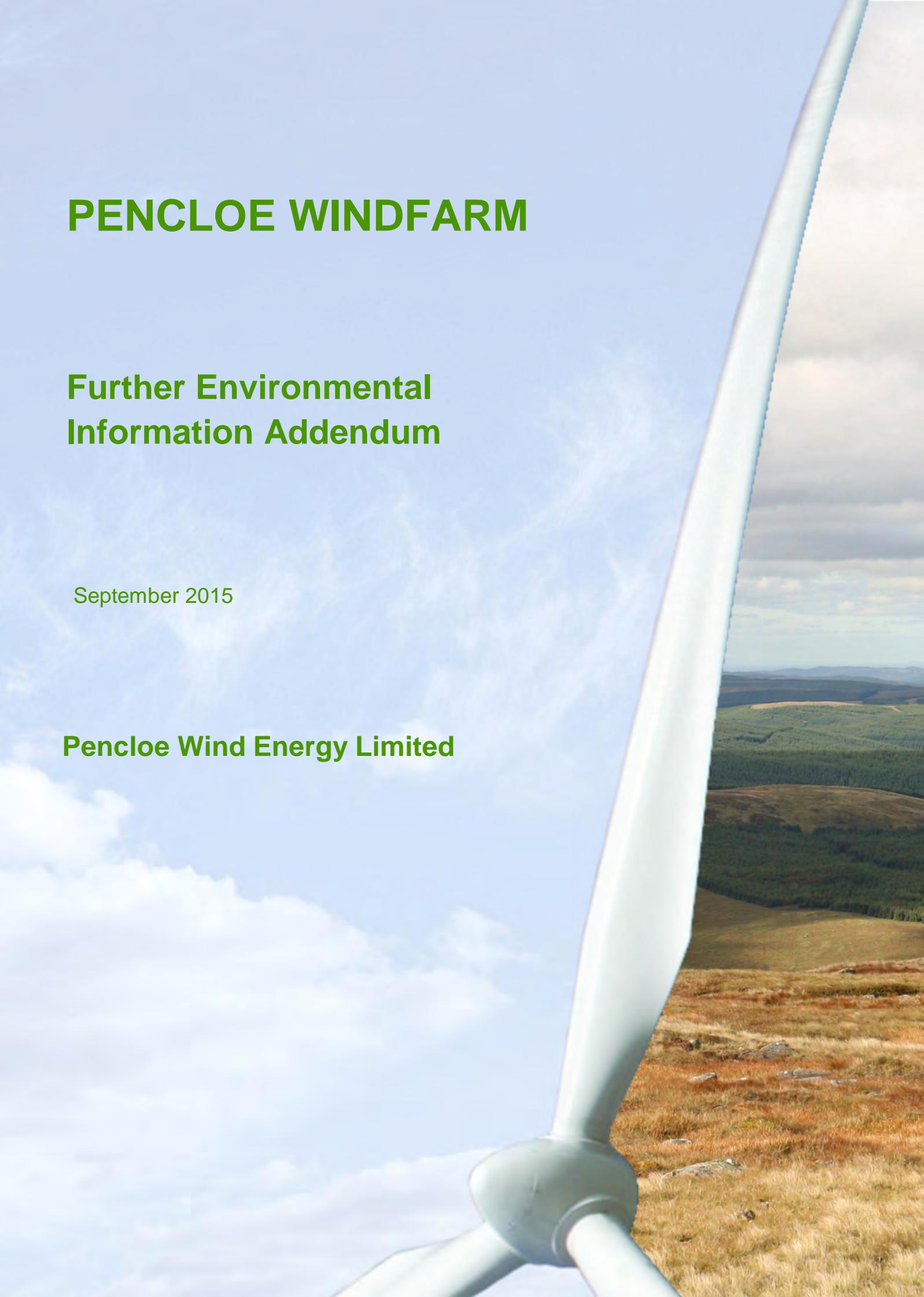


PENCLOE WINDFARM

Further Environmental Information Addendum

September 2015

Pencloe Wind Energy Limited



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1 Introduction

1.1 S36 Application for Pencloe Windfarm

In March of 2015 Pencloe Wind Energy Limited (PWEL) applied to the Scottish Government for consent under Section 36 of the Electricity Act and deemed planning permission under the Town and Country Planning Scotland Act 1997, Section 57 (2), for the development of Pencloe Windfarm.

1.2 Requirement for this Addendum

This Addendum has been prepared by PWEL and submitted to Scottish Ministers in response to requests made during the S36 consultation process. It also sets out revisions to the project description resulting from the consultation process. In summary the main changes are:

- Reduction in the number of turbines from 21 to 19;
- Increase in the size of the four proposed onsite borrow pits and the addition of one new onsite borrow pit; and
- Re-alignment of sections of onsite tracks and re-location of the proposed substation to avoid areas of deeper peat.

The contents of this Addendum are as follows:

- **Volume 1: Addendum**
 - Introduction.
 - Revised Project Description.
 - Overview of Additional Survey and Assessment.
 - Figure 1 - Revised Site Layout Plan
 - Appendices
 - Appendix 1 – Revised Borrow Pit Assessment (Grontmij).
 - Appendix 2 – Peat Depth Survey Report (Fluid EC).
 - Appendix 3 – Revised Peat Management Plan (Fluid EC).
 - Appendix 4 – Updated Landscape and Visual Assessment (hepla).
 - Appendix 5 – Revised and updated Noise Assessment (Jacobs).
- **Volume 2 : Landscape and Visual Assessment Figures**
- **Revised SNH Viewpoint Pack (provided separately)**

2 Revised Project Description

2.1 Introduction

The proposed Pencloe Windfarm layout has now been revised to take account various matters raised during the consultation process for the S36 Application. A summary has been provided below of the proposed changes in the development including turbine numbers, onsite site track layout, substation and borrow pits.

2.2 The Revised Windfarm Layout

The revised windfarm layout is shown on **Figure 1**, and the main components are set out in the summary table below.

Table 2.1 – Summary of Changes to Windfarm Layout

Component	Change to March 2015 Layout?
19 wind turbines, each with an anticipated maximum rated capacity of up to 3.3 MW and up to 125 m to tip	Yes – Reduction from 21 turbines by removing T1 and T2. Micrositing of Turbine 5.
Permanent foundations supporting the wind turbines and associated crane hardstandings (used during construction, operational repair and decommissioning)	No change
Transformers (one per turbine) which will be housed externally at the base of the turbine	No Change
One new access bell mouth arrangement at the entrance to Pencloe Farm from the unclassified road along Glen Afton	No change
Six water crossings to accommodate the access tracks	No change
Permanent access tracks into the application site from the public highway and between turbines, including upgrade to existing tracks	Yes – Realignment of various sections of track.
A control building and substation compound (including electrical metering, stores, office and welfare facilities)	Yes - Compound moved to eastern side of track to avoid deeper peat
Underground cabling between turbines and control building / substation compound, running alongside access tracks	No change
High voltage export cable or overhead line to the nearest Scottish Power Energy Networks (SPEN) substation (new facility planned immediately south of the application site)	No change
Five onsite borrow pits	Yes – Extensions to four previously proposed pits. Addition of further onsite pit
Three permanent free-standing anemometry masts up to 85 m in height with associated foundations and hardstanding	No change
Two temporary construction compounds and a temporary security office	No change

2.3 Layout Changes

Further detail on the proposed design changes are set out below, along with an outline of the reasoning behind each change.

2.3.1 Reduction in turbine numbers

It is no longer proposed that Turbines number 1 and 2 in the March 2015 windfarm layout be constructed. These two turbines have been removed from the layout to address comments made by SNH in their S36 consultation response dated 08/05/15, and a subsequent meeting on 30/06/15. The turbines were removed to improve the appearance of the proposed Pencloe Windfarm when viewed alongside the consented Afton Windfarm from the north, from viewpoints in and around New Cumnock and the southern edge of the town in particular. It is also proposed to microsite turbine 5, again to improve views from New Cumnock and surrounds.

The consultation with SNH is described in **Appendix 4**, along with further landscape assessment of the revised 19 turbine layout.

2.3.2 Realignment of internal access tracks

Additional peat depth probing has been undertaken over the proposed development footprint of the windfarm, and this has provided an increased definition of the presence of peat and peat depth (see Peat Depth Survey Report, **Appendix 2**). Some sections of the onsite tracks have been realigned to avoid deeper peat identified as a result of this survey. **Figure 1** shows where realignment has occurred and the previous routing.

The realigned track will require a total of 15.53 km of onsite access tracks from the public highway entrance. This will be comprised of 6.86 km of existing tracks that will be widened and 8.67 km of new tracks.

2.3.3 Re-location of Substation Compound

It is proposed to re-position the substation compound, which is currently sited to the west of the access track, to the east of the track (see **Figure 1**), this will again avoid an area of deeper peat. This re-positioned site is currently under mature commercial forestry plantation, and away from any mapped watercourses, and no additional significant environmental effects are predicted.

2.3.4 Increase in area of four proposed borrow pits

A revised calculation has estimated that around 117,500 m³ is needed from onsite borrow pits for construction of the proposed windfarm. The breakdown of this is provided in the table below.

Table 2.2 – Stone Volume Requirement for Windfarm Infrastructure

Infrastructure	Infrastructure dimensions footprint (m)	Excavated area footprint (m ²)	Infrastructure footprint requiring stone (m ²)	Stone requirement (m ³)
Construction Compound 1	Rectangle 100x50	5,000	5,000	3,750
Construction Compound 2	Rectangle 100x50	5,000	5,000	3,750
Substation	Rectangle 100x50	5,000	5,000	3,750
Turbine Foundation (19)	Diameter of 20m	5,947	5,415*	4,061
Crane Pad Section A (19)	Irregular Shape	45,638	45,638	34,229
Crane Pad Section B (19)	Irregular Shape	26,486	26,486	19,865
Borrow Pit 1	Irregular Shape	1,658	-	-
Borrow Pit 2	Irregular Shape	22,565	-	-
Borrow Pit 3	Irregular Shape	18,883	-	-
Borrow Pit 4	Irregular Shape	1,225	-	-
Borrow Pit 5	Irregular Shape	4,985	-	-
Met Mast and Hardstanding 1	Rectangle 31x17	527	527	395
Met Mast and Hardstanding 2	Rectangle 31x17	527	527	395
Met Mast and Hardstanding 3	Rectangle 31x17	527	527	395
Excavated track (new)	Irregular Shape	60,889	44,652**	33,489
Rockfill track (new)	Irregular Shape	2,740	2,009**	1,507
Existing track to be widened	Irregular Shape	46,409	15,470 ***	11,602
Turning Area	Irregular Shape	379	379	284
		254,385	156,630	117,472

Note:

* area overlaps crane hardstanding, therefore part is included in hardstanding area calculation

** assumes 5.5m width of 7.5m of total width filled with stone

*** assumes existing track is 3m wide and therefore a 2.5m width of stone is required to achieve the 5.5m width

A Revised Borrow Pit Report has been prepared (**Appendix 1**) and this shows the extension that will be needed to each of the four proposed borrow pits within the site boundary. A further potential borrow pit, number 5, has also been identified. The revised report demonstrates that there are sufficient reserves onsite to meet the construction needs of the windfarm. The planned borrow pit extensions will all take place on land that is currently under mature commercial forestry plantation. The revised borrow pit areas have sufficient separation distance from mapped watercourses and no additional significant environmental effects are predicted.

3 Overview of Additional Survey and Assessment

3.1 Introduction

This Section provides an overview of the additional survey and assessment in **Appendices 1 – 5** that has been undertaken for this Addendum.

3.1.1 Appendix 1 – Revised Borrow Pit Assessment (Grontmij)

In August 2015, Grontmij was commissioned to undertake a Revised Borrow Pit Assessment for the proposed Pencloe Windfarm.

This assessment supersedes the Borrow Pit Assessment presented as Appendix 10.6 of the March 2015 ES submitted in support of the S36 Application.

An overview of the solid geology is provided based on desk study and site survey, and an opinion as to the potential for rock extraction and use in the windfarm construction. Comment is given as to the viability of borrow pits where rock is anticipated to be present at shallow depth.

From the published geological information, supported by on site observation, the following main conclusions have emerged:

- The site is densely forested, with limited access by the existing Forestry Commission access track, firebreaks and local watercourse corridors. Superficial deposits within the site comprise widespread peat deposits of varying thickness, together with localised Glacial Till and alluvial deposits.
- Bedrock exposure was typically covered by superficial soils and the mature forestry, with outcrops limited to the areas identified for use as borrow pits. Where encountered, bedrock is typically of medium strong to strong brown and grey wacke (lithic sandstone). Little evidence of interbedded argillaceous (mudstone, siltstone) bedrock was recorded within the exposed bedrock.
- The proposed borrow pit locations provide good opportunity for development, with all potential material uses, including concrete aggregate, feasible, and it is estimated the borrow pits can provide the volume of aggregate (c.117,500 m³) required for windfarm construction. This conclusion is predicated on consistency of material type and quality within the borrow areas. However, due to the limited volume of observable exposure, diminution of the quality of resource (and consequently reduction of reuse suitability) cannot be discounted should the bedrock vary in nature or quality.
- Consequently, the above observations and reuse determinations will require appropriate investigation, including aggregate (rock) testing, in order to confirm the material properties and suitability for the various reuse requirements.

3.1.2 Appendix 2 – Peat Depth Survey Report (Fluid Environmental Consulting)

The following summarises the results of the peat survey campaign and subsequent peat depth contouring and excavated volume calculations:

- The various peat survey campaigns have provided a wide coverage of peat occurrence and depth across the proposed Pencloe Windfarm site with higher frequency probing undertaken in the areas of proposed infrastructure.
- Peat has been determined to be present up to a depth of 3.3 m based on 2,455 depth of penetration probes and 289 cores.

- The data collected has been used to produce an interpreted maximum depth of peat contour map using ArcGIS;
- The mapping indicates that the presence of peat at the site is not continuous and much of the site shows a complete absence of peat.
- The additional peat probing campaign at infrastructure locations has informed a review of the windfarm layout, and allowed areas of deep peat to be almost entirely avoided.
- The changes to the infrastructure layout included an increase in the size of the borrow pits to provide sufficient stone for the development, relocation of the southern construction compound and the substation away from deep peat, realignment of sections of track to avoid deep peat and use of a more realistic turbine base area of 20 m diameter rather than 12 m sided square.
- Based on the infrastructure Final Layout, deep peat (>1 m depth) was present across only 4.2% of the footprint, a substantial reduction from the 18% of infrastructure in the First Iteration layout.
- There is no peat (0 – 0.5 m depth) at 65% of the infrastructure locations.
- The total volume of peat that is required to be excavated based on the Final Layout has been calculated using ArcGIS spatial analysis and is estimated at 66,400 m³ which is comprised of about 5,100 m³ of acrotelm and 61,300 m³ of catotelm. The total volume of peat to be excavated has been reduced by about 12% from the previous total of 70,700 m³ even though there has been an increase in the infrastructure footprint from 200,629 m² to 235,158 m² (17% increase). This has been achieved by the detailed probing obtaining a greater understanding of peat depth and occurrence across the site, and the subsequent redesign of the layout to improve avoidance of deep peat.

3.1.3 Appendix 3 – Revised Peat Management Plan (PMP) (Fluid Environmental Consulting)

The Revised PMP has been completed to supersede the Outline PMP prepared as Appendix 10.5 of the ES that supported the S36 application to the Scottish Government in March 2015. It has been prepared in part to address matters relating to peat management raised by SEPA in the consultation response (ref PCS/139128) to the Scottish Government dated 1 May 2015. It also takes account of the amendments to the windfarm layout, including the reduction in turbine numbers from 21 to 19, track and other infrastructure realignment, and increased borrow pit size that are described in **Chapter 2**.

To obtain a detailed understanding of the spatial and depth distribution of peat and its properties, a series of site investigation tasks have been completed which include:

- Peatland habitat mapping (undertaken by Quadrant Scotland and SKM/Jacobs); and
- A total of 2,455 peat probes with a high concentration at known infrastructure locations (undertaken by Jacobs and Fluid Environmental Consulting). Each probe recorded the peat depth and the potential substrate below the peat layer. In conjunction with the probing a total of 289 cores were also obtained to gain additional information on the subsurface peat. This work is reported on in detail in **Appendix 2**.

This information allowed an interpreted maximum depth of peat contour map to be produced which indicates the potential peat depth based on the depth penetration probing results and verification by coring. The infrastructure layout was adjusted to avoid, wherever possible, areas of deep peat and good quality peat habitats and therefore minimise the volume of peat that would need to be excavated, in particular deep peat. The final iteration of the infrastructure layout was undertaken subsequent to detailed peat probing across all infrastructure which indicated the

presence of 18% of the infrastructure located on deep peat (>1 m depth). The final layout changes reduced this to only 4.2% of infrastructure.

The contoured surface of the peat created has been used along with ArcGIS spatial analysis to determine the average depth of peat under the excavation footprint of all proposed infrastructure and therefore the total volume of peat to be excavated as well as the volume of acrotelmic, catotelmic and amorphous peat. Based on the location of site infrastructure in relation to peat depth, it is calculated that the excavation of 66,400 m³ of peat will be required, comprising 5,100 m³ of acrotelmic peat and 61,300 m³ of catotelmic peat.

This volume of peat will be reused around the site in the following areas:

- In appropriate locations around the infrastructure perimeter such as track verges, the edges of crane hardstandings and the edge of the substation. Peat will be reused in a 1 m wide strip at a thickness of approximately 0.3 m, where the infrastructure is located in an existing peat area. This should essentially be the reinstatement of excavated peat turves and tie in with the adjacent peat. The length of the infrastructure coincident with peat, as defined by the peat contour mapping, has been calculated at 14,700 m;
- For reinstatement of the southern construction compound that occupies an area of 5,000 m². After construction the stone will be removed and the peat reinstated in this area to a similar depth as is currently present, 0.5 m;
- The section of crane hardstanding on the opposite side of the road to the turbine foundation will also be reinstated, as this section is only required for the construction period. The stone will be removed and replaced with peat in the same quantity as removed. For information, crane hardstanding section B has an area of 1,394 m².
- The section of the crane hardstanding on the same side of the track as the turbine base will remain as stone for any potential works. This area is referred to as crane hardstanding section A and covers an area of 2,402 m². The average depth of peat occupying these areas and the specific quantity that will be excavated and therefore reinstated has been calculated and is provided within **Appendix 3**; and
- The proposed five borrow pits amount to a total area of 49,316 m² and each will be reinstated with peat to a depth of 1m to produce engineered wetland areas.

These reuse volumes total approximately 67,500 m³ of peat with 5,200 m³ of acrotelm and 62,300 m³ of catotelm, which is about 1,000 m³ more than the estimated amount of peat to be excavated.

It is considered that the depth of peat in the borrow pits could potentially be increased to 1.2 m. This would allow a further 9,850 m³ of peat to be reinstated.

Based on the peat depth, characteristics and distribution investigations undertaken across the development area and the windfarm infrastructure layout, a surplus of peat is not expected to be generated by the Proposed Development. All estimated excavated peat is planned for reuse for restoration work during the construction, post-construction, and decommissioning phases of the windfarm.

Further investigation will be undertaken prior to works commencing to confirm peat depth, distribution and characterisation. The additional survey data will be used to inform any micro-siting, if required.

The Main Contractor, monitored by the ECoW, will maintain a record of actual peat volumes excavated and the subsequent peat reuse to compare the predicted and actual peat volumes.

This record during the construction, operation, decommissioning and restoration phases of the windfarm will be made available for review by regulators as and when required.

3.1.4 Appendix 4 – Updated Landscape and Visual Assessment (hepla)

Following the agreement with SNH to reduce the proposed Pencloe Windfarm from 21 turbines to 19 turbines, and consultation with the ECDU and East Ayrshire Council in August 2015, it was agreed that a selective update to the Landscape and Visual Impact Assessment (LVIA) should be undertaken to provide an understanding of the effect of removing two turbines.

To assist in understanding the visual effects of the amended windfarm layout the following revised figures have been prepared and are available in Volume 2 of this Addendum:

- **Figure 4.1.1** Blade Tip ZTV – projected to the full 35 km study area, presented at A3.
- **Figure 4.1.2** Hub Height Tip ZTV – projected to the full 35 km study area, presented at A3.
- **Figure 4.1.3** Blade Tip ZTV – high resolution ZTV to a 7 km radius of the proposed development, presented at A3 and A1.
- **Figure 4.1.4** Comparative ZTV (Pencloe 21 turbine proposal/Pencloe 19 turbine proposal).
- **Figure 4.2.3a-e** Viewpoint 3 – Afton Cemetery Car Park, Afton Road, New Cumnock, Revised Wireframes and Photomontages.
- **Figure 4.2.4a-e** Viewpoint 4 – Connel View, Southern Edge of New Cumnock, Revised Wireframes and Photomontages.
- **Figure 4.2.7a-e** Viewpoint 7 – Minor road near Mounthope Farm, Revised Wireframes and Photomontages.
- **Figure 4.2.9a-e** Viewpoint 9 - Minor road near Auchincross Farm, Revised Wireframes and Photomontages.
- **Figure 4.2.14a-e** Viewpoint 14 – Penders Wynd, Netherthird, Cumnock, Revised Wireframes and Photomontages.
- **Figure 4.2.20a-e** Viewpoint 20 – Afton Reservoir, Revised Wireframes and Photomontages.
- **SNH Viewpoint Pack:** Viewpoints 3, 4, 7, 9, 14 and 20.

The proposed adjustment is primarily intended to simplify the design of the windfarm in views from the north at New Cumnock, the adjacent settlement pattern, and the surrounding landscape of the Upland Basin. The adjustment also reduces visibility from Glen Afton.

The main findings of the updated assessment is that there are no changes in magnitude of change that are sufficient to reduce the overall effects of the proposed development and the reviewed assessment ratings are maintained at the level set out in the original assessment of March 2015. However, analysis of the original and revised proposals indicates important differences that provide beneficial improvements to landscape and visual amenity. The revised proposals have:

- reduced the instances overlapping turbines when Pencloe is visible with Afton Windfarm in views from the north, and have enhanced the combined profile of these two adjacent schemes to ensure that they read in views as a single windfarm;
- reduced intrusion on the ridgeline of sensitive Glen Afton;
- reduced the overall effects of windfarms in Glen Afton Sensitive Landscape Area;
- resulted in a minor reduction the horizontal spread of new development to the north when seen in views from Blackcraig Hill which is located above the eastern side of Glen Afton;
- consolidated the footprint of the development a further 827 m to the south fo New Cumnock; and
- enhanced the siting of Pencloe Windfarm as development located within a single landscape character type of Southern uplands with Forestry, and set clearly within the plateau upland landscape of the Southern Uplands.

In addition to the specific layout improvements identified above, whilst Pencloe was assessed to give rise to very limited cumulative effects, the recent changes to the pattern of proposed development, in particular the refusal of High Cumnock and Ashmark Hill, have further reduced potential cumulative effects.

In summary therefore, whilst the March 2015 assessment ratings remain unaltered, the revised 19 turbine design would lead to beneficial changes to views from assessed viewpoints and other assessed landscape and visual receptors, when compared with the 21 turbine layout in the March 2015 proposals.

The proposed Pencloe Windfarm has been designed to fit with the emerging pattern and scale of built and consented development, with a strong design rationale to the underlying form of the landscape, and within the area of capacity in the Southern Uplands with Forestry landscape character type identified in the East Ayrshire Landscape Wind Capacity Study, July 2013.

3.1.5 Appendix 5 – Revised and updated Noise Assessment (Jacobs)

The operational noise associated with the proposed Pencloe Windfarm has been reassessed in accordance with the guidance presented in ETSU-R-97 and 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (the GPG).

This reassessment has taken account of the reduction in turbine numbers from 21 to 19, and the refusal of Ashmark Hill. In addition, comments in relation to the previous noise assessment were made by ACCON UK Limited (ACCON) on behalf of East Ayrshire Council (EAC) on 2nd April 2015; all of these have been addressed.

This assessment provides updated information, and supersedes some elements of the previous noise assessment presented in the ES. However, the conclusions of the ES are not affected by the additional information provided in this document, and it is demonstrated the proposal can meet the ETSU-R-97 limits, during the operation of all cumulatively assessed wind developments.

4 Invitation to Comment

4.1 Where to view the Addendum

The Addendum will be available to view at the following locations during normal office hours:

- East Ayrshire Council, Planning and Economic Development, The Jonnie Walker Bond, 15 Strand Street, Kilmarnock, KA1 1HU.
- Cumnock Community Library, 1 Greenholm Road, Cumnock KA18 1LH.
- The New Cumnock Community Centre, Castle, New Cumnock KA18 4AH.

4.2 Obtaining Copies of the Addendum

Copies of the Addendum may be obtained from Peter Moynan Consulting (Telephone 07741 467999) at a cost of £400 for a hard copy and £25 for a disk.

4.3 Representations

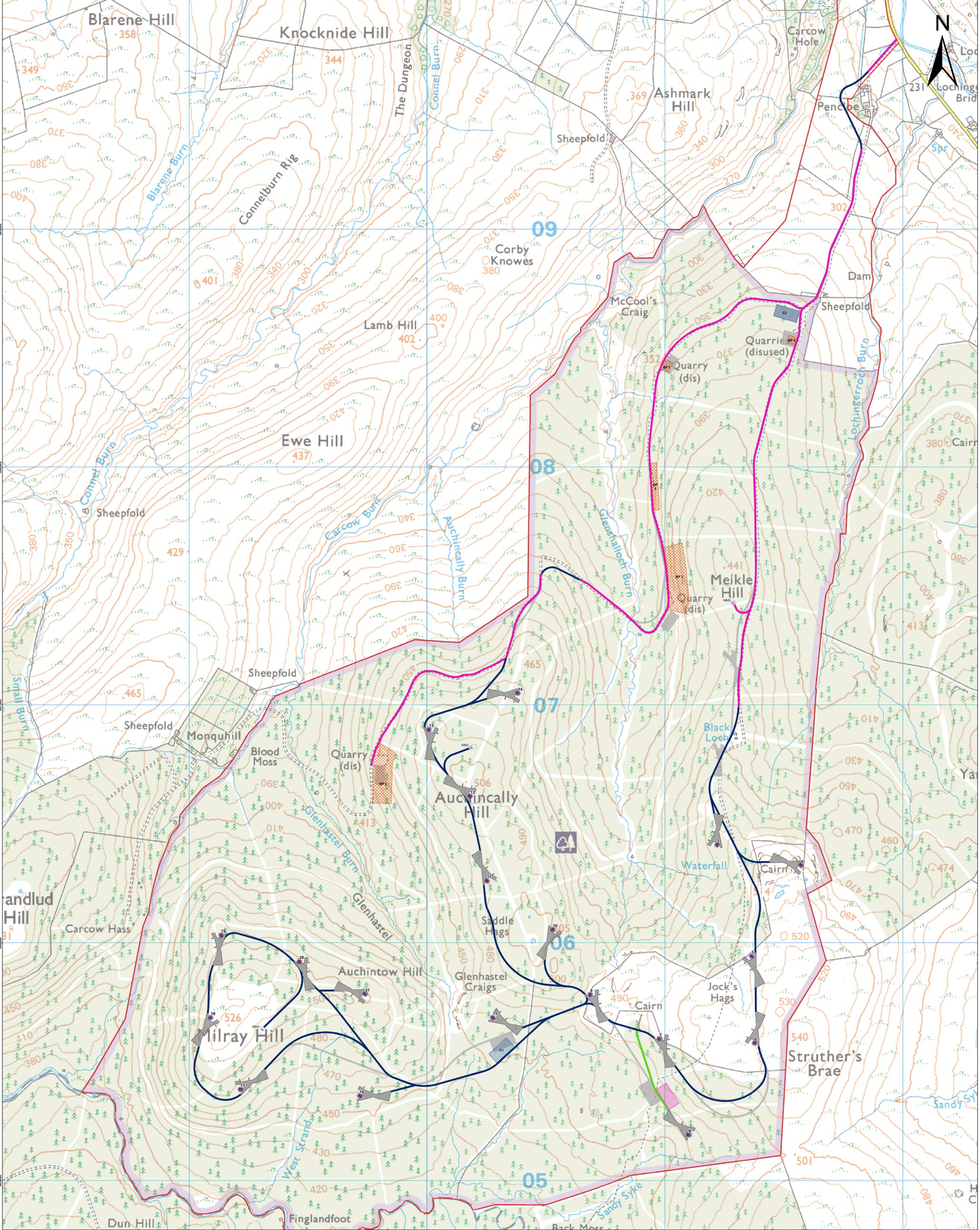
Any representations should be made in writing to The Scottish Government, Energy Consents Unit, 4th Floor, 5 Atlantic Quay, 150 Broomielaw, Glasgow G2 8LU or emailed to representations@scotland.gsi.gov.uk identifying the proposal and specifying grounds for objection or support, not later than the 30th October.

Representations should be dated and should clearly state the name (in block capitals) and full return email and postal address of those making representation. Only representations sent by email to the address stipulated will receive acknowledgement.

Please note that all previous representations received in relation to this development remain valid.

Figures

Figure 1 – Revised Site Layout Plan



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- KEY:**
- Site Boundary
 - Crane Hardstanding
 - Turbine Base
 - Construction Compound
 - Substation
 - Borrow Pit
 - Turning Area
 - Excavated Track
 - Existing Track To Be Widened
 - Rock Fill Track
 - Turbine
 - Existing Anemometry Mast
 - Anemometry Mast
 - Previous Layout

PROJECT

PENCLOE WINDFARM

FIGURE 1

Infrastructure Layout

SCALE

1:5,000 @ A0



PENCLOE WIND ENERGY LIMITED



Appendices

Appendix 1 – Revised Borrow Pit Assessment

Revised Borrow Pit Assessment Pencloe Windfarm

116638/SMcL/150911
Revision C

Report Prepared For Pencloe Wind Energy Limited

Issue	Date	Reason for Issue	Prepared	Checked	Approved
A	Sept 2015	Draft for Comment	SDV	SMcL	GR
B	8 th Sept 2015	Draft for Comment	SDV	SMcL	GR
C	11 th Sept 2015	FINAL Draft	SDV	SMcL	GR
D	11 th Sept 2015	FINAL	SDV	SMcL	GR

Revised Borrow Pit Assessment

116638/SMcL/150911

Revision D

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Revised Borrow Pit Assessment

116638/SMcL/150911

Revision D

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value beyond engineering

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Appendices

Appendix A	Borrow Pit Location Plan
Appendix B	Borrow Pit Photographs
Appendix C	Prospective Borrow Pit Details
Appendix D	Geotechnical Testing Requirements

1. Introduction

1.1 Project Overview

In August 2015, Grontmij Ltd were commissioned by Pencloe Wind Energy Limited to undertake a Revised Borrow Pit Assessment for the proposed Pencloe Windfarm development in East Ayrshire.

The proposed planning application site for the windfarm is predominantly mature forestry plantation (managed woodland), with some open moorland the northernmost end of the site which is used for sheep grazing.

This Borrow Pit Assessment is intended to support an application made under Section 36 of the Electricity Act and already submitted to the Scottish Government in March 2015. It provides a revised and updated view on the potential for developing borrow pits, and the use of site won rock for construction of the windfarm, including for access tracks, hardstandings and turbine foundations. This revised assessment is required to confirm that a sufficient material is available within the application site to meet the latest estimate for the volume of rock required for construction, (see Section 4 of this report)

This assessment supersedes the Borrow Pit Assessment presented as Appendix 10.6 of the Environmental Statement (ES) submitted in support of the S36 Application.

An overview of the solid geology is provided and an opinion as to the potential for rock extraction and use in the windfarm construction. Comment is given as to the viability of borrow pits where rock is anticipated to be present at shallow depth.

1.2 Site Location

The site is located on the southern border of East Ayrshire, at its closest point the boundary of the application site is approximately 2km south of New Cumnock. The National Grid Reference for the site centre is NS613067.

1.3 Site General Arrangement

The proposed Site General Arrangement is provided within the Main Addendum documentation associated with this report.. This indicates the proposed windfarm layout, including wind turbine locations, permanent meteorological masts (x3), internal access tracks and substation and construction compound (x2) locations. Site access is gained via a track from Pencloe Farm, to the north, off Afton Road which runs south from the B741 at New Cumnock.

2. Background to Borrow Pit Assessment

2.1.1 Materials

Borrow pits would be a potential source of stone for windfarm earthworks, granular pavement construction and concrete aggregates. These potential uses are described below.

2.1.2 Bulk Fill

Depending on the site topography, bulk fill may be required for tracks, hardstandings and lay down areas. This material may be sourced from rock, but granular soils (<15% of fines) are a preferable source as they can be less susceptible to weathering.

2.1.3 Capping (Class 6F or similar)

This is a granular material used in the upper layers of tracks and hardstandings, and needs to comprise relatively durable rock or sand and gravel. Capping layers are typically used to protect the underlying soils or poor quality general fill from construction traffic; typically a minimum of 400mm to 600mm of capping material is required.

2.1.4 Sub Base (Type 1 or similar)

Such material is used as final surfacing on unbound tracks and needs to be fine grained material. Sub base (Type 1) material is typically sourced from processed crushed rock.

2.1.5 Structural Fill (Class 6N)

This comprises of a granular well graded material which is placed below foundations to either provide a uniform construction platform or to improve and protect the natural sub-formation. The structural fill needs to be durable and is usually sourced from processed crushed rock.

2.1.6 Concrete Aggregate

On large remote sites an on-site concrete batching plant may be the most economical and practical method of supplying concrete to construct the turbine foundations. When an on-site batching plant is used, sourcing of the concrete aggregate from a suitable on site source will provide environmental and economic benefits. Concrete aggregate must be durable, un-weathered and strong, and is often the least readily available material from on-site borrow pits. The stone from the on-site borrow pits will require further investigation and testing to establish whether it is a suitable source of concrete aggregate.

3. Published Geology and Findings of Site Reconnaissance

3.1 Published Geology

A previous borrow pit assessment was carried out by Jacobs Ltd on behalf of Pencloe Wind Energy Limited in October 2014 (*Pencloe Windfarm Borrow Pit Assessment, October 2014*) which includes desktop assessment of the published geological data. The following section summarises the desktop geological information for the site, including that presented in the previous reporting (Jacobs, 2014).

Here, the primary source of data is the available British Geological Survey (BGS) mapping (Sheet S014W, New Cumnock, Solid and Drift, 2000) supplemented by online (BGS online) and in house resources.

3.1.1 Superficial Geology

The published geological mapping indicates the drift deposits within the site area are variable, and locally intermittent, with quaternary peat and alluvium and Devensian Glacial Till present locally within the site area.

Peat occurrence across the site has been defined by probing on 100m and 200m grids by Jacobs in 2012 and 2013 and at infrastructure locations by FluidEC in 2015. Shallow peat deposits (up to 1m in depth) are encountered across the majority of the southern part of the site, with the exception of the steep south west and west slopes of Milray Hill, the eastern slopes of Auchincally Hill and some other minor areas close to Glenhastel Burn and Glenshalloch Burn. In the northern part of the site the peat is less continuous being present along the upper section of the Lochingerroch Burn, the Glenshalloch Burn and the northern slopes of Auchincally Hill. Deep peat (>1m depth) is discontinuous and scattered in pockets across the site, being present in areas of low gradient at saddles, plateaus or within valleys surrounding watercourses.

Devensian Glacial Till deposits are more limited in extent, and are predominantly recorded in the valleys of the Glenshalloch Burn, Glenhastel Burn, Carcow Burn and Lochingerroch Burn. The Till deposits are recorded as diamicton, comprising a firm silty clay matrix, with frequent cobbles and boulders of mixed lithologies.

Alluvium deposits are limited in extent, and localised to small areas proximal to Glenshalloch Burn and an area around Lochingerroch Burn, in the north of the site.

It is noted that on the steeper sided slopes on the eastern flanks of Milray Hill, east and west of Auchincally Hill and the general extent of Meikle Hill, superficial deposits are recorded to be absent, with bedrock at or near ground level.

3.1.2 Solid Geology

The regional geology of the area surrounding the site typically comprises sedimentary successions of Ordovician age, with localized igneous intrusions of commensurate age.

Within the site boundary, the solid strata is recorded to comprise a number of sedimentary units, bound by normal and thrust faulting. The southern area of the site is underlain by the

Ordovician Blackcraig formation. The Blackcraig Formation is formed of wacke sandstone, siltstones and sporadic conglomerates. This unit extends from the southern flank of Milray Hill in the southwest of the site, to the east of Meikle Hill, in the north east. On the southern flank of Milray Hill, it is noted that a band of conglomeratic strata is noted, extending to the northeast.

The northern portion of the site is underlain by the Ordovician Kirkcolm formation. This unit comprises a typically well bedded turbidite sequence of lithic sandstone (wacke) and minor siltstones, and extends from Meikle Hill to Glen Afton. This unit encompasses all of the proposed borrow pits within the site boundary. The Kirkcolm formation is separated from the Blackcraig formation by a northeast south west trending normal fault.

To the north of the site, beyond the line of the Carcow Burn, the bedrock strata is recorded as comprising the Ordovician Marchburn Formation, comprising a similar turbidite sequence of wackes, siltstones and conglomerates. The Marchburn Formation is bound to the south by the Kirkcolm Formation by a thrust fault.

It is noted that the available mapping indicates the western extent of the site, local to Milray Hill, to be underlain by the Leadhills Supergroup. Previous reporting (*Jacobs, Pencloe Windfarm Borrow Pit Assessment, October 2014*) has interpreted the Leadhills Supergroup, and its north to south intersecting boundary to represent a faulted boundary between separate rock units. On inspection, however, it is noted that the Leadhills Supergroup comprises the parent unit of the Ordovician sedimentary strata, and it is therefore considered that the aforementioned units extend beyond this "boundary". It is considered that this anomaly represents variation in mapping frequency and scale between two adjoining maps, with more detailed mapping, indicating the separate Ordovician succession, to the east. This is supported by the available hydrological mapping, which indicates the Blackcraig and Kirkcolm formations to extend beyond this boundary.

In addition to the above, small igneous intrusions are recorded locally within the general area of the site, including a Siluro-devonian Dyke located along the normal fault on the eastern flank of Milray Hill. This is defined as an alkaline igneous rock composed principally of silicate minerals.

In terms of structural geology, and as noted, the major bedrock units local to the site area are fault bound. To the north of the site boundary, a thrust fault forms the boundary between the Marchburn Formation, to the north, and the Kirkcolm Formation. The thrust fault traces roughly southwest to north east, along the line of the valley of the Carcow Burn, with the hanging wall noted to the north of the fault.

Within the site area itself, a further normal fault of similar orientation to the aforementioned thrust fault marks the boundary between the Kirkcolm Formation, and the Blackcraig Formation. Here, the normal fault is downthrown to the south in the south west of the site, and to the north in the north eastern portion of the site.

In addition to the above, there are a series of normal faults running in a northwest to southeast direction within the site, perpendicular to the northeast-southwest trending fault and locally displacing the fault trace. Two of these faults run through the site. One fault runs from Meikle

Hill situated in the Kirkcolm Formation, southeast through the Blackcraig formation and the other runs between Auchincally Hill and Milray Hill.

3.1.3 Previous Reporting (Jacobs Ltd, October 2014)

As noted, Pencloe Windfarm has been subject to a previous Borrow Pit Assessment comprising both non-intrusive desktop investigation and site reconnaissance.

The reporting identified four (4 No.) of areas on site which were potentially suitable for borrow pit locations. These borrow pits were identified within areas overlying the Kirkcolm formation where previous quarrying of aggregates has occurred for use in the construction of forest tracks. The potential sites are described in **Section 3.2**, below:

The potential for sourcing rock from local quarries was also assessed. Three (3 No.) off-site quarries were identified, based on the proximity to the site and the suitability of the quarried material. It was concluded that all quarry options could be useful for supplementing small quantities of aggregate for the project. These potential sources are outlined below:

Sorn Quarry: sandstone quarry of the Lanark Group, located approximately 18km north of the site.

Morrinton Quarry: Greywacke, Silurian and Gala Unit 7 sandstones for use as high specification road stones and crushed rock aggregates, located approximately 33km southeast in Dumfries.

Duneaton Quarry: Greywacke crushed rock aggregate, located approximately 32km northeast in Abington.

3.2 Previous Site Reconnaissance (Jacobs)

A site walkover was undertaken by Jacobs. The walkover was targeted to assess the aforementioned locations identified from the desk study. A review of each prospective borrow pit site is given below:

Site 1: A small quarry site located northwest of Meikle Hill, adjacent to the east of the access track in the north-western area of the site. The geology is described as being 'a very weak to medium strong, thickly bedded, grey mottled dark grey, fine grained sandstone with occasional fine quartz crystals' of the Kirkcolm Formation. It was concluded that this material would be of sufficient quality for application as track construction, but there would not be sufficient quantity to provide the necessary volumes.

Site 2: A larger quarry located 1km south of Site 1 on Meikle Hill. The quarry is located on the Kirkcolm formation and is described as very weak to strong, with medium bedding.

Site 3: The largest former quarry in the area, located in the southern section of the site on the western slopes of Auchincally Hill. This quarry is located on the Kirkcolm formation and is described as being the same rock type as in Site 1.

Site 4: A small former borrow pit located at the far northern end of the forestry land, close to the main FCS entrance point. The quarry is located on the Kirkcolm Formation and is described as being a similar composition as sites 1, 2 and 3.

In addition to the above, a fifth potential borrow pit (Site 5) was identified, located along the access track to the east of Meikle Hill, and proximal to the location of Turbine T2. This location was identified by Jacobs through desktop and probe data only, and was not observed on site during their site reconnaissance. In this instance, given the scant information provided, and the outlying location of the potential, this location was not considered further.

3.3 Recent Site Reconnaissance

A site walkover was undertaken by Grontmij Ltd on the 26th of August 2015. The walkover was targeted to assess the aforementioned locations identified by Jacobs, together with identifying any further potential borrow pit locations that could be determined during the site visit.

The **Grontmij Figure B-1, Borrow Pit Location Plan**, contained within **Appendix B**, indicates the locations of the four borrow pits (BP1 to BP4 inclusive), identified during the previous reconnaissance together with a previously unidentified location (BP5) recorded during the Grontmij site walkover.

In general, discernible rock outcrops were limited to those areas identified during previous site reconnaissance as potential borrow pits, with the remaining site area heavily forested or covered in superficial deposits/ localised peat. The exception to this was a large section of exposed bedrock, circa 50m to 75m in length and some 1m to 2.5m in height, located adjacent to the current forestry track to the south of the location of BP1. The location, (referred to as BP5), and extending along the western flank of Meikle Hill, was not referenced in previous reconnaissance.

The bedrock strata encountered within the five potential borrow areas corroborated the anticipated geology, and was consistent across the five identified locations. The strata comprised of locally weathered and fresh mottled grey and brown fine to coarse lithic sandstone (wacke), which was generally of medium to high strength in situ, with localised areas of very weak to weak rock that had been exposed to significant weathering. Bedding, where evident, ranged from medium to thickly bedded, but was locally closely bedded. No evidence of argillaceous interbedding (siltstone or mudstone), indicated to be present by the published geology, was recorded.

As noted in the previous section, the borrow pit areas identified comprised previously exploited quarries utilised during the construction of the existing forestry access track. As such, areas of spoil left over during this extraction activity were evident within all four of the borrow pit areas, most notably at BP3 and BP4. It is also noted that in each case, the areas are all heavily vegetated and often support semi mature and mature forestry. As such, preparatory clearance and felling will be required to enable any working of the borrow pit areas.

Therefore, from the previous and recent site reconnaissance, prospective borrow pits have been identified at the locations shown on **Grontmij Figure B-1, Borrow Pit Location Plan**

included in **Appendix B** and are described in **Table 3.1: Description of Potential Borrow pits** on the following page.

Selected photographs detailing the identified borrow pits are included in **Appendix C**.

Table 3.1: Description of Potential Borrow pits

Borrow Pit ID	Location	Estimate of Extraction Volume (See Note 1 and 2)	Accessibility	Rock Type	Rock Reusability	Comments
Borrow Pit BP1 (corresponds with Jacobs ID BP1)	Northwest of Meikle Hill, adjacent to the east of the access track in the north-western area of the site	2,500m ³	Exposed bedrock adjacent to the east of the access track in the north western area of the site, approximately 2-3m back from the track side, approximately 5 m in height with a length of approximately 15-20 m.	Very weak to strong mottled brown and grey Wacke (lithic sandstone) of the Ordovician Kirkcolm Sandstone.	Reasonable rock where fresh, potential for reuse in all materials including concrete aggregate. Confirmation required via testing due to limited exposure and surface weathering.	Intrusive SI would be required to support and confirm site observations. It is possible small amounts of additional aggregate could be generated by sorting and processing the existing spoil heaps where they exist at the location.
Borrow Pit BP2 (corresponds with Jacobs ID BP2)	Within mature forestry to the northwest of Meikle Hill.	80,000m ³	Approximately 15 m back from the side of the access track, exposure approximately 12-15m in height. Central portion includes existing shelf cut during previous development.	Very weak to strong mottled brown and grey Wacke (lithic sandstone) of the Ordovician Kirkcolm Sandstone.	Reasonable rock where fresh, potential for reuse in all materials including concrete aggregate. Confirmation required via testing due to limited exposure and surface weathering.	Intrusive SI would be required to support and confirm site observations It is possible small amounts of additional aggregate could be generated by sorting and processing the existing spoil heaps where they exist at the location.

Borrow Pit ID	Location	Estimate of Extraction Volume (See Note 1 and 2)	Accessibility	Rock Type	Rock Reusability	Comments
Borrow Pit BP3 (corresponds with Jacobs ID BP3)	On the west facing slopes of Auchincally Hill	40,000m ³	Approximately 20 m to the east of the access track.	Very weak to strong mottled brown and grey Wacke (lithic sandstone) of the Ordovician Kirkcolm Sandstone	Reasonable rock where fresh, potential for reuse in all materials including concrete aggregate. Confirmation required via testing due to limited exposure and surface weathering.	Intrusive SI would be required to support and confirm site observations It is possible small amounts of additional aggregate could be generated by sorting and processing the existing spoil heaps where they exist at the location.
Borrow Pit BP4 (corresponds with Jacobs ID BP4)	At the far northern end of the site area, close to the main FCS entrance point	3,000m ³	Approximately 10 m to the west of the access track	Very weak to strong mottled brown and grey Wacke (lithic sandstone) of the Ordovician Kirkcolm Sandstone	Reasonable rock where fresh, potential for reuse in all materials including concrete aggregate. Confirmation required via testing due to limited exposure and surface weathering.	Intrusive SI would be required to support and confirm site observations. It is possible small amounts of additional aggregate could be generated by sorting and processing the existing spoil heaps where they exist at the location.

Borrow Pit ID	Location	Estimate of Extraction Volume (See Note 1 and 2)	Accessibility	Rock Type	Rock Reusability	Comments
Borrow Pit BP5	Adjacent to the existing access track, on western slope of location of Meikle Hill.	15,000m ³	Directly adjacent to existing access track.	Very weak to strong mottled brown and grey Wacke (lithic sandstone) of the Ordovician Kirkcolm Sandstone	Reasonable rock where fresh, potential for reuse in all materials including concrete aggregate. Confirmation required via testing due to limited exposure and surface weathering.	Intrusive SI would be required to support and confirm site observations

1. The estimates of extraction volumes have been calculated using an assumed borrow pit floor area and LIDAR level data. The depth of overburden / depth to rock head has assumed to be 0.5m. A contingency allowance has been provided above the estimated aggregate volume stated in Section 4 below.
2. Refer to Appendix B for a location plan of each potential borrow pit identified. Refer to Appendix D for prospective sections at the borrow pit locations.

4. Prospective Borrow Pit Sizes

The potential available resource at the borrow pits has been estimated using available LIDAR survey data. A plan area and depth deemed appropriate for the local topography was selected for each location. Based on this plan area and depth the estimate of potential extraction volumes were calculated assuming a typical topsoil and overburden depth of 0.5m. **Grontmij Figures D-1 to D-5, Prospective Borrow Pit Details** indicate envisaged sections for each of the prospective borrow pits including details of envisaged pit depths and plan areas. These are contained in **Appendix D**.

We have included a contingency within this assessment in order to allow for the assumptions contained within our calculations. The total extraction potential from the borrow pits identified is 140,500m³. The amount of aggregate required for the windfarm development has been estimated at c.117,500m³ (See Section 2 of the Addendum). This provides an approximate contingency buffer of 20%. This is sensible given the stage of the design process and information available for this assessment.

5. Conclusions and Recommendations

5.1 Conclusions

From the published geological information, supported by on site observation, the following main conclusions have emerged:

- The site is densely forested, with limited access by the existing Forestry Commission access track, firebreaks and local watercourse corridors. Superficial deposits within the site comprise widespread peat deposits of varying thickness, together with localised Glacial Till and alluvial deposits.
- Bedrock exposure was typically covered by superficial soils and the mature forestry, with outcrops encountered limited to the areas identified for use as borrow pits. Where encountered, bedrock is typically of medium strong to strong brown and grey wacke (lithic sandstone). Little evidence of interbedded argillaceous (mudstone, siltstone) bedrock was recorded within the exposed bedrock.
- The proposed borrow pit locations provide good opportunity for development, with all potential material uses, including concrete aggregate, feasible, and it is estimated the borrow pits can provide the volume of aggregate (c.117,500m³) required for windfarm construction. This conclusion is predicated on consistency of material type and quality within the borrow areas. However, due to the limited volume of observable exposure, diminution of the quality of resource (and consequently reduction of reuse suitability) cannot be discounted should the bedrock vary in nature or quality.
- Consequently, the above observations and reuse determinations will require appropriate investigation, including aggregate (rock) testing, in order to confirm the material properties and suitability for the various reuse requirements.

5.2 Recommendations

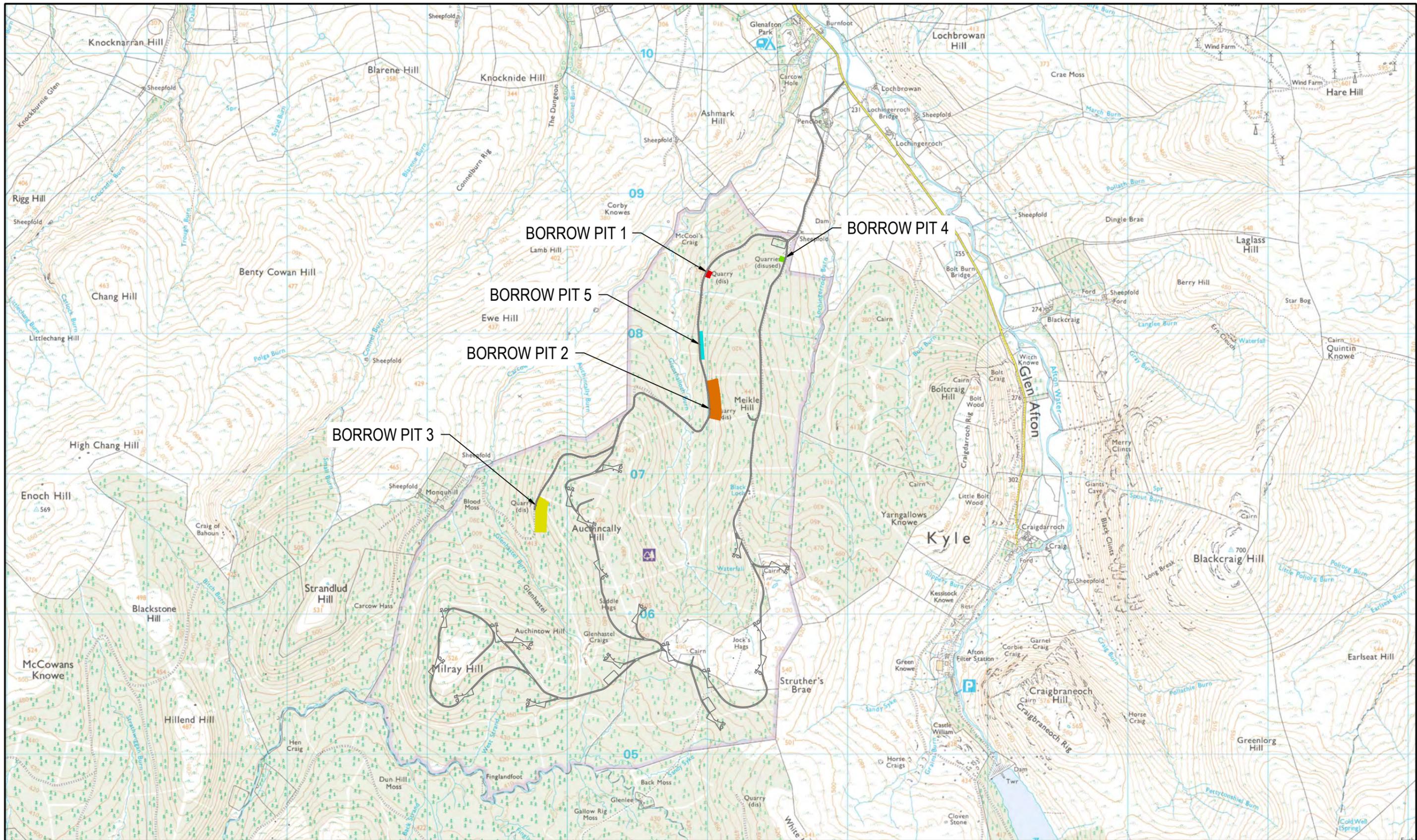
From the above, the following recommendations for future actions are presented:

- It is recommended that intrusive investigations are carried at the five identified borrow pit locations prior to the detailed design stage, in order to confirm the nature of the exposed rock. It is noted that site investigations would be predicated on suitable clearance of existing forestry in each of the five locations
- Intrusive works in this instance would typically comprise a scope of mechanically excavated trial pits and rotary (openhole and coring) boreholes. As noted, recovered rock samples (cores and bulks) would be subject to geotechnical laboratory (aggregate) testing in order to confirm suitability for re-use prior to the detailed design stage. A table detailing the typical requisite testing, with respect to the different material end uses, is presented in **Appendix E**.

Appendices

Appendix A – Borrow Pit Location Plan

113230/SMcL/141110 Rev C



No.	Date	Revision	By	Chk
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BORROW PIT LOCATION PLAN



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Appendices

Appendix B - Borrow Pit Photographs

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Picture 1: Borrow Pit BP1 Exposure



Picture 2: Borrow Pit BP2 Exposure



Picture 3: Borrow Pit BP3



Picture 4: Borrow Pit B4 Exposure

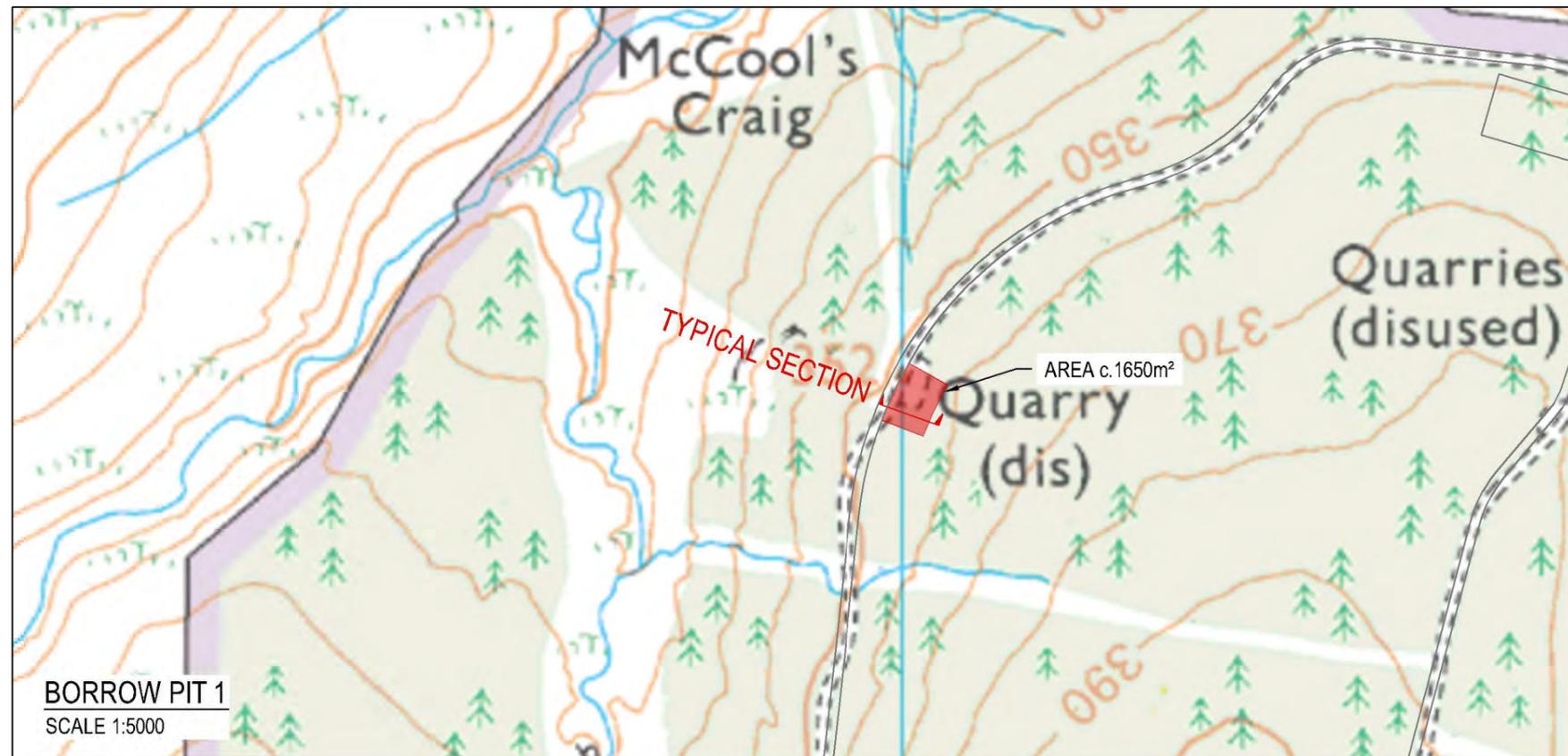
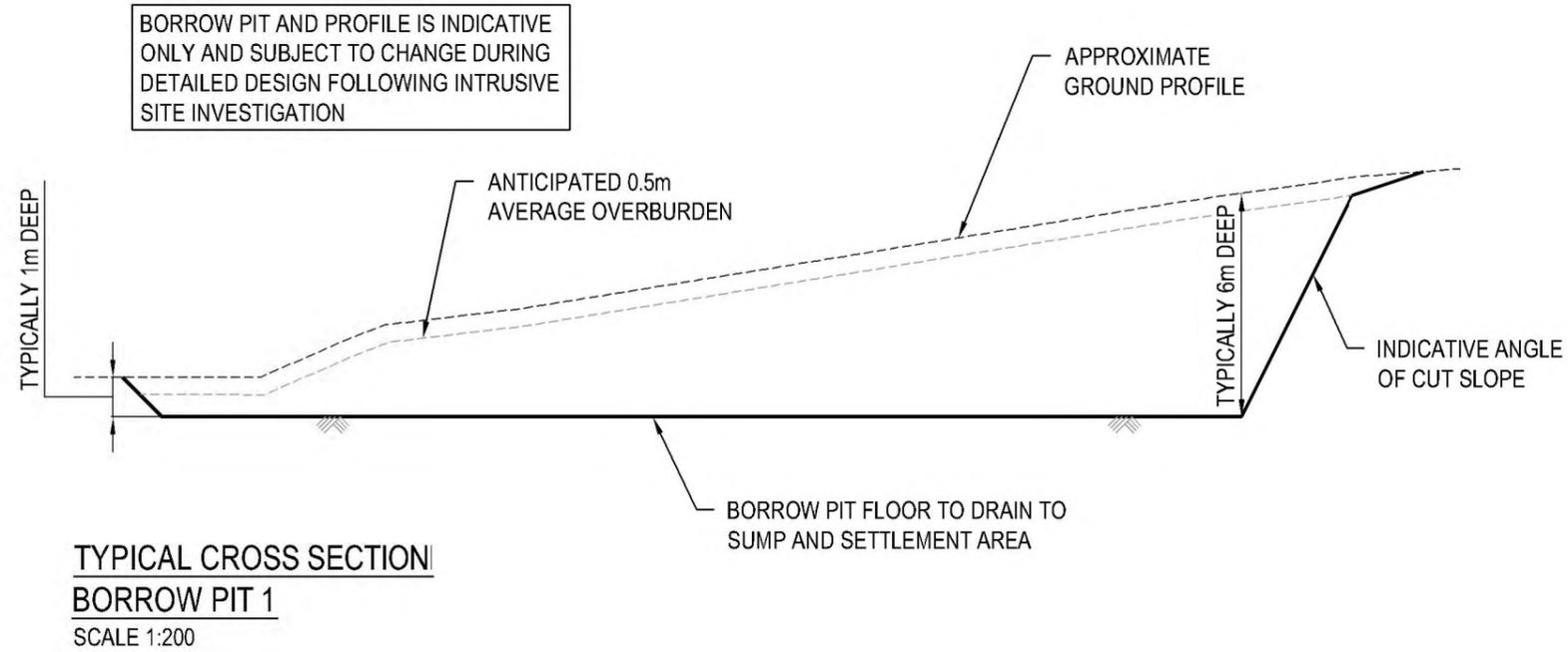


Picture 5: Borrow Pit B5 Exposure

Appendices

Appendix C – Prospective Borrow Pit Details

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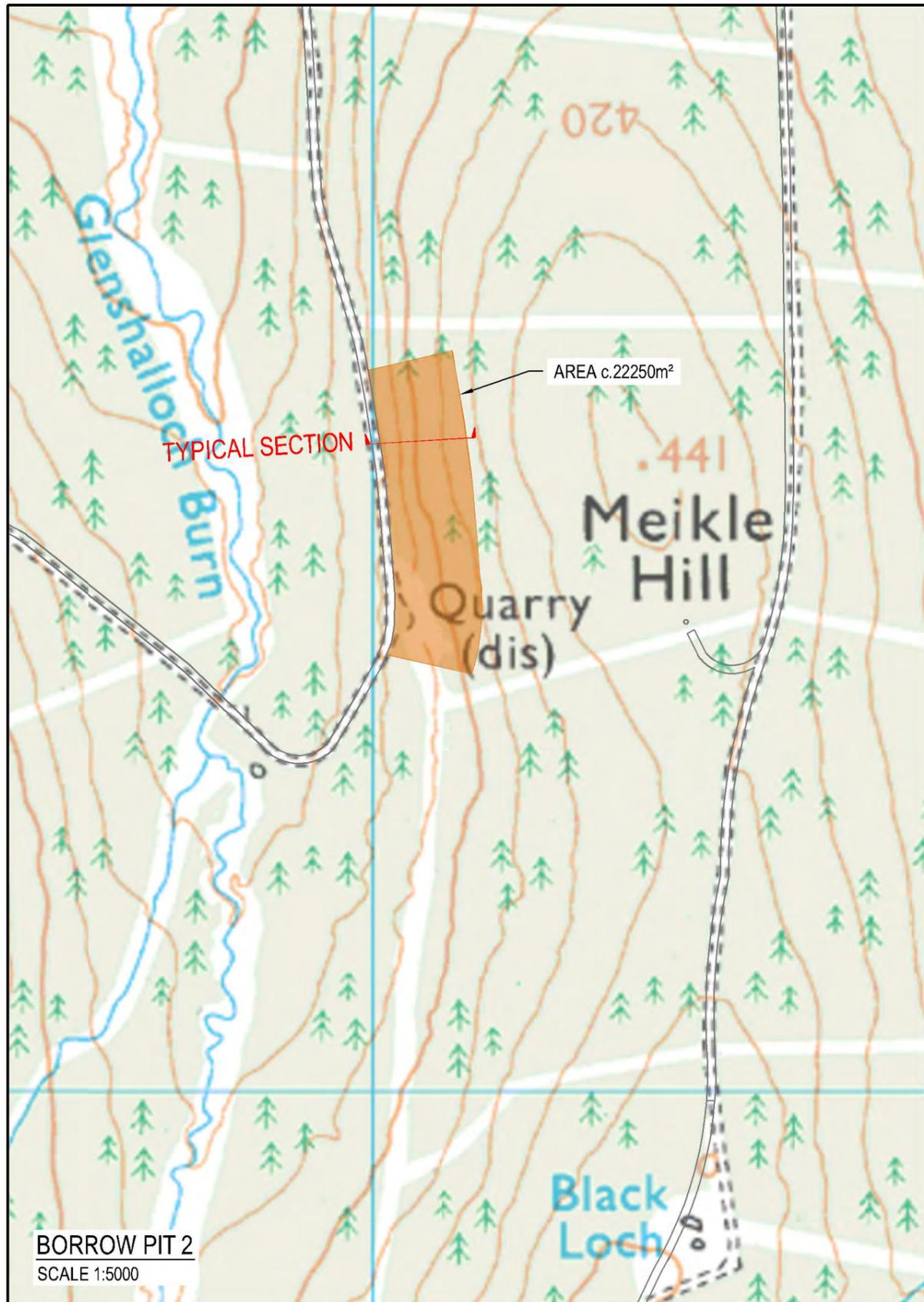
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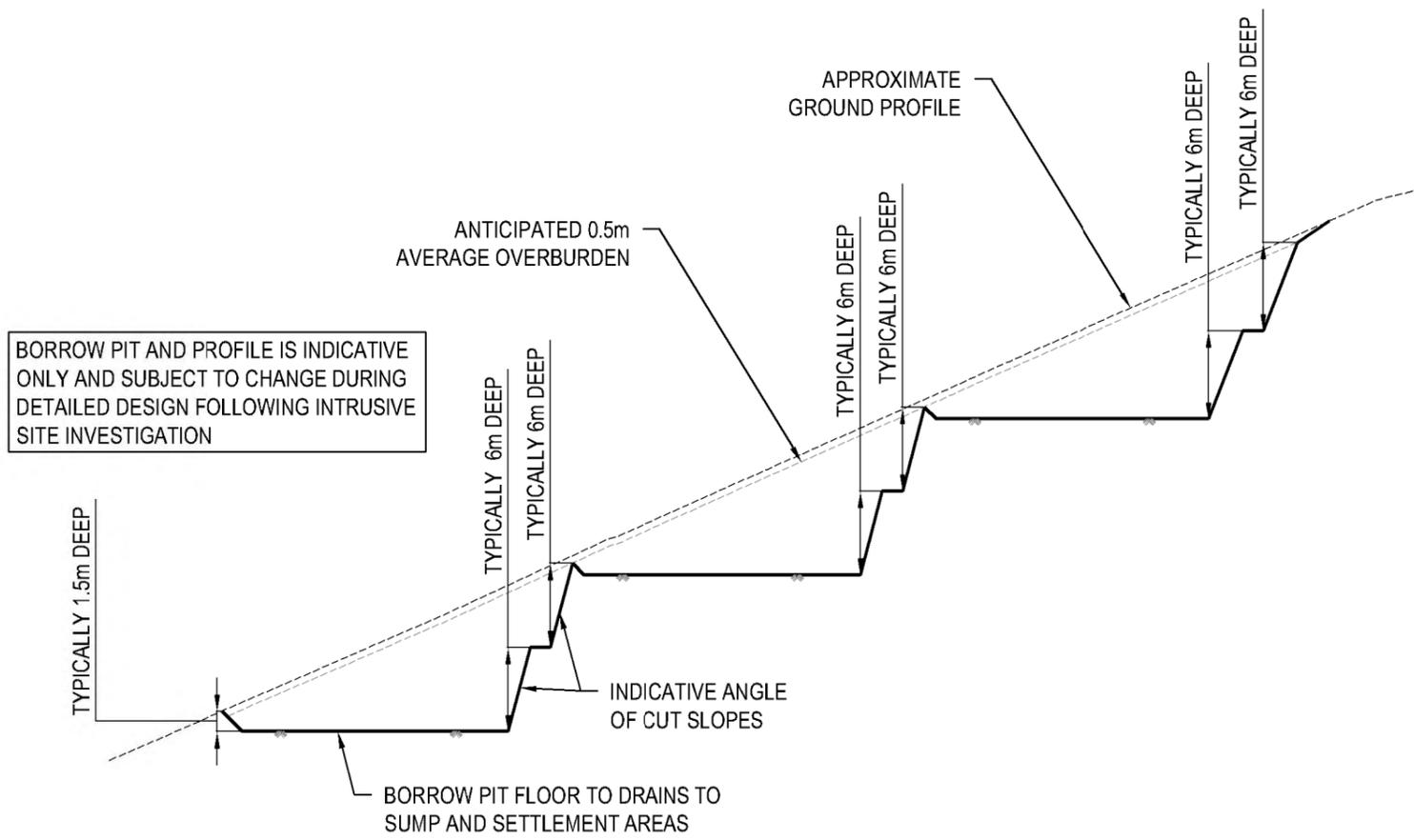
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BORROW PIT 2
SCALE 1:5000



TYPICAL CROSS SECTION
BORROW PIT 2
SCALE 1:500

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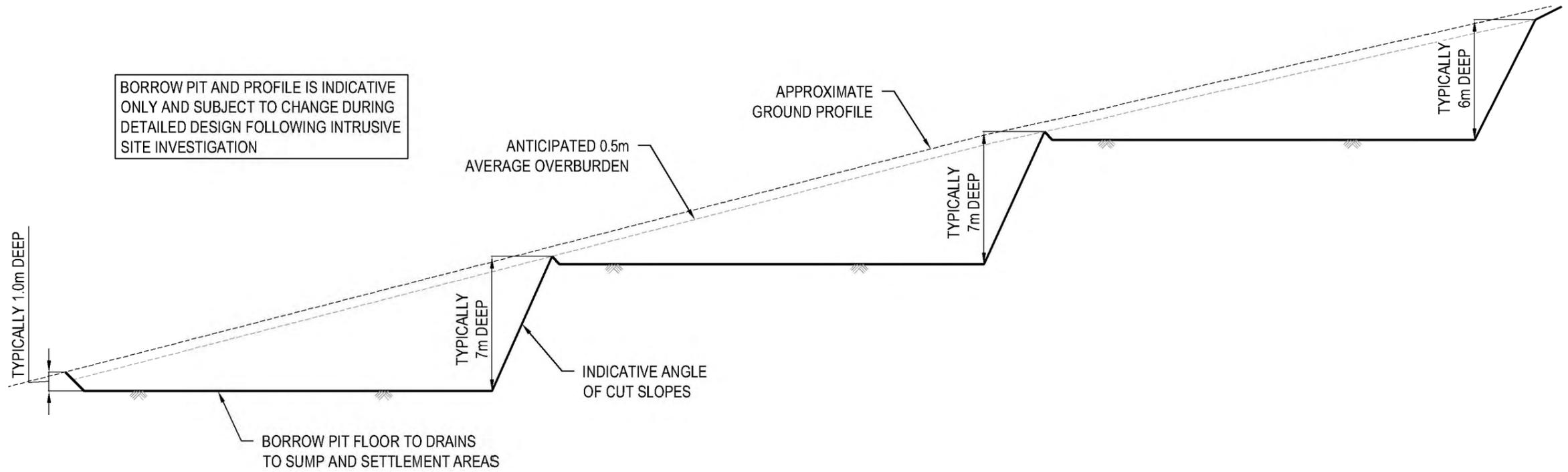
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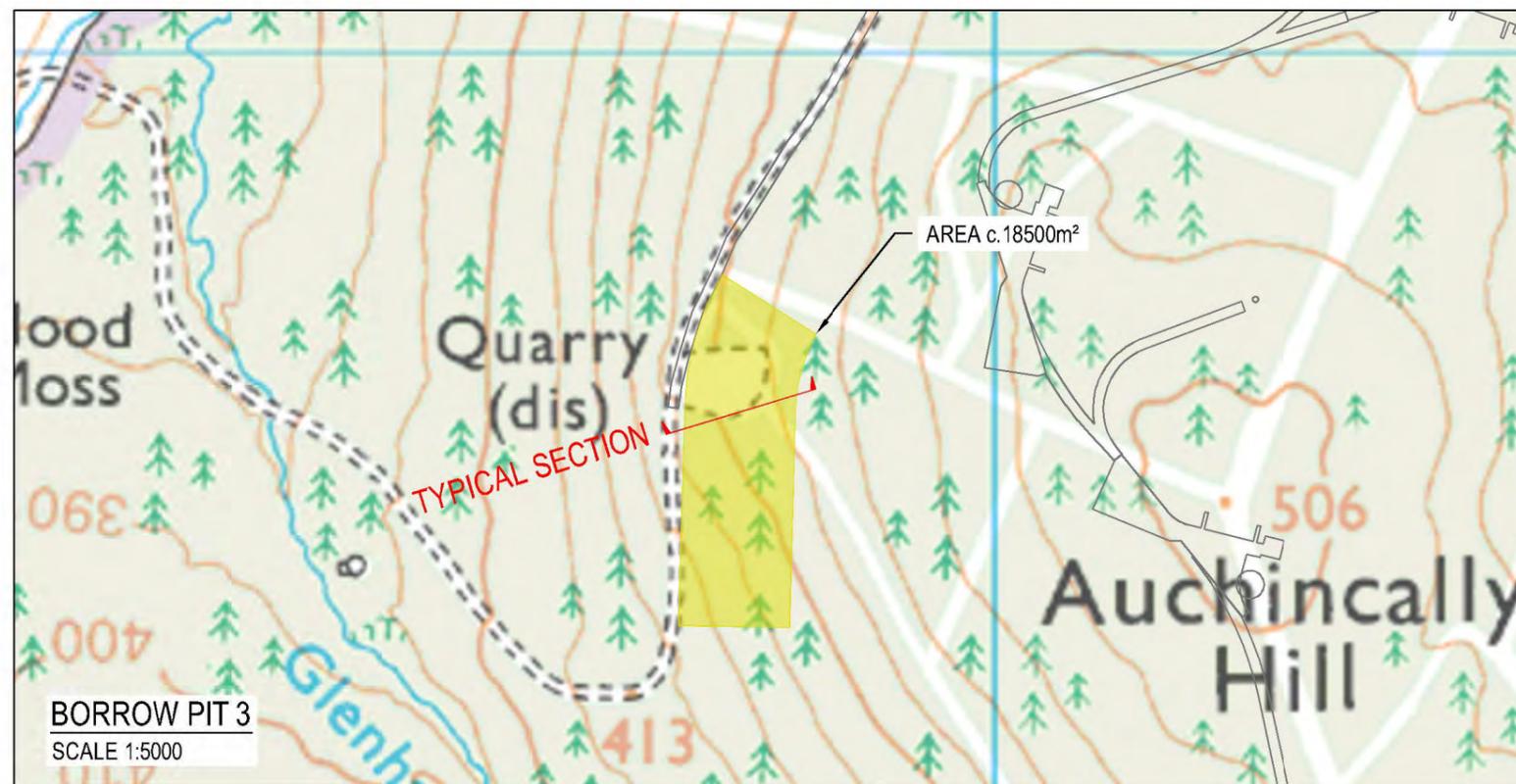
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**TYPICAL CROSS SECTION
BORROW PIT 3**
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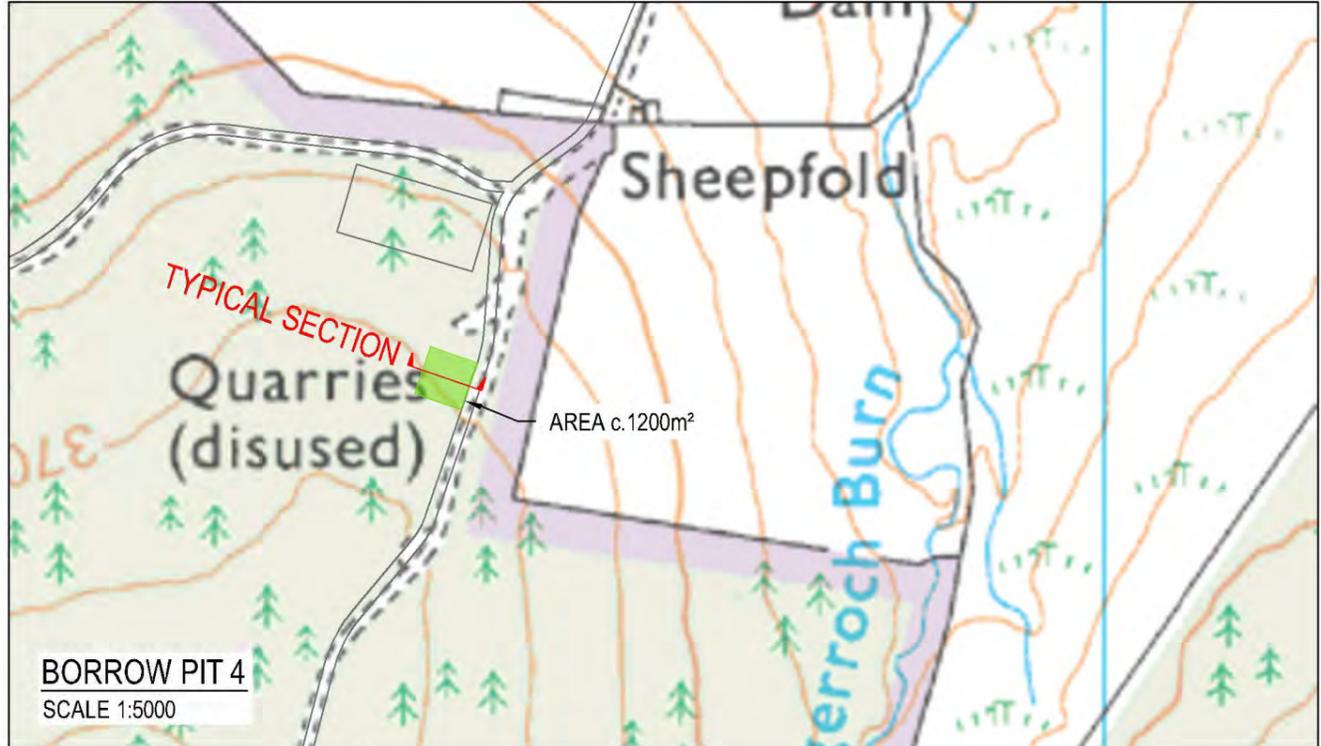
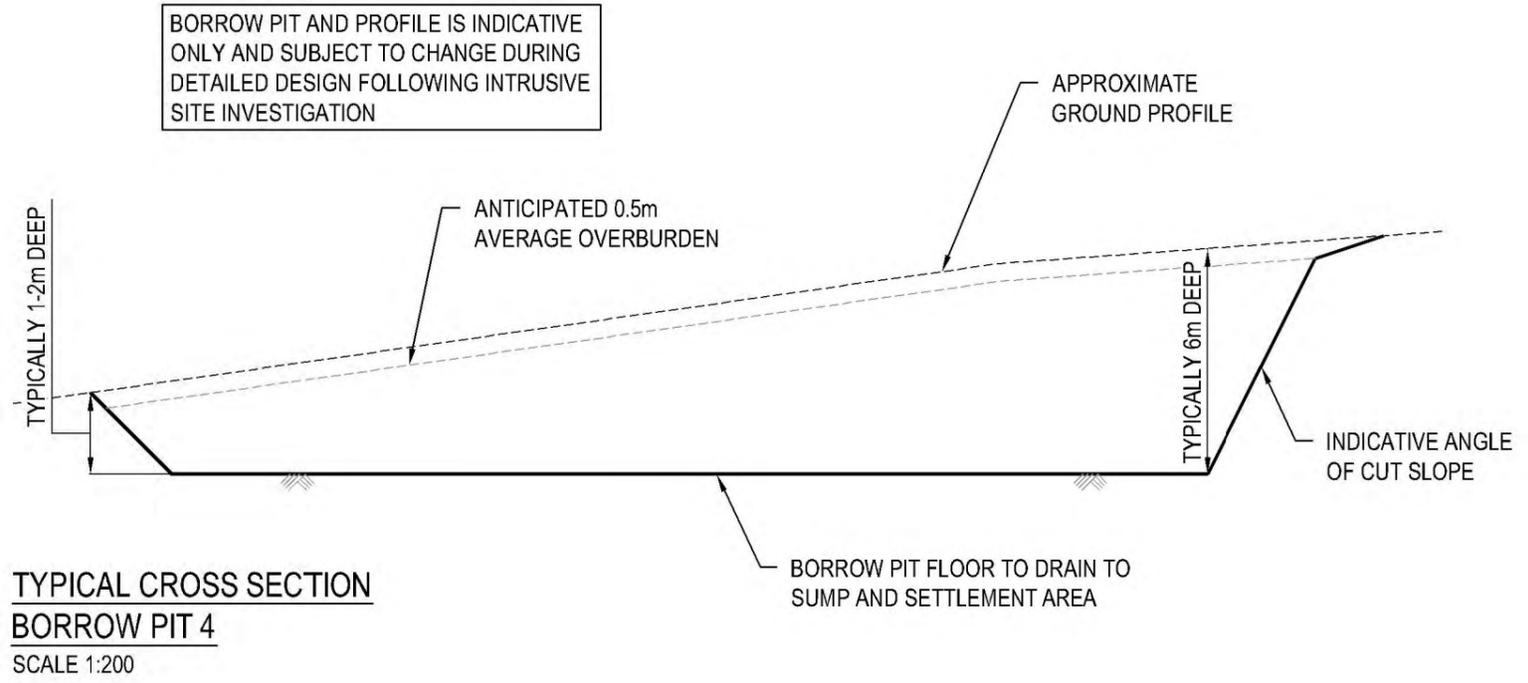
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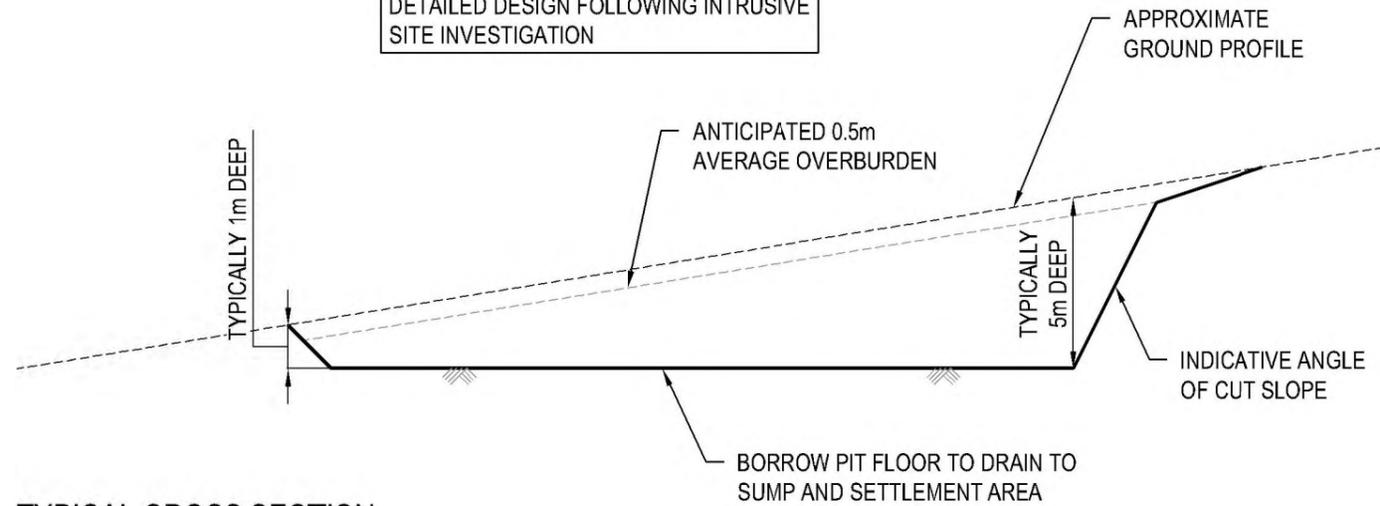


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BORROW PIT AND PROFILE IS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN FOLLOWING INTRUSIVE SITE INVESTIGATION



**TYPICAL CROSS SECTION
BORROW PIT 5**
SCALE 1:200



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Appendices

Appendix D - Geotechnical Testing

Requirements

113230/SMcL/141110 Rev C