

The long-term effectiveness of Environmental Stewardship in conserving lowland wet grassland

Botanical survey of permanent plots in seven Wet Grassland Areas in 2012



Report to Natural England

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Executive Summary

This report presents the results of a project to assess the condition of 99 Lowland Wet Grassland sites in England that were in Higher Level Stewardship (HLS) management in 2012. The objective of the project was firstly to provide an updated assessment of the impact of agri-environment schemes on Lowland Wet Grasslands by resurveying the botanical condition of a sample of sites for which there was an existing baseline from the Environmentally Sensitive Areas (ESA) scheme, and secondly, with a view to the future, to reinforce the sample by gathering new baseline data on an additional sample of sites in areas that had not previously been monitored. The assessment involved field survey of vegetation plots, analysis of vegetation and soil data, including comparison with data collected previously, and collection and analysis of site management information.

The focus of this project was on those sites that had *potential* to meet the dual criteria of both Lowland Meadow or Fen and Coastal and Floodplain Grazing Marsh. Within the National Vegetation Classification (NVC) habitats that meet both criteria are classified as MG4, MG8 and M22. Coastal and Floodplain Grazing Marsh also encompasses MG7c, MG7d, MG9, MG10, MG11 and MG13.

Of the 99 sites, 71 were located in former Environmentally Sensitive Areas (ESAs) and had previously been surveyed under ESA monitoring schemes set up in the 1980s and 1990s. These sites were in the former Somerset Levels and Moors ESA (31 sites); the Test Valley ESA (9 sites); the Avon Valley ESA (19 sites); The Norfolk Broads ESA (4 sites); and the Upper Thames Tributaries ESA (8 sites). At each of these sites a permanent monitoring plot was relocated (where possible) and the vegetation recorded. These plots took two forms: an ADAS nested plot or a series of five quadrats located on a line transect.

The remaining 28 sites were new sites selected by Natural England for survey during 2012. They included sites in the Avon Valley, Itchen Valley, Norfolk Broads, Nene Valley, Derwent Valley and Upper Thames Tributaries. At each new site permanent monitoring quadrats were established and the vegetation recorded. Soil samples were taken from each site for analysis. At all sites, recording in plots and quadrats was combined with a walkover condition assessment.

The vegetation in the monitoring sites was largely that of mesotrophic grassland or rush pasture, although some swamp communities were also encountered. A diverse range of NVC communities were recorded with 78 per cent of sites classified as one of the following: MG4, MG7, MG8, MG9, MG11, MG13 or M22. MG8 was the most frequently recorded community. Different regions supported different NVC communities, reflecting differences in landscape character, soils and hydrology: MG8 and MG13 were most frequent in the Somerset Levels; MG7, MG9 and MG11 were most frequent in the Avon Valley; M22 was encountered in the Somerset Levels, Test Valley and Norfolk Broads only but was found in most sites in the latter two regions; MG4 was restricted to the hay-meadows of several sites in the Derwent Valley and Upper Thames Tributaries plus a single site in the Nene Valley.

Change in vegetation communities in the Somerset Levels reflects a shift in the habitat to a more frequently/permanently waterlogged community, which might be expected under Raised Water Level management and exacerbated by episodes of flooding. The increase in *Juncus* spp. and

Deschampsia cespitosa may also reflect a relaxation in grazing pressure. Both increased wetness and less grazing are supported by the analysis of the suited species scores and the Ellenberg indices. Both the ADAS plots and 5-quadrat sites show similar patterns of significant decrease in suited species grazing score, increase in suited species moisture score and increase in Ellenberg soil wetness score. Species richness had declined at the sites with 5-quadrats but no change was observed in the ADAS plots. Species richness was related to NVC community. Few sites in the Somerset Levels passed the common standards monitoring (CSM) condition assessment for SSSIs. Most MG8 sites failed on cover of *Juncus* spp., whilst other community types failed on the frequency of positive indicator species. Most sites in the Somerset Levels are under HLS options for breeding or wintering waders.

Vegetation at most of the sites in the Test Valley appeared to have deteriorated in quality. Species richness declined significantly from 1988 to 2012 with specific declines in individual species of damp grassland. Vegetation has changed from species-rich mosaics of M22b and MG8 to grassland and wetland vegetation of lower conservation value. The suited species grazing score has declined reflecting a relaxation in appropriate management. Only three of the nine sites passed the CSM attribute targets. On three sites where management has been ideal, vegetation quality has been maintained and has even improved. Where vegetation has deteriorated, changes are likely to be reversible in the medium-term with increased grazing intensity.

2012 was the first year of monitoring the Derwent Valley sites. The majority of sites were found to contain grassland of conservation value, most of which was under appropriate management to maintain their condition. Of eight sites, only three passed all CSM attributes; another four however, which failed on frequency of positive indicator species, contained sufficient numbers of positive indicator species in the field at lower frequencies to potentially achieve a richer sward given appropriate management. Soils at these sites had the low Phosphorous content required for establishing species rich swards. There were some issues regarding control of water levels and flooding on these sites: land managers attributed more frequent and deeper flooding to a barrage installed on the River Derwent, but recent wet summers have also contributed to the size and frequency of flooding events and the relative contribution of these two factors is difficult to determine. Six of eight sites were under HLS options for breeding waders.

A significant increase in species richness was observed in the Avon Valley between 1993 and 2003, and a decrease from 2003 to 2012, but the 2012 sward is still significantly richer than the baseline in 1993. There was only one significant change in ecological criteria indices – that of the suited species high moisture score. On sites where HLS agreements were targeted at maintaining or improving botanical diversity, there was some evidence of success. A significant proportion of agreements were, however, targeted at wintering and/or breeding birds and these sites have shown little improvement or reductions in botanical quality. Few sites passed the CSM attributes, with most failing on meeting the botanical attributes for any SSSI grassland stand type. There were signals that recent flooding and high in-field water levels are affecting vegetation communities.

2012 was the first year of monitoring the Itchen Valley sites. The vegetation recorded at all sites was species-poor and with a degree of past agricultural improvement, although there were relics of former species-rich communities. The HLS option of restoration of species-rich grassland had been adopted at four sites, restoration of fen at one, maintenance of traditional water-meadows at three sites, and maintenance of species-rich grassland at one site. Three of the seven sites were found to

be possibly too dry for re-establishment of wet grassland communities: these former wet grasslands may have been affected by changes to river management, abstraction or groundwater supply, which would need to be considered in future restoration/maintenance management. At five of the seven sites soil Phosphorous was sufficiently high that potential for establishment of species rich communities could be reduced. All sites failed a CSM condition assessment for the relevant community.

At the four sites in the Norfolk Broads where surveys were repeated, there were significant positive changes in the conservation value of the vegetation communities. Species richness had increased and former semi-improved grasslands had developed into species-rich vegetation. The ecological indices showed a decline in frequency of more nitrogen-responsive species (Ellenberg indices for fertility) and an increase in frequency of less competitive species (suited species scores for grazing and moisture). Three new sites in the Norfolk Broads supported species-rich grassland with locally sub-optimal stands. Two sites passed all CSM attributes, five failed but on litter accumulation and *Juncus* spp. frequency: three were only in their first year of HLS. The two new Nene Valley sites failed the CSM assessment, which was an accurate reflection of the state of the vegetation in the field.

The dataset for the Upper Thames Tributaries was small with just 11 sites, only seven of which had been monitored previously. Statistical analysis of vegetation data in relation to variables such as soil properties, sward height, species richness and change over time showed no significant differences but there was an increase in *Deschampsia cespitosa* at several sites and *Rumex crispus* frequency had risen overall. High levels of mean species richness were maintained from 1995 to 2012. Degradation of habitat was noted at one site where management had been abandoned. The four new sites included two sites supporting species-rich vegetation (MG4), and a third with (MG9) vegetation of moderate diversity with potential for (re)establishment of species-rich grassland development into MG4. Two new sites and one established site passed the CSM condition assessment; all were MG4 stands under HLS options to maintain species-rich grassland. Seven of eight sites that failed CSM attributes failed on frequency of positive indicator species but were under HLS options for breeding/wintering birds.

Results suggest that management under the former ESA scheme and the current HLS scheme has benefited the sites in the Norfolk Broads, and some sites in the Somerset Levels, Avon Valley and Upper Thames Valley. Change on a number of sites is difficult to assess qualitatively as changes observed may be a shift from a one community type to another, e.g. MG8 wet pasture to M22 fen meadow, rather than a simple enhancement or degradation of the baseline community. However, on some sites it is clear that a combination of raised water levels (both natural and controlled), poorly targeted management objectives or ineffectual/inappropriate management have resulted in declines in the quality of the vegetation. In some sites including those in the Itchen Valley this is further hampered by high soil (Phosphorous) fertility.

1 INTRODUCTION

1.1 Project objectives

The objective of this project was to provide an updated assessment of the impact of agri-environment schemes on Lowland Wet Grasslands through a resurvey of the current condition of a sample of sites with an existing baseline, and to provide an updated baseline dataset suitable for evaluating HLS management by extending assessments to an additional sample of new sites in areas with poor or no coverage. The assessment was to involve field survey, analysis of vegetation and soil data, including comparison with data collected previously, and collection and analysis of site management information.

The specific aims were to:

- a. Provide an assessment of the current condition of a national sample of Wet Grassland sites under HLS management.
- b. Explore the current condition of Wet Grasslands within selected areas that are considered of importance for their wet grassland resource.
- c. Evaluate any change in condition of Wet Grasslands that has occurred during the period of agri-environment scheme management.
- d. Evaluate management, soil and other relevant information and explore the reasons for any change in vegetation condition observed.

1.2 Background

Agri-environment schemes have been a vehicle for encouraging farmers to adopt agricultural practices that protect and enhance the environmental value of land under their management. The Environmentally Sensitive Areas Scheme (ESA) was introduced in 1987 to focus attention on specific designated areas of high landscape, wildlife or historic value, which were considered to be dependent upon environmentally friendly land management. Stage I in 1987 saw the introduction of five ESAs, with a further three stages (II–IV) adding a further 17 ESAs (in 1988, 1993 and 1994). In all, 22 ESAs were designated covering around 10% of the agricultural land in England. To determine the success of the ESA scheme and to assess the performance of the land under ESA against its area-specific objectives, a programme of monitoring was initiated; part of which included the establishment of permanent monitoring quadrats or plots for botanical survey on sample sites within each ESA. Botanical monitoring of these quadrats/plots has continued periodically since establishment, although the sites resurveyed and the years in which resurvey has taken place has varied between ESAs.

The Countryside Stewardship Scheme (CSS) was introduced in 1991, initially as a pilot scheme: its aim was to provide payment to farmers to enhance and conserve areas of land representative of target landscapes that were outside designated ESAs. Permanent quadrats were also established within a sample of CSS sites between 1997 and 1999, but these have not been resurveyed since. Additionally, quadrats have been recorded at a selection of other high value sites.

Although some existing agreements under the ESA and CSS schemes continue until 2014, both schemes were closed to new applicants in 2004 and have been superseded by the Environmental

Stewardship scheme, which comprises four elements or levels: Entry Level Stewardship (ELS), Organic Entry Level Stewardship (OELS), Uplands Entry Level Stewardship (UELS), and Higher Level Stewardship (HLS). Environmental Stewardship also provides funding to farmers and land managers to provide effective environmental management on their land and its aim is to build on the achievements of the former ESA and CSS schemes, by offering a more outcome focussed approach. The current Environmental Stewardship Scheme is under review and will be subject to further development from 2014, but existing agreements will run their full course.

1.3 Lowland wet grassland

Lowland wet grassland encompasses a number of priority habitats of the UK Biodiversity Action Plan (UK BAP: <http://jncc.defra.gov.uk/page-5155>), published in 1994. These priority habitats include two that are botanically species-rich and of importance for their vegetation, *Lowland Meadows* and *Purple Moor Grass and Rush Pasture*, and one that is of importance for its bird, invertebrate or other fauna, *Coastal and Floodplain Grazing Marsh*. *Lowland Fen* – minerotrophic peatlands – are also often found in close association with these habitats.

The focus of this project was on those sites that had potential to meet the dual criteria of both *Lowland Meadows* (or in a few cases *Lowland Fen*) and *Coastal and Floodplain Grazing Marsh*. Within the National Vegetation Classification (NVC; Rodwell, 1991, 1992) such wet meadow and grazing marsh habitats are classified as the following communities.

- MG4 *Alopecurus pratensis*–*Sanguisorba officinalis* grassland: a species-rich floodplain meadow that is characteristic of land that has traditionally been managed as hay-meadow. Its main distribution lies in South–Central England (Rodwell, 1992).
- MG8 *Cynosurus cristatus*–*Caltha palustris* grassland: a species-rich grassland characteristic of traditional water-meadow management, but usually now managed as pasture. Its distribution is more widespread than that of MG4 but it is very localised (Rodwell, 1992). It is particularly characteristic of the Wessex chalk stream valleys.
- M22 *Juncus subnodulosus*–*Cirsium palustre* fen meadow: a species-rich but extremely variable fen-meadow which exhibits much local variation in floristic composition, and is typically managed by either or a combination of mowing/grazing. Its distribution is throughout southern England. There is a certain amount of overlap between MG8 and M22 and it has been suggested that the former be subsumed within the latter (Rodwell, 1991).

Some of the highest quality examples of these community types have been designated as Sites of Special Scientific Interest (SSSIs). MG4 is also listed under Annex 1 of the Habitat Regulations (<http://www.legislation.gov.uk/ukxi/1994/2716/contents/made>).

Less botanically diverse habitats that would meet the criteria for *Coastal and Floodplain Grazing Marsh* alone include: MG7c *Lolium perenne*–*Alopecurus pratensis*–*Festuca pratensis* grassland; MG7d *Lolium perenne*–*Alopecurus pratensis* grassland; MG9 *Holcus lanatus*–*Deschampsia cespitosa* grassland; MG10 *Holcus lanatus*–*Juncus effusus* rush pasture; MG11 *Festuca rubra*–*Agrostis stolonifera*–*Potentilla anserina* grassland; and MG13 *Agrostis stolonifera*–*Alopecurus geniculatus* grassland. Whilst SSSIs are not designated for these poorer communities alone, they are often found in mosaic with other areas of richer habitat within SSSIs or are found in sites where the former high

quality habitat has degraded. They are also found where designation has been based on faunal rather than botanical features.

1.4 2012 Lowland wet grassland project

In 2012 Natural England's Integrated Monitoring Team selected a sample of lowland wet meadow sites that were now under the HLS scheme – many of which were formerly under the ESA scheme – to be resurveyed, or, if a new site, to have monitoring quadrats established and surveyed. This report presents the results of the (re)survey of these sites and the subsequent analyses.

2 METHODS

2.1 Site Selection

A sample of 99 sites was selected by Natural England's Integrated Monitoring Team from the following geographically defined regions that were judged to be of particular importance for the wet grassland resource.

- Somerset Levels and Moors – 31 sites
- Test Valley – 9 sites
- Derwent Valley – 9 sites
- Avon Valley – 22 sites
- Itchen Valley – 7 sites
- The Broads *plus* Nene Valley – 9 sites
- Upper Thames Tributaries – 12 sites

Priority was given to sites which had been part of the ESA monitoring sample and were now under HLS management. Not all existing sites were used, as some were still under ESA management and others were now under ELS or non-scheme management. New sites were selected on the basis of being in target wet grassland areas and under appropriate management options.

Details of the sites selected and the locations of the existing monitoring quadrats/plots plus associated documentation were supplied by Natural England and are held by them.

2.2 Field Survey Methods

2.2.1 Monitoring unit type

Forty-eight of the sites selected for survey had previously been surveyed using a method developed by ADAS for use in ESA monitoring (Critchley & Poulton, 1998): the 'ADAS nested plot' method. A further 23 sites had also previously been surveyed but using five separate 2m × 2m quadrats arranged linearly across the site: the '5-quadrats' method. The remaining 28 sites were new sites

Table 1. The type of monitoring method used at each sample site selected for survey in 2012, by survey region.

	ADAS nested plot	5-quadrats	New	Total
Somerset Levels and Moors	21	10	0	31
Test Valley	0	9	0	9
Derwent Valley	0	0	9	9
Avon Valley	19	0	3	22
Itchen Valley	0	0	7	7
The Broads & Nene Valley	0	4	5	9
Upper Thames Tributaries	8	0	4	12
Total	48	23	28	99

selected for survey in 2012 and thus had no predetermined survey method: these 'new' sites had a 5-quadrat system established on the site, although there was some variation in its layout – see below.

2.2.1.1 ADAS nested plots

The ADAS nested plot method (Critchley & Poulton, 1998) was established, prior to 2012 on: 21 of the 2012 survey sites that were formerly within the Somerset Levels and Moors ESA; 19 of the former Avon Valley ESA sites; and 8 of the former Upper Thames Tributaries ESA sites.

During the original baseline survey a survey plot, hereafter referred to as an 'ADAS plot', was set up on each site, as follows. A fixed rectangular plot was established within the survey site, located objectively, measuring 4m × 8m. Each corner was marked with a metal marker pin/plate to facilitate relocation in the future for resurveys. Additional marker pins ('origin' pins) were positioned within the site to aid relocation of the plot in subsequent surveys – these were usually located in the corner of a field and the location of the origin pin, distance to plot, and compass bearing to the plot were recorded. Additionally a further marker pin was often sunk in the ground 10m (or 20m) from the origin on the same bearing to the plot. A sketch map of the plot location was also made. The 4m × 8m plot was further subdivided into 32 1m × 1m nests, and these into 10 cells of increasing sizes. Vegetation recording within these nests and cells took place, as is described below for the 2012 survey. There were GPS records from surveys in the early 2000s.

During the 2012 resurvey the plots were relocated (where possible) using the field notes and sketch maps and GPS locations where available provided by Natural England, and with the aid of metal detectors to locate the metal marker pins at the origin and plot. Where plots could not be relocated the plots were laid out as close as possible to the expected location, according to the measurements and compass bearings (plus any other notes) taken during the initial baseline survey.

During the resurvey the same methodology as that employed in the baseline survey was followed. This was as follows. The 4m × 8m plot was marked out using measuring tapes and poles: this was then further sub-divided into a grid of 32 'nests' of 1m × 1m (see Fig. 1, left panel), which were further sub-divided into a series of 10 cells (Fig. 1, right panel). Only 16 of the 32 available nests were resurveyed, as recommended by Burke & Critchley (1999): these were arranged in a chequerboard pattern and started with nest 2. Consequently, nests 2, 4, 5, 7, 10, 12, 13, 15, 18, 20, 21, 23, 23, 28, 29 and 31 were resurveyed.

The vegetation height at the centre of each of the 16 nests was recorded using a drop-disk prior to the botanical survey to avoid measuring trampled vegetation.

Each 1-m nest was then surveyed in turn by recording the vegetation in a series of 10 cells of increasing sizes, starting from a common corner with cell 2 being the first cell in the corner and cell 1 being a single pin-point in the centre of cell 2 (see Fig. 1, right panel). The method for recording vegetation within the each 1-m nest was as follows. The first vascular plant species to be encountered at the pin point of cell 1 was recorded with a score of '1'. The next cell, cell 2, was then searched for additional species. Each new species encountered in cell 2 was given a score of '2'. Each subsequent cell was searched in turn and only new species encountered in that cell were recorded, and given the corresponding score. Thus, only one species could have a score of 1 but multiple species could have a score of 2–10; each individual species could only be scored once per nest.

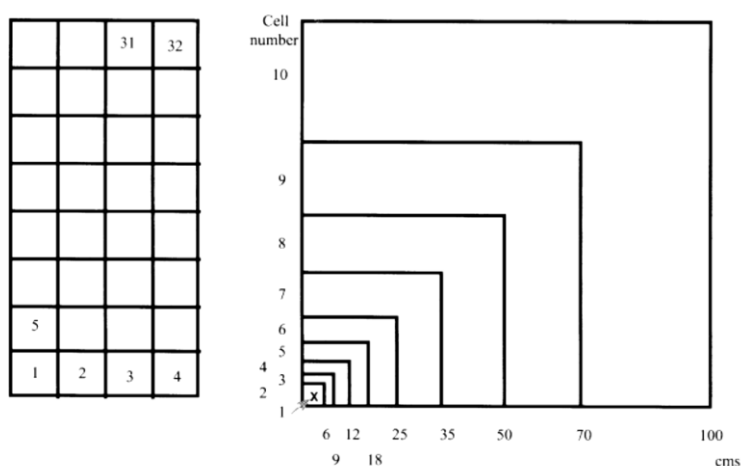
Although all vascular plants species were identified to species level where possible, including bryophytes – several were later amalgamated for analysis to ensure consistency with data from previous surveys were amalgamation of some species/groups had taken place.

For each plot a grid reference was recorded at corner 'A' (bottom right-hand corner as viewed from origin, and marked on baseline survey maps) using a hand-held GPS unit.

Representative digital images were taken of the plot and of one nest within the plot.

The field survey was carried out by experienced botanists, usually working in teams of two, following a standard field survey protocol, to ensure consistency, issued to each surveyor at an initial training day at one of the Avon Valley resurvey sites. The field survey commenced on the 19 June, 2012.

Figure 1. The layout of a 4m x 8m ADAS nested plot (left) with a 1m x 1m nest (right) with cell number (1–10), size (cm) and position shown (Reproduced from Critchley & Poulton, 1988).



Cell 1: A point in the centre of Cell 2.	Cell 6: 25cm
Cell 2: 6cm	Cell 7: 35cm
Cell 3: 9cm	Cell 8: 50cm
Cell 4: 12cm	Cell 9: 70cm
Cell 5: 18cm	Cell 10: 100cm

2.2.1.2 5-quadrat method

The 5-quadrats method, adapted from Smith *et al.* (1985) was established, prior to 2012 on: 10 of the 2012 survey sites that were formerly within the Somerset Levels and Moors ESA; 9 of the former Test Valley ESA sites; and 4 of the former Broads ESA sites.

During the baseline survey a transect line was positioned across each site. The location of the transect varied between sites but the transect usually ran from one corner of a field, diagonally to the opposite corner. The length of the transect and the compass bearing from one end to the other

was recorded. The start of the transect, the 'origin', was marked with a metal marker pipe: a further marker was usually sunk at 10m (or 20m).

Along the line of the transect five 2m × 2m quadrats were positioned, usually at set intervals along the transect – the location of these quadrats along the transect varied between sites and was related to the size of the site and therefore, length of the transect. Their location was described and sketched in the original survey documents. Metal marker pipes were also installed at each quadrat to permanently mark its location for future resurvey.

In 2012 the 2m × 2m quadrat were relocated where possible, using the baseline survey maps and with the use of metal detectors to relocate the metal pipes at the origin and at the quadrat locations. Where the metal marker pipes could not be relocated the transect and quadrats were laid out according to the measurements and compass bearings (plus any other notes) taken during the initial baseline survey. The vegetation survey then took place, which was a repeat of the original baseline survey as follows.

The vegetation height at the centre of each of the quadrats was recorded using a drop-disk prior to the botanical survey to avoid measuring trampled vegetation.

To survey the vegetation, a 1m × 1m quadrat was laid in the centre of each 2m × 2m quadrat. All vascular plant species rooted within the 1m × 1m quadrat were recorded with an estimate of their cover using the DOMIN scale. The presence of additional species in the surrounding 2m × 2m quadrat was also recorded. All species were assigned a DAFOR score. Records were also made of the cover of unvegetated ground, and percentage cover of the following amalgamated groups: bryophytes, grasses, forbs, sedges and rushes.

Although all vascular plants species were identified to species level where possible, including bryophytes – several were later amalgamated for analysis to ensure consistency with data from previous surveys where amalgamation of some species/groups had taken place.

For each plot a grid reference was recorded using a hand-held GPS unit.

Representative digital images were taken of the plot and of one quadrat.

The field survey was carried out by experienced botanists, usually working in teams of two, following a standard field survey protocol, to ensure consistency, issued to each surveyor at an initial training day at one of the Avon Valley resurvey sites. The field survey commenced on the 19 June 2012.

2.2.1.3 New sites

Natural England selected 28 sites under HLS which had not previously been surveyed; these included 9 sites in the Derwent Valley, which had never been part of an ESA; 3 sites in the former Avon Valley ESA; 7 sites in the Itchen Valley, which had never been part of an ESA; 3 sites in the former Broads ESA and 2 sites in the Nene Valley; plus 4 sites in the former Upper Thames Tributaries ESA.

At all of these sites new vegetation monitoring stands were set up using the 5-quadrats method described in 2.2.1.2, with the exception of the Derwent Valley and the Itchen Valley, where the 5-quadrats were set up in a quincunx pattern.

The quincunx arrangement of quadrats used in the Derwent and Itchen Valleys is as per the five dots on a dice, with four quadrats arranged in a square or rectangle, and the fifth at the centre. The central quadrat was positioned first in a large stand of homogeneous vegetation deemed typical for the field, and the four remaining quadrats were located equidistant from the first quadrat, on compass bearings of 0°, 90°, 180° and 270°, i.e. North, South, East and West. This was the first site in which new quadrats were set up and this method of quadrat arrangement was used as a trial, following discussion with Natural England. However, it was determined that although it was effective at sampling a homogeneous stand of vegetation, it was less effective at sampling variation across the site as a whole. Therefore at all subsequent sites, the standard method of 5-quadrats along a line transect (as 2.2.1.2) was employed.

All other aspects of field survey and recording detailed in 2.2.1.2 were the same for the new sites.

2.2.2 NVC survey

The original baseline survey aimed to describe the vegetation using the framework of the NVC. However, the 2012 survey included two different types of survey unit and sampling methodology; the ADAS nested plot method and the fixed 5-quadrat method.

The method of data collection for the vegetation analysis from the survey sites that included the 5-quadrats (i.e. DOMIN score for each species present in each of the 5 quadrats) was deemed sufficiently close to the standard methodology of an NVC survey that the resulting data was used for all aspects of the vegetation analysis, including the NVC survey. The deviation from a standard NVC survey that this method represented is that the locations of these 5 quadrats was determined by fixed measurements according to field shape and size and were permanent: quadrats in a standard NVC survey are instead positioned subjectively in areas of homogeneous vegetation deemed typical of the stand being sampled, and are not permanent. These quadrats generally had good spread across the site though and were deemed fairly successful in sampling the general vegetation within the site.

For sites with the ADAS nested plots, a standard NVC survey was carried out in the wider site to determine the NVC community in the site as a whole, following standard methodology (constancy and abundance within quadrats). The NVC community within the ADAS plot may not be the same as the vegetation in the site as a whole because the plots were not subjectively placed in stands of homogeneous vegetation representative of the site, but were instead located in predetermined positions within the site using random number generation. The NVC community within the survey plot alone was determined from the nested plot frequency data (transformed; see section 2.5.1.2) collected during the site survey.

2.2.3 Condition assessment

At each site a condition assessment was carried out according to common standards monitoring (CSM) for SSSIs (Robertson & Jefferson, 2000) or condition assessment of G06 – Lowland meadows BAP habitat (Natural England, 2010) for non-SSSIs using rapid condition assessment (RCA) field forms supplied by Natural England. The form to be used was determined on site but those used comprised:

- Lowland meadows: MG4
- River flood-plain grassland: MG8, MG8-related (south)

- Inland wet grassland: MG11-related, MG13-related
- Fen meadows & rush pastures: M22, M23
- Lowland *Molinia* meadows/ *Molinia caerulea*-*Potentilla erecta* mire: M24a, M25c

2.2.4 Soil sampling

Twenty soil samples were collected from each survey site using a pot auger following the method specified in Natural England Technical Information Note TIN035. The 20 samples were collected from across the site to ensure a wide spread of sampling locations; samples for each site were combined to form one sample per site by placing them in a single collection bag.

Soil samples were labelled with the sample ID, sample name and analysis code and kept cool until such time that they could be sent for analysis at Natural Resource Management Ltd by courier.

2.3 Data Management

All survey data were entered into a bespoke Access database, the Environmental Monitoring Database (EMD), constructed by Simon Poulton of BioEcoSS Ltd for this survey.

Data were imported from the EMD Worker into an Access database. Data from previous surveys were extracted from the AEMA database by Simon Poulton (BioEcoSS Ltd) and supplied to Belinda Wheeler & Associates in a format suitable for extraction and subsequent interrogation using statistical software packages. For ADAS plots, data for years previous to 2012 were subsampled to obtain equivalent figures for 16 quadrats.

2.4 Management Survey

The landowner, tenant or agent (as appropriate) was contacted during the course of the contract to discuss management of the site. A management questionnaire was formulated for this task (on file with Natural England) that included questions on cutting management, grazing management, weed control, drainage management, restoration activity and anecdotal observations of change.

2.5 Data Analysis

2.5.1 NVC classification

2.5.1.1 ADAS nested plots

For the wider site, data collected from the supplementary standard NVC quadrats were analysed using MATCH and the NVC community/subcommunity determined using the MATCH results in conjunction with the published tables and descriptions in Rodwell (1991–2000) and experienced NVC surveyor interpretation (as outlined above).

However, this NVC survey did not allow direct comparison with the NVC community type recorded in previous survey years. In previous years the data collected in the nested plots was transformed to allow analysis of NVC community within the plot itself. In 2012 the ADAS plot data was again transformed to facilitate analysis of NVC community. This required the transformation of frequency data from the 10 cells in each of the 32 (or 16 in 2003) nests into NVC compatible constancy data.

For the 2012 data:

1. The frequency score for each species within the plot at scale 10 (i.e. the presence/absence of a species in each 1m × 1m nest at cell 10 size, which equates to the entire 1m x 1m quadrat) was collated.
2. The frequency score, which was from 0–16 with 0 for absent in all nests and 16 for present in all nests, was transformed into constancy scores from 1–5 to correspond to NVC methodology.
3. The transformation was as follows:
 - Constancy 1 Frequency scores 1–3
 - Constancy 2 Frequency scores 4–6
 - Constancy 3 Frequency scores 7–9
 - Constancy 4 Frequency scores 10–12
 - Constancy 5 Frequency scores 13–16
4. The resulting species and accompanying constancy score were analysed using MATCH.

2.5.1.2 Fixed 5-quadrat method

Data collected from the fixed 5-quadrat survey sites, i.e. data on constancy (1–5) and abundance (DOMIN 1–10), were analysed using MATCH 2.1.6 (Malloch, 2000). MATCH is however an interpretive tool to supplement or corroborate the interpretation of the data by experienced NVC surveyors using the published tables and descriptions in Rodwell (1991–2000). Whilst MATCH frequently confirms the surveyor’s opinion on NVC community or sub-community, the stand type with the highest (%) similarity in the MATCH analysis is not always considered to be the correct diagnosis. Other factors can be taken into account by the experienced surveyor such as local variation in species composition, the source community where there has been successional (or other) change or anomalous species that may be swaying the data.

NVC data was available for most sites with previous monitoring survey data, although not for every survey year, enabling analysis of change in NVC community at different data points (survey years).

2.5.2 Soil analysis

Soil samples were analysed by Natural Resource Management Ltd, Bracknell. The analysis package included the following variables: soil pH (Water), phosphorous (Olsens P; mg/l and Total P), potassium (soil K; mg/l), magnesium (soil MG; mg/l), nitrogen (Total N %), and two measures of organic content (loss on Ignition and organic carbon).

2.5.3 Community variables and analysis of change

CANOCO 4.5 (ter Braak & Smilauer, 2002) was used to investigate relationships between vegetation composition and soil variables, and between vegetation compositions recorded in each year since the start of monitoring. Several techniques are available within this package.

Detrended Correspondence Analysis (DCA) was used to compare vegetation composition within a site between years, while Canonical Correspondence Analysis (CCA) was used to study the relationship between vegetation composition and soil parameters. Both sets of analyses were carried out on untransformed data with rare species downweighted. Data from the 16-nest ESA

plots were analysed as optimum frequencies (Critchley & Poulton, 1998), while DOMIN scores from 5-quadrat-based samples were converted to mean percentage covers for each field before analysis (refer to Table 2 for sample types for each ESA analysed).

DCA ordination diagrams of vegetation samples were plotted, with the trajectories of individual samples indicated through time from the first year of survey to 2012 by arrows. The relationships between vegetation composition and soil variables are displayed in ordination diagrams by vectors for the environmental variables with their lengths proportional to their importance and directions showing their correlation with each axis. It should be noted that the soil record for all years apart from 2012 was very incomplete. The statistical significance of soil parameters was tested using Monte Carlo permutation tests with 499 random permutations.

Table 2. Analyses were possible for the following datasets per ESA (ESA nested quadrat plot or 5-quadrat-based sample).

ESA	Sample type	
	ESA plots	5 Quadrats
Somerset Levels	*	*
Test Valley		*
Avon Valley	*	
Upper Thames Tributaries	*	
Norfolk Broads		* (wrt year only)

2.5.4 Species richness and ecological criteria variables

Species richness was calculated for the whole plot on ADAS plots and at the quadrat scale for the 5-quadrats. Vegetation heights were also available for ADAS plots over the entire period.

Community variables were calculated for plots as mean values from the nested quadrats or as raw values for each quadrat. Selected ecological criteria variables calculated were suited species scores (Critchley *et al.*, 1999) and Ellenberg values originally calculated for Central Europe by Ellenberg (1988) but more recently recalculated for the British flora by Hill *et al.* (2000). Only a few indices were selected as per the previous work (Manchester *et al.*, 2005). These were:

Suited species scores:

M – species suited to a high moisture content;

G – species suited to grazing.

Ellenberg indices:

N – index of soil fertility;

F – index of soil wetness.

Two types of data were available: (1) optimum frequencies from the ADAS plots (Avon Valley, Somerset Levels, and Upper Thames), and (2) DOMIN values from fixed 5-quadrat plots (Norfolk Broads, Somerset Levels and Test Valley).

For trend analyses, data were only used from years where there was an adequate sample. Years where only a few plots were visited were excluded. In addition, if plots were missed in a year with a good sample, these were excluded across the entire comparison series. In this way, only plots with

repeated data were included to minimize variance. For this reason, larger sites such as the Somerset Levels were analysed as a single site although other analyses (e.g. NVC) were possible for sub-sites.

For species trend analyses, a number of amalgamations were required where either two or more species were not separated in any one survey year included in the analysis, or where it was felt that identification to species level would have been difficult. Separation of *Juncus acutiflorus* and *J. articulatus* is an example where many plants showed features common to both species and, in practice, many were probably hybrids. These two species were therefore amalgamated across the data set for trend analyses.

Species amalgams used:

Agrostis stolonifera/Agrostis capillaris

Bryophytes

Festuca arundinacea/Festuca pratensis

Glyceria fluitans/Glyceria plicata

Juncus acutiflorus/Juncus articulatus (and the hybrid *Juncus x surrejanus*)

Lotus corniculatus/Lotus pedunculatus

Ranunculus acris/Ranunculus bulbosus

Data were investigated for normality using a normal plot and the Anderson–Darling test statistic. Where data conformed to normality or could be transformed to normality (log-transformed), a repeated measures ANOVA test was used with year as the repeat factor. Where data did not conform to normality, the Friedman rank analysis of variance test was used with adjustment for tied ranks (Zar, 1984). All statistical tests were performed in MINITAB 16 (Minitab Ltd., Coventry). Where data were transformed, means have been back-transformed.

3 SOMERSET LEVELS

3.1 Baseline Setting

3.1.1 Somerset Levels and Moors sites

Of sites 1–31, site 25 was not resurveyed: this site was withdrawn from the list by Natural England. All fields surveyed were included within the former Somerset Levels Environmentally Sensitive Area (ESA) monitoring programme. Sites (sites 22–31) were first surveyed in 1988 using five fixed-quadrats located on a transect. Sites 1–21 were first surveyed in 1993 when a single ADAS plot (4 m × 8 m nested quadrat) was set up on each site. These sites were targeted at monitoring the impacts of raising water levels on specific moors. In 2012 the sites were surveyed repeating the same monitoring plot method (ADAS plot or fixed 5-quadrats) as used in the initial survey. Additionally on ADAS plot sites three additional NVC quadrats were recorded (see Methods). Brief individual site reports are provided for each site in the Somerset Levels in Appendix 1.

3.1.2 NVC communities

NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. All sites surveyed within the former Somerset levels ESA fell within one of the following NVC communities/sub-communities.

- MG6 *Lolium perenne*-*Cynosurus cristatus* grassland
 - MG6b *Anthoxanthum odoratum* sub-community
- MG7 *Lolium perenne* leys :
 - MG7c *Lolium perenne*-*Alopecurus pratensis*-*Festuca pratensis* (flood pasture) grassland
 - MG7d *Lolium perenne*-*Alopecurus pratensis* grassland
- MG8 *Cynosurus cristatus*-*Caltha palustris* grassland (water meadow)
- MG9 *Holcus lanatus*-*Deschampsia cespitosa* grassland:
 - MG9a *Poa trivialis* sub-community
- MG10 *Holcus lanatus*-*Juncus effusus* rush-pasture:
 - MG10a Typical sub-community
- MG13 *Agrostis stolonifera*-*Alopecurus geniculatus* (wet alluvial meadow) grassland
- M22 *Juncus subnodulosus*-*Cirsium palustre* fen-meadow
 - M22a Typical sub-community
- M23 *Juncus effusus/acuteiflorus*-*Galium palustre* rush-pasture
 - M23b *Juncus effusus* sub-community

Results of MATCH analysis of the monitoring plots (ADAS plot and 5-quadrat) are presented in Appendix 1: included within the Table is an indication of the final NVC community to which each site was assigned. For the ADAS plot sites data is also provided for the supplementary NVC survey of the wider unit to enable positioning of the data from the limited stand area of the plot within the context of the wider community – this again aided with ambiguities.

The number of monitoring sites that were assigned to each of the above NVC communities is shown in Table 3 below. Of the 30 sites surveyed the majority of sites were assigned to either MG8

grassland (10 sites), MG8 grassland–rush pasture transition (MG8/M22 or MG8/M23b; 3 sites) or to MG13 wet grassland (7 sites). Two sites were assigned to (flood-pasture) grassland stands MG7c,d; one site to MG9a grassland; and four to MG10a rush pasture.

Table 3. NVC communities recorded in the former Somerset Levels ESA in 2012, determined from a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account. The sites are sorted by geographical area/SSSI.

NVC Community	NVC Sub-community	Tealham & Tadham Moors SSSI	Wet Moor SSSI	Other SSSIs	All
MG6	MG6b		1		1
MG7	MG7c		1‡		1
	MG7d		1‡		1
MG8		9		1	10
MG8/M22				2*	2
MG8/M23				1	1
M22	M22a			2	2
MG9	MG9a		1		1
MG10	MG10a		3	1	4
MG13		1†	4 + 2†		7
Total Sites		10	13	7	30

*Transitional to fen-meadow/rush-pasture

†Heavily colonised by *Eleocharis palustris* and transitional to a swamp community.

‡MG7–MG9 transition

Tealham and Tadham Moors

Tealham and Tadham Moors are drained peatlands, principally with reed peats overlain by more acidic moss peats but the fringes are peat overlain by alluvial clay. All ten sites on Tealham and Tadham Moors were within the Raised Water Level Area (RWLA). Nine of the ten sites (sites 1–6, 8–9 & 28) were recorded as MG8 *Cynosurus cristatus*-*Caltha palustris* grassland in 2012, although there was a marked transition in several of these towards a *Juncetum* community (MG10 *Holcus lanatus*-*Juncus effusus* rush-pasture, M22 *Juncus subnodulosus*-*Cirsium palustre* fen-meadow, M23 *Juncus effusus/acutiflorus*-*Galium palustre* rush-pastures; Rodwell 1991, 1992) – this is discussed in more detail in section 3.3.

The sward in these nine MG8 sites was generally quite species-rich: grasses *Agrostis stolonifera* and *Holcus lanatus* were constant but usually occurred with some or all of *Anthoxanthum odoratum*, *Cynosurus cristatus*, *Phleum pratense* and *Glyceria* spp. *Deschampsia cespitosa* was locally frequent. A particular feature of the MG8 here was the high cover of sedges with abundant *Carex disticha* in most sites and a suite of other sedges in several sites such as *C. nigra*, *C. panicea* and locally frequent *C. riparia* and *C. hirta*. *Eleocharis palustris*, a semi-aquatic associated with only narrowly fluctuating water levels, was abundant in many sites, as was *Equisetum palustre*. Rushes, *Juncus effusus*, *J. acutiflorus*, *J. articulatus* and/or the hybrid *J. × surrejanus* were frequent to locally abundant, and

sometimes overwhelmingly dominant. Typical wet meadow forbs were well-represented in most fields some or all of *Filipendula ulmaria*, *Ranunculus flammula*, *Ranunculus acris*, *Leontodon autumnalis*, *Galium palustre*, *Myosotis laxa*, *Veronica scutellata*, *Caltha palustris*, *Persicaria amphibia* and *Lychnis flos-cuculi* plus occasional *Triglochin palustre*, *Stellaria palustris*, *Thalictrum flavum*, *Oenanthe fistulosa* and *Cirsium dissectum*.

The tenth site (site 7) was MG13 *Agrostis stolonifera*-*Alopecurus geniculatus* grassland, although the plot was located in a unit that was heavily colonised by *Eleocharis palustris* and supported few species in addition to community constants *Agrostis stolonifera*, *Eleocharis palustris* and *Glyceria fluitans*. Whilst the highest MATCH similarity result, S19c *Eleocharis palustris* swamp, *Agrostis stolonifera* sub-community, is that of a swamp community of standing or running water fringing streams/lakes, and therefore more permanently aquatic than this inundation grassland community: the high (56.7%; Appendix 1) similarity with S19c is a strong indicator of the prolonged period of high inundation that this unit (and much of the Somerset levels) has endured in recent years. See 3.3 for further discussion.

Wet Moor

Wet Moor lies on the Midelney and Fladbury clays; south of the River Yeo, which has been embanked. Further drainage has occurred through rhynes and ditches. All thirteen sites on Wet Moor were within the Raised Water Level Area.

Two of the 13 sample plots on Wet Moor (sites 17 and 19) were MG7 *Lolium perenne* grasslands; either MG7c *Lolium perenne*-*Alopecurus pratensis*-*Festuca pratensis*, which is a flood-plain pasture type typical of soils that remain under water for much of the year; or MG7d *Lolium perenne*-*Alopecurus pratensis* grassland, a slightly drier and more species-rich community that, successionaly, is one step closer to the less improved MG6 *Lolium perenne*-*Cynosuretum* (Rodwell, 1992).

One plot, site 12, had closest affinities with MG6b but is derived from MG7d (although the community in much of the field was more akin to MG9 *Holcus lanatus*-*Deschampsia cespitosa* grassland, due to frequency of *Deschampsia cespitosa*).

One plot (site 18) with high *Deschampsia cespitosa* cover was recorded as MG9a, the *Poa trivialis* sub-community, which is a coarse, tussocky grassland type in which *Juncus effusus*, *Filipendula ulmaria* and other poor-fen species are frequent. This is a common intermediary between MG7c and fen-meadows or rush-pastures but *Deschampsia cespitosa* can be difficult to eradicate once established. Site 15 supported a similar sward but *Juncus effusus* was more abundant and *Deschampsia cespitosa* cover lower: this was MG10a. Plots in site 20 and 23 were also assigned to MG10a.

There are many similarities between MG9 and MG10, a community named only for two sites, sites 20 and 23, but with high similarity results for many of the plots in other sites owing to the presence of *Holcus lanatus* and/or *Juncus effusus* in those sites (Appendix 1).

Six sites (sites 10, 11, 13, 14, 16, 21) were MG13: four of these showed strong affinities with this community but sites 11 and 16, as with site 7 on Tealham Moor, also had affinities with S19c owing to the high cover of *Eleocharis palustris* and *Glyceria fluitans*. This again reflects prolonged periods of

deep inundation. MG13 grassland, whilst not as species-rich as the floristically diverse and often forb-rich MG8, is nonetheless a frequently encountered community in alluvial meadows and is of value for its invertebrate and bird habitat.

Other Sites

The remaining seven sites were spread across a number of SSSIs (Site 22, North Moor; site 24, Langmead & Weston Level; sites 26, 27 & 30, Catcott, Edington & Chilton Moors; site 29, Westhay Moor).

One site (site 26) supported good quality species-rich MG8, whilst a further five (sites 22, 24, 29 and 31) supported a species-rich fen meadow community that either appeared transitional between MG8 and M22 due to high cover of jointed rushes (or M23b in one case, site 29). As with the Tealham Moor sites, the jointed rushes recorded in the MG8/M22 stands were often *Juncus acutiflorus/articulatus* rather than *J. subnodulosus*.

Site 30 was a good example of M22a with constant *Juncus subnodulosus*. Only one site (site 27) was quite poor botanically, and grass–non-jointed rush dominated with few forbs: this was assigned to MG10a.

3.1.3 Option types

Tealham and Tadham Moors

All 10 sites on Tealham Moor are under the HK9 (Maintenance of wet grassland for breeding waders) option. All sites also receive the HK19 raised water level supplement and 9 of the 10 have HR1 cattle grazing supplement. The tenth site opted for HR2 native breeds supplement. Three sites (sites 1, 6 & 8) are of sufficiently small size to also receive the HR6 small fields supplement. These options are appropriate for these sites which are in an area where waders such as curlew, snipe, lapwing and redshank breed. The HK9 option also promotes habitat that is suitable for wintering waders and wildfowl (covered by the HK10/12 option).

Wet Moor

All thirteen sites on Wet Moor are also under the HK9 (maintenance of wet grassland for breeding waders) option. All sites also receive the HK19 raised water level supplement and the HR1 cattle grazing supplement. Five sites (sites 11, 15, 19, 20 & 21) are of sufficiently small size to also receive the HR6 small fields supplement. As with Tealham Moor, these options are appropriate for these sites which are in an area where breeding waders such as curlew, snipe, lapwing and redshank breed. The HK9 option also promotes habitat that is suitable for wintering waders and wildfowl (covered by the HK10/12 option).

Other Sites

Several other sites are under 'bird' options: site 31 on West Sedgemoor is under HK9 (maintenance of wet grassland for breeding waders), whilst sites 22 (North Moor), 26 and 27 (Catcott, Edington & Chilton Moors) have adopted option HK10 (maintenance of wet grassland for overwintering waders and wildfowl). These options were appropriate in these wet meadows. Two of these sites are also botanically quite species-rich and could have been selected for HK6. Sites 26 and 31 also have the HK19 raised water level supplement.

Only three sites surveyed in the Somerset Levels were under botanical options. Sites 24, 29 and 30 were under HK6 (maintenance of species-rich semi-natural grassland). All three sites had taken up the HR1 cattle-grazing supplement and site 24 qualified for HR6 small fields supplement. These three sites were sufficiently rich in indicator species of BAP quality lowland meadow for the maintenance option to be appropriate.

3.1.4 Species-richness

Species richness was related to the NVC community type recorded. The mean number of species recorded in the ADAS plots in 2012 was 22.49 ± 1.41 SE, whilst in the 5-quadrats was 14.86 ± 5.16 . The richest sites were the MG8 and M22 sites, often with around 20 species in 1-m² quadrats but sometimes with up to 30 species, whilst the MG13 sites were, as one would expect, less rich with 10–15 species more representative. The poorest stands were those supporting MG7, MG9 grasslands and MG10 rush-pastures, which often supported less than 10 species per m².

No significant inferences can be drawn from the lower mean species-richness recorded in the 5-quadrats than in the ADAS plots as the measures result from two different sampling methods, with data sampled from two differently-sized sample areas (i.e. 5 sq m versus 16 sq m); hence species-richness will vary due to species–area effect.

3.1.5 Soil properties

Tealham and Tadham Moors

All sites on Tealham Moor were mildly acidic to circumneutral, in the range 6.1–6.5. Phosphorous (Olsens P) was very low (Index P = 0 with the exception of one site), which is considered best for swards where development or maintenance of species-rich grassland is desired. Soil potassium was also universally low – this nutrient is less important in habitat restoration although it may result in low herbage yields.

Magnesium was universally high, which may impact on the nutrient availability of other nutrients. Total nitrogen was extremely high, even for old grassland where this nutrient is expected to be high due to prolonged years of dunging and accumulation of plant litter; however the nitrogen content of the soil, together with the high organic matter component (as measured by loss on ignition and organic carbon) probably simply reflect the peaty soils at this site (Tealham and Tadham Moors are peat moorland).

Both total nitrogen content and organic matter were higher on Tealham and Tadham Moors than on Wet Moor – this was also the case in the 2003 survey (Manchester *et al.*, 2005).

Wet Moor

All sites on Wet Moor were mildly acidic, in the range 5.4–5.9. Phosphorus (Olsens P) was low to moderate (Index P 1–2), higher than on Tealham and Tadham). Soil potassium was also higher low–moderate. As with Tealham and Tadham, magnesium was universally high. Total nitrogen was high, but nitrogen >1.0% is normal for old grasslands, and it was not as high as that on Tealham and Tadham; organic matter component (as measured by loss on ignition and organic carbon) was moderate – this site lies on clay rather than peat – and therefore much lower than the peat moor at Tealham.

Table 4. Results of soil analysis for soil samples collected from the Tealham Moor raised water level sites in the Somerset Levels monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil Mg (mg/l)	Index Mg	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 1	6.1	9	0	60	0	212	4	1.85	61.4	1334	27.5
LWG 2012 2	6.1	5	0	23	0	144	3	1.40	61.0	894	15.2
LWG 2012 3	6.5	6	0	34	0	186	4	1.65	51.9	973	15.6
LWG 2012 4	6.5	6	0	34	0	162	3	1.63	61.7	1041	19.5
LWG 2012 5	6.5	5	0	34	0	209	4	1.8	67.5	993	22.5
LWG 2012 6	6.0	4	0	43	0	214	4	1.75	61.8	1178	22.1
LWG 2012 7	6.2	6	0	54	0	148	3	1.30	43.8	988	11.6
LWG 2012 8	6.4	4	0	51	0	148	3	1.91	63.6	1269	20.6
LWG 2012 9	6.2	12	1	74	1	176	4	1.63	57.2	1306	16.3
LWG 2012 28	6.4	8	0	41	0	131	3	1.59	55.8	1022	16.7
range	6.1–6.5	4–12	0–1	23–74	0–1	144–214	3–4	1.30–1.91	43.8–67.5	894–1334	11.6–27.5

Table 5. Results of soil analysis for soil samples collected from the Wet Moor raised water level sites in the Somerset Levels monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index Mg	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 10	5.5	12	1	164	2–	187	4	1.22	33.6	1808	16.0
LWG 2012 11	5.9	11	1	158	2–	195	4	1.31	30.9	1869	16.0
LWG 2012 12	5.5	19	2	137	2–	192	4	0.96	28.6	1614	8.1
LWG 2012 13	5.9	10	1	147	2–	222	4	1.11	29.0	1469	13.5
LWG 2012 14	5.8	11	1	141	2–	213	4	1.24	33.1	1542	15.0
LWG 2012 15	5.7	10	1	158	2–	188	4	1.25	33.0	1687	15.5
LWG 2012 16	5.8	11	1	126	2–	174	3	1.39	30.7	1794	16.4
LWG 2012 17	5.6	24	2	89	1	190	4	0.99	27.6	1568	8.4
LWG 2012 18	5.5	20	2	94	1	188	4	0.98	27.3	1507	7.4
LWG 2012 19	5.8	17	2	146	2–	162	3	1.26	33.0	2083	15.5
LWG 2012 20	5.6	15	1	182	2+	187	4	1.18	29.4	1910	14.8
LWG 2012 21	5.4	10	1	191	2+	233	4	1.15	30.6	1559	14.4
LWG 2012 23	5.8	11	1	172	2–	224	4	1.10	30.0	1796	13.3
range	5.4–5.9	10–24	1–2	89–191	1–2+	174–233	3–4	0.96–1.39	27.3–33.6	1469–2083	7.4–16.4

Other Sites

There was wider variation in the soil properties of the remaining sites as these sites were scattered across different SSSIs and geographical areas of the Somerset Levels – the underlying geology, hydrology and soils therefore varied. Soil pH was still mildly acidic as with the sites above. Phosphorous was low, potassium low to moderate but magnesium was extremely high on many sites – this may require consideration on pasture sites as high magnesium may reduce the dietary availability of other nutrients. Nitrogen was also very high and organic matter (as measured by loss on ignition and organic carbon) ranged from high to extremely high. Site 27 has a loss on ignition

recorded as 72.0% and organic carbon at 72.0% – this site was the species-poor MG10a site on Edington Heath.

Table 6. Results of soil analysis for soil samples collected from the remaining sites in the Somerset Levels monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil Mg (mg/l)	Index Mg	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 22	6.0	7	0	161	2–	402	6	1.57	34.1	1046	19.9
LWG 2012 24	6.1	8	0	169	2–	534	6	1.73	37.3	1318	20.3
LWG 2012 26	6.8	5	0	104	1	170	3	2.38	53.3	1419	53.3
LWG 2012 27	6.3	7	0	116	1	312	5	2.43	72.0	1235	72.0
LWG 2012 29	5.8	10	1	107	1	225	4	2.31	75.0	975	36.7
LWG 2012 30	5.9	11	1	207	2+	177	4	2.80	68.9	1308	36.7
LWG 2012 31	6.0	5	0	114	1	458	6	2.05	52.6	1035	27.8
range	5.8–6.8	5–11	0–1	41–207	0–2+	131–534	3–6	1.10–2.80	34.1–72.0	975–1419	19.9–72.0

3.1.6 Plant communities in relation to soil properties

Vegetation composition in the ADAS plot sites was significantly related to % organic matter, Total and Olsen’s phosphorus content, potassium content and total nitrogen content (Table 7). The MG8 sites had a negative relationship with Olsens P: these species rich sites all had Index P \leq 1 with most having Index P = 0; MG8 sites 1–6 and 8 also had Index K = 0 and the highest Total N and Loss on ignition. Total P however was highest in sites supporting MG7, MG9 and MG13 stand types: these sites also largely had the highest Index P and Index K.

Composition of vegetation in the nine 5-quadrat sites was not significantly related to any of soil variables (Table 7), and the ordination diagram (Fig. 2) suggests that there is some correlation between soil variables. It is possible that this is due to insufficient replication of samples.

No patterns or significant relationships were observed between soil variables and individual species (Fig. 3; see key to species abbreviations below).

Table 7. Canonical correspondence analysis of the relationships between soil properties and the vegetation composition in the sample plots in the Somerset Levels: statistical significance of variables.

Somerset Levels	Soil pH (Water)	Olsens P (mg/l)	Soil K (mg/l)	Soil MG (mg/l)	Total N (%)	Loss on Ignition	Total P	Organic Carbon
ADAS plots	n.s.	$P = 0.008$	$P < 0.002$	n.s.	$P < 0.002$	n.s.	$P < 0.002$	$P < 0.002$
5-quadrats	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Table 8. Eigenvalues for the first four canonical axes for the CCA analysis of the relationships between soil properties (vectors) and the vegetation composition in the sample in the Somerset Levels in Fig. 2.

Somerset Levels	Axis 1	Axis 2	Axis 3	Axis 4
ADAS plots	0.203	0.152	0.106	0.069
5-quadrats	0.024	0.021	0.018	0.016

Figure 2. CCA biplot showing the relationships between soil properties (vectors) and the vegetation composition in the sample plots at each Somerset Levels survey site for (a) the ADAS plot sites and (b) the 5-quadrat sites. (Only 2012 samples are numbered; previous sample years are shown as dots only.)

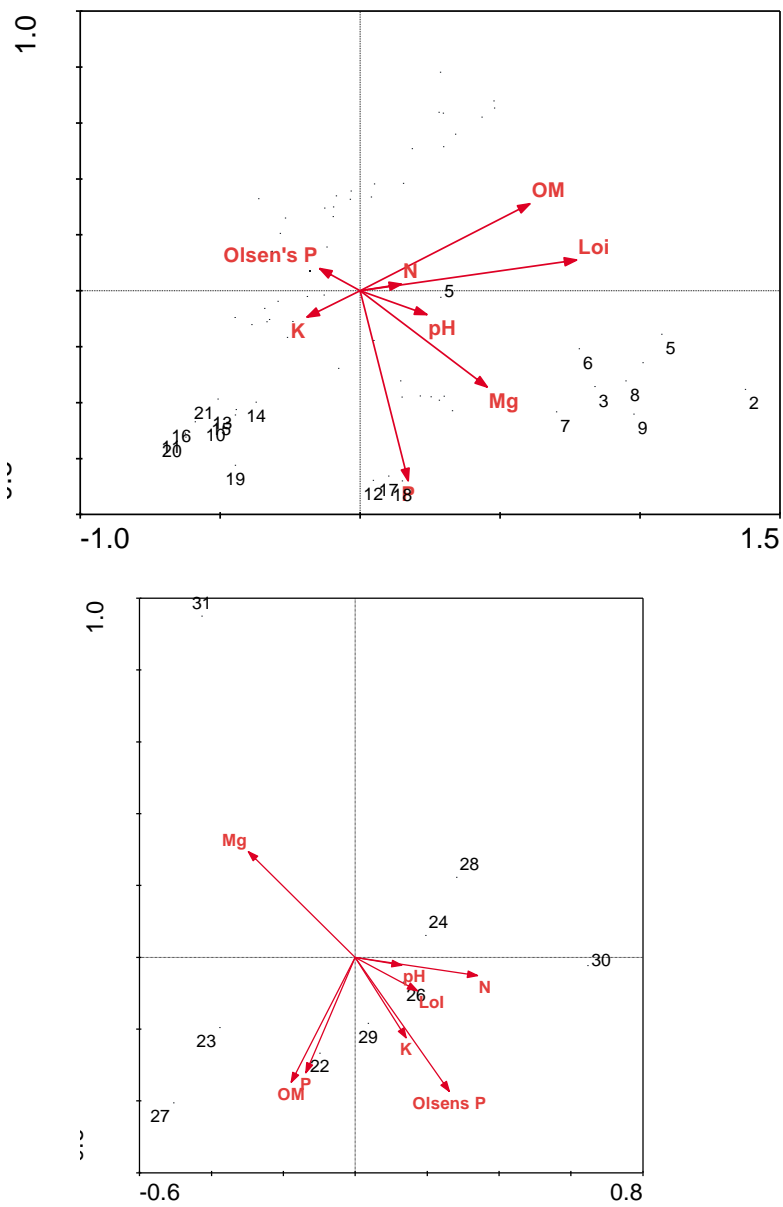
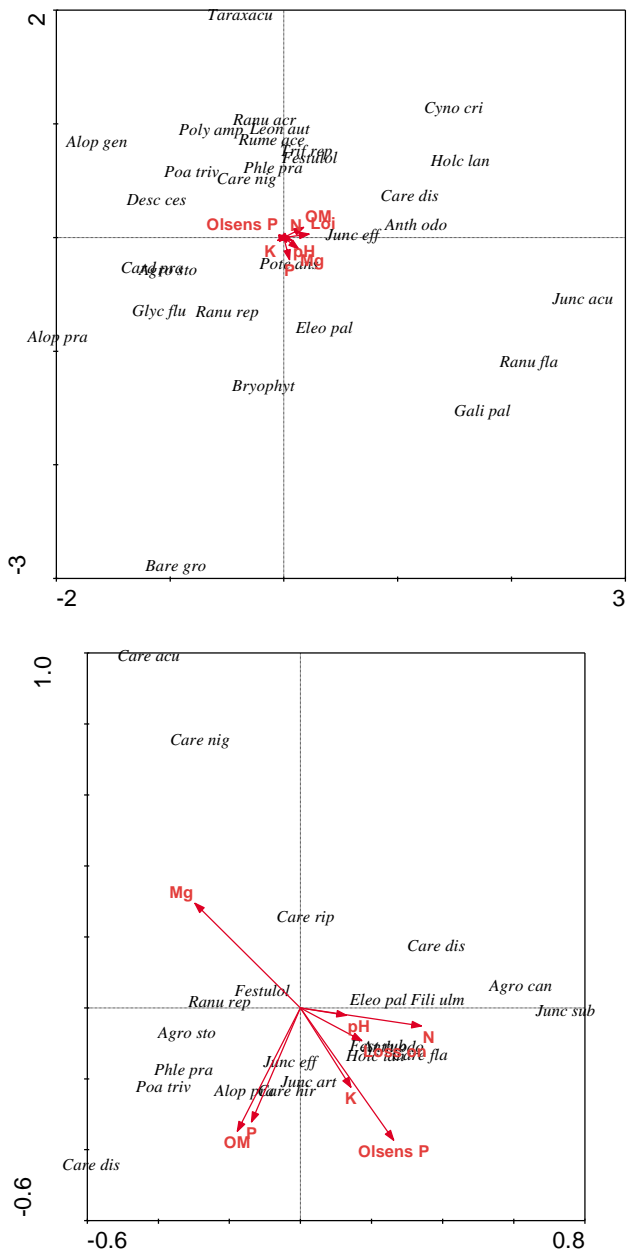


Figure 3. CCA biplot showing the relationships between soil properties (vectors) and the individual species in the sample plots at each survey site for (a) the ADAS plot sites and (b) the 5-quadrat sites. Species present in less than 20% of samples omitted for clarity.



Key to Fig. 3. *Agro sto* – *Agrostis stolonifera/capillaris*; *Alop gen* – *Alopecurus geniculatus*; *Anth odo* – *Anthoxanthum odoratum*; *Arrh ela* – *Arrhenatherum elatius*; *Bare gro* – Bare ground; *Bell per* – *Bellis perennis*; *Bryo sp.* – Bryophyte sp.; *Card pra* – *Cardamine pratensis*; *Care acu* – *Carex acuta*; *Care acu* – *Carex acutiformis*; *Care dis* – *Carex disticha*; *Care hir* – *Carex hirta*; *Care nig* – *Carex nigra*; *Care pan* – *Carex panicea*; *Cera fon* – *Cerastium fontanum*; *Cirs arv* – *Cirsium arvense*; *Cirs pal* – *Cirsium palustre*; *Cirs vul* – *Cirsium vulgare*; *Cyno cri* – *Cynosurus cristatus*; *Dact glo* – *Dactylis glomerata*; *Desc ces* – *Deschampsia cespitosa*; *Eleo pal* – *Eleocharis palustris*; *Elym rep* – *Elymus repens*; *Equi pal* – *Equisetum palustre*; *Fest aru* – *Festuca arundinacea*; *Fest aru* – *Festuca arundinacea and pratensis*; *Fest pra* – *Festuca pratensis*; *Fest pra* – *Festuca pratensis and/or Festulolium and/or Lolium multiflorum*; *Fest rub* – *Festuca rubra*; *Fili ulm* – *Filipendula ulmaria*; *Gera dis* – *Geranium dissectum/molle*; *Glyc flu* – *Glyceria fluitans*; *Halc lan* – *Holcus lanatus*; *Junc art* – *Juncus articulatus*; *Junc inf* – *Juncus inflexus*; *Lath pra* – *Lathyrus pratensis*; *Loli per* – *Lolium perenne*; *Loli pra* – *Lolium/Festuca pratensis/Festulolium*; *Lotu ped* – *Lotus pedunculatus*; *Phle pra* – *Phleum pratense*; *Plan lan* – *Plantago lanceolata*; *Plan maj* – *Plantago major*; *Poa pra* – *Poa pratensis*; *Poa tri* – *Poa trivialis*; *Pote ans* – *Potentilla anserina*; *Prun vul* – *Prunella vulgaris*; *Ranu acr* – *Ranunculus acris*; *Ranu rep* – *Ranunculus repens*; *Rume ace* – *Rumex acetosa*; *Rume con* – *Rumex conglomeratus*; *Rume cri* – *Rumex crispus*; *Rume sp.* – *Rumex sp.*; *Sene aqu* – *Senecio aquaticus*; *Tara off* – *Taraxacum officinale agg.*; *Trif pra* – *Trifolium pratense*; *Trif rep* – *Trifolium repens*.

3.1.7 Condition Assessment

Tealham and Tadham Moors

Only one site passes the generic attributes of the common standards condition assessment: site 7 is MG13 and passes on all attributes. All nine MG8 sites (1–6, 8–9, 28) fail: four fail on frequency of positive indicator species, all five others fail the attribute for percentage cover of large leaved *Carex* spp., *Deschampsia cespitosa*, *Juncus* spp. and large grasses (usually this was for % cover of *Juncus* spp.), but many would pass if they were instead assessed as M22 or M23; communities to which they have strong affinities.

These ten sites on Tealham and Tadham Moors fall within one of three SSSI Units: Units 114 (sites 1–6) and 115 (site 9) were assessed as Favourable in the last SSSI condition assessment by NE in 2010; whilst Units 111 (sites 7 & 8) and 112 (site 28) were Unfavourable Recovering.

Table 9. Summary of SSSI common standards condition assessment results for the Somerset Levels and Moors: Tealham and Tadham Moors.

Site	Option	NVC	Common standards assessment for SSSI grassland
1	HK9	MG8	Fail for MG8: +ve indicator sp. 2 freq., 2 occ., 3 rare. <i>Juncus</i> spp. > 10%
2	HK9	MG8	Fail for MG8/ Pass for M22: <i>Juncus</i> spp. > 10%
3	HK9	MG8	Fail: only 1 +ve indicator sp. frequent and 4 occasional; <i>Juncus</i> spp. > 10%
4	HK9	MG8	Fail for MG8/ Pass for M22: <i>Juncus</i> spp. > 10%
5	HK9	MG8	Fail for MG8/ Pass for M22: <i>Juncus</i> spp. > 10%
6	HK9	MG8	Fail: only 1 +ve indicator sp. frequent and 1 occasional; <i>Carex</i> + <i>Juncus</i> spp. > 10%
7	HK9	MG13	Pass for MG13
8	HK9	MG8	Fail for MG8/ Pass for M22: <i>Juncus</i> spp. > 10%
9	HK9	MG8	Fail for MG8/ Pass for M22: <i>Juncus</i> spp. > 10%
28	HK9	MG8	Fail: only 1 +ve indicator sp. frequent and 1 occasional; <i>Carex</i> + <i>Juncus</i> spp. > 10%

+ve, positive; -ve, negative; freq., frequent; occ., occasional.

Indicators of success for the HK9 option were generally beyond the scope of this project as they include sward attributes from autumn–spring and presence of breeding waders; however, most sites would fail on the indicator attribute for HK9 ‘cover of rushes should be between 10–30%’: most sites had >30% cover of *Juncus* spp.

Wet Moor

Only four sites (10, 11, 13, 16) pass the common standards monitoring condition assessment when assessed against mandatory attributes for the habitat type ‘inland wet grassland, *Agrostis–Carex* grassland, MG11-related, MG13-related’. All of these sites support inland wet grassland of the MG13 stand type. This is a fairly species-poor community type and the suite of positive indicator species includes several wet grassland species that are relatively common in such habitat and more tolerant of agricultural improvement, in addition to species of less-improved swards such as those for MG8. It is therefore, easier for a site to pass the condition assessment for MG13 than MG8 and the sites that passed on Wet Moor were considerably less species-rich than those on Tealham and Tadham Moors.

Table 10. Summary of SSSI common standards condition assessment and indicators of success results for the Somerset Levels and Moors: Wet Moor.

Site	Option	NVC	Common standards assessment for SSSI grassland
10	HK9	MG13	Pass for MG13
11	HK9	MG13	Pass for MG13
12	HK9	MG6	Fail for inland wet grassland; only 1 freq. +ve indicator species for MG11/13-related stands.
13	HK9	MG13	Pass for MG13.
14	HK9	MG13	Fail for MG13; only 2 freq. +ve indicator species and 3 rare.
15	HK9	MG10a	Fail for inland wet grassland; no freq. +ve indicator species, only 3 rare for MG11/13-related stands.
16	HK9	MG13	Pass for MG13.
17	HK9	MG7d	Fail for inland wet grassland; only 1 +ve indicator species and 2 rare for MG11/13-related stands.
18	HK9	MG9a	Fail for inland wet grassland; only 1 freq. +ve indicator species, and 1 rare for MG11/13-related stands.
19	HK9	MG7c	Fail for inland wet grassland; no freq. +ve indicator species, and 3 rare for MG11/13-related stands.
20	HK9	MG10a	Fail for inland wet grassland; only 1 freq. +ve indicator species, and 3 occ. for MG11/13-related stands; cover of <i>Juncus</i> spp. >25%.
21	HK9	MG13	Fail for MG13; 3 freq. +ve indicator species, and rare; cover of large <i>Carex</i> and <i>Juncus</i> spp. >25%.
23	HK9	MG10a	Fail for inland wet grassland; only 1 freq. +ve indicator species, and 3 rare for MG11/13-related stands; cover of <i>Juncus</i> spp. >25%..

The remaining nine sites (12, 14–15, 17–23) all failed the condition assessment for ‘Inland wet grassland, *Agrostis–Carex* grassland, MG11-related, MG13-related’. All sites failed on lack of sufficient positive indicator species, and additionally three sites failed by exceeding the attribute for percentage cover of large leaved *Carex* spp., *Deschampsia cespitosa*, *Juncus* spp. and large grasses.

These 14 sites on Wet Moor fall within seven SSSI Units: Units 50 (sites 10, 11, 16) and 55 (sites 17, 18) were assessed as Favourable in the last SSSI condition assessment by NE in 2010; Units 54, 56, 59, 60 and 61 (comprising all other sites) were deemed Unfavourable Recovering. Our results are in agreement with the condition assessment for sites 10, 11 and 16.

Indicators of success for the HK9 option were beyond the scope of this project as they include sward attributes from autumn–spring and presence of breeding waders; however, it was noted that some sites (e.g. 10–12) might not meet the sward height attribute for a short sward height (grazed sites only) for option HK9.

Other sites

Of the remaining sites in other SSSIs two sites passed the common standards monitoring condition assessment when assessed against mandatory attributes for MG8 and M22, respectively. One of these sites also met the indicators of success: the other site was under a breeding waders option and these indicators were not assessed.

Five sites failed on insufficient frequency of positive indicator species: three of these also failed on cover of *Juncus* spp. (when assessed against MG8 attributes).

Two of the three sites under option HK6 failed at least one of the indicators of success: site 24 failed to meet the attribute of at least four frequent high-value indicator species, and site 29 failed to meet the wildflower : grass ratio. Indicators of success for the HK9 and HK10 options were beyond the scope of this project as they include sward attributes from autumn–spring and presence of breeding waders; however, it should be noted that some sites might fail to meet the threshold for cover of *Juncus* spp.

Table 11. Summary of SSSI common standards condition assessment and indicators of success results for the Somerset Levels and Moors: miscellaneous 5-quadrat sites.

Site	Option	NVC	Common standards assessment for SSSI grassland	Indicators of success (for HK6 only)
22	HK10	MG8/M22	Fail for MG8: +ve indicator sp., 3 freq., 2 occ., 1 rare; <i>Juncus</i> spp. > 10%	–
24	HK6	M22	Fail for M22: +ve indicator sp., 2 freq., 2 occ., 3 rare	Fails on meeting 4 freq. +ve indicator sp.
26	HK10	MG8	Fail for MG8: only 2 +ve indicator species freq. and 1 rare.	–
27	HK10	MG10a	Fail: no freq. or occ. +ve indicator species, only rare; <i>Juncus</i> spp. 20%.	–
29	HK6	MG8/M23	Fail: +ve indicator sp., 2 freq., 2 occ., 1 rare; <i>Juncus</i> spp. 20%.	Fails on meeting ratio of wildflowers: grasses.
30	HK9	M22a	Passes for M22.	–
31	HK6	MG8	Passes for MG8.	Pass

3.2 Analysis of changes in vegetation within plots over time

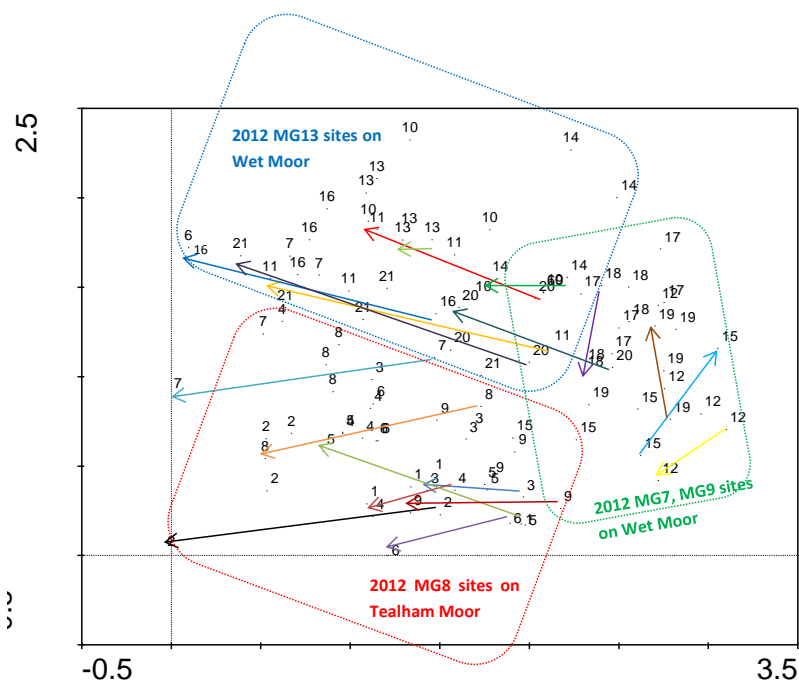
3.2.1 Vegetation community composition

Analysis of the vegetation data collected between 1988 and 2012 using Detrended Correspondence Analysis shows the pattern of change that has occurred since monitoring started (Figs 4 & 5). The trajectory of change for the between 1993 and 2012 (ADAS plots) or 1988 and 2012 (5-quadrat sites) was broadly similar, with the exception of sites 12, 15, 18, 19 and 26.

The MG8 ADAS plots on Tealham Moor (Fig. 4) showed remarkably similar trajectories of change: all of these sites in 2012 supported additional or greater frequency of species of more permanently flooded habitat such as *Veronica scutellata*, *Myosotis laxa*, *Equisetum palustre*, *Juncus* spp. and *Persicaria amphibia*, and a corresponding reduction in grasses of drier habitat.

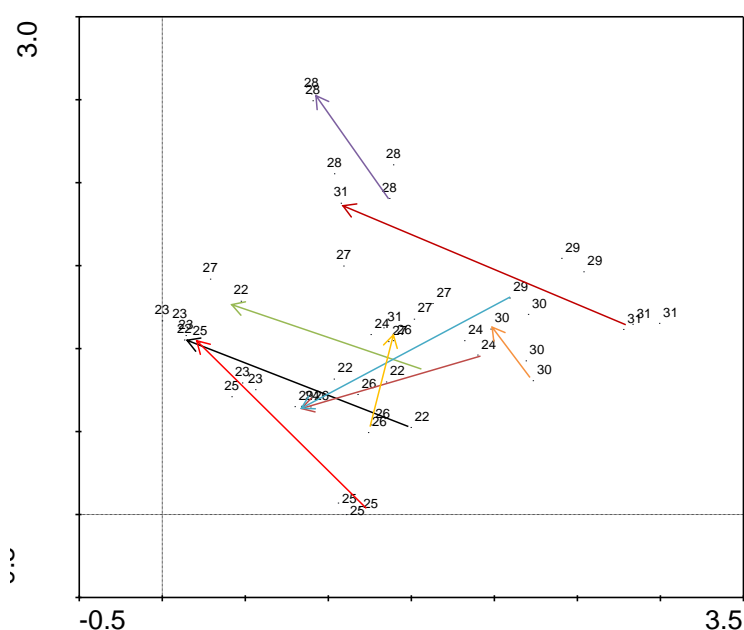
The MG13 ADAS plots of Wet Moor (Fig. 4) also showed remarkably similar trajectories of change: all of these sites in 2012 supported additional/greater frequency of species of more permanently flooded habitat such as *Eleocharis palustris*, *Lemna* spp., *Glyceria* spp. and *Persicaria amphibia*.

Figure 4. DCA plot of change in vegetation in monitoring plots in the Somerset Levels between 1988 and 2012 for the ADAS plots with 1993 data and 2012 data from the same plots linked by arrows.



Sites 12, 15, 18, 19 and 26 showed a different trajectory of change: all are ADAS plots on Wet Moor (Fig. 4) supporting either MG7c/d or MG9a communities, apart from site 26 which is on Edington Moor and supports MG8 (Fig. 5). At site 12 the plot could not be refound in 2012 and the change from MG7d to MG6b, a move to a drier community, indicated by the DCA plot may reflect either a genuine community change or a spatial shift in the sample area. All ADAS MG7 and MG9 plots on Wet Moor show the least change and their vegetation composition altering along an opposite trajectory to the MG8, MG13 and M22 sites on both moors.

Figure 5. DCA plot of change in vegetation in monitoring plots in the Somerset Levels between 1988 and 2012 for the 5-quadrat sites with 1988 data and 2012 data from the same plots linked by arrows.



All of the 5-quadrat sites in Fig. 5 started with an MG8 community at the beginning of the monitoring programme in 1988, perhaps with the exception of site 27 which was originally identified as MG4/M22b. All MG8 sites have moved towards more rush dominated M22 and M23 stands, with the exception of site 26 which has remained as MG8, but with affinities to MG10 – a *Juncus effusus* dominated sward rather than *Juncus acutiflorus* or *J. subnodulosus*.

A more detailed interpretation and analysis of the changes in species composition, with reference to NVC community stand types follows.

3.2.2 Changes in NVC community

Tealham and Tadham Moors

The ADAS plots in the raised water level sites at Tealham Moor were resurveyed in 1993, 1995, 1998 and 2003, whilst the single ESA 5-quadrat site was surveyed in 1988, 1991 and 1995.

MG8 was restricted to Tealham Moor, where it was recorded in 9 out of 10 sites at the start of the monitoring programme in 1993 and after a 10-year interval in 2003; the 10th site supported MG13 in both years (Appendix 1a). However, an increase in the frequency and abundance of rush species (*Juncus articulatus* and *J. acutiflorus* in particular, but also *J. effusus*) and sedges (most notably *Carex disticha*) and *Eleocharis palustris*; and a corresponding reduction in frequency and abundance of finer grasses (*Festuca rubra*) in favour of coarser grasses (*Holcus lanatus*, *Agrostis stolonifera*, *Deschampsia cespitosa*) has resulted in the MG8 swards now showing strong affinities with fen-meadow and rush-pasture communities. Whilst MATCH analysis places these affinities closest to MG10 *Holcus lanatus*-*Juncus effusus* or M23 *Juncus effusus/acutiflorus*-*Galium palustre* rush-pastures, there is a strong case for describing these transitional swards as a variant of M22a *Juncus subnodulosus*-*Cirsium palustre* fen-meadow (typical sub-community) (see section 3.3) for a discussion of the MG10–M22–M23 *Juncetum* communities in relation to our results).

The single MG13 stand (site 7) has seen a marked increase in the frequency of *Eleocharis palustris* since 1993 (1993, frequency 6 out of 16 nests; 2012 16 out of 16 nests), a small increase in *Glyceria fluitans* (1993, 13 nests; 2012, 16 nests) and a decrease in 'drier' grasses such as *Phleum pratense* (1993, 16 nests; 2012, 5 nests). In fact this plot supported few species in addition to the community constants *Agrostis stolonifera*, *Eleocharis palustris* and *Glyceria fluitans*. Whilst the highest MATCH similarity result is for the more permanently aquatic swamp community, S19c *Eleocharis palustris* swamp, *Agrostis stolonifera* sub-community, the current sward does not quite reach that community of standing or running water fringing streams/lakes, but the high (56.7%; Appendix 1a) similarity with S19c is a strong indicator of the prolonged period of high inundation that this unit (and much of the Somerset levels) has endured in recent years. See 3.3.1 for further discussion.

Wet Moor

Four of the 13 sample plots on Wet Moor (sites 11, 12, 17 and 19) were recorded as one of the MG7 *Lolium perenne* leys in 1993. By 2012 there had been a shift in one of these (site 19) from the drier MG7a/b stands to a stand type more typical of flood-pasture (MG7c; marked by an increase in *Agrostis stolonifera*, *Deschampsia cespitosa*, *Ranunculus acris*, *Rumex acetosa* and a reduction in *Phleum pratense*). A second site (12) had become drier with more *Agrostis capillaris* and *Festuca rubra* denoting a successional shift to MG6b, although the markers for this plot were not relocated and the ground north of this was wetter: the change may be attributed to a change in plot location. Further, by 2012, one of the MG7c/d flood-pasture stands (site 11) had changed sufficiently in species composition (loss of *Lolium perenne* and gain of abundant *Eleocharis palustris*) to show greater affinities with a more permanently inundated MG13 flood-plain grassland (which also had strong affinities with the swamp community S19c owing to the high cover of *Eleocharis palustris*). Only one site (17) was reclassified as the same MG7d community in 2012 as in 1993, although *Deschampsia cespitosa* cover had increased showing a move towards MG9.

An existing MG13 stand (site 16) also had affinities with S19c owing to the high cover of *Eleocharis palustris* and *Glyceria fluitans*. Other former MG13 sites (10, 13, 14 and 21) showed the least change and remained under the MG13 classification but were situated in fields where *Eleocharis palustris* (10), *Equisetum palustre* (13), *Glyceria fluitans* (13, 21), *Deschampsia cespitosa* (14), *Carex acutiformis* (21) or *Lemna* spp. were locally frequent to abundant.

The two MG9a sites, since 2003, appear to have become invaded by rushes, mainly *Juncus effusus*, leading to affinities with MG10 rush-pasture.

The final site (23) has affinities with a species-poor rush-pasture community (MG10a), although the cover of *Holcus lanatus* is low for that community. This site shows little change from its previous position in 1988 when the five quadrats were recorded variously as MG10a and MG11; however, the usual MG11 associates of *Festuca rubra* and *Potentilla anserina* were missing in both surveys and the MG11 result was more likely to be due to high cover of *Agrostis stolonifera* – also a MG13 associate. This field is considered somewhere between MG10 and MG13.

Table 12. NVC communities recorded in the Somerset Levels (Tealham Moor and Wet Moor) ADAS plots in at 9/10-year intervals in 1988/1993, 2003 and 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

		1988/1993	2003	2012	1988/1993	2003	2012
		Tealham	Tealham	Tealham	Wet Moor	Wet Moor	Wet Moor
MG6	MG6a						1
MG7	MG7a/b				1	1	
	MG7c/d				3	3	1 + 1‡
MG8		9	9	5 + 4*			
MG9	MG9a				2	2	2
MG10	MG10a				3	2	2
MG13		1	1	1†	4	5	4 + 2†

*Transitional to fen-meadow/rush-pasture

†Heavily colonised by *Eleocharis palustris* and transitional to a swamp community.

‡MG7–MG9 transition

3.2.3 Species richness

There was no significant change in the mean species richness per plot for the ADAS plots from 1993 to 2012 (Table 13). Species richness in the ADAS plots was relatively high with > 21 species per plot in every survey year.

Table 13. Mean number of species in Somerset Levels ESA ADAS plots.

Year	Mean	SE
1993	23.08	1.66
1995	21.09	1.50
1998	22.86	1.52
2003	21.40	1.69
2012	22.49	1.41
F-value	0.66	
P-value	n.s.	

There was, however, a significant decline in species richness in the 5-quadrat plots from 1998 to 2012, with a marked decrease from 2003 to 2012 (20.10 ± 5.8 to 14.86 ± 5.16 ; Table 14).

The two values of species richness (ADAS plot versus 5-quadrats) are not comparable as they relate to two differently-sized sample areas (i.e. 5 sq. m versus 16 sq. m); hence species-richness will vary due to species–area effect.

Table 14. Mean number of species in Somerset Levels fixed 5-quadrat plots.

Year	Mean	SE
1988	21.78	5.90
1990	21.72	5.99
1995	20.10	5.80
2012	14.96	5.16
F-value	39.05	
P-value	< 0.001	

There is a clear and significant decline (Table 14) in species richness in the fixed 5-quadrat sites that isn't shown in the ADAS plots. This thirty per cent decline over twenty five years is considerable. The sites that showed the greatest reduction in species richness were sites 27 and 29: each suffered a > 45% loss from 1998 to 2012. Sites 28 and 31 suffered a >35% loss. Only site 26 increased in species richness from 1988 to 2012.

Table 15. Mean number of species recorded in the 5-quadrats in the Somerset Levels in the monitoring surveys from 1998 to 2012, and decrease in diversity (as a %) from 1988 to 2012.

Site	1988	1990	1995	2012	% decrease from 1988 to 2012
22	20.2	20.8	16.8	15.4	24%
23	12.0	10.8	13.2	8.6	28%
24	27.6	28.2	25.8	21.8	21%
*26	18.8	18.8	18.2	22.2	–18%
27	20.4	21.8	21.4	11.2	45%
28	24.4	21.8	20.4	15.0	39%
29	28.2	27.8	25.8	15.0	47%
30	23.4	26.0	24.4	16.6	29%
31	22.0	20.6	16.2	13.8	37%
Mean per year	21.7	21.7	20.1	14.9	31%

*Site 26 saw an 18% increase in species richness.

The species most frequently lost from the nine 5-quadrat sites (4 sites or more) include a suite of fairly common species associated with both mesotrophic grassland and mire communities: *Cynosurus cristatus*, *Cerastium fontanum*, *Cardamine pratensis*, *Carex demissa* and *Taraxacum officinale* agg. Species lost from 30% (3) of the nine sites include common wildflower species associated with the same habitats: *Trifolium repens*, *Trifolium pratense*, *Leontodon autumnalis*, *Plantago lanceolata*, *Rumex acetosa*, *Ranunculus acris* (see Table 16). However, species lost from individual sites were diverse but included many species typical of wetter habitat or better quality

habitat, with some sites losing many of the positive indicator species. For example the suite of unimproved wet grassland wildflower species lost from sites 27, 29 and 30: sites which all showed a move towards ranker rush-pasture communities from their former MG8 stand (Table 16). The farmer in site 29 attributes this directly to the changes in water level management allowing high levels of water which make control of rushes too difficult and resulting in a lowering in the quality of the yield.

3.2.4 Individual species – abundance

Table 16 shows the results of tests for changes in species abundance levels in the ADAS plots. Although there are some highly significant changes among the species in Table 17, several, such as *Alopecurus geniculatus* and *Poa trivialis* have shown fluctuations returning to former levels. However, three species have shown major changes: Bryophyte amalgam has increased while *Festulolium* amalgam, *Ranunculus acris/bulbosus* and *Taraxacum officinale* agg. all showed major declines. The declines are all associated with increased frequency of wetting – the assumption being that *Lolium perenne* is probably a major component of the *Festulolium* amalgam which, together with the other two species, is poorly adapted to increased wetness. The parallel increase in *Eleocharis palustris*, although not so marked, would corroborate this.

Table 16. Individual species lost from 5-quadrat sites (22–31) in the Somerset Levels. Species were recorded in the site in at least one quadrat in one year out of 1998, 1990, 1995 but not in 2012. Species may have only appeared once and were not necessarily present during the last survey in 1995.

Species lost	22	23	24	26	27	28	29	30	31	Total no. sites
	MG8/M22	MG8	M22	MG8	MG10a	MG8	MG8/M23b	M22a	MG8/M22a	
<i>Cerastium fontanum</i>	•				•	•	•	•		5
<i>Cynosurus cristatus</i>	•		•		•				•	4
<i>Cardamine pratensis</i>					•	•	•	•		4
<i>Carex demissa</i>					•		•	•	•	4
<i>Taraxacum officinale</i>					•		•	•	•	4
<i>Trifolium repens</i>	•	•			•					3
<i>Trifolium pratense</i>	•		•				•			3
<i>Leontodon autumnalis</i>	•				•		•			3
<i>Ranunculus acris/bulb</i>	•						•		•	3
<i>Plantago lanceolata</i>	•						•		•	3
<i>Rumex acetosa</i>		•					•		•	3
<i>Hydrocotyle vulgaris</i>					•		•	•		3
<i>Glyceria fluitans</i>	•		•							2
<i>Lysimachia nummularia</i>	•						•			2
<i>Holcus lanatus</i>	•							•		2
<i>Centaurea nigra</i>	•								•	2
<i>Ranunculus repens</i>		•					•			2
<i>Phleum pratense</i>		•						•		2

Species lost	22	23	24	26	27	28	29	30	31	Total no. sites
<i>Festuca arun/prat</i>				•				•		2
<i>Bromus commutatus</i>				•					•	2
<i>Senecio aquaticus</i>					•		•			2
<i>Agrostis canina</i>					•		•			2
<i>Prunella vulgaris</i>					•			•		2
<i>Eleocharis palustris</i>							•		•	2
<i>Briza media</i>								•	•	2
<i>Festuca rubra</i>	•									1
<i>Anthoxanthum odoratum</i>		•								1
<i>Bryophyte amalgam</i>		•								1
<i>Cirsium arvense</i>		•								1
<i>Equisetum palustre</i>		•								1
<i>Lychnis flos-cuculi</i>			•							1
<i>Potentilla reptans</i>				•						1
<i>Oenanthe fistulosa</i>					•					1
<i>Carex panicea</i>					•					1
<i>Bellis perennis</i>					•					1
<i>Festulolium amalgam</i>					•					1
<i>Myosotis laxa</i>						•				1
<i>Mentha aquatica</i>						•				1
<i>Juncus artic/acut amalgam</i>						•				1
<i>Filipendula ulmaria</i>							•			1
<i>Ranunculus flammula</i>							•			1
<i>Isolepis setacea</i>							•			1
<i>Carex hirta</i>							•			1
<i>Carex riparia</i>								•		1
<i>Cirsium dissectum</i>								•		1
<i>Cirsium palustre</i>								•		1
<i>Dactylorhiza majalis</i> subsp. <i>praetermissa</i>								•		1
<i>Danthonia decumbens</i>								•		1
<i>Galium uliginosum</i>								•		1
<i>Luzula multiflora</i>								•		1
<i>Potentilla erecta</i>								•		1
<i>Succisa pratensis</i>								•		1
<i>Valeriana dioica</i>								•		1
<i>Triglochin palustre</i>									•	1
Total losses per site	12	8	4	3	15	5	19	20	11	

Table 17 shows the results of tests for changes in species abundance levels in the 5-quadrats. Changes in individual species reflect community changes that have caused a significant decline in species richness on these plots. The clearest changes are an increase in *Agrostis stolonifera* (already detectable in 1995) and an accompanying decrease in a number of species associated with species-rich communities such as MG8. Major declines are also observed in some of the more robust species

such as *Taraxacum officinale* agg. and *Trifolium repens*. These swards appear to be moving towards highly grass dominated communities with relatively few broad-leaved species.

Changes in individual species reflect community changes and the significant decline in species richness on these plots.

Table 17. Results of Friedman tests applied to species frequencies at optimum scale for Somerset Levels ESA ADAS plots (significant results only, $P < 0.05$).

Species	1993	1995	1998	2003	2012	Trend	Friedman S	P (d.f. = 4)
<i>Alopecurus geniculatus</i>	0.0	1.8	0.8	0.4	0.0	↔	22.17	< 0.001
<i>Anthoxanthum odoratum</i>	0.8	0.0	0.4	0.2	0.6	↔	17.14	0.002
Bryophyte amalgam	0.8	5.4	7.4	5.4	5.0	↑	29.79	< 0.001
<i>Carex nigra</i>	2.8	3.0	3.0	2.8	2.4	↔	13.58	0.009
<i>Eleocharis palustris</i>	1.8	2.0	2.0	2.2	2.0	↑	10.55	0.032
<i>Festulolium</i> amalgam	5.0	1.0	1.4	1.2	1.4	↓	19.41	0.001
<i>Holcus lanatus</i>	1.0	0.6	0.8	0.8	0.8	↔	12.06	0.017
<i>Poa trivialis</i>	4.4	7.0	7.2	1.0	4.4	↔	27.80	< 0.001
<i>Ranunculus acris</i> /bulb amalgam	5.6	1.4	1.6	0.4	1.0	↓	31.34	< 0.001
<i>Taraxacum officinale</i> agg	3.0	1.0	1.0	1.0	0.0	↓	24.79	< 0.001

Table 18. Results of Friedman tests applied to species frequencies for DOMIN values for Somerset Levels ESA fixed 5-quadrat plots (significant results only, $P < 0.05$).

Species	1988	1990	1995	2012	Trend	Friedman S	P (d.f. = 3)
<i>Agrostis stolonifera</i>	2.813	3.938	5.063	4.938	↑	31.85	< 0.001
<i>Anthoxanthum odoratum</i>	2.719	2.344	2.219	2.094	↓	22.45	< 0.001
Bryophyte amalgam	1.875	1.625	1.375	1.125	↓	12.91	0.005
<i>Cardamine pratensis</i>	1.375	1.125	1.375	0.625	↓	22.12	< 0.001
<i>Cynosurus cristatus</i>	2.125	1.625	1.125	0.625	↓	29.27	< 0.001
<i>Festuca rubra</i>	2.688	2.938	2.688	2.438	↔	23.04	< 0.001
<i>Festulolium</i> amalgam	4.500	3.750	2.750	1.000	↓	73.0	< 0.001
<i>Holcus lanatus</i>	4.938	3.563	3.063	3.188	↓	35.3	< 0.001
<i>Poa trivialis</i>	1.125	1.625	2.625	1.125	↔	32.17	< 0.001
<i>Ranunculus acris</i> /bulb amalgam	2.125	2.125	1.875	0.375	↓	57.16	< 0.001
<i>Ranunculus repens</i>	1.750	2.125	3.125	2.000	↓	28.57	< 0.001
<i>Taraxacum officinale</i> agg	2.250	1.750	1.500	0.500	↓	58.16	< 0.001
<i>Trifolium repens</i>	2.500	2.500	2.500	0.500	↓	57.44	< 0.001

3.2.5 Sward height

Sward heights on the Somerset Levels plots appear to show no particular pattern and are probably related largely to seasonal growth differences between years. The anomalous figure for 1995 is probably due to the severe drought conditions seen in that year leading to reduced growth although the standard error would indicate a wider range of sward heights. The 2003 survey was also during a period of atypically high temperatures and drought, whilst 2012 was the wettest year on record.

Table 19. Mean sward height in Somerset Levels ESA ADAS plots.

Year	Mean	SE
1993	31.06	1.88
1995	7.46	1.65
1998	19.25	1.88
2003	16.0	1.91
2012	22.52	1.67
<i>F</i> -value	22.23	
<i>P</i> -value	< 0.001	

3.2.6 Soils

Tables 20 and 21 show soil property values for years for which data were available (ADAS plot data only). The values for pH have increased slightly, but significantly, during the monitoring period but still remain broadly mesotrophic (within the range pH 5.5–6.5). Values for P, K & Mg increased from 1993 to 2003 and decreased from 2003 to 2012 ($P < 0.001$) but the significant increase is likely to refer to the 2003 data rather than the overall change from 1993–2012, where increases overall were small relatively and each soil variable remained broadly within the same index. Total Nitrogen (Table 21) was analysed only using the 1993 and the 2012 data (due to some unreliability in the dataset returned for this variable from 2003): total N showed a small, but significant ($P = 0.017$) decrease. Organic matter content is closely related to N and soil organic Carbon (Table 21) between 1993 and 2012 shows a concomitant significant decrease. Reduction in N and organic carbon might reflect land use change under the raised water level options (the ADAS plots are all in sites in the RWL management area), where an increase in hay cutting and aftermath grazing has resulted in less litter deposition and, therefore, lower soil carbon. It is possible that flooding has also impacted on carbon sequestration in the topsoil.

Table 20. Soil property values* in Somerset Levels ESA ADAS plots: all years (Friedman test).

Year	pH	Olsen Ext P	Ext K Litre	Ext Mg Litre	ADAS P	ADAS Mg
1993	5.7833	7.973	113.22	152.99	1.0	3.0
2003	5.5667	16.00	169.97	249.0	2.0	4.333
2012	5.9	9.427	116.05	187.67	1.0	3.667
<i>S</i> -value	31.0	34.38	21.24	28.67	31.7	26.15
<i>P</i> -value	< 0.001	> 0.001	< 0.001	< 0.001	< 0.001	< 0.001

*All values are medians.

Table 21. Soil values in Somerset Levels ESA ADAS plots: 1993 & 2012 only

Year	Total N	Organic Carbon	Loss on Ignition
1993	1.48	16.59	37.1
2012	1.31	15.5	33.1
<i>Wilcoxon signed rank</i>	184.5	194.0	114.0
<i>P-value</i>	0.017	0.007	n.s.

3.2.7 Ecological criteria

Both the ADAS plot and 5-quadrat sites show similar patterns of significant decreases in suited species grazing score, increase in suited species moisture score and increase in Ellenberg soil wetness score. The only difference is the significant increase in Ellenberg soil fertility index in the 5-quadrat plots. There is a clear signal of movement towards later hay-making and higher (winter?) water table as might be expected under the wide take up of Raised Water Level Area management under the ESA.

Table 22. Plant ecological criteria values in Somerset Levels ESA ADAS plots.

Year	SSS G	SSS M*	Ellenberg N	Ellenberg F
1993	0.17	0.364	4.94	6.45
1995	0.11	0.492	5.01	6.81
1998	0.17	0.48	4.86	6.76
2003	0.02	0.504	5.0	6.86
2012	-0.02	0.6	4.86	7.28
<i>F-value</i>	8.84	<i>S</i> = 21.2	1.7	12.17
<i>Significance (P)</i>	< 0.001	< 0.001	n.s.	< 0.001

SSS – suited species score; G – species suited to grazing; M – species suited to a high moisture content (*Median values); Ellenberg indices: N – index of soil fertility; F – index of soil wetness.

Table 23. Plant ecological criteria values in Somerset Levels fixed 5-quadrat plots.

Year	SSS G	SSS M	Ellenberg N	Ellenberg F
1988	0.1931	0.2497	4.7044	6.2081
1990	0.1894	0.2484	4.7956	6.1719
1995	0.1369	0.2997	4.8656	6.3219
2012	-0.0869	0.4909	4.9469	6.8006
<i>S-value</i>	72.78	42.01	17.98	45.64
<i>Significance (P)</i>	< 0.001	< 0.001	< 0.001	< 0.001

SSS – suited species score; G – species suited to grazing; M – species suited to a high moisture content (*Median values); Ellenberg indices: N – index of soil fertility; F – index of soil wetness.

3.3 Discussion

3.3.1 Vegetation communities

The former ESA sites included in the 2012 resurvey were first surveyed in either 1988 or 1993. In the initial survey: of the 30 sites, 4 were MG7; 16 were MG8; 2 were MG9; 2 were MG10; and 6 were MG13.

Over the period of 24 years up to 2012 the vegetation in three of the MG7 sites (11, 17 and 19: all on Wet Moor) demonstrated a shift towards a wetter (sub)community: MG7a in site 19 to the, typically wetter, MG7c; MG7c in site 11 to an MG13 inundation community; and MG7d in site 17 to a *Deschampsia cespitosa* invaded MG7d–MG9 transitional community. The anomalous change in site 12 from MG7d to a drier MG6b may be due to sampling error as this plot was not relocated and the sward to the north and east was more waterlogged and had affinities with MG9. These sites showed a different trajectory of change to the MG8 sites, moving towards wetter inundation grassland communities.

All nine of the MG8 stands on Tealham and Tatham Moors SSSI sampled were still classified in 2012 as MG8 but all demonstrated the same trajectory of change, towards a community that has a close affinity with rush-pasture. All could equally be considered transitional to a fen-meadow/rush-pasture community, or to have already reached it. Interestingly, the increase in *Juncus* spp. was not shown to be significant by the Friedman test: *Juncus* spp. were certainly present in all of these sites in 1993 but they have undoubtedly increased in both frequency and cover, which is not reflected in the statistical analysis. The increase in nests occupied by *Juncus acutiflorus/articulatus* amalgam from 1993 to 2012 is 5–12, 9–16, 13–16, 13–16, 6–14, 10–16, and 1–13 nests for sites 1, 2, 3, 4, 5, 8, and 9, respectively. Site 6 saw an increase in *Juncus effusus* from 4 nests to 15. Whilst MATCH analysis places these affinities with rush-pasture closest to MG10 *Holcus lanatus–Juncus effusus* or M23 *Juncus effusus/acutiflorus–Galium palustre* rush-pastures, there is a strong case for describing these transitional swards as a variant of M22a *Juncus subnodulosus–Cirsium palustre* fen-meadow (typical sub-community). M22a fen-meadow forms on fen peats and base-rich alluvial soils in the lowlands: the commonest associates are coarser grasses such as *Holcus lanatus*, *Festuca rubra* and mat-formers like *Agrostis stolonifera* and *Poa trivialis*. Whilst *Juncus subnodulosus* is the commonest dominant in the published tables, the community description for M22a states that in some stands '*J. subnodulosus* is supplemented or replaced [our italics] by other dominants like *J. inflexus*, *J. articulatus*, *C. acutiformis* or *C. disticha*' (Rodwell, 1998a, p. 229). The move from *J. subnodulosus* to *J. acutiflorus* reflecting a move from more calcareous to more calcifuge species and can mark a move from east to west across lowland Britain (there is probably also a climatic limit on *J. subnodulosus* distribution in the UK). *Filipendula ulmaria* and *Lotus pedunculatus* are preferential to this community but other species of MG8 communities (*Caltha palustris*, *Lychnis flos-cuculi*) also occur. For the community descriptions in Rodwell (1998b), only 15 stands of MG8 were sampled and the relationship between these two communities is acknowledged: 'it [MG8] has sufficient in common with the *Juncus–Cirsium* fen-meadow to be, perhaps, subsumed within it' (Rodwell, 1998a, pp. 237–8) and 'with further sampling among mire vegetation, it would be worth examining the relationship between the community [MG8] and the grassier assemblages included within the *Juncus subnodulosus–Cirsium palustre* fen-meadow'. The affinities with M23, particularly M23a, are largely

owing to an increase in *J. effusus* and *J. acutiflorus*, but many of the calcifuge associates of that community (*Molinia caerulea*, *Potentilla erecta*, *Agrostis canina*) are absent.

The seven MG8 sites recorded in North Moor SSSI, West Sedgemoor SSSI, Catcott, Edington & Chilton Moors SSSI and Westhay Moor SSSI (22, 24, 26–31), by 2012 were also showing affinities with rush-pasture communities: M22a, M23b or MG10. These sites had also suffered a significant decline in species richness.

One of the sites originally assigned to MG9 also showed a move towards a rush-pasture community: site 15 had seen a reduction in *Deschampsia cespitosa* (unusually) and a decline in many forbs such as *Filipendula ulmaria* leading to an MG10-related stand. In site 20 the frequency of *Phalaris arundinacea* and presence of *Iris pseudacorus* marks a shift towards the MG10c wetter sub-community, and in site 23 the community also had affinities with MG13 inundation grassland.

The former MG10a sites (20 and 23: Wet Moor), although still classified as MG10a in 2012, also showed a move towards a wetter community.

These changes in NVC community and species composition and abundance reflect a shift in the habitat to a wetter and more frequently/permanently waterlogged habitat. A higher water table might be expected in areas where Raised Water Level Management agreements had been adopted under the ESA, but this may also have been exacerbated by the recent string of wet summers and associated prolonged periods of summer flooding. The increase in *Juncus* spp. and *Deschampsia cespitosa* observed is likely to reflect not just an increase in wetness but also a relaxation in grazing pressure; either as a result of a move away from management as permanent pasture following adoption of ESA hay cutting–aftermath grazing prescriptions (where applicable) or as a result of the concomitant impacts of increased flooding on the ability of land managers to manage by cutting or grazing. Both increased wetness and less grazing are supported by the analysis of the suited species scores and the Ellenberg indices. Both the ADAS plots and 5-quadrat sites show similar patterns of significant decreases in suited species grazing score, increase in suited species moisture score and increase in Ellenberg soil wetness score. The significant reduction in soil organic Carbon between 1993 and 2012 in the ADAS plots also probably reflects the general increase in hay cutting and aftermath grazing under the raised water level options (more so for the ADAS plots where all sites are in the RWL management area), where above ground organic matter uptake would be much more efficient. The recent trend for wetter summers may have exacerbated the effects already noted as, certainly in 2012, taking the annual hay-cut was at best late, and at worst impossible.

3.3.2 Species-richness

Species richness was related to NVC community with MG8 stands being the most species rich, as one would expect. Species richness was higher on Tealham and Tadham Moors than on Wet Moor, reflecting the difference in community types on each SSSI: mostly MG8 on Tealham and Tadham but mostly MG7, MG9 and MG13 on Wet Moor.

3.3.3 Site condition

All sites in the Somerset Levels resurvey were within a SSSI. All were therefore assessed against the NVC community-specific generic attributes set out under the common standards monitoring condition assessment (Robertson & Jefferson, 2000), although the associated thresholds may not

reflect any individual tailoring that may have been undertaken in the Favourable Condition tables for individual SSSIs.

Few sites passed the CSM condition assessment: one MG13 site (7) on Tealham Moor passed, four MG13 sites (10, 11, 13, 16) on Wet Moor, an MG8 site (31) on West Sedgemoor, and an M22a site (30) on Catcott Heath. For the latter two sites, 30 and 31, this was despite a drastic loss of species from 1988 to 2012 with a 29% and 37% reduction in mean species diversity per quadrat, respectively. Many sites that failed on one or more of the common standards attributes assessed for this project were included within SSSI units that had been assessed as Favourable in 2010, and the remainder were all Unfavourable Recovering.

The greater proportion of MG13 sites passing the condition assessment relates to several factors: (1) MG13 is a fairly species-poor community type and the suite of positive indicator species includes several wet grassland species that are relatively common in such habitat and more tolerant of agricultural improvement; (2) the attribute for positive indicator species is for at least 2 frequent species plus 2 occasional, which is less than the two frequent plus four occasional requisite of MG8, M22 and M23); and (3) the MG13 sites sampled had not been subject to the same level of invasion by *Juncus* spp. It is considerably easier for a site to pass the condition assessment for MG13 than MG8 and the MG13 sites that passed the condition assessment on Wet Moor were considerably less species-rich than those MG8 communities that failed the condition assessment on Tealham and Tadham Moors.

Additionally, those MG8 sites on Tealham and Tadham Moors which failed the CSM assessment on cover of *Juncus* spp. would have passed if the attributes for M22 fen meadow or M23 rush pasture were adopted instead. There is a valid argument to be made that the communities are not degrading but are instead changing to a community type more suited to more prolonged flooding events, as has been seen in recent years. It may also be that the prolonged flooding has led to an (often unintended) change in management: hay cutting and grazing management has been reduced during flood events and *Juncus* spp. and species such as *Deschampsia cespitosa* and large-leaved *Carex* spp. will benefit from this.

With regard to the indicators of success, these were largely outside the scope of this project. Only three sites within the 30 sampled (24, 29, 31) were under an HLS option for maintenance of species-rich semi-natural grassland (HK6). One of these sites (31) met all indicators of success. Site 24 failed one of its indicators of success: it did not meet the attribute for positive indicator species and had suffered a 24% decline in mean species richness per quadrat. Site 29 had suffered a 46% decline in species richness and did not meet the condition threshold for the wildflower : grass ratio attribute. The farmer attributes this to poor water level management with levels consistently too high, particularly in the last two years, which makes it hard to control rushes, and he felt the ESA/HLS ban on spraying rushes had contributed.

All other sites were under HK9 or HK10 (maintenance/restoration of wet grassland for breeding waders). The botanical indicators of success for these options include attributes that could not be assessed during a mid-season visit, such as those pertaining to the sward height during April and May, or the year-round percentage cover of grass tussocks. The presence of breeding wader species was also outside the scope of a botanical survey. Therefore, whether sites met the HLS indicators of success could not be determined.

3.3.4 Plant community variables

The Somerset Levels sites demonstrated significant decreases in the suited species grazing score. There were increases in suited species moisture score and Ellenberg soil wetness score. This supports the inference that there has been a move away from permanent pasture to management for hay and/or that the ability to graze these sites is being negatively impacted by higher water levels: either as a result of the RWL management or as a result of recent wet summers (or both).

3.3.5 Effects of management

Relating changes in vegetation composition, species richness and general site condition to management practices was difficult in the Somerset Levels: perhaps more difficult than for other former ESA areas studies. Many of the numerous small units that the Somerset Levels is divided up into have 'absent landlords'. In many cases land agents manage the land parcels and the grass is let to different graziers each year. Several sites had changed hands recently, or owners/farmers had either died or become too old to be involved in the management of their land. Specific questions on the history of the cutting management, grazing management or observations on changes in the sward or yield were consequently often not answered satisfactorily. The sites on Tealham Moor yielded the best responses but most landowners or managers do not record accurately when they hay cut, or in which years, or how many stock went on and for how long. Land management is more pragmatic than prescriptive with farmers hay-cutting when the conditions allow after mid-July and stock being put on, and taken off again, as dictated by the wetness of the conditions and the availability of grass to graze. A short, sharp graze may occur in rare dry periods during a wet year but stock may remain on longer in a dry year.

The main observation that was made by farmers/graziers in the Somerset Levels was that they had little control over the water levels (the main drains are controlled by the Internal Drainage Board) and that the moor is generally wetter. Some mentioned that the management prescriptions were more restrictive under HLS than under their former ESA tier. Many said that rushes/sedges/tussocky grasses had increased. One farmer (site 29) believes that the wildlife and agricultural value of the whole moor had declined due to mismanaged (too high) water levels, promoting greater rush growth (making it harder to top them or graze), and the ban on spraying rushes has compounded the problem.

Commented [OE1]: Cut?

The general impression on Tealham Moor and Westhay Moor at least, is that these sites are under-managed in relation to cutting and grazing – perhaps as a result of higher water levels – and that this relates to the raised water level management, the recent trend for wet summers, and to the (mainly) HLS aim of wet grassland suitable for breeding waders, which is possibly producing a different, and sometimes less species rich sward than management that is aimed solely at the maintenance of species-rich semi-natural grassland. The greater restrictions on cutting dates, stock numbers, and the ban on spraying rushes may also be contributing factors, although any use of herbicides in species rich – and frequently flooded – habitats would obviously require serious consideration. It may be that, if the recent trend for wet summers continues, the objectives for these sites may require modification and a different approach to management developed.

Commented [OE2]: Main point

4 TEST VALLEY

4.1 Baseline setting

(Brief individual site reports are provided for each site in the Test Valley in Appendix 2)

4.1.1 NVC communities

All fields surveyed in the Test valley were included within the Test Valley Environmentally Sensitive Area (ESA) in 1989, and an initial survey was carried out then. All monitoring was carried out using five fixed quadrats located on a transect.

NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. MATCH analysis of each site (top five similarity coefficients), and the NVC community to which each individual site was assigned, is presented in Appendix 2a. Nine sites were surveyed in the River Test valley; vegetation at these sites was classified within nine NVC sub-communities.

- M22 *Juncus subnodulosus*–*Cirsium palustre* fen-meadow
 - M22a Typical sub-community
 - M22b *Briza media*–*Trifolium* spp. sub-community
- M24b *Molinia caerulea*–*Cirsium dissectum* fen-meadow, typical sub-community
- M25c *Molinia caerulea*–*Potentilla erecta* mire, *Angelica sylvestris* sub-community
- M27 *Filipendula ulmaria*–*Angelica sylvestris* mire
- MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community
- MG8 *Cynosurus cristatus*–*Caltha palustris* grassland
- MG9a *Deschampsia cespitosa*–*Holcus lanatus* grassland, *Poa trivialis* sub-community
- U4b *Festuca rubra*–*Potentilla erecta*–*Galium saxatile* grassland, *Trifolium repens* sub-community

Table 24. NVC communities recorded in the 5-quadrat based plots in the Test Valley, 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

Community	Sub-community	No. sites
M22	M22a	2
	M22b	3
M22b/M25c		1
M22a/M25c/M24a		1
MG8/M27	–	1
MG9	MG9a	1
U4	U4b	1

The most widespread NVC community in the Test Valley was M22b (*Juncus subnodulosus*–*Cirsium palustre* fen-meadow, M22b *Briza media*–*Trifolium* spp. sub-community), recorded at four sites. At three of these sites, it is present in a mosaic with other communities, at Sites 36 and 37 with the very closely related MG8, and at Site 38 with M25c. This community has an open canopy of a range of tall-fen species including here *Carex acutiformis*, *Juncus inflexus*, *Filipendula ulmaria*, and at one

site *Juncus subnodulosus*, a very rare species in Hampshire. Beneath this there is a species-rich understorey with abundant *Festuca rubra*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Carex panicea*, *Carex disticha*, *Carex nigra*, *Briza media*, *Plantago lanceolata*, *Cirsium palustre*, *Galium uliginosum*, *Trifolium pratense*, *Geum rivale*, *Valeriana dioica*, *Lotus pedunculatus*, *Rumex acetosa*, *Hypericum tetrapterum*, *Lathyrus pratensis*, *Potentilla erecta*, *Ranunculus acris*, *Agrostis stolonifera*, *Cynosurus cristatus*, *Festuca pratensis* and *Carex flacca*. A number of other species typical of old pastures were recorded, including *Dactylorhiza praetermissa*, *Lychnis flos-cuculi*, *Ophioglossum vulgatum*, *Succisa pratensis* and *Thalictrum flavum*.

M22b is very closely related to MG8 (*Cynosurus cristatus*-*Caltha palustris* grassland) grassland: the relationship between these two communities is acknowledged in Rodwell (1998b) (see Section 3.3). MG8 may be distinguished by the absence of *Juncus* spp. and paucity of large *Carex* spp. and a generally shorter sward including typical 'meadow' grasses. Characteristic species of chalk-stream grasslands on former water-meadows are frequent, including *Valeriana dioica*, *Geum rivale*, *Carex disticha*, *Lychnis flos-cuculi* and *Caltha palustris*. At site 33, MG8 occurs together with the tall-fen community M27 (*Filipendula ulmaria*-*Angelica sylvestris* mire). This is dominated by *Filipendula ulmaria* with *Carex acutiformis*, *Glyceria maxima*, *Arrhenatherum elatius* and *Festuca rubra*, and frequent *Holcus lanatus*, *Lathyrus pratensis*, *Mentha aquatica*, *Iris pseudacorus* and *Geum rivale*.

M22a (*Juncus subnodulosus*-*Cirsium palustre* fen-meadow, typical sub-community), was recorded at one site. It has a denser canopy of tall-fen species than M22b, and is generally less species-rich. At site 40 the dominant species included *Filipendula ulmaria*, *Juncus acutiflorus*, *Festuca rubra*, *Holcus lanatus*, *Arrhenatherum elatius*, *Molinia caerulea*, *Dactylis glomerata*, *Deschampsia cespitosa* and *Juncus inflexus*.

Molinia caerulea is abundant at site 39, Bransbury Common, forming stands of M24b (*Molinia caerulea*-*Cirsium dissectum* fen-meadow, typical sub-community) and M25c (*Molinia caerulea*-*Potentilla erecta* mire, *Angelica sylvestris* sub-community) over peaty soil. Although this vegetation has been rather undergrazed in recent years, these are still very species-rich communities. *Molinia caerulea* is abundant in both communities with *Festuca rubra*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Carex nigra*, *Angelica sylvestris*, *Pulicaria dysenterica*, *Potentilla erecta* and *Luzula campestris*. *Deschampsia cespitosa* is locally frequent. The richer M24b has abundant *Cirsium dissectum* with other species including *Succisa pratensis*, *Ononis spinosa*, *Juncus acutiflorus* and *Hydrocotyle vulgaris*, *Avenula pubescens*, *Briza media*, *Carex hostiana*, *Carex pulicaris*, *Galium uliginosum*, *Valeriana dioica*, *Gymnadenia conopsea* ssp. *densiflora*, *Leontodon hispidus* and *Menyanthes trifoliata*.

Species-poor dry grassland at site 39 associated with the M25 and M24 described above is MG1a (*Arrhenatherum elatius* grassland, *Festuca rubra* sub-community). This is dominated by *Arrhenatherum elatius*, *Festuca rubra* and *Holcus lanatus*. Species-poor grassland at site 34 is dominated by *Agrostis stolonifera*, *Festuca rubra*, *Festuca pratensis*, *Holcus lanatus*, *Poa trivialis*, *Carex hirta*, *Filipendula ulmaria*, *Ranunculus repens* and *Trifolium repens*. This is closest to MG9a, although it lacks the characteristic tussock-forming grass *Deschampsia cespitosa*.

U4b grassland at Stockbridge Common Marsh (35) is unlike any other recorded during this survey. It is freely-draining, lacking most of the species characteristic of regularly inundated grasslands and

those with a high water-table. *Agrostis capillaris*, *Festuca rubra* and *Holcus lanatus* are dominant with abundant *Anthoxanthum odoratum*, *Carex nigra*, *Potentilla anserina*, *Ranunculus acris*, *Ranunculus repens*, *Rumex acetosa* and *Potentilla erecta*. *Juncus acutiflorus* is occasional. *Briza media*, *Danthonia decumbens*, *Carex panicea*, *Molinia caerulea* and *Filipendula ulmaria* are rare.

4.1.2 Species richness

Mean species richness within the five fixed 1m² quadrats at each site was 10.6–21.6 (mean richness at all sites was 16.6). The four sites with the highest species-richness (sites 32, 36, 37, 39) were all M22b fen-meadow (or M22b in mosaics).

4.1.3 Option types

The most frequent option at sites in the Test Valley is HK7 (restoration of species-rich grassland; sites 33, 34, 35, 36, 37, 39), with HK6 (maintenance of species-rich grassland) at site 32. The additional HR2 (grazing supplement for native breeds at risk) is in place at sites 33 and 34. The related option for wetter sites, HQ7 Restoration of fen is in place at Bransbury Common (sites 38, 39, 40), with the wetland grazing supplement HQ12 to support grazing management at these sites. These are all appropriate options for these sites.

4.1.4 Soil properties

Soil properties differ between sites. Soil pH varies from moderately acidic at site 35 (Stockbridge Common Marsh), to slightly alkaline at 32 (Chilbolton Common) and 34 (Whitchurch). Soil pH at all other sites was circumneutral to slightly acidic. Phosphate content was low to very low in all sites apart from 34 where it was moderate. Potassium content was low to moderately low at all sites, apart from 34 and 40 where it was moderate. Magnesium levels are moderate at sites 32, 34, 35 and 40, and moderately low at other sites.

Total nitrogen content is high at all sites, and very high at sites 36, 37 and 40. It is lowest but still high at site 34. Organic matter content as indicated by loss on ignition and organic carbon content is high at all sites, but very high at 35, 36 and 37, where an accumulation of peat is present. It is lowest at site 34.

Table 25. Results of soil analysis for soil samples collected from the Test Valley monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 32	7.2	11	1	138	2–	231	4	2.21	47.8	1374	23.5
LWG 2012 33	6.2	7	0	76	1	97	2	2.39	52.8	1508	52.8
LWG 2012 34	7.2	16	2	191	2+	148	3	2.04	44.0	1739	24.1
LWG 2012 35	5.4	8	0	140	2–	164	3	2.4	71.9	1183	35.0
LWG 2012 36	6.8	13	1	118	1	90	2	2.93	66.7	1887	34.0
LWG 2012 37	6.4	10	1	92	1	61	2	3.21	76.1	2036	33.5
LWG 2012 38	6.4	8	0	103	1	92	2	1.76	45.8	1010	24.9
LWG 2012 39	6.6	9	0	140	2–	94	2	1.94	54.1	1090	27.8
LWG 2012 40	6.4	13	1	205	2+	156	3	3	62.5	1408	31.2

4.1.5 Plant communities in relation to soil properties

In Canonical Correspondence Analysis the only soil variable that showed a significant relationship with vegetation composition was total phosphorus (P) content (Fig. 6). It is likely that other variables would have shown significant relationships had there been sufficient replication. It may be worthy of note that the site that had the least species-rich vegetation (34) also had the lowest total nitrogen content and organic matter content, the highest phosphate content (Olsen's Method), and the highest potassium content. Sites 36 and 37 however both M22b sites with the highest species richness, had the highest total P levels of the Test valley sites, the highest nitrogen (total N) and were both low in potassium.

Figure 6. CCA biplot (CANOCO 4.5) showing the relationships between soil properties (vectors) and the vegetation composition in the sample plots at each survey site in the Test Valley.

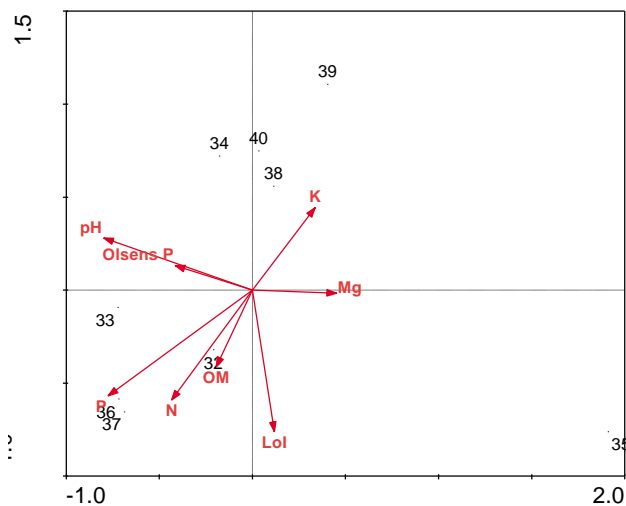


Table 26. Eigenvalues for the first four canonical axes for the CCA of relationships between soil variables and vegetation data.

Region	Axis 1	Axis 2	Axis 3	Axis 4
Test Valley	0.400	0.312	0.252	0.156

No patterns could be discerned from the CCA biplot of soil variables against individual species and this data is therefore not shown here.

4.1.6 Condition Assessment

Site condition was assessed using Common Standards Monitoring (CSM) methods as used by Natural England for condition assessment of SSSIs and also using the Indicators of Success for sites under Higher Level Stewardship described in site dossiers for each site. All sites are within the Test Valley, Chilbolton Common or Bransbury Common SSSIs. As the sites are within SSSIs, the Indicators of Success include targets relating to the site condition: sites are either required to be in favourable

condition, or – for sites that were presumably degraded when HLS commenced –required to be in recovering condition (unfavourable recovering).

Of the nine sites surveyed, only three pass all CSM attribute targets (Table 27): these three sites also met all of the indicators of success. At three of the sites that failed the CSM (33, 37, 39), failure was probably due to short-term under-management which had resulted in higher than acceptable cover of species such as *Glyceria maxima*, *Carex acutiformis* and *Carex riparia*, excessively tall sward and an accumulation of leaf litter. This unfavourable status is likely to be rectifiable by a favourable grazing and cutting regime.

Three sites failed the condition assessment because of the low frequency of positive indicator species. At site 40, sufficient species are present at low levels elsewhere within the sward to enable rapid recolonization under improved management, while site 34 is adjacent to other species-rich grasslands and under suitable management is likely to improve. Site 35 differs from all other sites surveyed. It is U4b grassland, a calcifuge grassland type on freely-draining acidic soil, probably gravelly alluvium, and is unlikely to develop into a wet grassland community under any form of management.

Table 27. Summary of condition assessment results for the Test Valley monitoring sites.

Site number	HLS Option	Common standards assessment for SSSI grassland	Indicators of success
32	HK6	Pass	‡Pass
33	HK7	Fail: 50% cover <i>Glyceria maxima</i> , 30% cover <i>Carex acutiformis</i>	‡Fail: not in favourable condition; >10% cover of indicators of waterlogging
34	HK7	Fail: only 2 frequent and 1 occasional +ve indicator spp. 75% cover large <i>Carex spp</i>	‡Fail: not in favourable condition; doesn't meet targets for +ve indicator spp; phosphate index too high.
35	HK7	Fail: only 1 frequent and 1 occasional +ve indicator spp.	*Fail: doesn't meet targets for +ve indicator spp.
36	HK7	Pass	*Pass
37	HK7	Fail: 50% of sward >75cm tall, 25% cover of reed grasses and large <i>Carex</i>	*Fail: cover of reed, rush & sedge too high.
38	HK7	Pass	*Pass
39	HK7/HQ7	Fail: cover of litter 40%, sward height 25cm	*Fail: cover of litter 40%, sward height 25cm
40	HQ7	Fail: only 1 frequent and 3 occasional +ve indicator spp.	*Fail: doesn't meet targets for +ve indicator spp..

‡Aim is for land to be in favourable condition

*Aim is for land to be at least in recovering condition (Unfavourable Recovering/Favourable)

4.2 Analysis of changes in vegetation within plots over time

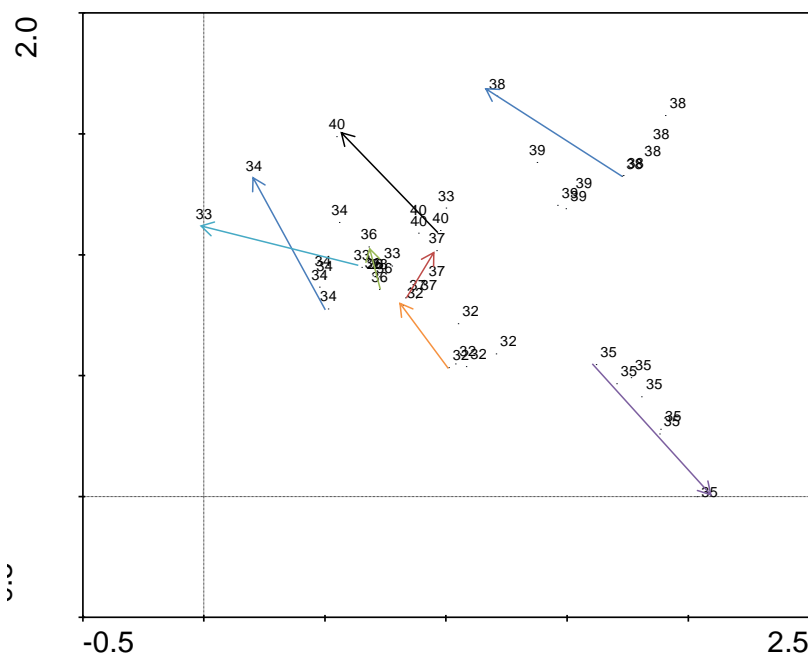
4.2.1 Vegetation community composition

Analysis of the vegetation data collected between 1988 and 2012 using Detrended Correspondence Analysis shows the pattern of change that has occurred since monitoring started (Fig. 7). The trajectory of change for all but one of the fields between 1988 and 2012 was broadly similar. The exception was site 35 (Stockbridge Common Marsh, U4b), where the change in vegetation was

opposite to that for all other sites (bottom right-hand, Fig. 7). There had been relatively little change at the two Longstock fields (sites 36 & 37; M22b).

While interpretation of these results is difficult, some overall conclusions may be made. Vegetation at all sites in 1988 was a mixture of M22b and MG8, suggesting a mosaic of species-rich wet grassland and taller species-rich fen-meadow. Two quadrats at Bransbury Common (one in each of sites 38 and 39) were classified as the calcicolous grassland community CG2c.

Figure 7. DCA plot of change in vegetation in monitoring (5-quadrat) plots in the Test Valley between 1988 and 2012. 1988 data and 2012 data from the same plots are linked by arrows.



The vegetation at the two Longstock sites (36 & 37) where there appears to have been little change was still classified as a mosaic of MG8 and M22b in 2012. The anomalous site at Stockbridge Common Marsh (35) has changed from entirely M22b to the very different dry calcifuge grassland type U4b, although the distance of the 1988 point on the diagram from the other 1988 points suggests that the M22b here was already rather atypical. The four other sites where there appears to have been most change are 33 and 34 (Whitchurch) and 38 and 40 (Bransbury Common). At all four of these sites, the vegetation has changed from a mosaic of M22b and MG8 in 1988 to communities that are dominated by tall-fen species including reed-grasses, large *Carex* spp. and bulky forbs and which are likely to be of lower conservation value. Changes at site 32 (Chilbolton Common) and 39 (Bransbury Common) have been smaller, and indeed the vegetation at Chilbolton Common now appears to be similar to that at the Longstock sites in 1988. The part of the diagram that includes all of the Longstock data, Chilbolton Common, Bransbury Common 39 and the 1988

data for all of the other sites appears to be a zone of species-rich fen-meadow vegetation. Sites 33, 34, 35, 38 and 40 have all moved out of this zone between 1988 and 2012.

4.2.2 Species richness

The mean number of species per quadrat has declined significantly ($P < 0.001$) between 1988 and 2012 from 26.07 in 1988 to 16.6 in 2012 (Table 28).

Table 28. Mean number of species per quadrat in the Test Valley monitoring (5-quadrat plot) sites.

Year	Mean	SE
1988	26.07	5.21
1991	28.47	5.13
1995	26.02	5.66
2012	16.60	5.67
F-value	73.49	
P-value	< 0.001	

4.2.3 Ecological criteria

Of the four criteria tested, only the suited species grazing score differed significantly between years (Table 29). It decreased between 1988 and 2012, suggesting that there had been a decline of species adapted to grazing at the sites over the period, possibly reflecting abandonment of management required to maintain the species rich wet grassland communities.

Table 29. Summary of suited species scores and Ellenberg values for vegetation in the Test Valley monitoring (fixed 5-quadrat) sites.

Year	SSS G	SSS M	Ellenberg N	Ellenberg F
1988	0.050	0.4625	4.2513	6.6300
1991	0.045	0.4525	4.1463	6.5875
1995	0.035	0.4675	4.2238	6.5925
2012	-0.100	0.4275	4.5138	6.5900
S-value	20.83	2.29	8.09	0.86
Significance	< 0.001	n.s.	0.044	n.s.

SSS, suited species score: G, species suited to grazing; M, species suited to high moisture content (*Median values). Ellenberg indices: N, index of soil fertility; F, index of soil wetness.

4.2.4 Individual species – abundance

Nine taxa showed significant declines between 1988 and 2012. All of these taxa are widespread and typical of grazed or hay-cut and grazed damp grassland. The wholesale significant decline in abundance of all of the species in Table X reflects the massive decline in species richness and traditional management of these meadows.

Table 30. Results of Friedman tests applied to species frequencies at optimum scale or DOMIN values for Test Valley ESA fixed 5-quadrat plots (significant results only, $P < 0.05$).

Species	1988	1991	1995	2012	Trend	Friedman S	P (d.f. = 3)
<i>Agrostis stol/cap/can</i> amalgam	2.094	2.219	2.844	1.719	↓	13.40	0.004
<i>Bryophyte</i> amalgam	3.938	3.688	3.188	0.938	↓	53.67	< 0.001
<i>Cardamine pratensis</i>	0.375	0.625	0.500	0.000	↓	35.41	< 0.001
<i>Cirsium palustre</i>	2.188	2.188	2.063	0.813	↓	33.90	< 0.001
<i>Festuca rubra</i>	6.750	6.750	6.750	5.750	↓	20.12	< 0.001
<i>Plantago lanceolata</i>	1.875	2.250	2.125	1.250	↓	17.47	0.001
<i>Ranunculus repens</i>	2.000	2.000	2.000	0.000	↓	35.04	< 0.001
<i>Trifolium pratense</i>	1.313	1.688	0.938	0.313	↓	30.86	< 0.001
<i>Trifolium repens</i>	2.094	1.844	1.219	0.219	↓	28.69	< 0.001

4.3 Discussion

4.3.1 Vegetation communities

In 1988 at the start of the ESA scheme, the vegetation communities at all of the Test Valley sites were predominantly M22b or the closely related MG8. The major variation was between the vegetation of enclosed fields that had probably been managed as water-meadows in the past (33, 34, 36, 37, 40), and the unenclosed commons of Stockbridge Common Marsh (35), Chilbolton (32) and Bransbury (38, 39). These communities typically include species-rich vegetation of permanently moist and seasonally inundated soils with neutral to calcareous ground-water, managed by grazing and occasional cutting (Rodwell, 1991). It is often species-rich vegetation of high conservation value, and the examples surveyed here that were still in favourable condition included a number of locally uncommon species.

Over the period of 24 years up to 2012, the vegetation at four of the sites (33, 34, 38 and 40) had shown marked changes from the former M22b and MG8 to a variety of communities including M22a, M25c, MG9a and M27: these were dominated by tall-fen species including reed-grasses, large *Carex* spp. and bulky forbs and mostly of lesser conservation value. Only one of these sites (38: M25c) was considered to be in favourable condition.

At site 35, the former fen-meadow community M22b had developed into a dry acidic grassland U4b, indicating a significant lowering of the water-table or of the frequency of inundation.

There has been less change at three sites (32, 36 and 37), which all retain vegetation of considerable conservation value: at Chilbolton Common (32) there may have been significant improvement. All of these sites were in favourable or near-favourable condition.

Site 39 on Bransbury Common was also in near-favourable condition but changes in vegetation at this site were noted. *Molinia caerulea* has increased in abundance and consequently much of the site has close affinities with M25c or, where *Cirsium dissectum* has increased in cover, M24a. Dry grassland at site 39 was recorded as MG1 in 2012 but as CG2c in 1988. These changes are likely to

have been due to a period of undergrazing in the 2000s which is being rectified by the current owner.

The overall tendency for the quality of the vegetation to decline is supported by the statistically significant decline in species-richness.

4.3.2 Plant community variables

The only ecological criterion for which there was a significant change between 1988 and 2012 was the suited species score for grazing tolerant species. The decrease in this score implies that there has been an overall relative decrease in the number of species favoured by grazing management. This is supported by the results for individual taxa. All of the significant results were for declines of species that are typical of well-grazed grasslands. For example, of the species showing significant decline *Cardamine pratensis* is a low rosette forming species that exploits gaps in the vegetation and is less common in tall grassland; *Cirsium palustre* and *Ranunculus repens* are also reliant on short or open vegetation for establishment (Grime *et al.*, 2007).

4.3.3 Effects of management

Management between 1988 and 2012 has varied between sites. At Chilbolton Common (32) the cattle grazing regime has been constant for at least 20 years and the grassland quality has probably improved. Cattle grazing at Longstock (36 & 37) has also been consistent and there has been little change to the vegetation.

Bransbury Common (38, 39, 40) is managed by grazing, although it has also been burnt in the past to remove *Molinia* and *Carex* litter, and parts have also been cut. Management has been insufficient in recent years: currently there are around 30 beef cattle grazing an area of approximately 180ha. This is probably responsible for a gradual decline in the quality of vegetation in all three fields. The owner is currently building up a herd of pedigree longhorn cattle which should be ideal for the restoration of site quality.

Management at the other sites has been more erratic. The fields at Whitchurch (33, 34) can be very wet during the summer, and this has limited the ability of the owner to cut hay or to control invasive tall-fen species, and this may also restrict grazing. Stockbridge Common Marsh (35) is grazed by a variable number of horses and occasionally cattle during the summer.

4.4 Conclusions

There appears to have been a tendency for vegetation at many of the sites surveyed in the Test valley to have deteriorated in quality, changing from species-rich mosaics of M22b and MG8 to grassland and wetland vegetation of lower conservation value. Where management has been ideal (36, 37 and 32), vegetation quality has been maintained and has even improved. At sites where vegetation has deteriorated, changes are likely to be reversible in the medium-term with increased grazing intensity.

5 DERWENT VALLEY

5.1 Baseline setting

5.1.1 Derwent Valley sites

Eight of the nine sites were surveyed in the Derwent Valley: site 48 was not surveyed due to severe flooding. Six of these are within one of the following SSSIs: Melbourne and Thornton Ings, Brighton Meadows and Derwent Ings. This is the first survey of these sites. Brief individual site reports are provided for each site in the Derwent Valley in Appendix 3.

5.1.2 NVC communities

Vegetation at the eight sites surveyed in the Derwent Valley all fell within the following six NVC communities or sub-communities (Table 31). NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. MATCH analysis of each site including an indication of the final NVC community to which each site was assigned is presented in Appendix 3a.

- MG4 *Alopecurus pratensis-Sanguisorba officinalis* grassland
- MG7 *Lolium perenne* leys :
 - MG7d *Lolium perenne-Alopecurus pratensis* grassland
- MG8 *Cynosurus cristatus-Caltha palustris* grassland (water meadow)
- MG9 *Holcus lanatus-Deschampsia cespitosa* grassland:
 - MG9a *Poa trivialis* sub-community
- MG10 *Holcus lanatus-Juncus effusus* rush-pasture:
 - MG10a Typical sub-community
- MG13 *Agrostis stolonifera-Alopecurus geniculatus* (wet alluvial meadow) grassland

Table 31. NVC communities recorded in the 5-quadrat based plots in the Derwent Valley, 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

Community	Sub-community	No. sites
MG4		2
MG7	MG7d	1
MG8		1
MG9		1
MG10	MG10a	1
Mosaic MG4/MG7c/S28		1

The vegetation encountered in the Derwent Valley was extremely heterogeneous. Of the eight sites surveyed, only one (43) was a good example of MG4 *Alopecurus pratensis-Sanguisorba officinalis* grassland, although grassland at another site (49) was considered to be closest to MG4, and at

another site (44) there was a mosaic of MG4 with other communities including MG7c (*Lolium perenne*-*Alopecurus pratensis*-*Festuca pratensis* grassland and S28 (*Phalaris arundinacea* swamp). MG4 is characteristic of flood-meadow that is traditionally managed as hay-meadow with aftermath grazing with no fertiliser input apart from that from the dung from grazing animals. This is species-rich grassland, here dominated by a mixture of species including *Agrostis capillaris*, *Festuca pratensis*, *Festuca rubra*, *Holcus lanatus*, *Filipendula ulmaria* *Alopecurus pratensis*, *Agrostis stolonifera*, *Sanguisorba officinalis*, *Poa trivialis*, *Cardamine pratensis* and *Calliergon cuspidatum* with abundant *Anthoxanthum odoratum*, *Plantago lanceolata*, *Ranunculus acris*, *Rumex acetosa*, *Carex disticha*, *Achillea ptarmica* and other frequent species including *Carex flacca*, *Lysimachia nummularium*, *Lychnis flos-cuculi*, *Carex nigra*, *Lathyrus pratensis*, *Silaum silaus*, *Myosotis laxa*, *Galium palustre*, *Oenanthe silaifolia* and *Caltha palustris*.

MG7d (*Lolium perenne*-*Alopecurus pratensis* grassland) was present at one site (42), although in a rather atypical and species-rich variant. *Lolium perenne* was dominant with abundant *Alopecurus pratensis*, *Poa trivialis*, *Leontodon autumnalis*, *Cardamine pratensis* and *Calliergon cuspidatum*. Other frequent species included *Bromus hordeaceus*, *Agrostis stolonifera*, *Agrostis capillaris*, *Ranunculus acris*, *Ranunculus repens* and *Taraxacum* sp. Other species characteristic of long-established grasslands that were present at low frequency included *Oenanthe silaifolia*, *Silaum silaus*, *Myosotis laxa*, *Caltha palustris* and *Stellaria palustris*.

A field which appears to have been in arable cultivation relatively recently (47) now has typical species-poor MG10a dominated by *Holcus lanatus* with tussocky *Juncus effusus* and locally *Deschampsia cespitosa*. *Ranunculus repens*, *Poa trivialis* and *Taraxacum* sp. were abundant. The only species typical of older grasslands are *Lathyrus pratensis* and *Lotus pedunculatus*.

Vegetation in three fields defied NVC classification. In site 46 there were two distinct grassland types including a species-poor inundation grassland dominated by *Agrostis stolonifera*, *Alopecurus pratensis*, *Poa trivialis*, *Ranunculus repens* and *Elymus repens*, and a slightly richer grassland approaching MG4 where drier. Site 45 was very wet and had moderately species-rich grassland that may have been derived from MG7c with increased inundation. This is dominated by *Filipendula ulmaria*, *Carex nigra*, *Agrostis stolonifera*, *Poa trivialis* and *Carex disticha* with locally abundant and frequent *Carex acutiformis*, *Alopecurus pratensis*, *Cardamine pratensis*, *Ranunculus repens*, *Persicaria amphibia*, *Myosotis laxa* and *Galium palustre*. The uncommon species *Oenanthe fistulosa* and *Stellaria palustris* are present but rare. Vegetation at site 41 was species-rich with affinities to MG8 and M22b, although with a high frequency of *Deschampsia cespitosa*. *Festuca rubra*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Holcus lanatus*, *Carex disticha*, *Filipendula ulmaria* and *Ranunculus acris* were abundant, *Carex acutiformis* was locally frequent, other frequent species included *Carex panicea*, *Equisetum palustre*, *Rumex acetosa*, *Carex hirta*, *Calliergon cuspidatum* and *Cardamine pratensis*, and a number of other species typical of older wet grasslands were present including *Carex nigra*, *Centaurea nigra*, *Lotus corniculatus*, *Lychnis flos-cuculi*, *Thalictrum flavum* and *Galium palustre*. Unusually *Eriophorum angustifolium* was also present.

5.1.3 Species richness

The three stands of MG4 and MG8/M22b were species-rich with several species typical of wet grasslands. A further site with a mosaic of MG4, MG7c and S28 had species-rich areas coinciding with the distribution of MG4, and another had a mosaic of richer and poorer MG7d. A frequently

flooded field with unclassifiable NVC and S28 swamp was species-poor. Recently reverted arable land at one site was species-poor MG10, and another site with MG11 and MG7d was also species-poor.

5.1.4 Option types

The major option adopted in the Derwent Valley (six of the eight sites) is HK9 (maintenance of wet grassland for breeding waders). This is an appropriate option given the high density of breeding birds in the Derwent Valley.

At two sites (41 & 43) the option was HK6 (maintenance of species-rich, semi-natural grassland) with the additional option of HK18 (hay-making supplement). These were the most botanically species-rich fields surveyed in the Derwent Valley, and this is the most appropriate option for these.

5.1.5 Soil properties

Soils at the majority of sites were circumneutral. The exceptions were 47 and 49 where soils were slightly acidic and 46 where soil was slightly alkaline. Potassium levels are low at all sites while magnesium levels are high. Phosphate levels given by Olsen's method are also low or very low at all sites apart from 46 where phosphate level was moderate. Olsen's phosphate broadly correlates with total phosphate. Nitrogen levels were medium-high to high at all sites as might be expected for permanent grasslands, and highest at site 45. Loss on ignition is a measure of total carbon content, and the two measures here are broadly correlated. Soil organic carbon content over 8% is thought to be high for permanent grasslands, and all soils included here had a high level of organic carbon.

Table 32. Results of soil analysis for soil samples collected from the Derwent Valley monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 41	6.5	7	0	71	1	213	4	0.85	28.8	881	9.2
LWG 2012 42	6.2	9	0	117	1	218	4	0.7	19.3	1206	9.2
LWG 2012 43	6.1	8	0	112	1	306	5	0.81	23.4	1107	9.8
LWG 2012 44	6.1	7	0	128	2-	350	5	0.96	23.8	1143	12.7
LWG 2012 45	6.7	7	0	120	1	252	5	1.12	25.6	1235	12.8
LWG 2012 46	7.1	22	2	115	1	282	5	0.75	18.5	1518	10.0
LWG 2012 47	5.6	9	0	52	0	174	3	0.9	30.9	1061	12.9
LWG 2012 49	5.5	11	1	155	2-	187	4	0.87	25.0	1546	11.8

5.1.6 Plant communities in relation to soil properties

With only 8 sample sites in the Derwent Valley and 8 soil variables, statistical analysis of vegetation composition in relation to soil variables was not carried out. No discernible patterns emerge through subjective assessment of soil fertility, for example, with species-richness or NVC community type.

5.1.7 Condition Assessment

Sites 41, 42, 43, 44, 45 and 49 fall within one of the following SSSIs: Melbourne and Thornton Ings, Brighton Meadows and Derwent Ings. Site condition was assessed using Common Standards Monitoring (CSM) methods as used by Natural England for condition assessment of SSSIs. Indicators of success were assessed for sites under HK6 (maintenance of species-rich, semi-natural grassland) but the attributes for sites with option 'HK9 maintenance of wet grassland for breeding waders' were largely outside the scope of this project. However, several of the CSM attributes are shared with the indicators of success and sites that failed to meet the CSM targets can also often be assumed to have failed at least one of the indicators of success.

Of the eight sites, three (41, 42 & 45) passed Common Standards assessment and two others (43 & 49) failed on the single criterion of only a single positive indicator species being frequent (Table 33). The remaining three sites failed on additional criteria: site 44 had excessive cover of *Phalaris arundinacea* and sites 46 and 47 (non-SSSI) had no frequent or occasional positive indicator species; at site 47 the combined cover of *Juncus effusus* and *Deschampsia cespitosa* also contributed to failure of Common Standards condition.

Table 33. Summary of condition assessment results for the Derwent Valley monitoring sites.

Site number	HLS Option	Common standards assessment	Indicators of success (HK6 only)
41	HK6	Pass	Pass
42	HK9	Pass	
43	HK9	Fail: only 1 +ve indicator species frequent.	Fail: may not meet recovering condition attribute; insufficient +ve indicator species frequent.
44	HK9	Fail: only 1 +ve indicator species frequent and 2 occasional. 50% cover of <i>Phalaris arundinacea</i>	
45	HK9	Pass	
46	HK9	Fail: no frequent or occasional +ve indicator species	
47	HK9	Fail: no frequent or occasional +ve indicator species. <i>Juncus effusus</i> & <i>Deschampsia cespitosa</i> cover >10%	
49	HK9	Fail: only 1 +ve indicator species frequent.	

5.2 Discussion

5.2.1 Vegetation communities

Vegetation communities typical of semi-natural grasslands were present at six of the eight sites in the Derwent Valley. All of these are characteristic grasslands of periodically inundated land. These vegetation types grade into each other, presumably depending on frequency, duration and periodicity of flooding, and distinguishing between grassland types can present problems. This is reflected in the low coefficients generated by MATCH analysis in some instances. At two sites the grassland was quite well-defined MG4, the characteristic community of winter-flooded hay

meadows on freely-draining soils, and elements of MG4 were present at a third site. Related communities MG8, MG7d and an unidentifiable community were also present at single sites. Species-poor grassland was present in one former arable field and in one other field.

5.2.2 Site condition

Where fields failed the condition assessment, the major reason was the lack of frequent positive indicator species. In all but one site however, there were sufficient numbers of positive indicator species in the field at lower frequencies, showing that there was considerable potential for recolonization from seed-sources within the field.

5.2.3 Effects of management

As this is the first year of monitoring fields in the Derwent Valley it is not possible to discuss the effects of management under HLS on the vegetation. All sites have a high potential for floristic improvement however. Soils at all sites are low in phosphorus which is the most important nutrient restricting development of botanically richer grassland, and at all sites management consists of hay cutting with aftermath grazing by cattle, providing of course that the fields are dry enough to allow tractor access.

5.3 Conclusions

2012 was the first year of monitoring at all of the Derwent Valley sites. The majority of sites already contain grassland of considerable conservation value, most of which are managed in a way that should at least maintain their condition. There are some features of management in the Derwent Valley which raise some concerns however. Of the eight sites that were surveyed, the owners of six had no livestock of their own and relied on graziers for aftermath grazing. Cattle are the preferred grazing animal for wet grasslands, but cattle were only available at two of the eight sites.

There are also issues regarding the control of water levels and flooding. The River Derwent was formerly a tidal river until the 1970s, but it is now barraged at its confluence with the Ouse to allow water abstraction for nearby towns. Feedback from land managers was that, as a result, water levels are kept permanently high and silt is no longer scoured from the river leading to an increased frequency of flooding, with flooding even in the summer. (Site 48 was totally inaccessible for the surveyors and the landowner during 2012 due to high flood levels.) At the same time, the river embankments are thought to have become eroded, allowing more frequent flooding. Management of drainage ditches has been neglected, impeding the return of flood-water to the river. All but one of the site owners reported problems with increased flooding. None of the individual owners has any control over flooding regimes, and all expressed frustration at the constraints that it imposed on the options for managing their land. However, the recent trend for wet summers is also an important contributory factor to the flooding observed in these sites. The Ouse Ings, which has no barrage, has also seen an increased frequency in wet loving species in response to recent flooding events (Simon Christian, Natural England, pers. comm.); the relative contribution by the barrage to the flooding is therefore difficult to accurately surmise. Increased flooding, by whatever means, is likely to lead to increases in cover of reed-grasses and large *Carex* spp., and failure of bird nesting attempts.

6 AVON VALLEY

6.1 Baseline setting

Twenty-one sites were surveyed in the valley of the Avon Valley, and all had formerly been under ESA management; five sites comprised two separate monitoring plots, which had originally been targeted for Raised Water Level Management. A 24th site (site 70) could not be surveyed due to excessive flooding, which did not abate by the end of the field season. (Brief individual site reports are provided for each site in Appendix 4.)

6.1.1 NVC communities

NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. MATCH analysis of each site is presented in Appendix 4a (included within the Table is an indication of the final NVC community to which each site was assigned). Vegetation at these sites was classified within the following NVC sub-communities (Table 34).

- MG7 *Lolium perenne* leys:
 - MG7b *Lolium perenne*–*Poa trivialis* ley
 - MG7c *Lolium perenne*–*Alopecurus pratensis*–*Festuca pratensis* (flood pasture) grassland
 - MG7d *Lolium perenne*–*Alopecurus pratensis* grassland
- MG8 *Cynosurus cristatus*–*Caltha palustris* grassland
- MG9 *Holcus lanatus*–*Deschampsia cespitosa* grassland
 - MG9a *Poa trivialis* sub-community
 - MG9b *Arrhenatherum elatius* sub-community
- MG9-related grassland
- MG10 *Holcus lanatus*–*Juncus effusus* -related rush-pasture
- MG11 *Festuca rubra*–*Agrostis stolonifera*–*Potentilla anserina* grassland
 - MG11a *Lolium perenne* sub-community
- MG11-related grassland
- MG13 *Agrostis stolonifera*–*Alopecurus geniculatus* (wet alluvial meadow)-related grassland

It was very difficult to classify many of the stands within the context of the NVC. Few differential species were present and where present there was little to distinguish the associated vegetation.

Many of the stands were species-poor grassland dominated by a restricted suite of species typical of regular seasonal inundation. These species include *Agrostis stolonifera*, *Poa trivialis*, *Holcus lanatus*, *Lolium perenne*, *Festuca rubra*, *Carex hirta* and locally *Deschampsia cespitosa*, with few frequent broad-leaved species. The majority of these broad-leaved species are ubiquitous in lowland grasslands including *Ranunculus repens*, *Rumex acetosa*, *Trifolium repens*, *Plantago lanceolata*, *Trifolium pratense*, *Taraxacum* agg., *Cirsium arvense* and *Cirsium palustre*. Few species typical of wet grasslands were present in more than individual stands, and these few included *Filipendula ulmaria*, *Cardamine pratense*, *Potentilla anserina* and *Equisetum palustre*. *Carex acutiformis* and *Carex riparia* were invasive in some fields.

Table 34. NVC communities recorded in the 23 nested-quadrat plots (across 18 sites), and the 3 new 5-quadrat-based plots in the Avon Valley, 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

Community	Sub-community	No. plots	Sites
MG6	MG6a	1	1
MG7	MG7c	3	3
	MG7d	1	1
MG8		4	4
MG9-related		1	1
	MG9a	2	2
	MG9b	2	1
MG10-related		2	2
MG11-related		8	4
	MG11a	1	1
MG13-related		1	1
Total no. plots		26	21

Four sites (56, 68, 69 and 71) were classified as MG7c and MG7d. Grassland in these fields consists largely of the ubiquitous species listed above. Grassland in field 58 was classified as MG11a, but this differed little from MG7c/d. Much drier grassland in Field 60 was MG6a with dominant *Festuca rubra* and *Lolium perenne* and frequent *Holcus lanatus*, *Cynosurus cristatus* and *Agrostis stolonifera*.

Field 61 was surveyed late in the summer due to flooding between May and August. Vegetation was dominated by *Agrostis stolonifera* with *Glyceria fluitans*, *Lolium perenne*, *Carex hirta*, *Mentha aquatica* and *Persicaria amphibia*. *Lemna* spp. were abundant, reflecting the recent inundation. This vegetation may be closest to MG13.

While MATCH analysis gave a good fit in some cases to MG10 (sites 50, 52, 53, 55, 64 & 66), *Juncus* spp. were infrequent and only present in patches and sometimes completely absent within a grassland matrix dominated by *Holcus lanatus*.

Grasslands in fields 51, 62 and 63 were classified as MG9. The grassland matrix at these sites was similar to that at sites classified as MG10, with the addition of tussocky *Deschampsia cespitosa*. These grasslands were slightly richer than the MG10, and may represent a stage in either the degradation from or recovery to higher quality communities such as MG8. Species such as *Geum rivale*, *Caltha palustris*, *Galium palustre*, *Galium uliginosum*, *Filipendula ulmaria*, *Carex disticha* and *Carex nigra* were occasional.

The most species-rich grasslands (54, 57, 59, 65 and 67) were recognisable as MG8 and grasslands transitional between MG8 and other communities. These were distinguished from poorer swards by the presence of characteristic wet grassland/fen species including *Carex disticha*, *Carex nigra*, *Eleocharis palustris*, *Cardamine pratensis*, *Filipendula ulmaria*, *Lotus pedunculatus*, *Galium palustre*,

Geum rivale, *Juncus acutiflorus*, *Valeriana dioica*, *Caltha palustris*, *Persicaria amphibia*, *Carex flacca*, *Lysimachia nummularium*, *Myosotis scorpioides* and *Lychnis flos-cuculi*, although these were rarely more than occasional. Where *Carex disticha* and *Carex acutiformis* became more frequent the vegetation may approach M22. The dominant species in this more species-rich grassland are however the same as those in MG9 and MG10.

6.1.2 Option types

The most frequent HLS option (12 sites; Table 37) adopted in the Avon Valley is HK15 (maintenance of grassland for target features), with a further 8 sites specifically aimed at restoration of wet grassland for target bird groups (6 sites: HK11 for breeding waders; 2 sites: HK12 for wintering waders and wildfowl). A single site is HK7 (restoration of species-rich semi-natural grassland).

Table 35. HLS options and supplements for the monitoring sites in the Avon Valley.

Option	Supplement	No. sites
HK7		1
HK11		6
HK12		2
HK15		12

HK15, the most frequent option, is a rather broad option that is aimed at existing semi-improved or rough grassland that already provides suitable habitat conditions for target species such as target bird or invertebrate species/groups. HK15 may also be used to protect grassland that does not quite meet BAP priority habitat conditions but meets local targets.

6.1.3 Differences in species-richness between sites

Species richness was related to the NVC community type recorded. The mean number of species recorded in the ADAS plots in 2012 was 24.85 ± 1.39 SE, whilst the three new plots ranged from 24 to 40 species over 5-quadrats.

The richest sites were the MG8 sites, often with around 30 species in 1-m² quadrats but with up to 44 species. MG11 sites were, less rich with 20 species more representative. The poorest stands were those supporting MG9, MG13 grasslands and MG10 rush-pastures, which often supported less than 15 species per m².

6.1.4 Soil properties

Soil pH within the Avon Valley ESA fell within the range 6.8–7.8 with the majority of sites recorded as quite strongly alkaline with pH >7.0. Only site 61 was pH < 7.0. Most of the fields occur on alluvial sands and/or gravels: the high pH (which has risen in the last 10 years) is probably owing to the influence of flooding by river water. The River Avon is one of the finest chalk rivers in the country.

Phosphorous (Olsen's P) was moderate to high at most sites, with only 3 sites showing low P (Index P = 1) and another 3 sites (58, 64, 68) with very high P (Index P = 4). Where botanical diversity is the main objective, soil P should be low (Index P ≤ 1). The only site under HK7 (restoration of species-

rich grassland), site 67, had Index P = 2, which may be sufficiently high to limit recolonization. Potassium is a less important constraint in grassland restoration and in most sites was low to moderate (Index K = ≤ 2-). Magnesium content (Index Mg) was mostly medium (1–2) with 5 sites showing high levels (3). High levels of Mg may reduce dietary availability of other nutrients for grazing animals.

Nitrogen levels varied between sites markedly, with a range of 0.33% (site 55; low for long-term grassland) to 2.08 and 2.12 (sites 67 and 54; extremely high). Total soil N is usually greater than 1% and therefore quite high in older, permanent grassland – higher than in fields with a recent history of arable – due to the effect of prolonged dunging and accumulation of plant litter. Of the 21 sites, 3 had low soil N for older grassland (< 0.5%), 4 had medium N (0.5–1.0%), 8 had high N (1.0–1.5%) and a further 6 were very high (>1.5%).

Organic matter content as indicated by loss on ignition and organic carbon is relatively low as might be expected from soils that are predominantly mineral.

Table 36. Results of soil analysis for soil samples collected from the Avon Valley monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 50	7.6	37	3	92	1	102	3	1.05	20.6	1690	6.3
LWG 2012 51	7.2	21	2	139	2-	92	2	1.12	28.2	1492	28.2
LWG 2012 52	7.7	30	3	135	2-	67	2	0.41	27.7	2079	10.9
LWG 2012 53	7.4	42	3	145	2-	89	2	1.36	28.6	2090	28.6
LWG 2012 54	7.0	13	1	185	2+	122	3	2.12	37.9	2583	19.5
LWG 2012 55	7.7	31	3	148	2-	102	3	0.33	27.0	2174	11.4
LWG 2012 56	7.8	40	3	121	2-	95	2	1.15	26.3	2006	7.6
LWG 2012 57	7.2	27	3	124	2-	99	2	1.77	40.3	1866	14.3
LWG 2012 58	7.6	47	4	177	2-	103	3	1.29	23.7	2164	23.7
LWG 2012 59	7.1	26	3	150	2-	109	3	0.95	22.1	1448	22.1
LWG 2012 60	7.7	20	2	151	2-	86	2	0.91	19.8	1422	19.8
LWG 2012 61	6.8	45	3	159	2-	81	2	0.48	15.1	935	6.8
LWG 2012 62	7.3	14	1	84	1	55	2	1.57	43.5	1581	12.5
LWG 2012 63	7.4	16	2	121	2-	60	2	1.52	37.3	1775	14.4
LWG 2012 64	7.5	51	4	215	2+	84	2	1.11	23.5	2012	23.5
LWG 2012 65	7.5	14	1	106	1	48	1	1.47	32.9	1646	11.1
LWG 2012 66	7.5	22	2	145	2-	92	2	1.61	37.8	1719	12.7
LWG 2012 67	7.4	18	2	119	1	56	2	2.08	44.7	1753	16.2
LWG 2012 68	7.5	46	4	167	2-	82	2	1.44	29.4	1897	29.4
LWG 2012 69	7.4	45	3	189	2+	100	2	0.83	17.0	1631	17.0
LWG 2012 71	7.8	19	2	110	1	84	2	0.63	14.2	1025	3.7

6.1.5 Plant communities in relation to soil properties

In Canonical Correspondence Analysis (Fig. 8) vegetation composition was significantly related to Magnesium and Potassium content, to total nitrogen content and to percentage of organic carbon.

Figure 8. CCA biplot showing the relationship between soil variables (as vectors) and the vegetation data for monitoring plots in the Avon Valley.

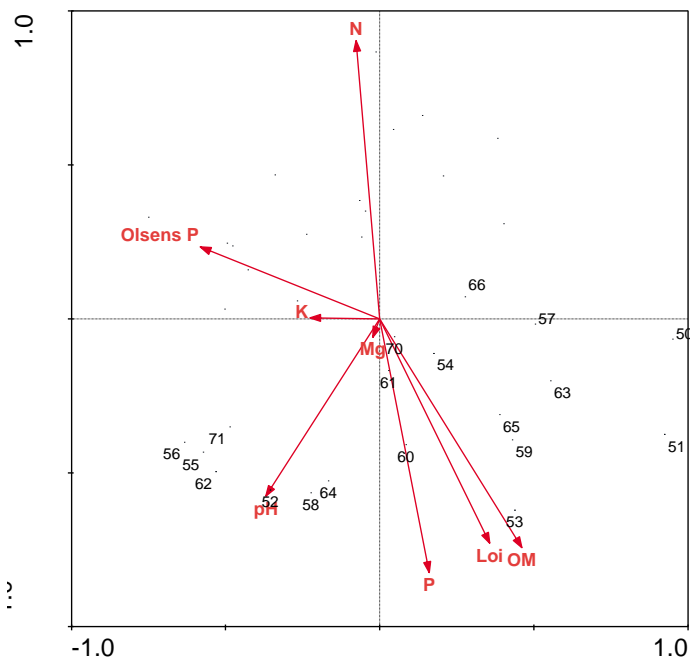


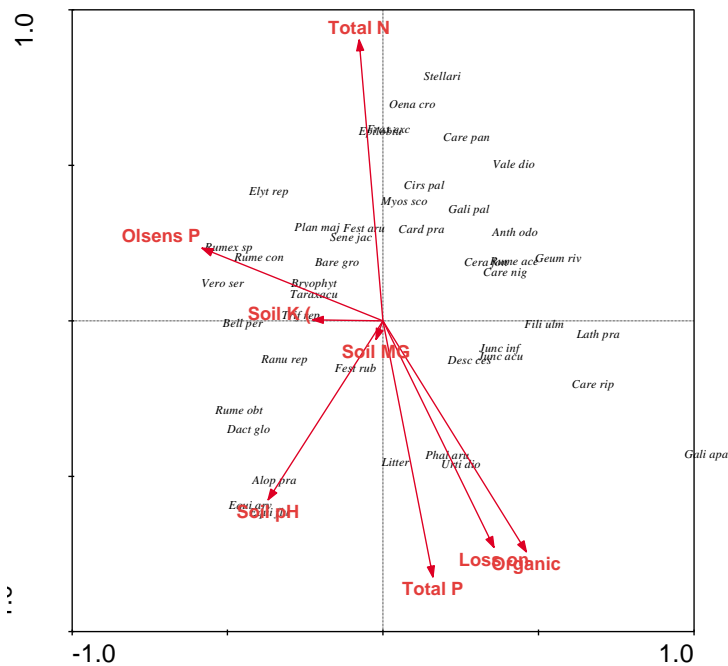
Table 37. Eigenvalues for the first four canonical axes for the relationships between vegetation sampled in each plot and soil variables in the Avon Valley.

Region	Axis 1	Axis 2	Axis 3	Axis 4
Avon Valley	0.210	0.136	0.126	0.104

Table 38. Avon valley: showing the significance of the relationships between vegetation recorded and soil variables using canonical correspondence analysis.

Avon Valley ESA	Soil pH (Water)	Olsens P (mg/l)	Soil K (mg/l)	Soil MG (mg/l)	Total N (%)	Loss on Ignition	Total P	Organic Carbon
P-value	n.s.	n.s.	0.028	0.006	0.046	n.s.	n.s.	0.004

Figure 9. CCA biplot showing the relationship between soil variables (as vectors) and individual species recorded in the nested quadrat plots in the Avon Valley. Species present in fewer than 15% of samples omitted for clarity.



6.1.6 Condition Assessment

Sites in the Avon valley were assessed against common standards monitoring (CSM) attributes and against BAP habitat type G06 Lowland meadow. It should be noted, however, that the majority of these sites were not under HLS to maintain or restore species-rich grassland; rather the notified feature was to maintain wet grassland habitat for target bird (or other) groups (i.e. BAP habitats: G15 Coastal and floodplain grazing marsh or G13 Habitat for wintering waders and wildfowl). Only a single site is HK7 (restoration of species-rich semi-natural grassland), and this site passed the CSM. The remaining sites, when assessed against CSM generic targets for G06 lowland meadow, failed variously on: frequency of positive indicator species, cover of coarse species or indicators of waterlogging, cover of negative species, litter, or sward height. The high cover of litter and the high sward height is likely to be a result of the extreme flooding this year as grazing and/or hay cuts have been delayed. When these sites were assessed against the indicators of success targets for HK11, HK12 and HK15, respectively as appropriate, many more sites (12) passed on the vegetation attributes that were apparent at the time of survey (see individual site accounts in Appendix 4). (Some vegetation attributes and most faunal species attributes were not assessable at the time of the survey and therefore beyond our scope.)

Site number	HLS Option	Common standards assessment for Lowland Meadow Priority Habitat and/or SSSI condition
50	HK15	Fails on three attributes - frequency of +ve indicator species, cover of –ve indicator species and average height of sward.
51	HK11	Fails on three attributes-cover of coarse rushes, sedges & grasses, frequency of +ve indicator species and average height of sward
52	HK12	Fails on two attributes; frequency of +ve indicator species and average height of sward.
53	HK15	Fails on two attributes - frequency of +ve indicator species and average height of sward.
54	HK15	*Fails for any SSSI wet grassland stand type on three attributes – frequency of +ve indicator species, frequency of <i>Senecio aquaticus</i> and average height of sward.
55	HK15	*Fails for any SSSI wet grassland stand type on two attributes- frequency of +ve indicator species and frequency and cover of negative indicator species.
56	HK15	*Fails for any SSSI wet grassland stand type on one attribute- frequency of +ve indicator species.
57	HK15	Fails on three attributes – frequency of +ve indicator species, cover of indicators of waterlogging and average height of sward.
58	HK12	Fails on two attributes- frequency of +ve indicator species and frequency of <i>Senecio aquaticus</i> .
59	HK15	May pass the condition assessment for G02 semi-improved grassland with potential for restoration to G06: Lowland meadow. The site failed on two attributes- frequency of +ve indicator species and average height of sward
60	HK15	Fails on two attributes - frequency of +ve indicator species and average height of sward.
61	HK15	Fails on one attribute- frequency of +ve indicator species (although a full condition survey was difficult due to the conditions).
62	HK11	Fails on two attributes- frequency of +ve indicator species, frequency of <i>Senecio aquaticus</i> and other negative indicator species combined
63	HK11	Fails for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two attributes - frequency of positive indicator species and average height of sward.
64	HK11	*Fails for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow on two attributes - frequency of positive indicator species and extent of litter.
65	HK11	*Fails for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two one attribute - frequency of positive indicator species
66	HK15	Fails for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on four attributes - frequency of positive indicator species, extent of litter, cover of indicators of waterlogging and average height of sward.
67	HK7	*Passes the MG8 and BAP habitat G06 Lowland meadows condition assessment on all attributes (& meets 2-year IoS)
68	HK15	May pass the condition assessment for G02 semi-improved grassland with potential for restoration to G06: Lowland meadow. The site fails the condition assessment for G06: Lowland meadows BAP habitat on two attributes- frequency of positive indicator species and average height of sward.
69	HK15	Fails the condition assessment for G06 Lowland meadow on three attributes- frequency of positive indicator species, cover of negative indicator species and average height of sward.
71	HK11	This site is not SSSI. The site does not pass the condition assessment for any BAP habitat such as G06 lowland meadow and the current FEP feature recorded is G12 Habitat for breeding waders

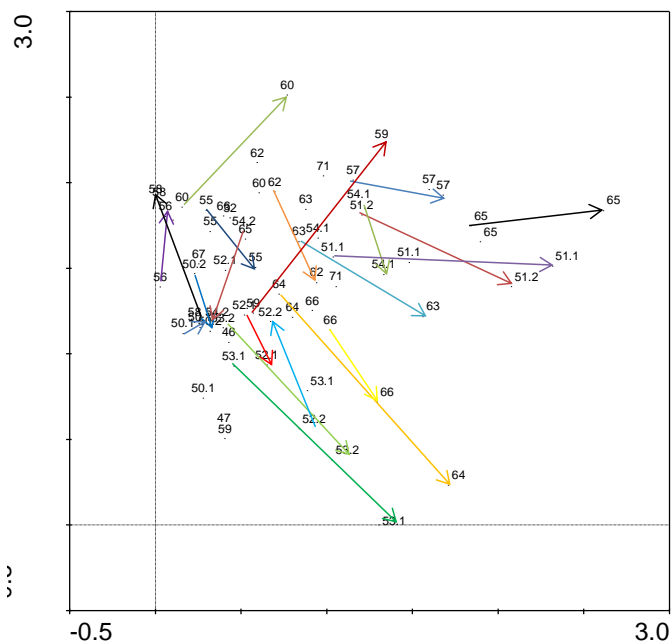
*Within SSSI Units

6.2 Analysis of changes in vegetation within plots over time

6.2.1 Vegetation community composition

Of the 24 plots from which data was collected in 2012, vegetation composition in 16 moved in the same direction in the ordination diagram. Plots 52.2, 58, 59 and 60 showed very different trajectories of change to most other plots, although their vegetation communities were different and displayed dissimilar changes: plots 58 and 60 had become less coarse. Plots 50, 57, 61, 62, 63 and 71 showed little movement in relation to the overall direction of the other plots, indicating that any change in NVC community recorded in 2012 was more a reflection of a different interpretation than an actual change in vegetation. Plots 53 and 64 showed quite substantial changes in composition over time: plot 53 had moved from MG13 to a more MG11-related stand whilst plot 64 remained within MG10 but there must have been changes in composition of species within that community.

Figure 10. DCA plot of change in vegetation in monitoring ADAS plots in the Avon Valley between 1988 and 2012. 1988, 2003 and 2012 data from the same plots are linked by arrows.



6.2.2 NVC community change

Avon Valley sites were initially set up in 1993 and resurveyed in 2003 and 2012. Two plots were established at some sites but resurvey of the double-plot sites has been inconsistent. None of the second plots in the double-plot sites were resurveyed in 2003, but in 2012 all apart from one of the second plots were resurveyed. NVC community diagnoses for the plots were provided in the data for

1993. Similar issues exist in comparing current communities with past ones as discussed above for the Somerset Levels: assessments may have erred towards the highest ranked NVC community in a MATCH type analysis, rather than reflecting an experienced surveyor's opinion (as in 2012), and may therefore not be entirely comparable to the current classification.

The MG8 water meadow community was recorded at three sites. There was no geographical pattern to these—they were spread along the valley. Only one site (57) had previously been classified as MG8. There was no particular pattern of change with these sites, although all three showed an increase in abundance of *Caltha palustris* and two a decrease in abundance of *Cynosurus cristatus* (two of the constant species for the community). There was also no particular trend in sedges, rushes and grasses on these plots although site 54 showed an increase in *Carex disticha* and *C. nigra*. All 3 MG8 stands showed some affinity with rush-pasture and 2 of these (sites 54 and 65) could be considered transitional to or from a fen-meadow/rush-pasture community.

Four sites were classified as MG9 grassland. Two of these (site 62 and 63) had been previously classified as MG9 while the other two (sites 51 and 59) were previously classified as MG10b and MG13. Both these latter sites have shown an increase in abundance of *Deschampsia cespitosa* while two sites, 51 and 63, have shown a decrease in the other community constant *Holcus lanatus*.

Two sites were classified as MG10-related and five sites MG11-related. There is much doubt about the true affinities of these communities as often the MG10 communities do not contain *Juncus effusus* and MG11 do not contain, or contain very little *Potentilla anserina* as community constants. This was indeed the case in the Avon Valley. However, the abundance of the other community constants, particularly the grasses *Agrostis stolonifera*, *Holcus lanatus*, *Festuca rubra* and the broad-leaved *Ranunculus repens* gives these species-poor communities a strong affinity to these communities. One site was classified as MG13-related due to the local abundance of *Glyceria fluitans*, an indicator of periodic inundation, but the community constant *Alopecurus geniculatus* was absent.

Two sites were classified as MG7c. These sites had abundant *Lolium perenne*, presumably as a result of long-term agricultural improvement and were otherwise markedly species-poor.

6.2.3 Species richness

The increase in species richness between 1993 and 2003 is on a larger scale to that seen in the previous report (24% compared with 13% reported in Manchester *et al.*, 2005). Although the overall change is significant, species richness appears to have stabilised at the higher level.

Table 39. Mean number of species in Avon Valley ESA ADAS plots.

Year	Mean	SE
1993	21.46	1.50
2003	26.69	1.52
2012	24.85	1.39
F-value	3.53	
P-value	0.041	

6.2.4 Sward height

There has been a considerable increase in sward height since the initial survey period. The standard errors show that swards did not vary hugely within survey years. The increase in growth shows a general increase in heights across all plots. Increases in sward height could be due to several factors: a later survey date in 2003 and 2012 than in the baseline survey of 1993 may result in a taller sward, although the date of the previous surveys is not known; environmental conditions in 2003 and 2012 may have promoted stronger growth; or there may have been an increase in the presence of species with tall growth forms, such as *Juncus* spp.

Table 40. Mean sward height in Avon Valley ESA ADAS plots.

Year	Mean	SE
1993	13.84	1.86
2003	11.64	1.79
2012	19.83	1.81
F-value	3.47	
P-value	0.043	

6.2.5 Soils

Table 41 shows soil property values for years for which data were available. Soil K showed no significant change whilst unfortunately an assessment of change in total N was not possible as the 2003 data returned for this variable were unreliable. However, there were significant changes in several other soil properties: an increase in pH (i.e. increased alkalinity), with a concomitant decrease in Phosphate, falling from index 4 (very high) to 3 (high). Magnesium (Ext Mg Litre⁻¹) increased but by a relatively modest amount and the results remain within the same (ADAS) index of 2. The change in P may be related to changes in management over the period, perhaps decreases in inorganic fertilizer applications and an increase in hay cutting and aftermath grazing, both of which would reduce soil nutrient levels. The large change in pH may be due to the increasing influence of river flooding, the water from which would generally be between 7.4 and 8.0.

Table 41. Analysis of change in soil variables values in Avon Valley ESA ADAS plots from 2003 to 2012 only. Data were available for 18 sites from 2003 only.

Year	pH	Total N	Olsen Ext P Litre	ADAS P	Ext K Litre	Ext Mg Litre	ADAS Mg
2003	7.05	-	65.5	4.0	138.0	57.5	2.0
2012	7.5	1.135	26.5	3.0	142.0	90.5	2.0
Wilcoxon signed rank	13.5	-	167.0	145.0	79.0	23.0	13.0
P-value	0.003	-	< 0.001	0.001	n.s.	0.012	n.s.

6.2.6 Ecological criteria

There was only one significant change in ecological criteria indices – that of the suited species high moisture score (Table 42). This score seems to show a large increase over the period 1993–2003 with some stabilisation from 2003–2012. Although non-significant, the suited species grazing score shows a steady downward trend away from grazing-suited species.

Table 42. Plant ecological criteria values in Avon Valley ESA ADAS plots.

Year	SSS G	SSS M*	Ellenberg N	Ellenberg F
1993	0.11	0.36	5.30	6.25
2003	0.08	0.48	5.25	6.46
2012	0.00	0.4	5.18	6.37
F-value	2.5	S-value 12.45	0.98	2.0
P-value	n.s.	0.002	n.s.	n.s.

SSS – suited species score; G – species suited to grazing; M – species suited to high moisture content (*Median values); Ellenberg indices: N – index of soil fertility; F – index of soil wetness.

6.2.7 Individual species – abundance

There has been a significant increase in the ruderal species *Rumex crispus* within sites. This species colonises gaps in the vegetation and may take advantage of bare ground created through flooding events.

Table 43. Results of Friedman tests applied to species frequencies at optimum scale for the Avon Valley ESA ADAS plots (significant results only, $P < 0.05$).

Species	1993	2003	2012	Trend	Friedman S	P (d.f. = 2)
<i>Agrostis stol/cap/can</i> amalgam	7.000	10.000	6.000	↔	12.28	0.002
<i>Festuca arund/prat</i> amalgam	0.000	2.667	0.333	↓	12.70	0.002
<i>Poa pratensis</i>	4.000	1.000	0.000	↓	15.78	< 0.001
<i>Rumex crispus</i>	0.000	0.333	0.667	↑	11.84	0.003
<i>Trifolium repens</i>	5.667	8.000	5.333	↔	10.75	0.005

6.3 Discussion

6.3.1 Vegetation communities

The seasonally inundated vegetation of the Avon Valley floodplain is difficult to classify within the NVC (Wilson *et al*, 2004). Substantial areas have had past agricultural improvement, resulting in impoverished swards. This improvement could have been either through the addition of nitrogen fertiliser or through carefully regulated flooding as water meadows which can have a similar effect. Unregulated winter flooding, particularly where water lies late in the spring or even into the early summer, is believed to have increased recently, and that is also likely to have had effects on the vegetation, transforming communities that are normally flooded only periodically. Many species are

intolerant of prolonged and repeated flooding, while others flourish, particularly those with underground rhizomes and rapidly growing clonal species that can take advantage of areas of soil exposed after flooding. The present ubiquity of *Agrostis stolonifera*, *Festuca rubra*, *Ranunculus repens* and *Filipendula ulmaria* may be a relatively recent phenomenon.

It is possible that the remaining areas of species-rich MG8 represent a relic of the predominant agricultural grassland type of the floodplain before the 20th century. The processes of agricultural improvement and possibly increasing inundation have resulted in a range of stages of impoverishment. These grasslands grade into each other on a continuum of variation in community, and in many cases correspond poorly with community descriptions in the NVC, due partly to the current dynamism of the system and partly to the ubiquity of some species but also to the under-sampling of some community types in the published data. Species-poor swards that are relatively dry but with impeded drainage that may have been partially agriculturally improved are largely MG7c, MG9a or MG10a. Lower-lying fields with increasing frequency of inundation approach MG11a or MG13 and OV28.

6.3.2 Species-richness

The overall increase in plot species richness observed since 1993 reflects the benefit of the ESA management regime, although much of this has been aimed primarily at increasing wintering wildfowl and breeding waders. Much of this increase will be related to general changes in vegetation communities, where some of the observed change has involved development towards inherently more species rich community types (such as the MG8 *Cynosurus cristatus*-*Caltha palustris* grassland).

The recent decline (2003-2012) in mean species richness of nearly ten per cent is difficult to explain but may be a result of recent flooding events which has possibly had two effects: 1. Plant communities being 'forced' towards more high moisture-suited ones from stable drier communities with a short-term loss of species associated with the latter; 2. An artefact of a number of the fields not being managed (e.g. for hay cut and aftermath grazing) as intended under agri-environment agreements or even in a stable way, over the last few flooding events - particularly in 2011-12 when many sites were totally unmanageable. Six of the seven HK11 or HK12 agreement sites that could be compared showed no overall improvement or declines in species richness. Four of the five sites showing increases in species richness were under HK15 agreements

6.3.3 Plant community variables

Although only one measure showed a significant change (M – species suited to a high moisture content), there are some clear trends over the monitoring period that indicate general change in the Valley land management and ecosystem. Both grazing and soil nutrient scores show a decline, clearly a reflection of changes in management under the ESA/HLS schemes from wider grazed pastures to more hay and aftermath grazing schemes.

Both the suited species high moisture content and the closely related Ellenburg soil wetness measure showed a rise in 2003 then a subsequent decline to 2012. Interestingly, this is reflected by changes in three of the species where changes were significant- *Agrostis stol/cap/can* amalgam, *Festuca arund/prat* amalgam and *Trifolium repens*. All three of these groups have peak associations with moderately moist soils but decline where soils become wet for long periods or are inundated

for longer periods (Grime *et al*, 1988). *Poa pratensis*, which showed a long-term decline, is fairly intolerant to regular, high soil moisture content and is now rare on the monitoring plots. *Agrostis stolonifera* would be the most tolerant of these species in waterlogged soils.

6.3.4 Effects of management

Agri-environment schemes appear to have had an overall beneficial effect on the continued maintenance of vegetation communities of high importance. However, where agreement holders have continued with non-botanically oriented schemes, the lower value grasslands have either persisted or developed with an associated loss of species. Eight of the 21 sites investigated are under either the HK11 or HK12 HLS options targeted at wintering wildfowl and/or breeding waders which are designed to produce structurally appropriate swards and hydrological management. While these options should technically lead to an improvement in sward species diversity, that is not their primary aim and it is suspected that improvements in the quality of their vegetation communities are not happening.

Recent long-term flooding events such as in 2008 and 2011–12 have made prescriptive management extremely difficult. For example, the most recent event prevented over thirty units in the lower Avon HLS scheme from having their normal hay cut and aftermath grazing, and some of these units have not been cut for several years due to persistently high water levels.

6.4 Conclusions

The Avon Valley has shown a mixed response to long-term management under agri-environment schemes. On sites where agreements have targeted maintenance or improvement in botanical diversity, there is some evidence of this occurring. However, a significant proportion of agreements are targeted at wintering and/or breeding birds and these sites have shown little improvement or indeed further reductions in botanical quality.

There are clear signals that recent flooding and high in-field water levels are affecting vegetation communities and that changes in the vegetation are likely to continue if these hydrological regimes become more frequent or the norm, but the changes noted are also likely to be compounded by an inability to deliver effective cutting management.

Three new sites were established in 2012: at one of these (67), the grassland was already species-rich but with areas of lower interest. These sites are either under HK15 or HK7 agreements so should show relatively rapid responses to improved management regimes.

7 ITCHEN VALLEY

7.1 Baseline setting

7.1.1 Itchen Valley sites

Seven sites were surveyed in the Itchen Valley. Six of these are within the Itchen Valley SSSI. The majority of these fields were managed as water-meadows in the past, and one site is still regularly flooded. This is the first survey of these sites. Brief individual site reports are provided for each site in the Itchen Valley in Appendix 5.

7.1.2 NVC communities

Vegetation at the seven sites surveyed in the Itchen Valley all fell within the following NVC communities or sub-communities (Table 44). NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. MATCH analysis of each site including an indication of the final NVC community to which each site was assigned is presented in Appendix 5a.

- MG1 *Arrhenatherum elatius* grassland
 - MG1a *Festuca rubra* sub-community
 - MG1c *Filipendula ulmaria* sub-community
- MG8 *Cynosurus cristatus-Caltha palustris* grassland
- MG9 *Holcus lanatus-Deschampsia cespitosa* grassland,
 - MG9b *Arrhenatherum elatius* sub-community
- MG10 *Juncus effusus-Holcus lanatus* grassland
 - MG10b *Juncus inflexus* sub-community
- S6 *Carex riparia* swamp
- S7 *Carex acutiformis* swamp

Table 44. NVC communities recorded in the 5-quadrat based plots in the Itchen Valley, 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

Community	Sub-community	No. sites
MG1	MG1a	1
	MG1c	1
MG8		2
MG9	MG9b	1
MG10	MG10b	1
S6/S7/MG8 mosaic		1

Vegetation at all sites surveyed in the Itchen Valley was species-poor and at least partially agriculturally improved; although at some sites there were relics of species-rich grassland.

The most frequent grassland type was MG8, but in contrast to typical stands, this was a species-poor variant. The grasses *Holcus lanatus* and *Festuca rubra* were dominant with *Agrostis stolonifera*, *Lolium perenne*, *Poa trivialis* and *Festuca arundinacea*. Other frequent species included *Filipendula ulmaria*, *Carex disticha*, *Ranunculus acris* and *Ranunculus repens*. A range of other grassland species occurred occasionally including *Trifolium repens*, *Ranunculus repens*, *Plantago lanceolata*, *Carex hirta*, *Prunella vulgaris* and *Trifolium pratense*. Relic patches of slightly more species-rich grassland had *Eleocharis palustris*, *Persicaria amphibia*, *Equisetum palustre*, *Geum rivale*, *Pulicaria dysenterica*, *Lotus pedunculatus*, *Carex flacca*, *Galium uliginosum*, *Mentha aquatica*, *Geum rivale*, *Caltha palustris*, *Thalictrum flavum* and *Juncus articulatus*. These may act as nuclei for enrichment of the adjacent poorer grassland.

Other species-poor dry grasslands were also recorded. Drier grasslands occur mainly where water-meadow panes are elevated above the water-table and normal flood-level of the river. These grasslands included MG1a, MG1c and MG9b. These are all similar in structure dominated by tussock-forming grasses *Arrhenatherum elatius*, *Festuca arundinacea*, *Dactylis glomerata*, *Deschampsia cespitosa* and *Festuca rubra* with other grasses such as *Holcus lanatus*, *Lolium perenne*, *Agrostis stolonifera* and *Poa trivialis*. With the exception of *Filipendula ulmaria*, species typical of agriculturally unimproved wet grasslands were uncommon, and included rare *Carex nigra*, *Filipendula ulmaria*, *Geum rivale* and *Carex disticha*. The negative indicator species *Cirsium arvense* was locally abundant.

At site 72, the water meadows are still flooded regularly and the grassland is MG10b. This is also a species-poor community with abundant *Holcus lanatus*, *Agrostis stolonifera*, *Festuca rubra*, *Iris pseudacorus* and tussocky *Juncus inflexus*. Species typical of wetter grasslands were more frequent here, and these included *Carex disticha*, *Filipendula ulmaria*, *Potentilla anserina*, *Ranunculus repens*, *Urtica dioica* and *Persicaria amphibia*. Much of the vegetation at this site was M22a tall fen and there was a relic of species-rich M22b fen-meadow.

Sedge swamp was present at one site (74) in mosaic with other communities. The site supports species-poor tall fen dominated by *Carex acutiformis*, *Carex riparia* and *Phalaris arundinacea*. These species are present in small stands in ditches and other wet places at other sites. Dry reseeded grassland is also present (MG6a *Lolium perenne*-*Cynosurus cristatus* grassland typical sub-community), while the wet grassland is probably species-poor MG8.

7.1.3 Species richness

All of the grasslands surveyed in the Itchen Valley were species-poor irrespective of the NVC community. Fields 72 and 76 had patches of more species-rich fen-meadow within species-poor matrices.

7.1.4 Option types

'Restoration' options have been adopted at four sites in the Itchen Valley: HK7 at three sites (restoration of species-rich grassland; sites 73, 74 & 75) and the related HQ7 at one site (restoration of fen; site 72). 'Maintenance' options have been adopted at four sites: HD10 at three sites (maintenance of traditional water-meadows; sites 72, 76 & 77), whilst HK6 is the option at just one site (maintenance of species-rich grassland; site 78). The HD10 option is appropriate at sites 72, 76 and 77, where sufficient water-meadow infrastructure remains and where there is a recent history of water-meadow flooding. However, site 78 is in need of restoration and therefore a restoration option (HK7/HQ7) would be more appropriate at this site where there is little existing species-rich grassland or fen present.

7.1.3 Soil properties

Soils at all sites are strongly alkaline, with the very high pH of 8.1 at site 72. This is expected from sites in the Itchen Valley where the ground water emerges entirely from the surrounding chalk aquifer. At many sites in the chalk stream valleys the water-meadow panes were built-up using imported chalky material and this would also have the effect of increasing alkalinity.

In general, levels of mineral nutrients are medium. The phosphate content of soils at five sites (Index = 2) may be sufficiently high to limit potential for recolonization.

Nitrogen level at all sites is high, but is particularly so at site 74 and 76. Organic matter content as indicated by loss on ignition and organic carbon is relatively low as might be expected from soils that are predominantly mineral.

Table 45. Results of soil analysis for soil samples collected from the Itchen Valley monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 72	8.1	13	1	72	1	66	2	1.03	23.8	1465	23.8
LWG 2012 73	7.5	23	2	370	3	155	3	1.03	18.8	1314	8.5
LWG 2012 74	7.3	24	2	214	2+	125	3	2.08	37.6	2056	18.9
LWG 2012 75	7.7	19	2	198	2+	99	2	1.64	32.8	2139	17.2
LWG 2012 76	7.5	18	2	169	2-	99	2	1.89	42.0	2231	22.1
LWG 2012 77	7.8	15	1	145	2-	88	2	1.25	23.1	1572	23.1
LWG 2012 78	7.7	22	2	189	2+	100	2	1.19	21.4	1593	21.4

7.1.5 Plant communities in relation to soil properties

With only 7 sample sites in the Itchen Valley and 11 soil variables, statistical analysis, such as Canonical Correspondence Analysis of vegetation in relation to soil variables, was not carried out. No discernible patterns emerge through subjective assessment of soil fertility, for example, with species-richness or NVC community type.

7.1.6 Condition Assessment

Site condition was assessed using Common Standards methods as used by Natural England for condition assessment of SSSIs and also using the Indicators of Success for sites under Higher Level Stewardship (under maintenance/restoration of grassland options) described in site dossiers for each site.

All seven sites failed the condition assessment on insufficient frequency or lack of positive indicator species. Additionally, sites 72 and 75 failed on cover of negative indicator species and site 74 on cover of indicators of waterlogging. Mean sward height was also too high at five of the seven sites. No site, notified for grassland features, has yet achieved its indicators of success but several sites are relatively new to HLS and have not yet had sufficient time to achieve their 2, 3 or 5 year targets, accordingly. However, the main issue will lie in achieving sufficient positive indicator species and most sites failed on an overly high soil phosphate content (index >1). Low soil phosphate is required for the establishment/maintenance of a species-rich sward.

Table 46. Summary of condition assessment results for the Itchen Valley monitoring sites.

Site number	HLS Option	Common standards assessment for SSSI grassland	Indicators of success (IoS)
72	HD10/HK7	Fail: only 1 +ve indicator sp. frequent and 1 occasional; –ve spp. <i>Rumex crispus</i> frequent. 50% of sward >40cm	New agreement in 2011. Botanical IoS are set for 2014, i.e. 3 years into HLS.
73	HK7	Fail: no +ve indicator spp	New agreement in 2011. Botanical IoS are set for 2014, i.e. 3 years into HLS but fails on phosphate index >1.
74	HK7	Fail: only 1 occasional +ve indicator sp. 40% cover of large <i>Carex</i> spp; 45% of sward >40cm	Botanical IoS targets are set for 2015 and are not yet met: fails on phosphate index >1
75	HK7	Fail: Only 1 +ve indicator sp frequent. –ve indicator spp <i>Cirsium arvense</i> , <i>Rumex</i> spp frequent, <i>Urtica dioica</i> occasional. Mean sward ht = 45cm	Botanical IoS targets are set for 2013 and are not yet met: fails on phosphate index >1
76	HD10	Fail: only 1 +ve indicator sp frequent and 1 occasional	
77	HK10	Fail: No +ve indicator spp; mean sward ht = 45cm	IoS are for bird target features.
78	HK6	Fail: No +ve indicator spp; mean sward ht = 40cm	This site does not have sufficient +ve indicator species by year 2 and the soil phosphate index >1. <i>Geum rivale</i> rare, <i>Primula veris</i> not recorded.

7.2 Discussion

7.2.1 Vegetation communities and species-richness

The majority of grassland recorded at the seven surveyed sites in the River Itchen valley appeared to have received some degree of agricultural improvement in the past. The vegetation present at all sites is species-poor and dominated by tussock-forming grasses and other competitive species. At the majority of sites however, there are relics of former species-rich communities, and it is to be hoped that these will act as sources of plant propagules for recolonization under suitable management regimes. A sustained regime of moderate levels of summer cattle-grazing with the topping of stands of species such as large *Carex* spp. should facilitate sward improvement, especially where stock are allowed access to adjacent fields that contain species-rich grassland.

Some of the sites (75, 77 & 78) may currently be too dry for the re-establishment of typical wet grassland communities such as species-rich MG8 and M22b. It is possible that this is the result of hydrological change from drainage, lowering river levels or water abstraction from surrounding aquifers, which would need to be addressed to restore wet grassland features. At these sites it may be that different targets should be specified; a more realistic target grassland type would be MG5 – *Cynosurus cristatus*-*Centaurea nigra* grassland.

Phosphate levels at all sites other than 72 & 77 may be sufficiently high to inhibit recolonization by poorly competitive species where highly competitive grasses are present. At these sites it must be ensured that cattle grazing pressure and topping frequency is adequate to suppress the more competitive species. Phosphate levels may be depleted gradually by taking an annual hay-cut.

7.2.2 Effects of management

As this was the first survey of these new sites conclusions cannot be drawn on the effects of management on the plant communities over time. Many of the sites have also only recently entered HLS and thus the effects of management on the botanical indicators of success could not be assessed. All the sites are grazed: sites 72, 75, 76, 77 and 78 have traditionally been managed as water-meadow and are currently cattle-grazed. Only site 74 is sheep grazed year-round, but with additional cattle in the summer months. Site 72 has been under continuous water meadow management for several hundred years. The failure of any site to meet the common standards assessment for SSSI grassland is likely to be a result of agricultural improvement, coupled with inappropriate/inconsistent grazing regimes plus knock-on effects from changes to hydrology in some sites.

8 BROADS AND NENE

8.1 Baseline setting

Nine sites were surveyed in the Norfolk Broads and Nene Valley regions, four existing sites and three new sites in the Broads, plus two new sites in the Nene Valley. Brief individual site reports are provided for each site in the Norfolk Broads and Nene Valley in Appendix 6.

8.1.1 NVC communities

Vegetation assessed within the nine sites surveyed in the Norfolk Broads and Nene Valley was classified as one of the following six NVC communities or sub-communities (Table 47). NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. MATCH analysis of each site is presented in Appendix 6 (included within the Table is an indication of the final NVC community to which each site was assigned).

- MG4 *Alopecurus pratensis-Sanguisorba officinalis* grassland
- MG10 *Holcus lanatus-Juncus effusus* rush-pasture:
 - MG10a Typical sub-community
- M22 *Juncus subnodulosus-Cirsium palustre* fen-meadow
 - M22a Typical sub-community
 - M22b *Briza media-Trifolium* spp. sub-community
- S5 *Glyceria maxima* swamp

Table 47. NVC communities recorded in the 5-quadrat based plots in the Broads and Nene, 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

Community	Sub-community	Broads	Nene
M22	M22a	1	
	M22a/b	2	
	M22b	3	
MG4			1
MG10	MG10a	1	
S5 swamp			1

The major vegetation type recorded in the Norfolk Broads sites was M22 (*Juncus subnodulosus-Cirsium palustre* fen-meadow). This is the typical fen-meadow community of seasonally wet but continually moist peaty soils with calcareous ground-water. Sub-communities M22a (typical sub-community) and M22b (*Briza media-Trifolium repens* sub-community) tend to reflect the intensity of grazing to which the sites are subjected. Under low intensities the relatively unpalatable *Juncus* and *Carex* species increase in density and stature to outcompete lower-growing and less-competitive species. M22a is therefore more typical of undergrazed sites or sites where there has been a lapse

of management, while the generally more species-rich M22b is found where cattle grazing has been more sustained and heavier.

The Broadland stands of M22b (sites 79, 81, 85) were floristically diverse, but all were species-rich vegetation of high conservation value. In general there was an open canopy of *Juncus subnodulosus* with other tall-fen species locally frequent including *Juncus effusus*, *Carex disticha*, *Juncus acutiflorus* and *Filipendula ulmaria* and, at one site, *Molinia caerulea*. Beneath this canopy or between patches of the taller species there was generally a species-rich turf with abundant *Festuca rubra*, *Holcus lanatus*, *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Carex panicea*, *Carex flacca*, *Carex nigra*, *Lotus pedunculatus*, *Plantago lanceolata*, *Galium uliginosum*, *Calliergon cuspidatum*, *Ranunculus acris*, *Cirsium palustre*, *Mentha aquatica*, *Lathyrus pratensis* and *Valeriana dioica*. A wide range of less frequent species was present, many of which were restricted to one or two sites, but which could be abundant where they occurred. These included *Carex hostiana*, *Eriophorum angustifolium*, *Potentilla erecta*, *Anagallis tenella*, *Triglochin palustris*, *Sagina nodosa* and the orchids *Epipactis palustris*, *Gymnadenia conopsea* ssp. *densiflora* and *Dactylorhiza praetermissa*.

M22a (sites 80, 82, 84) was characterised by denser stands of *Juncus subnodulosus* with *Juncus effusus*, but still retained some elements of the richer M22b community (sites 80, 82). There is clearly the potential for a fairly rapid flux between these two sub-communities mediated by grazing intensity.

The single example (site 83) of MG10a (*Juncus effusus*-*Holcus lanatus* rush-pasture, typical sub-community) probably represented a degraded stand of M22 in which the taller species had been reduced by topping or heavy grazing and the diverse fen-meadow turf impoverished by addition of fertiliser and drainage. Even at this site scattered individuals of plants characteristic of M22 persisted.

The Castor Flood Meadows (sites 86 & 87) are a system of fields in the floodplain of the River Nene, several of which are included in a SSSI. It is probable that until relatively recently much of this area was managed for hay production and the majority of the fields may have had floristically rich MG4 (*Alopecurus pratensis*-*Sanguisorba officinalis* grassland) and related communities. One of the sampled fields (87) still had a relatively species-poor example of this community. This was grass-dominated with abundant *Festuca rubra*, *Holcus lanatus* and *Cynosurus cristatus*, and frequent *Agrostis capillaris*, *Anthoxanthum odoratum* and *Phleum pratense*. Other frequent species included *Carex hirta*, *Plantago lanceolata*, *Ranunculus acris*, *Ranunculus repens*, *Rumex acetosa*, *Trifolium pratense* and *Stellaria graminea*. *Sanguisorba officinalis* and *Filipendula ulmaria* were locally frequent, and *Lathyrus pratensis*, *Silaum silaus*, *Carex disticha* and *Ophioglossum vulgatum* were rare. The other field (86) had probably been partially agriculturally improved, and had been invaded by swamp-forming species, chiefly *Carex acuta* and *Glyceria maxima*. The associated community was species-poor.

8.1.2 Species-richness

Five of the seven fields selected in the Broads had species-rich fen meadow vegetation throughout. Notable species including *Anagallis tenella*, *Sagina nodosa*, *Samolus valerandii*, *Epipactis palustris* and *Gymnadenia conopsea* ssp. *densiflora* were present. Field 85 had in excess of 30spp/m². The remaining two fields had a matrix of species-poor grassland with more species-rich areas .

The two fields in the Nene Valley had species-poor MG4 grassland and tall fen.

8.1.3 Option types

The major option adopted at the Norfolk Broads sites is HK7 (restoration of species-rich, semi-natural grassland; sites 79, 80, 82, 84). While there has probably been some deterioration through neglect at some of these sites, in general, current management appears ideal for restoration and maintenance of biological interest, and there is no need for additional intervention. One site (83) is managed under HK6 (maintenance of species-rich, semi-natural grassland). This was the only site of those surveyed in the Norfolk Broads where some degree of additional enhancement might be beneficial and where restoration option HK7 might be more appropriate. Two sites have the cattle-grazing supplement HR1. One site (81) is managed under HQ6 (maintenance of fen), and while this is broadly suitable for this site, the indicators of success require the presence of *Sphagnum* spp. across the field: this is not appropriate at this site.

Site 86 in The Nene Valley is under option HK10 (Maintenance for wintering waders and wildfowl), while Site 87 is under option HK6.

8.1.4 Soil properties

Soils at the seven Broadland sites have similarities. Soil pH is between 7.0 and 6.0, neutral to mildly acidic. Phosphate level is low to very low at all but one site (site 84) where it was moderate. Sites with a low phosphate level have a high potential for the restoration of species-rich grassland, which is the aim at four sites. Potassium level was low to very low at four sites, but moderate at three sites. Magnesium level was high to very high at all sites. The two fields at Barnby (81 & 82) had very high loss on ignition and organic carbon levels, implying a very high proportion of organic matter, probably fen peat, and these sites also had the highest nitrogen content. Nitrogen content and organic matter content was also high at all other sites.

Table 48. Results of soil analysis for soil samples collected from the Norfolk Broads monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 79	6.1	7	0	69	1	453	6	1.65	52.3	801	18.0
LWG 2012 80	6.8	7	0	59	0	196	4	1.38	38.8	663	13.9
LWG 2012 81	6.5	6	0	59	0	165	3	2.25	74.6	1007	28.3
LWG 2012 82	6.2	4	0	40	0	116	3	2.68	79.5	1148	27.0
LWG 2012 83	6.7	12	1	145	2–	185	4	1.85	53.6	1176	21.5
LWG 2012 84	7.0	19	2	133	2–	184	4	1.7	46.8	1427	16.4
LWG 2012 85	6.8	11	1	133	2–	184	4	1.99	57.8	1096	18.2

In the Nene Valley both sites had mildly alkaline soils with a moderate to low phosphate and potassium level. Magnesium content is high. While nitrogen content was high at both sites, and organic matter content was high at Site 86, there appeared to be no association between loss on ignition and organic carbon content at site 87.

Table 49. Results of soil analysis for soil samples collected from the Nene Valley monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 86	7.3	17	2	242	3	140	3	1.54	33.4	1942	18.9
LWG 2012 87	7.2	14	1	117	1	122	3	1.51	39.7	1629	5.8

8.1.5 Plant communities in relation to soil properties

Number of soil variables exceeded number of plots, so analysis was only carried out with respect to year (section 8.2).

8.1.6 Condition assessment

Site condition was assessed using Common Standards methods as used by Natural England for condition assessment of SSSIs and also using the Indicators of Success for sites under Higher Level Stewardship described in site dossiers for each site.

Table 50. Condition assessment of sites in the Norfolk Broad s and Nene Valley

Site number	HLS Option	Common standards assessment	Indicators of success
Norfolk Broads			
79	HK7	Fail: only 3 +ve indicator frequent, 1 occasional, 40% litter cover, 90% of sward is >40cm tall	Fail: only 7 high-value species present, 40% cover of <i>Juncus</i> spp
80	HK7	Fail: 40% litter cover, 90% of sward is >40cm tall	40% cover of <i>Juncus</i> spp
81	HK7	*Pass	Pass
82	HQ6	*Pass	Pass (although no <i>Sphagnum</i> spp present)
83	HK6	*Fail: only 1 +ve indicator frequent, 2 occasional	First year of HLS agreement
84	HK7	Fail: 50% of sward is >40cm tall	First year of HLS agreement
85	HK7	Fail: 65% of sward is >40cm tall	First year of HLS agreement
Nene Valley			
86	HK10	Fail: only 1 +ve indicator frequent	IoS are non-botanical.
87	HK6	*Fail: only 1 +ve indicator frequent, 2 occasional	Fail: 1 +ve indicator frequent, 2 occasional

*SSSIAll but two of the Norfolk Broads sites failed both assessments of condition (indicators of success are only relevant at four sites as the other three were only in their first year of HLS management). In three of these five failed sites however, the only reasons for failure were the accumulation of excessive amounts of litter and presence of a relatively closed canopy of *Juncus* spp. These are transitory states related to temporary periods of insufficient grazing or cutting, indeed the high canopy density may be simply the result of no grazing having been possible by the date of survey during the very wet summer of 2012. The introduction of a slightly more intensive grazing regime would be likely to rectify these reasons for failure. At site 79, the opening-up of the *Juncus*

canopy may also have the effect of enabling less-competitive species to reappear. Site 83 failed common standards assessment as it had probably had some agricultural improvement in the past.

Condition assessments at the two Nene Valley sites were an accurate reflection of the state of the vegetation in the field.

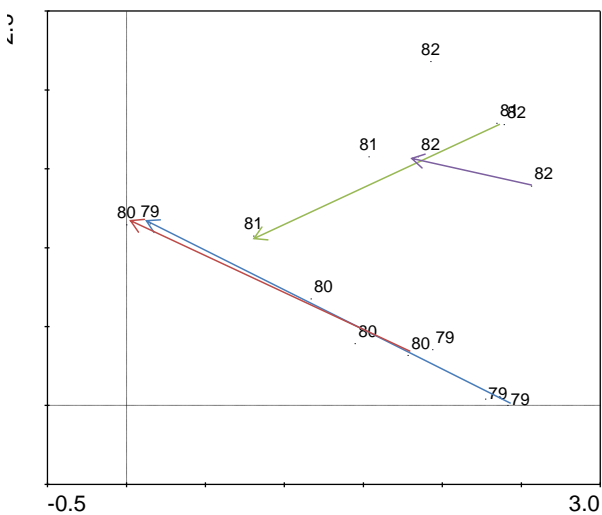
In general the common standards attributes and indicators of success used to assess condition at these sites were appropriate. The one exception to this was at site 82 where one of the indicators of success was 'By year 4, bog-moss (*Sphagnum*) should be at least frequent across the area of Fen'. Given the species present in the field and the soil chemistry it is highly unlikely that this condition will be met in the short or medium term.

8.2 Analysis of changes in vegetation within plots over time

8.2.1 Vegetation community composition

Trajectories between 1987 and 2012 of plots 79, 80 and 82 in the ordination diagram (Fig. 11) are the same. Plot 81 has also moved in the same direction but other factors have also affected the vegetation here. With so few plots it is difficult to interpret this diagram, but at all sites there has been a movement from grassland with at least some species-poor areas, to more species-rich, rush (particularly *Juncus subnodulosus*)-dominated vegetation.

Figure 11. DCA plot of change in vegetation in monitoring (5-quadrat) plots in the Norfolk Broads between 1987 and 2012. 1987 data and 2012 data from the same plots are linked by arrows.



8.2.2 Species richness

Of the nine plots assessed in the Norfolk Broads and Nene Valley, five were newly established and only four, all of which were in the Norfolk Broads, had been surveyed in previous years.

In the four plots established in 1987, there has been a significant increase in species-richness (Table 51) during the period under which they have been in ESA and subsequently HLS management. It is difficult to interpret this increase in relation to changes in management. At these sites, grazing is dependent on water levels in the fields and at 81 and 82 is let to a grazer who determines grazing levels according to his needs. Current practices seem suitable however. The wide SE values indicate differences between sites in species richness but these differences were fairly consistent for each survey year.

Table 51. Mean number of species in Norfolk Broads fixed quadrat plots.

Year	Mean	SE
1987	13.65	3.65
1990	16.2	4.35
2012	17.25	4.71
F-value	9.68	
P-value	< 0.001	

8.2.3 Ecological criteria

The only significant change in ecological criteria between 1987 and 2012 has been a decline in the Ellenberg index of soil fertility. There have also been non-significant increases in suited species scores for Grazing and Moisture.

Table 52. Summary of suited species scores and Ellenberg values for vegetation in the Norfolk Broads monitoring (fixed 5-quadrat) sites.

Year	SSS G	SSS M	Ellenberg N	Ellenberg F
1987	-0.1667	0.50	4.893	6.808
1990	-0.1550	0.54	4.618	6.937
2012	-0.0433	0.58	4.098	6.915
S-value	5.71	1.13	29.15	0.48
Significance (P)	n.s.	n.s.	< 0.001	n.s.

SSS, suited species score: G, species suited to grazing; M, species suited to high moisture content (*Median values). Ellenberg indices: N, index of soil fertility; F, index of soil wetness.

These results show that there has been a change in species-composition at these sites with a decline in the frequency of more nitrogen-responsive species and an increase in frequency of less competitive species. There is also a possibility that there has been an increase in species favoured by increased grazing and moister soils, but this is not consistent between sites.

8.2.4 Sward height

This variable was not recorded in previous surveys, thus change in sward height could not be assessed.

8.2.5 Individual species – abundance

The only two taxa which showed significant changes in frequency between 1987 and 1990 were *Holcus lanatus* and *Poa* spp. Both of these taxa declined during this period. *Holcus lanatus* is a CSR strategist (Grime *et al.*, 2007), which although it has great ecological versatility is favoured by high nutrient levels, moist rather than wet soils and is intolerant of grazing. The three *Poa* species identified in 2012 are ecologically distinct and any pattern in their occurrence is difficult to interpret.

Table 53. Results of Friedman tests applied to species frequencies at optimum scale or DOMIN values for the Norfolk Broads ESA fixed 5-quadrat plots (significant results only, $P < 0.05$).

Species	1987	1990	2012	Trend	Friedman S	P (d.f. = 2)
<i>Holcus lanatus</i>	6.000	5.500	4.000	↓	12.75	0.002
<i>Poa pratensis/trivialis/sub</i> amalgam	0.833	1.667	0.000	↓	18.49	< 0.001

8.3 Discussion

8.3.1 Vegetation communities

The principal vegetation community recorded in the Norfolk Broads sites in 2012 was M22b. M22a was present where grazing had been at a sub-optimal intensity, and a single site newly entered into HLS had MG10a that was probably derived from agriculturally improved M22. This is a characteristic community of permanently moist and seasonally inundated soils with neutral to calcareous groundwater, managed by grazing and occasional cutting (Rodwell, 1991). It is typically species-rich vegetation of high conservation value, and examples surveyed here included a number of locally uncommon species including *Sagina nodosa*, *Anagallis tenella*, *Triglochin palustre*, *Epipactis palustris* and *Gymnadenia conopsea* ssp. *densiflora*.

All sites surveyed had previously been in the Norfolk Broads ESA, and four of these had been previously monitored at intervals since entering the scheme in 1987. The continued presence of vegetation of high conservation-value at these sites suggests that management carried out during the period of the ESA agreement had at least been effective at maintaining the ecological interest of these sites.

Canonical Correspondence Analysis of vegetation data collected at these four sites between 1987 and 2012 showed that the vegetation had changed between these dates, and that the trajectory of change had been broadly similar at all sites. NVC diagnoses are only available from 1987 and 2012, and unfortunately the 1987 diagnoses apply to individual quadrats with no classification for the whole stand, while the 2012 diagnoses apply to the whole stand. It is nevertheless possible to make some tentative deductions about the direction of change of the vegetation at these sites.

Vegetation in fields 79 and 80 was clearly similar in 1987, with three quadrats of MG8, two of MG6, two of MG9a, two of MG10 and one of M22b. Six of these 10 quadrats were in vegetation that is typically species-poor and found in agriculturally semi-improved situations. Four quadrats however were in richer MG8 and M22b communities, showing that there were areas of ecologically valuable vegetation present at the start of the scheme. By 2012, the vegetation in these fields was M22b. A similar transition had occurred in field 81, where two quadrats recorded as MG10 and MG9a semi-improved grassland, two quadrats as M27 tall-herb fen and a single quadrat of M22b in 1987, had all become M22b by 2012. In field 82 the change was not so great, where quadrats of M22b, MG8, MG9a and SD17 had become a mosaic of M22a and M22b by 2012.

Over all four fields there appears to have been an overall shift from a heterogeneous mosaic of semi-improved grasslands with patches of species-rich vegetation, to more uniformly species-rich M22b fen-meadow.

8.3.2 Species-richness

These changes from patches of species-rich vegetation within a matrix of semi-improved grassland to a more homogeneously species-rich community are reflected in the statistically significant increase in species-richness between 1987 and 2012 at these sites.

8.3.3 Plant community variables

Changes in ecological criteria lend some support to the conclusions about changes in vegetation community at these sites. There is a significant tendency for species favoured by low nutrient status to increase while those favoured by high nutrient status to decrease, and this is what might be expected in a change from partly agriculturally-improved grassland to a more semi-natural community. The non-significant trend towards an increase in species favoured by grazing and those favoured by moister soils also suggests that other management factors may be having an effect on the vegetation.

8.4 Conclusions

At the four sites in the Norfolk Broads where surveys have been repeated, there appear to have been significantly positive changes in the conservation value of the vegetation communities. Former semi-improved grasslands with patches of richer grassland have developed into more uniformly species-rich vegetation. Where the canopy of tall species such as *Juncus subnodulosus* is too closed at sites 79 and 80, this may be a temporary situation caused by a lack of grazing in 2012 resulting from flooding.

Three new sites were established in 2012: at two of these (84 & 85), the grassland was already species-rich but locally in sub-optimal condition; and at the third (83), the sward overall was semi-improved but included nuclei of species-rich vegetation and uncommon species. All three of these sites should show relatively rapid responses to improved management regimes.

9 UPPER THAMES TRIBUTARIES

9.1 Baseline setting

Eleven sites were surveyed in the Upper Thames Tributaries area. A 12th site was excluded as it was found not to be under HLS. Brief individual site reports are provided for each site in Appendix 7.

9.1.1 NVC communities

NVC community/sub-community was determined using a combination of MATCH analyses and expert opinion, which allows local variation, anomalies and ambiguities to be dealt with more accurately. MATCH analysis of each site is presented in Appendix 7 (included within the Table is an indication of the final NVC community to which each site was assigned). Vegetation at these sites was classified within the following NVC sub-communities.

- MG4 *Alopecurus pratensis*-*Sanguisorba officinalis* grassland
- MG6 *Lolium perenne*-*Cynosurus cristatus* grassland
 - MG6a Typical sub-community
- MG7 *Lolium perenne* leys:
 - MG7c *Lolium perenne*-*Alopecurus pratensis*-*Festuca pratensis* (flood pasture) grassland
- MG9 *Holcus lanatus*-*Deschampsia cespitosa* grassland
 - MG9a *Poa trivialis* sub-community
- MG9-related grassland
- MG11-related *Festuca rubra*-*Agrostis stolonifera*-*Potentilla anserina* grassland
- MG13 *Agrostis stolonifera*-*Alopecurus geniculatus* (wet alluvial meadow)-related grassland

Plus fragments or mosaics of several other communities including

- M27 *Filipendula ulmaria*-*Angelica sylvestris* mire
- S28 *Phalaris arundinacea* tall-herb fen

Table 54. NVC communities recorded in the seven ADAS plots and four new 5-quadrat based plots in the Upper Thames Tributaries, 2012. The NVC community determined in 2012 is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

Community	Sub-community	Sites
MG4		3
MG7	MG7b	1
MG9	MG9-related	2
	MG9a	2
MG11-related		1
MG13		1
MG9/S28/M27 mosaic		1
Total no. plots		11

The most frequently recorded community in the Upper Thames Tributaries was MG9, which was recorded at four sites with an MG9-related stand at a fifth. These sites (90, 95, 96 and 99) were characterised by constant and often high cover of *Deschampsia cespitosa* with *Agrostis stolonifera*, *Lolium perenne* and *Phleum pratense* with varying quantities of *Holcus lanatus*. The stands of MG9 in this area varied somewhat in their composition. Two sites supported a suite of fen-meadow species: site 99 was very wet and relatively species-rich with several positive indicator species such as *Ranunculus flammula*, *Galium palustre*, *Lotus pedunculatus*, *Mentha x verticillata*, *Oenanthe fistulosa* (affinities with M23b rush-pasture); whilst site 90 was better drained and supported abundant *Centaurea nigra* and *Lathyrus pratensis* with occasional *Sanguisorba officinalis* and *Filipendula ulmaria* (indicating a move to – or from – MG4). However, other sites (95, 96 and 97) were species-poor and grass dominated, with stands of *Phalaris arundinacea*, *Glyceria maxima* and/or *Carex acutiformis*. These sites had little in common with one another apart from the presence of *Deschampsia cespitosa*, and appeared to originate from improved MG7c/d stands that have a very high water table or more frequent flooding. These sites also suffered worst from *Rumex* spp. invasion. Their fit with MG9 was not always good, but they did not really fall into any documented NVC community being somewhere between MG9, an MG10-related community (without *Juncus* spp.) and a wet, less improved MG7c/d (although lacking *Lolium perenne*).

Three sites supported MG4: two of these were new sites first surveyed in 2012 (sites 88 and 91), whilst the third (site 92) was Yarnton Mead. MG4 is a typical community of flood-plain meadows that have been managed as traditional hay meadows with aftermath grazing and winter flooding. Yarnton Mead has been managed as a hay meadow for over 1000 years according to the SSSI citation. The MG4 encountered in these sites does not conform to the published community tables: *Alopecurus pratensis* – a usual constant – was far less frequent than expected and was replaced by *Agrostis stolonifera*. *Festuca rubra* was the dominant grass in all cases with *Cynosurus cristatus* and *Holcus lanatus*. Several other grasses were frequent: *Anthoxanthum odoratum*, *Dactylis glomerata*, *Agrostis capillaris* and *Arrhenatherum elatius*. *Arrhenatherum elatius* may indicate a relaxation of grazing or a shorter grazing period – perhaps in response to recent wet summers/winters. Sites 88 and 92 had a high frequency of *Deschampsia cespitosa* which can also colonise in wetter sites in the absence of sufficient grazing. Forb species at all sites included the typical constant *Sanguisorba officinalis* with *Filipendula ulmaria* (although absent at site 92), with frequent *Lathyrus pratensis*, *Centaurea nigra*, *Ranunculus acris*, *Silaum silaus* and *Lotus corniculatus*. A suite of other positive indicator forbs were also recorded, with sites supporting some or all of: *Succisa pratensis*, *Filipendula vulgaris*, *Primula veris*, *Serratula tinctoria*, *Galium verum*, *Galium uliginosum*, *Thalictrum flavum* and *Linum catharticum*. These sites were species-rich, generally with over 20 species per m², and often with just under 30 m⁻². The MG4 at site 92, Yarnton Mead, whilst being the main community, was in mosaic with several other stand types in response to local variation in topography and hydrology, such as *Carex acutiformis*, *C. riparia* and *Juncus acutiflorus*.

Three sites (89, 94 and 98) appear to be derived from recently improved MG7 stands. Site 89 (a new site) supported MG7b, although a small corner – originally part of a separate unit – supported reasonable MG4. The MG4 area has been unimproved in recent history, whilst the larger area has clearly been subject to much improvement. However, although still largely grass dominated with an *Agrostis stolonifera*–*Lolium perenne*–*Phleum pratense*–*Holcus lanatus* sward forbs included constant *Lotus corniculatus* and a few plants of *Filipendula ulmaria*, *Sanguisorba officinalis*, *Agrimonia*

eupatoria and *Leucanthemum vulgare* just in the area closest to the existing MG4 stand. Floristic diversity in this hay-cut and sheep grazed field appears to be increasing.

MG13 – a typical community of the wetter alluvial meadows – was only recorded at site 98. A typical *Agrostis stolonifera*–*Alopecurus geniculatus* stand was recorded, sometimes with *Alopecurus pratensis* in addition to, or replacing *A. geniculatus*. Derived from MG7c this stand has few positive indicators but occasional plants of *Caltha palustris*, *Eleocharis palustris*, *Achillea ptarmica*, *Filipendula ulmaria* and *Oenanthe fistulosa* were recorded. There is a ready seed-source of forb species at the top end of this field on drier ground where a more species-rich stand with many additional forbs typical of MG4/8 were noted.

Site 94 defied classification. It has been recorded as MG11-related as its defining feature is the dominance of *Agrostis stolonifera*. *Festuca rubra*, *Holcus lanatus* and *Alopecurus pratensis* were also constant but the stand largely lacked *Lolium perenne*. Forbs were few with only *Ranunculus repens* of any frequency, although there were scattered individuals of several fen species. 40% of the field was extremely low-lying and supported *Glyceria maxima* swamp with *Typha latifolia* and *Phalaris arundinacea*. For any nondescript plot that has constant *Holcus lanatus* MATCH analysis gives a diagnosis of MG10, and where it includes any *Deschampsia cespitosa* MG9 is given as best fit but the sward here lacked *Juncus effusus*, or much *Juncus inflexus*, and was mostly lacking *Deschampsia cespitosa*. The community is transitional and typical of stands of species poor grasslands that have undergone some agricultural improvement in the past, and perhaps also suffered periods of neglect or relaxation of management in response to flooding events.

9.1.2 Species-richness

Of the new sites with 5-quadrat sampling, mean species richness (per m²) ranged from 15.4 to 21.8, with the two MG4 sites supporting most species (a total of 33 and 42 species in total spread across the 5 sq. m of the five sample quadrats; mean species per m² = 17.8 and 21.8). The MG9a site (90) supported a total of 32 species across the five quadrats with a mean of 15.4 per m², whilst the MG7b sites supported a total of 25 species in the sample with a mean of 15.8 per m². The vegetation in the MG9 site, therefore, was slightly more heterogeneous.

The mean total species richness for the existing sites with ADAS plots was 23.57 ± SE 1.47 for the 16 sq. m of the ADAS nests sampled. The richest site was the MG4 site (site 92), with a total of 52 species per plot, and a mean of 20 species per m² (for the three 1m² NVC quadrats recorded). With the exception of the MG9 site on Otmoor (site 99), which had relatively high species diversity for this habitat (35 species per ADAS plot), the other MG9- and MG11-related sites were similar in diversity (22–26 species per ADAS plot). The sole MG13 site was the least diverse with a total of 14 species per ADAS plot.

The species diversity of the new 5-quadrat sites and the ADAS plot sites cannot be directly compared as they relate to differing sample areas in m².

9.1.3 Option types

The option for all three of the new sites (88, 90 and 91) and also for site 92 is HK6 (maintenance of species-rich semi-natural grassland). Three of these sites support MG4 and are species-rich so management appears appropriate for a 'maintenance' option. Site 90, whilst showing some affinities

with a species-rich grassland type (MG4 or MG5) lacks sufficient indicator species and some degree of additional enhancement might be beneficial; a restoration option (i.e. HK7 restoration of species-rich, semi-natural grassland) might be more appropriate.

All other sites in the Upper Thames tributaries visited were under HLS options for breeding/wintering waders. Sites 89, 94, 97 and 99 were all in a 'maintenance' option: HK9 (maintenance of wet grassland for breeding waders) for sites 94 and 99; HK10 (maintenance of wet grassland for wintering waders/ wildfowl) for site 89; and HK15 (maintenance of grassland for target features – lapwing & curlew) for site 97. With the exception of site 99 these are largely species-poor stands of wet grassland with areas of tussocky grassland and/or rushes and these options appear suitable. Sites 95, 96 and 98 were all under restoration option HK11 (restoration of grassland for breeding waders): these sites appear transitional and restoration options more appropriate.

9.1.4 Soil properties

Soil pH ranged from the mildly acidic (pH 6.1 and 6.2 at sites 88 and 90, respectively) to quite calcareous (pH 7.7 and 7.8 at sites 95 and 96). The higher pH value may be related to a higher water table and frequent flooding events. Most sites, however, were circumneutral. Soil phosphorus levels (Olsen's P) are extremely low to low at all but three sites (94, 95 and 97) where it is moderate: Total P (which includes inorganic plus organic phosphorous) also suggested that a fourth site (98) had higher phosphorous levels. Sites with a low P index have highest potential for the restoration of species-rich grassland; four sites with the lowest Index P value of 0 are species-rich semi-natural grassland under option HK6 (maintenance of species-rich grassland). Sites 95 and 97 were species poor although they are under 'breeding/wintering wader' options HK11 and HK15. Potassium levels were low to moderate, but not sufficiently low (Index K = 0) to result in low herbage yields. Magnesium levels were high (index MG = 3) to very high (Index MG = 4 and 5) at all sites, with the exception of site 94 where it was moderate. Total nitrogen was medium (for long-term grass) for sites 88, 89 and 90 but high >1% for all other sites, but nitrogen content can vary with moisture and temperature: all sites had quite high organic matter content (as measured by loss on ignition and organic carbon).

Table 55. Results of soil analysis for soil samples collected from the Upper Thames Tributaries monitoring survey sites in 2012.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 88	6.1	4	0	164	2-	225	4	0.90	25.0	746	25.0
LWG 2012 89	6.8	5	0	219	2+	250	4	0.70	20.1	758	20.1
LWG 2012 90	6.2	5	0	126	2-	210	4	0.81	20.7	1028	20.7
LWG 2012 91	6.8	6	0	83	1	129	3	1.59	36.9	1183	36.9
LWG 2012 92	6.9	5	0	119	1	144	3	1.36	31.9	1025	31.9
LWG 2012 94	7.6	24	2	143	2-	74	2	1.08	24.7	1658	11.1
LWG 2012 95	7.8	16	2	137	2-	106	3	1.19	23.9	1482	23.9
LWG 2012 96	7.7	10	1	129	2-	106	3	1.19	25.6	1446	25.6
LWG 2012 97	7.1	20	2	133	2-	146	3	1.29	28.4	1910	28.4
LWG 2012 98	6.9	14	1	128	2-	114	3	1.39	31.7	1859	31.7
LWG 2012 99	6.4	7	0	298	3	288	5	1.22	29.4	997	29.4

9.1.5 Plant communities in relation to soil properties

In Canonical Correspondence Analysis (CCA; CANOCO 4.5) of the ADAS plot sites none of the soil variables were significantly related to vegetation composition in plots recorded in 2012 (Fig. 12) or to individual species (data not shown). There were too few new sites to permit the analysis.

Figure 12. CCA biplot (CANOCO 4.5) showing the relationships between soil properties (vectors) and the vegetation composition in the sample plots at each survey site in the Upper Thames Tributaries, for existing ADAS plot sites only.

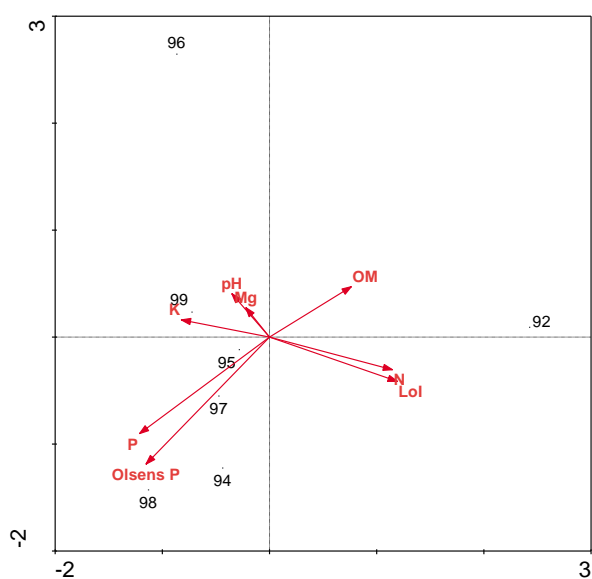


Table 56. CCA analysis of the relationships between soil properties (vectors) and the vegetation composition in the sample plots at each survey site in the Upper Thames Tributaries, for existing ADAS plot sites only: eigenvalues for the first four canonical axes.

Region	Axis 1	Axis 2	Axis 3	Axis 4
Upper Thames Tributaries	0.613	0.553	0.445	0.438

9.1.6 Condition Assessment

Site condition was assessed using Common Standards methods as used by Natural England for condition assessment of SSSIs (or the HLS condition assessment for BAP habitat G06 lowland floodplain meadows for non-SSSI) and also using the Indicators of Success for sites under Higher Level Stewardship described in site dossiers for each site. However it should be noted that seven of the 11 sites assessed were being managed for breeding or wintering waders/wildfowl rather than for species-rich grassland. Assessment of non-botanical indicators of success for 'bird' options was outside the scope of this project as it required bird survey and assessment of the sward beyond the survey period (e.g. sward height in April/May).

Table 57. Condition assessment of sites in the Upper Thames Tributaries.

Site number	HLS Option	Common standards assessment/SSSI/BAP habitat G06	Indicators of success
88	HK6	*Pass	Pass
89	HK10	Fail: only 1 +ve indicator frequent, 2 rare	Not assessed – breeding/wintering waders option
90	HK6	Fail: only 1 +ve indicator frequent, 1 occasional, 3 rare	Fail: only 1 +ve indicator frequent, 1 occasional, 3 rare
91	HK6	Pass	Pass
92	HK6	Pass	Pass
94	HK9	*Fail: no positive indicator species.	Not assessed – breeding/wintering waders option
95	HK11	Fail: no +ve indicator frequent, only 1 rare. Negative species >5%; indicators of waterlogging>30%.	Not assessed – breeding/wintering waders option
96	HK11	Fail: only 1 +ve indicator frequent: indicators of waterlogging >30%.	Not assessed – breeding/wintering waders option
97	HK15	Fail: only 1 +ve indicator frequent, 2 occasional, 1 rare.	Pass on HK15 indicators.
98	HK11	Fail: 0 +ve indicator frequent, 2 occasional, 5 rare.	Not assessed – breeding/wintering waders option
99	HK11	*Fail: although 3 +ve indicator frequent, 1 occasional, 2 rare the site fails on: indicators of waterlogging >30%.	This site may pass the botanical IoS as c. 50% cover of <i>Deschampsia</i> and large <i>Carex</i> is a pass for breeding/wintering waders option

*SSSI

9.2 Analysis of change in vegetation communities over time

9.2.1 Vegetation community composition

Analysis of the vegetation data collected between 1988 and 2012 using Detrended Correspondence Analysis shows the pattern of change that has occurred since monitoring started (Fig. 13). Eight ADAS plots were sampled in 1995, 2003 and 2012: all plots with the exception of plot 93 followed the same trajectory of change. However, site 93 was not resampled in 2012 as it was not under HLS (and therefore out of the scope of this project). Very little change is shown for the MG4 site (92).

9.2.2 NVC community change

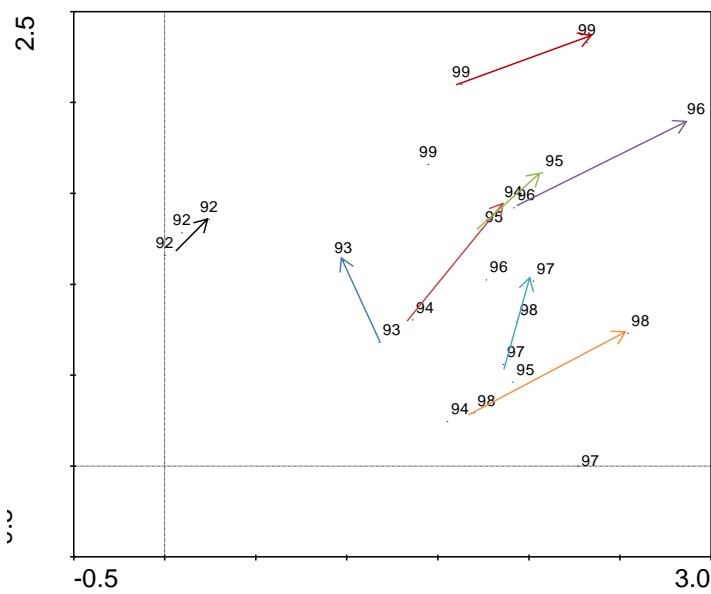
Site 92 (MG4) has seen no change in NVC community since 1995. Sites 97 and 99 were classified as the same NVC community in 1995, 2003 and 2012 (MG9), although the proportion of rushes has increased in site 99 and site 97 is fairly atypical.

The three sites that were improved grassland (MG7c) in 1995 have all been classified as different NVC communities in 2012. Site 94 is more species-rich than one would expect for MG7 and supports several fen-meadow species, although it has occasional *Deschampsia cespitosa* the community has been reclassified as MG11-related, although it may be somewhere between MG9 and MG11. Site 95 appears to have also seen a change, with more *Deschampsia cespitosa*, and now has closer affinities with MG9. Site 98 was classified as MG7c but was found to be fairly typical MG13: the species

compliment in the plot has changed little since 1995, apart from a reduction in *Lolium perenne*, so the shift from MG7c to MG13 is subtle.

Site 96 has become almost unclassifiable due to its mosaic of communities and invasion by *Phalaris arundinacea* and *Carex acutiformis* following a cessation in management and increased flooding: it was classified as MG10 in 1995, then MG9 in 2003 – it is now an MG9/S28c/M27 mosaic.

Figure 13. DCA plot of change in vegetation in ADAS monitoring plots in the Upper Thames Tributaries between 1995 and 2012: 1995 data and 2012 data from the same plots are linked by arrows.



9.2.3 Species richness

Species richness has remained similar over the entire period although there appears to be a small, if non-significant increase. This is different to the result reported in Manchester *et al.* (2005), where there was a significant increase in species richness from 1995 to 2003 (23.49 ± 1.35 to 26.56 ± 1.46), but this was for a much larger data set of 39 monitoring plots.

Table 58. Mean number of species in Upper Thames ESA ADAS plots.

Year	Mean	SE
1995	22.87	1.79
2003	24.52	1.45
2012	23.57	1.47
F-value	0.24	
P-value	n.s.	

9.2.4 Sward height

Analysis of change in sward heights did not yield significant or useful results. There was insufficient replication and the data were not normally distributed. The raw data (mean per plot) is provided.

Table 59. Sward heights in Upper Thames ESA ADAS plots.

ADAS plot	1995	2003	2012
92	20.63	26.31	27.56
94	26.06	11.75	18.56
95	23.25	13.81	11.50
96	11.13		61.19
97	19.69	16.88	26.13
98	4.88	6.50	5.75
99	18.88	31.38	20.88

Site 98 (MG13) has had a consistently short sward from 1995–2012, reflecting consistency in either management and/or vegetation composition. The sward at site 95 was much shorter in 2012 and 2003 than in 1995: this could be due to localised differences resulting from cattle grazing, or may reflect a real change overall. Plot 96 appears to have seen a vast increase in sward height: this plot could not be relocated in 2012 and there is, therefore, possible error in the replication of the sward heights for the plot. This plot in 2012 was located in a tall stand of *Phalaris arundinacea*: however, this site has also seen a withdrawal of management and it is possible that the sward in the unit is generally taller. Other differences recorded may be attributed to differences in the timing of the survey, localised grazing, or different environmental conditions.

9.2.5 Soils

Table 60 shows the analysis of changes in the levels of soil variables over the three recording periods in the Upper Thames.

Table 60. Soil values in Upper Thames ESA ADAS plots: all years. Significance at $P < 0.05$.

Year	pH	Total N	Olsen Ext P	Ext K Litre	Ext Mg Litre	ADAS P	ADAS Mg
1995	6.933	1.215	11.36	104.97	107.74	1.0	2.667
2003	6.767	-	27.56	142.06	107.51	3.0	2.5
2012	7.075	1.24	10.44	131.0	145.51	1.0	3.333
S-value	4.33	-	9.33	2.33	4.0	12.0	6.5
Wilcoxon signed rank		8.0					
P-value	n.s.	n.s.	0.009	n.s.	n.s.	0.002	0.039

The 2003 results for Total N were excluded as the results returned were unreliable, but analysis using a paired Wilcoxon of change in N from 1993 to 2012 was carried out and no significant change was found. A significant change in P was found, with an apparent increase from index 1.0 in 1995 to 3.0 in 2003, but decreasing to index 1.0 again in 2012. The reasons for this are unclear. High P is

usually related to application of inorganic fertilisers, which is unlikely to have occurred at these sites from 1993–2003. Additionally, P is very insoluble and its reduction from index 3.0 in 2003 to index 1.0 in 2012 is surprising. The 2003 result may be unreliable for unknown reasons. In conclusion, each of the soil values recorded was at more or less the same levels in 2012 as in 1995. This data set suffered from a small sample size.

9.2.6 Ecological criteria

No significant changes in the suited species scores or the Ellenberg indices were found in analysis of data from 1995, 2003 and 2012.

Table 61. Plant ecological criteria values in Upper Thames ESA ADAS plots.

Year	SSS G	SSS M*	Ellenberg N	Ellenberg F
1995	– 0.01	0.38	5.31	6.29
2003	– 0.07	0.23	5.47	6.19
2012	– 0.07	0.42	5.18	6.53
F-value	0.8	S-value=4.57	1.98	2.88
Significance (P)	n.s.	n.s.	n.s.	n.s.

SSS, suited species score; G, species suited to grazing; M, species suited to a high moisture content (*Median values); Ellenberg indices: N, index of soil fertility; F, index of soil wetness.

9.2.7 Individual species – abundance

Only two species (or amalgams) showed a notable change in optimum frequency from 1995 to 2012. The *Festulolium* amalgam (including *Lolium perenne*, *Festuca pratensis* x *Lolium perenne* and other *Festulolium* hybrids) showed a decrease over time, whilst *Rumex crispus* increased: neither result was significant at $P < 0.05$ but is worth highlighting. With such a small data set significant events are harder to determine.

Table 62. Results of Friedman tests applied to species frequencies at optimum scale or DOMIN values for the Upper Thames ESA ADAS plots ($P < 0.10$).

Species	1995	2003	2012	Trend	Friedman S	P (d.f. = 2)
<i>Festulolium</i> amalgam	4.0	6.0	1.0	↓	5.15	0.076
<i>Rumex crispus</i>	0.0	0.0	4.0	↑	5.78	0.056

9.3 Discussion

The majority of stand types recorded in the eleven sites in the Upper Thames Tributaries were mesotrophic, neutral grassland. The range of NVC communities recorded were limited to MG4, MG7c, MG9 and related stands, MG11-related, MG13 and some swamp and tall herb fen communities in mosaic (S28 and M27).

The most frequent vegetation type was MG9 (MG9a, 3 sites; MG9-related, 1 site; MG9 in mosaic with S28/M27, 1 site). The floristically-rich MG4 was recorded three times. However, little can be discerned from the frequency of these NVC communities in the sample as there were only 11 sites. A greater sample size would reveal more about the frequency of NVC stand types in the Upper Thames area. In the 2003 survey Manchester *et al.* (2005) also recorded higher incidences of MG9 than MG4, and that survey also recorded much MG6, which was missing from this survey.

There does appear to have been a change in the vegetation recorded in the seven sites that were part of the original ESA monitoring programme. Although not indicated in the analysis, there has been an increase in *Deschampsia cespitosa* at several sites. Site 95, having previously been described as MG7c, in 2012 had *D. cespitosa* in all 16 nests (it was recorded in 5 cells in 1995 and 2 in 2003). At site 96, *D. cespitosa* had already increased from 4 to 10 nests from 1995 to 2003, and this frequency was maintained in 2012. *Rumex* spp. had increased on both these sites too. *Rumex crispus*, which readily colonises bare ground, may increase after periods of prolonged flooding that creates areas of dead vegetation and open ground. Management on both these sites has changed: on site 95 HLS is perceived as more restrictive in its prescriptions than the former whilst management on site 96 has changed from hay-cutting with aftermath grazing to largely unmanaged. Both these sites are being managed under HLS option HK11: a restoration option to benefit breeding waders, rather than for species-rich semi-natural grassland.

Site 94 also appears to be moving away from the MG7c community recorded in 1995 and 2003, with a species-poor and coarse grassland sward with few obvious affinities to any NVC community developing. This is typical of many stands of species poor grasslands that have undergone some agricultural improvement in the past, and perhaps also suffered periods of neglect or relaxation of management in response to flooding events – such stands share similarities with poor rush-pasture but often lack any rushes. They support a *Festuca rubra*–*Holcus lanatus*–*Phleum pratense* sward, often with *Hordeum secalinum*, *Carex hirta* and *Ranunculus repens* but few other forbs. This site too is under HLS option HK9 for breeding waders. Whilst a move away from the agriculturally improved MG7 stand type in favour of a less improved MG9 can be viewed as positive, increases in *D. cespitosa* and other coarse species can be viewed as negative for plant species diversity, or positive for breeding/wintering waders. It's a matter of perspective as to whether the management is benefitting the sites or the reverse.

At site 98 the move away from MG7 to a species-poor MG13 in the plot was subtle, with only a loss of *Lolium perenne* to mark it as all other species have been constant from 1995 to 2012. There are signs of increasing species diversity with occasional records in the wider site for positive indicator species of semi-natural wet grasslands such as *Caltha palustris*, *Galium palustre*, *Oenanthe fistulosa* and *Eleocharis palustris*. It seems that this site is heading in the right direction in terms of species diversity. The aim of HLS is once again for breeding waders (HK11).

At the single MG4 site of the 1995 sample, Yarnton Mead (site 92), there has been an increase in *Carex acutiformis* and a decrease in *Carex flacca* perhaps in response to recent wet summers. In 2012 the baled hay could not be removed from the site because it was too wet. The other two MG4 sites were new to the monitoring programme in 2012, and both supported good quality MG4 with quite high species diversity. These sites too had indicators of waterlogging, but at Site 88 *Deschampsia cespitosa* and *Phalaris arundinacea* were restricted to the furrows of the historic ridge

and furrow system. At site 91 *Phalaris arundinacea* and *Cirsium palustre* were associated with a low lying, more waterlogged area. All three MG4 sites are under option HK6 (maintenance of species-rich semi-natural grassland) and are hay cut and aftermath grazed. These sites, with site 99, had the lowest levels of soil phosphorous – which is important for establishing and maintaining a species-rich sward – and the lowest levels of soil nitrogen.

There has been no significant change in species richness over the course of the three monitoring surveys although a larger data set may have revealed more. The changes noted in species composition seem to be more in the cover of individual species, rather than an increase or decrease in diversity. Although mean sward height increased significantly from 1995 to 2003, it was fairly similar in 2012 to 2003. In fact, sward height varied hugely between sites depending upon community type and current management. Sites supporting MG13, and grazed sites had shorter swards whilst those managed as hay meadows were much taller. The tallest stands included those where *Phalaris arundinacea* and *Carex acutiformis* were abundant.

9.4 Conclusions

Differences in species diversity in the Upper Thames sites, and the condition of these sites in terms of common standards monitoring were a reflection of the stand type present and the management aim under HLS. MG4 sites were species rich and managed for (HK6) maintenance of species-rich, semi-natural grassland. These sites (two of which were SSSIs) passed the condition assessment and met all indicators of success under the HLS agreement. Only one site had previously been monitored and no significant changes were noted other than an increase in *Carex acutiformis*. A fourth site had the potential to support MG4 but it failed the condition assessment and indicators of success: it was a moderately species-rich MG9.

All remaining sites were previously either MG7c or MG9, and in 2012 were a variant of MG9, MG11 or in one case MG13. All of these sites failed the condition assessment for BAP habitat lowland floodplain meadow, either on lack of positive indicator species or on excess cover of species indicating waterlogging. However, all of these sites are under HLS management for breeding waders (HK9, HK11, HK15) and their aim is to provide tussocky grassland with flooded areas. They did not start the monitoring programme as species-rich grassland and, with the exception of the SSSI site at Otmoor, were species poor. Management at some of these sites was said to be more restrictive than under the previous ESA agreement, and anecdotal evidence of an increase in tussocky species (called variously rush, sedge or grass depending on the botanical expertise of the farmer) was supported by a rise in species indicating waterlogging, particularly *Deschampsia cespitosa* and/or large *Carex* spp. This conforms to the HK9/11 requirement for high cover of tussocks of grass or sedge, but is at odds with management for species-rich lowland meadow.

The data set for the Upper Thames Tributaries was very small with just 11 sites, only seven of which had been monitored previously. Statistical analysis of vegetation data in relation to variables such as soil properties, sward height, species richness and change over time showed no significant differences.

10 DISCUSSION – WHOLE SAMPLE

10.1 Relocation of plots

Each site included within the resurvey of sites in this project had been permanently marked during the baseline survey in either 1988 (5-quadrats) or 1993 (ADAS plots). Individual quadrats or ADAS plots had been marked with metal pipes or plates. Further, sketch maps were made of their location and measurements (distance and bearing) taken from field corners (or other notable features). These were to aid the relocation of plots for future surveys. All such documentation was supplied to the surveyors for the 2012 resurvey.

The success rate in relocating was variable but the relocation rate for all former ESAs combined was only 40% (Table 63). The least success at relocation was in the Test Valley where only 2 of 9 sites were relocated, and the greatest was the Broads where all 4 plots were refound. The success at relocating plots was higher for the 5-quadrat method of sampling than for the single ADAS plot. The reasons for not refinding plots were fairly consistent between ESAs.

Table 63. The number of plots relocated per ESA as a percentage of the total.

	ADAS nested plot	relocated	5-quadrats	relocated	Overall %
Somerset Levels and Moors	21	6 (29%)	9	6 (67%)	12 (40%)
Test Valley	0		9	2 (22%)	2 (22%)
Avon Valley	19	8 (42%)	0		8 (42%)
The Broads & Nene Valley	0		4	4 (100%)	4 (100%)
Upper Thames Tributaries	8	3 (38%)	0		3 (38%)
Total	48	17 (36%)	23	12 (52%)	29 (40%)

Generally the locations of the five individual quadrats were easier to refind than the ADAS plots. This might be because these sites had a total of 7–9 marker pins, all located on a single line transect running from field corner to field corner: one at each field corner origin, one at each quadrat and usually one at the 5, 10 or 20m mark along the transect. There were therefore more chances to find a marker pin along a single bearing and once one or two had been found, it was easy to relocate the others along the same line using the distances provided. The ADAS plots however, had fewer marker pins along the transect (4: 1 at origin, 1 at 5, 10 or 20m mark, plus 2 at the plot) and therefore fewer chances of finding a marker. There was also more room for error as it was not always clear, if the bearing was incorrect, which of the four corners had been relocated.

The reasons for failing to refind plot markers at all were due to the following reasons:

- Origin buried or even removed.
 - It was common occurrence to find that field-margin ditches had been dredged or cleared and that the resulting material had been dumped in the field corner on top of the origin (frequent occurrence in Somerset Levels).
- Field corners reshaped.

- Ditch dredging and clearance often reshapes the corners of the fields and thus the field corner visible in 2012 may not have been the field corner in 1998 or 1993 (frequent occurrence in Somerset Levels).
- Origin landmark missing.
 - Such features as ‘fence-post’ or ‘tree’ were frequently used to locate the origin marker in 1988/1933. After 20–25 years many fences had been replaced or trees removed (frequent occurrence in Avon Valley, Test Valley and Upper Thames).
- Marker pins buried or removed.
 - In highly waterlogged sites, many of which were peat, with stock grazing it is highly likely that after 20–25 years many of the metal pins would have sunk further, been buried through trampling or been accidentally removed by stock.
- Vegetation structure hiding markers.
 - Many sites supported coarse, rank vegetation with high cover of tussock-forming species such as large-leaved *Carex* spp., *Juncus* spp. or *Deschampsia cespitosa*. The metal detectors could not detect the metal markers through this type of vegetation (frequent in MG8, M22, M23, MG9 and MG10 sites at all ESAs).
- Flooding.
 - In the extreme flooding of 2012 many sites were simply too deeply flooded for the metal detectors to operate correctly (frequent occurrence in Somerset Levels and Avon Valley).
- False positives.
 - Multiple metal readings from discarded metal (fencing, hard core, broken electric fencing equipment etc.) made refinding the exact location of the metal marker pin impossible in some sites (frequent occurrence in Avon Valley and Test Valley).
 - ‘Ground noises’, i.e. magnetic properties of minerals in the soil.
- Inaccurate measurements provided.
 - Discrepancies were found in the measurements provided for many plots, including erroneous distances to the plot, or more frequently, inaccurate compass bearings. In some plots (Avon Valley) the distances were in paces but this is a highly variable measure and no information was provided as to length of pace.

In 2012, where discrepancies in the measurements or other details provided were discovered, for those plots that were eventually refound, a note was taken of the correct variables.

Modern handheld GPS units were also used to record the 10-figure grid-reference of each ADAS plot or each of the five quadrats.

Manchester *et al.* (2005) highlighted the inaccuracy of the ADAS plot method for tall and/or tussocky vegetation as it is inherently difficult to lay out the 32 nests in the plot accurately, and this will have an effect on the data recorded. From the 2012 survey it also seems apparent that both plot relocation and accuracy in data sampling was greater for the 5-quadrat method of sampling.

10.2 Vegetation communities

Table 64 shows the NVC community types recorded in the 2012 survey and the number of sites assigned to each NVC community (to community level only).

Table 64. The number of stands assigned to each NVC community (to community-level only) in each of the study areas in the 2012 survey.

NVC community	Somerset Levels	Test Valley	Derwent Valley	Avon Valley	Itchin Valley	Broads & Nene	Upper Thames	Total
MG1					2			2
MG4			2			1	3	6
MG4/MG7/S28			1					1
MG6	1			1				2
MG7	2		1	4			1	8
MG8	10		1	4	2			17
MG8/M22	2							2
MG8/M23	1							1
MG8/M27		1						1
MG8/S6/S7					1			1
MG9	1	1	1	5			4	12
MG9/S28/M27							1	1
MG10	4		1	2	1	1		9
MG11				9			1	10
MG13	7			1			1	9
M22	2	5				6		13
M22/M25		1						1
M22/M24/M25		1						1
U4		1						1
S5						1		1
	30	10	7	26	6	9	11	99

MG8 and M22

MG8 and M22, or these communities in mosaic, make up 22% and 15% of the sample, respectively.

The most frequently encountered community in 2012 was MG8 with 17 sites, plus a further 5 sites that included MG8 within a mosaic of other mire or swamp communities. MG8 is a typical community of regularly inundated fields, often managed as permanent pasture. The Somerset Levels included 59% of all MG8 and MG8 mosaic sites sampled, with nine sites on Tealham and Tadham Moors SSSI and the remaining four sites spread across three separate SSSIs. MG8 was also recorded in a small proportion of sites in the Test valley, Derwent Valley, Avon Valley and Itchen valley. Most MG8 sites were being managed as hay-meadow with aftermath grazing rather than as permanent pasture.

Many MG8 sites showed a degree of movement towards a more rush dominated sward with *Juncus acutiflorus/articulatus* the most frequent rush encountered, but some stands had seen an increase in *Juncus effusus* or *Juncus subnodulosus*. The communities were often deemed to be transitional to

M22, M23 or to the more depauperate MG10. In one site in the Itchen MG8 was recorded in mosaic with a swamp community (S6/S7); whilst in the Test Valley it was found in mosaic with M27. Three former MG8 sites in the Somerset Levels were reclassified as M22 or MG10 in 2012.

Many of the MG8 stands were of high conservation value with moderate to high species richness and a wide range of positive indicator species although many were at low frequencies. Whilst some MG8 stands had increased in species richness (2 of 9 sites on Tealham Moor in the Somerset Levels, 7% and 45%; 2 of 3 Avon Valley sites, 16% and 75%), some had seen a reduction in species richness from the original 1988 baseline survey, notably those 5-quadrat sites in the individual SSSIs on the Somerset levels. These sites had suffered an 18–46% decrease in species richness.

M22 was recorded in 13 sites across the Somerset Levels, Test Valley and Norfolk Broads; a further two sites supported M22 in mosaic with M24 and/or M25. The majority of M22 stands were also of high conservation value and of moderate species richness to high species richness. Two of the Somerset Levels M22 sites were derived from former MG8 stands that had declined in species richness and become a coarser rush-dominated community. The less species-rich M22a sub-community was more frequently encountered in the Somerset Levels whilst the more species rich M22b sub-community was more frequently encountered in the Norfolk Broads.

The relationship between MG8 and M22 is close; in Rodwell (1998b, p.80) this is acknowledged and in Rodwell (1998a, pp. 237–8) it is suggested that there may be an argument for subsuming MG8 within M22 as a sub-community (.). However, although the two communities show many floristic similarities, MG8 is characteristic of traditional managed, periodically inundated pasture, occurring only occasionally around springs and flushes, whilst M22 can be viewed as a wider community occurring over a range of moist soils and very characteristic of base-rich springs, flushes and mires.

MG9 and MG10

MG9 or MG9-related stands/mosaics and MG10 make up 13% and 9% of the sample.

MATCH analysis often gave similar scores for MG9 and MG10 for a series of species-poor, rank swards with frequent *Deschampsia cespitosa* and *Juncus effusus* that appeared to have originated from improved MG7 stands: generally the floodplain grasslands MG7c or MG7d. Their lack of conformity to any particular community and their general lack of conservation value – at least in terms of floristic diversity – was the common denominator. MG9 and MG10 were recorded in all sample areas but the Avon Valley and Upper Thames had the highest number of MG9 sites (five in each area) and the Somerset Levels had the highest number of MG10 sites (four). One of the Somerset MG10 sites was originally classified, in 1988, as MG8 but had suffered significant decline in species richness (45% reduction). Conversely, two former MG10 sites in the Avon Valley had shown positive change, with closer affinities to MG8 in 2012.

In 1993 many more Avon Valley sites were classified as MG10 but in 2012 these were reclassified: sometimes reflecting community change but often reflecting differences in surveyor opinion. Several MG10 sites had been classified as MG11-related or MG13-related as they had a high cover of *Agrostis stolonifera*, or as atypical MG7c: there was a tendency to record all species-poor stands with a high proportion of *Holcus lanatus* as MG10, as this is a community MATCH defaults to in such cases, but often these sites lacked any or sufficient *Juncus effusus* for this interpretation. Several of

the former MG10 sites were reclassified as MG9: these sites had seen a rise in frequency of *Deschampsia cespitosa*.

MG11-related stands

MG11-related stands make up 10% of the sample.

There is much doubt about the true affinities of these communities as often the vegetation considered as MG11 do not contain, or contain very little *Potentilla anserina* as community constants. This was indeed the case in the Avon Valley, which recorded this community in 9 plots (5 sites). However, the abundance of the other community constants, particularly the grasses *Agrostis stolonifera*, *Holcus lanatus*, *Festuca rubra* and the broad-leaved *Ranunculus repens* gives these species-poor communities a strong affinity to these communities. This community was recorded once in the Upper Thames.

MG13

MG13 accounts for 9% of the sample.

MG13 was the most frequent on Wet Moor in the Somerset Levels (six sites) and also recorded (single sites) on Tealham Moor (Somerset Levels), Avon Valley and the Upper Thames. These were largely cattle-grazed pastures with low species diversity, high levels of inundation and a tendency to have exhibited a move towards the highly waterlogged swamp community types such as S28 and S19. One former MG13 site in the Avon Valley had shown positive change to become an MG8 stand. One existing MG13 stand in the Upper Thames had changed from MG7c.

MG7

MG7 accounts for 8% of the sample.

The improved species-poor floodplain grassland communities of MG7c and MG7d were recorded in the Avon valley, Somerset Levels, Derwent Valley and Upper Thames. These sites were of low conservation value floristically, and supported a grass-dominated stand with few forbs. These sites had exhibited little change since the baseline survey..

MG4

MG4 and mosaics of this community account for 7% of the sample.

The traditional hay-meadow community MG4 was recorded in three sites in the Upper Thames Tributaries, two sites in the Derwent Valley and a single site in the Nene Valley. One of the three sites in the Upper Thames has been consistently recorded as MG4 since 1993. This site had seen a small reduction in species richness and an increase in cover of *Carex acutiformis*. All other sites were new sites for the 2012 survey: one of these, in the Derwent Valley, occurred in mosaic with improved species-poor MG7 and *Phalaris arundinacea* dominated S28.

All other communities

The remaining 6% of the sample comprised MG1, MG6, U4 and S5.

10.3 Species richness

Species richness in the ADAS plots in the Somerset Levels, Avon Valley and Upper Thames Tributaries was similar in 2012 (mean 22.49, 24.85 and 23.57 ± 1.47 , respectively). Change in species richness over the 20-year survey period was not the same however: the Somerset Levels saw no significant change; the Avon Valley saw a significant increase from 1993–2003 and a small decrease from 2003–2012, but the 2012 species richness was still higher than at the baseline survey; finally, the Upper Thames saw a small but insignificant increase.

Species richness in the 5-quadrat plots, which is not comparable with the ADAS plots due to the difference in sample area, was also broadly similar in each former ESA, with a species richness for the Somerset Levels the lowest ($14.96 \pm SE 5.16$, showing wide variation); the Test Valley moderately higher (16.6); and the Norfolk Broads sites the highest (17.25). The pattern of change was different however, with both the Somerset Levels and Test Valley sites seeing a significant decline in species diversity in the 5-quadrat plots from 1998 to 2012 (20.10 to 14.86, and 26.07 to 16.6, respectively; whilst the Norfolk Broads sites showed a significant increase in species richness (13.65 to 17.25 from 1987–2012).

10.4 Ecological criteria

The Somerset Levels and Test Valley showed significant decreases in the suited species grazing score, whilst the Avon Valley also shows a steady (though not statistically significant) downward trend away from grazing-suited species. The Norfolk Broads showed a small but non-significant rise in the suited species grazing score suggesting that these sites at least are still being maintained by grazing.

The Somerset Levels and Avon valley also showed significant increases in suited species moisture score and, the Somerset Levels a significant increase in Ellenberg soil wetness score. There were also (non-significant) increases in suited species scores for moisture in the Norfolk Broads. The Somerset Levels sites are nearly all within the raised water level management area and a move towards species adapted to wetter conditions is to be expected.

A significant difference in the Ellenberg soil fertility index was recorded in the Somerset Levels 5-quadrat sites; where it increased. These sites have also suffered the greatest species richness decline: it seems that management practices in these sites are raising nutrient levels to the detriment of the sward. In the Norfolk Broads, however, where species richness has increased, there has been a significant decline in soil fertility. Low levels of nutrients, but particularly phosphorous, are required for the maintenance and restoration of species-rich grassland.

The only former ESA that saw no significant changes in the suited species scores or the Ellenberg indices was the Upper Thames Tributaries. There was no change in species richness in these sites from 1995 to 2012.

10.5 Individual species

Changes in the optimum frequency of individual species were recorded; these were specific to different ESAs and reflect, to a large degree, the changes noted in other community variables already reported.

Somerset Levels plots, reflecting the increase in suited species score for moisture and its increased Ellenberg Index for moisture, showed significant declines in a small number of species poorly adapted to increased wetness, and a parallel increase in *Eleocharis palustris* (ADAS plots) and *Agrostis stolonifera* (5-quadrat sites). The Test Valley showed significant declines in species typical of grazed grassland. Whilst in the Avon valley and Norfolk Broads, where species richness has changed little, or increased, few declines in optimum frequency were seen. The main changes for each seem to be an increase in the ruderal *Rumex crispus* in the Avon valley and a decrease in *Holcus lanatus* in the Norfolk Broads, where nutrient levels (Ellenberg soil fertility index) have declined.

The Upper Thames Tributaries showed no significant changes in species optimum frequency scores and this reflects the lack of change noted in the suited species scores, Ellenberg values and species richness. The Upper Thames sites appear relatively stable. There are however some non-significant changes within this very small sample. Sites appear to be a little damper and with a higher frequency of bulky monocotyledonous species with increases in indicators of waterlogging at several sites.

10.6 Management and site condition

The Somerset Levels sites were predominantly managed as hay meadows with aftermath grazing by cattle although some sites were managed only as pasture. At some sites management varied between years. Many land managers reported an increase in *Juncus* spp. and other bulky and competitive species, and increased flooding. This would correspond to the observations made in the field with MG8, for example, moving towards M22 and MG13 towards swamp communities. With regard to other aspects of management, this ESA has many 'absent landlords' and sites are managed by land agents and/or using third party graziers. It was difficult to glean accurate information about many sites as too many people were involved in the different aspects of site management including ownership, cutting, grazing, main drain clearance, ditch clearance, gutter clearance. Many sites also had elderly or recently deceased farmers and management history was vague. The majority of Somerset Levels sites were under HLS 'bird' options, HK9 (maintenance of wet grassland for breeding waders). This management does not seem to be promoting the maintenance of species-rich semi-natural grasslands, which in the many MG8 and M22-related stands, is what the sites are. Only one site on Tealham Moor passed the SSSI condition assessment; four sites on Wet Moor (although MG13 and of lower botanical diversity); and two sites elsewhere.

Most sites in the Test Valley are cattle grazed, although one site was horse grazed. These sites are topped, or in the case of three, burnt occasionally to control litter and *Molinia*. Only two sites were hay-cut and aftermath grazed. Due to the loss in species diversity noted in these fields it appears that the management of Test valley sites, most of which are in HLS option HK6/7 (maintenance/restoration of species-rich grassland) or HQ7 (restoration of fen), is not ideal. It should be noted however that management at the three Bransbury Common sites has recently changed and it is likely that condition will improve. Three sites passed the condition assessment and met the indicators of success.

The Derwent Valley sites are all managed as hay-meadow (or in one site for silage); four of them use sheep for aftermath grazing, whilst two use cattle. One owner has no stock. The most frequent problem reported with these sites was excessive flooding, which is perceived as occurring for longer periods due to siltation in the rivers: this has been attributed to the installation of river barrages.

The majority of Derwent Valley sites were under HLS 'bird' option HK9 (maintenance of wet grassland for breeding waders; only two were under HK6 (maintenance of species-rich grassland). As these are new sites it is not possible to determine the success of these management options for the sites. Three sites passed the condition assessment and met the indicators of success.

The Avon Valley sites are almost entirely permanent pasture, grazed by cattle from spring to summer/autumn. Only four sites were managed as hay-meadow with aftermath grazing (by cattle or ponies). Most sites were topped to control weedy species and rushes. Only one site is managed for (HK7) restoration of species-rich semi-natural grassland – all other sites are under options HK11 (restoration of grassland for breeding waders), HK12 (maintenance of grassland for target features; these are usually breeding/wintering waders) or HK12 (maintenance of grassland for wintering waders). While these options should lead to an improvement in sward species diversity, that is not their primary aim and this survey suggests that the quality of their vegetation communities is not improving. Only one site passed the SSSI condition assessment and met its indicators of success: reasons for failure in these sites were usually multiple.

All sites apart from one in the Itchen Valley sampled were cattle-grazed, many with traditional breeds. The seventh site was sheep grazed. All sites are under an HLS option to maintain/improve the botanical diversity; HK6, HK7, HQ7 or HD10. All sites failed the common standards condition assessment and the indicators of success on insufficient frequency or lack of positive indicator species. The high nutrient, and especially phosphorous levels noted in 10.6 may be responsible for failure to establish/maintain a species-rich sward. As this is the first survey of these sites however it is not possible to determine whether there have been any changes at these sites as a result of the HLS options.

All apart from one of the Norfolk Broads and Nene Valley sites sampled are cattle-grazed; the last is hay-cut and aftermath grazed. Seven sites are managed for their botanical diversity (HK6, HK7, HQ6) and one site under 'bird' option HK10. Two sites passed the condition assessment and met the indicators of success. In the Norfolk Broads sites, three sites failed due to accumulation of excessive amounts of litter and presence of a relatively closed canopy of *Juncus* spp. These are transitory states related to temporary periods of insufficient grazing or cutting; these probably relate more to the very wet summer that the site condition generally. The two Nene sites that failed however were an accurate reflection of the state of the vegetation in the field.

The Upper Thames sites were a mixture of traditional hay-meadows, managed for their species-rich semi-natural grassland, or were species-poor stands of wet grassland managed by a hay-cut and/or cattle-grazing. Only one site was aftermath grazed by sheep. The species-poor sites were all under HLS options for breeding/wintering waders. There has been little change in species diversity in these sites so the management is successful in maintaining the species-rich swards, but it is not benefitting the species diversity in the species-poor swards. This is a similar pattern to the Avon valley. Consequently only the existing species-rich sites (three sites) passed the condition assessment and met the indicators of success.

11 Conclusions – whole sample

During the 2012 survey, as with the previous 2003 resurvey, not all plots or quadrats could be relocated. There was a higher success rate at relocating the five quadrats than the ADAS plots. The positioning of the quadrats in the 5-quadrat sites was easier than ADAS plots in tall tussocky vegetation and therefore less affected by the structure of the sward. Consequently the accuracy of the data for sites using the 5-quadrat method compared with the ADAS plots is thought to be greater. It is recommended that this style of plot is adopted for future surveys in habitats of a tall and/or tussocky nature. It is also recommended that less transitory landmarks than fence-posts and small trees are used for origin markers, although it is acknowledged that permanent markers can be hard to find at some sites. It is likely that the improved accuracy of the GPS will assist greatly in plot relocation in future surveys

The major NVC stand-types recorded in the sample as a whole were (in order) MG8, M22, MG9, MG10, MG13, MG7, MG4 with single samples of U4, S5 and various mosaics. Many sites had maintained the same NVC community since baseline surveys were carried out. Where there were changes however, notably in the Somerset Levels raised water level management areas, these reflected a move towards wetter and/or more rush (*Juncus* spp., *Eleocharis palustris*) dominated NVC community types (MG8 to M22; MG9 to MG10; or MG13 towards S19); or to those that supported more *Deschampsia cespitosa* – an indicator of both waterlogging and a relaxation in grazing pressure (MG7 to MG9). Raised water levels are clearly responsible for increased soil moisture but the flooding events of recent years will have exacerbated this. Several sites in the Test Valley had changed from a mosaic of M22b and MG8 in 1988 to communities that are dominated by tall-fen species including reed-grasses, large *Carex* spp. and bulky forbs. Many sites in the Avon Valley were reclassified in 2012 but very few were to more species-rich stands of greater conservation value.

Several ESAs had maintained their species richness but the 5-quadrat sites in the Somerset Levels and Test Valley had seen a significant decline. Only the Norfolk Broads saw a rise in species richness.

The vast majority of sites failed the CSM condition assessment, with the most frequently failed attribute being frequency of positive indicator species, followed by failure to meet cover of *Juncus* spp. attributes. Most sites surveyed were under HLS options for breeding/wintering waders and not for maintenance or restoration of species-rich swards. The management is therefore not targeted at attributes of the grassland that would, in later years, achieve a pass in CSM if reassessed. There may be a discrepancy between management to achieve a species rich sward appropriate to SSSI designation and a habitat that favours waders.

Commented [OE3]: Main point?

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Appendices

Appendix 1: SOMERSET LEVELS

Appendix 1a: MATCH analysis of individual sites

MATCH analysis of the monitoring plots recorded in the Somerset Levels in 2012 for (a) Tealham Moor, (b) Wet Moor, and (c) remaining miscellaneous sites. For ADAS plots analysis of both plot data (Plot) and the supplementary NVC quadrats recorded in the wider unit (Unit). The top five results are shown. The previous NVC community recorded is provided. The NVC community determined in 2012 is provided, based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

(a)		TEALHAM – MATCH rank (top 5)											
Site	Sample	1		2		3		4		5		NVC 2012	NVC 2003
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%		
1	Plot	M23a	50.4	MG8	49.6	M23	47.9	M23b	47.6	MG10	47.1	MG8	MG8
	Unit	MG8	49.8	M23a	49.2	M23	47.8	M23b	46.3	MG10	44.3		
2	Plot	S27a	40.3	M23a	40.1	M23	36.7	M23b	36.2	S11b	34.7	MG8*	MG8
	Unit	M23a	40.7	M23	39.9	M23b	39.2	MG8	37.1	M22	36.2		
3	Plot	MG10a	53.2	MG10	50.0	MG8	49.9	M23a	44.3	MG9	44.3	MG8	MG8
	Unit	MG10a	41.6	M27c	40.6	M23a	40.3	MG10	40.0	MG8	36.2		
4	Plot	MG8	49.6	M23a	45.1	MG10	44.7	MG10a	43.0	M22b	41.1	MG8	MG8
	Unit	MG8	57.5	MG10	46.6	M22b	45.2	M23	44.5	M23a	44.0		
5	Plot	M23b	46.4	M23	45.9	MG10	44.6	M23a	43.3	MG8	42.6	MG8	MG8
	Unit	MG8	52.7	MG10	51.5	MG10a	50.4	MG9a	49.6	M23a	47.8		
6	Plot	MG10a	52.6	MG10	48.2	M27c	46.9	M27b	42.3	MG8	41.9	MG8*	MG8
	Unit	MG10a	43.8	MG10	41.9	M27c	40.9	MG9	38.1	MG9a	36.2		
7	Plot	S19c	45.6	S19	42.8	S19a	35.6	MG10a	33.9	MG13	33.7	MG13†	MG13
	Unit	S19	56.7	S19a	49.1	S19c	47.1	MG10a	38.4	MG13	37.2		
8*	Plot	S19	43.8	S19c	37.7	S19a	36.8	M23b	34.5	MG10a	34.4	MG8*†	MG8
	Unit	S19	43.0	S19a	41.6	MG10a	39.6	S19c	36.8	M23b	35.7		
9	Plot	MG8	55.9	MG10a	53.5	MG10	52.9	M23a	49.9	M23b	49.3	MG8	MG8
	Unit	MG10a	53.8	MG9	50.4	MG10	47.5	MG9a	46.4	M27c	46.2		
28	Quads	MG10a	51.7	S19	49.3	MG10	49.0	MG9a	46.4	MG9a	46.2	MG8	*MG8

*1988

(b)		WET MOOR – MATCH rank (top 5)											
Sit	Sampl	1		2		3		4		5		NVC 2012	NVC 2003
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%		
10	Plot	MG13	45.	MG10c	38.	MG10	35.	MG10	34.	OV28	33.	MG13	MG13
	Unit	MG13	47.	S19a	46.	S19a	44.	OV28a	37.	S22c	37.		
11	Plot	S19	48.	S19c	41.	S19a	40.	MG13	38.	OV28	35.	MG13†	MG7c
	Unit	S19	55.	S19a	55.	S12	31.	S12a	30.	MG13	30.		
12	Plot	MG6b	60.	MG6a	55.	MG6	55.	MG7c	48.	MG7d	48.	MG6b	MG7d
	Unit	MG9	51.	MG10	49.	MG9a	48.	MG9b	48.	MG7d	46.		
13	Plot	MG13	37.	MG10c	36.	MG10	35.	MG9a	35.	MG10	34.	MG13	MG13
	Unit	MG13	53.	S19	52.	S19a	51.	SD17a	46.	SD17	45.		
14	Plot	MG9a	48.	MG10	48.	MG10c	48.	MG10	48.	MG13	45.	MG13	MG13
	Unit	MG10	53.	MG13	52.	MG10	50.	MG10a	49.	MG10c	49.		
15	Plot	MG10a	61.	MG9	58.	MG10	57.	MG9a	57.	MG10	53.	MG10a	MG9a
	Unit	MG10a	60.	MG13	55.	MG10	53.	MG10	51.	MG11a	44.		
16	Plot	MG13	42.	S19	41.	S22c	38.	S19a	35.	S22a	35.	MG13†	MG13
	Unit	S19	48.	MG13	46.	S22	43.	S22c	43.	S22a	42.		
17	Plot	MG9a	54.	MG10	53.	MG9	52.	MG7d	52.	MG10	51.	MG7d	MG7d
	Unit	MG7d	53.	MG9a	51.	MG10a	51.	MG9	51.	MG7c	49.		
18	Plot	MG10a	52.	MG9a	51.	MG10	50.	MG7d	50.	MG9	49.	MG9a	MG9a
	Unit	MG9a	47.	MG10	46.	MG9	46.	MG7d	43.	MG10	43.		
19	Plot	MG10a	56.	MG10	53.	MG9a	52.	MG7d	51.	MG7c	50.	MG7c‡	MG7a
	Unit	MG10a	57.	MG7a	49.	MG7c	49.	MG7b	48.	MG10	48.		
20	Plot	MG10c	46.	MG10	43.	MG10	41.	M23b	40.	MG10a	39.	MG10a	MG10a
	Unit	MG10a	52.	MG10	50.	MG10c	49.	MG10	46.	MG13	45.		
21	Plot	MG13	49.	S19	40.	S22c	38.	S10a	36.	S22	35.	MG13	MG13
	Unit	MG13	58.	S22c	49.	MG10a	39.	S19a	37.	S19	36.		
23	Quads	MG10a	61.	MG10	57.	MG10c	56.	MG10	53.	MG13	52.	MG10a	MG10

*Transitional to fen-meadow/rush-pasture

†Heavily colonised by *Eleocharis palustris* and transitional to a swamp community.

‡MG7/MG9 transition

Site	Sample	OTHER SITES – MATCH rank (top 5)										NVC 2012	NVC 1988
		1		2		3		4		5			
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%		
22	Plot	MG10a	49.6	MG10	49.3	MG10b	47.1	MG9	45.8	MG9a	45.1	MG8/M22	MG8
24	Plot	MG8	50.2	MG9a	49.5	MG10	48.9	MG10a	47.3	M22	47.0	M22	MG8
25	Plot												
26	Plot	MG8	62.1	MG9a	61.1	MG9	57.2	MG10	57.1	MG4	57.0	MG8	MG8
27	Plot	MG10a	49.5	MG9a	45.2	MG10	44.1	MG13	43.3	MG9a	43.2	MG10a	MG8
29	Plot	MG10a	50.9	MG10	48.4	M23b	45.4	MG8	45.2	MG9	44.5	MG8/M23b	MG8
30	Plot	M23a	56.1	M23a	54.1	M23b	53.3	M22	51.0	M22a	48.4	M22a	MG8
31	Plot	MG10	46.0	M23b	42.8	MG10c	42.5	MG10a	42.1	M23	40.6	MG8/M22a	MG8

Appendix 1b: Individual Site Descriptions for 2012 survey

ESA	Somerset Levels and Moors
2012 Site No.	1
Grid ref.	ST 4100 4588
Location	Tealham & Tadham Moors SSSI, Unit 114
Survey Method	ADAS nested plot
Survey Date	4 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 1
HLS Parcel No.	0180
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HR6 Small fields; HK19 Raised water level

Site 1 lies below sea level and is bounded by drainage ditches. The single fixed-plot was set up on this site in 1993 and re-surveyed in 1995, 1998 and 2003. In 2012 the metal plot markers were relocated at the 10 m point along the transect and at corners A, C and D. Average sward height in the plot was 38.6cm.

Management: Site 1 is a small cattle-grazed pasture within the raised water level management area. It is hay-cut on a 5-year rotation, and grazed only in 2012 in late summer.

Vegetation: The sward was species-rich: 20–35 species in 1m-quadrats. Grasses *Agrostis capillaris*, *A. stolonifera*, *Anthoxanthum odoratum*, *Cynosurus cristatus* and *Holcus lanatus* were constant, but a particular feature is the high cover of sedges with abundant *Carex disticha* and *C. panicea* plus frequent *C. riparia* and *C. nigra*. *Eleocharis palustris*, a semi-aquatic associated with only narrowly fluctuating water levels, is patchily abundant. Rushes, *Juncus effusus*, *J. acutiflorus*, *J. articulatus* and/or the hybrid *J. × surrejanus* are frequent to locally abundant. Typical wet meadow forbs are well-represented with *Filipendula ulmaria*, *Ranunculus flammula*, *Ranunculus acris*, *Galium palustre*, *Caltha palustris* and *Lychnis flos-cuculi* plus occasional *Triglochin palustre*, *Stellaria palustris*, *Thalictrum flavum*, *Oenanthe fistulosa* and *Cirsium dissectum*.

NVC: The vegetation community is intermediate between that of a typical MG8 water meadow and an M22/23 rush pasture. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, respectively, as M23a (50.4%, 49.2%) and MG8 (49.6%, 49.8%) but the community is more similar to a local variant of M22 with *Juncus articulatus/acutiflorus* replacing *J. subnodulosus*. In 1993, 1998 and 2003 the plot was recorded as MG8: the plot data on record show that jointed rushes were occasional within the plot 20 years ago but are now abundant, and that non-jointed rushes have also increased – this change was apparent by the 2003 survey.

Site condition: The site failed the SSSI condition assessment for MG8 on cover of *Juncus* spp: (> 10%) and on frequency of positive indicator species: 2 frequent, 2 occasional, 2 rare.

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*). The site should be hay-cut every 3 years. The sward is also too tall, but grazing/cutting in 2012 was delayed by the extreme flooding.

Soils: The soil is ±neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen levels, loss on ignition and organic carbon are high, which is to be expected on peat sites.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 1	6.1	9	0	60	0	212	4	1.85	61.4	1334	27.5

ESA	Somerset Levels and Moors
2012 Site No.	2
Grid ref.	ST 4107 4576
Location	Tealham & Tadham Moors SSSI, Unit 114
Survey Method	ADAS nested plot
Survey Date	4 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 2
HLS Parcel No.	0580
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 2 lies below sea level and is bounded by drainage ditches. The single fixed-plot was set up on this site in 1993 and was re-surveyed in 1995, 1998 and 2003. No plot markers were refound during 2012: the site was flooded to 10–15cm depth.

Management: Site 2 is a small cattle-grazed pasture within the raised water level management area. The site has been managed for hay in the past but recently it has been too wet. It is topped in drier years (not for several years). The 3 smaller drains are cleared on a 3-year rotation.

Vegetation: The average sward height in the plot was 37.1cm and was moderately rich with 16–23 species in 1m-quadrats. The community is rush dominated (20–40%) and sedges (20–70%). Constants included *Agrostis stolonifera*, *Deschampsia cespitosa*, *Carex disticha*, *Juncus articulatus/acuteiflorus*, *Ranunculus flammula*, *Galium palustre*, *Hydrocotyle vulgaris* and *Filipendula ulmaria*. Other sedges were frequent (*Carex nigra* and *C. panicea*). Semi-aquatics *Eleocharis palustris* and *Equisetum fluviatile* were patchily frequent. Typical wet meadow forbs included *Caltha palustris*, *Cardamine pratensis*, *Leontodon autumnalis*, *Mentha aquatica*, *Myosotis laxa*, *Oenanthe fistulosa*, *Persicaria amphibia* and *Stellaria palustris*. *Thalictrum flavum* and *Cirsium dissectum* were occasional.

NVC: The vegetation community is intermediate between that of a typical MG8 water meadow and an M22/23 rush pasture. MATCH analysis gave the highest similarity coefficients for the plot as S27a (40.3%) due to the high cover of *Equisetum fluviatile* and for the plot and wider unit as M23a (40.1%, 40.7%) due to the high cover of *Juncus* spp. However the grass, sedge and forb component are more suggestive of a waterlogged MG8 (plot: 37.1%), or a local variant of M22 with *Juncus articulatus/acuteiflorus* replacing *J. subnodulosus*. All previous surveys recorded MG8 and no *Equisetum* spp. were recorded. The cover of rushes has increased in the last 20 years: high water levels from several years of high rainfall have shifted the community towards a wetter stand.

Site condition: The site failed the SSSI condition assessment for MG8 on cover of *Juncus* spp: (> 10%); however, the site passed the condition assessment for M22.

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is ± neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen levels, loss on ignition and organic carbon are high, which is to be expected on peat sites.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 2	6.1	5	0	23	0	144	3	1.40	61.0	894	15.2

ESA	Somerset Levels and Moors
2012 Site No.	3
Grid ref.	ST 4112 4581
Location	Tealham & Tadham Moors SSSI, Unit 114
Survey Method	Fixed plot
Survey Date	11 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 3
HLS Parcel No.	1578
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 3 lies below sea level and is bounded by drainage ditches. The single fixed-plot was set up on this site in 1993 and re-surveyed in 1995, 1998 and 2003. No plot markers were refound during 2012: the site was flooded to 10–15cm depth.

Management: Site 3 is a very small cattle-grazed pasture within the raised water level management area, managed as a single unit with Site 4. It is hay-cut on rotation (every 5 years) and was last cut in 2010. In non-hay-cut years it may be topped.

Vegetation: The average sward height in the plot was 38.1cm. The sward was moderately species-rich with 13–23 species recorded in 1m-quadrats. Jointed rushes (*Juncus acutiflorus*, *J. articulatus* and/or the hybrid *J. × surrejanus*) dominate this field. Other constants include grasses *Agrostis stolonifera*, *Anthoxanthum odoratum* and *Holcus lanatus*. No typical wet meadow forb species was constant but *Filipendula ulmaria*, *Ranunculus repens*, *R. acris* and *Persicaria amphibia* were frequent; occasionals included *Galium palustre*, *Cirsium dissectum*, *Triglochin palustre*, *Myosotis laxa*, *Oenanthe fistulosa*, *Caltha palustris* and *Leontodon autumnalis*. *Carex disticha* and *Eleocharis palustris* feature highly in adjoining fields but here are only patchily abundant. Negative indicator species *Senecio aquaticus* was frequent.

NVC: The vegetation community in the field is slightly degraded MG8 water meadow (36.2% similarity), which has some affinities with rush-pasture due to the high cover of jointed rushes (M23a: 44.3%, 40.3% for plot and field) although the high cover of *Holcus lanatus* returned higher MATCH coefficients for MG10a (53.2%, 41.6% for plot and field). In the 1993, 1998 and 2003 surveys the plot was recorded as MG8. The main changes have been the loss/reduction of some species less tolerant of waterlogging such as *Plantago lanceolata*, *Trifolium pratense* and *Leontodon autumnalis* and an increase in semi-aquatics *Persicaria amphibia*, *Ranunculus flammula* and *Myosotis laxa*.

Site condition: The site failed the SSSI condition assessment for MG8 on cover of *Juncus* spp. (> 10%); however, the site passed the condition assessment for M22.

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is ± neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen levels, loss on ignition and organic carbon are high, which is to be expected on peat sites.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 3	6.5	6	0	34	0	186	4	1.65	51.9	973	15.6

ESA	Somerset Levels and Moors
2012 Site No.	4
Grid ref.	ST 4118 4577
Location	Tealham & Tadham Moors SSSI, Unit 114
Survey Method	ADAS nested plot
Survey Date	11 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 4
HLS Parcel No.	1578
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 4 lies below sea level and is bounded by drainage ditches. The single fixed-plot was set up on this site in 1993 and re-surveyed in 1995, 1998 and 2003. The metal plot marker pins were relocated at the 10 m point along the transect and at corners B, C and D.

Management: Site 4 is a very small cattle-grazed pasture within the raised water level management area, managed as a single unit with Site 3. It is hay-cut on rotation (every 5 years) and was last cut in 2010. In non-hay-cut years it may be topped.

Vegetation: The average sward height in the plot was 32.6cm. The sward was species-rich with 20–31 species recorded in 1m-quadrats. Constant grasses included *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Cynosurus cristatus* and *Holcus lanatus*. High cover of sedges was a particular feature with constant, abundant *Carex disticha* and *C. nigra*. The semi-aquatic *Eleocharis palustris* is patchily abundant. Rushes, *Juncus effusus*, *J. acutiflorus*, *J. articulatus* and/or the hybrid *J. × surrejanus* are frequent to locally abundant. Frequent wet meadow forbs included *Filipendula ulmaria*, *Ranunculus flammula*, *Ranunculus acris*, *Galium palustre*, *Lysimachia nummularia*, *Persicaria amphibia* and *Lychnis flos-cuculi*: occasional species included *Caltha palustris*, *Iris pseudacorus* and *Cirsium dissectum*.

NVC: The vegetation in this site has consistently been recorded in all surveys as MG8; MATCH analysis for 2012, 49.6% similarity for plot and 57.5% the field). The site also has affinities with rush pasture (M23a: 45.1%, 44.0% for plot, field) due to the high frequency of jointed rushes and frequency of *Galium palustre* and M22b (41.1%, 45.2%). It also has affinities with MG10 (44.7%, 46.6%) due to the grassy sward with high cover of *Holcus lanatus*. It could be considered a local variant of M22a with *Juncus articulatus/acutiflorus* replacing *J. subnodulosus*. Jointed rushes have increased over the last 20 years, as have *H. lanatus*, *Persicaria amphibia* and *Ranunculus flammula*.

Site condition: The site failed the SSSI condition assessment for MG8 on cover of *Juncus* spp: (> 10%); however, the site passed the condition assessment for M22.

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is ±neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen levels, loss on ignition and organic carbon are high, which is to be expected on peat sites.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 4	6.5	6	0	34	0	162	3	1.63	61.7	1041	19.5

ESA	Somerset Levels and Moors
2012 Site No.	5
Grid ref.	ST 4117 6455
Location	Tealham & Tadham Moors SSSI, Unit 114
Survey Method	ADAS nested plot
Survey Date	4 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 5
HLS Parcel No.	1658
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR2 Native breeds; HK19 Raised water level

Site 5 lies below sea level and is bounded on three sides by drainage ditches, and the North Drain on the fourth. The single fixed-plot was set up on this site in 1993 and re-surveyed in 1995, 1998 and 2003. No plot markers were refound during 2012: the site was flooded to 8–10cm depth and the origin covered by recent ditch dredging.

Management: Site 5 is within the raised water level management area. It is summer cattle-grazed with Dexters and hay-cut on 2-3 year rotation with aftermath grazing. It was not cut in 2012. Rushes are topped occasionally but no other weed control. In 2012 rushes increased in 2012 and high levels of silt accumulated in external ditches due to flooding. No recent management of in-field ditches.

Vegetation: The sward was rich with 19–31 species recorded in 1m-quadrats, with an average height in the plot of 36.1cm. Constant species include *Agrostis stolonifera*, *Phleum pratense*, *Carex disticha*, *Persicaria amphibia* and *Ranunculus repens*. Semi-aquatic *Eleocharis palustris* is abundant; *Equisetum fluviatile* locally frequent. Rushes *Juncus effusus*, *J. acutiflorus*, *J. articulatus* and/or the hybrid *J. × surrejanus* are frequent/locally abundant. Sedges are at high cover with *Carex disticha*, *C. nigra*, *C. panicea*, *C. riparia*, *C. distans* and *C. hirta*. Wet meadow forbs include frequent *Filipendula ulmaria*, *R. flammula*, *R. acris*, *Galium palustre* and *Cardamine pratensis* and rare–occasional *Caltha palustris*, *Stellaria palustris*, *Lychnis flos-cuculi*, *Lysimachia nummularia* and *Cirsium dissectum*.

NVC: The site supports MG8 floodplain grassland, with a higher similarity coefficient for the field (52.7%) than for the plot (42.6%). It was recorded as MG8 in all previous surveys. The field has a high cover of *Holcus lanatus* and *Juncus effusus* with much *J. articulatus*, resulting in high coefficient for rush pasture (plot: M23b 49.6%, MG10 44.6%; field MG10 51.5%, M23a 47.8%). *Juncus effusus* and both jointed rushes *Juncus acutiflorus* and *J. articulatus* have increased in cover and spread in the twenty year survey period. Other species showing increase in cover and/or frequency include *Persicaria amphibia*, *Galium palustre*, *Eleocharis palustris*, *Glyceria* spp. and *Ranunculus flammula*.

Site condition: The site failed the SSSI condition for MG8 on cover of *Juncus* spp: (> 10%); however, the site passed the condition assessment for M22.

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is ±neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen levels, loss on ignition and organic carbon are high, which is to be expected on peat sites.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 5	6.5	5	0	34	0	209	4	1.8	67.5	993	22.5

ESA	Somerset Levels and Moors
2012 Site No.	6
Grid ref.	ST 4131 4553
Location	Tealham & Tadham Moors SSSI, Unit 114
Survey Method	ADAS nested plot
Survey Date	12 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 6
HLS Parcel No.	3154
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HR6 Small fields; HK19 Raised water level

Site 6 lies below sea level and is bounded on 3 sides by drainage ditches, and the North Drain on the 4th. The single fixed-plot was set up on this site in 1993 and re-surveyed in 1995, 1998 and 2003. No plot markers were refound during 2012: the site was flooded to 8–10cm depth and the origin covered by recent ditch dredging.

Management: Site 6 is cut and cattle-grazed pasture within the raised water level management area. The site is usually topped and grazed with cattle, although it was not cut in 2012 due to excessive waterlogging. 4 head of cattle went on in late summer. No extra weed control takes place. In-field drains have not been cleared in recent years.

Vegetation: The average sward height in the plot was high at 41.1cm. It was species-poor with 10–15 species recorded in 1m-quadrats. The field is species-poor fen meadow dominated by sedges, mostly *Carex disticha* with patchily abundant *C. riparia*. *Filipendula ulmaria* was abundant but there were few other forbs. Grasses were frequent, dominated by *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Phleum pratense* and *Cynosurus cristatus*. Rushes *Juncus effusus* was locally abundant and *J. articulatus* was occasional. *Glyceria maxima* was frequent in the grips. *Galium palustre*, *Carex panicea*, *Persicaria amphibia*, *Potentilla anserina* were occasional, *Thalictrum flavum* was rare.

NVC: Described in 1993 as '*Carex riparia* sedge fen' this unit has been recorded as MG8 water meadow in all previous surveys. MATCH analysis in 2012 returned a weak similarity coefficient for MG8 for plot (41.9%) and field (35.7%). *Carex riparia*, which is constant, is not recorded in the NVC table for MG8, and *Juncus effusus*, *Carex disticha* and *Filipendula ulmaria* are at a higher constancy than expected. The highest result was for poor rush-pasture MG10 (plot: 52.6%; field 43.8%) with some affinities to M27c tall herb fen (46.9%, 40.9%) due to the high cover of *Filipendula ulmaria* and *Juncus effusus* although it lacks most tall herbs typical of M27. This field is poor quality with permanently high water levels and an overly high cover of rushes and semi-aquatic sedges.

Site condition: The site failed the SSSI condition for MG8 and M22/23 as it only had one positive indicator species frequent and four occasional, plus cover of *Carex riparia* and *Juncus* spp. (> 10%).

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is \pm neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen levels, loss on ignition and organic carbon are high, which is to be expected on peat sites.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 6	6.0	4	0	43	0	214	4	1.75	61.8	1178	22.1

ESA	Somerset Levels and Moors
2012 Site No.	7
Grid ref.	ST 4032 4535
Location	Tealham & Tadham Moors SSSI, Unit 111
Survey Method	ADAS nested plot
Survey Date	13 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 7
HLS Parcel No.	3042
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 7 lies below sea level and is bounded by North Drain to the north and smaller drainage ditches on the remaining three sides. The field is well gripped. The single fixed-plot was set up on this site in 1993 and resurveyed in 1995, 1998 and 2003. The metal plot marker pin was relocated at the origin but not at the 10 m point or at corners A, C and D: the site was flooded to 15-20cm.

Management: Site 7 is within the raised water level management area. It is not hay-cut but is topped when conditions allow and cattle grazed (under tenancy). Minor ditches are cleared out occasionally but in-field ditches have not been managed recently. Rushes cover has increased.

Vegetation: The average sward height in the plot was 18.1cm. The sward was quite poor with 10–13 species recorded in 1m-quadrats. The sward was species-poor floodplain grassland dominated by *Agrostis stolonifera*, *Glyceria fluitans*, *Eleocharis palustris*, *Persicaria amphibia* and *Juncus articulatus* with constant *Cardamine pratensis* and *Galium palustre*. Other species were occasional to locally frequent: such as *Carex nigra*, *Oenanthe fistulosa*, *Potentilla anserina*, *Veronica scutellata* and *Leontodon autumnalis*.

NVC: The vegetation in this field originates from an MG13-related grassland, although the usual constant *Alopecurus geniculatus* is at lower frequency than expected and the overwhelming abundance of *Eleocharis palustris* led to a community that appeared transitional between MG13 and the swamp community S19c. MATCH analysis resulted in fairly high similarity coefficients for S19c (field, 56.7%; plot 45.6%), whilst the results for MG13 were low (37.2% and 33.7%, respectively). MG10a rush-pasture scored more highly than MG13 (38.4%; 33.9%), although this is not considered a good fit. Ten species were recorded in the plot in 1993 that were absent in 2012 – most of which were already absent by 2003; most notably the abundant *Ranunculus repens* and *R. acris* had all but disappeared along with *Cynosurus cristatus* and *Leontodon autumnalis*. Consistently high water levels in this field are resulting in a transition from a flood-plain pasture to a swamp community.

Site condition: The site passed the SSSI RCA for MG13-related grassland, which includes forb species more relevant to this more depauperate sward type. Indicators of waterlogging (*Juncus* spp.) do not exceed the < 25% cover requirement for MG13 but rushes are on the increase in this field.

HLS Indicators of success: This site is under option HK9 for breeding waders (lapwing/redshank): the sward height is much taller than the requisite 5cm (across 2/3) although the field had been too wet to graze in 2012 due to the extreme flooding. Rushes are still between 10–30% but are increasing.

Soils: The soil is \pm neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen and loss on ignition are high (due to peat content) and organic carbon moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 7	6.2	6	0	54	0	148	3	1.30	43.8	988	11.6

ESA	Somerset Levels and Moors
2012 Site No.	8
Grid ref.	ST 4075 4535
Location	Tealham & Tadham Moors SSSI, Unit 111
Survey Method	ADAS nested plot
Survey Date	13 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 8
HLS Parcel No.	7138
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HR6 Small fields; HK19 Raised water level

Site 8 lies below sea level and is bounded by Bounds Rhyne to the east and smaller drainage ditches on the remaining three sides. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated: the site was deeply flooded to 15-20cm.

Management: Site 8 is within the raised water level management area and is cattle grazed. Rushes are topped most years if not too wet and if needed. The owner clears out the drains on a 3-year rotation (approximately). In field grips are reinstated periodically. The sward has seen an increase in non-productive grasses and rushes in recent years.

Vegetation: The average sward height in the plot was 32.3cm. The sward was quite poor with 9–16 species recorded in 1m-quadrats. The field was highly waterlogged, which was reflected in the community constants: *Agrostis stolonifera*, *Glyceria fluitans*, *Carex disticha*, *Equisetum fluviatile*, *Eleocharis palustris*, *Juncus articulatus/acutiflorus* and *Galium palustre*. Other species were occasional to locally frequent, such as *Carex nigra*, *Oenanthe fistulosa*, *Potentilla anserina*, *Veronica scutellata* and *Stellaria palustris*.

NVC: The vegetation in this field, in the 1993, 1995 and 2003 surveys, was described as MG8; however, MATCH analysis of the plot and the wider field resulted in 2012 in similarity coefficients of less than 30% for this community – which really indicates very little similarity at all. The highest coefficients were attributed to the swamp community S19 (43.0% & 43.8%, field & plot, respectively) and the rush-pasture communities (MG10a: 39.6% & 34.4%; M23b: 35.7% & 34.5%). This pasture may once have been MG8 but it is now much changed. Most of the MG8 associates are missing and instead of a herb-rich grassy sward, a very waterlogged variant of an MG13-related stand dominated by *Eleocharis palustris*, *Carex disticha* and *Agrostis stolonifera* remains.

Site condition: The site failed the SSSI condition for MG8 on cover of *Juncus* spp: (> 10%); however, the site passed the condition assessment for M22.

HLS Indicators of success: This site is under option HK9 for breeding waders: although not assessed for this it is noted that it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is ±neutral. Phosphorous and potassium levels are very low, magnesium is high. Nitrogen and loss on ignition are high (due to peat content) and organic carbon moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 8	6.4	4	0	51	0	148	3	1.91	63.6	1269	20.6

ESA	Somerset Levels and Moors
2012 Site No.	9
Grid ref.	ST 4100 4588
Location	Tealham & Tadham Moors SSSI, Unit 115
Survey Method	ADAS nested plot
Survey Date	13 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 9
HLS Parcel No.	9141
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 9 lies below sea level and is bounded by North Drain to the north, Bounds Rhyne to the east and smaller drainage ditches on the remaining two sides. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated: the site was deeply flooded to 15-20cm.

Management: Site 9 is within the raised water level management area; it is topped (to control rushes) and cattle-grazed pasture. *Oenanthe crocata* is controlled on the southern boundary using herbicide spray. A scrape has been created for waders. The eastern drain is cleared periodically.

Vegetation: The average sward height in the plot was 29.5cm. The sward was moderately species-rich with 11–21 species recorded in 1m-quadrats. Grasses were diverse and at high cover (40–70%) with *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Cynosurus cristatus*, *Festuca rubra* and *Holcus lanatus* \pm constant. Rushes *Juncus effusus*, *J. articulatus* and *Eleocharis palustris*, and sedges *Carex disticha* and *C. hirta* were also at high cover (up to 50%). Herbs included frequent *Filipendula ulmaria*, *Rumex acetosa* and locally frequent *Ranunculus acris*, *R. flammula*, *Lotus pedunculatus* and occasional *Thalictrum flavum*, *Lychnis flos-cuculi*, *Oenanthe fistulosa*, *Leontodon autumnalis*, *Lathyrus pratensis*.

NVC: The vegetation in this field was that of a typical MG8 water meadow (MATCH analysis, 55.9% similarity for plot and 45.9% for wider field); however, owing to the high cover of *Juncus effusus* and *Holcus lanatus* it also has some affinities with MG10a rush-pasture (plot 53.5%, field 53.8%). The plot was also recorded as MG8 during the 1993, 1998 and 2003 surveys. Change in vegetation recorded within the plot is largely an increase in *Persicaria amphibia* and *Eleocharis palustris* and the rushes *Juncus acutiflorus*, *J. effusus* and *J. articulatus* and a decrease in some grasses (*Phleum pratense*, *Cynosurus cristatus*, *Poa trivialis*) and some forbs (*Cardamine pratensis*, *Cerastium fontanum*, *Taraxacum officinale*).

Site condition: The site failed the SSSI condition for MG8 on cover of *Juncus* spp: (> 10%); however, the site passed the condition assessment for M22.

HLS Indicators of success: This site is under option HK9 for breeding waders: it fails one of the HK9 (botanical) indicators of success (*cover of rushes should be 10–30%*).

Soils: The soil is \pm neutral. Phosphorous and potassium levels are low, magnesium is very high. Nitrogen and loss on ignition are high (due to peat content) and organic carbon moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 9	6.2	12	1	74	1	176	4	1.63	57.2	1306	16.3

ESA	Somerset Levels and Moors
2012 Site No.	10
Grid ref.	ST 4341 2457
Location	Wet Moor SSSI, Unit 50
Survey Method	ADAS nested plot
Survey Date	20 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 11
HLS Parcel No.	4660
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 10 is a triangular field lying at, or below, sea level and bounded on all sides by drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated, either at the origin or at the plot.

Management: The site is within the raised water level management area of Wet Moor and is cattle grazed. The recent history of management is unknown due to a change in management. A few head of cattle were on site in June 2012. The boundary ditches were cleared of weed in late 2012.

Vegetation: The average sward height in the plot was quite short at 10.1cm. The species composition in the field was quite poor with 11–14 species recorded in 1m-quadrats. The monitoring plot was located in a drier portion of the field grass-dominated with abundant *Agrostis stolonifera* and *Alopecurus pratensis* with high cover of *Alopecurus geniculatus* and frequent *Glyceria fluitans*. Forbs *Persicaria amphibia*, *Ranunculus repens*, *Leontodon autumnalis* and *Cardamine pratensis* were also frequent to abundant. Bryophytes were also frequent at moderate cover: mainly *Calliergonella cuspidata* and *Brachythecium rutabulum*. Additional species in the plot and/or wider field included *Eleocharis palustris*, *Ranunculus flammula*, *Myosotis laxa*, *Carex disticha* and *Oenanthe fistulosa*: *Eleocharis palustris* and *Carex disticha* were much more abundant in the wetter areas of the field.

NVC: This field has consistently been recorded as MG13 (MATCH similarity coefficient in 2012: plot 45.2%; field 47.4%). Due to the frequency of semi-aquatics such as *Eleocharis palustris* and *Glyceria fluitans* in the wider field, a relatively high match for S19 swamp was also returned (46.6%), but the site does not share most other characteristics of that community.

Site condition: The site passed the SSSI RCA for MG13-related grassland, which includes forb species more relevant to this more depauperate sward type.

HLS Indicators of success: This site is under option HK9 for breeding waders (lapwing and redshank): although not fully assessed for this, it is likely to pass the botanical indicators of success for this option, although the sward may be a little tall (0–12cm with 2/3 at >5cm).

Soils: The soil is mildly acid. Soil analysis results (below) show levels of low phosphorous; moderate potassium; high magnesium, nitrogen, loss on ignition and organic carbon.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 10	5.5	12	1	164	2–	187	4	1.22	33.6	1808	16.0

ESA	Somerset Levels and Moors
2012 Site No.	11
Grid ref.	ST 4365 2501
Location	Wet Moor SSSI, Unit 50
Survey Method	ADAS nested plot
Survey Date	28 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 13
HLS Parcel No.	7197
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HR6 Small fields; HK19 Raised water level

Site 11 is a small field lying at, or below, sea level and bounded on all sides by drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. Metal plot marker pins were relocated, at 20m from the origin and at corners A, B and D.

Management: The site is within the raised water level management area of Wet Moor. The land is held in trust by absent landlords. The grass keep is apparently let but no further information could be found on management.

Vegetation: The average sward height in the plot was 19.2cm. The species composition in the field was very poor with 6–7 species recorded in 1m-quadrats. The monitoring plot was dominated by *Agrostis stolonifera*, *Glyceria fluitans* and *Eleocharis palustris* with frequent *Poa trivialis*, *Ranunculus repens* and *Deschampsia cespitosa*. *Alopecurus pratensis* is frequent in the field but not in the plot. Occasional species in the plot and wider field included *Caltha palustris*, *Persicaria amphibia*, *Cardamine pratensis*, *Carex disticha*, *Oenanthe fistulosa*, *Ranunculus flammula*, *Stellaria palustris* and occasional *Juncus effusus*. Consistently high water levels in the field were apparent from the presence of *Spirodela polyrhiza* and filamentous algae in the monitoring plot.

NVC: This field has previously been recorded as MG7c but it bears little relation to this community now (MATCH similarity coefficient for MG7c in 2012: field 17.6%). Rather, the community appears to be a species-poor and extremely waterlogged and impoverished MG13-related grassland (plot, 38.3%; field 30.0%). The highest MATCH result was for S19 swamp (55.4%; 48.1%) due to the high cover of *Eleocharis palustris* but this is a swamp community of lake-sides and true swamp and the site does not share most other characteristics of that community.

Site condition: The site passed the SSSI RCA for MG13-related grassland.

HLS Indicators of success: This site is under option HK9 for breeding waders (lapwing and redshank): it fails on sward height (0–12cm with 2/3 at >5cm).

Soils: The soil is mildly acid. Soil analysis results (below) show levels of low phosphorous; moderate potassium; high magnesium, nitrogen, loss on ignition and organic carbon.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 11	5.9	11	1	158	2–	195	4	1.31	30.9	1869	16.0

ESA	Somerset Levels and Moors
2012 Site No.	12
Grid ref.	ST 4438 2390
Location	Wet Moor SSSI, Unit 56
Survey Method	ADAS nested plot
Survey Date	05 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 16
HLS Parcel No.	3995
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 12 is a small field lying at, or below, sea level and bounded to the west by Poplar Drove and associated main drain, and on all other sides by minor drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated, the area of the origin was covered by a large bramble patch.

Management: The site is within the raised water level management area of Wet Moor. Little information could be gleaned regarding cutting/grazing management as grass keep is let and the tenant grazier of this site and 5 others was repeatedly too busy to discuss it. The site appears to be managed as permanent pasture – a small herd of steers graze this field with fields 17 and 18 as a single unit. Rushes are cut and in field gutters are cleared on an ad hoc basis when there is pooling in the field. Ditches are cleared on 3-year rotation.

Vegetation: The average sward height in the plot was 14.25cm. The species composition in the field was poor with 6–12 species recorded in 1m-quadrats. The monitoring plot was located in an area of drier grassland than much of the field. It supported a diverse suite of grasses: *Agrostis capillaris*, *Anthoxanthum odoratum*, *Cynosurus cristatus*, *Hordeum secalinum*, *Holcus lanatus* *Lolium perenne* and *Phleum pratense* and a small quantity of *Festuca rubra*. Forbs were largely restricted to *Ranunculus repens*, *R. acris*, *Rumex acetosa*, *Cardamine pratensis* and *Cerastium fontanum*. The northern half of the field away from the pot was much wetter though and here *Agrostis stolonifera*, *Alopecurus pratensis*, *Deschampsia cespitosa* dominated.

NVC: This field has previously been recorded as MG7d (MATCH similarity coefficient: plot 48.3%; field 46.0%) but the vegetation in the plot is now more similar to a poor MG6b (60.8%) due to frequency of *Cynosurus cristatus* and *Agrostis capillaris*. It is likely to represent a successional change from MG7d to MG6, a common sequence on the Somerset Levels in relation to changes in soil moisture and management. The wetter northern part of the field is more akin to MG9 (53.4%) due to the frequency of *Deschampsia cespitosa* and *Holcus lanatus* with frequent *Agrostis stolonifera*.

Site condition: The site failed the SSSI RCA for Inland wet grassland (MG11/MG13-related): it only had one frequent positive indicator species. However, it probably meets the conditions required for BAP habitat G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: it fails on sward height (5–15cm over 1/3 of the field; <5cm for 2/3).

Soils: The soil is mildly acid. Soil analysis results (below) show moderate levels of phosphorous and potassium; medium levels of nitrogen, loss on ignition and organic carbon; and high magnesium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 12	5.5	19	2	137	2–	192	4	0.96	28.6	1614	8.1

ESA	Somerset Levels and Moors
2012 Site No.	13
Grid ref.	ST 4497 2411
Location	Wet Moor SSSI, Unit 59
Survey Method	ADAS nested plot
Survey Date	28 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 17
HLS Parcel No.	9611
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 13 is a small field lying in one of the lowest parts of Wet Moor and with very high water levels. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated, probably due to depth of water.

Management: The site is within the raised water level management area of Wet Moor. It has been managed for field dried hay for many years but could not be cut last year due to flooding. It is aftermath grazed by cattle on a put-and-take system according to grass growth and levels of poaching. Rushes have occasionally been sprayed using a knapsack spray. Ditches are cleared every 3 years.

Vegetation: The average sward height in the plot was 22.4cm. The species composition in the field was moderately poor with 9–14 species recorded in 1m-quadrats. The monitoring plot was located centrally in the field in a highly waterlogged area. *Agrostis stolonifera*, *Glyceria fluitans*, *Eleocharis palustris* and *Ranunculus repens* were the most dominant species, but *Deschampsia cespitosa*, *Poa trivialis*, *Equisetum palustre*, *Oenanthe fistulosa* and *Leontodon autumnalis* were also frequent. Occasional species in the plot or in the wider site included *Cardamine pratensis*, *Myosotis laxa*, *Oenanthe pimpinelloides*, *Galium palustre* and *Persicaria amphibia*. Negative species were few: *Senecio aquaticus* was occasional and there was some *Phalaris arundinacea*.

NVC: This field has consistently been recorded as MG13 (MATCH similarity coefficient in 2012: plot 37.5%; field 53.4%). Due to the frequency of semi-aquatics such as *Eleocharis palustris* and *Glyceria fluitans* in the wider field, a relatively high match for S19 swamp was also returned (52.1%) – a strong indicator of the prolonged period of high water levels in this unit, which are unlikely to have been restricted to 2012 alone.

Site condition: The passed the SSSI RCA for Inland wet grassland (MG11/MG13-related).

HLS Indicators of success: This site is under option HK9 for breeding waders: presence of waders not assessed.

Soils: The soil is mildly acid. Soil analysis results (below) show moderate levels of phosphorous and potassium; high levels of nitrogen, loss on ignition and organic carbon; and high magnesium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 13	5.9	10	1	147	2–	222	4	1.11	29.0	1469	13.5

ESA	Somerset Levels and Moors
2012 Site No.	14
Grid ref.	ST 4526 2445
Location	Wet Moor SSSI, Unit 61
Survey Method	ADAS nested plot
Survey Date	27 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 18
HLS Parcel No.	2450
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 14 lies at or below sea level on Wet Moor. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated.

Management: The site is within the raised water level management area of Wet Moor. Little information could be gleaned regarding cutting/grazing management as grass keep is let and the tenant grazier of this site and 5 others was repeatedly unavailable. This site had been shut up for hay and is presumably aftermath grazed by the tenant herd of cattle. Rushes are cut and in field gutters are cleared on an ad hoc basis when there is pooling in the field. Ditches are cleared on 3-year rotation.

Vegetation: The average sward height in the plot was 21.7cm. This is a species-poor field (9–12 species in 1m-quadrats) comprising tall grassland dominated by *Agrostis stolonifera* and *Alopecurus pratensis* with much *Poa trivialis* and tussocks of *Deschampsia cespitosa* – which was dominant in some areas. The only frequent forbs were *Persicaria amphibia*, *Ranunculus repens* and *Cardamine pratensis*. Semi-aquatic species *Glyceria fluitans*, *Eleocharis palustris* and *Equisetum palustre* were locally frequent. Occasional forbs included *Ranunculus acris*, *R. flammula*, *Oenanthe fistulosa* and *Galium palustre*. *Senecio aquaticus* was locally frequent.

NVC: This field has consistently been recorded as MG13 (MATCH similarity coefficient in 2012: plot 41.4%; field 52.7%), although there are also affinities with MG9 due to the frequency and occasional dominance of *Deschampsia cespitosa* (plot 48.9%). *Alopecurus geniculatus*, a normal constant in MG13, is occasional only in this field.

Site condition: The site failed the SSSI RCA for MG13-related grassland on frequency of positive indicator species: two frequent but additional 3 indicator species all rare. It may however pass the condition assessment and for G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: presence of waders not assessed.

Soils: The soil is mildly acid. Soil analysis results (below) show moderate levels of phosphorous and potassium; high levels of nitrogen, loss on ignition and organic carbon; and high magnesium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 14	5.8	11	1	141	2–	213	4	1.24	33.1	1542	15.0

ESA	Somerset Levels and Moors
2012 Site No.	15
Grid ref.	ST 4562 2461
Location	Wet Moor SSSI, Unit 60
Survey Method	ADAS nested plot
Survey Date	27 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 19
HLS Parcel No.	6164
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK6 Maintenance of species-rich semi-natural grassland Small fields; HK19 Raised water level

Site 15 lies just to the south of Long Load Main Drain and is at or below sea level on Wet Moor. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated.

Management: The site is within the raised water level management area of Wet Moor. It is cattle grazed only with occasional topping of rushes. Grazing is occasional and occurs when the field is dry enough. The owner notes a decline in the quality of the sward with more weeds and rushes.

Vegetation: The average sward height in the field was c. 30cm. This is a species-poor field (5–10 species in 1m-quadrats) comprising rather rank, tall grassland dominated by *Agrostis stolonifera*, *Holcus lanatus*, *Lolium perenne*, *Alopecurus pratensis*, and clumps of *Juncus effusus*. *Deschampsia cespitosa* was occasional–frequent in the sward. The forb component was poor with *Ranunculus acris* the only constant, with frequent *R. repens* and scattered plants of *Oenanthe pimpinelloides*, *Cardamine pratensis*, *Filipendula ulmaria*, *Lathyrus pratensis* and *Lysimachia nummularia*. Negative indicator *Cirsium arvense* was occasional.

NVC: Although previously described as MG9a *Deschampsia cespitosa*, although present, was not as abundant as would be expected in that stand type (MATCH similarity coefficient in 2012: plot 58.4%; field 39.6%). There were greater affinities with MG10 rush pasture (plot MG10a 61.8%; field 60.8%) due to the frequency of *Juncus effusus* and *Holcus lanatus*. Both community types are of rank, grassland types and are species-poor. From the previous site data it appears that cover of *D. cespitosa* may have decreased since the last survey.

Site condition: The site failed the SSSI RCA for MG13-related grassland on frequency of positive indicator species: no frequent positive indicator species; all rare. It may however pass the condition assessment and for G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: presence of waders not assessed.

Soils: The soil is mildly acid. Soil analysis results (below) show moderate levels of phosphorous and potassium; high levels of nitrogen, loss on ignition and organic carbon; and high magnesium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 15	5.7	10	1	158	2–	188	4	1.25	33.0	1687	15.5

ESA	Somerset Levels and Moors
2012 Site No.	16
Grid ref.	ST 4323 2476
Location	Wet Moor SSSI, Unit 50
Survey Method	ADAS nested plot
Survey Date	20 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 20
HLS Parcel No.	2375
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 16 is a small field lying at, or below, sea level bounded on three sides by drains and by a hedge on the fourth (west side), although an infield gutter running N-S ¼ of the way in along the west side bounds the wet grassland area (east). The single fixed-plot was set up on this site in 1993 and resurveyed in 1995, 1998 and 2003. No metal plot marker pins were relocated in 2012.

Management: The site is within the raised water level management area of Wet Moor and is cattle grazed. Recent management history is unknown – the present landowner took over management recently. No cattle were present in June 2012, the site appeared too wet to graze or cut. The boundary ditches were cleared of weed in late 2012.

Vegetation: The average sward height in the plot was tall at 18.75 cm. The species composition in the field was poor with 8–11 species recorded in 1m-quadrats. The monitoring plot was located in a flooded area dominated by grasses *Agrostis stolonifera*, *Alopecurus geniculatus* and *Glyceria fluitans* with spike-rush *Eleocharis palustris*. Sedge *Carex nigra* was frequent. The only constant forb was *Persicaria amphibia* although *Oenanthe fistulosa* was frequent. Duckweed (*Lemna minor*, *L. trisulca* and *Spirodela polyrhiza*,) were frequent. Additional species in the field included locally frequent *Phalaris arundinacea*, *Glyceria maxima* and *Carex acuta* with occasional *Ranunculus flammula*, *Rorippa sylvestris* and *Iris pseudacorus*.

NVC: This field has consistently been recorded as MG13 (MATCH similarity coefficient in 2012: plot 42.7%; field 46.1%). Due to the frequency of semi-aquatics such as *Eleocharis palustris* and *Glyceria fluitans* in the wider field, a relatively high match for S19 swamp was also returned (48.1%) – a strong indicator of the prolonged period of high water levels in this unit, which are unlikely to have been restricted to 2012 alone.

Site condition: The site passed the SSSI RCA for MG13-related grassland, which includes forb species more relevant to this more depauperate sward type.

HLS Indicators of success: This site is under option HK9 for breeding waders: presence of waders not assessed.

Soils: The soil is mildly acid. Soil analysis results (below) show levels of low phosphorous; moderate potassium; high magnesium, nitrogen, loss on ignition and organic carbon.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 16	5.8	11	1	126	2–	174	3	1.39	30.7	1794	16.4

ESA	Somerset Levels and Moors
2012 Site No.	17
Grid ref.	ST 4470 2423
Location	Wet Moor SSSI, Unit 55
Survey Method	ADAS nested plot
Survey Date	5 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 21
HLS Parcel No.	4629
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 17 lies to the west of Broad Drove and is adjacent to site 18. It is bounded on all other sides by minor drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. The origin marker was not found but plot marker pins were relocated at 10m and at corners A, B, C & D.

Management: The site is within the raised water level management area of Wet Moor. Little information could be gleaned regarding cutting/grazing management as grass keep is let and the tenant grazier of this site and 5 others was repeatedly unavailable. The site appears to be managed as permanent pasture – a small herd of steers graze this field with fields 17 and 18 as a single unit. Rushes are cut and in field gutters are cleared on an ad hoc basis when there is pooling in the field. Ditches are cleared on 3-year rotation.

Vegetation: The average sward height in the plot was 8.5cm. The species composition in the field was poor with 10–12 species recorded in 1m-quadrats. The field was grass dominated with much *Deschampsia cespitosa* plus *Agrostis stolonifera*, *Alopecurus pratensis*, *Lolium perenne*, *Poa trivialis*, *Hordeum secalinum* and *Holcus lanatus*. There were few forbs (*Ranunculus repens*, *R. acris*, *Rumex acetosa*, and *Cardamine pratensis*.) *Juncus effusus*, *Equisetum palustre*, *Alopecurus geniculatus* and *Potentilla anserina* were locally frequent in damper areas but wet meadow indicator species were restricted to frequent *Cardamine pratensis* and rare *Galium palustre* and *Myosotis laxa*.

NVC: The sward in the plot has affinities with both MG7d (52.1%) and MG9a (54.3%), with the wider field showing similar coefficients. It has previously been described as MG7d and it is probably most similar to this community, but with some *Deschampsia cespitosa* invasion.

Site condition: With only one species frequent and two rare the site failed the SSSI RCA for inland wet grassland and MG11/MG13-related grassland. However, the site is likely to meet the conditions for BAP habitat G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: presence of waders not assessed.

Soils: The soil is mildly acidic. Soil analysis results (below) show moderate levels of phosphorous; low potassium; high magnesium, and moderately high nitrogen, loss on ignition and organic carbon.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 17	5.6	24	2	89	1	190	4	0.99	27.6	1568	8.4

ESA	Somerset Levels and Moors
2012 Site No.	18
Grid ref.	ST 4460 2422
Location	Wet Moor SSSI, Unit 55
Survey Method	ADAS nested plot
Survey Date	5 July, 2012.
Previous Derivation	ESA Wet Grassland Stand 22
HLS Parcel No.	6024
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 18 is bordered by Broad Drove to the east and is adjacent to site 17. It is bounded on all other sides by minor drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. All metal plot marker pins were relocated at origin, 10m and at corners A, B, C & D. There is a large flooded area to the south of the field.

Management: The site is within the raised water level management area of Wet Moor. Little information could be gleaned regarding cutting/grazing management as grass keep is let and the tenant grazier of this site and 5 others was repeatedly unavailable. The site appears to be managed as permanent pasture – a small herd of steers graze this field with fields 17 and 18 as a single unit. Rushes are cut and in field gutters are cleared on an ad hoc basis when there is pooling in the field. Ditches are cleared on 3-year rotation.

Vegetation: The average sward height in the plot was 12cm. The species composition in the field was poor with 8–10 species recorded in 1m-quadrats. The sward was dominated by *Alopecurus pratensis* with much *Deschampsia cespitosa* (5%), *Phleum pratense* and *Lolium perenne*. *Hordeum secalinum* was locally abundant, particularly in the drier northern part. There were few forbs (*Ranunculus repens*, *R. acris*, *Rumex acetosa*, *Trifolium repens* and *Cardamine pratensis*.) Wet meadow indicator species were restricted to frequent *Cardamine pratensis* and rare *Lathyrus pratensis*.

NVC: This unit has consistently been described as MG9a and the MATCH analysis supported this (plot 51.9%: field 47.1%). There were also strong affinities with floodplain pasture community MG7d (plot 50.2%), which is found in the adjacent field (unit 17). This pasture may originate from that community but have suffered *Deschampsia cespitosa* invasion through flooding events.

Site condition: With only one species frequent and one rare the site failed the HLS condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and the SSSI RCA for MG13-related grassland. However, the site is likely to meet the conditions for G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: presence of waders not assessed.

Soils: The soil is mildly acidic. Soil analysis results (below) show moderate levels of phosphorus; low potassium; high magnesium, and moderately high nitrogen. Organic matter content indicated by loss on ignition and organic carbon content is low–medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 18	5.5	20	2	94	1	188	4	0.98	27.3	1507	7.4

ESA	Somerset Levels and Moors
2012 Site No.	19
Grid ref.	ST 4479 2499
Location	Wet Moor SSSI, Unit 54
Survey Method	ADAS nested plot
Survey Date	28 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 23
HLS Parcel No.	7995
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 19 lies just to the south of Long Load Main Drain and is bounded on all sides by minor drains, and has infield gutters and ditches. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated in 2012.

Management: The site is within the raised water level management area of Wet Moor. Little information could be gleaned regarding cutting/grazing management as grass keep is let and the tenant grazier of this site and 5 others was repeatedly unavailable. This site had been shut up for hay and is presumably aftermath grazed by the tenant herd of cattle. Rushes are cut and in field gutters are cleared on an ad hoc basis when there is pooling in the field. Ditches are cleared on 3-year rotation.

Vegetation: The average sward height in the plot was 14.4cm. The species composition in the field was poor with 7–12 species recorded in 1m-quadrats. The field had been shut up for hay and supported a tall, rank sward with much *Agrostis stolonifera*, *Lolium perenne* and *Alopecurus pratensis* with abundant *Ranunculus repens*. Negative indicator *Rumex crispus* was frequent. Tussocks of *Deschampsia cespitosa* were locally abundant (8% cover). There was a low cover of *Juncus effusus*. Typical mesotrophic pasture species were occasional, such as *Trifolium repens*, *Ranunculus acris* but typical wet meadow indicator forbs were infrequent: *Cardamine pratensis* was occasional and *Lychnis flos-cuculi*, *Oenanthe fistulosa*, *O. pimpinelloides* were rare in the sward.

NVC: Previously described as MG7a or b, this field now has greater affinities with the wetter grassland communities of MG7c (plot 50.1%, field 49.2%) or MG7d (plot 51.7%). This MATCH analysis gave a higher result for MG10a rush pasture (plot 56.4%: field 57.6%), but the cover of *Juncus effusus* and *Holcus lanatus* was considered too low to be a true match with this community. An increase in *Deschampsia cespitosa* may see a move towards MG9a.

Site condition: With only one species occasional and two rare the site failed the HLS condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and the SSSI RCA for MG13-related grassland. However, the site is likely to meet the conditions for G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: the indicators of success for this option were not assessed.

Soils: The soil is mildly acidic. Soil analysis results (below) show moderate levels of phosphorous and potassium; high magnesium, and high nitrogen. Organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 19	5.8	17	2	146	2–	162	3	1.26	33.0	2083	15.5

ESA	Somerset Levels and Moors
2012 Site No.	20
Grid ref.	ST 4548 2420
Location	Wet MoorSSSI, Unit 60
Survey Method	ADAS nested plot
Survey Date	28 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 24
HLS Parcel No.	6117
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HR6 Small fields; HK19 Raised water level

Site 20 is an extremely small field accessed directly off Bowmead Drive. It is bounded on all sides by minor drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated in 2012.

Management: The site is within the raised water level management area of Wet Moor. Little information could be gleaned regarding cutting/grazing management as grass keep is let and the tenant grazier of this site and 5 others was repeatedly unavailable. This site had been shut up for hay and is presumably aftermath grazed by the tenant herd of cattle. Rushes are cut and in field gutters are cleared on an ad hoc basis when there is pooling in the field. Ditches are cleared on 3-year rotation.

Vegetation: The average sward height in the plot was 47.4cm. The species composition in the field was poor with 9–12 species recorded in 1m-quadrats. The plot was located in a tall, tussocky stand of inundated grassland/poor fen with the usual grass species of this area *Agrostis stolonifera* and *Alopecurus pratensis*, with much *Phalaris arundinacea*, *Deschampsia cespitosa* and *Elytrigia repens*. The stand was also rush invaded by much *Juncus effusus*. Sedges were few but *Carex nigra* was frequent. Forbs within the plot included typical wet meadow species: frequent *Cardamine pratensis* and *Galium palustre*, occasional *Myosotis laxa* and rare individuals of *Lysimachia nummularia*, *Ranunculus flammula*, *Oenanthe fistulosa* and *Iris pseudacorus*. The vegetation within the plot was fairly representative of the field as a whole.

NVC: This field has consistently supported MG10 rush pasture – previously recorded as MG10a, although the frequency of *Phalaris arundinacea* and presence of *Iris pseudacorus* mark a shift towards the MG10c wetter sub-community. MATCH analysis results were inconclusive: MG10a (plot 39.0%, field 52.0%), MG10b (41.3%, 46.2%), MG10c (46.3%, 49.7%). This plot is MG10a–c transition due to recent years of high water levels.

Site condition: The site marginally failed the failed the SSSI RCA for MG13-related grassland on frequency of indicator species (3 frequent plus 2 rare); however, it also failed this assessment on cover of large *Carex* and *Juncus* spp. (>25% limit). The site is G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: the indicators of success for this option were not assessed.

Soils: The soil is mildly acidic. Soil analysis results (below) show low levels of phosphorous and moderate potassium; very high magnesium, and high nitrogen. Organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 20	5.6	15	1	182	2+	187	4	1.18	29.4	1910	14.8

ESA	Somerset Levels and Moors
2012 Site No.	21
Grid ref.	ST 4544 2387
Location	Wet Moor SSSI, Unit 60
Survey Method	ADAS nested plot
Survey Date	28 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 25
HLS Parcel No.	6117
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HR6 Small fields; HK19 Raised water level

Site 21 is an extremely small field accessed directly off Bowmead Drive. It is bounded on all sides by minor drains. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated in 2012.

Management: The site is within the raised water level management area of Wet Moor. It is cattle grazed only with occasional topping of rushes. Grazing is occasional and occurs when the field is dry enough. The owner notes a decline in the quality of the sward with more weeds and rushes.

Vegetation: Average sward height in the plot was 15.1cm. Species composition in the field was extremely poor with 5–8 species recorded in 1m-quadrats. The plot was located in the middle of large flooded depression: it supported few species and largely comprised (often floating) mats of grasses *Agrostis stolonifera*, *Alopecurus geniculatus* and *Glyceria fluitans*. Large sedge tussocks *Carex nigra/acuteformis* were frequent. Forbs were few in the plot: there was ±constant *Persicaria amphibia* with frequent *Ranunculus flammula* and *Cardamine pratensis*, and occasional *Galium palustre* and *Lysimachia nummularia*. An aquatic moss (*Warnstorfia fluitans/Drepanocladus aduncus*) was occasional and *Lemna minor* was present. Some *Glyceria maxima* had colonised the plot and a small area of *Juncus effusus* was also present. *Juncus effusus* was patchy across the rest of the field, and locally dominant. *Deschampsia cespitosa* tussocks were also noted in the field

NVC: This unit was initially recorded as MG10a in 1993 but in 2003 was recorded as MG13; a generally wetter community. The vegetation in 2012, certainly in the more waterlogged centre, is now closest to MG13 (MATCH plot 49.7%, field 58.4%), although the frequency of *Glyceria fluitans* with constant *Ag. stolonifera* and *Al. geniculatus* also reflects affinities with the water-margin community S22c that can occur in wet depressions in pastures and fens (plot 38.3%, field 49.1%).

Site condition: The site narrowly failed the SSSI RCA for MG13-related grassland on positive indicator species; it had three frequent plus 2 rare positive indicator species; however, it also failed this assessment on rush cover (>25% limit). The site probably meets the conditions for G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: the indicators of success for this option were not assessed.

Soils: The soil is mildly acidic, low in phosphorous, with moderate potassium, very high magnesium, and high nitrogen. Organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 21	5.4	10	1	191	2+	233	4	1.15	30.6	1559	14.4

ESA	Somerset Levels
2012 Site No.	22
Grid ref.	ST31822895
Location	North Moor SSSI, Unit 88
Survey Method	Five quadrats on transect
Survey Date	31.7.2012
Previous Derivation	ESA Perm Grassland Site 25
HLS Parcel No.	8486
HLS Options	HK10 Maintenance of wet grassland for wintering waders & wildfowl
HLS Supplements	HR1 Cattle grazing

A small triangular field adjacent to the former railway line to the north of the small aggregate of farms along the limestone ridge at West Lyng. The farm is divided between arable land and ley grassland on the better-drained limestone soils, and permanent dairy pasture on the levels to the north. The quadrats were first laid out and surveyed in 1988: resurveys took place in 1989, 1990 and 1995. Marker at 5m post and quadrats 1, 4 and 5 refound.

Management: This site is occasionally cut for 3rd class hay but it usually treated as permanent pasture. A herd of dairy cows are put on as soon as the weather permits and stay on until it becomes too wet or there is insufficient left to graze. Rushes are topped once or twice per year. There is no spraying – the field is organic. Minor drains and field gutters are cleared when needed but less than once every 5 years.

Vegetation: The grassland is not species-rich (11–16 species m⁻²), and has probably had some agricultural improvement in the past: it is poor in the typical species of long-established semi-natural grasslands. *Alopecurus pratensis* is abundant throughout with *Juncus acutiflorus*, *Carex hirta*, *Ranunculus repens* and *Agrostis stolonifera*. *Festuca rubra*, *Phleum pratense*, *Ranunculus acris*, *Carex disticha*, *Lotus pedunculatus*, *Rumex acetosa* and the more competitive tall species *Carex riparia* and *Juncus effusus* are locally frequent. Other occasional species typical of semi-natural grasslands include *Carex nigra*, *Filipendula ulmaria*, *Lysimachia nummularium*, *Lychnis flos-cuculi* and *Centaurea nigra*.

NVC: Vegetation in this field is typical of regularly inundated grassland, but is difficult to classify within the NVC. MATCH analysis puts it as to the species-poor tussocky grasslands MG9a (coefficient 45.8%) or MG10a (49.6%), but *Holcus lanatus* is notably lacking, and the tussock-forming *Deschampsia cespitosa* and *Juncus effusus* are rare. The five quadrats were classified as MG8, MG4, MG8, MG5a and MG5a in 1988. It now has the appearance of a rush invaded species poor stand of MG8 (37.3%) or M23 (37.3%).

Site Condition: Fails the condition assessment for MG8 on frequency of positive indicator species, it has 3 frequent and 2 occasional. It also fail on 40% cover of *Juncus* spp. (mainly *J. acutiflorus* but also *J. effusus*).

Indicators of success: Fails SSSI the condition assessment and cover of *Juncus* spp. is greater than 30%.

Soils: Soil pH is mildly acidic. Phosphate content is low, potassium content is moderate while magnesium content is very high. Nitrogen content is high and organic matter content as measured by loss on ignition and organic carbon level is high.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
22	6	7	0	161	2-	402	6	1.57	34.1	1046	19.9

ESA	Somerset Levels and Moors
2012 Site No.	23
Grid ref.	ST 4542 2443
Location	Wet Moor SSSI, Unit 61
Survey Method	Five quadrats on transect
Survey Date	20 June, 2012.
Previous Derivation	ESA Permanent Grassland Stand 89
HLS Parcel No.	3486
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 23 is located west of Bowmead Drove on Wet Moor. It is bounded on all sides by minor drains. The quadrats were first laid out and surveyed in 1988: resurveys took place in 1989, 1990 and 1995. All metal marker pins were relocated in 2012.

Management: The site is within the raised water level management area of Wet Moor. It is cattle grazed only with occasional topping of rushes. Grazing is occasional and occurs when the field is dry enough. The owner notes a decline in the quality of the sward with more weeds and rushes.

Vegetation: Average sward height in the quadrats was 39.2cm. Species composition in the field was extremely poor with 5–13 species recorded in 1m-quadrats. The sward was tall and grass dominated with dominant *Agrostis stolonifera*, *Alopecurus pratensis* and *Poa trivialis* with frequent tussocks of *Juncus effusus* and occasional *J. articulatus*. *Lolium perenne* was frequent. Other grasses were patchy in their occurrence such as *Alopecurus geniculatus* and *Deschampsia cespitosa*. Forbs were poorly represented with much *Ranunculus repens* but few typical water-meadow species. Only *Cardamine pratensis* was frequent of these.

NVC: The five quadrats in 1998 were recorded as either MG10b or MG11a. In 2012 the sward appeared to have closest affinity with MG10a (MATCH coefficient 61.1%), although the cover of *Holcus lanatus* is low for that community; however, the usual MG11 associates of *Festuca rubra* and *Potentilla anserina* were missing. The high cover of *Agrostis stolonifera* is similar to MG13 (MATCH 52.6%) and this field is considered somewhere between MG10 and MG13.

Site condition: The site failed the SSSI RCA for Inland Wet Grassland (MG11/13-related) on positive indicator species; it had 1 frequent plus 3 rare positive indicator species; however, it also failed this assessment on rush cover (>25% limit). The site probably meets the conditions for G15 – flood plain grazing marsh.

HLS Indicators of success: This site is under option HK9 for breeding waders: the indicators of success for this option were not assessed.

Soils: The soil is mildly acidic, low in phosphorous, with moderate potassium, very high magnesium. Nitrogen is high but this is normal for old grazed pasture. Organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 23	5.8	11	1	172	2–	224	4	1.10	30.0	1796	13.3

ESA	Somerset Levels
2012 Site No.	24
Grid ref.	ST36443318
Location	Langmead & Weston Level SSSI, Unit 41
Survey Method	Five quadrats on transect
Survey Date	31.7.2012
Previous Derivation	ESA Perm Grassland Site 26
HLS Parcel No.	4317
HLS Options	HK6 Maintenance of species-rich semi-natural grassland.
HLS Supplements	HR1 Cattle grazing; HR6 Small fields

This long, narrow field is part of a system of similar fields (Longmead) to the west of the village of Middlezoy. Markers pins refound apart from origin.

Management: This site is managed by an agent – Tamlin & Sons, Bridgewater. The grass is let annually but under the stipulation that it is hay cut and aftermath grazed. This is always cattle. If the grass is let to the same person for several years in succession then they are responsible for weed control and clearance of ditches and gutters. If a new tenant arose every year then the managing agents would arrange these aspects.

Vegetation: Mean sward height 15.8 cm. The grassland in this field is generally species-rich (11–16 species in 1-m quadrats) and locally very species-rich. While *Juncus effusus* and *Carex riparia* are generally abundant they are not overwhelmingly so, and the sward between the tussocks has abundant *Carex disticha*, *Carex flacca*, *Anthoxanthum odoratum*, *Festuca rubra*, *Holcus lanatus* and *Filipendula ulmaria* with frequent *Agrostis stolonifera*, *Carex nigra*, *Cardamine pratensis*, *Cirsium palustre*, *Plantago lanceolata*, *Ranunculus acris* and *Stellaria graminea*. *Juncus subnodulosus*, *Lychnis flos-cuculi* and *Carex panacea* are also present. There are marginal zones of *Phragmites australis* which because of the shape of the field occupy a significant area of the site.

NVC: In 1998 Match analysis classified quadrats in this field as MG8 (three quadrats), MG4 and MG5a. The overall classification for the whole stand in 2012 was MG8, although the high cover of *Carex riparia*, *Carex disticha* and *Juncus* spp. suggest a transition to the closely related M22a or M22b, and this is confirmed by the high MATCH coefficient for M22a. This suggests an increase in wetness of the field.

Site Condition: This field fails the SSSI condition assessment for M22 on frequency of positive indicator species: two species were frequent and two occasional: there were many that were rare in the sward.

Indicators of success: Fails the SSSI assessment.

Soils: Soil pH is mildly acidic. Phosphate content is low, potassium content is moderate while magnesium content is very high. Nitrogen content is high and organic matter content as measured by loss on ignition and organic carbon level is high.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
24	6.1	8	0	169	2-	534	6	1.73	37.3	1318	20.3

ESA	Somerset Levels
2012 Site No.	25
Grid ref.	ST315288
Location	Lyng
Survey Method	Five quadrats on transect
Survey Date	Not surveyed
Previous Derivation	ESA Perm Grassland Site 45
HLS Parcel No.	4785
HLS Options	HK10 Maintenance of wet grassland for wintering waders & wildfowl
HLS Supplements	

This site was not surveyed during 2012 – it was withdrawn from the list by Natural England.

ESA	Somerset Levels
2012 Site No.	26
Grid ref.	ST37914177
Location	Catcott Edington & Chilton Moors SSSI, Unit 137
Survey Method	Five quadrats on transect
Survey Date	20 July 2012
Previous Derivation	ESA Perm Grassland Site 62
HLS Parcel No.	8781
HLS Options	HK10 Maintenance of wet grassland for wintering waders & wildfowl
HLS Supplements	HR1 Cattle grazing; HR6 Small field; HK19 Raised water level

This small field lies just west of the Chilton Road on Edington Moor. It is bounded by a dismantled railway to the west and by drainage ditches on all sides. The quadrats were first laid out and surveyed in 1988: resurveys took place in 1989, 1990 and 1995. Markers pins not refound – bramble had grown over origin and there were scraps of wire in the vicinity which gave false ‘hits’ for the metal detector.

Management: This site is usually shut up for hay and then aftermath grazed with cattle. Previously a dairy herd but now a suckler herd. Rushes are flail mown and often weed-wiped afterwards.

Vegetation: The field supported a diverse and grass dominated rush pasture/ floodplain meadow. Species diversity was moderately high at 20–25 species in 1-m quadrats. Rushes *Juncus effusus* and *J. inflexus* were frequent, whilst *J. articulatus* was occasional. The most frequent grasses included *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Cynosurus cristatus*, *Deschampsia cespitosa*, *Festuca rubra*, *Holcus lanatus* and *Lolium perenne*. *Carex nigra* and *C. hirta* were frequent. Whilst forbs *Filipendula ulmaria*, *Cardamine pratensis*, *Ranunculus acris*, *R. repens*, *Rumex acetosa* and *Plantago lanceolata* were frequent, all other forbs were occasional only and included few indicator species of wet meadow (e.g. rare *Thalictrum flavum*, *Centaurea nigra*, *Leontodon autumnalis*).

NVC: In 1998 Match analysis classified the quadrats in this field as MG6b, MG4 and MG8: the overall classification was therefore probably MG8. By 2012 the rush component of the field had increased giving the appearance of rush pasture but the closest community is probably still MG8 (MATCH coefficient 62.1%), although the affinity with rush pasture is marked by a reasonably high MATCH result for MG10 too (57.1%).

Site Condition: The site failed the SSSI RCA for MG8 on frequency of positive indicators: it had only 2 frequent plus one rare.

Indicators of success: The site failed on the SSSI condition stipulation. This site is under HK10 for wintering waders – the indicators of success for this option were outside the scope of this project.

Soils: Soil pH is neutral. Phosphate and potassium content are low; while magnesium content is high. Nitrogen content is extremely high, as is organic matter content as measured by loss on ignition and organic carbon level is high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 26	6.8	5	0	104	1	170	3	2.38	53.3	1419	53.3

ESA	Somerset Levels
2012 Site No.	27
Grid ref.	ST39254227
Location	Catcott Edington & Chilton Moors SSSI, Unit 145
Survey Method	Five quadrats on transect
Survey Date	20 July 2012
Previous Derivation	ESA Perm Grassland Site 65
HLS Parcel No.	3627
HLS Options	HK10 Maintenance of wet grassland for wintering waders & wildfowl
HLS Supplements	HR1 Cattle grazing

This small field lies just east of the Edington Road on East Edington Heath. It is bounded by the road to the west and by drainage ditches on all sides. The quadrats were first laid out and surveyed in 1988: resurveys took place in 1989, 1990 and 1995. All metal marker pins refound.

Management: After initial contact to arrange access we failed to reach landowner again to discuss management. The HLS prescription is to manage for hay with aftermath grazing, or to manage by grazing alone (6 weeks between 01 May and 30 November) to achieve grass tussocks and areas of shorter grass. There has been a 45% loss in species richness from 1988 to 2012.

Vegetation: A mosaic of poor to moderately species rich rush pasture (9–17 species in 1-m quadrats). The vegetation was dense with few forbs but there was little accumulated litter. It comprised mixes of dominant *Agrostis stolonifera* with frequent *Holcus lanatus*, *Phleum pratense*, *Juncus articulatus*, *Carex disticha* and some *Potentilla anserina* with areas where either *Juncus effusus* was dominant, or where *Carex disticha* was dominant. There were also patches of *Glyceria maxima* and *Phalaris arundinacea* denoting areas of more permanent waterlogging. *Eleocharis palustris* was occasional.

NVC: The vegetation in this field has closest affinities with MG10a rush pasture (MATCH coefficient 49.5%), although MG9a and MG13 also returned similar results (45.2%, 43.3%). In 1988 the individual quadrats were recorded as MG4 and M22b. However, the usual forb associates of MG4 were missing in 2012 and the sward was not rich enough for M22b. This field has probably degraded in the period of the survey and become more rush invaded resulting in the impoverished stand of rush pasture today.

Site Condition: The site failed the HLS condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and the SSSI RCA for MG4, MG8 or M23 on frequency of positive indicators – all were rare.

Indicators of success: This site is under HK10 for wintering waders – the indicators of success for this option were outside the scope of this project.

Soils: Soil pH is mildly acid/circumneutral. Phosphate and potassium content are low; while magnesium content is extremely high. Nitrogen content is also extremely high, as is organic matter content as measured by loss on ignition and organic carbon level is high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 27	6.3	7	0	116	1	312	5	2.43	72.0	1235	72.0

ESA	Somerset Levels
2012 Site No.	28
Grid ref.	ST40704507
Location	Tealham and Tadham Moors SSSI, Unit 112
Survey Method	ADAS nested plot
Survey Date	13 July 2012
Previous Derivation	ESA Perm Grassland Site 69
HLS Parcel No.	7598
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing; HK19 Raised water level

Site 28 lies below sea level and is bounded Bounds Rhyne to the east and smaller drainage ditches on the remaining three sides. The single fixed-plot was set up on this site in 1993 and subsequent surveys took place in 1995, 1998 and 2003. No metal plot marker pins were relocated.

Management: Site 28 is within the raised water level management area; it cattle grazed pasture (summer–autumn) but is also topped (to control rushes) – last cut 2 years ago. *Oenanthe crocata* is controlled using spot spraying.

Vegetation: The average sward height in the plot was 29.4cm. The sward was moderately species-rich with 12–20 species recorded in 1m-quadrats. The sward was dominated by grasses, sedges and rushes with a poorer forb component. *Carex disticha*, *Eleocharis palustris* and *Agrostis stolonifera* were constant with *Persicaria amphibia*, *Potentilla anserina* and *Ranunculus repens*. Frequent species included tussocky grasses *Holcus lanatus* and *Festuca pratensis* plus *Carex nigra*. Indicator species of floodplain meadow included frequent *Oenanthe fistulosa* and occasional *Galium palustre*, *Ranunculus flammula* plus many species that were rare within the sward such as *Lotus pedunculatus*, *Lathyrus pratensis*, *Filipendula ulmaria* and *Mentha aquatica* – but these were sparse.

NVC: This sward originates from MG8 and it still has affinities with that community type, although the sward is an impoverished or degraded stand which is reflected in the MATCH results that put the community closest to MG10a (51.7%) or even S19 (49.3%) due to the constancy of *Eleocharis palustris*. However, poor MG8 is still the most suitable community type to aim management at.

Site condition: The site failed the HLS condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and the SSSI RCA for MG8 or M22/23 on frequency of positive indicators – it had one frequent, two occasional and several rare.

HLS Indicators of success: This site is under HK9 for breeding waders – the indicators of success for this option were outside the scope of this project.

Soils: The soil is very mildly acidic. Phosphorous and potassium levels are low, magnesium is high. Nitrogen and loss on ignition are high (due to peat content) and organic carbon moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 28	6.4	8	0	41	0	131	3	1.59	55.8	1022	16.7

ESA	Somerset Levels
2012 Site No.	29
Grid ref.	ST45134513
Location	Westhay Moor SSSI, Unit 93
Survey Method	Five quadrats on transect
Survey Date	20.7.2012
Previous Derivation	ESA Perm Grassland Site 79
HLS Parcel No.	1311
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HR 1 Cattle grazing

This field is to the south of the village of Mudgley, to the south of a low limestone ridge that crosses the Somerset Levels. It is part of the Westhay moor SSSI. It was wet in places at the time of survey and had been heavily grazed recently. All marker pins refund.

Management: This field is permanent pasture and cattle grazed during the late Spring to Autumn as weather and grass allow. The farmer feels that the water levels are too high and that the RWL management is ruining the moor and killing wildlife. The field has, in his opinion, become much more rush dominated and the yield is declining in quality and quantity. He would like to be able to spray rushes.

Vegetation: Grassland in this field is relatively species-poor, and although *Carex flacca*, *Carex panacea* and *Carex lepidocarpa* were frequent or abundant, broad-leaved species were sparse. Grasses including *Holcus lanatus*, *Festuca rubra*, *Agrostis stolonifera*, *Anthoxanthum odoratum* and *Cynosurus cristatus* were abundant with *Juncus effusus* and the *Carex* spp. mentioned above. The only frequent broad-leaved species was *Lotus pedunculatus*.

NVC: In 1998 quadrats in this field were identified by Match as MG8 (3 quadrats) and MG5a (2 quadrats). In 2012 the overall NVC community was determined in the field as MG10a but with affinities to MG11a or M23a. This was confirmed by MATCH with the top-ranking community being MG10a (coefficient=50.9) and M23b ranked third (coefficient=45.4).

Site Condition: The site fails a CSM condition assessment on the frequency of positive indicator species (2 frequent, 1 occasional).

Indicators of success: The site fails Indicators of Success targets on the frequency of positive indicator species.

Soils: The pH of the soil is moderately acidic. Phosphate and potassium levels are low but magnesium level is high. Nitrogen content is very high, and organic matter content as measured by loss on ignition and organic carbon level is very high, suggesting a high peat content.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
29	5.8	10	1	107	1	225	4	2.31	75	975	36.7

ESA	Somerset Levels
2012 Site No.	30
Grid ref.	ST40604126
Location	Catcott Edington & Chilton Moors SSSI, Unit 151
Survey Method	Five quadrats on transect
Survey Date	31.7.2012
Previous Derivation	ESA Perm Grassland Site 81
HLS Parcel No.	3444
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HK18 Haymaking

This field is part of the Somerset Wildlife Trust reserve at Catcott Heath and is also within the Catcott, Edington and Chilton Moors SSSI. It is one of a system of small fields separated by ditches between Higher Ropes Drove and Lower Ropes Drove. The field was divided into two by a dry ditch in 1998, but this was not discernible in 2012. Metal marker pins refound.

Management: This site is generally hay cut every year but it was too wet in 2012. Every 5th year a late season cut is carried out to allow more species to set seed. Aftermath grazing using belted Galloway, Dexter and/or Aberdeen Angus so far. *Senecio aquaticus* is pulled by hand. In field gutters are cleared by hand – side ditches are cleared on a 3–4 year rotation. There is a perception that the site has more rushes than before.

Vegetation: The fen-meadow vegetation in this field is species-rich. *Juncus subnodulosus* is dominant throughout forming an open canopy with *Carex disticha*, *Filipendula ulmaria* and *Lotus pedunculatus*. Beneath this is a species-rich sward of *Agrostis canina*, *Anthoxanthum odoratum*, *Agrostis stolonifera*, *Holcus lanatus*, *Carex flacca*, *Carex panicea* and *Calliergon cuspidatum*. Although few dicotyledonous species are frequent, there is a wide range of species at lower frequencies typical of long-established fen-meadow. These include *Lysimachia nummularia*, *Succisa pratensis*, *Potentilla erecta*, *Potentilla palustris*, *Carex lepidocarpa*, *Dactylorhiza praetermissa*, *Lysimachia vulgaris*, *Cirsium dissectum*, *Thalictrum flavum* and most notably *Lathyrus palustris*. There is a thicket of *Salix cinerea* scrub in the north-west corner.

NVC: Match diagnoses for individual quadrats in 1998 were MG8 (3 quadrats) and MG12a (2 quadrats). In 2012 the whole stand was M22a (coefficient=48.4), although the highest coefficient was for M23a (coefficient=56.1): the dominance of *Juncus subnodulosus* and *Carex disticha* point clearly to M22. There has clearly been a change between 1998 and 2012 from a grass-dominated, grazed community to a *Juncus* and *Carex*-dominated fen-meadow. This may be associated with a change in management or rise in water-level.

Site Condition: The site passes all CSM targets for M22 and M23.

Indicators of success: The site passes all indicators of success targets.

Soils: Soil pH is mildly acidic. Phosphate level is low, potassium level is moderate and magnesium level is high. Nitrogen content is very high, and organic matter content as measured by loss on ignition and organic carbon level is very high, suggesting a high peat content.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
30	5.9	11	1	207	2+	177	4	2.8	68.9	1308	36.7

ESA	Somerset Levels
2012 Site No.	31
Grid ref.	ST34872521
Location	West Sedgemoor SSSI, Unit 121
Survey Method	Five quadrats on transect
Survey Date	31.7.2012
Previous Derivation	ESA Perm Grassland Site 93
HLS Parcel No.	8518
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	HK19 Raised water level

This site is situated on West Sedgemoor to the south-east of Huntham and is one of a pair of fields here within HLS under the same ownership. It is part of the West Sedgemoor SSSI. Plot markers not refound – sward too tall and swamp-like.

Management: This site is managed for field dried hay and aftermath grazed with 6–12 cattle once there is sufficient grass following this. The farmer proposes to weed-sipe rushes in the future as they are increasing in the field. The drains are mostly under the control of the IDB but one drain is cleared every few years by the neighbouring landowner.

Vegetation: Grassland in this field is moderately species-rich. *Agrostis stolonifera* and *Carex nigra* are dominant with frequent *Ranunculus repens*, *Plantago lanceolata*, *Leontodon autumnalis*, *Galium palustre*, *Filipendula ulmaria* and *Cardamine pratensis*. *Juncus effusus* and *Phalaris arundinacea* are locally frequent. The eastern and western ends of this field have stands of *Carex riparia* and *Carex acuta* which although quite dense are still moderately species-rich. *Stellaria palustris*, *Cirsium dissectum*, *Caltha palustris*, *Carex panicea* and *Thalictrum flavum* are all occasional. *Oenanthe fistulosa* is rare.

NVC: In 1998 MATCH determined the individual quadrats as MG4 (3 quadrats), MG5a and MG8. In 2012 the whole stand was determined as MG10 (coefficient = 46.0), or M23b (42.8%) although *Juncus* spp had a low cover. The grassland is probably closer to MG8 but it is very difficult to determine. The sedge-swamp is probably S6 *Carex riparia* swamp, which can include *Phalaris arundinacea* and *Carex acuta* as subsidiary dominants.

Site Condition: The site passes all CSM targets for MG8 and M23. Although there are beds of *Carex* spp at the ends of the field, these occupy much less than the 20% maximum required for favourable condition.

Indicators of success: This site passes all indicators of success targets.

Soils Soil pH is mildly acidic. Phosphate content is very low, potassium content is low and magnesium content is very high. Nitrogen content is very high, and organic matter content as measured by loss on ignition and organic carbon level is high, suggesting a high peat content.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
31	6	5	0	114	1	458	6	2.05	52.6	1035	27.8

Appendix 2: TEST VALLEY

Appendix 2a: MATCH analysis of individual sites

Results of MATCH analysis of the 5-quadrat plots recorded in the Test Valley. The top five results are shown. The NVC community determined in 2012 is provided (in bold in final column), which is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

TEST VALLEY – MATCH rank (top 5)										2012	
	1		2		3		4		5		
	NVC	%	NVC	%	NVC	%	NVC	%	NVC	%	
32	M22b	55.4	M22	55.2	MG8	54.7	MG9a	52.1	M22a	51.5	M22b
33	M27	54.5	M27c	50.6	MG9a	47.3	OV26	46.6	MG9	45.8	M27/MG8 mosaic
34	MG9	60.8	MG9a	57.1	MG9b	56.1	OV26	54.1	MG10a	52.3	MG9 (Mosaic with <i>C. riparia/ acutiformis</i>)
35	U4b	49.2	MG6b	46.7	MG5c	46.7	MG8	45.1	MG9	44.8	U4b
36	M22	59.7	M22b	59.3	M22a	57.9	MG9a	55.8	MG8	54.1	M22b
37	M22b	61.4	M22	60.7	M22a	58.8	MG8	55.9	M26b	52.6	M22b
38	MG9	58.7	MG9a	56.3	MG9b	54.1	M22a	51.4	MG1c	48.7	M22b/M25c mosaic
39	M22a	51.8	M22b	51.4	M22	50.8	M24	49.5	MG9	48.4	M22a/M25c/M24a/MG1a mosaic
40	MG9	57.3	MG9b	54.6	MG9a	53.9	OV26c	52.7	M22a	49.9	M22a (with M27/MG9)

Appendix 2b: Individual Site Descriptions for 2012 survey

ESA	Test Valley
2012 Site No.	32
Grid ref.	SU38874008
Location	Chilbolton Common SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	1.8.2012
Previous Derivation	ESA grassland site 1
HLS Parcel No.	7615
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	

Chilbolton Common is a large area of common grazing land to the west of the village of Chilbolton. It was included in the Test Valley ESA in 1989. The majority of the common is situated between two branches of the River Test, although there is a small area to the east of the eastern branch. The transect is situated in the east of the common. Only origin marker found.

Management: The common is owned by Chilbolton Parish Council and managed by a management committee. It is grazed by young cattle between April and October at approximately 1 animal/ha. It is topped in the autumn to control taller grasses.

Vegetation: Grassland along the transect is species-rich with no single dominant. Abundant species include *Festuca rubra*, *Holcus lanatus*, *Filipendula ulmaria*, *Plantago lanceolata*, *Trifolium pratense*, *Iris pseudacorus*, *Juncus inflexus* and *Carex acutiformis*. The last two species also form denser stands locally. Other locally frequent species include *Valerianella dioica*, *Potentilla erecta*, *Ranunculus acris*, *Agrostis stolonifera*, *Cynosurus cristatus*, *Festuca pratensis* and *Carex flacca*. A number of other species typical of old pastures were recorded, including *Dactylorhiza praetermissa*, *Lychnis flos-cuculi*, *Geum rivale*, *Ophioglossum vulgatum*, *Succisa pratensis* and *Carex panicea*.

NVC: This is a good example of M22b (coefficient = 55.4), although the patchiness of the tall sedge and rush cover suggests a transition to MG8 (coefficient = 54.7) which may increase with time under the present management regime.

Site Condition: This site passes the condition assessment.

Indicators of Success: This site passes all indicators of success.

Soil: Soil pH is slightly alkaline and phosphate content is low. Potassium level is moderate while magnesium level is high. Nitrogen content is very high, while organic matter content as indicated by loss on ignition and organic carbon content is high, suggesting some peat accumulation.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 32	7.2	11	1	138	2-	231	4	2.21	47.8	1374	23.5

ESA	Test Valley
2012 Site No.	33
Grid ref.	SU47524765
Location	Bere Mill Meadows SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	25.7.2012
Previous Derivation	ESA grassland site 3
HLS Parcel No.	SU47475265
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is one of two adjacent fields included in this survey that are managed as a single unit. They are situated to the south of the River Test to the east of Whitford. No markers refound.

Management: Hay is normally cut from part of these fields in most years, but not in 2012 as it was too wet. Rushes are normally topped. Areas not cut for hay are grazed by cattle between April and November with sheep sometimes, and the aftermath of the hay-cut areas is also grazed..

Vegetation: Much of the field had tall fen dominated by *Carex acutiformis* and *Filipendula ulmaria*. There are areas of *Glyceria maxima* swamp and patches dominated by *Arrhenatherum elatius* and *Festuca rubra*. The tall fen was relatively species-poor with in addition to the dominant species, *Holcus lanatus*, *Lathyrus pratensis*, *Mentha aquatica*, *iris pseudacorus*, and *Geum rivale*. Patches of richer fen-meadow within this had abundant *Festuca rubra*, *Carex nigra*, *Carex panicea*, *Lotus pedunculatus* and *Lathyrus pratensis* with lesser amounts of *Succisa pratensis*, *Geum rivale* and *Valeriana dioica*. The *Glyceria maxima* swamp was species-poor and also had abundant *Carex acutiformis* and *Filipendula ulmaria*.

NVC: The tall-fen was closest to M27 (coefficient = 54.5), with *Glyceria maxima*-dominated areas being S5. The patches of richer fen meadow were MG8. It is likely that with a more sustained programme of cattle-grazing and cutting, this vegetation would develop into a richer fen-meadow.

Site Condition: This site fails the condition assessment. There is a 50% cover of *Glyceria maxima* and 30% cover of *Carex acutiformis*. Despite much of the vegetation being tall and relatively species-poor, the site passes the positive indicator species target.

Indicators of Success: This site fails the indicators of success due to the high cover of *Glyceria maxima*.

Soil: Soil pH is slightly acidic and phosphate content is very low. Potassium level is low while magnesium level is moderate. Nitrogen content is very high, while organic matter content as indicated by loss on ignition and organic carbon content is high, suggesting some peat accumulation.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 33	6.2	7	0	76	1	97	2	2.39	52.8	1508	52.8

ESA	Test Valley
2012 Site No.	34
Grid ref.	SU47804787
Location	Bere Mill Meadows SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	25.7.2012
Previous Derivation	ESA grassland site 4
HLS Parcel No.	8087
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is one of two adjacent fields included in this survey that are managed as a single unit. They are situated to the south of the River Test to the east of Whitford. Markers not refound – all landmarks removed, i.e. fence and tree.

Management: Hay is normally cut from part of these fields in most years, but not in 2012 as it was too wet. Rushes are normally topped. Areas not cut for hay are grazed by cattle between April and November with sheep sometimes.

Vegetation: Grassland at this site is relatively species-poor with few of the more-exacting species normally considered characteristic of older, agriculturally unimproved swards. Abundant species include *Agrostis stolonifera*, *Festuca rubra*, *Festuca pratensis*, *Holcus lanatus*, *Poa trivialis*, *Carex hirta*, *Filipendula ulmaria*, *Ranunculus repens* and *Trifolium repens*. There are large beds of *Carex acutiformis*, *Carex riparia* and *Glyceria maxima*.

NVC: The grassland community is difficult to identify within the NVC. It is closest in many respects to MG9a (coefficient = 57.1), although lacking the characteristic tussock-forming species *Deschampsia cespitosa*.

Site Condition: This site fails the condition assessment. There are only two frequent and one occasional positive indicator species, and the cover of large *Carex* spp is 75%.

Indicators of Success: This site fails indicators of success criteria. There are only two frequent and one occasional positive indicator species. Soil phosphate index is 2.

Soil: Soil pH is mildly alkaline. Phosphate content is moderate. Potassium and magnesium levels are moderate. Nitrogen content is high. Organic matter content is high as indicated by the loss on ignition and organic carbon level.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 34	7.2	16	2	191	2+	148	3	2.04	44.0	1739	24.1

ESA	Test Valley
2012 Site No.	35
Grid ref.	SU35493437
Location	Stockbridge Common Marsh SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	25.7.2012
Previous Derivation	ESA grassland site 6
HLS Parcel No.	4320
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is an area of common grazing adjacent to the River Test to the south of Stockbridge. It is much used for public recreation, and is owned by the National Trust. It was included in the ESA. No markers refound – landmarks moved (fence renewed).

Management: This site is grazed by horses and occasionally by small numbers of cattle. It has been topped in the past.

Vegetation: Grassland at this site is more typical of freely-draining acidic Soil, and there is relatively little similarity with the regularly inundated flood-plain grasslands included in the rest of this survey. It is dominated by *Agrostis capillaris*, *Festuca rubra* and *Holcus lanatus* with abundant *Anthoxanthum odoratum*, *Carex nigra*, *Potentilla anserine*, *Ranunculus acris*, *Ranunculus repens*, *Rumex acetosa* and *Potentilla erecta*. *Juncus acutiflorus* is occasional throughout. *Briza media*, *Danthonia decumbens*, *Carex panicea*, *Molinia caerulea* and *Filipendula ulmaria* are rare.

NVC: This grassland is a reasonably good example of the calcifuge grassland U4b (coefficient = 49.2). It is species-poor, with affinities to the mesotrophic grassland types MG6b (coefficient = 46.7) and MG5c (coefficient = 46.7).

Site Condition: This site fails the condition assessment as there is only one frequent and one occasional positive indicator species.

Indicators of Success: This site fails indicators of success criteria. There are only two frequent and one occasional positive indicator species.

Soil: Soil pH is acidic. Phosphate level is low, potassium and magnesium content are moderate, while total nitrogen content is very high. Organic matter content is very high as indicated by the loss on ignition and organic carbon level.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 35	5.4	8	0	140	2-	164	3	2.4	71.9	1183	35.0

ESA	Test Valley
2012 Site No.	36
Grid ref.	SU37933857
Location	River Test SSSI, Unit 41
Survey Method	Five quadrats on transect
Survey Date	25.7.2012
Previous Derivation	ESA grassland site 7
HLS Parcel No.	8966
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is one of a group of five fields managed by the owner as a single unit. These fields are enclosed to the east and south by a bend of the River Test, and to the north and west by deep ditches. They are situated to the north of Stockbridge and south of Longstock. The fields were probably managed as water-meadows in the past.

Management: The fields are grazed by cattle through the summer.

Vegetation: The grassland in these fields is a very species-rich mosaic of short fen-meadow with areas of more tussocky rush pasture. This becomes taller and less species-rich towards the eastern margin with an increase in cover of *Arrhenatherum elatius* and *Festuca arundinacea*. There is no single dominant species, *Festuca rubra*, *Carex panicea*, *Carex disticha*, *Carex nigra*, *Filipendula ulmaria*, *Plantago lanceolata*, *Geum rivale*, *Galium uliginosum* and *Valeriana dioica* are abundant with frequent and locally abundant *Anthoxanthum odoratum*, *Holcus lanatus*, *Briza media*, *Carex acutiformis*, *Cirsium palustre* and *Trifolium pratense*. Also present are *Caltha palustris*, *Linum catharticum*, *Hypericum tetrapterum* and *Potentilla erecta*.

NVC: This fen-meadow vegetation is a mosaic of M22b (coefficient = 59.7) with MG8 where closer-grazed and lacking *Juncus* spp. (coefficient = 54.1).

Condition assessment: This field passes all condition assessment targets

Indicators of Success: This field passes all indicators of success targets

Soil: PH is circumneutral. Phosphate and potassium levels are low and magnesium level is high. Total nitrogen content is very high, and organic matter content is also very high as indicated by the loss on ignition and organic carbon level. This suggests some accumulation of peat.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 36	6.8	13	1	118	1	90	2	2.93	66.7	1887	34.0

ESA	Test Valley
2012 Site No.	37
Grid ref.	SU38033870
Location	River Test SSSI, Unit 41
Survey Method	Five quadrats on transect
Survey Date	25.7.2012
Previous Derivation	ESA grassland site 8
HLS Parcel No.	8966
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is one of a group of five fields managed by the owner as a single unit. These fields are enclosed to the east and south by a bend of the River Test, and to the north and west by deep ditches. They are situated to the north of Stockbridge and south of Longstock. The fields were probably managed as water-meadows in the past. All plot markers refund.

Management: The fields are grazed by cattle through the summer.

Vegetation: In common with field 36, most of the vegetation in this field is a mosaic of short, very species-rich grassland with taller fen vegetation. The shorter grassland has abundant *Festuca rubra*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Briza media*, *Carex nigra*, *Carex panicea*, *Lotus pedunculatus*, *Filipendula ulmaria*, *Plantago lanceolata*, *Rumex acetosa*, *Trifolium pratense*, *Galium uliginosum*, *Geum rivale*, *Valeriana dioica* and *Hypericum tetrapterum*. *Carex acutiformis*, *Carex riparia* and *Filipendula ulmaria* are dominant in the taller vegetation, with smaller quantities of the smaller, less-competitive species. Other species typical of agriculturally-unimproved and long-established grasslands include *Caltha palustris*, *Linum catharticum*, *Succisa pratensis*, *Lychnis flos-cuculi* and *Dactylorhiza praetermissa*. Unusually, two spikes of the chalk grassland orchid *Anacamptis pyramidalis* were present.

NVC: This fen-meadow vegetation is a mosaic of M22b (coefficient = 61.4) with MG8 where closer-grazed and lacking *Juncus spp* (coefficient = 55.9).

Condition assessment: Although a very species-rich field of great conservation interest, it is in unfavourable condition. More than 50% of the sward is over 75cm in height and there is more than 25% cover of large *Carex spp* and reed-grasses.

Soil: PH is slightly acidic. Phosphate and potassium levels are low and magnesium content is moderate. Nitrogen content is extremely high and organic matter content is also very high as indicated by the loss on ignition and organic carbon level. This suggests some accumulation of peat.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 37	6.4	10	1	92	1	61	2	3.21	76.1	2036	33.5

ESA	Test Valley
2012 Site No.	38
Grid ref.	SU41504130
Location	Bransbury Common SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	24.7.2012
Previous Derivation	ESA grassland site 9
HLS Parcel No.	4927
HLS Options	HQ7 Restoration of fen
HLS Supplements	

Bransbury Common is a large area of unenclosed land between the River Test to the west, and its tributary the River Dever to the east. It has never been flooded as water meadows, and it retains an unaltered floodplain topography including numerous hummocks and ridges of chalk and gravel which have allowed the development of a mosaic of calcareous grassland and calcifuge grassland within the fen and fen-meadow of the floodplain. Plot markers not refound.

Management: The whole common (180ha) is currently grazed by 30 beef cattle, with plans to increase numbers and to switch to longhorn cattle. The site has been burnt in the past to remove *Molinia* and *Carex* litter.

Vegetation: This field has dry calcifuge grassland on slightly raised areas in the north and centre, dominated by *Festuca rubra* with *Rumex acetosella*, *Senecio jacobaea*, *Galium verum*, *Potentilla erecta*, *Agrostis capillaris*, *Arrhenatherum elatius* and *Deschampsia cespitosa*. The wetter area to the south-east is tall-fen dominated by *Filipendula ulmaria*, *Iris pseudacorus*, *Carex riparia*, *Eupatorium cannabinum*, *Mentha aquatica*, *Angelica sylvestris* and *Urtica dioica*. The transect runs from east to west, initially through tussocky grassland dominated by *Festuca rubra*, *Molinia caerulea* and *Deschampsia cespitosa* with *Holcus lanatus*, *Anthoxanthum odoratum*, *Filipendula ulmaria* and *Iris pseudacorus*, into rush-pasture with increasing quantities of *Juncus inflexus*. Other species present include *Lathyrus pratensis*, *Galium uliginosum*, *Valeriana dioica*, *Scutellaria galericulata*, *Carex acuta*, *Juncus subnodulosus*, *Geum rivale*, *Thalictrum flavum* and *Briza media*.

NVC: The high frequency of *Deschampsia cespitosa* leads to a classification by MATCH of the fen-meadow through which the transect runs as MG9 (coefficient = 58.7). It would however be better to consider it as a gradation from M25c to M22b (coefficient = 51.4). The dry grassland is U1d, and the tall-fen in the south-east is M27.

Condition assessment: If assessed as M25c, this vegetation passes for all attributes.

Indicators of Success: Pass

Soil: PH is slightly acidic. Phosphate and potassium levels are low, magnesium level is moderate, Nitrogen content is high, and organic matter content is also high as indicated by the loss on ignition and organic carbon level.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 38	6.4	8	0	103	1	92	2	1.76	45.8	1010	24.9

ESA	Test Valley
2012 Site No.	39
Grid ref.	SU41374151
Location	Bransbury Common SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	24.7.2012
Previous Derivation	ESA grassland site 10
HLS Parcel No.	5483
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

Bransbury Common is a large area of unenclosed land between the River Test to the west, and its tributary the River Dever to the east. It has never been flooded as water meadows, and it retains an unaltered floodplain topography including numerous hummocks and ridges of chalk and gravel which have allowed the development of a mosaic of calcareous grassland and calcifuge grassland within the fen and fen-meadow of the floodplain. Only quadrat 3 relocated.

Management: The whole common (180ha) is currently grazed by 30 beef cattle, with plans to increase numbers and to switch to longhorn cattle. The site has been burnt in the past to remove *Molinia* and *Carex* litter, and parts of this area have been cut in the past.

Vegetation: The transect starts in an area dominated by *Molinia caerulea* with *Festuca rubra*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Carex nigra*, *Angelica sylvestris*, *Pulicaria dysenterica*, *Potentilla erecta* and *Luzula campestris*. *Deschampsia cespitosa* is locally frequent. This grassland becomes richer to the west, with locally abundant *Cirsium dissectum*. Other species present in this fen meadow grassland include *Succisa pratensis*, *Ononis spinosa*, *Juncus acutiflorus* and *Hydrocotyle vulgaris*, *Avenula pubescens*, *Briza media*, *Carex hostiana*, *Carex pulicaris*, *Galium uliginosum*, *Valeriana dioica*, *Gymnadenia conopsea* ssp *densiflora*, *Leontodon hispidus* and *Menyanthes trifoliata*. Towards the River Test the ground becomes drier, and the grassland becomes much poorer, dominated by *Arrhenatherum elatius*, *Festuca rubra* and *Holcus lanatus*. Calcicolous grassland is present on dry knolls in this area.

NVC: Match classifies this complex habitat transition as M22a (coefficient = 51.8). It is in fact M25c at the eastern end, grading into M24a and into MG1a on the drier land in the west.

Condition assessment: This vegetation fails the condition assessment. Cover of litter is 40% and the average sward height is 25cm.

Indicators of success: Fails because it does not pass the SSSI Condition Assessment.

Soil: PH is circumneutral. Phosphate and potassium levels are low, magnesium level is moderate, Nitrogen content is high, and organic matter content is also high as indicated by the loss on ignition and organic carbon level.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 39	6.6	9	0	140	2-	94	2	1.94	54.1	1090	27.8

ESA	Test Valley
2012 Site No.	40
Grid ref.	SU41164120
Location	Bransbury Common SSSI, Unit 1
Survey Method	Five quadrats on transect
Survey Date	24.7.2012
Previous Derivation	ESA grassland site 11
HLS Parcel No.	1021
HLS Options	HQ7 Restoration of fen
HLS Supplements	

Bransbury Common is a large area of unenclosed land between the River Test to the west, and its tributary the River Dever to the east. It has never been flooded as water meadows, and it retains an unaltered floodplain topography including numerous hummocks and ridges of chalk and gravel which have allowed the development of a mosaic of calcareous grassland and calcifuge grassland within the fen and fen-meadow of the floodplain. Plot markers not refound.

Management: The whole common (180ha) is currently grazed by 30 beef cattle, with plans to increase numbers and to switch to longhorn cattle. The site has been burnt in the past to remove *Molinia* and *Carex* litter, and parts of this area have been cut in the past.

Vegetation: The vegetation in this field is tall fen-meadow. Although moderately species-rich it is less species-rich than the other two fields 38 and 39. *Filipendula ulmaria*, *Juncus acutiflorus*, *Festuca rubra*, *Holcus lanatus* and *Arrhenatherum elatius* are dominant with tussocky *Molinia caerulea*, *Dactylis glomerata*, *Deschampsia cespitosa*, *Juncus inflexus* locally. Frequent species include *Anthoxanthum odoratum*, *Poa trivialis*, *Phalaris arundinacea*, *Angelica sylvestris*, *Lathyrus pratensis*, *Vicia cracca* and *Galium uliginosum*. *Valeriana dioica*, *Thalictrum flavum*, *Carex panicea*, *Carex nigra* and *Carex disticha* are also present.

NVC: This vegetation is difficult to classify within the NVC, and may well be a mosaic of tussocky grassland and fen-meadow types. Overall it may be best considered as M22a (coefficient = 49.9).

Condition assessment: This site fails the SSSI condition assessment as there is only one species frequent and three occasional.

Indicators of Success: This site fails the indicators of success targets as these include SSSI targets

Soil: PH is slightly acidic. Phosphate level is low, potassium level is moderate and magnesium level is high. Total nitrogen content is very high, and organic matter content as indicated by loss on ignition and organic carbon content is high suggesting some peat accumulation.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 40	6.4	13	1	205	2+	156	3	3	62.5	1408	31.2

Appendix 3: DERWENT VALLEY

Appendix 3a: MATCH analysis of individual sites

Results of MATCH analysis of the 5-quadrat plots recorded in the Derwent Valley. The top five results are shown. The NVC community determined in 2012 is provided (in bold in final column), which is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

	DERWENT VALLEY – MATCH rank (top 5)										2012
	1		2		3		4		5		
	NVC	%	NVC	%	NVC	%	NVC	%	NVC	%	
41	MG9a	52.4	MG9	52.1	MG8	50.7	MG6b	46.8	M22b	46.6	MG8
42	MG7d	50.7	MG7c	49.1	MG7b	42.9	MG9a	42.9	MG10	42.7	MG7d
43	MG4	51.9	MG8	51.1	MG9	46.4	MG7c	46.4	MG9a	46.3	MG4
44	MG9a	50.2	MG9	50.1	MG7c	48.3	MG4	47.8	MG8	44.8	MG7c
45	MG10c	39.5	SD17d	36.1	SD17	35.8	M27	35.8	SD17a	34.8	MG11/13
46	MG10a	51.6	MG10	49.4	MG7d	48.8	MG9a	48.7	MG10c	47.9	MG13+MG9
47	MG10a	61.7	MG10	57.4	MG9a	52.9	MG9	50.9	M23b	47.1	MG10a
48											
49	MG9	40.9	MG9a	39.6	MG8	39.5	M27a	39.3	MG7c	39.2	MG4

Appendix 3b: Individual Site Descriptions for 2012 survey

ESA	Derwent Valley
2012 Site No.	41
Grid ref.	SE758446
Location	Melbourne and Thornton Ings SSSI, Unit 11
Survey Method	Five quadrats
Survey Date	13.6.2012
Previous Derivation	New site
HLS Parcel No.	8361
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HK18 Haymaking

This field is part of a system of small fields to the north of the Pocklington Canal to the south of the village of Thornton. Five quadrats were marked in the centre of the field. This is the first survey. The HLS agreement started in 2011.

Management: Grass is cut for hay annually in July. The aftermath is grazed by sheep. Flooding occurs annually between November and March. The owner thinks that flood duration has increased as a result of poor ditch management.

Vegetation: The species-rich grassland in this field is dominated by a mixture of species including the grasses *Festuca rubra*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Holcus lanatus*, *Carex disticha*, *Filipendula ulmaria* and *Ranunculus acris*. *Deschampsia cespitosa* is frequent throughout but cover is low and *Carex acutiformis* is locally frequent. Other frequent species include *Carex panicea*, *Equisetum palustre*, *Rumex acetosa*, *Carex hirta*, *Calliergon cuspidatum* and *Cardamine pratensis*. A number of other species typical of older wet grasslands are present including *Carex nigra*, *Centaurea nigra*, *Lotus corniculatus*, *Lychnis flos-cuculi*, *Thalictrum flavum* and *Galium palustre*. Unusually *Eriophorum angustifolium* is frequent in a small area of the centre of the field.

NVC: Match analysis gave the closest community as MG9a (coefficient = 52.4), probably as a result of the high frequency of *Deschampsia cespitosa* and *Holcus lanatus*. The vegetation was however considerably more species-rich than typical MG9 and the abundance of *Filipendula ulmaria* and *Carex disticha* is suggestive of MG8 (coefficient=50.7) or M22b (coefficient=46.6), and this is supported by the presence at low frequencies of species such as *Lychnis flos-cuculi*, *Thalictrum flavum* and *Galium palustre*.

Site Condition: This grassland passes the condition assessment for all attributes for MG8 grassland.

Indicators of Success: This field passes all indicators of success criteria.

Soil: The soil is circum-neutral with low phosphate, potassium and nitrogen content, but a high level of magnesium and organic matter.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
41	6.5	7	0	71	1	213	4	0.85	28.8	881	9.16

ESA	Derwent Valley
2012 Site No.	42
Grid ref.	SE697402
Location	Derwent Ings SSSI, Unit 142
Survey Method	Five quadrats
Survey Date	14.6.2012
Previous Derivation	New site
HLS Parcel No.	7915
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

This is one of a group of small fields to the east of the River Derwent, west of the village of Ellerton. Five quadrats were marked in the centre of the field. This is the first survey. The HLS agreement started in 2009

Management: This field is cut annually for hay. It is sometimes possible to take a second hay cut, but more usually it is grazed by sheep between mid-October and mid-November. There has been a derogation for spot-spraying of docks. The field is flooded annually in the winter. It is thought by the owner that the flood-water is now retained for longer, and that this has led to an increase of sedges.

Vegetation: Grassland in this field is species-poor at the northern end, becoming more species-rich towards the south. *Lolium perenne* is dominant with abundant *Alopecurus pratensis*, *Poa trivialis*, *Leontodon autumnalis*, *Cardamine pratensis* and *Calliargon cuspidatum*. Other frequent species include *Bromus hordeaceus*, *Agrostis stolonifera*, *Agrostis capillaris*, *Ranunculus acris*, *Ranunculus repens* and *Taraxacum* sp. Other species characteristic of long-established grasslands present at low frequency include *Oenanthe silaifolia*, *Silaum silaus*, *Myosotis laxa*, *Caltha palustris* and *Stellaria palustris*.

NVC: Match analysis gave the closest community as MG7d (coefficient = 50.7). This grassland is however more species-rich than is typical for this community, particularly at the southern end of the field, with several species characteristic of flood-meadows including *Silaum silaus*, *Myosotis laxa*, *Caltha palustris* and the uncommon *Oenanthe silaifolia* and *Stellaria palustris*.

Site Condition: This grassland passes the condition assessment for all attributes for inland wet grassland: MG11-related, MG13-related.

Indicators of Success: HK9 indicators are outside the scope of the project but as SSSI shares many of the CSM targets, which it passes.

Soil: The soil is circum-neutral with low phosphate, potassium and nitrogen content, but a high level of magnesium and organic matter.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
42	6.2	9	0	117	1	218	4	0.7	19.3	1206	9.16

ESA	Derwent Valley
2012 Site No.	43
Grid ref.	SE700325
Location	Breighton Meadows SSSI, Unit 7
Survey Method	Five quadrats
Survey Date	12.6.2012
Previous Derivation	New site
HLS Parcel No.	0549
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HK18 Haymaking

This field belongs to Holmes House Farm and is situated to the west of the River Derwent. Five quadrats were marked in the centre of the field. This is the first survey. The HLS agreement started in 2011.

Management: Hay is cut annually. The aftermath is grazed by sheep if the field is dry enough @ 3/acre for between one and two weeks. *Senecio spp* are hand-pulled. Flooding is annual between November and January and occasional in the summer.

Vegetation: Species-rich grassland is present throughout this field. This is dominated by a mixture of species including *Agrostis capillaris*, *Festuca pratensis*, *Festuca rubra*, *Holcus lanatus*, *Filipendula ulmaria* and *Calliergon cuspidatum* with abundant *Anthoxanthum odoratum*, *Cardamine pratensis*, *Plantago lanceolata*, *Ranunculus acris*, *Rumex acetosa* and *Carex disticha*. *Sanguisorba officinalis* and *Achillea ptarmica* are locally abundant. Other species typical of older grasslands include *Carex flacca*, *Lathyrus pratensis*, *Lysimachia nummularium* and *Lychnis flos-cuculi*.

NVC: Match analysis gave the closest community as MG4 (coefficient = 51.9), although it is close to MG8 (coefficient= 51.1). It is a good example of this grassland although *Sanguisorba officinalis* is less frequent than usual.

Site Condition: This grassland passes the condition assessment for all attributes for MG4 apart from frequency of positive indicator species, only four species are frequent and none are occasional.

Indicators of Success: HK9 indicators are outside the scope of the project but as SSSI shares many of the CSM targets, which it passes for all attributes for MG4 apart from frequency of positive indicator species.

Soil: The soil is circum-neutral with low phosphate, potassium and nitrogen content, but a high level of magnesium and organic matter.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
43	6.1	8	0	112	1	306	5	0.81	23.4	1107	9.8

ESA	Derwent Valley
2012 Site No.	44
Grid ref.	SE70693577
Location	Derwent Ings SSSI, Unit 176
Survey Method	Five quadrats
Survey Date	12.6.2012
Previous Derivation	New site
HLS Parcel No.	6977
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

Situated immediately to the west of the River Derwent and to the south of the village of Bubwith. This field is enclosed by drains on all sides. Five quadrats were marked in the centre of the field. This is the first survey. The HLS agreement started in 2010.

Management: This field is cut annually for hay, although the timing of this varies according to wetness of the field. In most years the aftermath is grazed until mid-October, but there have been problems with fencing. *Senecio spp* are pulled by hand. The fields may be flooded at any time of year.

Vegetation: Approximately 50% of this field is species-poor *Phalaris arundinacea* swamp which has probably developed by recent invasion of grassland. The grassland is a mosaic with species-rich patches within a less rich matrix. *Agrostis capillaris*, *Alopecurus pratensis*, *Lolium perenne*, *Festuca rubra* and *Filipendula ulmaria* are generally abundant throughout with frequent *Cardamine pratensis*, *Carex nigra*, *Lathyrus pratensis* and *Hordeum secalinum*. *Anthoxanthum odoratum*, *Festuca pratensis*, *Leontodon autumnalis*, *Poa trivialis*, *Silaum silaus* and *Carex disticha* are locally frequent, and other species typical of older grasslands include *Caltha palustris*, *Sanguisorba officinalis*, *Lysimachia nummularia*, *Thalictrum flavum*, *Galium palustre* and *Oenanthe silaifolia*.

NVC: Match analysis gave the closest community as MG9a (coefficient = 50.2), although neither *Deschampsia cespitosa* nor *Holcus lanatus* are constant or more than locally abundant. It is in fact a mosaic of grassland types, probably mainly MG4 (coefficient=47.8) within a matrix of less species-rich MG7c (coefficient = 48.3). Much of the field is now *Phalaris arundinacea* swamp.

Site Condition: This field fails a condition assessment carried out against MG4 or inland wet grassland targets. Only one positive indicator species was frequent and two occasional although six more were present but rare. There was approximately 50% cover of *Phalaris arundinacea* over the whole field although substantial areas had none.

Indicators of Success: HK9 indicators are outside the scope of the project but as SSSI shares many of the CSM targets, which it fails for frequency of high-value indicator species. The field also has an approximate total of 50% cover of *Phalaris arundinacea*.

Soil: The soil is circum-neutral with low phosphate, potassium and nitrogen content, but a high level of magnesium and organic matter.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
44	6.1	7	0	128	2-	350	5	0.96	23.8	1143	12.7

ESA	Derwent Valley
2012 Site No.	45
Grid ref.	SE73744525
Location	Melbourne and Thornton Ings SSSI, Unit 9
Survey Method	Five quadrats
Survey Date	13.6.2012
Previous Derivation	New site
HLS Parcel No.	7425
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

This field is situated between the Pocklington Canal and The Beck to the west of the village of Melbourne and adjacent to the lower Derwent Valley NNR. It is probably very wet even in a normal year and in 2012 there was shallow standing water over the whole field, with a large pool in the south. Land along the northern edge is slightly higher and drier than the rest of the field. The HLS agreement started in 2012.

Management: This field is normally cut annually for silage. It was not cut in 2011 because of high summer water-levels, but it was cut twice in 2010. The owner has no stock. Flooding occurs annually in the winter and occasionally in the summer.

Vegetation: Grassland is typical of regularly inundated flood-meadows. It is relatively species-poor with abundant *Filipendula ulmaria*, *Carex nigra*, *Agrostis stolonifera*, *Poa trivialis* and *Carex disticha*. *Carex acutiformis* was locally abundant. Other frequent species include *Alopecurus pratensis*, *Cardamine pratensis*, *Ranunculus repens*, *Persicaria amphibia*, *Myosotis laxa* and *Galium palustre*. The uncommon species *Oenanthe fistulosa* and *Stellaria palustris* are present but rare. *Phalaris arundinacea* is present at low cover throughout the field, forming a denser stand around the large pool.

NVC: This vegetation corresponded poorly to any NVC community. The highest match coefficient was with MG10c (39.5), but the stand showed little resemblance to that community. It may be derived from MG7d where the water table has been raised so that the field is more frequently inundated and for longer periods.

Site Condition: This field passes a condition assessment carried out against inland wet grassland targets. Five positive indicator species were frequent and a further four were present but rare. If the area around the pool is excluded, there was approximately 5% cover of *Phalaris arundinacea* over the whole field.

Indicators of Success: HK9 indicators are outside the scope of the project but as SSSI shares many of the CSM targets, which it passed.

Soil: The soil is circum-neutral with low phosphate, potassium and nitrogen content, but a high level of magnesium and organic matter.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
45	6.7	7	0	120	1	252	5	1.12	25.6	1235	12.8

ESA	Derwent Valley
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2012 Site No.	46
Grid ref.	SE69664566
Location	Wheldrake (non SSSI)
Survey Method	Five quadrats
Survey Date	14.6.2012
Previous Derivation	New site
HLS Parcel No.	6666
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

The floodplain on the western side of the River Derwent is here very narrow, and this small field includes both the full width of floodplain and the lowest slopes of the valley bank to the west. Much of the southern part of the field is occupied by a large permanent pond with a surrounding zone of semi-permanent inundation. There is also an area of woodland on the dry bank above the pond. The HLS agreement started in 2009.

Management: Hay is usually cut annually in July. The aftermath is grazed by young cattle between July and September depending on water-levels. Flooding occurs annually in the winter, but also at other times of the year. Flooding frequency and duration has increased since river barrages were installed and siltation has increased.

Vegetation: Grassland in the floodplain is in two zones. At the base of the western slope it is moderately species-rich and dominated by *Agrostis capillaris*, *Filipendula ulmaria*, *Lolium perenne*, *Holcus lanatus* and *Ranunculus acris*, with *Poa trivialis*, *Ranunculus repens*, *Anthoxanthum odoratum*, *Sanguisorba officinalis* and *Lathyrus pratensis*. The more regularly flooded grassland nearer the river is species-poor and dominated by *Agrostis stolonifera*, *Alopecurus pratensis*, *Poa trivialis*, *Ranunculus repens* and *Elymus repens*.

NVC: This vegetation corresponded poorly to any NVC community. The highest match coefficient was with MG10a (39.5), but the stand showed little resemblance to that community, lacking *Juncus spp* and *Holcus lanatus*. The two zones described above appear to have distinct communities, with MG7d (coefficient = 48.8) further from the river, and a poorly defined inundation grassland related to MG11a nearer the river.

Site Condition: This field fails a condition assessment carried out for inland wet grassland targets. There were no frequent or occasional positive indicator species, although six were present but rare.

Indicators of Success: HK9 indicators are outside the scope of the project but on botanical targets this field fails the BAP lowland meadow indicators of success on frequency of indicator species. No species were frequent or occasional, although eight were present but rare.

Soil: The soil is slightly calcareous with low potassium and nitrogen content, a moderate phosphate content, and a high level of magnesium and organic matter.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
46	7.1	22	2	115	1	282	5	0.75	18.5	1518	9.97

ESA	Derwent Valley
2012 Site No.	47
Grid ref.	SE74354656
Location	Sutton Upon Derwent/Thornton (non-SSSI)
Survey Method	Five quadrats
Survey Date	15.6.2012
Previous Derivation	New site
HLS Parcel No.	3556
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

This field is bordered to the east by the Sails Beck which runs into the Pocklington Canal. The field to the west was being used for turf production in 2012, and the area had the appearance of having been under arable cultivation until recently. The HLS agreement started in 2009.

Management: Hay is usually cut annually in July. The aftermath is grazed by young cattle between July and September depending on water-levels. Flooding occurs annually in the winter, but also at other times of the year. Flooding frequency and duration has increased since river barrages were installed and siltation has increased.

Vegetation: The majority of the field appears to have a high water-table, with species-poor vegetation dominated by *Holcus lanatus* with tussocky *Juncus effusus* and locally *Deschampsia cespitosa*. *Ranunculus repens*, *Poa trivialis* and *Taraxacum spp* are abundant. The only species typical of older grasslands are *Lathyrus pratensis* and *Lotus pedunculatus* both of which are rare. This type of grassland is typical of an early successional community on former arable land. *Phalaris arundinacea* and *Glyceria maxima* form small patches in the east of the field, *Elymus repens* is abundant in the south-east corner, and *Arrhenatherum elatius* and *Festuca rubra* form a tussocky grassland in the west and north.

NVC: Vegetation in this field shows a good correspondence with MG10a (coefficient=61.7), although where *Deschampsia cespitosa* is frequent in the north it approaches MG9a (coefficient = 52.9). The tussocky grassland in drier parts of the field to the north and west is MG1a.

Site Condition: This field fails a condition assessment carried out against inland wet grassland targets. The only occasional positive indicator species was *Cardamine pratensis*. Cover of *Juncus effusus* is 30% and that of *Deschampsia cespitosa* is 8% which together exceeds the target of 25%.

Indicators of Success: HK9 indicators are outside the scope of the project but this field does not pass the indicators of success criteria for BAP lowland grasslands. It fails on the frequency of high-value indicator species and cover of wild flowers.

Soil: The soil is mildly acidic with low phosphate, nitrogen and potassium content. Magnesium content is moderate and organic matter content is high.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
47	5.6	9	0	52	0	174	3	0.9	30.9	1061	12.9

ESA	Derwent Valley
2012 Site No.	48
Grid ref.	SE74354656
Location	Derwent Ings
Survey Method	Not surveyed
Survey Date	15.6.2012
Previous Derivation	New site
HLS Parcel No.	7586
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

This field was completely flooded and inaccessible and was therefore not surveyed.

ESA	Derwent Valley
2012 Site No.	49
Grid ref.	SE69584464
Location	Derwent Ings SSSI, Unit 107
Survey Method	Five quadrats
Survey Date	14.6.2012
Previous Derivation	New site
HLS Parcel No.	5864
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

This is one of several broad strips under different ownerships within a larger field adjacent to the River Derwent to the south of Sutton upon Derwent. The HLS agreement started in 2009.

Management: This field is normally cut for hay at the end of July. The aftermath is normally grazed by sheep for 2-4 weeks, but this has been temporarily suspended because of problems with *Senecio aquatica*. Flooding occurs annually between October and April, and the owner believes the flooding period has become longer recently as a result of river silting.

Vegetation: The grassland is moderately species-rich and uniform over much of the field, although in two areas *Phalaris arundinacea* is dominant, and there is a zone of poorer vegetation in the south. The most abundant species are *Alopecurus pratensis*, *Agrostis stolonifera*, *Festuca rubra*, *Sanguisorba officinalis*, *Filipendula ulmaria*, *Poa trivialis*, *Cardamine pratensis* and locally *Carex nigra*. Other species typical of older grasslands include *Achillea ptarmica*, *Lathyrus pratensis*, *Silaum silaus*, *Myosotis laxa*, *Galium palustre*, *Oenanthe silaifolia*, *Lysimachia nummularium* and *Caltha palustris*. The less-rich vegetation is dominated by *Alopecurus geniculatus* with abundant *Ranunculus repens* and *Carex acutiformis*.

NVC: Although the grassland over much of this field appears to be a good example of MG4, Match gave the closest agreement with MG9a (coefficient = 39.6).

Site Condition: Although the grassland appeared well-managed and moderately species-rich, it failed the condition assessment on the frequency of positive indicator species (1 frequent, 4 occasional). A further nine positive indicator species were present but rare.

Indicators of Success: HK9 indicators are outside the scope of the project but within the SSSI, many indicators of success are shared with common standards attributes.

Soil: The soil is mildly acidic with low phosphate and nitrogen content. Magnesium and potassium content are moderate and organic matter content is high.

	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
49	5.5	11	1	155	2-	187	4	0.87	25	1546	11.8

Appendix 4: AVON VALLEY

Appendix 4a: MATCH analysis of individual sites

Results of MATCH analysis of the monitoring plots recorded in the Avon Valley in 2012 for (a) existing ADAS plots (Plot) and the supplementary NVC quadrats recorded in the wider unit (Unit); and (b) the new 5-quadrat plots. The top five results are shown. The NVC community determined in 2012 is provided (final column), which is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account: the previous NVC community recorded (2003) is indicated by red text.

(a)		ADAS PLOTS – MATCH rank (top 5)											
Sit	Sampl	1		2		3		4		5		2012	2003
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%		
50	Plot 1	MG11	64.2%	MG10	59.9%	MG10	57.5%	MG10	55.2%	MG7b	55.1%	MG11 relate	MG10 MG10
	Plot 2	MG9b	50.8%	MG7b	48.9%	MG10	48.5%	MG9	48.1%	OV23	47.7%		
	Unit	MG11	52.8%	MG10	52.7%	MG10	46.1%	MG9	46.0%	MG6a	45.1%		
51	Plot 1	MG9b	52.1%	MG9	48.9%	MG9a	42.7%	M27	40.5%	OV26	40.5%	MG9b MG9b	MG10 MG10
	Plot 2	MG9	60.9%	MG9b	57.2%	MG9a	56.4%	MG10	49.5%	MG10	49.0%		
	Unit	MG9	63.7%	MG9b	57.9%	MG10	56.7%	MG9a	56.6%	MG10	51.2%		
52	Plot 1	MG10	63.7%	MG10	57.2%	MG10	51.3%	MG9a	50.5%	MG11	50.0%	MG11 relate	MG10 MG10
	Plot 2	MG10	58.0%	MG10	57.7%	MG9a	51.9%	SD17	51.5%	MG10	50.9%		
	Unit	MG10	57.3%	MG10	54.8%	MG10	49.3%	SD17	48.1%	MG10	48.0%		
53	Plot 1	MG11	47.5%	MG10	47.5%	MG11	45.7%	MG9b	44.8%	OV26	43.2%	MG11 relate	MG13 MG13
	Plot 2	MG10	50.5%	MG9	47.6%	MG10	47.1%	MG10	45.2%	MG9a	43.9%		
	Unit	MG10	62.8%	MG10	55.8%	MG10	54.3%	MG11	52.1%	MG7c	49.0%		
54	Plot 1	MG9a	59.0%	MG8	55.9%	MG9a	55.0%	MG10	54.1%	MG10	52.3%	MG8 MG9	MG10 MG10
	Plot 2	MG9	46.9%	MG6	46.7%	MG9b	46.4%	MG6a	46.2%	MG11	44.7%		
	Unit	MG10	51.5%	MG9	51.3%	MG9a	50.1%	MG10	48.4%	MG10	47.9%		
55	Plot	MG10	62.1%	MG9a	60.6%	MG7c	58.6%	MG6a	57.6%	MG9	57.5%	MG7c	MG10
	Unit	MG10	63.9%	MG10	59.2%	MG11	55.3%	MG10	55.3%	MG9	54.2%		
	Plot	MG6a	62.2%	MG10	62.0%	MG10	60.6%	MG10	60.3%	MG7c	60.0%		
56	Unit	MG10	64.1%	MG1	56.5%	MG10	55.6%	MG7c	54.4%	MG9	53.5%	MG7c	MG10
	Plot	M27c	44.4%	M22a	44.1%	MG9	43.5%	OV26	42.9%	M23a	42.7%		
	Unit	OV26	53.4%	M27	50.9%	S7	49.2%	M27b	48.9%	M27c	45.6%		
58	Plot	MG11	62.6%	MG6a	60.7%	MG7e	57.5%	MG6a	56.0%	MG11	55.7%	MG11	MG9b
	Unit	MG10	54.1%	MG11	53.4%	MG6a	52.0%	MG7a	50.9%	MG7b	50.0%		
	Plot	MG8	59.9%	MG9a	56.4%	MG4	55.6%	MG7c	53.0%	MG9	52.6%		
59	Unit	MG10	62.4%	MG9	61.5%	MG10	59.2%	MG9a	58.6%	MG10	57.8%	MG9a	MG13
	Plot	MG6a	65.20	MG6	62.50	MG7e	61.50	MG6b	59.00	OV23	58.30		
	Unit	MG6a	68.5%	MG6	66.8%	MG6b	60.9%	MG6c	59.3%	MG7e	58.0%		
61	Plot	MG13	45.8%	S12	41.5%	MG10	40.9%	S22a	40.2%	S22	39.9%	MG13 relate	MG10
	Unit	MG10	47.2%	MG10	40.7%	OV28	39.8%	MG10	37.8%	MG11	35.8%		
	Plot	MG10	61.9%	MG10	61.7%	MG11	61.6%	MG9a	59.9%	MG10	59.1%		
62	Unit	MG9b	56.1%	MG10	55.5%	MG9	55.1%	MG10	53.2%	MG9a	52.4%	MG9a	MG9
	Plot	MG9	49.1%	MG9a	46.9%	MG9b	44.8%	MG10	40.7%	MG12	39.6%		
	Unit	MG9a	55.6%	MG11	53.5%	MG9b	52.3%	MG9a	51.3%	MG10	50.5%		
64	Plot	MG10	47.1%	MG10	45.7%	MG10	44.8%	MG9	43.9%	MG12	41.5%	MG10 relate	MG10
	Unit	MG10	42.8%	MG10	41.8%	MG10	39.8%	MG13	38.1%	MG12	37.9%		
	Plot	MG10	47.6%	MG10	47.6%	MG8	46.1%	MG9a	45.5%	SD17c	43.2%		
65	Unit	MG8	55.1%	MG9a	51.3%	MG7c	49.7%	MG9	49.7%	MG10	49.7%	MG8	MG10
	Plot	MG10	48.1%	MG10	44.3%	MG10	43.7%	MG9	41.7%	MG9a	39.3%		
	Unit	MG10	50.1%	MG9a	49.0%	MG10	49.0%	MG9a	48.7%	MG10	48.0%		
71	Plot	MG11	60.1%	SD17	54.5%	MG10	53.5%	MG7a	53.3%	MG7b	49.7%	MG11 relate	MG7b
	Unit	MG11	57.4%	MG10	52.3%	MG7d	50.9%	MG7e	50.9%	MG10	48.0%		

(b)		'NEW' 5-QUADRAT SITES – MATCH rank (top 5)												
Site	Sample	1		2		3		4		5		2012		
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%			
67	Plot 1	MG8	64.8%	MG9a	59.5%	MG9	58.3%	MG10	52.7%	MG10a	52.7%	MG8 MG7c MG7d		
68	Plot 1	MG10a	55.7%	MG11a	53.7%	MG7c	53.5%	MG9a	53.3%	MG9	52.6%			
69	Plot 1	MG6a	61.1%	MG6	58.2%	MG7d	57.6%	MG9	56.3%	MG11a	56.2%			

Appendix 4b: Individual site descriptions

ESA	Avon Valley
2012 Site No.	050
Grid ref.	SU 148 133
Location	Redbrook, Fordingbridge (non-SSSI)
Survey Method	Fixed plots (2)
Survey Date	2 & 4 July, 2012.
Previous Derivation	ESA Wet Grassland Site 1
HLS Parcel No.	7426B
HLS Options	HK15 - Maintenance of grassland for target features
HLS Supplements	

Site 50 lies to the west of the main river and is bounded by drainage ditches. The two fixed-plots were set up on this site in 1993. Plot 1 only was re-surveyed in 2003. In 2012 none of the metal plot markers were relocated. Average sward height in the plots was 30.4cm and 16.1cm respectively.

Management: Site 50 is a cattle-grazed pasture on an old water meadow system. Cattle are usually put on in May and taken off at the end of October. There is some flexibility over the grazing regime so stock may come and go over the summer.

Vegetation: The sward was of low to moderate species-richness: 10–15 species in 1m-quadrats. Grasses *Agrostis stolonifera*, *Holcus lanatus* and *Lolium perenne* were constant, but *Festuca rubra* and *Arrhenatherum elatius* were also frequent to locally abundant. *Carex hirta* was constant. *Juncus inflexus* was the only rush species present although the horsetails *Equisetum palustre* and *E. arvense* were also occasional. Typical wet meadow forbs were rare with *Ranunculus repens* and *Cirsium arvense* both locally abundant with only *Galium palustre* being of interest.

NVC: The vegetation community is intermediate between that of a typical MG11 water meadow and an MG10 rush pasture. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, respectively, as MG11a (64.24%, 54.8%) and MG10b (59.9%, 52.7%) but they lack the constants *Juncus effusus* and *Potentilla anserina* for the MG10 and MG11 communities respectively. In 1993 plots 1 and 2 were recorded as MG10b and MG10a respectively. This ubiquitous and species-poor, rank sward can be described as MG10-related but is not true MG10.

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on three attributes - frequency of positive indicator species, aggregate cover of negative indicator species and average height of sward.

Indicators of success: The site is likely to pass the vegetation and water level indicators of success but it is not known whether it passes on the presence of wintering wildfowl.

Soils: The soil is calcareous. Phosphorous levels are high, which may prohibit restoration to a species-rich sward. Potassium and Organic Carbon levels are relatively low. Most other measures are on the high side but in the mid-range for the Avon Valley.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 50	7.6	37	3	92	1	102	3	1.05	20.6	1690	6.3

ESA	Avon Valley
2012 Site No.	051
Grid ref.	SU 171 202
Location	Downton (non-SSSI)
Survey Method	Fixed plots (2)
Survey Date	17 & 24 July, 2012.
Previous Derivation	ESA Wet Grassland Site 2
HLS Parcel No.	0415
HLS Options	HK11 - Restoration of wet grassland for breeding waders
HLS Supplements	HR2 - Supplement for native breeds at risk

Site 51 lies to the west of the main river but has a main carrier running through it. The two fixed-plots were set up on this site in 1993. Plot 1 only was re-surveyed in 2003. In 2012 the start marker and one of the metal plot markers (plot 2) were relocated. Average sward height in the plots was 26.7cm and 41.6cm respectively.

Management: Site 51 is a cattle-grazed pasture. Beef cattle are usually put on in May and taken off in September. No cattle were present during the survey and they weren't put on until September in 2011 but the length of the sward indicates a long-term lack of grazing. Nettles and other weeds are topped when required

Vegetation: The sward was of moderate species-richness: 10–15 species in 1m-quadrats. Grasses *Holcus lanatus*, *Deschampsia cespitosa* and *Festuca rubra* were frequent to locally abundant while *Arrhenatherum elatius* was also widespread at low cover. The rush *Juncus inflexus* was constant and *J. acutiflorus/J. articulatus* was also frequent. The sedge *Carex riparia* was locally frequent indicating areas of permanent waterlogging. Typical wet meadow forbs were poorly represented with *Filipendula ulmaria* locally abundant with occasional *Geum rivale*, *Galium palustre* *G. uliginosum* and *Caltha palustre* being of interest.

NVC: The vegetation community is intermediate between that of typical MG9 and MG9b grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 52.1/60.9%, for MG9b and MG9. The MG9b variant relates to the higher cover of *Arrhenatherum elatius* which was very patchy but common throughout the sward. In 1993 plots 1 and 2 were recorded as MG10b: this would indicate a general level of grazing management which is below that required to control the spread of *Deschampsia cespitosa* and possibly a higher water table.

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat/G12 Habitat for breeding waders. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on three attributes-cover of coarse rushes, sedges & grasses, frequency of positive indicator species and average height of sward.

Indicators of success: The site fails on two of the HK11 indicators of success (*cover of tussocks of grass or sedge (year-round), should be between 5% and 10% and cover of rushes should be less than 10%; average sward height during April and May should be 3cm to 5 cm. The sward should consist of patches of taller and shorter vegetation*). It almost certainly fails on the presence of breeding waders as well (not confirmed through this survey).

Soils: The soil is calcareous. Phosphorous levels are moderate, perhaps indicating the lack of recent stock grazing. Most other measures are in the mid-range for the Avon Valley.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 51	7.2	21	2	139	2-	92	2	1.12	28.2	1492	28.2

ESA	Avon Valley
2012 Site No.	052
Grid ref.	SU 181 241
Location	Standlynch (non-SSSI)
Survey Method	Fixed plots (2)
Survey Date	26 & 27 July, 2012.
Previous Derivation	ESA Wet Grassland Site 3
HLS Parcel No.	1302
HLS Options	HK12 - Restoration of wet grassland for wintering waders and wildfowl
HLS Supplements	

Site 52 lies to the east of the main river but is between it and a major side branch. The two fixed-plots were set up on this site in 1993. Plot 1 only was re-surveyed in 2003. In 2012 none of the metal plot markers were relocated. Average sward height in the plots was 29.6cm and 21.3cm respectively.

Management: Site 52 is a cattle-grazed pasture. Beef cattle are usually put on in April and taken off in October, although they will be left on to 'clear' sedges if conditions stay dry. The field is topped most years in the autumn but this was not done in 2011.

Vegetation: The sward was of moderate species-richness: 14–18 species in 1m-quadrats. Grasses *Agrostis stolonifera*, *Lolium perenne* and *Poa trivialis* were constant while *Alopecurus geniculatus* was also widespread. The sedge *Carex hirta* was also constant. *Eleocharis palustris*, a semi-aquatic associated with narrowly fluctuating water levels was frequent to locally common as was the horsetail *Equisetum palustre*. Typical wet meadow forbs were poorly represented although in the wetter areas *Cardamine pratensis*, *Galium palustre* and *Iris pseudacorus* were occasional.

NVC: MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 63.7%, for MG10b for plot 1, 58.0% for MG10 for plot 2 and 57.3% for MG10b for the whole field. The MG10b variant relates to the higher cover of *Carex hirta* which was common throughout the sward. However, community constants *Holcus lanatus* and *Juncus effusus* were both very patchy in distribution. In 1993 plots 1 and 2 were recorded as MG10b and MG10. This ubiquitous and species-poor, rank sward can be described as MG11-related due to the frequency of *Agrostis stolonifera*, *Festuca rubra*, *Potentilla anserina* and the absence of *Juncus effusus*.

Site condition: Features for HLS are BAP habitat G06 Lowland (floodplain) meadow, which it fails on two attributes- frequency of positive indicator species and average height of sward. It also failed on any other BAP or SSSI habitat. It is also features G13 Habitat for wintering waders and wildfowl.

Indicators of success: The site passes all of the HK12 vegetation and water level indicators of success but it is not known whether it passes on the presence of wintering wildfowl.

Soils: The soil is calcareous. Phosphorous levels are high. Soil Magnesium and Nitrate levels are relatively low as is Organic Carbon, while Phosphate levels are relatively high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 52	7.7	30	3	135	2-	67	2	0.41	27.7	2079	10.9

ESA	Avon Valley
2012 Site No.	053
Grid ref.	SU 177 262
Location	Alderbury Meadows (non-SSSI)
Survey Method	Fixed plots (2)
Survey Date	19 July, 2012.
Previous Derivation	ESA Wet Grassland Site 4
HLS Parcel No.	7420
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 53 is an old water meadow which lies to the east of the main river but is surrounded by ditches and drains. The two fixed-plots were set up on this site in 1993. Plot 1 only was re-surveyed in 2003. In 2012 only one of the metal plot markers (plot 1) were relocated. Average sward height in the plots was 21cm and 12.9cm respectively.

Management: Site 53 is an alternately cattle and sheep-grazed pasture. Cattle are usually put on in April and taken off in October, although numbers aren't known as grazing is let. The field is topped to control thistles when required.

Vegetation: The sward was of moderate species-richness: 14–18 species in 1m-quadrats. Grasses *Agrostis stolonifera*, *Festuca rubra*, *Holcus lanatus* and *Lolium perenne* were frequent to locally abundant while *Poa trivialis* was also widespread. The sedges *Carex hirta* and *C. acutiformis* were also frequent. The horsetail *Equisetum palustre* was also widespread but rushes were rare. Typical wet meadow forbs were poorly represented although in the wetter areas *Mentha aquatica*, *Cardamine pratensis* and *Iris pseudacorus* were occasional.

NVC: The vegetation community is a poor representative of any single NVC community. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 47.5%, for MG11a for plot 1; 50.5% for MG10a for plot 2; and 62.8% for MG10b for the whole field. The MG10b variant relates to the higher cover of *Carex hirta* which was common throughout the sward. However, community constants for MG11 and MG10, respectively, *Potentilla anserina* and *Juncus effusus* were both absent from samples. In 1993 plots 1 and 2 were recorded as MG13, but that community is more of an inundation community rather than that of a stable wet mesotrophic grassland as here: there appears to have been some overall change, evidently related to a lowering of the water table.

Site condition: This site features G13 Habitat for wintering waders and wildfowl. The site would fail the RCA for SSSI wet grassland stand types, and BAP habitat G06 Lowland (floodplain) meadow on two attributes on two attributes - frequency of positive indicator species and average height of sward.

Indicators of success: The site passes all of the HK15 vegetation and water level indicators of success but it is not known whether it passes on the presence of wintering wildfowl.

Soils: The soil is calcareous. Soil Phosphate and Nitrate levels are relatively high as is Organic Carbon. Most other measures are in the mid-range for the Avon Valley.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 53	7.4	42	3	145	2-	89	2	1.36	28.6	2090	28.6

ESA	Avon Valley
2012 Site No.	054
Grid ref.	SU 121 343
Location	Lower Woodford Water Meadows SSSI, Unit 1
Survey Method	Fixed plots (2)
Survey Date	19 June, 2012.
Previous Derivation	ESA Wet Grassland Stand 5
HLS Parcel No.	0727
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 54 is an old water meadow which lies to the west of the main river but is surrounded by ditches and drains. The two fixed-plots were set up on this site in 1993. Plot 1 only was re-surveyed in 2003. In 2012 none of the metal plot markers were relocated. Average sward height in the plots was 26.6cm and 22.4cm respectively.

Management: Site 54 is a cattle-grazed pasture. Cattle are usually put on in April and taken off in late September, although this field forms part of a wider grazing unit. The field is topped to control thistles once or twice a year (it was topped during the survey period). Spot-spraying of nettles and thistles is also carried out due to the terrain.

Vegetation: The sward was of moderate to high species-richness: 8–25 species in 1m-quadrats. Grasses *Festuca rubra* and *Holcus lanatus* were constant while *Lolium perenne*, *Poa trivialis*/*P. pratensis* and *Deschampsia cespitosa* were frequent and widespread. The sedge *Carex hirta* was constant while *C. disticha* and *C. nigra* were occasional. The rush *Juncus acutiflorus* was occasional. *Eleocharis palustris*, a semi-aquatic associated with narrowly fluctuating water levels was occasional to locally common typical wet meadow forbs were well represented in the north part of the site with *Cardamine pratensis*, *Filipendula ulmaria*, *Lotus pedunculatus*, *Galium palustre* and *Geum rivale* all occasional. *Myositis scorpioides* was present along the old ditches.

NVC: This stand has quite strong affinities with a species-poor MG8 flood-meadow but this is not reflected in the MATCH analysis. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 59%, for MG9a for plot 1, 46.9% for MG9 for plot 2 (both due to the relatively high cover of *Deschampsia cespitosa*) and 51.5% for MG10a for the whole field. In 1993 plots 1 and 2 were recorded as MG10 and MG10b respectively. Species diversity appears to have increased, particularly the *Carex* spp. and wet meadow forbs. The site is now a poor MG8/9 mosaic.

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on three attributes – frequency of positive indicator species, frequency of *Senecio aquaticus* and average height of sward.

Indicators of success: The site passes all of the HK15 vegetation and water level indicators of success but it is not known whether it passes on flowering heads of wild flowers (should be frequent) and the presence of wintering wildfowl.

Soils: The soil is neutral. Soil Magnesium and Potassium levels are relatively high as is Nitrate and one measure of Phosphate. Loss on Ignition is one of the highest in the Avon Valley. Other measures are in the mid-range for the Avon Valley. This may indicate a measure of over-stocking.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 54	7.0	13	1	185	2+	122	3	2.12	37.9	2583	19.5

ESA	Avon Valley
2012 Site No.	055
Grid ref.	SU 121 344
Location	Lower Woodford Water Meadows SSSI, Unit 1
Survey Method	Fixed plots (1)
Survey Date	21 June, 2012.
Previous Derivation	ESA Wet Grassland Site 6
HLS Parcel No.	0844
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 55 is an old water meadow which lies to the west of the main river but is surrounded by ditches and drains. Two fixed-plots were set up on this site in 1993 and both were resurveyed in 2003. In 2012 both of the metal plot markers were relocated. Average sward height in the plot was 14.9cm.

Management: Site 55 is a cattle-grazed pasture. Cattle are usually put on in April and taken off in late September, although this field forms part of a wider grazing unit. The field is topped to control thistles once or twice a year (it was topped during the survey period). Spot-spraying of nettles and thistles is also carried out due to the terrain.

Vegetation: The sward was of low to moderate species-richness: 9–16 species in 1m-quadrats. Grasses *Festuca pratensis* and *Holcus lanatus* were constant while *Festuca rubra*, *Lolium perenne*, and *Poa trivialis* were frequent and widespread. The sedge *Carex hirta* was moderately common. Typical wet meadow forbs were not well represented in the site although *Cardamine pratensis*, *Filipendula ulmaria* and *Lysimachia nummularia* were present but rare.

NVC: MATCH analysis gave the highest similarity coefficients for MG10b for the plot and wider unit but it lacks *Juncus effusus*. In 1993 plot 1 was also recorded as MG10b. However, the absence of *Juncus effusus* and the frequency of *Deschampsia cespitosa* are more akin to an MG9a community (60.6%) or a *Deschampsia cespitosa* invaded MG7c sward (58.6%).

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two attributes- frequency of positive indicator species and frequency and cover of negative indicator species.

Indicators of success: The site passes all of the HK15 vegetation and water level indicators of success but it is not known whether it passes on flowering heads of wild flowers (should be frequent) and the presence of wintering wildfowl.

Soils: The soil is calcareous. Phosphorous levels are high, Potassium moderate, and Magnesium high. Total Nitrate however is the lowest in the Avon Valley. This site would not lend itself to re-establishing a wildflower-rich sward.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 55	7.7	31	3	148	2-	102	3	0.33	27.0	2174	11.4

ESA	Avon Valley
2012 Site No.	056
Grid ref.	SU 122 344
Location	Lower Woodford Water Meadows SSSI, Unit 1
Survey Method	Fixed plots (1)
Survey Date	20 June, 2012
Previous Derivation	ESA Wet Grassland Site 7
HLS Parcel No.	0844
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 56 is an old water meadow which lies to the west of the main river but is surrounded by ditches and drains. The two fixed-plots were set up on this site in 1993. In 2012 neither of the metal plot markers was found. Average sward height was 13.8cm.

Management: Site 56 is a cattle-grazed pasture. Cattle are usually put on in April and taken off in late September, although this field forms part of a wider grazing unit. The field is topped to control thistles once or twice a year (it was topped during the survey period). Spot-spraying of nettles and thistles is also carried out due to the terrain.

Vegetation: The sward was of low to moderate species-richness: 9–16 species in 1m-quadrats. Grasses *Holcus lanatus* and *Lolium perenne* were constant while *Festuca pratensis* and *Agrostis stolonifera* were frequent and widespread. The sedge *Carex hirta* was frequent. Typical wet meadow forbs were rare with only *Cardamine pratensis* and *Scrophularia aquatica* present.

NVC: Although MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 62.2%, for MG6a for plot 1 and 64.1% for MG10b for the whole field, the field is too wet for MG6 and lacks the *Juncetum* associates of MG10. The sward has closest affinities with MG7c flood-plain grassland. In 1993 plots 1 and 2 were recorded as MG10a: this is considered an inaccurate interpretation.

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on one attribute- frequency of positive indicator species.

Indicators of success: The site passes all of the HK15 vegetation and water level indicators of success but it is not known whether it passes on flowering heads of wild flowers (should be frequent) and the presence of wintering wildfowl.

Soils: The soil is calcareous. Phosphorous levels are high, potassium moderate and magnesium moderate. Nitrogen levels are high but normal for long-term grassland. Organic Carbon is relatively low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 56	7.8	40	3	121	2–	95	2	1.15	26.3	2006	7.6

ESA	Avon Valley
2012 Site No.	057
Grid ref.	SU 161 182
Location	Breamore Estate (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	10 July, 2012
Previous Derivation	ESA Grassland Site(Site 22)
HLS Parcel No.	1217
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 57 is a meadow which lies to the west of the main river, between it and the A338 road, and is surrounded by ditches and drains. The plot was established in 1993 and resurveyed in 2003. In 2012 neither of the two metal plot markers was found. Average sward height was 32.4cm.

Management: Site 57 is a cattle-grazed pasture. Cattle are usually put on in April and taken off in late October, although this field forms part of a wider grazing unit which currently involves using sheep. Weed control only involves ragwort pulling which is part of an estate wide control programme.

Vegetation: The sward was of moderate species-richness: 10–21 species in 1m-quadrats. The grass *Holcus lanatus* was constant while *Lolium perenne*, *Poa trivialis* and *Festuca rubra* were frequent. The sedge *Carex nigra* was \pm constant while *C. acutiformis* and *C. riparia* were occasional or locally abundant. The rush *Juncus acutiflorus* was frequent. Typical wet meadow forbs were well represented with *Valeriana dioica*, *Filipendula ulmaria*, *Lotus corniculatus*/ *L. pedunculatus*, *Galium palustre* and *Geum rivale* all locally frequent. *Caltha palustris* was occasional.

NVC: MATCH analysis gave the highest similarity coefficients as 44.4% for MG27c and 53.4% for OV26 for the plot and wider unit respectively. These are low coefficients so the vegetation community is difficult to classify and not likely to be intermediate between the two. In 1993 the plot was recorded as MG8 and this would fit much better with the overall species composition. However, there appears to have been some overall change, probably with a decrease in abundance of *Caltha palustris* and the apparent absence of species such as *Cynosurus cristatus* (which is often the case in the Avon Valley).

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the MG8 SSSI RCA and BAP habitat G06 Lowland (floodplain) meadow condition assessment on three attributes – frequency of positive indicator species, cover of indicators of waterlogging and average height of sward.

Indicators of success: The site fails some of the HK15 vegetation indicators of success but it is not known whether it passes on the presence of breeding waders.

Soils: The soil is neutral–calcareous. Phosphorous levels are high, potassium and magnesium moderate. These measures are common for the Avon Valley. Nitrogen however is very high, and loss on ignition (organic matter content) very high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 57	7.2	27	3	124	2–	99	2	1.77	40.3	1866	14.3

ESA	Avon Valley
2012 Site No.	058
Grid ref.	SU 179 221
Location	Barford Park Farm (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	12 July, 2012
Previous Derivation	ESA Grassland (Site 28)
HLS Parcel No.	9328
HLS Options	HK12 – Restoration of wet grassland for wintering waders and wildfowl.
HLS Supplements	

Site 58 is a meadow which lies to the east of the main river channel, south of Trafalgar Fish Farm and is bordered by a deep channel. The plot was established in 1993 and resurveyed in 2003. In 2012 all three of the metal plot markers were found. Average sward height was 9 cm.

Management: Site 58 is a cattle-grazed pasture. Cattle are usually put on in March/April and taken off in September/October, although this field forms part of a wider grazing unit. The field is topped to control thistles as necessary. Summer flooding is seen to be a problem although stock were on the field when it was surveyed in the very wet summer of 2012.

Vegetation: The sward was of low to moderate species-richness: 8–18 species in 1m-quadrats. Grasses *Holcus lanatus* and *Lolium perenne* were constant while *Agrostis stolonifera* and *Dactylis glomerata* were frequent and widespread. The sedge *Carex hirta* was occasional. The rush *Juncus acutiflorus* was occasional. *Eleocharis palustris*, a semi-aquatic associated with narrowly fluctuating water levels was occasional to locally common. Typical wet meadow forbs were poorly represented with *Cardamine pratensis* the only positive indicator present.

NVC: The vegetation community is probably closest to MG11a grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 62.6% for MG11a for the plot and 54.1% for MG10b for the whole field. In 1993 the plot was recorded as MG9b so there appears to have been some overall change, probably with a decrease in abundance of *Deschampsia cespitosa*.

Site condition: This site features G06 Lowland (floodplain) meadow – BAP habitat and G12 Habitat for breeding waders. It fails the RCA for any SSSI wet grassland stand type, or G06 Lowland (floodplain) meadow, on two attributes- frequency of positive indicator species and frequency of *Senecio aquaticus*.

Indicators of success: The site passes the HK12 vegetation height but fails the bare ground indicators of success but it is not known whether it passes on the presence of wintering wildfowl and winter water level indicators.

Soils: The soil is calcareous. Soil phosphorous levels are extremely high (potential agricultural run-off should be explored); potassium moderate; magnesium and nitrogen high. Organic Carbon levels are relatively high. Other measures are in the mid-range for the Avon Valley. This may indicate a measure of over-stocking. High levels of phosphorous will hinder restoration to a species-rich sward.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 58	7.6	47	4	177	2–	103	3	1.29	23.7	2164	23.7

ESA	Avon Valley
2012 Site No.	059
Grid ref.	SU 174 260
Location	Longford Estate (Alderbury Meadows) (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	11 July, 2012
Previous Derivation	ESA Grassland Site(32)
HLS Parcel No.	3492
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 59 is a meadow which lies to the east of the main river channel, south of Longford Castle and is bordered on all sides by drains. The plot was established in 1993 and resurveyed in 2003. In 2012 two of the metal plot markers were found. Average sward height was 7.75 cm.

Management: Site 59 is a cattle-grazed pasture. Cattle are usually put on in mid-March and taken off in late September or beginning of October, although this field forms part of a wider grazing unit. The field is perceived to have more rushes currently than in the past.

Vegetation: The sward was of moderate species-richness: 9–20+ species recorded in 1m-quadrats. Grasses *Agrostis stolonifera*, *Festuca rubra*, *Lolium perenne* and *Holcus lanatus* were constant while *F. pratensis* was frequent and widespread. *Deschampsia cespitosa* was frequent. The sedge *Carex nigra* was constant. The rush *Juncus acutiflorus* was locally frequent. Typical wet meadow forbs were locally frequent with *Cardamine pratensis* and *Filipendula ulmaria* frequent and *Persicaria amphibia* and *Lysimachia nummularia* also present.

NVC: The vegetation community is intermediate between that of MG9a and species-poor MG8 grassland (this could also be described as MG11-related as it is a poor fit with any). MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 59.9%, for MG8 for the plot and 56.4% for MG9a. These are fairly high coefficients so the community is probably more MG9a. There are also affinities with MG10a due to the occasional patches of *Juncus effusus*. In 1993 the plot was recorded as MG13 but this seems a poor fit with the suite of species noted – either there has been much change (a decrease in abundance of *Alopecurus geniculatus* and a stabilization of the community/lowering of water table) or the community was not interpreted correctly.

Site condition: No BAP habitat is named or this site under HLS although it may pass the condition assessment for G02 semi-improved grassland with potential for restoration to G06: Lowland meadow. The site failed the condition assessment for G06: Lowland meadows BAP habitat on two attributes- frequency of positive indicator species and average height of sward.

Indicators of success: The site passes all of the HK15 vegetation and water level indicators of success but it is not known whether it passes on the presence of wintering wildfowl and summering Lapwing, Snipe and Bats.

Soils: The soil is neutral. Phosphorous and magnesium levels are high, potassium moderate. Other measures are in the mid-range for the Avon Valley.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 59	7.1	26	3	150	2–	109	3	0.95	22.1	1448	22.1

ESA	Avon Valley
2012 Site No.	060
Grid ref.	SU 165 176
Location	Breamore Estate, Woodgreen (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	12 July, 2012
Previous Derivation	ESA Grassland Site19
HLS Parcel No.	5561
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 60 is a meadow which lies south east of the main river channel, the north boundary of which forms a ward boundary and the south borders the Woodgreen to Breamore road. The plot was established in 1993 and resurveyed in 2003. In 2012 two of the metal plot markers were found. Average sward height was 8.5 cm.

Management: Site 60 is a cattle-grazed pasture. Cattle are usually put on in April and taken off in late October, although this field forms part of a wider grazing unit which currently involves using sheep. Weed control only involves ragwort pulling which is part of an estate wide control programme.

Vegetation: The sward was of moderate species-richness: 10–21 species in 1m-quadrats. Grasses *Festuca rubra* and *Lolium perenne* were constant while, *Holcus lanatus*, *Cynosurus cristatus* and *Agrostis stolonifera* were frequent and widespread. No sedges or rushes were present. Typical wet meadow forbs were poorly represented with no positive indicators present.

NVC: The vegetation community is MG6 grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 65.2%, for MG6a for the plot and 68.5% for MG6a for the whole field. In 1993 the plot was recorded as MG1a: a reduction in cover of *Arrhenatherum elatius* (probably as a result of improved management – more intensive grazing) and an increase in *Cynosuretum* species has resulted in an overall community change. This site does not support a typical wet grassland community.

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two attributes - frequency of positive indicator species and average height of sward.

Indicators of success: The site passes all of the HK15 vegetation indicators of success but it is not known whether it passes on the presence of breeding waders and wintering wildfowl.

Soils: The soil is calcareous. All soil attributes recorded fell within the moderate or medium range and were also in the mid-range for the Avon Valley.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 60	7.7	20	2	151	2–	86	2	0.91	19.8	1422	19.8

ESA	Avon Valley
2012 Site No.	061
Grid ref.	SU 150 037
Location	Moortown, Ringwood (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	5 September, 2012
Previous Derivation	ESA Grassland Site 7
HLS Parcel No.	0171
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 61 is a wet meadow, to the east of the main river channel and bordered along its west boundary by a millstream. The ground showed evidence of heavy grazing and was flooded. In 2012 none of the metal plot markers were found. Average sward height was 10 cm.

Management: Site 61 is a hay or silage field with aftermath-grazed pasture. Cutting is usually carried out in mid-June if possible although nothing was possible in 2012. Cattle or ponies are used for grazing but not in March-June when birds are nesting. The field is topped to control thistles and rushes as needed.

Vegetation: (This site was surveyed late summer 2012 when the flood water was still present). The sward was of low species-richness: 6–12 species in 1m-quadrats. The grass *Agrostis stolonifera* was constant while *Lolium perenne* and *Glyceria fluitans* were frequent and widespread. The sedge *Carex hirta* was occasional. The rush *Juncus acutiflorus* was rare. Typical wet meadow forbs were rare but *Mentha aquatica* and *Persicaria amphibia* were occasional and *Myositis* sp. was present. *Lemna* spp. were frequent demonstrating the unusual wetness of the site.

NVC: The vegetation community is probably closest to and MG13-related grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 45.8%, for MG13 (despite the lack of *A. geniculatus* and the presence of *Lolium perenne*); and 47.2% for MG10b for the whole field. These are low coefficients but the community is probably closest to MG13 due to the presence of *Agrostis stolonifera* and *Glyceria fluitans*. In 1993 the plot were recorded as MG10b respectively so there appears to have been some overall change, probably due to the increased wetness in recent years.

Site condition: This site supports G15 Coastal and floodplain grazing marsh – BAP habitat. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on one attribute- frequency of positive indicator species (although a full condition survey was difficult due to the conditions).

Indicators of success: The site passes all of the HK15 vegetation indicators of success but it is not known whether it passes on water level ones.

Soils: The soil is neutral but with the lowest pH of all sampled in the Avon Valley. One measure of soil Phosphate (Olsen's P) is high but another (Total P) is the lowest in the Avon Valley Loss on Ignition and Total Carbon are among the lowest in the Avon Valley. Other measures are in the mid-range for the Avon Valley. This may be a result of the prolonged flooding effects.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 61	6.8	45	3	159	2–	81	2	0.48	15.1	935	6.8

ESA	Avon Valley
2012 Site No.	062
Grid ref.	SU 139 994
Location	Avon Tyrell, Fairford (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	5 July, 2012
Previous Derivation	ESA Grassland Site 5
HLS Parcel No.	8939
HLS Options	HK11 – Restoration of wet grassland for breeding waders
HLS Supplements	

Site 62 is a wet grassland field, lying to the west of the main river channel, which borders all along the field's east boundary. The plot was established in 1993 and resurveyed in 2003. In 2012 both of the metal plot markers were found. Average sward height was 22.1 cm.

Management: Site 62 is a cattle-grazed pasture. Cattle are usually put on in early June and taken off in November, depending on weather and flood levels although flooding has prevented any grazing for the past two years. The field is topped to control rushes, docks and ragwort as necessary.

Vegetation: The sward was of moderate to high species-richness: 13–20+ species in 1m-quadrats. Grasses *Agrostis stolonifera* and *Festuca rubra* were constant while *Holcus lanatus*, *Lolium perenne*, *Poa trivialis*, *Deschampsia cespitosa* and *Phleum pratense* were frequent and widespread. The sedge *Carex hirta* was constant while *C. disticha* was locally abundant. The rush *Juncus acutiflorus* was occasional. Typical wet meadow forbs were rare with *Cardamine pratensis* and *Filipendula ulmaria* occasional.

NVC: The vegetation community is intermediate between that of an MG10 rush pasture and MG9 grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 61.9%, for MG10 for the plot and 56.1% for MG9b for the whole field. The community is probably intermediate but with local variations between the two. In 1993 the plot was recorded as MG9 so there appears to have been some overall change, probably with a decrease in abundance of *Deschampsia cespitosa*, perhaps resulting from an increased/prolonged grazing pressure.

Site condition: HLS is aimed at benefitting G15 Coastal and floodplain grazing marsh/G12 Habitat for breeding waders. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two attributes- frequency of positive indicator species, frequency of *Senecio aquaticus* and other negative indicator species combined.

Indicators of success: It is not known whether the site passes on the HK11 vegetation and water level indicators of success or the presence of breeding waders.

Soils: The soil is calcareous. Soil phosphorous and Potassium levels are low, magnesium moderate whereas nitrogen levels are high, even for long-term grassland. Loss on ignition is also high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 62	7.3	14	1	84	1	55	2	1.57	43.5	1581	12.5

ESA	Avon Valley
2012 Site No.	063
Grid ref.	SU 142 996
Location	Avon Tyrell, Fairford (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	5 July, 2012
Previous Derivation	ESA Grassland Site 6
HLS Parcel No.	1564
HLS Options	HK11 – Restoration of wet grassland for breeding waders
HLS Supplements	

Site 63 is a wet grassland field, lying to the east of the main river channel, which borders most of the field's west boundary. The plot was established in 1993 and resurveyed in 2003. In 2012 the metal plot markers were not found. The whole field was flooded. Average sward height was 25.4 cm.

Management: Site 63 is a cattle-grazed pasture. Cattle are usually put on in early June and taken off in November, depending on weather and flood levels although flooding has prevented any grazing for the past two years. The field is topped to control rushes, docks and ragwort as necessary.

Vegetation: The sward was of low to moderate species-richness: 6–26 species in 1m. The grass *Holcus lanatus* was constant while *Festuca rubra*, *Poa trivialis*/*P. angustifolia* and *Agrostis stolonifera* were frequent and widespread. *Deschampsia cespitosa* was locally frequent. The sedge *Carex nigra* was frequent while *C. disticha* was occasional to locally frequent. The rush *Juncus acutiflorus* was frequent. Typical wet meadow forbs were rare with only *Filipendula ulmaria* frequent.

NVC: The vegetation community is that of MG9 grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 49.1%, for MG9 for the plot and 55.6% for MG9a for the whole field. In 1993 the plot was recorded as MG9 so there appears to have been little overall change.

Site condition: HLS is aimed at benefitting G15 Coastal and floodplain grazing marsh/G12 Habitat for breeding waders. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two attributes - frequency of positive indicator species and average height of sward.

Indicators of success: The site fails two of the HK11 vegetation and water level indicators of success (condition and cover of sedges) but it is not known whether it passes on the presence of breeding waders.

Soils: The soil is calcareous. Phosphorous, Magnesium and Potassium levels are moderate. Nitrogen is high, even for long-term grassland. These measures are in the mid-range for the Avon Valley.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 63	7.4	16	2	121	2–	60	2	1.52	37.3	1775	14.4

ESA	Avon Valley
2012 Site No.	064
Grid ref.	SZ 160 959
Location	Avon Valley (Bickton–Christchurch) SSSI (Unit 151)
Survey Method	Fixed plots (1)
Survey Date	6 August, 2012
Previous Derivation	ESA Grassland Site 3
HLS Parcel No.	9886
HLS Options	HK11 – Restoration of wet grassland for breeding waders
HLS Supplements	

Site 64 is a wet grassland field, lying to the east of the main river channel, which borders most of the field's west boundary. The plot was established in 1993 and resurveyed in 2003. In 2012 the metal plot markers were not found. 75% of the field was flooded to a depth of 15 cm. Average sward height was 22.8 cm.

Management: Site 64 is managed as a hay-meadow with aftermath grazing. Cutting is usually early. Cattle and New Forest ponies are usually put on for an intensive 2-3 week period of grazing. The field is topped to control thistles and other weeds as necessary.

Vegetation: The sward was of low to moderate species-richness: 9–15 species in 1m. Grasses *Agrostis stolonifera* and *Holcus lanatus* were constant while *Festuca arundinacea* and *Poa trivialis* were frequent and widespread. The sedge *Carex disticha* was frequent while *C. hirta* was occasional. The rush *Juncus acutiflorus* was frequent. Typical wet meadow forbs were rare with only *Filipendula ulmaria* frequent and *Mentha aquatica* and *Persicaria amphibia* both present

NVC: The vegetation community is that of an MG10 rush pasture. MATCH analysis gave the highest similarity coefficients for the plot and wider unit as 47.1%, for MG10a for the plot and 42.8% for MG10b for the whole field. These are fairly low coefficients so the community is probably intermediate but with local variations between the two. In 1993 the plot was recorded as MG10a so there appears to have been little overall change.

Site condition: HLS is aimed at benefitting G15 Coastal and floodplain grazing marsh/G12 Habitat for breeding waders. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two attributes - frequency of positive indicator species and extent of litter.

Indicators of success: The site fails some of the HK11 vegetation indicators of success (e.g. presence of positive indicators) but it is not known whether it passes on water levels and the presence of breeding waders and wintering wildfowl.

Soils: The soil is calcareous. The two measures of soil phosphorous and one of Potassium are the highest in the Avon Valley – phosphorous is extremely high, which is unsuitable for restoration to species-rich grassland. Nitrogen is high, but normal for permanent grassland. High phosphorous may indicate an issue with agricultural run-off/water quality.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 64	7.5	51	4	215	2+	84	2	1.11	23.5	2012	23.5

ESA	Avon Valley
2012 Site No.	065
Grid ref.	SU 142 046
Location	Avon Valley (Bickton–Christchurch) SSSI (Unit 52)
Survey Method	Fixed plots (1)
Survey Date	3 July, 2012
Previous Derivation	ESA Grassland Site 9
HLS Parcel No.	2256
HLS Options	HK11 – Restoration of wet grassland for breeding waders
HLS Supplements	

Site 65 is a grassland field, almost entirely bordered around north and west borders by a bend the main river channel and with a reed bed taking up its southern corner. The plot was established in 1993 and resurveyed in 2003. In 2012 the metal plot markers were not found. Average sward height was 22.3 cm.

Management: Site 65 is cut for hay and aftermath grazed. Cutting is usually from the third week of June to mid-July. Grazing was not possible in 2011 and flooding prevented cutting in 2012. The field is topped to control thistles, rushes and nettles as necessary.

Vegetation: The sward was of moderate species-richness: 15–20+ species in 1m. Grasses *Agrostis stolonifera*, *Poa trivialis*, *Lolium perenne* and *Holcus lanatus* were constant while *Festuca rubra* and *Phalaris arundinacea* were frequent and widespread. The sedge *Carex disticha* was constant while *C. acutiformis*, *C. flacca* and *C. nigra* were occasional. The rush *Juncus articulatus* was rare. *Eleocharis palustris*, a semi-aquatic associated with narrowly fluctuating water levels was occasional to locally common. Typical wet meadow forbs were moderately well represented with *Caltha palustris* and *Cardamine pratensis* occasional and *Filipendula ulmaria* frequent. *Myosotis* spp. were occasional.

NVC: The vegetation community is closest to MG8 grassland. MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 47.6% for MG10a for the ADAS plot and 55.1% for MG8 for the whole field. These are fairly low coefficients but the community is probably intermediate but with a lack of the MG8 constant *Cynosurus cristatus* pushing the classification towards MG10. In 1993 plot was recorded as MG10b so there appears to have been some overall change.

Site condition: HLS is aimed at benefitting G15 Coastal and floodplain grazing marsh/G12 Habitat for breeding waders/G13 Habitat for wintering wildfowl. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on two one attribute- frequency of positive indicator species

Indicators of success: The site fails some of the HK11 vegetation indicators of success (e.g. presence of positive indicators) but it is not known whether it passes on water levels and the presence of breeding waders and wintering wildfowl.

Soils: The soil is calcareous. Soil Phosphorous, Magnesium and Potassium levels are low. Nitrogen is high, even for permanent grassland. Organic content as measured by Loss on ignition is also quite high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 65	7.5	14	1	106	1	48	1	1.47	32.9	1646	11.1

ESA	Avon Valley
2012 Site No.	066
Grid ref.	SU 164 187
Location	Breamore Estate (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	10 July, 2012
Previous Derivation	ESA Grassland Site 23
HLS Parcel No.	3358
HLS Options	HK15 – Maintenance of grassland for target features
HLS Supplements	

Site 66 is a grassland field lying alongside the A338 Breamore to Downton road, to the west of the river. The plot was established in 1993 and resurveyed in 2003. In 2012 the metal plot markers were not found. Average sward height was 38 cm.

Management: Site 66 is a cattle-grazed pasture. Cattle are usually put on in April and taken off in late October, although this field forms part of a wider grazing unit which currently involves using sheep. Weed control only involves ragwort pulling which is part of an estate wide control programme.

Vegetation: The sward was of low to moderate species-richness: 6–22 species in 1m-quadrats. Grasses *Agrostis stolonifera*, *Festuca rubra* and *Holcus lanatus* were constant while *Poa trivialis* and *Phleum pratense* were frequent and widespread. The sedge *Carex acutiformis* was frequent and widespread. The rush *Juncus inflexus* was frequent and widespread. *Eleocharis palustris*, a semi-aquatic associated with narrowly fluctuating water levels was occasional to locally common. Typical wet meadow forbs were not particularly well represented but *Filipendula ulmaria*, *Galium palustre* and *Persicaria amphibia* were all occasional.

NVC: MATCH analysis gave the highest similarity coefficients for the plot and wider unit, as 48.1% for MG10b for the plot and 50.1% for MG10a for the whole field, despite the lack of *Juncus effusus*. These are fairly low coefficients so the community and influenced by the constancy of *Holcus lanatus* and *Agrostis stolonifera*. In 1993 the plot was recorded as MG10b so there appears to have been little overall change.

Site condition: This field supports G15 Coastal and floodplain grazing marsh. It fails the RCA for any SSSI wet grassland stand type, or BAP habitat G06 Lowland (floodplain) meadow, on four attributes - frequency of positive indicator species, extent of litter, cover of indicators of waterlogging and average height of sward.

Indicators of success: The site fails some of the HK15 vegetation indicators of success (e.g. favourable condition) but it is not known whether it passes on water levels and the presence of breeding waders and wintering wildfowl.

Soils: The soil is calcareous. Phosphorous, potassium and magnesium levels are moderate. Nitrogen levels are high, even for permanent grassland.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total IP	Organic Carbon
LWG 2012 66	7.5	22	2	145	2–	92	2	1.61	37.8	1719	12.7

ESA	Avon Valley
2012 Site No.	067
Grid ref.	SU 1406 0864
Location	Avon Valley (Bickton–Christchurch) SSSI (Unit 27)
Survey Method	5 quadrats
Survey Date	25 June, 2012
Previous Derivation	New Site
HLS Parcel No.	0864
HLS Options	HK7 – Restoration of species-rich, semi-natural grassland.
HLS Supplements	

Site 67 is a new site. It is a grassland field lying to the west of the A338 Ringwood to Fordingbridge road and adjoining the river for much of its western most boundary. Most of the field was splash wet. In 2012 over 5 quadrats surveyed, the average sward height was 21.4 cm.

Management: Site 67 is hay cut and aftermath grazed. Detailed management information is not available but it is known that half the site was hay-cut in 2012.

Vegetation: The sward was of moderate species-richness: 20–25 species in 1m. Grasses *Agrostis stolonifera*, *Festuca rubra* and *Festuca pratensis* were constant while *Holcus lanatus*, *Poa trivialis* and *Lolium perenne* were frequent and widespread. The sedges *Carex hirta*, *C. disticha* and *C. nigra* were occasional. The rush *Juncus acutiflorus* was occasional. *Eleocharis palustris*, a semi-aquatic associated with narrowly fluctuating water levels was occasional. Typical wet meadow forbs were well represented with *Filipendula ulmaria* frequent and *Cardamine pratensis*, *Lychnis flos-cuculi*, *Galium palustre* and *Myositis scorpioides* all occasional.

NVC: The vegetation community is MG8 grassland. MATCH analysis gave the highest similarity coefficients for the plots as 64.8%, for MG8, although several common associates of that community were missing.

Site condition: The site passed the RCA MG8 and BAP habitat G06 Lowland meadows condition assessment on all attributes.

Indicators of success: The site passes the 2-year indicators of success set for the site.

Soils: The soil is calcareous. Potassium levels are low, whilst phosphorous and magnesium are moderate. Nitrogen levels were extremely high, one of the highest in the Avon Valley, and organic matter (as measured by loss on ignition) was also high. High nitrogen can lead to loss of meadow wildflower species in favour of aggressive grasses and perennial weeds – this should be monitored.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 67	7.4	18	2	119	1	56	2	2.08	44.7	1753	16.2

ESA	Avon Valley
2012 Site No.	068
Grid ref.	SU 146 123
Location	Bickton, Fordingbridge (non-SSSI)
Survey Method	Fixed quadrats (5)
Survey Date	16 July, 2012
Previous Derivation	New Site
HLS Parcel No.	6334
HLS Options	HK15 - Maintenance of grassland for target features
HLS Supplements	

Site 68 is a new site. It is a grassland field lying to the west of the river which forms some of its eastern boundary. Most of the field was at least splash wet. In 2012 over 5 quadrats surveyed, the average sward height was 9 cm.

Management: Site 68 is cattle grazed pasture. Cattle are usually put on in May and taken off in August but lightly grazed at 0.5 lu/ha. Topping is carried out for docks when necessary.

Vegetation: The sward was of low to moderate species-richness: 8–16 species in 1m. Grasses *Agrostis stolonifera*, *Festuca rubra* and *Lolium perenne* were constant while *Phleum pratense* was frequent and widespread. The sedge *Carex hirta* was frequent and widespread and *C. flacca* was occasional. The rush *Juncus acutiflorus* was occasional. Typical wet meadow forbs were not well represented with *Filipendula ulmaria* frequent, *Cardamine pratensis* and *Lathyrus pratensis* occasional and *Galium palustre*/*G. uliginosum* rare. Other forbs included *Trifolium pratense*, *T. repens*,

NVC: The vegetation in this site did not conform to any specific NVC community: the high cover of *Agrostis stolonifera* gives it affinities with MG10a rush pasture (coefficient = 55.7%), although it lacked *Juncus effusus*, and with MG11a (53.7%), although without *Potentilla anserina*. The high cover of *Lolium perenne* with other flood-pasture species results in an affinity with MG7c (53.5%). However, the community has the appearance of a severely degraded MG8, which can be a response to a prolonged period of drying out, increased nutrients or an increase in grazing pressure. It is best described as MG7c.

Site condition: No BAP habitat is named or this site under HLS although the aim appears to be G12 Habitat for breeding waders. It may pass the condition assessment for G02 semi-improved grassland with potential for restoration to G06: Lowland meadow. The site failed the condition assessment for G06: Lowland meadows BAP habitat on two attributes- frequency of positive indicator species and average height of sward.

Indicators of success: The site passes all of the vegetation indicators of success (e.g. favourable condition) but it is not known whether it passes on water levels and the presence of breeding waders and wintering wildfowl.

Soils: The soil is calcareous. Phosphorous levels are extremely high, whilst potassium and magnesium levels are low. Nitrogen levels were very high, and organic matter content moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Inde x P	Soil K (mg/l)	Inde x K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Tota l P	Organic Carbon
LWG 2012 68	7.5	46	4	167	2-	82	2	1.44	29.4	189 7	29.4

ESA	Avon Valley
2012 Site No.	069
Grid ref.	SU 175 219
Location	Downton (non-SSSI)
Survey Method	Fixed quadrats (5)
Survey Date	23 July, 2012
Previous Derivation	New Site
HLS Parcel No.	5892
HLS Options	HK15 - Maintenance of grassland for target features
HLS Supplements	

Site 69 is a new site. It is a grassland field lying to the west of the river which forms its eastern boundary. In 2012 over 5 quadrats surveyed, the average sward height was 17.6 cm.

Management: Site 69 cattle grazed pasture. Cattle are usually put on in March and taken off at the end of October. Topping is carried out for thistles, ragwort and nettles when necessary. Spot-treatment for ragwort may also be done.

Vegetation: The sward was of low to moderate species-richness: 11–17 species in 1m quadrats. The grass *Lolium perenne* was constant while *Agrostis stolonifera*, *Festuca rubra* and *Holcus lanatus* were frequent and widespread. The sedge *Carex hirta* was occasional and *C. acutiformis* was locally frequent. Typical wet meadow forbs were rare with *Filipendula ulmaria* the only representative.

NVC: The vegetation community has closest affinities with MG6a (61.1%) although it is a poor example of this vegetation type, with missing associates (such as *Cynosurus cristatus*). MG6 is more typical of moist, free-draining soils, not flood-pasture. The abundance of *Agrostis stolonifera* in the field, denoting wet conditions, is atypical for MG6. *Arrhenatherum elatius* has invaded the sward, as has *Deschampsia cespitosa* – probably due to a lack of winter grazing or light grazing. The sward is more usefully considered to be an older, more developed stand of an MG7 flood-plain pasture (MG7d – 57.6%).

Site condition: The site is featured under HLS as G01 improved grassland with target feature H06 – Historic water meadow. The site failed the condition assessment for G06 Lowland meadow on three attributes- frequency of positive indicator species, cover of negative indicator species and average height of sward.

Indicators of success: The indicators of success for H06 appear to be met although outside the remit of this survey.

Soils: The soil is calcareous. Soil phosphorous is high, whilst potassium and magnesium are moderate. Total nitrogen was medium, but this is quite a low level for a permanent pasture. Organic matter content was correspondingly quite low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 69	7.4	45	3	189	2+	100	2	0.83	17.0	1631	17.0

ESA	Avon Valley
2012 Site No.	071
Grid ref.	SU 145 039
Location	Ringwood (non-SSSI)
Survey Method	Fixed plots (1)
Survey Date	3 July, 2012
Previous Derivation	ESA Grassland Site 8
HLS Parcel No.	5394
HLS Options	HK11 - Restoration of wet grassland for breeding waders
HLS Supplements	

Site 71 is a grassland field lying to the north of the river which forms part of its southern boundary. The plot was established in 1993 and resurveyed in 2003. In 2012 the metal plot markers were not found. The average sward height was 4.75 cm.

Management: Site 71 is cattle grazed pasture. Cattle are usually put on in mid-May and taken off mid-October. Topping is carried out for thistles, rushes and nettles when necessary.

Vegetation: The sward was of low species-richness: 3–10 species in 1m quadrats. The grass *Lolium perenne* was constant while *Agrostis stolonifera*, *Festuca rubra* and *Holcus lanatus* were frequent and widespread. Sedges were absent. Typical wet meadow forbs were also absent. This was an extremely species-poor sward.

NVC: The vegetation community has strong affinities with MG11a (coefficient = 60.1%) due to the constancy of *Agrostis stolonifera* and *Festuca rubra*, although it lacks *Potentilla anserina*. It also has features of a species-poor improved pasture, one of the MG7 stands, although MATCH resulted in various sub-communities (MG7a, 53.3%; MG7b, 49.7% for the plot and MG7d, 50.9%, MG7e, 50.9% for the wider field). In 1993 this site was described as MG7b – it shows little change from this but is more accurately described as MG11-related.

Site condition: This site is not SSSI. The site does not pass the condition assessment for any BAP habitat such as G06 lowland meadow but its current aim is G12 Habitat for breeding waders.

Indicators of success: The site passes all of the vegetation indicators of success but it is not known whether it passes on water levels and the presence of breeding waders and wintering wildfowl.

Soils: The soil is calcareous. Soil phosphorous is moderate, whilst potassium is low and magnesium is moderate–high. Total nitrogen was medium, but this is quite a low level for a permanent pasture. Organic matter content was correspondingly quite low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 71	7.8	19	2	110	1	84	2	0.63	14.2	1025	3.7

Appendix 5: ITCHEN VALLEY

Appendix 5a: MATCH analysis of individual sites

Results of MATCH analysis of the 5-quadrat plots recorded in the Itchen Valley. The top five results are shown. The NVC community determined in 2012 is provided (in bold in final column), which is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

	ITCHEN VALLEY – MATCH rank (top 5)										2012
	1		2		3		4		5		
	NVC	%	NVC	%	NVC	%	NVC	%	NVC	%	
72	MG10b	52.7	MG9	49.4	MG10	49.3	MG9a	49.2	MG10a	47.2	MG10b + <i>C. riparia</i> swamp
73	MG8	57.1	MG5a	56.5	MG6b	55.0	MG6	54.7	MG5	54.6	MG8 (MG6b)
74	MG10a	51.5	OV26	51.2	MG9	50.5	MG9a	49.5	MG10	49.3	S6/7 swamp/ MG8 mosaic.
75	MG9b	55.3	MG9	54.0	MG1c	53.5	MG10a	51.3	MG10b	50.9	MG1c
76	MG10b	56.1	MG10a	55.5	MG10	52.7	MG9a	50.5	MG8	48.9	MG8
77	MG1a	56.3	MG9b	54.7	MG11a	54.7	MG9	53.8	MG1c	53.3	MG1a
78	MG9b	60.5	MG9	56.4	MG1a	51.7	MG1b	49.9	MG1c	49.2	MG9b

Appendix 5b: Individual Site Descriptions for 2012 survey

ESA	Itchen Valley
2012 Site No.	72
Grid ref.	SU56583169
Location	(Itchen Stoke Mill) River Itchen SSSI (Unit 14)
Survey Method	Five quadrats
Survey Date	2.8.2012
Previous Derivation	New site
HLS Parcel No.	5770a
HLS Options	HD10 Maintenance of traditional water meadows & HQ7 Restoration of fen
HLS Supplements	HQ12 Wetland grazing; HR2 Native breeds

This field to the south-east of Itchen Stoke Mill has been under continuous water meadow management for several hundred years and is one of few meadows still managed in this way. It is situated to the south of the River Itchen and is crossed by two major carriers and several smaller ditches. It is within the Itchen Valley SSSI.

Management: The site is currently grazed by 10 Dexter cattle, although in the past larger breeds were used by a local grazier. It is intended to increase grazing pressure as the herd expands. The field is topped annually. The owner floods the field periodically between November and February.

Vegetation: Much of the field is tall fen dominated by *Carex riparia*, *Filipendula ulmaria*, *Juncus inflexus* and *Iris pseudacorus*. The area where the quadrats were located is largely species-poor grassland with abundant *Holcus lanatus*, *Agrostis stolonifera*, *Festuca rubra*, *Iris pseudacorus* and tussocky *Juncus inflexus*. *Carex disticha*, *Filipendula ulmaria*, *Potentilla anserina*, *Ranunculus repens*, *Urtica dioica* and *Persicaria amphibia* are occasional. Species-rich fen meadow vegetation is present at the western end of the field, including *Menyanthes trifoliata*, *Valeriana dioica*, *Geum rivale* and *Briza media*.

NVC: The area where the quadrats were located has grassland that corresponds well to MG10b (coefficient = 52.7). The taller fen vegetation over much of the rest of the field is M22a, with a small area of richer M22b at the western end.

Site Condition: Condition of the site is unfavourable. There is a single frequent positive indicator species and one occasional. *Rumex crispus* is frequent and *Urtica dioica* is occasional although total cover of negative indicator species is only 3%. Approximately 50% of the vegetation is more than 40cm in height.

Indicators of Success: This site entered HLS in 2011 and has not had sufficient time to achieve the 3-year botanical targets; the site is currently unfavourable..

Soil: PH is strongly alkaline. Phosphate content and potassium content are low and magnesium content is medium. Total nitrogen content is medium, and organic matter content indicated by loss on ignition and organic carbon content is relatively low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 72	8.1	13	1	72	1	66	2	1.03	23.8	1465	23.8

ESA	Itchen Valley
2012 Site No.	73
Grid ref.	SU56313180
Location	(Itchen Stoke Mill) River Itchen SSSI (Unit 13)
Survey Method	Five quadrats
Survey Date	10.9.2012
Previous Derivation	New site
HLS Parcel No.	3081
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	HR6 Small fields; HR2 Native breeds

This very small field is situated to the west of Itchen Stoke Mill, to the north of the River Itchen. The site is not managed as a water meadow and is not regularly flooded. It is within the Itchen Valley SSSI.

Management: The site is currently grazed by 10 Dexter cattle in the spring, although in the past larger breeds were used by a local grazier. Cattle and ponies graze the field intermittently throughout the summer. The field is topped annually to control *Rumex spp.*

Vegetation: Grassland in this field is generally species-poor, although a full assessment was difficult as the field was surveyed after topping. *Agrostis stolonifera*, *Festuca rubra*, *Holcus lanatus*, *Carex hirta*, *Persicaria amphibia*, *Plantago lanceolata*, *Prunella vulgaris*, *Ranunculus acris* and *Trifolium pratense* are abundant. *Menyanthes trifoliata* and *Dactylorhiza praetermissa* are present elsewhere in the field, and it is possible that survey before topping could give a more accurate picture of the vegetation.

NVC: Match gives a reasonably good fit with MG8 (coefficient = 57.1), although it is a rather species-poor example of this community, and is close to a variant of MG6b (coefficient = 55.0).

Site Condition: Site Condition is unfavourable. There are no positive indicator species.

Indicators of Success: Fails on Phosphate >1. New HLS in 2011, insufficient time to achieve 3-year botanical targets.

Soil: PH is alkaline. Content of phosphate, potassium and magnesium is medium. Total nitrogen content is medium, and organic matter content indicated by loss on ignition and organic carbon content is low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 73	7.5	23	2	370	3	155	3	1.03	18.8	1314	8.5

ESA	Itchen Valley
2012 Site No.	74
Grid ref.	SU48833188
Location	(Headbourne Worthy) River Itchen SSSI (Unit 60)
Survey Method	Five quadrats
Survey Date	2.8.2012
Previous Derivation	New site
HLS Parcel No.	8490
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This site is situated to the north of Winchester in the suburb of Headbourne Worthy. A small tributary of the River Itchen flows through it from west to east and land to the south of this is fenced off from the rest of the field. The northern part of the field is on chalk and is dry and was not assessed. This field is within the SSSI.

Management: Sheep graze the field throughout the year with cattle in the summer. The drier part of the field is usually topped in early June and again in the autumn.

Vegetation: The dry, gently sloping northern part of the field has species-poor grassland that may have been reseeded relatively recently, while the area to the south of the stream is fenced off from the rest of the field. These areas were not assessed. The part of the field immediately to the north of the stream has tall fen vegetation dominated by *Carex riparia*, *Carex acutiformis* and *Phalaris arundinacea* with *Iris pseudacorus* and *Filipendula ulmaria*. The wet grassland zone between the tall fen and the dry grassland is species-poor, dominated by *Holcus lanatus*, *Festuca rubra* and *Lolium perenne* with *Poa trivialis*, *Trifolium repens* and a selection of occasional typical wetland species including *Eleocharis palustris*, *Filipendula ulmaria*, *Carex disticha*, *Geum rivale*, *Lotus pedunculatus* and *Juncus articulatus*.

NVC: The dry reseeded grassland is MG6a. The tall fen vegetation is probably a mosaic of S6 and S7, while the wet grassland is probably species-poor MG8.

Site Condition: This site fails the condition assessment for MG8 or M22. Only a single positive indicator species is occasional, there is 40% cover of large *Carex* spp. and approximately 45% of the assessed area has vegetation over 40cm in height. It should be noted that swamp communities such as that present here can be valuable habitat for Desmoulin's whorl snail.

Indicators of Success: The soil phosphate index >1 fails; botanical IoS targets are set for 2015 and are not yet met.

Soil: PH is alkaline. Content of phosphate, potassium and magnesium is medium. Total nitrogen content is very high, and organic matter content indicated by loss on ignition and organic carbon content is low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 74	7.3	24	2	214	2+	125	3	2.08	37.6	2056	18.9

ESA	Itchen Valley
2012 Site No.	75
Grid ref.	SU47652545
Location	(Compton Lock) River Itchen SSSI (Unit 78)
Survey Method	Five quadrats
Survey Date	2.8.2012
Previous Derivation	New site
HLS Parcel No.	7147
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	HR2 Native breeds; HR7 Difficult sites

This field is part of a system of former water-meadows to the south of Winchester to the west of Twyford and to the east of the River Itchen. This field contains the remains of the ditch and pane profile with very high panes raised well above the water table. The field is owned by Twyford Parish Council and much used by the public. The northern part of this field is within the SSSI but the southern part assessed in this survey is not.

Management: The site is grazed by British white and Lincoln red cattle between April and October, and these range over this field and an adjacent field at a rate of approximately 1 animal per ha. It has been topped in the past but this is hindered by the water-meadow topography.

Vegetation: The grassland is species-poor, dominated by the tussocky species *Arrhenatherum elatius* and *Festuca arundinacea* with *Festuca rubra*, *Holcus lanatus*, *Poa trivialis* and occasional *Filipendula ulmaria*. *Cirsium arvense* is frequent. The wetter ditches have locally frequent *Glyceria maxima*, *Juncus inflexus* and *Carex riparia*.

NVC: The best fit given by match was with MG9b (coefficient = 55.3), although *Deschampsia cespitosa* is absent. It is probably better regarded as closer to MG1c (coefficient = 53.5), with MG10b (coefficient = 50.9) in the ditches.

Site Condition: This site fails the condition assessment for MG8 and M22. Only one positive indicator species is frequent. The negative indicator species *Cirsium arvense* and *Rumex spp* are frequent, and *Urtica dioica* is occasional. Mean sward height is 45cm.

Indicators of Success: Fails on phosphate index >1. Botanical IoS are set for 2013; site has not yet met these: only one positive indicator species is frequent; negative indicator species *Cirsium arvense* and *Rumex spp* are frequent; and *Urtica dioica* is occasional. Mean sward height is 45cm.

Soil: PH is strongly alkaline. Phosphate, potassium and magnesium contents are medium. Total nitrogen content is high, and organic matter content indicated by loss on ignition and organic carbon content is low.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 75	7.7	19	2	198	2+	99	2	1.64	32.8	2139	17.2

ESA	Itchen Valley
2012 Site No.	76
Grid ref.	SU46182100
Location	(Eastleigh) River Itchen SSSI (Unit 87)
Survey Method	Five quadrats
Survey Date	1.8.2012
Previous Derivation	New site
HLS Parcel No.	2792
HLS Options	HD10 Maintenance of traditional water meadows
HLS Supplements	

This field is situated to the north of Eastleigh, to the north of and adjacent to the River Itchen, and bordered to the west by a main railway line. It is within the River Itchen SSSI. It was formerly managed as a water-meadow and retains some of the topography and infrastructure of this management. It is crossed by a pylon line.

Management: The field is grazed by beef cattle, and is topped annually to control undesirable species. It should be noted that the only HLS option in place here is HD10 (maintenance of traditional water-meadows).

Vegetation: Grassland is largely relatively species-poor, but with patches that are richer. The bulk of the sward is composed of *Festuca rubra*, *Holcus lanatus*, *Festuca arundinacea*, *Ranunculus repens*, *Filipendula ulmaria*, *Agrostis stolonifera*, *Equisetum palustre* and *Pulicaria dysenterica*. A range of other species typical of older established grasslands that are either occasional or rare include *Carex disticha*, *Carex flacca*, *Galium uliginosum*, *Mentha aquatica*, *Geum rivale*, *Caltha palustris* and *Thalictrum flavum*.

NVC: The closest fits identified by MATCH were to MG10 and its sub-communities and to MG9a. *Deschampsia cespitosa* is however absent from this part of the field, and *Juncus spp* are no more than occasional. A better agreement is with a species-poor variant of MG8 (coefficient = 48.9).

Site Condition: This field fails a condition assessment for MG8. Only a single positive indicator species is frequent and one is occasional. Several other indicator species are however present, and it is likely that under continued suitable management, condition of this field will improve.

Indicators of Success: For HLS option HD10 there are no botanical indicators of success targets.

Soil: PH is strongly alkaline. Phosphate, potassium and magnesium contents are medium. Total nitrogen content is high, and organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 76	7.5	18	2	169	2-	99	2	1.89	42.0	2231	22.1

ESA	Itchen Valley
2012 Site No.	77
Grid ref.	SU47382308
Location	(Brambridge) River Itchen SSSI (Unit 83)
Survey Method	Five quadrats
Survey Date	9.7.2012
Previous Derivation	New site
HLS Parcel No.	3409
HLS Options	HK10 Maintenance of meadowsweet grassland for wintering waders & wildfowl
HLS Supplements	HR1 Cattle grazing

This is one of a pair of fields managed as a single unit, situated to the north of the village of Colden Common between Eastleigh and Winchester. They are to the east of the River Itchen and one of its principal carriers, and were formerly managed as part of an extensive water-meadow system. They are within the River Itchen SSSI. Both fields appear to have been seriously affected by water abstraction from nearby bore-holes.

Management: A total of approximately 100ha is grazed by 200 adult red Devon cattle between April and October. The fields are topped annually, and ragwort is spot-sprayed.

Vegetation: The grassland in this field is species-poor and tussocky, dominated by *Dactylis glomerata*, *Arrhenatherum elatius*, *Festuca rubra* and *Agrostis stolonifera*. Other frequent species are *Lolium perenne* and *Holcus lanatus*. Species typical of agriculturally unimproved wet grasslands are uncommon, including rare *Carex nigra*, *Filipendula ulmaria*, *Geum rivale* and *Carex disticha*.

NVC: This grassland corresponds well with MG1a (coefficient 56.3).

Site Condition: This field fails a condition assessment for the target community MG8. There are no frequent or occasional positive indicator species. Mean sward height is 45cm.

Indicators of Success: IoS are not for the grassland feature.

Soil: PH is strongly alkaline. Phosphate level is low, and potassium and magnesium contents are medium. Total nitrogen content is high, and organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 77	7.8	15	1	145	2-	88	2	1.25	23.1	1572	23.1

ESA	Itchen Valley
2012 Site No.	78
Grid ref.	SU47472283
Location	(Brambridge) River Itchen SSSI (Unit 83)
Survey Method	Five quadrats
Survey Date	9.7.2012
Previous Derivation	New site
HLS Parcel No.	4984
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HR1 Cattle grazing

This is one of a pair of fields managed as a single unit, situated to the north of the village of Colden Common between Eastleigh and Winchester. They are to the east of the River Itchen and one of its principal carriers, and were formerly managed as part of an extensive water-meadow system. They are within the River Itchen SSSI. Both fields appear to have been seriously affected by water abstraction from nearby bore-holes.

Management: A total of approximately 100ha is grazed by 200 adult red Devon cattle between April and October. The fields are topped annually, and ragwort is spot-sprayed.

Vegetation: The grassland in this field is species-poor and tussocky, dominated by *Dactylis glomerata*, *Deschampsia cespitosa*, *Arrhenatherum elatius* and *Festuca rubra*. Other frequent species are *Lolium perenne* and *Holcus lanatus*. The negative indicator species *Cirsium arvense* is locally abundant, and *Filipendula ulmaria* is also locally abundant. Species typical of agriculturally unimproved wet grasslands are very rare

NVC: This grassland corresponds well with MG9b (coefficient 60.5).

Site Condition: This field fails a condition assessment for the target community MG8. There are no frequent or occasional positive indicator species. Mean sward height is 40cm and both *Cirsium arvense* and *Cirsium vulgare* are occasional.

Indicators of Success: This site does not have sufficient positive indicator species by year 2 and the soil phosphate index >1.

Soil: PH is strongly alkaline. Phosphate, potassium and magnesium contents are medium. Total nitrogen content is high, and organic matter content indicated by loss on ignition and organic carbon content is medium.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 78	7.7	22	2	189	2+	100	2	1.19	21.4	1593	21.4

Appendix 6: BROADS AND NENE

Appendix 6a: MATCH analysis of individual sites

Results of MATCH analysis of the 5-quadrat plots recorded in the Broads and Nene. The top five results are shown. The NVC community determined in 2012 is provided (in bold in final column), which is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

BROADS AND NENE – MATCH rank (top 5)											
	1		2		3		4		5		2012
	NVC	%	NVC	%	NVC	%	NVC	%	NVC	%	
79	M22b	49.1	MG10	48.5	MG10a	48.3	M22a	48.3	M22	47.4	M22b
80	M22a	55.7	M22	55.2	SD17	52.1	M22b	51.5	SD17a	51.5	M22a/b
81	M22b	59.0	SD17	57.5	M22	55.0	SD17a	53.1	M22a	59.9	M22b
82	MG10	58.5	MG9a	57.2	M23b	57.2	M23	51.1	MG10a	56.1	M22a(+M22b)
83	MG9a	53.0	MG10a	51.8	M22a	50.9	MG10	50.6	M22	50.4	MG10a
84	M22	60.6	M22a	60.2	M22b	59.1	MG8	52.7	M22d	48.1	M22a
85	M22	69.8	M22b	68.5	M22a	66.2	M24	61.1	M24b	58.6	M22b
86	OV26c	38.3	OV26	37.1	M27	36.8	S5	36.3	S26	34.9	S5 variant
87	MG4	58.1	MG6a	58.1	MG6b	56.1	MG6	55.9	MG8	55.3	MG4

Appendix 6b: Individual Site Descriptions for 2012 survey

ESA	Norfolk Broads
2012 Site No.	79
Grid ref.	TG33480455 (non-SSSI)
Location	Rockland
Survey Method	Five quadrats on transect
Survey Date	17.7.2012
Previous Derivation	ESA grassland site 2
HLS Parcel No.	5556
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is one of a system of strip fields separated by dikes and hedges to the south and east of Rockland Broad in the floodplain of the River Yare. Several of these fields are managed under an HLS agreement, and have been in the Norfolk Broads ESA since the start of the scheme in 1987.

Management: Management here had been neglected for some years, but the field has been grazed by cattle since 2009, although it had been too wet in the summer of 2012 to allow cattle access. It is grazed as a single unit with site 80. All plot markers refound but not origin.

Vegetation: This is a tall, moderately species-rich rush and sedge-dominated fen-meadow. The dominant species are the bulky rushes *Juncus effusus* and *Juncus subnodulosus*, with other abundant species including *Agrostis stolonifera*, *Carex disticha*, *Carex panicea* and *Lotus pedunculatus*. *Anthoxanthum odoratum*, *Festuca rubra*, *Holcus lanatus*, *Carex flacca*, *Cirsium palustre*, and *Galium uliginosum*.

NVC: This is a good example of M22 *Juncus subnodulosus*-*Cirsium palustre* fen meadow, although as a result of recent undergrazing the fit with M22b is relatively poor (coefficient = 49.1), and there are affinities with the less species-rich communities MG10a (coefficient = 48.3) and M22a (coefficient = 48.3). In 1987 the quadrats were classified separately; 1&2 = MG6, 3&4=MG8, 5 = MG10.

Site Condition: This site fails a condition assessment as only three positive indicator species are frequent and none are occasional. There is a 40% cover of litter and 90% of the sward is more than 40cm tall. This probably reflects the lack of grazing up to 2009, and the inability of the farmer to get cattle onto the land in the very wet summer of 2012. It is likely that with continued cattle grazing condition will improve.

Indicators of success: The site fails the criteria for species frequency as only seven high-value indicator species were recorded and *Juncus spp* had a combined cover of approximately 40%.

Soils: Soil pH is circumneutral. Phosphate and potassium levels are low, while magnesium level and organic carbon percentage are high. Nitrogen content is high. High loss on ignition and organic carbon suggest a soil with a high organic matter content and possibly an accumulation of peat.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 79	6.1	7	0	69	1	453	6	1.65	52.3	801	18.0

ESA	Norfolk Broads
2012 Site No.	80
Grid ref.	TG33210458 (non SSSI)
Location	Rockland
Survey Method	Five quadrats on transect
Survey Date	17.7.2012
Previous Derivation	ESA grassland site 9
HLS Parcel No.	2056
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This is one of a system of strip fields separated by dikes and hedges to the south and east of Rockland Broad in the floodplain of the River Yare. Several of these fields are managed under an HLS agreement, and have been in the Norfolk Broads ESA since the start of the scheme in 1987.

Management: Management here had been neglected for some years, but the field has been grazed by cattle since 2009, although it had been too wet in the summer of 2012 to allow cattle access. It is grazed as a single unit with site 79. All plot markers refound.

Vegetation: *Juncus subnodulosus* also dominates in this field, forming an open canopy over a very species-rich fen-meadow community. Abundant in this are *Agrostis stolonifera*, *Festuca rubra*, *Holcus lanatus*, *Carex panicea*, *Carex flacca*, *Calliergon cuspidatum*, *Lotus pedunculatus*, *Plantago lanceolata*, *Potentilla anserina* with locally *Anthoxanthum odoratum*, *Carex hostiana*, *Carex nigra*, *Juncus effusus*, *Eriophorum angustifolium*, *Potentilla erecta*, *Galium uliginosum* and *Valeriana dioica*. Several of these species are indicative of a long-established fen-meadow community.

NVC: This vegetation is a good example of M22 fen-meadow, classified by Match as M22a (coefficient = 55.7), but on the basis of the presence of a number of grassland species including *Briza media*, *Trifolium repens*, *Plantago lanceolata* and *Anthoxanthum odoratum* in some quadrats, it may be closer to M22b (coefficient = 51.5). Separately classified quadrats in 1987 were; 1&2 = MG9, 3 = MG8, 4 = M22b, 5 = MG10.

Site Condition: This site fails a condition assessment as 90% of the vegetation exceeds 40cm in height due to the dominance of *Juncus subnodulosus* over much of the field, and there is a litter cover of 40%. This probably reflects the lack of grazing up to 2009, and the inability of the farmer to get cattle onto the land in the very wet summer of 2012. It is likely that with continued cattle grazing condition will rapidly improve.

Indicators of success: This site fails as cover of *Juncus* spp (chiefly *J. subnodulosus*) is c40%. All other criteria are passed however, and it is likely that resumed cattle grazing will rapidly reduce the cover of the relatively palatable *J. subnodulosus*.

Soil: Soil pH is circumneutral. Phosphate and potassium levels are low, while magnesium level and organic carbon percentage are high. Nitrogen content is high. Loss on ignition and organic carbon content are medium level.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 80	6.8	7	0	59	0	196	4	1.38	38.8	663	13.9

ESA	Norfolk Broads
2012 Site No.	81
Grid ref.	TM48469119
Location	(Barnby) Barnby Broad & Marshes SSSI (Unit 24)
Survey Method	Five quadrats on transect
Survey Date	18.7.2012
Previous Derivation	ESA grassland site 51
HLS Parcel No.	3517
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

The two adjacent fields at Barnby are situated in the floodplain of the River Waveney to the north of the village of Barnby and are part of a mosaic of small fields and woodlands. It was included in the ESA from 1987. All plot markers refund.

Management: The two adjacent fields at Barnby are managed as a single unit by the grazier and are lightly grazed through the summer by cattle.

Vegetation: The grassland in this field is species-rich and includes a number of unusual species. This was some of the richest vegetation encountered in this survey. It is a moderately well-grazed sward with patches of taller rush-pasture dominated by *Juncus subnodulosus*. Abundant species include *Festuca rubra*, *Holcus lanatus*, *Carex disticha*, *Carex nigra*, *Carex panicea*, *Lotus pedunculatus*, *Calliargon cuspidatum*, *Cardamine pratensis*, *Plantago lanceolata*, *Potentilla anserina* and *Galium uliginosum*. The field is notable for the local abundance of the uncommon *Sagina nodosa*, normally a species of dune-slacks and exposed chalk, and *Anagallis tenella*, more usually found in base-rich flushes on heathland and dune slacks. Also present are *Samolus valerandi*, *Triglochin palustris*, *Hydrocotyle vulgaris* and *Isolepis setacea*. Together these species give the vegetation some of the character of a base-rich, spring-fed fen or coastal flush.

NVC: Despite some of the more unusual species present, this vegetation is a good example of M22b fen-meadow (Match coefficient = 59.0), although Match gives SD17 (*Carex nigra-Potentilla anserine* dune slack) as the second-best fit (coefficient = 57.5). Separately classified quadrats in 1987 were; 1=M22b, 2 = MG9a, 3&4 = M27, 5=MG10.

Condition assessment: This field easily passes all condition assessment criteria.

Indicators of success: This field fulfils all of the indicators of success.

Soil: PH is circumneutral, phosphate and potassium content are very low and magnesium content is moderate. Organic matter content as shown by loss on ignition and organic carbon levels is very high, suggesting that the soil has a substantial peat component which may partly account for the unusual vegetation here. Nitrogen content is very high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 81	6.5	6	0	59	0	165	3	2.25	74.6	1007	28.3

ESA	Norfolk Broads
2012 Site No.	82
Grid ref.	TM48469087
Location	(Barnby) Barnby Broad & Marshes SSSI (Unit 24)
Survey Method	Five quadrats on transect
Survey Date	18.7.2012
Previous Derivation	ESA grassland site 52
HLS Parcel No.	3517
HLS Options	HQ6 Maintenance of fen
HLS Supplements	

The two adjacent fields at Barnby are situated in the floodplain of the River Waveney to the north of the village of Barnby and are part of a mosaic of small fields and woodlands. It was included in the ESA from 1987. All plot markers refound but not origin.

Management: The two adjacent fields at Barnby are managed as a single unit by the grazer and are lightly grazed through the summer by cattle.

Vegetation: Vegetation in this field differs from that in Field 81 in the abundance of *Juncus effusus* which forms a tussocky cover over much of the field. *Juncus subnodulosus* is still frequent locally. Approximately 20% of field has species-rich grassland similar to that in Field 81 including *Sagina nodosa* and *Anagallis tenella*. Abundant species throughout the field include *Agrostis stolonifera*, *Holcus lanatus*, *Carex panicea*, *Carex disticha*, *Cardamine pratensis*, *Filipendula ulmaria*, *Gallium palustre*, *Lotus pedunculatus*, *Ranunculus flammula* and *Ranunculus repens*, with more locally *Trifolium repens*, *Carex nigra*, *Juncus articulatus* and *Juncus inflexus*.

NVC: Match gives best fits with MG10 (coefficient = 58.5), MG9a (coefficient = 57.2) and M23b (coefficient = 57.2). The vegetation is probably a mosaic of atypical tussocky, *Juncus effusus*-dominated M22a, with approximately 20% shorter, more species-rich M22b. Separately classified quadrats in 1987 were; 1=M22, 2=MG8, 3=MG9a, 4=MG8, 5=SD17

Condition assessment: This field passes all condition assessment criteria

Indicators of success: This field fulfils all of the indicators of success apart from the presence of *Sphagnum* sp. No *Sphagnum* species were recorded in either field 81 or 82. Given the soil pH this would seem to be an unfeasible goal here and this should not be used as an indicator of success.

Soil: PH is circumneutral, phosphate and potassium content are very low and magnesium content is moderate. Organic matter content as shown by loss on ignition and organic carbon levels is very high, suggesting that the soil has a substantial peat component which may partly account for the unusual vegetation here. Nitrogen content is very high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 82	6.2	4	0	40	0	116	3	2.68	79.5	1148	27.0

ESA	Norfolk Broads
2012 Site No.	83
Grid ref.	TM50649223
Location	(Oulton Broad) Sprat's Water and Marshes SSSI, Carlton Colville (Unit 6)
Survey Method	Five quadrats
Survey Date	18.7.2012
Previous Derivation	New site
HLS Parcel No.	6620
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HR1 Cattle grazing

This field is part of the Suffolk Wildlife property at Oulton Broad. It is in the broad estuarine floodplain of the River Waveney to the west of Lowestoft immediately to the south of Oulton Broad.

Management: It is managed as one of a system of fields and grazed lightly by cattle. HLS management started in 2012.

Vegetation: Vegetation in this field is a mosaic of moderately species-rich and less species-rich rush pasture. There is an open and patchy canopy of *Juncus subnodulosus*, *Juncus inflexus* and *Carex acutiformis* over a grassy understorey of *Holcus lanatus*, *Festuca rubra*, *Persicaria amphibia*, *Potentilla anserina* and *Calliergon cuspidatum*. More species-rich areas have *Lotus pedunculatus*, *Trifolium pratense*, *Galium uliginosum*, *Carex disticha* and *Lathyrus pratensis*. Other species typical of long-established grasslands include *Lychnis flos-cuculi*, *Trifolium fragiferum*, *Carex panicea*, *Ranunculus flammula*, *Caltha palustris*, *Cardamine pratensis* and *Dactylorhiza praetermissa*. A ditch crossing the field has *Caltha palustris*, *Menyanthes trifoliata*, *Carex rostrata* and *Berula erecta*.

NVC: The closest fit given by Match is to MG9a (coefficient = 53.0), although there is no *Deschampsia cespitosa* present, and the vegetation better resembles MG10a (coefficient = 51.8).

Condition assessment: This field fails the condition assessment. Only one species is frequent and two occasional throughout the sward.

Indicators of success: This is the start year of the HLS scheme.

Soil: PH is neutral, phosphate content is low, potassium and magnesium levels, nitrogen content and organic matter levels as shown by loss on ignition and organic carbon levels are high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 83	6.7	12	1	145	2-	185	4	1.85	53.6	1176	21.5

ESA	Norfolk Broads
2012 Site No.	84
Grid ref.	TM50869441
Location	Oulton Broad (Non SSSI)
Survey Method	Five quadrats
Survey Date	18.7.2012
Previous Derivation	New site
HLS Parcel No.	8931
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	HR1 Cattle grazing

This field is part of the Suffolk Wildlife property at Oulton Broad. It is in the broad estuarine floodplain of the River Waveney to the west of Lowestoft immediately to the north of Oulton Broad. HLS management started in 2012. The field is divided into several sections by ditches. This survey assessed the two northern sections which would have been a separate field, separated from the rest to the south by a deep ditch. The HLS option for this field is HK7 Restoration of species-rich semi-natural grassland (restoration of species-rich grassland), but given the existing species-richness of the vegetation, HK6 Maintenance of species-rich semi-natural grassland (maintenance of species-rich grassland) might be more appropriate.

Management: It is managed as one of a system of fields and grazed lightly by cattle.

Vegetation: *Juncus subnodulosus* is dominant over much of this field, replaced locally by *Juncus articulatus*. Other abundant species include *Filipendula ulmaria*, *Lotus pedunculatus*, *Festuca rubra*, *Holcus lanatus*, *Galium uliginosum*, *Calliargon cuspidatum*, *Carex disticha* and *Carex flacca*. *Anthoxanthum odoratum*, *Agrostis stolonifera*, *Juncus acutiflorus*, *Lathyrus pratensis*, *Mentha aquatica*, *Plantago lanceolata*, *Ranunculus acris* and *Valeriana dioica* are occasional throughout the sward or locally frequent. Several of these species are indicative of long-established grasslands, and others include *Succisa pratensis*, *Triglochin palustris* and *Dactylorhiza praetermissa*.

NVC: This vegetation is a good example of M22a fen-meadow (match coefficient = 60.2), although there are a number of grassland species present which suggest that with a sustained regime of cattle grazing, this vegetation may develop into M22b (coefficient = 59.1).

Condition assessment: This vegetation fails a condition assessment as more than 50% of the sward exceeds 40cm in height. It passes on all other attributes, although the amount of accumulated litter is high. The *Juncus* canopy should be reduced and opened with sustained grazing by cattle, and this will also disperse accumulated litter.

Indicators of success: This is the start year of the HLS scheme.

Soil: Soil pH is mildly alkaline. Phosphate and potassium levels are moderate. Magnesium level, nitrogen content and organic matter component as shown by loss on ignition and organic carbon levels are high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 84	7.0	19	2	133	2-	184	4	1.7	46.8	1427	16.4

ESA	Norfolk Broads
2012 Site No.	85
Grid ref.	TG37000220
Location	(Langley Street) Poplar Farm Meadows, Langley SSSI (Unit 1)
Survey Method	Five quadrats
Survey Date	19.7.2012
Previous Derivation	New site
HLS Parcel No.	9314
HLS Options	HK7 Restoration of species-rich semi-natural grassland
HLS Supplements	

This field is at the upper edge of the River Yare floodplain on Langley marshes near the village of Langley Street. It is divided into sections by several deep ditches, and this survey looks at the north-eastern section only. It is one of a number of fields under the same ownership entered into HLS in 2012.

Management: It is grazed by cattle and was formerly in the Norfolk Broads ESA.

Vegetation: The fen-meadow vegetation in this part of the field is very species-rich with over 30 species per quadrat. Several uncommon species are present. *Festuca rubra*, *Holcus lanatus*, *Carex flacca* and *Juncus subnodulosus* are co-dominant with frequent *Agrostis stolonifera*, *Molinia caerulea*, *Briza media*, *Carex disticha*, *Carex panicea*, *Calliergon cuspidatum*, *Lotus pedunculatus*, *Vicia cracca*, *Potentilla erecta* and *Succisa pratensis*. Several of these species are characteristic of long-established fen-meadow, and others include *Valeriana dioica*, *Galium uliginosum*, *Leontodon hispidus* and the orchids *Epipactis palustris*, *Gymnadenia conopsea ssp densiflora*, *Dactylorhiza praetermissa* and *Dactylorhiza fuchsii*. There are small areas of less species-rich grassland in the northern corner of this part of the field.

NVC: This field is a good example of M22b (coefficient=69.8).

Condition assessment: Although this was one of the richest and most interesting sites visited during this survey, it failed the condition assessment as over 65% of the sward was more than 40cm in height.

Indicators of success: This HLS agreement started in June 2012.

Soil: Soil pH was circumneutral, phosphate level was low, potassium level was moderate and magnesium level was high. Total nitrogen was high, and the high values for loss on ignition and organic carbon suggest a peaty soil.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 85	6.8	11	1	133	2-	184	4	1.99	57.8	1096	18.2

ESA	Nene Valley (not an ESA)
2012 Site No.	86
Grid ref.	TL10279744
Location	Castor Flood Meadows (Non SSSI)
Survey Method	Five quadrats
Survey Date	19.7.2012
Previous Derivation	New site
HLS Parcel No.	2744
HLS Options	HK10 Maintenance of wet grassland for wintering waders & wildfowl
HLS Supplements	HR1 Cattle supplement

There is a series of agriculturally unimproved and semi-improved fields in the floodplain of the River Nene to the south of Peterborough. These include the Castor Flood Meadows SSSI. This field is to the west of the SSSI near the village of Water Newton and between the A1 road and the river.

Management: It is usually topped to control sedges and rushes, and it is grazed by cattle in the summer when dry enough. The HLS agreement started in 2011.

Vegetation: *Carex acuta* is dominant over most of this field forming an open canopy with *Glyceria maxima* and *Filipendula ulmaria* which are locally abundant. The vegetation is generally species-poor, with frequent *Agrostis stolonifera*, *Poa trivialis*, *Equisetum palustre*, *Lysimachia nummularia* and *Potentilla reptans*.

NVC: The dominance by *Carex acuta* is unusual, the more normal invasive *Carex* species in this situation being *Carex acutiformis* and *Carex riparia*. Match analysis gives no good fits, and it may be that this should be regarded as a variant of S5 *Glyceria maxima* swamp (coefficient = 36.3).

Condition assessment: This field fails the condition assessment. Only one species is frequent and cover of large *Carex* spp. is approximately 60%.

Indicators of success: Most of the criteria for this site are non-botanical. Cover of *Juncus* spp is already less than 40% after one year of the scheme.

Soil: Soil pH is slightly alkaline. Phosphate, potassium and magnesium levels are moderate, nitrogen% is high and the organic matter fraction as shown by loss on ignition and organic carbon levels is moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 86	7.3	17	2	242	3	140	3	1.54	33.4	1942	18.9

ESA	Nene Valley (not an ESA)
2012 Site No.	87
Grid ref.	TL12049732
Location	(Castor Flood Meadows) Castor Flood Meadows SSSI (Unit 3)
Survey Method	Five quadrats
Survey Date	19.7.2012
Previous Derivation	New site
HLS Parcel No.	0432
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	HK18 Haymaking

There is a series of agriculturally unimproved and semi-improved fields in the floodplain of the River Nene to the south of Peterborough. This field is part of the Castor Flood Meadows SSSI near the village of Water Newton and between the A1 road and the river, and it includes a section of Roman road in the south-west corner.

Management: The field is cut annually for hay and the aftermath is grazed. The HLS agreement started in 2011.

Vegetation: The majority of the grassland in this field is moderately species-rich, although it becomes less rich at the western end. Quadrats were sited in the species-rich area. The most abundant species are *Festuca rubra*, *Holcus lanatus* and *Cynosurus cristatus*, and other frequent species include *Agrostis capillaris*, *Anthoxanthum odoratum*, *Phleum pratense*, *Carex hirta*, *Plantago lanceolata*, *Ranunculus acris*, *Ranunculus repens*, *Rumex acetosa*, *Trifolium pratense* and *Stellaria graminea*. *Sanguisorba officinalis* and *Filipendula ulmaria* are locally frequent, and *Lathyrus pratensis*, *Silaum silaus*, *Carex disticha* and *Ophioglossum vulgatum* are rare. There is a large bed of *Carex acuta* adjacent to the river.

NVC: The majority of grassland in this field is MG4 (coefficient = 58.1), although lacking a number of typical species, with others being rare. This is reflected in the MATCH analysis by MG6a, a typical community of semi-improved grasslands having the same coefficient as MG4. The poorer grassland at the western end of the field is closer to MG11a.

Condition assessment: This grassland fails the condition assessment on the frequency of positive indicator species. Only one positive indicator species is frequent and two are occasional. A further five are present but rare.

Indicators of success: Here, the indicators of success are identical with the SSSI condition assessment attributes. After one year of management under HLS the vegetation has yet to fulfil the species-frequency attribute.

Soil: Soil pH is slightly alkaline, phosphate and potassium levels are low and magnesium levels are moderate. Total nitrogen content is high, while the level of organic matter is moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 87	7.2	14	1	117	1	122	3	1.51	39.7	1629	5.8

Appendix 7: UPPER THAMES TRIBUTARIES

Appendix 7a: MATCH analysis of individual sites

Results of MATCH analysis of the monitoring plots recorded in the Upper Thames Tributaries sites in 2012. Tables (a) New sites show the results for the 5-quadrats recorded and (b) Existing sites show the results for the ADAS plots (Plot) and the supplementary NVC quadrats recorded in the wider unit (Unit) of the Upper Thames Tributaries. The top five results are shown. The NVC community determined in 2012 is provided (in bold and in final column), which is based on a combination of MATCH analysis and surveyor experience, taking transitional communities and local variation into account.

(a)		NEW SITES– MATCH rank (top 5)										
Site	Sample	1		2		3		4		5		2012
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%	
88	Quads	MG9	61.4	MG9	59.4	MG9	56.6	MG4	54.6	MG5a	48.5	MG4
89	Quads	MG6a	53.6	MG1	52.9	MG9	51.9	MG1	51.7	MG7b	50.2	MG7b
90	Quads	MG9a	61.0	MG6	58.5	MG9	58.1	MG7	57.7	MG7c	57.3	MG9a
91	Quads	MG9	55.4	MG9	52.1	MG4	50.8	MG9	49.7	MG1c	48.8	MG4

(a)		EXISTING SITES – MATCH rank (top 5)										
Site	Sample	1		2		3		4		5		2012
		NVC	%	NVC	%	NVC	%	NVC	%	NVC	%	
92	Plot	MG4	63.0	MG5a	57.2	MG5	56.4	MG5b	55.1	MG5c	54.3	MG4
	Unit	MG9	59.8	MG4	57.4	MG9b	56.8	MG9a	55.9	MG5a	53.0	
94	Plot	MG10b	52.1	MG9	50.4	MG10a	49.1	MG9a	48.0	MG9b	47.3	MG11-related
	Unit	MG10b	54.4	MG10a	51.6	MG9	50.0	MG13	49.2	MG9b	48.6	
95	Plot	MG10a	57.4	MG9a	56.7	MG10	55.5	MG7b	55.0	MG11a	53.3	MG9a
	Unit	MG11a	55.1	MG9b	48.8	MG9	57.0	MG9a	46.8	MG11a	45.4	
96	Plot	S28	42.4	S28c	40.5	S28a	39.6	MG9	38.3	MG9a	36.2	S28/MG9 mosaic
	Unit	S7	37.3	S5	32.5	OV26	29.1	M27b	27.6	S28	25.4	
97	Plot	MG9a	38.0	MG10	36.8	MG10a	36.7	MG9	36.6	MG10c	36.6	MG9-related
	Unit	S5	45.2	S28c	34.9	M27c	34.8	S28a	34.7	OV28	34.1	
98	Plot	MG13	46.4	MG10c	46.0	MG10b	44.2	MG10	42.5	MG10a	38.4	MG13
	Unit	MG13	56.1	S22c	48.6	MG10c	40.5	MG10	39.8	OV29	39.2	
99	Plot	M23b	47.5	MG9a	45.9	M23	45.3	SD17d	45.2	MG9	44.4	MG9a
	Unit	M23b	46.3	SD17d	45.8	M23	44.9	MG10	42.9	SD17	42.4	

Appendix 7b: Individual Site Descriptions for 2012 survey

ESA	Upper Thames Tributaries
2012 Site No.	88
Grid ref.	SP60931867
Location	(Lower Arccott–Ambrosden, River Ray valley) Arccott Bridge Meadows SSSI (Unit 1)
Survey Method	Five quadrats
Survey Date	15.8.2012
Previous Derivation	New site
HLS Parcel No.	9764
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	

This is a small 2.42 ha meadow in the floodplain of the River Ray, Oxon: it is part of the Arccott Bridge Meadows SSSI. It lies along a green lane from Lower Arccott to Ambrosden. The field is cut annually for hay and the aftermath is grazed. The HLS agreement started in April 2012.

Management: The site is managed as a traditional hay meadow with aftermath grazing. It is usually cut in mid-July although in 2012 this was late due to the wet conditions; 30–40 sheep (occasionally a few young cattle) are put on the meadow for a few weeks following hay cut. A salt lick is provided.

Vegetation: The majority of the grassland in this field is moderately species-rich, although it the more herb-rich vegetation is associated with the higher ground associated with an historic ridge and furrow system. The furrows support a damper, more grass dominated sward. The most abundant grass species are *Festuca rubra*, *Agrostis stolonifera*, *Agrostis capillaris* and patchily abundant *Deschampsia cespitosa*. *Anthoxanthum odoratum*, *Festuca arundinacea*, *F. pratensis* and *Lolium perenne* are occasional to frequent. A suite of positive indicator species for lowland wet meadow are present including abundant *Sanguisorba officinalis* and *Filipendula ulmaria*; frequent *Centaurea nigra*, *Lathyrus pratensis* and *Silvaum silaus*; and rare to occasional *Lotus corniculatus*, *Filipendula vulgaris*, *Succisa pratensis*, *Oenanthe fistulosa*.

NVC: The majority of grassland in this field is MG4 (coefficient = 54.6) and is a reasonably good example of this community, although the furrows are atypical and reflect the damper conditions. The high cover of *Deschampsia cespitosa* across the site within the furrows also gives strong affinities with MG9 (coefficient = 61.4) but it would be misleading to assign the whole field to this poorer community.

Condition assessment: This grassland passes the SSSI common standards and BAP habitat G06 lowland meadow condition assessment on the frequency of positive indicator species and all other attributes. Five positive indicator species were frequent and one occasional. A further six were present but rare.

Indicators of success: This site meets all indicators of success.

Soil: Soil pH is slightly alkaline, phosphate and potassium levels are low and magnesium levels are moderate. Total nitrogen content is moderately high, while the level of organic matter is moderately high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 88	6.1	4	0	164	2–	225	4	0.90	25.0	746	25.0

ESA	Upper Thames Tributaries
2012 Site No.	89
Grid ref.	SP54211425
Location	Oddington, River Ray valley (Non SSSI)
Survey Method	Five quadrats
Survey Date	15.8.2012
Previous Derivation	New site
HLS Parcel No.	1528
HLS Options	HK10 Maintenance of wet grassland for wintering waders & wildfowl
HLS Supplements	

Site 89 comprises 7.54 ha of floodplain grassland, a small area of which (0.76 ha) is MG4 and is under option HK6 (Maintenance of species-rich grassland); the remaining 6.78 ha is under HK10: this larger area was the area sampled in 2012. The grassland lies in the floodplain of the River Ray, which forms the southern boundary. The HLS agreement started in January 2010. It is non-SSSI.

Management: The site is managed as a traditional hay meadow. Sheep graze the aftermath – usually in the winter months until it is too flooded.

Vegetation: With the exception of a small area of the field in the NE corner (which is reasonable quality MG4, this field supports a typical low–moderate quality meadow flora. It is grass dominated with the dominant species including *Agrostis stolonifera* (denoting its dampness), *Holcus lanatus*, *Hordeum secalinum*, *Lolium perenne* and *Phleum pratense*. Other species such as *Agrostis capillaris*, *Cynosurus cristatus* and *Deschampsia cespitosa* are rare. Positive indicator species for lowland meadow were few with only *Lotus corniculatus* frequent: *Rhinanthus minor*, *Sanguisorba officinalis*, *Leucanthemum vulgare* and *Filipendula ulmaria* were rare in the main part of the field. Other frequent forbs included *Ranunculus acris*, *Ranunculus repens* and *Trifolium repens*.

NVC: Although the area of the field under option HK6 is MG4, the main part of the field which was sampled supports a sward that appears to be derived from a former MG7b sown ley (coefficient = 50.2); however, it has been managed as a traditional hay meadow for some time and is now starting to see an a transition to a less improved floodplain meadow community such as MG4. With continued appropriate management this site may attain MG4. The high cover of *Holcus lanatus* and patchy cover of *Deschampsia cespitosa* across the site lend it some characteristics of MG10a and MG9a, respectively.

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows as it only has one frequent positive indicator species and two rare; however the site is more usefully assessed as G13 Grassland for wintering waders and wildfowl. The site probably meets the conditions for G13.

Indicators of success: Indicators of success for bird options were not assessed.

Soil: Soil pH is neutral. Phosphate levels are low, whilst potassium levels are moderate. Magnesium levels are very high. Total nitrogen content is medium for long-term grassland and the level of organic matter is low–moderate.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 89	6.8	5	0	219	2+	250	4	0.70	20.1	758	20.1

ESA	Upper Thames Tributaries
2012 Site No.	90
Grid ref.	SP24472394
Location	Bledington, River Evenlode valley (Non SSSI)
Survey Method	Five quadrats
Survey Date	16.08.2012
Previous Derivation	New site
HLS Parcel No.	4999
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	

Site 90 comprises 2.19 ha of pasture in the floodplain of the River Ray, which forms the eastern boundary. The HLS agreement started in October 2009. Non-SSSI.

Management: The site is managed as permanent pasture. It is grazed by cattle – usually five head – which go on in mid-April and come off in late October, weather permitting. The field is occasionally topped with a mower to 3–4' height in late July. The infield ditch is cleaned out every few years. The field floods naturally.

Vegetation: The lower, north-eastern part of the field was species-poor but the central and southern areas supported a damp pasture with moderate species diversity (10–21 species per m²). Grasses *Agrostis capillaris*, *Agrostis stolonifera*, *Lolium perenne*, *Phleum pratense* and patchily frequent *Deschampsia cespitosa* characterise the sward. Positive indicator species of lowland wet meadows included frequent *Centaurea nigra*, occasional *Lathyrus pratensis* and rare (to locally frequent) stands of *Sanguisorba officinalis*, *Filipendula ulmaria*, and *Leontodon autumnalis*. Other more common forbs included *Ranunculus acris*, *R. repens*, *Cardamine pratensis*, *Lysimachia nummularia*, *Trifolium pratense* and *T. repens*.

NVC: The community in this field does not lend itself to definition by NVC community – it has affinities with several communities but lacks the usual constants. The highest MATCH result was for MG6a (coefficient = 58.5), although the high cover of *Centaurea nigra* and occasional plants of *Sanguisorba officinalis* and *Filipendula ulmaria* are more akin to MG4 or MG5, although it lacks the usual grass constants of these swards. The frequency of *Deschampsia cespitosa* results in a strong match with MG9a (61.0%) and this community certainly can support a few fen species. This field may be derived from an MG7 grassland and be gradually in transition to a richer floodplain meadow pasture type such as MG4. It is best described as MG9a currently.

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and for the RCA for MG4: only one positive indicator species was frequent with one occasional and three rare.

Indicators of success: After 3 years in HLS this site does not yet meet the (2-year) indicator of success: at least 2 frequent and 2 occasional indicator species.

Soil: Soil pH is mildly acid. Phosphate levels are low, whilst potassium levels are moderate. Magnesium levels are very high. Total nitrogen content is medium for long-term grassland and the level of organic matter is low–moderate.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 90	6.2	5	0	126	2–	210	4	0.81	20.7	1028	20.7

ESA	Upper Thames Tributaries
2012 Site No.	91
Grid ref.	SP33971125
Location	Crawley, River Windrush valley (Non SSSI)
Survey Method	Five quadrats
Survey Date	01.08.2012
Previous Derivation	New site
HLS Parcel No.	0277 (replaced proposed site – parcel 0448 – which had a bull in it)
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	

Site 91 comprises 3.3 ha of pasture in the floodplain meadow in the valley of the River Ray, which forms the eastern boundary. The HLS agreement started in November 2009. Non-SSSI.

Management: The site is managed as a traditional hay-meadow and aftermath grazed. The grazing which is let to a tenant, is by cattle sometime during September–November, usually as a short, sharp graze. No weed control is carried out. Winter flooding of the site is natural.

Vegetation: This field supports reasonable quality species-rich grassland with 16–22 species per m², although overall species diversity across the field was quite high with many locally frequent or patchy species. The *Agrostis stolonifera*–*Dactylis glomerata*–*Festuca rubra* dominated sward also supported *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Holcus lanatus* and sedges *Carex flacca*, *C. disticha*, *C. hirta*. *Equisetum palustre* was recorded in damper stands. Positive indicator forbs for lowland wet meadow included frequent *Centaurea nigra*, *Filipendula ulmaria*, *Lathyrus pratensis* and occasional *Sanguisorba officinalis*, *Lotus corniculatus*, *Galium uliginosum* plus rare *Lychnis flos-cuculi*, *Lotus pedunculatus*, *Leontodon autumnalis*, *Primula veris*, *Rhinanthus minor*, *Silaum silaus* and *Filipendula vulgaris*. There were some small area of invasion by *Phalaris arundinacea* along the damp western boundary and this area also had much invasion by *Cirsium palustre*.

NVC: This field supports a grassland that is closest to MG4 (coefficient = 50.8), although it lacked the usual constant *Alopecurus pratensis*. It is likely that the grazing has been too light over the autumn and winter months to control coarse grasses such as *Arrhenatherum elatius* and *Deschampsia cespitosa*, resulting in affinities with MG9 grassland (55.4%).

Condition assessment: This grassland passes the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and for the RCA for MG4: two positive indicator species were frequent and three–four occasional within the sward. A further seven were rare.

Indicators of success: The site meets the 3-year indicators of success.

Soil: Soil pH is neutral. Phosphate and potassium levels are low, whilst magnesium levels are high. Total nitrogen content is high, even for long-term grassland and the level of organic matter is moderate.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 91	6.8	6	0	83	1	129	3	1.59	36.9	1183	36.9

ESA	Upper Thames Tributaries
2012 Site No.	92
Grid ref.	SP47641036
Location	Yarnton Mead (River Thames valley) Pixey and Yarnton Mead SSSI (Unit 1)
Survey Method	ADAS plot
Survey Date	02.08.2012
Previous Derivation	ESA Grassland Site 1/site 111
HLS Parcel No.	2531
HLS Options	HK6 Maintenance of species-rich semi-natural grassland
HLS Supplements	

Site 92 is a 31 ha ancient hay-meadow bordering the River Thames in Oxon and is part of Pixey & Yarnton Meads SSSI and Oxford Meadows SAC. Notified as a SSSI in 1956, it entered HLS in 2009. The origin marker was refound.

Management: It is known that Pixey and Yarnton Meads have been hay-cut and aftermath grazed for over 1000 years (see SSSI citation). The site is still owned by a number of 'Meadsmen' but management has been by FAI Farms, under lease, since 2010. Traditional management has continued, although year-to-year variations in cutting times and grazing are not known < 2010. In 2011 the site was hay-cut and grazed by 300 tupping ewes and a few rams. Grazing was not possible in 2012 due to the wet and the hay-bales remained on site.

Vegetation: The bulk of the sward is a stand of a typical floodplain hay-meadow community dominated by a mixture of *Festuca rubra*, *Agrostis stolonifera*, *Cynosurus cristatus*, *Carex Flacca*, with positive forb indicators of lowland wet grassland *Sanguisorba officinalis*, *Filipendula ulmaria*, *Centaurea nigra* and *Succisa pratensis*. Other forbs typical of lowland wet meadows included frequent *Lathyrus pratensis*, *Lotus corniculatus*, occasional *Silaum silaus* and rare *Galium verum*, *Primula veris* and *Thalictrum flavum*. However, there were also large stands (or mosaics) where *Juncus acutiformis* dominated (to the western end and along the river) with much *Deschampsia cespitosa*, but the wet meadow forbs persisted here with locally frequent *Cirsium dissectum*. There were also discrete, quite extensive areas, dominated by *Carex riparia*, *Carex acutiformis* or *Phragmites australis*, marking ore permanently waterlogged depressions.

NVC: The bulk of the vegetation in this meadow supports a good example of MG4 grassland (coefficient = 63.0), although the lack of *Alopecurus pratensis* and constancy of *Cynosurus cristatus* and *Centaurea nigra* give it almost equal affinity with that community's drier counterpart MG5a (57.2%). This meadow was also recorded as MG4 in the previous 1995 and 2003 surveys.

Condition assessment: This grassland passes the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows and for the RCA for MG4: seven positive indicator species were frequent, one occasional and a further three were rare.

Indicators of success: The site meets indicators of success.

Soil: Soil pH is neutral. Phosphate and potassium levels are low, whilst magnesium levels are high. Total nitrogen content is high, even for long-term grassland and the level of organic matter is moderate.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 92	6.9	5	0	119	1	144	3	1.36	31.9	1025	31.9

ESA	Upper Thames Tributaries
2012 Site No.	94
Grid ref.	SP24651261
Location	Upton (Burford) (Non SSSI)
Survey Method	ADAS plot
Survey Date	04.09.2012
Previous Derivation	ESA Grassland Site 11/site 223
HLS Parcel No.	5171
HLS Options	HK9 Maintenance of wet grassland for breeding waders
HLS Supplements	

Site 94 occupies 5.86 ha of low-lying floodplain to the west of Burford, bordering the River Windrush. It entered HLS in October 2009. Plot markers not refound.

Management: The field is managed for field-dried hay and aftermath grazed by sheep supplied by a tenant grazier. Dry ewes are used due to the lack of fencing along the riverside. Coarser vegetation (rushes/sedges) has become more abundant under ESA and HLS – the sward is perceived as less species rich than the surrounding cattle-grazed permanent pastures.

Vegetation: Species poor (mean 10 species/m²), quite rank grass dominated sward with few forb species. The drier areas (60%) supported a grassy *Agrostis stolonifera*–*Festuca rubra*–*Holcus lanatus* dominated vegetation. Grasses, *Alopecurus pratensis*, *Poa trivialis*, *Phleum pratense*, *Hordeum secalinum* were frequent, whilst *Deschampsia cespitosa*, *A. geniculatus* and *Elymus repens* were occasional. Lowland wet meadow indicator species were restricted to occasional plants of *Cardamine pratensis*, *Filipendula ulmaria* and *Lathyrus pratensis*. *Mentha aquatica* was rare. *Juncus* spp. included occasional stands of *J. articulatus* and *J. inflexus* whilst *Carex* spp. were represented by *C. otrubae* and *C. riparia*. The remaining 40% of the site was more permanently inundated and supported *Glyceria maxima* swamp with *Typha latifolia* and *Phalaris arundinacea*.

NVC: The vegetation in this field does not lend itself to definition by NVC community. The highest similarity coefficient (for the main stand type) was for rush-pasture (MG10b = 54.4) but it lacked the usual constancy of *Juncus effusus*. In 1995 it was described as MG7c, probably due to the high cover of *Alopecurus pratensis*. The sward is intermediate between that community and MG10b grassland.

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows as it has no frequent or occasional positive indicator species, only species of rare occurrence. However, the HLS aim of this grassland is G13 – habitat for wintering waders and wildfowl.

Indicators of success: The site was not assessed for 'bird' option indicators as they relate to features assessed in spring/autumn.

Soil: Soil pH is calcareous. Phosphate, potassium and magnesium levels are moderate. Total nitrogen content is high, but normal for long-term grassland and the level of organic matter is moderate, and much lower than many other sites in the sample.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 94	7.6	24	2	143	2–	74	2	1.08	24.7	1658	11.1

ESA	Upper Thames Tributaries
2012 Site No.	95
Grid ref.	SP26751146
Location	Burford (non-SSSI)
Survey Method	ADAS plot
Survey Date	16.08.2012
Previous Derivation	ESA Grassland Site 12/site 224
HLS Parcel No.	7943
HLS Options	HK11 Restoration of wet grassland for breeding waders
HLS Supplements	HR1 Cattle grazing

Site 95 occupies 6.19 ha of low-lying floodplain to the east of Burford, bordering the River Windrush. It entered HLS in March 2012. Non-SSSI. Plot markers refound but not origin.

Management: The grass keep has been let for over a decade to a tenant. The tenant has consistently grazed this site using a small herd (c. 10 head) of cattle. The sward is occasionally topped when it becomes too rank, and ragwort occasionally pulled but no other management is used. The tenant perceives that the management prescriptions are more restrictive under HLS than under ESA.

Vegetation: Species poor (7–12 species/m²), quite rank grass dominated sward with few forb species. Grasses *Agrostis stolonifera*, *Holcus lanatus*, *Lolium perenne* and tussocky *Deschampsia cespitosa* are constant with frequent *Phleum pratense*. Forbs included occasional *Potentilla anserina*, *Potentilla reptans*, *Ranunculus repens* but lowland wet meadow indicator species were restricted to rare plants of *Cardamine pratensis*, *Galium palustre*, *Lysimachia nummularia* and *Persicaria amphibia*. Negative indicator *Rumex crispus* was frequent.

NVC: This field supports a sward that has affinities with both MG9a grassland (coefficient = 56.7) and MG10b rush pasture (Coefficient = 57.4). Due to the abundance of *Agrostis stolonifera* and frequency across the wider field of *Potentilla anserina* there are also affinities with MG11a. In 1995 it was defined as MG7c, despite the low cover of *Alopecurus pratensis*. *Deschampsia cespitosa* has increased in cover since 1995.

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows as it has no frequent or occasional positive indicator species, only species of rare occurrence. Indicators of waterlogging are >30% and negative species are >5%. However, the HLS aim of this grassland is G12 – habitat for breeding waders.

Indicators of success: The site was not assessed for ‘bird’ option indicators.

Soil: Soil pH is alkaline. Phosphate and potassium levels are moderate, whilst magnesium levels are high. Total nitrogen content is high, but not overly so for long-term grassland and the level of organic matter is moderate.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index x P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 95	7.8	16	2	137	2–	106	3	1.19	23.9	1482	23.9

ESA	Upper Thames Tributaries
2012 Site No.	96
Grid ref.	SP31101156
Location	Minster Lovell (Non SSSI)
Survey Method	ADAS plot
Survey Date	1.08.2012
Previous Derivation	ESA Grassland Site 14/ Site 226
HLS Parcel No.	0960
HLS Options	HK11 Restoration of wet grassland for breeding waders
HLS Supplements	

Site 96 occupies 6.13 ha of low-lying floodplain on the north bank of the River Windrush. It entered HLS in August 2009. The location of the ADAS plot could not be found due to the extremely rank vegetation. Plot markers not refound – vegetation too dense. Plot markers not refound. Non-SSSI.

Management: This field used to be fertilized and hay-cut, followed by a hard aftermath graze. However, the field was badly flooded in July 2007; since the flood it has been left largely unmanaged. There has been some sheep grazing, but no hay-cut. The sward has become ranker and taller.

Vegetation: The vegetation in this field is not homogeneous. In the area of the ADAS plot the vegetation is dominated by a tall stand of *Phalaris arundinacea* with abundant *Deschampsia cespitosa*, *Carex acutiformis* and *Agrostis stolonifera*. Forbs were few: positive indicator species of lowland wet meadow included frequent *Persicaria amphibia* and isolated plants of *Galium palustre*; other frequent forbs included *Ranunculus repens* and negative species *Rumex conglomeratus*. Other areas of the field supported frequent positive indicator *Filipendula ulmaria* in a *Deschampsia cespitosa*–*Carex acutiformis* dominated sward. There were also areas of *Glyceria maxima* swamp in mosaic with the *Deschampsia* dominated vegetation.

NVC: The vegetation in this field does not lend itself to definition by NVC community. The highest similarity coefficient (for the plot) was for a swamp community S28 (42.4%) because of the high cover of *Carex acutiformis*: the high cover of *Deschampsia cespitosa* gave affinities with MG9 (38.3%) but the wider field was a mosaic of wet grassland and poor fen communities. Where *Filipendula ulmaria* was constant the vegetation was akin to M27b, although this had low coefficient values (<30%). The *Deschampsia cespitosa* dominated areas were a waterlogged MG9; *Glyceria maxima* dominated areas, S5 (32.5%). This field is a mosaic of MG9, S28, S5 and M27. In 1995 this field was described as MG10b but MG9 in 2003, reflecting an increase in *Deschampsia cespitosa* and a ranker sward.

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows as it only had one frequent positive indicator species. It also had indicators of waterlogging >30%. However, the HLS aim of this grassland is G12 – habitat for breeding waders.

Indicators of success: The site was not assessed for ‘bird’ option indicators.

Soil: Soil pH is alkaline. Phosphate is low, potassium levels are moderate, whilst magnesium levels are high. Total nitrogen content is high, but not overly so for long-term grassland and the level of organic matter is quite high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 96	7.7	10	1	129	2-	106	3	1.19	25.6	1446	25.6

ESA	Upper Thames Tributaries
2012 Site No.	97
Grid ref.	SP49022058
Location	Tackley (Non SSSI)
Survey Method	ADAS plot
Survey Date	3.08.2012
Previous Derivation	ESA Grassland Site 24/site 513
HLS Parcel No.	0844
HLS Options	HK15 Maintenance of grassland for target features
HLS Supplements	

Site 97 occupies 3.07 ha of low-lying floodplain to the west of Tackley, in the Cherwell Valley. The River Cherwell borders the site. It is regularly under water for weeks/months. It entered HLS in January 2011, after being in ELS. Plot markers not refound. Non-SSSI.

Management: This field is hay-cut (mid-July) and then aftermath grazed with sheep as soon as there is sufficient regrowth. Sheep are kept on until there is insufficient to graze, but may be put back on in a dry autumn/winter/spring if possible. The sward has become less dominated by weeds since entering ELS 8 years ago (nettle, docks etc.) and the sward is getting better.

Vegetation: Species poor (10–13 species/m²), quite rank swampy grassland. The sward was fairly uniform with constant and often abundant *Filipendula ulmaria*, *Phleum pratense*, *Agrostis stolonifera* with locally frequent *Glyceria maxima*, *Phalaris arundinacea*, *Poa trivialis*, *Holcus lanatus* and some *Carex* spp. Positive indicator species *Lathyrus pratensis* was occasional with *Persicaria amphibibia*. Negative indicator *Rumex crispus* was occasional.

NVC: The vegetation in this field in 1995 and 2003 was described as MG9 but *Deschampsia cespitosa* is only occasional in the sward. All MATCH coefficients were less than 40% and therefore not diagnostic. The sward is waterlogged, impoverished and, probably, transitional. It can best be described as MG9-related and perhaps derives from a former improved MG7 stand. There are areas of swamp (S28, S5)

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows as it has only one frequent and one occasional positive indicator species. However, the HLS aim of this grassland is G12 – habitat for breeding waders (Curlew and Lapwing).

Indicators of success: The indicators of success for this site are few: >10% grasses with seedheads from September–February inclusive and <5% cover of undesirables. These indicators are met.

Soil: Soil pH is circumneutral. Phosphate and potassium levels are moderate, whilst magnesium levels are high. Total nitrogen content is high, but not overly so for long-term grassland and the level of organic matter is high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 97	7.1	20	2	133	2–	146	3	1.29	28.4	1910	28.4

ESA	Upper Thames Tributaries
2012 Site No.	98
Grid ref.	SP49613119 (Non SSSI)
Location	Clifton, Oxon
Survey Method	ADAS plot
Survey Date	2.08.2012
Previous Derivation	ESA Grassland Site 25/ site 521
HLS Parcel No.	7134
HLS Options	HK11 Restoration of wet grassland for breeding waders
HLS Supplements	

Site 98 occupies 8.15 ha of low-land between the River Cherwell and the Oxford Union canal. The site is bordered by drains. It entered HLS in October 2009. Plot markers refound.

Management: The management of this site is unknown: the landowner/manager was unavailable. The HLS prescription is to manage the sward by grazing/cutting to achieve a sward height of 3–10cm in December. No stock were on the site at the time of survey but the sward is uniformly short over much of the field. Management appears suitable.

Vegetation: The lower-lying ground where the plot is situated comprises species poor (7–10 species/m²), but typical, wet alluvial meadow. It is dominated by a mixture of *Agrostis stolonifera*, *Alopecurus geniculatus* and *Alopecurus pratensis* with *Ranunculus repens*. Positive indicators *Cardamine pratensis* is frequent, *Oenanthe fistulosa* and *Filipendula ulmaria* are occasional, whilst *Caltha palustris*, *Achillea ptarmica*, *Eleocharis palustris*, *Galium palustre* and *Persicaria amphibia* are rare. Negative species *Rumex crispus* is frequent. The upper ground to the east supports drier, more species-rich grassland with additional species *Juncus acutiflorus*, *Lathyrus pratensis*, *Carex flacca*, *Lychnis flos-cuculi*, *Rhinanthus minor* and *Leontodon autumnalis*.

NVC: The vegetation in the low-lying ground and plot was MG13 (coefficient 56.1% and 46.4% respectively). In 1995 and 2003 it was described as MG7c – a *Lolium perenne* dominated floodplain grassland. *Lolium perenne* is now largely absent and this field has undergone transition to a less improved, more permanently waterlogged community. (The upper, drier stand is more akin to MG4, although lacking *Sanguisorba pratensis*.)

Condition assessment: This grassland fails the condition assessment for BAP habitat G06 – Lowland (Floodplain) meadows as it only two occasional and five rare positive indicator species. However, the HLS aim of this grassland is G13 – habitat for breeding waders, and the sward is obviously getting better. It is likely to pass a condition assessment in the future given suitable management. (The top of the field would probably pass now.)

Indicators of success: The site was not assessed for ‘bird’ option indicators.

Soil: Soil pH is circumneutral. Phosphate levels are low, potassium levels are moderate, whilst magnesium levels are high. Total nitrogen content is high, even for long-term grassland and the level of organic matter is very high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 98	6.9	14	1	128	2–	114	3	1.39	31.7	1859	31.7

ESA	Upper Thames Tributaries
2012 Site No.	99 AG00282783
Grid ref.	SP57171345
Location	(Otmoor) Otmoor SSSI Unit 3
Survey Method	ADAS plot
Survey Date	22.08.2012
Previous Derivation	ESA Grassland Site 36/site 625
HLS Parcel No.	1561
HLS Options	HK11 Restoration of wet grassland for breeding waders
HLS Supplements	HR2 Native breeds; HR4 Control of invasive plants; HR7 Difficult sites

Site 99 is located on Otmoor ranges. It occupies 3.03 ha of low-lying land in the floodplain of the River Ray. It is part of Otmoor SSSI. It entered HLS in November 2010. Plot markers not refound.

Management: This site is permanent pasture grazed along with the extremely large field to the east by a herd of angus and shorthorn cattle. Field ditches are cleared regularly but this site floods for several months each year. Rushes are topped every year at the end of the season.

Vegetation: The small triangular field supports moderately rich (12–15 species/m²) tussocky grassland dominated by *Deschampsia cespitosa* with grasses *Agrostis stolonifera*, *Poa trivialis* and *Lolium perenne*. Sedges were frequent with locally abundant *Carex riparia* indicating more permanent area of waterlogging, ±constant *Carex otrubae* and occasional *Carex disticha*, *Carex nigra* and *Carex ovalis*. *Juncus effusus* and *J. inflexus* were frequent. Frequent positive forbs included *Galium palustre*, *Lotus pedunculatus*, *Ranunculus flammula*, and *Mentha x verticillata*. *Oenanthe fistulosa* was rare.

NVC: This field and plot supports MG9a (coefficient 45.9%), although there were also strong affinities with M23b because of the frequency of *Juncus effusus* and *Galium palustre* (47.5%). In 1995 and 2003 it was described as MG9.

Condition assessment: This grassland fails the SSSI RCA condition assessment and that for BAP habitat G06 – Lowland (Floodplain) meadows on cover of indicators of waterlogging (mainly *Deschampsia cespitosa*, at 50%) but it passes on all other features, including the frequency of positive indicator species. The aim of the grassland is G12 – habitat for breeding waders.

Indicators of success: The site probably passes the botanical indicators of success but the presence of waders was not assessed.

Soil: Soil pH is very mildly acidic. Phosphate levels are very low but potassium levels are high, whilst magnesium levels are extremely high. Total nitrogen content is high, even for long-term grassland and the level of organic matter is high.

Sample name	Soil pH (Water)	Olsens P (mg/l)	Index x P	Soil K (mg/l)	Index K	Soil MG (mg/l)	Index MG	Total N (%)	Loss on Ignition	Total P	Organic Carbon
LWG 2012 99	6.4	7	0	298	3	288	5	1.22	29.4	997	29.4

