

## The rehabilitation of lagg fen to lowland raised mires in Cumbria, North West England. F.J.Mawby & A. Brock

### Introduction

The South Solway Mosses lowland raised mires comprise four SSSI's (Sites of Special Scientific Interest) Wedholme Flow (779 hectares), Bowness Common (759 hectares), Glasson Moss (224 hectares) and Drumburgh Moss (189 hectares). They are located on the South side of the Solway Firth in North West England. These four mosses form the South Solway Mosses SAC (Special Area of Conservation). Large areas of Wedholme Flow, Bowness Common and Glasson Moss are also designated as NNR (National Nature Reserve) mostly owned and managed by Natural England. Drumburgh Moss NNR is substantially owned and managed by the Cumbria Wildlife Trust. A number of other Landowners also own parts of the 'mosses' and most of these areas are managed under Management Agreements with Natural England. On Bowness Common a key land owner is the RSPB, (Royal Society for the Protection of Birds). To achieve the first lagg rehabilitation schemes English Nature (now part of Natural England) the RSPB and the Cumbria Wildlife Trust formed a working partnership.

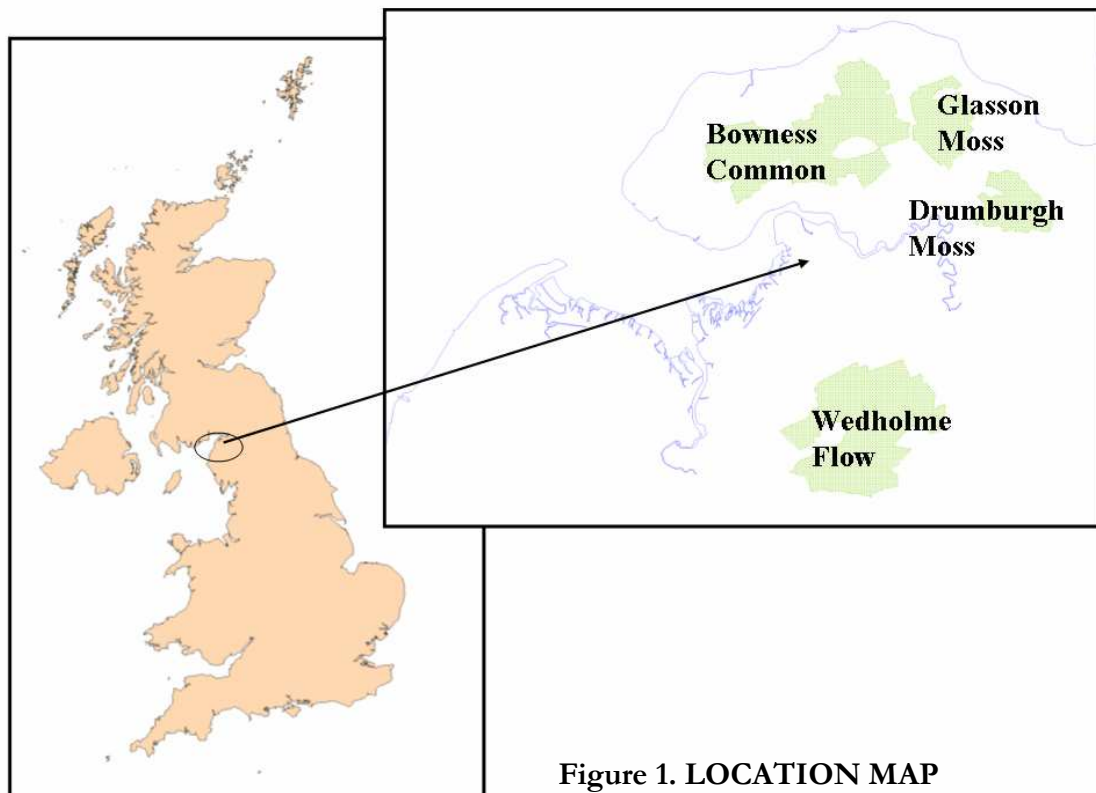


Figure 1. LOCATION MAP

### Historical background

These Mosses have been cut-over for peat for at least three centuries. During the nineteenth and early 20<sup>th</sup> century many local people cut peat to use as domestic fuel. The local history is complex but in summary during the early 1800's the mires were divided into many ownerships of various sizes. The method of peat cutting was to drain the mire edge and cut inwards, clearing the peat almost to the mineral soil and working to a vertical face. When cutting for domestic fuel finally ceased in the late 1900's several kilometres of the mire edge was left as a vertical peat face from 1 to 3 metres high. Much

of the cleared area was converted to agricultural land or became dry heath, scrub and woodland. The lagg fen was completely removed and drained.

Commercial peat exploitation commenced on Drumburgh Moss and Glasson Moss from about 1901 and it seems the peat was “compressed to be used as fuel” (Bulmers Directory of Cumberland 1901) it may also have been used to extract ‘Paraffin’ wax and oils. On Wedholme Flow cutting commenced at about the same time, possibly for horticultural and agricultural use. Large areas on Wedholme Flow and Glasson Moss and a small area of Bowness Common were more intensively exploited from 1948. The cutting ceased on Glasson and Bowness in 1954; however it was further developed on Wedholme Flow where it only ceased in 2000. Commercial exploitation occurred mostly on the deeper, intact peat and further reduced the rand and lagg. Bowness Common is the least cut over and is considered one of the best geomorphologically intact mires in the UK (Ratcliffe.D.A. 1977), notwithstanding considerable drainage works in 1845 (Bulmer 1901) and the construction of a railway line across the deepest peat in the 1860’s (Edgar.S & Sinton J.M. 1990)

Agricultural improvement has and continues to have a considerable impact on the lagg area. Much of this land is now highly productive grassland, including some on peat between 1 and 3 metres deep; notably around Bowness Common where over 120 hectares of the former mire has been drained and converted to pasture. The boundary between the mire and the farmland is usually a deep, well maintained drain. Where the drainage is no longer effective some fields have reverted to rush pasture, mostly soft rush *Juncus effusus*.

## **The project**

In 2000 a substantial injection of money into English Nature’s ‘Peatlands for People’ project enabled the first attempts to restore lagg fen and projects were carried out on Bowness Common, Glasson Moss and Drumburgh Moss. Project investigations and preliminary work also commenced on Wedholme Flow and work is ongoing on all of these mosses.

## **Project Selection and constraints**

A number of issues had to be resolved when selecting the project areas. Principally the problem of conflict with adjoining owners whose concern is that their agricultural fields will be made wetter. The project areas were chosen carefully to avoid this conflict, which meant the areas had to be within the current site boundaries and owned, leased or managed by the conservation bodies. If there was a possibility that adjoining land might be affected the landowners were consulted at an early stage. The choice was further restricted because the boundary of every site is mostly a drain between the mire and agricultural land intercepting water draining off the mire and also draining the field.

This raises the issue of hydrological protection zones, boundaries thought to be adequate 20 years ago prove less satisfactory when lagg rehabilitation is considered. The SSSI boundaries were determined between 1980 to 86 when the sites were designated under the 1981 Wildlife and Countryside Act using the Guidelines for the selection of Biological SSSI’s. The SSSI boundary was usually determined as the edge of the main peat body and only small areas of peat under improved grassland were included. The concept of hydrological protection zones that included areas of agricultural land was first issued in 1994. *The JNCC (Joint Nature Conservation Committee) guidelines (1994) require that this land should be included in the SSSI as ‘land judged necessary to provide and maintain the hydrological functions needed to conserve the special features of the site.’* The guidance is now available in:

## Morgan-Jones, W. Poole, J.S, Goodall, R. 2005. Characterisation of Hydrological Protection Zones at the Margins of Designated Lowland Raised Peat Bog Sites

The site knowledge of the Site Manager was an important factor in site selection. The acquisition of Rogersceugh farm on Bowness Common through the English Nature/RSPB partnership was a major achievement that enabled one of the larger projects to proceed.

### **Project Management**

To achieve the projects within the funding timescale it was decided to contract out much of the work. Consultants with the expertise and ability to carry out site investigations were selected by tender and interview. This comprised site survey and assessment work, drawing up plans and specifications, obtaining planning permission and land drainage consent, tendering the work and supervising and managing the contracts all of which fell within the CDM regulations (Construction Design and Management)

The site survey and assessment work included detailed topographical surveys over areas of very uneven ground. Modern surveying equipment was invaluable for this exercise, although it pre-dated the most recent developments in GPS. Surveys had to be done carefully for accurate positioning of bunds at 20 cm and 30 cm contours. (LIDAR is useful but should be used with caution because it only shows the top of the vegetation where the ground is covered by bracken, heather and Molinia.)

The catchments, existing drains and drainage and its relationship to adjacent agricultural land and local rainfall data were surveyed because this influenced the design of dams, outfalls and overflows. The volume of water flowing to lagg areas varies considerably because of the drainage and peat cutting. Some areas receive and drain relatively large amounts of water and others very little. The agricultural land catchments were surveyed for potential problems of eutrophication from enriched water and land drainage adjacent to the mire.

The depth and condition of the peat, water tables, cracks and fissuring of the main peat body, especially the area that might loosely be defined as the 'rand' slope was examined.

The mineral soils were examined to establish if they were glacial or estuarine in origin and whether they were impermeable clays or permeable sands and gravels.

The schemes were drawn up and submitted for Planning permission from the Local Planning Authority and land drainage consent from the Environment Agency. In the UK work that is deemed to be construction work has to be approved by the Planning Authority that will amongst other things look at the landscape issues and consult the local community. The plans are open to scrutiny by any member of the public and anyone may object. The Environment Agency is a Government body with powers that include land drainage and flood defence and any work that involves alterations to land drainage requires their consent. This ensures that the work will not change water flow patterns and volumes that might cause flooding or holds large volumes of water that might deem it to be a reservoir. Notwithstanding, both of these bodies have a duty to Nature Conservation and they would need very sound technical reasons for objecting to a scheme.

### **Factors influencing the schemes.**

#### **Cracks and fissures**

The old domestic cutting 'faces' presented several problems a major one being cracks and fissuring, which has occurred in many situations around the margins of the peat body and along drains. The drying and shrinking that occurs after drainage is the cause.

Cracks usually run parallel to a cut face or a deep drain. They are not always located until work is in progress or sometimes not until it is completed. In the latter case failure to retain water can usually be traced back to a crack. Following drainage peat becomes a porous, free draining medium, although it should be realised that this also gives some stability to the mire edge. In the shallow peat on the mire margins water drains freely and flows sub-surface at the mineral soil peat interface. This problem was discovered when work was in progress and caused changes in dam construction methods. Dry, cracked peat is a significant problem and finding where the water is flowing is a challenge and also illustrates why the mineral soil contours should be determined.

The cracks and fissures may also create a risk of 'bog burst', whilst perfectly stable when dry and drained some structural instability might arise when the peat is re-saturated. The drainage of peat bogs over many decades has consolidated the peat round the edges and as a general rule it seems to remain stable when re-wetted. However, there have been two instances in the Irish Republic and Wales where small rehabilitation schemes at the mire edge have failed. Water draining off a damaged bog is often channelled into preferred pathways and the entire peat column may be saturated turning it into a semi-liquid medium, a phenomenon first observed on Wedholme Flow.

The shape, structure and vegetation of the cut peat edge are a problem. The rand slope is over-steepened, often finishing at a vertical, stepped face down to very shallow peat or mineral soil with drains leading water away. Pine, birch and willow woodland and scrub, bracken, purple moor grass and rush are all characteristic species of the mire edge. Bracken *Pteridium aquilinum* is an indicator that the peat drains freely whilst Purple Moor Grass *Molinia caerulea* indicates a widely fluctuating water table. To achieve lagg fen and subsequent sphagnum peat development it is usually necessary to immerse these areas under shallow water for at least part of the year and into the growing season and maintain high water tables throughout the year. Scrub and woodland was usually felled and chipped and the chippings left on site. Where flooding was planned the scrub was left standing to die and eventually fall into the water.

Generally the mineral soils around the mire margins are heavy, impermeable glacial clays, although lenses of sands and gravels do occur. On the lower margins the glacial material may have been covered by estuarine sediments that may vary from free draining to relatively impermeable. The permeability and water table in the mineral soil may have been affected by the land drainage on the adjoining agricultural land and this might affect the design of the dams. This was a factor on Drumburgh Moss.

Agricultural land being rehabilitated was assumed to be rich in nutrients (residual nitrogen and phosphates) and this was an important factor in the scheme design, especially where the land drains down to the mire edge.

## **The Projects.**

### **Glasson Moss - North.**

This short section of the boundary was chosen because a narrow mineral soil ridge provided a natural boundary with the mire. It was probably the only section closely resembling a lagg on the entire moss despite damage from early 20<sup>th</sup> century peat cuttings; the drainage was the only problem preventing lagg fen reforming. The adjacent area of main mire is primary intact bog (Lindsay, R.A. & Immerzi, C.P. (1996) and provides large and diverse catchments. The natural drainage was modified by the cuttings and half the area drained north along a drain cut through the mire, the other half drained north east by a caravan park. Survey levels showed it was possible to dam the northern

drain and maintain the drainage that would avoid conflict with the caravan park. The old peat cuttings also provided good compartments for the damming

The main dams were constructed with peat 3 to 4 metres wide and a metre high and built on existing causeways that had been part of the former peat cuttings. This width provided access for machinery and public access. During construction work a problem arose when the machine operator noticed deep fissures in the peat that were clearly draining water. This was rectified where the peat was less than a metre deep by inserting a vertical polyethylene sheet membrane to stop the flow. In the deeper peat; up to 3 metres, a short length of plastic pile wall was inserted to seal the fissures.

Smaller dams 2 metre wide and 1 metre high were constructed where the water volumes were less and access was not required. Water flow and levels were controlled through the dams by a 300 mm diameter rigid, twin wall sewer pipe, fitted with a 90 degree elbow that could be turned to adjust the water level. There is a caution when using these elbows; they are difficult to turn and are easily dislodged. A sluice structure would be a more expensive alternative. However, it is anticipated that as the bog regenerates the outflow pipes will become redundant. The trees in the lagg area were left standing in the knowledge that they would die and eventually collapse into the lagg and become part of the natural system of regeneration. They also prevent wind and wave action and provide wildlife habitat.

The northern drain was dammed with plastic pile dams at every 30 cm fall in level. The pile length was double the depth of the drain to counter the head pressure and a horizontal support beam was installed to stop buckling under water pressure. This drain was 1.5 metres deep and the piles 3 metres long. This is the maximum recommended length for pile dams. The pile extended at least 1 metre either side of the drain to cover possible cracks and in some situations over 2 metres to provide shallow flooding in the drain valley. Piling of this length may be difficult to drive into mineral soil without a vibrating pile driver and almost impossible into stony mineral soil. Each dam was reinforced by backfilling 2 metres of the drain behind the dam with peat

### **Glasson Moss: South West.**

This area was intensively cut for domestic fuel during the 19<sup>th</sup> and early 20<sup>th</sup> century and the deep peat was opened up and drained for cutting from 1948 to 1954. The peat cuttings were rehabilitated between 1986 and 2003. Peat depths vary from none on the mineral soil to over 1 metre deep at the cut face where the peat depth then increases from 3 to 5 metres deep. The edge of the deep peat is badly cracked with lines of deep fissures up to 30 metres or more into the mire and which have already caused problems for rehabilitation. The birch scrub was cut and chipped and left on the surface. A narrow band of trees was retained along some of the edge.

The two small projects here were experiments for a future large project. The first was to construct a three metre wide bund along 50 metres of the deep peat face extending it a further 100 metres round an area of shallow cut away peat. The was well supplied with water and by managing this water through a series of pools the aim was to create lagg and to raise the ground water mound in the deeper peat.

The bund round the shallow peat area has been successful and created a form of lagg with good sphagnum regeneration. The only issue is that it should have been made some 30 cm higher because, despite being kept wet, it has shrunk and water is overtopping it in one or two places. The section of bund close to the deep peat face has not been

successful except in the higher pool which is well fed with water. The second pool has failed despite a good water supply. The leak is difficult to detect, there is no obvious outflow, and no surface flow beyond the dam. The problem seems to be the porosity of the fringe peat and this is causing a rapid seepage down to the mineral soil where the water flows undetected to the boundary drain. This problem materialised on later projects and the solution is to dig out the peat to the mineral soil, turn it over and press it back firmly with the machine bucket and squeeze air pockets to make it less porous. An alternative would be rebuilding the dam off the mineral soil and insert a water proof membrane. Bentonite clay matting could be an alternative to Polyethylene sheet.

The second scheme was to install a plastic pile curtain wall across the corner of the old cuttings in the deep peat. The aim was to intercept drains and fissures. The piles were 3 metres long and set along a contour. They were pushed in using the machine bucket just to the mineral soil. The piling is working on one section of cuttings but seems to have failed on another section. The problem has not been diagnosed but the water is either leaking through the pile joints or more probably it is going under the piling. A secondary problem is that another crack has been created. Driving the piling into the mineral soil and sealing the pile joints may be the only way to resolve the problem.

#### **Glasson Moss North and West.**

In 2006/07 a further experimental design was implemented taking the form of small 'paddy field' compartments with low bunds 1.5 metre wide and covered with heavy duty 'Hessian' erosion matting. The compartments were raised in 20 cm increments up the slope of the peat face. There are no overflows and the water is allowed to overflow over the top of the bund using the Hessian mat to prevent erosion. A similar project was completed on the eastern edge of Bowness Common in 2005.

#### **Bowness Common (Rogersceugh Farm)**

Rogersceugh Farm is on a Drumlin that is totally surrounded by the mire. Beyond the drumlin slopes much of the farm land is grassland on peat that was formerly part of the bog. This land was claimed from the bog from around 1878. Peat depths revealed that some of the peat is over 2 metres deep. Below the mineralised top layers the peat is still an intact sphagnum moss peat. The farm land drains east, south and west and in all directions drains were cut to take it through the Moss. The main access track comes up from the south and a second track goes out to the east.

The fields on peat had reverted to rush pasture and required re-draining. This also necessitated deepening the main drain through the moss. In the knowledge that this would be resisted by English Nature because of the damage it would do to the site and their imminent retirement the owners eventually agreed to sell the farm to the RSPB in partnership with English Nature.

A key issue that had to be resolved was agricultural enrichment both for the lagg fen and damming the main drain through the mire. The original idea was to pipe the water down the 600 meter length of drain through the moss and backfill over the pipe to re-wet the moss. This proved prohibitively expensive because the engineers deemed that the 600 mm diameter pipe would need anchoring on mini-piles to prevent it floating when the drain was dammed and flooded. The second solution was to install large peat dams across the drain at every 30 cm of fall with 600 mm diameter plastic overflow pipes fitted with 90 degree elbows. The water level was set to allow a period of lower than desired water levels whilst the farmland nutrients were flushed through. A collar will be added at a future date, when monitoring shows that the water is less eutrophic, to raise water

tables to the best attainable level. A steel mesh safety grill was fitted over the pipe outlet. Similarly around the interface with the former farmland and the good mire the water levels were set relatively low to allow for a nutrient flushing period of several years and to prevent nutrients affecting the intact mire vegetation.

Damming the drain between the farmland and the moss was a relatively simple operation. Peat dams with plastic pipe overflows fitted with 90 degree elbows were placed in the perimeter drain at every 30 cm of fall. However, the bottom of the drain was so soft that it was necessary to cut a ledge on the side of the drain for the pipe and surround it with clay, dug from a nearby area before building the dam with peat. A substantial peat dam was constructed at the point where the drain entered the Moss. Another was constructed across the upper field to allow for water levels to be raised in the future and to provide access to the moss. A third was placed across the lower field in a position determined by levels that would prevent water draining over the catchment to the east.

A small area of lagg was created at the end of the main drain on an area of former domestic cutting. The lower cleared area had an average of 0.5 metres of peat grading into a steep slope at the main peat face that rose some three metres to the main mire surface. The lower area was dominated by *Molinia*. The peat face and drain line was covered with birch scrub and it was cleared and chipped and spread on site. The area was surveyed to determine the positions of the low contour bunds that were installed. During the construction of the outer bund it was discovered that the water was draining through the shallow peat and flowing at the interface of the peat and the mineral soil. Bund construction was amended by digging out the peat down to and into the mineral soil, turning it over and consolidating it with the machine bucket; this seems to have been successful.

The old cut face was re-profiled and a low peat bund was constructed along it to slow down and trap some water in an attempt to induce sphagnum regeneration.

The project engineers were quite concerned about the cracks in the main peat body so close to the edge and the main drain that was flooded. After construction a leak appeared in the last dam in the main drain and the contractor was called back. The problem was a crack in the peat running parallel to the drain and it was excavated and the dam re-built.

The work seems to have been successful but the concerns about eutrophication were well founded and monitoring work suggests that it may take many years to resolve the problem. A idea being discussed is the development of a reed bed on the fields to take up the nutrients and provide a valuable habitat.

### **Drumburgh Moss.**

On the north and west side a large area of the Moss has been cut and cleared for both domestic fuel and early 20<sup>th</sup> century commercial cutting. An old railway line divides the cleared area. The area to the south of the old railway provided an ideal area for lagg and mire rehabilitation. The vegetation was mainly dry heath and scrub.

Frequent uncontrolled fires have prevented both the main mire and the cleared area from becoming covered with birch scrub and woodland.

The mire developed over marine sediments and a tidal creek pattern is clearly discernable in the cleared area on some of the old aerial photographs, the creeks clearly extend under the peat body. It was the opinion of a hydrologist consulted some years previous that these creeks may well be contributing to the drainage of the area and perhaps also the main mire area. The site offered an opportunity to rehabilitate a substantial area to lagg

Site investigations by the consultants required a detailed examination of the mineral soils. Four trial pits were dug two metres deep along the line of the proposed main bund. They showed that there was little or no peat remaining on a layer of clayey silt about a metre thick overlying a sandy substrate; both of estuarine origin. The sand became saturated with water at about 2 metre. This had an important bearing on the main outer bund design. The concern was that the water table in the sandy substrate was being lowered by the agricultural drains in the nearby fields and this could have an impact on any damming. The clay/silt layer was sufficiently impermeable to hold water relative to rainfall and it was decided that the main bund should be constructed with the silty clay, but the borrow pits would be no more than half a metre deep leaving half a metre of this relatively impermeable material intact over the sand. Machine operators would need to be well briefed and supervised.

The bund would also serve as site access and public access.

The remainder of the area up to the deeper peat was surveyed and sub compartmentalised on contours at 30 cm intervals in height and the bunds were constructed with the mineral soil but only 2 metres wide at the base.

Where present the scrub and woodland along bund lines was cleared by machine and piled up on site. Most of it was birch and it was left to rot down.

A few problems occurred in the following winter. Heavy rain soon filled the area and one of the outfall pipes in the main bund became blocked with debris; mostly dead *Molinia* stems, water over-topped it and erosion quickly breached it. Post construction maintenance and inspections are important to locate and quickly rectify problems like this. Leaks were also discovered through the smaller inner bund probably caused by the fact that the work was carried out during a dry period and the clay material was quite dry and blocky and consequently did not consolidate well. The problem was rectified by digging a 1 metre deep trench down the centre of the bund into the substrate and inserting a polyethylene sheet membrane.

The old cut face of the main peat body was the subject of another experiment. It was graded back to a slope of 1 in 20 and a continuous 2 metre deep plastic pile wall was pile driven into the mineral substrate at the foot of the slope. The aim was to stop deep water movement in the mineral soil and the old creeks and attempt to raise the water table and the ground water mound within the overall mire body. A concern raised to this part of the project was the creation of a bare peat area that would not readily re-vegetate.

A feature of this project was the overall scale of habitat disturbance.

After three years this 'eco-havoc' has largely disappeared and new vegetation has colonised. The lagg area has responded very fast and illustrates how quickly natural vegetation responds.

### **Wedholme Flow.**

The project on Wedholme Flow was on a 200 metre length of drain cut originally to drain peat cuttings round the end of the Lawrenceholme drumlin. This drain was up to 4 metres deep and over 5 metres and became redundant when the peat cuttings were converted to peat milling in the late 1980's. Trees had grown up along its length. Most of the trees were felled and chipped to get access to drain, other were left to be flooded.

Following much debate the solution that was finally decided was to install two steel pile dams. Piling over 5 metres long was driven in with a vibration pile driver suspended on a 360 excavator and supported at the top with a steel beam welded to the piles. A notch was cut in the top at the desired water level. The tree chippings and logs were backfilled into the drain and the peat edge was re-profiled and material backfilled into the drain.

The result seems to be have the desired effect although re-colonisation of the bare peat is quite slow after 3 years.

### **Outcomes and issues.**

The outcome of these early schemes ranges from very good to some local failures.

The least successful scheme is the sheet pile wall on Glasson Moss and the reason has not been diagnosed yet. This curtain wall may also create a new crack in the peat and add to rather than resolve the problem of cracks and fissures in the peat.

A number of lessons were learnt and some important discoveries were made during construction, in particular the problem of water draining through shallow peat and flowing at the mineral soil interface, which has direct consequences for dam design.

Cracking and deep fissures are a significant problem for rehabilitation schemes and need new solutions. They must be considered as potential areas of instability when rehabilitating lagg.

Dams constructed with the mire edge peat should be substantial, well consolidated and may need a waterproof membrane. Similarly clay mineral soil has to be well consolidated when it is used as dam/bund material if it is to form a watertight structure. Small structures are generally more prone to failure than large structures.

All peat dams require a substantial excavation of material and a rule of thumb is that the volume is about twice the volume of the dam. The excavation should be not more than half a metre deep and with good planning it should fill with water that will quickly regenerate with sphagnum, deeper water does not colonise quickly.

Large areas of shallow water are prone to wind and wave action that will erode peat and mineral soil until the vegetation re-colonises. Water level control outflow pipes need regular checks in wet, windy conditions to clear floating vegetation and dry peat sods that are the main cause of pipe blockage. This raises the question of the need for water control. Large volumes of water should be managed but it may be possible to allow smaller volumes to overtop bunds providing erosion controls are in place.

There are a number of designs for water control structures, they are important if water levels are to start off shallow and gradually increased as the vegetation develops.

A simple wave action control is to line the front of vulnerable dams and bunds with birch or pine scrub cuttings, which often has to be cleared before work commences.

Where a dam or bund is close to the main peat body raising the water table may cause the bog edge to become unstable and a big burst could occur.

Re-grading the margins of the main peat body (perhaps loosely described as the current rand) at the interface with old peat cuttings is an experiment and the effect of the first trials should be observed for a few years to assess the overall effect.

Eutrophication problems when rehabilitating agricultural land may take many years to resolve. A solution may be to establish a reed bed of Common Reed *Phragmites australis* to take up the nutrients. Stratigraphical studies show this plant formed a large part of the original lagg community in this area of the UK.

The rehabilitation of lagg fen to the whole mire will take many decades to achieve. In the short term it is hoped that the agri-environment schemes may help to secure further lagg rehabilitation schemes. Nevertheless several landowners are apprehensive about having wetland next to their farmland and much consultation will be necessary. Further land purchase may be necessary and the boundaries of these legally designated sites may need to be re-drawn if a fully functioning lagg is to be possible, this will be a long and complex

process. However, hydrological protection zones are essential if the rehabilitation of lagg zones is to make progress and the overall protection of the mire is to be achieved.

Tree removal is not necessary in every case, standing dead trees may look unsightly but provide good habitat. If they are cut down it may not be necessary to remove all of the material, it can be used for erosion control or chipped and used to backfill drains or just left. Woody material becomes damp and seems to attract sphagnum mosses, which soon overwhelm it.

Finally any scheme to rewet land will allow little scope for machinery to return to carry out more work, unless the whole area can be drained and dried out.

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