SHEIRDRIM RENEWABLE ENERGY DEVELOPMENT

Technical Appendix 8.5: Habitat Management Plan
Prepared for: ScottishPower Renewables UK Ltd

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BASIS OF REPORT

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1.0 Introduction

The overall purpose of the Sheirdrim Renewable Energy Development (proposed Development) Habitat Management Plan ("the HMP") is to implement positive land management for the benefit of landscape and nature conservation which will compensate any adverse impacts that the proposed Development may have had. In addition to purely mitigating against any adverse impacts, ScottishPower Renewables is also committed to enhancing the nature conservation and landscape value of the Site. As well as delivering benefits for blanket bog habitats the HMP is also likely to benefit a range of species including Black Grouse & Hen Harrier. The HMP defines the Aims and Objectives of the land management that will be implemented on site to achieve this overall purpose.

1.1 Background

Sheirdrim Renewable Energy Development will comprise a maximum of 19 wind turbines, 16 of which would be up to 149.9 m to blade tip and 3 up to 135 m to blade tip, solar PV panels (including ground-mounted) and ancillary grid technologies including battery storage (Map 1).

The HMP was developed to describe how potential impacts the development may have on the surrounding habitat will be mitigated during the operational phase. Mitigation measures are focussed on the restoration of blanket bog habitat.

The HMP includes the following:

- A description of baseline (pre-construction) habitat conditions;
- The identification of habitat management areas including maps;
- Clear Aims and Objectives;
- Detailed methodology and prescriptions of habitat management measures, including timescales with defined criteria for the success of the proposed measures;
- Details of regular monitoring of habitat management measures using fixed quadrat locations and contingency measures should monitoring reveal unfavourable results; and
- Details of the production of regular monitoring reports to be submitted to the Planning Authority at agreed intervals.

2.0 Land Ownership

The land covered by the HMP is owned by Gartnagrenach Estate. It is envisaged that this land will be leased to SPR for the duration of the proposed windfarm development and the lease agreements will include a provision to enable SPR to implement management works within the area.

3.0 Site Location and HMP Area

Sheirdrim Renewable Energy Development is located at the northern end of the Kintyre peninsula approximately 11 km south west of Tarbert. The HMP area lies within the development boundary and encompasses a total area of 84ha. This area comprises wet modified bog habitat and the restoration of this area is considered to compensate and enhance 14.90 ha of regionally important blanket bog and up to 29.07 ha of locally important modified bog habitat predicted to be directly and indirectly lost as part of the proposed Development.

4.0 Habitat Condition

4.1 Overview

Detailed Phase 1 habitat and National Vegetation Classification (NVC) surveys have been undertaken to support the EIA (see **Technical Appendix 8.1 Phase 1 Habitat and National Vegetation Classification (NVC) Survey Report**). Where potentially sensitive habitats such as blanket bog or wet modified bog were identified, further surveys were carried out to inform condition and provide more detailed information on peat depth, vegetation composition and the underlying site hydrology. Peat depth varies across the site, with the maximum depth recorded circa. 7 m. Where peat depth decreases habitats transition from blanket bog and wet modified bog to marshy grassland, although most of the open habitats within the site are classified as blanket bog and wet modified bog.

4.2 Peatland Habitat Status

Peatland habitat across the site is mostly in a degraded condition as a result of extensive historical drainage, although some less modified areas remain in places. Many drains are visible and active within the area (drains present within the HMP area can clearly be seen on the aerial photograph presented in Map 2). Peatland habitats within the site comprise modified forms of NVC communities M25 *Molinia caerulea - Potentilla erecta* mire and M17 *Scirpus cespitosus - Eriophorum vaginatum* blanket mire, with areas of M15 *Scirpus cespitosus - Erica tetralix* wet heath also present.

5.0 Aims and Objectives

The habitats which exist in the current landscape are largely the result of climatic, topographic, biotic, anthropogenic and geological factors. At any location, it is the relative combination of these factors which shape the habitats that exist.

5.1 Delivery Process

The delivery of an HMP is based on achieving the various Aims, which are assessed by measuring the extent to which clearly defined Objectives and their associated condition indicators have been met. The definition of each Objective is therefore a key requirement for an HMP to allow progress to be assessed in a quantified, objective way which has clear implications for whether the overall Aims are likely to be met and any management measures which need to be put in place or amended.

A summary of the stages is shown in Figure 1 which has been applied to each Objective within this HMP. For Objectives where the required management is not obvious, or the processes not well enough understood to allow them to be defined in detail, a programme of trials is advocated to allow the methods, costs, rates and effects of management measures to be assessed before being implemented more widely.

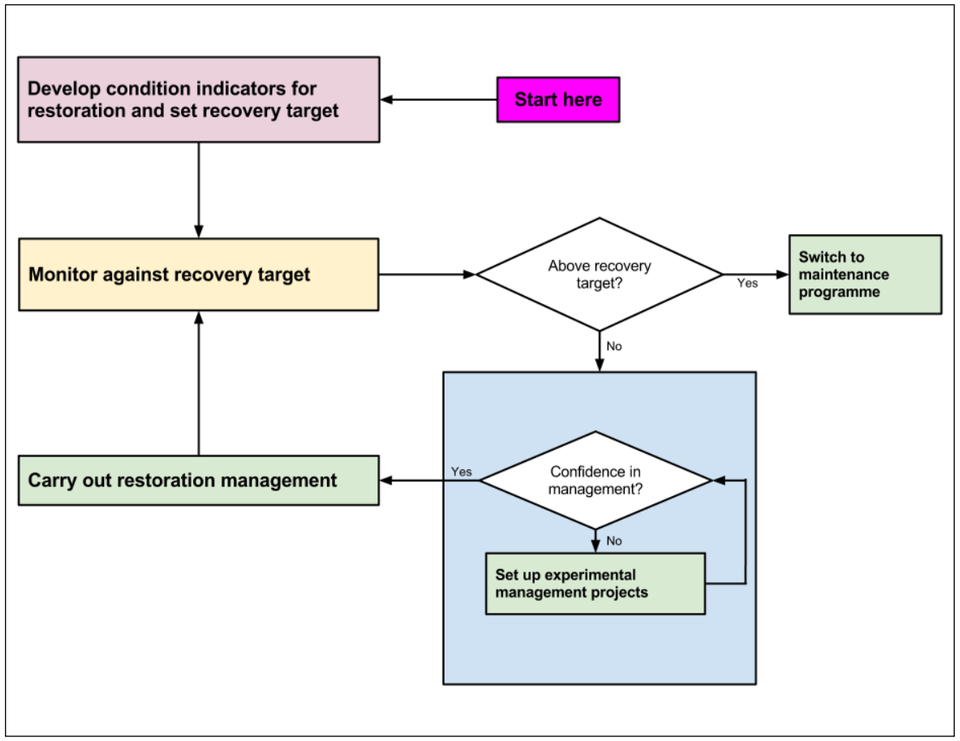


Figure 5-1
Process for monitoring and management to achieve habitat restoration, redrawn from Hurford and Schneider (2007)

5.2 Quantifying Restoration Outcomes

Some objectives are considered to be more fundamental than others to achieve in order for habitats to be restored, and have therefore been weighted accordingly (see individual Objectives within each Aim for the weighting). This allows an overall weighted average score for the entire site to be produced out of 100 and compared with Table 5-1 below, with 100 demonstrating each objective is met at every sample location. This method allows an overall assessment of restoration progress to be made.

Table 5-1
Scoring System for HMP Targets

Condition Class	Weighted Average Score
Very poor	<60.0
Poor	60.01-70.0
Acceptable	70.01-80.0
Good	80.01-90.0
Excellent	90.01-100

Table 5-2 shows the breakdown of each individual objective along with the weighting which is based on the relative importance for the overall Aim being achieved. The highest weighting is given to bog water table as good hydrology is critical to the function of healthy bog habitat. Higher weighting is also given to the *Sphagnum* moss objectives as these are the constants of blanket bog habitat and also indicate the basic hydrology is intact.

Table 5-2
Weighted Score Given to Each Objective

Aim	Group	Objective	Short Description	Weighting
Aim 1: Underlying Conditions	Bog Water Table	1.1	Water table in drought: <20cm	25%
		1.2	Water table in drought: <10cm	15%
		1.3	Water table in drought: 0cm	5%
Aim 2: Conservation Status and Quality	*Sphagnum* and Peat	2.1	*Sphagnum* present	15%
		2.2	Thick branched *Sphagnum* present	5%
		2.3	*Sphagnum* cover >30%	10%
		2.4	*Sphagnum* trampling absent	2.5%
		2.5	Bare peat cover <1%	5%
	Higher Plants	2.6	*Eriophorum* spp. present	5%
		2.7	*Calluna* present	5%
		2.8	*Calluna* >20cm and <20% browsed	2.5%
		2.9	True grass cover <5%	2.5%
		2.10	Key plant cover <75%	2.5%

The score for a treated area is therefore calculated as follows:

Weighted Average Score for each habitat grouping (example for blanket mire) = Sum (% Samples which meet Obj. 1.1 * 0.20, % Samples which meet Obj. 1.2 * 0.10..., % Samples which meet Obj. 3.10 * 0.025)

Proposed management measures for each area are described in Section 6.0 and a description of monitoring methods is included in Section 7.0.

5.3 Aim 1: Restore Underlying Conditions for Modified Blanket Bog

5.3.1 Definition and Distribution

An area within the site boundary has been identified as supporting modified bog habitat which would benefit from positive management activities (Map 1 and 2). This area covers a total of 84ha and is located within the application boundary.

5.3.2 Background

The condition of bog habitat within the HMP area is poor due to excessive drainage. In order to create the underlying conditions required for the establishment of typical bog species, restoration works will need to be carried out to reverse the effects of negative historical management activities and prevent further habitat degradation.

5.3.3 Condition Requirements

The primary condition required to support blanket bog habitat is a water table depth which is close to the surface throughout the year, including the drought period (typically April – August). Based on this requirement, a set of Objectives have been defined which will allow restoration progress to be monitored.

5.3.4 Objectives

Based on the requirements specified above a set of Objectives have been defined which will allow progress to be monitored (Table 5-3). An Objective is considered to be met when at least 70% of sample plots meet the specified criteria.

Table 5-3
Bog Water Table Objectives

	Objective	Description	Weighting
Bog water table	1.1	The bog water table should be no deeper than 20cm from the surface of the main peat mass on each sampled plot when assessed in summer 'drought conditions' (defined as the time at which water table levels on site are considered to in the lowest 10% of their measured range, and rainfall has been negligible for at least 3 weeks; surveys undertaken any time between 1st April and 31st August).	25%
	1.2	The bog water table should be no deeper than 10cm below the surface of the main peat mass on each sampled plot when assessed in summer 'drought conditions'.	15%
	1.3	The bog water table should be at or above the surface of the main peat mass on each sampled plot when assessed in summer 'drought conditions'.	5%

5.4 Aim 2: Improve Quality of Blanket Mire Habitat

5.4.1 Definition and Distribution

An area within the site boundary has been identified as supporting modified bog habitat which would benefit from positive management activities (Map 1 and 2). This area covers a total of 84ha and is located within the application boundary.

5.4.2 Background

The blanket mire habitat within the HMP area has been heavily drained and is of a lower quality than would be expected on intact blanket mire. This is evidenced by the plant assemblages observed within the HMP area, which is not as diverse as would be expected from a high quality bog.

The long-term aspiration (>5 years) is to restore the blanket mire habitat within the HMP area to a high quality. Monitoring undertaken by SPR on other restoration sites has shown that once underlying conditions are restored, typical bog species will start to recolonize treated areas. The precise vegetation assemblage which would be expected is difficult to define at this stage due to an absence of high quality reference areas on site, or within close proximity, and variation is also expected between the mesotopes present.

5.4.3 Objectives

A number of indicators have been used to formulate Objectives which reflect different aspects of blanket mire quality over time (Table 5-4). These will be compared against suitable reference areas where possible to allow the quality of the restored blanket mire to be assessed in context. An Objective is considered to be met when at least 70% of sample plots meet the specified criteria.

Table 5-4
***Sphagnum*, peat and higher plant Objectives**

	Objective	Description	Weighting
Sphagnum and peat	2.1	At least one species of *Sphagnum* should be present (open range land: predicted community M17, 18 or 19) on each sampled plot.	15%
	2.2	*Sphagnum papillosum* or *S. magellanicum* should be present (open range land where expected type is M17 & 18) on each sampled plot.	5%
	2.3	*Sphagnum* spp. should account for at least 30% of basal cover on each sampled plot.	10%
	2.4	Visible trampling or uprooting impacts of large grazing mammals on *Sphagnum* hummocks (or lawns) should be absent on each sampled plot.	2.5%
	2.5	Bare peat should comprise <1% of 'basal' cover on each sampled plot, in situations where it is arising due to trampling effects or disturbance by machinery (where sites are naturally eroding this target can be modified to suit).	5%
Higher plants	2.6	*Eriophorum* spp. should be present on each sampled plot.	*5%*
	2.7	*Calluna vulgaris* should be present on each sampled plot.	5%

	Objective	Description	Weighting
	2.8	*Calluna vulgaris* of at least 20cm average canopy height and with < 20% leading shoots browsed by deer/sheep on average should be present on each sampled plot.	2.5%
	2.9	'True grasses' foliar cover should be less than 5% on each sampled plot.	2.5%
	2.10	The combined cover of *Calluna vulgaris*, *Eriophorum* spp. and *Tricophorum cespitosum* should account for no more than 75% of foliar cover on each sampled plot.	2.5%

6.0 Habitat Management Measures

The habitat management measures proposed by SPR reflect the different requirements of site conditions which are variable.

6.1 Physical Interventions on Degraded Bog Habitat

Physical interventions are defined as measures which comprise mechanical treatment to an area of land.

6.1.1 Drain Damming

There are approximately 38 km of drains across the HMP area which would benefit from being dammed in order to prevent further damage to the hydrological regime. SPR has developed a technique to successfully restore drained blanket bog, termed "wave damming" which has proven successful on a number of similar sites in Scotland (Photos 1 and 2). The method rapidly creates dams within existing drains to prevent water flow, which helps stabilize the hydrology and support bog forming species such as *Sphagnum* mosses. SPR initially tested this method at Black Law windfarm where a comprehensive monitoring programme was set up to verify the technique. The results proved the method to be successful in raising the water table, and showed that the pools quickly occluded with bog vegetation. SPR have now treated approximately 192 km of drains at sites including Black Law and Whitelee windfarms and have found the technique to be consistently effective. Throughout the development of peatland restoration techniques, SPR have engaged stakeholders including Scottish Natural Heritage, Peatland Action and the Royal Society for the Protection of Birds, by demonstrating techniques and sharing the results of monitoring. Peatland Action has now adopted this wave damming technique for use on a number of sites[1]. Further description of the wave damming technique is provided in Appendix A.

Photos 1 and 2
Area of wave damming at Black Law windfarm immediately following treatment (left) and two years post treatment (right)

7.0 Monitoring

SPR has developed a protocol to monitor vegetation in relation to the Objectives set out within the HMP based on extensive experience monitoring similar habitats across Scotland.

Monitoring will be undertaken on a set of n=31 permanent 1 m radial samples within the HMP area. At each 1 m radial sample point the following information will be collected for species relevant to the Objectives (target species):

1. Presence/absence of target species
2. By eye cover targets of key metrics (see 2a below)
3. Height and offtake of *Calluna*
4. Depth to water table (using fixed dipwell)
5. 3 pin hits of foliar and basal vegetation cover equally spaced along a 20 m transect (long format only)

There are two monitoring methods used: a long monitoring protocol and short monitoring protocol. The short monitoring protocol only records items 1, 2, 3 and 4. The protocols will be applied according to the programme below.

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Method	Long	Short	Long	Short	Long		Short		Long

[1] http://www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/file_attach/Session%208%20Combined%20Workshop%20Presentation.pdf

7.1 Field Protocol

7.1.1 Frequency Assessment

At each monitoring sample plot a rope demarcated at 0.25m, 0.50 m and 1 m will be used to form a radial quadrat. Starting with the smallest distance and working up to 1m, the presence of each target species is to be recorded, noting the smallest distance found. This nested unit size allows different sizes of sampling units to be applied to species of differing abundances for trend monitoring i.e. common species are assessed in smaller units and rarer species are assessed in larger units.

7.1.2 General Cover Assessment

Record each by eye cover assessment within each frequency point (1 m circle):

- is *Sphagnum* cover > 30% (if unsure record lower)
- is bare peat cover < 1% (if unsure record higher)
- is true grass cover (excluding *Molinia*) < 5% (if unsure record higher)
- is the combined cover of *Calluna, Eriophorum* and *Tricophorum* < 75% (if unsure record higher)

7.1.3 *Calluna* Height and Offtake

Record the height of a representative *Calluna* plant within each 1 m radial plot. Record *Calluna* height from top of the basal layer the depth of the basal layer to peat surface separately. Record the percentage of *Calluna* long shoots browsed.

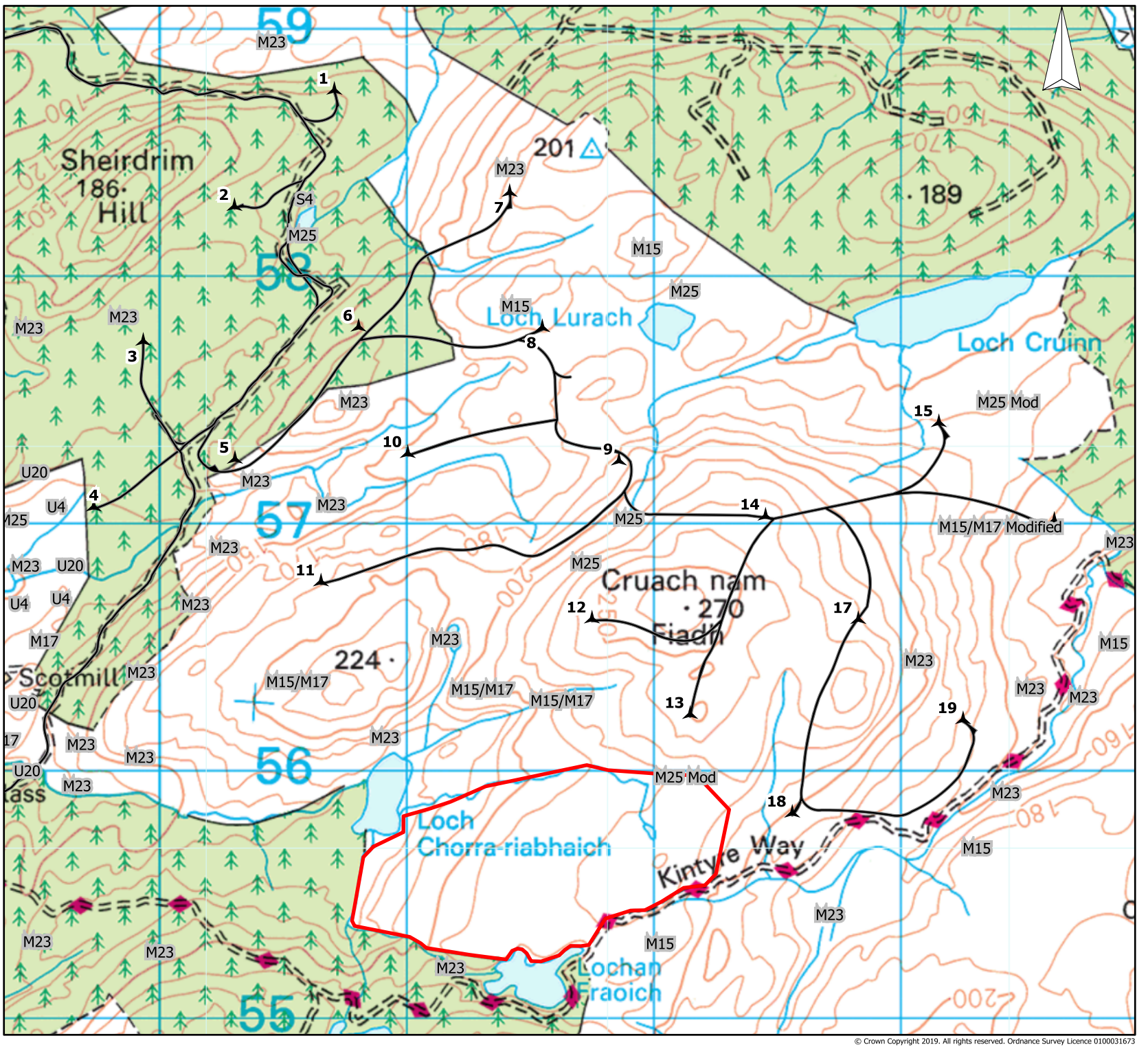
7.1.4 Dipwell Protocol

Permanent dipwells will be installed at each monitoring sample plot. During a drought period where there has been no limited rainfall in the preceding 14 days (typically between April and August, although can occur at other times), the dipwells will be measured by measuring from the top of the dipwell to the water table (termed “water depth”), and from the top of the dipwell to the main peat mass surface (termed “peat offset”). By subtracting the peat offset from the water depth it is possible to calculate the true value of the water table within the bog.

7.1.5 Pin Hits

At each monitoring sample plot a rope demarcated at 1m, 11 m and 19 m is set out to the west. At each marker point a laser pointer is stood on the north side of the rope and used to record any living plant species, plant litter or bare peat that it hits directly below. Both basal layer and higher vegetation are to be recorded.

MAPS



SCOTTISHPOWER RENEWABLES

Legend

- Access track
- Turbine
- HMP Area

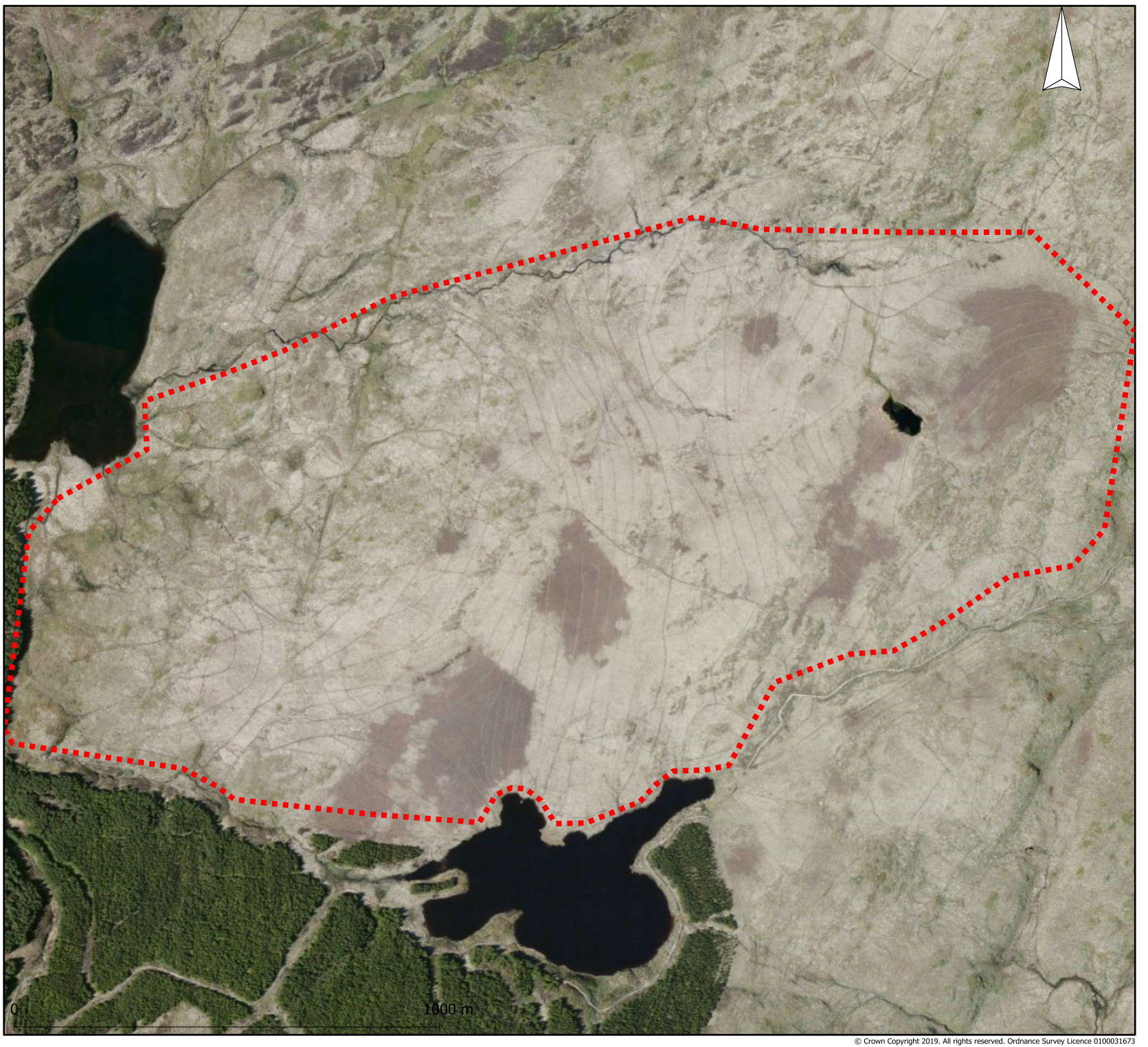
Scale: 1:21000 @ A4

0 >200 m

Status	Date	Dr.	Ch.	Apj
FINAL	Oct 2019	RS	PR	PR

Sheirdrim Renewable Energy Development

Proposed Site Layout and HMP Location	Map 1



SCOTTISHPOWER RENEWABLES

Legend

HMP Area

Scale: NTS

Status	Date	Dr.	Ch.	Apj
FINAL	Oct 2019	RS	PR	PR

Sheirdrim Renewable Energy Development

HMP Area	Map 2

APPENDIX A

Wave Damming Summary

Appendix A: Wave Damming Summary

The Process

1. Identify the drain. In the photo below the excavator has tracked down the drain, flattening the vegetation and exposing the oxidised peat slope either side of the cut channel. The excavator will straddle the drain, facing upslope. The operator will begin working at the top of the slope, building the dams as they move downhill.

2. The operator will start work on one side of the dam, on the oxidised peat slope. The operator uses the bucket to cut into the peat mass circa. 800 mm depth. The bucket is then used to pull the peat towards the excavator, thrusting material upwards. Care should be taken to ensure that the operator does not flip the peat during this process, and the vegetated surface remains on top.

3. Using the back of the bucket, the operator pushes the back of cut peat towards the machine so that it is compressed into place with a ramped face.

4. The operator will repeat this action a second time, in the middle of the drain.

5. The operator will then repeat this action a third time on the other side of the drain, on the oxidised peat slope. The dam is now three bucket widths wide, although additional width can be achieved using additional bucket widths when required.

6. The operator then uses the bucket to flatten and compress the top of the dam.

7. The operator then uses the bucket to flatten the edge of the cut face behind the dam. This will enable any livestock a way to climb out of the dam.

8. The finished process.

About Wave Damming

Timing

The time taken to build a wave dam is on average about 1minute; significantly faster than traditional dams which typically take over ten minutes to build.

Spacing

Wave dams should be installed close together, roughly every 3-4 m. This spacing typically ensures that there is not more than a 10cm drop in ground level between each dam so that water stored behind the dam can re-wet the intermediate drain space and adjacent ground. However the spacing of dams is site-specific and should be assessed depending on the local gradient present.

Width

The width of the dam ensures that not only the ditch itself is blocked, but also the collapsed oxidised slopes on either side of the channel. This reduces the likelihood of a new hydrological flow around the side of the dam, and encourages the water to spread out and rewet the wider bog. This is also site-specific and should be assessed depending on the width of the existing channel.

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