EUCHANHEAD RENEWABLE ENERGY DEVELOPMENT

Technical Appendix 10.2: Peat Management Plan

Prepared for: ScottishPower Renewables UK Ltd

SLR Ref: 405.00481.00052
Version No: 4
October 2020

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CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1.0 Introduction

SLR Consulting Ltd (SLR) was commissioned by ScottishPower Renewables UK Ltd (SPR) to undertake a Stage 1 Peat Management Plan (PMP) at the proposed Euchanhead Renewable Energy Development (the Site). The proposed Development would be located approximately 9.8 km south west of Sanquhar, in Dumfries and Galloway, as measured to the nearest turbine location. The Site location is identified in **Figure 10.2.1.**

The proposed Development detailed in **Figure 10.2.2** is likely to comprise a 21 turbine (tip height of 230 m) renewable energy development with associated infrastructure including:

- turbine foundations;
- crane hardstandings;
- transformer/switchgear housings located adjacent to turbines;
- new and upgraded access tracks including watercourse crossings where necessary;
- underground cabling;
- substation compounds including control buildings, external equipment and ancillary grid service equipment/energy storage;
- one permanent anemometer mast;
- site signage;
- search areas for up to seven borrow pits; and
- one main construction compound area, and two secondary compounds.

In addition, the following activities are required during the construction phase of the project:

- potential establishment of on-site concrete batching plant; and
- removal and management of material during foundation and track construction.

1.1 Scope of Assessment

A comprehensive programme of soils and peat probing has been completed at the site. This document uses this information and provides indicative volumes for peat extraction and outlines recommendations for the handling, re-use and storage of peat during construction and operation of the site. The results of the probing survey are detailed within **Figure 10.2.3** (Peat Depth). Areas of the site where soils are less than 0.5 m thick are considered to be too thin to be classified as peat and are therefore classified as soils. **Figure 10.2.4** (Peat Depth >0.5 m) shows the areas of the site where soils/peat >0.5 m have been identified. Areas of the Site subject to the proposed Development and which have been proven to have soil depths of <0.5 m are not within the scope of the PMP.

The purpose of this report is to ensure that there has been a systematic consideration of peat management and a quantitative assessment throughout the development process.

1.2 Methodology

Scottish Planning Policy states that *"Where peat and other carbon rich soils are present, applicants should assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be release of CO_2 to the atmosphere. Developments should aim to minimise this release."*

The Stage 1 PMP considers the excavation of peat and soil across the site as a result of construction of the proposed Development. It considers the potential for minimising excavation and disturbance in order to reduce any unnecessary surplus of soils and peat.

SEPA has provided a hierarchy of management approaches through which the effectiveness of the approach to peat management is optimised at development sites, as summarised below (SEPA 2017[1], Scottish Government, SNH and SEPA[2] and SEPA 2012[3]):

- **Prevention** – avoiding generating excess peat during construction (e.g. by avoiding peat areas or by using construction methods that do not require excavation such as floating tracks);
- **Re-use** – use of peat produced on site in restoration or landscaping, providing that its use is fully justified and suitable;
- **Recycling/Recovery/Treatment** – modify peat produced on site for use as fuel, or as a compost/soil conditioner, or dewater peat to improve its mechanical properties in support to re-use; and
- **Storage** – storage of peat up to a depth of 2 m on a temporary basis for future re-use is not classified as a waste and does not require authorisation from SEPA, however care must be taken to ensure that it does not cause environmental pollution, create an unnatural habitat or a safety risk.

The guidance identifies three main stages in the development process and describes what data should be gathered and assessed at each stage to inform a site-specific PMP:

- **Stage 1**: Environmental Impact Assessment (EIA);
- **Stage 2**: Post-consent/pre-construction; and
- **Stage 3**: Construction

This report presents site specific data and proposals to address the requirements of Stage 1 of SEPA's guidance and proposes that **prevention** and **re-use** are the most appropriate means of managing peat excavated during construction at the Site. It details the methodologies required to assess all potential surplus materials and presents preliminary estimates of the expected volume of excavated materials and required re-use volumes for reinstatement and restoration purposes. In particular, this report considers the construction of access tracks, site compounds, turbine foundations and all other associated infrastructure which result in the excavation of peat and sub-soils potentially resulting in surplus materials.

Many of the issues associated with peat on a renewable energy development site can be accommodated by modifying the Development layout to avoid potentially difficult or sensitive areas. Such areas would include:

- areas of deep peat, requiring potentially large volumes of excavation;
- areas of very wet peat (such as flushes, pool and hummock complexes and gullied peatland);
- areas of moderate to steep slopes (where site infrastructure might increase the chance of peat instability); and
- areas of sensitive habitat.

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[1] SEPA (May 2017)., SEPA Regulatory Position Statement – Developments on Peat and Off-site Uses of Waste Peat) SEPA Guidance, WST-G-052. Version 1.

[2] Scottish Government, SNH, SEPA (2017)., Peatland Survey. Guidance on Developments on Peatland, on-line version only.

[3] Scottish Renewables, Scottish Environmental Protection Agency (2012) Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste, Version 1

This report estimates the extent of materials generated during the construction phase and identifies potential areas where peat can be re-used through the following:

- the avoidance of creating surplus materials, and
- re-use of materials on site.

1.3 Guidance and Good Practice

Legislation relevant to the management of peat includes the following:

- The UK Climate Change Act 2008 (c27);
- Environmental Protection Act 1990 (as amended);
- Landfill (Scotland) Regulations 2003 (as amended);
- The Waste Management Licensing (Scotland) Regulations 2011; and
- Scottish Planning Policy (2014).

There are several guidance documents appropriate to the activities planned on site which have been used to guide this assessment, as follows:

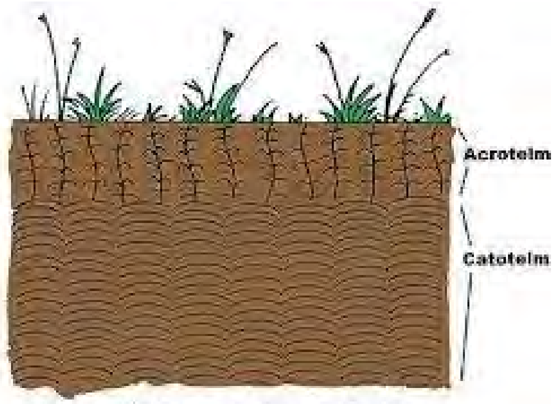
- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland, on-line version only, Guidance on the assessment of peat volumes, re-use of excavated peat and the minimisation of waste SR, SEPA (2012);
- SEPA Regulatory Position Statement – Developments on Peat (SEPA, May 2017);
- Good practice during wind farm construction (SR, SNH, SEPA, FCS, HES, Marine Scotland Science, 4th Edition (2019);
- Floating roads on peat (SNH, FCS; August 2010);
- Constructed tracks in the Scottish Uplands (SNH, September 2015); and
- Restoration techniques using peat spoil from construction works (SEPA 2011).

1.4 Definitions of Peat

Peat is defined as a sedimentary material consisting of the partially decomposed remains of plant material and organic matter preserved over a period of time in a waterlogged environment resulting in anaerobic conditions, and is considered to be of depths > 0.5 m.

Peat can be classed as two principal types, the acrotelm layer, and the catotelm layer as shown on **Diagram 1-1** and described in the following paragraphs.

Diagram 1-1
Hydrological Layers in Bogland Habitat



Hydrological Layers in Bogland Habitat

The acrotelm layer is found in the upper layer of peat where conditions are relatively dry and comprises living vegetation and partially decomposed plant material. Hydraulic conductivity in this layer tends to be higher in relation to distance from the water table.

The thickness of the acrotelm layer varies depending on topography such as steepness of slope, peat hags, and hummocks. In particular, the acrotelm layer can be affected during periods of drought or as a consequence of drainage. Fibrous in texture, the acrotelm layer has some tensile strength and is generally considered to be stable for storage and re-use.

The catotelm layer is found under the acrotelm layer and comprises decayed plant material and organisms and is denser and with a very low hydraulic conductivity. The catotelm layer sits below the water table resulting in permanent anaerobic conditions. The catotelm layer is amorphous and has very low tensile strength making it less suitable for storage and re-use.

2.0 Occurrence of Peat

2.1 Peat Conditions

Peat surveys were undertaken to address the presence of peaty soils and/or peat. Peat is generally defined as an organic soil in excess of 0.5 m, if the soil is less than 0.5 m, then it is considered peaty soil. The peat was found to vary across the site in terms of thickness and coverage.

Thin peat was classed as being 0.5 m to 1.49 m thick, with deposits in excess of this being classed as thick peat. The thickness ranges used were intended to reflect the probability of instability associated with both peat slides (in thin peat) and bog slides. Where the probing recorded less than 0.5 m thick, this has been considered to be an organic peaty soil rather than peat.

The results of the probing survey are detailed within **Figure 10.2.3**, with a summary of peat depths included within **Table 2-1** below.

Table 2-1
Peat Probing Data

Peat Thickness (m)	No. of Probes	Percentage (of total probes undertaken on site)
0 (no peat)	56	1.4
0 – 0.49 (peaty soil)	2349	59.2
0.50 – 0.99 (thin peat)	836	21.1
1.00 – 1.49 (thin peat)	372	9.4
1.50 – 1.99 (thick peat)	236	5.9
2.00 – 2.49 (thick peat)	86	2.2
2.50 – 2.99 (thick peat)	30	0.8
3.00 – 3.49 (thick peat)	5	0.1
3.50 – 3.99 (thick peat)	0	0.0
4.00 - 4.50 (thick peat)	1	<0.1

In summary the peat depth probing has shown that:

- More than half of probes (61%) intersected no peat or peaty soils;
- Approximately 9% of peat probes undertaken across the entire Site found peat in excess of 1.5 m thick; and
- Of the probes that intersected peat, approximately 91% was <1.5 m thick.

The assessment of the underlying substrate from the probing data was interpreted as predominately glacial soils and weathered bedrock. Bedrock was identified in outcrop and close to surface on many of the topographically high areas.

Table 2-2
Ground Conditions at Proposed Turbine Locations

Turbine No.	Peat Thickness (m)	Peat Conditions	Slope (°)
1	0.2	Peaty Soil	10.63
2	0.2	Peaty Soil	9.20
3	0.7	Thin Peat	7.64
4	0.2	Peaty Soil	5.94
5	0.2	Peaty Soil	6.86
6	0.2	Peaty Soil	6.47
7	0.3	Peaty Soil	6.66
8	0.2	Peaty Soil	7.97
9	0.2	Peaty Soil	6.22
10	0.1	Peaty Soil	6.93
11	0.4	Peaty Soil	6.87
12	0.6	Thin Peat	11.96
13	0.7	Thin Peat	0.68
14	2.5	Thick Peat	2.13
15	0.5	Peaty Soil	3.87
16	0.4	Peaty Soil	6.07
17	1.2	Thin Peat	10.45
18	0.8	Thin Peat	1.85
19	0.2	Peaty Soil	9.05
20	0.2	Peaty Soil	10.65
21	0.2	Peaty Soil	11.80

3.0 Potential Impacts on Peat from Construction Activities

3.1 Wind Turbines

Wind turbine foundations in peatlands would normally require full and permanent excavation of peat to competent strata, with temporary excavation of peat from a wider diameter to enable safe access to the base of the excavation.

The resulting peat generated could be considered as a permanent loss, unless satisfactory re-use could be achieved within the Site. The peat would normally be used to reinstate track shoulders, around crane hardstandings and turbine bases.

3.2 Crane Hardstanding

In order to assemble the wind turbine and enable servicing during operation, crane pads are constructed adjacent to each wind turbine. These must be sufficient to take the weight of both the crane and turbine components, and therefore excavation to underlying competent strata is required. Without adequate drainage controls, permanent excavation may disrupt natural hydrological pathways.

Crane pads must remain in place for the life of the proposed development to enable routine inspection and maintenance. Peat generated from these excavations would be considered a permanent loss, unless satisfactory re-use could be achieved within the development site.

3.3 Substation, Control Building and Energy Storage Compound

The substation compound contains the control building and energy storage compound, along with areas where transformers and electrical infrastructure is housed. The control building and substation require concrete foundations, and therefore excavation to a depth of approximately 1 m is required. Without adequate drainage controls, permanent excavation may disrupt natural hydrological pathways.

3.4 Construction Compounds

Temporary compounds are provided during the construction phase to enable storage of construction materials, turbine components and fuel, concrete batching plant, siting of welfare facilities and site offices.

Because of their temporary nature, peat excavated for compounds would normally be stored and reinstated, and therefore re-use is required.

3.5 Borrow Pits

Where access track and hardstanding construction materials are required, it is intended to source the material from borrow pits within the Site boundary.

Peat/peaty soil overlying Glacial Till and weathered bedrock is normally excavated and temporarily stored for the duration of construction, and then re-used for borrow pit restoration and landscaping post construction, and therefore re-use is required. Peat is not anticipated at any of the proposed borrow pit options for the development.

3.6 Access Tracks

Access tracks are required to enable passage of construction and servicing traffic around the proposed development site. Over peatlands, the choice of access track design normally reflects the peat depths along the route, with thin peat/ organic soils <1 m deep excavated to competent strata (cut and fill tracks), and deeper peats overlain by floating tracks (with no excavation).

Access tracks are permanent infrastructure, peat excavated for cut and fill would be considered a permanent loss, unless the peat can be re-used elsewhere on site.

No excavations are undertaken for floating tracks, and therefore there is no associated peat excavation.

In excavated tracks, the surface vegetation (i.e. habitat) would be lost unless stored and reinstated elsewhere, however the intention will be to re-use excavated turves and peat on verges and track shoulders (including along the verges of floated track sections) and hardstandings for landscaping and restoration purposes.

Both types of access track have the potential to disrupt natural hydrological drainage pathways, appropriate drainage will be designed to mitigate this.

3.7 Cable Trenching

Electrical cabling is typically buried or ducted adjacent to the access track network (cable trenching), either into existing peat (requires excavation, laying and backfilling) or wherever possible ducts are laid within reinstated material at the sides of floated tracks (no excavation of in-situ peat required). Where excavation is required, peat generated from cable trenching is normally replaced at its point of origin, and therefore is not considered a volume loss and re-use is a certainty.

4.0 Proposed Mitigation During Construction

There are a number of ways in which detailed design and construction activities can be specified to minimise impacts on peatlands. The following section outlines briefly the likely mitigation required to minimise impact, based on the reuse of peat specific to key elements of the proposed development.

4.1 Wind Turbine Foundations

Wind turbine foundations represent permanent excavation and the primary mitigation measure is to locate the wind turbines to avoid the areas of deepest peat, thereby reducing excavated volumes.

All turbine locations for the proposed Development are located on peat/peaty soils, with an average peat/peaty soil depth of 0.48 m, ranging from 0.1 m to 2.5 m. The peaty soils will be used for restoration around the turbine.

4.2 Substation, Control Building and Energy Storage Compound

The substation, control building and energy storage is located on an area of peaty soils only, there is no significant peat at this location, and therefore no mitigation is required.

4.3 Crane Hardstandings and Temporary Compounds

In relation to crane hardstanding, guidance is to avoid their full reinstatement post-construction, given the likelihood of re-use for maintenance activities associated with the wind turbines.

In relation to temporary compounds, the following good practice guidance applies:

- peat stripped from compound and hard standing areas will require particularly careful storage due to its volume, and the relatively long residence times for stored peat;
- stripped turves are generally used for final restoration, however where turves are insufficient or vegetation regeneration requires reseeding, temporary fencing may be considered around compound areas undergoing restoration in order to prevent grazing; and
- the choice of seed mix for reseeding should be appropriate to the ecological and hydrological conditions of the restored compound location and surrounding habitats.

4.4 Borrow Pits

Peat may be re-used within borrow pits for the purpose of their restoration provided the method of reuse is consistent with the environmental reinstatement objectives of the site and presents no residual risks from pollution of the environment or harm to human health (SEPA, 2017[1]).

Key issues for borrow pit restoration are:

- prevention of desiccation and carbon losses from peat used in the restoration;
- development of complete vegetation cover through emplacement of peat turves or seeding with an appropriate species; and
- fencing where required, to exclude grazing stock and to encourage vegetation establishment.

4.5 Access Tracks

In comparison to infrastructure specific to wind turbines, there is considerably more guidance available to support access track design in peatlands. Guidance is generally focused on floating tracks and excavated tracks and is summarised below.

4.5.1 Floating Access Tracks

Over deeper peat (typically >1.0 m), floating tracks are used to remove the requirement for peat excavation and limit disruption of hydrological pathways. The success of construction requires careful planning to take account of the unique characteristics of peat soils. Specific guidance[4] is available on design, the duration and timing of construction, the sequence of construction and the re-use of peat on the shoulders of the floating access track.

Design of Floating Access Tracks

The following issues should be considered during detailed design of floating access tracks:

- adopting conservative values for peat geotechnical properties during detailed design (post-consent);
- applying a maximum depth rule whereby an individual layer of geogrid and aggregate should not normally exceed 450 mm without another layer of geogrid being added;
- on gently sloping ground and where the access track runs transverse to the prevailing slope, accommodating natural hydrological pathways such as flushes and peat pipes through installation of a permanent conduit within or underneath the track and allowing for as much diffuse discharge (while minimising disturbance to existing peatland) on the downslope as possible;
- ensuring transitions between floating tracks and excavated tracks (or other forms of track not subject to long term settlement) are staged in order to minimise likelihood of track failure at the boundary between construction types;
- scheduling access track construction to accommodate for, and reduce peat settlement characteristics; and
- re-use of existing roads (with upgrading if required), where possible.

Duration and Timing of Construction of Floating Access Tracks

The critical factor in successful construction of floating access tracks is the timescale of construction, and the following good practice guidance is provided:

- the settlement characteristics of peat; should be accommodated by appropriate scheduling of access track construction, as follows:
    - prior to construction works, the setting out the centreline of the proposed access track to identify any ground instability concerns or particularly wet zones;
    - identifying ‘stop’ rules, i.e. weather dependent criteria for cessation of access track construction based on local meteorological data;
    - maximising the interval between material deliveries over newly constructed access tracks that are still observed to be within the primary consolidation phase;

Sequence of Construction

The sequence of construction is normally stipulated in guidance provided by the supplier of the geotextile or geogrid layer, and suppliers are often involved in the detailed access track design. Good practice in relation to the sequence of access track construction is as follows:

- retaining rather than stripping the vegetation layer (i.e. the acrotelm, providing tensile strength), and laying the first geotextile/geogrid directly on the peat surface;

[4] Floating Roads on Peat (SNH, FCS; August 2010)

- adding the first rock layer;
- adding the second geotextile/geogrid, and add overlying graded rock fill as a running surface;
- heavy plant and heavy goods vehicles (hgv) using the access tracks during the construction period should be trafficked slowly in the centre of the track to minimise dynamic loading from cornering, breaking and accelerating;
- ensuring wheel loads should remain at least 0.5 m from the edge of the geogrid, markers should be laid out, monitored and maintained on the access track surface to clearly emphasise these boundaries; and
- initial ‘toolbox’ talks and subsequent feedback to construction and maintenance workers and drivers to emphasise the importance of the implementing the above measures.

Use of Peat as Trackside Shoulders

A key opportunity to re-use peat is to employ it in landscaping of constructed access tracks. Wedge-shaped reinstatement at the margins of a floating access track (which is elevated above the peat surface) is termed shoulders, and good practice guidance is as follows:

- re-using peat excavated from elsewhere on site as shoulders adjacent to the floating track;
- peat shoulders should taper from just below the track sides (thereby preventing over high shoulders from causing ponding on the track surface) to join the surrounding peat surface, keeping as natural a profile as possible to tie in with existing slope profiles; and
- limiting the width of peat shoulders to avoid unnecessary smothering of intact vegetation adjacent to the floating track.

4.5.2 Excavated Access Tracks

Excavated tracks require complete excavation of peat to a competent substrate. Excavated tracks are generally undertaken where peat depths are less than 1 m. This peat would require storage ahead of re-use elsewhere on site. Good practice guidance relates mainly to drainage in association with excavated tracks:

- trackside ditches should capture surface water (within the acrotelm) before it reaches the road;
- interceptor drains should be shallow and flat bottomed (and preferably entirely within the acrotelm to limit drawdown of the water table);
- any stripped peat turves should be placed back in the invert and sides of the ditch to assist regeneration; and
- culverts and cross drains should be installed under excavated tracks to maintain subsurface drainage pathways (such as natural soil pipes or flushes). discharge from constructed drainage should allow for as much diffuse dispersion of clean (silt free) water as possible while minimising disturbance to existing peatland as far as possible. silt mitigation measures will be incorporated into all constructed drainage as per the requirements of the CEMP.

Although excavation is normally undertaken in peat of minor thickness (< 1.0 m), there is a possibility of minor slippage from the cut face of the peat mass. Accordingly:

- free faces should be inspected for evidence of instability (cracking, bulging, excessive discharge of water or sudden cessation in discharge); and
- where significant depths of peat are to be stored adjacent to an excavation, stability analysis should be conducted to determine factor of safety (fos) and an acceptable fos adopted for loaded areas.

As with floating tracks, monitoring should be scheduled post-construction to ensure that hydrological pathways and track integrity have been suitably maintained.

4.6 Cable Trenches

Cable trenches either require peat excavation specifically for this purpose, or they can be constructed within landscaping of shoulders adjacent to floating tracks. Guidance is as follows:

- utilise peat shoulders for cable lays where possible to minimise peat excavations specifically for this purpose, in this case, peat shoulders should be 1.0 m to 1.5 m thick;
- where cable trenching is constructed adjacent to a floating road, ensure the trench is backfilled to prevent void filling by material migration;
- minimise time between excavation of the cable trench and peat reinstatement, preferably avoiding excavation until the electrical contractor has cables on-site ready for installation; and
- avoid incorporating substrate materials in the excavation, to minimise contamination of the peat to be reinstated. replace excavated materials sequentially.

4.7 Site Drainage

Turbines, crane hardstandings and other site infrastructure have been designed and located to avoid drainage features where possible. A detailed drainage management plan will be agreed with SEPA prior to the commencement of construction on any part of the site. This will feature in the CEMP or as a standalone document and refers to the conceptual design of the site drainage system to ensure minimal impact on the site hydrology.

4.8 Peat Excavation, Storage and Transport

The construction process will both generate peat and use peat. Where possible, "restore-as-you-go" techniques will be used to place excavated peat material in its final destination rather than in temporary stockpiles. However there may, in some circumstances, be a time-delay between these actions. During the interim period, peat would be stored on-site. It is important both for the peat itself and for the surrounding environment that the peat is not allowed to substantially erode or become dry, while it is stored. Procedures to control the hydrology of stored peat are described in the outline Construction Environmental Management Plan (CEMP).

If peat is to be re-used or reinstated with the intention that its supported habitat continues to be viable, the following good practice applies:

4.8.1 Excavation

- excavated peat should be excavated as turves, including the acrotelm (surface vegetation) and a layer of adjoining catotelm (more humified peat) typically up to 500 mm thick in total, or as blocks of catotelm; the acrotelm should not be separated from its underlying peat;
- the turves should be as large as possible to minimise desiccation during storage;
- contamination of excavated peat with substrate materials should be avoided; and
- consider timing of excavation activities to avoid very wet weather and multiple handling to minimise the likelihood of excavated peat losing structural integrity.

If possible, extract intact full depth acrotelm layers from the top surface of the peat deposit. This technique will maintain connectivity between the surface vegetation and the partially decomposed upper layers of the catotelm.

4.8.2 Storage

The following good practice applies to the storage of peaty soils/peat:

- stripped materials should be carefully separated to keep peat and other soils apart;
- to minimised handling and haulage distances, excavated material should be stored local to the site of excavation or end point of restoration;
- peat turves should be stored in wet conditions or irrigated in order to prevent desiccation (once dried, peat will not rewet);
- stockpiling of peat should be in large volumes to minimise exposure to wind and sun (and desiccation), but with due consideration for slope stability;
- stockpiles should be isolated from watercourses or drains with appropriate bunding to minimise pollution risks;
- excavated peat and topsoil should be stored to a maximum of 1 m thickness;
- stores of non-turf (catotelm) peat should be bladed off to reduce the surface area and desiccation of the stored peat; and
- peat storage areas should be monitoring during periods of very wet weather, or during snowmelt, to identify early signs of peat instability.

4.8.3 Temporary Storage

Any peaty soils/peat to be removed during construction would require a temporary storage area near to the construction works. Where peat cannot be transferred immediately to an appropriate restoration area, short term storage will be required. In this case, the following good practice applies:

- peat should be stored around the turbine perimeter at sufficient distance from the cut face to prevent overburden induced failure,
- local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes should be avoided for peat storage;
- stored upper turves (incorporating vegetation) should be organised and identified according to nvc community (assisted by the environmental clerk of works, ecow) for reinstatement adjacent to like communities in the intact surrounding peat blanket;
- drying of stored peat should be avoided by irrigation (although this is unlikely to be significant for peat materials stored less than 2 months).

For crane pads, borrow pits and compounds (with longer term storage requirements), the following good practice applies:

- peat generated from crane pad locations should be transported directly to its allocated restoration location, to minimise the volume being stockpiled with the possibility of drying out;
- stores of catotelmic peat should be bladed off to reduce their surface area and minimise desiccation;
- where transport cannot be undertaken immediately, stored peat should be irrigated to limit drying and stored on a geotextile mat to promote stability;
- monitoring of large areas of peat storage during wet weather or snowmelt should be undertaken to identify any early signs of peat instability. prior to the excavation of relevant infrastructure, vegetation, peat and superficial geology will be removed and stored in overburden stockpiles (or used directly in restoration of other areas; see below);
- care will be taken to segregate peat from other materials, to ensure that turves are kept reasonably intact, and to store turves right-side-up to form a protective layer on top of any deeper peat stockpiles;

- overburden stockpiles will be located adjacent to the infrastructure at least 50 m from watercourses in order to reduce the potential for sediment to be transferred into the wider hydrological system;
- run-off from overburden stockpiles will be directed through the infrastructure suds measures (as described in the cemp), including silt fences and mats, drainage measures and settlement lagoons, as appropriate; and
- peat will not be allowed to dry out in the overburden stockpiles.
- storage areas and dimensions will remain largely unknown until the site work has commenced and the peat condition and requirements are better known.

4.8.4 Transport

Movement of turves should be kept to a minimum once excavated, and therefore it is preferable to transport peat planned for translocation and reinstatement to its destination at the time of excavation; and;

If HGVs/dump trucks that are used for transporting non-peat material are also to be used for peat materials, measures should be taken to minimise cross-contamination of peat soils with other materials.

4.8.5 Handling

Following refinement of the Site peat model, a detailed storage and handling plan should be prepared, including:

- best estimate excavation volume at each infrastructure location (including peat volumes split into area/volume of 'acrotelm' or 'turf', and volume of catotelm);
- volume to be stored locally and volume to be transferred directly on excavation to restoration areas elsewhere (e.g. disused quarries, borrow pits or forest drains) in order to minimise handling;
- location and size of storage area relative to turbine foundation, crane hardstanding and natural peat morphology / drainage features;
- irrigation requirements and methods to minimise desiccation of excavated peat during short term storage.

These parameters are best determined post-consent in light of detailed ground investigation with the micro-siting areas for each element of infrastructure.

4.9 Restoration

During restoration, the following best practice should be followed:

- carefully evaluate potential restoration sites, such as borrow pits for their suitability, and agree that these sites are appropriate with the ecow, landowners and relevant consultees;
- undertake restoration and revegetation work as soon as possible;
- where required, consider exclusion of livestock from areas of the site undergoing restoration, to minimise impacts on revegetation; and
- as far as reasonably practicable, restoration should be carried out concurrently with construction rather than at its conclusion.

5.0 Site Based Peat Excavation and Management Assessment

The Stage 1 PMP has been undertaken as part of the Environmental Impact Assessment in support of the proposed Development, to ensure that there is an understanding of the extent of peat on site, the total amount of peat that might be excavated, a demonstration that the current design avoids areas of deep peat where possible and that the re-use of the excavated materials is certain and minimised where possible.

5.1 Peat Probing

Probing was undertaken in three phases, initially in March 2013, then in February - March 2020 to an approximate 100 m grid and secondly as a detailed survey in May, June 2020 and October 2020. The results have been used to produce a peat isopach map (**Figure 10.2.3**). A total of 3,971 probe locations were undertaken in areas of identified peaty soil/peat to determine the thickness thereof; and the overall conclusion regarding peat stability is that there is a low risk of peat instability over most of the site although some limited areas of medium and high risk have been identified.

The layout has been carefully designed to minimise excavating or disturbing thick peat, where possible, and where this cannot be avoided, mitigated by the use of floating roads.

Table 5-1
Excavation Materials Management Plan

Method	Volume of Excavated Material (m^3)	How much of this can be re-used on site (%)	Opportunity for Avoidance or Minimisation of Excavated Material	Re-use Requirements	Hierarchy Adherence	Limitations and Considerations
Excavated Access Tracks Total Length of the access tracks would be 52.5 km and would consist of the following: • 29.2 km of new access track (excavated); • Up to 3.6 km of new access track (floated); • 19.8 km of existing upgraded tracks The excavated access tracks would be located on an average	107,173 m^3 (29,074 m x 7 m x 0.48 m + 19,757 m x 1 m x 0.48 m	100%	The access track route has been subject to a number of design iterations to avoid thicker peat and steep slopes. Where possible track width would be minimised. The peat along the proposed excavated tracks on the site is fibrous – pseudo fibrous and does not exhibit thick catotelmic peat. The peat is generally fairly dry and reasonably well drained.	Verge Restoration and visual screening, particularly along access track. Sections of the route may require cut and fill and these slopes would require restoration to minimise visual impact 116,859 m^3 (29,074 m x 3 m x 0.5 m x 2) + (19,757 m x 3 m x 0.5 x 1) of excavated peat and peaty soil would be used along access tracks. Assumes an average depth of peat of 0.5 m over a width of 3.0 m on both sides of the track	Avoidance was first level of screening to avoid areas of thicker peat. Routing has been planned on thinner peat or peaty soils where possible. The layout design has been guided by constraints which highlight ecological, hydrogeological and geomorphological - all of which identify the peat areas to avoid	Requires detailed ground investigation to fully characterise peat. Detailed assessment may identify further lengths of floating access tracks, which would further reduce requirement for excavation.

Method	Volume of Excavated Material (m^3)	How much of this can be re-used on site (%)	Opportunity for Avoidance or Minimisation of Excavated Material	Re-use Requirements	Hierarchy Adherence	Limitations and Considerations
peaty soil/peat depth of 0.48 m.			There are some areas of thick catotelmic peat on the route of the site access tracks; however, these areas would utilise floated access tracks to minimise disturbance of the peat.			
Floating Access Tracks It is anticipated that 3.6 km of floating tracks would be required, which would generate no surplus peat.	Not applicable	Not applicable	No excavated material except where cable trenches are proposed (see below).	Verge restoration along access tracks ~**17,076** m^3 (3557 m x 3 m x 0.8 m x 2)	Looked at different cut off depths for floating access track. Based on > 1 m depth.	Verge restoration must avoid impacting existing unexcavated peat.
Turbine Foundations 21 No. turbines	14,556 m^3 (38 m x 38 m x 0.48 m X 21)	100%	Turbine locations have been subject to a number of design iterations to avoid thicker	At turbine foundations topsoil would be stripped keeping top 200 mm of turf intact. This would be stored adjacent to the base working area and	Avoided areas of thick peat for turbine bases to minimise removal of excessive materials.	Requires detailed ground investigation to fully characterise peat.

Method	Volume of Excavated Material (m^3)	How much of this can be re-used on site (%)	Opportunity for Avoidance or Minimisation of Excavated Material	Re-use Requirements	Hierarchy Adherence	Limitations and Considerations
With average excavation of 38 m diameter x 0.48 m (average thickness of peat at turbines).			peat and steep slopes. Average thickness of peat at turbine sites is ~0.48m	would be limited to 1 m height. 3,591 m^3 (114 m x 3 m x 0.5 m x 21)		
Crane Pads 21 No. crane hardstandings. With average excavation of 100 m x 30 m x 0.50 m with additional areas for cranes and blades.	42,000 m^3 (31,500 + 3,780 + 6,720) (based on 100 m x 30 m x 0.50 m) x 21 plus ancillary pads	100%	Crane hardstanding locations have been influenced by the turbine design iterations to avoid thicker peat and steep slopes. Average thickness of peat at turbine sites is ~0.5 m; hence crane hard standings would be similar	At crane hardstandings topsoil would be stripped keeping top 200mm of turf intact. This would be stored adjacent to the base working area and would be limited to 1 m height. 10,332 m^3 (6,720 + 1,764 + 1,848) could be re-used to dress the edges of the hardstanding area. (160 m x 2 m x 1 m x 21) plus ancillary pads and blade fingers.	Avoided areas of thick peat for turbine bases to minimise removal of excessive materials. Orientation of crane hardstandings to be designed following detailed ground investigation, to avoid constraints and minimise requirement for peat excavation.	Requires detailed ground investigation to fully characterise peat.
Turning Heads (16 No.)and Passing Places (10 No.)	9216 m^3 (1152 m^3 + 8064 m^3)	100%	Average thickness of peat at turning heads and passing places sites is ~0.48m	Verge Restoration at these areas. 2620 m^3 could be re-used to dress the edges of the turning head area.	Avoided areas of constraint but limited by design.	Verge Restoration at these areas.

Method	Volume of Excavated Material (m^3)	How much of this can be re-used on site (%)	Opportunity for Avoidance or Minimisation of Excavated Material	Re-use Requirements	Hierarchy Adherence	Limitations and Considerations
Turning Heads average excavation of 30 x 5 m x 16 No x 0.48 m (average thickness of peat). And Passing Places 70 m x 4 m x 60 No. x 0.48	(30 m x 5 m x 0.48 m x 16) + (70 m x 4 m x 0.48 m x 60)			(65 m x 0.5 m x 16) plus passing places (70 m x 0.5 m x 60)		
Substation, Control Building and Energy Storage	2805 m^3 (100 m x 75 m x 0.37 m)	100%	The proposed substation locations would largely be located on glacial till adjacent to the proposed access tracks.	125 m^3 (250 m x 1 m x 0.5 m) can be re-used dressing the area around the substation – the remainder can be re-used elsewhere on site.	Avoided siting substation on thick peat areas where possible	None
Laydown Area	365 m^3 (100 m x 50 m x 0.07 m)	100%	The proposed laydown area would largely be located on shallow soils adjacent to the proposed access tracks.	365 m^3 (100 m x 50 m x 0.07 m) Materials would be re-used on site to reinstate working areas and for appropriate landscaping.	Avoided siting laydown area on thick peat areas where possible	None

Method	Volume of Excavated Material (m^3)	How much of this can be re-used on site (%)	Opportunity for Avoidance or Minimisation of Excavated Material	Re-use Requirements	Hierarchy Adherence	Limitations and Considerations
Main Construction Compound	2800 m^3 (100 m x 100 m x 0.28 m)	100%	The construction compound would largely be located on glacial till adjacent to the proposed access tracks.	Materials would be re-used on site to reinstate working areas and for appropriate landscaping. 2800 m^3 (100 m x 100 m x 0.28 m)	Avoided siting temporary compounds on thick peat areas where possible	None
Temporary Construction Compound North	575 m^3 (50 m x 50 m x 0.23 m)	100%	The construction compound would largely be located on glacial till adjacent to the proposed access tracks.	Materials would be re-used on site to reinstate working areas and for appropriate landscaping. 575 m^3 (50 m x 50 m x 0.23 m)	Avoided siting temporary compounds on thick peat areas where possible	None
Temporary Construction Compound South	7725 m^3 (100 m x 75 m x 1.03 m)	100%	The construction compound would largely be located on glacial till adjacent to the proposed access tracks.	Materials would be re-used on site to reinstate working areas and for appropriate landscaping. 7725 m^3 (100 m x75 m x 0.1.03 m)	Avoided siting temporary compounds on thick peat areas where possible	None

Method	Volume of Excavated Material (m^3)	How much of this can be re-used on site (%)	Opportunity for Avoidance or Minimisation of Excavated Material	Re-use Requirements	Hierarchy Adherence	Limitations and Considerations
Meteorological Masts It is anticipated that one meteorological mast will be required on the site.	227 m^3 (30 m x 20 m x 0.38 m)	100%	The proposed met mast locations would largely be located on peaty/glacial soils adjacent to the proposed access tracks.	Verge restoration along access tracks 128 m^3 (80 m x 2 m x 0.8 m x 1)	Avoidance was first level of screening to avoid areas of thicker peat. Routing has been planned to utilise existing tracks.	Requires detailed ground investigation to fully characterise peat and conditions of existing track.
Borrow Pits There are 7 borrow pit options, all of which have limited peat cover. (0.38m)	21,392 m^3	Not applicable	There is limited peaty soils/peat overlying the selected borrow pits.	Limited peaty topsoil can be stockpiled and used for restoration. Peat/peaty soils from elsewhere on site could be used to restore the proposed borrow pits with the following volumes: Borrow Pits: 55,700 m^3 Assumes an average peat depth of 1 m over restored borrow pit.	Site selection avoided areas of peat for borrow pits, identified sites on bedrock or close to minimise removal of excessive materials.	Current calculations are based on conservative re-use and based on the use of allseven borrow pits. Detailed design has yet to be undertaken on the proposed borrow pits.
Total Excavated	203,037 m^3			217,896 m^3		

Based on the values indicated, there is a balance of materials with no surplus peat anticipated to be generated on site (refer to Appendix A).

Should further ground investigation information become available, the figures will need to be re-calculated, the figures in the table are indicative only.

6.0 Peat Excavation Considerations

This section of the PMP includes the method for dealing with peat which could potentially be classified as waste (only if the above volumes estimate significant quantities of catotelmic peat, which cannot be re-used).

Table 6-1 below outlines where those materials that are likely to be generated on site fall within the Waste Licensing Regulations.

It has been concluded that all of the materials to be excavated on site would fall within the non-waste classification as most of the topsoil and peaty soils would be re-used on site. Based on a detailed probing exercise and visual inspection of the peat, it is predominantly fibrous peat which would be suitable to be re-used on site. Typically, the peat was found to be fibrous and fairly dry within the top metre before becoming more amorphous with depth.

The majority of the excavated peat is therefore entirely re-useable as it is predominantly fibrous and easily re-used on site. Areas of deep peat have been avoided by design where possible.

Table 6-1
Excavated Materials – Assessment of Suitability

Excavated Material	Indicative Volume on Site by % of total excavated soils	Is there a suitable use for material	Is the Material required for use on Site	Material Classified as Waste	Re-use Potential	Re-use on Site
Mineral Soil	30	Yes	Yes	Not classified as waste	Yes	Will be re-used in reinstatement of floated access track verges, cut and fill verges, road verges, side slopes and check drains. Peripheral embankments of turbine bases, crane hardstandings and restoration of borrow pits.
Turf (Surface layer of vegetation and fibrous matt)	40	Yes	Yes	Not classified as waste	Yes	
Acrotelmic peat	25	Yes	Yes	Not classified as waste	Yes	Will be re-used in reinstatement of floated access track verges, cut and fill verges, road verges, side slopes and check drains. Peripheral embankments of turbine bases, crane hardstandings and restoration of borrow pits.

Excavated Material	Indicative Volume on Site by % of total excavated soils	Is there a suitable use for material	Is the Material required for use on Site	Material Classified as Waste	Re-use Potential	Re-use on Site
Catotelmic Peat (amorphous material unable to stand unsupported when stockpiled >1 m)	5 Very limited as it has been avoided by design.	Potentially	Potentially [5]	Potentially if not required as justifiable restoration of habitat management works	Limited	If peat does not require treatment prior to re-use it can be used on site providing adequate justification and method statements are provided and approved by SEPA. If it is unsuitable for use without treatment, then it may be regarded as a waste. However every attempt to avoid this type of peat has been incorporated into the design.

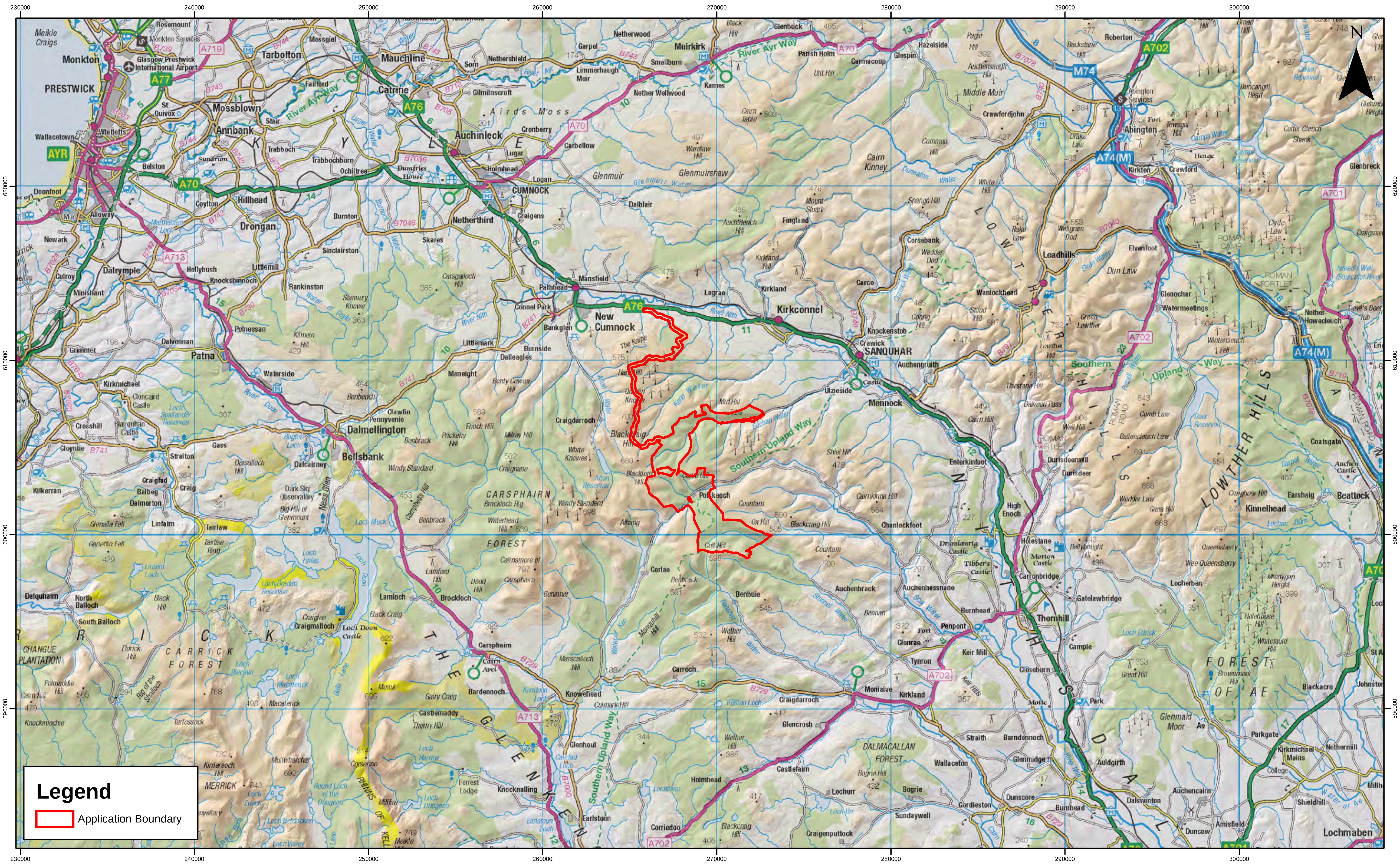
[5] Such uses for this type of material are limited, however there may be justification for use in the base of borrow pits to maintain water logged conditions and prevent desiccation of restored area and in some habitat management works such as gully or ditch blocking where saturated peat is required to mimic mire type habitats and encourage establishment of sphagnum.

7.0 Conclusion

The appendix detailed within this report are to be considered indicative at this stage and will require review following the results of detailed ground investigation. The figures shown in the tables suggest that the volumes of peat excavated on site would be re-used without creating surplus materials which would require to be classified as waste. Post consent, the Stage 1 PMP and the outline Construction Environmental Management Plan (CEMP) would be updated with information obtained during detailed ground investigations and design stage.

These plans would be developed to update the CEMP, with detailed post construction restoration plans. This would be reviewed and monitored along with the updated PMP and CEMP to ensure compliance with method statements and to keep track of volumes.

FIGURES AND APPENDICES



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Peat Management Plan

Site Location

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Rev	A
Date	13/10/20
Figure	10.2.1

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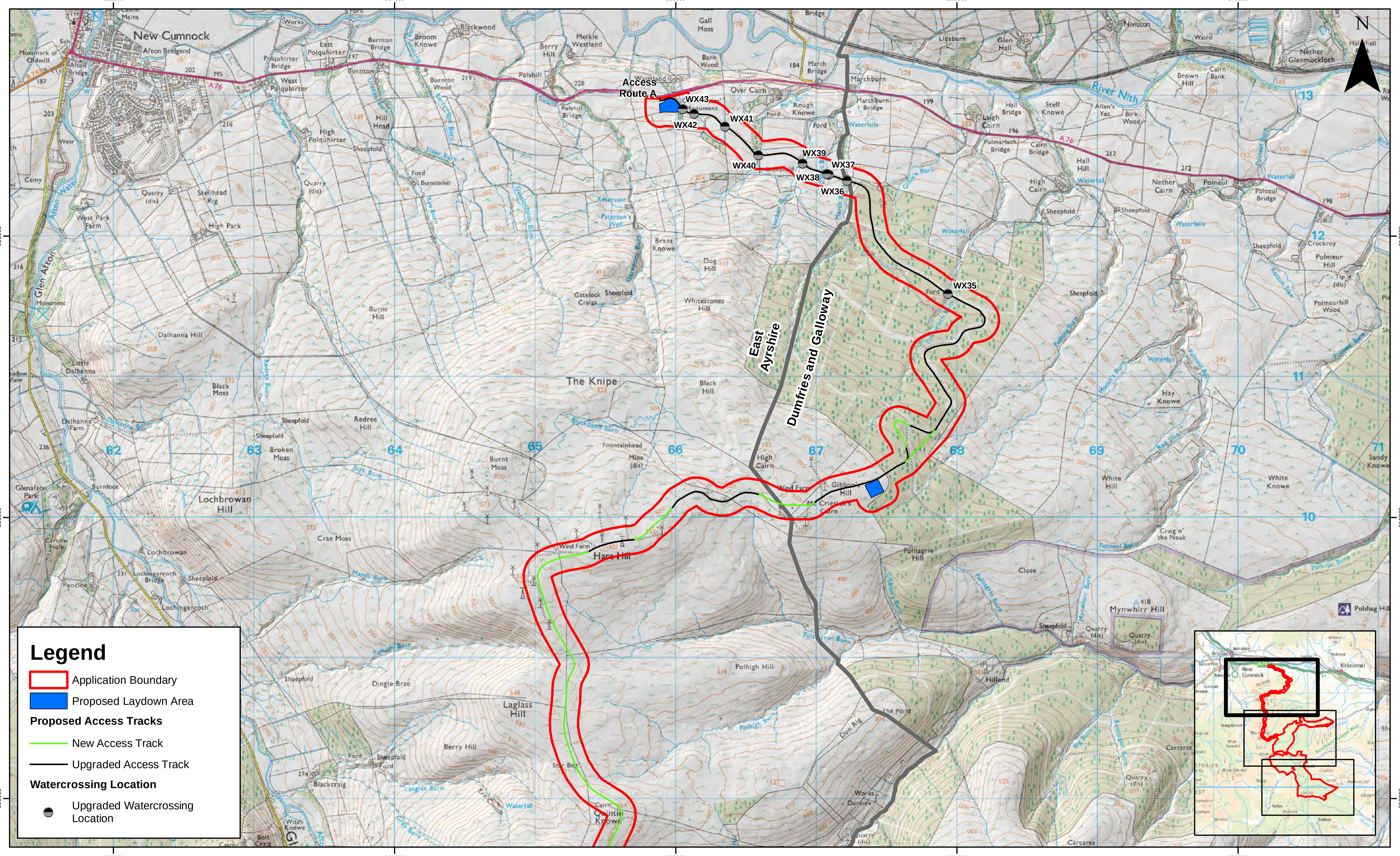

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Peat Management Plan

Site Layout

Page 1 of 3

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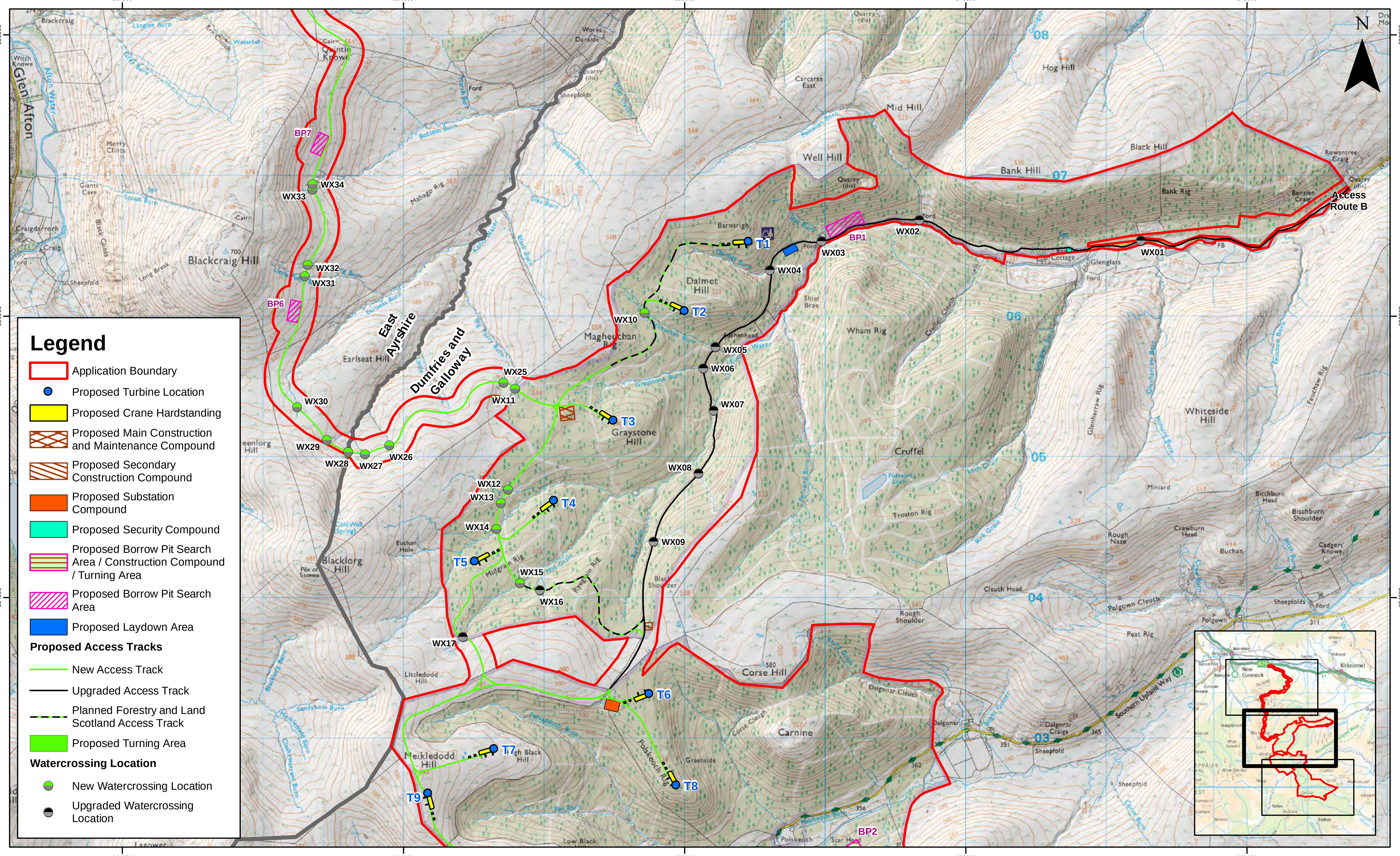

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Peat Management Plan

Site Layout

Page 2 of 3

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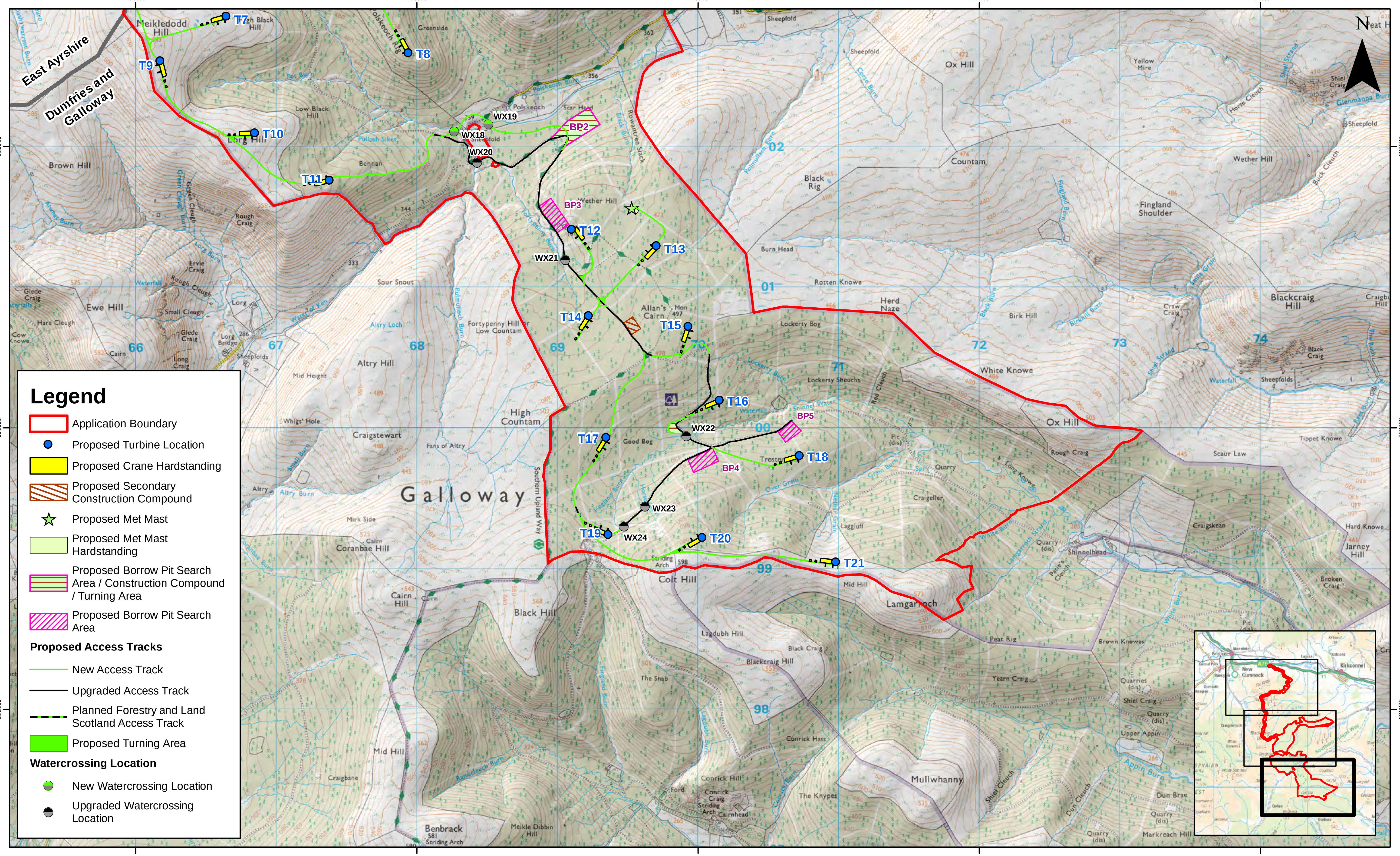

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Peat Management Plan

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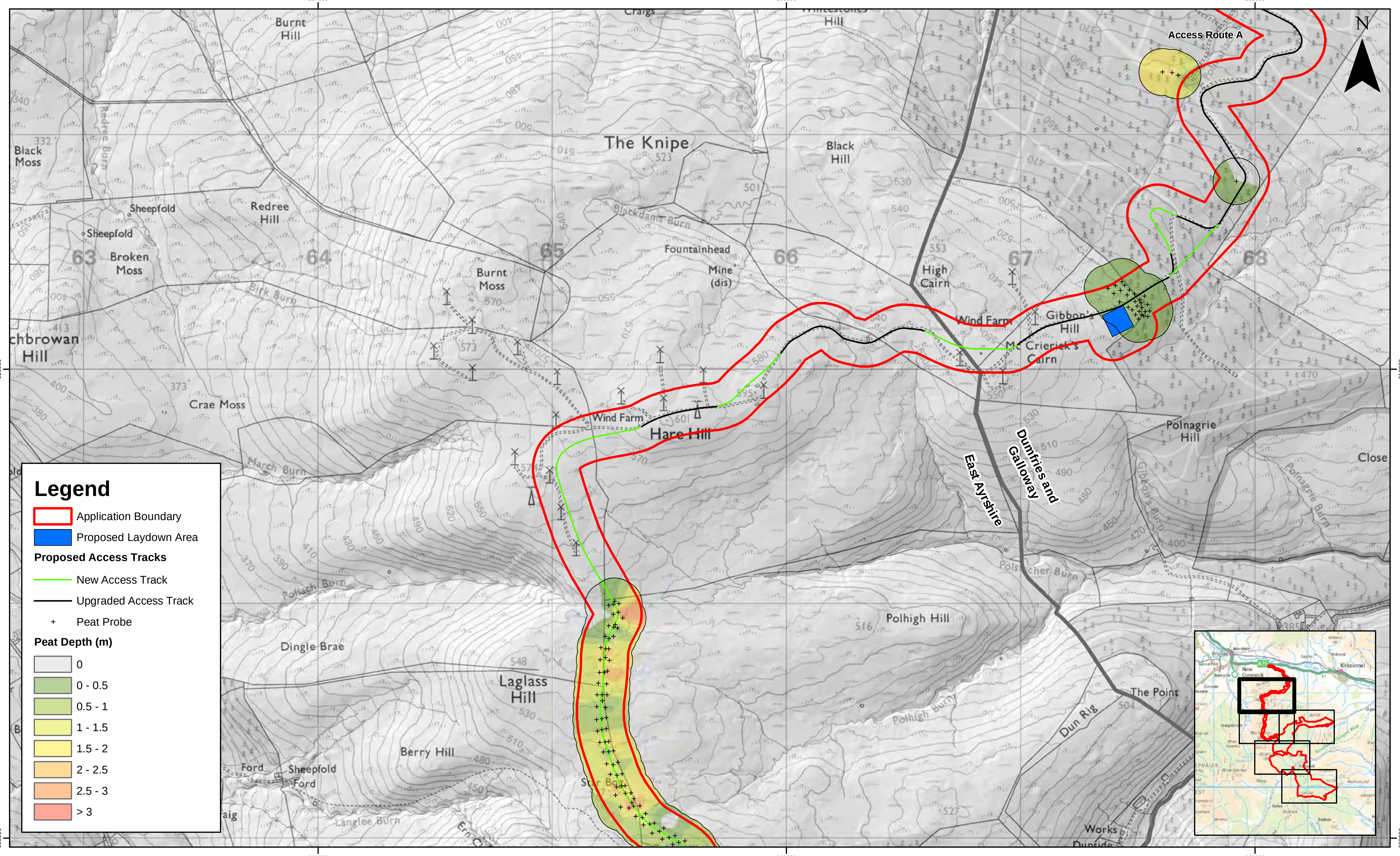

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Peat Management Plan

Peat Depth

Page 1 of 5

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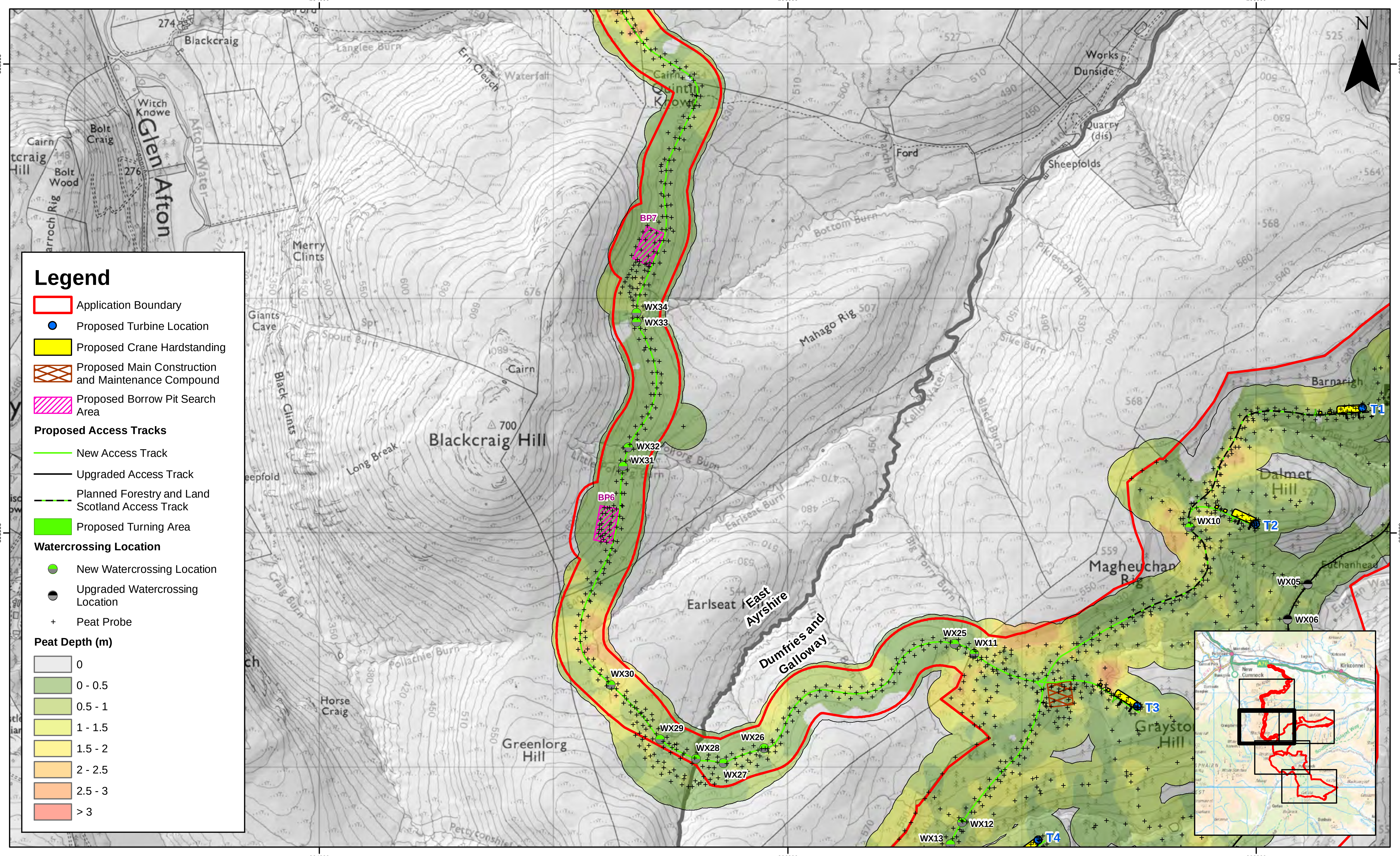

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Peat Management Plan

Peat Depth

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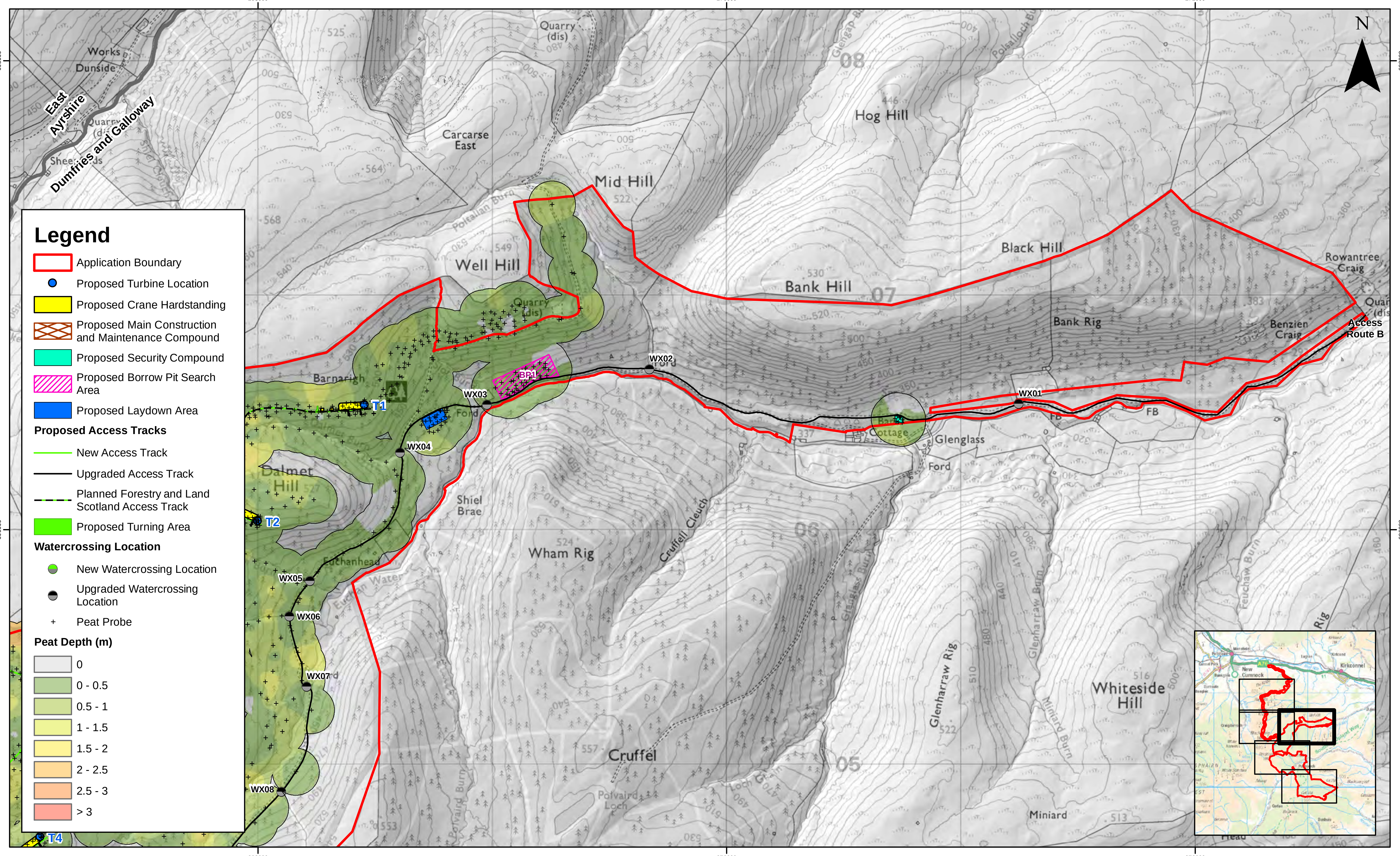

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Peat Management Plan

Peat Depth

Page 3 of 5

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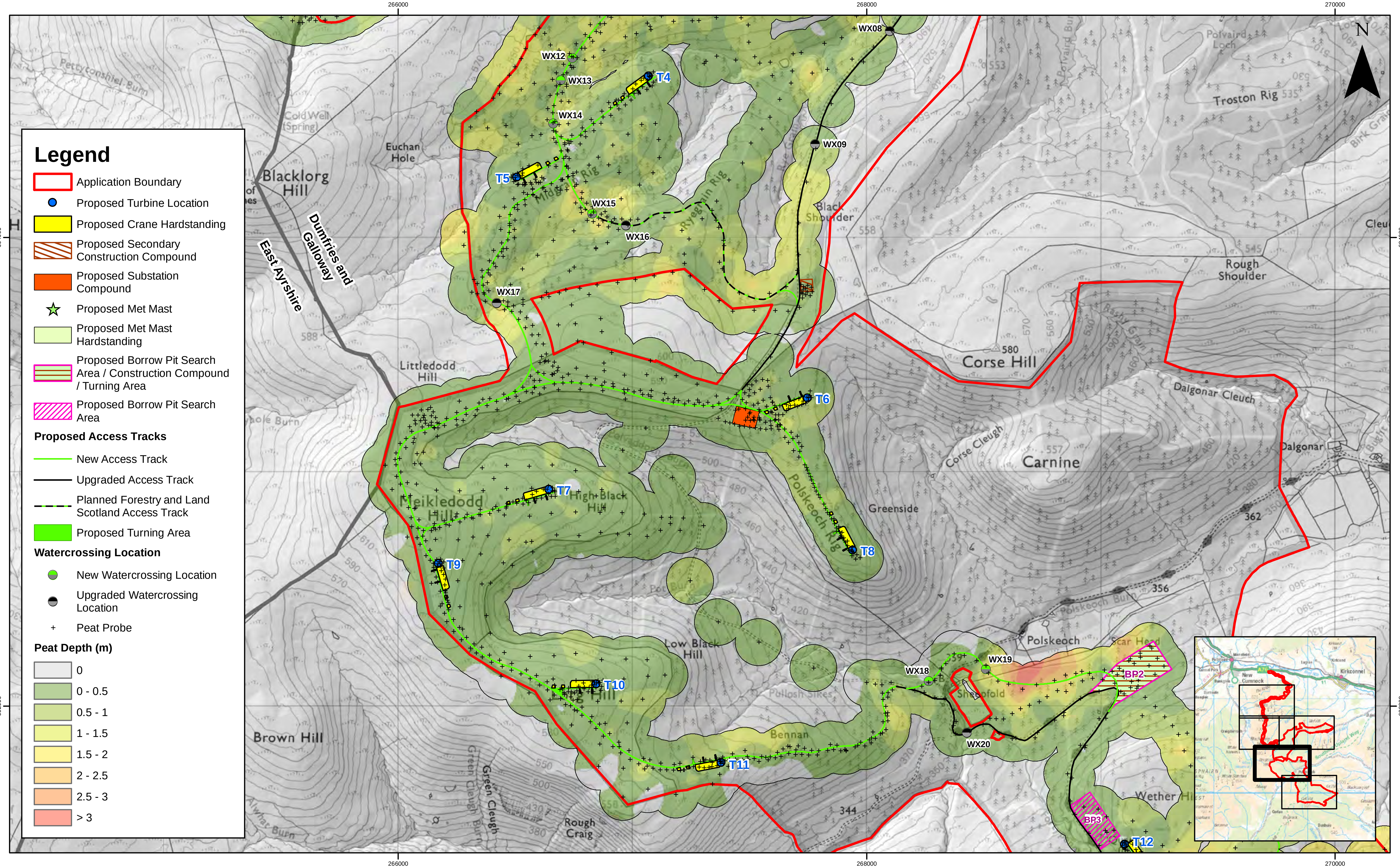

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Peat Management Plan

Peat Depth

Page 4 of 5

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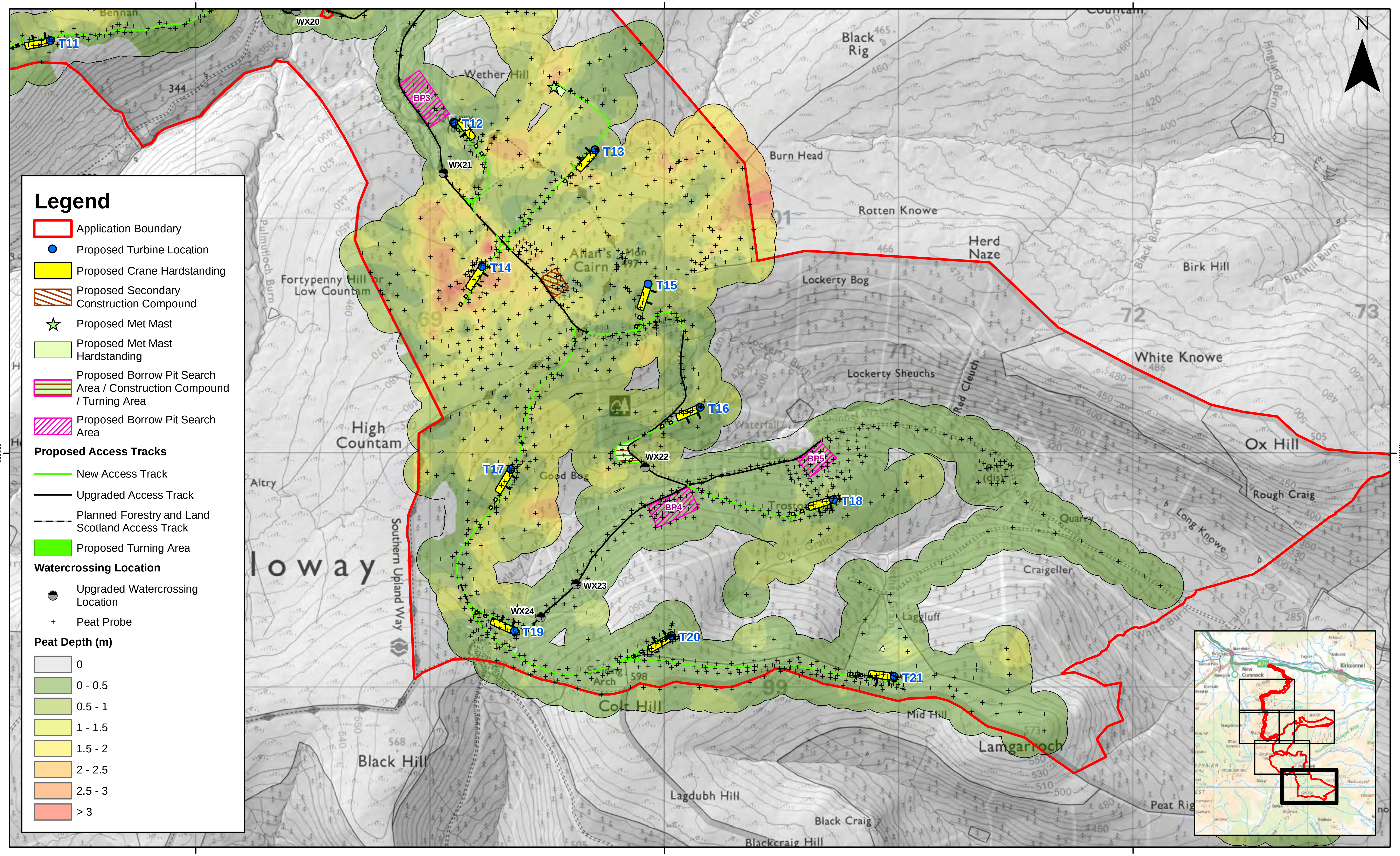

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Peat Management Plan

Peat Depth

Page 5 of 5

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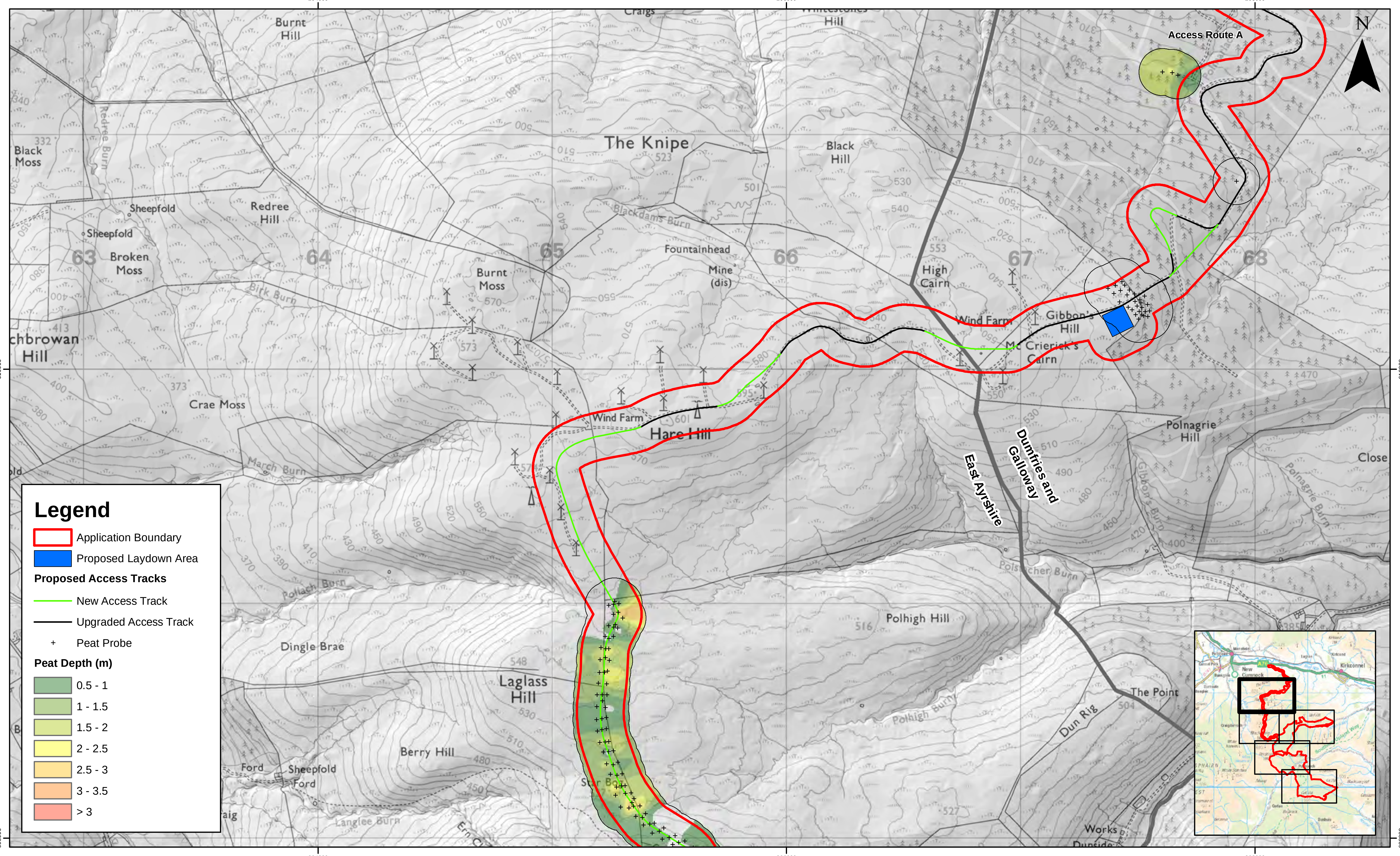

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Peat Management Plan

Peat Depth > 0.5m

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Figure	10.2.4.1

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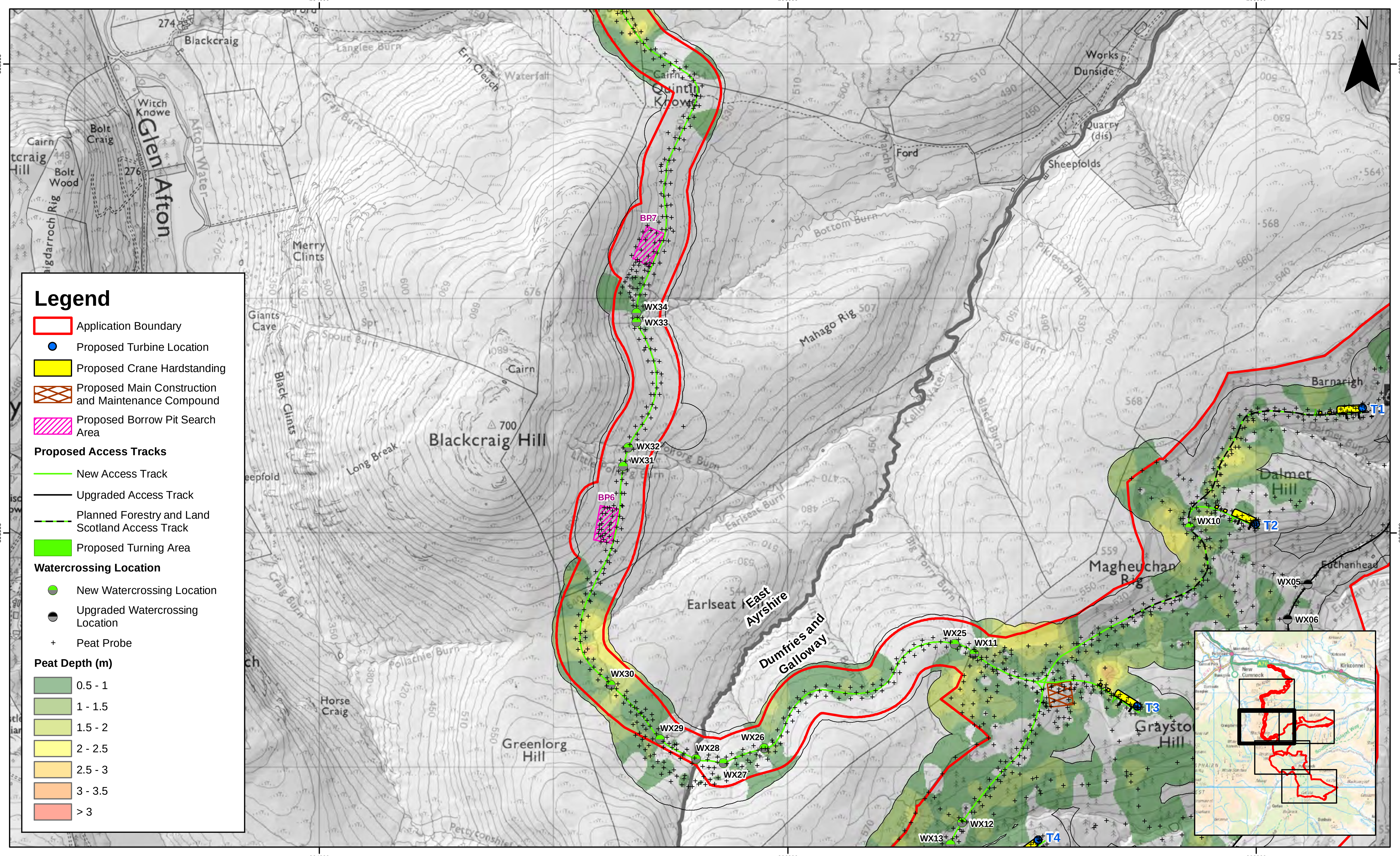

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Peat Management Plan

Peat Depth > 0.5m

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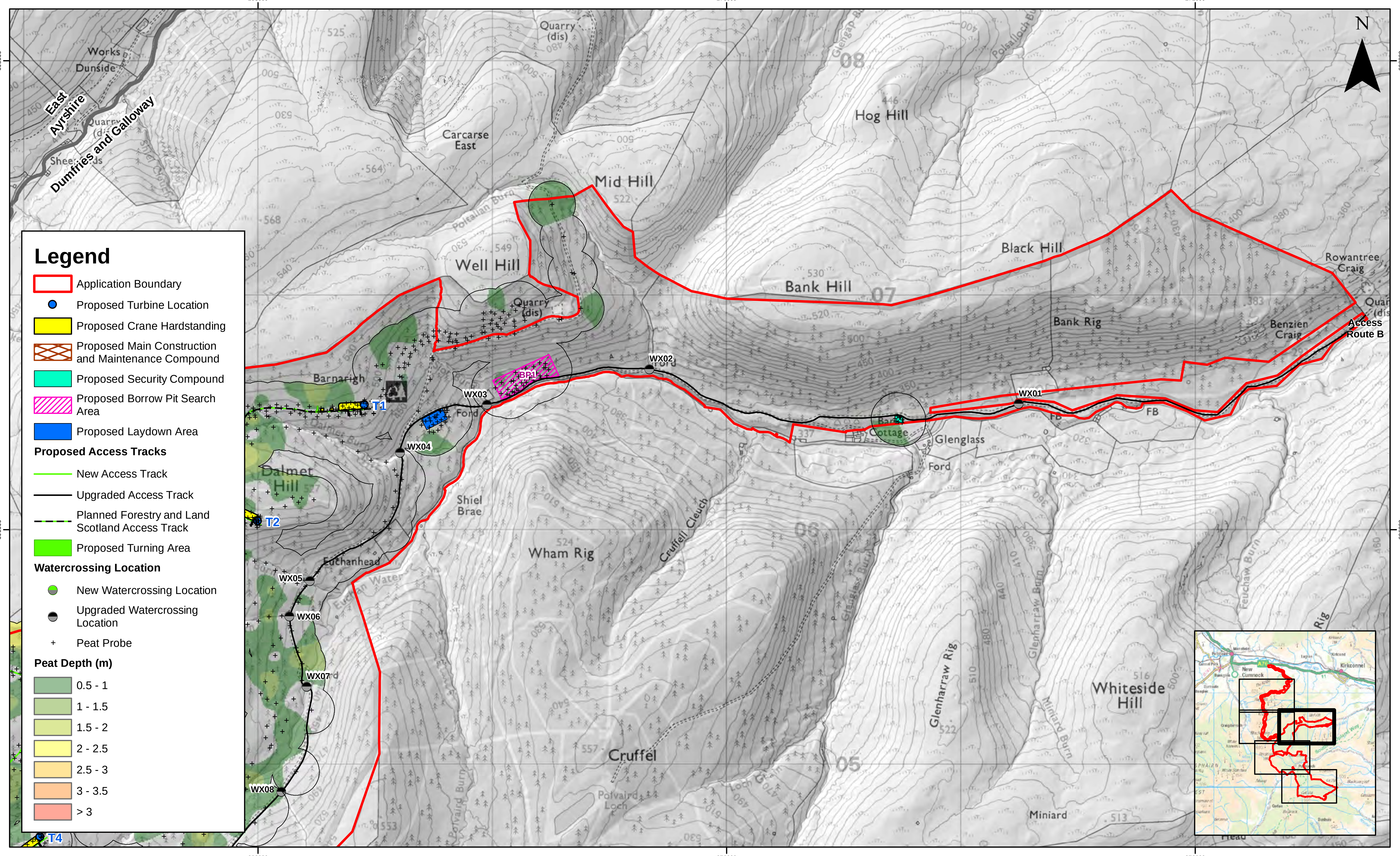

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Peat Management Plan

Peat Depth > 0.5m

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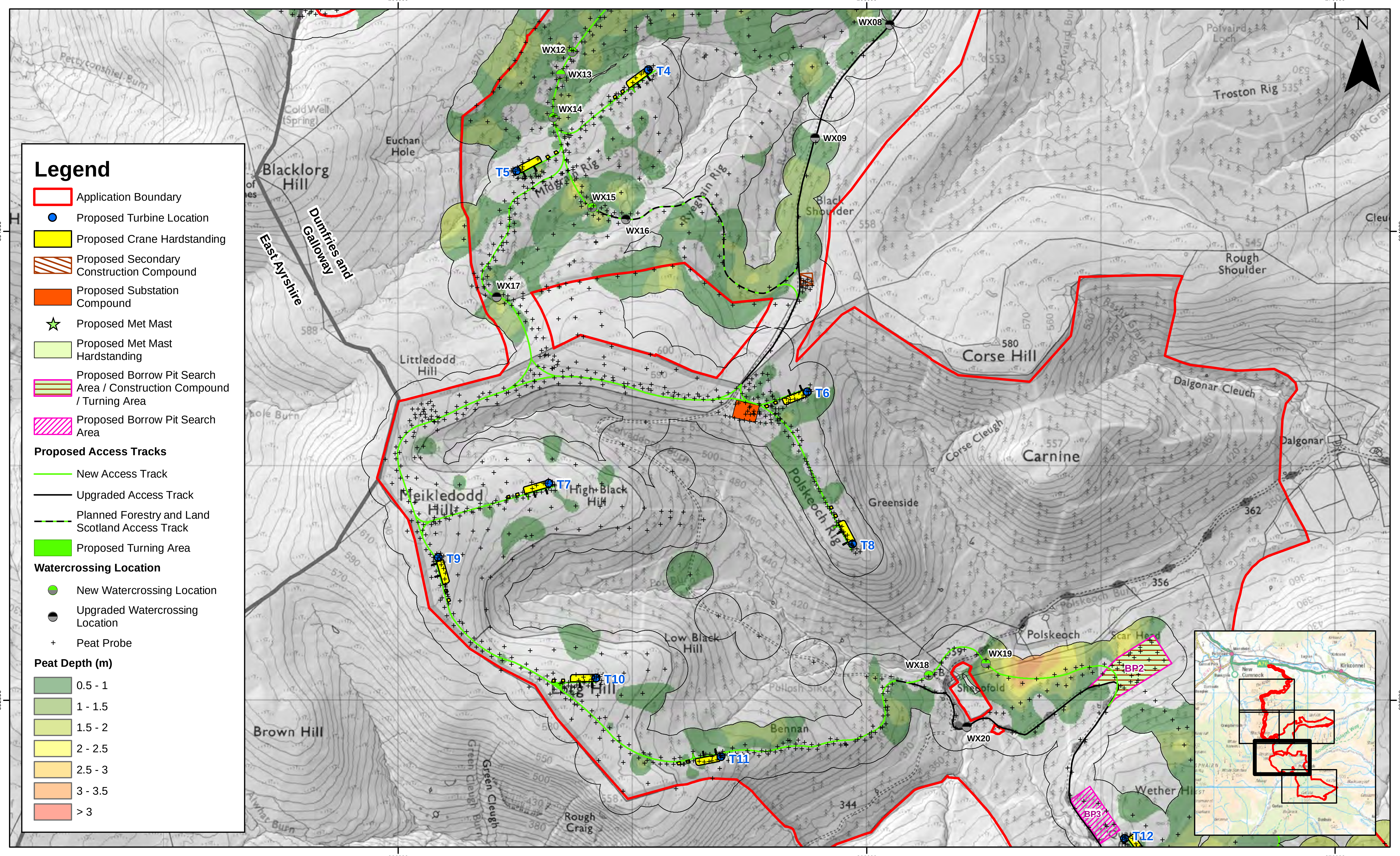

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Peat Management Plan

Peat Depth > 0.5m

Page 4 of 5

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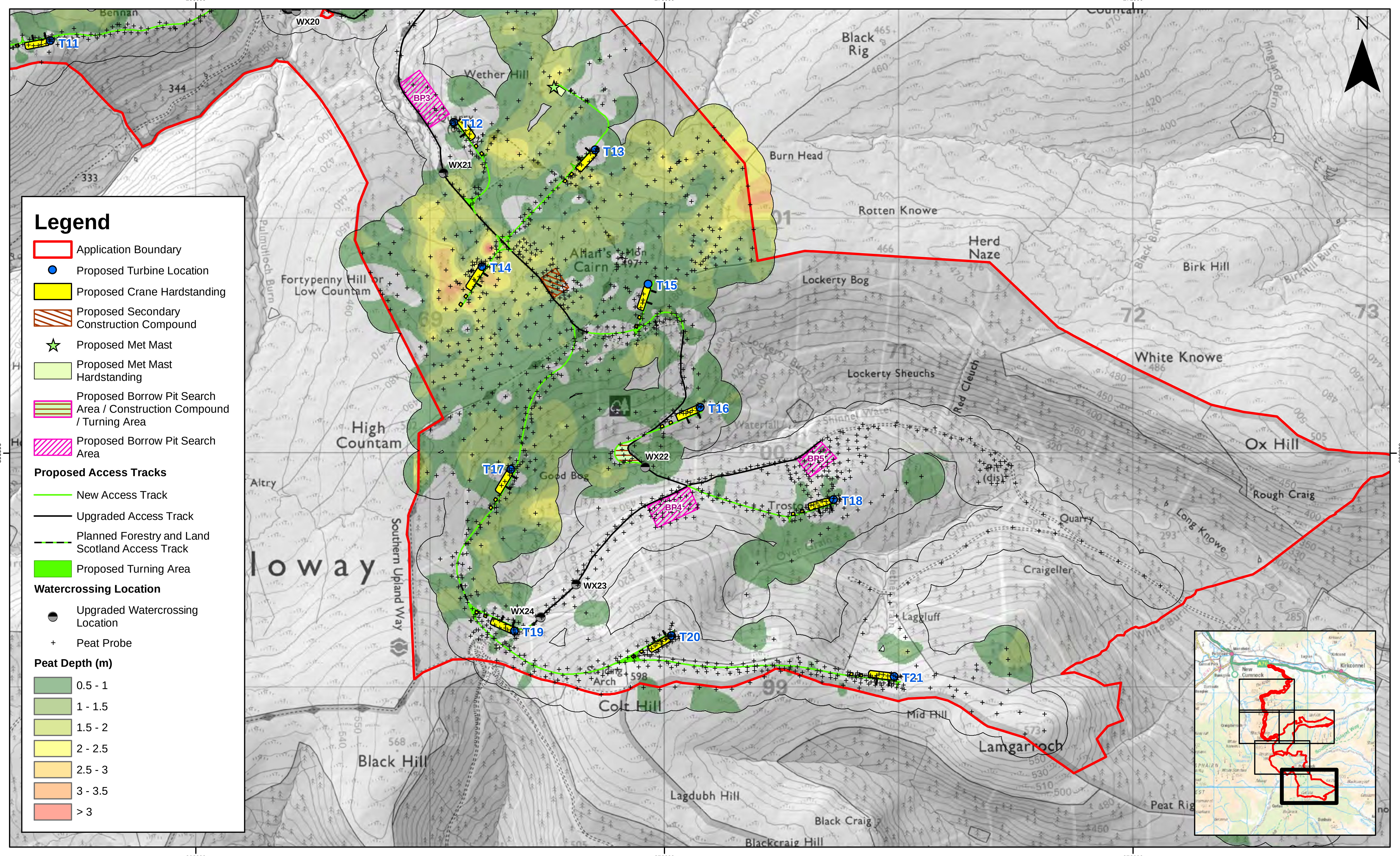

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Peat Management Plan

Peat Depth > 0.5m

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Figure	10.2.4.5	

APPENDIX A

MATERIAL VOLUME CALCULATOR

Infrastructure	Length (m)	Width (m)	Average Depth (m)	Number	Total Volume Excavated (m3)	Length (m)	Width (m)	Average Depth (m)	Number	Total Re-use Volume (m3)	Notes
Excavated Track (new)	29074.32	7	0.48	1	97690	29074.32	3	0.50	2	87223	
Existing Upgraded Track	19757.2	1	0.48	1	9483	19757.2	3	0.50	1	29636	
Floating Track (new)	3557.5	0	0.00	0	0	3557.5	3	0.80	2	17076	
Turbine Bases (Formation only)	38	38	0.48	21	14556	114	3	0.50	21	3591	
Crane Hardstandings	100	30	0.50	21	31500	160	2	1.00	21	6720	
Auxiliary hardstandings (crane pads)	12	12	0.50	42	3024	42	2	0.50	42	1764	
Auxiliary hardstandings (blade fingers)	20	4	0.50	42	1680	44	2	0.50	42	1848	
Turning Heads	30	5	0.48	16	1152	65	1	0.50	16	520	
Passing Places	70	4	0.48	60	8064	70	1	0.50	60	2100	
Substation, Control Building ansd ESC	100	75	0.37	1	2805	250	1	0.50	1	125	
Met Masts	30	20	0.38	1	227	80	2	0.80	1	128	
Laydown Area	100	50	0.07	1	365	100	50	0.07	1	365	
Main Construction Compound	100	100	0.28	1	2800	100	100	0.28	1	2800	
Construction Compound South	100	75	1.03	1	7725	100	75	1.03	1	7725	
Construction Compound North	50	50	0.23	1	575	50	50	0.23	1	575	
Borrow Pit 1	150	50	0.33	1	2466	150	50	1.00	1	7500	
Borrow Pit 2	120	50	0.31	1	1888	120	50	1.00	1	6000	
Borrow Pit 3	120	60	0.34	1	2445	120	60	1.00	1	7200	
Borrow Pit 4	170	100	0.40	1	6768	170	100	1.00	1	17000	
Borrow Pit 5	100	70	0.55	1	3850	100	70	1.00	1	7000	
Borrow Pit 6	100	60	0.35	1	2075	100	60	1.00	1	6000	
Borrow Pit 7	100	50	0.38	1	1900	100	50	1.00	1	5000	

Total Excavated Volume (m3)	203037
Total Re-use Volume (m3)	217896
Net Balance (m3)	-14859

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