Hinderclay Fen

Vegetation Survey

2006

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Hinderclay Fen

Vegetation Survey using the National Vegetation Classification

Fieldwork undertaken July-August 2005

Work undertaken on behalf of:

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SUMMARY

1. Hinderclay Fen is one of a series of valleyhead fens situated in the corridor occupied by the modern headwaters of the Little Ouse and Waveney rivers. The fen itself is a small wetland formed in a depression marking the former channel and embayment of the Little Ouse. It abuts the free-draining margins of the Lopham Terrace, and is bounded by the artificial course of the modern Little Ouse to the north, and two minor streams, the Thelnetham Stream to the west, and the Botesdale Brook to the east.

2. The vegetation of Hinderclay Fen was surveyed and classified by Ecology Land and People (ELP) to fulfill a contract with the Little Ouse Headwaters Project. The survey was undertaken during several site visits between 11th and 20th July 2005 to characterize its vegetation communities according to the National Vegetation Classification (NVC). The standard NVC methodology was adopted for all habitats. Twenty three distinct vegetation communities were established, and the samples plots taken recorded 186 species of higher plants, ferns, lichens and bryophytes.

3. The survey site is sub-divided into four distinct hydrogeological zones, each with differing hydrological and chemical characters. The sandy surface of the Lopham Terrace supports eight non-woodland communities, including a series of parched grasslands supporting notable populations of lichens and suites of drought-tolerant plants reflecting a variable soil chemistry, ranging from strongly acid and nutrient-poor to mildly calcareous or nutrient-rich.

4. The degraded edge of the Terrace slopes down to peat-filled depressions at various angles, forming a sequence of substrates from dry mineral soils to the thin, peats of the footslope, which often extends across the valley floor. This gradation supports nine distinct vegetation communities, including marked areas of dry purple moor-grass tussocks, degraded fen meadow and eutrophic stands of grey willow scrub with an understorey of nettles with reed.

5. Across the terrace and its slopes, a number of stands of oak-birch woodland occur, which vary in age and structure and support a ground flora reflecting their position on the terrace. To the west, the narrow peat-filled channel of the Thelnetham Stream is occupied by alderwood, the lower fringes of which have been cut back to increase the area of fen vegetation occupying the peat-filled depressions at the lowest elevation of the site. Much of this is dominated by reed, rushes and pond-sedge, often with few associate species. A riparian spoil bank forms the northern margin of the site; this supports a weak willow scrub over extensive nettlebeds.

6. Map 3 shows the distribution of the four zones and their constituent vegetation communities. A description is given of each community, and floristic tables are provided for all significant stands. All communities are named within the framework of the National Vegetation Classification, though some kinds of vegetation are regarded as intermediate, or are indeterminate and provided with appropriate titles. Several vegetation management considerations are given, addressing the key factors of grazing, scrub encroachment and drainage.

CONTENTS

1. LANDSCAPE SITUATION

1.1 Position in the landscape

Hinderclay Fen is one of a series of valleyhead fens situated in the corridor occupied by the modern headwaters of the Little Ouse and Waveney rivers. The fen itself is a small wetland formed in a depression marking the former channel and embayment of the Little Ouse. It abuts the free-draining margins of the Lopham Terrace, and is bounded by the artificial course of the modern Little Ouse to the north, and two minor streams.

The Lopham Terrace forms the upland along the southern parts of the site. The surface of the terrace is composed largely of free-draining sands and gravels, though the character of the vegetation suggests that the substrate may vary from an acidic reaction to circum-neutral. The main terrace communities, however, are a dry, often acidic grassland which gives way in places to stands of birch or oak. These woodland colonists have sometimes formed a dense stand that shuts out the grassland flora, but remains of the grassland vegetation are sufficiently frequent to mark out their former extent.

The topography of the terrace margin is also variable; in some areas abrupt slopes fall quickly into a peat-filled basin, while elsewhere the slopes are gentler and incorporate hollows and other signs of degradation. The steeper slopes are associated with the course of a deep, peat-filled channel, which forms the focus of the fen itself.

Much of the lower-lying land forms a narrow fringe to the modern course of the river. Apart from fragmentary stands of marginal alderwood, it is made up of various stands of grey willow scrub and extensive nettlebeds. In places these grade to areas of rough grassland and former fen meadow, before ascending the degraded terrace slopes as oak-birch woodland or close-knit tussock grasslands of almost pure purple moor-grass.

To the west, the margin of the terrace recedes rapidly to form an embayment between its edge and the course of the modern river. Here, a stand of reed-dominated vegetation marks an area of deep peat associated with an earlier course of the river.

At the western extremity, the fen is bounded by the 'Thelnetham Stream', which has been canalised through a field ditch to form a discrete boundary, though former courses of the stream can be traced through several abandoned, peat-filled routes in its vicinity. The most obvious former section of these earlier courses lies within a narrow headwater alderwood at the western part of the fen, where a short, deeply-incised

channel crosses the terrace, forming a highly shaded swamp at the foot of short, steep slopes.

The northern margin of the Hinderclay Fen is marked by a bund of river spoil, which is clearly defined as an embankment above the level of the peat surface to the west of the site, while to the east its topography is more subdued, sometimes with no obvious margin with the low-lying terrace deposits.

The so-called 'Botesdale Brook' may follow the original course of the Little Ouse, and forms the eastern boundary of Hinderclay Fen as its joins the modern course of the Little Ouse in an abruptly-sided channel.

1.2 Hydro-geological zones and habitat conditions

The Hinderclay Fen site displays the characteristic topographical sequence of the footslopes and valley floor of the headwaters of the Little Ouse river. This sequence consists of several landscape elements. The upland parts of the site along the southern margin are defined by their position on the higher part of the Lopham Terrace, the first element. The central and eastern areas are located on the second element – a transitional slope at the margin of the terrace of varying amplitude. The degraded margin of the terrace varies from a strip of a few metres at the foot of a sharp bluff above the peat-filled depression, to an extensive strip of uneven ground extending across the whole site to the river. At the western margin and extending over a large part of the western third of the site, the peat-filled depression forms a discrete third landscape element. Overlying the peat and the terrace margin along the northern boundary, a fourth element has recently been formed by the river spoil banks.

At Hinderclay Fen, each landscape element has different hydrological and chemical characters associated with their differing composition, mode of formation or location. For this reason, each element is regarded as a separate hydro-geological zone, affecting the character and composition of the vegetation that occupies it.

1.2.1 Sandy terrace

The free-draining soils of the sandy terrace are widely distributed along the southern boundary of the site, but are particularly notable to the north of the duck farm lagoon towards the eastern margin. Over much of the open area in this part of the site the vegetation is parched during the summer months, and also shows evidence of rabbit grazing. It is in this zone that heather *Calluna vulgaris* and other species associated with acidic, dry conditions are prevalent. The low nutrient status of this area of the sandy terrace zone also aids the maintenance of an open sward, which favours the growth of dryland ephemeral species and a number of *Cladonia* lichens.

Elsewhere on the sandy terrace the substrate, though still prone to summer droughting, is clearly not as acidic or nutrient poor. In these areas other

forms of dry grassland occur, which suggest that the soils verge on only mildly acidic or are even circum-neutral in their chemistry. Nonetheless, the over-riding character of the zone is of parched, at least mildly acidic soils, which supports not only dry, parched grasslands but also gorse scrub and oak-birch woodland. The woodland varies in age, composition and canopy cover, from recent birch scrub, through dense poles of birch *Betula pendula* and aspen *Populus tremula*, to stands of mature trees, usually oak, which vary in their density and canopy cover.

The margins of the site also exhibit signs of recent disturbance, and nutrient enrichment, both along the fenceline forming the southern boundary and in a block of land where the Thelnetham Stream is crossed by the public right-of-way, where hawthorn, ash and nettle are dominant.

1.2.2 Transitional slopes

A remarkable feature of Hinderclay Fen is the loyalty of the tussock grass *Molinia caerulea* to the slightly flushed transitional slopes of the terrace margin. The species picks out such soils across much of the site, from the eastern boundary to the margin of the terrace where it meets the peat-filled depression in the west. The importance of the slight flushing to the distribution of plant communities is emphasised by the sequence of communities across the slope.

The full sequence observed at Hinderclay, in terms of species dominants, is as follows:

Calluna vulgaris ↘

Molinia caerulea ↘

Holcus lanatus ↘

Salix cinerea / *Juncus* species

This transitional response to soil conditions varies in width from c. 5 metres to 40 metres or so. The fragments of *Calluna* stands are located on the lower margin of the sandy terrace, and often merge with the *Molinia* stands. These are often fragmentary stands themselves, surrounded by but surviving under a variable canopy of birch or oak. However, in places, the canopy is open at a lower elevation, and here the *Molinia* stands give way to a thick, straggly sward of Yorkshire Fog *Holcus lanatus*. This species is associated with the lower areas of the transitional slope in the site, and appears to mark out stands of fen meadow that have been dewatered. Below the *Holcus*, and in the dampest areas of this zone, grey willow *Salix cinerea* and rush *Juncus* species are frequent dominants.

1.2.3 Peat-filled depression

This hydro-geological zone is defined by the extent of peat at the ground surface. The zone is therefore found only in the west of the site, though a skirt of peaty topsoil continues eastwards alongside and beneath the spoil bank. One area of peat is associated with the former course of the

Thelnetham Stream within the woodland forming the western boundary. This area has cut into Lopham Terrace, and contains sites of seepages or springs, and is subject to flooding in the winter months. The second area is the 'sump' wetland associated with the former channel of the Little Ouse in the main part of the site. While the first area supports a natural range and distribution of wetland vegetation beneath an alder canopy, the sump wetland and peat margins appear to be rather a degraded form. Stands of the pond sedges *Carex riparia* and *C. acutiformis*, reed *Phragmites australis* and a lush fen meadow vegetation dominated by the rushes *Juncus subnodulosus* and *J. effusus* occupy this area.

1.2.4 Spoil bank

The southern bank of the Little Ouse is masked by a substantial bank of spoil, which is covered in a thick stand of nettles *Urtica dioica* and other species indicative of very fertile conditions. The bank itself is a mixture of peat, sands and gravels, and a loamy clay. Lifted above the watertable, the deposits are denaturing, and releasing nutrients. The vegetation contains an element of riparian vegetation that has colonised the fertile soils, including *Salix cinerea*, *Betula pendula* and elder *Sambucus nigra*, with reed and vestiges of eutrophic fen. There can be no doubt, also, that leachate from this zone has penetrated into the adjacent peats and sands.

1.3 Summary of vegetation units

The vegetation assessment of Hinderclay Fen has been structured around these hydro-geological zones, as they represent the range of environmental conditions that have promoted the pattern and composition of vegetation types found on the site today. The assessment of vegetation units (summarised below and developed in section 3) builds on this framework, by referring all vegetation types to it.

Sandy terrace	Dry, often parched character, often with strongly acidic conditions. Dry grasslands, scrub and tall-herb stands Oak-birch woodland with drought-tolerant species
Transitional slopes	Sloping, slightly flushed zone, very variable in width. Moist grasslands Oak-birch woodland with damp species indicators
Peat-filled depression	Peat-filled channel with small, marginal embayments. Reed swamp and sedge-beds Fen-meadow Alder woodland
Spoil bank	Linear bank of variable width; very fertile. Tall-herb stands and scrub

2. SURVEY METHODOLOGY

2.1 Field survey

Hinderclay Fen was surveyed during several site visits between 11th and 20th July 2005 to determine its vegetation communities, according to the National Vegetation Classification (NVC). A further visit was undertaken in late August to provide supplementary information on the character of the summer flora, and to establish the areas of permanent groundwater presence in the peat-filled depressions.

The standard NVC methodology was adopted for all habitats (Rodwell, 1991-2000).

The methodology requires the identification and delimitation of visually homogeneous areas of vegetation referred to as 'stands'. Characteristics of each stand were collected on its physiognomy, which is a collective term for vegetation height and disposition, and on its floristic composition.

The methodology emphasizes the importance of sampling each stand, by locating small 'plots' of vegetation judged as being representative of the floristics, physiognomy and ground conditions of the stand. The plots are located 'by eye' on this basis. With the exception of sample quadrat sizes (see below), the data gathered by each sample was of identical detail and scope.

Where necessary and possible, five samples per stand were taken. In some cases, the samples confirmed that the stands were either mosaics of more than one vegetation-type or, more commonly, had either diffuse boundaries with contiguous stands or disjunct distributions across the survey site. In these cases, subsequent samples were taken to confirm the extent and distribution of stands where this was not possible to ascertain by eye. For this reason, a number of final stands were created with less than, or more than, five samples per stand. A few stands warranted further samples on account of the internal variation they displayed.

Lastly, other stands were excluded from detailed sampling on account of their common or ephemeral character, resulting either in a simple list of their constituent species, or in an allocation of only one or two samples.

In each stand, the vegetation was sampled within discreet plots for the species present and their abundance. The plots were set out as square or broadly rectangular shapes known as quadrats. The size of sample quadrat selected depended on the structure and floristic diversity of the stand. The standard quadrat size of 2m x 2m was used for short, species-rich vegetation, and 4m x 4m was used to sample tall herb and scrub vegetation. In the woodland samples, the canopy and sub-canopy layers

were sampled by quadrats approximating to 50m x 50m where practicable, or as large a sample as could be accommodated.

Each species in the sample quadrat (including woody plants, herbs, grasses and their allies, bryophytes and lichens) had their cover abundance rated using the DOMIN scale. This is the standard estimate used within the NVC of the proportion of the ground surface within the sample area that is hidden by the living, above-ground parts of each species when viewed from above.

The measure includes all plant parts obscured from view by taller species, and so the summed cover values of a sample will frequently add up to more than 100 per cent.

DOMIN value	Cover value
10	91 – 100 %
9	76 – 90 %
8	51 – 75 %
7	34 – 50 %
6	26 – 33 %
5	11 – 25 %
4	4 – 10 %
3	Less than 4 % (many individuals – scattered)
2	Less than 4 % (a few individuals - clumped)
1	Less than 4 % (1 – 2 individuals)

2.2 Floristic tables and community classification

Floristic tables were prepared for each homogeneous stand (see section 5). Where more than three samples were taken from a stand, the frequency of occurrence of each species in the stand (per cent presence) is given in the penultimate column of the table, according to the scale:

Frequency	Range
V	81 – 100 %
IV	61 – 80 %
III	41 – 60 %
II	21 – 40 %
I	1 – 20 %

In the last column, the range of DOMIN values is given, indicating the variability of cover recorded by the stand samples. Further information on the exact meanings of terms used in the community floristics tables is given in section 5.

The stand tables were compared with the synoptic community tables in the British Plant Communities series (Rodwell, 1990 – 2000), and the characteristics of each stand compared with the community chapters. Many of the vegetation communities at Hinderclay Fen are readily referred to groups of vegetation samples forming a community or sub-community syntaxon within the NVC. Where practicable, the names and terms used by the NVC are then employed in subsequent descriptions of

the vegetation found at the site. Nonetheless, it should be borne in mind that these names and terms refer to types of vegetation classified by grouping vegetation samples from across the British mainland, and are not intended to specify more than the general type of vegetation recorded by this survey.

In determining the position of some stands within the classification, it has been appropriate to make a determination to community level only. In other cases, the stand has been ascribed to one community but also allied to another (using brackets around the minor code); or found to be intermediate between two NVC communities (shown by '/' between the codes). Similarly, a stand may not match any published account within the classification, and is described as 'indeterminate'. In such cases, where similar vegetation has been described at association level within the phytosociological class-ifications of neighbouring countries in mainland Europe, that name is given as a pertinent authority.

3. DESCRIPTIONS OF VEGETATION UNITS AND THEIR CONSTITUENT COMMUNITIES

3.1 Overview of vegetation composition

Section 1 emphasised the importance of geology and hydrology at Hinderclay Fen. The contribution of these factors and of the physiognomic differences produced by the intensity and character of past management has produced twenty-three distinct vegetation communities. Table 1 groups the communities within the hydro-geological zones described the section 1.

Table 1. Vegetation communities – stand ref. and NVC code

Vegetation zone	Vegetation community	Stand ref.	NVC code	Area (Ha)*
Sandy terrace	Acid parched grassland	Ga	U1a	0.68
	Calluna vulgaris community	Cv	U1b(H1c)	0.12
	Parched grassland	Gp	U1c	0.20
	Parched neutral grassland	Gn	U1d(FHA)	0.16
	Dry ruderal grassland	Gr	U1	0.07
	Dry *Holcus lanatus* community	Hd	U1d(W23b)	0.51
	Dry nettlebed	Dn	OV24b	0.15
	Nutrient-rich scrub	Sn	W21b	0.36
	Oak-birch woodland	OB	W10d	4.56
Transitional slope	*Molinia caerulea* grassland	M	Indet.	0.58
	Cleared birchwood	B	Indet.	0.20
	Neutral grassland	Nc	MG5b	0.01
	Moist *Holcus lanatus* grassland	Hm	M24b/MG1b	0.05
	Sedge grassland	Ca	MG1b/M22d	0.21
	Grey willow-nettle scrub	S	W6a-incipient	0.08
	Eupatorium cannabinum community	E	Indet.	0.08
	Recently cleared valley floor area	F	Indet.	0.30
	Dryopteris dilatata stand	Dd	Indet.	-
Peat-filled depressions	Alder woodland	Aw	W5b(W7b)	1.05
	Pond sedge bed	Cr	S24	0.09
	Reedbed	Rb	S24	0.52
	Fen meadow	Js	M22a	0.35

Spoil bank	Riparian nettlebed	SB	OV24a	1.50

* Calculated from Map 3, and rounded-up to 2 decimal places

Sections 3.2-3.5 provide a description of the vegetation comprising each of the hydro-geological zones, the general and distinctive characters of each community and how the communities interact within each zone.

3.2 Sandy terrace communities

The vegetation communities in this zone have been divided into three classes:

3.2.1 Parched grasslands
3.2.2 Nutrient-rich stands
3.2.3 Oak-birch woodland

3.2.1 Parched grasslands

Large areas of the sandy terrace are open, dry grasslands of various structures and compositions. Three constant and often abundant species characterise these swards: Common bent-grass *Agrostis capillaris*, Sheep's sorrel *Rumex acetosella* and Yorkshire fog *Holcus lanatus*. Six distinct stands are recognised, and the communities are listed below against the NVC syntaxa with which they have the strongest affinity. The NVC community names are given in their common abbreviated forms – the names are given in full towards the end of each stand description. The determinations of some stands include reference to other, similar communities, given in brackets.

Stand ref.	Vegetation community	NVC code	NVC community (or alternative)
Ga	Acid parched grassland	U1a	*Festuca-Agrostis-Rumex* grassland, *Cornicularia-Cladonia* sub-comm.
Cv	*Calluna vulgaris* community	U1b(H1c)	*Festuca-Agrostis-Rumex* grassland, Typical sub-comm. (*Calluna-Festuca* heath, *Teucrium scorodonia* sub-comm.)
Gp	Parched grassland	U1c	*Festuca-Agrostis-Rumex* grassland, *Erodium-Teesdalia* sub-comm.
Gn	Parched neutral grassland	U1d(FHA)	*Festuca-Agrostis-Rumex* grassland, *Anthoxanthum-Lotus* sub-comm. (*Festuca-Holcus-Agrostis* grassland)
Gr	Dry ruderal grassland	U1	Undeveloped ruderal form of *Festuca-Agrostis-Rumex* grassland
Hd	Dry Holcus lanatus community	U1d(W24b)	Undeveloped form of *Festuca-Agrostis-Rumex* grassland, *Anthoxanthum-Lotus* sub-comm. (*Rubus-Holcus* underscrub, *Arrhenatherum-Heracleum* sub-comm.)

The communities are distributed across the sandy terrace in distinct stands and, although each community is somewhat similar in its species composition, and may merge with its neighbours, that distribution appears to reflect the particular conditions and management history of different areas of this zone.

The acid parched grassland (stand Ga) and the smaller patches of the *Calluna vulgaris* community (stand Cv) represent the most strongly acid open areas of the sandy terrace, and tend to occupy the margin of the terrace beside the transitional slope to the fen. The parched grassland (stand Gp) is somewhat transitional to the parched neutral grassland (stand Gn), and tends to abut or replace the acid parched grassland. Higher up the terrace, and notably to the east, these grasslands trend rapidly to a genuinely neutral grassland (stand Gn), which, though parched, contains a rather more mesophytic component, and lacks species most clearly confined to the more acid areas. Disturbed areas along the southern margin of the site are occupied by a dry ruderal sward (stand Gr), which shows affinity with both acidic and nutrient-rich vegetation.

Large areas to the west are occupied by an often species-poor stand dominated by the grass *Holcus lanatus*. This stand (Hd) would appear to be at least in part a replacement for cleared scrub.

These grasslands represent the most xeric (ie. extremely dry) and acid aspect of the valley terrace. They collectively have an affinity with vegetation typical of the heathland habitat, and are widely managed for on nature reserves.

Acid parched grassland

(Stand Ga, samples 1-4,81)

This stand represents the most extreme aspect of the valley terrace. Here, the dry, somewhat acid sward is kept open by a combination of rabbit grazing and extreme summer drought. [Photo 1] The grassland is a simple matrix of *Cladonia* lichens, of which *Cladina impexa* is by far the most common, and a limited range of grasses, dominated by *Agrostis capillaris*, often growing with lesser amounts of *A. vinealis*, and the fine-leaved form of the aggregate *Festuca ovina* agg. group; this is *F. filiformis*, which is the common sheep's fescue grass of dry, East Anglian soils.

Photo 1. Acid parched grassland

On the southern margin, the stand gives way to a dry, more mesophytic and species-rich parched sward. Where this stand is grazed by rabbits, there is considerable species overlap between the two stands, and the acid parched grassland may represent a more nutrient-impoverished, xeric form, rather than an entirely separate form of vegetation. Nonetheless, it should be considered that the mineral composition of the terrace surface may differ on this southern margin, perhaps as a result of a smaller proportion of loessic fines. This may correspond to a propensity of the oak-birch woodland to follow a similar trend elsewhere on the site.

On the northern margin, however, there is often an abrupt boundary to this stand, which corresponds to the southern-most fringe of the *Molinia*-dominated vegetation of the transitional slope (referred to as the Molinietum). This ecotone marks the clearly-defined transition from the parched character of this stand to one reflecting the presence of at least seasonal moisture retention in the root zone. This feature is mirrored in the oak-birch woodland stands, and would appear to be a consistent feature along the northern margin of the terrace.

In places, the ground has been clearly disturbed, and here *Calluna* and *Cladonia* spp. species are particularly evident. As in the *Calluna* stands themselves, this species is maintained in a pioneer habit, presumably by rabbit grazing, and forms prostrate patches, usually of between 10-30 cm in diameter. Disturbance and drought are both factors that may have influenced the notable absence of plant litter, or thatch. Gaps between vascular plants are occupied by lichens or by a variety of bryophytes, of which two acrocarpous, mat-forming species are particularly frequent:

Polytrichum juniperum and *P. piliferum*. These mosses are known to thrive on soils with very low levels of nitrogen, by garnering nutrient from precipitation; indeed, such moss ecosystems are thought to be extremely efficient at removing nitrogen from rainfall, dew and windblown dust Bowden RD (1991). Scattered within the sward are other mosses, including *Hypnum jutlandicum*, *Plagiomnium rostratum* (associated with very dry, open habitats). There are also several small, young patches of *Ceratodon purpureus*, a moss species typical of disturbed, mildly acidic substrates.

The acid parched grassland corresponds to the *Cornicularia aculeata-Cladonia arbuscula* sub-community of the *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland (U1a). This grassland will henceforth be referred to as the *Festuca-Agrostis-Rumex* grassland. The key distinguishing features of the sward are the prevalence of lichens, the reduced cover of the main grasses on the sandy terrace, and the open sward, often containing seedlings of vascular plants, and scattered wefts and mats of small mosses.

Calluna vulgaris community

(Stand Cv, samples 11,13,36)

There are several fragmentary patches of *Calluna*-dominated vegetation located between the parched grasslands and the Molinietum. Only two stands were sampled and mapped, owing to their small size. The stands are rarely exclusive for this species, and the development of the vegetation-type may be restricted to a narrow zone that is both rabbit-grazed, open and yet subject to sufficient levels of soil moisture to preserve heather seedling growth.

In all cases, the *Calluna* is maintained in a pioneer habit by close grazing. Where plants have coalesced, patches reach up to 3 metres in the longest dimension and exclude all but the occasional stems of *Galium saxatile*, *Festuca filiformis* and *Rumex acetosella*. In the main, however, the stands are more clearly derived from the dry, parched grassland, and their separation in this account is a function of the scale at which the survey has been conducted. Only one species, the moss *Pleurozium schreberi*, is recorded as being an exclusive associate of this *Calluna*-dominated vegetation.

The *Calluna vulgaris* community can be regarded as a variant of the Typical sub-community of the *Festuca-Agrostis-Rumex* grassland (U1b). If the heather patches continue to persist, and are maintained in this low, vigorous condition by grazing, the stands can be expected to develop more of the characteristics of the *Teucrium scorodonia* sub-community of the *Calluna vulgaris-Festuca ovina* heath (H1c).

Parched grassland

(Stand Gp, samples 5, 30, 32, 34, 35)

This community is comprised of two stands similar in many respects, and somewhat intermediate between the acid parched grassland and dry

neutral grasslands. The stands straddle the track from Hinderclay village across the site towards Phoenix Lodge. Photo 2 shows the eastern stand. They can be viewed as an extension of the terrace dry neutral grassland to the east, but here the more mesic species generally diminish in number and cover, and the dominance of *Agrostis capillaris* and appearance of *Galium saxatile* presage the appearance of the neighbouring stands dominated by *Calluna vulgaris* and *Molinia caerulea*. While the lichen *Cladina impexa* confirms the droughtiness of these grasslands, the other lichen species are occasional at most.

Photo 2. Parched grassland

A small number of otherwise common species make their appearance in this grassland, particularly *Pilosella officinarium, Danthonia decumbens, Myosotis ramosissima* and the annual grass *Vulpia myuros*. The first species, though not common here, forms occasional large patches and suggests that rabbit grazing is a normal feature of this sward. The *Vulpia* grass is a strict annual and, owing to its ability to release allelopathic deterrents into the soil, typically forms particularly species-poor patches. There is also some colonisation by the gorse shrub *Ulex europaeus*.

Sample 34 illustrates the structural diversity of this stand resulting from differential intensities of management. Here, light grazing of young bushes has permitted their tops to shoot vigorously, while the bases of each bush are kept confined. The sward, however, is ungrazed, and litter levels are high enough to prevent the regeneration of most species from seed. Sample 35 illustrates the other extreme, where grazing of almost floristically identical grassland has produced a very open sward, with low levels of

litter and additional species such as *Galium verum* and *Campanula rotundifolia*.

The parched grassland has many species in common with the other swards on the sandy terrace, and is most easily recognised as a somewhat grassier stand, lacking many of the key species that distinguish the other swards. The group of species which were only located in this grassland are typical denizens of a dry, well-grazed sward. This group includes the pleurocarpous moss *Brachythecium albicans* and the drought-tolerant annuals *Cerastium semidecandrum, Myosotis ramosissima* and *Sagina procumbens*. The grassland fits most closely with the *Erodium cicutarium-Teesdalia nudicaulis* sub-community of the *Festuca-Agrostis-Rumex* grassland (U1c), though the physiognomy of the sward, and the occasional appearance of somewhat stronger-growing species, indicates that the sward is inclined to develop characters of the more common *Anthoxanthum odoratum-Lotus corniculatus* sub-community (U1d).

Parched neutral grassland
(Stand Gn, samples 15, 16 and 27)
Amongst the range of dry grasslands on the terrace, the parched neutral grassland not only displays homogeneity in its composition, it also contains a high proportion of neutral grassland species. In this respect, it quite closely resembles a small area of neutral grassland on the transitional slope, though it lacks the range of species of calcicolous element present in that stand. Nonetheless, this type of vegetation is quite distinct from the other parched swards, and has a distinct boundary with them and with the other neighbouring stands.

The principal grasses are *Festuca rubra, Agrostis capillaris* and *Holcus lanatus*, though the constant presence of *Holcus mollis* emphasises that this sward is not solely composed of mesophilic species. Similarly, the forbs *Glechoma hederacea, Galium verum* and *Potentilla reptans* are common here and also in neutral swards generally, but the presence of *Stellaria graminea, Rumex acetosella* and *Senecio jacobaea* are similarly indicative of mildly acid conditions.

This long list of constant species defines the floristics of the sward throughout the stand. However, the structure of the grassland is inconsistent, with well-established patches of grassy perennials often interrupted by small bare areas, often of soft sand, which acts as the locus for species such as *Achillea millefolium, Prunella vulgaris* and *Erodium cicutarium*. The variable height of the sward reflects this patterning.

The parched neutral grassland therefore lacks many of the species that define the characters of the parched and acid parched stands, which are replaced by a group of more mesophile species, notably *Festuca rubra*. As Rodwell *et al* (1992) points out, *Festuca rubra* may replace *F. ovina* as a constant species in the less extreme dry acid grasslands of eastern England. These differences place the stand within the *Anthoxanthum odoratum-Lotus corniculatus* sub-community of the *Festuca-Agrostis-Rumex* grassland (U1d), but show clearly a relationship to

the drier aspects of NVC *Festuca rubra-Holcus lanatus-Anthoxanthum odoratum* grassland, a rather similar mesotrophic community recognised in Suffolk (Harding 1993) lacking some of the acidophilous elements of the U1 grassland (Rodwell *et al*, 2000).

Dry ruderal grassland

(Stand Gr, samples 28,29)

This peripheral stand along the southern boundary of the site is a degraded form of the surrounding swards. Here, the rather mesophytic *Festuca rubra* joins *Agrostis capillaris* and *Rumex acetosella* to form the background to the taller character species, *Senecio jacobaea* and *Urtica dioica*. While both can be characteristic of disturbed but unmanaged grassland, it is the latter which clearly separates this rather rank grassland from other grasslands on the site, and indicates the relationship of this stand with the marginal nettle vegetation which follows the southern fenceline on this part of the site.

The dry ruderal grassland clearly belongs to the class of grasslands located on dry, sandy substrates, by virtue of the abundance of the dominant grasses. However, the frequency of disturbance and availability of nutrients has encouraged a mixture of drought resistant annuals and ruderal eutrophiles to assemble within the stand. The grassland is best regarded as an undeveloped form of the *Festuca-Agrostis-Rumex* grassland (U1); Rodwell (1992) notes that *Festuca rubra* can replace *F. ovina/filiformis* in this kind of grassland. The proximity of nettle indicates that a lack of defoliation would encourage the growth of the *Arrhenatherum elatius-Rubus fruticosus* agg. sub-community of the *Urtica dioica-Galium aparine* community (OV24b), whereas repeated defoliation would stabilise the stand into a rather eutrophic form of parched grassland, similar to stand Gp.

Dry *Holcus lanatus* community

(Stand Hd, samples 8,9,37,39,40)

Where scrub or oak-birch woodland has been cleared from the sandy terrace, some species have clearly exploited the higher light levels and rapidly oxidised stores of nutrients built up in frass and leaf litter. *Holcus lanatus*, in particular has taken advantage of this change in conditions. In fact, the stand dominated by this grass has remained largely ungrazed by rabbits; the species is unpalatable to grazers once established, owing to the unpleasant texture conferred to its leaves by the long, spreading hairs. In physiognomic terms, the stand shows the simple structure and patterns of species-dominance of cleared and disturbed ground. *Holcus lanatus* is ubiquitous and forms the overwhelming dominant over much of the sward except for patches of finer grasses and the more established species of former canopy gaps. [Photo 3]

Photo 3. Dry *Holcus lanatus* community

To the west of the central track crossing the terrace, an uncleared area of colonising scrub has been included within this stand. Much of the scrub consists of individual bushes of gorse *Ulex europaeus*, with some *Rubus fruticosus* agg., and a large clone of *Prunus spinosa*. *Chamerion angustifolium* and *Lonicera periclymenum* are also characteristic associates of the more developed, fringing scrub, but *Holcus lanatus* remains dominant throughout.

The dry *Holcus lanatus* community is a rather more undeveloped version of the *Festuca-Agrostis-Rumex* grassland (U1) than the dry ruderal grassland (stand Gr) discussed above. As illustrated in Photo 3, the presence of *Ulex* confirms that the stand has floristic similarities with the *Rumex acetosella* sub-community of the *Ulex europaeus-Rubus fruticosus* scrub (W23b). In places, the grassland is clearly being colonised by the scrub (in proximity to sample 37); elsewhere, the grassland stands appears to have developed from recently cleared scrub or scattered canopy (sample 8). In terms of its physiognomy, however, the sward should be regarded as grassland, and is recorded as U1d(W24b), to indicate the transitional state of the stand. Where left unmanaged, the absence of rabbit grazing would suggest that the stand progressively develop into *Ulex-Rubus* scrub.

3.2.2 Nutrient-rich stands

Two nutrient-rich stands occupy quite small areas on the Lopham Terrace.

Dry nettlebed

(Stand Dn)
The first, a fragmentary dry nettlebed, is almost entirely concentrated along the southern fenceline, and must be associated with disturbance along that boundary, probably coupled with local nutrient movement from the very fertile land of the adjacent duck farm. The constant and often dominant species throughout is nettle *Urtica dioica*, and this species is either accompanied along the fenceline by *Rubus fruticosus* agg., or by tussock grasses and ruderal herbs as the stand grades into dry, ruderal grassland and the parched grasslands of the terrace.

The dry nettlebed has a clear affinity with the *Arrhenatherum elatius-Rubus fruticosus* agg. sub-community of the *Urtica dioica-Galium aparine* community (OV24b), It would appear that the stand has developed from areas similar to the dry ruderal grassland (stand Gr), when periods of disturbance coupled with nutrient enrichment have been followed by nettle and bramble colonisation and little further disturbance or defoliation. Indeed, there are places where bramble scrub has coalesced on the fenceline, and these small areas are best placed in the *Arrhenatherum elatius-Heracleum sphondylium* sub-community of the *Rubus fruticosus* agg.-*Holcus lanatus* underscrub (W24b).

Nutrient-rich scrub
(Stand Sn)
The second community type is represented by the block of scrub on the western margin of the site. Raised high up on the margin of the site, this small stand is very clearly separated from the adjacent alderwood by the abrupt slope of the channel side, and from the neighbouring oak-birch woodland by both structure and species composition. It is likely that the stand has, at least in part, developed from arable land, or from high ground disturbance resulting from pheasant rearing.

The scrub is dominated by an understorey of *Urtica dioica*, with large patches of the eutrophile mosses *Eurhynchium praelongum* and *Brachythecium rutabulum* that form a thick, dense carpet interweaved by the over-wintering shoots of the diminutive ground ivy *Glechoma hederacea*. The sweet violet *Viola odorata* is a common denizen of the shaded ground, while hemlock *Conium maculatum* overtops the nettle in the sunny glades between the scattered oak *Quercus robur* and ash *Fraxinus excelsior* canopy and the scrub patches formed by hawthorn *Crataegus monogyna* and blackthorn *Prunus spinosa*. The ground flora has a stronger affinity with the nettle-dominated scrub on the riparian spoil bank than with neighbouring stands. Thick zones of sycamore *Acer pseudoplatanus* saplings serve to confirm the dynamic character of this vegetation.

The block of nutrient-rich scrub is best placed within the *Mercurialis perennis* sub-community of the *Crataegus monogyna-Hedera helix* scrub (W21b). Here, *Urtica dioica* and *Glechoma hederacea* are often particularly abundant over a scattered canopy of mixed shrubs and trees, with associates in the field and ground layer including *Poa trivialis* and *Arum maculatum*. This type of scrub is typical of young woodland, and its

composition would not be expected to change as the *Acer pseudoplatanus* saplings develop.

Within and on the margins of the oak-birch woodland on the terrace (see section 3.2.3) the ground flora sometimes reflects this eutrophilic aspect to the terrace flora. Nettle and ground ivy, in particular, tend to occupy shaded shallow hollows just above or on the transitional slope.

3.2.3 Oak-birch woodland

(Stand OB, samples 6,7,14,17-19,26,33,38,41,42)
Several stands within the site are clearly aligned to the oak-birch community-type. The range of physiognomic and floristic variation between and, to a lesser extent, within the stands, partly reflects their age and shading characters. In the more mature stands, the canopy is typically clustered, with both deeply shaded and open areas, and is more frequently dominated by oak *Quercus robur*. The stand including sample 41, for example, has a canopy overwhelming composed of oak, with only scattered birch *Betula pendula*, and a sparse ground flora including the fern *Dryopteris dilatata* and scattered patches of creeping soft-grass *Holcus mollis*. [Photo 4]

The aspen *Populus tremula*, noted for its high seed production, can take on the pioneer role of birch on a somewhat better soil on the upper part of the sandy terrace, but birch is clearly the main pioneer species, most noticeably colonising the grassland swards of the sandy terrace and transitional slopes. Much of the tree population appears to have grown as patches of pole-stage stock, which have developed small canopies by growing close together.

The gaps in the woodland canopy are therefore the result of this patchy habit, and also are the consequence of windblow. In close-canopied patches, there is usually only a very scattered ground flora, often represented by a few trailing stems of *Lonicera periclymenum*. In gaps between these patches, and as a result of windblow, the ground flora is more clearly derived from upper or lower terrace species. In the former, the vegetation often resembles closely that found in the more acid, nutrient-impoverished grasslands. Bryophytes are at a disadvantage in oak-birch woodland because of the leaf litter, which, in places where the canopy has closed and wind-speed dropped, tends to accumulate thickly each year. However, as the wind blows freely through open stands of colonising birch woodland, the litter layer is not continuous and acid tolerant mosses (inc. *Polytrichum formosum*) are able to develop to a varying extent.

Photo 4. Oak-birch woodland – oak canopy

The oak-birch woodland is the one community that stretches from the upper sandy terrace to the lower transitional slopes. This is highlighted in Map 3, which shows two stands straddling the division between the sandy terrace and the transitional slopes. As such, variation within the field and ground layer of the constituent stands markedly reflects the differing characters of the surrounding vegetation. In particular, different parts of the stand can be distinguished according to the presence of:

Dry, acid-tolerating species – Some samples (eg. 7) have a well-developed acid grassland flora, often under a canopy of birch or only scattered trees, with species such as *Rumex acetosella, Agrostis capillaris* and *Galium saxatile* often patchily abundant. In these situations, too, where the ground is not too dry, both species of *Holcus* often dominate grassy patches. *H. lanatus* sprawls are more tolerant of low light levels and, once established, tends to occupy its ground long after a light canopy of birch has closed over. *H. mollis* creeps underground and is not only slower to occupy new ground but tends to thin out as canopy cover increases. [Photo 5] While the floristics suggest that such areas have the closer affinity with the *Holcus lanatus* sub-community of the *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland (W10d), the presence of these species indicates some relationship with the more acidophilous *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland (W16).

Molinia caerulea tussocks – In particular areas, and most noticeably where the birch has recently colonised, *Molinia*-dominated vegetation

has survived under the shade of the young canopy. This is evident in samples 26, 33 and 38. Thus, the transitional slope zone occupied by this species can be traced precisely within some of the oak-birch woodland stands, and clearly links up the areas of open-grown *Molinia*. As described for that stand in section 3.3.1, this species appears to follow a very clear boundary marking the upper edge of the degraded sandy terrace. Such areas are likely to represent recently scrubbed over areas of the *Molinia caerulea* grassland (stand M). Some species continue to survive under the light birch canopy, including *Holcus lanatus, Agrostis capillaris, Rumex acetosella* and *Galium saxatile*. Others are lost, notably *Calluna vulgaris, Festuca ovina (filiformis*) and *Carex pilulifera*. Bryophytes, too, are casualties of the shade and smothering by leaf litter: *Campylopus pyriformis, Hypnum cupressiforme* and *Dicranum scoparium* are largely absent from these areas. A number of species colonise the developing woodland stands, notably sprawls of *Glechoma hederacea* and *Lonicera periclymenum*, but also the aggressive clump-forming plant *Urtica dioica* and *Rubus fruticosus* agg. While the floristics suggest that such areas have the closer affinity with the *Holcus lanatus* sub-community of the *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland (W10d), the presence of these species indicates some relationship with the more acidophilous *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland (W16).

Photo 5. Oak-birch woodland – birch canopy

Eutrophilic species – Some samples (eg. 14) are located in relatively mature areas of woodland, usually oak-dominated, where the field and ground layer is noticeably frequented by such eutrophilic species as *Urtica*

dioica and *Glechoma hederacea*. These are often found in hollows, often towards the foot of the transitional slope, and may be a response to higher moisture levels, or to the build-up of a nutrient-enriching leaf litter. The presence of a remnant shrub layer in these areas, normally a combination of *Crataegus monogyna, Salix cinerea* or *Sambucus nigra*, suggests that these woodland blocks may have developed from a mixed scrub on disturbed areas. This is in contrast to the other variants, where woody plants appear to have colonised directly into grassland. The paucity of the flora, and the absence of species associated with better soils, suggests that these samples be retained within the *Holcus lanatus* sub-community (W10d). However, the differences with other woodland areas on the site indicate some resemblance to the drier forms of *Crataegus monogyna-Hedera helix* scrub (W21) and to the Typical sub-community of the *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland (W8).

3.3 Transitional slope communities

As described in section 1.2.2, the transitional slope zone is a significant factor in the distribution of vegetation communities on Hinderclay Fen. These often degraded margins of the Lopham Terrace vary in aspect and degree of slope, but tend to highlight a change of ground moisture conditions between the strongly droughty soils of the terrace, the increasingly moist brown sands as one descends the slope, and the patches of thin peat skirt soils towards its base.

Two classes of vegetation have been grouped together in this account:

3.3.1 Upper slope vegetation
3.3.2 Lower slope vegetation

3.3.1 Upper slope vegetation

The three communities described here all occupy similar positions on the transition from the terrace to the lower-level vegetation, but exhibit very different characters. Interestingly, nonetheless, they share the same three constant species as the parched grasslands described in section 3.2.1: common bent-grass *Agrostis capillaris*, sheep's sorrel *Rumex acetosella* and Yorkshire fog *Holcus lanatus*. This may necessarily provide a connection between the growing conditions of the two areas of vegetation. The three communities are listed below against the NVC syntaxa with which they have the strongest affinity. The inability to determine two of the communities within the classification is due both to recent land management, but also to the transitional character of the hydrogeological zone.

Stand ref.	Vegetation community	NVC code	NVC community (or alternative)
M	Molinia grassland	-	Indeterminate
B	Cleared birchwood	-	Indeterminate
Nc	Neutral grassland	MG5b	*Cynosurus-Centaurea* grassland, *Galium verum* sub-comm.

***Molinia caerulea* grassland**

(Stand M, samples 10,12,20-22,31)

This rather scattered stand stretches in an often narrow band across much of the site, and represents one of the more distinctive features of Hinderclay Fen. In the main, areas dominated by *Molinia caerulea* are open and un-treed, though their presence is noted beneath the canopy of the oak-birch stands in intermediate locations. This species dominates grassland on the distinct break of slope, however abrupt, at the margin of the sandy terrace.

Mature plants of *Molinia* often dominate the stand, forming large tussocks separated by heavily shaded beds of litter formed by their leaves. [Photo 6] Young specimens of this species are largely absent from these areas, and only a scattered flora of occasional associates have been recorded.

Luzula multiflora, *Carex nigra*, *Calluna vulgaris* and *Juncus effusus* are present in the slightly lower elevations occupied by this stand. *Festuca ovina* and *Rumex acetosella* are more likely to be recorded from slightly higher elevations, and would seem to indicate areas on the southern (upland) fringe of the stand where *Molinia* plants have successfully colonised the edge of the contiguous parched grassland stands.

Photo 6. *Molinia caerulea* grassland

Such dominant behaviour of *Molinia* is normally recorded from sites with wetter soils, and for this reason the fragmentary areas at Hinderclay, which lie on the driest margins of the terrace slope, can only be regarded as indeterminate within the NVC.

The samples taken illustrate the predominance of dry acid grassland species in the composition of the sward, which suggest that the stands can be viewed as transitional between the *Festuca-Agrostis-Rumex* (U1) grasslands of the terrace itself, and the fenland vegetation below. This transition is picked out by a small number of individuals of species uncommon elsewhere on the site: *Carex nigra, Juncus effusus* and *Luzula multiflora*. This group of species represents plants most commonly encountered on moist-to-wet, acid substrates. In grazed situations where they are frequent, they form part of the characteristic *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (U4) encountered in the higher rainfall areas of western and northern Britain. Small areas of similar vegetation are also associated with the sandy fen margins on the terraces of the River Waveney (Stone et al, 2004).

However, *Molinia caerulea* is no more than an occasional component of either grassland, whereas stand M is dominated by its constant species, to the exclusion of other species. In fact, the associate species appear to be associated with the moisture gradient of the slope rather than an accepted community. For these reasons, the stand is referred to as

Molinia caerulea-dominated community. In European schemes, this simple vegetation is called the Molinietum caerulae Koch 1926.

The stand is also a focus for young birch saplings (*Betula pendula*). This may be the result of the absence of grazing – *Molinia* is avoided by rabbits where there is a selection of herbage available, though it is reputed to be favoured by muntjac – or be due to the somewhat higher moisture levels likely to be found between the tussocks. The potential development of the saplings shows the close relation of this stand to the oak-birch woodland.

Cleared birch woodland

(Stand B, samples 54-58)

The recent clearance of an area of birch woodland on the margin of the terrace has produced dense micro-thickets of *Betula pendula* stems and the recovery and development of *Molinia* tussocks. This simple physiognomy gives the young stand much of its structure, though the ground layer is often mantled by a deep blanket of the moss *Campylopus introflexus*. This is a large, non-native species that forms a very thick layer of vegetative stems that effectively prevents regeneration from the soil seed-bank. Where *Campylopus* has not successfully colonised, the associated flora includes species of a dry, acid substrate, notably *Rumex acetosella*, the small, annual grass *Aira praecox* and the moss *Dicranum scoparium*. *Calluna vulgaris* seedlings are among the species that have colonised or regenerated in this area, which, in total, indicate a strongly acid substrate.

The area of cleared birchwood does not correspond to published NVC accounts of sampled communities, and is best regarded as an indeterminate community. In phytosociological terms, the stand has affinities with both *Quercus-Betula-Deschampsia* woodland (W16 – see the commentary on the more acid forms of oak-birch woodland, section 3.2.3) and *Festuca-Agrostis-Rumex* grassland (U1, section 3.2.1) without being strongly aligned to either on account of its juvenile character. It is best regarded by the vernacular 'cleared birch woodland' until such time as a scrub, tall-herb or grassland stage is attained.

The character of the vegetation is fast-changing following clearance of the birch scrub. If left undisturbed, the stand will quickly assume characteristics of young *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland (W10), perhaps through intermediate tall herb of scrub phases. If browsing or regular defoliation is maintained, however, the young sward is likely to add variety to the mosaic of surrounding swards on the sandy terrace and upper transitional slopes. Rabbits and muntjac deer were both observed browsing the birch shoots during the survey. In time, their activities may reduce the vigour of both young and mature birch stools, and disturbance at appropriate times of the year may stimulate the growth of grasses and grassland forbs.

Neutral grassland

(Stand Nc, samples 23,24)

A small area of atypical grassland was sampled from a location immediately below the cleared birchwood and apparently on the lower margins of the *Molinia* stands. Samples 23 and 24 describe a sward of no more than 5 metres radius with the floristics and structure of slightly calcareous neutral grassland. In addition to the constant species for this class, the sward contains abundant red fescue *Festuca rubra*, wild thyme *Thymus polytrichus* and lady's bedstraw *Galium verum*. Although it has some similarities to the more extensive parched neutral grassland of the sandy terrace (stand Gn), it is the single location for a number of grassland species, including bulbous buttercup *Ranunculus bulbosus*, quaking grass *Briza media* and common knapweed *Centaurea nigra*.

As with the *Calluna vulgaris* stand, this vegetation would often be disregarded on a larger site, but its marked contrast with the surrounding vegetation, and the sharpness of its boundary, are of interest. A similar feature is recognised at Clumber Park, Nottinghamshire, a National Trust property, where the somewhat larger stand is thought to have developed on a calcium-rich substrate imported for road-building (Stone and Williamson, 2004). Aside from this kind of explanation, it may be supposed that the stand represents the remnants of a former seepage of calcareous waters.

In terms of its floristics, the patch can be regarded as a variant of the *Galium verum* sub-community of the *Cynosurus cristatus-Centaurea nigra* grassland (MG5b). The presence of the competitive perennials creeping thistle *Cirsium arvense*, false oat-grass *Arrhenatherum elatius* and cock's-foot grass *Dactylis glomerata* confirm that this small sward is undergrazed and being enveloped by taller species.

3.3.2 Lower slope vegetation

The lower section of the transitional slope is particularly variable in width, and sometimes extends across the lower part of the site as far as the river. In this regard, this class of vegetation rivals that of the peat-filled depression zone in extent. Furthermore, some of the communities in this class may occupy ground once associated with wetland vegetation before the channel of the Little Ouse was altered. In effect, communities included here range from those at the foot of the break of slope to those abutting the spoil bank, with the exception of the stands of reed, sedge and alder described in section 3.4. Four distinct communities are recognised within this class. Their weedy character and probable derivation from other kinds of vegetation more likely to have been sampled by the national survey, means that no community can be satisfactorily placed within a single community of the NVC. Where possible, stands are described as of an intermediate character to two NVC communities, or, if that is not reasonable, European syntaxa have been given in their place.

Stand ref.	Vegetation community	NVC code	NVC community (or alternative)
Hm	Moist *Holcus lanatus*	M24b/MG1b	Intermediate between:

	grassland		*Molinia-Cirsium* fen-meadow, Typical sub-comm. *Arrhenatherum elatius* grassland, *Urtica dioica* sub-comm.
Ca	Sedge grassland	MG1b/M22d	Intermediate between: *Arrhenatherum elatius* grassland, *Urtica dioica* sub-comm. *Juncus-Cirsium* fen-meadow, *Iris pseudacorus* sub-comm.
S	Grey willow-nettle scrub	W6a-incipient	*Alnus-Urtica* woodland, Typical sub-comm.
E	*Eupatorium cannabinum* community	-	Indeterminate
F	Recently cleared valley floor area	-	Indeterminate
Dd	*Dryopteris dilatata* stand	-	Indeterminate

Moist *Holcus lanatus* grassland
(Stand Hm, samples 47-51)
This small stand occupies an area of low elevation to the north of the Molinietum stand. It is surrounded by *Salix cinerea* scrub (along the riparian fringe) and oak-birch woodland to the south. The stand has the appearance of a glade amongst this vegetation, but possesses a distinct floristic composition that clearly separates it both from riparian disturbance (willow scrub) and from the dry, acid communities of the terrace. It has, in part, been overcome by the adjacent sedge grassland (stand Ca), and appears to have been derived from a more species-rich fen-meadow vegetation, and to have been subject to drying out in the past and periods of flooding from the river in recent times.

There are three constant species, *Holcus lanatus, Festuca rubra* and *Stellaria graminea*. The first species is largely abundant throughout, and gives the vegetation its overall physiognomy and character. *Stellaria graminea* is particularly associated with damp grassland, and is often regarded as a relic of managed grassland.

The moist *Holcus lanatus* grassland is one of a number of communities of the lower transitional slopes that does not clearly correspond to any one community within the NVC classification. In common with these other kinds of vegetation, it is probable that the stand is transitional and can be regarded as the product of drainage of fen-meadow vegetation. If viewed in this light, it is preferable to assign the stand to an intermediate position within the classification than to leave it undetermined. A significant component of the sward floristics is assignable to the Typical sub-community of the *Molinia caerulea-Cirsium dissectum* fen-meadow (M24b). This correlation reflects the presence of *Molinia caerulea* itself, and associates including *Lotus uliginosus, Carex disticha* and *Potentilla*

erecta, and suggests the local influence of calcium-poor waters on the lower margins of the terrace.

The remainder of the sampled species, particularly *Stellaria graminea* and *Galium aparine*, are referable to the *Urtica dioica* sub-community of the *Arrhenatherum elatius* grassland (MG1b). Additionally, the presence of young bramble clumps with their arching stems suggest that, unmanaged, the stand will develop towards Rubus-Holcus underscrub (W24). The stand can therefore be regarded as M24b/MG1b intermediate.

Sedge grassland

(Stand Ca, samples 52,53,59-61)

This community is represented by two somewhat contrasting stands on the northern fringe of Hinderclay Fen. Both areas are situated immediately to the south of the riparian spoil bank. In both cases, it is likely that the sedge *Carex acutiformis* has colonised and come to dominate two different kinds of vegetation: a species-rich moist grassland (western stand – samples 52-53) and a ruderal grassland of low species richness (eastern stand – samples 59-61).

Both stands are now dominated by *C. acutiformis* and *Arrhenatherum elatius*, often with *Festuca rubra* being the most frequent associate. The cover of the two dominants casts a heavy shade and, with the thick litter of an unmanaged stand of this character, there is little opportunity for extensive growth of bottom species. In the western stand, occasional stems of grassland species, including *Pilosella officinarium*, *Succisa pratensis* and *Galium verum* survive, while in the eastern stand only *Agrostis stolonifera* occupies this niche. The eastern stand, however, has a taller component, notably *Conium maculatum*. This species is a colonist most frequently occupying the spoil bank nettle bed; the height and spread of the individual plants here provide a visually characteristic physiognomy to the stand.

The sedge grassland is an intimate mixture of *Carex acutiformis* and *Arrhenatherum elatius*, which form a canopy over a variety of associate species that collectively indicate the transitional character of the stand. The vegetation is likely to be the product of drainage of fen-meadow vegetation, perhaps coupled with the influence of spoil deposition on its margins. In relation to the moist *Holcus lanatus* grassland, with which it has several similarities, this stand lies further down on the transitional slope, and its species composition suggests that the stand may have been influenced by rather more calcareous and nutrient-rich groundwaters. The remnant fen-meadow species, dominated by *Carex acutiformis* but including *Succisa pratensis* and *Vicia cracca*, are assignable to the *Iris pseudacorus* sub-community of the *Juncus subnodulosus-Cirsium palustre* fen-meadow (M22d).

However, the smothering effect of the tall tussocks of Arrhenatherum elatius and the thick litter dropped by the dominant species, have reduced many of the remaining fen-meadow species to a palimpsest in

the sward, and the group of competing associates are very much correlated with the *Urtica dioica* sub-community of the *Arrhenatherum elatius* grassland (MG1b). The stand can therefore be regarded as MG1b/M22d intermediate.

Grey willow-nettle scrub

(Stand S, sample 72)

In the more eutrophic moist hollows of the peat-free and thin peat skirt areas of the lowest parts of the transitional slope, particularly at the base of the river spoil bank, the shrub *Salix cinerea* has become established as the sole woody dominant of small patches of derelict fen and nettlebed. The shrub attains a height of 4-6 m and assumes a sprawling, open habit, which casts a variable shade over the nettle-dominated herb layer beneath. Here, the associate species are drawn from a number of eutrophic, moist sources, *Phragmites* and *Glechoma*, being the most common. The community is typical of eutrophic lower valley side locations where degraded peat and river floodwater provide a ready supply of nutrients. Nettle is particularly associated with phosphate-rich conditions.

The field and ground layer of the community corresponds to that described for the Typical sub-community of the *Alnus glutinosa-Urtica dioica* woodland (W6a). However, in the complete absence of alder in the canopy, the stand is best regarded as W6a-incipient. This kind of vegetation has been described by European authors as the Urtico-Salicetum cinereae (Somsak 1963) Passarge 1968.

In a separate stand higher up on the transitional slope, in the lower part of sample 14, stand OB, a dense sub-canopy of *S. cinerea* has formed beneath oak standards. Here, the shade is significant and much of the ground is bare. The sallow is accompanied by *Sambucus nigra* shrubs.

***Eupatorium cannabinum* stand**

(Stand E, samples 64,65)

The *Eupatorium cannabinum* stand occupies a discrete area on the lower part of the transitional slope, and abuts the peat-filled depressions. It occupies a very definite zone associated with the clearance of woodland on the margin of the peat. Here, it acts as a transitional stand between the shaded, dry oak-birch woodland and the sump wetland occupied by stands dominated by *Carex riparia* and *Phragmites australis*.

This stand is dominated by the tall-herb *Eupatorium cannabinum*, which, with the associates *Mentha aquatica, Agrostis stolonifera, Scutellaria galericulata* and *Juncus subnodulosus*, form a thick tangle of stems over a moist substrate on the margin of the peat body. [Photo 7] These tall herbs stand some 70 cm high, and mask the changing composition of their associates from fen species, including *Valeriana officinalis* and *Juncus articulatus*, to species more frequently found in the dry woodland, like *Glechoma hederacea* and *Brachypodium sylvaticum*.

Photo 7. *Eupatorium cannabinum* stand

While the stand is somewhat ruderal in character, and the dominance of *Eupatorium* suggests a drying peat fringe, the assemblage is nonetheless a valuable adjunct to the reedswamp and reed fen communities. *Eupatorium* is a typical dominant of disturbed vegetation on the fringes of peat, and is often associated with rank vegetation occupying the drying sides of peat baulks, such as at Redgrave and Lopham Fen (Stone et al 2004). In such situations, it may be the transitional vegetation between reed and nettle dominated stands. At Hinderclay Fen, however, it is likely that small elevation between the fringes of the stand and the fenland vegetation of the peat-filled depressions will promote the development of fen-margin characters with time.

At the present time, the stand is indeterminate within the NVC. However, this kind of vegetation has been described by European authors as the Eupatorietum cannabini Tüxen 1937. This community is widely recognised throughout Europe, but is rather diffuse in character and the associates are drawn from neighbouring fen and wet woodland communities.

Recently cleared valley floor

(Stand F)

This recently cleared area lies at the foot of the degraded terrace and occupies a large part of the zone within the looping line of the dyke. The ground surface was dry-moist at the time of survey, the conditions corresponding to the distinctly uneven ground surface. In two linear strips

running roughly perpendicular to the modern channel, the surface is distinctly lower, wetter and apparently formed on peat, while other areas are dry and clearly composed of at least surficial sands and gravels. Logs of *Betula pendula* were laid out over part of the area and this species, together with the contiguous stand of *Salix cinerea*, appear to have been the main cleared woody species.

The recently-cleared valley floor is indeterminate within the NVC.

***Dryopteris dilatata* fern stand**

Within the alder woodland discussed in section 3.4, the lower margin of the channel is often marked by a fragmentary stand of the broad-buckler fern *Dryopteris dilatata*. This community is also found along the lower margin of the transition slope on the southern side of the peat-filled basin. *D. dilatata* has become established on the seasonally moist fringe of peaty sand in this location. As such, it serves as a marker of this transitional boundary, at a somewhat lower elevation than *Molinia*. It has few associates and would appear to be a remnant of former woodland. [visible in Photo 11]

The *Dryopteris dilatata* fern stand is indeterminate within the NVC, though it is likely to have derived from the margins of *Alnus glutinosa-Carex paniculata* woodland (W5).

3.4 Peat-filled depressions

This zone refers only to the remaining thick, peat-floored wetland habitat within the site. As such, it excludes large areas of the lower slopes of the Lopham Terrace, and the river spoil bank along its northern margin. As described in section 1.2.3, the zone also includes the narrow channel crossing the terrace at the western boundary of Hinderclay Fen. Floristically the vegetation of this zone is quite distinct from the other communities described in this account. Although this aspect of the site's vegetation has not been investigated by this survey, it is anticipated that many of the stand descriptions from this zone will prove to be at variance from past descriptions of this part of the site. While much of the alderwood appears to be largely undistrubed, the reed bed and associated fen-meadow and swamp stands are dominated by three species – *Phragmites australis*, *Carex riparia* and *Juncus subnodulosus* – with few associates. Areas of almost pure reed were noted, and a bryoflora was almost totally absent.

The four communities are listed below against the NVC syntaxa with which they have the strongest affinity.

Stand ref.	Vegetation community	NVC code	NVC community (or alternative)
Aw	Alder woodland	W5b(W7b)	*Alnus-Carex* woodland, *Lysimachia vulgaris* sub-comm. *Alnus-Fraxinus-Lysimachia* woodland, *Carex-Cirsium* sub-comm.
Cr	Pond sedge bed	S24	Simple form of: *Phragmites-Peucedanum* tall-herb fen
Rb	Reedbed	S24	Degraded form of: *Phragmites-Peucedanum* tall-herb fen
Js	Fen meadow	M22a	*Juncus-Cirsium* fen-meadow, Typical sub-comm.

Alder woodland
(Stand Aw, samples 25,44-46,73)

The abruptly sloped channel that defines the western margin of the fen is occupied by alderwood. The narrow channel passes between distinct bluffs cutting through the degraded Lopham terrace until the banks recede at its base, when the channel debouches into the sump peatland of the former meander, which is the main peat-filled depression within the zone.

The alderwood is confined to the channel through the terrace and is largely characterised by two distinct size class populations of alder *Alnus glutinosa*, which is the sole canopy dominant throughout the stand. Particularly at the lowest elevations, the species is notable for the

characteristic stilt roots that indicate a fluctuating water level. [Photo 8] These project from the bole some 40 cm above the peaty mud. Ash *Fraxinus excelsior* and silver birch *Betula pendula* are no more than occasional components of the canopy margin.

At the time of survey, the channel was largely dry and consisted of a sequence of shallow pools of peat-stained water. This sequence has a distinct break at the end of the terrace, just downslope of the right-of-way. The intervening track of peaty muds were often coated with an ochreous-yellow calcitic crust, indicating that the calcareous character of the issuing groundwaters in this area.

Photo 8. Alder woodland – stilt roots

The central, open, muddy peat track along the course of the channel and into the sump peatland at the northern end of the stand is best regarded as sump, or swamp, woodland. [Photo 9] Small stands of *Carex acutiformis* occupy the wettest of the pools, and they are fringed by *Cardamine pratensis, Cirsium palustre, Carex remota* and *Ranunculus repens*. Bryophytes are an occasional feature of the bare peat surface, often associated with the edge of the semi-permanent pools. This is a simple and fragmentary micro-habitat, usually found on fragments of leaf litter and twigs lying on the ground. It is comprised of *Epiphylla epiphylla* and *Eurhynchium hians* (formerly *E. swartzii*) with occasional *Bryum pseudotriquetrum*. *E. hians* is also occasionally found in fine strands on the surface of the peat, particularly where it is growing from a dry plant base.

The acid-barked adventitious roots of the alders are sometimes clothed in a moss flora dominated by *Eurhynchium praelongum*. Amongst the *E. praelongum, Brachythecium rivulare* is evident, particularly on the lower fringes of this micro-habitat. Here, occasional wefts of the *Hypnum androi* are also present on some roots. *Plagiomnium undulatum*, *Bryum pseudotriquetrum* and *Pellia epiphylla* are also found on the stilt roots at or just above the peat surface. In the moist, dark recesses between the roots, the leprose lichens of the *Lepraria* genus are present as a pale green powder; probably *L. incana* and *L. lobificans*.

Solanum dulcamara, Scutellaria galericulata and scattered *Urtica dioica* form a scrappy patchwork of fen species in-between dense alder cover and the bare pools. At a slightly higher elevation, *Mentha aquatica, Solanum dulcamara* and *Scutellaria galericulata* form a loose and scattered sprawl of fen vegetation, often studded with young saplings of ash *F. excelsior*. These saplings are ubiquitous throughout this part of the wood, and are absent at lower elevations.

Photo 9. Alder woodland – sump woodland

The fringing zone of the channel is characterised in places by seepage from the surrounding mineral substrates and can be regarded as areas of flush woodland within a brook catchment. The occurrence of *Carex remota* and *F. excelsior* saplings here emphasises the oxygenated character of the percolating waters. Alder is present on the channel margins as scattered, mature trees and does not produce the distinct stilt roots of the sump woodland. Where the alderwood abuts the short, steep slopes of the degraded terrace, the broad-leaved buckler fern *Dryopteris*

dilatata and lady fern *Athyrium filix-femina* form a dense fringe to the channel (with scattered *Rubus* and *Lonicera*), and often mark the boundary of the stand. *D. dilatata* is also commonly found perched on the base of alder boles, above the stilt roots, and is one of the more consistently occurring associates of the field layer.

At the northern end of this small woodland, a few alders form a canopy over large sedges to form a small stand of sump woodland. Part of the area formerly occupied by this stand has recently been cleared, to leave the field layer as a pond-sedge dominated swamp.

The alder woodland as a whole can be considered as predominantly sump woodland, that is to say, woodland in more or less permanent contact with base-rich groundwater and/or standing pools of surface waters. The narrow, peat-filled course of the Thelnetham stream is occupied by vegetation clearly associated with the *Lysimachia vulgaris* sub-community of the *Alnus-Carex* woodland (W5b). The field and ground layer is very fragmentary and is represented by the small sedge stands and scattered fen marginals towards the fringes of the stream course. Ferns are only frequent in small stands and groups on the margins and on the boles of alders.

Where the channel reaches the deeper peats of the valley floor depressions, much of the woodland has recently been removed. The remnants suggest that this area, with large sedges predominating in the field layer, is also best placed within W5b. Elsewhere, particularly where groundwater flows are evident from the terrace floor along the stream channel, *Carex remota* becomes the character species with ash saplings, and these patches can be referred to the *Carex remota-Cirsium palustre* sub-community of the *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland (W7b). They are, however, a minor element of the woodland complex.

Pond sedge bed

(Stand Cr, samples 62,63)

This stand of the dominant sedge *Carex riparia* occupies an area of the sump wetland that was, until recently, at least partly occupied by alder woodland. [Photo 10] *C. riparia* is the sole dominant here, though the stand gives way on its eastern margin to an extensive area of reed-swamp where the sedge is co-dominant with *Phragmites australis*. *Phragmites* is a constant, too, though only with a low cover. The canopy produced by these species is thick but with occasional gaps, and the fen species *Mentha aquatica, Eupatorium cannabinum, Filipendula ulmaria* and *Solanum dulcamara* are all occasional (and the sole) associates. Sample 62 contains small pools of standing water (at the time of survey) and areas where the sedge has not yet come to dominate. Here a number of bryophytes were recorded, and small specimens of the delicate stonewort *Chara virgata* were recorded from the vicinity. The presence of this genus indicates the presence of calcium-rich waters in this part of the site.

Photo 10. Pond sedge bed

The pond sedge bed appears to have recovered from woodland clearance on its fringes, when it would have been referable to the field layer of W5b woodland. Judged as a swamp stand, its floristic composition and structure suggest that this vegetation, rather than developing into the species community *Carex riparia* swamp (S6), which is overwhelmingly dominated by the sedge, is better assigned to a simple form of *Phragmites australis-Peucedanum palustre* tall-herb fen (S24).

Reedbed

(Stand Rb, samples 68-71,82)

The reedbed occupies the lowest elevations of the peat-filled depressions, including the old meander channel. At the time of survey, much of the peat surface was exposed, with a surficial pale ochreous paste. This paste is some 3-5 mm thick, and would appear to be a calcium-iron complex. Its presence corresponds with the occasional occurrence of a stonewort species beneath the *Carex riparia* stand.

The reedbed is a rather variable stand, including zones with an understorey of *Carex elata, Juncus* species and *Carex riparia*, as well an impoverished form where reed is the overwhelming dominant. [Photo 11] Similarly, the stand grades into both the fen meadow and pond sedge bed (stands Js and Cr), and the mapped boundaries between these stands are only indicative. As a unit, the reedbed can be classified as a largely degraded form of the *Phragmites-Peucedanum* tall-herb fen (S24),

though individual samples suggest that the stand grades from very species-poor areas (sample 82), through areas clearly experiencing eutrophication (sample 69), to parts of the stand still containing species assemblages recognisable as belonging to the S24 community.

Photo 11. Reedbed – view from sandy terrace over eastern area

Fen meadow

(Stand Js, samples 66,67)

On the eastern margins of the deep, peat-filled meander, reed is joined, and patchily replaced by, the rush *Juncus subnodulosus*. The fen meadow is located entirely within the reedbed, largely on the southern fringes of the main peat-filled depression. Although the distribution and extent of the stand is largely provisional, as it grades into the reedbed stand, the floristic core of the stand lies firmly within the Typical sub-community of the *Juncus subnodulosus-Cirsium palustre* fen-meadow (M22a). Species-richness is low, and the associate species are very subordinate to the dense, sprawling rush tussocks. *Mentha aquatica, Lythrum salicaria* and *Galium uliginosum* are the main companions to the rush, and they are accompanied by a few spots of the pleurocarpous moss *Calliergonella cuspidata*, which is a frequent denizen of rich fens.

3.5 Spoil bank

Riparian nettlebed
(Stand SB, samples 74, 77-80)
Along the northern and eastern fringes of the site lies a fairly uniformly contoured spoil bank. The bank is occupied by a large stand of *Urtica dioica*, with numerous associates, and by a scatter of woody species, principally *Betula pendula* and *Salix cinerea*.

On top of the mound, nettle and birch are often accompanied by *Galium aparine* and *Holcus lanatus*, with scattered *Sambucus*, *Poa trivialis* and the moss *Eurhynchium praelongum*.

Where the mound descends to peat, the lower slopes are of nettle and *Salix cinerea*, which are more likely to be accompanied by scattered *Phragmites* stems, *Conium* and the moss *Brachythecium rutabulum*.

The distribution of the extensive areas of riparian nettlebed is strongly correlated with river spoil deposition along the northern fringe of Hinderclay Fen. The area of vegetation is somewhat approximate, as the community grades and forms a mosaic with the grey willow-nettle scrub (stand S) where the lower transitional slopes abut or are mantled by spoil. Along the eastern fringe, the nettlebed extends onto the most, humic topsoil of the lowest slopes of the degraded terrace.

In general, the vegetation is dominated by *Urtica dioica*, with the sprawling *Galium aparine* as a constant associate. The stand includes the individual willow trees, which, where their canopies merge, form an incipient W6a community (as has been described for stand S). In open ground, the nettlebed includes a number of eutrophiles, such as the grasses *Poa trivialis* and *Dactylis glomerata*, the moss *Brachythecium rutabulum*, and a variety of usually minor associates typical of moist-to-dry disturbed riparian habitats. *Conium maculatum, Phragmites australis* and *Carex acutiformis* have all spread within the nettlebed, and occasionally form dense patches within the dominant spread of nettle.

Large areas of the vegetation are closely allied to the Typical sub-community of the *Urtica dioica-Galium aparine* community (OV24a), with small patches of incipient W6a where the scrub canopy has closed over. Along the margins of the stand, the boundary of the stand with the grassy communities of the lower transitional slopes is marked by the more open, grass-dominated nettle vegetation of the *Arrhenatherum elatius-Rubus fruticosus* agg. sub-community (OV24b).

4. VEGETATION MANAGEMENT CONSIDERATIONS

A number of key issues arise from the distribution and character of the vegetation communities described, and of the location of the site itself.

4.1 Sandy terrace

4.1.1 Intensity of management

The open vistas of large areas of the sandy terrace, and the sparse, lichen-rich vegetation require grazing to maintain these characters. While rabbit populations should be supported, supplementary forms of defoliation should be considered.

4.1.2 Nutrients

In addition to the general principle of removing nutrients introduced onto the terrace surface or accumulating there, it is also clear that localised eutrophication has occurred along the southern boundary where the site abuts the duck farm. These sensitive grassland areas should be protected from nutrient-addition, in any form.

4.2 Transitional slopes

4.2.1 Colonization by birch and gorse scrub

The most extensive areas of recent birch and gorse colonization appear to be concentrated on the upper transitional slopes. The remaining open areas are also susceptible to scrubbing over. It is recommended that open areas are maintained, and that a proportion of recent scrub colonization is targetted for clearance.

4.2.2 Regrowth of cut areas

Where areas of birch have recently been cleared, it is apparent that regrowth from stumps, and the development of saplings, can be prolific. The potential for birch to 'get away' and form a thick scrub should not be underestimated, and follow-up management on the clearance operation should be considered.

4.2.4 Lower transitional slope communities

The vegetation communities in this area are largely transitional in character. On the higher elevations, where the substrate appears to be less nutrient-rich, the moist *Holcus lanatus* grassland and sedge grassland are both degraded forms of fen-meadow, resulting from drying-out of the substrate. At lower elevations, the grey willow-nettle scrub has developed under similar, if more nutrient-rich conditions. Where the woodland fringe has been cleared on these lower slopes, it is possible that ruderal vegetation will develop if appropriate wetland conditions are not present.

4.3 Peat-filled depressions

4.3.1 Changes in hydrological regime

In these low elevation areas, only very limited seepage of groundwater is evident, and this is concentrated on the western margin. The surface of the peat was largely dry at the time of survey, except in these areas. The meander loop may also act as a sump for overbank flooding from the river. The reedbed and associated stands lacked a ground flora, and bryophytes are mainly absent. The condition of these stands is dependent upon the re-creation of a more appropriate hydrological regime.

4.3.2 Denaturation of peat

As seen on the lower elevations of the transitional slopes, dry peat, where the watertable is below the surface for long periods during the growing season, appears to be releasing nutrients through oxidation. The re-creation of a more appropriate hydrological regime should be complimented by a consideration of peat removal in affected areas.

4.4 Spoil bank

4.4.1 Disposition of spoil

The area of spoil disposition varies from well-defined, steep-sloped bunds, mainly to the west, to lower, more extensive spreads to the east, where the spoil appears to overlap the lower transition slopes. Areas affected by spoil deposition should be reduced wherever possible.

4.4.2 Denaturation of spoil

The original spoil slurry, as it dries out and denatures, inevitably releases nutrients into the adjacent hydrogeological zones, where they are able to seep into the root-zone and become incorporated into growing plants. Spoil should be removed from the site wherever possible.

Map 3. Hinderclay Fen: Hydrogeological zones and vegetation communities

MAP LEGEND

Hydrogeological zone	Stand ref.	Vegetation community	NVC code
Sandy terrace	Ga	Acid parched grassland	U1a
	Cv	*Calluna vulgaris* community	U1b(H1c)
	Gp	Parched grassland	U1c
	Gn	Parched neutral grassland	U1d(FHA)
	Gr	Dry ruderal grassland	U1
	Hd	Dry *Holcus lanatus* community	U1d(W23b)
	Dn	Dry nettlebed	OV24b
	Sn	Nutrient-rich scrub	W21b
	OB	Oak-birch woodland	W10d
Transitional slope	M	*Molinia caerulea* grassland	Indet.
	B	Cleared birchwood	Indet.
	Nc	Neutral grassland	MG5b
	Hm	Moist *Holcus lanatus* grassland	M24b/MG1b
	Ca	Sedge grassland	MG1b/M22d
	S	Grey willow-nettle scrub	W6a-incipient
	E	*Eupatorium cannabinum* community	Indet.
	F	Recently cleared valley floor area	Indet.
Peat-filled depressions	Aw	Alder woodland	W5b(W7b)
	Cr	Pond sedge bed	S24
	Rb	Reedbed	S24
	Js	Fen meadow	M22a
Spoil bank	SB	Riparian nettlebed	OV24a
		In Map 3, the actual distribution of the nettlebed is shown, where it extends onto the lower transitional slopes along the eastern fringe of the site.	

5. FLORISTIC TABLES OF VEGETATION UNITS

All descriptions of significant communities within the vegetation units are accompanied by a table of samples taken during the survey. These are set out as whole-stand records in the following tables, though it is important to bear in mind that the samples taken, though carefully selected to be representative, do not cover all the vegetation at the site, and local variation is present in many stands. The layout of the tables emphasises the differences between stands within the units.

Further species recording may identify species not listed in section 6. It is recommended that new records be added to the site species list and to the relevant stand table in this section.

The sample tables include a number of categories, with precise meanings in the NVC methodology:

Site name	This survey was undertaken in the area shown in Map 1.
Stand name	General descriptive name, referred to within the text in this context of this site only. It is not meant to represent all types of similar vegetation found elsewhere.
NVC	Formal code of the NVC community, and the relevant sub-community. In some cases, it has been necessary to place the sample group in a position intermediate between two communities, or to refer to it as indeterminate. Full details are given in the relevant account in section 3.
Sample number	Samples for this site were taken during a comprehensive survey of the site undertaken during several visits. For this reason, the sample number refers to field tables and notes, rather than to a sequential numbering sequence of samples for this site
NVC table	Ordered data table, usually of several stands, illustrating their different floristic composition. Where sufficient samples are given, constancy and cover abundance values are given (explained in section 2)
Sward height (cm)	In grassland and tall-herb stands, the height of the sward is given as the median height of the layer of tallest plants.
% cover values	An approximate value for several components of the plot sample is given as a percentage of the plot area when viewed from above the sward.

Canopy (%)	In woodland stands, the approximate proportion of sky covered by the species in the canopy.
Total no. of species	This refers solely to the number of species recorded within each sample, and gives an indication of species richness of the stand when the average species number per sample is considered.

6. NVC SURVEY SPECIES LIST

This list includes those plant species recorded from samples taken within vegetation stands at Hinderclay Fen during the NVC survey. The list is based entirely on the samples taken from plots; nearly all of these are included in the community tables given in section 4. The list is not intended to be a comprehensive record of all species occurring at the survey site.

The list is made up of sections according to the type of species present (Woody plants, Forbs, Grasses, sedges and rushes, Ferns and Bryophytes). Plants in each section are listed alphabetically by Scientific Name. The authority for all vascular plants is Stace (1997); for bryophytes, Blockeel and Long (1998) is the standard reference. Lichens are listed according to the Checklist of Lichens of Great Britain and Ireland (Coppins, 2002), as amended by the active document on the British Lichen Society website http://www.thebls.org.uk/checklist.html. Formal Common Names are also given for all groups except lichens.

In all, the plots recorded 186 species; of these, 41 were ferns, bryophytes and lichens, the remainder were higher plants.

Scientific name	Common name
Bushes and trees	
Acer campestre	Field maple
Acer pseudoplatanus	Sycamore
Alnus glutinosa	Alder
Betula pendula	Birch
Crataegus monogyna	Hawthorn
Fraxinus excelsior	Ash
Ilex aquifolium	Holly
Ligustrum vulgare	Privet
Populus tremula	Aspen
Populus x canescens	Grey poplar
Prunus spinosa	Blackthorn
Quercus robur	Pedunculate oak
Rosa canina agg	Dog rose aggregate
Rubus fruticosus agg	Bramble aggregate
Rubus idaeus	Raspberry
Salix caprea	Goat willow
Salix cinerea	Grey sallow
Sambucus nigra	Elder
Sorbus aucuparia	Rowan
Ulex europaeus	European gorse
Viburnum opulus	Guelder rose

Scientific name	Common name
Forbs and woody	
Achillea millefolium	Yarrow
Ajuga reptans	Bugle
Arctium minus agg	Lesser burdock
Arum maculatum	Lords-and-ladies
Bilderdykia convolvulus	Black bindweed
Calluna vulgaris	Heather
Caltha palustris	Marsh marigold
Campanula rotundifolia	Harebell
Cardamine pratensis	Lady's smock
Centaurea nigra	Black knapweed
Cerastium fontanum	Common mouse-ear
Cerastium semidecandrum	Little mouse-ear
Chamerion angustifolium	Rosebay willowherb
Cirsium arvense	Creeping thistle
Cirsium palustre	Marsh thistle
Cirsium vulgare	Spear thistle
Conium maculatum	Hemlock
Conyza canadensis	Canadian fleabane
Crepis capillaris	Smooth hawk's-beard
Datura stramomum	Thorn-apple
Epilobium montanum	Broad-leaved willowherb
Epilobium parviflorum	Hoary willowherb
Erodium cicutarium	Common stork's-bill
Eupatorium cannabinum	Hemp agrimony
Filipendula ulmaria	Meadow-sweet
Galium aparine	Cleavers
Galium saxatile	Heath bedstraw
Galium uliginosum	Fen bedstraw
Galium verum	Lady's bedstraw
Geranium molle	Dove's-foot cranes-bill
Geranium robertianum	Herb Robert
Geum urbanum	Wood avens
Glechoma hederacea	Ground ivy
Hedera helix	Ivy
Heracleum sphondylium	Hogweed
Humulus lupulus	Hop
Hypericum tetrapterum	Square-stemmed St John's-
Iris pseudacorus	Yellow flag
Lapsana communis	Nipplewort
Linaria vulgaris	Common toad-flax
Lithospermum officinale	Common gromwell
Lonicera periclymenum	Honeysuckle
Lotus pedunculatus	Marsh bird's-foot trefoil
Lycopus europaeus	Gypsy-wort

Scientific name	Common name
Lythrum salicaria	Purple loosestrife
Medicago lupulina	Black medick
Mentha aquatica	Water mint
Moehringia trinervia	Three-veined sandwort
Myosotis arvensis	Field forget-me-not
Myosotis ramosissima	Early forget-me-not
Myosoton aquaticum	Water chickweed
Pilosella officinarum	Mouse-ear-hawkweed
Plantago lanceolata	Ribwort plantain
Potentilla erecta	Tormentil
Potentilla reptans	Creeping cinquefoil
Prunella vulgaris	Self-heal
Ranunculus bulbosus	Bulbous buttercup
Ranunculus repens	Creeping buttercup
Rumex acetosa	Common sorrel
Rumex acetosella	Sheep's sorrel
Rumex sanguineus	Wood dock
Sagina procumbens	Procumbent pearlwort
Scrophularia aquatica	Water figwort
Scutellaria galericulata	Skullcap
Senecio jacobaea	Ragwort
Senecio sylvaticus	Heath groundsel
Senecio vulgaris	Groundsel
Silene latifolia	White campion
Solanum dulcamara	Bittersweet
Stachys sylvatica	Hedge woundwort
Stellaria graminea	Lesser stitchwort
Stellaria media	Chickweed
Succisa pratensis	Devil's-bit scabious
Taraxacum officinale agg	Dandelion aggregate
Thymus polytrichus	Wild thyme
Trifolium repens	White clover
Urtica dioica	Common nettle
Valeriana officinalis	Common valerian
Veronica chamaedrys	Germander speedwell
Veronica officinalis	Heath speedwell
Vicia cracca	Tufted vetch
Vicia sepium	Bush vetch
Viola canina	Heath dog-violet
Viola hirta	Hairy violet
Viola odorata	Sweet violet
Viola riviniana	Common dog-violet

Scientific name	Common name
Grasses, sedges and rushes	
Agrostis capillaris	Common bent
Agrostis stolonifera	Creeping bent
Agrostis vinealis	Brown bent
Aira praecox	Early hair-grass
Anthoxanthum odoratum	Sweet vernal-grass
Arrhenatherum elatius	False oat-grass
Brachypodium sylvaticum	Wood false-brome
Briza media	Quaking-grass
Bromus hordeaceus	Soft brome
Carex acuta	Slender tufted-sedge
Carex acutiformis	Lesser pond-sedge
Carex caryophyllea	Spring sedge
Carex disticha	Brown sedge
Carex flacca	Glaucous sedge
Carex hirta	Hairy sedge
Carex nigra	Common sedge
Carex pilulifera	Pill sedge
Carex remota	Remote sedge
Carex riparia	Greater pond-sedge
Dactylis glomerata	Cock's-foot
Danthonia decumbens	Heath-grass
Elytrigia repens	Couch-grass
Festuca ovina (filiformis)	Sheep's fescue (fine-leaved)
Festuca pratensis	Meadow fescue
Festuca rubra	Red fescue
Holcus lanatus	Yorkshire fog
Holcus mollis	Creeping soft-grass
Juncus articulatus	Jointed rush
Juncus effusus	Soft rush
Juncus subnodulosus	Blunt-flowered rush
Luzula campestris	Field wood-rush
Luzula multiflora	Heath wood-rush
Molinia caerulea	Purple moor-grass
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Common reed
Poa pratensis	Smooth meadow-grass
Poa trivialis	Rough meadow-grass
Vulpia myuros	Rat's-tail fescue
Ferns	
Athyrium filix-femina	Lady fern
Dryopteris dilatata	Broad-leaved buckler fern

Scientific name	Common name
Bryophytes	
Amblystegium serpens	Creeping feather-moss
Brachythecium albicans	Whitish feather-moss
Brachythecium rivulare	River feather-moss
Brachythecium rutabulum	Rough-stalked feather-moss
Bryum pseudotriquetrum	Marsh bryum
Campylopus introflexus	Heath star moss
Campylopus flexuosus	Rusty swan-neck moss
Campylopus pyriformis	Dwarf swan-neck moss
Cephaloziella divaricata	Common thread-wort
Ceratodon purpureus	Redshank
Dicranella heteromalla	Silky forklet-moss
Dicranum scoparium	Broom fork-moss
Drepanocladus aduncus	Kneiff's hook-moss
Eurhynchium hians	Swartz's feather-moss
Eurhynchium praelongum	Common feather-moss
Fissidens adianthoides	Maidenhair pocket-moss
Funaria hygrometrica	Common cord-moss
Hypnum andoi	Mamillate plait-moss
Hypnum cupressiforme	Cypress-leaved plait-moss
Hypnum jutlandicum	Heath plait-moss
Mnium hornum	Swan's-neck thyme-moss
Pellia epiphylla	Overleaf pellia
Plagiomnium rostratum	Long-beaked thyme-moss
Plagiomnium undulatum	Hart's-tongue thyme-moss
Pleurozium schreberi	Red-stemmed feather-moss
Pohlia nutans	Nodding thread-moss
Polytrichum formosum	Bank haircap
Polytrichum juniperinum	Juniper haircap
Polytrichum piliferum	Bristly haircap
Rhytidiadelphus squarrosus	Springy turf-moss
Scleropodium purum	Neat feather-moss
Lichens	
Cladina impexa	a lichen
Cladonia fimbriata	a lichen
Cladonia floerkeana	a lichen
Cladonia furcata	a lichen
Cladonia macilenta	a lichen
Cladonia ramulosa	a lichen
Cladonia squamosa	a lichen
Lepraria spp.	a lichen

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