Gordonbush Wind Farm

Proposed Extension

Appendix 9.2

Groundwater Dependent Terrestrial Ecosystems Risk Assessment

SLR Ref : 405-00660-00025

June 2015

Version: Final

CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

SLR Consulting Limited (SLR) was commissioned by SSE Renewables Developments (UK) Ltd to provide technical hydrological and geological advice for the proposed extension of their existing Gordonbush Wind Farm, located near Brora, Highland.

This technical report considers the potential occurrence of Groundwater Dependent Terrestrial Ecosystems (GWDTEs) at the site and their potential to be sustained by groundwater.

The scope of this report has been informed by pre-application advice given by the Scottish Environment Protection Agency (SEPA)[1] (see Appendix A), investigations completed at the site and SEPA Guidance Note 31[2].

This report was first submitted to SEPA on 22nd January 2015 following additional site work undertaken at site which assessed in more detail areas of potential GWDTE identified at the site. Following review of the report SEPA confirmed[3] (see Appendix A) that:

> *'We can confirm that we are content that the information provided makes a suitable case that the layout is acceptable in terms of impacts on GWDTE.'*

It is confirmed that the Development layout presented in the Environmental Statement is the same as submitted to SEPA in January 2015.

The layout of the Development has been subject to much iterative development, and has been informed by detailed constraints mapping (as detailed in Chapter 3: Site Selection, Design Evolution and Consideration of Alternatives). To further minimise potential impacts it is proposed to re-open two borrow pits that were worked during construction of the existing Gordonbush Wind Farm.

The Development has been designed to avoid any direct impacts on potentially highly groundwater dependent habitat.

1.1 Existing Consultation Advice Provided by SEPA

SLR initially sought pre-application advice from SEPA with respect to GWDTEs in September 2014[4] and provided to SEPA details of the draft site layout and the findings of assessment works completed at that time.

SEPA, in their consultation response dated 6th October 2014 confirmed, with respect to areas of potential moderately groundwater dependent habitat:

> *'We agree that the findings from the site, in particular the trial pits, suggest that much of the M15 habitat, which is listed as a moderately groundwater dependent in our guidance, is in this hydrogeological setting likely to be rainwater fed. As a*

[1] Letter from S Haslam, SEPA to G Robb, SLR dated 6th October 2014 (ref.: PCS/136085).

[2] Land Use Planning System – SEPA Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. Version 1, Published 6th October 2014.

[3] Letter from S Haslam, SEPA to G Robb, SLR dated 27th January 2015 (ref.: PCS/136096).

[4] Email G Robb, SLR to SEPA, dated 25th September 2014.

> *result we are content that avoidance of disturbance of M15 at this site is not required. In addition we are content that the buffers quoted in our guidance relating to indirect effects also need not apply. We suggest that the information provided in your email forms part of the formal ES'.*

And with respect to areas of potential highly groundwater dependent habitat:

> *We also agree that the M6c habitat is likely to be groundwater dependant in this setting and as such our published guidance should apply. We are pleased to note that the current layout of the turbines avoids direct impacts on M6c habitat; locating of the tracks should take a similar approach. The location of turbine T5 and T13 do however seem to be within 250m of M6c habitat. We suggest that in the finalised layout these turbines are revised slightly to locate them out with the 250m buffer. If this is not done then we are likely to seek some form of monitoring to demonstrate that the source is not affected. The draft CEMP should also include the general construction measures proposed to maintain hydrological flows.*

This assessment considers further the source of water(s) to areas of potential highly groundwater dependent habitat, and presents the findings of additional site investigation works and revisions to the proposed site layout undertaken since the initial pre-application consultation undertaken with SEPA and described above.

1.2 Report Structure

This report is structured as follows:

- Section 2 — Presents a summary of the site setting, including the site geology and hydrogeology and National Vegetation Classification (NVC) habitat mapping in order to develop a hydrological conceptual site model.
- Section 3 — Using site investigation data discusses sources of water that sustain areas of possibly highly groundwater dependent habitat and the likelihood that groundwater contributes to these habitats. Mitigation measures are proposed where appropriate.
- Section 4 — Presents SEPAs checklist for assessing the impacts of development proposals on groundwater abstractions and GWDTEs.

2.0 CONCEPTUAL SITE MODEL

There is much published and site specific data that can be used to characterise the hydrology, geology and hydrogeology of the site. This information is summarised below and is used to develop the conceptual site model.

To develop the (hydrological and hydrogeological) conceptual site model and inform the site design, the following site works have been completed:

- Phase I and Phase II peat depth and characterisation surveys;
- National Vegetation Classification (NVC) surveys;
- Hand dug trial pitting to assess near surface soils and geology; and
- Water quality sampling to assess water quality and likely source.

The results of these surveys are discussed below.

2.1 Local Hydrology

Ground elevations range from approximately 150m Above Ordnance Datum (AOD) in the south-west of the site to approximately 330m AOD in the north-east of the site.

The centre of the site comprises a plateau, which falls towards the south-west and south-east of the site (see Figure 1).

Parts of the plateau area have been subject to grip cutting, the majority, it is understood, was undertaken in the 1950s.

2.2 Local Geology

The British Geological Survey (BGS) 1:50,000 superficial geology map (see Figure 2) shows that the north, centre and south-west of the site is underlain by peat deposits, with Glacial Till across much of the remainder of the site. Bedrock is found at or near the surface in a few localised areas of the site, including areas adjacent to the largest watercourses draining the site. Deposits of alluvium are found adjacent to larger streams to the east and west of the site.

The BGS 1:50,000 solid geology map (see Figure 3) indicates that the solid geology beneath the site comprises psammite and micaceous psammite of the Kildonan Psammite Formation, which is part of the Loch Eil Group and Moine Supergroup. The psammite is a metamorphosed sedimentary rock.

A granite intrusion is located in the north-west of the site.

A comprehensive programme of peat depth probing has been completed and has included a Phase I and Phase II peat survey. A peat depth plan is presented as Figure 4 which confirms:

- over much of the site the peat depth is less than 2m;
- pockets of peat greater than 2m depth are recorded, the greatest peat depth recorded is >4m; and
- the current site design (tracks, turbines and borrow pits) has avoided the deepest pockets of peat across the site where possible.

To support the site design a number of hand dug trial pits were advanced to assess the nature and saturation of near surface soils. The location of the trial pits dug are shown on Figure 1 and the trial pit logs are shown in Appendix B. Review of the logs confirms that virtually without exception:

- ground conditions at all the trial pit locations were dry (e.g. dry underfoot); and
- little or no water ingress was recorded in the trial pits (where water was recorded it was witnessed as a seepage from the surface of the peat rather from the deposits beneath the peat).

2.3 Local Hydrogeology

A description of the hydrogeological characteristics of the geological units at the site is presented in Table 1. This is based on BGS hydrogeological mapping and SEPA's aquifer productivity and groundwater vulnerability maps.

The regional hydrogeological data provided by BGS indicates that the bedrock beneath the site is impermeable, generally without groundwater except in the near surface weathered zone and secondary fractures. SEPA's aquifer productivity map similarly classifies the bedrock as a fracture flow aquifer of very low productivity. The superficial Glacial Till deposits are classified by SEPA as a low productivity intergranular flow aquifer.

Table 1: Hydrogeological Characteristics of Geological Units

Period	Geological Unit	Hydrogeological Characteristics	Groundwater Vulnerability
Pleistocene to recent	Peat	Characteristically wet underfoot and generally dominated by carpets of Sphagnum moss. Peat comprises two hydrogeological layers: the upper very thin (about 30 cm) acrotelm layer contains upright stems of Sphagnum mosses and allows relatively free water movement and the lower catotelm layer comprising the thicker bulk of peat where individual plant stems have collapsed. Water movement in the catotelm layer is very slow and normally the water table in peat deposits never drops below the acrotelm layer. Artificial drainage of deposits of peat can locally dewater water normally retained in the catotelm layer.	Not classified
Pleistocene to recent	Glacial Till	Sand and gravel horizons within this unit are capable of storing groundwater, although their lateral and vertical extent realises a variable and often very small groundwater yield. Intergranular flow mechanisms dominate. Clay within this unit acts as an aquitard to the more permeable sand and gravel lenses and will hinder/prevent large scale groundwater movement. Regionally, groundwater flow will be limited by the variability of these deposits and consequently any groundwater yields are normally low.	Not classified
Precambrian	Kildonan Psammite Formation	Generally without groundwater except at shallow depth in the near surface weathered zone and secondary fractures at depth. Very low productivity.	Moderate to high vulnerability due to dominance of fracture flow and depending on thickness of superficial peat and Glacial Till deposits.

2.4 National Vegetation Classification Mapping

In accordance with best practice guidance a NVC survey has been completed[5]. The principle findings included:

- The majority of the site supports M17 *Trichophorum-Eriophorum* mire and M15 *Trichophorum-Erica* wet heath. Drier slopes support H10 *Calluna-Erica* heath and H12 *Calluna-Vaccinium* heath. Acid M6 *Carex-Sphagnum* mire marks out flush lines, typically along the fringes of watercourses. Other communities include small areas of U4 *Festuca-Agrostis-Galium* grassland, bracken and U6 *Juncus-Festuca* grassland.

- The blanket bog has been subject to historic draining, peat cutting and, more recently, burning. This has modified the floristics in certain areas giving rise to a drier bog community largely dominated by *Trichophorum germanicum* and *Calluna vulgaris*. In other, flatter areas, drainage has had a limited impact on floristics with good levels of *Sphagnum* still present.

- Burning has also created a hybrid wet/dry heath community with affinities to the M15 *Trichophorum-Erica* wet heath and H10 *Calluna-Erica* dry heath.

- The only truly potential GWDTE on site is the M6c, comprising flushes along the fringes of watercourses and valley bottoms. However, this is a fairly species-poor community of limited floristic diversity and characteristic of flushing by base-poor water.

- Species of local interest include *Sphagnum fuscum* and *Drosera anglica*.

The extents of habitats recorded by the NVC mapping and by SEPA guidance as potential moderately or highly groundwater dependent are shown on Figure 1. Review of which confirms that:

- much of the highly GWDTE is associated with streams e.g. bounds the streams / found in stream corridors; and
- the majority of the moderately GWDTE is remote from steams and may be rainwater fed, where water ponds above the low permeability clay / peat.

The NVC mapping confirms, without exception, that the potentially highly dependent GWDTE habitat at site is M6c.

Rodwell[6] records that M6c is typically found in seepage areas and water tracks where there is local accumulation of peat or a peaty topsoil to gleys of various kinds. Where the community occurs on drift smeared slopes, Rodwell reports that '*outlying patches of the mire may mark areas of local water logging in hollows and on gentle slopes, creating a mosaic with the grasslands and heaths*'. This is consistent with Averis et al[7] who reports M6 is found in wet hollows, seepage lines, flushes, shallow gullies cutting down hillsides, and along the margins of streams within expanses of blanket mire, dwarf shrub heath or acid grassland.

[5] NVC Survey at Gordonbush Wind Farm. Northern Ecological Services, Contract No. J509, September 2013.

[6] Rodwell J.S., British Plant Communities Volume 2, Mires and Heaths, 1991.

[7] Averis et al., An Illustrated Guide to British Upland Vegetation, 2004.

2.5 Water Quality Monitoring

A further site survey was completed on 8th January 2015 to assess areas of potential highly groundwater dependent habitat. In addition to mapping local catchment areas to this habitat water samples were obtained and subject to major ion analysis. The test certificates are presented in Appendix C.

Two water samples were taken from surface water streams downstream (SW1) and upstream (SW2) of the site. Seven water samples were also obtained from within areas of potentially high GWDTE (F1 – F7). The sampling locations are shown on Figure 5.

Durov and Piper diagram plots for the water samples collected are presented as Plates 1 and 2. These plots can be used to assess the major ion chemistry of water samples and show pictorially different water types.

Waters sourced from groundwater (a psammite) would be expected to have a chemical signature dominated by a relatively low mineralisation and buffering capacity, acidic pH and relatively low concentrations of major ions. The latter would depend on the mineral (feldspathic) content. Water dominated by rainfall runoff would be expected to have a chemical signature dominated by slightly acidic with low mineralisation and buffering capacity. This would include lower concentrations of major ions (than groundwater) and the presence of organic matter would expect to be elevated if the runoff was associated with areas of peat.

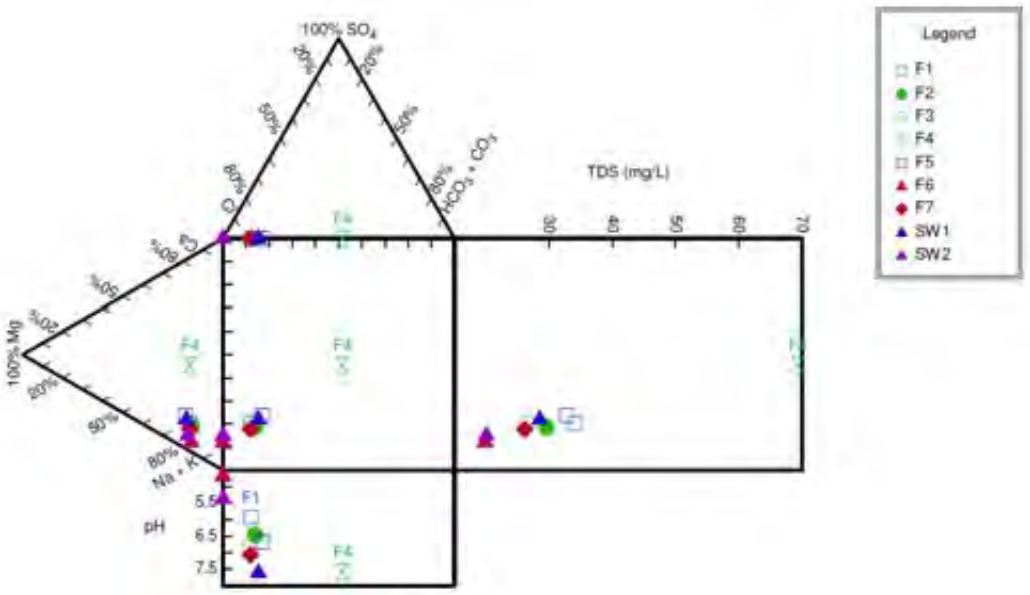


Plate 1 – Durov Plot Showing Water Quality Analysis

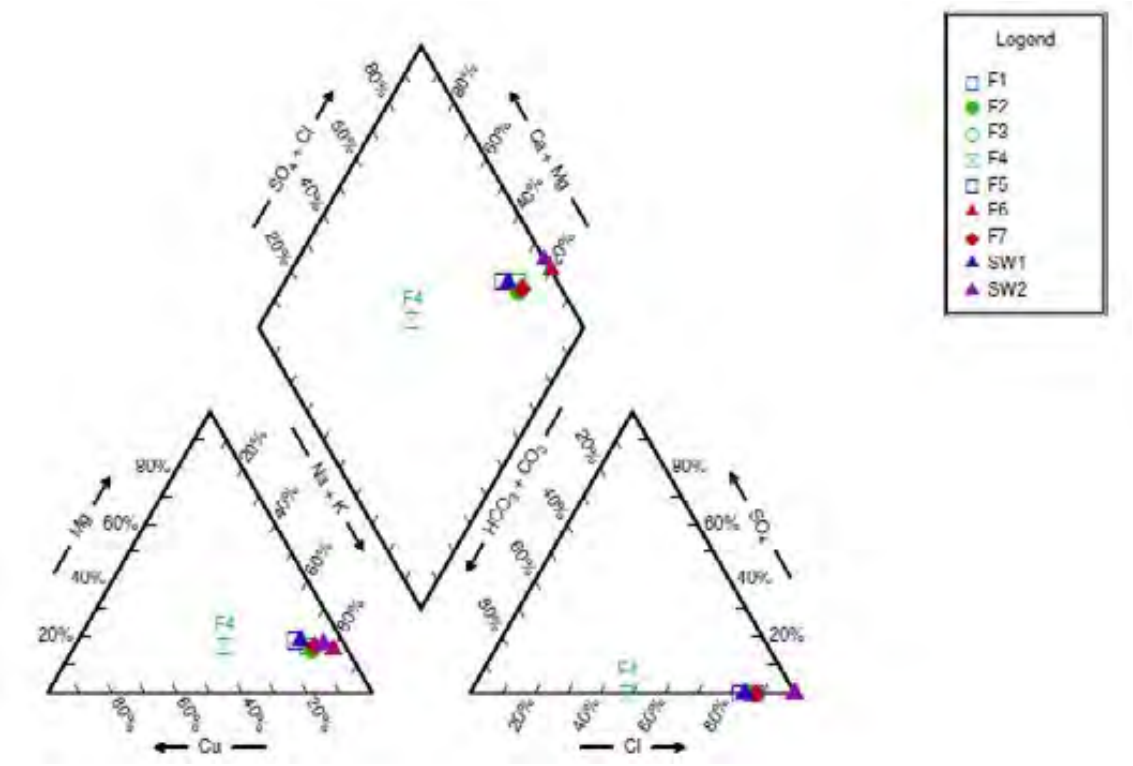


Plate 2 – Piper Diagram Showing Water Quality Results

Review of the water analysis and Plates 1 and 2 suggests:

- the majority of the waters are dilute (low mineralisation) and are Na-Cl type. The exception is F4 which is Fe-HCO3 type;

- the samples have low major ion content and approximate to that of rain water. The slightly acid nature may be attributed to a larger rain water component or perhaps (as suggested by the Total Organic Carbon (TOC) concentration, drainage from peat forms a component of the water; and

- the majority of the water is of a similar chemistry and therefore it is most likely that they are from the same source and considered likely to be surface rainfall-runoff dominated.

It is noted that sample location F4 has higher iron and elevated calcium/sodium compared to other monitoring points (e.g. it plots in a different location on the Piper and Durov diagrams). Sample F4 was obtained from a small pool of standing water (see Photograph 1) located within a much larger area of rushes. The pool contained much red (and possibly iron rich) colloidal matter. Peat depth probing has confirmed that there is little peat near to F4 (also see observation point 3, Appendix B). The peat / soils are locally underlain by granular material, interpreted as being weathered bedrock.

The slightly different chemistry of water does suggest the source of the water in this area may be different. The F4 water has elevated calcium, sodium, iron and alkalinity which could indicate it has originated within a host rock which contains carbonates or psammites with a higher proportion of that mineralogy. The local psammite may also have a higher proportion of iron oxide (haematite) which would explain the high iron content. The latter may also be explained by peat but given that the other waters had relatively low iron content, this possibly implies a different source.

It is noted that a short distance downstream of F4, the water sample collected at F5 shows a water chemistry dominated by surface water rainfall-runoff, which confirms the localised nature of the F4 discharge.

Photograph 1 – Location of Water Sample F4

2.6 Conceptual Site Model

Following review of the site setting using published information sources and the results of site investigation the following conceptual model can be developed:

- there is potential for some groundwater to be present at site in the upper weathered surface of the psammite;
- water recharge to the psammite will be limited by the extensive cover of peat and Glacial Till recorded over much of the site;
- groundwater flow in the upper weathered surface of the psammite is likely to follow local surface water profiles (e.g. groundwater and surface water catchments are likely to be similar);
- NVC mapping confirms that potential GWDTE habitat is limited to stream boundaries and areas of very shallow relief on site;
- where recorded the GWDTE habitat is a fairly species-poor community of limited floristic diversity and characteristic of flushing by base-poor water (e.g. rainfall runoff);
- virtually without exception areas of potential GWDTE are underlain by deposits of peat; and
- water quality monitoring suggests in most of the areas of potential GWDTE the water has the chemical signature of surface water rainfall-runoff rather than a groundwater.

It is noted however, that the GWDTE recorded at water sample point F4 is located on shallow deposits of peat. At this location the deposits below the peat are recorded by peat probing to be granular, which is likely to reflect the weathered upper surface of the psammite bedrock. While the chemical signature at F4 does not strongly reflect groundwater, the sample does suggest that the water found within this GWDTE habitat may be partly sustained by groundwater (e.g. it is sustained by a limited groundwater flux in addition to surface water rainfall-runoff). A short distance downstream of F4, and within the same GWDTE habitat, water quality sampling suggests that the flush habitat is sustained by surface water rainfall-runoff.

3.0 ASSESSMENT OF GWDTES

Following site investigation works and as agreed with SEPA[8] (see Appendix A) areas of M15 habitat, which are listed as moderately groundwater dependent in SEPA guidance are, in this hydrological setting, likely to be rainwater fed and therefore avoidance of disturbance of M15 habitat at this site is not required. Similarly buffers to this habitat stated in SEPA guidance need not apply.

The assessment below considers the source of water to M6c habitat recorded at site, a potentially highly groundwater dependent habitat.

3.1 Buffer Zones

SEPA guidance[9] specifies that the following buffer should be used to assess for potential impacts on groundwater abstractions and GWDTEs:

1. 100m for all excavations less than 1m in depth; and
2. 250m for all excavations deeper than 1m.

Existing track infrastructure developed as part of Gordonbush Wind Farm would be utilised where possible. A limited length of new access track would be required to access the proposed wind turbines from the existing tracks. It is proposed that where new access tracks are required they would be excavated to a maximum depth of 1m. If the depth of peat beneath the track is greater than 1m then the access track would be constructed using floating track techniques. Therefore, a 100m buffer should be applied to new access tracks. It is noted however, that the site design has avoided, where possible, areas of deep peat.

The foundations required to establish the proposed wind turbines would be more than 1m deep and it is assumed that borrow pits would also be more than 2m deep, therefore a 250m buffer should be applied to these components of the scheme.

Figure 5 shows the 100m and 250m buffers and areas of potential highly dependent GWDTE. There are a few limited areas of overlap between the buffers and areas of potential GWDTE across the site and as such Option 4 of SEPA's GWDTE guidance applies, which states that a bespoke risk assessment (of possible impacts on GWDTEs) is required.

3.2 GWDTE Risk Assessment

3.2.1 Methodology

The significance of potential impact on GWDTEs has been assessed by considering two factors: the sensitivity of the GWDTE; and the potential magnitude of change, should that impact occur. The assessment methodology has been informed by experience of carrying out such assessments for a range of wind farm and other developments, knowledge of soils, geology and the water environment characteristics, and cognisance of best practice.

[8] Letter from S Haslam, SEPA to G Robb, SLR dated 6th October 2014 (ref.: PCS/136085).

[9] Land Use Planning System – SEPA Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. Version 1, Published 6th October 2014.

This approach provides a mechanism for identifying the areas where mitigation measures are required and for identifying mitigation measures appropriate to the significance of potential effects presented by the Development.

Areas of potential GWDTE have been given a sensitivity of **Very High** as a worst case.

The criteria that have been used to assess the magnitude of the change are defined below.

Magnitude of Change	Criteria
Major	Results in total loss of attribute.
Moderate	Results in effect on the integrity of attribute or loss of part of attribute.
Minor	Results in minor effect on attribute.
Negligible	Results in an effect on attribute but of insufficient magnitude to affect the use/integrity.

The sensitivity of the receiving environment together with the magnitude of the change defines the significance of the effect, as identified below.

Matrix to Determine Significance of Effect

	Sensitivity of Receptor			
Magnitude of Change	*Very High*	*High*	*Medium*	*Low*
Major	Major	Major	Moderate	Minor
Moderate	Moderate	Moderate	Moderate	Minor
Minor	Minor	Minor	Minor	Not significant
Negligible	Not significant	Not significant	Not significant	Not significant

3.2.2 Risk Assessment

Figures 5 – 8 show areas of potential highly GWDTE habitat identified at site, the surface water catchments to these habitats, recorded peat depth and photographs of the habitats and surface water catchments. Proposed adjacent wind farm infrastructure is also shown. A discussion is also presented which assesses the contribution groundwater and surface water makes to these habitats, and required mitigation measures to sustain the habitats. Review of these drawings confirms:

Area X (Figure 6)

The highly GWDTE habitat falls within the 100m buffer of the access track to turbine 11, and also within 250m buffer of turbines 8 and 11.

This potential GWDTE habitat is assessed as locally being sustained by groundwater, however, the contribution that groundwater makes to the extent of the habitat has been shown to be limited. Surface water rainfall-runoff also sustains this habitat.

Target Note 12 (see Appendix 8.1a) reported by Northern Ecological Services[10] is located in the same potential GWDTE as water sample F4. The target note records '*sedge rich flushed area dominated by Juncus effusus, Juncus acutiflorus, Carex nigra & Carex echinata. Acid-neutral flushing'*.

[10] NVC Survey at Gordonbush Wind Farm. Northern Ecological Services, Contract No. J509, September 2013.

Review shows that very little development infrastructure is proposed in the ground / surface water catchment to this GWDTE habitat. As a result it is concluded that there is little or no potential for the Development to effect either the surface or groundwater contribution to this area of GWDTE subject to the application and use of best practice construction techniques (see Section 3.3 below).

The development proposals are considered to not to pose a significant risk to this GWDTE habitat.

Area Y and Z (Figures 7 and 8)

The highly GWDTE habitat within Area Y falls within the 100m buffer of the access track to turbine 13 and turbine 3, and also within the 250m buffer of turbines 3, 5, 9, 10, 12, 13 and a borrow pit.

Within Area Z the highly GWDTE falls within the 100m buffer of access track to turbine 4 and within the 250m buffer of turbine 4 and a borrow pit.

This potential GWDTE habitat is assessed as not being sustained by groundwater as peat depth probing, trial pitting and water quality sampling all suggest no continuity with groundwater. M6c flushing is likely to be associated with seepage of water from superficial deposits of peat across the area.

Target Notes 16, 17, 18 and 23 (see Appendix 8.1a as recorded by Northern Ecological Services[11]) in area Y (see Figure 7) report the following descriptions:

Target Note No.	Location	Description
16	NC 84889 13253	Hybrid wet heath/dry heath community dominated by *Calluna vulgaris, Trichophorum germanicum, Erica tetralix and Eriophorum angustifolium over Hypnum* moss. Species poor, derived from burning.
17	NC 84914 13341	M6 flushing surrounded by U4/U6 grassland dominated by *Juncus squarrosus, Agrostis capillaris, Anthoxanthum odoratum, Carex nigra, Luzula multiflora, Galium saxatile, Potentilla erecta* and *Deschampsia flexuosa.*
18	NC 84919 13507	Further M6c acid flushing
23	NC 85043 13585	Flushed area dominated by Juncus effusus, Sphagnum fallax, Sphagnum palustre, Carex nigra. Surrounded by sedge rich U4 grassland.

And in Area Z (see Figure 8) Target Note 27 is recorded:

Target Note No.	Location	Description
27	NC 85693 13542	M6c acid flush dominated by *Juncus effusus, Sphagnum fallax*. Water Vole habitat.

The development proposals are considered to not to pose a significant risk to this GWDTE habitat.

Area adjacent to the Proposed Temporary Construction Compound and Operations Building

A small area of highly GWDTE habitat falls within the 100m buffer of the proposed temporary construction compound and operations building. The potential GWDTE habitat is assessed

[11] NVC Survey at Gordonbush Wind Farm. Northern Ecological Services, Contract No. J509, September 2013.

as being sustained by surface water due to its location adjacent to a surface watercourse. Furthermore, the potential GWDTE habitat is located upstream from the proposed construction compound and operations building, therefore its surface water catchment will not be impacted by the development proposals.

The development proposals are considered not to pose a significant risk to this GWDTE habitat.

3.3 Best Practice Mitigation and Monitoring

Subject to adoption of best practice construction techniques hydrogeological flows within the water catchment areas to the areas of highly GWDTE habitat can be readily maintained. For example:

- it will be necessary, at the time of construction to install cross drains beneath the proposed new access track that lies within these surface water catchments to ensure current surface water flow paths are maintained;

- any temporary (and limited) dewatering from the proposed wind turbines within the surface water catchments should be discharged locally to ground and within the same surface water catchments as it is abstracted;

- aggregate required to construct access tracks and crane hardstandings should be sourced from local rock with the same geochemical properties as the existing underlying bedrock in these catchments;

- during construction (and decommissioning) an Ecological Clerk of Works (ECoW) should be deployed to assess the efficacy of the drainage measures; and

- drainage and water monitoring protocols should be specified in the site Construction and Environmental Management Plan (CEMP) that will allow the contractor and ECoW to monitor and maintain drainage paths and water quality.

3.4 Conclusion

The qualitative and quantitative risk assessment above demonstrates that the development proposals are unlikely to have a significant impact on groundwater flow and groundwater quality feeding identified sensitive receptors through the proposed design, construction and operation of the infrastructure.

It is anticipated that requisite monitoring of the GWDTE habitat identified on site will be included in the site CEMP which would be agreed with The Highland Council and SEPA prior to any works being undertaken at site. The monitoring protocol would be robust enough to demonstrate that the water quality and hydraulic connectivity is being maintained to the areas of GWDTE.

4.0 SEPA CHECKLIST FOR SUBMITTED INFORMATION

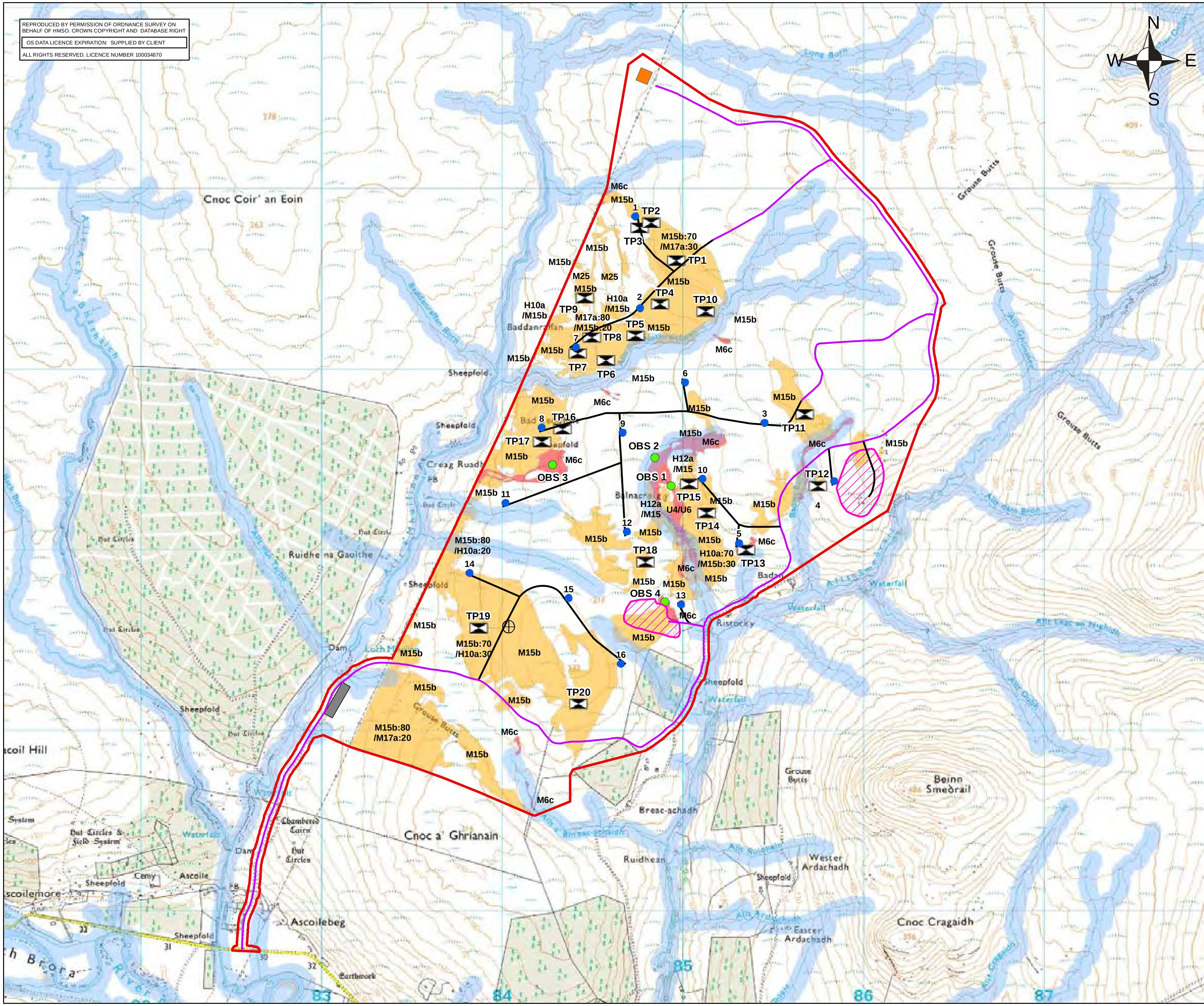
In accordance with SEPA guidance Table 2 below presents a checklist of information provided within this technical report.

Table 2: GWDTE Checklist

	Information Requirements	Circle & Initial to confirm	SEPA Actions
1	Plans showing all proposed infrastructure, including temporary works	Yes	If not provided SEPA will object due to lack of information & request
2	Plans overlain with details of the extent and depths of all proposed excavations	Yes	If not provided – SEPA will object due to lack of information & request
3	Plans show the relevant specified buffer zones (100m and 250m)	Yes	If not provided – SEPA will object due to lack of information & request
4	Plans overlain with source of groundwater abstractions: all groundwater abstractions within 100m radius of all excavations less than 1m in depth - all groundwater abstractions within 250m of all excavations deeper than 1m in depth Or statement provided to confirm none	Yes	If not provided - SEPA will object due to lack of information & request **N/A – No water abstractions identified**
5	Plans overlain with GWDTE (Phase 1 habitat survey) data. - within 100m radius of all excavations less than 1m in depth; - within 250m of all excavations deeper than 1m. Or statement provided to confirm none	Yes	If not provided – SEPA will object due to lack of information & request
6	Applicant can confirm one of following (as shown on above plans): i) no groundwater abstractions & GWDTE on site; ii) groundwater abstractions and/or GWDTE identified & 250m buffer zones implemented iii) confirmation that the groundwater abstraction owners have agreed contingency plans including temporary or permanent replacement of a groundwater supply.	Yes	If confirmed SEPA will request condition A (maintenance of buffer zones) **No – see 9 & 10 below**
7	Applicant can confirm above plans show excavations or intrusions within 100m buffer zone are less than 1m in depth BUT excavations or intrusions are **not** on/in a groundwater abstractions or GWDTE	Yes	If confirmed SEPA will request condition B (monitoring) **No – see 9 & 10 below**
8	Applicant can confirm above plans show excavations or intrusions are on/in a groundwater abstractions or GWDTE	Yes	If confirmed SEPA will require a bespoke risk assessment **No – see 9 & 10 below**
9	Applicant can confirm infrastructure involves excavations deeper than 1m depth within 250m of sensitive receptors or unable to comply with monitoring requirements of Condition B	Yes	If confirmed SEPA will require a bespoke risk assessment
10	Bespoke risk assessment provided	Yes	SEPA will provide a bespoke response

Signature	Organisation	Date

FIGURES



LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- EXISTING TRACK
- PROPOSED NEW TRACK
- PERMANENT MET MAST
- PROPOSED TEMPORARY CONSTRUCTION COMPOUND AND OPERATIONS BUILDING
- CONTROL BUILDING
- POTENTIAL BORROW PIT
- OBSERVATION POINT (SEE APPENDIX B)
- TRIAL PIT LOCATION (SEE APPENDIX B)
- 50m BUFFER FROM WATERCOURSE

GWDTE HABITAT

- HIGHLY GROUNDWATER DEPENDENT
- MODERATELY GROUNDWATER DEPENDENT

sse

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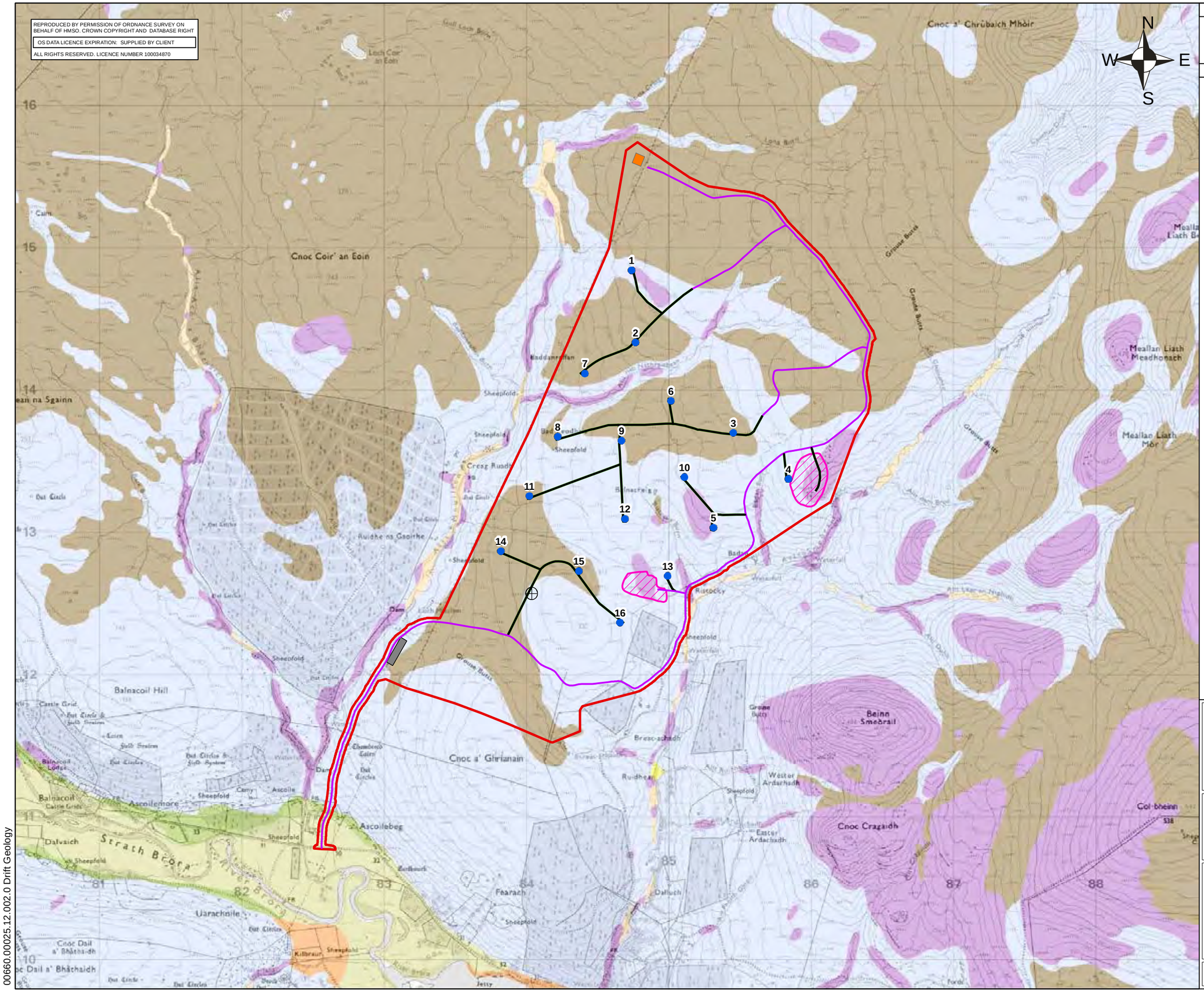
GORDONBUSH EXTENSION WIND FARM

APPENDIX 9.2

GWDTE TRIAL PIT LOCATIONS AND NVC MAPPING

1

Scale	Date
1:20,000 @ A3	MARCH 2015



NOTES

1. BGS DIGITAL GEOLOGY LICENCE NO. 2011/3PDL/213517 BRITISH GEOLOGICAL SURVEY © NERC.

LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- EXISTING TRACK
- PROPOSED NEW TRACK
- PERMANENT MET MAST
- PROPOSED TEMPORARY CONSTRUCTION COMPOUND AND OPERATIONS BUILDING
- CONTROL BUILDING
- POTENTIAL BORROW PIT

DRIFT GEOLOGY

- ALLUVIAL FAN DEPOSITS
- ALLUVIUM
- LACUSTRINE DELTAIC DEPOSITS
- LACUSTRINE DEPOSITS
- PEAT
- RIVER TERRACE DEPOSITS
- TILL, DEVENSIAN - DIAMICTON
- BEDROCK AT OR NEAR SURFACE

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GORDONBUSH EXTENSION WIND FARM

APPENDIX 9.2

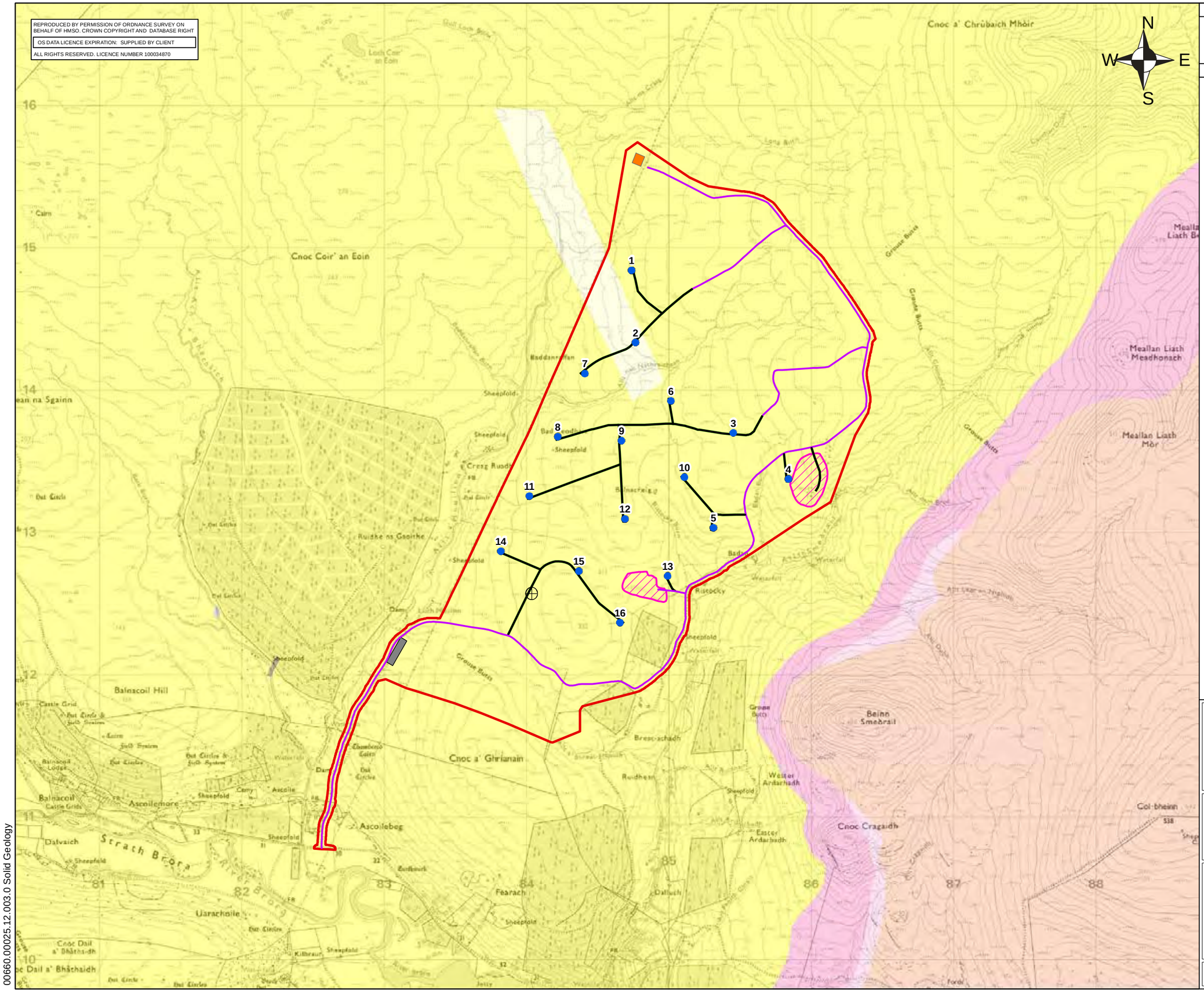
DRIFT GEOLOGY

2

Scale 1:25,000 @ A3

Date MARCH 2015

00660.00025.12.002.0 Drift Geology



NOTES

1. BGS DIGITAL GEOLOGY LICENCE NO. 2011/3PDL/213517 BRITISH GEOLOGICAL SURVEY © NERC.

LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- EXISTING TRACK
- PROPOSED NEW TRACK
- PERMANENT MET MAST
- PROPOSED TEMPORARY CONSTRUCTION COMPOUND AND OPERATIONS BUILDING
- CONTROL BUILDING
- POTENTIAL BORROW PIT

SOLID GEOLOGY

- UNNAMED METAMORPHOSED IGNEOUS ROCKS, PRE-CALEDONIAN TO CALEDONIAN
- ROGART PLUTON, ARGYLL AND NORTHERN HIGHLANDS GRANITIC SUITE, CALEDONIAN SUPERSUITE
- MOINE SUPERGROUP
- KILDONAN PSAMMITE FORMATION, LOCH EIL GROUP, MOINE SUPERGROUP
- BERRIEDALE SANDSTONE FORMATION, CAITHNESS FLAGSTONE GROUP, OLD RED SANDSTONE SUPERGROUP
- OUSDALE ARKOSE FORMATION, SARCLET GROUP, OLD RED SANDSTONE SUPERGROUP
- ULBSTER SANDSTONE FORMATION, SARCLET GROUP, OLD RED SANDSTONE SUPERGROUP

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GORDONBUSH EXTENSION WIND FARM

APPENDIX 9.2

SOLID GEOLOGY

3

Scale 1:25,000 @ A3

Date MARCH 2015

00660.00025.12.003.0 Solid Geology

N
W E
S

NOTES

1. PEAT INTERPOLATED TO A DISTANCE OF 100m FROM PEAT PROBE POINT.

LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- EXISTING TRACK
- PROPOSED NEW TRACK
- PERMANENT MET MAST
- PROPOSED TEMPORARY CONSTRUCTION COMPOUND AND OPERATIONS BUILDING
- CONTROL BUILDING
- POTENTIAL BORROW PIT
- SLR PEAT PROBE LOCATION
- URS PEAT PROBE LOCATION

PEAT DEPTH (m)

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

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GORDONBUSH EXTENSION WIND FARM

APPENDIX 9.2

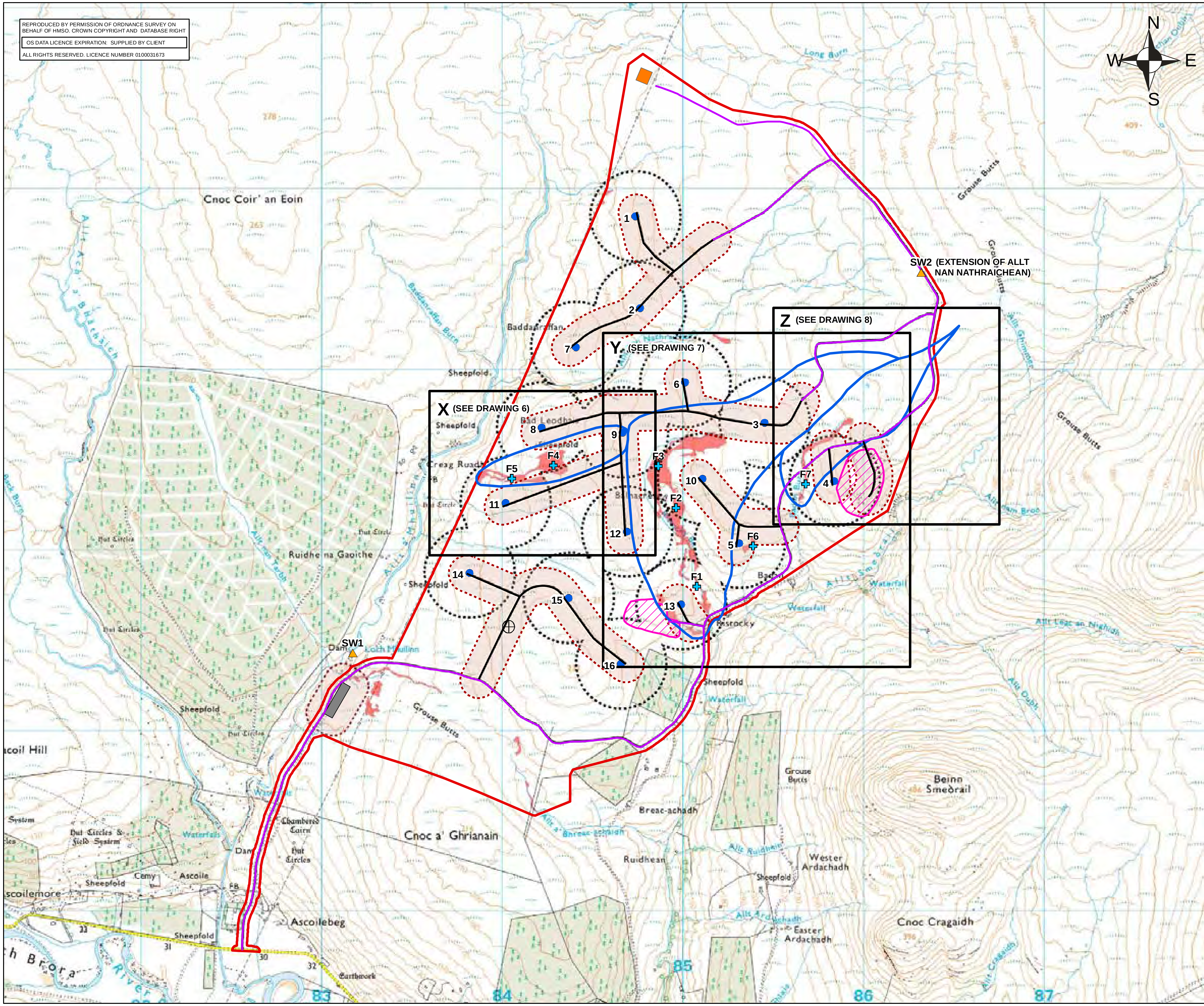
PEAT DEPTH PLAN

4

Scale 1:20,000 @ A3

Date MARCH 2015

00660.00025.12.004.0 Peat Depth Plan



LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- 250m BUFFER FROM PROPOSED TURBINE
- EXISTING TRACK
- PROPOSED NEW TRACK
- PROPOSED TEMPORARY CONSTRUCTION COMPOUND AND OPERATIONS BUILDING
- 100m BUFFER FROM PROPOSED ACCESS TRACK AND CONSTRUCTION COMPOUND
- CONTROL BUILDING
- PERMANENT MET MAST
- POTENTIAL BORROW PIT
- SURFACE WATER CATCHMENT BOUNDARY TO HIGHLY GROUNDWATER DEPENDENT HABITAT
- GWDTE WATER QUALITY MONITORING POINT (F1 - F7)
- SURFACE WATER QUALITY MONITORING POINT (SW1 - SW2)

GWDTE HABITAT

- HIGHLY GROUNDWATER DEPENDENT

sse

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GORDONBUSH EXTENSION WIND FARM

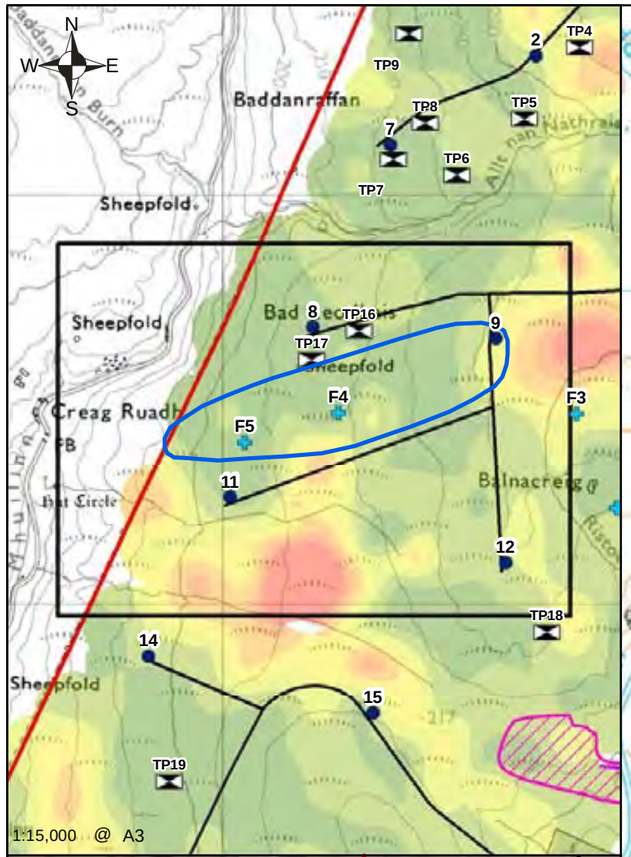
APPENDIX 9.2

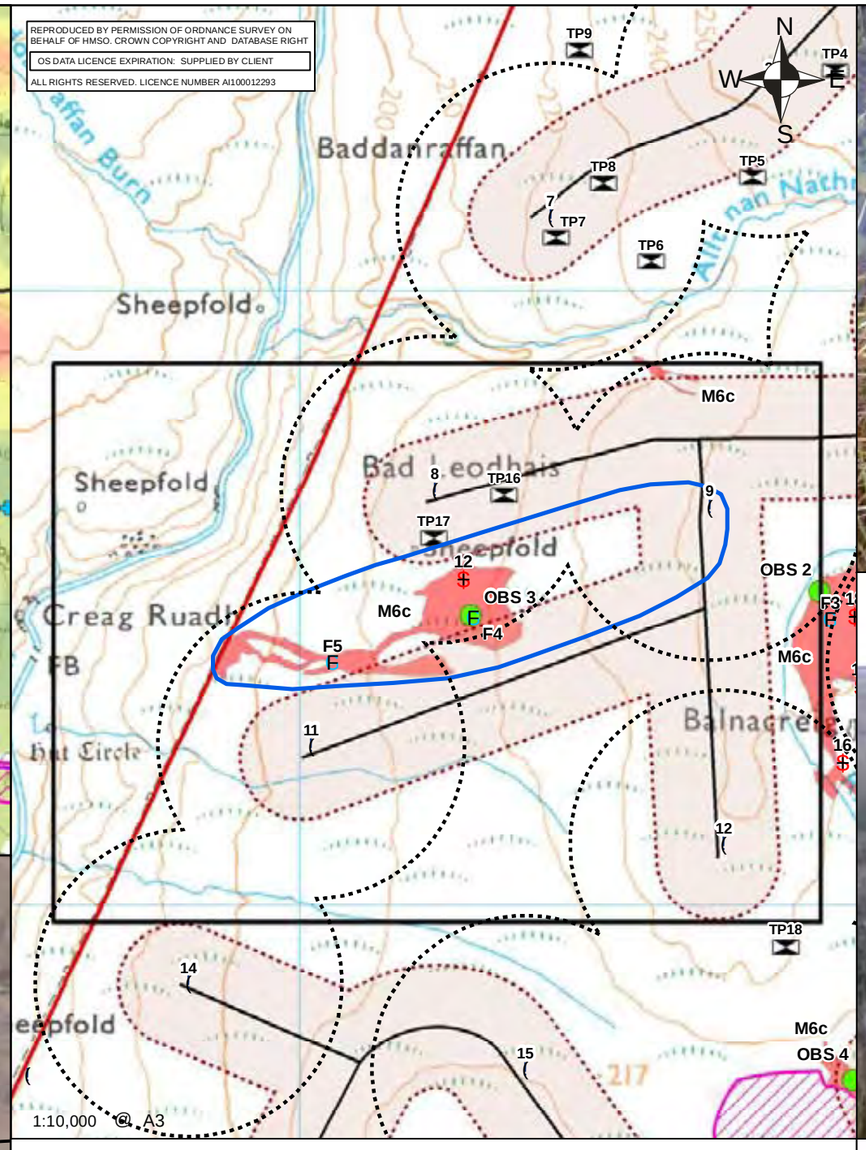
HIGHLY DEPENDENT GWDTE AND BUFFER ZONES

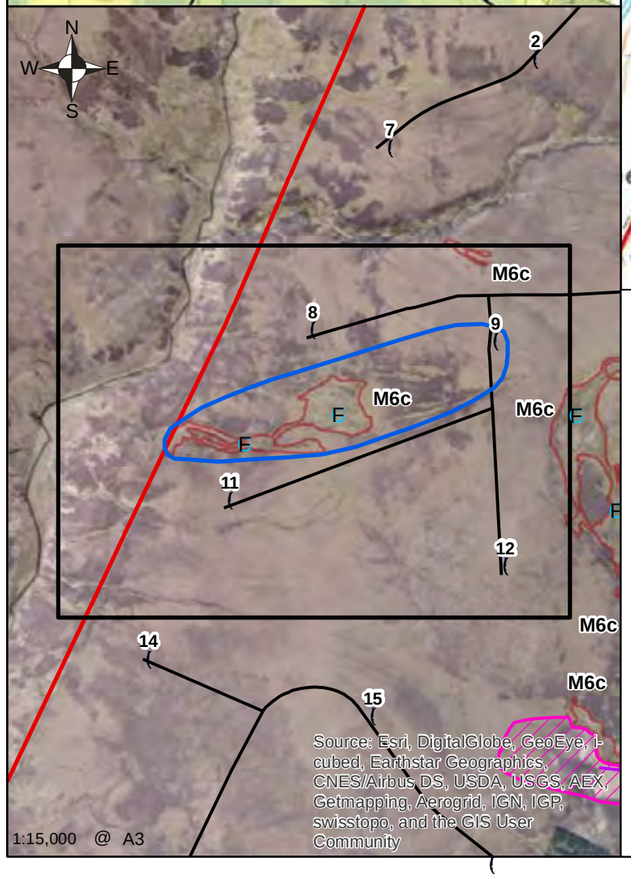
5

Scale	Date
1:20,000 @ A3	MARCH 2015

00660.00025.12.005.0 GWDTE and Buffer Zones







Impact Assessment

GWDTE within 100m buffer of track to T11 and within 250m buffer of T8 and T11.

Water quality sampling suggests slight groundwater contribution at F4 and surface water rainfall-runoff. Habitat mapping confirms M6c species is of poor value. Groundwater likely to be sourced from upper weathered surface of bedrock. Groundwater catchment likely to be the same as the local surface water catchment.

T8 and T11 (and associated tracks) shown not to be within surface / groundwater catchment to habitat and thus construction of the turbines (and tracks) unlikely to impact habitat. Any effects would be temporary and localised given low groundwater yield. T9 (and adjacent track) in headwaters of catchment but outside buffer zones.

Magnitude of Change: Negligible*
Sensitivity of Receptor: Very High
Significance of Effect: Not Significant
*with adoption of best practice construction techniques to maintain existing surface water flow paths (see Section 3)

NOTES

1. REFER TO APPENDIX 9.2B FOR TRIAL PIT LOGS

LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- 250m BUFFER FROM PROPOSED TURBINE AND BORROW PIT
- EXISTING TRACK
- PROPOSED NEW TRACK
- 100m BUFFER FROM PROPOSED ACCESS TRACK AND CONSTRUCTION COMPOUND
- POTENTIAL BORROW PIT
- TRIAL PIT LOCATION (SEE APPENDIX B)
- OBSERVATION POINT (SEE APPENDIX B)
- GWDTE WATER QUALITY MONITORING POINT
- SURFACE WATER CATCHMENT BOUNDARY

GWDTE HABITAT

- HIGHLY GROUNDWATER DEPENDENT
- PHASE 1 TARGET NOTE

PEAT DEPTH (m)

	0		1.5 - 2
	0 - 0.5		2 - 2.5
	0.5 - 1		2.5 - 3
	1 - 1.5		3 - 4

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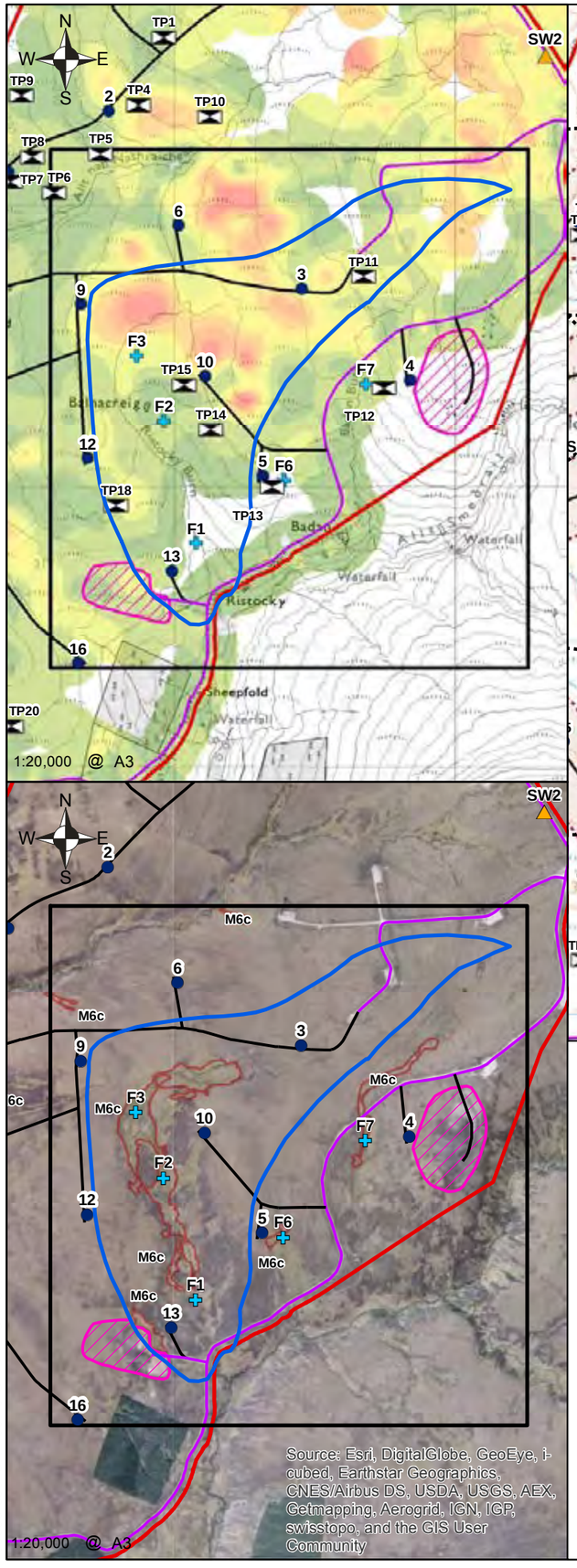
APPENDIX 9.2

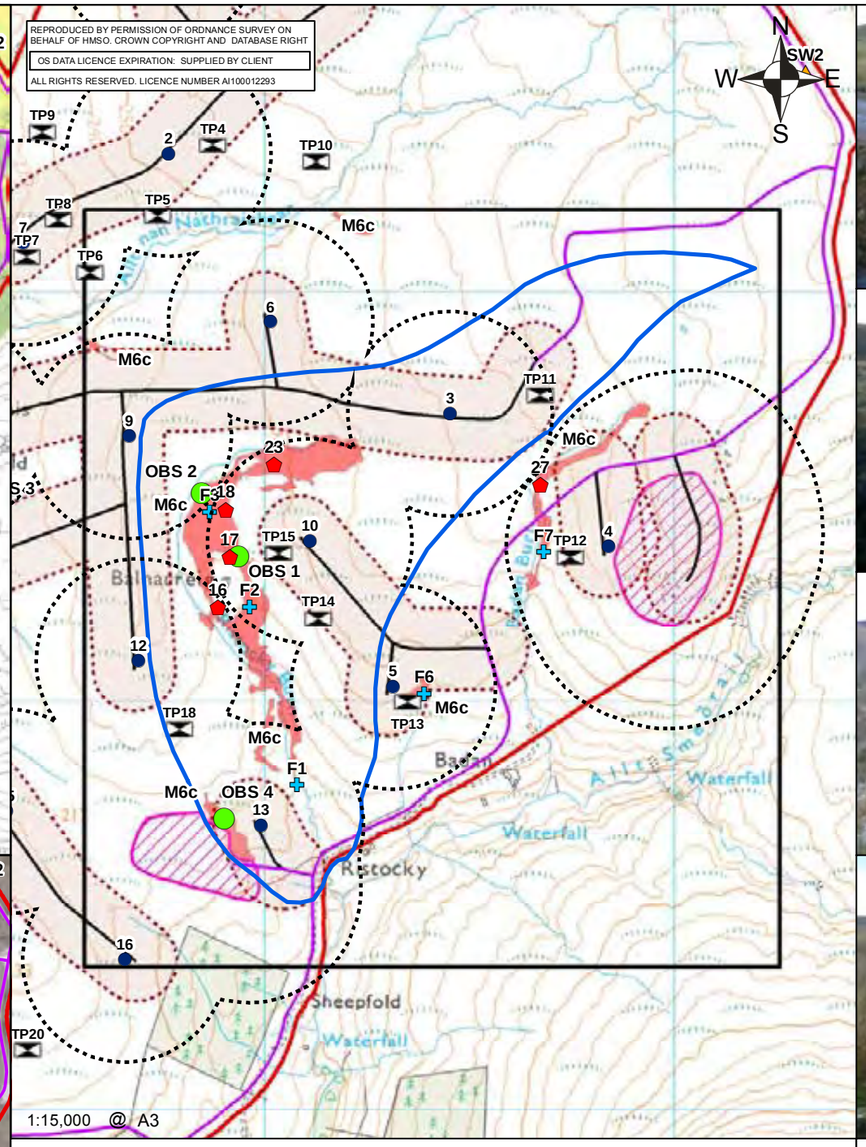
AREA X: GWDTE IMPACT ASSESSMENT

6

Date MARCH 2015

00660.00025.12.006.0 GWDTE CATCHMENT X





Impact Assessment

GWDTE within 100m buffer of track to T13 and T3 and within 250m buffer of T9, T12, T13, Borrow Pit, T5, T10 and T3.

Water quality sampling suggests no groundwater contribution at F1, 2, 3 or 6. Water quality is surface water rainfall-runoff dominated. Habitat mapping confirms M6c species is of poor value. Majority of M6c habitat developed in low lying 'bowl' with saturated soils or within disturbed soils used to restore the margins of existing borrow pit or adjacent to an established watercourses. Peat recorded below all M6c habitat esp. in 'bowl' that forms watercourse headwaters.

Magnitude of Change: Negligible*
Sensitivity of Receptor: Very High
Significance of Effect: Not Significant
*with adoption of best practice construction techniques to maintain existing surface water flow paths (see Section 3)

NOTES

1. REFER TO APPENDIX 9.2B FOR TRIAL PIT LOGS

LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- 250m BUFFER FROM PROPOSED TURBINE AND BORROW PIT
- EXISTING TRACK
- PROPOSED NEW TRACK
- 100m BUFFER FROM PROPOSED ACCESS TRACK AND CONSTRUCTION COMPOUND
- POTENTIAL BORROW PIT
- TRIAL PIT LOCATION (SEE APPENDIX B)
- OBSERVATION POINT (SEE APPENDIX B)
- GWDTE WATER QUALITY MONITORING POINT
- SURFACE WATER QUALITY MONITORING POINT
- SURFACE WATER CATCHMENT BOUNDARY

GWDTE HABITAT

- HIGHLY GROUNDWATER DEPENDENT
- PHASE 1 TARGET NOTE

PEAT DEPTH (m)

	0		1.5 - 2
	0 - 0.5		2 - 2.5
	0.5 - 1		2.5 - 3
	1 - 1.5		3 - 4

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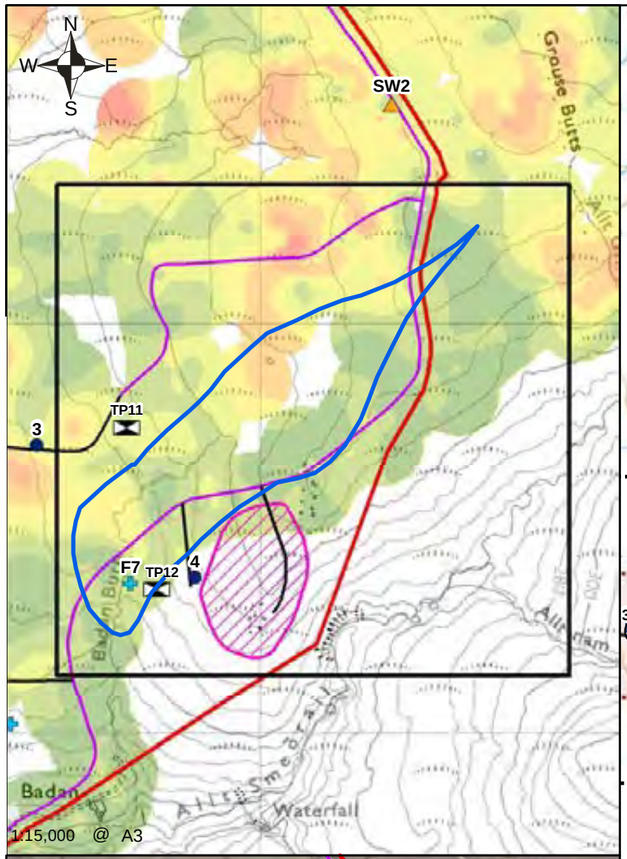
APPENDIX 9.2

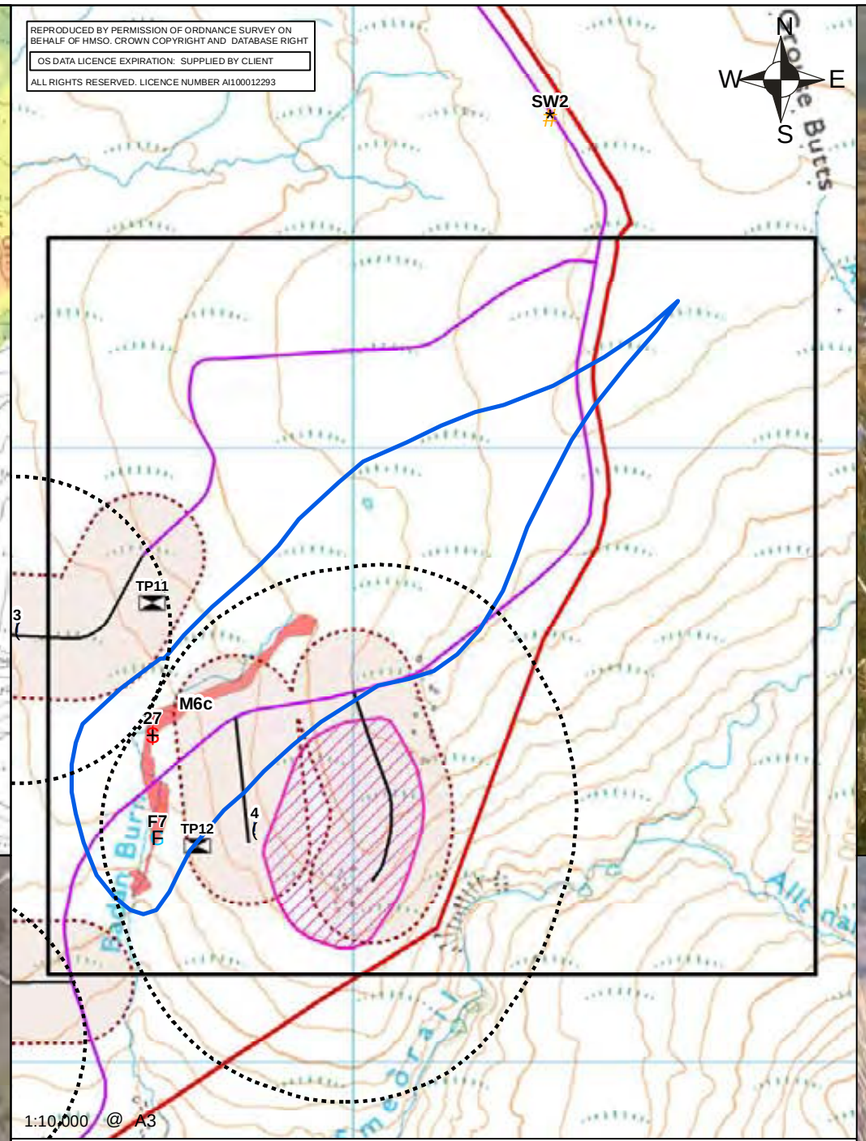
AREA Y: GWDTE IMPACT ASSESSMENT

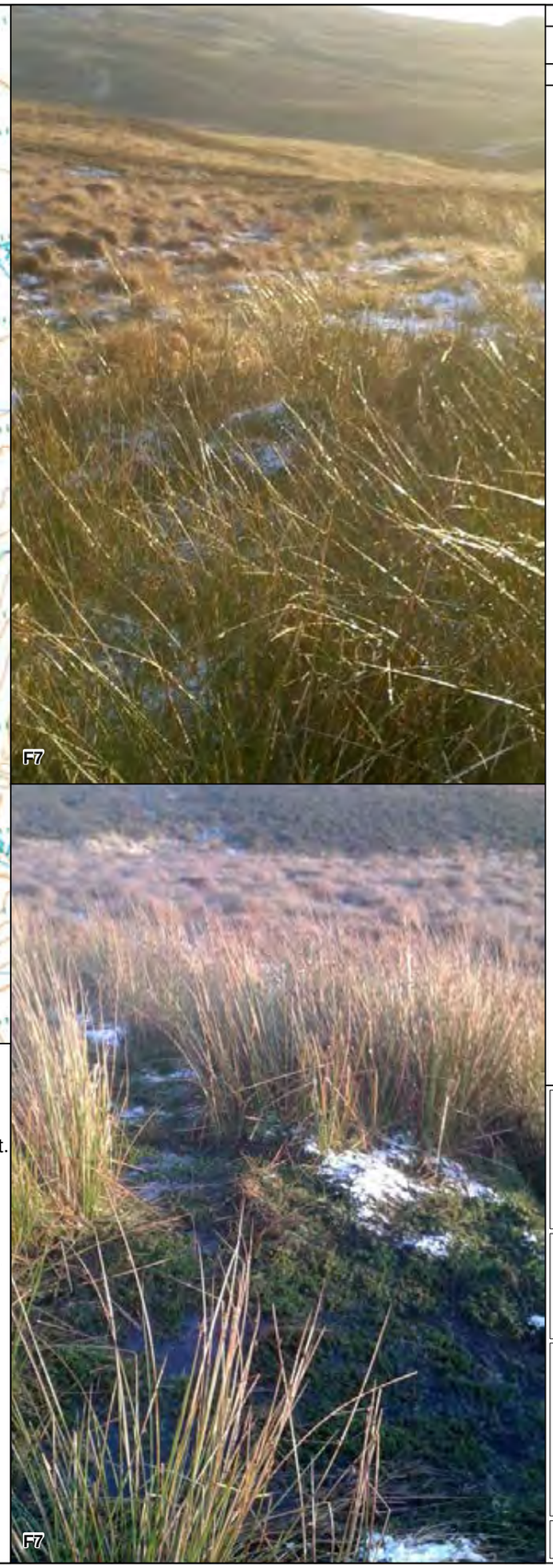
7

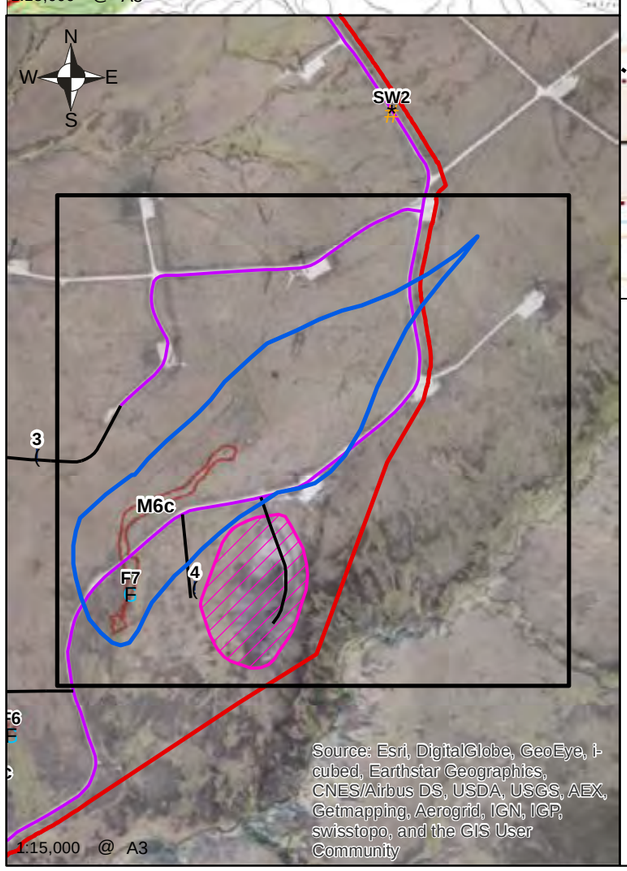
Date MARCH 2015

00660.00025.12.007.0 GWDTE CATCHMENT Y









Impact Assessment

GWDTE within 100m buffer of track to T4 and within 250m buffer of T4 and Borrow Pit.

Water quality sampling suggests no groundwater contribution at F7. Water quality is surface water rainfall-runoff dominated. Habitat mapping confirms M6c species is of poor value. Peat recorded below M6c habitat. Little new development proposed in upstream surface water catchment. Habitat recorded next to established watercourse.

Magnitude of Change: Negligible*
Sensitivity of Receptor: Very High
Significance of Effect: Not Significant
*with adoption of best practice construction techniques to maintain existing surface water flow paths (see Section 3)

NOTES

1. REFER TO APPENDIX 9.2B FOR TRIAL PIT LOGS

LEGEND

- SITE BOUNDARY
- PROPOSED TURBINE
- 250m BUFFER FROM PROPOSED TURBINE AND BORROW PIT
- EXISTING TRACK
- PROPOSED NEW TRACK
- 100m BUFFER FROM PROPOSED ACCESS TRACK AND CONSTRUCTION COMPOUND
- POTENTIAL BORROW PIT
- TRIAL PIT LOCATION (SEE APPENDIX B)
- OBSERVATION POINT (SEE APPENDIX B)
- GWDTE WATER QUALITY MONITORING POINT
- SURFACE WATER QUALITY MONITORING POINT
- SURFACE WATER CATCHMENT BOUNDARY

GWDTE HABITAT

- HIGHLY GROUNDWATER DEPENDENT
- PHASE 1 TARGET NOTE

PEAT DEPTH (m)

	0		1.5 - 2
	0 - 0.5		2 - 2.5
	0.5 - 1		2.5 - 3
	1 - 1.5		3 - 4

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APPENDIX 9.2

AREA Z: GWDTE IMPACT ASSESSMENT

8

Date MARCH 2015

00660.00025.12.008.0 GWDTE CATCHMENT Z

APPENDICES

APPENDIX A

SEPA LETTERS
06 OCTOBER 2014 and 27 JANUARY 2015

Our ref: PCS/136085
Your ref: 113001/4.4/L130925

Gordon Robb
SLR Consulting
Edinburgh

If telephoning ask for:
Susan Haslam

6 October 2014

By email only to: grobb@slrconsulting.com

Dear Mr Robb

Gordonbush Wind Farm Extension
Peat and Groundwater Dependant Terrestrial Ecosystems (GWDTEs)

Thank you for consulting SEPA on the above information prior to its formal inclusion in the Environmental Statement (ES). We very much welcome consultation at this early stage as it hopefully allows all potential issues to be identified and hopefully solutions found. We provide the following advice.

1. Groundwater Dependant Terrestrial Ecosystems (GWDTEs)

1.1 We welcome the quality of the GWDTE mapping information provided.

1.2 We agree that the findings from the site, in particular the trial pits, suggest that much of the M15 habitat, which is listed as a moderately groundwater dependent in our guidance, is in this hydrogeological setting likely to be rainwater fed. As a result we are content that avoidance of disturbance of M15 at this site is not required. In addition we are content that the buffers quoted in our guidance relating to indirect effects also need not apply. We suggest that the information provided in your email forms part of the formal ES.

1.3 We also agree that the M6c habitat is likely to be groundwater dependant in this setting and as such our published guidance should apply. We are pleased to note that the current layout of the turbines avoids direct impacts on M6c habitat; locating of the tracks should take a similar approach. The location of turbine T5 and T13 do however seem to be within 250 m of M6c habitat. We suggest that in the finalised layout these turbines are revised slightly to locate them outwith the 250 m buffer. If this is not done then we are likely to seek some form of monitoring to demonstrate that the source is not affected. The draft CEMP should also include the general construction measures proposed to maintain hydrological flows.

1.4 We are content that no information on GWDTEs is required for the borrow pit which is in an area of recently felled forestry.

2. Peat

2.1 Unsurprisingly there are areas of deep peat on the site. They do however seem to be distinct pockets and the current location of the turbines does seem to avoid the deepest areas - which is good.

2.2 The only advice we would give at this stage would be (1) to ensure that the track follows the shallower peat areas (so for example we wouldn't want to see a straight track directly from T11 to T15), (2) it is not clear how deep the peat greater than 3 m is and we ask that the finalised peat depth plan make this clear and (3) ensure that peat depth information is provided for the borrow pit, which does not currently seem to have been considered.

Should you wish to discuss this letter please do not hesitate to contact me on 01349 860359 or planning.dingwall@sepa.org.uk.

Yours sincerely

Susan Haslam
Senior Planning Officer
Planning Service

Our ref: PCS/138096
Your ref: 113001/4.4/L130925

Gordon Robb
RSL Consulting

By email only to: grobb@slrconsulting.com

If telephoning ask for:
Susan Haslam

27 January 2015

Dear Mr Robb

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000
Gordonbush Wind Farm Extension

Thank you for consulting SEPA with early copies of your Construction Environmental Management Plan and Groundwater Dependant Terrestrial Ecosystem assessment by way of your email of 22 January 2015. We very much welcome this continued early consultation. We provide the following advice.

1. Groundwater Dependant Terrestrial Ecosystems (GWDTE)

1.1 Firstly, we commend you for the quality of the survey and assessment work and of the presentation of it.

1.2 We can confirm that we are content that the information provided makes a suitable case that the layout is acceptable in terms of impacts on GWDTE.

2. Peat disturbance and management

2.1 We note that the new layout plans now include on site borrow pits and tracks.

2.2 In relation to avoiding peat then we are pleased to note that the new track avoids the pockets of deepest peat on the site. With some very minor amendments you could make a clear case that all areas of deep peat have been avoided. For example (1) a slight reconfiguration of the track leading to Turbine 16 and 14 could move the bend onto shallower peat and (2) the track between Turbines 3 and the spur to Turbine 6 could more clearly be located on the shallower peat in this area. It obviously needs to be ensured that any changes do have knock-on effect for other sensitivities such as GWDTE. An alternative approach in this case could be to explain in the ES text why it is not possible to avoid some of the areas of deep peat.

2.3 We highlight that we would expect the ES to include peat probing work in the vicinity of Turbine 4 and the nearby borrow pit.

2.4 We welcome the fact that you are currently preparing a Peat Management Plan and would be happy to provide advice on a draft if there is time. Our only advice on this at this stage is to make sure it complies with the recognised Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste. For example, the CEMP currently makes reference to the contractor to consider the location of any temporary peat storage areas but this information should be provided at the application stage.

3. Construction environmental management plan

3.1 As briefly discussed, the CEMP that you have supplied is very generic and doesn't yet include any specific site information. We have therefore not considered it in detail at this stage as we would prefer it if the document was targeted specifically to the issues at this site. For example rather than including generic comments on watercourse crossings we would like to see clear information on what watercourses will require to be crossed for this development, including photographs, and proposed crossings type.

Should you wish to discuss this letter please do not hesitate to contact me on 01349 860359 or planning.dingwall@sepa.org.uk.

Yours sincerely

Susan Haslam
Senior Planning Officer
Planning Service

APPENDIX B

TRIAL PIT AND OBSERVATION POINT LOGS

TRIAL PIT 1

TRIAL PIT CO-ORDINATE
284964, 914600

DIMENSIONS: 0.5m x 0.5m

0 – >0.5m DAMP BROWN FIBEROUS PEAT

NO WATER INGRESS. DRY UNDERFOOT

BASE OF PEAT PROBED c. 1.1m DEEP

BASE PROBED AS GRANULAR

TRIAL PIT 2

TRIAL PIT CO-ORDINATE
284825, 914810

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

TRAIL PIT 3

TRIAL PIT CO-ORDINATE
284760, 914781

DIMENSIONS: 0.5m x 0.5m

0 – 0.3m DAMP BROWN FIBEROUS PEAT

0.3 - >0.5m FROM 0.3m LESS FIBEROUS, LARGE ROOT c. 0.4m

NO WATER INGRESS. DRY UNDERFOOT

BASE OF PEAT PROBED c. 1.5m

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

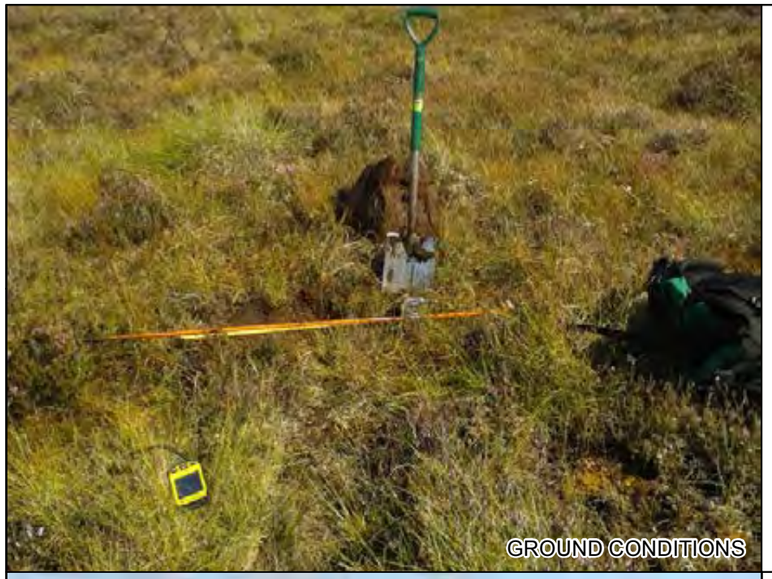
TRIAL PITS 1 - 3

A1

Scale: NA

Date: JANUARY 2015

00660.00025.12.A1.0 Trial Pits 1 - 3



TRIAL PIT 4

TRIAL PIT CO-ORDINATE
284873, 914359

DIMENSIONS: 0.3m x 0.3m

0 – >0.3m DRY BROWN FIBEROUS PEAT

NO WATER INGRESS. DRY UNDERFOOT

BASE OF PEAT PROBED c. 1.5m

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

TRIAL PIT 5

TRIAL PIT CO-ORDINATE
284739, 914185

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

TRAIL PIT 6

TRIAL PIT CO-ORDINATE
284574, 914048

DIMENSIONS: 0.3m x 0.3m

0 – >0.4m DAMP BROWN FIBEROUS PEAT

NO WATER INGRESS. DRY UNDERFOOT

BASE OF PEAT PROBED c. 1m DEEP

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

TRIAL PITS 4 - 6

A2

Scale	Date
NA	JANUARY 2015

00660.00025.12.A2.0 Trial Pits 4 - 6

TRIAL PIT 7

TRIAL PIT CO-ORDINATE
284419, 914086

DIMENSIONS: 0.3m x 0.3m

0 – >0.4m DAMP BROWN FIBEROUS PEAT

SLIGHT WATER INGRESS AT SURFACE FROM ACROTELM, WET UNDERFOOT

BASE OF PEAT PROBED c. 1m

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

TRIAL PIT 8

TRIAL PIT CO-ORDINATE
284496, 914175

DIMENSIONS: 0.4m x 0.4m

0 – 0.5m DAMP BROWN FIBEROUS PEAT

>0.5m PALE BEDROCK

NO WATER INGRESS. DRY UNDERFOOT

TRAIL PIT 9

TRIAL PIT CO-ORDINATE
284457, 914392

DIMENSIONS: 0.5m x 0.5m

0 – 0.5m DAMP BROWN FIBEROUS PEAT

0.5 – 0.6m WEATHERED PALE BEDROCK (GRAVEL AND SAND)

>0.6m PALE BEDROCK

NO WATER INGRESS. DRY UNDERFOOT

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

TRIAL PITS 7 - 9

A3

Scale: NA

Date: JANUARY 2015

00660.00025.12.A3.0 Trial Pits 7 - 9

TRIAL PIT 10

TRIAL PIT CO-ORDINATE
285127, 914318

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

TRIAL PIT 11

TRIAL PIT CO-ORDINATE
285674, 913748

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

TRAIL PIT 12

TRIAL PIT CO-ORDINATE
285747, 913351

DIMENSIONS: 0.3m x 0.3m

0 – 0.4m DARK BROWN GREY FIBEROUS PEAT

0.4 - 0.5m SANDY SILTY WEATHERED BEDROCK

> 0.5m BEDROCK

NO WATER INGRESS. DRY UNDERFOOT

BASE OF PEAT PROBED c. 0.8m

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

TRIAL PITS 10 - 12

A4

Scale: NA

Date: JANUARY 2015

00660.00025.12.A4.0 Trial Pits 10 - 12

TRIAL PIT 13

TRIAL PIT CO-ORDINATE
285350, 912998

DIMENSIONS: 0.3m x 0.3m

0 – 0.4m SATURATED DARK BROWN FIBEROUS PEAT

>0.4m PALE BEDROCK

WATER INFLOW FROM ACROTELM.
WET UNDERFOOT

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

TRIAL PIT 14

TRIAL PIT CO-ORDINATE
285131, 913202

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

TRAIL PIT 15

TRIAL PIT CO-ORDINATE
285035, 913363

DIMENSIONS: 0.3m x 0.3m

0 – 0.5m DRY DARK BROWN FIBEROUS PEAT (SANDY TOWARDS BOTTOM)

>0.5m PALE BEDROCK

NO WATER INGRESS. DRY UNDERFOOT

BASE OF PEAT PROBED c. 0.5m

SSE Renewables

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www.slrconsulting.com

GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

TRIAL PITS 13 - 15

A5

Scale: NA

Date: JANUARY 2015

00660.00025.12.A5.0 Trial Pits 13 - 15

TRIAL PIT 16

TRIAL PIT CO-ORDINATE
284334, 913667

DIMENSIONS: 0.3m x 0.3m

0 – 0.3m DRY DARK BROWN FIBEROUS CLAY, SANDY AT DEPTH

>0.3m PALE BEDROCK

NO WATER INGRESS. DRY UNDERFOOT

TRIAL PIT 17

TRIAL PIT CO-ORDINATE
284219, 913597

DIMENSIONS: 0.3m x 0.3m

0 – 0.7m WET DARK BROWN FIBEROUS PEAT

>0.7m PALE BEDROCK

WATER SEEPAGE FROM ACROTELM.
DRY UNDERFOOT

TRAIL PIT 18

TRIAL PIT CO-ORDINATE
284793, 912931

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

TRIAL PITS 16 - 18

A6

Scale: NA

Date: JANUARY 2015

00660.00025.12.A6.0 Trial Pits 16 - 18

TRIAL PIT 19

TRIAL PIT CO-ORDINATE
283727, 912553

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

TRIAL PIT 20

TRIAL PIT CO-ORDINATE
284240, 912220

TRIAL PIT NOT DUG AS PEAT DEPTH PROBED >1m

NOTES

1. REFER TO DRAWING 1 FOR TRIAL PIT LOCATIONS

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

TRIAL PITS 19 - 20

A7

Scale: NA

Date: JANUARY 2015

00660.00025.12.A7.0 Trial Pits 19 - 20

OBSERVATION POINT 1

CO-ORDINATE
284937, 913355

PROBED c.1.5m OF PEAT

WET UNDERFOOT

OBSERVATION POINT 2

CO-ORDINATE
284847, 913510

PROBED 1.5 - 2m OF SATURATED PEAT

VERY WET UNDERFOOT

OBSERVATION POINT 3

CO-ORDINATE
284280, 913472

PROBED c.0.5m SOFT SILT/CLAY

ABOVE ROCK

STANDING WATER

OBSERVATION POINT 4

CO-ORDINATE
284902, 912713

PROBED c.1m OF PEAT

DRY UNDERFOOT

DISTURBED/MADE GROUND?

NOTES

1. REFER TO DRAWING 1 FOR OBSERVATION LOCATIONS

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GORDONBUSH WIND FARM EXTENSION

HYDROLOGY ASSESSMENT

OBSERVATION POINTS

A8

Scale: NA

Date: JANUARY 2015

00660.00025.12.A8.0 Observation Points

APPENDIX C

WATER QUALITY TEST CERTIFICATES

ALcontrol Laboratories

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Manor Road (off Manor Lane)
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Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: mkt@alcontrol.com
Website: www.alcontrol.com

SLR Consulting Ltd
4 The Roundal
Roddinglaw Business Park
Gogar
Edinburgh
Lanarkshire
EH12 9DB

Attention: Gordon Robb

CERTIFICATE OF ANALYSIS

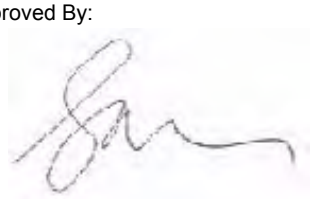
Date:	15 January 2015
Customer:	H_SLR_EDH
Sample Delivery Group (SDG):	150110-46
Your Reference:	405/00660/00025
Location:	GORDONBUSH
Report No:	298798

We received 9 samples on Saturday January 10, 2015 and 9 of these samples were scheduled for analysis which was completed on Thursday January 15, 2015. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:



Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
10654653	F1			08/01/2015
10654654	F2			08/01/2015
10654655	F3			08/01/2015
10654656	F4			08/01/2015
10654657	F5			08/01/2015
10654658	F6			08/01/2015
10654659	F7			08/01/2015
10654651	SW1			08/01/2015
10654652	SW2			08/01/2015

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

LIQUID

Results Legend

X **Test**

N **No Determination Possible**

			Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container
			10654653	F1			0.5l glass bottle (AL
			10654654	F2			1lplastic (ALE221)
			10654655	F3			HNO3 Filtered (ALE
			10654656	F4			0.5l glass bottle (AL
			10654657	F5			1lplastic (ALE221)
			10654658	F6			HNO3 Filtered (ALE
			10654659	F7			0.5l glass bottle (AL
			10654651	SW1			1lplastic (ALE221)
			10654652	SW2			HNO3 Filtered (ALE
Alkalinity as CaCO3	All	NDPs: 0 Tests: 9					
Anions by Kone (w)	All	NDPs: 0 Tests: 9					
Metals by iCap-OES Dissolved (W)	All	NDPs: 0 Tests: 9					
Metals by iCap-OES Unfiltered (W)	All	NDPs: 0 Tests: 9					
pH Value	All	NDPs: 0 Tests: 9					
Redox Potential	All	NDPs: 0 Tests: 9					
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 9					

CERTIFICATE OF ANALYSIS

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	F1	F2	F3	F4	F5	F6
			Depth (m)	.	.	.	.	.	.
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)
			Date Sampled	08/01/2015	08/01/2015	08/01/2015	08/01/2015	08/01/2015	08/01/2015
			Sample Time	.	.	.	.	.	.
			Date Received	10/01/2015	10/01/2015	10/01/2015	10/01/2015	10/01/2015	10/01/2015
			SDG Ref	150110-46	150110-46	150110-46	150110-46	150110-46	150110-46
			Lab Sample No.(s)	10654653	10654654	10654655	10654656	10654657	10654658
			AGS Reference						
Alkalinity, Total as CaCO3	<2 mg/l	TM043		2.5 #	3 #	2.5 #	20.5 #	4 #	<2 #
Organic Carbon, Total	<3 mg/l	TM090		9.06 #	8.64 #	7.81 #	7.18 #	9.56 #	10.3 #
Redox potential	mV	TM110		115	92	76	163	107	152
Sulphate	<2 mg/l	TM184		<2 #	<2 #	<2 #	<2 #	<2 #	<2 #
Chloride	<2 mg/l	TM184		12.8 #	13.2 #	13 #	13.6 #	14 #	12.2 #
Calcium (diss.filt)	<0.012 mg/l	TM228		1.03 #	0.913 #	0.985 #	5.76 #	1.42 #	0.293 #
Sodium (diss.filt)	<0.076 mg/l	TM228		7.24 #	7.24 #	6.91 #	8.19 #	7.6 #	6.58 #
Magnesium (diss.filt)	<0.036 mg/l	TM228		0.885 #	0.802 #	0.854 #	1.55 #	1.13 #	0.686 #
Potassium (diss.filt)	<1 mg/l	TM228		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Iron (diss.filt)	<0.019 mg/l	TM228		0.438 #	0.424 #	0.34 #	0.309 #	0.872 #	0.0553 #
Iron (tot.unfilt)	<0.024 mg/l	TM228		0.505	0.681	0.385	14	0.784	0.0541
pH	<1 pH Units	TM256		5.93 #	6.49 #	6.81 #	7.58 #	6.7 #	4.68 #

CERTIFICATE OF ANALYSIS

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	F7	SW1	SW2			
			Depth (m)	.	.	.			
			Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)			
			Date Sampled	08/01/2015	08/01/2015	08/01/2015			
			Sample Time	.	.	.			
			Date Received	10/01/2015	10/01/2015	10/01/2015			
			SDG Ref	150110-46	150110-46	150110-46			
			Lab Sample No.(s)	10654659	10654651	10654652			
			AGS Reference						
Alkalinity, Total as CaCO3	<2 mg/l	TM043		2.5 #	3.5 #	<2 #			
Organic Carbon, Total	<3 mg/l	TM090		8.23 #	12.2 #	12.3 #			
Redox potential	mV	TM110		145	187	95			
Sulphate	<2 mg/l	TM184		<2 #	<2 #	<2 #			
Chloride	<2 mg/l	TM184		13.2 #	13.7 #	12.1 #			
Calcium (diss.filt)	<0.012 mg/l	TM228		0.773 #	1.19 #	0.453 #			
Sodium (diss.filt)	<0.076 mg/l	TM228		7.05 #	7.3 #	6.41 #			
Magnesium (diss.filt)	<0.036 mg/l	TM228		0.835 #	1.03 #	0.783 #			
Potassium (diss.filt)	<1 mg/l	TM228		<1 #	<1 #	<1 #			
Iron (diss.filt)	<0.019 mg/l	TM228		0.348 #	0.409 #	0.22 #			
Iron (tot.unfilt)	<0.024 mg/l	TM228		0.403	0.43	0.0774			
pH	<1 pH Units	TM256		7.08 #	7.61 #	5.36 #			

CERTIFICATE OF ANALYSIS

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters		
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples		
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser		
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit		
TM110	BS 1377: Part 3 1990	Redox Potential		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM191	Standard Methods for the examination of waters and wastewaters 16th Edition, ALPHA, Washington DC, USA. ISBN 0-87553-131-8.	Determination of Unfiltered Metals in Water Matrices by ICP-MS		
TM228	US EPA Method 6010B	Determination of Major Cations in Water by iCap 6500 Duo ICP-OES		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

CERTIFICATE OF ANALYSIS

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	10654653	10654654	10654655	10654656	10654657	10654658	10654659	10654651	10654652
Customer Sample Ref.	F1	F2	F3	F4	F5	F6	F7	SW1	SW2
AGS Ref.									
Depth									
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
Alkalinity as CaCO3	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	15-Jan-2015	13-Jan-2015
Anions by Kone (w)	14-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	14-Jan-2015	14-Jan-2015	13-Jan-2015	13-Jan-2015	14-Jan-2015
Metals by iCap-OES Dissolved (W)	14-Jan-2015	14-Jan-2015	14-Jan-2015	14-Jan-2015	14-Jan-2015	14-Jan-2015	14-Jan-2015	14-Jan-2015	14-Jan-2015
Metals by iCap-OES Unfiltered (W)	15-Jan-2015	15-Jan-2015	15-Jan-2015	15-Jan-2015	15-Jan-2015	15-Jan-2015	15-Jan-2015	15-Jan-2015	15-Jan-2015
pH Value	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	12-Jan-2015	13-Jan-2015
Redox Potential	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015
Total Organic and Inorganic Carbon	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	13-Jan-2015	15-Jan-2015	13-Jan-2015

SDG:	150110-46	**Location:**	GORDONBUSH	**Order Number:**	405/7707
Job:	H_SLR_EDH-61	**Customer:**	SLR Consulting Ltd	**Report Number:**	298798
Client Reference:	405/00660/00025	**Attention:**	Gordon Robb	**Superseded Report:**	

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

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