MONITORING PRESCRIPTIONS
SE BOG OF *CORS CARON NNR*

Ken Parry, Countryside Council for Wales

Note: This report reflects the ideas put forward by the workshop and not necessarily those of CCW.

1. Brief Site Description

Cors Caron NNR is owned by the Countryside Council for Wales (CCW) and contains three separate raised bogs which have developed in a flat valley bottom around the upper reaches of the River Teifi. The site has been surveyed accurately and a contour map has been produced (contours at 0.5 m intervals); it has also been marked out on a grid, using galvanised earth anchors at every 200 m intersection. This prescription is restricted to the south-east bog for which most knowledge is available.

The south-east bog is at an altitude of around 160 m and is located approximately 2 km north of Tregaron (Grid Ref. SN 682 620), Dyfed, Wales. The original bog extended to approximately 120 ha, but around 102.5 ha (85%) of this has suffered from extensive drainage and peat cutting, particularly around the perimeter of the central dome, with peat having been removed up to a depth of 5 m in places. In this area the vegetation is dominated by thick, tussocky *Molinia caerulea*, although some wetter peat cuttings support good open *Sphagnum* communities with abundant *Vaccinium oxycoccus*. There is still an estimated 3-4 m depth of peat remaining in this area. A series of large drains (approx. 3 m wide & 1-2 m deep) were also dug around the edges of the remaining area (17.5 ha) of intact central dome in preparation for peat cutting. This never took place and there is up to a 10 m depth of peat on this part of the site.

The peat cutting has created a marked height difference between the centre of the intact dome and the edges of the original peat body, which has been estimated from site survey as a fall of approximately 5 m over a horizontal distance of 550 m. This height difference is particularly marked on the edges of the intact dome, where there is a sharp rand slope over a relatively short distance which falls up to 1.5 m in 20 m. This means there is quite a considerable flow of water away from the central dome to the surrounding area, which is not helped by the remains of old peat workings and drains on the edges of the intact dome. This work lowered the water table considerably and has been causing a shift in the vegetation of the central dome from one typified by pools and hummocks towards wet heath, with much *Trichophorum cespitosum* and *M. caerulea*, although there are some pools remaining.

The site is known to support the rosy marsh moth, a nationally rare species restricted to Wales (2 sites), which is presumed to feed on *Andromeda polifolia* (its normal food plant is *Myrica gale*, but this is absent), but this species is not monitored. The large heath butterfly (a threatened species at its most southerly site in Britain) is also present on site and is monitored by using the standard butterfly transect technique. No other invertebrate monitoring takes place and this group have been excluded from consideration in this prescription.

1.1 Site Management

Action to restore the hydrological integrity of this bog started in 1988 and the large drains around the eastern edge of the intact dome were the first to be dammed. Since then further extensive damming work has been undertaken around parts of the perimeter of the 'original' bog, installing a series of peat embankments, with water being sluiced through each embankment to progressively lower ground before being released into a nearby drain running into the river. This has produced marked rises in water levels (un-quantified), drowning some of the *M. caerulea* dominated vegetation close to the edges. Baseline monitoring has been undertaken to monitor the effects of this (see Section 8). During the summer of 1992 a small amount of work was undertaken to dam the remaining drains and peat cuttings on the western slopes on the edge of the intact dome.

Additional capital works are required to complete the damming of peat cuttings on the north-west edges of the 'original' peat body, for which costs are difficult to estimate. During this work an archaeologist should be available on site to undertake a watching brief (Lampeter College, University of Wales, would be the best place to contact for further advice).

2. Management Objectives

Management of the site to date has had two main aims:

a) In the area around the intact dome it is to raise and maintain the water levels sufficiently high to kill off/reduce the overwhelming dominance of *M. caerulea*, increase the diversity of the vegetation, and contribute towards maintaining the water table on the intact dome.

b) Work on the dome has been done in an attempt to force the run off sideways over the bog surface and so increase surface wetness and reduce the rate at which water drains down the rand slope. By helping to retain water it is hoped that there may also be beneficial effects on the vegetation, particularly in terms of the restoration of a more complete cover of *Sphagnum* spp.

3. Monitoring Objectives

3.1 Hydrology

To demonstrate how effective the management works have been at raising, maintaining and stabilising the water table, and slowing the rate of water flow off the peat dome.

3.2 Vegetation

Objectives for the cut-over areas is to see whether the quality of the vegetation is improving: in particular, is the dominance of *Molinia* declining and is there an increase in the diversity/cover of other species?

For the central dome, is the vegetation responding to any increased wetness (around the centre & on the rand slope)? This is probably best illustrated by looking for increases in the frequency/cover of *Sphagnum* spp. No increase in the frequency/cover of Molinia would also be an encouraging sign.

4. Methods and Techniques

4.1 Hydrology

A rain gauge, R16 continuous water level recorder and peat plate are already in position, and have been on site since 1980/81; a lysimeter was installed on the edge of the peat cuttings dammed in 1988 soon after that work was completed.

There has been no recording of water levels on the flatter ground affected by peat cutting to monitor how water levels have changed following the embankment work. It was agreed that 2 electronic continuous water level recorders (A&P Chambers type) should be installed to address this situation, placed in the northern and southern parts of the site (although ideally water levels should have been monitored before management work was undertaken).

To monitor water levels in the flooded areas close to the embankments it was suggested that a staff gauge (stage board) should be installed near the sluice in each of the embankments; it would be possible to take readings of these from nearby vantage points using binoculars. If a v-notch weir was put in some/all of the sluices, readings from them and the stage boards could be used to help measure the rate of surface water loss from the system.

In case there are any effects on the water levels/drainage on immediately joining land to the south of the site, it was suggested that a simple maximum/minimum recorder (WaLRaG) should be installed and readings taken at monthly intervals (more frequently during periods of heavy continuous rainfall). There was insufficient knowledge about the hydrology of the site amongst group members to know whether this was a real problem and this recorder may be unnecessary.

8 water samples are collected every month from the flooded workings to monitor any effects of roosting gulls/wildfowl on water quality, which may influence any subsequent development of the vegetation.

4.2 Vegetation

The first requirement is for a habitat map of the site to illustrate the distribution of the main vegetation communities and the approximate position of the boundaries between them. This will be particularly valuable in helping to demonstrate whether the area of *Molinia* dominated vegetation is contracting/expanding.

Insufficient time and lack of quantitative knowledge about the variability of the vegetation meant that no decision could be reached about numbers of sample quadrats required for the following monitoring proposals:

a) On one of the peat cutting areas install a series of fixed permanent quadrats (0.5 m x 0.5 m, subdivided into 25 cm x 25 cm cells) along transects running from the edge towards a point below the rand slope of the intact dome (see Figure 1 for positions). Within each subdivision of each quadrat record the cover of all species according to the following scale: 3 - dominant (>70%), 2 - sub-dominant (10-70%) and 1 - scattered/rare (<10%).

b) On the uncut peat surface around the centre of the dome install a series of fixed permanent quadrats (0.5 m x 0.5 m subdivided into 25 cells, 10 cm x 10 cm). Within each sub-division record individual species presence/absence together with an assessment of the total % cover of *Sphagnum* spp. using the following cover scale: 5 - > 80% cover, 4 - >60-80% cover, 3 - >40-60%, 2 - >20-40%, 1 - 2-20% and + - <2%.

It may also be considered worthwhile to record the cover of *Molinia* on the same scale. A similar set up would be required on the rand slope to monitor any effects of the damming work, though the number of samples required would be less.

At present the peat surface is sufficiently firm and *Sphagnum* cover sufficiently low that it is considered there is less need to be concerned about the effects of trampling damage on the vegetation in and around the quadrats. Nevertheless, using a board or short ladder to help spread body weight whilst recording will help to reduce direct trampling of the vegetation in the immediate surroundings of the quadrat and keep damage to a minimum.

Individual photographs (slide or print) should be taken of each quadrat during the baseline recording, with two copies of each (for slides it is better to take two identical shots than copy a single slide afterwards). Repeat photographs should only be taken on subsequent occasions when a change from the original print is discernible. It is debatable whether the extra costs of taking stereo pairs of slides are warranted given the generally tall nature of the vegetation, particularly in the *Molinia* dominated areas.

The frequency of recording in these areas is difficult to judge and is likely to differ for the two areas. In the peat cuttings changes will probably be slow, and after inspecting the quadrats 3-5 years after the baseline it may be that a 5-10 year interval will be suitable. On the dome changes may be quicker and annual inspections may be appropriate in the first few years before deciding on a wider interval.

5. Resource Implications

Estimates of likely costs are difficult to agree on so the following figures are only a very approximate guide and more accurate figures would need to be costed out. Much of the actual recording could (should?) be done by CCW staff.

Completion of the damming working is likely to be a significant capital cost, given that £14,000 has already been spent on damming works, particularly since the network of cuttings on the NW edges is extensive and complex. It is not possible to estimate costs for this work, which should include an additional sum towards the costs of an archaeologist. Additional equipment for hydrological monitoring was estimated to cost £3,000 + VAT, to include the costs of computer training in the setting up and use of spreadsheets. In terms of time required, it was estimated that approximately 4 days per month (summer) would be required to undertake hydrological recording and subsequent data entry/analysis.

Vegetation recording was estimated to require an average of at least 6 days field recording together with around 3–4 weeks to analyse the data and report on the results. This is likely to be required every 2 years on average, but this will need to be reviewed and amended in the light of experience. Health and safety regulations may require that two people need to work on site which is likely to add to costs significantly.

The hydrological and vegetation recording is likely to cost an average of at least £2500-3500 per year, including some allowance for overheads (but may be significantly more).

6. Data Collection, Storage and Analysis

This was only very briefly addressed by the group to the extent that standard computer spreadsheets would need to be designed and used for data entry/storage. Data analysis was not discussed.

7. Reporting and Feedback

The results of hydrological monitoring should be reviewed monthly and annually to determine whether the recording intervals are appropriate and gauge the effectiveness of the management works. Any problems (e.g. excessive water loss from the system) should be identified and dealt with where feasible. Results of the vegetation monitoring should similarly be reviewed after each recording to assess the effectiveness of management works.

A brief report should be produced annually, and should be circulated to key CCW staff, adjacent occupiers whose land may be affected and other appropriate persons/organisations to whom the results may prove of value. The results of this work will determine the effectiveness of management works and help towards the decision on whether this approach is worth using on other parts of this reserve and other sites where similar situations exist.

8. Actual Monitoring

Apart from the equipment already installed to monitor the hydrology there are two vegetation monitoring projects in progress on the site.

In the area flanked by the 1991 works a series of 22 pairs of 0.5 m x 0.5 m permanent quadrats (subdivided into 4) were positioned along 5 transects in 1991. Species cover in each quadrat subdivision was assessed using the 5-point cover scale given above. Colour photographs (prints) were taken of each quadrat, where the vegetation was not overwhelmingly dominated by *Molinia*.

In the area affected by drain blocking in 1992 5 pairs of contiguous quadrats (0.5 m x 0.5 m, subdivided into 16) were permanently marked in 1993. In each subdivision species presence/absence was recorded, together with a record of which species dominated the cover, and a colour print of each quadrat was taken.

9. QUESTIONS RAISED

Tim Jacobs, Scottish Natural Heritage

Q: enquired whether any baseline information was collected prior to undertaking the management works.

A: No vegetation recording had been done but the R16 water recorder has been in place since 1980/81

National Trust, Northern Ireland

Q: asked why the transects did not cross the vegetation boundary between the flat peat cutting area and the rand slope of the intact dome

A: This monitoring was specifically installed to see if the raised water levels had any effect on the dominance of *Molinia* on the flatter peat cuttings (though note that no direct monitoring of changes in the water levels was set up). In any case the steepness of the slope between the edge of the rand and the lower lying ground was such that it was highly unlikely that the effects of the embankment work would have any effect here.

Brian Johnson, English Nature

Statement: Highlighted the fact that no specific targets were set in the monitoring objectives.

Response: Admitted this omission but explained that setting targets was considered to be complicated (since we do not know what the site was like before it became degraded). It was difficult to quantify when mire vegetation had reached the stage when it could be considered representative of the desired habitat type/condition (setting a target of a particular NVC type is NOT adequate), unless one was content with setting some arbitrary value for desired *Sphagnum* spp. cover/frequency, for example. Nevertheless, such a decision must be reached and this may be the only practical approach: it would require consultation with persons having more knowledge about these habitats to help advise on a sensible target cover/frequency value.

AN IDEAL PEATLAND MONITORING PROGRAMME FOR *BELL CRAG FLOW* BORDER MIRES NORTHUMBERLAND

John Dunbavin : Northumberland Wildlife Trust.

1. Site Description

Name :	Bell Crag Flow.	Status :	None.
Grid ref :	NY 772 724	Site Area :	70 ha
Altitude :	320 m		

The Border Mires are a collection of 48 peatland sites located in western Northumberland which, due to afforestation, are mostly surrounded by conifer plantations. They have considerable wildlife conservation value because of their undisturbed nature and ombrogenous plant communities. Bell Crag Flow is one of these mires, located within Wark Forest, 45 km north-west of Newcastle.

The site is composed of a number of hydrological units which have fused together to form one (Lowe 1993). Bell Crag Flow is a valley mire running in an east-west direction connecting two spur mires to the west named, Byreshaw Hill Moss and Todd Crags Moss. Bell Crag has had central peat depths over 9 m recorded.

Bell Crag is artificially divided in two sections by a Forestry Commission road (refer to map). The eastern section has been used for commercial peat extraction and has approximately 35 extraction trenches cutover at 22 m spacing, 5m wide and 1m deep running in a north-south direction across the peat surface. These trenches are also connected up by east-west running drainage ditches. The western section of Bell Crag is relatively intact having had a number of drains already dammed.

The site vegetation corresponds with the M18a - *Erica tetralix - Sphagnum papillosum* mire with *Sphagnum magellanicum - Andromeda polifolia* sub-community of Rodwell (1991). The ridges of the cutover section have plant species similar to the intact section, however *Calluna vulgaris* and areas of bare peat are to be found in greater occurrences where *Sphagna* and other ombrotrophic species appear to have declined considerably (Dunbavin 1994). The lowering of water table levels due to peat extraction and drainage has also resulted in a reduction in surface microtopography across the cutover section and large areas of bare eroding peat on the mire margins are clearly visible.

2. Management Objectives and Measures

Management of the Border Mires is carried out by owners and managers of the majority of sites (Forest Enterprise, English Nature, Northumberland Wildlife Trust, Northumberland National Park) and various academic interests. The main management activities have been under the guidance of the Border Mires Management Plan involving mainly drain blocking, using plywood dams, and conifer removal. The aim being to conserve and restore the hydrological integrity of many of the mires which had been damaged by past attempts at drainage.

Bell Crag Flow however has further problems created by peat extraction and therefore sit specific management objectives can be summarised as:

- To restore an active mire system to Bell Crag Flow.

- To maintain water table levels of the intact mire section in order to conserve the present plant communities (M18a).

- To raise water table levels on the cutover section in order to restore plant communities similar to the intact mire.

These objectives are to be achieved by a programme of damming the east-west running drainage ditches on the cutover section in order to reduce water loss from the mire. Plywood dams sandwiching 2 m of infilled peat will be installed starting at the western end of the ditches and progress eastwards as funds and manpower permit.

3. Monitoring Objectives

The recommended objectives for monitoring on Bell Crag Flow are solely concerned with determining the success or failure of damming cutover drainage ditches. However, management activities on the cutover section may affect the intact which is equally important. A number of monitoring objectives can be identified:

- To monitor for hydrological change on the intact mire section.

- To monitor for hydrological and vegetation change as damming operations progress eastwards across the cutover mire section.

- To use the data obtained as a tool to secure further funds for continued damming operations.

4. Monitoring Methods and Techniques

The monitoring should be aimed initially at gathering data before management activities occur - baseline data to use as a comparison with future monitoring results. The intact mire section is currently being monitored (see below) therefore further methods and techniques focus on the cutover section. A baseline data set should be gathered for a minimum twelve month period to include seasonal variation, and then continue as management activities begin.

1. Continue with the present hydrological monitoring on the intact mire section using the twelve dipwells already installed. These are spatially arranged to provide information into water table level variability across the mire with one year of data being available.

2. Continue collating daily precipitation data from Cawburn Shield Farm (Grid ref : NY 726 683), a nearby recording station operated by Northumberland National Park.

Vegetation data

3. To monitor long term changes in vegetation using permanent quadrats, strategically placed in positions where habitat change would be expected as water levels rise. Places decided by an initial survey would include the edges of drainage ditches, the middle of ridges, areas of bare peat and the boundary line between open water and ridge sides. The cover values of indicator species (*Sphagna*, *Erica tetralix*, *Calluna vulgaris*, any species of note and bare peat), should be recorded in quadrats measuring 0.5 × 1 m, divided into a 10 cm grid to increase accuracy. Trampling affects on the quadrats during recording should be minimised using ladders laid on short posts inserted next to quadrat sides.

4. Fixed point black and white photography should be used to monitor general site topography and large scale vegetation change. Seasonal variation needs to be recorded therefore summer and winter monitoring is recommended.

5. Fixed point photography taken directly over the permanent quadrats should be used to monitor small scale vegetation change. This provides further information into vegetation change within that quadrat, other than cover values.

Hydrological data

6. Two transects of dipwells running in an east-west direction should be installed, one running along the southern cutover edge and the second along the centre on the uncut ridges. These should be located to the immediate east and west of each dam constructed so as dam installation progresses eastwards, water level changes in each successive dipwell can be observed.

7. Dipwells should be placed next to a number of key permanent quadrats to enable water table level change to be directly related to vegetation change.

5. Resource Implications

The monitoring scheme has endeared to utilise the minimum resources needed but remain effective enough to identify any trends operating on the mire. As well as financial, human resources are the main limitation which restricts the monitoring to vegetation and hydrology. The mire's remote location and staffing of the Trust limits any monitoring to infrequent recording, which has implications of missed data opportunities. It is therefore recommended that at least four WALRAGs are installed, located towards each end of the transects.

6. Data Collection, Storage and Use

Collection

Hydrological data should be collected on a monthly basis or during important events - periods of drought/floods, the latter dependant on whether WALRAGs are used. Vegetation and photo-monitoring should be on an annual or every other year time scale.

Storage

The hydrological and quadrat data should be entered directly into a spreadsheet package to minimise the chances of lost data. The prints and negatives from photo-monitoring should be carefully documented in relation to quadrat and fixed point number, marking on the date and stored with a site map in hanging file sheets.

Use

The spreadsheet package used to store the data should be capable of generating data plots providing a useful tool for analysis. Plots of each dipwell can be displayed to highlight changes visually, while precipitation records help to distinguish the seasonal variation of water tables. Vegetation change at each quadrat similarly, can be shown in relation to the indicator species recorded using graphical methods such as split bar charts. The comparisons of baseline and long term data will provide information into how effective management is being with trends such as consistent rises in water table levels, increases in *Sphagna* and decreasing bare peat cover being information of value. Photo-monitoring can verify the above by comparing long term images.

The data should be reviewed on a regular basis to determine if the monitoring objectives are being met, and if not changes made to the monitoring scheme. The data should also be used as a positive feedback mechanism for the management activities. If the management objectives are being met then further work is justified, if not management techniques may need modifying. The analysed data, if confirming effective management, can then be used as a tool to obtain funding for further dam installation.

7. Present Monitoring

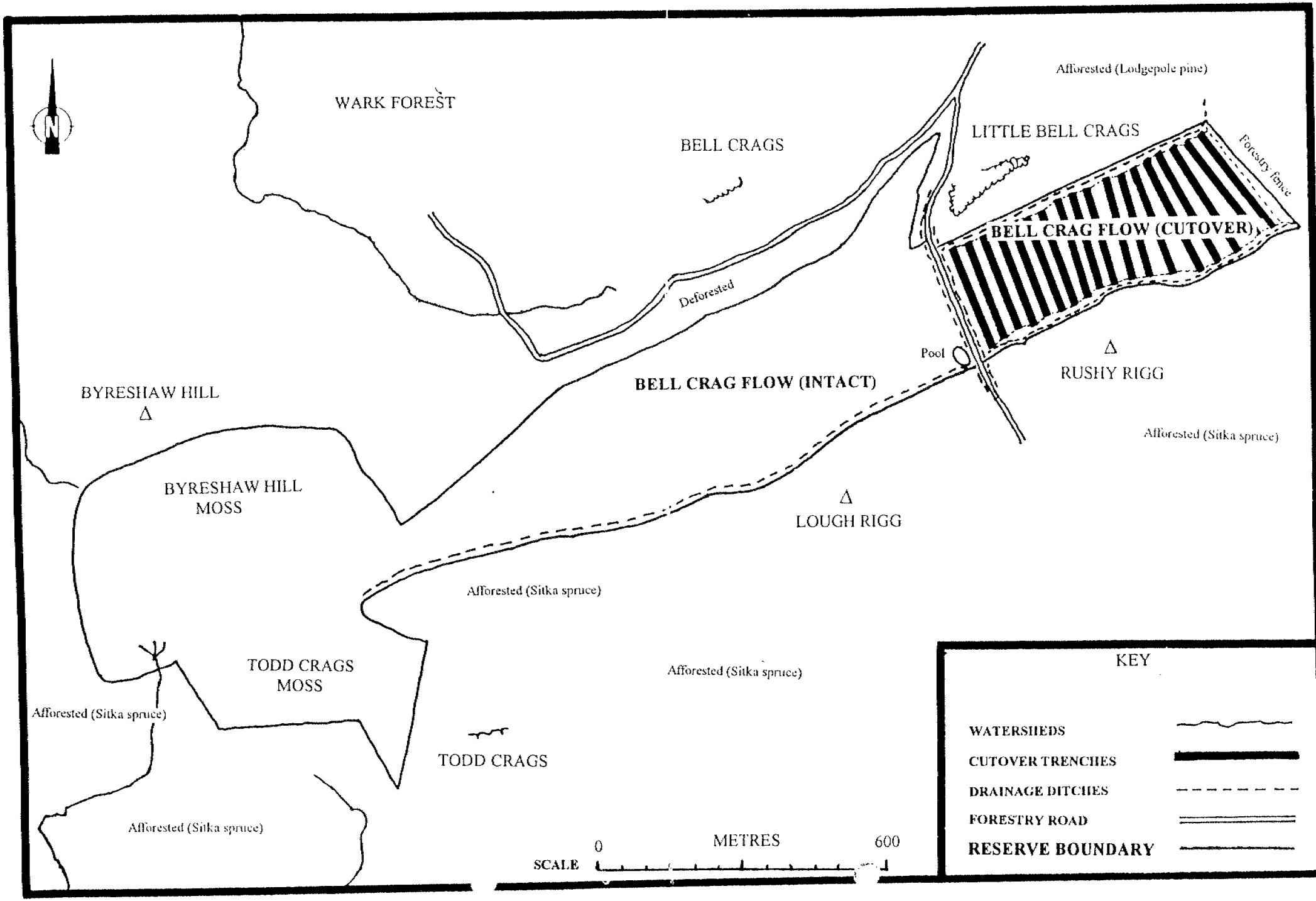
The present monitoring on the cutover section of Bell Crag Flow consists of infrequent water level recording from seven widely spaced dipwells, arranged so as to determine water table variability across the whole section.

References

Dunbavin, J. (1994). An investigation into the effects of peat extraction on Bell Crag Flow : An ombrogenous mire in Northumberland. *Unpub. BSc. Dissertation.* University of Sunderland.

Lowe, S. (1993). *Border Mires: Redefinition of hydrological boundaries (1992 -1993).* English Nature, Newcastle upon Tyne.

Rodwell, J (ed.) (1991). *British Plant communities. Vol. 2 : Mires and Heaths.* Cambridge University Press.


N
WARK FOREST
BELL CRAGS
LITTLE BELL CRAGS
Afforested (Lodgepole pine)
Forestry fence
BELL CRAG FLOW (CUTOVER)
Deforested
Pool
RUSHY RIGG
BELL CRAG FLOW (INTACT)
BYRESHAW HILL
Afforested (Sitka spruce)
BYRESHAW HILL MOSS
LOUGH RIGG
Afforested (Sitka spruce)
Afforested (Sitka spruce)
TODD CRAGS MOSS
Afforested (Sitka spruce)
TODD CRAGS
Afforested (Sitka spruce)
KEY
WATERSHEDS
CUTOVER TRENCHES
DRAINAGE DITCHES
FORESTRY ROAD
RESERVE BOUNDARY
SCALE
0
METRES
600

Langlands Moss Monitoring Proposals From The 1994 Solway Mosses Workshop

Stuart Brooks. Scottish Wildlife Trust

1. Introduction

1.1 Background

Several initiatives have been brought together to culminate in the development of the Langlands Moss project. with the main aim of designating and managing the site as a Local Nature Reserve.

In brief these are:

1 East Kilbride District Council Local plan policies; highlight areas of ecological and conservation value for possible LNR designation.

2 East Kilbride District Council - Calderglen/Langlands Recreational Path Project; the council has identified initiatives to increase the provision of public footpaths. Part of these plans involve the creation of a pathway from the Calderglen Country Park, alongside the Calder Water across Langlands Moss and back to Calderglen.

3 East Kilbride Development Corporation - Woodland Regeneration Project: As part of a "wind down" process the corporation is to dispose of its assets (the pine plantation on Langlands being part). Due to the conservation potential of the site they have agreed to harvest the plantation in a manner amenable to raised bog rehabilitation.

4 Scottish Wildlife Trust - Scottish Raised Bog Conservation Project: The Trust is co-ordinating the Scottish Raised Bog Conservation Project, on behalf of the European Commission, which aims to develop a strategy to conserve Scotland's raised bogs. Part of the project involves the investigation of bog rehabilitation techniques.

A steering group comprising members from the above and Scottish Natural Heritage was established in January 1994 to prepare and help implement a management plan (as part of the LNR designation process).

The site is currently under dual ownership. The afforested section and adjoining land to the south east is currently owned by the East Kilbride Development Corporation. The remaining area of bog is owned by East Kilbride District Council. The whole site will come under ownership of the District Council from April 1st 1995 following the winding up of the Development Corporation.

Given that 30% of Scotland's raised bogs are wooded (Lindsay et al.1993) there is a considerable potential for expanding the active raised bog resource through rehabilitation of afforested sites. Unlike milling or block cutting it is only the acrotelm that is effectively removed, leaving the catotelm relatively intact beneath the wooded surface. The role of monitoring would therefore be vital in providing evidence to further other similar initiatives.

1.2 Site Details

Name: Langlands Moss Status: Proposed Local Nature Reserve.

Grid Ref: NS 635 511 Area: Approx 25 ha.

OS Map: OS 1:50,000 Map 64.; 1:10,000 NS 65 SW

Ownership: East Kilbride Development Corporation - Afforested.; East Kilbride District Council - Open.

1.3 General Description

Langlands Moss (refer to map) is a relatively large area of primary (not cut-over) raised bog and exhibits a marked domed appearance. The western half has been afforested with Sitka spruce (planted c. 1950's). The site is bordered by a golf course, agricultural land, light industrial development and woodland/fen. The adjacent land-uses have had some impact on the site through drainage and peripheral peat extraction.

However, the unforested area still contains species typical of raised bog. Due to peripheral peat extraction, drainage, afforestation and a lowering of the ambient water-level there has been a subsequent loss of pool and lawn vegetation communities. Presently, hummock (drier) vegetation communities dominate the site, represented by dominant stands of *Calluna vulgaris* with associated *Erica tetralix* (in wetter areas) and *Eriophorum vaginatum*.

Sphagnum capillifoloim is the commonest *Sphagnum* species with other abundant bryophytes being *Pleurozium schreberii, Hypnum cupressiforme, Polytricum alpestre, Aulacomnium palustre* and *Odontoschisma sphagnii*.

Variety is increased on the marginal slopes by the flushing of erosion runnels which tend to support wetter community types such as *Sphagnum magellanicum, Sphagnum tenellum, Eriophorum angustifolium* and *Narthecium ossifragrum*.

Generally the afforested side is far more *Calluna* and *Cladonia* dominated. Not all the trees planted have grown successfully, leaving a mosaic of uneven size and densities. Open areas within the plantation are dominated by *Calluna vulgaris* across the ridges and *Sphagnum recurvum* within the ditches. Self sown *Pinus sylvestris* is also common.

The main area of damage relates to afforestation where the acrotelm has been destroyed through tree planting with its associated ploughing, drainage and shading impacts. Due to afforestation there is a net decrease in the amount of water entering the system (Gash,Wright and Lloyd, 1980) due to losses incurred from direct evaporation, increased transpiration and surface drainage. The lowering of the water-levels on the afforested section will ultimately cause a subsequent lowering of the open bog water-levels.

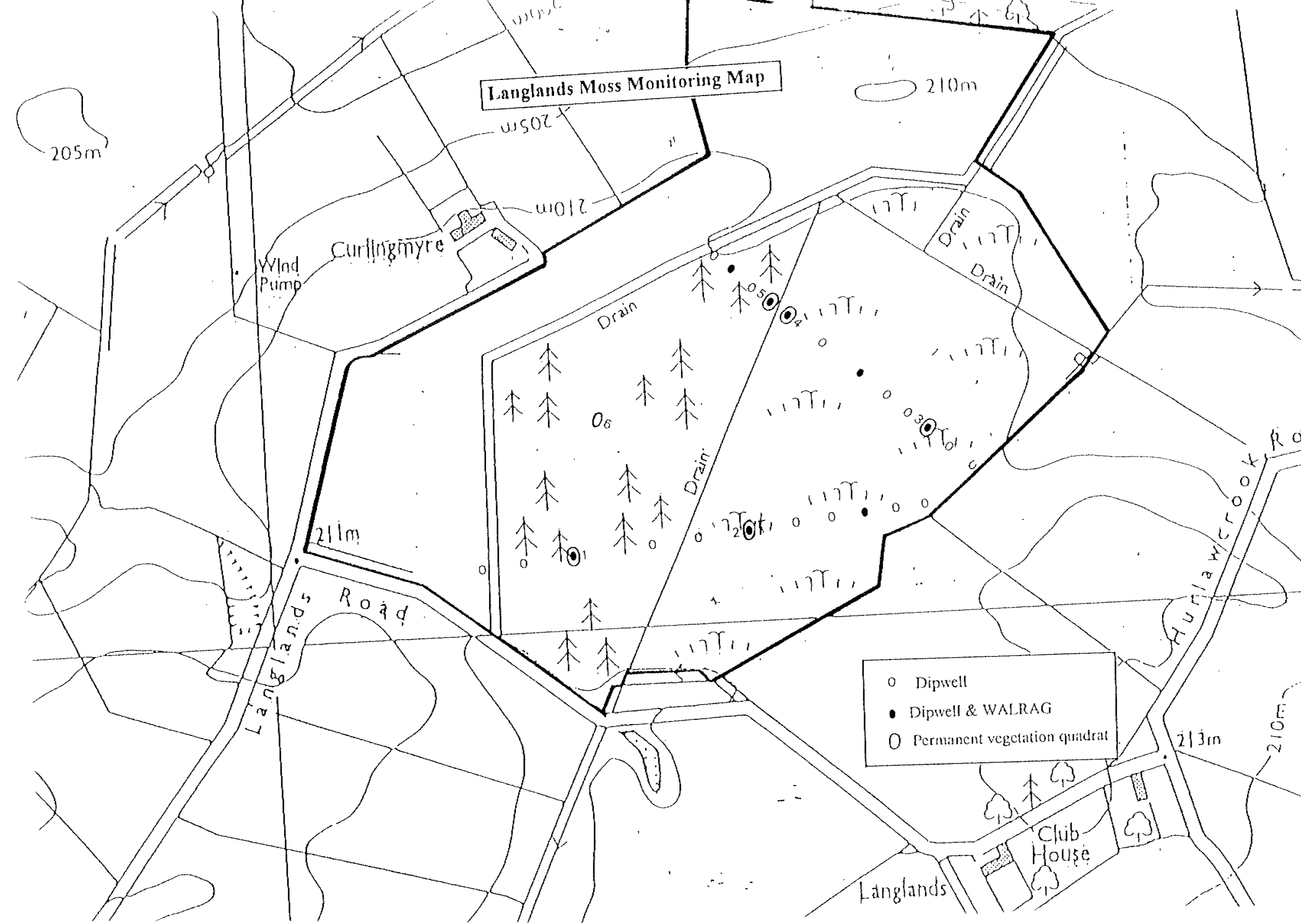
2. Management Objectives

1. Conserving Langlands Moss as an active raised bog:

- To remove all plantation and invasive species from the raised bog.
- To manage and maintain water-levels to promote the growth of raised bog species across the site.

2. Scientific Research and Monitoring:

- To record detailed botanical and hydrological data prior to and after practical management initiatives.
- To establish long term practical site monitoring.
- To encourage further applied scientific research.


Langlands Moss Monitoring Map
205m
210m
Curlingmyre
Wind Pump
Drain
Drain
Drain
Drain
211m
Langlands Road
Hurlaw Crook
213m
Club House
Langlands
Dipwell
Dipwell & WALRAG
Permanent vegetation quadrat

3. Education:

- To incorporate educational programmes within the Scottish National Curriculum.
- To promote controlled educational access for practical projects.
- To explain the natural heritage of bogs within a local, national and international context.

4. Public Enjoyment and Interpretation:

- To involve the local community with the site.
- To provide safe, controlled public access.
- To interpret, market and publicise the site.

3. Management Techniques

3.1 Tree Removal

The felling operation must leave the site surface as suitable for *Sphagnum* recolonisation as possible. The exact requirements and mechanisms for *Sphagnum* recolonisation from coniferous plantation harvesting are not yet known. The following represents the aims defined by available knowledge at the moment:

- Avoid excess damage to the surface topography.
- Avoid increased nutrient inputs from brash/needles.
- Avoid leaving large quantities of brashings on site which may cause nutrient inputs and shading effects.
- Remove the whole tree, cutting as close to the surface as possible.
- Avoid leaving trees on site for any length of time.
- Block the outflows and internal drainage systems to raise water levels back to the surface.

3.2 Raising water levels

Drains exist on both sides of the bog, and around the entire periphery. It is the intention to block these with plastic sheet and ply dams at appropriate locations. Sluices will be installed where drains form the boundary with the golf course and the road.

It is the intention to install dams immediately after completion of the plantation harvest.

4. Monitoring Objectives

- To record short term detailed botanical and hydrological data, with special regard to coniferous plantation harvesting.
- To establish a long term, practical integrated monitoring scheme, to aid in the future management of the site.

The monitoring strategy for the site can be broken down into 3 target phases:

Phase One - Pre-management Monitoring

Where monitoring schemes are designed to evaluate known impacts (ie. management) a prerequisite must be the collation of a baseline data set. As management work is targeted at both vegetation and hydrology, these 2 parameters will form the basis of our phase one monitoring strategy. It is from this initial data analysis that a monitoring scheme can be devised or refined, and targets can be set.