Lowland MOSSLANDS

Lowland raised bog in the UK has fallen by 94% from 95,000 ha to 6,000 ha, and is now internationally threatened

Ecology

Greater Manchester's lowland mosslands, (also known as lowland raised bog), began to form c10, 000 years ago. It dates back to the last ice age when peat began to be laid down on marine, estuarine or fluvial deposits adjacent to estuaries, on river floodplains, or on the site of shallow glacial lakes. These wet, waterlogged areas were originally colonised by reeds and rushes. Due to the waterlogged anaerobic conditions, dead plant material could not be fully broken down and began to build up on the bottom of water bodies and this led to the formation of fen peat. Bog mosses (*Sphagnum* mosses) began to colonise. At this point, the *sphagnum* content of the underlying peat increased and the peat changed from fen to bog peat. As the peat accumulated, the surface of the bog was elevated above the surrounding land, forming a dome, hence the term - raised bog. Being elevated above the surrounding groundwater, raised bogs are fed purely from rainfall and this helps to maintain nutrient poor conditions within the bog system. The *Sphagnum* mosses also increase the acidity of the water. As a result, the characteristic vegetation found on mosslands is adapted to nutrient-poor, acidic conditions and plant species are therefore highly specialised in their requirements and many of these species can be found no-where else.

Mosslands can also support characteristic assemblages of uncommon invertebrates, including the large heath butterfly, once known as the Manchester Argus, but now extinct in the County. Mossland habitat is capable of supporting a range of important bird species, such as curlew. Recent survey

evidence has shown that the ditches in mossland habitats provide important breeding areas for Water Vole.

Peat cutting or drainage has modified the majority of Britain's raised bog and much has been converted to agriculture. There are no intact raised mosslands left within Greater Manchester, with the majority of them having been drained and fertilised to create farmland and some being worked for peat.

Typical regenerated cut over mossland

Priority habitat description

The mossland within Greater Manchester has been significantly altered and all the remnant sites are cutover examples of the habitat. The Manchester mosslands either support secondary semi-natural vegetation or are currently bare peat sites as a result of current extraction. Due to the rate of loss of the habitat and its increased rarity, all uncultivated examples that have the potential to be restored (whether they are vegetated or not) are to be considered as important and a key part of the regions critical environmental capital.

The aim of restoration is to meet the condition of favourable habitat. The best examples of lowland raised bog habitat can be defined using the following criteria:

- Characteristic bog-moss species, notably *Sphagnum papillosum* and *Sphagnum magellanicum*, are abundant and cover at least 25% of the surface.

- Sites where the hydrology of the mossland is maintained at an appropriate level for the growth of mossland vegetation.

- Any site which supports one or more of the following species – even where the habitat quality appears poor:

Round leaved Sundew	*Drosera rotundifolia L.*
Cross-leaved heath	*Erica tetralix*
Bog myrtle	*Myrica Gale*
Bog asphodel	*Narthecium ossifragum*
Bog Rosemary	*Andromeda polifolia*
Cranberry	*Vaccinium oxycoccus*

- Bog pools occur on the open bog surface

Lowland Mosslands

The NVC communities in Table 1 are characteristic of the habitat type and the presence of one or more of these communities should be taken as an indicator that the priority habitat type might be present. Species listed in tables 2 and 3 are characteristic of the habitat type but not exclusive to it.

Table 1: NVC Communities associated with lowland raised bog in Greater Manchester

BOGS WITH HIGH WATER TABLE

M17 Scirpus cespitosus - Eriophorum vaginatum blanket mire

M18 Erica tetralix - Sphagnum papillosum raised mire

BOG POOL COMMUNITIES

M1 Sphagnum auriculatum bog pool community

M2 Sphagnum cuspidatum/recurvum bog pool community

M3 Eriophorum angustifolium bog pool community

COMMUNITIES ON MODIFIED BOGS

M15 Scirpus cespitosus - Erica tetralix wet heath

M19 Calluna vulgaris - Eriophorum vaginatum blanket mire

M20 Eriophorum vaginatum blanket and raised mire

M16 Erica tetralix - Sphagnum compactum wet heath

M25 Molinia caerulea-Potentilla erecta mire

W4 Betula pubescens - Molinia caerulea woodland

H9 Calluna vulgaris - Deschampsia flexuosa heath

H12 Calluna vulgaris - Vaccinium myrtillus heath

Table 2: Vascular plants and bryophytes associated with lowland raised bog in Greater Manchester

Active raised bog has at least 25% sphagnum cover. Typical species include:

Bog moss	*Sphagnum papillosum*
	Sphagnum magellanicum
Common cotton-grass	*Eriophorum angustifolium*
Hair's-tail cotton-grass	*Eriophorum vaginatum*

Cross-leaved heath	*Erica tetralix*
Common butterwort	*Pinguicula vulgaris*
Cranberry	*Vaccinium oxycoccus*
Bog rosemary	*Andromeda polifolia*
Bog myrtle	*Myrica gale*
Bladderworts	*Urtricularia spp.*
Round-leaved sundew	*Drosera rotundifolia*
Bog asphodel	*Narthecium ossifragum*
Bog bean	*Menyanthes trifoliate*

Bogs that are drying out, or those where the surface has been cut over, support large areas of:

Purple moor-grass	*Molinia caerulea*
Heather	*Calluna vulgaris*
Bilberry	*Vaccinium myrtillus*
Crowberry	*Empetrum nigrum*
Downy birch	*Betula pubescens*

Table 3: Animal species associated with lowland raised bog in Greater Manchester

Birds

Curlew	*Numenius arquata*
Snipe	*Galinago galinago*

Invertebrates

Common hawker dragonfly	*Aeshna juncea*
Ruddy darter dragonfly	*Sympetrum sanguineum*
Black darter dragonfly	*Sympetrum danae*

Current status and distribution

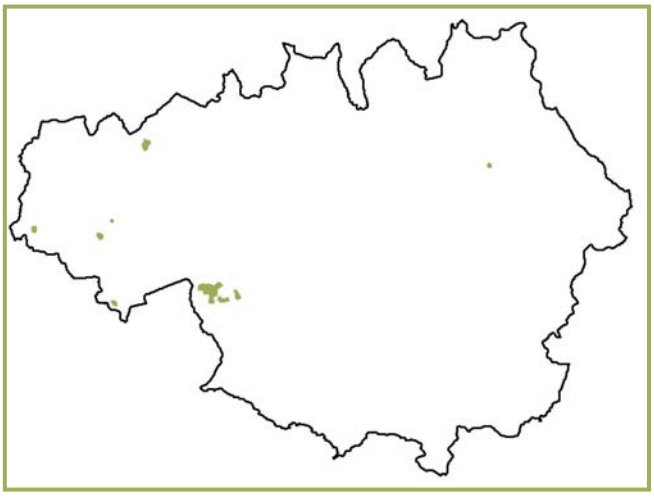
Lowland raised bog is on Annex 1 of the EC Habitats and Species Directive and is listed in the UK BAP as a priority habitat. Mossland habitat is now internationally threatened. Mosslands once covered large areas of our region, but as elsewhere across Europe there has been a dramatic loss in the area of this habitat. Since c.1850, the area of lowland raised bog in the UK has fallen by 94% from 95,000 ha to 6,000 ha.

In England over the same period, there has been a massive 98.6% reduction of our mossland heritage, with only 500ha now remaining. The North West of England once supported a large proportion of England's lowland raised bog resource, yet even here there has been substantial losses with 99% of the mossland habitat within Lancashire, Greater Manchester and North Merseyside having been destroyed. The remaining fragments are in all cases damaged, and there are less than 100ha of wet mossland left.

Within Greater Manchester, the areas of Chat Moss, Carrington Moss, Ashton Moss and Clifton Moss originally supported huge expanses of mossland habitat. Many of these areas have been lost to agricultural improvement, peat extraction or development.

Lowland Mosslands

A recent survey of mossland habitat has recorded only 14 sites within Greater Manchester supporting deep peat deposits many of the sites being only a few hectares in size. Many of the larger remnants are currently under excavation with only a few being protected by statutory designations. Astley and Bedford Moss are protected, as part of the larger Manchester Mosslands Special Area of Conservation (SAC) and Red Moss in Bolton and Highfield Moss are Sites of Special Scientific Interest (SSSI).



Distribution of mosslands in Greater Manchester

In view of the rarity of intact habitat, degraded examples considered capable of restoration within 30 years are of high conservation priority. COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 (European Habitats Directive), considers that raised bog still capable of restoration are of European Importance. Both active and degraded examples are therefore considered to be priority habitats for conservation.

Mosslands are also considered to be important from both a historical and archaeological point of view. British mossland habitat began to form c10,000 years ago. Due to the preservative quality of peat, mosslands have an immense value as an archaeological and palaeoecological archive of the past ten millennia.

"Intact mossland habitat has a beneficial effect on global warming by locking up carbon within the peat" (Worrall 2008)

Recent research has shown intact mossland habitat to have a beneficial effect on global warming by locking up carbon within the peat. The UK's peatland store more carbon than the forests of the UK, France and Germany, equivalent to 35 years of total UK output of CO_2 (Worrall 2008). Functioning mossland habitat has an additional benefit of being able to sequester carbon, this is an on-going process, which keeps the carbon locked-up and 'sinks' more carbon each year (Worrall 2008). Mosslands also have a beneficial affect on water quality if managed appropriately, and reducing flood risk as they soak up water during heavy periods of rainfall

and gradually releases it over a period of time.

Factors affecting the habitat

The primary factors affecting lowland raised bogs in Greater Manchester are:

- Development, including peat, sand and gravel extraction.

  Three large peat extraction sites are currently in operation within Greater Manchester. These are at Chat Moss, Little Woolden Moss and Astley Moss East. Planning conditions imposed on the extraction site at Twelve Yards Road, required that 2 metres of peat will be retained on site and that peat extraction would cease in 2010. After use includes conservation.

  A new proposal to extend the peat extraction for another 25 years and to take the peat down to 1 meter is currently being submitted. Parts of Astley Moss East will be lost to peat, sand and gravel extraction. The remainder of the site is to be re-wetted and restored to mossland habitat. The Little Woolden Moss application is to convert the land to agricultural use, with a loss of the whole peatland habitat.

  The peat surface left by milling does not allow any bog species to survive on areas exploited for peat extraction.

- Surface water drainage and groundwater abstraction causing lower water levels

  The presence of land drains on adjacent farmland serves to maintain artificially low water tables next to the mossland sites. Water abstraction within the Chat Moss area may also affect and further reduce water levels. Both factors can have an adverse effect on the hydrological gradient between mossland habitat and adjacent lands. This reduces the ability of mossland habitat to maintain sufficient water levels, increases drying out and leads to an incremental loss of habitat through oxidation of the peat and natural succession to heathland and scrub woodland.

  Attempts to counteract this and raise water levels on the mossland sites can be met with opposition from landowners and farmers on adjacent land because of

perceived potential effects on the drainage of their own land.

In the past, the loss of mossland habitat has largely been caused by drainage and the conversion to agriculture. Many of the agricultural lands surrounding the current fragmented mossland habitat still retain peat deposits. However, the process of farming the land and the use of heavy machinery has led to compaction and oxidation of the peat soils. Once the peat becomes oxidised it is vulnerable to wind blow and erosion.

- Afforestation, scrub encroachment and lack of management

  Many of the remaining mossland fragments are not in conservation management. The resource is often in private ownership and a lack of a suitable management regime results in the site drying out and the loss of characteristic bog species.

  Locally, there is little pressure for afforestation on mossland habitat at present. Scrub encroachment due to a lack of appropriate management is however commonplace. The presence of large areas of scrub, exacerbate the drying out process and allows the development of wet woodland. If this process is allowed to continue, the peat becomes dry and oxidises, becoming unsuitable for restoration purposes.

- Water quality – water pollution, air pollution, pesticide and nutrient enrichment

  Bog vegetation requires nutrient poor and acidic conditions to flourish. Within the mosslands of Greater Manchester, the past exploitation of peatlands for extraction and agriculture has resulted in the disappearance of the peat domes and the construction of numerous deep drainage ditches and shallower in field drains. This not only allows water to escape the bog system but also allows nutrient rich waters to enter the habitat from adjacent land. Pollution, pesticides and fertiliser run off from both agricultural and industrial land reduces the viability of mosslands to be restored.

  Air pollution may also have an adverse effect, although its effects are similar to reduced water levels and may therefore be underestimated. Mosslands are fed by rainfall, and high levels of sulphur, ammonia and nitrogen are still being recorded. Bisulphites have an inhibitory effect on some *Sphagnum* Mosses and high levels of nitrogen encourage the

spread of competitors such as purple moor grass. (JNCC)

- Habitat isolation as a result of fragmentation of existing areas.

The last fragments of mossland habitat are becoming increasingly isolated and smaller. The remnant mosslands exist as stand alone islands, which characteristically stand higher than the surrounding land due to compaction of the peat deposits. The isolation of the mossland from the surrounding landscape leads to a deterioration in habitat quality. The increased hydrological gradient reduces the ability of the mossland habitat to retain sufficient water levels.

Twelve Yards Road *(GMEU)*

The characteristic species, which depend on mosslands, have themselves also become isolated and there are fewer habitats available. This increases the chance of local extinctions and the eventual loss of species from the region.

Historically, a range of different habitat types radiating out from the central core mossland area would have provided complimentary habitat. Such habitats would have included lag fen, marsh, open water, reedbeds and wet woodland. These associated habitats would have helped to maintain the wetness of the mossland and would have provided a protective buffer from adjacent land uses. These buffer habitats have in most cases now been lost, either to development are intensively drained agricultural lands.

- A lack of appropriate characteristic species

The cutover nature of Manchester's mossland habitat has resulted in a reduction in the number of species available for colonisation of restored sites. A number of species such as the hummock forming *Sphagna* are necessary to obtain a sustainable and growing mossland habitat. The hummock formers such as *S. papillosum*, *S. capillifolium and S. magellanicum* tend to be in short supply within the region as a whole. Due to the mosses ability to retain water, mosslands supporting a greater

coverage of *Sphagna* are better able to maintain optimal water levels.

- Global warming

  The trend for hotter drier summers and the prediction for unpredictable weather patterns is cause for some concern. Bog vegetation grows best under a certain set of parameters. The ground should not be too dry nor should it be too wet. Optimal water levels for the growth of bog vegetation are at or just above ground level. Current options for re-wetting sites are to capture rainfall and maintain the levels at the desired height. This is dependant on summer rains replenishing the system. If these do not occur then the sites may well become too dry. Conversely the trend for heavy down pours of rain may also adversely affect the habitat as water levels may become too high very quickly.

- Poor public perception

  Despite mossland being a vital part of our region's heritage, they are hugely undervalued and suffer from poor public perception. Historically, there has been a lack of understanding, appreciation and interest in mossland habitat. Mosslands seem always to have been regarded as wasteland, areas either to be avoided or exploited. This has resulted in it being difficult to raise public opinion to safeguard and protect our mossland resource. Funding opportunities have also been restricted, as community interest is low.

- Recreational pressures

  There is little current recreation pressure on the mosslands of Greater Manchester. Much of the habitat is in private ownership and access to sites is limited. This may change if mosslands can be promoted as areas of valuable open green space. Mossland habitat and the species it supports are vulnerable to disturbance and will require protective measures.

Current actions

Policy

1. The importance of mossland habitat has been recognized within Bolton's, Salford's and Wigan's Unitary Development Plans, with specific policies protecting the mossland resource. The replacement of UDP's by the Local Development Framework is currently taking place across Local Planning Authorities. As part of this process, Salford has produced a Supplementary Planning Document for Biodiversity, specifically UK Priority Habitats, within which the importance of the mossland resource is highlighted. Both Bolton and Wigan have produced

mossland habitat action plans within their own local BAP's. The BAP process is supported with all 3 UDP's.

2. All planning applications that may have an adverse effect on mossland habitat and hydrology are now assessed fully. The approval to grant peat, sand and gravel extraction at Astley Moss East, although resulting in a loss of 1/3 of the site, has been used to bring into conservation management a large part of the site plus additional mossland habitat within the adjacent Botany Bay Wood.

3. Salford City Council and Wigan MBC have declared a number of air quality management areas, within which the air quality is measured and monitored.

4. Efforts to phase out the use of peat products by local authorities has had limited success. Of the 10 local authorities, only Salford and Manchester were able to able to say that they were peat free. The remainder implied that peat was still being used within local authority parks and that there was a resistance by Parks Departments to use peat free alternatives. Of the 10 local authorities within Greater Manchester only 4 (Manchester, Salford, Rochdale and Wigan) signed the Peatlands Protection Charter.

Site Safeguard

1. The recent revision of the Site of Biological Importance – selection guidelines has allowed the opportunity to strengthen the protection of remnant mossland habitat by including areas of lowland mossland on peat over 0.5m deep, which supports semi-natural vegetation on unmodified mossland soils as potential SBI's. Astley and Bedford Mosses is part of the Manchester Mossland Special Area of Conservation (SAC) receiving both British and European protection. Mossland habitat is listed in Annex 1 of the EC Habitats and Species Directive. COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 (European Habitats Directive), considers that raised bog still capable of supporting bog vegetation within 30 years should be considered as of European Importance.

2. A Mossland Group consisting of the Environment Agency, Natural England, the Lancashire Wildlife Trust, and the BAP Managers of Greater Manchester, Lancashire and Merseyside meet monthly to discuss and prioritise action on mossland sites. A report undertaken by one of the members of the group details the remaining 31-mossland sites within Greater Manchester, Lancashire and North Merseyside. The report describes the condition of the individual sites and the potential for restoration. The report identifies 14 sites within Greater Manchester that

support acid peat habitat and priority sites have been identified. As part of the Hydrological Plan for Astley and Bedford Moss, parcels of land surrounding the mossland sites that are considered as important for the restoration of the mossland habitat have been identified.

3. The Lancashire Wildlife Trust has been successful in funding 2 mossland officers, covering Lancashire, Greater Manchester and North Merseyside. It is envisaged that through landowner liaison, a landscape scale approach to mossland conservation can be delivered.

4. Work to provide suitable Nightjar habitat on Chat Moss has been limited. The restoration works undertaken by the Wildlife Trust on the 12ha mossland habitat at 12 Yards Road, may well contribute to the provision of some suitable habitat. However, large-scale habitat creation works will only be possible when the whole of the peat extraction site at 12 Yards Road ceases and the land comes available for appropriate management.

5. The Lancashire Wildlife Trust has included the acquisition of both mossland habitat and land adjacent to peatland areas as one of its main priorities and is included within its business plan. 4.3ha of land adjacent to the Astley Moss Reserve has already been purchased and further land is currently being identified.

6. The Environment Agency licences water abstraction and have developed Catchment Abstraction Management Strategies (CAMS) to help balance the needs of water-users, the environment, and aid the sustainable management of water resources on a catchment scale. Licences for abstractions are issued when the rate of abstraction is above 20m^3/day.

Under the licensing arrangements for abstraction, only impacts on designated sites are currently assessed. The Environment Agency also implement the Catchment Flood Management Plan (CFMP). This is a strategic planning tool through which the Agency seeks to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.

Land Management

1. Section 106 Agreements are attached to permissions to extract peat (Croxten's site) and peat, sand and gravels (Astley Moss East). The Astley Moss East agreement has guaranteed restoration works to be undertaken on 2/3 of the site. 16 ha of mossland adjacent to Botany Bay Wood will also be restored. Conditions attached to the Croxten's site are to provide recreational

opportunities including nature conservation, however, a proposal to extend the peat extraction for another 25 years and to take the peat down to 1 meter is currently being submitted.

Further negotiation will be required with landowners to ensure the maximum biodiversity gain. Currently the whole of the Little Woolden Moss is to be turned over to agriculture, with the loss of over 100ha of potential mossland/lagg fen habitat. The current assessment of the site is that there is between 0.5 to 1 meters of peat depth remaining.

2. A Management plan for the Lancashire Wildlife Trust Reserve at Astley Moss has been completed and the reserve has been entered into Environmental Stewardship. The Bedford Moss site is currently under the Reserves Enhancement Scheme, operated by Natural England. A further 10 ha at Astley Moss and 12 ha at 12 Yards Road (Croxten's site) are currently being restored, with a program of scrub removal, bunding and ditch blocking. The works undertaken on the Astley Moss reserve, have allowed Natural England to re-classify one of the compartments from Unfavourable Declining to Unfavourable Recovering.

Restoration works on Ince Moss, Wigan, have also been undertaken. Land lowering works adjacent to the moss, revealed 0.33 ha of underlying peat habitat. The new peat area has been bunded so that it is now isolated from outside hydrology and rewetted. The land lowering work at Ince Moss has also enhanced 4ha of reedbed, a complimentary habitat to mosslands.

3. Overall 28 ha of scrub/woodland have been cleared from the mossland sites, increasing the chances of successful restoration.

4. The Chat Moss Action Group has been formed, composed of stakeholders and environmental organisations. A vision document was commissioned by Red Rose Forest. The Vision document aims to secure a long-term vision for the mossland area and address the current fragmentation and decline of the landscape as a whole. The vision identifies operational zones so that a cohesive structure between the different land uses can be formed. Within the Vision, biodiversity and hydrological zones have been identified around the mossland sites to protect the hydrological integrity of the mossland habitat and provide complementary wetland habitat, enhancing the biodiversity of the area.

Salford City Council has commissioned a study within part of the Chat Moss area. The study aims to identify the necessary hydrological zone required to protect the interest of the mossland habitats.

Twelve Yards Road *(GMEU)*

5. A further mossland group, comprising, Natural England, the Environment Agency, the Lancashire Wildlife Trust and the 3 Biodiversity Managers from Manchester, Lancashire and Merseyside meets to discuss mossland management, acquisitions and the strategic long-term management of the mossland landscape across the 3 regions.

6. At Red Moss, the actions in the 2001 restoration plan have been completed. Of the 33ha within the restoration plan, approximately 80% of the land has now been re-wetted sufficiently for the growth of bog vegetation. Round-leaved Sundew has been recorded on the site for the first time since 1925. Spha*gnum magellanicum* recorded in June 2007, was the first record for the vice county of South Lancashire.

Advisory

1. Red Moss has been used as an example of Best Practice. Within this mossland BAP review is a section on best practice guidance.

2. As part of the Wildlife Trust's mossland project, mossland talks have been undertaken in the schools within Wigan and surrounding Astley Moss, allowing a wider audience to be reached. The talks have promoted the importance of mossland habitat and their current vulnerability. This type of engagement has given the opportunity to promote the use of non-peat based products, thereby reducing the development pressures on the remaining mossland resource.

3. The funding and establishment of a mossland officer is central to the provision of advice to mossland owners and adjacent landowners. The Lancashire Wildlife Trust has been successful in funding 2 mossland officers for the next 2 years (March 2009-Apr 2011). It is envisaged that through landowner liaison, a landscape scale approach to mossland conservation can be delivered.

Research and Monitoring

1. A report was commissioned by the Environment Agency (Paul Thomas), detailing the State and extent of surviving acid mossland habitats within Lancashire, Greater Manchester and North Merseyside. The report describes and maps the condition of the individual sites and the potential for restoration. Restoration works on mossland habitats are inputted into BARS annually. As part of the Mossland Project, the Lancashire Wildlife Trust have been inputting into the BARS Countdown 2010 on biannual bases for the past 2 years.

2. Current research is building up new evidence on the role mosslands have in locking up carbon and thereby having a positive effect on climate change.

Communication and Publicity

Press releases and radio appearances have helped to publicise the importance of and threat to our mossland resource.

Objectives and targets

Objective	Target	Quantity	Target Date	Units
Maintaining extent	Maintain the extent of the existing Greater Manchester lowland raised mire resource.	167	2015	Ha
Maintaining extent	Ensure no further loss of peat deposits.	435	2015	Ha
Achieving Condition	Rehabilitate degraded bog habitat still capable of natural regeneration (in targeted areas) to bring most of the primary and secondary resource into or approaching favourable condition through appropriate management.	167	2020	Ha
Restore	Restore Lowland Raised Bog immediately on chosen areas of archaic peat to ensure a sustainable hydrological regime for adjacent extant habitat	100	2020	Ha

Proposed actions

1. Develop landscape approach to mossland conservation.

The Lancashire Wildlife Trust has now been able to fund 2 mossland officers for a 2-year period. The officers will lead the way forward in developing a landscape scale approach to mossland conservation. WT's, NE, GMBP, LA's. 2015

2. Ensure no future loss of our peatland resource through development and/or peat extraction.

- No further peat extraction licences should be approved beyond the lifespan of the current extraction periods.
- Review the designation of all deep peat sites, including bare peat habitats and designate as Sites of Biological Importance (SBI)
- Liase with landowners of peat extraction sites and negotiate restoration of all peat extraction sites to mossland habitat**.** LA's, NE, EA, GMEU, WT's. 2011

3. Ensure that Water Abstraction adjacent to peatland sites have no adverse impact on the hydrology or the restoration of the habitat.

- Plot all abstractions adjacent to peatland sites and investigate hydrological impacts.
- Ensure that licences are granted to abstractions that do not impact on any area of important peatland habitat. Currently, only abstractions above 20m^3/day that may impact on designated mossland sites are currently licensed. Ensuring at the planning stage that developments needs for abstraction licenses are fully assessed could strengthen the protection of the water table. EA, SCC, WMBC, GMEU, LWT. Ongoing

4. Afforestation/scrub encroachments and the absence of targeted management for existing mossland habitat.

- Target mossland sites and either bring the sites into the ownership of environmental organisations or aid landowners to bring the sites into appropriate management.

- Management on mossland sites brought into conservation management will be aimed at controlling invading scrub/tree species, reducing water loss and controlling the water levels bringing the water table up to optimal levels for the growth of mossland vegetation. EA, NE, WT's, LA's, RRF, LBM. Ongoing

5. Habitat isolation as a result of fragmentation of existing areas, oxidation and compaction of peat deposits under agricultural management

Work closely with landowners adjacent to peatland areas to deliver a landscape scale mossland conservation vision. The development of mossland corridors will enable fragmented sites to be linked and reduce isolation. The development of complimentary wetland habitat adjacent to mossland sites will increase the sustainability of the core mossland habitat by aiding the retention of appropriate water levels. Working with landowners will ensure that operations undertaken on adjacent land will not damage the hydrological integrity of the mossland habitat. LA's, EA, NE, WT's, LBM, GMBP. 2015

6. Research the desirability of translocation of characteristic species into newly developed mossland sites

Many of the sphagnum species should be able to establish themselves naturally within the mossland areas. This should be monitored and the abundance of mosses assessed regularly. If then required donor sites should be sourced with the view to translocation of certain species if deemed necessary. WT's, LBM. Ongoing

7. Provide evidence and publicise Mosslands as an important Carbon Sink/ enhance public perception and opening up new avenues of funding for mossland conservation

The vital part peat deposits have in providing a carbon sink will be highlighted. The World's northern peatlands are its most important terrestrial carbon store; it is estimated that 20-30% of the global terrestrial carbon is held in 3% of its land area, i.e. in northern peatlands. Mosslands also have the ability to sequester carbon, if they are managed correctly. Wet mossland habitat that supports a good coverage of *Sphagnum* moss is therefore of significant environmental and economic importance. It is therefore vitally important to build up this new evidence base of the role mosslands have in locking up carbon thereby having a positive effect on climate change. The research will also enable new and initiative ways of funding the protection of the mossland resource. WT's, NE, LA's, EA, GMBP. Ongoing

8. Provide habitat within the mosslands suitable for breeding nightjar

- Identify areas on the mossland where the raising of water levels would not be possible and encourage the development of drier habitats such as heathland to encourage the colonisation by Nightjar.

- Within the mossland restoration areas, some sites will support higher drier habitat, which should also be managed for nightjar.
- The former peat workings at Astley Moss East, Little Woolden Moss and Chat Moss should be targeted to restoring heathland habitat on the drier areas, which should then be brought into appropriate long-term management. WT's, LA's, GMBP, LBM. 2015

By working closely with landowners adjacent to peatland areas, a landscape scale mossland conservation vision can be delivered. The establishment of good quality heathland habitat, merging into wet heath and mire will greatly increase the amount of suitable habitat available for breeding Nightjar.

LEAD PARTNERS

EA	Environment Agency
GMBP	Greater Manchester Biodiversity Project
GMEU	Greater Manchester Ecology Unit
LA's	Local Authorities
LBM	Local Biodiversity Manager
NE	Natural England
RRF	Red Rose Forest
SCC	Salford City Council
WMBC	Wigan MBC
WT's	Wildlife Trusts

Best practice guidelines

Pristine mossland will require little or no management, but as there are no examples of pristine mossland habitat in the Northwest, it is vital that appropriate management is undertaken on the remaining mossland resource. The damage to our mossland resource has been caused mostly through peat extraction and/or conversion to agriculture. This has resulted in the loss of vegetation cover, a loss of the peat dome and a massive reduction in water levels due to the installation of ditches and drains. Re-vegetation can occurred, although many of the characteristic species may have been lost. The viability of the seeds of many of the bog species is greatly reduced after only a few years and is therefore difficult to re-establish. The management to restore mossland habitat needs to reverse the past damage. This usually involves raising the water table to a level suitable for the growth of bog species.

The main objective of mossland management is to achieve:

- A range of mossland communities
- Optimal water levels for mossland vegetation, especially sphagnum mosses, which will be suitable for a range of other associated species.
- Prevention of serial scrub succession.

- Development of mossland corridors.
- Develop a range of small pools for aquatic plant species and Odonata etc.
- Management of non-native weed species as required.
- Control of disturbance and damage by human influence

It is critical to the successful restoration of mosslands to achieve the correct water levels. This is primarily achieved by the blocking of the drainage ditches.

Bund heightening to isolate peat compartments

Ditches can be blocked using a number of different materials, including peat plugs, plastic piling dams or marine ply dams. Usually a belt and braces approach is desirable and ply and plastic dams should be backed filled with peat to ensure a waterproof barrier. Advice should be sought from the Environment Agency, as consent may be required for any in channel structures.

The peat used to construct the dams should not be dry or too wet in consistency. If it were too dry, it would not provide a hydrological barrier. Too wet and it would be difficult to work with. Large vegetated turfs should also be avoided as these do not fit tightly together and provide access for water movement. Dams should be constructed so that water levels can rise to the best height to ensure the growth of bog vegetation, usually bringing the water levels to or just above the ground level.

In practice this is a matter of judgement, as mosslands are not an entirely flat environment. Some areas may become too wet, whilst others remain too dry. The position and number of dams will have to reflect this change in land levels. Collation of land level data will aid this process, providing information on the fall and rise of land throughout the site. Collation of waterflows will also be required to provide an accurate steer on the positioning of dams.

Bunding (raising land levels over a linear distance) works help to isolate the mossland from outside ground water influence and raise water levels. Again the land level and water flow data can be used to predict the best positioning of the bunds. The bunds have added advantage in that through the installation of pipes and right-angled bends, the level of water within the bunded areas

can be controlled. Water levels can therefore be manipulated and raised gradually as the colonisation process proceeds. The bund creation works also allows the creation of shallow scrape areas where bog vegetation can establish.

Plastic piling dams and peat plugs help raise the water table. Right-angled pipes can then be used to fine-tune the desired height.

When working peat to build bunds, the depth of the peat should first be assessed. Digging up too much peat may punch a hole in the peat mass and allow water to escape downwards. It is vital that enough ombrotrophic peat is present for successful restoration works. Surface vegetation should be skimmed off and the underlying peat used to create the bunds. Only the first 1-meter of peat should be removed. The skimmed surface vegetation should then be replaced after the peat has been removed. Mosslands have been shown to support populations of Water Vole and it may therefore be necessary to undertake vole surveys and mitigation works to ensure the protection of this species, if recorded.

Dipwells and staging boards can be installed to monitor water levels and how they respond to the restoration works. Fixed-point quadrates can be placed within the restoration area to assess the response of bog vegetation.

Impact of Invasive species

Particularly invasive species on mosslands are Downy Birch and Bracken. These can be managed through re-wetting of the mosslands, as well as, scrub clearance and herbicide spraying. Larger scrub and trees are removed from the mosslands, or used to block ditches, sometimes requiring specialised machinery to chip and remove.

Further information about control of invasive species can be found at:

Bracken control and management – Natural England

Bracken management in the uplands – RSPB

Bracken control, vegetation restoration and land management – Natural England

Links to relevant BAP's

Native Woodlands

Reedbeds & Bittern

Water voles

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