward of deergrass (*Trichophorum germanicum*), common cotton-grass (*Eriophorum angustifolium*), hare's tail cottongrass (*E. vaginatum*) (often at low cover), purple moor grass (*Molinia caerulea*), heather (*Calluna vulgaris*), cross-leaved heath (*Erica tetralix*), bog asphodel (*Narthecium ossifragum*); over ground layer with Sphagnum (mainly *S. papillosum* and *S. capillifolium/rubellum* with *S. tenellum, S. subnitens* more patchy). The moss *Racomitrum lanuginosum* forms distinctive hummocks in some places.

Round-leaved sundew *(Drosera rotundifolia),* tormentil *(Potentilla erecta)* and milkwort (*Polygala serpillifolia)* are frequent.

*Sphagnum medium (*formerly *S. magellanicum)* is distinctive in some flat, wet areas with pools (although this species is often regarded as a fairly strong indicator of M18).

White beak sedge *(Rhynchospora alba)* is also found in wet areas around pools and hollows.

Star sedge (*Carex echinata*)*,* common sedge (*C. nigra*), *c*arnation sedge (*C. panicea*)*,* devil's bit scabious (*Succisa pratensis*) are present in marginal areas and transitions to wet heath and acid grassland.

Typical form has a very uniform appearance with abundant but sometimes quite patchy Sphagnum, not generally forming a thick layer so the surface feels quite firm underfoot. Abundant *Eriophorum angustifolium* can give the vegetation a distinctive red appearance from a distance.

M17_S This sub-type has pronounced microtopography with hummocks, hollows and a soft wet substratum dominated by Sphagnum in hollows, around pools and in low hummocks. Pleurocarpous mosses are also abundant. [This is a form of M17a but is more distinctive structurally. M17a which can also occur as very uniform habitat patches on quite firm surfaces with abundant Sphagnum which doesn't form a spongy layer].

M17_M Purple moor-grass-rich sub-type, which has a taller sward with abundant purple moor-grass, but not usually forming tall tussocks, and a more sparse representation of M17 species, with Sphagnum generally only occasional or patchy.

Ecology

This is a community of ombrogenous peatlands (typically blanket bogs) occurring at a range of altitudes, typically on hill bog and mounded peat surfaces which are exclusively fed by rainfall (ombrotrophic). It usually occurs as extensive tracts, particularly in the south-west and north-west of England and throughout Wales.

NVC Sub-communities

M17a *Drosera rotundifolia – Sphagnum* spp. sub-community
M17b Typical sub-community
M17c *Juncus squarrosus – Rhytidiadelphus loreus* sub-community

Similar communities and transitions

M17 shares a similar set of species with M18 and M19 (heather, cottongrasses, *Sphagnum* spp) but tends to have a rather uniform mixed sward with frequent to abundant deergrass, purple moor grass, cotton-grasses and bog asphodel, with dwarf shrubs less prominent than in M18 and M19.

M18 is characterised by having more cross-leaved heath and cranberry, as well as the preferential species *S. medium* and bog rosemary; M19 has more heathy species e.g. bilberry, cowberry, crowberry, and more pleurocarpous mosses; cloudberry is preferential to M19 where it occurs in upland situations.

M17 also grades into wet heath (M15) and acid grassland (U5 and U6).

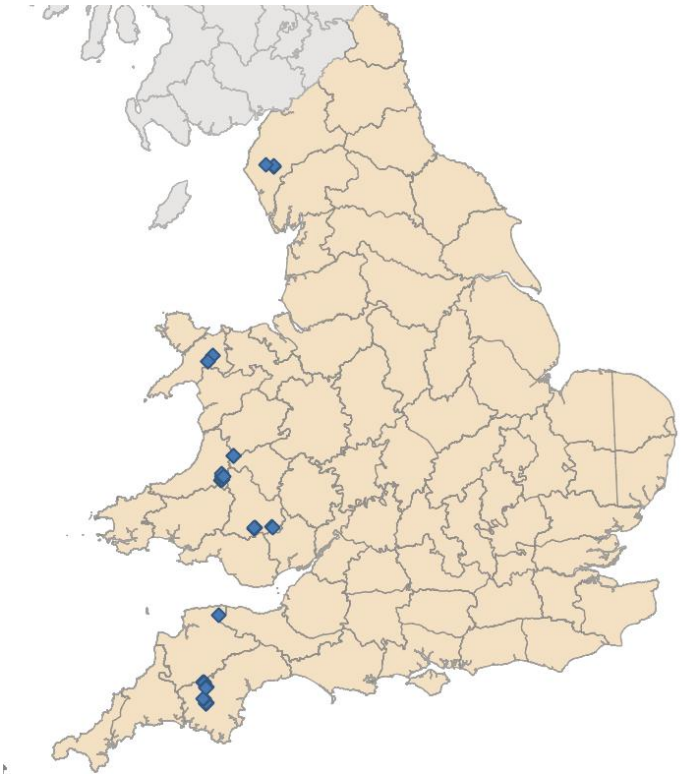
Synoptic table M17 (n= 52) with most frequent 45 species. Frequency (from I-V). Cover range: Domin score (min med max).

Species name / vegetation type or sub-type	**M17**				**M17_S**				**M17_M**			
Number of samples	27				11				14			
Mean species per sample	14	range			14	range			11	range		
Erica tetralix	V	1	4	6	V	2	4	6	V	1	3	5
Trichophorum germanicum	V	2	5	8	V	4	5	6	V	2	4	6
Eriophorum angustifolium	V	1	4	6	V	3	5	6	IV	2	3	5
Eriophorum vaginatum	V	1	4	7	IV	1	4	5	IV	2	3	5
Molinia caerulea	IV	1	6	8	V	5	6	8	V	8	9	9
Narthecium ossifragum	IV	2	4	6	V	3	5	7	III	3	5	6
Sphagnum papillosum	IV	3	4	7	V	4	6	7	III	2	3	5
Calluna vulgaris	IV	1	3	7	V	2	3	5	II	1	3	3
Sphagnum capillifolium	IV	1	4	7	IV	3	3	4	II	1	4	5
Polygala serpyllifolia	III	2	3	3	IV	1	3	3	II	1	2	3
Potentilla erecta	III	1	3	3	I	1	1	1	IV	1	2	4
Drosera rotundifolia	II	1	2	4	V	2	2	3	I	1	1	1
Sphagnum cuspidatum	III	2	3	4	V	1	3	3	I	3	3	3
Hypnum jutlandicum	III	1	3	4	I	3	3	3	III	2	3	4
Vaccinium myrtillus	III	1	3	6	I	1	1	1	III	1	1	6
Sphagnum subnitens	II	1	4	6	II	1	2	4	II	1	3	4
Juncus squarrosus	III	1	3	6					I	1	2	2
Racomitrium lanuginosum	I	1	2	4	IV	1	3	6	II	2	4	4
Deschampsia flexuosa	II	2	3	4					II	3	3	4
Sphagnum tenellum	I	1	1	3	II	1	3	3	I	1	2	2
Cladonia portentosa	I	1	2	3	II	1	1	1	I	3	3	3
Sphagnum fallax	I	3	4	5	I	4	4	4	II	2	2	3
Empetrum nigrum	I	1	5	5					I	5	5	5
Sphagnum denticulatum	I	3	3	3	III	3	3	5				
Hylocomium splendens	I	1	1	3					I	2	2	2
Polytrichum strictum	I	3	3	4								
Sphagnum medium	I	2	3	3	II	5	6	6				
Carex panicea	I	1	1	3	I	1	1	1	I	1	1	1
Cladonia uncialis	I	1	1	1	I	1	2	3	I	1	1	1
Odontoschisma sphagni	I	1	1	1	I	2	2	2	I	1	1	1
Pleurozium schreberi	I	1	3	8					I	2	2	2
Rhytidiadelphus loreus	I	1	1	2								
Sphagnum palustre	I	1	4	4					I	1	2	3
Aulacomnium palustre	I	1	1	2								
Rhynchospora alba	I	3	3	3	II	2	3	4				
Rhytidiadelphus squarrosus	I	1	1	4					I	4	4	4
Agrostis canina	I	2	2	3								
Campylopus sp	I	3	3	4								
Dicranum scoparium	I	2	2	2								
Nardus stricta	I	1	2	3								
Vaccinium oxycoccos	I	2	3	3	I	2	2	2				
Festuca ovina	I	2	3	3								
Juncus effusus	I	2	2	2					I	1	1	1
Polytrichum commune	I	5	5	5					I	4	4	4
Sphagnum fimbriatum									I	3	4	4

In the table M17 samples are those that are not allocated to the Molinia dominated sub-type (M17_M) or Sphagnum-rich sub-type (M17_S).

Vegetation dataset from 2022-2025 surveys of upland ombrotrophic peatlands in England and Wales.

Distribution map (based on Blanket Bog eco-hydrological survey dataset)



M17

Occurs in upland areas, particularly where rainfall is very high. Can also occur at lower altitudes.

Widespread in the uplands of south-west England, Cumbria, and Wales, where it is found in hill bogs and in hump-mounded bogs on flatter ground on cols.

Summary	**M17**	**M17_S**	**M17_M**
Number of samples	28	13	14
Altitude (mean)	459	497	464
Rainfall (annual average)	2358	2008	2056
Slope %	4.1	1.4	4.2
Peat depth (m)	2.65	4.72	2.08
pH	3.8	4.3	-

Affinities

Yorkshire Peat Partnership: Equivalent to YPP community Wet Bog (*Eriophorum vaginatum*) (WBEV)
Irish Vegetation Classification: BG2C *Erica tetralix – Molinia caerulea – Cladonia portentosa* peatland, BG2E *Calluna vulgaris – Eriophorum* spp. bog , BG2F *Trichophorum cespitosum/germanicum – Eriophorum angustifolium* peatland
EUNIS: D1.1 Raised Bog and D1.2 Blanket Bog
Annex 1 habitats: H7130 Blanket Bog

Conservation Value

Although the botanical species-richness of bogs is typically low, several rare species occur on undamaged bogs including several bryophytes, for example *Sphagnum austinii* (formerly *S. imbricatum*)*, S. beothuk* (formerly *S. fuscum*).
Ombrogenous peatlands are an important carbon store.
Management:
Drainage, afforestation, agricultural improvement and some upland management practices (drainage, burning, grazing) are threats or have had a historic impact in many places. Past peat cutting has taken place around the margins of many sites.

Selected references

Averis A., Averis B., Birks, J. Horsfield D., Thompson D. and Yeo M. (2004). *An Illustrated guide to British Upland Vegetation*. JNCC.
Eades, P., Tratt, R., Wheeler, B.D., Shaw, S. (2026). *Eco-hydrological guidelines for upland peatlands and associated habitats*. Environment Agency.
Rodwell, J.S. (Ed.) (1991). *British plant communities. Volume 2. Mires and heaths.* Cambridge University Press, Cambridge.

Photos:



Winney's Down, North Dartmoor. View of M17 vegetation, *Molinia*-rich type (M17_M) in foreground.

(a)  (b) 

Peat cutting and restoration (a) Floor and edge of former peat cutting at Cater's Beam, South Dartmoor, and (b) restoration works on eroding margins of intact peat areas, adjoining former peat cuttings.



Buttermere Fells, Cumbria. Flat and gently sloping ground on a broad col, showing signs of previous erosion, now fully revegetated with M17 bog vegetation, with some uneven ground and shallow pools.



Plym Head, South Dartmoor showing Sphagnum-rich M17 vegetation (M17_S) with pool features over 6.7m of peat.



Cwmystwyth Uplands of central Wales: Sphagnum-rich M17 hummocks and islands, with M1 pools and water flow tracks. Peat is 3-5 m deep. Grades into *Molinia*-dominated M17 vegetation on firm shallow peat on surrounding slopes.

Synopsis version: 1.0	synopsis date: 18May2026	synopsis author(s): Ros Tratt & Phil Eades

18.2 M18 mire community synopsis

England and Wales wetland vegetation classification – community synopsis

Scientific name	*Erica tetralix – Sphagnum papillosum community*
Common name	Cross-leaved heath – *Sphagnum papillosum* community
Community code	M18

Vegetation description

Mixed, often quite open, vegetation made up of cross-leaved heath (*Erica tetralix*), heather (*Calluna vulgaris*) and cottongrasses (common cottongrass (*Eriophorum angustifolium*) and hare's tail cottongrass (*E. vaginatum*)) over a ground layer with abundant Sphagnum - typically *Sphagnum papillosum* but often accompanied by a range of other species including *S. capillifolium, S. cuspidatum, S. fallax. S. tenellum* (sometimes with rarities such as *S. austinii, S. fuscum, S. pulchrum*). There is often some cranberry (*Vaccinium oxycoccos*) and sundews, most commonly round-leaved sundew (*Drosera rotundifolia*). Deergrass (*Trichophorum germanicum*), bog asphodel (*Narthecium ossifragum*), crowberry (*Empetrum nigrum*) and purple moor grass (*Molinia caerulea*) can be frequent.

Sphagnum medium (formerly *S. magellanicum*) is a distinctive species characteristic of this vegetation and is often abundant; bog rosemary (*Andromedia polifolia*) is also strongly associated with this type of vegetation, within its range.

Bottle sedge (*Carex rostrata*) and white beak sedge (*Rhynchospora alba*) occur locally in wetter areas around the edges of soakways and pools.

Bushy lichens (*Cladonia* spp.) are locally prominent and the liverwort *Odontoschisma sphagnii* can often be found amongst the Sphagnum. Pleurocarpous mosses (feather mosses), for example, *Hypnum jutlandicum, Pleurozium schreberi, Racomitrium lanuginosum* can also be abundant especially in transitions to M19.

Dwarf shrubs generally make up less than 50% of the cover, but the abundance of heather and other dwarf shrubs such as bilberry (*Vaccinium myrtilis*) and crowberry (*Empetrum nigrum*) increases in drained situations and in transitions to M19 (**M18/M19 vegetation**).

Pronounced hummock–hollow-pool complexes often occur in this type of vegetation, particularly in the **M18_S subtype**. Small pools and wet hollows are regarded as part of the vegetation mosaic whereas more extensive pool / soak features can be assigned to M1 and M2 communities.

M18_S Sphagnum sub-type has a spongy ground layer dominated by Sphagnum (typically *S. papillosum*), but usually mixed with other species which can be abundant for example *S. capillifolium, S. cuspidatum, S. fallax. S. medium, S. tenellum*. There are usually some distinctive microtopographical features: hummocks, hollows and pools occur frequently in various combinations.

M18_M Molinia rich sub-type: Molinia forms a dominant and tussocky sward and some character species are present but at low cover.

Ecology

This is a community of ombrogenous peatlands (aka raised bogs and blanket bogs) occurring at a range of altitudes, typically on mounded peat surfaces which are exclusively fed by rainfall (ombrotrophic). It can occur as extensive tracts or as more localised features surrounded by minerotrophic vegetation.

NVC Sub-communities

M18a *Andromeda polifolia – Sphagnum magellanicum* sub-community
M18b *Empetrum nigrum – Cladonia* spp. sub-community

Similar communities and transitions

M18 and M19 share a core set of species: heather, cottongrasses, Sphagnum spp. and transitions from M18 to M19 are frequent (see M18/M19 samples).

M18 is characterised by having more cross-leaved heath, cranberry, deergrass and *Sphagnum papillosum* as well as the preferential species *S. medium* and bog rosemary; M19 has more heathy species e.g. bilberry, cowberry, crowberry, and more pleurocarpous mosses; cloudberry is preferential where it occurs in upland situations.

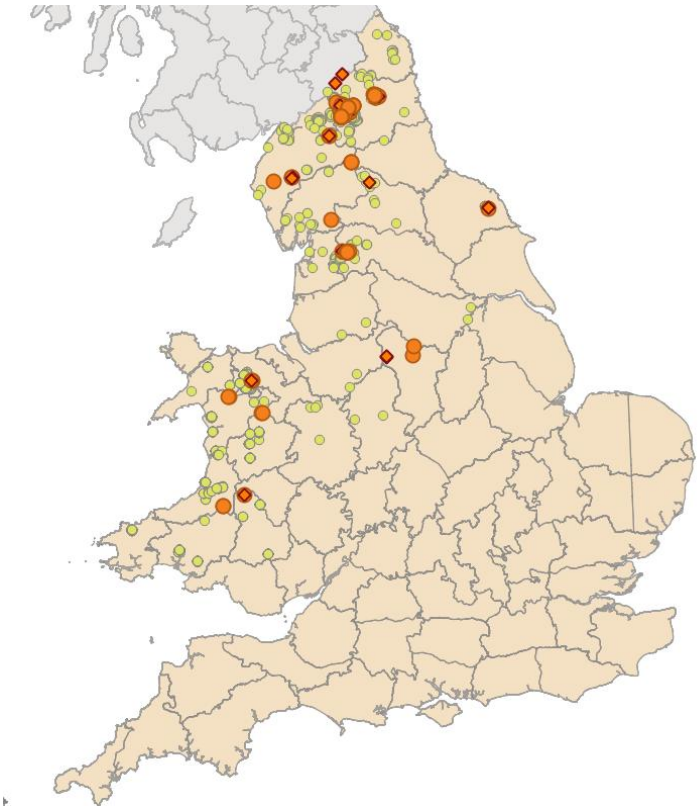
Synoptic table (n= 101) with most frequent 45 species. Frequency (from I-V). Cover range: Domin score (min med max).

Species name / vegetation type or sub-type	**M18**				**M18_S**				**M18/M19**			
Number of samples	20				46				35			
Mean species per sample	14	Range			14	Range			13	Range		
Eriophorum vaginatum	V	1	5	7	V	1	6	8	V	3	6	8
Erica tetralix	V	3	5	7	V	1	5	7	V	3	4	7
Vaccinium oxycoccos	V	1	3	5	V	1	3	5	IV	1	3	4
Calluna vulgaris	V	3	6	8	V	2	6	8	V	4	7	8
Sphagnum papillosum	IV	1	4	8	V	2	6	9	IV	1	4	8
Hypnum jutlandicum	V	3	4	7	IV	2	3	6	V	1	4	7
Sphagnum capillifolium	IV	2	4	6	IV	1	4	8	V	3	4	8
Eriophorum angustifolium	IV	1	3	4	IV	1	3	7	IV	1	3	5
Trichophorum germanicum	IV	1	5	7	IV	1	3	7	III	1	4	7
Narthecium ossifragum	III	2	6	8	IV	1	3	6	III	2	4	6
Sphagnum magellanicum	III	2	3	4	IV	2	4	7	III	1	3	5
Andromeda polifolia	III	1	3	4	III	1	3	4	II	1	1	4
Empetrum nigrum	III	2	3	4	II	1	3	4	III	1	3	5
Pleurozium schreberi	III	2	3	7	II	2	3	4	III	1	4	6
Polytrichum commune	III	3	4	6	I	1	4	4	II	1	3	5
Polytrichum strictum	III	1	3	4	II	2	4	5	II	3	4	5
Sphagnum cuspidatum	II	2	3	5	II	2	4	5	II	2	3	3
Cladonia portentosa	II	1	4	4	II	1	3	5	II	1	3	5
Sphagnum tenellum	II	1	2	3	III	1	3	4	I	2	3	3
Vaccinium myrtillus	III	3	4	7	I	1	1	4	II	1	3	6
Aulacomnium palustre	I	1	3	3	II	1	2	3	II	1	3	5
Deschampsia flexuosa	II	2	3	4	I	1	2	3	II	1	3	4
Sphagnum fallax	II	1	4	5	II	2	4	7	II	2	5	7
Drosera rotundifolia	I	1	2	3	II	1	2	3	I	1	1	1
Molinia caerulea	I	3	3	4	I	1	2	7	I	1	5	8
Sphagnum subnitens	II	2	4	5	I	2	3	4	II	1	4	8
Odontoschisma sphagni	I	1	1	2	II	1	2	3	I	1	2	3
Sphagnum palustre	I	3	3	3	I	1	3	6	I	1	3	5
Dicranum scoparium					I	1	2	3	I	1	2	3
Dryopteris carthusiana					I	1	1	1	I	1	1	3
Campylopus sp	I	3	3	3	I	2	2	3	I	2	3	3
Racomitrium lanuginosum	I	3	5	6	I	1	3	3	I	5	5	7
Rhytidiadelphus loreus	I	2	2	2	I	3	3	3	I	1	2	4
Cladonia uncialis	I	3	3	3	I	3	3	3	I	2	3	3
Potentilla erecta	I	1	1	1	I	1	3	3	I	4	4	4
Galium saxatile	I	1	1	1								
Lophocolea bidentata					I	1	1	2				
Nardus stricta					I	1	2	2				
Plagiothecium undulatum									I	2	2	3
Sphagnum fimbriatum					I	1	2	2	I	2	2	2
Agrostis canina					I	3	3	3				
Carex rostrata	I	7	7	7	I	5	5	5				
Listera cordata	I	1	1	1	I	1	1	1				
Rhynchospora alba					I	8	8	8				
Rhytidiadelphus squarrosus					I	1	1	1				

In the table M18 includes samples which are transitional to other communities (M2 and M20) but does not include the Molinia dominated sub-type. Most samples fit into M18_S or M18/M19.

Vegetation dataset from 2022-2025 surveys of upland ombrotrophic peatlands in England and Wales.

Distribution map (based on Blanket Bog eco-hydrological survey dataset)



M18 and M18_S;

M18/M19 transitional vegetation

additional records for M18 in England and Wales from national inventory datasets.

Occurs in lowland areas, particularly where rainfall is high and in the headwaters of river valleys.

Widespread in the uplands where it is found in mounded bogs (crowns) and embedded in hill bogs, usually on flatter ground (slackenings) and in wetter areas in troughs and sumps.

Summary	**M18**	**M18/M19**
Number of samples	90	40
Altitude (mean)	325	370
Rainfall (annual average)	1309	1331
Slope %	1.4	2.1
Peat depth (m)	4.41	3.55
pH	4.0	3.9

Affinities

Yorkshire Peat Partnership: Equivalent to YPP community Wet Bog (*Erica tetralix*) (WBET)
Irish Vegetation Classification: BG2A *Eriophorum vaginatum – Vaccinium oxycoccos* bog BG2B *Erica tetralix – Andromeda polifolia* bog
EUNIS: D1.11 Active, relatively undamaged raised bogs
Annex 1 habitats: H7110 Raised bog

Conservation Value

Although the species-richness of bogs is typically low, several rare species occur on undamaged bogs including great sundew (*Drosera anglica*) and several bryophytes *Sphagnum austinii* (formerly *S. imbricatum*), *S. beothuk* (formerly *S. fuscum*).
Ombrotrophic peatlands are an important carbon store.
Management:
Drainage, afforestation, agricultural improvement and some upland management practices (drainage, burning, grazing) are threats in many places or have had a historic impact in many places. Past peat cutting has taken place around the margins of many sites.

Selected references

Averis A., Averis B., Birks, J. Horsfield D., Thompson D. and Yeo M. (2004). *An Illustrated guide to British Upland Vegetation*. JNCC.
Eades, P., Tratt, R., Wheeler, B.D., Shaw, S. (2026). *Eco-hydrological guidelines for upland peatlands and associated habitats*. Environment Agency.
Rodwell, J.S. (Ed.) (1991). *British plant communities. Volume 2. Mires and heaths.* Cambridge University Press, Cambridge.

Photos:



Felicia Moss, Northumberland showing M18 vegetation with microtopographical features

(a)  (b) 

Distinctive species that are characteristic of M18 (a) Bog rosemary (*Andromeda polifolia*) [growing with crowberry (*Empetrum nigrum*)] and (b) *Sphagnum medium* (formerly *S. magellanicum*).



M18 vegetation grading into M19 at Geltsdale, Northumberland



Cranberry (*Vaccinium oxycoccos*) is frequently present in M18 vegetation, growing over Sphagnum hummocks (*S.medium* in this photo).

Synopsis version: 1.0	synopsis date: 18May2026	synopsis author(s): Ros Tratt & Phil Eades

18.3 M19 mire community synopsis

England and Wales wetland vegetation classification – community synopsis

Scientific name	*Calluna vulgaris – Eriophorum vaginatum community*
Common name	Heather – Cottongrass community
Community code	M19

Vegetation description

Vegetation dominated by mixtures of heather (*Calluna vulgaris*) and hare's tail cottongrass (*Eriophorum vaginatum*) with a very variable range of associates including bilberry (*Vaccinium myrtilis*), crowberry (*Empetrum nigrum*), cowberry (*Vaccinium vitis-idaea*), common cottongrass (*Eriophorum angustifolium*) and wavy hair grass (*Deschampsia flexuosa*). Cloudberry (*Rubus chamaemorus*) is distinctive but does not occur in all habitat patches.

Pleurocarpous mosses are often abundant with *Hypnum jutlandicum* and *Pleurozium schreberi* most prominent. *Sphagnum capillifolium* and *S. rubellum* are usually present and sometimes abundant, forming tall hummocks (see M19_S sub-type).

Patches of a wide range of *Sphagnum* spp. are often present locally (including *S. fallax*, *S. fimbriatum*, *S. papillosum*, *S. subnitens*).

Cross-leaved heath (*Erica tetralix*), deergrass (*Trichophorum germanicum*) and bog asphodel (*Narthecium ossifragum*) occur locally and in transitions to M18 cross-leaved heath – *Sphagnum papillosum* community.

M19_S Sphagnum rich form with tall hummocks of *Sphagnum capillifoium*, often with bushy lichens (*Cladonia* spp.). Other Sphagnum species may be present but at generally lower cover.

M19_P Species-poor heather and hare's-tail cottongrass dominated vegetation with few other species at very low cover. Moss layer generally poorly developed and generally no *Sphagnum*, or only very rare patches.

M19_M Molinia rich form, tends to be localised and rather species-poor.

Ecology

This is a community of ombrotrophic peatlands (typically blanket bogs) occurring at a range of altitudes, usually on hill bog surfaces which are exclusively fed by rainfall (ombrotrophic).

It usually occurs as extensive tracts, particularly in northern England and Wales, often appearing as distinctive patchworks of different heather age classes where the habitat has been managed by rotational burning or cutting. In montane areas the heather can be stunted and montane species can be conspicuous e.g. *Cetraria islandica* lichen.

NVC Sub-communities

M19a *Erica tetralix* sub-community
M19b Typical sub-community
M19c *Vaccinium vitis-idaea – Hylocomium splendens* sub-community

Similar communities and transitions

M19 shares a similar set of species with M17 and M18 (heather, cottongrasses, *Sphagnum* spp) but has more heathy species e.g. bilberry, cowberry, crowberry, and more pleurocarpous mosses; cloudberry is preferential to M19 where it occurs in upland situations. Species-poor stands with very low dwarf shrub cover are usually allocated to M20, but recovery of the dwarf shrub component of the vegetation (following changes in management) usually results in vegetation aligned with M19.

M17 has a more uniform cover of deergrass and purple moor-grass alongside cottongrasses, and more sparse cover of dwarf shrubs. purple moor-grass and deergrass can be prominent in M19 but are usually localised and patchy.

M18 is characterised by having more cross-leaved heath and cranberry, as well as the preferential species *S. medium* (formerly *S. magellanicum*) and bog rosemary, transitions to M18 are frequent (see M18/M19).

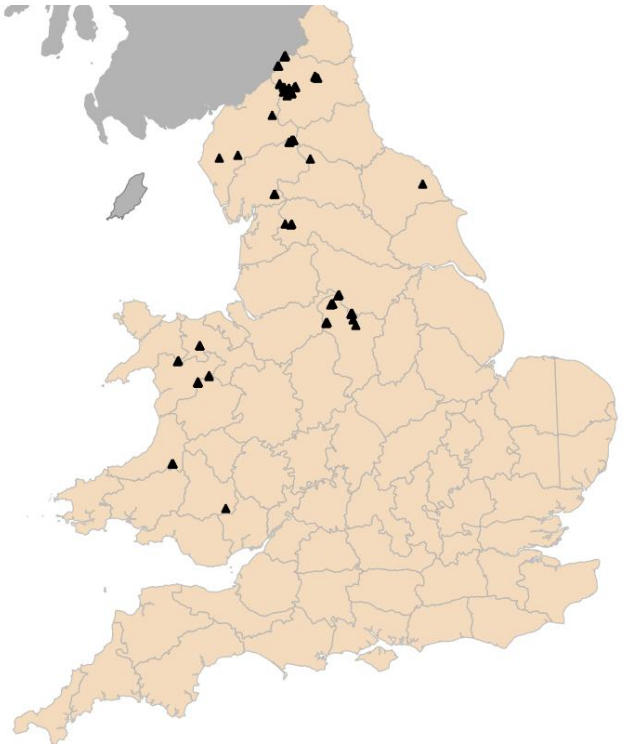
M19 also grades into dry heath (H9, H12), wet heath (M15) and acid grassland (U5 and U6). In some areas a heathy vegetation type has developed over dried out deep peat and this is likely to have been derived from M19.

Synoptic table M19 (n= 65) with most frequent 40 species. Frequency (from I-V). Cover range: Domin score (min med max).

Species name / vegetation type or sub-type	**M19**				**M19_S**				**M19_P**			
n	30				20				15			
species-richness	11				12				7			
species	freq	min	med	max	freq	min	med	max	freq	min	med	max
Calluna vulgaris	V	1	7	9	V	3	7	8	V	3	8	9
Eriophorum vaginatum	V	3	6	9	V	5	7	9	V	3	7	8
Hypnum jutlandicum	V	3	4	9	IV	3	5	7	V	5	7	8
Vaccinium myrtillus	V	1	4	8	IV	1	3	5	III	2	4	6
Empetrum nigrum	IV	1	4	8	III	1	4	6	IV	1	3	4
Pleurozium schreberi	IV	2	5	7	IV	3	5	6	I	7	7	7
Sphagnum capillifolium	IV	1	3	5	V	3	5	7	I	2	2	2
Eriophorum angustifolium	III	1	3	6	III	1	3	5	III	2	4	6
Erica tetralix	III	1	3	5	IV	2	3	5	II	3	3	4
Deschampsia flexuosa	III	2	3	5	III	1	4	5	II	2	4	4
Polytrichum commune	III	2	3	5	III	2	3	5	I	1	1	1
Rhytidiadelphus loreus	III	1	3	4	II	2	3	4				
Hylocomium splendens	III	2	4	6	I	4	4	4				
Sphagnum papillosum	II	1	2	3	III	2	3	7	I	3	3	3
Aulacomnium palustre	II	1	2	3	II	2	2	3	I	3	3	3
Plagiothecium undulatum	II	1	2	3	I	1	2	3	I	3	3	3
Rhytidiadelphus squarrosus	II	2	4	5	II	3	3	3	I	3	3	3
Sphagnum subnitens	II	1	3	4	II	3	6	8	II	3	3	3
Trichophorum germanicum	II	1	3	7	II	2	3	4				
Vaccinium vitis-idaea	II	1	4	5	I	1	1	1				
Vaccinium oxycoccos	I	1	3	3	III	1	2	4	I	3	3	3
Dicranum scoparium	I	1	2	4	I	3	3	3	I	2	2	2
Molinia caerulea	I	2	3	3	II	1	2	4	I	3	3	3
Polytrichum strictum	I	2	3	3	III	2	3	4	I	3	3	3
Campylopus sp	I	2	3	4	I	1	2	3	II	3	3	5
Cladonia portentosa	I	2	3	4	II	2	3	4				
Sphagnum fimbriatum	I	1	1	3	I	1	3	5	II	1	3	3
Rubus chamaemorus	I	2	3	4	I	1	2	3	II	2	3	3
Sphagnum fallax	I	3	4	4	II	3	4	5				
Dryopteris carthusiana	I	1	1	3	I	1	2	2				
Galium saxatile	I	1	3	4	I	2	2	2				
Sphagnum palustre	I	1	1	3					I	3	3	3
Narthecium ossifragum	I	3	3	3	I	1	4	4				
Sphagnum cuspidatum	I	3	3	3	I	3	3	3				
Festuca ovina	I	3	4	4	I	2	2	2				
Carex nigra	I	1	2	3								
Juncus squarrosus	I	4	5	5								
Nardus stricta	I	3	4	4								
Potentilla erecta					I	3	4	4				
Racomitrium lanuginosum					I	3	4	4				
Sphagnum magellanicum					I	3	4	5				

M19 samples are those that are not allocated to the Sphagnum-rich sub-type (M19_S), species-poor sub-type (M19_P) or Molinia-rich sub-type (M19_M).
Dataset from 2022-2025 surveys of upland ombrotrophic peatlands in England and Wales.

Distribution map (based on 2025 Blanket Bog eco-hydrological survey dataset



▲ M19

Occurs in upland areas in northern England and Wales.

Widespread in the uplands of the North and South Pennines, Northumberland, North York Moors and North Wales, where it is extensive in Hill Bogs on Hill Peat Slopes, Slackenings and Crests. Also occurs on Aprons and Bottoms at the margins of mounded bogs and troughs.

Summary	**M19**	**M19_S**	**M19_P**
Number of samples	41	24	17
Altitude (mean)	434	452	450
Rainfall (annual average)	1513	1565	1381
Slope %	7.4	3.4	3.8
Peat depth (m)	1.97	2.66	2.33
pH	3.9	3.9	4.0

Affinities

Yorkshire Peat Partnership: Equivalent to YPP community Blanket Bog (Calluna vulgaris) (BB split into three classes based on abundance of heather: <25%, 25-75%, >75%)
Irish Vegetation Classification: HE3F *Calluna vulgaris – Eriophorum vaginatum* bog, BG2E *Calluna vulgaris – Eriophorum* spp. bog.
EUNIS: D1.1 Raised Bog and D1.2 Blanket Bog;
Annex 1 habitats: H7130 Blanket Bog

Conservation Value

Although the botanical species-richness of bogs is typically low, they are extensive and provide important habitats for a range of wildlife. In the higher altitude examples of M19 there are sometimes montane species e.g. northern bilberry (Vaccinium uliginosum), mountain crowberry (*Empetrum nigrum ssp. hermaphroditum*). *Sphagnum beothuk* (formerly *S. fuscum*) is also found in some montane stands.
Ombrotrophic peatlands are an important carbon store.
Many Hill Bogs are affected by erosion and are the focus of restoration programmes.
Management:
Drainage, afforestation, agricultural improvement and some upland management practices (drainage, burning, grazing) are threats or have had a historic impact in many places.
Past peat cutting has taken place around the margins of many sites.

Selected references

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Photos:



Moorhouse, North Pennines. View of M19 vegetation, Sphagnum-rich type (M19_S) with tall hummocks in foreground. Peat depth 1-2m.

(a)  (b) 

Distinctive structure (a) mature dwarf shrubs and cottongrass with *Sphagnum capillifolium*, bushy lichens and (b) much shorter sward in more exposed upland areas (Moorhouse Knock Fell at 700m aOD, peat depth 1-2m).



Combs Moss, Staffordshire. *Molinia*-rich M19 in foreground (M19_M) on Hill Peat Slope (peat depth 2.6m).



Featherbed Moss, South Pennines. Eroded (restoration) area on a Slackening in a col.



Langsett Moor, South Pennines. Species-poor M19_P on Hill Peat Slopes with historic rotational heather burning.

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