Peat Management Plan
Sandwater Road
Stage 1: Environmental Impact Assessment

Prepared By SLR Consulting Ltd

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1 INTRODUCTION

1.1 Development Description

1.1.1 In April 2012, Viking Energy Wind Farm (VEWF) gained consent to build the 'Viking Wind Farm', comprising 103 wind turbines across mainland Shetland. The 'Viking Wind Farm' relies on a number of access points from the local road network, one of which is the B9075, Sandwater Road.

1.1.2 The existing B9075 is a single track road with passing places and is operated and maintained by Shetland Island Council (SIC). For access to the proposed wind farm development and associated substation platform, VEWF shall construct a new road, for a length of approximately 2.1km, parallel to the north of the existing B9075 (Sandwater Road). Following completion of the wind farm construction the new road and all associated infrastructure shall be adopted by SIC. The Sandwater Road has been designed to accommodate the delivery of wind farm infrastructure, without compromising the B9075 road which would be operated normally during the construction period and on completion will be upgraded to adoptable standards.

1.1.3 Further information relating to the Proposed Development is available in EIA Report Chapter 4: Description of Proposed Development.

1.2 Development Design Overview

1.2.1 A planning application (2016/226/PPF) was submitted in July 2016 (the '2016 Application'), from which Scottish Environment Protection Agency (SEPA) (PCS/147694, 1st August 2016) as a statutory consultee raised an objection to the application. The objection was based on four areas of concern, including the 'Disturbance and re-use of Peat'. Conditions were applied to this aspect including submitting a finalised Peat Management Plan (PMP), which would consider re-use of the peat, addressing its use locally and identifying appropriate uses of the peat elsewhere.

1.2.2 In summary, the 2016 Application for the site indicated that the peat excavation due to the proposed development was estimated to be in the order of 170,000m^3. The 2016 Application was estimated to give rise to a permanent displacement of 105,000m^3 of peat and the temporary displacement of 65,000m^3 of peat. The permanently displaced peat volume was estimated to comprise approximately 25,000m^3 of acrotelmic peat and 80,000m^3 of catotelmic peat.

1.2.3 In accordance with good practice and to alleviate SEPA concerns, a complete re-design of the road was undertaken in an attempt to reduce the volume of peat requiring excavation to facilitate the road construction. In response to SEPA's objection, VEWF engaged with design engineers (Tony Gee and Partners LLP (Tony Gee)) to further refine the alignment. Informed by design refinement and supplementary site investigation data, Tony Gee developed a final detailed design (Appendix A & B). Based on this layout, SLR completed a revised PMP (dated March 2019). The refined alignment is presented in Figure 1: Sandwater Road Realignment.

1.2.4 The PMP was developed in consultation with SEPA. A summary of the consultation response(s) is detailed in Table 1.

Table 1: Summary of SEPA Consultation in relation to the survey and management of peat

Table 1: SEPA Consultation			
Planning Office/Officer (SEPA)	**Consultation method**	**General Aspect**	**Consultation Comments**
Judith Montford	E-mail	Planning Application 2016/226/PPF. Proposed widening and upgrading of 730 metres of existing B9075 Sandwater Road, and the realignment of 1530 metres, all between its junction with Road A970 at Sandwater and Burn of Weisdale, Sandwater, Weisdale, Shetland	Objection to Peat Management and a condition is applied requiring the submission of a finalised Peat Management Plan. The previous Peat Management Plan was completed in June 2016 by Jacobs.
Zoe Griffin Senior Planning Officer, Aberdeen	E-mail Consultation	Submitted proposed peat probing plan, prior to undertaking the works in 2018. With respect to the Sandwater Road, Kergord Access Track and the main wind farm.	SEPA commented on plan. SLR took on comments addressing issues where relevant. Responded to Zoe Griffin on 24/7/2018. Submitted proposed peat probing plan, prior to undertaking the works, this addressed the Kergord Track, Sandwater Road and the main wind farm. SEPA commented on plan outlining peat probing plan for Viking Wind Farm, SLR took on comments addressing issues where relevant. SEPA indicated all peat surveys should be carried out in accordance with Government guidance which can be found here: http://www.gov.scot/Resource/0051/00517174.pdf With reference to Sandwater Road, specifically, SEPA indicated the probing grid distances appear to be appropriate along the access roads. SLR responded to Zoe Griffin on 24/7/2018. SLR are currently working through the site and are undertaking detailed grids along the tracks at Sandwater Road as part of the entire site programme. Site work now complete.

2 PEAT MANAGEMENT PLAN CONTEXT

2.1 Background Guidance

2.1.1 Developments on peat soils and / or in peatland environments may in some cases generate waste excavated materials if no suitable re-use options are available on site. In such circumstances, excavated peat may constitute a waste and, consequently, regulatory controls apply to its management. In February 2010, SEPA produced the "*SEPA Regulatory Position Statement – Developments on Peat*" to help ensure a sustainable and consistent approach to the management of peat.

2.1.2 Guidance was subsequently published to ensure the consistent application of the principles contained within the SEPA position statement: '*Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste'*, Scottish Renewables and SEPA, Version 1, January 2012.

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

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

2.1.4 The following documents were reviewed in accordance with the requirements of **Stage 1,** as part of the planning application. Where appropriate peat data from the following reports was used to support the submission of this Peat Management Plan for Sandwater Road:

- Peat Stability Assessment, Technical Appendix 14.1 to the ES (Viking Wind Farm Addendum Environmental Statement, 2010);
- Estimated Peat Extraction and Re-use Volumes, Appendix A14.4 to the Addendum ES (Viking Wind Farm Addendum Environmental Statement, 2010);
- Peat Management Plan Technical Appendix 10.4, Sandwater Road Planning Application (2016/266/PPF) 2016;
- Peat Stability Landslide Hazard and Risk Assessment, Technical Appendix 10.3, Sandwater Road Planning Application (2016/266/PPF) 2016;
- Outline Construction Environmental Management Plan (CEMP[1], Technical Appendix A14.6 to the Addendum ES), including Technical Schedule TS7, Excavated Materials and Reinstatement Plan;
- Sandwater Cable Route Factual Report (GLRP 0003), May 2013. URS Corporation;

[1] Now called a Construction Environmental Management Plan (CEMP)

- Sandwater Substation Factual Report (GLRP 0003), May 2013. URS Corporation;
- Sandwater Peat Work October 2013, van Post logs. Raeburn Drilling Ltd; and
- Viking Wind Farm, Addendum Peat Management Plan, Mouchel Ltd, September 2010 Viking Wind Farm, Habitat Management Plan 2016, Final version 1, RPS.

2.1.5 The data and information informing the above documents demonstrates to SEPA and other relevant parties that: (i) the extent and characteristics of peat at the study site were investigated; (ii) excavations in peat were minimised wherever possible through design iterations and adoption of appropriate design hierarchy[2]; and (iii) excavation and subsequent management of peat, including an estimation of quantities, was considered as part of the EIA.

2.1.6 This PMP has been prepared in accordance with the requirements of **Stage 1** and further refines the preliminary data prepared previously. The refinements to the PMP take into consideration further and more detailed ground intrusive investigation undertaken in July/August 2018 to assist in completion of a detailed re-design.

2.1.7 A **Stage 2** PMP will be prepared at the Post-Consent Stage, prior to any construction activity.

2.1.8 Peat management will be monitored during construction (**Stage 3**) to ensure that excavated peat volumes continue to be minimised wherever possible through micro-siting and construction method refinements.

2.1.9 Where significant changes to the PMP are identified during construction (for example if unexpected ground conditions are encountered or changes to consented design are required), the PMP will be updated in consultation with SEPA where required.

2.1.10 Design decisions, proposed construction practices and peat management standards for this site are aligned with current good practice guidance (e.g. Good Practice During Windfarm Construction[3], and 'Floating Roads on Peat[4], refer to Section 8) relating to the range of environmental and engineering constraints associated with developments on peatlands, such as ecological considerations, topography, construction issues, carbon accounting etc.

2.2 Scope & Objectives

2.2.1 This PMP provides further information to that previously submitted for the Viking Wind Farm (2010) and previous planning application for the Sandwater Road (submitted in 2016). All of the peat depth data collected has been included in the PMP; the existing data was validated by checking depths and interpretation. The previous data was suitable to be reused in the assessment.

2.2.2 This PMP is applicable to the works associated with the construction of track infrastructure

[2] Design hierarchy as detailed within the SR/SEPA guidance: prevent excavation, reduce excavation volumes and reuse excavated peat in a manner to which it is suited.

[3] *Good Practice During Windfarm Construction*, Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency, Forestry Commission Scotland, Version 3, September 2015.

[4] *Floating Roads on Peat*, Forestry Civil Engineering and Scottish Natural Heritage, August 2010.

for the wind farm known as Sandwater Road, herein known as the "Works". The extent of the Works is illustrated in Figure 1 Sandwater Road Alignment.

2.2.3 The Works shall entail the following construction activities:

- construction of new road (2.1km) using a mix of floating and cut (excavated) construction methods;
- construction of bridge over Burn of Pettadale flowing to Sandwater (SSSI);
- construction of temporary and permanent drainage systems; and
- cable laying parallel to proposed road with up to 11 cables present.

2.2.4 The objectives of this PMP are as follows:

- to provide a description of the peat encountered during intrusive ground investigation to date;
- detail relevant works activities that are likely to generate peat, and demonstrate a sustainable approach to peat management via the guiding principles of reduce and re-use;
- consider the anticipated volumes of peat that will be excavated on site and estimated quantities required for re-use; and
- establish a sustainable approach to peat management during the works.

2.2.5 Following the completion of targeted site investigation prior to the commencement of the Works; a Stage 3 PMP will be prepared to consider the management of peat in relation to all aspects of the development.

3 DESIGN CONSIDERATIONS FOR REDUCING PEAT EXCAVATION

3.1 General Design Principals

3.1.1 The development has been designed in recognition of a number of environmental and geological constraints, informed by detailed site surveys, constraints mapping and design interrogation. This iterative approach to the road design was largely undertaken pre-application, although this process shall continue post-consent in an attempt to optimise the scheme layout from an environmental, economic and geotechnical perspective.

3.1.2 The consideration of peat and peatland habitats has featured prominently in the scheme design. The road alignment has sought to avoid areas of peat on site as far as reasonably practical and within the relatively narrow planning application corridor. However, where this is considered unfeasible, infrastructure has been located on the shallowest possible peat deposits within the confining limits of other environmental constraints and engineering feasibilities. Furthermore, the layout has endeavoured to avoid peatland habitats of notable ecological interest, which are often correlated with pockets of deeper peat.

3.1.3 The precise cabling installation method has still to be determined. Where practical, cable installation will occur at the same time as track construction and located alongside to reduce disturbance and temporary peat storage requirement. Furthermore, in relation to floated track sections, cables will be constructed in reinstated verges to avoid excavation of undisturbed peat.

3.1.4 All additional information emerging post-consent and any subsequent design considerations shall be interrogated from the perspective of peat depth and opportunity to reduce peat excavations further.

3.2 Redesign of Sandwater Road

3.2.1 The Sandwater Road has been re-designed (August 2018 to January 2019) to minimise disturbance to peat while still accommodating the engineering requirements to satisfy the specification for road design. The road has been modified to tie-in to the existing B9075 beyond the Burn of Pettadale which will be adopted by SIC. The road will ultimately bridge the Burn of Pettadale and continue to the proposed Substation location via Kergord (Kergord Access Track) and the Burn of Weisdale.

3.2.2 The original design for the Sandwater Road in 2016 was based on total excavation of peat along the entire route; as such the original peat management plan made no provision for floating road and associated earthworks. The PMP undertaken in 2016 therefore addressed an excavated track over a length of 2.06km long and included for a section to the north of the existing B9075 to access the Kergord farm track. At the western extent of the site there is a junction with the Upper Kergord track, which runs north from the existing B9075 to Upper Kergord.

3.2.3 It was agreed as part of the Viking Wind Farm ES Addendum that all Sandwater Road construction works shall be incorporated north of the existing B9075 road, so the works do not encroach on Sand Water Loch Site of Special Scientific Interest (SSSI).

3.2.4 Based on the original calculations from the 2016 PMP, peat volumes estimated to arise from the construction of the previous design (between chainage 0 and 2,040m) amounted to a total of 170,000m^3, of which 105,000m^3 would be permanently displaced. This volume excluded a small section between chainage 2,040m and 2,089m and the final section from 2,090m to 2,260m where no peat probing had been undertaken.

3.2.5 The total volume of peat excavation conveyed by the previous design was, therefore, at least 170,000m^3. Consequently, the previous design was estimated to give rise to the permanent displacement of 105,000m^3 of peat and the temporary displacement of 65,000m^3 of peat. Permanently displaced peat was estimated to comprise approximately 25,000m^3 of acrotelmic peat and 80,000m^3 of catotelmic peat.

3.2.6 The previous Sandwater Road design was considered environmentally sub-optimal, based on predicted peat displacement. Thus, in accordance with good practice, a re-design was considered where a proportion of the road would accommodate a floated design to minimise excavating deep peat. This design has been completed and this PMP is based on the principal that a significant amount of the track will be floated over deep peat, thereby minimising excessive peat excavation.

3.2.7 The re-design for the track is shown on the attached Sandwater Access Location Plan, with attached plans and profiles (Appendix A & B Sheets 1 to 7). Peat probing was initially undertaken as part of the track and cable design route undertaken in 2013, with various phases of probing and more recently Russian augering along the proposed route to determine the character and strength of the underlying peat. A new design has now been completed which includes a number of floating track sections over the deepest peat to reduce peat displacement (Figure 2).

3.3 SANDWATER ACCESS ROAD CONSTRUCTION

3.4 Quantifying Peat Excavation Volumes

3.4.1 To determine the peat volume generated, peat volumetric calculations have utilised CAD drawings (Appendix A & B) submitted by the project design engineer. These drawings allow modelling of the anticipated excavation along the route and derive the cut volume of peat based on peat probing data. The track alignment extends to an overall length of 2,091m. The total excavated volume of peat is presented in Table 2. The detailed calculations of peat volumes associated with each of the excavation and reuse activities are presented in Section 8.

3.4.2 The peat volume was calculated from the 5m DTM produced from LiDAR data and an interpolated surface derived from the peat probes. The interpolation method used was of a spline, constrained to a maximum of 70m from the peat probe locations. Both the DTM and the peat depth interpolation were resampled to a resolution of 1m, to account for the irregular shape of the cut areas. The lower surface of the peat was calculated from the DTM minus the peat depth interpolation. The volume of peat was calculated by comparing the DTM to the calculated height of the lower surface of the peat, using the Cut and Fill tool of ArcGIS.

3.5 Predicted Peat Excavation Volumes

3.5.1 Table 2 outlines the proposed volume of excavated peat, based on the current engineering assessment using best practice guidance, i.e. design parameters allowing for a significant proportion of the track to be floated. Consequently, the overall peat excavation has reduced from 105,500m^3 (estimate from 2016) to the current figure of 31,150m^3. This is a significant reduction (~70%) in the volume of peat excavated.

Table 2: Sandwater Road - Estimated Peat Excavation Volumes*

Chainage	Estimated Peat Depth	Construction Method	Peat Volumes Excavated m^3	Acrotelmic / Catotelmic m^3	Comments
0-25	0.77	Founded	3,500	2,800/700	From A970, built up to meet main road
25-50	1.82	Transition			
50-298	2.87	Floated	0	0	Deep Peat
298-320	2.75	Transition	3,050	2,550/500	Deep Peat
320-380	0.63	Founded			Bridge (Burn of Pettadale)
380-390	0.61	Transition			Shallow Peat
390-720	3.25	Floated	0	0	Deep Peat
720-740	2.82	Transition	8,850	270/240	Deep Peat
730-1260	0.55	Founded		8,340/0	Shallow Peat
1260-1270	0.64	Transition			Shallow Peat
1270-1430	2.61	Floated	0	0	Deep Peat
1430-1460	4.39	Transition	15,750	315/630	Deep Peat
1460-2091	0.64	Founded		14,805/0	Shallow Peat
TOTAL PEAT EXCAVATED			**31,150m^3**	**28,450m^3 /2,700 m^3**	

*The peat calculations have utilised the drawings submitted by Tony Gee Engineers.

3.5.2 The peat volumes outlined in Table 2 have been calculated utilising the excavated areas identified by Tony Gee and modelling the cut volume of peat based on peat probing data. The areas where cut peat has been modelled, i.e. transition and founded zones are indicated. The total excavated peat volume along the route was estimated to give rise to the temporary displacement of 31,150m^3 of peat. The temporarily displaced peat is estimated to comprise approximately 28,450m^3 of acrotelmic peat and 2,700m^3 of catotelmic peat.

3.5.3 The detailed calculations of peat volumes associated with each of the excavation and reuse activities are presented in Table 6.

4 PEAT CONDITIONS

4.1 Peatland Landscape and Habitats

4.1.1 The vast majority of the survey area and wider landscape is covered by blanket bog; the exceptions being the steeper, dryer eastern slopes of Scalla Field and Whaa Field, the shallower substrates bordering the Burn of Weisdale, and the few acid and base rich flushes dotted through the area (RPS, 2016).

4.1.2 All of the blanket mire within the survey area and the surrounding landscape has been modified to some extent through historical crofting activities. The majority appears to show signs of historic peat cutting, with alternating ridges, or banks, of dryer bog vegetation interspersed with much wetter bog vegetation. It is possible that some of these areas have recovered from previous erosion. At the north of the survey area in the valley of Kergord this alternate dry/wet complex of bog may be due to differences in hydrology caused by the more variable depth of peat overlying the bedrock

4.1.3 The Sandwater area was subject to **some** agricultural improvement in the 1950s and 1960s. This converted a large area of blanket bog into pasture for sheep grazing. A considerable amount of drainage work appears to have been undertaken with lime and fertiliser added and, in places, surface seeding. Agricultural improvement is also evident along the Burn of Weisdale. It is also apparent that some drains have been cut into the blanket bog vegetation in places, although these do not appear to be recent.

4.1.4 In broad terms of the habitats present, the vast majority of the survey area is generally actively peat forming and as such should be classed as blanket bog, currently showing very little sign of erosion. By Shetland standards, this can be described as relatively intact to moderately degraded blanket bog. A series of base rich flushes at the southern end of the survey site are present; these are highly likely to be ground water dependent and in a Shetland context of moderate to high conservation interest. A series of M6 flushes were identified and are also likely to be ground water dependent but are ubiquitous in Shetland and thus of less conservation interest.

4.2 Peat Depth and Extent

4.2.1 The Sandwater area was subject to a round of peat probing as part of the ES (2010) stage to determine peat depth across the site. During the EIA Report stage, a total of 40 (40 of which recorded peat) probes were carried out along the proposed track alignment for approximately 1.6km at a spacing of 50m intervals

4.2.2 In 2013, the road and cable route were subject to further investigation of 148 peat probes for a cumulative total of 188 peat probes for the entire site. Further probing was undertaken as part of the wind farm access tracks (including Sandwater) by RPS and later by SLR Consulting Ltd, with a site walkover and further probing carried out in July/August 2018. Further detailed site investigation including 16 No. cable percussion boreholes and piston sampling was undertaken by Tony Gee Engineers to refine final design in October 2018. The current number of probes used in the analysis is 406 no. probes.

4.3 Interpretation

4.3.1 Based on the accumulated peat probing survey results, peat depths at the site are consistent with those recorded at the ES stage along Sandwater Road alignment and further

investigation stages in 2018 i.e. predominately found to be an average depth of 1.58m over the entire length but significantly deeper, between chainage lengths 60-280m, 390-700m and 1270-1410m, where the maximum values recorded extend to depths up to 4.2m, 5.5m and 5.2m respectively. Peat was generally thinner in the other areas as demonstrated in the peat contour plan (Figure 3 – Peat Contour Plan).

4.3.2 Peat coring was undertaken during a recent site visit; this generally aligned with previously collected data. Peat cores sampled in 2013, generally identified the peat as fibrous to around 1m with an increase in humification and water content (i.e. becoming more catotelmic) below 1.5m. However, interpretation of recent (July/August 2018) data indicated that the peat was generally fibrous throughout its extent, with decomposition evident but not to an amorphous state and generally only to an H_7 classification on the von Post scale.

4.3.3 The percentage depth distribution for the site as a whole is detailed in Table 3.

Table 3: Accumulated Peat Probes Depths

Table 3: Accumulated Peat Probes Depths		
Depth	**No. Probes**	**%Total**
0-0.5	130	32.02%
0.5-1	70	17.24%
1-1.5	24	5.91%
1.5-2	36	8.87%
2-2.5	25	6.16%
2.5-3	43	10.59%
3-3.5	26	6.40%
3.5-4	23	5.67%
4-4.5	13	3.20%
4.5-5	7	1.72%
5-5.5	7	1.72%
5.5-6	2	0.49%
Grand Total	**406**	**100.00%**

- A total of 2.09km of road, allowing for a 6m track width. (6m running width plus 2 x 1.5m verge). The excavated peat volumes have been calculated utilising the proposed design drawings for the track.

- Based on the cut and fill modelling, the extent of peat to be excavated along the cut sections of track from chainage 0-50 (embankment to A970) is 3,500m^3, from chainage 298 to 390 is 3,050m^3, from chainage 720 to 1270 is 8,850m^3 and from chainage 1430 to 2090 is 15,750m^3; giving a combined volume of 31,150m^3. This is based on floating track over deep peat and an excavated track over shallow peat and crossing watercourses (Figure 2).

4.4 Peatland Landscape

4.4.1 The typical geomorphological characteristics of the road route are moderately undulating topography utilised primarily for rough grazing of sheep. The start of the track crosses a flat

lying alluvial plain which accommodates the Burn of Sandwater, which has been the subject of land improvement for farming activities. This flat lying plain extends to chainage 700 where the road alignment climbs onto the central plateau known as Mid Kame. The elevated terrain in the central portion comprises moderately steep, free-draining slopes in the central portion of the track with the majority positioned on a moderately sloping central plateau. The land subsequently falls to the west towards the Burn of Weisdale, where agricultural improvement is similarly evident. This central plateau has limited peat accumulations at the southern end; the peat has been worked locally for peat in the past. Blanket peat covers a considerable extent of the area.

4.4.2 In a Scotland-wide context, soil erosion is prevalent in the uplands, typically driven by a combination of climate, topography, and grazing pressure. Peatland erosion, in the form of hagging, is evident locally across the site, although most pronounced in areas of wet modified and unmodified blanket bog where bare peat is regularly exposed, particularly to the west of the Burn of Sandwater. The hags ranged in depth from 0.5m to greater than 1.0m deep and are predominantly un-vegetated, notwithstanding an occasional thin scattering of common cotton-grass and deer-grass. In addition to hagging, evidence of historic, small scale peat movements was recorded in the Peat Landslide Hazard and Risk Assessment, carried out in 2016 for Sandwater Road, although it was concluded that the implementation of suitable mitigation measures would adequately control peat slide risk at the site.

4.4.3 In a local context, naturally occurring peat slips have occurred at the Viking Wind Farm site in the past 5 years in areas highlighted in the PHLRA and evident along the Mid Kame area. However, in proximity to Sandwater Road, there is no evidence of any major slips, primarily due to the flat lying nature of the land, where it crosses the central Mid Kame Plateau it has much less peat present and is not at risk from peat slides.

4.5 Classification of Excavated Material

4.5.1 The findings of the 2013 Soil augers indicate that the majority of peat present can be described as acrotelmic (lower humification (H0-H5) and moisture content) over first 1-1.5m with more humified and wetter peat (H6- H10) at depths in excess of this, based in accordance with the Von Post Scale of Humification (Ekono 1981). However recent findings (July/August 2018) suggest it is less decomposed than originally anticipated.

4.5.2 Following analysis and review of the soil augers/peat probe logs and consulting the Von Post Scale, peat has been classified into one of three re-use suitability categories (i) Green, (ii) Yellow or (iii) Red (Table 4). The method of peat classification into these categories is determined by allocating a proportion of the Von Post Scale of Humification and Moisture Content descriptions with suitability for re-use description. The three categories are defined below:

Table 4 Re-use Suitability Characteristics

Category	Von Post Scale of Humification and moisture Content	Description
Green	H1:B1-4, H2:B1-B4, H3:B1-B3, H4:B1-B3, H5:B1-B2, H6:B1-2	This category represents fibrous to pseudo-fibrous material. The Low humification numbers are representative of undecomposed peat with fibrous structure ideal for reinstatement of upper peat layers. The latter humification numbers represent a Moderately to Moderately-Highly content of amorphous material, although the moisture content remains low. This category of material is considered suitable for all types of reinstatement as the peat structure is likely to remain unchanged during excavation, storage and handling.
Yellow	H1:B5, H2:B5, H3:B4-B5, H4:B4-B5, H5:B3-B4, H6:B3-B4, H7:B1-B3, H8:B1-B2	This category represents fibrous material with higher moisture content and further decomposed highly amorphous materials with Low moisture. This category of material is considered suitable for all types of reinstatement if handled, stored and managed strictly in accordance with the principles outlined in Section 4. Due to the diversity in this range and variable nature, the least fibrous material shall be used in the reinstatement of lower peat layers, complementing natural peat structure.
Red	H5:B5, H6:B5, H7:B4-B5, H8:B3-B5, H9:B1-B5, H10:B1-5	This category represents Very Highly to Completely decomposed amorphous peat with all moisture contents and the middle-scale of humification with High and Very High moisture content. This category is considered the most challenging for excavation, storage and handling on site and generally only suitable for reinstatement in limited areas due to its amorphous nature.

4.5.3 Table 5 (below) provides a summary of the peat data classified according to the above descriptions. The data analysis indicates that the peat to be excavated is likely to be classified as 80% 'Green', 11% 'Yellow' and 9% 'Red'.

4.5.4 An analysis of ground investigation data and likely peat classification for each of the separate infrastructure elements is summarised in Table 6.

Table 5: Peat Classifications for Main Infrastructure Elements

Table 5: Peat Classifications for Main Infrastructure Elements			
	Peat Characteristics		
Infrastructure Peat Data	Green	Yellow	Red
New Access Tracks (Cut and Floating Construction)*	80	11	9
Cable Routes	100	0	0

5 PEAT MANAGEMENT- GOOD PRACTICE PRINCIPLES

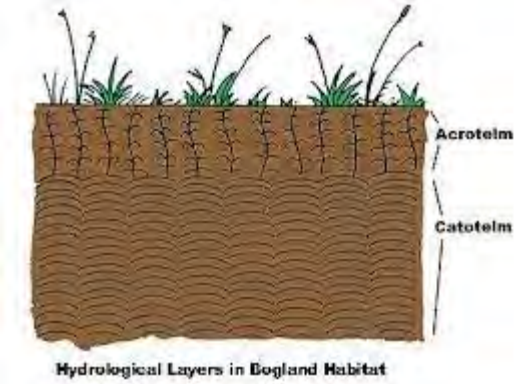
5.1 Environmental Management Plan

5.1.1 An outline Construction Environmental Management Plan (CEMP) is submitted as an appendix to the EIA Report. This CEMP shall be submitted to the planning authority for discharge of relevant pre-commencement planning conditions in accordance with commitments made in the planning submissions. The CEMP will include strict, good practice requirements in relation to the excavation, storage and reuse of peat during the construction phase of the project.

5.2 Peat Excavation

5.2.1 Excavated peat shall be excavated as turves, including the acrotelm (surface vegetation) and a layer of adjoining catotelm (more humified peat) typically up to 500mm thick in total, or as blocks of catotelm; the acrotelm should not be separated from its underlying peat;

- the turves should be as large as possible to minimise desiccation during storage;
- contamination of excavated peat with substrate materials should be avoided; and
- consider timing of excavation activities to avoid very wet weather and multiple handling to minimise the likelihood of excavated peat losing structural integrity.



Hydrological Layers in Bogland Habitat

5.2.2 Where ground conditions allow, peat shall be extracted as intact, full depth acrotelm layers from the top surface of the deposit. This technique will maintain connectivity between the surface vegetation and the partially decomposed upper layers of the catotelm.

5.3 Peat Storage & Handling

5.3.1 Temporary storage locations will be appropriately located and designed to avoid environmental constraints (e.g. sensitive peatland habitats, watercourses, etc.) and, thus, minimise ecological impact, prevent risks from material instability and avoid sediment-laden run-off discharging directly into watercourses.

5.3.2 The precise location of temporary peat stockpiles will be determined at a site-level following consideration and assessment of suitable areas by the ECoW and Contractor to ensure locations are optimal in terms of environment, construction practicality and safety.

5.3.3 The following good practice shall be adopted in relation to peat storage and handling:

- movement of turves should be kept to a minimum once excavated, and therefore it is preferable to transport peat planned for translocation and reinstatement to its destination at the time of excavation;
- if HGVs 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
- stockpiling of peat should be in large volumes to minimise exposure to wind and sun (and desiccation), but with due consideration for slope stability and other environmental (e.g. habitats) constraints;
- excavated peat and topsoils should be stored to a maximum of 1m thickness and peat turves shall not be stacked to preserve the living vegetation;
- stores of non-turf (catotelm) peat should be bladed off to reduce the surface area and desiccation of the stored peat;
- monitor areas of steep peat and peat storage areas during periods of very wet weather, or during snowmelt, to identify early signs of peat instability;
- peat should be stored in a linear bund along the cut track route at sufficient distance from the cut face to prevent overburden induced failure;
- local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes should be avoided for peat storage;
- where necessary, drying of stored peat should be avoided by irrigation; and
- as far as reasonably practicable, restoration should be carried out concurrently with construction rather than at its conclusion. The timing of activities may preclude this, however, good management of the site will ensure the peat is not allowed to degrade over time.

5.3.4 Prior to the commencement of construction, a detailed storage and handling plan / method statement shall be prepared by the Contractor as will be specified within the CEMP:

- estimate excavation volume at each infrastructure location (including peat volumes split into area / volume of 'actrotelm' or 'turf', and volume of catotelm);
- volume to be stored locally and volume to be transferred directly on excavation to restoration areas elsewhere in order to minimise handling;
- location and size of storage area relative to natural peat morphology / drainage features; and
- irrigation requirements and methods to minimise desiccation of excavated peat during short term storage.

5.3.5 These parameters are best determined post-consent in light of detailed ground investigation and in conjunction with the appointed civil works contractor and the ECoW.

5.4 Reinstatement

5.4.1 In accordance with reinstatement good practice, consideration will be given to the surrounding landform. Principally, this will involve avoidance of the creation of uniformed construction batters and straight-lined infrastructure edges. Shallow construction batters will be favoured to ensure a subtle transition from construction slopes to existing land.

5.4.2 Reinstatement of vegetation will be focused on natural regeneration utilising peat or other vegetated turves or soils stripped and stored with their relevant seed bank. To encourage stabilisation and early establishment of vegetation cover, peat turves or other topsoil and vegetation turves in keeping with the surrounding vegetation type will be used to provide a dressing for the final surface.

5.4.3 Where there are insufficient turves for top dressing, i.e. where bare peat prevails as a consequence of construction, seeding shall be undertaken to encourage vegetation re-establishment. The site ECoW shall monitor the success of reinstatement and vegetation reestablishment. Where the site ECoW determines requirement for additional reinstatement effort, the Contractor shall submit proposals for re-seeding, including specification for seed mixes, application methods and monitoring requirements, to the ECoW for review and acceptance.

5.4.4 Finally, to prevent scour and run-off and facilitate vegetation re-establishment, any down-slope embankments will be graded such that the slope angles are not too steep and there is a gradual transition with the surrounding / existing ground profile.

6 CONSTRUCTION OF PROJECT INFRASTRUCTURE – GOOD PRACTICE PRINCIPLES

6.1 Excavated Road Construction

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

6.1.2 Excavated tracks require complete excavation of peat to a competent substrate. Excavated tracks are generally undertaken where peat depths are less than 1m. This peat would require storage ahead of reuse, generally local to the site of excavation or elsewhere on site where required. Good practice guidance relates mainly to drainage in association with excavated tracks:

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

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

- free faces should be inspected for evidence of instability (cracking, bulging, excessive discharge of water or sudden cessation in discharge);
- If peat is used along verges it can be used on appropriate slopes along open peat faces creating a finished surface which can be gently compacted and tapered to running level to prevent slippage; and
- where significant depths of peat are to be stored adjacent to an excavation, stability analysis should be conducted to determine Factor of Safety (FoS) and an acceptable FoS adopted for loaded areas.

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

6.2 Floating Road Construction

6.2.1 Over deeper peat (typically >1.0m), floating tracks are used to remove the requirement for peat excavation and limit disruption of hydrological pathways. The success of construction requires careful planning to take account of the unique characteristics of peat soils. Specific guidance[5] is available on design, the duration and timing of construction, the sequence of construction and the reuse of peat on the shoulders of the floating road.

6.2.2 The following issues should be considered during detailed design of floating roads:

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

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

- the settlement characteristics of peat; should be accommodated by appropriate scheduling of access track construction, as follows:
- prior to construction works, the setting out the centreline of the proposed access track to identify any ground instability concerns or particularly wet zones;
- identifying ‘stop’ rules, i.e. weather dependent criteria for cessation of access track construction based on local meteorological data; and

[5] Floating roads on peat (SNH, FCS; August 2010);

- maximising the interval between material deliveries over newly constructed access tracks that are still observed to be within the primary consolidation phase.

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

- retaining rather than stripping the vegetation layer (i.e. the acrotelm, providing tensile strength), and laying the first geotextile/geogrid directly on the peat surface;
- adding the first rock layer;
- adding the second geotextile/geogrid, and add overlying graded rockfill as a running surface;
- heavy plant and Heavy Goods Vehicles (HGV) using the access tracks during the construction period should be trafficked slowly in the centre of the track to minimise dynamic loading from cornering, breaking and accelerating;
- ensuring wheel loads should remain at least 0.5m from the edge of the geogrid, markers should be laid out, monitored and maintained on the access track surface to clearly emphasise these boundaries; and
- initial 'toolbox' talks and subsequent feedback to construction and maintenance workers and drivers to emphasise the importance of the implementing the above measures.

6.3 Cable Corridors

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

- Cables can be placed close to tracks where there is sufficient room at side of track and the habitat classification does not prohibit cable laying;
- the cable corridors have the potential to be up to 5m wide to accommodate 6 cables initially, increasing up to 11 cables (10m wide) beyond Whaa Field to the Kergord Substation;
- utilise peat shoulders for cable lays where possible to minimise peat excavations specifically for this purpose, in this case, peat shoulders should be 1.0m to 1.5m thick to accommodate cables;
- minimise time between cable laying and peat reinstatement, preferably avoiding excavation until the electrical contractor has cables on-site ready for installation; and
- avoid incorporating substrate materials in the excavation, to minimise contamination of the peat to be reinstated. Replace excavated materials sequentially.

7 PEAT MANAGEMENT – EXCAVATION ACTIVITIES & PROPOSED REUSE

7.1 Peat Excavation Activities associated with Construction

7.1.1 The following activities require excavation, including stripping of vegetation turves and excavation of underlying soils, including peat, down to formation level (e.g. excavation down to a stratum with suitable engineering properties to meet required design criteria).

- 'Cut' track construction (in areas of peat <1m deep or where floating track construction is not physically possible); and
- Excavation of cable trenches for underground cabling (laid in previously reinstated material at road edge).

7.1.2 Furthermore, the updated CEMP will include a requirement for details relating to excavated materials to be recorded by the Contractor in a Materials Excavation Register.

7.2 Peat Reuse in Road Verge Reinstatement

7.2.1 During and upon completion of the Works, there will be a requirement for the reinstatement of construction disturbed areas, infrastructure edges and embankments, including:

- verge reinstatement and landscaping to cut sections of the road (to compliment surrounding topography, reduce landscape and visual impacts, establish vegetation and reduce erosion etc.);
- reinstatement around watercourse crossing structures; and
- reinstatement of cable trenches.

7.2.2 A key opportunity to reuse peat is to employ it in reinstatement of constructed access tracks. Wedge-shaped reinstatement at the margins of floating sections of the road (which is elevated above the peat surface) is termed 'shoulders'. The reuse of peat in this manner allows for the avoidance of patently engineered embankments. Instead, reinstated land can transition subtly, complimenting local surface profiles and wider landforms. The road shoulder reinstatement shall consider the following:

- peat excavated from elsewhere along the road construction route will be reused to generate shoulders adjacent to the floating road sections;
- peat shoulders shall taper from just below the road sides (to prevent water draining onto the track surface) and join the surrounding peat surface, keeping as natural a profile as possible to tie-in with existing landscape; and
- limit the width of peat shoulders to avoid unnecessary smothering of intact vegetation adjacent to the floating road.

7.2.3 Peat excavated during cable trenching operations will be re-used for trench backfilling, alongside excess peat from the track excavation. At the road side where cables are installed, dependant on the adjacent track level, peat and peat turves can be reused to profile land to compliment surrounding topography and ensure existing drainage regimes are maintained.

7.3 Peatland Restoration as a consequence of Construction Activities

7.3.1 In addition to the re-uses identified above, following construction of the Sandwater Road, peat would also be required for wider peatland restoration. The primary area will be restoration of the main Viking Wind farm area, during and following construction as well as specific habitat restoration areas.

7.3.2 Further to this requirement, a number of small areas have been identified in the vicinity of Sandwater Road where peatland would benefit from restorative efforts. Further suitability assessment and detailed plans for restoration would be undertaken as part of a Stage 2 PMP.

7.3.3 Restoration relates to all construction disturbed areas and therefore this is something that will be carried out to restore any construction disturbed areas along the route.

7.3.4 In addition, restoration using excavated peat may also be carried out for Habitat Management Plan (HMP) purposes and in these instances detailed surveys of candidate restoration areas will be undertaken prior to construction commencing. Potential candidate restoration areas are identified within the existing HMP for the wider wind farm site, however other areas may also be identified during the works and the methods used for restoration of these additional areas will be agreed in advance with the ECoW and Habitat Management Plan Officer.

7.3.5 The HMP for the consented wind farm (which encompassed Sandwater Road) sets out proposed measures for habitat restoration and enhancement and is provided as Technical Appendix 8.9: Habitat Management Plan and Technical Appendix 8.10: Habitat Management Plan Figures as part of the Viking Wind Farm ES, 2016. Proposed measures include the restoration of peatland habitat throughout the area. Candidate and potentially suitable areas for blanket bog restoration are identified in the HMP and include up to c.260ha of restoration. There would be sufficient area to utilise peat generated on site for habitat improvement. Candidate areas along the Sandwater Road have been identified as temporary storage areas prior to utilising peat on the main Viking Wind Farm area. As identified earlier these would require a suitability assessment to be undertaken and detailed in the Stage 2 PMP.

7.3.6 Whilst the HMP identifies that excavated peat could be reused in proximity to the development's infrastructure for the purposes of peatland restoration, careful consideration will need to be given to the nature of the peat excavated and its suitability for peat restoration purposes, the methods of excavation, transportation, and reuse to satisfy SEPA that this is a legitimate use for peat.

7.3.7 Peatland restoration work on site will operate as part of the construction process, and although not directly part of the HMP, it will be integrated to ensure peatland related obligations are met. At this stage it is proposed that the works will be implemented under the project's CEMP, and aim to minimise the excavation, movement and storage of peat. Construction will generate blanket bog turfs and volumes of peat, a significant proportion of which have the potential to be used for additional peatland restoration at locations in proximity to wind farm and access track construction. This restoration work will therefore contribute to the HMP's blanket bog objectives.

7.3.8 The progression of this restoration work will be complex and will require significant forward planning. Peat management during construction also maximises its contribution to the delivery of the wider blanket bog restoration. It is also important that information on peat volumes, peat storage and peat slide risk are also shared across the construction and restoration teams so that overall peat protection, blanket bog restoration, pollution prevention and health and safety requirements are met. To this end therefore, the wider environment team (ECoW, Habitat Management Plan Officer, Contractor's Environmental representative and Geotechnical Clerk of Works in particular) will be aware of the HMP and its activities and objectives, so that 'on site' handling of blanket bog vegetation and peat during construction and reinstatement can be orchestrated to best overall use where required.

7.3.9 Based on the peat characteristics described in Section 4, it is anticipated that the peat excavated on site will be of a suitable composition for reuse in all of the applications listed above. However, a small volume of wet, amorphous (e.g. conveying characteristics consistent with the Red category as described in Section 3) peat is expected to be encountered. Peat of this nature shall be placed in appropriate locations such as the base of borrow pits, or as part of peatland restoration works in eroded haggy areas where it can be dressed with a sequence of semi-fibrous and fibrous peat (e.g. peat representative of the Yellow and Green class outlined in Section 3).

7.3.10 Suitable areas for reuse of catotelmic peat are present, albeit limited to areas such as borrow pits and / or peatland restoration areas. Peat of this type will be used in restoration where it poses no risk of run-off or peat slide and the areas and restoration methods will be agreed on site with the ECoW, Habitat Management Plan Officer and other relevant stakeholders onsite.

8 ESTIMATION OF EXCAVATION AND RE-USE VOLUMES

8.1 General

8.1.1 Summary peat excavation and reuse volumes for the site are provided in Table 6 & 7 below and re-use volumes detailed in Figure 4 and Appendix C.

Table 6: Summary of Peat Excavation and Reuse Volumes

Table 6: Summary of Peat Excavation and Reuse Volumes				
		Assumed Characteristic		
Volume Comparison	**Total**	(m^3)	(m^3)	(m^3)
Volume of peat excavated (m^3)	31,150	24,920	3,530	2,700
Volume of reinstated peat for infrastructure(m^3)	31,150	20,765	0	0
Volume of reinstated peat for reuse on wind farm site or habitat restoration(m^3)		4,155	3,530	2,700
Difference	**0**	**0**	**0**	**0**

Table 7: Summary of Peat Excavation and Reuse Volumes by Infrastructure

Table 7: Summary of Peat Excavation and Reuse Volumes by Infrastructure		
Infrastructure	**Estimated Total Peat Excavation Volume (m^3)**	**Estimated Total Peat Reinstatement Volume (m^3)**
New Road (Cut Construction) (1,353m)	31,150	**11,226**
New Road (Floating Construction) (738m)	0	**4,409**
Cable Routes (up to 6 cables parallel to road to chainage 1050m) and an additional 5 cables from chainage 1050 to chainage 2091m. *5 cables will accommodate a width of 5 metres while the 11 cables up to 10 metres wide*	*(1,050m x 5m x 1m) + (1,041m x 10m x 1m)* *=15,660*	*(15,660 (total reinstatement)* **0**
Additional Cover up to 0.5 metre over cable routing corridor adjacent to track where road is in fill (Subject to detailed design assessment)	0	*(730 x 5 x 0.5) + (861x10 x0.5) =* **5,130**
Reuse across the Viking Wind Farm (exact location to be determined). The peat will be stored on a temporary basis at 4 possible locations adjacent to or close to Sandwater Road. An alternative option is to use peat for habitat restoration in the Sandwater Road area. The final solution has yet to be finalised.	0	**10,385**
Total	**31,150**	**31,150**

8.2 Results

8.2.1 All excavated material is considered suitable for site reuse. The current volume estimates indicate that there is no surplus or deficit of peat on site. This balanced volume estimate is considered acceptable at this stage.

8.2.2 The generation of 'waste' (according to legal definition of waste) peat during construction and a deficit of peat found during construction is considered unlikely due to the following factors:

- The excavated volume estimates are based on conservative input parameters and further design refinements will be possible during construction to further reduce the volume of excavated peat;
- The reinstatement volume estimates are based on indicative design proposals and further design refinements will be possible during construction; and
- The nature of the peat is such that it is considered suitable for reuse as a material for both engineering and environmental purposes.

9 CONCLUSIONS

9.1.1 This PMP (Stage 1) presents a pre-construction assessment of the expected peat extraction and reuse volumes associated with the Works phase of the construction of Sandwater Road.

9.1.2 Through a process of continued design refinement (focused on minimising peat excavation volumes) and adoption of best practice working method, the development is expected to achieve an overall peat balance, i.e. the volume (and character) of excavated peat compliments requirements for reuse and reinstatement. Thus, all excavated material will be required for reuse as part of the works and no surplus peat is anticipated.

9.1.3 The site supports peat of moderately decomposed peat with a very distinct plant structure that is considered suitable for reuse during reinstatement work, e.g. dressing of infrastructure edges, restoration and borrow pit restoration. Good practice standards, which are detailed in the Outline CEMP, relating to excavation, handling and storage of peat, shall ensure against any compromise to the structural integrity of the peat and its associated suitability for reuse.

9.1.4 Avoidance of localised pockets of deep peat that would otherwise require excavation will continue to be a key design refinement objective. Furthermore, it is expected that such micro-siting onto land supporting shallower peat deposits shall be possible during the Works.

10 REFERENCES

Legislation relevant to the management of peat includes the following:

- The UK Climate Change Act 2008 (c 27);
- Environmental Protection Act 1990 (as amended);
- Landfill (Scotland) Regulations 2003 (as amended);
- The Waste Management Licensing (Scotland) Regulations 2011; and
- Scottish Planning Policy (2014).

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

- Guidance on Developments on Peatland (SNH, SEPA 2017);
- Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (SR, SEPA, January 2012);
- SEPA Regulatory Position Statement – Developments on Peat (SEPA, February 2010);
- Good practice during wind farm construction (SR, SNH, SEPA, FCS, HES; September 2015);
- Floating roads on peat (SNH, FCS; August 2010);
- Constructed tracks in the Scottish Uplands (SNH, September 2015); and
- Restoration techniques using peat spoil from construction works (SEPA 2011).

Peat data from the following reports was used to support the submission of this Peat Management Plan for Sandwater Road:

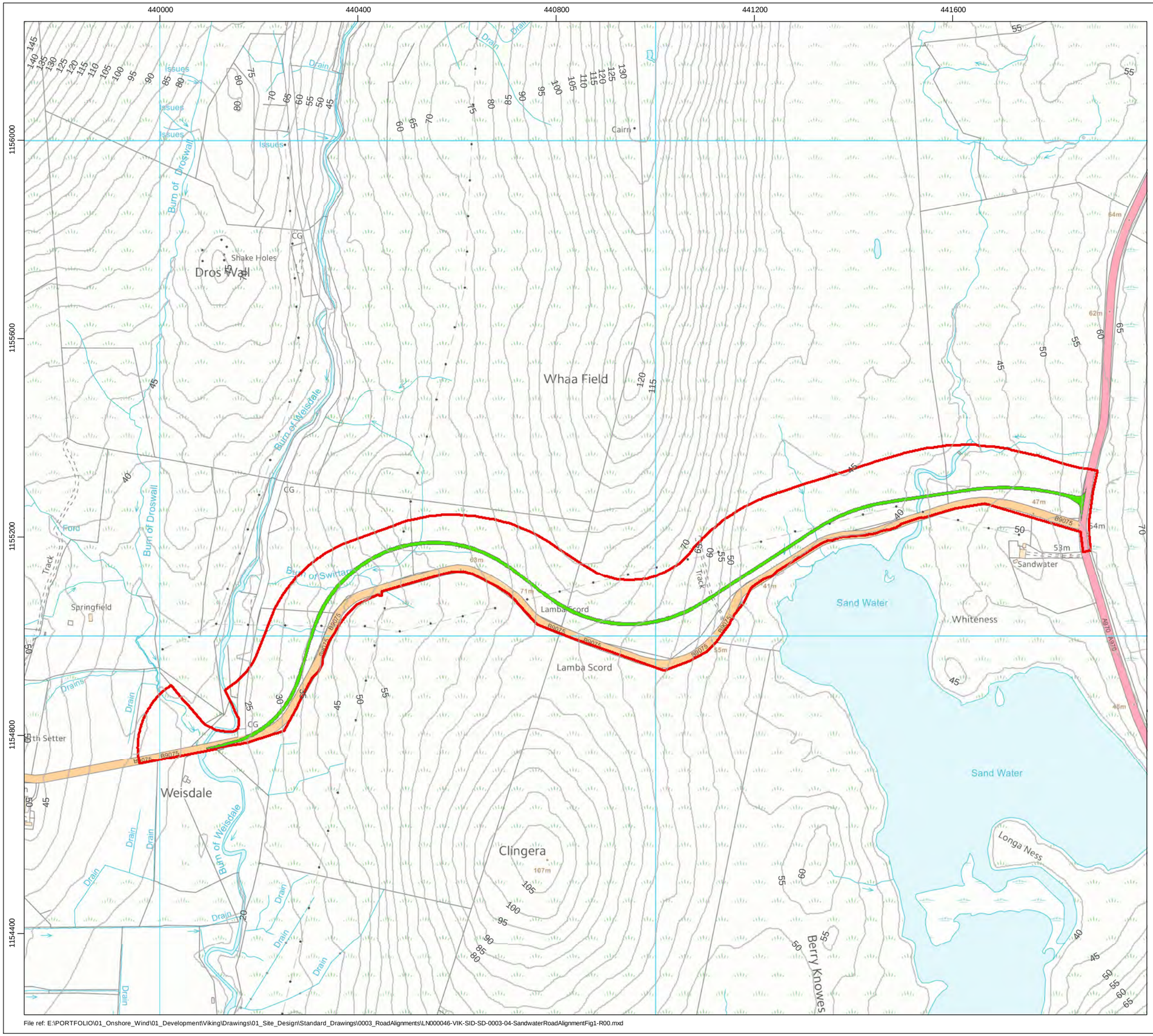
- Peat Stability Assessment, Technical Appendix 14.1 to the ES (Viking Wind Farm Addendum Environmental Statement, 2010);
- Estimated Peat Extraction and Re-use Volumes, Appendix A14.4 to the Addendum ES (Viking Wind Farm Addendum Environmental Statement, 2010);
- Peat Management Plan Technical Appendix 10.4, Sandwater Road Planning Application (2016/266/PPF) 2016;
- Peat Stability Landslide Hazard and Risk Assessment, Technical Appendix 10.3, Sandwater Road Planning Application (2016/266/PPF) 2016;

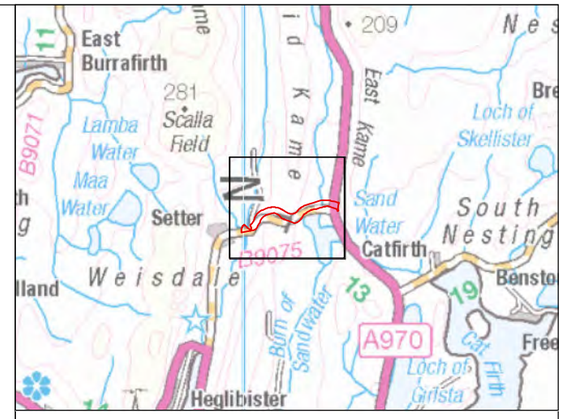
- Outline Construction Environmental Management Plan (CEMP6, Technical Appendix A14.6 to the Addendum ES), including Technical Schedule TS7, Excavated Materials and Reinstatement Plan;
- Sandwater Cable Route Factual Report (GLRP 0003), May 2013. URS Corporation;
- Sandwater Substation Factual Report (GLRP 0003), May 2013. URS Corporation;
- Sandwater Peat Work October 2013, van Post logs. Raeburn Drilling Ltd; and
- Viking Wind Farm, Addendum Peat Management Plan, Mouchel Ltd, September 2010 Viking Wind Farm, Habitat Management Plan 2016, Final version 1, RPS.

[6] Now called a Construction Environmental Management Plan (CEMP)

Figures

Figure 1 : Sandwater Road Alignment





Legend

- Sandwater Site Boundary
- Proposed Sandwater Road

0 100 200 400 m

N

Project Name

VIKING WIND FARM

Drawing Title

FIGURE 1 SANDWATER ROAD ALIGNMENT

Rev	Date	Remarks	Drwn	Chkd
R0	29/01/2019	First Issue	TD	BM

Drawing Number

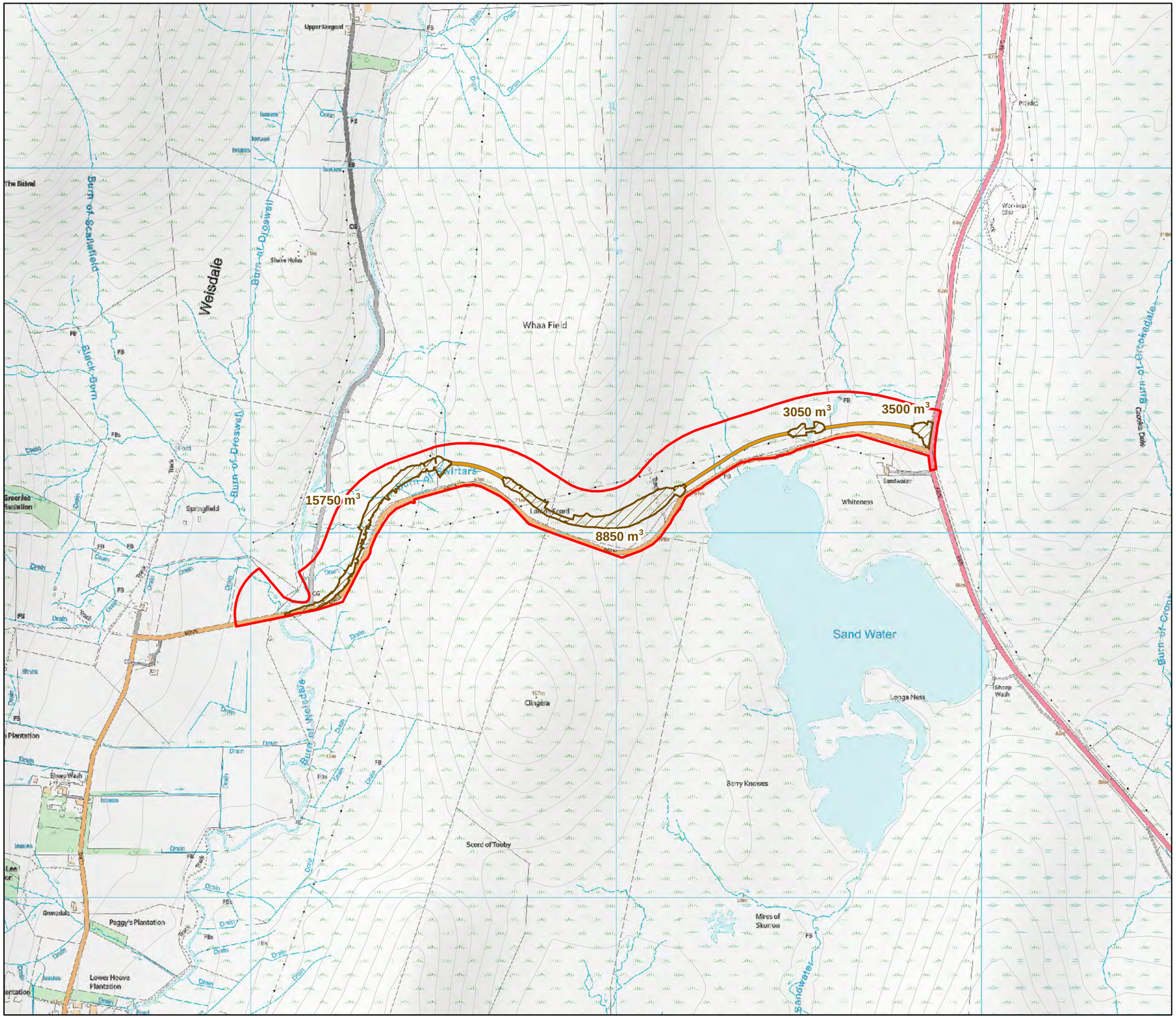
LN000046-VIK-SID-SD-0003-04

Scale	Plot Size	Datum	Projection
1:7,500	A3	OSGB36	BNG

viking energy
Harnessing Shetland's natural resources

File ref: E:\PORTFOLIO\01_Onshore_Wind\01_Development\Viking\Drawings\01_Site_Design\Standard_Drawings\0003_RoadAlignments\LN000046-VIK-SID-SD-0003-04-SandwaterRoadAlignmentFig1-R00.mxd

Figure 2 : Excavated Peat Volumes along Sandwater Road



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SLR

Key

- Sandwater Road Site Boundary
- Cut Area (Road,Verge and Cut)
- Floated Road

Scale 1:10,000 @ A3

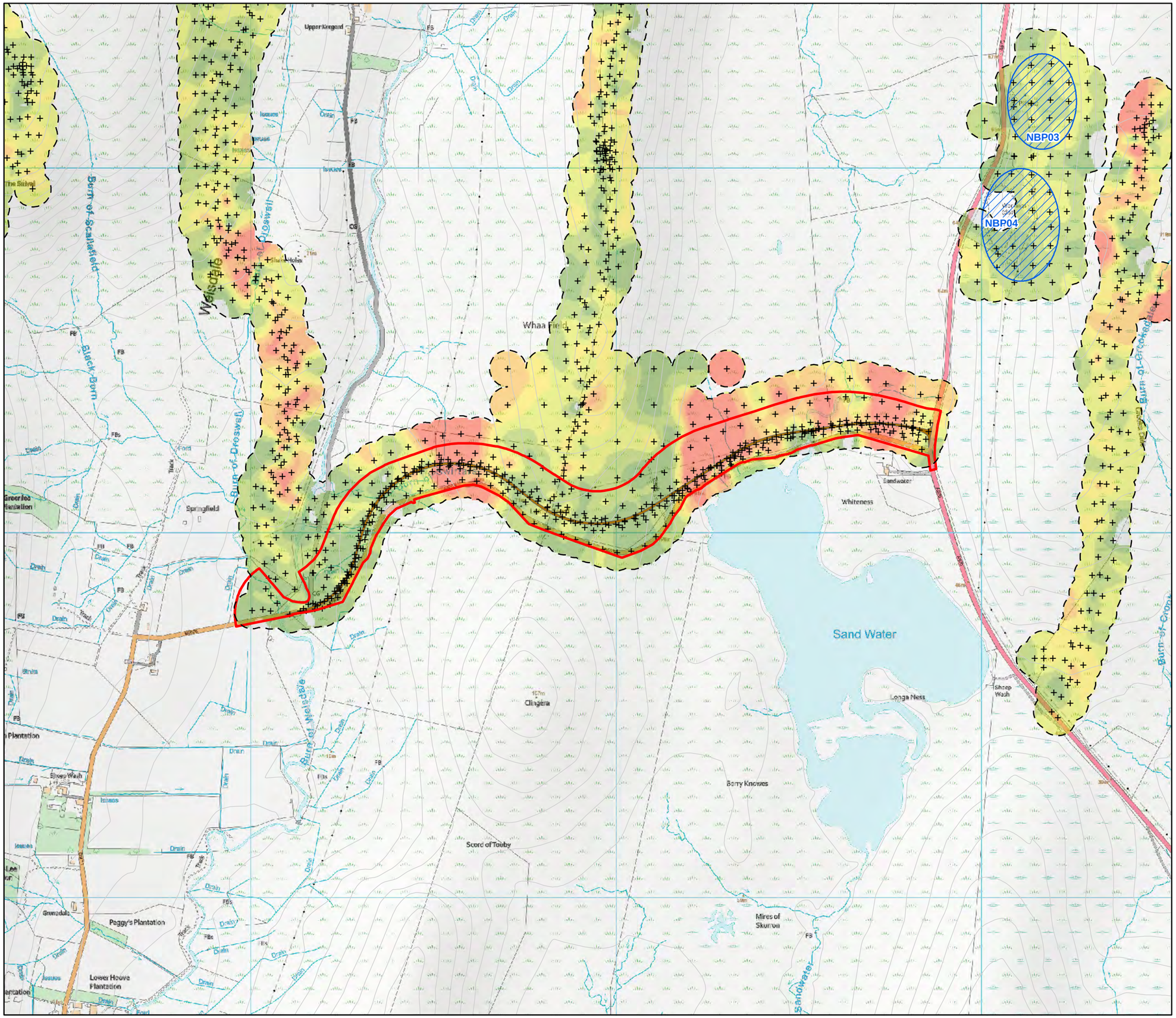
0 0.2 0.4 Km

N

Figure 2
Excavated/Floating Road
Peat Volumes

Peat Management Plan
Sandwater Road
Stage 1 Environmental Impact Assessment

Figure 3: Peat Contour Plan along proposed Sandwater Road alignment



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SLR

Sandwater Road Site Boundary
Proposed Sandwater
Borrow Pit Search Area
\+ Peat Probe Location

Peat Depth (m)

- 0
- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- > 3

Scale 1:10,000 @ A3

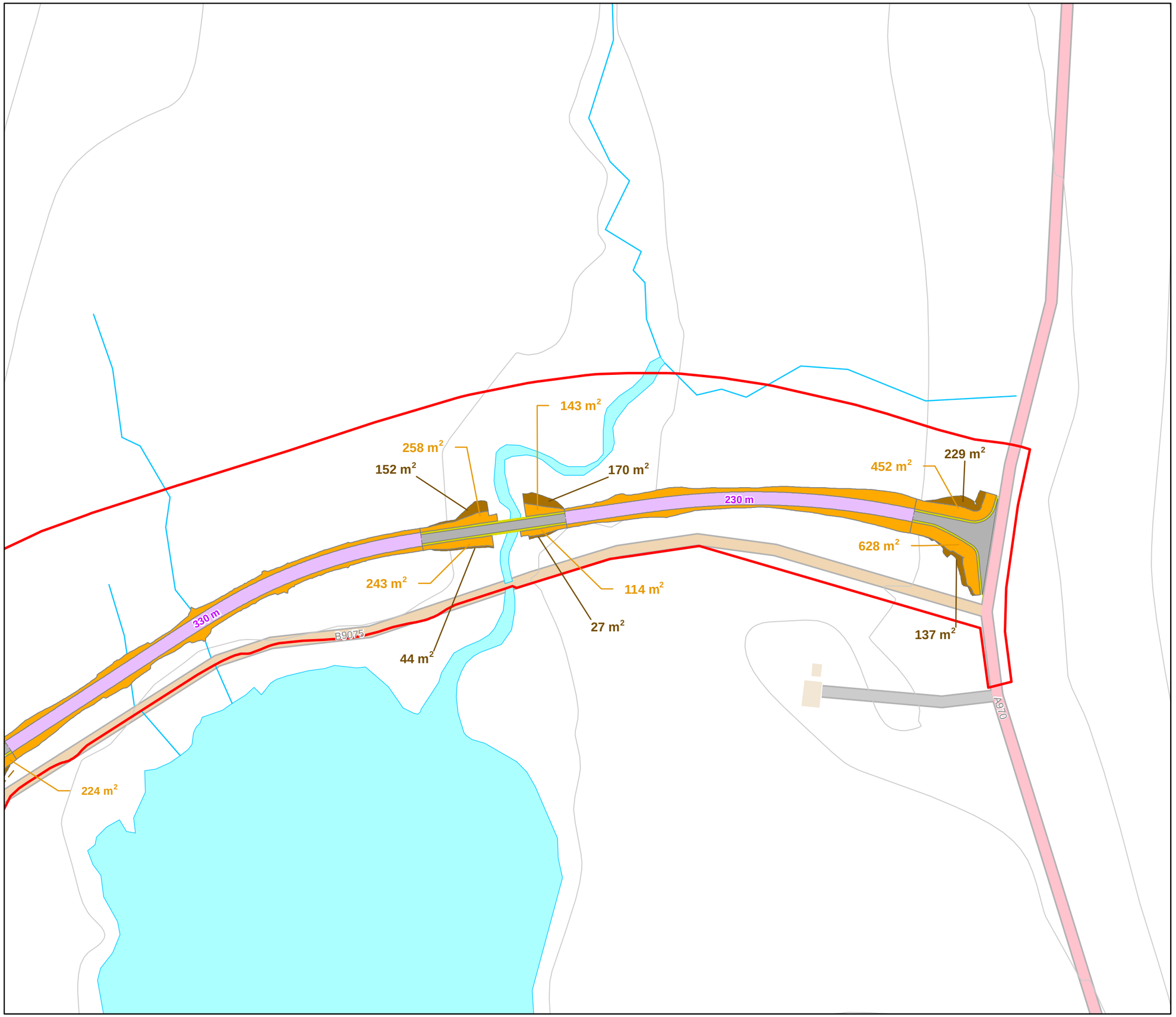
0 0.2 0.4 Km

N

Figure 3
Peat Contour Plan Along Proposed Sandwater Road Alignment

Peat Management Plan
Sandwater Road
Stage 1 Environmental Impact Assessment

Figure 4a-c: Excavated/Floated Road Re-use Volumes along Sandwater Road



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SLR

Key

- Sandwater Road Site Boundary
- Road (Excavated)
- Floated Road
- Earthworks Cut
- Earthworks Cut Added by SLR
- Verge

Scale 1:2,500 @ A3

Meters

0 50 100

N

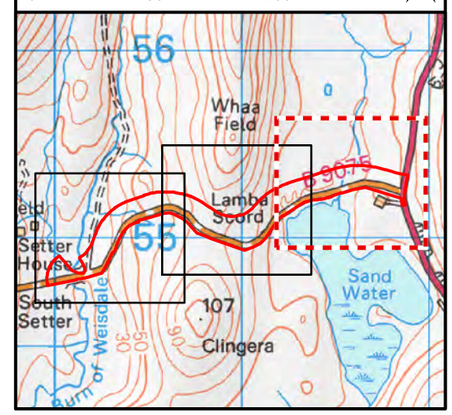

Figure 4a
Excavated/Floating Access Re-Use Volumes Along Sandwater Road

Peat Management Plan
Sandwater Road
Stage 1 Environmental Impact Assessment

889 m²
5843 m²
88 m²
64 m²
252 m²
1173 m²
224 m²
3732 m²
160 m
330 m
B9075

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SLR

Key

- Sandwater Road Site Boundary
- Road (Excavated)
- Floated Road
- Earthworks Cut
- Earthworks Cut Added by SLR
- Verge

Scale 1:2,500 @ A3

0 50 100 Meters

N

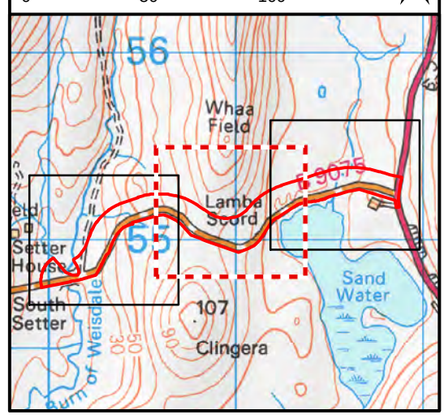
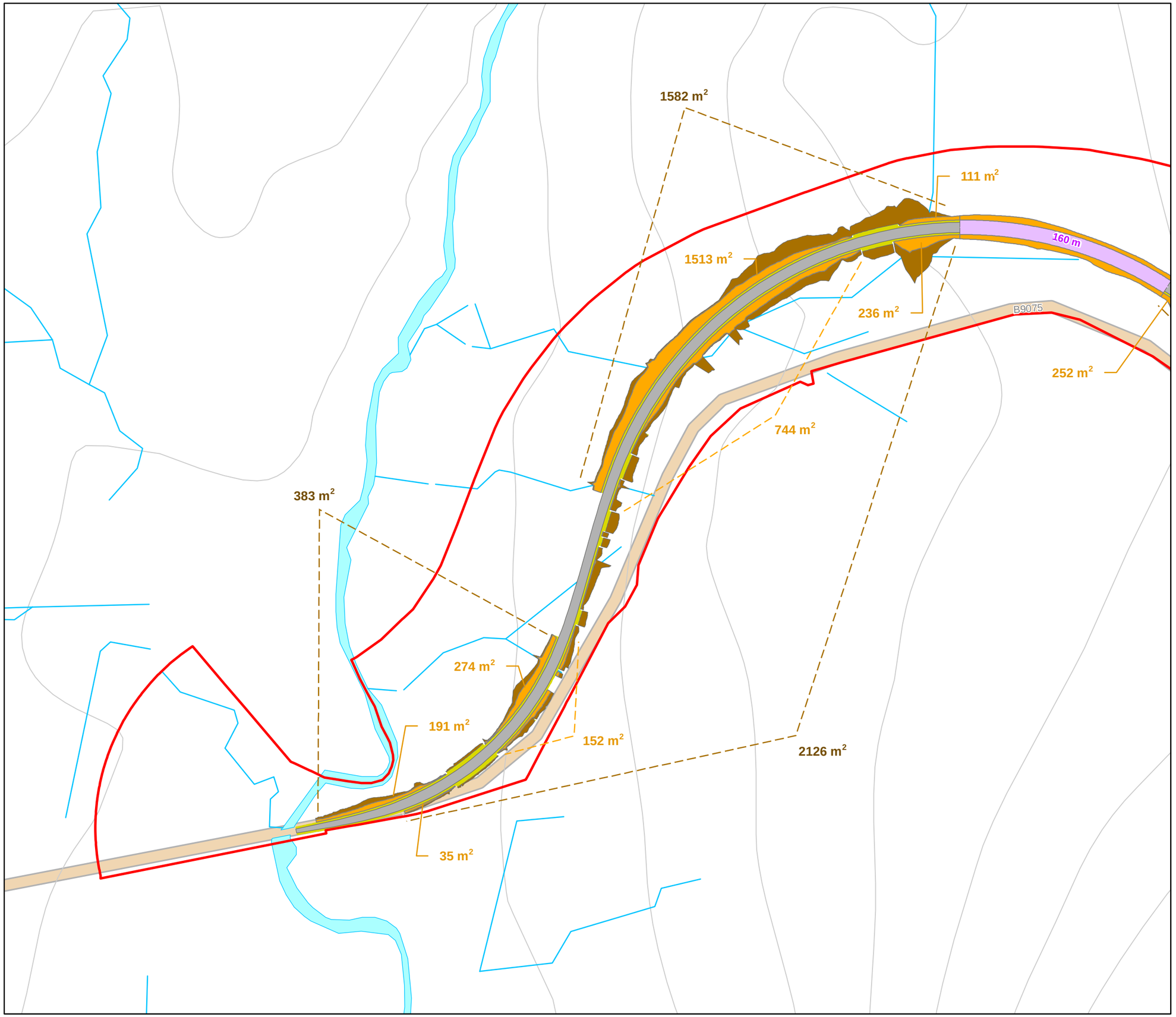


Figure 4b
Excavated/Floating Access Re-Use Volumes Along Sandwater Road

Peat Management Plan
Sandwater Road
Stage 1 Environmental Impact Assessment



viking energy
Harnessing Shetland's natural resources

SLR

Key

- Sandwater Road Site Boundary
- Road (Excavated)
- Floated Road
- Earthworks Cut
- Earthworks Cut Added by SLR
- Verge

Scale 1:2,500 @ A3

0 50 100 Meters

N

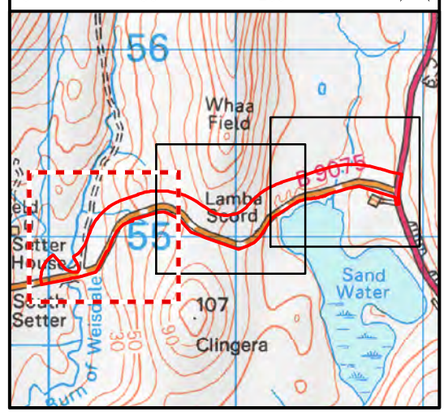
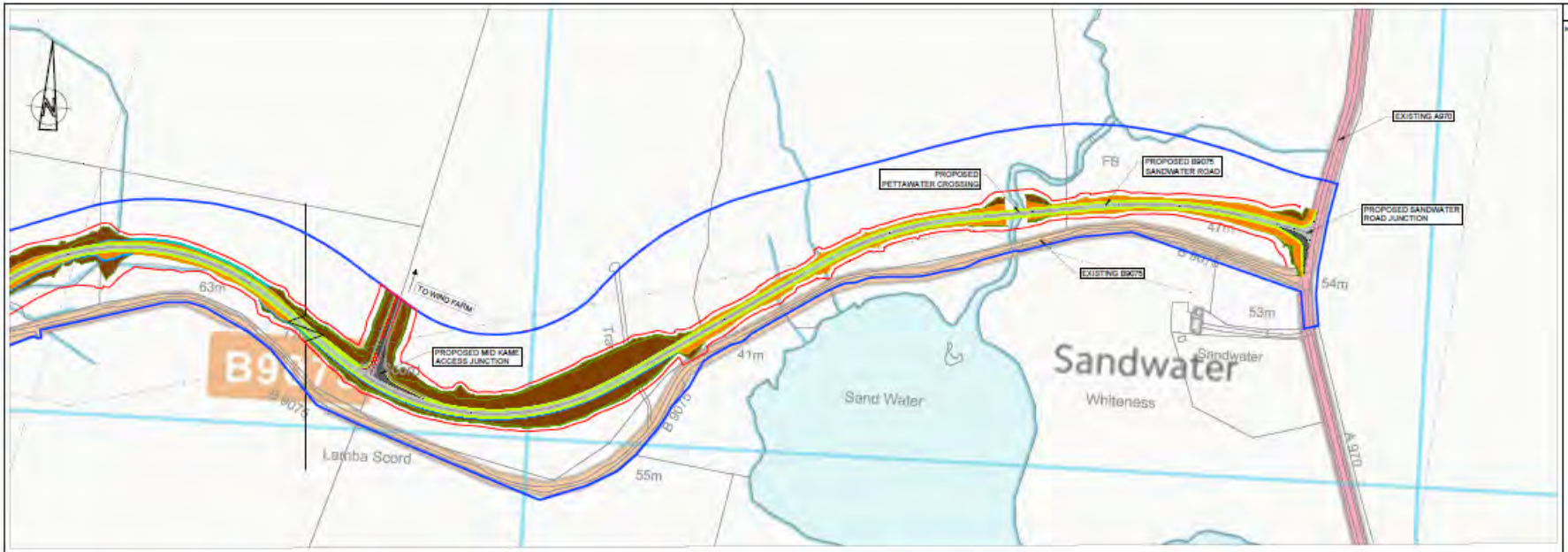


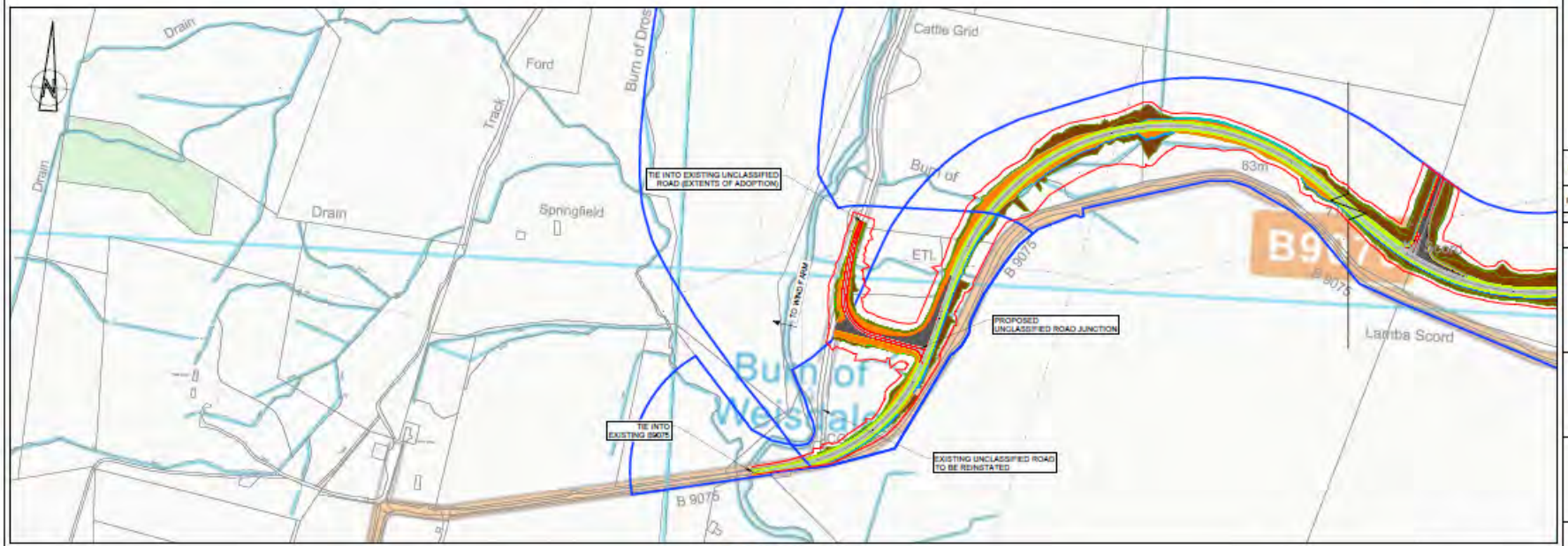
Figure 4c
Excavated/Floating Access Re-Use Volumes Along Sandwater Road

Peat Management Plan
Sandwater Road
Stage 1 Environmental Impact Assessment

Appendix

Appendix A: Sandwater Track Design Drawings (Tony Gee Engineers) S118021-TG-HGN-SR-DR-C-1000





LOCATION PLAN

SCALE 1:2500

SCALE 1:3500

RESIDUAL HAZARD	SUGGESTED CONTROL MEASURE

SIGNIFICANT RESIDUAL HAZARDS

NOTE: The above hazards do not include every hazard or assumption, but identify significant residual construction hazards that are not likely to be obvious to a competent contractor and those that could be difficult to manage effectively. Refer also to the designer's risk documentation.

DO NOT SCALE FROM THIS DRAWING

NOTES

LEGEND
- SITE BOUNDARY
- DEVELOPMENT BOUNDARY
- EARTHWORKS CUT
- EARTHWORKS FILL

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ON BEHALF OF viking energy

VIKING WIND FARM
SANDWATER ROAD

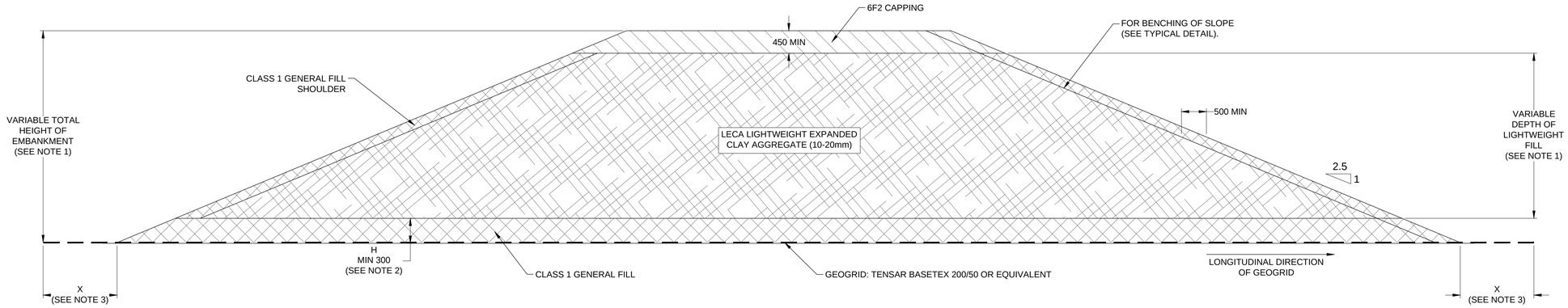
LOCATION PLAN
SANDWATER ROAD

SHEET 1 OF 1

DRAWING No. S118021-TG-HGN-SR-DR-C-1000

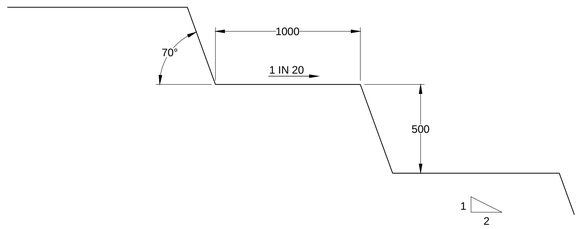
DRAWN : EMcG	DESIGNED : EMcG	REVISION P01
SCALE : 1:2500	ORIGINAL SIZE : A1	

Appendix B: Track Cross Sections (Tony Gee Engineers)



TYPICAL FLOATING TRACK SECTION (LIGHTWEIGHT FILL)

SCALE 1:50



TYPICAL BENCHING DETAIL

N.T.S.

1m 0 1m 2m 3m 4m 5m

SCALE 1:50

DO NOT SCALE FROM THIS DRAWING

NOTES

1. REFER TO EARTHWORKS SPECIFICATION S118021-TG-GEN-XX-SP-C-0600 FOR TOTAL EMBANKMENT HEIGHTS AND DEPTH OF LECA LIGHTWEIGHT FILL.
2. REFER TO EARTHWORKS SPECIFICATION S118021-TG-GEN-XX-SP-C-0600 FOR DEPTH, H, OF CLASS 1A FILL AT BASE OF EMBANKMENT.
3. REFER TO EARTHWORKS SPECIFICATION S118021-TG-GEN-XX-SP-C-0600 FOR LENGTH, X, THE MINIMUM EXTENT OF GEOGRID OUTWITH BASE OF EMBANKMENT.

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SANDWATER ROAD

TYPICAL FLOATING TRACK CROSS SECTION (LIGHTWEIGHT FILL)

SHEET 1 OF 1

RESIDUAL HAZARD	SUGGESTED CONTROL MEASURE

SIGNIFICANT RESIDUAL HAZARDS

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DRAWING. No.
S118021-TG-HML-SR-DR-CH-00

DRAWN : EMcG	DESIGNED : KMcG	REVISION
SCALE : AS SHOWN	ORIGINAL SIZE : A1	P01

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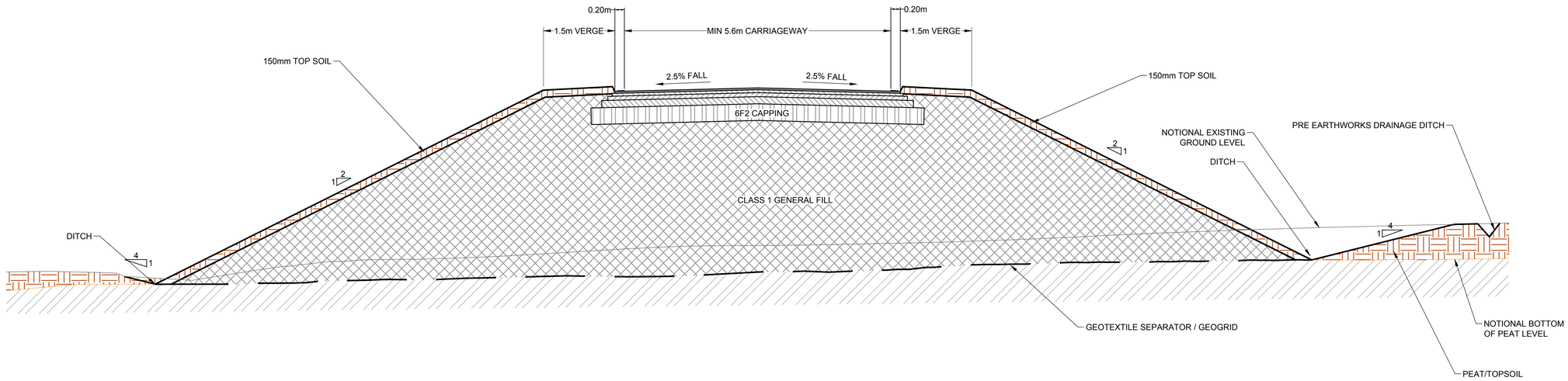
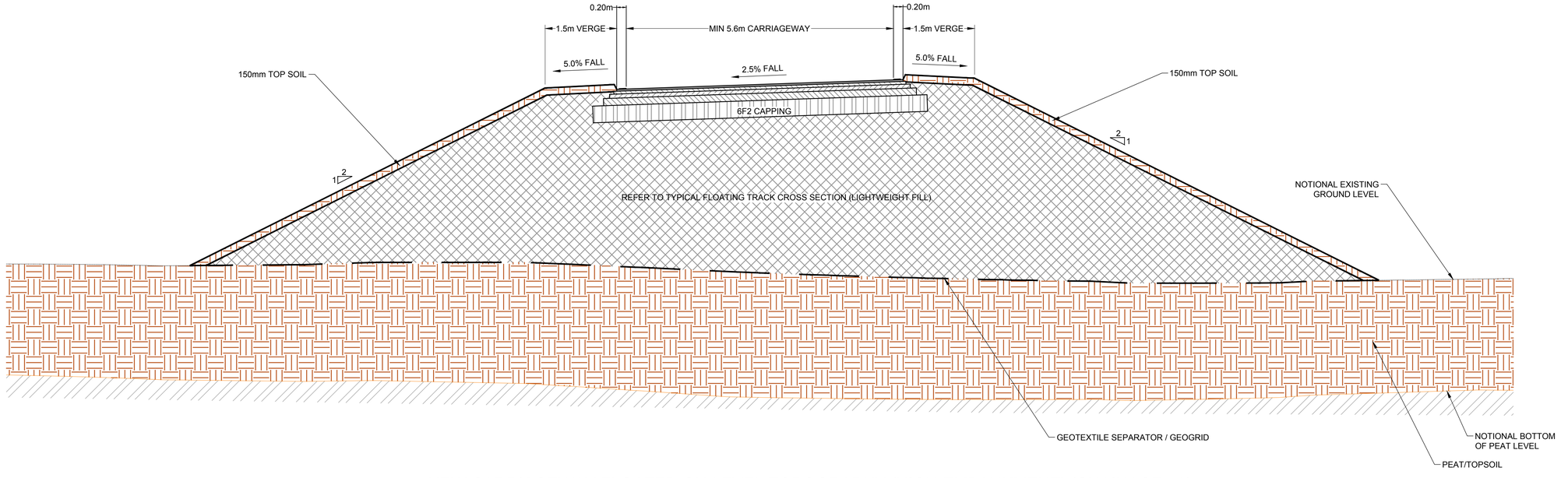
NOTES

1. TYPICAL SECTIONS TO READ IN CONJUNCTION WITH THE PLAN & PROFILE DRAWINGS.
2. UNLESS SPECIFICALLY SHOWN AN OBSERVATIONAL APPROACH IS TO BE ADOPTED FOR EXPOSED CUTTING FACES, IF PERSISTENT SEEPAGES OR FLOWS ARE OBSERVED DRAINAGE SHALL BE INSTALLED.
3. FOUNDED EMBANKMENT GENERALLY TO BE CONSTRUCTED WITH 1 IN 2 SIDE SLOPES AND CUTTINGS WITH 1 IN 2.5 UNLESS OTHERWISE AGREED.
4. A GEOTEXTILE SEPERATOR TO BE USED AT INTERFACE BETWEEN FORMATION AND ROAD CONSTRUCTION WHERE PLACEMENT AND COMPACTION OF THE MATERIAL IS LIKELY TO CAUSE MIXING OF THE FORMATION MATERIALS AND THE NEW ROAD CONSTRUCTION.
5. PRE-EARTHWORKS DITCHES AND DISCHARGES TO BE INSTALLED PRIOR TO CONSTRUCTION TO DIVERT CLEAN WATER AROUND THE WORKS IN THE TEMPORARY AND PERMANENT CONDITION IN ACCORDANCE WITH THE SUDS DESIGN.
6. CLASS 1 GENERAL FILL MINIMUM LAYER THICKNESS IN ACCORDANCE WITH S.H.W.



NEW CARRIAGEWAY FOUNDED ON GENTLY SLOPING TOPOGRAPHY (HIGH EMBANKMENT) (CHAINAGE 40)

SCALE 1:50



NEW CARRIAGEWAY FLOATED ON LEVEL TOPOGRAPHY (HIGH EMBANKMENT) (CHAINAGE 70)

SCALE 1:50

1m 0 1m 2m 3m 4m 5m

SCALE 1:50

PEAT DEPTHS AND INSTABILITY	PEAT DEPTHS >5m IN AREAS. ENSURE PEAT IS CUT AT SAFE BATTERS. PROVIDE MEASURES FOR SAFE PEAT STORAGE
RESIDUAL HAZARD	SUGGESTED CONTROL MEASURE

SIGNIFICANT RESIDUAL HAZARDS

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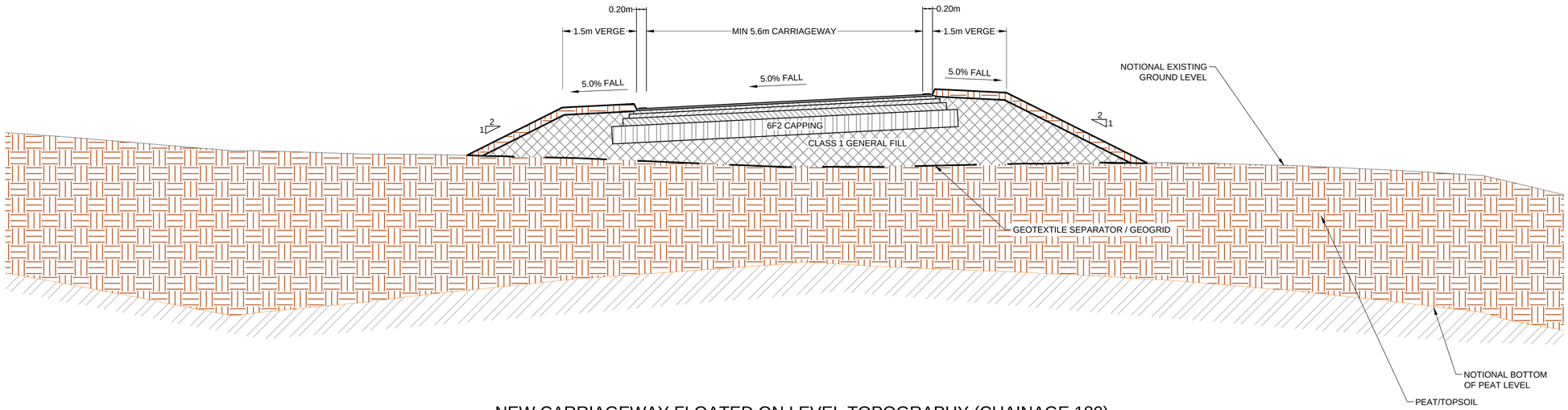
SANDWATER ROAD

PROPOSED MAINLINE
TYPICAL SECTIONS

SHEET 1 OF 3

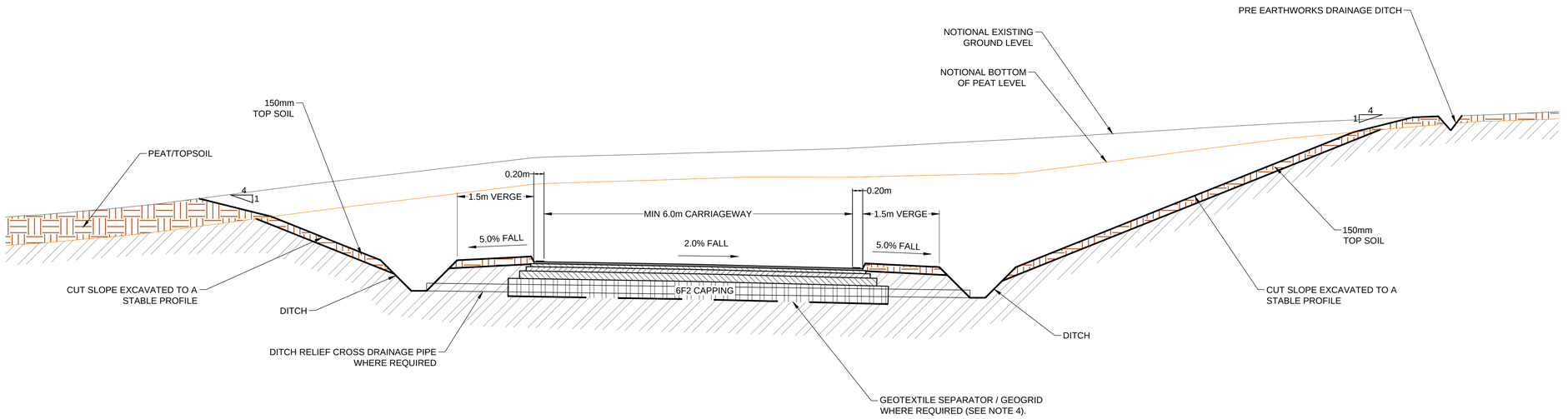
DRAWING. No.
S118021-TG-HML-SR-DR-CH-0050

DRAWN : EMcG	DESIGNED : GM	REVISION
SCALE : 1:50	ORIGINAL SIZE : A1	P03



NEW CARRIAGEWAY FLOATED ON LEVEL TOPOGRAPHY (CHAINAGE 180)

SCALE 1:50



NEW CARRIAGEWAY FOUNDED IN A CUTTING (CHAINAGE 1170)

SCALE 1:50

1m 0 1m 2m 3m 4m 5m

SCALE 1:50

PEAT DEPTHS AND INSTABILITY	PEAT DEPTHS >5m IN AREAS. ENSURE PEAT IS CUT AT SAFE BATTERS. PROVIDE MEASURES FOR SAFE PEAT STORAGE
RESIDUAL HAZARD	SUGGESTED CONTROL MEASURE

SIGNIFICANT RESIDUAL HAZARDS

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DO NOT SCALE FROM THIS DRAWING

NOTES

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7. ALL PIPES SHALL BE TO CLAUSE 501 OF THE MCHW - EXCAVATED IN ACCORDANCE WITH CLAUSE 502; BEDDED, LAID AND SURROUNDED IN ACCORDANCE WITH CLAUSE 503; AND BACKFILLED IN ACCORDANCE WITH CLAUSE 505. LAID IN NATURAL GROUND OR BED OF WATERCOURSE WHERE APPLICABLE. AIM FOR BED CONTINUUM, FOR FLORA AND FAUNA. INLETS TO BE PROVIDED WITH EROSION CONTROL, OUTFALLS SHOULD BE SO CONSTRUCTED AS TO ELIMINATE POSSIBLE EROSION. DITCH RELIEF CROSS DRAINAGE PIPES TO BE SIZED AND SPACED IN ACCORDANCE WITH THE SUDS DESIGN.

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PROPOSED MAINLINE TYPICAL SECTIONS

SHEET 2 OF 3

DRAWING. No.
S118021-TG-HML-SR-DR-CH-0051

DRAWN : EMcG	DESIGNED : GM	REVISION
SCALE : 1:50	ORIGINAL SIZE : A1	P02

DO NOT SCALE FROM THIS DRAWING

NOTES

1. TYPICAL SECTIONS TO READ IN CONJUNCTION WITH THE PLAN & PROFILE DRAWINGS.
2. UNLESS SPECIFICALLY SHOWN AN OBSERVATIONAL APPROACH IS TO BE ADOPTED FOR EXPOSED CUTTING FACES, IF PERSISTENT SEEPAGES OR FLOWS ARE OBSERVED DRAINAGE SHALL BE INSTALLED.
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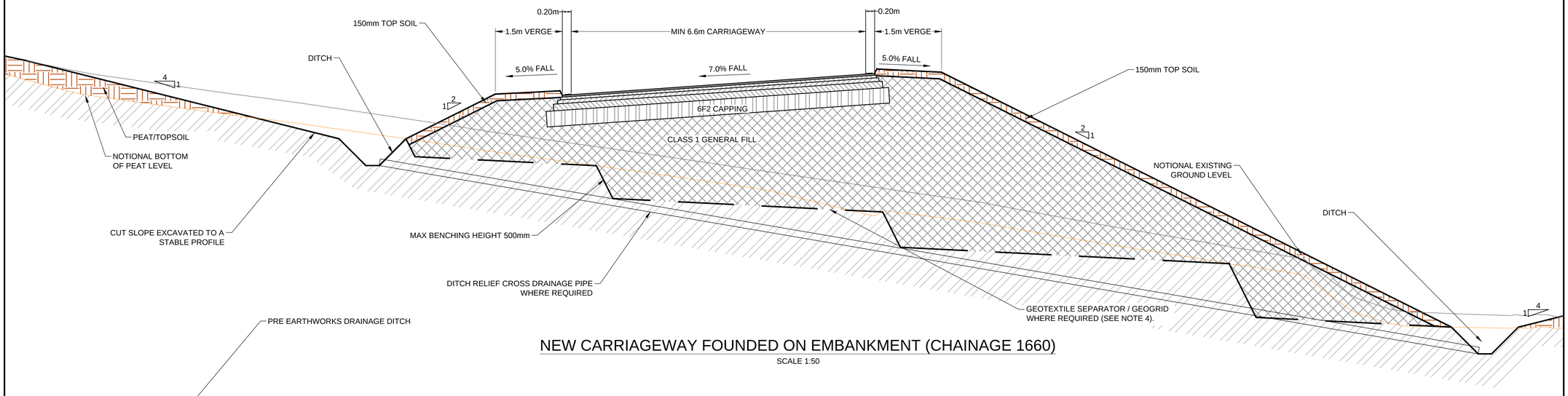
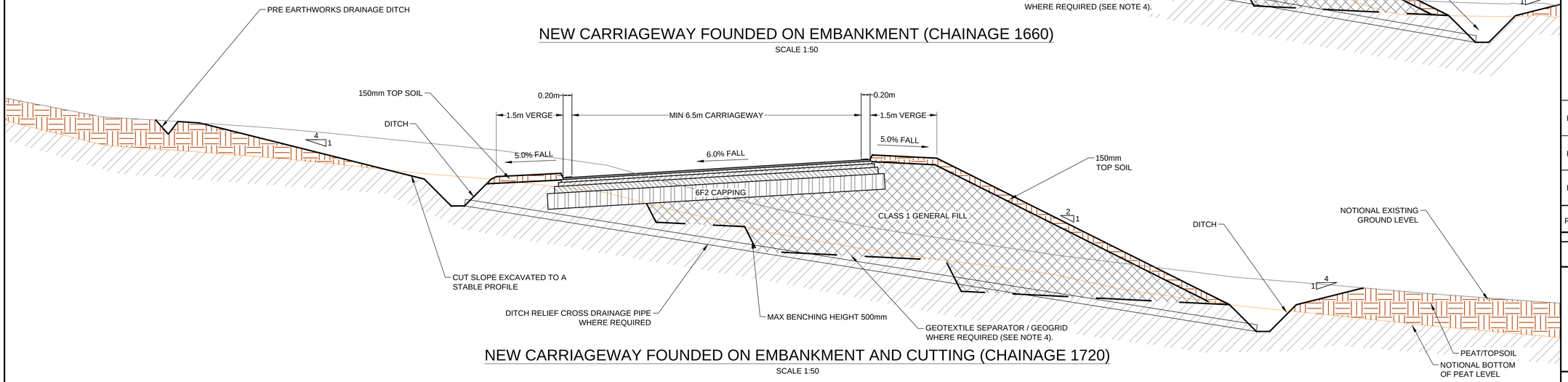


NEW CARRIAGEWAY FOUNDED ON EMBANKMENT (CHAINAGE 1660)

SCALE 1:50



NEW CARRIAGEWAY FOUNDED ON EMBANKMENT AND CUTTING (CHAINAGE 1720)

SCALE 1:50

1m 0 1m 2m 3m 4m 5m

SCALE 1:50

PEAT DEPTHS AND INSTABILITY	PEAT DEPTHS >5m IN AREAS. ENSURE PEAT IS CUT AT SAFE BATTERS. PROVIDE MEASURES FOR SAFE PEAT STORAGE
RESIDUAL HAZARD	SUGGESTED CONTROL MEASURE

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PROPOSED MAINLINE TYPICAL SECTIONS

SHEET 3 OF 3

DRAWING. No.
S118021-TG-HML-SR-DR-CH-0052

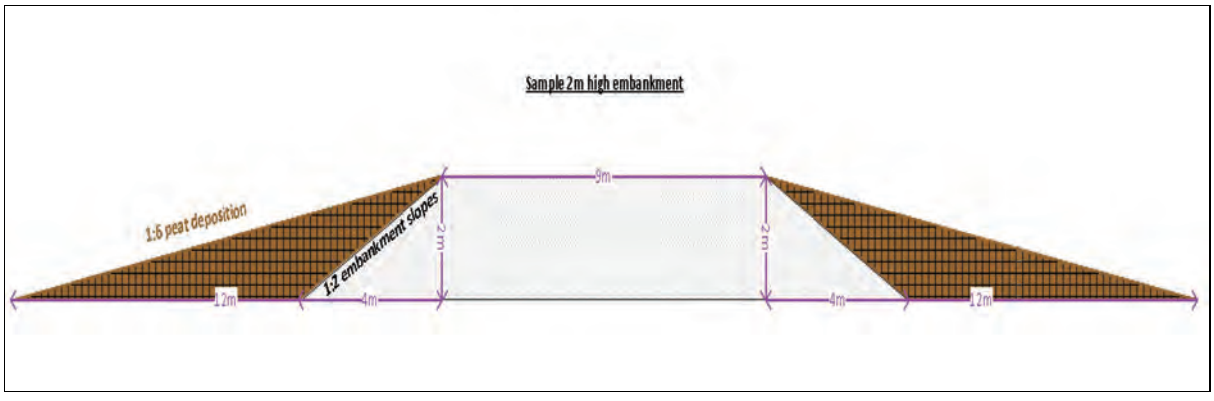
DRAWN : EMcG	DESIGNED : GM	REVISION
SCALE : 1:50	ORIGINAL SIZE : A1	P03

Appendix C: Re-use Peat Volume Calculations along Sandwater Road with indicative, schematic cross sections

Re-use Peat Volumes along Sandwater Road

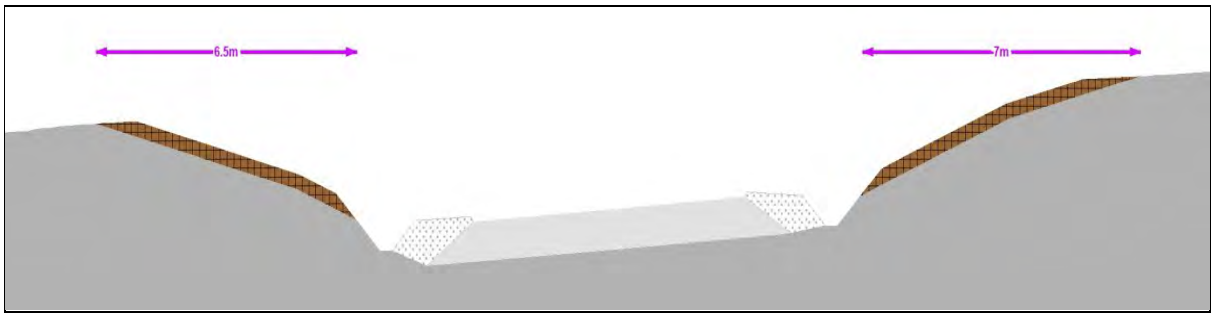
(with illustrative Cross Sections)

Floating Track Sections Re-use Volumes (m^3)				
Chainage	Height of track	Sectional Area of peat m^2	Length of floating track	Volume of Peat Reused m^3
50	3			
100	2.7			
150	1.2			
200	1.5			
250	1.8			
280	0.9			
50-100	3	18	50	900
100-298	1.6	5.1	198	1009.8
400	1.5			
450	1.8			
500	1.6			
550	1.6			
600	1.9			
650	1.1			
700	1.9			
390-720	1.6	5.1	330	1683
1300	1.5			
1350	1.8			
1400	1.6			
1270-1430	**1.6**	**5.1**	**160**	**816**
				4408.8



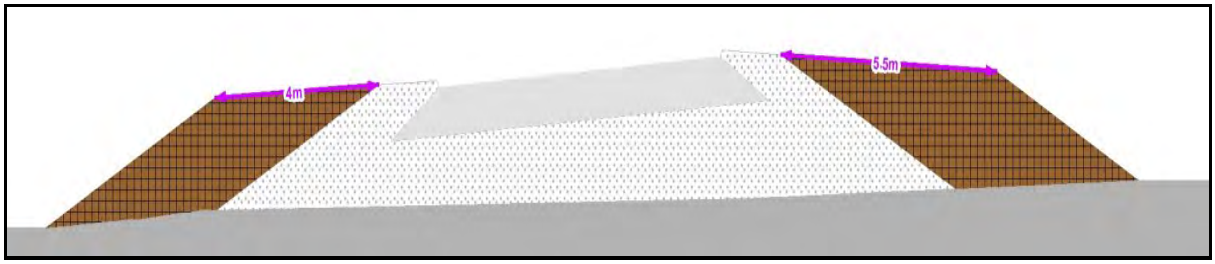
Typical Floating Road Section showing indicative Peat Re-use

Earthworks Cut Re-use Volumes (m^3)				
FID	**Area_m2**	**Label**	**Peat**	**Volume m^3**
1	229.201485	229	0.3	68.7
2	136.634193	137	0.3	41.1
3	169.521465	170	0.3	51
4	151.688278	152	0.3	45.6
6	5843.29169	5843	0.3	1752.9
7	3732.16848	3732	0.3	1119.6
5	71.352373	71	0.3	21.3
8	889.426256	889	0.3	266.7
9	1582.05799	1582	0.3	474.6
10	2125.58535	2126	0.3	637.8
11	383.348642	383	0.3	114.9
				4594.2



Typical 'Cut' Section Showing indicative Re-use of Peat

Embankment Re-use (m^3)				
FID	**Shape_Area**	**Label**	**Maximum Height /2**	**Volume m^3**
1	451.506245	452	2	904
2	628.315479	628	2	1256
3	143.043947	143	1.8	257.4
4	114.381441	114	1.8	205.2
5	258.010771	258	1.8	464.4
6	242.823981	243	1.8	437.4
7	63.754488	64	0.8	51.2
8	223.764102	224	0.8	179.2
9	251.53776	252	0.8	201.6
10	87.50895	88	0.8	70.4
11	110.75046	111	0.8	88.8
12	236.452607	236	0.8	188.8
13	1513.17682	1513	0.8	1210.4
14	743.6678	744	0.8	595.2
15	273.969509	274	0.8	219.2
16	152.110668	152	0.8	121.6
17	191.337342	191	0.8	152.8
18	34.634956	35	0.8	28
				6631.6



Typical 'Fill' Section Showing indicative Peat Re-use