# Kilgallioch Windfarm Extension

## Habitat Management Plan

**November 2019**

**Version 1**

# CONTENTS

## List of Figures and Maps

# 1 Introduction

Kilgallioch Windfarm Extension (the Development) is a proposed extension to the existing Kilgallioch Windfarm which has been in operation since 2017.

The overall purpose of the Kilgallioch Windfarm Extension Habitat Management Plan ("the HMP") is to implement positive land management for the benefit of landscape and nature conservation which will mitigate any adverse impacts that the windfarm may have had. The HMP defines the Aims and Objectives of the land management that will be implemented on site to achieve this overall purpose.

This HMP outlines the Aims and Objectives of the land management that will be implemented during the operation of the Development until its decommissioning. The HMP has been written in a manner that provides a clear link between management and monitoring with a focus on habitats that can be managed directly. It is viewed as an iterative document which will be updated based on the results of monitoring.

# 2 Site Location and Ownership

The Development is situated approximately 12 km north-west of Kirkcowan in Dumfries and Galloway and is anticipated to encompass up to 11 turbines with the potential for battery storage and solar photovoltaic arrays (Map 1).

The Development area is bordered to the north and east by the Kirkcowan Flow SAC which covers approximately 775ha of land that has been designated to protect valuable blanket bog habitats (Map 1). This boundary broadly follows a ridge of higher, rocky ground forming the watershed between three different catchments. The land generally slopes down from the Kirkcowan Flow SAC in the north to the Development in the south and comprises a mosaic of habitats reflecting the distribution of peat soils which vary in depth from 10cm on slopes to over 3m in flatter areas leading to a mix of bog and grassland habitat.

The land encompassed within this HMP is owned by Mochrum Estate and managed by a tenant farmer.

# 3 Current Land Use and Habitat Condition

The primary habitat types across the Development are M25 *Molinia cearulea–Potentilla erecta* mire, M15 *Scirpus cespitosum-Erica tetralix* wet heath and M23 *Juncus effusus*/*acutiflorus-Galium palustre* rush mire. The farmer currently grazes around 60 cattle under a Moorland Management Plan under the Agri-Environment Climate Scheme across the Development and Kirkcowan Flow SAC between the months of May and September. The purpose of this grazing is to add pressure to the extensive *Molinia caerulea* found across the site and to allow other more desirable peatland vegetation such as *Eriophorum* and *Sphagnum* species to recolonise. Sheep that are grazed throughout the year across the Development and Kirkcowan Flow SAC area are removed for two months of the year during November and December. Table 1 outlines the number of livestock units across the Development and SAC through the year.

**Table 1:** Livestock units per hectare by month across the Development and Kirkcowan Flow SAC

| Month | Max sheep | Max cattle | LU/ha |
|---|---|---|---|
| January | 800 | 0 | 0.099 |
| February | 800 | 0 | 0.099 |
| March | 800 | 0 | 0.099 |
| April | 800 | 0 | 0.099 |
| May | 800 | 60 | 0.149 |
| June | 800 | 60 | 0.149 |
| July | 800 | 60 | 0.149 |
| August | 800 | 60 | 0.149 |
| September | 800 | 60 | 0.149 |
| October | 800 | 0 | 0.099 |
| November | 0 | 0 | 0 |
| December | 0 | 0 | 0 |

The peatland habitat across the Development and the Kirkcowan Flow SAC is generally in a degraded condition as a result of historical drainage and over grazing. The most recent site condition assessment undertaken of the Kirkcowan Flow SAC was done in 2013. The assessment encompassed a total of 29 sampling points within blanket bog features and eight within depressions of peat substrates of the *Rhynchosporion* feature. Ten of the Blanket bog sampling points failed and as a result the feature was assessed as not in favourable condition.

The primary reasons for the unfavourable condition status were high livestock pressure at Craigmoddie Fell and Eldrig Moss, conifer regeneration on Lodens Moss, spread of *Molinia caerulea* and extensive historic drainage which is still visible on aerial photography (Map 2). A small area of ditch blocking was undertaken across 8 hectares within the SAC west of Craigmaddie under a PeatlandACTION grant award in 2017.

## 4 Habitat Management Area

An area of approximately 39 hectares of habitat comprising of blanket bog and modified bog is predicted to be lost by the construction of the Development, as well as around 7.44 ha under the solar arrays. Therefore the Habitat Management Area (HMA) encompassed in this HMP comprises two units (Unit 1 = 33 hectares and Unit 2= 19.3 hectares) giving a total area of approximately 52 hectares (Map 3), approximately 10% larger than the impacts identified to allow some contingency for uncertainty and flexibility when undertaking implementation.

These units consist of modified blanket bog habitat and have been identified as areas in poor condition primarily due to the historic drainage that will benefit from positive management activities.

These units are located within the Kirkcowan Flow SAC and peatland restoration works undertaken as part of this Development are expected to have a positive impact on the overall site condition of the SAC and SSSI which is currently in an unfavourable condition in part due to the drainage across the site. Proposed management measures for the HMA are described in Section 6 and a description of monitoring methods is included in Section 7.

# 5 Aims and Objectives

## 5.1 Delivery Process

The delivery of a HMP is based on achieving 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 of an HMP, allowing progress to be assessed in a quantified and objective way and giving a clear indication of the progress of each Aim and whether any management measures are required.

A summary of the process applied to each Objective is shown in Figure 1. This process is applied to all Objectives contained within this HMP.

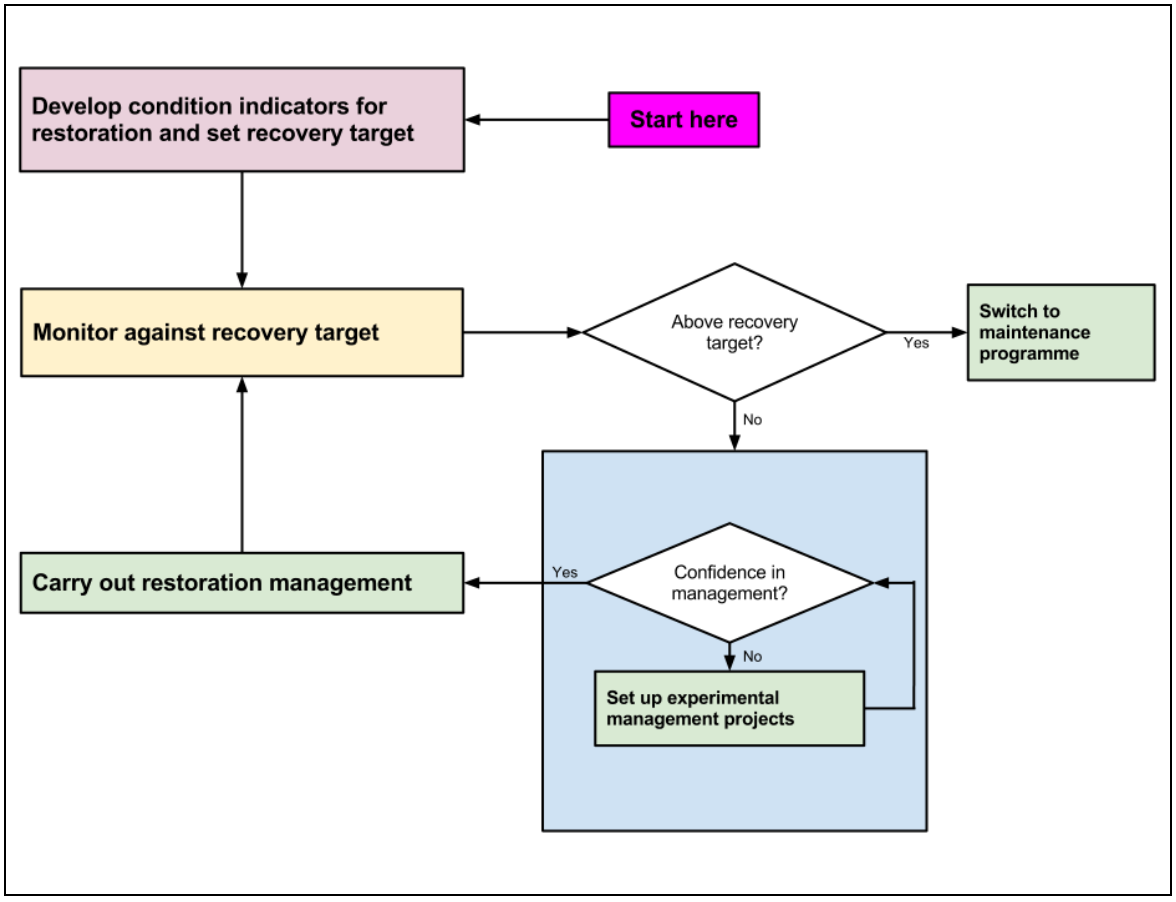



**Figure 1**: Process for monitoring and management to achieve habitat restoration, redrawn from Hurford and Schneider (2007).

Aims and Objectives are described below with any required management measures described in Section 6. Objective monitoring methodology is included in Section 7.

## 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 2 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 2**: 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 3 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 3**: 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 * 0.25, % Samples which meet Obj. 1.2 * 0.15..., % Samples which meet Obj. 2.10 * 0.025).

## Aim 1: Restore Conditions of Modified Blanket Bog

**Definition and Distribution**

Due to the variable peat distribution across the site two distinct units of modified blanket bog habitat have been identified that will benefit from positive management activities (Map 3). These HMP units comprise a total of 52 hectares of blanket bog (the HMA) that will be restored by blocking approximately 31km of drains.

**Background**

The condition of bog habitat within the HMA is poor due to excessive drainage. In order to create the underlying conditions required for the establishment of typical bog species physical intervention in the form of drain blocking is required. Drain blocking will reduce the rate of water run-off from the bog which will raise the water table closer to the surface.

**Condition Requirements**

The primary condition required to support active blanket bog habitat is a water table depth that is close to the ground surface throughout the year including drought periods (generally April-June). A set of Objectives are defined below which will enable the progress against this Aim to be monitored and scored.

**Objectives**

The Objectives for blanket bog conditions are shown in the table below along with the weighting each carries against the final score. An Objective is considered to be achieved when at least 70% of sample plots meet the criteria.

| | 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% |

## Aim 2: Improve Quality of Modified Blanket Bog Habitat

**Definition and Distribution**

Due to the variable peat distribution across the site two distinct units of modified blanket bog habitat have been identified that will benefit from positive management activities (Map 3). These HMP units comprise a total of 52 hectares of blanket bog (the HMA) that will be restored by blocking approximately 31km of drains.

**Background**

The long term goal for the HMA is to restore the degraded bog habitat to high quality, active blanket bog. The precise vegetation assemblage that would be expected is difficult to define and variation is expected due to localised conditions (i.e. slope, aspect).

**Condition Requirements**

A number of indicators have been used to formulate several trend Objectives which reflect different aspects of blanket bog quality over time. The response of these indicators will be monitored to gauge the success of Aim 2.

**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% |
| | 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 Habitat Management Measures

The habitat management measures proposed by SPR reflect the conditions on site and the work required to restore the HMA to active bog.

## 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 31km of drains across the HMA which would benefit from being dammed in order to prevent further damage to the hydrological regime of the peat. SPR has successfully developed a technique to restore drained blanket bog, termed "wave damming" which has proven successful on a number of similar sites in Scotland (Photos 1 and 2). This method creates dams within existing drains to prevent water runoff, 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 of the bog, and showed that the pools created by the technique quickly occluded with bog vegetation.

SPR have now treated approximately 192km 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)

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

### 6.1.2 Conifer removal

There is a low density of non-native conifers across the site mainly Sitka spruce which will be having a negative impact on the bog, adding to the water loss from the site. Regenerating conifers will therefore be removed from within the HMA by hand clearance using chain saws. Trees will be cut below the lowest whorl in order to prevent any future growth and will be left on site.

# 7 Monitoring

SPR have developed a protocol to monitor vegetation in relation to the Objectives set out in this HMP based on extensive experience of post restoration monitoring across other sites.

Monitoring will be undertaken across a minimum of n=30 permanent sample locations within the HMP area.

At each permanent post a 1m radial quadrat will be used to collect the following information on target species noted in this HMP's Objectives:

1. Presence/absence of target species
2. By eye cover targets of key metrics
3. Height and offtake of *Calluna*
4. Depth to water table (using fixed dipwell)
5. A 20m transect to gather 3 pin hits of foliar and basal vegetation cover

There are two monitoring strategies will be used on alternate monitoring years: a long monitoring protocol and short monitoring protocol.

The short monitoring protocol only records items 1, 2, 3 and 4 whereas the long protocol includes items 1-5. 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 |

## 7.1 Monitoring Methodology

1. Frequency Assessment

At each monitoring permanent plot a rope demarcated at 0.25m, 0.50m and 1m will be used to form a radial quadrat. Starting with the smallest distance and working up to 1m, the presence of each target species will be recorded, noting the smallest distance from the post at which the species is 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, rarer species are assessed in larger units.

2. General Cover Assessment
   a) Record each by eye cover assessment within each frequency point (1m circle):
      i) is *sphagnum* cover > 30% (if unsure record lower)
      ii) is bare peat cover < 1% (if unsure record higher)
      iii) is true grass cover (excluding *Molinia*) < 5% (if unsure record higher)
      iv) is the combined cover of *Calluna*, *Eriophorum* and *Tricophorum* < 75% (if unsure record higher)

3. *Calluna* height and offtake

Record the height of a representative *Calluna* plant within each 1m 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.

4. Dipwell monitoring

Permanent dipwells will be installed at each monitoring sample plot with water depth measurements taken during a drought period where there has been limited to no rainfall in the preceding 14 days (typically between April and June). The water table depth is calculated by measuring the "water depth" (the top of the dipwell to the water level) and the subtracting the "peat offset" (top of the dipwell to the surface of the peat mass). By subtracting the peat offset from the water depth the true value of the water table depth within the bog is calculated.

5. Pin hits

At each monitoring sample plot a rope transect will be set out to the west of the post to take pin hits of basal and foliar vegetation at 1m, 11m and 19m from the post. At each marker point a laser pointer is set on the north side of the rope and used to record any living plant species, litter or bare peat that it the laser intersects directly below.

## Appendix A: Wave Damming Technique 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. 800mm 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

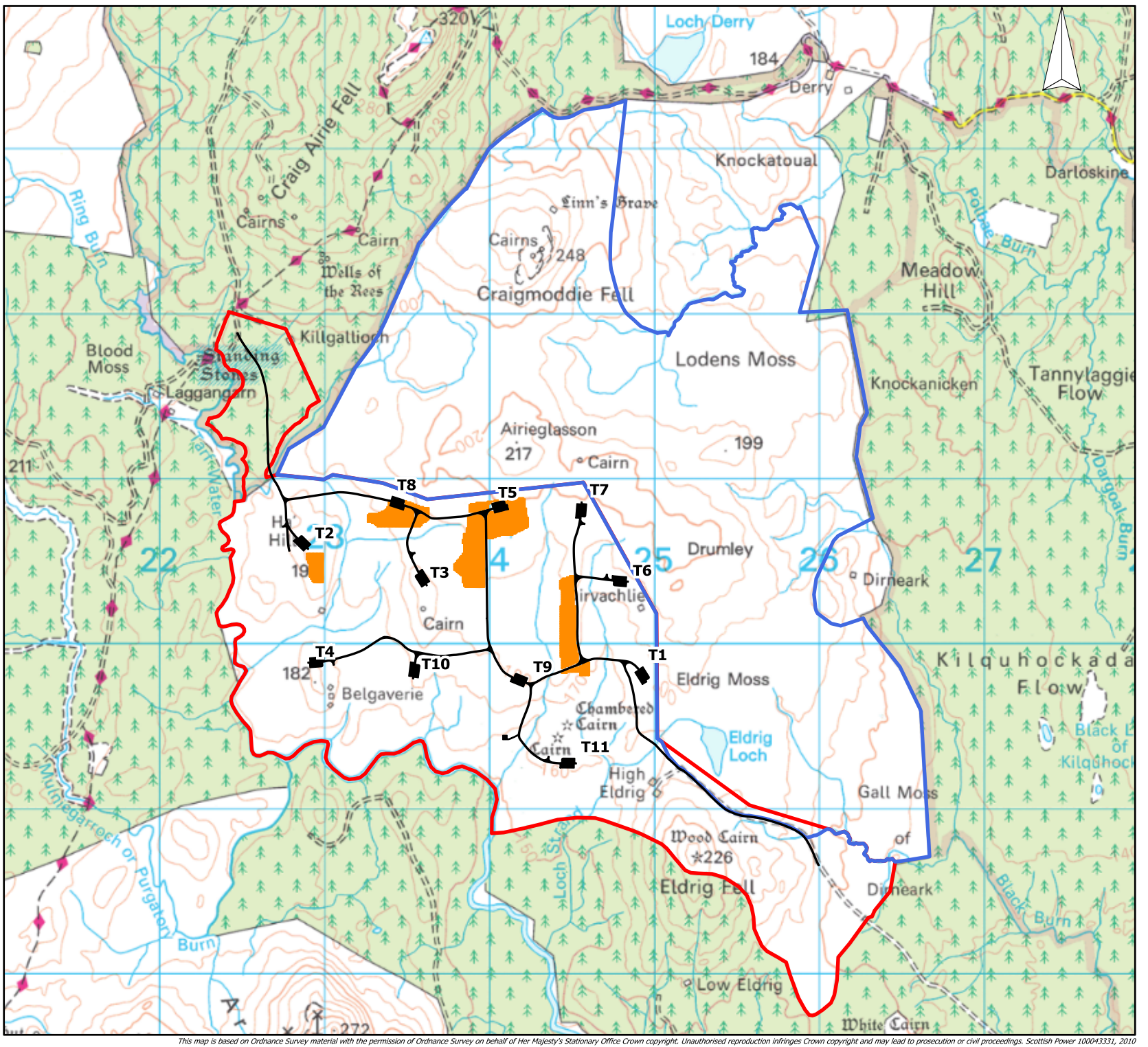
The time taken to build a wave dam is on average about 1minute; significantly faster than traditional dams which typically take over ten minutes to build.

Spacing

Wave dams should be installed close together, roughly every 3-4m. 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.




SCOTTISHPOWER RENEWABLES

## Legend

**Kilgallioch Extension**
Development boundary

**Kirkcowan Flow SAC**
Boundary

**Proposed infrastructure**
Turbine location
Roads
Solar area

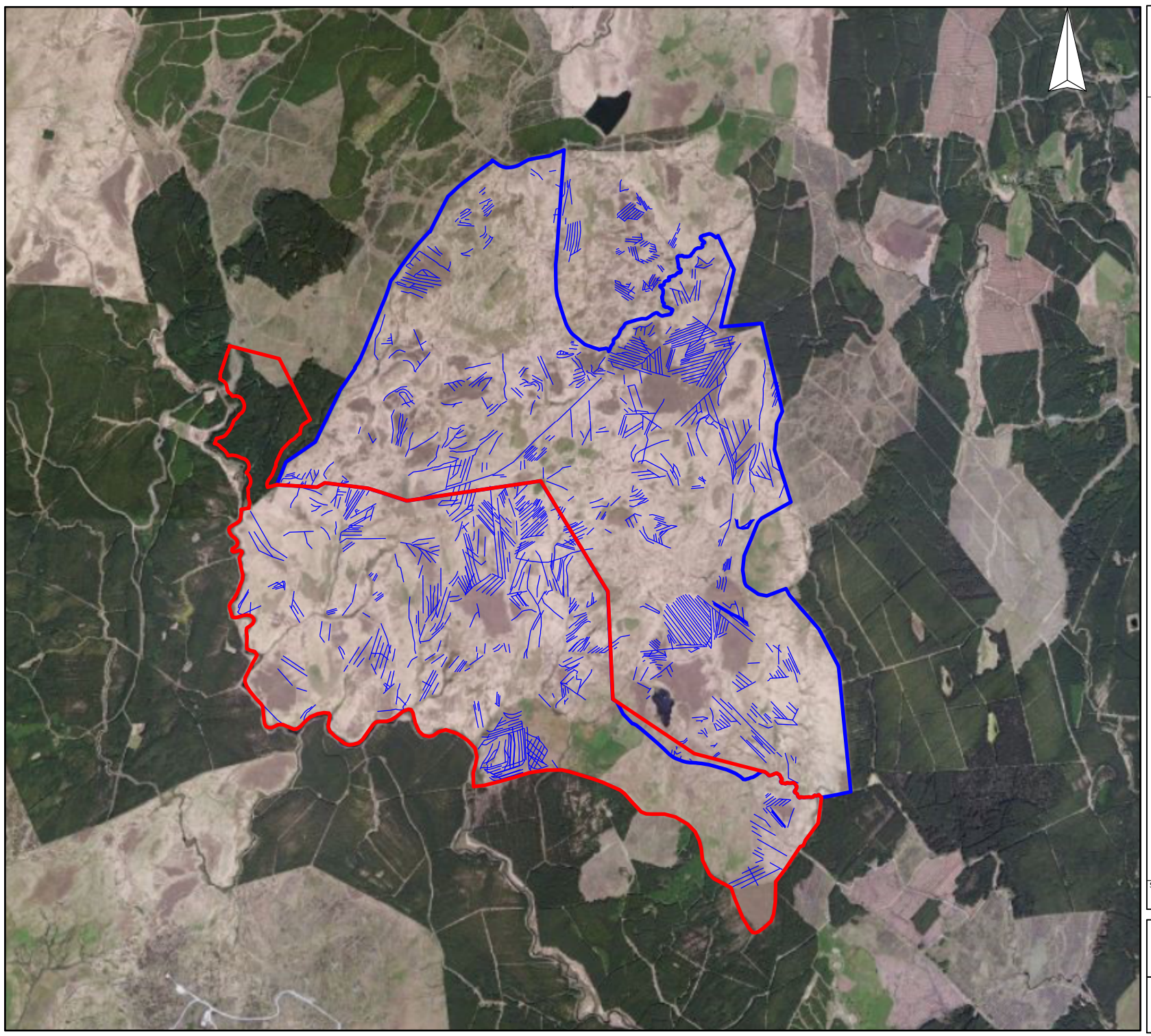
Scale: 1:32000 @ A4

| Status | Date | Dr. | Ch. | Apj |
|---|---|---|---|---|
| FINAL | Nov 2019 | CB | PR | PR |

Development Boundary

Kilgallioch Windfarm Extension
Habitat Management Plan Version 1

Map 1



SCOTTISHPOWER RENEWABLES

## Legend

**Kilgallioch Extension**
Development boundary
**Kirkcowan Flow SAC**
Boundary

**Site Drainage Network**
Drain

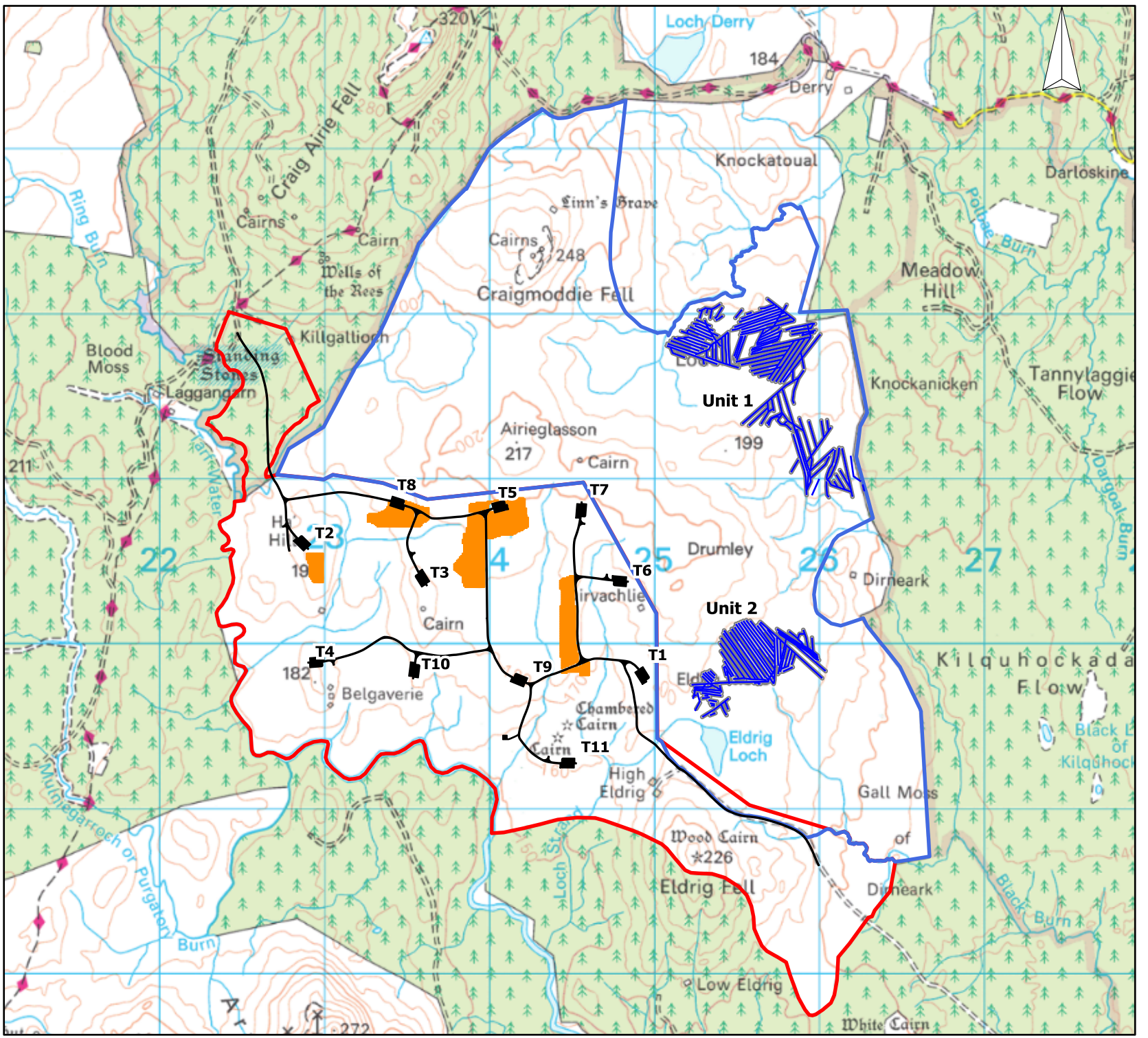
Scale: 1:64000 @ A4

| Status | Date | Dr. | Ch. | Apj |
|---|---|---|---|---|
| FINAL | Nov 2019 | CB | PR | PR |

# Site Drainage Network

Kilgallioch Windfarm Extension
Habitat Management Plan Version 1

Map 2




SCOTTISHPOWER RENEWABLES

## Legend

**Kilgallioch Extension**
Development boundary
**Kirkcowan Flow SAC**
Boundary

**Proposed infrastructure**
Turbine location
Roads
Solar area

**HMP units**
**Unit 1**
Unit name
Area
Drain

Scale: 1:32000 @ A4

| Status | Date | Dr. | Ch. | Apj |
|---|---|---|---|---|
| FINAL | Nov 2019 | CB | PR | PR |

Habitat Management Area

Kilgallioch Windfarm Extension
Habitat Management Plan Version 1

Map 3