North Lowther Energy Initiative:
Appendix 4.4
Soil and Peat Management Plan

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Document Control Sheet

Project Title	North Lowther Energy Initiative
Report Title	Soil and Peat Management Plan
Revision	2
Status	Final
Control Date	05/05/2017

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
1	Draft	M. Brennan	30/03/0217	S. Bone	04/04/2017	S. Bone	04/04/2017
2	Final	S. Bone	05/05/0217	S. Bone	05/05/2017	S. Bone	05/05/2017

Distribution

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1 Introduction

This report has been developed to provide additional information to *Chapter 7: Hydrology, Hydrogeology, Geology and Soils* of the ES for NLEI (Mouchel, 2017a) and should be read with reference to this chapter and associated figures.

NLEI Ltd. is applying for Consent under Section 36 of the Electricity Act 1989 for a 35 turbine windfarm located between Sanqhuar, Corsebank and Wanlockhead, Dumfries and Galloway (the Development). The Development is situated upon a number of fells, including Willowgrain Hill, and Brown Hill to the south, Conrig Hill to the west, Stood Hill and Glengaber Hill to the east, and Wedder Dod, Slough Hill and Clackleith Hill to the north. The fells of Well Hill and Tongue Hill are located within the centre of the Development Area. The Development Area is predominantly open moorland with areas of coniferous plantations in the north western areas. Within the Development Area there are numerous watercourse channels and a number of small artificial channels which are associated with conifer plantation and pastoral land drainage.

During initial investigations it was established that peat was present within the Development Area and further work was commissioned to establish peat characteristics, depths and extent.

In its regulatory position statement *Developments on Peat* (SEPA, 2010a), the Scottish Environment Protection Agency (SEPA) state that "*developments on peat should seek to minimise peat excavation and disturbance to prevent the unnecessary production of waste soils and peat*". This report examines the volume of soil and peat likely to be excavated during the construction process, and the potential for minimising excavation and identifying volumes for re-use. It is recognised that while re-use of any peat and soil during the construction process represents the preferred option, any such use should be carefully considered regarding risks to the environment or human health.

2 Scope of Work

During the construction phase of the project there will be a need to excavate peat and soil for infrastructure such as access tracks and turbine bases. Where there is not a defined use for this material during the construction process, excess material will be considered as waste and will need to be disposed of in accordance with regulatory requirements.

This report defines the likely excavation volume based on the Development's layout and dimensions and evaluates options to minimise excavated volumes and examines potential re-use strategies for excavated material. While there may be minor amendments to the site layout prior to construction i.e. micrositing, this strategy ensures appropriate plans for excavation, storage, re-use, and (if necessary) disposal of soil and peat have been considered in advance of the construction phase of the project.

Reference has been made to the following guidance documents during the development of this report:

- Promoting the sustainable re-use of greenfield soils in construction (Natural Scotland, 2010);
- Regulatory Position Statement – Developments on Peat (SEPA, 2010a); and
- Developments on Peatland Guidance – Waste (SEPA, 2010b).

3 Methodology

Excavated soil and peat management during the construction process falls into four main categories. These are as described below:

- Excavation – at the location of all site infrastructure, including tracks, turbine bases, hardstandings, substation and site compounds;
- Re-use – including backfilling around turbine bases and trackside banking. There may be options for further re-use of excavated material on-site;
- Storage – limited to the short term storage of excavated material before re-use; and
- Disposal – where there is an excess of excavated material following reasonable opportunities for re-use in line with good practice, there may be a need for disposal of that material to a licensed waste facility.

Volumes are generally quoted to the nearest 100m^3, in recognition that the numbers used are in many cases estimates based on professional judgement and design data available..

Peat probing is a 'blind' exercise and determines the depth of soils through which a probing rod will travel. It is not possible to confirm the nature of these soils other than by intrusive investigation, such as coring or trial pitting, which would form part of the pre-construction ground investigation.

Soil mapping of the Development Area suggests the majority of the site is covered by peat-containing soils such as peaty podzols and peaty gleys, with limited extents of blanket peat. Non-calcareous gleys, humus-iron podzols and brown forest soils are also present as per information in ES Chapter 7 Chapter 7 also provides evidence that priority peatland areas are limited on this site, with Importance Category 1 limited to distinct upland areas, often on highest ground. A proportion of the sub-soils may therefore be suitable as a base on which to lay aggregate for construction of hardstandings and access tracks, thus reducing the requirement to excavate material. The values calculated are therefore considered to be a combination of soil types, including peat. Catotelmic peat is considered in a distinct section below.

The Soil Survey of Scotland (MLURI, 1982) and Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments (Scottish Government, 2006), both indicate a minimum depth for soil to be defined as peat of 0.5 m.

3.1 Excavation

Peat depths applied to this report are based on a combination of actual probing data or estimated from the indicative peat depth map, ES Figure 7.5, with methodology and further details provided in Appendix 7.2 - Peat Stability Assessment (Mouchel, 2017b).

The estimation of volume of excavated material includes all soil types, based on site characteristics, a substantial proportion of this material will not be peat, as discussed in the section above.

Site probing provides evidence that the majority of the site has shallow soil cover, using a dataset of 2,607 peat probes, 64% of probing locations recorded depths of less than 0.5 m (emphasising that a minority of soils within the Development Area would not be considered to be peat based on the 0.5 m depth-based definition), 94% less than 1.0 m and an average depth of 0.44 m. Within 25m of the new track infrastructure, there are 999 probing records, which include turbine bases and hardstandings, with the average probe depth being 0.50 m, which includes floating track sections. Locations adjacent to the existing track for upgrade were generally shallower at 0.24 m.

The layout of the windfarm and dimensions of infrastructure are presented within Chapter 4 (Scheme Description) of the Environmental Statement.

Initial excavation estimates for access tracks, turbine bases, hardstandings, construction compounds and other identified infrastructure were developed in a spreadsheet to provide a total excavated volume. A refinement exercise was then carried out to revise the initial estimates and identify good practice opportunities to minimise the excavated soil and peat volumes.

3.2 Re-use

The initial estimation of the volume of excavated soil and peat that can be re-used during construction was very conservative and limited to backfilling the batter areas around turbine bases and hardstandings and use of small bankings either side of access tracks.

By using an iterative approach, values have been refined to generate volumes of material where there is clearly identified and quantified potential for additional re-use.

Consideration is also given to the use of excavated material on site for habitat restoration and landscaping of the site.

3.3 Storage

Storage considerations relate to short term storage and segregation of excavated material identified for re-use on site, typically it would be expected that such material would be re-used nearby and within 6 weeks of excavation. At all times the volume and duration of storage will be minimised.

This report does not include long term material storage, e.g. for decommissioning purposes, as none is proposed or required.

3.4 Disposal

Should there be an excess of excavated material or material unsuitable for re-use, disposal options will be explored and recommendations made as to the potential disposal routes for any such material.

4 Results

In this section, calculated values for excavation and re-use, review of the data and layout, and discussion of the re-use volumes is detailed for each infrastructure type. The results are summarised in Table 1, at the rear of this document.

4.1 Access Tracks

Access tracks comprise a total length of approximately 36km, with the majority of tracks being new 'cut and fill' type due to the typically shallow soil depth (average depth of 0.50 m within 25 m of centrelines of all track types). This technique requires excavation of surface deposits and backfilling with aggregate to produce a final track level at, or close to, the existing surface level.

There are some existing track sections requiring upgrade/widening and also 3 relatively short sections of floating track, planned in areas where deeper peat was encountered.

Track types and routes are displayed overlying aerial photography and peat depth mapping on ES Figures 7.1 and 7.5, respectively.

Dimensions – Cut and Fill Track

Typical track construction information for cut and fill tracks is provided in Chapter 4 (Scheme Description) and associated drawings of the Environmental Statement for the North Lowther Energy Initiative Wind Farm. A standard running width of 5 m for cut and fill tracks is indicated in this figure. Associated with this will be verge/shoulders at each side of approximately 1.0 m at either side of the track. Cut and fill sections of track will also have a ditch of approximately 0.5 m on both sides, giving a total excavated width of 8 m for these standard cut and fill tracks.

Where existing tracks are to be upgraded/widened, this track has been assumed to require a 4.0 m excavation to widen the running width and include equivalent sized shoulders and ditch to the standard design to one side.

The track positioning has taken account of constraints mapping, avoiding areas of deeper peat, wherever practicable. To provide additional depth information, specific to the cut track locations, analysis was undertaken to identify the average peat depth within 25 m of the planned new cut track routes, excluding floating track and existing track sections; from 955 records the average depth is 0.46 m. The equivalent average depth for the existing track to be widened is 0.24 m.

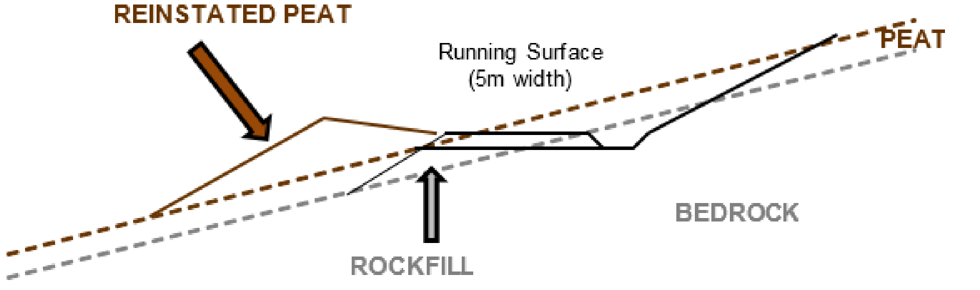
Using mean averages for the 32.47 km (rounded to nearest 0.01 km) of new excavated track and 3.08 km of widened existing track gives an initial estimated excavation combined volume of 122,400 m^3.

Assuming a narrow triangular profile bank at either side of the track of 1.75 m width and 1.0 m height for the cut and fill tracks, the estimated re-use of excavated material for new track and widened existing track (to one side only) is 59,500 m^3.

The depth of excavated material at the shallow cut track locations is likely to be less than that initially assumed because either the full depth or a proportion therein will be suitable for access track construction. It is considered that achieving a 0.1 m improvement in soil depth is feasible for cut track locations, given that the average value includes all depth records within 25 m of the new cut track centreline. Note that the existing track requiring widened will not have the opportunity for such improved positioning as is dictated by the present alignment. Taking account of this reduced excavation requirement, the new cut track excavated volume would reduce by 25,900 m^3 to 96,500 m^3.

The use of excavated material for reinstatement and/or landscaping will not be uniform across the site, and experience of other similar projects has shown that substantial volumes of excavated material may be necessary for reinstatement and/or landscaping for banking downslope of cut and fill tracks where these traverse a hillside, as occurs on this site, as shown on Illustration 1.

Illustration 1. Cross-gradient cut and fill track construction



For this type of construction, the quantity of excavated material required for landscaping of the downslope banking varies with the cross slope angle. The extent of downslope banking required may be substantial. The re-use of peat and soil on the disturbed ground immediately adjacent to the track corridor is considered pragmatic. Assuming a revised larger average bank at either side of the track of 3.5 m width (retained at 1.0 m in height) for the cut and fill tracks, the potential estimated re-use of excavated material is increased to 119,000 m^3.

Note that cables are assumed to follow site tracks and any excavation would be included within the site track values, cables conduits tend to be recovered to same depth as excavated and hence would be anticipated as net zero values with regard to peat volume calculations.

Dimensions – Floating Track

Typical track construction for floating tracks information is provided in Chapter 4 (Scheme Description) and associated drawings of the Environmental Statement for the North Lowther Energy Initiative Wind Farm. It is anticipated that 0.94 km of floating track is required, with a running width of 5 m.

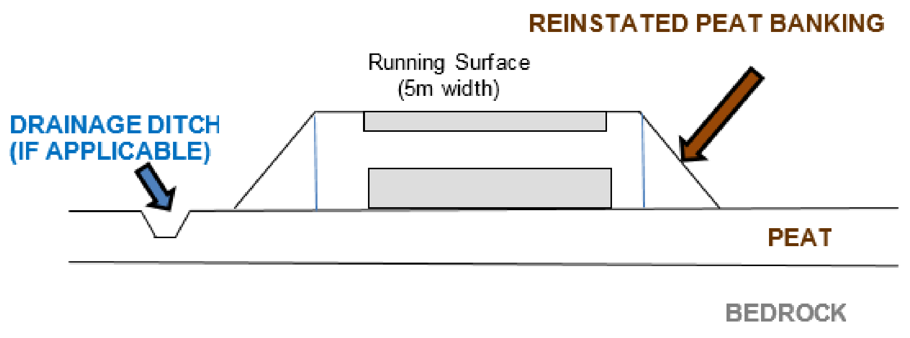
Illustration 2 shows that volumes of peat may be necessary for reinstatement and/or landscaping for both exposed bankings. Note that no soil or peat is planned to be excavated during construction of the floating track and no adjacent drainage ditches are planned at this site. There are 3 distinct track sections identified for floating track construction, determined by peat depth data, these are located between T20-T21 (570 m length section), to the south west of T22 (130 m length section) and between T32-T33 (240 m length section). Each of these areas are discussed further in the Catotelmic Peat section, later in this report.

Use of floating track techniques will require pre-construction confirmation of suitability at each location suggested, taking account of cross-slope and other local factors. Guidance for this is available in the Floating Roads on Peat guidance document (Scottish Natural Heritage and Forestry Civil Engineering, 2010).

It is envisaged that when using excavated materials for track banking reinstatement, that acrotelmic peat material or other excavated soils with reasonable engineering properties will be used to provide a stable surface.

Assuming that both banks are 1.75 m wide and 1.0 m above the surrounding surface, this equates to approximately 1,600 m^3 of re-used material for the 0.94 km of floating track.

Illustration 2. Schematic of floating track construction



4.2 Turning Heads

It has been determined that a number of turning heads shall be required to enable safe delivery and installation of site equipment, particularly turbine components.

Each turning head is located perpendicular to the access track and information provided by the civil engineering design team indicates an individual surface area of 1,422 m^2. The average soil depth for the turning heads is 0.46 m, with the range of average results at each location from 0.2 - 0.73 m.

With 19 planned turning heads across the site, the combined volume of excavated material is estimated as being 12,400 m^3. It is not anticipated that there is potential for minimising excavation or re-use of material, as this infrastructure requires to be retained for maintenance purposes through the operational phase.

Should there be the potential to re-use excavated material for some of the turning heads and/or reduce size, this would provide an appropriate re-use of excavated material and/or minimise excavation. This will be considered further at the pre-construction stage.

4.3 Passing Places

It has been determined that a number of passing places shall be required to enable safe delivery and installation of site equipment, particularly turbine components.

Each passing place is located parallel to the access track and information provided by the civil engineering design team indicates an individual surface area of 374 m^2. The average soil depth for the turning heads is 0.42 m, with the range of average results at each location from 0.15 - 0.73 m.

With 16 planned passing places across the site, the combined volume of excavated material is estimated as being 2,500 m^3. It is not anticipated that there is potential for minimising excavation or re-use of material, as this infrastructure requires to be retained for maintenance purposes through the operational phase.

Should there be the potential to re-use excavated material for some of the passing places and/or reduce size, this would provide an appropriate re-use of excavated material and/or minimise excavation. This will be considered further at the pre-construction stage. .

4.4 Turbine Bases

Construction of the 35 turbine bases requires excavation to a suitable load-bearing layer. Chapter 4 (Scheme Description) and associated drawings of the Environmental Statement for the North Lowther Energy Initiative Wind Farm, identifies the turbine base foundation as 28 m diameter. The excavation area required to facilitate construction is estimated to be 30 m x 30 m and will be backfilled with aggregate and reinstated with excavated material to the previous ground surface level. This includes an adjacent 'batter area' surrounding each turbine.

The initial excavation estimate uses actual probing data, giving an average depth at the turbine bases of 0.50 m and an estimate for total excavated material of 13,200 m^3 across 35 turbine bases.

Assuming excavated material will be re-used for reinstatement of the turbine batter areas, the initial estimated re-use of excavated material is 1,900 m^3 (equivalent to approximately 54 m^3 at each of the 35 turbine foundations).

Re-covering the turbine bases to a depth of 0.50 m will result in 10,900 m^3 additional re-used material (311 m^3 at each of the 35 turbine foundations).

T7, T20 and T35 are located in peat depths greater than 1.0 m, if micrositing allows and taking account of other constraints, by relocating to known shallower depths nearby would reduce the potential excavation requirements. This will be considered further at the pre-construction stage when detailed Ground Investigation findings are available.

4.5 Crane Hardstandings

The crane hardstandings associated with the turbine bases are required for supporting lifting equipment. These are created by excavation to suitable load-bearing layer and backfilling the excavation with aggregate to form a stable surface from which construction activities can be carried out.

The proposed dimensions for crane hardstanding associated with each turbine are 62.5 m by 25 m, as per Chapter 4 (Scheme Description) and associated drawings of the Environmental Statement for the North Lowther Energy Initiative Wind Farm. It has been assumed that all hardstandings will be excavated, with the excavation dimensions being 67.5 m x 30 m, with no floating type construction and that the hardstanding will have one edge adjacent to the associated turbine base.

The assumption for soil / peat excavated at hardstandings was based on peat probing data, giving an average peat depth of 0.54 m and a total excavated volume of 34,000 m^3 for 35 hardstanding areas, including surrounding batter area. These batter areas surround the hardstanding and extend the overall excavation size to 67.5 m x 30 m, representing an additional 462 m^2 of surface area per hardstanding, which will be partially backfilled with excavated material, resulting in re-use of 4,400 m^3 across the site.

If micrositing allows and taking account of other constraints, relocation of the hardstandings positioned in peat depths greater than 1.0 m should be considered (hardstandings adjacent to T6, T20 and T33), by relocating to known shallower depths nearby this would reduce the potential excavation requirements. This will be considered further at the pre-construction stage when Ground Investigations findings are available.

4.6 Substation

The proposed location of the substation is 350 m north east of Turbine 28. For the purposes of the report it has been assumed that all peat / soil will be excavated at the substation location. Based on Chapter 4 (Scheme Description) and associated drawings of the Environmental Statement for the North Lowther Energy Initiative Wind Farm, the proposed dimensions for the substation are 100 m x 60 m, giving an area of 6,000 m^2, when taking into account a surrounding batter area, this footprint becomes 105 m x 65 m. Peat probing at the location of the substation provides an average depth of 0.5 m giving an estimated excavated volume of 3,200 m^3.

Approximately 500 m^3 of material will be re-used for reinstatement around the edges of the constructed substation.

4.7 Temporary Site Construction Compounds

There are 5 temporary site compounds planned for the project, based on design information from Chapter 4 (Scheme Description) and associated drawings of the Environmental Statement for the North Lowther Energy Initiative Wind Farm, the proposed dimensions of the 2 larger compounds are 120 m x 60 m, with an individual footprint including batter area of 8,125 m^2. There are also 3 smaller satellite compounds of 50 m x 40 m, with an individual footprint including batter area of 2,475 m^2. The compounds are distributed across the development area. For the purposes of the report it has been assumed that all peat/soil will be excavated at each compound location.

The average peat depth at the larger compounds was 0.38 m, giving an estimated excavated volume of 5,800 m^3.

The average peat depth at the smaller compounds was 0.53 m, giving an estimated excavated volume of 3,600 m^3.

The construction compounds will be fully reinstated to original depth, thus reusing 9,400 m^3 of material.

4.8 Borrow Pits

Details of the proposed borrow pit locations are provided in Appendix 4.1, Borrow Pit Assessment (Mouchel, 2017c).

A total of 5 borrow pits are proposed for the North Lowther Energy Initiative, each of these borrow pits are located in areas with shallow surface deposits (overburden):

- BP01, from Access A, on track approach to T32, footprint of 10,140 m^2, with mean overburden depth of 0.17 m;
- BP02, from Access A, on track approach to T31, footprint of 16,290 m^2, with mean overburden depth of 0.27 m;
- BP03, from Access B, on existing forest road, footprint of 10,083 m^2, with mean overburden depth of 0.20 m;
- BP04, from Access B, on existing forest road, footprint of 4,745 m^2, with mean overburden depth of 0.17 m;
- BP05, from Access B, on existing road, footprint of 5,603 m^2, with mean overburden depth of 0.25 m;
- The total proposed footprint of the borrow pits on the site is approximately 46,900 m^2.

The overburden is very shallow and hence is not anticipated as peat, it is likely to contain a mix of aggregate and peat-containing soils. The combined overburden excavation volume is 10,300 m^3.

Restoring the borrow pit footprints with excavated material provides a re-use purpose, with most borrow pits planned to be fully restored and BP02 being restored for 75% of footprint to retain potential for future extraction for maintenance of tracks etc. If reinstated to their baseline respective depths (equivalent to the removed overburden), this would balance the excavated volume at the borrow pits by reusing 9,200 m^3, assuming BP02 is not fully restored, with any deeper reinstatement providing the potential to usefully re-use additional material, such as for habitat creation.

Each additional 0.1 m of material required for reinstatement / reprofiling of the borrow pits equates to a further 4,280 m^3 of re-used material. Thus, an average reinstatement depth of 1.0 m would equate to 42,800 m^3 of re-used material.

Any reinstatement depths greater than 1.0 m would be anticipated to involve discussion of rationale and engineering techniques with SEPA.

5 Storage and Soil Management

This section focuses on temporary storage of peat and soil on site during the construction phase.

5.1 Management of Excavated Peat and Soils

It is expected that prior to construction commencing, in accordance with the Construction and Decommissioning Environmental Management Plan (CDEMP), the contractor will provide a plan detailing potential locations for temporary storage and an outline programme indicating the duration and quantity of stored peat and measures to mitigate and/or capture sediment runoff from stored material. At all times the primary objectives shall be to minimise both the time and volume of temporary storage and to prevent sedimentation of any watercourse or waterbody. Where practical, excavated peat shall immediately be used locally for reinstatement and/or landscaping.

Good practice methods include careful removal of vegetated turves, short timescales between lifting and replacement of turves (with a 6 week reinstatement objective) and ensuring stored turves are kept in good condition (including watering when weather conditions could lead to desiccation). Revegetation of bare soil with native vegetation will be undertaken as soon as practicable. Excavated material would be re-used as close to excavation location as practicable and as soon as possible.

- The scheme would follow standard good practice with regards to soil/peat storage (CIRIA, 2006) and provided in Appendix 4.: CDEMP. This would include temporary storage of materials at a minimum distance of 10 m from any watercourses and 50 m from any watercourse identified on Ordnance Survey 50,000 scale mapping, with soil mounds no higher than 2 m and with stable banking. Specific details on catotelmic peat management are provided separately below.
- Elements of the management and re-use of excavated material may require approval from statutory stakeholders, including SEPA, taking account of reducing erosion/compaction, protecting the soils from pollution and retaining/enhancing soil functionality as a resource.

5.2 Re-use for On-Site Habitat Management and Landscaping

Locally excavated peaty podzols and peaty gleys could be used to aid habitat management and landscaping of the site, in particular those areas where coniferous forestry will be removed. Soil mapping suggests that these soil types dominate the development area, as provided in ES Chapter 7.

This potential re-use option has not been quantified but would provide an additional method to retain and beneficially re-use material on site if required.

5.3 Amorphous Catotelmic Peat

Peat is a soft to very soft, highly compressible, highly porous organic material which can consist of up to 90% water by volume. Unmodified peat typically has two layers, a surface layer or acrotelm which is often considered to be 0.1-0.3 m deep, highly permeable and receptive to rainfall. The acrotelm layer generally has a high proportion of fibrous material and often forms a crust under dry conditions. The second layer, or catotelm, lies beneath the acrotelm and forms a stable colloidal substance which is generally saturated and acts as an impermeable layer. As a result, the catotelm usually remains saturated with little groundwater flow. Within the catotelmic peat there can be amorphous material, which is a key concern in terms of site environmental management.

Due to the inherent lack of structure in amorphous catotelmic peat, which often displays liquid rather than solid physical properties, it is more difficult to manage and successfully re-use when excavated. Thus, site design should seek to avoid excavating such material in the first instance, but where there is a requirement to excavate deeper peat, it is important to establish the likely volumes of amorphous catotelmic peat in a pragmatic manner in order to apply practicable measures to minimise adverse effect on this material.

The split between excavated acrotelmic and catotelmic peat is difficult to precisely quantify, where a variety of topographic and peatland features are present, such as at this site, the amorphous catotelmic threshold depth is likely to vary widely across short distances and amorphous catotelmic peat may not always be present within the peat-containing soil structure.

As aforementioned, within 25m of the new track infrastructure, there are 999 probing records, which include turbine bases and hardstandings, with the average probe depth being 0.50 m, 77% of depth records were less than 1.0 m, 90% were less than 1.5 m. With such shallow peat depths confirmed at the infrastructure locations, it is unlikely that the conditions necessary for amorphous catotelmic peat to be present are commonplace.

Based on peat depth surveys and site characteristics noted in Appendix 7.2 Peat Stability Assessment (Mouchel, 2017b) and also taking account of soil mapping suggesting site coverage is mainly peaty podzols from ES Chapter 7 rather than blanket peat, there were few locations where amorphous catotelmic peat would be anticipated where infrastructure is planned. The most likely locations are where deeper peat was recorded, with the most probable location being the ‘saddle’ on the ridge between the summits of Slough Hill and Reecleuch Hill in the northern area of the site, midway between T32 and T33, shown on Photograph 1. At this location, soil mapping suggests blanket peat is present with site observation confirming this, multiple depth records were deeper than 2.50 m, with a maximum depth of 4.02 m recorded. An extensive peat survey has been undertaken at this location and established that deep peat in this ridge area, which is surrounded by steep slopes, is unavoidable for an access route due to combination of topography and site ownership boundary. Other locations considered to have a strong likelihood of amorphous catotelmic peat underlie the track planned to the east of Back Burn on the south west slope of Duntercleuch Rig and the track planned between T20 and T21 on the northern flanks of Highmill Knowe, both in the central area of the site. At all three of these track locations the intention is to use floating track technique to minimise peat excavation, which will be subject to pre-construction geotechnical confirmation of suitability with regard to local conditions, including cross-slope angle.

Peat depth records at T7 (and adjacent hardstanding), T20 (and adjacent hardstanding) and T35, plus specifically the hardstandings adjacent to T6 and T33 all have depth records greater than 1.0 m, which suggest a greater probability of the conditions necessary for amorphous catotelmic peat being present. Therefore, these areas are also highlighted and opportunities for pre-construction micrositing of turbines and hardstandings will be considered as ground investigation data becomes available.

In order to assist in establishing the sensitivity of the amorphous catotelmic threshold depth in determining likely excavation volumes of catotelmic peat, a set of three nominal catotelmic depth values have been determined to enable comparison at depths of 0.3 m, 0.5 m and 1.0 m. These results are presented in Table 3, at the rear of this document.

A threshold value of 1.0 m depth for amorphous catotelmic peat has been suggested as a generally accepted value by SEPA in the published waste guidance related to peatland (SEPA, 2010b). Given soil map evidence and local characteristics across the large site area, it is likely that applying the 1.0 m threshold value is reasonably precautionary and potentially still overestimates amorphous catotelmic peat conditions that would require excavation below infrastructure. Application of a threshold depth of 1.0 m for amorphous catotelmic peat leads to an estimation of 1,800 m^3 of this excavated material.

Such disparity in volumes shown on Table 3 between these amorphous catotelmic threshold depth scenarios provides evidence of the importance of further micrositing activities during construction to shallowest possible locations in order to both reduce the overall volume of excavated material and reduce the more onerous handling and re-use issues associated with amorphous catotelmic peat. Locations where amorphous catotelmic peat is most likely to be present are the areas where infrastructure has been largely avoided, or as aforementioned, floating tracks are planned to avoid excavation. As we increase the threshold depth for amorphous catotelmic peat, the turbines and particularly the crane hardstandings become the locations of greatest potential, therefore any modifications to these locations or reductions in excavation requirements during construction would be likely to provide notable benefit.

Should amorphous catotelmic peat be identified during pre-construction or construction activities, this material should be reported and consideration should be given to relocating infrastructure or use of alternative methods of construction to reduce excavation. If necessary to excavate such material, provisions should be made to re-use this material rapidly, in close proximity and for appropriate purposes. Handling via plant equipment and transportation is likely to lead to loss of structure and the material becoming more susceptible to stability failure or increasingly subject to wind or water erosive forces. Amorphous catotelmic peat should be laid under acrotelmic peat, with associated vegetation encouraged to regenerate above. Confirmation of acceptable re-use of amorphous catotelmic peat from stakeholder bodies should be sought at the pre-construction stage and built into construction phase environmental and waste management plans.

Photograph 1. Track route proposed between Slough Hill and Reecleuch Hill (T32-T33) will pass through mid-ground of this image (‘saddle’ area), taken from NGR 28496 61671 facing north east

5.4 Decommissioning

No decommissioning phase storage has been evaluated or quantified in this report, in keeping with previous consultation with SEPA representatives for similar projects.

5.5 Disposal

It is anticipated that by considering the various discussed techniques and applying these at appropriate locations all of the excavated site material can be re-used and no disposal will be required.

In the event that there is an excess of excavated material, application of additional options at the detailed design and construction phases will be required, as outlined above, in order to avoid off-site disposal. Furthermore, if no site use is available, off site re-use options should be explored, with appropriate disposal as waste considered only as the final option, in line with the "waste hierarchy" (SEPA, 2013) and discussion with SEPA.

6 Summary and Conclusions

This report identifies a number of areas of excavation, reinstatement and re-use around infrastructure to be carried out during construction. It is recognised that there is a degree of professional judgement involved in quantified assumptions, with volumes presented in Table 1, at the rear of this document.

There are a number of opportunities, as identified in the text above and summarised in Table 2, at the rear of this document, to reduce the extent of excavation and/or increase the extent of re-use opportunities as good practice measures. These include:

- Reducing excavation depth and footprint required for site infrastructure;
- Appropriate re-use of excavated material for reinstatement and profiling of track verges on disturbed ground;
- Re-covering turbine bases; and
- Appropriate re-use of excavated material to reinstate and / or reprofile borrow pits to 1.0 m depth.

Applying the reasonable assumptions discussed in sections above, summarised in Table 1 and Table 2, indicates sufficient re-use opportunities as per the 'Revised Estimate Balance' column to demonstrate re-use potential exceeds estimated excavated volume by approximately 9,000 m^3.

Should there be the potential to re-use excavated material for some of the turning heads or passing places and/or reduce sizes of these, this would further improve the excavation:re-use balance.

Note that no import of soil would be anticipated, with re-use matching excavated volume across the Development Area. All excavated material shall be re-used nearby and in as short a timeframe as is feasible during the construction phase.

Amorphous catotelmic peat issues are described in the section above and volumes are summarised in Table 3, at the rear of this document, including estimates at 1.0 m threshold depth. Amorphous catotelmic material is anticipated to be limited to very few site locations, identified in the amorphous catotelmic peat section above. The use of floating track techniques for 3 sections of new access track will further reduce potential for excavating this material, with the excavations required in areas adjacent to T6, T7, T20, T33 and T35 highlighted as locations where further micrositing could improve depths and reduce potential excavation. Due to the iterative design process using peat constraint maps and application of floating tracks, amorphous catotelmic material is unlikely to be found in large quantities below infrastructure and the application of a 1.0 m threshold for these calculations takes a reasonably precautionary approach, given the particular peatland conditions present on this site and leads to an estimate of 1,800 m^3 of amorphous catotelmic material arising. Should such material be found during pre-construction trial pits or excavation, relocating infrastructure or alternative methods of construction should be considered in order to retain catotelmic material *in situ*.

Pre-construction it would be recommended to undertake a series of trial pits at excavation locations to enhance understanding of infrastructure-specific soil conditions and potentially further improve the iterative design, this study should include determination of amorphous catotelmic material and also enable sample collection for laboratory analysis.

Table 1. Volume Estimates for Excavation and Re-use of Soil / Peat (to nearest 100 m^3)

Infrastructure Description	Initial Estimate (m^3)			Revised Estimate (m^3)		
	Excavation	Re-use	Balance	Excavation	Re-use	Balance
Access Tracks	122,400	61,100	61,300	96,500	120,600	-24,100
Turning Heads	12,400	0	12,400	12,400	0	12,400
Passing Places	2,500	0	2,500	2,500	0	2,500
Turbines	13,200	1,900	11,300	13,200	12,800	400
Crane Hardstandings	34,000	4,400	29,600	34,000	4,400	29,600
Substation	3,200	500	2,700	3,200	500	2,700
Large Temporary Construction Compounds	5,800	5,800	0	5,800	5,800	0
Small Temporary Construction Compounds	3,600	3,600	0	3,600	3,600	0
Borrow Pits	10,300	9,200	1,100	10,300	42,800	-32,500
Total	**207,400**	**86,500**	**120,900**	**181,500**	**190,500**	**-9,000**

Table 2. Summary of Justification for Revised Volumes (to nearest 100 m^3), as Applied to Table 1

Infrastructure Description	Reduction and Re-use	Excavation Volume (m^3)	Re-use Volume (m^3)
Access Tracks	Micrositing to reduce peat depth by 0.1 m in cut track sections	-25,900	
	Extended width of bankings for re-use of peat on track verge for cut track		59,500
Turbines	Covering all turbine foundations to 0.5 m		10,900
Borrow Pits	Fully restoring most borrow pits with excavated material to an average depth of 1.0 m, with BP02 restored for 75% of footprint		33,600
	Total	**-25,900**	**104,000**

Table 3. Volume Estimates for Amorphous Catotelmic Peat Excavation at Various Threshold Depths (to nearest 100 m^3)

Infrastructure Description	Total Soil / Peat Excavation (m^3)	Estimated Excavated Amorphous Catotelmic Peat At Various Threshold Depths (m^3)		
	Based on Revised Estimate	0.3 m	0.5 m	1.0 m
Access Tracks	96,500	33,600	0	0
Turning Heads	12,400	4,300	0	0
Passing Places	2,500	700	0	0
Turbines	13,200	5,800	2,700	500
Crane Hardstandings	34,000	15,500	7,000	1,300
Substation	3,200	1,300	0	0
Large Temporary Construction Compounds	5,800	1,200	0	0
Small Temporary Construction Compounds	3,600	1,500	200	0
Borrow Pits	10,300	0	0	0
Amorphous Catotelmic Peat Total Volume	**181,500**	**63,900**	**9,900**	**1,800**

7 References

CIRIA (2006). Control of water pollution from linear construction projects: technical guidance. Publication C648; Construction Industry Research and Information Association, London.

Land Use Consultants (2017). Chapter 4, Scheme Description, of the Environmental Statement for the North Lowther Energy Initiative.

Macaulay Land Use Research Institute (MLURI (1982). Soil and Land Capability for Agriculture Maps and Handbook.

Mouchel (2017a). North Lowther Energy Initiative Environmental Statement, Chapter 7 - Hydrology, Hydrogeology, Geology and Soils.

Mouchel (2017b). North Lowther Energy Initiative Environmental Statement, Appendix 7.2 - Peat Stability Assessment.

Mouchel (2017c). North Lowther Energy Initiative Environmental Statement, Appendix 4.1 - Borrow Pit Report.

Scottish Government (2006). Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments.

Scottish Government (2010). Promoting the sustainable re-use of Greenfield soils in construction.

Scottish Environment Protection Agency (2010a). Regulatory Position Statement – Developments on Peat.

Scottish Environment Protection Agency (2010b). Development on Peatland Guidance – Waste. Available at: http://www.sepa.org.uk/media/144152/development_on_peatland_guidance_final_august_2010.pdf or via http://www.sepa.org.uk/environment/energy/renewable/

Scottish Government (2017). Guidance - Developments on Peatland, Site Surveys and Best Practice. Available at: http://www.gov.scot/Resource/0044/00445028.doc via http://www.sepa.org.uk/environment/energy/renewable/

Scottish Natural Heritage and Forestry Civil Engineering (2010). Floating Roads on Peat. http://www.roadex.org/index.php/services/partner-knowledge-bank/scotland/floating-roads-on-peat-report (accessed August 2010), Scottish Natural Heritage and Forestry Civil Engineering.