# Appendix 10.6

## Outline Peat Management Plan

# Contents

# Tables



# Figures



# Annexes

# 1 Introduction

1.1.1 In support of **Chapter 10** (**Volume 1**) of the Design Manual for Roads and Bridges (DMRB) Stage 3 Environmental Impact Assessment (EIA) report; this technical appendix presents an Outline Peat Management Plan (OPMP) for Project 8 – Dalwhinnie to Crubenmore of the A9 Dualling Programme (hereafter referred to as the Proposed Scheme).

1.1.2 The purpose of the OPMP is to present estimated peat soil and peat excavation volumes, and demonstrate that management of these during construction of the Proposed Scheme has been considered and shall be treated appropriately. It describes the management approach adopted through design development of the Proposed Scheme related to peat, and presents an outline of options that may further minimise impacts and/ or provide mitigation via potential re-uses.

1.1.3 The information presented herein supports the potential impact assessment in **Chapter 10** (**Volume 1**) and has been prepared utilising available information as described in **Appendix 10.1** (**Volume 2**). This and other relevant aspects of the DMRB Stage 3 EIA should therefore be referred to as necessary.

# 2 Developments on Peatland

## 2.1 Definition of Peat

2.1.1 In Scotland, peat is defined as *"an organic soil which contains more than 60 per cent of organic matter and exceeds 50cm in thickness"* (Macaulay Institute, 1984). Scotland's National Peatland Plan also encompasses organic soil less than 50cm, which can support typical peatland vegetation (SNH, 2015a). Organic deposits less than 50cm in thickness are therefore considered in this and related aspects of the DMRB Stage 3 EIA as 'peaty soils'. Joint Nature Conservation Committee (JNCC) (2011) and Scottish Government (2014) guidance on peat surveys also follow this peaty soil definition. 'Deep peat' is considered to be a peat soil with a surface organic layer greater than 1.00m thickness (Bruneau and Johnson, 2014).

2.1.2 The structure of a true active peatland typically comprises a thin surface layer of living vegetation (the *acrotelm*) overlying a usually thicker layer of well decayed and humified peat, comprising the consolidated remains of former surface vegetation (the *catotelm*). Below the peat forming layers is the basal *substrate*, either a mineral soil, mineral superficial deposit or bedrock.

2.1.3 The acrotelm is the upper aerobic layer of peat and consists of living and partially decayed plant material. It typically has a higher hydraulic conductivity than underlying peat and is usually defined with relation to the water table. Acrotelm thickness varies with topography – such as hummocks, peat hags, hollows and with time, especially in dry periods or when it is drained.

2.1.4 The catotelm layer sits beneath the acrotelm and consists of well decayed and humified material and is denser with a very low hydraulic conductivity. Conditions are anaerobic and anoxic because the catotelm is permanently below the water table. The catotelm is less cohesive than the acrotelm layer and is generally considered to be less suitable for storage and re-use.

## 2.2 Peat Importance

2.2.1 Over 20% of Scotland's land area is covered by peatlands, and Scotland hosts a significant proportion of the European and world resource. Foremost, peatlands are long-term carbon stores, important to tackling climate change; but they are also important to rural farming, tourism, in providing clean water and in lowering flood risks. Scotland's National Peatland Plan

published by Scottish Natural Heritage (SNH) also notes that they form beautiful landscapes, represent key habitats and are a defining characteristic of wild Scotland (SNH, 2015a).

2.2.2 Drying and physical damage to peat can release greenhouse gases, reduce water quality and diminish a range of other services. Peat is also geotechnically complex, and special consideration must be given to the practicalities of engineering in peat and peat soils, with careful management of construction activities required to avoid such damage.

## 2.3 Requirement for an Outline Peat Management Plan

2.3.1 The significance of peatlands is most evident in their protection by various legislation, policy and local, national or international initiatives including, but not limited to; the United Kingdom Biodiversity Action Plan (UKBAP), Scotland's National Peatland Plan (SNH, 2015), European Council Habitats Directive 92/43/EEC (Council of the European Communities, 1992), the Scottish Biodiversity List (SBL) (Scottish Government, 2013), Cairngorms Nature Action Plan (CNAP) (CNPA, 2013), the European Council Water Framework Directive 2000/60/EC (Council of the European Communities, 2000), Scottish Government discussion paper on the Management of Carbon-Rich Soils (Scottish Government, 2010), Scottish Soil Framework (Scottish Government, 2009) and the Climate Change Plan (2017-2032) (Scottish Government, 2017).

2.3.1 Indeed, the Scottish Environment Protection Agency (SEPA) has a statutory and legislative duty to ensure that where peat spoil is generated during construction; that it is stored, re-used, treated or disposed of correctly; which may require authorisation or permits.

2.3.2 SEPA's policy on the management of peat spoil is set out within *'Regulatory Position Statement – Developments on Peat'* (SEPA, 2010). This highlights that the best management option for peat spoil is the prevention of its production, by seeking to minimise peat excavation and disturbance. Where this is unavoidable, developers should attempt to re-use as much of the peat produced on site as is possible, in justifiable and environmentally beneficial ways.

2.3.3 The fact that materials have a potential re-use within the site boundary is not sufficient in itself to determine that they are not waste. For example, where there is no justified requirement or demonstrable need for the peat to be used, or it is clearly not suitable for the identified use, it will likely be classed as a disposal operation, and the proposed activity will require authorisation from SEPA accordingly. In this respect, SEPA will seek to ensure that there are no risks to the environment, or human health associated with the proposed activities, and will identify any regulatory requirements that would affect such activities.

2.3.4 It is therefore strongly recommended that OPMPs are formulated to ensure that peatlands are managed in accordance with best practice and specifically, that damage to peatland habitats and vegetation are, wherever possible, avoided during construction and, where this is not possible, that peat is re-instated effectively with a minimal loss of carbon.

## 2.4 Construction Considerations

### Geotechnical Characteristics

2.4.1 Geotechnically, peat soils are complex as previously noted; comprising broken down plant remains rather than mineral particles. As such, conventional soil mechanics theory does not apply well (Hobbs, 1986), and site specific experience is often as useful in understanding peat behaviour under construction activities as modelled behaviour. The primary geotechnical characteristic of relevance to road construction is the behaviour of peat under loading, which normally occurs as a rapid phase of primary consolidation followed by a much slower phase of secondary compression (SNH, 2013). Scheduling of construction activities must take into account

this behaviour to ensure that infrastructure constructed over peat takes account of its settlement characteristics.

2.4.2 In addition, peat strength plays a role in determining the settings in which certain infrastructures are appropriate. The acrotelm is typically stronger than catotelm peat, with the former afforded a degree of tensile strength from its vegetation layer, and the latter lacking this and the cohesion associated with some other soft sediments such as clays.

### Construction Methods

2.4.3 The geotechnical characteristics of peat affect the choice of appropriate construction methods that are available for building infrastructure on peatland. Such methods include:

- **Excavation (Cut and Fill):** This is likely to be the most commonly used technique, used in most areas except the deepest peat, or where roads are expected to take low traffic volumes. The technique involves removing peat so that further cuttings can be made into substrate, or so that engineering grade fill can be placed onto a stratum of suitable bearing capacity to achieve the horizontal and vertical alignment required. Auxiliary elements such as Sustainable Drainage Systems (SuDS), compensatory flood storage areas, watercourse diversions and drainage are all likely to be achieved through excavation techniques
- **Floating:** The technique of floating roads is usually reserved for access tracks, private and low traffic-volume roads. Floating roads can be described as a road that is constructed directly on top of the peat, relying on the strength of the in-situ peat for its support. The road does not actually 'float' on the peat, rather, an equilibrium builds up between the weight of the road and the in-situ strength of the peat whereby the combined system comes into balance. Modern construction practice generally calls for a geosynthetic layer to be placed on the surface of the peat, before the road is constructed, to give a working platform for the road and provide a separation layer between the road and the peat below. This layer, however, does not support the road – the road is supported by the peat (FCE and SNH, 2010)
- **Piling:** Piling techniques are usually reserved for areas where major routes need to cross peat consistently in excess of 2.00m deep. The technique involves the laying of a 'piling mat' over the peat, through which piles are driven to reach a stratum of suitable bearing capacity, without any excavation taking place. The road is subsequently constructed on the piles
- **Bridging:** Similar to piling, such a technique would only be considered for major carriageways crossing the deepest areas of peat. Bridging would involve creation of bridge abutments either side of peat areas with a bridge deck being created between the two abutments to carry the road over the peat

2.4.4 Generally; floating, piling and bridging do not require, or at least substantially limit, excavation of peat, and can be key techniques to reduce the impact of road construction in peatlands.

2.4.5 Vibro-replacement is another technique which is sometimes considered to improve the bearing capacity of soft soils. However, such an approach is not considered appropriate in peat due to the lack of lateral confinement offered by the peat material (Vibro Menard, 2017).

### Re-use Considerations

2.4.6 Minimising the volumes of peat generated by construction is preferable in order to preserve the various ecosystem services associated with peatlands, and to reduce potential carbon losses associated with construction. The key guiding principle is only to re-use peat where it is suitable for the identified and required use, as previously noted. Careful handling is essential in order to

retain the structure and integrity of the excavated materials and thereby maximise the potential for excavated material to be re-used.

2.4.7 *'Developments on Peatland: Guidance on the Assessment of Peat Volumes, Re-use of Excavated Peat and the Minimisation of Waste'* (Scottish Renewables (SR) and SEPA, 2012) identifies examples of valid re-uses of excavated peat during construction, to potentially include dressing off and re-instating peat on the slopes and edges of constructed infrastructure, such as road and access track verges, re-instatement of service trenches and foundations, and peatland restoration via water table restoration, habitat enhancement or wetland creation.

# 3 Peat Conditions

## 3.1 Study Area

3.1.1 The study area for the Proposed Scheme is situated entirely within the Cairngorms National Park, extending from south of the A9/ A889 junction at Dalwhinnie to the existing Crubenmore dual carriageway in the north. The River Truim runs generally parallel and to the west of the existing A9, and there are a number of hillside tributaries which pass under the existing carriageway.

3.1.2 There are a wide range of predominantly open upland habitats, but also some vegetation and habitat types more typical of lowland areas. Terrain to the west of the existing A9 carriageway is generally lower-lying and flatter than that to the east, and supports a mixture of mire, heaths, upland grassland and lowland grasslands in the floodplain of the River Truim. On the hillsides to the east, there are a wide range of upland grasslands, mires and heaths.

3.1.3 As well as the existing A9 carriageway and associated infrastructure, land uses within the study area include rough sheep grazing, grouse moor and, locally, plantation woodland (primarily a winter resilience snow shelter belt for the existing A9). Much of the area under use for grazing and grouse moor has shallow artificial surface drainage. Other land uses in the vicinity of the Proposed Scheme include the Highland Mainline (HML) railway, the National Cycle Network Route 7 (NCN7), residential properties at Dalwhinnie, Cuaich and Crubenmore, the Scottish Southern Energy (SSE) Aqueduct and Beauly to Denny Powerline and associated pylons.

## 3.2 Geomorphology

3.2.1 As the study area is situated within Glen Truim; glaciation and subsequent deglaciation have been the predominant landscape forming influences. These have created a steep-sided valley in which the River Truim is a 'misfit', flowing through a comparatively, flat and wide valley bottom to the west of the Proposed Scheme.

3.2.2 As shown in **Drawing 10.1** (**Volume 3**), published BGS mapping indicates that the flat-lying valley bottom is predominantly comprised of alluvial and glaciofluvial deposits and in some areas, the River Truim has incised through these to create relatively flat river terraces, which are now elevated above the contemporary floodplain. Areas of alluvial fan are also present at the outflow of larger tributaries to the River Truim, including Allt Coire Chuirn, Allt Coire Bhotie and Allt Cuaich. The hillslopes in the east of the study area are generally mantled with hummocky glacial deposits and diamicton till, with peaty soils throughout and some areas of peat.

3.2.3 Based on the geology and wider geomorphological context (Evans and Warburton, 2007), the study area provides two principal environments ('macrotopes') in which discontinuous mosaics of peat forming areas exist; the flatter flood plain and terraces to the west (where local areas of peatland are low lying and marshy, most comparable to low-lying fens and transition mire) and the hillslopes to the east (where areas of peatland are most comparable to upland blanket peat).

A feature which morphologically resembles a raised bog (but is ecologically identified as blanket bod) is also present to the west of the southern tie-in of the Proposed Scheme to Project 7 – Glen Garry to Dalwhinnie, with a low dome perched on a low terrace above the River Truim floodplain.

3.2.4 Peat cover deeper than 0.50m is discontinuous in these mosaic environments and smaller-scale morphological ('mesotope' and 'microtope') features are therefore sporadic. However, some are evident within and to the east of the study area; including several springs, flushes and hummocks on the sloping ground through Drumochter, Dalwhinnie and Crubenmore, and some localised hollows and bog pools to the east at Dalwhinnie and north of Cuaich. No peat haggs, gullies or pipes have been identified and the otherwise lack of these smaller-scale hydro-ecological features is likely to be a result of anthropogenic impacts throughout the study area over time via muirburn, grazing, drainage and locally, plantation woodland for winter resilience.

## 3.3 Habitats and Vegetation

3.3.1 Based on Phase 1 Habitat and NVC Surveys, peatland habitat and peat-forming vegetation types have been identified in the study area. These include mire, blanket mire, wet heaths or mosaics of these, with some of the typical and indicative core vegetation ranges (Bruneau and Johnson, 2014) of blanket bog (M17, M19 and M1 to M3), wet heaths (M15 and M16), degraded bog (M25) and locally, fens and flushes (M4, M6 and M10) represented. Semi-natural vegetation not associated with waterlogged peat formation, but that can occur over thinner organic and peaty soils on shallow peatlands includes dry heath (H10 and H12), acid grasslands (U2 and U4 to U6) and locally, semi-natural grasslands (MG9 and MG10) and bracken (U20).

3.3.2 The distribution of habitats and vegetation types within the study area is shown in **Drawings 12.7** to **12.30** (**Volume 3**) and described within **Chapter 12** (**Volume 1**). In summary and approximately however, those which are indicative of blanket mire account for 3% in total, with wet heaths (including areas in mosaic with blanket mire) accounting for 27%, dry heath 32%, grasslands approximately 21% and fen or flushes less than 2%. Most of the vegetation has been impacted as noted. However, some areas of blanket mire and wet heath to the east of the Proposed Scheme at Dalwhinnie and in mire areas to the east and west at Cuaich appear sufficiently wet and/ or contain bog pool communities indicative of locally good condition.

## 3.4 Hydrology

3.4.1 A detailed hydrological catchment baseline survey for the study area based on field visits (CFJV, 2016 and 2017) and desk-based data assessments is presented in **Appendix 11.4** (**Volume 2**). This indicates that the study area drains to the River Truim valley and is within the wider River Spey catchment. There are at least sixty-nine minor and/ or major surface watercourses present; the majority of which are direct tributaries to the River Truim, and **Chapter 11** (**Volume 1**) identifies individual sub-catchments for each of these.

3.4.2 Few well-defined natural watercourses drain areas of peat, with the exception of an unnamed watercourse to the east of the Proposed Scheme at Dalwhinnie; which drains an expanse of deep peat and blanket mire. A network of artificial drainage channels of varying continuity and length also exist across parts of the study area, variably draining to existing watercourses and the points at which they cross the existing A9; as illustrated in **Drawings 10.12** to **10.20** (**Volume 3**). These are most frequent to the east of the Proposed Scheme, in areas utilised for sheep grazing or movement, sporting interests or grouse drives; and several are located in areas of peat. This suggests the channels have been cut either to reduce levels of saturation for these purposes, or to transfer run-off to culverts from the upslope to the downslope side of the existing A9.

3.4.3 The artificial drainage is concentrated within southern and central parts of the study area, to the east of Dalwhinnie and the Cuaich aqueduct. These will serve to lower water table levels in areas of peat to make areas more amenable for a particular purpose, but they can also degrade peat. Groundwater levels from standpipes within or nearby peat areas indicate average standing water table depths of between 0.43m and 3.90m. However, water has also been observed locally at, or near, the surface within, or nearby, the bog pool communities and elsewhere; indicating local saturation as previously noted.

3.4.4 No sub-surface peat pipes were identified in the peat profiles during available investigation, peat probing or other walkover surveys completed.

## 3.5 Peat Depth and Characteristics

3.5.1 Available data has been used to generate a detailed map of peaty soil and peat depth for the Proposed Scheme. This is shown in **Drawings 10.12** to **10.20** (**Volume 3**) and the methodology used to create the map is described in **Appendix 10.1** (**Volume 2**). Approximately 5% of the permanent and temporary works boundaries of the Proposed Scheme do not presently have peat depth data coverage. However, desk-based information and ecological surveys indicate that peat greater than 0.50m is unlikely to be present in these areas.

### Peat Depth

3.5.2 The peat depth model and data indicate that the full range of recorded peat and peaty soil depths across areas investigated varied from 0.00m to 4.95m, as illustrated in **Drawing 10.12** to **10.20** (**Volume 3**). The majority of areas (approximately 70%) within the permanent and temporary works boundaries are underlain by peaty soil or topsoil less than 0.50m thickness, and approximately 10% is underlain by no peat. Shallow peat is present underlying approximately 11% of the areas and only 3% is underlain by deep peat.

3.5.3 The occurrences of peaty soils and peat correspond well with published mapping and ecology survey findings; with peaty soils and topsoil (less than 0.50m thickness) predominant in areas of dry or wet heath and mosaics of these and acid grassland transitions. These ranged from 0.05 to 0.50m in thickness and were generally described to vary from silty, sandy, gravelly soil or topsoil that is peaty or contains pockets of peat, but also thin fibrous or pseudo-fibrous peat horizons.

3.5.4 Discontinuous and localised pockets of shallow peat (between 0.50m and 1.00m thickness) are also present in similar areas, as well as wet heath/ blanket mire mosaics. Deep peat (greater than 1.00m thickness) is present within and adjacent to the Proposed Scheme at Dalwhinnie, and surrounding it in pockets elsewhere, most frequently in areas of mire, blanket mire and mosaics of these and wet heath.

3.5.5 The peat depth model is based on a substantial dataset of real data points acquired in the field and is therefore believed to be of very high quality. The interpolation methods used have been shown to be suitable for this kind of assessment in other peat related assessments (RWE, 2013). However, it should be noted that the peat depth model is, by its nature, an interpolation between real data points and there remains the possibility that deeper or shallower peat than that represented by the model may be present between the real data points.

### Peat Characteristics

3.5.6 The true depth of the acrotelm is often difficult to determine in the field and may be deeper than suggested by indicators such as living mosses and poorly decomposed plant material. Indeed, it has frequently been the case from investigation information available for the Proposed Scheme

that the acrotelm (i.e. that part of the peat profile which experiences fluctuations in water table) was recorded to be impacted or degraded.

3.5.7 In this respect, the acrotelm across the Proposed Scheme has been observed to predominantly comprise thin (0.05 to 0.11m) moderately decomposed (H3 to H5, locally greater) layers and variably distinct semi-natural vegetation. Such decomposition is higher than would be expected for an acrotelm that is healthy, and actively peat-forming – which was only locally observed adjacent to the Proposed Scheme at Dalwhinnie, where thicker (0.20m) layers showing no or only very slight decomposition (H1 to H3) and distinct vegetation were observed.

3.5.8 The acrotelm is underlain by catotelm layers varying between spongy, plastic and firm condition. The type of peats also varied from dark brown and black fibrous to pseudo-fibrous, and locally amorphous peat; with highly variable root and wood content. Pseudo-fibrous peat was typically described as H4 to H5 on the von Post scale (slight to moderate decomposition), fibrous peat was typically H3 to H6 (very slight to moderate decomposition), while locally more (but not wholly) amorphous peat or amorphous content within it was described as H7 to H8 (strong to very strong decomposition) within deeper areas of blanket bog and mire.

3.5.9 No evidence of H9 to H10 peat (nearly complete to completely decomposed) has been observed and humification of the peat appears to increase with depth, as would be expected. In this respect, the implication is that deeper peat is likely to have a lower strength than that at shallow depth. However, where recorded, it is also noted that samples have generally been classified highly in terms of fibre content or are predominantly described as fibrous and pseudo-fibrous, which may indicate that the peat has some degree of tensile strength and structure.

3.5.10 Estimated water contents in samples have covered the full range of possible values on the Von Post scale.

### Laboratory Testing

3.5.11 Laboratory testing of peaty soil and peat samples for all, or a selection of, organic matter, loss on ignition, moisture content, bulk density, pH, total carbon and total organic carbon from selected trial pit/ borehole and peat core locations was undertaken as part of GI works for the Proposed Scheme, as described in **Chapter 10** (**Volume 1**) and **Appendix 10.1** (**Volume 2**).

3.5.12 Peaty soil/ topsoil samples were recovered across a range of habitat types, including dry and wet heath, grassland transitions and mire/ heath mosaics. The testing results indicate bulk densities for these ranging between 1.04 and 1.48 Mg/m$^3$, dry densities between 0.14 and 0.68 Mg/m$^3$ and moisture contents of between 4.4 and 963%. Results for total organic carbon ranged from 1.5 to 62%, from 2.2 to 57% for total carbon content and from 6.9 to 93.2% for mass loss on ignition. pH values ranged from 3.6 to 6.7.

3.5.13 Shallow peat samples were recovered across a similar range of habitat types, with bulk densities ranging between 0.65 and 1.31 Mg/m$^3$, dry densities ranging from 0.07 to 0.27 Mg/m$^3$ and moisture contents of between 53 and 972%. Results for total organic carbon ranged from 3.6 to 57%, from 3.5 to 69% for total carbon content and from 18.5 to 97% for mass loss on ignition. pH values ranged from 3.8 to 6.3.

3.5.14 Within deeper peat profiles in areas of mire, wet heath, mosaics of these or swamp, bulk densities ranged between 0.27 and 1.67 Mg/m$^3$, dry densities ranged from 0.08 to 1.16 Mg/m$^3$ and moisture contents were recorded between 11 and 1,324%. Results for total organic carbon varied between 0.9 and 58%, between 1 and 59% for total carbon content and from 22.6 to 96.9% for mass loss on ignition. pH values ranged from 3.3 to 5.9.

# 4 Peat Management

## 4.1 Management Approaches

4.1.1 The hierarchy of management approaches in relation to developments on peat provided by SEPA is as follows (SR and SEPA, 2012; SEPA, 2010):

- **Prevention:** avoiding generating excess peat during construction (e.g. by avoiding areas of peat or by using construction methods that do not require excavation, such as floating tracks)
- **Re-use:** use peat produced on site in designated areas in an environmentally beneficial and suitable way, in the restoration of temporary works areas or as part of landscaping strategy
- **Recycling/ recovery/ treatment:** modification of peat produced on site for use as a fuel, or as a compost/ soil conditioner, or dewater peat to improve its mechanical properties in support of re-use
- **Storage:** temporarily store peat on-site (for example, during short periods in the construction period) and then, re-use.

4.1.2 Throughout the DMRB Stage 3 iterative design development process for the Proposed Scheme described in **Chapter 4** (**Volume 1**); a number of environmentally-led workshops considered each aspect of the developing design and made recommendations for certain features to be included, or aspects of the design to be reconsidered. Peat was afforded significant consideration throughout this process and was informed by the progressive collection of peat survey information as described in **Appendix 10.1** (**Volume 2**).

4.1.3 The OPMP for the Proposed Scheme has therefore been developed as part of an iterative and informed process, and has adopted prevention, minimisation and re-use as the core management principles, together with an element of temporary storage as means of managing peat excavated during construction.

## 4.2 Prevention

4.2.1 Prevention and avoidance of peat excavation or other impacts altogether has been achieved through detailed assessment of the distribution of peat across the Proposed Scheme and adjacent areas. This has informed a number of infrastructure layout and positioning changes and alternatives that were considered for particular scheme elements including Dalwhinnie junction, SuDS basins 225, 241 (removed from the Proposed Scheme) and 254, the proposed Drumochter Estate access track and the positioning of compensatory flood storage areas, as further described in **Chapter 4** (**Volume 1**).

4.2.2 Collectively, these changes and the consideration of alternatives has resulted in approximately **35,000m$^3$** reductions of estimated peat and peaty soil excavation volumes. Further actions to avoid or reduce peat excavation may still also be achievable during detailed design and through the use of construction techniques such as floating road construction for access tracks wherever peat deposits are of suitable depth and size. These will be undertaken wherever practically achievable from an engineering perspective and not economically prohibitive.

4.2.3 In this respect, *'A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland'* (Forestry Civil Engineering and SNH, 2010) states that there is no consensus about the depth of peat over which a road should be floated. This study indicated that while depths ranging between 0.60m and 1.50m are

typically proposed, the decision to float a road would not wholly rest on depth but on other criteria such as the type and characteristics of the peat, the length of the road section, the construction equipment available and associated haul distances.

4.2.4 At present, it has been assumed that access tracks will not be floated as part of the Proposed Scheme in the estimated excavation volumes. However, if conditions permit, there is the potential for excavation volumes of deep peat to be reduced by up to **3,000m$^3$** if tracks were floated across particular areas.

## 4.3 Re-instatement

4.3.1 Although the Proposed Scheme layout prevents and avoids peat excavation as far as is practicable at this stage, the nature of the various other constraints detailed in **Chapter 4** (**Volume 1**) has meant that some infrastructure is located in areas with peat. As this cannot be avoided in these instances, the subsequent management option adopted for the Proposed Scheme is to re-instate that peat at the point of excavation wherever possible. This will principally be limited to the following instances:

- Where peat or peaty soil must be excavated to accommodate embankment slopes which must be taken below existing ground level, but once constructed, a proportion of the peat excavated can be re-instated at the embankment toe
- Where excavation must occur for compensatory flood storage areas, but peaty soil or peat turves up to 0.50m thickness can be set aside and re-instated once excavation of the substrate or deeper material is removed.

## 4.4 Re-use

4.4.1 Where the excavation of peat cannot be prevented or avoided, and re-instatement at the point of excavation cannot be achieved; the management option for the Proposed Scheme is for excavated peat and peaty soil to be re-used in suitable and environmentally beneficial ways that maintain their provisioning, regulating, cultural and ecosystem supporting services. In this respect, the following have been identified as the core potential opportunities for re-use as part of the Proposed Scheme:

- **Landscaping Restoration:** Re-instatement and re-use of peaty soils and topsoil as dressing for widening, cutting and embankment slopes and verges to assist in creating tie-ins with the surrounding topography, landscape and habitats to reduce visual impacts. It may also be possible for proportions of excavated and sympathetically handled shallow peat finished with acrotelm peat turves, to be re-used for dressing and verge re-instatement on particular sections of access track. Acrotelm turves from peaty soil areas will only be used where consistent with adjacent soils and vegetation, and where the adjacent substrate (placed or *in situ*) is peat
- **Habitat Re-instatement, Restoration and Creation:** Potential areas considered to be of suitable slope, existing and surrounding ecology and hydrology have been identified; where the re-use of peat, along with local water table restoration could restore, re-instate and/ or create extended peat-based habitats. These include areas of blanket mire and/or wet heath/ mire mosaic within and at the margins of the permanent and temporary works boundaries of the Proposed Scheme which are degraded, or where temporary works will take place. Re-instatement, restoration and creation of such peatland habitats is also likely to have the further benefit of reducing run-off rates to watercourses

- **Sustainable Drainage Systems (SuDS):** Re-use of peat as a natural filter material in the main basin of SuDS for the Proposed Scheme, to reduce the rate at which road run-off is discharged to watercourses and improve the quality of the water discharged to watercourses. Detailed design of SUDS will be such as to maximise the filtration surface area and include lining with vegetated acrotelm turves and to determine the method for the placement of the peat within the SuDS basins

- **Compensatory Flood Storage:** Re-use of peat for the creation of wetland-based habitats within proposed compensatory flood storage areas, which by their nature will be more low-lying than surrounding areas. The specific design and practice of peat reuse in each area will be developed at the detailed design stage. This should include consideration of whether sufficient hydrological conditions can be achieved to maintain the condition of the re-used peat

4.4.2 It is the intention that all excavated peat can be re-used in one of the above ways, as set out within this OPMP. However, should none of these be achievable for a particular portion of the excavated peat, then this peat will be considered as 'waste' and an appropriate licence or exemption for the use of the material would be applied for.

### 4.5 Temporary Storage

4.5.1 Temporary storage of peat should be avoided wherever possible by transporting to an allocated re-use location as soon as is practicable, to help retain as much structural integrity within the peat as possible, minimise volumes in storage and minimise the likelihood of drying. However, this should not be undertaken at the expense of re-instatement, re-use or restoration outcomes (i.e. if, on balance, storage will produce a better long-term outcome, then it should be used prior to the re-use).

4.5.2 For instances where this may be required during construction of the Proposed Scheme therefore, provisional locations likely to be suitable for the temporary storage of peat have been identified and are shown in **Drawings 10.39** to **10.47** (**Volume 3**). These take into account land available within the permanent and temporary works boundaries, the proximity to points of excavation and the level of peat landslide risk determined in **Appendix 10.5** (**Volume 2**). Where temporary storage is necessary, it will be undertaken in line with the guidance provided in **Paragraphs 6.3.5 to 6.3.8** of this OPMP.

## 5 Peat Balance

### 5.1 Proposed Scheme Elements

5.1.1 The development of a peat balance for the Proposed Scheme has involved calculation of volumes excavated during construction, volumes re-instated during or following construction, residual volumes, and volumes of re-use that may be achieved via landscaping restoration, habitat restoration and creation, or within selected SuDS and/ or compensatory flood storage areas.

5.1.2 Taken together, these describe whether the Proposed Scheme may have a positive, negative or neutral peat balance (i.e. produces more, less or approximately the same amount of peat as can be appropriately and suitably re-used within the permanent and temporary works boundaries).

5.1.3 The following sections describe the calculations for each element of the Proposed Scheme. Mean peat depths referred to are derived from the peat depth model shown in **Drawings 10.12**

to **10.20** (**Volume 3**) and are specific to the footprint of each element of the Proposed Scheme considered, which are as follows:

- Mainline alignment, including embankments, widenings and cuttings, but excluding the part of the mainline which runs through the proposed Dalwhinnie junction
- Dalwhinnie junction, including link road to the A889, embankments and cuttings
- SSE Aqueduct diversion, including embankments and cuttings
- Access tracks, including embankments, widenings and cuttings
- Permanent SuDS basins
- Watercourse diversions
- Drainage, including cut-off drains
- Compensatory flood storage areas

5.1.4 Each element required a slightly different approach to, as accurately as possible, represent the initial peat excavation that will be required and any subsequent re-instatement at the point of excavation that may be possible, to arrive at residual excavation volumes.

5.1.5 The linear nature and extent of some elements such as the mainline, junctions and access tracks means that peat depth varies throughout their footprint. These features were therefore divided into 50m sections, such that total volumes and the mean depth of peat beneath each 50m section could be used to calculate the required excavation.

5.1.6 Estimated volumes are expressed to the nearest $m^3$. However, the uncertainty in the figures makes it prudent to consider any figure as correct to the nearest $10m^3$ where less than $100m^3$, the nearest $100m^3$ where less than $10,000m^3$ and the nearest $1,000m^3$ where over $10,000m^3$.

5.1.7 The initially presented excavation volumes assume that the proposed Drumochter Estate access track (which follows the alignment of an existing temporary track constructed for the Beauly to Denny Powerline development in the area of Allt Coire Chuirn) would not be re-instated prior to construction of the Proposed Scheme. The use of floated access track construction techniques are a matter for detailed design. As such, the excavation volumes initially presented also assume no floating; but estimates of the potential reduction in excavation volumes through the use of this technique, and the consequent impact on the overall volumes, is presented.

5.1.8 Opportunities to float access tracks and reduce peat excavation volumes should be taken at the detailed design stages wherever practical in engineering terms and not cost prohibitive.

## 5.2 Excavation and Re-instatement Volumes

5.2.1 The estimated volumes of peaty soil and peat, and the way they have been calculated for each element of the Proposed Scheme is described below and is supported with schematic diagrams where necessary. In all instances, the excavation volumes have been uprated to account for the areas not yet covered by the peat depth model. This uprating assumes that excavation volumes (and their distribution between peaty soil, shallow and deep peat) is proportionally the same in the 'no data' area as it is in the area where data is available.

### Mainline Alignment

5.2.2 The mainline alignment for the Proposed Scheme covers approximately 10 km, with an additional 180m tie-in to Project 7 – Glen Garry to Dalwhinnie at its southern end. For the purposes of this assessment, the mainline alignment scheme element comprises embankments, widenings, cuttings and 'other earthworks' (areas of cut or fill between embankments, widenings or cuttings such as verges, carriageways and the central reserve).

5.2.3 It is assumed that under the embankments and other earthworks, all peat will be excavated in order to found construction on strata of a suitable bearing capacity. Theoretical exceptions to this would be where the road was of floated construction, of piled construction or where a structure is used to carry the road across an area of softer ground. However, ground conditions beneath the mainline alignment (particularly peat depths, which do not exceed 2.00m) do not lend themselves to such methods and therefore none are anticipated.

5.2.4 Additionally, in areas of embankment fill, a core embankment will be required to continue below existing ground level. Due to the slope of the core (assumed to be 1:2), this will require a lateral extension of the excavation footprint equivalent to twice the depth of the peat, in order to accommodate the core embankment itself. A further lateral extension to accommodate a return slope which will be formed from a series of 0.50m high benches will also be required. To calculate the distance of this lateral extension, the mean peat depth under a 50m section of embankment or at grade stretch of road has been used.

5.2.5 **Figure 1** shows a schematic diagram to illustrate the considerations in this calculation and also shows that, following construction, some excavated peat can be re-instated at the point of excavation. The volume of peat that will be re-instated is therefore included within the initial excavation volumes but not in net residual excavation volumes.

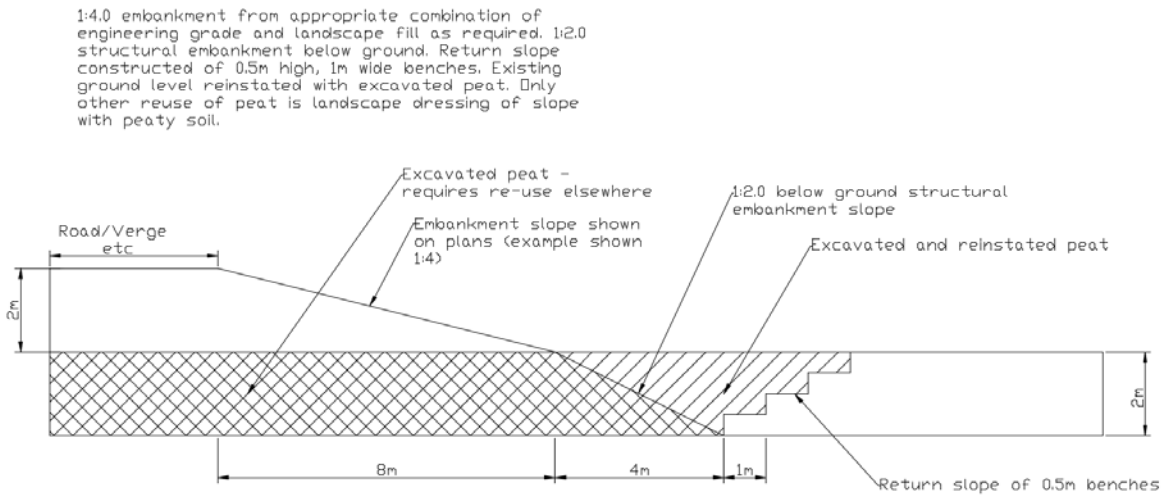


*Figure 1: Calculation of Excavation and Re-instatement Volumes (Embankments and At Grade)*

5.2.6 Where cut slopes are present on either side of the mainline, it is assumed that total excavation of peat will be required, with the exception of a band at the top of the cutting equivalent to four times the depth of the peat where only 50% of the peat will require excavation. **Figure 2** shows a schematic diagram of the considerations in this calculation on the assumption that the part of the cut slope in peat is at 1:4 – considered the most likely to be applied within areas of peat.

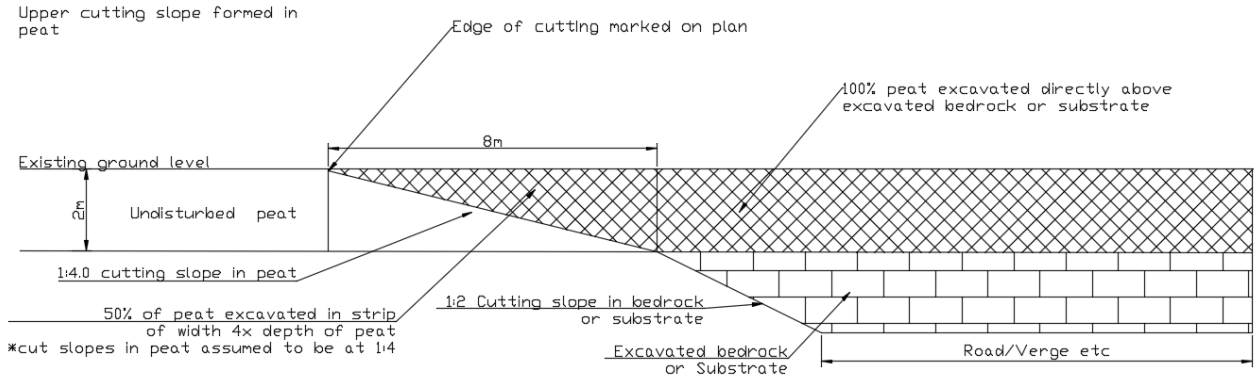


*Figure 2: Calculation of Excavation and Re-instatement Volumes (Widenings and Cuttings)*

### Dalwhinnie Junction

5.2.7 The proposed Dalwhinnie junction includes embankments, cuttings and variable earthworks associated with slip and access roads required to tie-in to the existing A889 between ch. 21,900 and ch. 22,300. The volumes presented for the Dalwhinnie junction also include the mainline alignment between ch. 21,900 and ch. 23,200, an extended access track to reach SuDS Basin 222 and proposed underpass at ch. 22,250. The same considerations as shown in **Figure 1** and **Figure 2** for the mainline alignment have been applied to embankments and cuttings associated with the Dalwhinnie junction.

### SSE Aqueduct Diversion

5.2.8 The widening of the Proposed Scheme to the east between ch. 23,400 and ch. 23,550 will require an embankment to extend over the current alignment of the SSE-operated aqueduct, which takes water from the Allt Cuaich catchment to Loch Ericht. To accommodate the embankment in this area an approximate 300m long diversion of the aqueduct is required.

5.2.9 The diversion is predominantly in cut and it is assumed that all of the peat will need to be excavated from beneath the footprint. As such, the same considerations as shown in **Figure 2** for the mainline alignment have been applied for the cuttings associated with the aqueduct diversion.

### Access Tracks

5.2.10 Access tracks are proposed at several locations throughout the Proposed Scheme. These are often parallel to the mainline alignment and provide access to SuDS basins or for landowners.

5.2.11 The volumes of peat that will need to be excavated for the access tracks have been calculated on the same basis as for the mainline alignment, in so far as the access tracks are formed of embankments, widenings, cuttings and 'other earthworks'. In this respect, embankments and other earthworks in peat will require excavation beyond the design footprint to accommodate a below-ground structural embankment, and widenings or cuttings will have a band equivalent to a width four times the depth of the peat in which only 50% of the peat need be excavated.

5.2.12 The excavation figures presented in **Table 1** assume that any access tracks or parts thereof will not be floated, as this is a matter for detailed design. However, estimates of the potential for reducing peat excavation through the use of floating roads in areas where peat exceeds 1.00m in depth are presented in later sub-sections.

### Permanent SuDS Basins

5.2.13 The permanent SuDS basins proposed are considered to consist of a combination of cuttings and bunds to form enclosed basins in which road run-off can be temporarily retained to filter solid and solute contaminants, and reduce the rate of run-off to watercourses.

5.2.14 Under the footprint of bund areas, it is assumed that, similar to embankments where they are constructed in areas of peat, there will need to be a lateral extension of the footprint to accommodate a below ground extension of the bund to a stratum of sufficient bearing capacity. Under the footprint of cuttings, it is assumed that all peat will be excavated except in a band equivalent to four times the depth of the peat at the top of the cutting slope. Within this band it is assumed that only 50% of the peat will need to be excavated as shown in **Figure 3**.

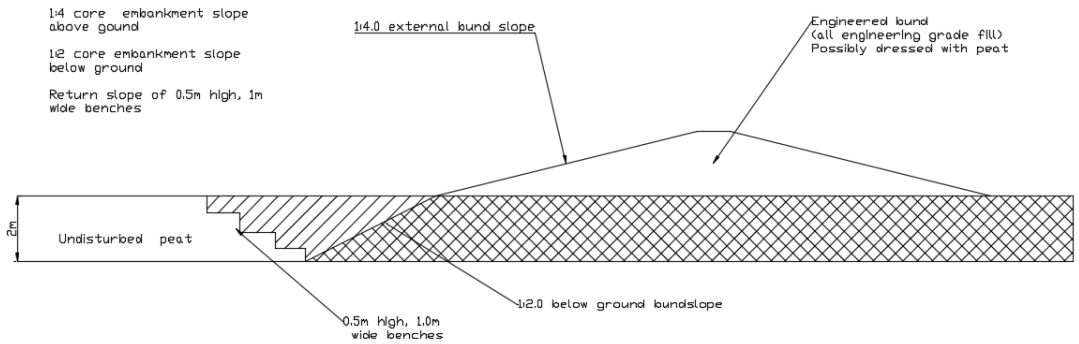


*Figure 3: Calculation of Excavation and Re-instatement Volumes (Permanent SuDS Basins)*

### Drainage

5.2.15 Throughout the Proposed Scheme, there are a series of open cut-off drains to capture upslope run-off before it reaches the tops of widenings and cuttings, and to capture run-off from embankments on the downslope side. The linear nature, and consistent cross-sectional geometry of these drains, allows for peat excavation volumes to be calculated using the average peat depth within a 50m long section of drain and hence the area of the trapezoidal cross-section of the drain occupied by that depth of peat.

5.2.16 **Figure 4** shows the considerations in this calculation and it is assumed that all peat excavated to create the drain must be re-instated or re-used elsewhere.

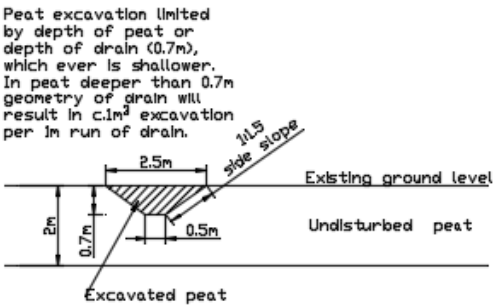


*Figure 4: Calculation of Excavation and Re-instatement Volumes (Cut-off Drains)*

5.2.17 In addition to the cut-off drains, several cross-drain culverts with the specific purpose of maintaining hydrological pathways are proposed along the Drumochter Estate access track to the east of the southern portion of the Proposed Scheme. It is assumed that all peat is excavated to create the drain and must be re-instated or re-used elsewhere. However, wherever possible, drains should be lined with peat turves stripped during their creation.

### Watercourse Diversions

5.2.18 The Proposed Scheme cuts across numerous existing surface watercourse features; some of which are artificial drains cut to facilitate the existing road, and some of which are natural watercourses. Watercourse diversions have been designed to ensure the continued transfer of flow from the upslope/ upstream side to the downslope/ downstream side via bridges or culverts. These watercourse diversions are of varying dimensions and so have been assessed individually, with the required excavation volumes calculated based on peat depth within a 50m section and the dimensions of the watercourse diversion. It is assumed that all peat excavated for the watercourse diversion will require re-instatement or re-use elsewhere.

### Compensatory Flood Storage Areas

5.2.19 Several compensatory flood storage areas are proposed throughout the Proposed Scheme, to compensate for the loss of existing flood storage capacity through construction within the extent of the 1:200 return period flood level. Each of these areas will be subject to detailed design and are likely to be terraced in nature. However, it is presently assumed that their construction will typically require removal and setting aside of soils or peat turves, to a maximum depth of 0.50m, removal of the underlying material (be that deeper peat, substrate or bedrock) by a further 1.00m, before re-instatement of soils or peat turves to create an area 1.00m lower than existing ground level. Peat turves to be reinstated should be stored in accordance with the guidance given in Paragraphs 6.3.5 to 6.3.8 of this plan.

5.2.20 In most instances, these areas are proposed to be cut into existing sloping ground adjacent to watercourses and **Figure 5** shows the consideration applied in calculation of excavation volumes.

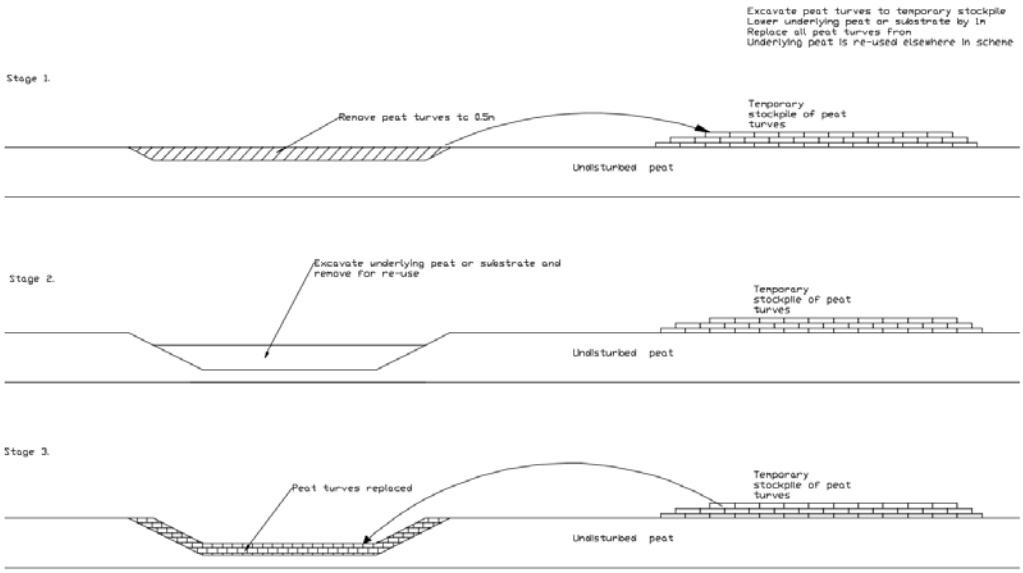


*Figure 5: Calculation of Excavation and Re-instatement Volumes (Compensatory Flood Storage)*

### Temporary Works

5.2.21 Although land is included within the Proposed Scheme boundaries for temporary works, the locations and nature of temporary activities do not form part of the design at this stage. The impacts of these activities on peat excavation volumes therefore cannot be quantified. However, it is anticipated that the following temporary works activities may result in impacts on peat:

- Temporary SuDS requirements
- Haul roads for construction traffic and material transport
- Temporary storage of excavated materials (including peat).

5.2.22 For temporary SuDS and related drainage, peat disturbance shall be avoided by additional micro-siting during detailed design and construction to avoid excavation in areas of peat and where this is not possible, the use of above-ground solutions requiring no or limited excavation, such as siltbusters. Any areas of peat which are unavoidable, and in which excavation is required for temporary SuDS, shall be fully re-instated by the Contractor following construction.

5.2.23 In the case of haul roads, these shall avoid areas of peat wherever possible and, where they must cross areas of deep peat (deeper than 1.00m), floated track construction shall be considered. It is anticipated that all temporary access roads will be fully re-instated following construction.

5.2.24 As previously noted, temporary storage of peat shall also be avoided wherever possible by transporting excavated peat and peaty soil to allocated potential re-use locations. However, for where this may not be possible during construction; provisional locations which are likely to be suitable for temporary storage have been identified and are shown in **Drawings 10.39** to **10.47** (**Volume 3**).

5.2.25 Analysis of the areas indicates that there is sufficient space within the permanent and temporary works boundaries for all shallow and deep peat and the vast majority of peaty soil. The remaining amount of peaty soil, which is a small proportion of the overall volumes generated, should be able to be accommodated through sensible sequencing of construction.

### Excavation and Re-instatement Volumes

5.2.26 The excavation and re-instatement volumes for the Proposed Scheme are presented as volumes of peaty soil and topsoil (less than 0.50m thickness), shallow peat (between 0.50 and 1.00m thickness) and deep peat (greater than 1.00m thickness) in **Table 1**. The residual estimated excavation volumes for each category are also highlighted and illustrated for each section and element of the Proposed Scheme considered in **Drawings 10.6.1** to **10.6.15** (**Volume 3**). Each category refers to the total peat depth in a given $m^2$ area. As such, all volumes in **Table 1** include both acrotelm and catotelm, with this further considered below.

*Table 1: Estimated Peaty Soil/ Topsoil and Peat Excavation and Re-instatement Volumes*

| Scheme Element[1] | Initial Excavation ($m^3$) | | | Volume of Re-instatement at the Point of Excavation ($m^3$) | | | Residual Excavation Volume ($m^3$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Peaty Soil/ Topsoil | Shallow Peat | Deep Peat | Peaty Soil/ Topsoil | Shallow Peat | Deep Peat | Peaty Soil/ Topsoil | Shallow Peat | Deep Peat |
| Mainline Alignment | 51,538 | 19,107 | 3,302 | 279 | 166 | 67 | 51,260 | 18,940 | 3,234 |
| Dalwhinnie Junction | 16,357 | 16,129 | 7,990 | 321 | 493 | 146 | 16,036 | 15,636 | 7,844 |
| SSE Aqueduct Diversion | 1,812 | 3,605 | 798 | 20 | 31 | 0 | 1,792 | 3,573 | 798 |

| Scheme Element[1] | Initial Excavation ($m^3$) | | | Volume of Re-instatement at the Point of Excavation ($m^3$) | | | Residual Excavation Volume ($m^3$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Peaty Soil/ Topsoil | Shallow Peat | Deep Peat | Peaty Soil/ Topsoil | Shallow Peat | Deep Peat | Peaty Soil/ Topsoil | Shallow Peat | Deep Peat |
| Access Tracks | 6,851 | 2,400 | 23 | 196 | 237 | 1 | 6,655 | 2,164 | 23 |
| Permanent SuDS Basins | 4,625 | 886 | 0 | 35 | 1 | 0 | 4,590 | 884 | 0 |
| Drainage | 4,845 | 1,801 | 672 | 0 | 0 | 0 | 4,845 | 1,801 | 672 |
| Watercourse Diversions | 6,760 | 4,038 | 1,512 | 0 | 0 | 0 | 6,760 | 4,038 | 1,512 |
| Compensatory Flood Storage Areas | 2,641 | 256 | 68 | 2,641 | 190 | 31 | 0 | 66 | 37 |
| **Totals** | **95,429** | **48,222** | **14,365** | **3,492** | **1,118** | **245** | **91,938** | **47,102** | **14,120** |

**Table Notes:**

1. Estimated volumes assume the existing Beauly-Denny powerline access track is not re-instated prior to construction of the Proposed Scheme.

5.2.27 Based on acrotelm-catotelm contact observed within the study area and the total estimated excavation volumes, **Table 2** provides details of the estimated volume split between these two layers for shallow and deep peat. In doing so, an average acrotelm depth of 0.09m has been applied across all scheme elements with the exception of Dalwhinnie junction, where this was distinctly and locally thicker at 0.20m.

*Table 2: Estimated Peat Excavation and Re-instatement Volumes (Acrotelm-Catotelm)*

| Scheme Element | Initial Excavation ($m^3$) | | Volume of Re-instatement at the Point of Excavation ($m^3$) | | Residual Excavation Volume ($m^3$) | |
|---|---|---|---|---|---|---|
| | Acrotelm[1] | Catotelm | Acrotelm[1] | Catotelm | Acrotelm[1] | Catotelm[2] |
| Mainline Alignment | 2,841 | 19,568 | 53 | 181 | 2,788 | 19,387 |
| Dalwhinnie Junction | 2,756 | 21,363 | 147 | 492 | 2,609 | 20,871 |
| SSE Aqueduct Diversion | 548 | 3,855 | 9 | 22 | 539 | 3,832 |
| Access Tracks | 341 | 2,081 | 59 | 178 | 282 | 1,903 |
| Permanent SuDS Basins | 119 | 767 | 0 | 0 | 118 | 766 |
| Drainage | 387 | 2,082 | 0 | 0 | 387 | 2,082 |
| Watercourse Diversions | 874 | 4,676 | 0 | 0 | 874 | 4,676 |
| Compensatory Flood Storage Areas | 40 | 284 | 0 | 221 | 40 | 63 |
| **Totals** | **7,906** | **54,675** | **269** | **1,095** | **7,637** | **53,580** |
| **Ratio (acrotelm: catotelm)** | **1:7** | | **1:4** | | **1:7** | |

**Table Notes:**

1. Although acrotelm layers have been recorded to be absent, impacted or thin; it is recommended that for the purposes of construction, re-use and re-instatement, that where a sufficient peat depth exists, the top 0.50m should be treated as acrotelm. This will allow excavation of intact turves for re-instatement purposes which will in turn facilitate quicker regeneration of disturbed areas.

2. Based on data presented in **Appendix 10.1** (**Volume 2**), no evidence of nearly complete to completely decomposed (amorphous) peat (H9 or H10) has been observed based on von Post (Hobbs, 1986) classifications. However, of the calculated residual catotelm quantities, approximately 16% (equivalent to **8,573m$^3$**) may be strongly decomposed (H7 or greater) and for which re-use options may be more limited than less decomposed peat.

## 5.3 Residual Excavation and Re-use Volumes

### Landscape Restoration

5.3.1 Residual peaty soil and topsoil volumes may locally be re-used as dressing of widening, cutting and embankment slopes and verges within the Proposed Scheme; to assist creating tie-ins with the surrounding topography, habitats and landscape. This would be undertaken in accordance with the requirements of the Outline Habitat Management Plan (OHMP) in **Appendix 12.11** (**Volume 2**) and soils would be removed as turves where necessary and possible, to keep as much of these with the vegetation mat, and re-instated as such.

5.3.2 It is estimated that the scheme has capacity for all peaty soil and topsoil generated to be used this way, based on a topsoil depth of 0.20m; which can be increased if a greater volume of peaty soil is generated, or where turves are of a greater thickness. Additional capacity may also be available for re-use this way surrounding proposed SuDS basins or in re-instatement of temporary works areas.

5.3.3 It additionally may be possible for small proportions of excavated and sympathetically handled shallow peat finished with acrotelm peat turves, to be re-used as dressing and re-instatement for selected sections of access tracks – particularly if these are floated, and if selected lengths of the existing Beauly to Denny Powerline track at Drumochter are suitable. In such instances, peat and acrotelm peat turves could be deposited where consistent with adjacent soils and vegetation, and where the adjacent substrate (placed or *in situ*) is peat. These would be placed on one or both sides of the track, adjacent to the track surface and used to form variably gentle slopes (minimum 1:5) which gradually grade raised verges into the surrounding land and retain existing habitat and vegetation. Low angles of re-instated slopes would reduce run-off and therefore reduce peat loss and improve the likelihood of successful vegetation regeneration along verges.

5.3.4 Finally, in areas where new planting or woodland is proposed, it may be possible for more strongly decomposed peat (**Table 2**) to be used as an add mixture to the replanting area as a soil improver, to ensure success of the vegetation being planted.

### Habitat Re-instatement, Restoration and Creation

5.3.5 Residual volumes of shallow peat and deep peat are also proposed to be re-used, and potential areas for this have been identified. These areas are considered to be suitable for use if required, for temporary peat storage, but are also generally considered to be of suitable slope, existing and surrounding ecology and hydrology, where re-use of peat, along with possible selected local water table restoration could re-instate, restore and create extended or improved peat-based habitats. These include existing areas of wet heath, bog, dry heaths or grasslands, some of or proportions of which are fragmented or degraded, within or adjacent to points of peat excavation and the permanent and temporary works boundaries.

5.3.6 The locations and extents of the areas are shown in **Drawings 10.39** to **10.47** (**Volume 3**) and photographs of each are provided in **Annex 10.6.1**. The Contractor may also identify additional or alternative areas for peat re-use within the temporary and permanent boundaries of the Proposed Scheme or elsewhere, by agreement with landowners or stakeholders prior to or during construction. However, the outline objectives in proposing utilisation of those presently identified is to:

- Ensure residual volumes of excavated peat from the Proposed Scheme are re-used in areas where ecological benefits and maintained or increased carbon sequestration can be delivered

- Promote the re-use of excavated peat materials and avoid their disposal to landfill
- Promote use of novel and best practices, and ensure that benefit is made from experience on other sites in re-using materials for ecological enhancement
- Complement planned mitigation identified in the OHMP in **Appendix 12.11** (**Volume 2**); to contribute to an existing mosaic of habitats and promote the restoration, re-instatement or extension of blanket bog and/ or wet heath communities that may be impacted at the margins of the Proposed Scheme, for integration with and enhancement of adjoining areas.

5.3.7 Based on these objectives, the potential outline re-use activities that may be undertaken within the areas include:

- Placement, spreading and appropriate profiling/ tapering of excavated peat, with local removal of acrotelm turves where necessary for re-capping, or capping with otherwise excavated acrotelm turves, as available from nearby, to variable depth. Care will be taken to avoid discontinuities with the adjacent landforms, habitats and topography and the use of mulchings or cuttings from healthy heath/ bog habitats shall also be considered as a seed source for restoring sphagnum to bare peat, as the Cairngorms Peatland project has trialled this with success
- Blocking of minor active drains using peat turves, plastic piling and/ or heather bales to restrict drain flows and raise water levels sufficiently where present, to create conditions for sphagnum, cotton grasses and cross-leaved heather development (as appropriate). Where appropriate, such drains may also be smothered with peat to ensure a continuous peat cover
- The inclusion of check-dams or off-takes in major drains and watercourse diversions and cut-off drains which flow through some areas, to assist maintaining high water tables, but allow excess flow to pass through
- Following peat placement, temporary fencing around the areas and cessation of burning activities will be considered, to aid the restoration process, with seed/ vegetation cut from nearby areas and used as a mulch to protect any bare ground present and act as a seed source.

5.3.8 These outline activities are consistent with the basic OHMP objectives in **Appendix 12.11** (**Volume 2**) and particular attention would be given to the nature of the peat being re-used. In this respect for example, nutrient-rich peat (i.e. that excavated from floodplain areas) would only be considered suitable for re-use in areas with similar hydrological conditions, and would not be re-used where nutrient-poor ombrotrophic conditions prevail.

5.3.9 Based on the above, **Table 3** presents the outline objectives, re-use activities and maximum potential capacity of peat re-use within each potential area that has been identified. Existing vegetation in each area would be managed in accordance with the requirements of and the target NVC communities within the OHMP in **Appendix 12.11** (**Volume 2**), while also considering the nature of temporary construction activities (material storage etc.) that may be undertaken within them.

*Table 3: Candidate Peat Re-Use Areas – Objectives, Activities and Re-Use Volumes*

| Area Ref. | Area ($m^2$) | Existing Conditions | Objectives[1] | Potential Re-use and Other Activities[2] | Estimated Re-use Volume ($m^3$)[3] | Comments/ Considerations for Re-use |
|---|---|---|---|---|---|---|
| P01 | 3,272 | Degraded bog and heath over peaty soil and shallow peat | Reinstate and restore to wet heath/ blanket bog within and adjacent to permanent works boundary | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 1,636 | Channel at south-end of area too incised to realistically provide water.<br>However, minor drains cross afforested area to the east and could provide hydrological connectivity from upslope areas.<br>Cut-off drain at top of proposed low cutting adjacent to the area would be proposed to be lined, so that it only carries excess surface run-off and does not lower water table under normal conditions. |
| P02a and P02b | 2,542 (P02a) and 504 (P02b) | Mixture of heath, grassland and degraded bog over peaty soils | Reinstate and create wet heath/ blanket bog within and adjacent to permanent works boundary | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 1,271 (2a) and 252 (2b) | Inclusion of check-dams in proposed watercourse diversion and the existing drain to the east would be required to maintain high groundwater levels during normal conditions, but allow flood flows to pass through. |
| P03 | 1,557 | Area of wet heath, mire and degraded bog over peaty soils | Reinstate and restore to wet heath/ blanket bog within and adjacent to permanent works boundary | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 779 | Site observations indicate the northern part of the area is likely to be most suitable for re-use, with the southern part likely to require tapering of any peat placed to tie-in with existing slopes. However, minor drains cross afforested area to the east and could provide hydrological connectivity from upslope areas.<br>Cut-off drain at the base of the proposed low embankment (or removal of this entirely if possible) adjacent to the area would be proposed to be lined, so that it only carries excess surface run-off and does not lower water table under normal conditions. |
| P04 | 5,333 | Area of fragmented shallow and deep peat, wet heath, degraded bog and local grassland adjacent to the proposed Dalwhinnie junction | Join and extend fragmented areas of shallow and deep peat-based habitats and create wet heath/ blanket bog within and adjacent to permanent and temporary works boundaries | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 2,667 | Water supply from plans appears difficult. However, site observations of the area indicate that this is part of a wide north-south hydrological pathway draining toward Allt Coire Bhathaich.<br>The area is low lying and likely to be a natural recipient of precipitation and run-off from surrounding and slightly more elevated areas. |
| P05 and P07 | 7,764 (P05) and 1,816 (P07) | Areas of fragmented shallow and deep peat, wet heath, degraded bog, local grassland and other mire adjacent to the proposed Dalwhinnie junction | Reinstate, join and extend fragmented areas of shallow and deep peat-based habitats and create wet heath/ blanket bog within and adjacent to permanent and temporary works boundaries | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Existing minor drainage channels within the area to be blocked using peat turves, plastic piling and/ or heather bales to restrict outflows from the area and raise water levels as high as possible during normal conditions. | 3,882 (P05) and 908 (P07) | The area is crossed by drainage channels, some of which will be cut off from the upstream water supply on the east side of the Proposed Scheme. However, the hydrology of the area will continue to be supplied from embankment slopes.<br>Cut-off drains at the toe of the proposed embankment would be recommended to be removed if possible, to allow more natural drainage through and towards the area. |
| P06a and P06b | 20,588 (P06a) and 6,498 (P06b) | Large area of mire and wet heath adjacent to expanse of drained but locally good condition blanket bog at Dalwhinnie junction | Reinstate and extend deep peat cover, improve and restore to blanket bog within and adjacent to permanent and temporary works boundaries | Placement of peat to a depth of up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Existing minor drainage channels within the area to be blocked using peat turves, plastic piling and/ or heather bales to restrict outflows from the area and raise water levels as high as possible during normal conditions. | 20,588 (P06a) and 6,498 (P06b) | The area is relatively flat and wet, with several hollows which may be able to receive deeper peat if undulating topography preculdes it in other areas.<br>Numerous small artificial drains cross the area as noted, the blocking of which will assist in retaining high groundwater levels. |
| P08 | 1,474 | Mixture of dry and wet heath | Reinstate, join and extend fragmented areas of shallow and deep peat-based habitats and create wet heath/ blanket bog within and adjacent to permanent and temporary works boundaries | Placement of peat or peaty soils to a depth of up to 0.50m or less, with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 737 | Off-takes from the proposed pre-earthworks drainage to the east and watercourse diversion to the north could supply water to the area, but this may be locally difficult due to sloping ground.<br>The area is also upslope of the SSE aqueduct and specific further assessment and consideration of stability will be required as a result, as should a failure of placed peat occur, it may run-out into this. Peaty soil re-use may therefore be more appropriate. |
| P09 | 3,196 | Area of dry heath, grassland and degraded blanket bog over peat soils and adjacent to fragmented pockets of shallow and deep peat | Reinstate, join and extend fragmented areas of shallow and deep peat-based habitats and re-instate and create wet heath/ blanket bog within temporary works boundary | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 1,598 | Some surface water is evident in the wetter parts of this area. However, off-takes from proposed watercourse diversions and check-dams in the channels may be necessary ensure the area is sufficiently wet.<br>Lining of the proposed cut off drain at the top of the proposed cutting would assist in maintaining high groundwater levels during normal conditions. |
| P10 | 4,963 | Area of wet heath and degraded bog over peaty soil adjacent to Cuaich farm settlement | Re-instate and restore area to wet heath/ blanket bog within temporary works boundary | Placement of peat to a depth of up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 4,963 | Water is already present at the surface of the area. However, inclusion of an off-take from the watercourse near the northern end may provide additional supply.<br>Removal of cut-off drains from the base of proposed embankments adjacent to the area, and bunding around the northwestern and northern edges may also assist retention of water. |
| P11 | 18,141 | Mixture of wet heath, dry heath and grassland over peaty soils adjacent to upslope areas of wet heath and blanket bog | Re-instate, create and extend areas of wet heath | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 9,070 | Water supply to the area would be from upslope, with a number of visible small channels present which would bring water into the area. |
| P12 | 7,517 | Area of wet heath, local degraded bog and grassland over peaty soils | Improve existing wet heath/ blanket bog and create wet area which may be beneficial for reducing the speed of flood flows to larger watercourses. | Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Existing minor drainage channels within the area to be blocked using peat turves, plastic piling and/ or heather bales to restrict outflows from the area and raise water levels as high as possible during normal conditions. | 3,759 | A bund was observed running through the north-western part of the site which would require further investigation.<br>However, removal or breach of this feature may enable wetter conditions to be maintained combined with the inclusion of check dams in the watercourse which passes through the area. |

| Area Ref. | Area ($m^2$) | Existing Conditions | Objectives[1] | Potential Re-use and Other Activities[2] | Estimated Re-use Volume ($m^3$)[3] | Comments/ Considerations for Re-use |
|---|---|---|---|---|---|---|
| P13 | 3,630 | Area of wet heath and local dry heath over peaty soils | Re-instate, join and extend locally fragmented areas of wet heath | Placement of peat or peaty soils to a depth of up to 0.50m or less, with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required. | 1,815 | Site observations have indicated that the nature of the ground is sloping, with water likely to be received upslope and some minor drainage channels which may be blocked.<br>While the Proposed Scheme design shows the area adjacent to a small embankment, the lie of the natural ground would place the area identified above the road, so specific further assessment and consideration of stability would be required, which may inform that peaty soil re-use here is more appropriate. |
| P14a and P14b | 1,918 (14a) and 2,129 (14b) | Areas of wet heath and dry heath over peaty soil in hollow, where proposed wide and shallow embankment will be created | Improve and extend with adjacent wet heath areas and create a wetland area in the topographic low created by the Proposed Scheme | Placement of peat to a depth sufficient to create the low embankment form, removing cut-off drain from the design and creating off-takes from the adjacent watercourses if necessary. | 2,877 (14a) and 3,149 (14b) | Area is likely to receive water from upslope.<br>However, detailed design of the central watercourse culvert entrance should take account of the requirement to prevent erosion and deposition of peat in the culvert.<br>Ways to prevent and slow drainage from these areas to the surrounding watercourses should also be considered. |
| | | | | **Total** | **66,449** | |

**Table Notes:**

1. The objectives for each area are outline and shall be subject to additional consideration and design by the Contractor via the construction-stage Peat Management Plan and Habitat Management Plan.

2. The potential re-use activities are outline and shall be subject to additional consideration and design by the Contractor via the construction-stage Peat Management Plan and Habitat Management Plan, which would enable refinement of where identified re-use areas overlap slightly with Proposed Scheme infrastructure elements.

3. The potential re-use activities are outline and the estimated re-use volumes are potential maximums, which have been adjusted where or if relevant based on the current understanding of existing habitat/ vegetation conditions. Both shall be subject to additional consideration and design by the Contractor via the construction-stage Peat Management Plan and Habitat Management Plan, which would enable refinement of the re-use volumes, accounting for appropriate profiling, compression and blading off etc. taking account of the surrounding topography, landform and habitats

### Potential Re-use for Other Purposes

5.3.10 A total of fourteen SuDS detention basins form part of the Proposed Scheme, with some of these potentially representing an opportunity to re-use a proportion of deeper excavated peat in an environmentally beneficial way, and in locations close to the point of excavation. In such circumstances, peat could potentially be included within the main (downstream) basin, which may carry the following benefits:

- Unlike the sediment forebay, which receives run-off directly from the road, the main basin of the SuDS would not require periodic maintenance emptying and would receive already filtered water. The predominant function of the peat and the main basin more generally would be to reduce the rate of run-off from the road and to capture any remaining carbon based contaminants which pass through the sediment forebay
- SuDS basins can be over-excavated (over-deepened) by up to 2.00m into substrate or bedrock, to generate the capacity for the peat, at the same time generating additional fill for use in road construction. Where peat is removed from the footprint of the basin in this respect, it could be placed directly back into the basin
- The detailed design of the main basins can be such that the outfall is above the level of the re-used peat, ensuring that fully saturated conditions exist in the peat before any of the water is drained from it
- Depending on the location of the basin and the nature of the excavated peat, detailed design of the main basin can either incorporate lining, to prevent seepage to surrounding soils and prevent nutrient inputs from groundwater sources, or leave the basin unlined so that exchange of nutrients from shallow groundwater can take place. Discussion with SEPA Regulatory Services and local water team should take place during detailed design to determine whether a lining is required.

5.3.11 At the locations of proposed SuDS 258 and 259 to the east of Cuaich, and at SuDS 225 adjacent to A889 link road from Dalwhinnie junction, significant excavations of shallow and deep peat are anticipated and the above would enable at least some of this to be re-used very close to the point of excavation. Based on this, **Table 4** presents the maximum potential capacity of potential peat re-use within SuDS basins at varying depth, excluding those considered to be unsuitable based on the existing ecological and peat conditions, and where their locations would hinder re-use due to a requirement to transport peat across a live carriageway.

*Table 4: SuDS Basin Potential Capacity for Peat Re-use*

| SuDS Ref. | Approximate Chainage (Ch.) | Maximum Potential Capacity for Re-use | | | Comments/ Considerations for Re-use |
|---|---|---|---|---|---|
| | | 0.50m deep ($m^3$) | 1.00m deep ($m^3$) | 2.00m deep ($m^3$) | |
| SuDS 225 | ch. 22,500 | 507 | 1,013 | 2,026 | Existing area of dry heath with degraded bog and wet heath, located in direct proximity to area of deep peat excavation which may enable re-use close to the point of excavation. |
| SuDS 233 | ch. 23,300 | 55 | 115 | 230 | Existing area of dry heath and grassland over shallow peat and peat soils, located directly adjacent to large areas of blanket mire and excavation of shallow and deep peat at Dalwhinnie junction. Would enable re-use adjacent to points of excavation. |

| SuDS Ref. | Approximate Chainage (Ch.) | Maximum Potential Capacity for Re-use | | | Comments/ Considerations for Re-use |
|---|---|---|---|---|---|
| | | 0.50m deep ($m^3$) | 1.00m deep ($m^3$) | 2.00m deep ($m^3$) | |
| SuDS 254 | ch. 25,400 | 777 | 1,554 | 3,108 | Located within felled area of Lechden Woods over peaty soils. Adjacent drainage works to the north are likely to require excavation of shallow or deep peat from wet heath and mire areas, which may enable re-use close to the point of excavation in afforested area. |
| SuDS 258 | ch. 25,800 | 293 | 586 | 1,172 | Existing area of wet heath, grassland and mire over shallow and deep peat – which will be excavated to create the basin and adjacent works. Would enable re-use at the point of excavation. |
| SuDS 259 | ch. 25,900 | 71 | 142 | 284 | Existing area of grassland adjacent to wet heath, mire and grassland mosaic over peaty alluvial soils. Adjacent SuDS 258 and other works will require excavation of shallow and deep peat in this area, and re-use adjacent to the point of excavation would be possible here. |
| SuDS 286 | ch. 28,600 | 229 | 457 | 914 | Existing area of dry heath and grassland over peaty alluvial soils. Adjacent works may require excavation of shallow peat within areas of degraded bog and dry heath, enabling re-use close to the point of excavation. |
| **Totals** | | **1,932** | **3,752** | **7,734** | |

5.3.12 There are also a range of proposed compensatory flood storage areas which form part of the Proposed Scheme. It is already assumed in the excavation calculations that the top 0.50m of peat (or the maximum depth of peaty soil) will be re-instated following excavation of these areas to the required depth. However, there is also the possibility of over-excavating some, or some parts, of the storage areas with the specific purpose of creating low-lying wet areas which may be able to receive groundwater or surface water inputs from the surrounding ground.

5.3.13 Not all the areas identified for compensatory flood storage will be appropriate for over-excavation, and it is recognised that over-excavation of some may require excavation of peat additional to that already estimated. Notwithstanding and in outline, initial estimates indicate that there is a potential capacity for the re-use of approximately **15,000m³** of shallow and deep peat, if additional re-use depths are limited to an average of 1.00m within this context, and more if average re-use depths can be greater. Detailed design of the compensatory flood storage areas should consider the net peat balance of each storage area, it's capacity to accommodate additional peat of an appropriate nature from elsewhere in the Proposed Scheme and expected fluctuations in water table depth to ensure peat does not dry out.

## 5.4 Net Balance

5.4.1 At this stage, it is not possible to be any more precise about the exact volumes of peat that will be re-used in the various ways and opportunities identified. Further stages of design beyond this OPMP will be required to refine the re-use proposals and identify those which are most suitable.

5.4.2 It is considered that the peat balance indicates there is sufficient capacity in the permanent and temporary works boundaries and potential areas identified, for re-use of the residual **91,938m³** of peaty soil and topsoil, **47,102m³** of shallow peat and **14,120m³** of deep peat that may be excavated during construction.

5.4.3 For shallow and deep peat, the balance is comprised from a maximum potential capacity for re-use of **up to 66,449m³** in identified candidate habitat re-instatement, restoration and creation

areas, and **up to 22,000m$^3$** potential capacity re-use if SuDS and compensatory flood storage areas with minimal over-excavation is undertaken specifically to provide environmental benefits, more with slightly deeper excavation. Additional capacity is also likely to be possible via local floated access track-side verge re-instatement (where conditions permit to adopt this), or other re-instatement and restoration required for temporary works or storage areas, as referenced in the OHMP in **Appendix 12.11** (**Volume 2**).

5.4.4 As a result, the estimates indicate that no, or very little, surplus peat will be generated, resulting in no, or very limited, net loss arising from construction of the Proposed Scheme.

# 6 Excavation, Storage, Re-use and Monitoring

## 6.1 General

6.1.1 While the peat balance has estimated that the Proposed Scheme has appropriate provision for peat excavated during construction, it will be essential that good practice measures are employed by the Contractor prior to, during and following the construction period. The following sections outline minimum good practice measures that the Contractor shall adopt in this respect, to ensure that peat deposits are appropriately handled, managed and re-used. Additional detail on these measures is also included in **Annex 10.6.2**.

## 6.2 Good Practice Prior to Construction

### Peat Model Refinement

6.2.2 Prior to construction, the peat depth model for the Proposed Scheme shall be refined by the Contractor considering any additional ground investigation or survey information that becomes available in preparation for construction. The revised model should then provide further information to enable additional refinement of the volume estimates for all Proposed Scheme elements, such that additional design and micro-siting can be employed to further minimise excavation volumes where possible.

### Construction-stage Peat Management Plan

6.2.3 Prior to construction, and based on any additional refinement of the peat model that is possible, and further detailed design, the OPMP shall be refined by the Contractor in consultation with SEPA, SNH and CNPA as necessary. This will become the construction-stage Peat Management Plan (PMP) and shall include as a minimum, refinement of estimated volumes of peat that will be excavated, details of where and how excavated peat will be used in re-instatement, landscaping, habitat restoration or other ways, and details/ method statements related to its excavation, storage, transportation, handling and monitoring for doing so.

### Monitoring

6.2.4 Outline monitoring requirements for additional baseline establishment prior to construction, assessing change to peatland areas during construction and following construction, and for monitoring the proposed habitat restoration and creation areas following peat placement post-construction are provided in **sub-section 6.4**. To obtain the greatest value from the monitoring, it is essential that baseline conditions, particularly ecology and hydrology, are well understood and used to set realistic targets for post-construction mitigation and restoration.

## 6.3 Good Practice during Construction

### Excavation

6.3.2 During the construction of all infrastructure, the Contractor shall adopt the following good practice in relation to peat excavation:

- Peat turves shall be excavated as intact blocks of upper peat comprising the surface vegetation layer (acrotelm) and adjoining upper catotelm
- Underlying turves shall be extracted as close to intact as is feasible, with remoulding by the excavator kept to a minimum
- Excavation of contaminated peat turves (those incorporating substrate) shall be avoided if possible, and where unavoidable, these shall be stored separately to non-contaminated peat turves to avoid further contamination on re-instatement, re-use or during transport.

6.3.3 Where possible and practical, a technique known as 'macroturfing' (large scale cutting and re-laying of turf blocks) (Bruelheide and Flintrop, 2000) shall be employed during construction, to extract intact full depth acrotelm layers from the top surface of the peat deposits. This technique will maintain connectivity between the surface vegetation and the partially decomposed upper layers of the catotelm.

6.3.4 Classification of excavated materials will depend on their identified re-use or re-instatement. For the Proposed Scheme, it is anticipated that the material to be excavated will comprise peaty soils and topsoil, peat (which may be sub-divided into fibrous, pseudo-fibrous, locally amorphous peat and turf), mineral soils (substrate) and rock.

### Temporary Storage

6.3.5 Temporary storage of peat shall be avoided where possible by re-instating or transporting it to allocated re-use locations, to minimise the volume in storage, retain as much structural integrity within the peat as possible and to minimise the likelihood of drying. However, this shall not be undertaken at the expense of re-instatement, re-use or restoration outcomes (i.e. if, on balance, storage will produce a better long-term outcome, then storage can be employed prior to re-use).

6.3.6 Several provisional locations for temporary storage have been identified within the permanent and temporary works boundaries of the Proposed Scheme as shown in **Drawings 10.39** to **10.47** (**Volume 3**). These consider available land, setbacks from excavations, proximity to the point of excavation and the level of peat landslide hazard determined by **Appendix 10.5** (**Volume 2**); covering a footprint of sufficient collective area to store excavated peat from nearby locations at a height no greater than 1.00m.

6.3.7 These areas, or alternative and additional ones identified by the Contractor shall be documented in the refined, construction stage PMP, which shall apply the following outline good practice:

- Peat shall be stored at sufficient distance from excavation faces to prevent overburden induced failure. Slope analysis based on geotechnical characteristics derived from additional detailed ground investigation shall be employed to assess failure potential and stand-off distances set appropriately
- Local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes shall be avoided for peat storage

- Stored upper turves incorporating vegetation shall be stored vegetation side up and organised and labelled according to NVC community, under the supervision of the Contractor's Environmental Clerk of Works (EnvCoW) and Ecological Clerk of Works (ECoW), for re-instatement adjacent to like communities within intact surrounding peat
- Stores of catotelm peat shall be smoothed or 'bladed off' to reduce their surface area and minimise desiccation. Where and when required, additional measures to prevent drying such as light irrigation should be used.
- Where transport cannot be undertaken immediately, stored peat shall be irrigated to limit drying and stored on a geotextile mat to promote stability, although this is unlikely to be critical for peat stored less than two months
- Monitoring of peat storage areas during wet weather or snowmelt may be required and shall be undertaken as necessary by the Contractor, to identify any early signs of peat instability.
- Run-off from the stored peat should be managed to avoid impacts to habitats or watercourses.
- Locations for temporary storage should avoid good quality habitat (including areas identified as moderately and/ or highly groundwater dependent terrestrial ecosystems (GWDTE)) and buffers around watercourses appropriate to the location should be determined according to the terrain and sensitivity of the watercourse and storage within these avoided.

6.3.8 It is anticipated that peat will not be stored for more than three years and therefore, will not require a permit under The Landfill (Scotland) Regulations 2003.

### Handling

6.3.9 Following refinement of the peat depth model and preparation of the construction-stage PMP, a detailed storage and handling plan shall be prepared by the Contractor as part of the Construction Environmental Management Plan (CEMP), specifying details of the following:

- The refined estimated excavation volumes at each infrastructure location (including volumes of acrotelm, turf or catotelm)
- The volumes that may require storage locally and volumes that may be transferred directly upon excavation to re-instatement, re-use or restoration areas, in order to minimise handling
- The refined location and size of storage areas (or additional areas) if considered to be required, relative to points of excavation, watercourses, drainage features and slope
- Irrigation requirements and methods to minimise desiccation of excavated peat during short term storage.

### Re-instatement, Re-use and Restoration

6.3.10 The locations and extents of the potential peat re-use areas are shown in **Drawings 10.39** to **10.47** (**Volume 3**) and photographs of each are provided in **Annex 10.6.1**. The Contractor may also identify additional or alternative areas for peat re-use within the temporary and permanent boundaries of the Proposed Scheme or elsewhere, by agreement prior to or during construction.

6.3.11 The following principles shall apply wherever peat is being re-instated or re-used in these areas, or elsewhere as part of construction, for habitat restoration/ re-instatement or in other ways:

- Re-instatement of peat turves shall ensure that surface vegetation is incorporated and where possible, peat turves with vegetation communities similar to the communities present on the intact peat at receiver sites should be used
- Re-seeding of any significant areas of bare peat shall be undertaken with species appropriate to the surrounding peatland and habitats
- Grazing may need to be prevented by installation of fencing until the peat has fully recovered
- If peat does become dewatered/ desiccated, it shall not be exposed at the top of any re-instatement or re-use areas.

### Access Tracks

6.3.12 For floating track sections, if adopted, existing vegetation shall be left in place under the new running surface and adjacent vegetation under the planned shoulder footprint shall be rolled back for emplacement of peat beneath. The rolled vegetation shall then be re-lain over the emplaced peat. For cut-and-fill tracks, any bare peat surfaces created during the construction of side drains shall be re-instated with peat turves to stabilise the surface and prevent drying.

### Drainage Features

6.3.13 As part of the detailed design, a survey of artificial drainage extent and drain slopes shall be undertaken by the Contractor, to fully define the scope of drain re-instatement and volumes of peat (and brash) required to restore them, where proposed or considered possible. Depending upon local slope and proximity of watercourses to drain outflows, the need for plastic or other dam types, and required spacings, shall be determined following the guidance in Armstrong et al, 2009.

### Timing

6.3.14 The available best practice guidance makes various recommendations regarding the preferred seasons in which peat management work should be undertaken, whether for ease of construction or the efficacy of restoration. In practice, these seasonal preferences often conflict. For example, restoration guidance generally indicates that peat turve cutting is best conducted in autumn or winter to minimise drying. However, most construction guidance suggests that major excavation activities should be conducted in drier months, typically during spring and summer.

6.3.15 This scheduling conflict is often difficult to resolve, although the adoption of the good practice measures outlined in this OPMP, and as shall be refined by the Contractor in the construction-stage PMP, especially concerning irrigation, will minimise the effects of these seasonal dependencies.

## 6.4 Monitoring Requirements

6.4.1 Prior to construction, monitoring of groundwater levels in areas of peat and those identified for re-use, shall be undertaken monthly, ideally for a twelve-month period; in order to understand the expected annual cycle of fluctuation in groundwater levels in the context of the planned construction activities and proposed peat re-use.

6.4.2 The groundwater monitoring shall continue during the construction period, when frequent and repeat visual inspections of adjacent peat and habitat restoration and creation areas by a team of suitably qualified geotechnical engineers and Ecological/ Environmental Clerk of Works (ECoW) shall also be undertaken – to monitor for signs of settlement, instability or other impact, to

oversee all peat management, placement and re-use activities and to conduct repeat vegetation/ NVC surveys as necessary in accordance with the OHMP in **Appendix 12.11** (**Volume 2**).

6.4.3 **Table 5** identifies typical monitoring requirements for particular elements of the Proposed Scheme (SNH/ FCS, 2010) during and following construction, and **Table 6** presents example threshold 'stop conditions' under which construction may require to be stopped.

*Table 5: Monitoring During Construction and Post-Construction*

| Scheme Element | Monitoring During Construction | Potential Mitigation | Monitoring Post-Construction | Potential Mitigation |
|---|---|---|---|---|
| All excavations | • monitor water table drawdown around excavation perimeter<br>• monitor free faces for signs of instability (cracking, settlement, standing water)<br>• monitor stored peat for signs of drying or local slumping and collapse | • consider irrigation of peat if signs of drying<br>• reinforce excavation or drain | • monitor backfilled excavation for water table relative to surrounding non-excavated peatland to determine recovery<br>• monitor vegetation cover to ensure acrotelm remains functional | • consider re-routing local surface drainage into former excavation to maintain water levels |
| Access tracks (cut and fill) | • monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage<br>• monitor transitions to floating track sections for settlement | • undertake maintenance of under-track drainage as necessary<br>• undertake remedial work to track as necessary | • monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage | • undertake maintenance of under-track drainage as necessary |
| Access tracks (floating) | • monitor shoulders for drying<br>• monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage<br>• monitor track for lateral displacement and rate of vertical settlement (using line of sight pegs)<br>• monitor for evidence of lateral migration into cable trenches | • consider irrigation of dried shoulders, or re-seeding dry areas with nurse crops tolerant of drier peat<br>• if waterlogging leads to enhanced settlement, consider installation of drains | • monitor shoulders for drying<br>• monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage<br>• monitor track for lateral displacement and vertical settlement | • consider irrigation of dried shoulders, or re-seeding dry areas with nurse crops tolerant of drier peat<br>• if waterlogging leads to enhanced settlement, consider installation of drains |

*Table 6: Threshold 'Stop' Conditions (Used in Ireland) for Floating Road Construction*

| Stop Rule | Requirements[1] |
|---|---|
| High Intensity Rainfall | Rainfall during construction >10mm hour |
| Long Duration Rainfall | Rainfall in the preceding 24 hours >25mm |
| 7-day Cumulative Rainfall (1) | Rainfall 7-days of rainfall >50% of monthly average |
| 7-day Cumulative Rainfall (2) | Preceding 7-days of rainfall >50mm |

**Table Notes:**

1. Monitoring of rainfall for stop conditions would require an appropriate meteorological station to measure these conditions on site, or a suitable local source of data to allow identification of these conditions being exceeded, so that appropriate action can be taken.

6.4.4 Monitoring intervals during construction and post-construction monitoring shall be determined by the Contractor via the refined construction stage PMP.

6.4.5 The Contractor shall also be required to undertake monitoring of the water table within proposed or adopted habitat re-instatement, restoration and creation areas following construction and the implementation of peat re-use works. It would be anticipated that this is undertaken for a period of at least 5 years following peat placement, but a committed

monitoring frequency, duration and approach shall be established and implemented by the Contractor with agreement from SEPA, SNH and CNPA as necessary.

6.4.6 As a minimum, this shall involve the use of pressure transducers and fully perforated dipwells where appropriate, so that a continuous picture of the hydrology in the areas restored and created can be obtained. The monitoring shall cover all major areas of restoration and re-use, and comprise a systematic grid-based approach.

6.4.7 A range of additional treatment work might be required during the monitoring period to help understand the long-term prognosis for excavated peat that has been placed and re-used. This may include:

- Flattening of the re-instated surfaces to try and reduce the degree to which local surface drawdown in the summer will lead to local oxidative wastage of placed peat
- Compacting the peat in places where there is a high degree of void spaces, if evident
- Tapering of the peat masses at its edges
- Removal of any invasive species present, if and as they colonise
- Temporarily fencing off of areas where peat has been re-used and re-seeded or cuttings or mulch have been placed, to prevent grazing of young vegetation and enable heath/ bog vegetation to establish as necessary.

6.4.8 The implementation of these additional treatments and their timing shall be subject to ongoing discussions between the Contractor and SEPA, SNH and CNPA as necessary, and vegetation-based post-placement care measures and monitoring shall also be undertaken in tandem with this work as detailed in the OHMP in **Appendix 12.11** (**Volume 2**).

6.4.9 It is important that good record keeping is undertaken to ensure that the most can be made of the data collected during construction. In relation to peat, these would include photographs and records of as-built and post-construction peat condition around all infrastructure locations, collected by a suitably qualified ECoW.

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# Annex 10.6.1

## Candidate Peat Re-use Areas

| Area Ref. | Photographs and Comments/ Considerations for Re-use |
|---|---|
| P01 |  Degraded bog and heath over peaty soil and shallow peat<br>Reinstate and restore to wet heath/ blanket bog within and adjacent to permanent works boundary<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Channel at south-end of area too incised to realistically provide water. However, minor drains cross afforested area to the east and could provide hydrological connectivity from upslope areas.<br>Cut-off drain at top of proposed low cutting adjacent to the area would be proposed to be lined, so that it only carries excess surface run-off and does not lower water table under normal conditions. |
| P02a and P02b |  Mixture of heath, grassland and degraded bog over peaty soils<br>Reinstate and create wet heath/ blanket bog within and adjacent to permanent works boundary<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Inclusion of check-dams in proposed watercourse diversion and the existing drain to the east would be required to maintain high groundwater levels during normal conditions, but allow flood flows to pass through. |
| P03 |  Area of wet heath, mire and degraded bog over peaty soils<br>Reinstate and restore to wet heath/ blanket bog within and adjacent to permanent works boundary<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Site observations indicate the northern part of the area is likely to be most suitable for re-use, with the southern part likely to require tapering of any peat placed to tie-in with existing slopes. However, minor drains cross afforested area to the east and could provide hydrological connectivity from upslope areas.<br>Cut-off drain at the base of the proposed low embankment (or removal of this entirely if possible) adjacent to the area would be proposed to be lined, so that it only carries excess surface run-off and does not lower water table under normal conditions. |
| P04 |  Area of fragmented shallow and deep peat, wet heath, degraded bog and local grassland adjacent to the proposed Dalwhinnie junction<br>Join and extend fragmented areas of shallow and deep peat-based habitats and create wet heath/ blanket bog within and adjacent to permanent and temporary works boundaries<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Water supply from plans appears difficult. However, site observations of the area indicate that this is part of a wide north-south hydrological pathway draining toward Allt Coire Bhathaich. The area is low lying and likely to be a natural recipient of precipitation and run-off from surrounding and slightly more elevated areas. |
| P05 and P07 |  Areas of fragmented shallow and deep peat, wet heath, degraded bog, local grassland and other mire adjacent to the proposed Dalwhinnie junction<br>Join and extend fragmented areas of shallow and deep peat-based habitats and create wet heath/ blanket bog within and adjacent to permanent and temporary works boundaries<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Existing minor drainage channels within the area to be blocked using peat turves, plastic piling and/ or heather bales to restrict outflows from the area and raise water levels as high as possible during normal conditions.<br>The area is crossed by drainage channels, some of which will be cut off from the upstream water supply on the east side of the Proposed Scheme. However, the hydrology of the area will continue to be supplied from embankment slopes.<br>Cut-off drains at the toe of the proposed embankment would be recommended to be removed if possible, to allow more natural drainage through and towards the area. |

| Area Ref. | Photographs and Comments/ Considerations for Re-use |
|---|---|
| P06 |  Large area of mire and wet heath adjacent to expanse of drained but locally good condition blanket bog at Dalwhinnie junction<br>Extend deep peat cover, improve and restore to blanket bog within and adjacent to permanent and temporary works boundaries<br>Placement of peat to a depth of up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Existing minor drainage channels within the area to be blocked using peat turves, plastic piling and/ or heather bales to restrict outflows from the area and raise water levels as high as possible during normal conditions.<br>The area is relatively flat and wet, with several hollows which may be able to receive deeper peat if undulating topography preculdes it in other areas. Numerous small artificial drains cross the area as noted, the blocking of which will assist in retaining high groundwater levels. |
| P08 |  Mixture of dry and wet heath<br>Join and extend fragmented areas of shallow and deep peat-based habitats and create wet heath/ blanket bog within and adjacent to permanent and temporary works boundaries<br>Placement of peat or peaty soils to a depth of up to 0.50m or less, with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Off-takes from the proposed pre-earthworks drainage to the east and watercourse diversion to the north could supply water to the area, but this may be locally difficult due to sloping ground.<br>The area is also upslope of the SSE aqueduct and specific further assessment and consideration of stability will be required as a result, as should a failure of placed peat occur, it may run-out into this. Peaty soil re-use may be more appropriate. |
| P09 |  Area of dry heath, grassland and degraded blanket bog over peat soils and adjacent to fragmented pockets of shallow and deep peat<br>Join and extend fragmented areas of shallow and deep peat-based habitats and re-instate and create wet heath/ blanket bog within temporary works boundary<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Some surface water is evident in the wetter parts of this area. However, off-takes from proposed watercourse diversions and check-dams in the channels may be necessary ensure the area is sufficiently wet.<br>Lining of the proposed cut off drain at the top of the proposed cutting would assist in maintaining high groundwater levels during normal conditions. |
| P10 |  Area of wet heath and degraded bog over peaty soil adjacent to Cuaich farm settlement<br>Re-instate and restore area to wet heath/ blanket bog within temporary works boundary<br>Placement of peat to a depth of up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Water is already present at the surface of the area. However, inclusion of an off-take from the watercourse near the northern end may provide additional supply.<br>Removal of cut-off drains from the base of proposed embankments adjacent to the area, and bunding around the north-western and northern edges may also assist retention of water. |
| P11 |  Mixture of wet heath, dry heath and grassland over peaty soils adjacent to upslope areas of wet heath and blanket bog<br>Re-instate, create and extend areas of wet heath<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Water supply to the area would be from upslope, with a number of visible small channels present which would bring water into these area. |

| Area Ref. | Photographs and Comments/ Considerations for Re-use |
|---|---|
| P12 |    Area of wet heath, local degraded bog and grassland over peaty soils<br>Improve existing wet heath/ blanket bog and create wet area which may be beneficial for reducing the speed of flood flows to larger watercourses.<br>Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required.<br>Existing minor drainage channels within the area to be blocked using peat turves, plastic piling and/ or heather bales to restrict outflows from the area and raise water levels as high as possible during normal conditions.<br>A bund was observed running through the north-western part of the site which would require further investigation. However, removal or breach of this feature may enable wetter conditions to be maintained combined with the inclusion of check dams in the watercourse which passes through the area. |
| P13 |   Area of wet heath and local dry heath over peaty soils<br>Re-instate, join and extend locally fragmented areas of wet heath<br>Placement of peat or peaty soils to a depth of up to 0.50m or less, with appropriate profiling, tapering and capping with acrotelm turves, suitable vegetation or seeding as required<br>Site observations have indicated that the nature of the ground is sloping, with water likely to be received upslope and some minor drainage channels which may be blocked, but hydrology generally may be difficult.<br>While the Proposed Scheme design shows the area adjacent to a small embankment, the lie of the natural ground would place the area identified above the road, so specific further assessment and consideration of stability would be required, which may inform that peaty soil re-use here is more appropriate. |
| P14a and P14b |   Areas of wet heath and dry heath over peaty soil in hollow, where proposed wide and shallow embankment will be created<br>Improve and extend with adjacent wet heath areas and create a wetland area in the topographic low created by the Proposed Scheme<br>Placement of peat to a depth sufficient to create the low embankment form, removing cut-off drain from the design and creating off-takes from the adjacent watercourses if necessary.<br>Area is likely to receive water from upslope. However, detailed design of the central watercourse culvert entrance should take account of the requirement to prevent erosion and deposition of peat in the culvert. Ways to prevent and slow drainage from these areas to the surrounding watercourses should also be considered. |

# Annex 10.6.2

## Good Practice for Developments on Peatland

## Sources of Good Practice Information

In the last decade, considerable guidance material relating to developments on peatland have been produced, particularly in Scotland. This has typically focused on wind farm developments, but where relevant to the Proposed Scheme, this section summarises advice from Scottish and other sources that together effectively constitute UK-wide best practice. Relevant guidance documents referenced as part of this OPMP are identified in **Table 1**.

While much of this guidance is less than ten years old, it is also supplemented where appropriate by older, but still relevant, academic and industry literature that provides case studies on many aspects of peat relevant to built infrastructure, including its geotechnical behaviour, hydrological response to disturbance and ability to recover ecologically. A number of manuals and guidelines have also been prepared to promote effective peat restoration (Quinty and Rochefort, 2003; Schumann and Joosten, 2008; Peatlands and Uplands Biodiversity Group, 2010).

*Table 1: Sources of Good Practice Information in Relation to Developments on Peatland*

| Source | Indicative Content |
|---|---|
| Guidance on the assessment of peat volumes, re-use of excavated peat and the minimisation of waste (SR/ SEPA, 2012) | Guidance on pre-consent, post consent and post construction assessment in support of evaluation of the peat resource in order to minimise waste |
| SEPA Regulatory Position Statement – Developments on Peat (SEPA, 2010) | Outline guidance on peat as a by-product of development, with specific focus on peat as a waste material, and with steer on re-use, recycling, storage and disposal |
| Floating roads on peat (SNH/ FCS, 2010) | Detailed guidance on floating road construction over peatlands, suitable to aid road design at the design stage |
| Constructed tracks in the Scottish Uplands, Second Edition (SNH, 2013) (updated in September 2015) | Outline guidance on track construction in all types of Scottish upland, with emphasis on minimising impacts on landscape and natural heritage |
| Good practice during windfarm construction (SR/SNH/SEPA/FCS, 2010) | Outline guidance on all aspects of wind farm construction (although not always related to peat), suitable to identifying good practice at the consenting stage |
| Calculating carbon savings from wind farms on Scottish peat lands, a new approach (Nayak *et al*., 2008) | Context to and detailed guidance on calculation of carbon losses associated with wind farm construction (in support of carbon balance calculations) |
| Peat landslide hazard and risk assessments: best practice guide (Scottish Government, 2006) | Guidance on undertaking peat landslide hazard assessments to support assessment of potential wind farm development sites |
| Guidelines for the Risk Management of Peat Slips (MacCulloch, 2006) | Outline guidance on minimising the likelihood of local and more extensive instability of peat during construction of excavated and floating tracks |
| Investigating the impacts of windfarms on peatlands (Natural England, 2010) | Guidance for Natural England to support consenting decisions on wind farms in England, based on understanding of wind farm impacts on peat |
| CCW Guidance Note: Assessing the impact of wind farm developments on peatlands in Wales (CCW, 2010) | Guidance on assessment methodology for characterising peatland resource and identifying hydrological, stability and carbon impacts of proposed wind farms, and guidance on the content of habitat management plans |
| A Strategic Assessment of the afforested peat resource in Wales (Vanguela *et al*, 2012) | Review of the status of peatlands under the Assembly Government Woodland Estate (AGWE) and their potential for restoration |

## Good Practice Pre-construction

Many of the concerns associated with peat on a development site can be addressed by modifying the scheme layout to avoid 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 moderately sloping deep peat where site infrastructure might increase the chance of peat instability
- areas of sensitive habitat in which planning consent may be difficult to achieve

Avoiding these areas requires sufficient baseline data and investigation at the planning and design stage. In relation to this, SEPA make a number of recommendations for best practice in relation to the assessment of peat depths and the means of mitigation and compensation at developments in peatland, which are detailed below.

### Peat Depth Model

In relation to peat depth assessment as an input to design, the following is recommended:

- That peat depth probing should be undertaken to provide a 'low resolution' survey, to identify where peat is present and provide information on peat depth variability (SNH/SEPA/JHI, 2014)
- A detailed survey at 50m intervals along proposed track and road locations using 10m right-angled offsets (SNH/SEPA/JHI, 2014)
- That a representative sample of cores be logged to assist in classification of the peat characteristics (e.g. through the von Post method) (CCW, 2010)
- That the collated peat data be used to develop a peat depth model for the site, and that the method used to prepare the model be clearly stated (CCW, 2010)
- That the peat model be used to undertake preliminary excavation and re-use calculations and to identify intended methods of re-use (SR/SEPA, 2012) through preparation of a peat management plan (an example format for which is provided in Annex 1 of the SEPA guidance).

### Layout Planning

Given preparation of a site wide peat model, the following principles are recommended by CCW in relation to layout planning:

- Minimise infrastructure overlap with peat
- Minimise construction of/ the area covered by permanent crane pads and consider piling construction methodologies as alternatives to bulk excavation of foundations
- Minimise carbon loss by re-use of excavated peat in compensatory restoration (e.g. in use as peat dams, for infilling grips and drains)
- Minimise protracted storage of excavated peat by careful phasing of ditch blocking/ filling
- Minimise the width of peat batters on floating roads
- Employ best practice construction and restoration methodologies.

## Good Practice during Construction

Assuming that the Proposed Scheme has been designed to take best advantage of site conditions, there are a number of ways in which detailed design and construction activities can be specified, to further minimise adverse effects on peatlands. The sections below consider specific good practice measures in relation to access tracks. Guidance is generally focused on floating tracks and cut-and-fill tracks (CCW, 2010), and is summarised below.

### Floating Tracks

Over deeper peat (typically >1.00m), floating tracks provide a good option for minimising peat excavation and the potential disruption of hydrological pathways. The success of construction requires careful planning to take account of the unique characteristics of peat soils. Specific guidance is available on design, the duration and timing of construction, the sequence of construction and the re-use of peat as shoulders at the margin of the floating track (SNH/FCS, 2010). This is summarised below:

#### *Design*

The following issues should be considered during detailed design:

- Adoption of conservative values for peat geotechnical properties during detailed design (post-consent) (SNH/FCS, 2010)
- Use of a maximum depth rule whereby an individual layer of geogrid and aggregate should not normally exceed 450mm without another layer of geogrid being added
- The routing of access tracks on flat ground in order to avoid any requirement for drainage design and works (SNH/FCS, 2010)
- Where sloping ground cannot be avoided and where the track runs transverse to the prevailing slope, the protection of natural hydrological pathways such as flushes and peat pipes through the installation of a permanent conduit within or underneath the floating road (SNH/FCS, 2010)
- Ensuring transitions between floating tracks and excavated tracks (or other forms of track not subject to long term settlement) are gentle (e.g. 1:10 basal transition slope) in order to minimise likelihood of track failure at the boundary between construction types (SNH/FCS, 2010)
- The scheduling of track construction to accommodate for peat settlement characteristics (see below) (SNH/FCS, 2010).

Further detail is provided in *Floating Roads on Peat* (SNH/FCS, 2010) and *Guidelines for the Risk Management of Peat Slips* (MacCulloch, 2006).

### *Duration and Timing of Construction*

The critical factor in the successful construction of floating tracks is the timescale of construction, to which end the following good practice guidance is provided:

- the settlement characteristics of peat (see earlier sections) should be accommodated by appropriate scheduling of track construction, as follows:
  - allowing peat to undergo primary consolidation, which takes place in a matter of days, by adopting rates of road construction appropriate to weather conditions (SNH/FCS, 2010)
  - monitoring the effects of secondary compression on track integrity, which will follow the primary consolidation phase and continue through the life of the development while the tracks are utilised (up to 25 years) (SNH/FCS, 2010)
  - identifying 'stop' rules, e.g. weather dependent criteria for cessation of track construction based on local meteorological data (SNH/FCS, 2010)
  - maximising the interval between material deliveries over newly constructed tracks that are still observed to be within the primary consolidation phase (SNH/FCS, 2010)
  - prior to construction, setting out the centreline of the proposed track to identify any ground instability concerns or particularly wet zones (SR/SNH/SEPA/FCS, 2010)

Adoption of an appropriate track construction rate will generally prevent the need for drainage under floating roads on flat ground.

### *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 track design. Good practice in relation to the sequence of track construction is as follows (SNH/FCS, 2010; SR/SNH/SEPA/FCS, 2010):

- 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
- Adding the first rock layer and incorporating culverting if any major surface or near surface drainage pathways have been identified during the set-out phase prior to construction (see above)
- Adding the second geotextile/ geogrid, and add overlying graded rockfill as a running surface
- Heavy plant and HGVs using the tracks during the construction period should be trafficked gently to minimise dynamic loading from cornering, breaking and accelerating
- Ensuring wheel loads should remain at least 0.5m from the edge of the geogrid, and markers should be laid out, monitored and maintained on the track surface to emphasise these boundaries
- '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 berms at the margins of a floating track (which is elevated above the peat surface) are termed shoulders, and good practice guidance is as follows:

- Re-use peat excavated from elsewhere on site as shoulders adjacent to the floating track
- Peat shoulders should taper from just below the track sides to join the surrounding peat surface, thereby preventing over high shoulders from causing ponding on the track surface (SR/SNH/SEPA/FCS, 2010)
- Limiting the width of peat shoulders to avoid the unnecessary smothering of intact vegetation adjacent to the floating track

### Cut and Fill Tracks

Cut-and-fill tracks require the complete excavation of peat to a competent substrate. This peat will require storage ahead of its re-use or disposal. Good practice guidance relates mainly to drainage in association with excavated tracks, as follows (SNH/FCS, 2010; SR/SNH/SEPA/FCS, 2010):

- Trackside ditches should capture surface water from within the acrotelm before it reaches the road
- Interceptor drains should be shallow, 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
- Culverts should be installed under excavated tracks to maintain subsurface drainage pathways (such as natural soil pipes or flushes)

Although excavation is normally undertaken in peat of limited depth (< 1.00m), 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 including cracking, bulging, excessive discharge of water or sudden cessation in discharge (Scottish Government, 2006) and
- Where substantial depths of peat are to be stored adjacent to an excavation, stability analysis should be conducted to determine the Factor of Safety (FoS) and an acceptable FoS adopted for loaded areas (MacCulloch, 2006)

### Peat Excavation, Storage and Transport

If peat is to be re-used or reinstated with the intention that the habitat it supports continues to be viable, the following good practice applies (SEPA, 2010):

### *Excavation*

- Excavated peat should be excavated as turves, including the acrotelm (surface vegetation) and a layer of adjoining catotelm (humified peat) typically up to 300mm thick in total (SR/SNH/SEPA/FCS, 2010), 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 (Peatlands and Uplands Biodiversity Group, 2010)
- Contamination of excavated peat with substrate materials should be avoided (SR/SNH/SEPA/FCS, 2010)
- Consider the timing of excavation activities to avoid very wet weather, to minimise the likelihood of excavated peat remoulding into peat slurry (with potential consequences off site) (SR/SNH/SEPA/FCS, 2010).

### *Storage*

- Peat turves should be stored in wet conditions, for example, within waterlogged former excavations, or should be irrigated in order to prevent desiccation (once dried, peat will not re-wet) (SR/SNH/SEPA/FCS, 2010)
- Peat should be stockpiled in large volumes to minimise exposure to wind and sun which can lead to desiccation, but with due consideration for slope stability (SR/SNH/SEPA/FCS, 2010)
- Excavated topsoils should be stored on geotextile matting to a maximum of 1m thickness (SNH, 2013)
- Stores of non-turf (catotelm) peat should be bladed off to reduce the surface area and desiccation of the stored peat (SR/SNH/SEPA/FCS, 2010)
- Peat storage areas and areas of steep peat should be monitored during periods of very wet weather, or during snowmelt, to identify early signs of peat instability (Scottish Executive, 2006)

### *Transport*

- Movement of excavated turves should be kept to a minimum, and it is preferable to transport peat intended for translocation to its destination at the time of excavation (Peatlands and Uplands Biodiversity Group, 2010)
- If vehicles 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

### *Restoration*

- Carefully evaluate potential restoration sites for their suitability, and agree that these sites are appropriate with landowners and relevant consultees (SR/SNH/SEPA/FCS, 2010)
- Undertake restoration and revegetation work outside winter months
- Consider the exclusion of livestock from areas of the site undergoing restoration, to minimise impacts on revegetation (SR/SNH/SEPA/FCS, 2010)
- Where feasible, restoration should be carried out concurrently with construction rather than at its conclusion

## Peat Restoration and Good Practice Post-Construction

Once project design and construction activities have been optimised with respect to the preservation of peat, the remaining good practice opportunities relate to the restoration of degraded parts of the development site, where there is opportunity to do so, and to the monitoring of peatland adjoining scheme elements to determine if there is a need for further mitigation. Good practice guidance indicates the following:

### *Restoration*

- If a development is sited on degraded peatland, it is desirable to implement measures to restore the peatland for biodiversity and to improve the carbon balance of the development (SR/SNH/SEPA/FCS, 2010)
- Any opportunities to enhance local habitats by rewetting former drained peatland, such as by drain blocking, should be considered (SR/SNH/SEPA/FCS, 2010)
- Where peat drains are extensive and frequent, and generally on shallow slopes, peat should be considered the preferred blocking material from the perspective of minimising peat wastage, rather than other alternatives such as plastic sheeting (SR/SNH/SEPA/FCS, 2010)
- Where drain blocking is identified as a possibility, re-used peat should comprise humified catotelm peat which retains sealing properties, in preference to desiccated or dried peat which would be buoyant (SR/SNH/SEPA/FCS, 2010)
- Critical to the restoration of viable peatland is raising and maintaining water tables to a level sufficient to support peat forming vegetation communities (SR/SNH/SEPA/FCS, 2010; SNH, 2013)
- Also critical is the maintenance of a functioning acrotelm, and therefore careful excavation that supports this should be encouraged (SR/SEPA, 2012)

### *Monitoring*

Peat habitat restoration can be a slow process and monitoring might need to be specified over a very long period. Monitoring refers to ongoing restoration measures and to inspection of the integrity of the Proposed Scheme and the peatland adjoining it. Good practice guidance suggests:

- Monitoring should be put in place around major scheme components located in peat to check for water table drawdown, and this should trigger mitigation, if required (SR/SNH/SEPA/FCS, 2010)
- The settlement of floating tracks during and post-construction should also be monitored to determine if consolidation is occurring as expected, and to identify signs of lateral displacement (SNH/FCS, 2010)
- Comprehensive inspection and maintenance records should be kept for all floating tracks on site to enable reasons for track degradation to be identified (e.g. heavy rainfall) (SNH/FCS, 2010)
- There should be a commitment to the monitoring of rehabilitating peatland through the life of the development, given the typical timescale for peat restoration projects to achieve their objectives (from 5 - 30 years) (SR/SNH/SEPA/FCS, 2010)