Email: chris.gell@watermangroup.com
Tel: 01738 449 801

Our Ref: WIE13408_100_170830_GA_BP
Your Ref: -

Date: 30th August 2017

Nick Sage
Project Director
Infinergy Ltd
Creative Exchange
29 Constitution Street
Leith
Edinburgh
EH6 7BS

Dear Nick,

LOCHLUICHART WINDFARM EXTENSION: PRELIMINARY BORROW PIT INVESTIGATION

Introduction

Infinergy Ltd (Infinergy), are submitting a Planning Application for an 6 No. turbine 18MW extension to the existing 23 No. turbine 69MW Lochluichart Wind Farm near Garve. The proposed extension site can be centred by an approximate National Grid Reference E232590, N867900.

As part of the planning application, Infinergy wish to identify proposed Borrow Pit locations to be included within the application, and in relation to this aspect have commissioned Waterman to undertake a Desk Study review of pertinent information, and undertake logging of trial pit excavations undertaken by Infinergy's contractor.

This letter report details the findings of Waterman's assessment, which has been undertaken in accordance with our appointed scope as detailed in letter ref: WIE175031-100-F02-CG-NS dated 19th July 2017.

Proposed Borrow Pit Locations and Anticipated Geology

Five candidate borrow pit locations have previously been identified by Arcus Consulting Ltd (Arcus), under their appointment to Infinergy to complete the project Environmental Statement (which related to a previously proposed 8 turbine extension). The locations are numbered 1 to 5 on Arcus Drawing 2414-PUB-004, a copy of which is included within Appendix A.

Borrow Pit 1 relates to the potential option to re-commission the (reinstated) borrow pit associated with the main development, located near the site access off the A835 Garve to Ullapool Trunk Road. Borrow Pits 2 to 5 are virgin locations.

It is understood that the locations have been selected by Arcus due to likelihood of encountering rock (from outcrops visible nearby), ease of access, proximity to proposed works, and limited peat depths.

At the request of Infinergy, borrow pit 5 has been removed from Waterman's scope due to revisions to the proposed extension scheme layout (removal of two turbines at south end of scheme, from the previously proposed 8 turbine extension).

From review of published geological information, the anticipated bedrock geology at the remaining 4 borrow pit locations is as summarised in Table 1. In general, borrow pits working 'Psammite', which is a metamorphosed quartzitic Sandstone, would be expected to yield strong and durable rock wheras borrow pits working 'Pelite', which is a metamorphosed Mudstone, may yield rock of lower strength and durability.

Table 1: Anticipated Bedrock Geology

Borrow Pit	Location (NGR)	Anticipated Bedrock Geology*
BP01	233102, 870023	Psammite (Crom Psammite Formation)
BP02	233092, 868945	Psammite (Crom Psammite Formation)
BP03	232976, 868306	Psammite (Crom Psammite Formation)
BP04	232442, 868375	Pelite and Semipelite (Vaich Pelite Formation)

**Based on review of 1:50,000 scale mapping available on BGS Interactive Geology Viewer accessed 28/07/17: (http://mapapps.bgs.ac.uk/geologyofbritain/home.html)*

The superficial deposits are expected to consist of Peat and/or Glacial Till of varying depths overlying bedrock. Peat probing data available is fairly sparse across the specific borrow pit locations however, data available for site suggests that the peat depths around the borrow pit locations is likely to be less than 1.00m with the exception of BP04, where depths may be up to 3.0m deep.

Review of Ordnance Survey 1:25,000 scale mapping and high resolution aerial photography avialble on line suggests that the extension to the previously reinstated BP01 will likely consist of gently sloping ground towards the north covered by peat, an immature pine plantation and a number of drainage channels.

BP02 is located immediately west of the main access track and drainage ditch on the edge of an immature pine plantation on ground sloping gently towards the north east. Ground conditions at this location appear to consist of sparse trees, shallow peat including poorly defined drainage channels and sporadic boulders (possible bedrock outcrops).

BP03 is located immediately west of the main access track to the north west of Corriemollie Forest on ground sloping gently to the east. Ground conditions appear to consist of peat, poorly defined drainage channels and isolated boulders (possible bedrock outcrops).

BP04 is located approximately 600m west of BP03 on the south westerly facing gentle slope of 'Meallan Caoruinn'. There is a discrepancy here between the 1: 25,000 OS mapping and available aerial photographs, as the aerial photographs were taken pre-construction and hence show no turbines or tracks in this area. However, the 1: 25,000 mapping indicates that BP04 is immediately north of a wind farm access track. It is assumed that there will be a drainage ditch on the northern side of the track to pick up any surface flows. The ground conditions appear to consist of peat hags and isolated boulders (possible bedrock outcrops). Peat probing from this area suggests peat depths of up to 3.0m, however that probing data does not detail if this is a depth from the top of a hag or within an area of erosion.

SEPA Flood Mapping

Review of SEPA Flood Mapping data available on line indicates that all 4 borrow pit locations are not within areas shown to be at risk of flooding. This is on the basis of the existing site condition, and therefore takes no account of the effects of groundwater ingress within borrow pit excavations. This would need considered further at scheme design stage, with borrow pit profiles designed to provide positive drainage to agreed discharge points.

Archaeology

A search of the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) website (www.canmore.org) indicates that there are 3 features of interest located on site. All three are located close to existing tracks, two are described as "chimneys" and one as a standing stone.

The standing stone is located to the east of the main access track at National Grid Reference (NGR) 233086, 869066, which is close to the location of BP03 however, the standing stone is indicated as being on the eastern side of the road with the borrow pit located to the western side.

One of the “Chimneys” is located close to the area of BP01 at NGR 233181, 870057, the remaining “Chimney” is located to the south east of Loch na Salach and as such does not coincide with any of the proposed borrow pit locations.

The location of these features did not conflict with the trial pitting operations completed under this scope of works, but prior to commencing with development of the Borrow Pits it would be prudent to confirm any special measures to be allowed for in relation to the recording or protection of archaeological features within the vicinity.

Field Work

Following completion of the information review, a trial pitting exercise was conducted between the 21st and 23rd August 2017 at the four proposed borrow pit locations. The objective of the trial pitting was to confirm the depth to rock, and nature of overburden materials.

The trial pits were excavated and reinstated by a Contractor appointed to Infinergy, with Waterman providing an Engineer to undertake logging in accordance with BS 5930 (2015) ‘Code of Practice for Ground Investigations’. A site induction by the windfarm operator (Eneco UK Ltd) was provided prior to works commencing on site.

The weather was generally warm and overcast with light winds, as expected for the time of year. An assessment of each borrow pit location is provided below and all trail pit logs and photographs are included within Appendix B. Overview photographs, showing proposed Borrow Pit locations, are included within Appendix C.

Borrow Pit 1 (Reinstated former Borrow Pit)

Four trial pits (TP01 to TP04) were excavated in the general vicinity of BP01 and were positioned in order to obtain outline information regarding the extension of the former Borrow Pit. Generally ground conditions consisted of PEAT (to a depth of 0.30m to 1.20m bgl) over gravelly very silty SAND (0.70m to 2.10m bgl) over probable bedrock (Psammite). All trial pits remained stable and were dry throughout with the exception of surface waters.

Borrow Pit 2

Four trial pits (TP05 to TP08) were excavated in the area of the proposed borrow pit and were positioned towards each of the four corners. Generally ground conditions consisted of PEAT (to a depth of 0.30m to 0.60m bgl) over gravelly very silty SAND (0.90m to 1.50m bgl) over probable bedrock (Psammite). With the exception of TP06 which encountered very gravelly sandy SILT with frequent cobbles (0.30m bgl to 0.70m bgl) over probable bedrock. All trial pits remained stable and were dry throughout with the exception of surface waters.

Borrow Pit 3

Three trial pits (TP09 to TP11) were excavated in the area of the proposed borrow pit. Generally ground conditions consisted of PEAT (to a depth of 0.40m to 1.10m bgl) over gravelly very silty SAND (0.80m to 3.00m bgl) over probable bedrock (Psammite). All trial pits remained stable and were dry throughout with the exception of TP11 where groundwater was encountered at rockhead (2.30m).

Borrow Pit 4

Five trial pits (TP12 to TP16) were excavated in the area of the proposed borrow pit. Generally ground conditions consisted of PEAT (to a depth of 0.30m to 0.90m bgl) over gravelly silty SAND to a maximum depth of 3.20m bgl. Bedrock was not encountered in any of the trial pits excavated. All trial pits remained stable and were dry throughout with the exception of TP13 where a slight seepage was noted at 0.60m.

Outline Borrow Pit Assessment

From the information obtained during the information review and subsequent field works, it is suggested that Borrow Pit 4 be discounted. This is on the basis that published geological mapping indicates the bedrock at this location to be Pelite or Semipelite, which is generally not as strong or durable as the Psammite recorded at the remaining 3 locations. In addition, the field work did not encounter rockhead by 3.20m, suggesting that a significant amount of overburden may require removal prior to the borrow pit being productive.

Trial pits at Borrow Pit 1 encountered probable bedrock between 0.70m and 2.10m bgl. However, in some areas bedrock appeared to be outcropping at surface. This Borrow Pit has previously been successfully worked in the construction of the main development, and would remain a viable option for the extension scheme. It is noted that the borrow pit has not been completely backfilled, and therefore re-commissioning would consist of the excavation of backfill materials placed against the south west face to then drive this face into the rising topography in a south westerly direction. This would require the removal of fencing, and semi-mature coniferous trees. Subjectively, leaving a belt of trees in place around the vicinity of the borrow pit will provide a degree of screening, although it may be visible when viewed from the A835 Trunk Road located to the north (full landscape visual assessments would require to be completed as confirmation). The downside of this location is that it is located the furthest away from the proposed windfarm extension area, and hence would incur additional haulage time when compared with locations 2 to 4.

The trial pits excavated at proposed Borrow Pit 2 encountered probable bedrock at relatively shallow depth between 0.70m and 1.50m bgl, and bedrock is exposed within a shallow cutting adjacent to the wind farm track. However, the topography is relatively slack when compared with other locations, and hence there is not an obvious face that could be driven without also driving the invert of the borrow pit downwards. This may entail the creation of sumps and active drainage systems (i.e. pumping) to mitigate against groundwater flooding, but would need considered further at scheme design stage. Subjectively, the location also feels quite open to the east and may therefore be visible from a number of surrounding points (full landscape visual assessments would require to be completed as confirmation).

The trial pits undertaken at Borrow Pit 3 encountered probable bedrock between 0.80m and 3.00m bgl. It should be noted that the shallowest bedrock was encountered in TP09 towards the north-western corner of the proposed borrow pit, which coincides with rising topography. If developed, it would therefore be sensible to re-orientate the alignment of this borrow pit from that shown by Arcus, such that the working face is driven west and north west into the rising slopes of 'Meallan Caoruinn'. This may require the construction of a short spur road, to provide access to the borrow pit location from the existing infrastructure. Subjectively, the location feels less open than Borrow Pit 2, however is still likely to be visible from a number of hill top locations to the east and south-east (full landscape visual assessments would require to be completed as confirmation).

Recommendations

There are a number of factors which need to be considered when identifying the most suitable location for the excavation of a new borrow pit for the proposed windfarm extension including:

1. The volume of rock required for tracks, wind turbine hardstands and fill to underside of turbine foundations which will then determine the required dimensions of the borrow pit.
2. Proximity to works area and ease of access.
3. Depth to rock, and likely rock quality.
4. Visibility from surrounding areas.
5. Ecological, archaeological or environmental constraints.
6. Surface flooding and groundwater levels.
7. Stability of slopes above and below borrow pit location.
8. Proximity to sensitive receptors (such as watercourses).

In general the above items would be considered further and detailed out at scheme design stage, but we have taken reasonable cognisance within this initial assessment as far as possible, and in accordance with our appointed scope.

On the basis of this preliminary investigation, it is suggested that the following two options would prove the most viable, and should be considered as part of the planning application:

- Option 1: Recommissioning of Borrow Pit 1. This location is known to be productive and yield rock of suitable quality, has relative ease of access, has rock at or near surface, offers a degree of natural screening, and has previously been approved through planning. However, it is located furthest from the windfarm extension area (in the order of 1km further than the alternative location of BP02), and will require the removal of fencing and semi-mature coniferous trees.
- Option 2: Borrow Pit 2. This location offers ease of access from the existing windfarm infrastructure, is close to the proposed extension site and has rock at or near surface (and indicated to be Psammite). It is however visible from a number of surrounding vantage points, and subject to topographical surveying and volume requirements may require the borrow pit invert to be driven downwards in order to yield sufficient volume (which will entail additional drainage measures to be designed in).

Appendix D contains a drawing showing the proposed locations to be considered in the planning application, to which it is suggested a buffer zone be added to accommodate volume requirements which will only become clear at scheme design stage.

Appendix A – Borrow Pit Location Plans

Broxden House, Lamberkine Drive, Perth , PH1 1RA
t. 01738 449801 **e.** tdi@waterman-group.co.uk **w.** www.watermangroup.com

Waterman Infrastructure & Environment Limited
Registered in England Number: 3269195 Registered Office: Pickfords Wharf, Clink Street, London SE1 9DG

Project Id:	WIE13408	Title:	Site Plan
Project Title:	Lochluichart	Scale:	1:5000
Location:	Lochluichart Windfarm	Engineer:	Waterman Infrastructure and Environment
Client:	Infinergy	Contractor:	

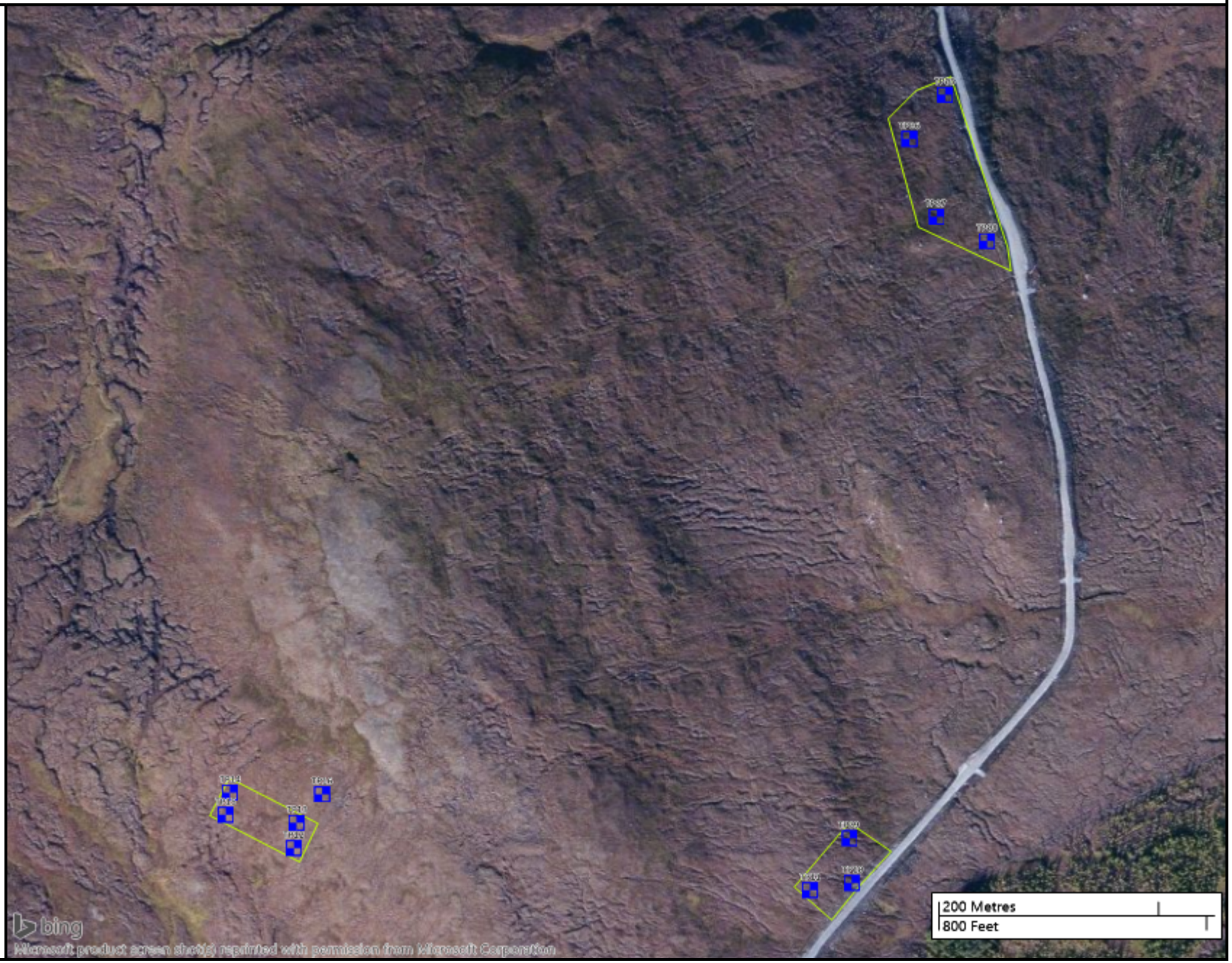
Legend Key

- Locations By Type - Empty
- Locations By Type - TP
- 2414_Possible_BP_Locations - 1

Project Id:	WIE13408	Title:	Site Plan
Project Title:	Lochluichart	Scale:	1:5000
Location:	Lochluichart Windfarm	Engineer:	Waterman Infrastructure and Environment
Client:	Infinergy	Contractor:	

Legend Key

- Locations By Type - Empty
- Locations By Type - TP
- 2414_Possible_BP_Locations - 1



Appendix B – Trial Pit Logs and Photographs

Broxden House, Lamberkine Drive, Perth , PH1 1RA
t. 01738 449801 **e.** tdi@waterman-group.co.uk **w.** www.watermangroup.com

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**01 (BP01)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33182, 69938
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	23/08/17
				Dimensions:	1.10m x 2.00m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with frequent rootlets.	0.70				
Greyish brown gravelly very silty fine to medium SAND with frequent cobbles. Gravel is subangular to subrounded fine to coarse of psammite.	2.00				
Probable rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:
Trial pit was moved from intended position to further outside previous Borrow Pit location to provide wider information.

Trial pit was terminated at 2.00m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Logged by: GA

Backfilled with arisings upon completion.

Checked by: CG

Status		Trial Pit No
FINAL	**TRIAL PIT LOG PHOTOGRAPHIC RECORD**	**01** Sheet 2 of 2

Picture 1: Trial Pit 01

Picture 2: Trial Pit 01 (Spoil)

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**02 (BP01)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33134, 69965
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	23/08/17
				Dimensions:	1.20m x 2.20m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with frequent rootlets.	0.30				
Greyish brown gravelly very silty fine to medium SAND with frequent cobbles. Gravel is subangular to subrounded fine to coarse of psammite. Turning grey at 1.40.	1.90				
Probable Rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:

Trial pit was terminated at 1.90m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Logged by: GA

Backfilled with arisings upon completion.

Checked by: CG

Status		Trial Pit No
FINAL	**TRIAL PIT LOG PHOTOGRAPHIC RECORD**	**02** Sheet 2 of 2

Picture 1: Trial Pit 02

Picture 2: Trial Pit 02 (Spoil)

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**03 (BP01)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33063, 70050
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	23/08/17
				Dimensions:	1.20m x 2.00m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with frequent rootlets.	0.30				
Greyish brown gravelly very silty fine to medium SAND with frequent cobbles. Gravel is subangular to subrounded fine to coarse of psammite.	0.70				
Probable Rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:

Trial pit was terminated at 0.70m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Logged by: GA

Backfilled with arisings upon completion.

Checked by: CG

Status		Trial Pit No
FINAL	**TRIAL PIT LOG PHOTOGRAPHIC RECORD**	**03** Sheet 2 of 2

Picture 1: Trial Pit 03

Picture 2: Trial Pit 03 (Spoil)

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**04 (BP01)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33106, 70084
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	22/08/17
				Dimensions:	1.20m x 3.80m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with occasional tree fragments and frequent rootlets.	1.20				
Light brown gravelly very silty fine to medium SAND with frequent cobbles. Gravel is subangular to subrounded fine to coarse of psammite.	2.10				
Probable Rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:

Trial pit was terminated at 2.10m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Backfilled with arisings upon completion.

Logged by: GA

Checked by: CG

Status		Trial Pit No
FINAL	**TRIAL PIT LOG PHOTOGRAPHIC RECORD**	**04** Sheet 2 of 2

Picture 1: Trial Pit 04

Picture 2: Trial Pit 04 (Spoil)

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**05 (BP02)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33100, 69011
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	22/08/17
				Dimensions:	1.70m x 2.00m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with frequent rootlets and boulders (0.60x0.40x0.30).	0.60				
Grey gravelly very silty fine to medium SAND with frequent cobbles. Gravel is subangular to subrounded fine to coarse of psammite.	0.90				
Probable rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:

Trial pit was terminated at 0.90m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Logged by: GA

Backfilled with arisings upon completion.

Checked by: CG

Status		Trial Pit No
FINAL	**TRIAL PIT LOG PHOTOGRAPHIC RECORD**	**05** Sheet 2 of 2

Picture 1: Trial Pit 05

Picture 2: Trial Pit 05 (Spoil)

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**06 (BP02)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33066, 68972
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	22/08/17
				Dimensions:	1.50m x 2.00m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with frequent rootlets.	0.30				
Brown very gravelly sandy SILT with frequent cobbles. Gravel is subangular to rounded of predominantly psammite.	0.70				
Probable rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:

Trial pit was terminated at 0.70m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Logged by: GA

Backfilled with arisings upon completion.

Checked by: CG

Status		Trial Pit No
FINAL	**TRIAL PIT LOG PHOTOGRAPHIC RECORD**	**06** Sheet 2 of 2

Picture 1: Trial Pit 06

Picture 2: Trial Pit 06 (Spoil)

Status		Trial Pit No
FINAL	**TRIAL PIT LOG**	**07 (BP02)**
Date: 30/08/17		Sheet 1 of 2

CIV No:	WIE13408	Excavation Method:	Tracked 360 Excavator	Coords:	NH33087, 68900
Workstage:	101	Shoring : No		Ground Level:	N/A
Project Title:	Lochluichart Windfarm			Date Started:	22/08/17
				Dimensions:	1.40m x 3.40m

Description of Strata	Depth to base (m)	Level (mOD)	Sampling Type & Depth		Testing
Grass, heather and moss over dark brown amorphous PEAT with frequent rootlets.	0.30				
Orange brown gravelly silty fine to coarse SAND with frequent cobbles. Gravel is angular to subrounded fine to coarse of predominantly psammite.	0.70				
Greenish grey gravelly very silty fine to medium SAND with frequent cobbles. Gravel is subangular to subrounded fine to coarse of psammite.	1.50				
Probable rockhead (Psammite)					

Sample Key: B. Bulk D. Disturbed U. Triaxial Sample W. Water HV. Hand Vane HP. Hand Penetrometer

G. Glass T. Tub J.Jar

Comments:

Trial pit was terminated at 1.50m due to probable rockhead.

Trial pit was dry throughout excavation.

Trial pit walls stable.

Logged by: GA

Backfilled with arisings upon completion.

Checked by: CG