Slamannan Bog

Restoration Project

Year 2 Report

23rd November 2016

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Saving the small things that run the planet

CONTENTS

Left: Round-leaved sundew. Centre: Deep-trench cell-bunding, before top bund added. Right: Garden tiger moth caterpillar

SUMMARY

The Slamannan Bog Restoration Project began in September 2014 with the aim of restoring at least 150 hectares (ha) of degraded raised bog habitat in the Slamannan Plateau. The project is focused on an area of peatland called Fannyside Muir, 3km from Cumbernauld.

The project is managed by Buglife Scotland in partnership with landowners Forest Enterprise Scotland (FES), North Lanarkshire Council (NLC), Scottish Wildlife Trust (SWT) and additional stakeholders Royal Society for the Protection of Birds (RSPB), Cumbernauld Living Landscape (CLL) and Scottish Natural Heritage (SNH).

The production of a Management Plan and the work associated with the restoration of bog habitats at Fannyside Muir has been funded by WREN grant BAF14 - 'The Slamannan Bog Restoration Project' and through contributions of the European Union to the EcoCo LIFE+ project LIFE13 BIO / UK / 000428 '*Implementation of integrated habitat networks to improve ecological coherence across the CSGN'.* This work was supported by SNH as part of the Peatland Action project and contributes to Scotland's National Peatland Plan and North Lanarkshire Council's Bog Action Plan.

Progress in the second year of the project is summarised below:

- A Habitat Regulations Assessment (HRA) of proposed works in newly identified areas in 2016 was carried out by SNH based on the original management plan and work plans provided by Buglife.
- Two phases of restoration work (Phase 2 & Phase 3) were carried out during 2016:
- Phase 2 was carried out by Openspace (Cumbria) Ltd, and took place between 21st March and 6th May. Phase 3 was carried out by Conservefor Ltd and took place between 16th August and 15th September. The contracts for both phases were awarded following a public tendering process (Public Contracts Scotland website). The deadline for completion of all works this year was 20th September, which is the earliest date that wintering Taiga bean geese have returned to the Slamannan Plateau.
- During 2016, 3230 peat dams and 46 reinforced plastic piling dams were installed across ~119 ha of the site to raise and stabilise ground water levels on the bog.
- 26 hectares of cell-bunds were installed to raise ground water levels and retain surface water. 170 m of steep-sided gully was reprofiled to slow water movement across the site
- 8 ha of birch scrub was cleared and stump-treated, and 29.5 ha of regenerating lodgepole pine were removed. Volunteer work parties cleared over 23 ha of the conifers (under 2m tall), while contractors cleared an additional 6.5 ha of dense conifer regeneration and approximately 45 larger trees..
- Monitoring of the site included monthly hydrological monitoring of 32 dipwells across the site, checking 7 fixed vegetation monitoring quadrats, 32 mini vegetation quadrats, protected species surveys,nesting bird surveys, moth trapping, butterfly timed counts, aquatic invertebrate surveys and other invertebrate surveys.
- Over 430 peat depth readings were measured across the site and surrounding peat deposits. The deepest reading within the project site was 915cm, while a reading of 930cm was recorded just outside the project area.
- Fixed point photography and aerial photographs and video of the site were taken.
- A grass fire in April 2016 damaged approx.12 ha of Compartment 11 (area with goose roost pools), however surrounding re-wetted areas were unaffected.
- A total of 717 species have been recorded on the site since the start of the project.

1. Introduction

This report summarises the second year of progress in delivering the aims of the Fannyside Muir Bog Restoration Project Management Plan through a set of agreed and prioritised objectives and prescriptions.

MANAGEMENT AIM

To restore bog activity across Fannyside Muir and improve ecological coherence of Fannyside Muir with the wider Slamannan Plateau.

The long term aims are to:

1. **Restore bogs in the Fannyside Muir area**
2. **Secure the favourable management of lowland raised bogs for wildlife**
3. **Support the delivery of the North Lanarkshire LBAP and Scottish Biodiversity Strategy**
4. **Protect and if possible enhance habitat for the Slamannan Plateau SSSI & SPA designated features**
5. **Enhance ecological coherence of Fannyside Muir with the wider Slamannan Plateau**
6. **Build knowledge of all biological taxa at the site**
7. **Raise public awareness of the importance of peatlands**

The production and implementation of the site management plan is a partnership between Buglife Scotland (BS), Forest Enterprise Scotland (FES), North Lanarkshire Council (NLC), Scottish Wildlife Trust (SWT), Royal Society for the Protection of Birds (RSPB) and Scottish Natural Heritage (SNH).

The management plan and work associated with the restoration of bog habitats at Fannyside Muir has been funded by WREN grant BAF14 - 'The Slamannan Bog Restoration Project' and through contributions of the European Union to EcoCo LIFE+ project LIFE13 BIO / UK / 000428 '*Implementation of integrated habitat networks to improve ecological coherence across the CSGN'.* This work is supported by SNH as part of the Peatland Action project and contributes to Scotland's National Peatland Plan and North Lanarkshire Council's Bog Action Plan.

2. Background

There has been a dramatic decline in the area of lowland raised bogs in the past 200 years. In Scotland, it is estimated that the original 28,000 hectares (ha) of raised bog habitat has now diminished to under 5,600 ha - a loss of 80% (*EC Habitats Directive Annex 1 Habitats from UK 2013 reporting.* http://jncc.defra.gov.uk/page-6392.). Most of the remaining raised bog habitat in Scotland is located within the Central Belt and is threatened by detrimental land management activities. Historically the greatest decline has occurred through agricultural intensification (drainage), afforestation and commercial peat extraction. Future declines are likely to be the result of the gradual desiccation of bogs which are hydrologically fragmented from each other and damaged by previous attempts at drainage.

Scotland's peatlands and raised bogs are internationally important habitats for wildlife and plants including moorland birds, insectivorous sundews (*Drosera* sp.) and invertebrates such as the Large heath butterfly (*Coenonympha tullia*), a bog–specialist that has suffered population declines across Europe, due to loss of bog habitat.

Peat soils in Scotland contain almost 25 times as much carbon as all other soils in the UK. The carbon stored in Scotland's soils (notably peat and peaty soil) is equivalent to over 180 years of greenhouse gas emissions from Scotland at current emission rates.
Healthy peatlands keep carbon locked up, and continue to absorb more carbon. Degraded bogs emit carbon dioxide and other greenhouse gasses, which contribute to climate change. Restoring peat-forming habitat that has previously been damaged ensures that the bog remains as a long-term carbon sink and significantly reduces greenhouse gas emissions.

Raised bogs also help maintain the quality of water by absorbing atmospheric pollutants and retaining carbon, which can significantly pollute streams downstream of degraded bogs. Healthy bogs function as sponges, regulating and slowing the movement of rain water which helps to prevent flooding.

Fannyside Muir

Fannyside Muir lies approximately three kilometres east of the town of Cumbernauld in North Lanarkshire. The project site lies just north-east of Palacerigg Country Park and north of Fannyside Loch. (See Map 1).

Fannyside Muir comprises of a mix of peatland habitat types, including blanket bog, lowland raised bog and intermediate bog types. The area has been subject to historic, wide-ranging, adverse management including drainage to facilitate commercial peat extraction and afforestation. A significant proportion of the restoration project site is within the boundaries of the Slamannan Plateau Site of Special Scientific Interest (SSSI) and Special Protection Area (SPA). These areas were designated for the nationally important population of Taiga bean geese (*Anser fabalis fabalis*) which visit the Slamannan Plateau in winter. The project site falls within the Cumbernauld Living Landscape boundary, which is a landscape scale conservation programme lead by the Scottish Wildlife Trust, North Lanarkshire Council, and Forestry Commission Scotland.

This project is needed to restore areas of the designated site to improve the overall peatland functioning and coherence of the plateau area. This project builds on bog restoration work previously undertaken by North Lanarkshire Council on a small area of Fannyside Muir that established the restoration potential of bogs in this area.

3. Progress with Management Objectives and Prescriptions in Year 2

The Fannyside Muir Bog Restoration Project Management Plan describes a set of objectives and prescriptions required to achieve the overall management aim:
To restore bog activity across Fannyside Muir and improve ecological coherence of Fannyside Muir with the wider Slamannan Plateau.

This section reports on progress in achieving each of the management objectives through the prescriptions listed for each one. Management objectives and prescriptions have been divided into the following categories: **A: Habitat Management; B: Monitoring, Survey and Research; C: Public Engagement and Promotion; and D: Administration.**

Management Objectives:

A: Habitat Management

Objective 1:
To re-wet the bog and establish bog vegetation in areas currently lacking bog species

Rationale:
Large areas of Fannyside Muir have been subjected to historic drainage to facilitate either commercial peat extraction or afforestation. Drainage has the effect of lowering water table levels, drying out the peat and inhibiting the growth of peat-forming *Sphagnum* sp. Waterlogged, anoxic conditions inhibit the decomposition of peat, locking carbon in the peat for thousands of years, however once the peat is drained, aerobic decomposition begins and huge volumes of carbon dioxide and methane can be released. Over time, some drainage ditches may occlude with vegetation, which slows the removal of water and may eventually lead to the reestablishment of Sphagnum and restoration of bog activity. However, this process can take decades and without intervention further drying, afforestation and loss of bog-specialist flora and fauna is likely.

Installing dams on active drainage ditches will help raise and stabilise water table levels throughout the year and encourage recolonisation of bog vegetation. Plastic piling dams or peat dam dams can be used depending on the size, slope and activity of the drain. Large, active ditches are considered a priority for dam installation, while heavily occluded drains with low activity are considered a low priority. Once dammed, open water retained in ditches can be subject to evaporation. A number of methods have been used in the past to reduce evaporation and fluctuations in water level such as adding straw bales, brash, or bundles of heather harvested from the site. Partially infilling ditches or reprofiling the sides of steep-sided large ditches to make them shallower can increase the rate of ditch-colonisation by Sphagnum and other bog vegetation.

Despite 20 years having passed since commercial peat milling ceased at Fannyside Muir, areas of bare peat as still evident across the site due to the peat surface becoming water-logged in winter and then drying out in summer.

Good quality bog vegetation is present in a variety of areas across the restoration site and by improving hydrological connectivity across the entire site these can be encouraged to spread and recolonise degraded areas.

Variations in local micro-topography left by peat milling and ploughing prior to conifer planting can act as a significant barrier to colonisation of bog plants. Highpoints are generally too dry in summer, while low points can be too wet for suitable plants to colonise.

Broadleaf scrub and regenerating conifers were removed as they increase nutrients, damage the bog surface and further dry out the bog through transpiration. Scrub was removed either by contractors using chainsaws or excavators with mulching heads depending on the size of the trees, or by volunteer work parties using hand tools. Broadleaf stumps (out with FES-owned land) were carefully treated with herbicide to prevent re-growth in line with Scottish Natural Heritage specifications. All work with herbicide and machinery including excavators, brush cutters and chainsaws was carried out by experienced contractors to avoid any damage to the peat moss surface and to comply with FC and FISA guidance.

All of the work within, and near to the SSSI and SPA was undertaken with the agreement of Scottish Natural Heritage following an appropriate Habitat Regulations Assessment. Whilst much of the work was carried out by specialist contractors, there were a number of volunteer work parties involving local people helping to clear scrub across the site.

All of the restoration actions discussed here were carried out with the aim of re-wetting the bog and to protect, or enhance habitat for the existing SSSI and SPA designated features of the bog (see Objective 2)

Prescriptions:

1.1 Ground reprofiling with low ground pressure machine

In early August 2015 the restoration contractors made an attempt to level-out variations in micro-topography of the peat-milled strips in compartments 8 and 13a. It was hoped that by tracking across the ridges with a low ground-pressure excavator this technique would improve local hydraulic gradients and help to promote bog vegetation colonisation. This technique has been used successfully on restored plantation sites, but the effectiveness on milled sites with various micro-topography ridges and features was not known. The initial trial involved tracking 3 excavators (7.5 tons with 700mm tracks) along a wide ridge of drained peat in compartment 13a. This had almost no effect other than flattening vegetation. Investigation revealed the presence of slit drains in many of the raised strips in this compartment that had significantly dried out the peat surface. Other ridges in compartment 13a were found to be exceptionally soft and made of piles of loose peat that were too narrow to support the width and weight of the excavators without the support of bog mats (thick wooden boards).

No further attempts at cross-tracking were carried out in year 2 of the project

1.2 Dam installation

Drainage ditches across the project area were blocked using a combination of recycled plastic sheeting and peat dams to retain water on the site. This will help increase the summer water table on the site to stimulate the recovery of bog-forming sphagnum species. The number and size of ditches varies on each of the bog compartments, thus the frequency and size of dams required also varied across the site (see Figures 2, 4 and 6).

1.2.1 Plastic piling dams

Approximately 1,330m of plastic piling was utilised in 46 dams installed across the restoration site in 2016. The use of plastic piling was kept to a minimum, but was required at

the ends of long runs of peat dams and on wide or steeply inclined ditches where peat dams would likely wash out. Plastic piles of between 1.5m and 3m were used depending on the depth of ditches, with the majority being of 2-3m length. The majority of the piling dams were reinforced by timber bracing and supports where the ditches were wide or on an incline, and the majority were also backed with peat. Volunteer work parties in early spring 2016 helped to extend the width of a number of plastic piling dams to improve their water-holding potential. During hydrological monitoring visits in early 2016, a small number of the plastic piling dams installed during Phase 1 were observed to be leaking, and not holding water. The leaking dams were mainly on large, old ditches, and leakage was attributed to peat cracks. These were rectified by the contractor during spring 2016 by digging small trench bunds on either side of the piling dams to block cracks and by backing-up the piling dams with peat and vegetation. (See Figures 4 and 6).

1.2.2 Peat dams

A total of 3230 peat dams were installed on primary drains and a number of secondary drains during 2016. Each peat dam is associated with a borrow-pit pool of approximately 4m^2 in size. This has resulted in a significant increase in standing bog pool habitat. Plastic piling dams were installed at the ends of runs of peat dams, and these were generally also backed with a peat dam for added strength (See Figure 2).

1.2.3 Reprofiling the sides of large ditches

During 2016 a low ground pressure excavator was used to reprofile an 80m section of the steep-sided gully (2-3m deep) that runs along the northwest boundary of compartment 2. During this procedure a 2m strip of surface vegetation on either side of the original ditch was removed and placed aside, then the ditch walls were reprofiled by partially collapsing the sides of the ditch to make them wider and shallower, additional excavator buckets of peat were ‘borrowed’ from further up the ditch to raise the ditch level further, then the strips of surface vegetation were restored to reduce erosion and promote drain occlusion. Peat dams and plastic piling dams were also installed at intervals along the length of the now shallower ditch. A further 100m section of the steep-sided ditch running between compartments 5 and 6 was also reprofiled in 2016, which continued similar successful work on this ditch in 2015. (See Figures 4 and 6).

1.2.4 Reducing water evaporation from ditches with bundles of cut heather

This activity was not carried out during 2015 or 2016, however felled scrub and conifer brash was added to dammed ditches to help slow water evaporation and increase the rate of ditch of ditch occlusion and Sphagnum colonisation.

1.2.5. Use of cell bunds to block ditches and retain surface water

This activity was trialled in 2015 in a few small areas of Compartments 6 and 7, where three cell-bunds of approximately 20m x 20m were created with a 15cm high bund on top. The main aim of this technique is to use a deep trench of compressed peat to restrict sub-surface water flow, with a small top bund to slow surface water movement. On highly damaged sites ditches, forestry plough furrows, peat cracks, slumping or tree root damage can draw water away from the peat surface and this restricts peat-forming conditions. The deep trench technique restricts the water loss by creating an underground ‘wall of wet putty’ peat, which slows water movement. This improves hydrological connectivity and rehydrates the entire peat resource with improved water table conditions. The small bund on top helps to retain a shallow pool of surface water which helps to encourage Sphagnum recolonisation. This technique was used extensively in Compartments 1 and 2 during 2016, and in a new area of degraded bog near Palacerigg Country Park (see Figures 3 and 6). In total 26 ha of cell-bunding was installed at Fannyside Muir during year 2.

1.3 Scrub removal

1.3.1 Felling and treatment of broad leaf scrub and conifers

During 2016 contractors cleared approximately 8 ha of birch scrub, 6 ha of dense Lodgepole pine regeneration and around 45 large conifers. Only large birch stumps over 5cm in size were treated with herbicide. Large logs were stacked to create habitat piles, while brash was added to blocked ditches to facilitate faster occlusion (See Map 4 and Figures 5 and 6). Yearly monitoring of scrub regeneration is recommended (see prescription 3.4.2), to help inform the frequency of follow-up work.

1.3.2 Hand pulling of small scrub with volunteers

An area of 23 ha was cleared of Lodgepole pines by volunteers using hand tools. Small birch saplings were pulled-up by hand (see Figures 5 and 6)

Objective 2:

To protect, or enhance habitat for existing SSSI and SPA designated features of the bog.

Rationale:

The Slamannan Plateau SSSI and SPA are both designated for winter-visiting Taiga bean geese which roost on pools and surrounding peatland within compartment 11 of the restoration area. The bean geese are generally on the Slamannan Plateau between October and February. Management objectives for the SPA state that it is essential to avoid deterioration of the bog habitat and to ensure that the distribution and extent of habitats supporting the species and the structure, function and supporting processes of the habitats are maintained.

Protecting the designated features and ensuring that the geese continue to use the site is essential. Bean geese are intolerant of disturbance, choosing open areas with unobstructed lines of sight for both feeding and roosting.

As a consequence of bog restoration management work, increasing water-retention across Fannyside Mur in winter may provide additional winter roosting pools beyond those currently used by the bean geese.

Prescriptions:

2.1 Enhancing habitat for roosting Taiga bean geese at Fannyside Muir

During the first phase of restoration work in August and September 2015, 2 new shallow (0.5m deep) 25m x 25m scrapes were excavated in Compartment 10 to the north-west of the current roosting pools in Compartment 11. The removed peat was then used to block drainage channels nearby. Once filled with rainwater, these pools may potentially be used as additional goose roosting habitat, as well as providing breeding habitat for amphibians and aquatic invertebrates. No bean geese were recorded using the new pools during the winter of 2015/2016, but Redshanks, Snipe, Mallards (with ducklings), diving beetles, dragonflies (Common hawker, Black darters, Large red and Emerald damselflies) were all recorded at these pools in 2016. Just over 26 ha of flooded cell-bunding was created in Compartments 1 and 2, and in a new area to the north, which may provide potential roosting habitat for Taiga bean geese and other wildfowl. While undertaking hydrological monitoring on November 2016, 49 snipe were recorded from the cell-bunded area of Compartment 1 (that had been dry heather the year before). (See Figures 3 and 6)

2.2 No restoration work with heavy machinery to occur while Taiga bean geese present on the site.
Contractors tendering for restoration work at Fannyside Muir in 2016 were made aware that the deadline for completion of work using heavy machinery within the SPA/SSSI would be the 20th September, which is the earliest date that wintering Taiga bean geese have been recorded on the Slamannan Plateau. Additionally all site infrastructure such as welfare units (if used) had to be removed from the car park area by the 25th of September. In spring, work with machinery within the SSSI/SPA could only occur after the last Taiga bean goose had left. The 4th of March is the latest date that Taiga bean geese have been recorded on the Slamannan Plateau.

Manual ditch blocking and the hand-clearance of scrub and conifers using hand tools was possible all year round. However, from 21st September through to the 15th March, such activities were restricted to between 1 hour after sunrise and 1 hour before sunset to avoid potential disturbance to geese moving between their roosting and feeding sites.

2.3 Restoration work to avoid areas containing winter roost pools used by Taiga bean geese.
All contractors were supplied with maps to indicate which areas were off-limits to tracked machinery, and during site inductions all work crew were made aware of this.

2.4 Restoration work infrastructure and machinery removed from site while geese are present
All machinery and infrastructure such as the site office and excavators were removed from the site before midday on the 15th September 2015.

2.5 Use of heavy machinery and equipment on the site
Routes for tracked machinery to follow across the bog surface were agreed prior to work commencing to minimise excessive crossing of the site.

B: Monitoring, survey & research

Objective 3:
To establish a monitoring programme to allow review of management prescriptions and assess ecological connectivity with the wider Slamannan Plateau

Rationale:
A comprehensive set of monitoring procedures is required to assess the effectiveness of any habitat management work in furthering the main aim and long-term objectives of the project. This includes ensuring that there are no detrimental effects from the habitat management work on the designated features of the Slamannan Plateau SSSI and SPA. The results of the monitoring will be used to guide the habitat management work.

Prescriptions:
3.1 **Taiga bean goose monitoring**
3.2 Annual monitoring of the bean geese wintering population on the Slamannan Plateau is carried out by the Bean Geese Monitoring Group on behalf of Scottish Natural Heritage. Bean goose data has been collected for a number of years prior to the commencement of the bog restoration project. Returning Taiga bean geese were recorded on the Slamannan Plateau on the 3rd of October 2016. Four geese were fitted with GPS

transmitter tags by BTO staff on the 9th of October 2015 to help monitor their movements. Location data is collected at intervals during the day and night and is available for use by researchers within 24 hours (http://monitoring.wwt.org.uk/our-work/goose-swan-monitoring-programme/species-accounts/taiga-bean-goose/). It has been encouraging to see that the geese are continuing to roost each night at the roost pools within compartment 11, with all 4 of the tagged geese returning here each night after feeding/loafing in surrounding agricultural fields. It therefore appears that the restoration work on the site has had no negative impact on the geese using the site.

3.3 Hydrological monitoring

The main aim of the habitat management activities is to restore bog activity at Fannyside Muir by raising the water levels within the peat so that bog vegetation can recolonise. Monitoring how water table levels fluctuate in the bog during the year is essential to ascertain whether the ditch blocking and scrub removal are having the requisite effect. Hydrological monitoring equipment was marked with a white-painted stake and fluttering tape prior to the arrival of excavators on the site to minimise the risk of accidental damage. (see Table 3, Appendix iii for summary of monthly hydrology monitoring data)

3.3.1 Water loggers

Three hydrological data loggers were installed on the site in September 2014 on behalf of SNH (See Figure 7). Water level data is collected every 30 minutes and data is sent automatically once per week. This data will be made publically available on Scotland's Environment Web (SEWeb).

The OS grid references for each logger are:

Logger 1: NS 7992 7447
Logger 2: NS 7980 7422
Logger 3: NS 8027 7423

3.3.2 Dip wells

A network of 32 ground water dip wells were installed across the restoration site in July 2015 to enable ground water levels to be monitored (Figure 7). Each compartment generally has at least 2 dipwells, with one within 0.5m of a major ditch and another approximately 25m from the first. Dipwells consist of a 1.5m long pipe of 50mm diameter with drilled holes and cap. Readings are taken on a monthly basis using an electronic dipwell meter to collect as much data as possible during the course of the site restoration.

3.3.3 Checking integrity of installed dams

The integrity of peat dams and plastic piling dams has been checked regularly after installation to asses their effectiveness in raising ditch water levels , and any issues with leakage identified. The quality of all dams was guaranteed by each of the installing contractors for at least 6 months following installation. This resulted in a number of dams that were installed in 2015 being revisited in April 2016 to deal with leakages. .An annual survey of dam integrity should be carried out on a randomly selected set of dams. Water level below ground level at the face of the dam will be recorded and dams also inspected for damage.

3.4 Peat surveys

3.4.1 Peat depth survey

Peat depth surveys to help estimate the volume of peat within the project area were carried out during 2016. Over 430 peat depth readings were measured across the site and surrounding peat deposits. The deepest reading within the project site was 915cm, while a reading of 930cm was recorded just outside the project area. This data will also allow a better estimate of the carbon resource contained within peat. This will complement peat

depth data collected during the bog restoration feasibility study carried out by Strath Caulaidh Ltd in 2014 and an earlier study carried out in 2009 on behalf of Scotts Company Ltd. (RPS, 2011). A report including a peat depth survey will be provided to SNH by the end of year 3 of the project.

3.4.2 Peat stability monitoring survey

Peat instability events may be triggered following intense rainfall and snow melt or loading of the peat mass by heavy machinery. Due to the generally flat and confined nature of the restoration area, peat slides and bog burst events are considered to be a low risk.

While the restoration work was on-going and machinery was on the bog, a monthly walk-over of each worked on compartment and neighbouring compartments was carried out to check for the following indicators of peat instability: the presence of recent failure scars, indicators of surface tension, features indicative of compression, evidence of peat creep, the formation of new sub-surface drainage bodies and cracking related to drying. No new peat instability features were observed

3.5 Fixed-point photography to monitor condition of the bog

Fixed-point photographs have been taken next to each of the vegetation monitoring quadrats across the restoration site and along a selection of primary ditches to compile a visual record of the changes occurring during the restoration process.(See Figure 4 for examples). In August 2016 RSPB staff kindly assisted in capturing aerial images of the site using a drone with a camera. A number of very useful photographs and videos were obtained showing the extent of the goose roost pools this year just prior to the return of the bean geese. Some of the recently installed restoration features such as reinforced plastic piling dams and cell-bunded areas were also photographed (see Figure 6).

3.6 Bog vegetation monitoring

3.6.1 Fixed-point vegetation quadrat transects

Seven 2m x 2m vegetation monitoring quadrats were installed across the restoration site in spring 2015. These will be monitored on an annual basis to assess whether habitat management is improving the distribution and abundance of bog vegetation.

Quadrats were marked out using bamboo canes and GPS data collected for each location. Additional information on peatland features such as ditches; grazing and wildlife were also recorded for each quadrat. (See Table 2 for Vegetation Quadrat locations)

Positive (and negative) bog indicator species are clearly defined through JNCC guidance (http://jncc.defra.gov.uk/pdf/CSM_lowland_wetland.pdf), so it is possible to assess increases or decreases in the distribution and abundance or dominance of positive indicators and negative indicator species. (See Figure 8). Timing of the monitoring should be June-September each year. Prior to the start of restoration work the majority of quadrats were assessed to be in fairly poor condition with restricted Sphagnum moss coverage and few bog specialist species present.

During hydrological monitoring of dipwells, 32 mini vegetation quadrats (0.5m x 0.5m) were recorded at the position of each of the dipwells to enable vegetation change to be compared to any hydrological changes. Data collected included a photograph and % coverage of Sphagnums, graminoids, and ericoid shrubs %. Strikingly 8 out of 32 (25%)of the mini-quadrats showed significant differences in just 1 year, with 7 showing surface flooding due to restoration work and 1 having been burnt by the fire in April 2016.

Vegetation Monitoring Quadrat locations			
Quadrat	**Compartment**	**Grid Reference**	**Current condition**
1	2	NS 79652 73893	Poor/ improving
2	3	NS 79838 73943	Good (Control)
3	3 (border with 4)	NS 79210 74391	Poor/ Improving
4	5	NS 79841 74507	Medium/ Improving
5	6	NS 80543 74436	Poor/ improving
6	9	NS 80379 74362	Wet/ improving
7	10	NS 80184 73952	Flooded/ improving

Table 2. Locations of vegetation monitoring quadrats

An area of Japanese knotweed (*Fallopia japonica*) in the car park entrance area (NS 8025 7378) was stem-injected with herbicide by FC staff and fenced off prior to contractors arriving on the site in 2015. A small amount of regrowth was observed in May 2016, and retreated with herbicide.

3.6.2 Annual survey of broadleaf scrub

An annual survey of broad leaved scrub will be made, with the location of new saplings, or conifer regeneration identified by GPS so that they can be removed by contractors or volunteer work parties. This is on-going.

3.6.3 Species-specific butterfly transects

Butterfly transects and timed counts can be used to monitor the impact of habitat management on biodiversity. Butterflies have a 1 year life-cycle and respond rapidly to changes in habitat quality and quantity. UK butterflies include habitat generalists and specialist. Monitoring the presence and abundance of species recorded on a fixed transect transect or during a timed count in a specific area can provide a large amount of data. Butterfly transects are generally carried out once per week for 26 weeks of the year, and only under specific environmental conditions which allows data to be compared with other sites and between years. Species-specific transects and timed counts can be used to monitor particular species. These restricted surveys are carried out only during the flight period of the species that is of interest. Distribution data can be used to assess the ecological connectivity of the site, and abundance data can be used to assess habitat management changes.

3.6.4 Butterfly transect - Large heath (*Coenonympha tullia*)

The Large heath (*Coenonympha tullia*) is a UK BAP species and a bog specialist, with its larvae feeding on Common cottongrass (*Eriophorum angustifolium*) and Hare's tail cottongrass (*E. vaginatum*), that are fairly widespread across Fannyside Muir. The species has declined across Europe. The adult flight period in central Scotland is generally from mid June through to the end of July, with individuals occasionally still flying in early August. Adults are attracted to the flowers of Cross-leaved heath (*Erica tetralix*). Weekly timed-counts for this species were carried out from mid-June through to early August, but no confirmed observations were made.

3.6.5 Butterfly transect - Small pearl-bordered fritillary (*Boloria selene*)

The Small pearl-bordered fritillary (*Boloria selene*) is a UK BAP species and in central Scotland is associated with damp meadows, bogs and other wetland habitats. The larvae generally feed on the leaves of Marsh violet (*Viola palustris*), but other *Viola sp.* may be used. Marsh violets were observed to be present in small quantities along the verges of

Fannyside Road and within the fen vegetation present between compartments 1 and 2 of the project area. Small pearl-bordered fritillary has been lost from many parts of the UK, but remains widespread in Scotland. The adult flight period in central Scotland is generally from mid-June through to the end of July, with individuals occasionally still flying in early August. Timed counts for this species were carried out from early-June through to early August. Individuals were recorded during July and August at various locations close to where marsh violets had been observed. Records from 5 new 1km squares surrounding Fannyside Muir were made during 2016.

3.7 Bog-specialist invertebrate surveys

Invertebrates make up the majority of the UK's biodiversity. Analysis of the rich diversity of invertebrate species found within a site can provide useful information regarding the types and quality of the habitat present. Generalist species can be found in many different habitats and in some cases may be negative-indicators of habitat quality. On the other hand, bog specialists may be restricted to high-quality bog habitat containing the specific resources required to complete that species' lifecycle. Aquatic invertebrate surveys were carried out, sampling various bog pools and blocked ditches from March to May 2016. (Figure 7).

3.7.1 Sun bog-jumper spider (*Heliophanus dampfi*)

The Sun bog-jumper spider (*Heliophanus dampfi*) is a small black jumping spider (family Salticidae), associated with raised bogs. The species is known from only a handful of sites in the central belt of Scotland and a single site in Wales. A planned survey during July by a spider expert was delayed due to poor weather, and carried out in early September. This appears to have been too late in the year for adults to be present. A number of other spiders and invertebrates were recorded during this survey. (Figure 7).

3.7.2 Light trapping for moths

The UK has over 2,500 species of moths, comprising a wide range of families, with habitat generalists and specialists, mobile and sedentary species, and includes a number of species associated with peatlands and bogs. Research on habitat restoration has shown that light-trapping for moths can be an effective way of monitoring changes in vegetation structure and connectivity to other habitats. The loss of species feeding on broad leaf scrub and non-bog vegetation, and an increase in wetland specialist might be expected.

Two types of light traps have been used at Fannyside Muir during 2016: a 6W bucket trap, and an 15W actinic heath trap. (See Figure 8). In addition to species recorded using light trapping, observations of day-flying species, caterpillars and distinctive leaf-mines were used to add additional species to the site species list.

3.7.3 Other species surveyed

At the start of the project, very few species had been recorded from the restoration site. An assessment of aquatic species using the site would provide a good baseline for further assessment of habitat work. Increasing the presence of standing water on the site through blocking ditches is expected to have a positive effect on the presence and abundance of dragonflies and damselflies, water beetles, stoneflies, mayflies, alderflies, caddisflies and other species.

Pitfall transects across the bog were installed to collect data on beetle and spider composition across the restoration site. Both of these orders contain a range of families and genera with habitat specialists that can be informative of habitat changes occurring during the restoration process.

C: Visitor engagement and promotion

Objective 4:
To raise public awareness of issues affecting peatlands

Rationale:
This project has the opportunity to raise public awareness of the issues affecting lowland raised bogs in the Central belt and peatlands in Scotland. Engaging with local communities, community groups and schools around Fannyside Muir will be a key part of outreach associated with the project. Through the project at least 50 young people will be engaged each year through educational events. As well as ecological and environmental benefits, the project will provide the local community with opportunities for volunteering and outdoor education. Opportunities may be provided for members of the public to visit the restoration site, hear about the project at community events and talks, and to take part in habitat management volunteer work. Volunteer training workshops will also be provided to help with monitoring activities. All outreach and communication actions will be coordinated with other local groups already raising awareness of the importance of peatland including North Lanarkshire Council, Forestry Commission, Cumbernauld Living Landscape, SWT, RSPB and the Bean Goose Action Group.

Prescriptions:

4.1 Press releases and media
A number of press releases, articles for newsletters and magazines, and social media posts were produced throughout the year to promote the work at Fannyside Muir and raise awareness of our peatlands. An STV national news bulletin on the bog restoration work at Fannyside Muir was shown in October 2016

4.2 Educational visits
A programme of educational activities for local schools has been created to raise awareness of the importance of Fannyside Muir and our wider peatlands. Schools in Cumbernauld, Slamannan and other communities around Fannyside Muir will learn about peat bogs, and focus on 2 key species: the Large heath butterfly and the Taiga bean goose. A school visit to Plains Primary School, Airdrie was carried out in October 2016 with 25 pupils. A site visit with the school is planned in spring 2017. Three school visits to St Mary's Primary School, Cumbernauld, which were delivered in November 2016 with 51 pupils, including visits to see bog habitat at Ravenswood Nature reserve near the school.

4.3 Community engagement activities
In addition to local school visits, local community engagement activities this year have involved delivering guided walks on site and running volunteer work parties.

4.3.1 Walks and talks.
Site visits with different groups were held at Fannyside Muir during 2016. Groups including staff, members and volunteers of various conservation NGOs (Butterfly Conservation, Scottish Wildlife Trust, Cumbernauld Living Landscape and RSPB) SNH staff and local MSP Angus Macdonald were shown round the restoration site. Talks to raise awareness of peatlands and the restoration project at Fannyside Muir have been given to organisations including the Scottish Wildlife Trust (Falkirk and Ayrshire groups) and the Edinburgh Entomological Club.

4.3.2 Volunteer recruitment and training workshops.

Five habitat management volunteer work parties were held in the last year. On Sunday 6th December 2015, a joint event with Butterfly Conservation's Bog Squad attracted 16 volunteers (and 2 film crew from SNH) helped clear regenerating lodgepole pines. Joint Bog Squad events were also held on the 31st January 2016 (12 volunteers) and 13th March 2016 (8 volunteers), again clearing lodgepole pines. On 16th July 2016 4 volunteers helped map remaining scrub across the site using GPS prior to the start of Phase 3. A work party with 9 volunteers from the Edinburgh-based Wild Reekie group was held on the 27th August 2016 to clear more lodgepole pines and add felled brash to blocked ditches.

Administration

Objective 5:

To fulfil all legal or contractual obligations committed to within the plan period

Rationale:

All legal and contractual obligations committed to within the plan period must be carried out.

Prescriptions:

5.1 Hold regular Stakeholder/ Steering Group meetings

The current Steering Group for the project comprises individuals from the Bean Goose Action Group, Buglife, Cumbernauld Living Landscape, Forestry Commission Scotland, North Lanarkshire Council, RSPB, Scottish Natural Heritage and the Scottish Wildlife Trust. Site visits and meetings with stakeholders were held throughout 2015 and 2016 to discuss restoration work. The most recent meeting was held at Palacerigg Country Park on 23rd September 2016, followed by a site visit to see some of the work.

5.2 Annual review of project implementation

A review of progress on the implementation of objectives and prescriptions to deliver the management plan has taken place annually. This ensures that management techniques are delivering the anticipated results and allows budgeting of staff time, funding and development of more detailed work plans for the coming year.

5.3 Revise management plan

Progress on the delivery of the management plan has been assessed annually, with a full review after 5/10 years.

5.4 Comply with all relevant legislation

A new Habitat Regulations Assessment (HRA) of the planned work at Fannyside Muir was required in 2016, due to the inclusion of a new area of bog that had not been covered in original (2015) HRA. The assessment was carried out by SNH, and the restoration work was given consent prior to work beginning on the site. The assessment process helps to minimise the risk of any of the interventions having a negative impact on the designated features of the Slamannan Plateau SSSI and SPA.

5.5 Maintain site species lists (all taxa)

A total of 717 species have been recorded at Fannyside Muir, and surrounding sites since the launch of the project in September 2014. Records of all species observed and monitored during the project will be maintained in a database. Records include details of scientific name (with common name if there is one), location, OS grid reference (at least 6 figure), date (first record if common and frequently recorded), abundance, recorder, determiner, survey method and any additional comments.

Summary of species recorded in Year 2:
(A full list of species recorded at Fannyside Muir is given in the appendix)

Flora and Fungi
A total of **128** vascular plants and **33** lower plants and fungi have been recorded at Fannyside Muir this year, including **16** mosses, **9** fungi, **6** lichens and **2** slimemoulds.

Notable bog-associated plant and bryophytes recorded at Fannyside include:
Blaeberry (*Vaccinium myrtillus*)
Bog asphodel (*Narthecium ossifragum*)
Common cottongrass (*Eriophorum angustifolium*)
Cranberry (*Vaccinium oxycoccus)*
Cross-leaved heath (*Erica tetralix)*
Deer grass (*Trichophorum cespitosum*)
Hare's-tail cottongrass *(Eriophorum vaginatum*)
Heather (*Calluna vulgaris)*
Round-leaved sundew (*Drosera rotundifolia*)
White-beaked sedge (*Rhynchospora alba*)
Acute-leaved bog-moss (*Sphagnum capillifolium*)
Blunt-leaved bog-moss (*Sphagnum palustre*)
Bogmoss flapwort (*Odontoshisma sphagnii*)
Feathery bog-moss (Sphagnum *cuspidatum*)
Flat-topped bog-moss (*Sphagnum fallax*)
Lustrus bog-moss (*Sphagnum subnitens*)
Magellanic bog-moss (*Sphagnum magellanicum*)
Papilose bog-moss (*Sphagnum papillosum*)
Soft bog-moss (*Sphagnum tenellum*)
Strict haircap moss (*Polytrichum strictum*
Magellanic bog-moss (*Sphagnum magellanicum*)
Papilose bog-moss (*Sphagnum papillosum*)
Soft bog-moss (*Sphagnum tenellum*)

Birds:
A Total of **76** species of birds have been recorded at Fannyside Muir since the start of monitoring in 2014. During the spring of 2016, daily surveys for nest building activity were carried-out while the second phase of restoration work was underway (March-May). Records of **10** breeding species (singing & courtship, nest building, feeding young, and presence of newly fledged birds) were recorded during site visits All of which are either Amber-listed or Red-listed species in the Birds of Conservation Concern List (BoCC) (Eaton *et al*. 2009)

Breeding species recorded in 2016
Cuckoo (*Cuculus canorus*) (Red listed)
Curlew (*Numenius arquata*). (Amber listed)
Grasshopper warbler (*Locustella naevia*). (Red listed)
Mallard (*Anas platyrhynchos*) (Amber listed)
Meadow pipit (*Anthus pratensis*) (Amber listed).
Redshank (*Tringa tetanus*). (Amber listed).
Reed bunting (*Emberiza schoeniclus*) (Amber listed)
Skylark (*Alauda arvensis*). (Red listed).
Snipe (*Gallinago gallinago*) (Amber listed)
Willow warbler (*Phylloscopus trochilus*). (Amber listed).

Non-breeding notable species recorded in 2016
Taiga bean goose (*Anser fabalis fabalis*) (Amber listed). Winter resident and designated natural feature of the Slamannan Plateau SSSI and SPA. Taiga bean geese first began overwintering on the Slamannan Plateau in 1981. Numbers vary from year to year, with around 130- 150 birds in the 1990's which has increased in recent years to around 220-300 birds. The geese tend to feed on agricultural fields around the plateau and return at dusk to roost on the Fannyside Lochs or in the bog pool matrix present in the south-east of the core restoration site (Compartment 11). The first geese to return in 2015 arrived on the Slamannan Plateau on the 29th September, and left for their breeding gournds in Scandinavia on the 10th February 2016. The four tagged individuals returned with the Bean goose flock to the Slamannan Plateau on the 2nd October 2016
Hen harrier (*Circus cyaneus*). (Red Listed) - young bird flying over cell-bunded area (Compartments 1 & 2)
Herring gull (*Larus argentatus*). (Red listed)
Lapwing (*Vanellus vanellus*). (Red listed)
Starling (*Sturnus vulgaris*). (Red listed)
Whinchat (*Saxicola rubetra*) (Red listed)
Woodcock (*Scolopax rusticola*) (Red listed)
Yellowhammer (*Emberiza citronella*) (Red listed)
Other species (including Amber-listed species) are listed in the appendices.

Mammals:
A total of **13** species of mammal have been recorded at Fannyside Muir since the start of the project.

Mammal species recorded at Fannyside Muir in 2016:
Badger (*Meles meles*) – tracks and remains of dead hedgehog found on site
Bank vole (*Myodes glareolus*) – remains and droppings
Brown hare (*Lepus europeaus*)
Common shrew (*Sorex araneus*)
European mole (*Erinaceus europeaus*)- mole hills
Field vole (*Microtus agrestis*)
Grey squirrel (*Sciurus carolinensis*) – edge of bog near Palacerigg Country Park
Hedgehog (*Erinaceus europeaus*) –remains and a live individual
Otter (*Lutra lutra*) – scat & foot prints
Red fox (*Vulpes vulpes*) –scat & footprints
Roe deer (*Capreolus capreolus*)
Stoat (*Mustela erminea*)
Weasel (*Mustela nivialis*)

Amphibians and Reptiles:
A total of **3** amphibian species and **1** reptile species have been recorded at Fannyside Muir since the start of the project.

Amphibian and reptile species recorded at Fannyside Muir in 2016:
Common frog (*Rana temporaria*)
Common toad (*Bufo bufo*)
Common lizard (*Zootoca vivipara*)
Palmate newt (*Lissotriton helveticus*)

Invertebrates:
A total of **458** invertebrate species have been recorded from Fannyside Muir since the start if the project including **178** species of moths & butterflies, **78** flies, **73** beetles, **31** true bugs, **31** ants, bees, sawflies & wasps, **26** spiders, **9** dragonflies & damselflies, **7** slugs & snails, **4** caddisflies, **3** millipedes, **3** springtails, **3** woodlice, **2** grasshoppers, **2** harvestmen, **2** mites, **2** lacewings, **2** mayflies, **2** stoneflies, **1** alderfly, **1** centipede, **1** earwig, **1** pseudoscorpion and **1** scorpionfly.

Notable Invertebrate species recorded at Fannyside include:
Blaeberry bumblebee (*Bombus monticola*) Scottish Biodiveristy List
Broom moth (*Ceramica pisi*) UKBAP
diving beetle (*Rhantus suturellus*) –Scottish Biodiversity List
diving beetle (*Stictonectes lepidus*) IUCN Near threatened
Cinnabar (*Tyria jacobaeae*) UKBAP
Garden Tiger (*Arctia caja*) UKBAP
Grey dagger (*Arconicta psi*) UKBAP
ground beetle (*Agonum ericeti*) Nationally Scarce * bog indicator species
Haworth's minor (*Celaena haworthii*) UKBAP
Heath rustic (*Xestia agathina*) UKBAP
Latticed heath (*Chiasmia clathrata*) UKBAP
Neglected rustic (*Xestia castanea*) UKBAP
Powdered quaker (*Orthosia gracilis*) UKBAP
Sallow (*Xanthia icteritia*) UKBAP
Small heath (*Coenonympha pamphilus*) UKBAP
Small pearl-bordered fritillary (*Boloria selene*) UKBAP
Small square-spot (*Diarsia rubi*) UKBAP
White ermine (*Spilosoma lubricipeda*) UKBAP

5.6 Produce connectivity maps for key bog species
Species distribution data collected during the project will be used to produce connectivity maps to identify ecological coherence in the project area. Monitoring data will also be used to assess changes in habitat quality with regards to key bog-species colonisation and/or resource usage. This is on-going.

5.7 Ensure all species records regularly added to NBN
Records collected from the site (excluding sensitive data) will be added to the National Biodiversity Database (NBN) at capture resolution on an annual basis to improve public knowledge of species distribution. Potentially sensitive data will be added at lower resolution, or omitted from datasets depending on discussions with stakeholders. All species data will be shared with stakeholders and landowners in formats suitable for incorporation into existing stakeholders datasets.

4. Plans for 2017

During 2017, the focus will be on monitoring. Hydrological and vegetation monitoring will continue throughout the site. There will be further surveys for key bog-specialist invertebrates such as the Bog sun-jumper spider and Large heath butterfly.

Volunteer work parties will be held when possible to look for and remove remaining small Lodgepole pines. Educational visits with local schools will also occur in Spring 2017.

Acknowledgements

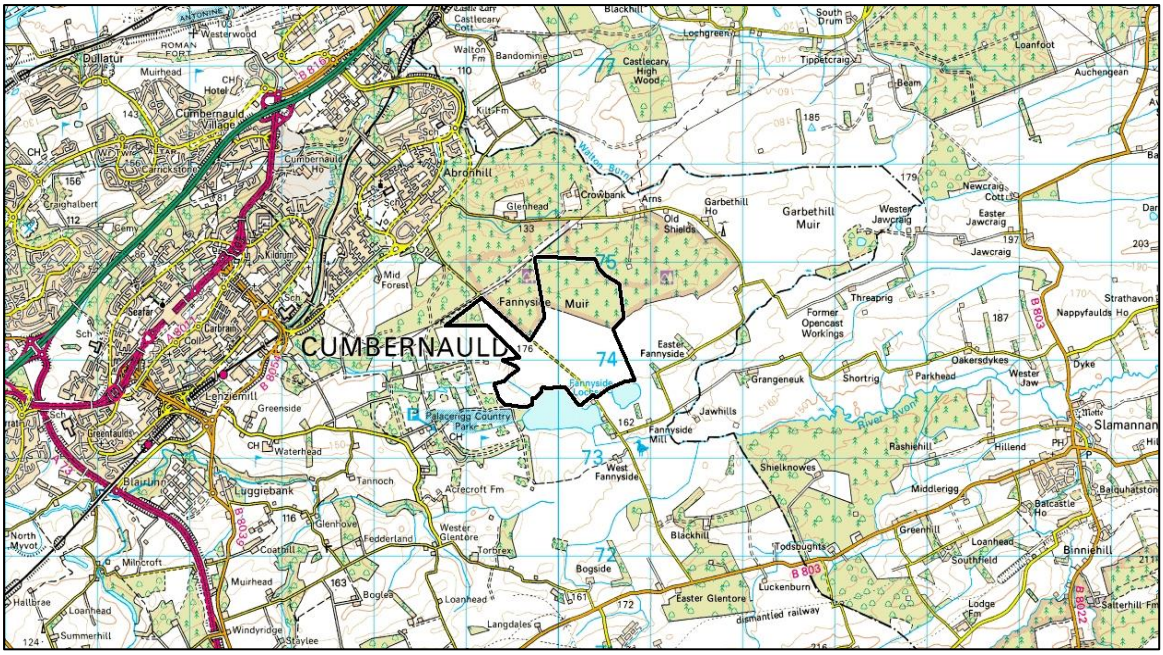
Buglife Scotland would like to thank everyone who has contributed their support and advice during the second year of the Fannyside Muir Bog Restoration Project including all the volunteers that have helped since the start of the project, staff from Forest Enterprise Scotland, Scottish Wildlife Trust, North Lanarkshire Council, Butterfly Conservation Scotland, RSPB, Cumbernauld Living Landscape, Caledonian Conservation Ltd, East Ayrshire Coalfield Initiative and Scottish Natural Heritage.
Thank you!

Projects Planned to Occur During the Life of the Plan
The numbers refer to priority, 1 being essential and 2 highly desirable. Yellow: achieved. Orange: partially achieved. Red- not achieved.

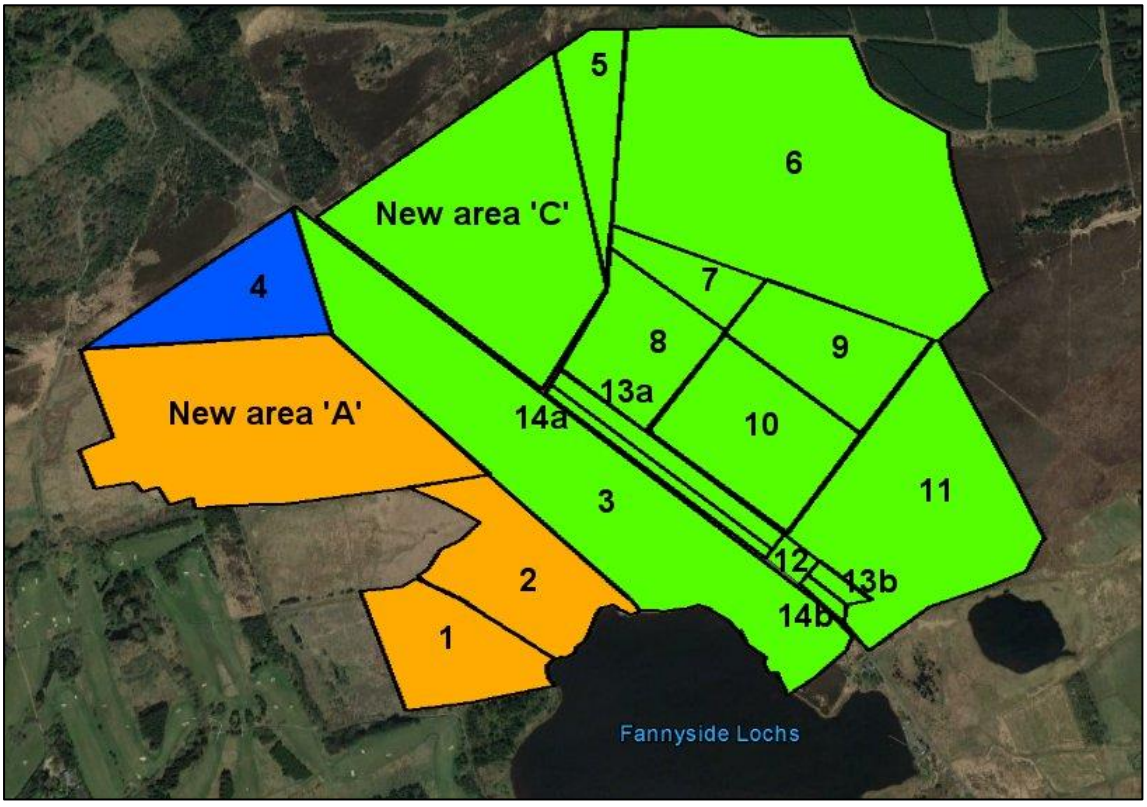
Code	Project	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1.1	Use of low ground-pressure machine to cross-track bog surface *	**1**	2								
1.2.1	Dam Installation (plastic piling)	**1**	1	2			2				
1.2.2	Dam Installation (peat dams)	**1**	1	2	2		2				
1.2.3	Reprofile sides of steep primary ditches	**2**	2	2	2	2					
1.2.4	Reducing water evaporation from ditches with heather bundles	**2**	2	2	2	2	2	2	2	2	2
1.3.1	Felling and treatment of broadleaf scrub & conifers	**1**	1		2		1		2		1
1.3.2	Hand pulling of small broadleaf scrub & conifers with volunteers	**1**	1	1	1	1	1	1	1	1	1
1.3.3	Conservation grazing			2	2	2	2	2	2	2	2
2.1	Enhancing habitat for roosting geese at Fannyside Muir	**1**	1	2	2	2	2	2	2	2	2
2.2	No restoration work to occur while geese present on the site.	**1**	1	1	1	1	1	1	1	1	1
2.3	Restoration work to avoid areas containing winter roost pools used by Taiga bean geese.	**1**	1	1	1	1					
2.4	Sensitive use of heavy machinery on site	**1**	1	1	1	1					
3.1	Taiga bean goose monitoring	**1**	1	1	1	1	1	1	1	1	1
3.2	Hydrological monitoring – water loggers and dip wells	**1**	1	1	1	1	1	1	1	1	1
3.3.1	Peat depth survey	**2**	2	1							
3.3.2	Peat stability monitoring	**1**	1	1	2	2	2	2	2	2	2
3.4	Fixed-point photography to monitor condition of bog	**1**	1	1	1	1	1	1	1	1	1

3.4.1	Bog vegetation monitoring – Fixed-point quadrat transects	**1**	1	1	1	1	1	1	1	1	1
3.4.2	Annual survey of broad leaf scrub	**1**	2	2	2	2	2	2	2	2	2
3.5.1	Butterfly transect- Large Heath	**1**	1	1	1	1	1	1	1	1	1
3.5.2	Butterfly transect- Small pearl-bordered fritillary	**1**	1	1	1	1	1	1	1	1	1
3.6.1	Bog-specialist invertebrate surveys – Bog sun-jumper spider	**1**	1	1	1	2	2	2	2	2	2
3.6.2	Bog-specialist invertebrate surveys – light trapping	**1**	1	2	2	2	2	2	2	2	2
3.6.3	Bog-specialist invertebrate surveys – Odonata surveys	**1**	1	2	2	2	2	2	2	2	2
3.6.4	Bog-specialist invertebrate surveys – aquatic invertebrate survey	**1**	1	2	2	2	2	2	2	2	2
3.6.5	Bog-specialist invertebrate surveys – other species	**1**	1	2	2	2	2	2	2	2	2
4.1	Press releases and media	**1**	1	1	1	1	1	1	1	1	1
4.1	Educational activities (50 young people engaged per year)	**1**	1	1	1	1	1	1	1	1	1
4.2	Local community engagement activities- talks & guided walks	**1**	1	1	1						
4.3	Local community engagement activities- volunteer training	**1**	1	1	1						
5.1	Hold regular Steering Group and stakeholder meetings	**1**	1	1	1	1	1	1	2	2	2
5.2	Annual review of project implementation	**1**	1	1	1	1	1	1	1	1	1
5.3	Revise the management plan					1					1
5.4	Comply with all relevant legislation	**1**	1	1	1	1	1	1	1	1	1
5.5	Maintain site species lists (all taxa)	**1**	1	1	1	1	1	1	1	1	1
5.6	Produce connectivity maps for key bog species	**1**	1	1	2	2	2	2	2	2	2
5.7	Ensure all species records regularly added to NBN	**2**	2	2	2	2	2	2	2	2	2

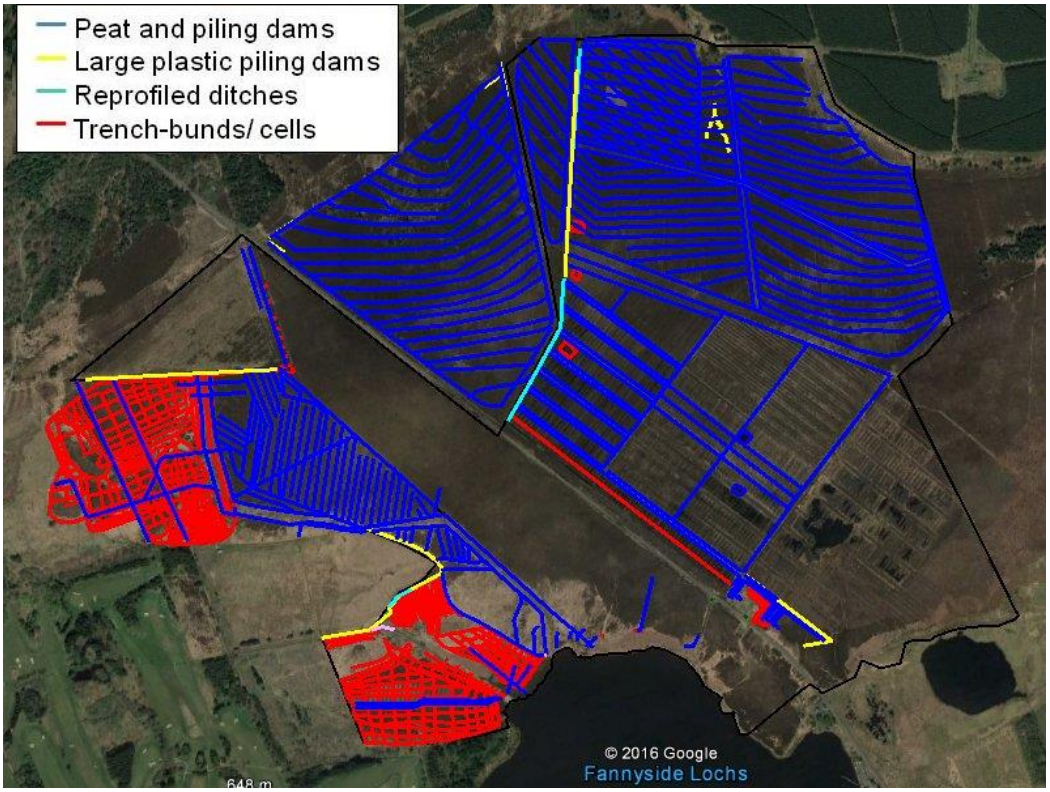
Appendix i. Maps



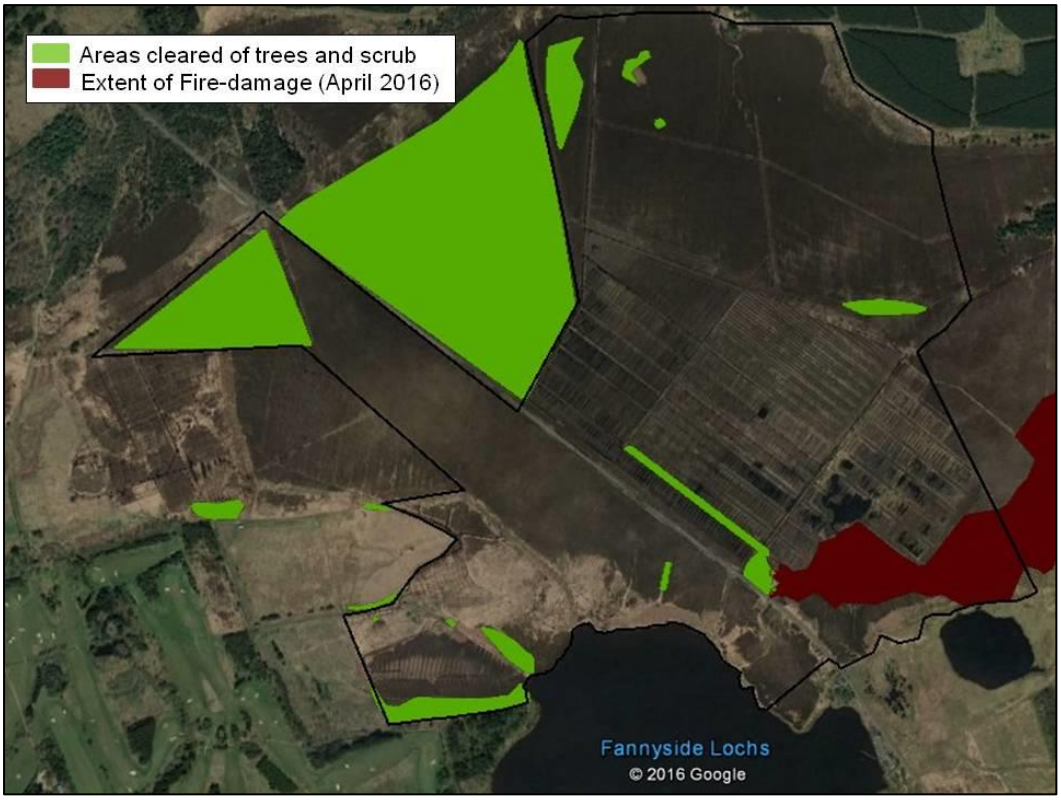
Map 1: Location of Fannyside Muir bog restoration site
Core project area outlined in black. 3km east of Cumbernauld on the Slamannan Plateau.



Map 2: Compartments and land ownership within restoration area.
North Lanarkshire Council (NLC) in orange; Forest Enterprise Scotland (FES) in green and Scottish Wildlife Trust (SWT) in blue. Numbers relate to Compartments mentioned in the Management Plan.



Map 3. Overview of restoration work carried out at Fannyside Muir (dams and bunds).



Map 4. Overview of tree-felling and scrub removal work carried out at Fannyside Muir. Also showing Area of Compartments 11, 12 and 13b damaged by fire on 21st April 2016.

Appendix ii. Photographs

Figure 1. Installation of linear trench bund in Compartment 13a.
Top Left: Excavator installing trench bund (2 m deep) in August 2015. Top Right: Bund and peat dams working to raise water level to surface of compartment in August 2016.

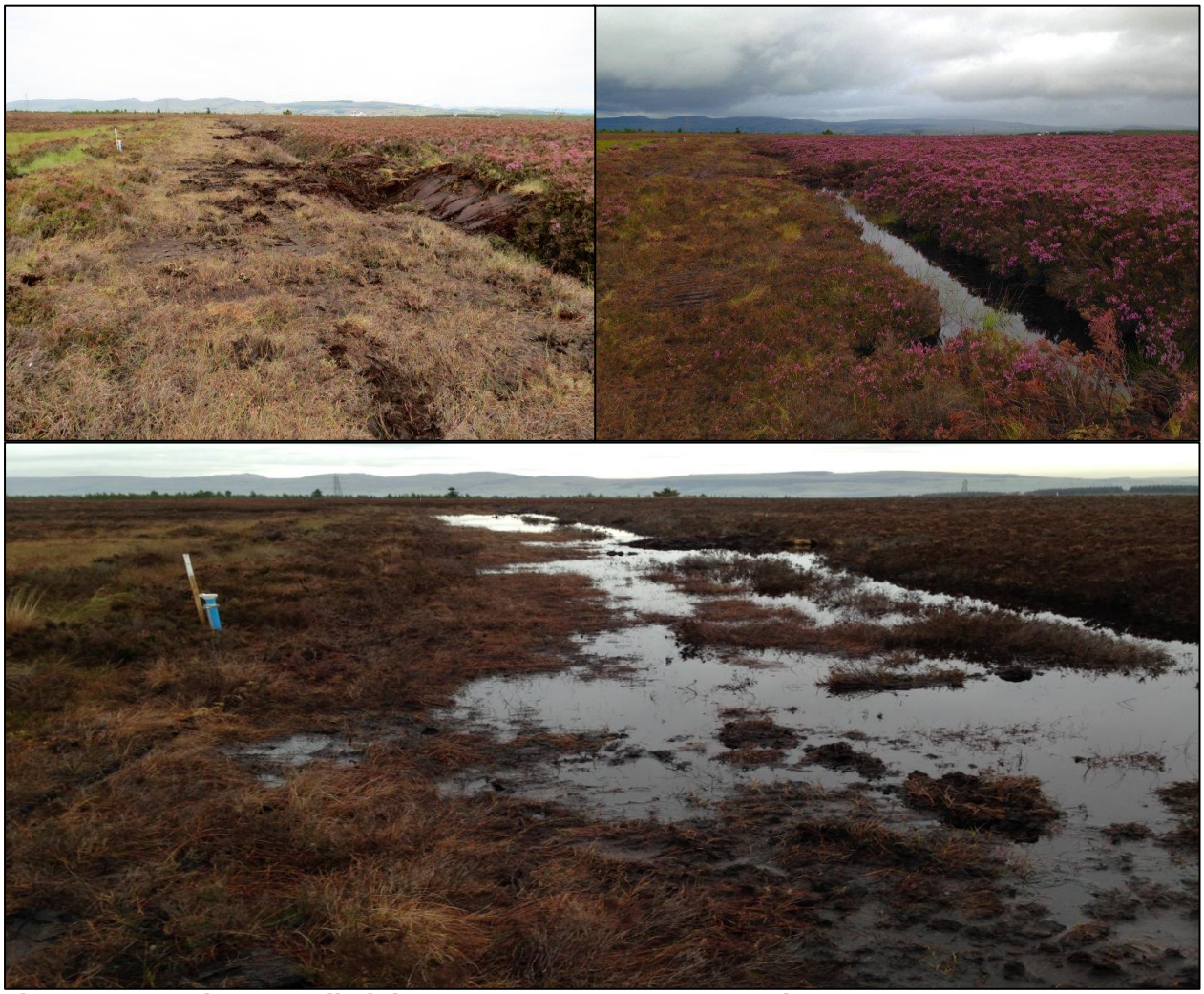


Figure 2. Peat dams on ditch between Compartments 7 and 8.
Top Left: Just after dam installation. Top Right: Late September2015- blocked ditches filling with water. Bottom: March 2016- ground water raised to surface level of the peat.

Figure 3. Installation of cell-bunding in hand-cut area of Compartment 1
Top Left: Preparing trench of compressed peat to block ditches and peat cracks prior to topping with surface bund. Top Right: After adding surface bunds. Middle Left: View facing south-west across completed cell-bunds. Middle Right: Surface water retained 2 months after cell-bund installation (June 2016). Bottom Left: Cell-bunds flooded with ~10-15cm of surface water (June 2016). Bottom Right: Four-spot chaser dragonfly one of 8 species of Odonata recorded at the newly cell-bunded area in 2016.

Figure 4. Large ditch in Compartment 2 at Fannyside Muir before and after installation of reinforced plastic piling dams.
Top Left: Before work began. Top Right: Ditch in late October 2015 after dam installation. Bottom Left: Ditch in June 2016 after further dams added, lower section reprofiled and existing dams backed with peat and vegetation. Bottom Right: Ditch showing *Sphagnum cuspidatum* colonisation and ovipositing dragonflies (Common hawker and Black darters)

Figure 5. Clearing regenerating lodgepole pines with volunteers.
Left: Wild Reekie volunteers (August 2016) at end of workparty. Right: Some of felled conifers before they were added to blocked ditches to help slow water evaporation.

Figure 6. Aerial photographs of restoration work
Top: Cell-bunding in Compartment 1. Middle: Looking north-west over Fannyside Muir from carpark on Fannyside Road. Showing extent of roost pools in Compartment 11 and new pools created in Compartment 10. Bottom: Reprofiled, dammed ditch between re-wetted Compartment 8 (left) and new area 'C' (right) after removal of lodgepole pines and installation of peat dams on larger ditches. All photos taken September 2016 with kind assistance of RSPB Glasgow & South West Scotland staff using an aerial drone.

Figure 7. Monitoring at Fannyside.

Top Left: Dipwell (flooded in compartment 1). Top Right. Downloading hydrology data from logger. Centre Right: Pitfall trap. Centre Left: Bog sun-jumper spider survey using Bug-Vac (with Caledonian Conservation Ltd). Bottom Left: Aquatic invertebrate sampling in goose roost pools (Compartment 11). Bottom Right: Diving beetle larva from recently blocked ditch.

	Rainfall (cm)	0	6.55	1.52	2.53	2.14	6.92	13.05	11.25	11.83	5.57	5.56	2.34	4.67	4.67	13.41	4.01	5.18	
	Reading No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
	Date	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	
	Grid Ref		Phase 1	Phase 1						Phase 2	Phase 2	Phase 2			Phase 3	Phase3			
1	NS8030073771	28.0	36.5	40.5	44.0	21.0	10.5	11.5	26.5	31.0	26.0	28.5	27.5	11.0	9.5	3.5	17.5	10.0	Control* (May 16)
2	NS8025873853	8.5	18.0	22.0	15.5	4.5	3.5	5.5	6.0	9.0	4.0	4.0	14.5	4.0	3.0	0.0	14.0	5.0	
3	NS8024073868	15.0	16.5	20.0	12.0	2.5	3.0	4.0	8.0	7.5	4.0	5.5	7.0	2.0	1.0	3.5	9.0	2.5	
4	NS8040174093	9.0	15.5	22.5	9.5	1.0	0.0	-0.5	3.0	7.5	2.0	3.5	6.0	0.0	1.0	1.0	5.5	2.0	
5	NS8038174089	3.0	1.5	5.0	2.0	-1.5	-2.0	-2.0	-1.0	0.0	-2.0	-2.0	1.0	-2.0	-1.5	-3.0	-1.0	-2.0	
6	NS8055474278	12.0	15.0	21.5	17.0	1.0	-1.0	2.0	4.5	8.0	2.0	4.0	8.0	0.0	7.0	9.0	11.0	7.0	
7	NS8053474295	10.0	9.5	14.0	10.0	5.0	2.5	5.0	7.0	8.0	6.5	7.0	9.0	6.0	5.5	4.0	7.5	6.0	
8	NS5056074270	19.5	32.0	41.5	46.0	8.0	5.5	6.5	21.0	28.0	19.0	20.0	28.5	18.0	24.5	15.0	28.0	15.0	Control
9	NS8056574246	6.5	13.0	17.0	14.0	2.5	1.5	2.0	4.0	8.5	4.0	4.5	6.5	3.0	2.5	1.0	8.0	3.0	
10	NS8021074448	18.5	27.0	36.0	37.0	11.0	9.0	9.0	10.0	12.0	10.0	10.5	13.0	9.0	11.5	9.0	13.5	7.5	
11	NS8022674469	6.0	14.0	21.0	24.5	4.0	3.0	4.5	5.5	8.5	5.0	5.5	6.0	5.0	7.0	6.0	8.0	5.0	Above ground
12	NS8020674446	5.5	11.0	21.0	12.0	5.0	4.0	5.0	4.5	7.5	5.5	6.0	8.5	5.0	5.0	3.0	8.5	5.0	0 - 10.0
13	NS8019074427	4.5	9.0	11.5	10.0	4.0	2.5	3.5	4.0	5.5	4.5	4.0	7.5	4.0	3.0	1.5	5.0	4.5	10.5 - 20.0
14	NS8011474337	8.5	9.5	19.0	9.5	6.5	5.0	6.0	7.5	10.0	7.5	7.0	9.0	5.5	6.0	4.5	8.5	5.5	20.5 - 30.0
15	NS7989374508	3.0	10.0	13.0	3.0	-1.5	-3.0	-4.0	-3.0	-3.0	-4.0	-2.5	-0.5	-4.0	-2.0	-3.0	-3.0	-3.5	30.5+
16	NS7990974526	11.0	7.0	9.0	4.0	3.5	3.0	4.0	4.5	6.5	4.5	5.0	5.5	4.0	3.5	2.5	6.0	4.0	
17	NS7985474547	6.0	7.0	14.0	14.0	3.5	2.0	3.5	6.5	5.5	4.0	4.0	2.0	0.0	2.0	-0.5	3.0	1.0	
18	NS7983074547	7.0	9.0	12.5	10.5	3.5	3.0	4.0	6.0	7.5	4.0	5.0	7.0	4.5	3.0	2.0	6.0	3.5	
19	NS7986574609	5.5	10.0	14.0	3.0	1.5	1.0	-0.5	2.5	4.0	2.0	2.5	4.0	1.5	-0.5	-0.5	3.5	1.0	
20	NS7988874605	4.5	8.0	9.5	4.5	0.0	0.5	-1.0	4.5	6.5	4.5	5.0	6.5	4.0	4.0	2.5	6.5	4.5	
21	NS7972874220	22.5	19.5	25.0	23.5	11.0	7.5	10.5	11.5	12.0	11.0	11.5	13.5	11.0	11.0	7.0	13.0	11.0	
22	NS7993174138	4.0	12.5	21.5	8.5	0.5	0.0	0.5	2.5	5.0	2.0	2.0	7.5	2.5	2.5	2.0	6.0	2.5	
23	NS7993274114	24.0	34.5	32.0	36.0	-3.5	-3.0	-9.0	-8.0	-6.0	-5.0	-5.0	-3.0	-3.0	-5.0	-7.0	-4.0	-5.0	
24	NS7989173872	2.0	3.0	16.0	6.0	1.0	-1.0	0.0	1.0	0.0	1.0	1.0	2.0	-3.0	0.0	-1.0	2.0	0.0	
25	NS7984673804	12.5	18.5	20.0	12.0	10.0	10.5	10.0	11.5	15.0	12.0	11.5	16.0	10.0	10.0	9.5	15.0	10.0	
26	NS7983273782	11.5	21.0	26.0	21.0	9.0	8.0	7.0	11.0	15.5	9.5	10.0	10.5	7.5	9.5	5.5	13.5	9.5	
27	NS7982973780	6.0	15.0	23.0	17.0	0.5	0.0	-1.5	2.0	4.0	2.0	1.0	4.0	-2.0	1.0	-1.0	4.0	0.0	
28	NS7981673758	16.0	15.5	17.0	4.5	1.0	1.5	0.0	2.5	5.0	3.5	3.5	6.0	2.0	2.0	1.0	8.5	2.0	
29	NS7965773596	12.5	21.0	29.5	26.0	15.0	17.0	14.5	16.5	21.0	15.5	16.5	20.0	9.0	-6.0	-10.0	-11.0	-14.0	
30	NS7965773572	18.5	26.0	36.0	31.0	12.5	14.5	9.0	16.0	20.0	20.0	18.0	19.0	7.0	0.0	-3.0	-8.0	-8.0	
31	NS7920074474	10.0	20.0	30.5	36.0	-2.5	-2.0	-4.0	-1.0	0.5	-2.5	-2.5	0.0	-2.5	-3.0	-3.0	-1.0	-3.0	
32	NS7918074468	15.5	17.0	24.0	20.0	8.0	9.0	6.5	12.0	14.0	13.0	18.0	14.0	14.0	17.5	16.0	14.0	13.0	Control
			Phase 1	Phase 1						Phase 2	Phase 2	Phase 2			Phase 3	Phase3			
	Average	10.8	15.7	21.4	17.0	4.6	3.6	3.5	6.5	8.9	6.1	6.6	8.9	4.2	4.2	2.4	6.8	3.3	
	% within 10cm	56.25	34.375	9.375	40.625	84.375	87.5	90.625	75	71.875	78.125	75	65.625	87.5	87.5	93.75	71.875	90.625	

Appendix iii Table 3. Monthly Hydrology Monitoring data. Blue & green colours indicate area suitable for Sphagnum. Orange & red indicate unsuitable

Appendix iv. Site Species Lists

Lists of species recorded within the Fannyside Muir bog restoration area.
* Species recorded nearby (ie. Fannyside RSPB reserve or Palacerigg Country Park etc.).
# Species only recorded from car park/ site compound or road verges

3.1 Flora and fungi

3.1.1 Higher Plants

Key bog indicator species

Blaeberry (*Vaccinium myrtillus*)
Bog asphodel (*Narthecium ossifragum*)
Common cottongrass (*Eriophorum angustifolium*)
Cranberry (*Vaccinium oxycoccus)*
Cross-leaved heath (*Erica tetralix)*
Deer grass (*Trichophorum cespitosum*)
Hare's-tail cottongrass *(Eriophorum vaginatum*)
Heather (*Calluna vulgaris)*
Round-leaved sundew (*Drosera rotundifolia*)
White-beaked sedge (*Rhynchospora alba*)

Other species (including negative bog quality indicator species)

Alder (*Alnus glutinosa*) #
Ash (*Fraxinus excelsior*) #
Angelica (*Angelica sylvestris*)
Annual meadow-grass (*Poa annua*)
Beech (Fagus sylvatica) #
Bird's foot trefoil (*Lotus corniculatus*)
Biting stonecrop (*Sedum acre*) #
Bog pond weed (*Potamageton polyponifolius*)
Bottle sedge (*Carex rostrate*)
Bracken (*Pteridium aquilinum*)
bramble (*Rubus fruticosus*) #
bridewort (*Spirea* sp.) #
Broad-leaved dock (*Rumex obtusifolius*) #
Broad leaved willowherb (*Epilobium montanum*) #
Broom (*Cytisus scoparius*) #
Bush vetch (*Vicia sepium*)#
Carnation sedge (*Carex panicea*)
Chickweed wintergreen (*Trientalis europaea*)
Cock's foot grass (*Dactylis glomerus*) #
Colts foot (*Tussilago farfara*)
Common bent (*Agrostis capillaris*)
Common couch grass (*Elytrigia repens*) #
Common hemp-nettle (Galeopsis tetrahit) #
Common knapweed (*Centaurea nigra*)
Common orache (*Atriplex patula*) #
Common plantain (*Plantago major*) #
Common rhododendron (*Rhododendron ponticum*)
Common silverweed (*Argentina anserine*) #
Common sorrel (*Rumex acetosa*) #
Common spotted orchid (*Dactylorhiza fuchsia*)
Common twayblade (*Listera ovata*)
Common valerian (*Valeriana officinalis*) #

Common vetch (*Vicia sativa*)
Cow parsley (*Anthriscus sylvestris*) #
Creeping buttercup (*Ranunculus repens*)
Creeping forget-me-not (*Myositis secunda*) #
Creeping thistle (*Cirsium vulgare*) #
Cuckoo flower (*Cardamine pratensis*) #
Daisy (*Bellis perennis*) #
Dame's violet (*Hesperis matronalis*) #
dandelion (*Taraxacum* sp.)
Devil's bit scabious (*Succisa pratensis*)
Downy birch (*Betula pubescens*)
Early marsh orchid (*Dactylorhiza incarnata*)
eyebright (*Euphrasia* sp.)
Field horsetail (*Equisetum arvense*) #
Field wood-rush (*Luzula campestris*)
Garden strawberry (*Fragaria x ananassa*) #
Glaucous sedge (*Carex flacca*)
Goat willow (*Salix caprea*)
Gorse *(Ulex europeaus*)
Great willowherb (*Epilobium hirsutum*)
Greater butterfly orchid (*Platanthera chlorantha*)
Ground elder (*Aegopodium podagraria*) #
Hard fern (*Blechnum spicant*)
Hawkweeds (*Hieracium* sp.) #
Hawthorn (*Crataegus monogyna*)
Heath bedstraw (*Galium saxatile*)
Heath milkwort (*Polygala serpyllifolia*)
Heath spotted orchid (*Dactylorhiza maculata*)
Heath wood-rush (*Luzula multiflora*)
Hop trefoil (*Trifolium campestre*) #
Japanese knotweed (*Fallopia japonica*) #
Japanese rose (*Rosa rugosa*) #
Kidney vetch (*Anthyllis vulneraria*) #
Knotgrass (*Polygonum aviculare*) #
Lodgepole pine (*Pinus contorta*)
Lousewort (*Pedicularis sylvatica*)
Lungwort (*Pulmonaria officinalis*) #
Marsh arrow-grass (*Triglochin palustris*) #
Marsh cinquefoil (*Potentilla palustris*)
Marsh lousewort (*Pedicularis palustris*)
Marsh thistle (*Cirsium palustre*)
Marsh violet (*Viola palustris*)
Meadow vetchling (*Lathyrus pratensis*)
Michaelmas daisy (*Aster x salignus*) #
Montbretia (*Crocosmia x crocosmiiflora*) #
Narrow buckler fern (*Dryopteris carthusiana*)
Nipplewort (*Lapsana communis*) #
Pignut (*Conopodium majus*)
Pineapple weed (*Matricaria discoidea*)
Purple moor grass (*Molinia caerulea*)
Ragwort (*Senecio jacobaea*) #
Raspberry (*Rubus idaeus*) #
Red bartsia (*Odontites vernus*) #

Red clover (*Trifolium pratense*) #
Red fescue (*Festuca rubra*) #
Redshank (*Persicaria maculosa*)#
Reed mace (*Typha latifolia*)
Ribwort plantain (*Plantago lanceolata*)
Rosebay willowherb (*Epilobium angustifolium*) #
Round-leaved plantain (
Rowan (*Sorbus aucuparia*)
rushes (*Juncus sp.*)
sallows (*Salix sp.*)
Scots pine (*Pinus sylvestris*)
Selfheal (*Prunella vulgaris*)
Sharp-flowered rush (*Juncus acutiflora*)
Sheeps sorrel (*Rumex acetosella*)$
Short-fruited willowherb (*Epilobium obscura*) #
Silver birch (*Betula pendulus*)
Sitka spruce (*Picea sitchensis*)
Smooth sow-thistle (*Sonchus oleraceus*) #
Sneezewort (*Achillea ptarmica*)
Soft rush (*Juncus effusus*)
Spear thistle (*Cirsium arvense*) #
Stinging nettle (*Urtica dioica*) #
St. John's wort (*Hypericum sp.*)
Sweet vernal grass (*Anthoxanthum odoratum*)
Tormentil (*Potentilla erecta*)
Tufted hair grass (*Deschampsia cespitosa*)
Wavy bittercress (*Cardamine flexuosa*) #
White clover (*Trifolium repens*) #
Wild strawberry (*Fragaria vesca*)
Yarrow (*Achillea milllefolium*)
Yellow flag iris (*Iris pseudacorus*)
Yellow loosestrife (*Lysimachia vulgaris*) #
Yellow rattle (*Rhinanthus minor*) #

3.1.2 Bryophytes, fungi and lichens

Bryophytes (including key bog indicator species)
Acute-leaved bog-moss (*Sphagnum capillifolium*)
Blunt-leaved bog-moss (*Sphagnum palustre*)
Bog bead moss (*Aulacomnium palustre*)
Bogmoss flapwort (*Odontoshisma sphagnii*)
Common haircap moss *(Polytrichum commune*)
Feathery bog-moss (Sphagnum *cuspidatum*)
Flat-topped bog-moss (*Sphagnum fallax*)
Heath plait moss (*Hypnum jutlandicum*)
Heath star moss (*Campylopus introflexus*)
Lustrus bog-moss (*Sphagnum subnitens*)
Magellanic bog-moss (*Sphagnum magellanicum*)
Papilose bog-moss (*Sphagnum papillosum*)
Soft bog-moss (*Sphagnum tenellum*)
Strict haircap moss (*Polytrichum strictum*)
turf moss (*Rhytidiadelphus* sp.)
Waved silk moss (*Plagiothecium undulatum*)

Lichens
lichen (*Cladonia chlorophaea* agg.)
lichen (*Cladonia coniocraea*)
lichen (*Cladonia floerkeana*)
lichen (*Cladonia portentosa*)
lichen (*Evernia prunastri*)
lichen (*Peltigera membranacea*)

Fungi
Alder tongue gall (*Taphrina alni*)
Beefsteak fungus (*Fistulina hepatica*)$
Common earthball (*Scleroderma citrinum*)
Honey fungus (*Armillaria sp.*)
Rosy crust (*Peniophora incarnate*) – on gorse
Sickner (*Russula emetica*)
Waxcaps (*Hygrocybe sp.)*
Yellow brain (*Tremella mesenterica*) – on gorse
Yellow staghorn fungus (*Calocera viscosa*)

Slimemoulds
Dog sick slimemould (*Fuligo septica*)
Bubblegum fungus (*Lycogala epidendrum*)

3.2 Birds
Barn owl (*Tyto alba*) * Recorded at Palacerigg Country Park
Barn swallow (*Hirundo rustica*)
Blackbird (*Turdus merula*)
Black-headed gull (*Chroicocephalus ridibundus*)
Blue tit (*Cyanistes caeruleus*)
Bullfinch (*Pyrrhula pyrrhula*)
Buzzard (*Buteo buteo*)
Canada goose (*Branta canadensis*)
Carrion crow (*Corvus corone*)
Chaffinch (*Fringilla coelebs*)
Coal tit (*Periparus ater*)
Coot (*Fulica atra*)
Common crossbill (*Loxia curvirostra*)
Common gull (*Larus canus*)
Common sandpiper (*Actitis hypoleucos*)
Cuckoo (*Cuculus canorus*)
Curlew (*Numenius arquata*)
Dunlin (*Calidris alpina*)
Feral pigeon (*Columba livia*)
Fieldfare (*Turdus pilaris*)
Goldcrest (Regulus regulus)
Goldeneye (*Bucephala clangula*) * Recorded at RSPB Fannyside
Goldfinch (*Carduelis carduelis*)
Gooseander (*Mergus merganser*) * Recorded at RSPB Fannyside
Grasshopper warbler (*Locustella naevia*)
Greater spotted woodpecker (*Dendrocopos major*)
Great black-backed gull (*Larus marinus*)
Great tit (*Parus major*)

Greylag goose (*Anser anser*)
Grey Heron (*Ardea cinerea*)
Grey partridge (*Perdix perdix*) * Recorded at RSPB Fannyside
Hen harrier (*Circus cyaneus*)
Herring gull (*Larus argentatus*)
House Martin (*Delichon urbicum*)
Jackdaw (*Corvus monedula*)
Jay (*Garrulus glandarius*)
Jack snipe (*Lymnocryptes minimus*)
Kestrel (*Falco tinnunculus*)
Lapwing (*Vanellus vanellus*)
Lesser black-backed gull (*Larus fuscus*)
Lesser redpoll (*Acanthis cabaret*)
Linnet (*Carduelis cannabina*) * Recorded at RSPB Fannyside
Little grebe (*Tachybaptus ruficollis*) * Recorded at RSPB Fannyside
Long-eared owl (*Asio otus*) * Recorded at RSPB Fannyside
Mallard (*Anas platyrhynchos*)
Magpie (*Pica pica*)
Marsh harrier (*Circus aeruginosus*) * Recorded at RSPB Fannyside
Meadow pipit (*Anthus pratensis*)
Merlin (Falco columbarius) * Recorded at Toddleknowe Muir
Moorhen (*Gallinula chloropus*)
Oystercatcher (*Haematopus ostralegus*)
Raven (*Corvus corax*) –flying overhead
Redshank (*Tringa tetanus*)
Peregrine (*Falco peregrinus*)
Pink-footed goose (*Anser brachyrhynchus*)
Ringed plover (Charadrius hiaticula) * Recorded at RSPB Fannyside
Pheasant (*Phasianus colchicus*)
Pied wagtail (*Motacilla alba*)
Robin (*Erithacus rubecula*)
Red grouse (*Lagopus lagopus* scotica)
Red-necked diver (*Podiceps grisegena*) * Recorded at RSPB Fannyside
Redshank (*Tringa totanus*)
Redwing (*Turdus iliacus*)
Reed bunting (*Emberiza schoeniclus*)
Sand martin (*Riparia riparia*)
Sedge warbler (*Acrocephalus schoenobaenus*) * Recorded at RSPB Fannyside
Short-eared owl (*Asio flammeus*)
Skylark (*Alauda arvensis*)
Snipe (*Gallinago gallinago*)
Songthrush (*Turdus philomelos*) * Recorded at Palacerigg Country Park
Sparrowhawk (*Accipiter nisus*)
Starling (*Sturnus vulgaris*)
Stonechat (*Saxicola rubicola*)
Swift (*Apus apus*)
Taiga bean goose (*Anser fabalis fabalis*) (BAP, SPA & SSSI designated feature)
Tawny owl (*Strix aluco*)
Teal (*Anas crecca*)
Tufted duck (*Aythya fuligula*)
Water rail (*Rallus aquaticus*) * Recorded at RSPB Fannyside
White-fronted goose (*Anser albifrons*)
Wigeon (*Anas penelope*)

Willow warbler (*Phylloscopus trochilus*)
Wheatear (*Oenanthe oenanthe*)
Whinchat (*Saxicola rubetra*)
Whitethroat (*Sylvia communis*)
Woodcock (*Scolopax rusticola*)
Wood pigeon (*Columba palumbus*)
Wren (*Troglodytes troglodytes*)
Yellowhammer (*Emberiza citronella*)

3.3 Mammals

Badger (*Meles meles*) * Recorded at RSPB Fannyside and Palacerigg Country Park
Bank vole (*Myodes glareolus*) – remains found on site
Brown hare (*Lepus europaeus*)
Common pipistrelle (*Pipistrellus pipistrellus*) * Recorded at RSPB Fannyside
Common shrew (*Sorex araneus*) #
European hedgehog (*Erinaceus europeaus*)
European mole (*Talpes europea*)
European otter (*Lutra lutra*) – scat
Field vole (*Microtus agrestis*)
Grey squirrel (*Sciurus carolinensis*)
Pine martin (*Martes martes*) * Recorded at Palacerigg Country Park
Red fox (*Vulpes vulpes*) –scat & footprints
Roe deer (*Capreolus capreolus*)
Stoat (*Mustela erminea*)
Water vole (*Arvicola amphibious*) * Recorded at Palacerigg Country Park
Weasel (*Mustela nivialis*) #

3.4 Invertebrates

Acari (mites)
birch gall mite (*Acalitus rudis*)
Alder gall mite (*Eriophyes inagulis*)

Araneae (spiders)
Common crab spider (*Xysticus cristatus*)
comb-footed spider (*Enoplognatha ovata agg.*)
comb-footed spider (*Theridion sisyphium*)
Cucumber spider (*Araniella sp.*)
Four-spot orb weaver (*Araneus quadratus*)
Furrowed orb-weaver (*Larinioides cornutus*)
Garden orb weaver (*Araneus diadematus*)
Grass blade spider (*Tibellus oblongus*)
jumping spider (*Neon reticulatus*)
Lace-webbed spider (*Amaurobius similis*) #
long-jawed spider (*Metellina mengei*)
long-jawed spider (*Metellina segmentata*)
long-jawed spider (*Tetragnatha extensa*)
long-jawed spider (*Tetragnatha montana*)
money spider (*Gonatium rubens*)
mesh-web spider (*Dictyna sp*)
mesh-web spider (*Dictyna arundinacea*)
orb-weaver spider (*Hypsosinga pygmaea*)
sac spider (*Cheiracanthium erraticum*)
sac spider (*Clubonia trivialis*)

wolf spider (*Pardosa sp.*)
wolf spider (*Pardosa amentata*)
wolf spider (*Pardosa nigriceps*)
wolf spider (*Pardosa palustris*)
wolf spider (*Pirata piraticus*)
wolf spider (*Trochosa ruricola*)

Coleoptera (beetles)
Birch leaf roller weevil (*Deporaus betulae*)
Black snail beetle (*Silpha atrata*)
Blue willow beetle (*Phratora vulgatissima*)
click beetle (*Athous haemorrhoidalis*)
click beetle (*Ctenicera cuprea*)
click beetle (*Denticollis lineatus*)
diving beetle (*Agabus bipustulatus*)
diving beetle (*Agabus sturmii*)
diving beetle (*Dytiscus sp,*)
diving beetle (*Hydroporus gyllenhalli*)
diving beetle (*Hydroporus erythrocephalus*)
diving beetle (*Hydroporus incognitus*)
diving beetle (*Hydroporus morio*)
diving beetle (*Hydroporus obscurus*)
diving beetle (*Hydroporus palustris*)
diving beetle (*Hydroporus pubescens*)
diving beetle (*Hydroporus tritis*)
diving beetle (*Rhantus suturellus*)
diving beetle (*Stictonectes lepidus*)
ground beetle (*Agonum ericeti*) – bog specialist
ground beetle (*Agonum fuliginosum*)
ground beetle (*Bembidion stepheni*)
ground beetle (*Calodromius spilotus*)
ground beetle (*Carabus problematicus*)
ground beetle (*Dromius quadrimaculatus*)
ground beetle (*Loricera pilicornis*)
ground beetle (*Paranchus albipes*)
ground beetle (*Pterostichus adstrictus*)
ground beetle (*Pterostichus diligens*)
ground beetle (*Pterostichus maddidus*)
ground beetle (*Pterostichus niger*)
ground beetle (*Pterostichus rhaeticus*)
Heather beetle (*Lochmaea suturalis*)
Hieroglyphic ladybird (*Coccinella hieroglyphica*)
Larch ladybird (*Aphidecta obliterata*)
leaf beetle (*Phaedon armoraciae*)
leaf beetle (*Phyllotreta flexuosa*)
leaf beetle (*Plagiodera versicolora*)
leaf beetle (*Neocrepiodera transversa*)
Orange ladybird (*Halyzia sedecimguttata*)
Raspberry beetle (*Byturus tomentosus*)
Red soldier beetle (*Rhagonycha fulva*)
reed beetle (*Plateumaris discolor*)
rove beetle (*Anthophagus caraboides*)
rove beetle (*Platydracus stercorarius*)

rove beetle (*Quedius fuliginosus*)
rove beetle (*Quedius sp.*)
rove beetle (*Stenus brunnipes*)
rove beetle (*Stenus lustrator*)
rove beetle (*Stenus nitens*)
rove beetle (*Stenus pubescens*)
rove beetle (*Stenus similis*))
Seven-spot ladybird (*Coccinella 7-punctata*)
sexton beetle (*Nicrophorus vespiloides*)
soldier beetle (*Cantharis pellucida*)
soldier beetle (*Rhagonycha limbata*)
Ten-spot ladybird (*Adalia 10-punctata*)
thick-legged flower beetle (*Oedemera virescens*)
Two-banded longhorn (*Rhagium bifasciatum*)
tumbling flower beetle (*Anaspis thoracica*)
water scavenger beetle (*Anacaena lutescens*)
water scavenger beetle (*Anacaena globulus*)
water scavenger beetle (*Helophorus flavipes*)
water scavenger beetle (*Hydrobius fuscipes*)
weevil (*Limnobaris dolorosa*)
weevil (*Micrelus ericae*)
weevil (*Otiorhynchus singularis*)
weevil (*Orchestes rusci*)
weevil (*Phyllobius pyri*)
weevil (*Polydrusus cervinus*)
whirligig beetle (*Gyrinus substriatus*)
whirligig beetle (*Gyrinus caspius*)
Willow leaf beetle (*Lochmaea caprea*)

Collembola (spring tails)
globular springtail (*Dicyrtomia minuta*)
globular springtail (*Dicyrtomia saundersi*)
globular springtail (*Sminthurus viridis)*

Dermiptera (earwings)
Common earwig (*Forficula auricularia*)

Diptera (flies)
biting midge (*Culicoides sp.*)
biting midge (*Culiseta sp*
biting mosquito (*Aedes sp.*) -larvae
blowfly (*Calliphora sp.*)
blowfly (*Lucilia sp.*)
conopid fly (*Conops quadrifasciatus*)
conopid fly (*Sicus ferrugineus*)
cluster fly (*Pollenia sp.*)
cranefly (*Dolichopeza albipes*)
cranefly (*Idioptera pulchella*)
cranefly (*Limonia mitis*)
cranefly (*Pedica rivosa*)
cranefly (*Phalacrocera replicata*)
cranefly (*Tipula paludosa*)
cranefly (*Tipula subnodicornis*)

cranefly (*Ula mollissima*)
dancefly (*Hybos culicormis*)
Deer ked (*Lipoptena cervi*)
Down-looker snipefly (*Rhagio scolopaceus*)
gall midge (*Iteomyia capreae*)
Holly leaf miner (*Phytomyza ilicus*)
hoverfly (*Cheilosia bergenstammi*)
hoverfly (*Cheilosia grossa*)
hoverfly (*Cheilosia pagana*)
hoverfly (*Chrysotoxum arcuatum*)
hoverfly (*Dasysyrphus venustus*)
hoverfly (*Epistrophe grossulariae*)
hoverfly (*Episyrphus balteatus*)
hoverfly (*Eristalis arbustorum*)
hoverfly (*Eristalis horticola*)
hoverfly (*Eristalis intricarius*)
hoverfly (*Eristalis nemorum*)
hoverfly (*Eristalis pertinax*)
hoverfly (*Eristalis tenax*)
hoverfly (*Eupeodes luniger*)
hoverfly (*Helophilus hybridus*)
hoverfly (*Helophilus pendulus*)
hoverfly (*Helophilus trivittatus*)
hoverfly (*Lucozona glaucia*)
hoverfly (*Leucozona lucorum*)
hoverfly (*Meliscaeva cinctella*)
hoverfly (*Melanostoma scalare*)
hoverfly (*Melanostoma mellinum*)
hoverfly (*Melangyna lasiophthalma*)
hoverfly (*Myathropa florea*)
hoverfly (*Neoascia tenur*)
hoverfly (*Pipizella viduata*)
hoverfly (*Parasyrphus punctulatus*)
hoverfly (*Platycheirus albimanus*)
hoverfly (*Platycheirus clypeatus*)
hoverfly (*Platycheirus granditarsus*)
hoverfly (*Platycheirus occultus*)
hoverfly (*Platycheirus ramsarensis*)
hoverfly (*Platycheirus rosarum*)
hoverfly (*Rhingia campestris*)
hoverfly (*Scaeva pyrastri*)
hoverfly (*Sericomyia lappona*)
hoverfly (*Sericomyia silentis*)
hoverfly (*Sphaerophoria sp.*)
hoverfly (*Syrphus ribesii*)
hoverfly (*Syrphus vitripennis/rectus*)
hoverfly (*Syritta pipiens*)
hoverfly (*Volucella bombylans*)
hoverfly (*Volucella pellucens*)
marsh fly (*Pherbellia albocostata*)
mothflies (*Psychodidae*)
Noon fly (*Mesembrina meridiana*)
picture-wing fly (*Campiglossa argyrocephala*)

picture-wing fly (*Tephritis conura*)
picture-wing fly (*Xyphosia miliaria*)
pipunculid fly (*Verrallia aucta*)
Red-legged St Marks fly (*Bibio pomonae*)
soldierfly (*Beris chalybata*)
soldierfly (*Beris vallata*)
St Mark's fly (*Bibio marci*)
tachinid fly (*Gymnochaeta viridis*)
tachinid fly (*Tachina ursina*)
tachinid fly (*Tachina grossa*)
winter gnats (Trichoceridae)
Yellow dung fly (*Scathophaga stercoraria*)

Ephemeroptera (mayflies)
Claret dun (*Leptophlebia vespertina*)
Pond olive (*Cloeon dipterum*)

Hemiptera (true bugs)
Alder spittlebug (*Aphrophora alni*)
back swimmer (*Notonecta sp*.)
Common froghopper (*Philaenus spumarius*)
Gorse shieldbug (*Piezodorum lituratus*)
ground bug (*Nysius* sp.)
lace hopper (*Cixius nervosus*)
leaf hopper (*Cicadella viridis*)
leaf hopper (*Cicadula quadrinotata*)
leaf hopper (*Idiocerus lituratus*)
leaf hopper (*Conosanus obsoletus*)
Marsh damselbug (*Nabis limbatus*)
Marsh froghopper (*Neophilaenus lineatus*)
Meadow plant bug (*Leptopterna dolabrata*)
mirid plant bug (*Capus ater*)
mirid plant bug (*Orthotylus ericetorum*)
mirid plant bug (*Pithanus maerkelii*)
mirid plant bug (*Stenodema calcarata*)
mirid plant bug (*Stenodema holsata*)
mirid plant bug (*Stenodema laevigata*)
mirid plant bug (*Teratocoris* sp.)
mirid plant bug (*Trigonotylus caelestialum*)
plant hopper (*Conomelus anceps*)
pond skater (Gerris sp.)
pond skater (*Gerris thoracicus*)
Spiked shieldbug (*Picromerus bidens*)
Water boatman (*Arctocorisa germani*)
water boatman (*Callicorixa wollastoni*)
water boatman (*Hesperocorixa sahlbergi*)
water boatman (*Sigara sp.*)
water cricket (*Velia caprai*)
water cricket (*Velia saulii*)

Hymenoptera (ants, bees, sawflies & wasps)
ant (*Formica lemani*)
ant (*Lasius niger*)

ant (*Lepothorax acervorum*)
ant (*Myrmica ruginodis*)
Bedeguar gall wasp (*Diplolepis rosae*)
Blaeberry bumblebee (*Bombus monticola*)
Buff-tailed bumblebee (*Bombus terrestris*)
Clarke's mining bee (*Andrena clarkella*)
Common carder bumblebee (*Bombus pascuorum*)
Common social wasp (*Vespa vulgaris*)
Cryptic bumblebee (*Bombus cryptarum*)
Early bumblebee (*Bombus pratorum*)
Early mining bee (*Andrena haemorrhoa*)
Field cuckoo bumblebee (*Bombus campestris*)
Forest cuckoo bumblebee (*Bombus sylvestris*)
furrow bees (*Lasioglossum* sp.)
Giant horntail (*Urocerus gigas*)
Gypsy cuckoo bumblebee (*Bombus bohemicus*)
Heath bumblebee (*Bombus jonellus*)
Heather colletes (*Colletes succinctus*)
Honeybee (*Apis mellifera*)
Northern white-tailed bumblebee (*Bombus magnus*)
Orange-legged furrow-bee (*Halictus rubicundus*)
Parasitic wasps (*Ophion sp.*)
Red wasp (*Vespa rufa*)
Rose pea gall wasp (*Diplolepis nervosa/ eglanteriae*)
Sabre wasp (*Rhyssa persuasoria*)
Sallow sawfly (*Nematus ferruginea*)
Scabious sawfly (*Abia sericea*)
Tree wasp (*Dolichovespula sylvestris*)
White-tailed bumblebee (*Bombus lucorum agg*)

Isopoda (woodlice)
Common striped woodlouse (*Philoscia muscorum*)
Common rough woodlouse (*Porcellio scaber*)
Pygmy woodlouse (*Trichoniscus pusillus*)

Lepidoptera (butterflies and moths)
Angle shades (*Phlogophora meticulosa*)
Antler moth (*Cerapteryx graminis*)
Autumnal rustic (*Eugorisma glareosa*)
Barred straw (*Gandaritis pyraliata*)
Beautiful yellow underwing (*Anarta myrtilli*)
Bird cherry ermine (*Yponomeuta evonymella*) * Palacerigg Country Park
Blaeberry roller (*Ancylis myrtillana*)
Blaeberry tortrix (*Apheilia viburnana*)
Black rustic (*Aporophyla nigra*)
Bordered white (*Bupalus piniaria*)
Brimstone moth (*Opisthograptis luteolata*)
Brindled flat-body (*Agonopterix arenella*)
Brindled pug (*Eupithecia abbreviata*)
Broom moth (*Ceramica pisi*)
Brown china-mark (*Elophila nymphaeta*)
Brown rustic (*Rusina ferruginea*)
Brown silver-lines (*Petrophora chlorosata*)

Buff-tip moth (*Phalera bucephala*)
Burnished brass (*Diachrysia chrysitis*)
Canary-shouldered thorn (*Ennomos alniaria*)
Carrion moth (*Monopsis weaverella*)
Chestnut (*Conistra vaccinii*)
Cinnabar moth (*Tyria jacobaeae*)
Clouded border (*Lomospilis marginata*)
Clouded drab (*Orthosia incerta*)
Common birch pygmy (*Stigmella betulicola*)
Common carpet (*Epirrhoe alternata*)
Common flat-body (*Agonopterix heracliana*)
Common grass veneer (*Agriphila tristella*)
Common heath (*Ematurga atomaria atomaria*)
Common marbled carpet (*Chloroclysta truncate*)
Common plume (*Emmelina monodactyla*)
Common pug (*Eupithecia vulgata*)
Common quaker (*Orthosia cerasi*)
Common rush case-bearer (*Coleophora alticolella*)
Common wainscot (*Mythimna pallens*)
Common white wave (*Cabera pusaria*)
Common wave (*Cabera exanthemata*)
Copper underwing (*Amphipyra pyramidea*)
Coxcomb prominent (*Ptilodon capucina*)
Dark arches (*Apamea monoglypha*)
Dark brocade (*Blepharita adusta*)
Dark green fritillary (*Argynnis aglaja*)
Dark marbled carpet (*Chloroclysta citrata*)
December moth (*Poecilocampa populi*)
Diamond-back moth (*Plutella xylostella*)
Dotted border (*Agriopis marginaria*)
Dotted clay (*Xestia baja*)
Double square-spot (*Xestia triangulum*)
Drinker moth (*Euthrix potatoria*)
Ear moth agg (*Amphipoea sp.*)
Early grey (*Xylocampa areola*)
Early tooth-striped (*Trichopteryx carpinata*)
Elephant hawkmoth (*Deilephila elpenor*)
Emperor moth (*Saturnia pavonia*)
Engrailed (*Ectropis bistortata*)
Feathered thorn (*Colotois pennaria*)
Flame carpet (*Xanthorhoe designata*)
Flame shoulder (*Ochropleura plecta*)
Fox moth (*Macrothylacia rubi*)
Garden grass-veneer (*Chrysoteuchia culmella*)
Garden tiger (*Arctia caja*)
Gold spangle (*Autographa bractea*)
Gold spot (*Plusia festucae*)
Golden pigmy (*Stigmella aurella*))
Gothic (*Naenia typica*)
Grass veneer (*Crambus pascuella*)
Grey dagger (*Acronicta psi*)
Grey pine carpet (*Thera obeliscata*)
Grey rush case-bearer (*Coleophora glaucicolella*)

Green-brindled crescent (*Allophyes oxycanthae*)
Green carpet (*Colostygia pectinataria*)
Green hairstreak (*Callophrys rubi*)
Green-veined white (*Pieris napi*)
Haworth's minor (*Celaena haworthii*)
Heart & dart (*Agrotis exclamationis*)
Heath rustic (*Xestia agathina*)
Heath twist (*Philedonides lunana*)
Heather groundling (*Neofaculata ericetella*)
Hebrew character (*Orthosia gothica*)
Hook-streaked grass-veneer (*Crambus lathoniellus*)
Ingrailed clay (*Diarsia mendica*)
July highflyer (*Hydriomena furcata*)
Large emerald (*Geometra papilionaria*)
Large white (*Pieris brassicae*) * Recorded at RSPB Fannyside
Large yellow underwing (*Nocta pronuba*)
Latticed heath (*Chiasmia clathrata*)
Lempke's gold spot (*Plusia putami gracilis*)
Lesser broad-bordered yellow underwing (*Noctua janthe*)
Lesser swallow prominent (*Pheosia gnoma*)
Light emerald (*Campaea margaritata*)
Lesser yellow underwing (*Noctua comes*)
Little cosmet (*Mompha raschikiella*)
Lunar hornet moth (*Sesia bembeciformis*)
Lunar marbled brown (*Drymonia ruficornis*)
Map-winged swift (*Hepialus fusconebulosa*)
Manchester treble-bar (*Carsia sororiata*)
March dagger (*Diurnea fagella*)
March moth (*Alsophila aescularia*)
Marbled conch (*Eupoecilia angustana*)
May highflyer (*Hydriomena impluviata*)
Meadow brown (*Maniola jurtina*)
Meadow longhorn (*Cauchas rufimitrella*)
Mottled beauty (*Alcis repandata*)
Mottled grey (*Colostygia multistrigaria*)
Mottled umber (*Erannis defoliaria*)
Narrow-winged pug (*Eupithecia nanata*)
Neglected rustic (*Xestia castanea*)
Northern eggar (*Lasiocampa quercus callunae*)
Northern spinach (*Eulithis populata*)
November moth (*Epirrita dilutata*)
Nut-tree tussock (*Colocasia coryli*)
Oak beauty (*Biston strataria*)
Orange tip (*Anthocharis cardamines*)
Orange underwing (*Archiearis parthenias*)
Painted lady (*Vanessa cardui*)
Peacock (*Aglais io*)
Pearl-banded grass veneer (*Catoptria margaritella*)
Pebble prominent (*Notodonta ziczac*)
Peppered moth (*Biston betularia*)
Pine beauty (*Panolis flammea*)
Pine bell (*Epinotia rubiginosana*)
Pine bud moth (*Pseudococcyx torionella*)

Pink-barred sallow (*Xanthia togata*)
Plain gold (*Micropterix calthella*)
Poplar hawkmoth (*Laothoe populi*)
Powdered quaker (*Orthosia gracilis*)
Red admiral (*Vanessa atalanta*)
Red-green carpet (*Chloroclysta siterata*)
Red-necked footman (*Atolmis rubricollis*)
Red sword grass (*Xylena exsoleta*)
Riband Wave (*Idaea aversata*)
Ringlet (*Aphantopus hyperantus*)
Rush marble (*Bactra lancealana*)
Rustic shoulder-knot (*Apamea sordens*)
Sallow (*Xanthia icteritia*)
Scalloped oak (*Crocallis elinguaria*)
Scarce silver Y (*Syngrapha interrogationis*)
Shaded broadbar (*Scotopteryx chenopodiata*)
Shears (*Hada plebeja*)
Silver-ground carpet (*Xanthorhoe montanata*)
Silver Y (*Autographa gamma*)
Six-spot burnet (*Zygaena filipendulae*)
Six-striped rustic (*Xestia sexstrigata*)
Small argent & sable (*Epirrhoe tristata*)
Small autumnal moth (*Epirrita filigrammaria*)
Small copper (*Lycaena phlaeas*)
Small dotted buff (*Photedes minima*)
Small fan-footed wave (*Idaea biselata*)
Small heath (*Coenonympha pamphilus*)
Small pearl-bordered fritillary (*Boloria selene*)
Small quaker (*Orthosia cruda*)
Small square-spot (*Diarsia rubi*)
Small tortoiseshell (*Aglais urticae*)
Small wainscot (*Chortodes pygmina*)
Small white (*Pieris rapae*)
Spruce carpet (*Thera britannica*)
Square-spot rustic (*Xestia xanthographa*)
Straw dot (*Rivula sericealis*)
Swallow-tailed moth (*Ourapteryx sambucaria*)
The chevron (*Eulithis testata*)
The spectacle (*Abrostola tripartita*)
True lover's knot (*Lycophotia porphyria*)
Twin-spot carpet (*Perizoma didymata*)
Twin-spot plume (*stenopilia bipunctidactyla*)
Twin-spot quaker (*Orthosia munda*)
Vapourer (*Eupithecia nanata*)
Water carpet (*Lampropteryx suffumata*)
Willow beauty (*Peribatodes rhomboidaria*)
White blotch bell (*Epinotia trigonella*)
White ermine (*Spilosoma lubricipeda*)
White sallow bell (*Epinotia subocellana*)
Winter moth (*Operophtera brumata*)
Woodland marble (*Orthotaenia undulana*)
Yellow-barred gold (*Micropterix aureatella*)
Yellow horned (*Achlya flavicornis*)

Yellow-lined quaker (*Agrochola lota*)
Yellow shell (*Camptogramma bilineata*)

Lithobiomorpha (stone centipedes)
Common brown centipede (*Lithobius forficatus*)

Mecoptera (scorpion flies)
scorpionfly (*Panorpa germanica*)

Megaloptera (alderflies)
Common alderfly (*Sialis lutaria*)

Molluscs (slugs and snails)
Black slug (*Arion ater*)
Dusky slug (*Arion subfuscus*)
Garlic snail (*Oxychilus alliarius*) #
Hedgehog slug (*Arion intermedius*)
Marsh slug (*Derocerus laeve*)
Rounded snail (*Discus rotundatus*) #
Slippery snail (*Cochlicopa lubrica*) #

Myriapods (centipedes and millipedes)
Black snake millipede (*Tachypodoiulus niger*)
Orange striped millipede (*Ommatoiulus sabulosus*)
Flat-backed millipede (*Polydesmus* sp.)

Neuroptera (lacewings)
green lacewing (*Chrysopa pallens*)
green lacewing (*Chrysopa perla*)

Odonata (dragonflies and damselflies)
Azure damselfly (*Coenagrion puella*)
Black darter (*Sympetrum danae*)
Blue-tailed damselfly (*Ischnura elegans*)
Common blue damselfly (*Enallagma cyathigerum*)
Common darter (*Sympetrum striolatum*)
Common hawker (*Aeshna juncea*)
Emerald damselfly (*Lestes sponsa*)
Four-spotted chaser (*Libellula quadrimaculata*)
Golden-ringed dragonfly (*Cordulegaster boltonii*) *Recorded at RSPB Fannyside
Large red damselfly (*Pyrrhosoma nymphula*)

Opilliones (harvestmen)
harvestman (*Mitopus morio*)
harvestman (*Parologolophus agrestis*)

Orthoptera (grasshoppers and crickets)
Common green grasshopper (*Omocestus viridulus*)
Field grasshopper (*Chorthippus brunneus*)

Plecoptera (stoneflies)
Early needle fly (*Leuctra hippopus*)
Small brown stonefly (*Nemoura cinerea*)

Pseudoscorpiones (Pseudoscorpions)
Common moss nipper (*Neobisium carcinoides*)

Trichoptera (Caddisflies)
caddisfly (*Limnephilus griseus*)- Cinnamon sedge
caddisfly (*Limnephilus lunatus*)
caddisfly (*Plectocnemia conspersa*)
caddisfly (*Rhadicoleptus alpestris*)

3.5 Reptiles and Amphibians

Reptiles
Adder (*Vipera berus*) *Recorded at SWT Forest Wood
Common lizard (*Zootoca vivipara*)

Amphibians
Common frog (*Rana temporaria*)
Common toad (*Bufo bufo*)
Palmate newt (*Lissotriton helveticus*)
Smooth newt (*Lissotriton vulgaris*) * Recorded at Palacerigg Country Park

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