SECTION 5 : SOILS AND GEOLOGY

5.1 INTRODUCTION

5.1.1 Purpose of Study

This study presents available information on the soils and geology within and immediately beyond the site of the proposed restoration works at Blackhall, Punchestown, Co. Kildare, together with an interpretation of the existing local geological environment. It will identify how this environment will be impacted by the proposed restoration works and, where possible, will identify how these impacts may be mitigated.

5.1.2 Difficulties Encountered in Compilation

This impact assessment is based on a visual inspection of the site, published geological maps and available ground investigation data. No difficulties were encountered in the compilation of this section of the Environmental Impact Statement.

5.1.3 Personnel

This study of soils and geology was undertaken and prepared by:

Peter Glanville, B.A., Ph.D., Geomorphologist, John Barnett and Associates Ltd
Mike Kelley, B.Sc., M.Sc., M.I.E.I., Geotechnical Engineer, John Barnett and Associates Ltd

5.1.4 Consultations

In undertaking this study, documentation and information was obtained from the following bodies:

- Quarternary Section, Geological Survey of Ireland, Haddington Road, Dublin 4
- Bedrock Geology Section, Geological Survey of Ireland, Haddington Road, Dublin 4
- Groundwater Section, Geological Survey of Ireland, Haddington Road, Dublin 4

5.2 RECEIVING ENVIRONMENT

5.2.1 Outline of the Baseline Study

This study was prepared using previously published regional geological and geomorphological data, together with site-specific ground investigation information in respect of the application site at Blackhall, Punchestown, Naas, Co. Kildare. Existing exposures of in-situ soil deposits were also visually inspected to assist in the interpretation of ground conditions occurring across and beyond the application site.

5.2.2 Quaternary Geological and Geomorphological Setting

Quaternary geology comprises the study of soils deposited or formed during the last 2 million years. Such soils are termed quaternary soils. The two main types of quaternary soil in Ireland are glacial till, deposited at the base or margins of ice sheets, and sand and gravel soils, whose deposition is generally associated with the melting of ice sheets, at the end of periods of glaciation. Other extensive quaternary soils in Ireland include basin and blanket peat, river alluvium and estuarine deposits.

Sand and gravel deposits are broadly categorised as glacio-fluvial outwash deposits, and can consist of esker, outwash and deltaic soils deposited beneath, or at the edge of, the melting ice sheets. The majority of quaternary soils in Ireland were formed or deposited during, or at the end of, the last glaciation, termed the 'Midlandian Glaciation'. In Ireland, the peak (maximum) extent of this glaciation occurred approximately 24,000 to 20,000 years ago. However, by around approximately 11,000 years ago, the associated ice sheets had largely retreated and melted from the island of Ireland.

During the maximum of the last glaciation, the Midlandian ice sheet covered most of central Ireland. The ice sheet spread out from central Ireland and pushed in a south-easterly direction to the edge of the Wicklow Mountains, terminating and forming an end-moraine approximately 1km to 2km north-west of Blessington. The sands and gravels which occur in the vicinity of the application site at Blackhall are interpreted to be glacio-fluvial outwash deposits which were transported in glacial meltwaters and laid down at the front of the ice sheet as it retreated at the end of the last ice age.

5.2.3 Regional Quaternary Geology

The 1855 1:63,360 scale (1'') Geological Map of the Blessington area (Sheet 120) published by the Geological Survey of Ireland (GSI) indicates that the quaternary soils in the vicinity of the application site comprises '*drift deposits, chiefly limestone gravel*'.

More recently, published geological data from the GSI indicates that the quaternary soils at the Blackhall site includes *limestone sands and gravels* and *tills with clasts (stones) of sandstone and chert.* Other soils in the immediate vicinity of the site include glacial till with Carboniferous Limestone clasts (to the west) or Lower Palaeozoic clasts (to the east).

Isolated areas of *lacustrine sediments* were identified within approximately 1km, to the south and west of the site. Near-surface bedrock is indicated to exist approximately 2km east of the site, associated with Glen Ding ridge. A map of quaternary soil deposits is reproduced as Figure 5.1.

5.2.4 Regional Solid Geology

The 1:100,000 scale solid geology map (*Geology of Kildare – Wicklow (Sheet 16))* published by the Geological Survey of Ireland indicates that the regional bedrock geology at the site comprises fine-grained greywackes, siltstones and shales of the Carrighill Formation. This forms part of the Kilcullen Group which is believed to be entirely of Silurian age (443 to 417 million years old). Rock strata within this formation are indicated to dip towards the north-west. An extract from the above map is reproduced as Figure 5.2.

5.2.5 Available Ground Investigation Information

A ground investigation was completed in November 2007 to investigate the nature of the inert fill materials and the surrounding ground and groundwater conditions at the Blackhall site. The details of the site investigation are reported in the Ground Investigation Report prepared by JBA (Report No. 3746)

Eighteen trial pits were completed at the Blackhall site under the supervision of an engineering geologist. Twelve trial pits were completed within the active restoration area in the south-east portion of the site and the remaining six trial pits were completed in the partially restored areas along the northern and western portions of the site. The trial pits were completed to depths of between 2.0m and 4.6m below the existing ground level and soil samples were collected for laboratory testing or analysis. Details of this ground investigation are provided in Appendix 5.1. Locations of trial pits excavated as part of the ground investigation are shown on Figure 5.3.

5.2.6 Geotechnical Interpretation: Ground Conditions

Based on the available ground investigation information, the general subsoil profile across the application site at Blackhall is inferred to comprise varying depths of inert fill materials overlying in-situ sand and gravel deposits at or below the water table. Key findings of the ground investigation are summarised below:

Former / Active Restoration Area (TP1 to TP12)

- The inert fill used in the restoration of the former quarry to date (in south-eastern corner) predominantly comprises a matrix of grey */ brown sandy gravelly CLAY with occasional fragments of brick and concrete* to depths of up to 4.60m;
- Rare inclusions of steel, wood, plastic and electrical cable fragments were noted through the area;
- Fragments of concrete and reinforcement were noted in Trial Pits TP4 and TP9;
- Natural ground comprising *brown medium to coarse SAND* was identified below the inert fill at a depth of 3.4m in trial Pit TP1, located at the south-eastern corner of the restoration area;
- Natural Ground comprising *brown sandy GRAVEL* was identified below the inert fill at a depth of 1.8m in Trial Pit TP12, in an area of sloping ground along the south-eastern site boundary (adjacent to a local road leading to Eadestown).

- Groundwater was occasionally identified as seepages at depths of between 0.8m and 1.5m.
- Test results found localised exceedences of inert waste threshholds for leachate concentrations of sulphates (TP6 and TP9) and antimony (TP5) set by Council Decision 2003/33. None of other samples tested exceeded any threshold limits for inert waste.

Future Restoration Area (TP13 to TP18)

- The fill predominantly comprises a matrix of *brown sandy gravelly CLAY with occasional cobbles boulders and gravel lenses* to depths of up to 4.4m;
- No inclusions of concrete, steel, wood, plastic or electrical cable were identified;
- Natural sands and gravels were not identified below the fill;
- Groundwater was identified as seepages at depths of between 0.3m and 0.6m in trial pit TP16, and identified as a water table at a depth of 2.0m in trial pit TP14.

5.2.7 Geohazards

The Blackhall site is underlain by Silurian age greywackes, siltstones and shales. There are no Carboniferous age limestones or other solution prone bedrock within the study area and therefore no karst solution features occur within the area.

Based on the relatively flat to slightly undulating topography and surrounding quaternary geology predominantly comprising glacial tills, the site is unlikely to be susceptible to natural geological hazards such as landslides. There are no raised bogs in the vicinity of the site and no historical landslides were identified in the East Kildare area in the survey undertaken by the Irish Landslides Working Group (GSI, July 2006).

The OPW flood database (www.floodmaps.ie) indicates two 'recurring' flood points' in the vicinity (within 1km to 2km) of the Blackhall site. The flood sites are located at the Punchestown Racecourse entrance and the Eadestown Cemetery, both of which correspond to low points along existing roads. Given the sloping nature of the ground immediate beyond of the site, the risk of flooding locally is considered low.

The exposed slopes along the former extraction areas within the application site, being relatively steep, are prone to erosion and localised slope instability. The lack of vegetation over these slopes may be any indication of ongoing erosion. Minor tension cracking, consistent with onset of slope instability, was observed along the perimeter of the site at the time of the ground investigation.

5.2.8 Geological Heritage

The Geological Survey of Ireland has confirmed that there are no proposed geological National Heritage (pNHA) sites in the vicinity of the application site. No sites of geological interest or importance are identified in the Kildare County Development Plan (2005 – 2011).

5.2.9 Economic Geology

The location of naturally occurring sand and gravel deposits between two local population centres at Naas, Co. Kildare and Blessington, Co. Wicklow, coupled with its proximity to a large population centre in the Greater Dublin Area, has meant that this area has historically supported businesses engaged in sand and gravel extraction activity. Extracted sand and gravel is generally processed and supplied to the construction industry as drainage stone or mortar sand or alternatively, is used to produce construction materials such as blocks, paving blocks or ready-mix concrete.

Sand and gravel extraction activity ceased at the Blackhall site in the late 1990's when extraction of the remaining resource below the water table became economically unviable and environmentally unsustainable. Although extraction activity has ceased at the application site, it continues at two relatively large scale operations in the immediate vicinity, the Cemex (Ireland) site in Walshestown and the CPI site at Newtown Great. There are also several smaller scale operations within 5km to 10km radius of the application site.

5.2.10 Agricultural Soils

Topsoil (the upper layer of soil capable of sustaining vegetation and crop growth) was previously stripped from the application site in order to facilitate the development of the former quarry. The agricultural soils surrounding the site are classified as Grey Brown Podzolics of the Elton Series. These soils are described as having a wide use range of agricultural uses, including tillage, pasture, meadow and forestry (An ForasTaluntais, 1970).

In recent years, the south-eastern corner of the application site has recently been completely restored to agricultural use, principally as agricultural grassland. While the lands on the western side of the application site have been partially restored using clayey mineral soils, they are generally soft and poorly drained during winter months and are of low agricultural value.

5.2.11 Made Ground

Restoration and backfilling activities undertaken at the application site since the cessation of extractive activity have been completed in compliance with waste permits issued by Kildare County Council.

Recent ground investigations did not identify any significant contamination issues associated with the imported soil, stones and inert construction materials imported to the site to date for restoration purposes. The available groundwater quality data indicates that there is no difference in groundwater quality up hydraulic-gradient and down hydraulic-gradient of the application site, which corroborates the findings of the ground investigation.

5.3 IMPACT OF RESTORATION SCHEME

5.3.1 Evaluation of Impacts

The evaluation of impacts on the soil and geology at and in the vicinity of the inert waste recovery site at Blackhall, Co. Kildare is generally based on a methodology similar to that outlined in the draft 'Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes' (2008).

The importance of existing soil and geology attributes discussed previously is assessed in Table 5.1 below :

Attribute	Status / Occurrence	Importance
Geohazards	Ongoing erosion of exposed soils on slopes. Evidence of onset of instability at crest of existing slopes	Low
Geological Heritage	None near site	Low
Economic Geology	Economic extraction complete at application site. Ongoing extraction at other sites in immediate vicinity.	Medium
Agricultural Soils	Productive soils previously removed at application site. Other soils in vicinity of site used for wide range of agricultural activities.	Medium
Made Ground	Imported soils generally of low economic value. No evidence of soil contamination at application site.	Low

Table 5.1 Importance of Geological Attributes in vicinity of Application Site

The significance of the impacts on the soil and geology attributes is assessed in Table 5.2 overleaf:

Attribute	Impact of Proposal on Attribute	Magnitude
Geohazards	Elimination of localised erosion over slope faces. Elimination of risk of slope instability.	Small
Geological Heritage	None	Neglible
Economic Geology	Extraction of remaining mineral resource at site is uneconomical and unsustainable. No impact on extraction activities at sites in immediate vicinity	Neglible
Agricultural Soils	Restoration of former landform and placement of topsoil/subsoil on completion of backfilling will restore lands to agricultural use.	Small
Made Ground	Importation of soil, stones and inert construction and demolition waste introduces a risk of potential soil contamination	Small

Table 5.2 Significance of Impacts on Soil and Geology

The backfilling and restoration of the application site to former ground level will eliminate ongoing erosion and the risk of potential slope instability at the northern end of the application site. As it constitutes a small improvement on a geological feature of low importance, this impact is judged to be a minor positive impact.

The proposed restoration scheme will also provide for the re-establishment of agricultural soils across the application site and its return to agricultural use. As it constitutes a small improvement on a soil feature of moderate importance, this impact is also judged to be a minor positive impact.

The importation of soil, stones and inert construction and demolition waste introduces a risk of potential soil contamination at the application site. Based on the findings of the recent ground investigation which indicated no soil contamination, and assuming continued good management of the existing facility, this risk is likely to be small. As the potential risk of introducing contamination to soils of low importance is small, this impact is considered to have a minor negative impact.

5.3.2 Interaction with Other Environmental Receptors

The potential risk of introducing contaminated soil in backfilling and restoring the application site could have implications for groundwater quality were infiltrating rainfall to percolate down through the contaminated backfill materials. This aspect is discussed in more detail in Section 6 of the EIS.

When successfully completed however, the proposed site restoration works will provide an increased thickness of soil cover above the existing groundwater table, thereby reducing the potential risks of future groundwater contamination.

During the site restoration works, the presence of exposed, unvegetated soil surfaces could give rise to dust blows during dry windy weather, most likely during summer months. These issues are discussed in more detail in Section 7 of the EIS (Air Quality).

5.3.3 Do-nothing Scenario

If the application site is not restored completely to former ground level as proposed, and it remains essentially unchanged from its existing layout, it will have the following implications for soil and geology :

(i) the limited soil cover overlying the sand and gravel aquifer will result in a potential risk to groundwater quality;
(ii) there is the potential for continued degradation of existing slopes, leading to possible slope failures;
(iii) the site may be a target for unauthorised disposal / fly-tipping of waste by unscrupulous operators.

5.4 MITIGATION MEASURES

In order to minimise the risk of importing and introducing contaminated soil to the site, management systems will be introduced at the application site to establish the source of imported materials in advance and to confirm that they are inert. Multiple level soil testing regimes will be established at the site and will include

(i) basic characterisation testing covering a wide range of parameters to determine the leaching behaviour of soils imported to site
(ii) more frequent, compliance testing covering a limited range of key soil parameters and
(iii) comprehensive on-site verification, comprising visual inspection and record of all imported soil unloading at the site

During backfilling, all temporary surfaces should be graded to facilitate overground run-off of surface water, thereby minimising the volume of rainfall percolating through the backfilled soil. This will further reduce any residual risks of potential contaminants leaching into the soil and groundwater. In order to confirm that there are no residual risks to soil or groundwater, monitoring of groundwater should continue for the duration of the restoration works and for a short aftercare period.

In order to reduce the risk of localised erosion and potential dust emissions at soil slopes during the restoration works, the area of bare or exposed soils should, insofar as practicable, be kept to a minimum. Consideration could be given to establishing temporary vegetation cover over such slope pending final backfilling and restoration to original ground level.

In order to maximise the future agricultural potential of the restored land, a minimum 150mm thick layer of topsoil and 850mm thick layer of subsoil should be placed over the backfilled clayey mineral soils. The final landform should also be graded so as to facilitate overground run-off of surface water and avoid ponding of surface water in closed depressions.

REFERENCES

Teagasc (2004) 'Subsoil Map of Ireland'

GSI (2004) **'**Geology of Kildare-Wicklow – Sheet 16'

Kildare County Development Plan (2005 – 2011)

GSI Irish Landslides Working Group (2006) 'Landslides in Ireland'

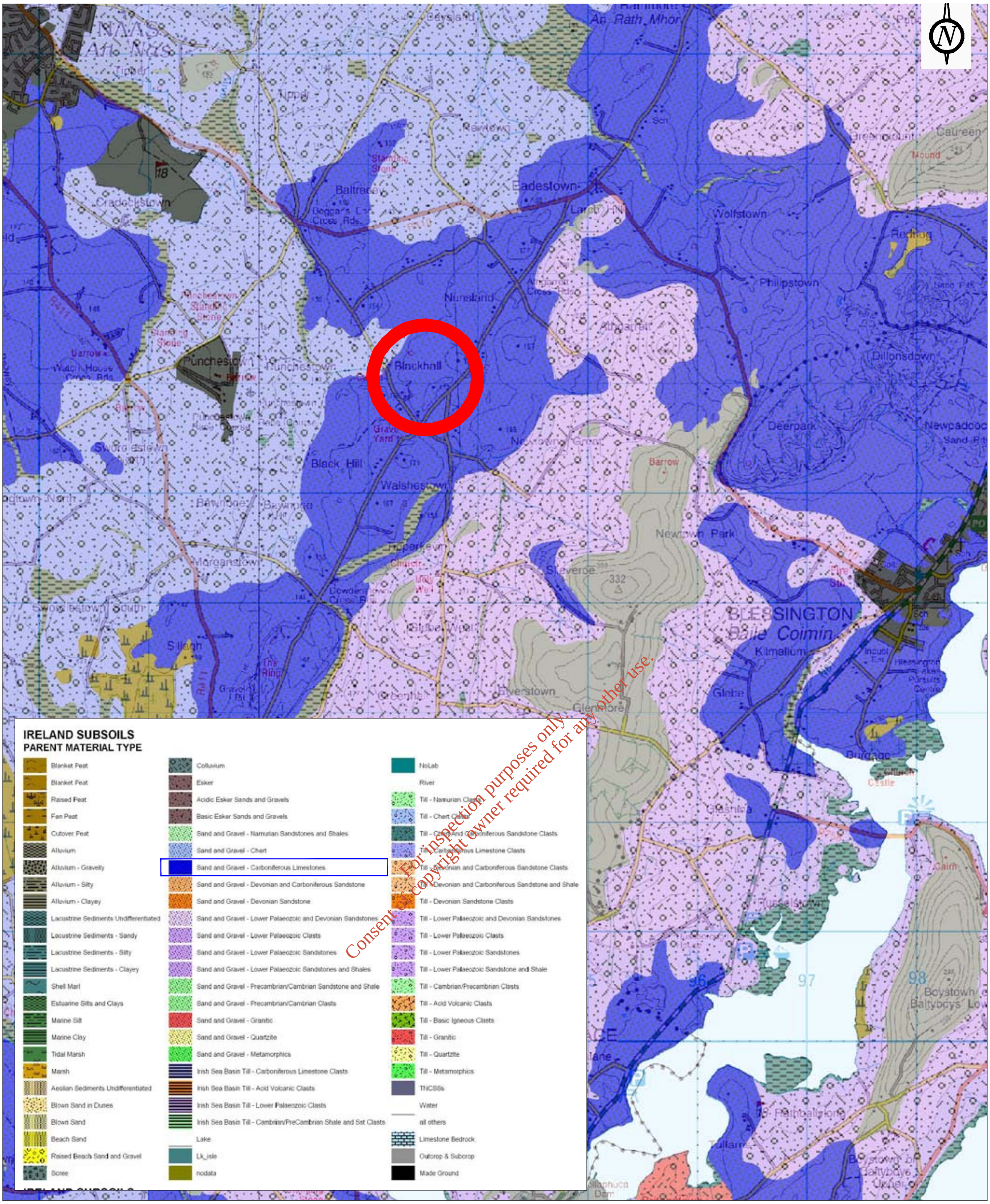
Office of Public Works – www.floodmaps.ie

An Foras Taluntais (1970) – National Soil Survey of Ireland, Soils of Co. Kildare

APPENDICES

Appendix 5A Ground Investigation Report (December 2007)

FIGURES



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Location of Site

Extract from 1:50,000 O.S. Discovery Series Map No. 56

1:50,000

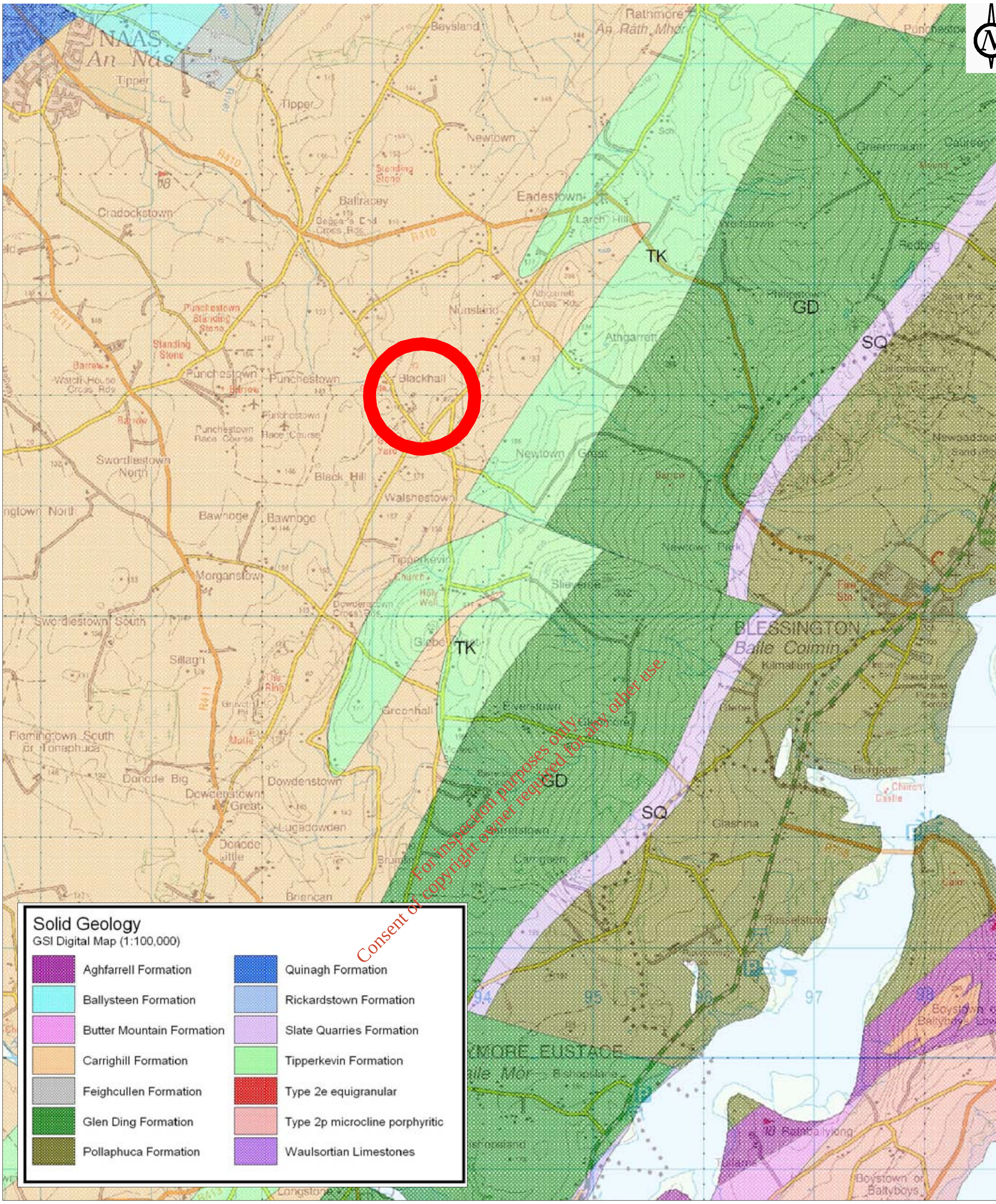
0m 1000m 3000m

JBA

JOHN BARNETT & ASSOCIATES
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14

Site:	Blackhall, Punchestown, Naas, Co. Kildare
Title:	**Subsoils Map**
Drawn: TP/PM	**Scale:** 1: 50,000
Job. No: 3746	**Date:** March 2008

Figure 5.1



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Location of Site

Extract from 1:50,000 O.S. Discovery Series Map No. 56

1:50,000

0m 1000m 3000m

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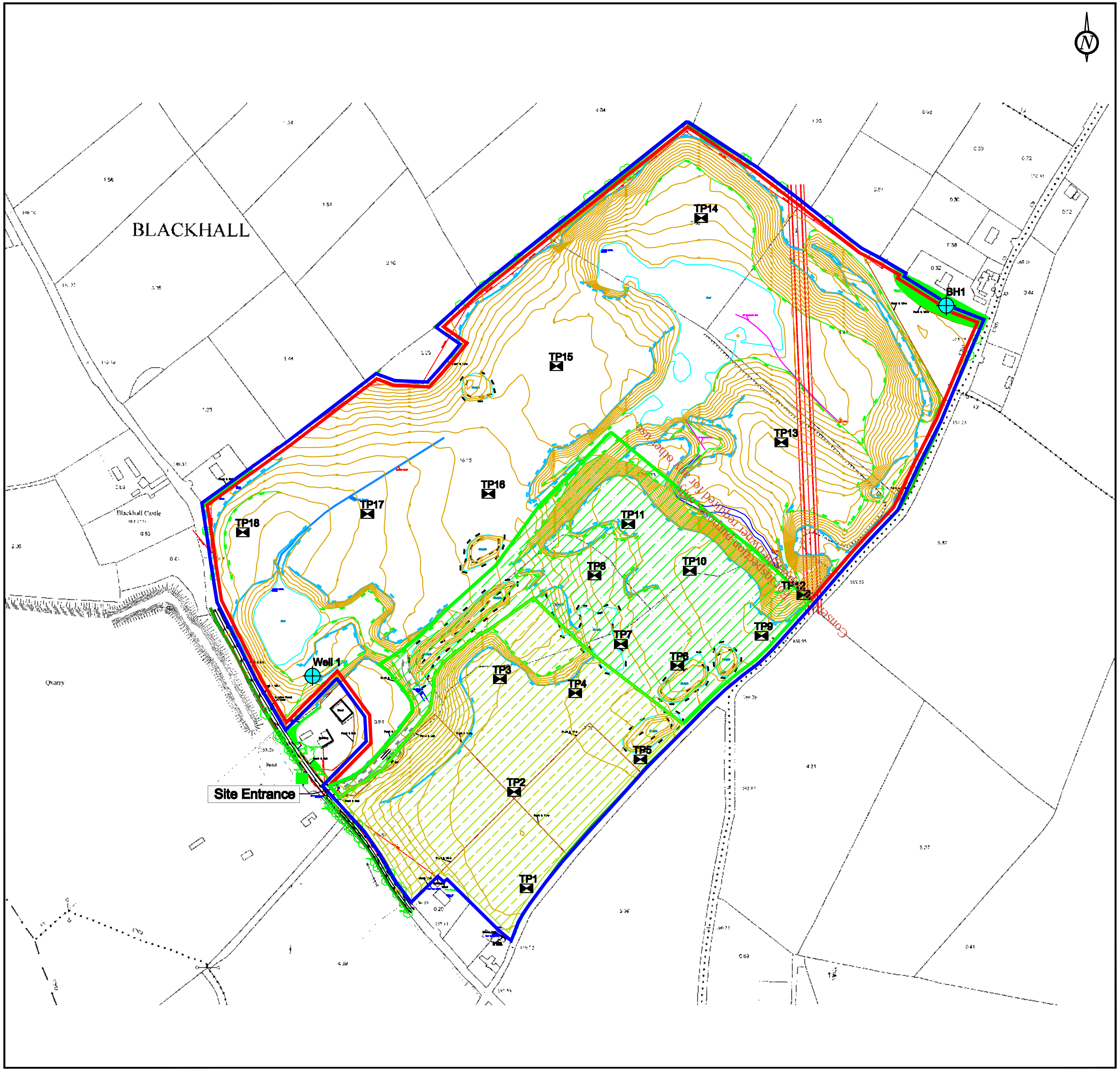
DUBLIN 14

Site: Blackhall, Punchestown, Naas, Co. Kildare		
Title: Bedrock Geology		
Drawn: TP/PM	**Scale: 1: 50,000**	**Figure 5.2**
Job. No: 3746	**Date: March 2008**	



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Land Interest (c. 35.6ha)

TP No.	Easting	Northing	Height
TP1	293521.3	215719.1	163.1
TP2	293508.4	215819.2	163.5
TP3	293493.7	215935.9	163.0
TP4	293571.8	215921.4	164.1
TP5	293639.3	215852.7	164.3
TP6	293677.6	215949.9	166.8
TP7	293619.2	215972.3	164.5
TP8	293591.7	216043.4	164.3
TP9	293764.9	215980.7	168.9
TP10	293690.5	216048.3	168.3
TP11	293626.8	216096.5	167.4
TP12	293808.2	216023.1	163.0
TP13	293785.4	216181.3	159.5
TP14	293702.3	216413.8	151.2
TP15	293552.2	216260.3	156.3
TP16	293481.8	216128.0	154.7
TP17	293356.2	216107.1	151.2
TP18	293227.7	216088.1	149.7

BH No.	Easting	Northing	Height
BH1	293956.3	216323.0	164.0
Well 1	293299.5	215939.2	147.5

Topographic Survey Update: August 2007

Scale 1:4,000

0m 75m 300m

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DUBLIN 14

Site: Blackhall, Punchestown, Naas, Co. Kildare

Title: Trial Pit Locations

Drawn: TP/PMC	Scale: 1: 4,000	**Figure 5**
Job. No: 3746	Date: March 2008	

APPENDIX 5.1

GROUND INVESTIGATION REPORT

John Behan

Inert Waste Facility

Waste Licence Application: Supporting Information

GROUND INVESTIGATION REPORT

December 2007

DRAFT

John Barnett and Associates
Unit 7 Dundrum Business Park
Windy Arbour
Dublin 14

CONTENTS

1. INTRODUCTION

John Behan at the request of the EPA is submitting a waste licence application for an inert waste facility at the existing facility at Blackhall, Punchestown, Naas, Co. Kildare. The site lies approximately 5km south east of Naas and 600m east of Punchestown racecourse. The total land holding is approximately 35 hectares and was previously worked as a sand and gravel pit by Readymix (ROI) Ltd.

A waste permit was obtained from Kildare Co. Council to facilitate restoration of part of the worked out lands in September 2001 and provided for the recovery of waste (other than hazardous waste) at Blackhall quarry. A further permit was obtained in 2004 to continue these operations. Following a further waste permit application in May 2007, Kildare Co. Council consulted with the Environmental Protection Agency (EPA). The EPA having considered the existing operation, have requested Mr. Behan to submit a waste licence application. Kildare Co. Co. is in the process of granting a temporary waste permit for a period of 6 to 8 months to enable a waste licence application to be prepared and submitted to the EPA.

The existing operation comprises restoration of a worked out sand and gravel pit using inert soil, stone and concrete / brick. Some of the concrete imported to the site for recovery is stockpiled temporarily prior to crushing and screening. Any small amounts of steel reinforcement, timber or paper arising from the recovery operations are stored temporarily in designated areas, prior to dispatch to Silliot Hill recycling facility.

This ground investigation report presents information on the ground and groundwater conditions across the site. Laboratory testing has been carried out on samples from across the site to confirm the nature of the material that has been imported as inert waste.

2 REGIONAL GEOLOGY AND HYDROGEOLOGY

2.1 Quarternary Geology

The drift geology map published in the Royal Irish Academy Atlas of Ireland and reproduced as Figure 2 indicates that the Blackhall area is underlain by sands, gravels and gravelly tills. The Subsoil Map of Ireland (Teagasc, 2004) indicates that the area is underlain by Sand and Gravel derived from Carboniferous Limesones.

2.2 Bedrock Geology

The GSI 1:100,000 geology map Sheet 16, reproduced in Figure 3, indicates that the Blackhall area lies within an area underlain by the Silurian Calcareous greywacke, siltstones and shales. The regional geological map indicates that there are no major faults or changes in lithology in the vicinity of the site. The regional geological map indicates a series of tectonic folds throughout this formation.

3 GROUND INVESTIGATION

3.1 Introduction

The ground investigation at the restored areas of the former quarry at Blackhall was undertaken on 12th/13th November 2007 and comprised the excavation of 18 No. trial pits. The objective of the trial pit excavations was

(i) to inspect the ground conditions, specifically the nature of the inert fill
(ii) to establish the depth to groundwater (where observed)
(iii) to obtain representative bulk samples for laboratory testing (environmental).

The depth of the excavated trial pits varied from 2.0 to 5.0 metres. All pits were excavated using a mechanical excavator. Trial pit excavation was typically terminated where the excavator arm was at maximum reach.

Six of the trial pits were located outside the existing operation area to obtain a profile of the previously worked and restored area.

Trial pit logs are presented in Appendix A of this report. Photographs of the excavated materials and trial pit sidewalls are also provided in Appendix B

3.2 Topsoil

For the purposes of this report topsoil is defined as the upper layer of soil that is capable of supporting vegetation. Topsoil was only encountered in trial pits TP15, TP16, TP17 and TP18 and extended to a depth of 0.3m. The topsoil is generally described as *firm slightly plastic dark brown gravelly CLAY*.

3.3 Made Ground

Trial pits TP1 through to TP12 which were located within the area under restoration all encountered made ground from ground level with only TP1 and TP12 reaching natural ground at 3.4m and 1.8m depth respectively.

The Made Ground is generally described as *brown / grey sandy gravelly clay intermixed with occasional fragments of brick and concrete*. Very occasional steel, timber, electrical cable and plastic inclusions were recorded in trial pits TP1 to TP12 to depths of at least 4.5m.

Trial Pit TP6 encountered a pocket of *black stained (odorous) sandy gravelly clay with timber, chipboard, concrete, brick and plastic inclusions* from 0.7 to 2.5m. This was not continuous across the trial pit and appeared confined to the northern section of the trial pit.

Trial pits TP4 and TP9 contained layers which were predominantly concrete and gravel fill, in TP4 this layer was from 0.3m to 2.6m and was described as *concrete and re-bar with a gravelly clay matrix with brick and occasional electrical cable* and TP9 encountered this from 0.7m to 1.5m and described as *concrete and gravel fill, with concrete blocks up to 1.0m in diameter*.

3.4 Natural Ground

Natural ground was only encountered in trial pits TP1 and TP12 at depths of 3.4m and 1.8m respectively. This was described as *brown medium to coarse slightly gravelly SAND* in TP1 and *brown slightly sandy fine sub-rounded GRAVEL with occasional sub-rounded to sub-angular cobbles and boulders* in TP12.

3.5 Possible Made Ground

The trial pits outside the area under restoration generally encountered *brown sandy gravelly CLAY with occasional cobbles and boulders and gravel lenses.* This area had been previously worked and restored by Readymix (ROI) Ltd., no concrete or other visual evidence of made ground was identified in any of the trial pits excavated in this area.

3.6 Groundwater

Groundwater was encountered in four trial pits, TP5, TP8, TP14 and TP16 at depths of 0.8m, 1.5m, 2.0m and 0.3m respectively.

Trial pits TP4, TP6, and TP12 showed signs of instability in some sections of the uncompacted fill. Trial pits TP 13 and TP15 exhibited slight instability at 1.4m and 1.5m respectively, while TP14 showed continual collapsing from 2.0m which coincided with where groundwater was encountered.

4 LABORATORY TEST DATA

As part of the investigation, a number of samples of soil within the fill were taken from each trial pit and were tested to establish the concentration of a number of contaminants including metals, inorganic and organic matter.

Contaminant testing indicated that the concentration of sulphates exceeded the maximum limits for Inert Waste set by Council Decision 2003/33 from two samples. One sample from TP6 was taken at 1.8m and gave a sulphate value of 1532 mg/kg with the threshold limit being 1000 mg/kg. The other, from TP9 gave a value of 7005 mg/kg. These high sulphate values may be caused by the presence of gypsum (plasterboard) contained in the imported fill. Council Decision 2003/33 permits the Total Dissolved Solid content to be used as an alternative test to the Chloride and Sulphate tests. The available data shows that none of the samples taken including the samples from TP6 and TP9 exceed the 4000mg/kg limit for Total Dissolved Solids for inert waste. Tests for Chloride and Fluoride on these samples don't show any exceedances of permitted threshold values, with the recorded concentrations well below the permitted limits.

The sample taken from 1.7m in trial pit TP5 recorded an Antimony value of 0.10mg/kg this exceeds the acceptance criteria limit of 0.06mg/kg. Antimony is a naturally occurring element used in the metal industry, flame retardant materials, batteries and matches. It can also occur naturally from weathering of rocks. None of the other samples tested exceed any of the limits set out for metals.

None of the samples tested exceed the threshold limit of 100mg/kg for PAH's (polycyclic aromatic hydrocarbons) permitted by Council Decision 2003/33, The mineral oil content is also below the limit of 500mg/kg in each of the samples tested.

Laboratory test data is presented in Appendix B of this report.

REFERENCES

British Standards Institution (1999) 'BS 5930 – Code of Practice for Site Investigation'

Environment Agency (2005) 'Guidance on Sampling and Testing of Wastes to meet Landfill Waste Acceptance Procedures'

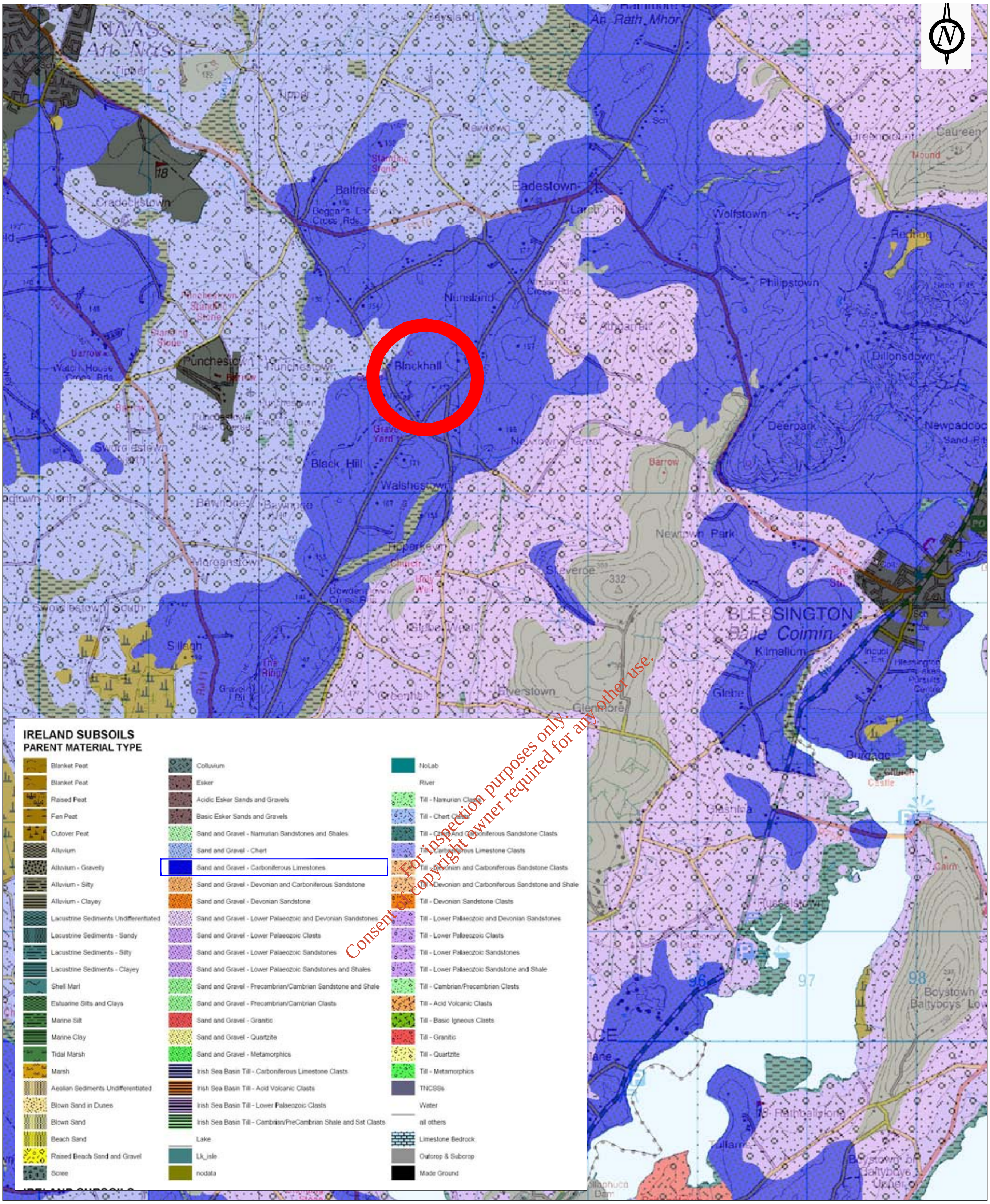
Geological Survey of Ireland (2004) 'Geology of Kildare-Wicklow – Sheet 16'

Official Journal of the European Communities (2002) 'Establishing Criteria and Procedures for the Acceptance of Waste at Landfills'

Royal Irish Academy (1979) 'Atlas of Ireland'

Teagasc (2004) 'Subsoil Map of Ireland'

FIGURES



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Location of Site

Extract from 1:50,000 O.S. Discovery Series Map No. 56

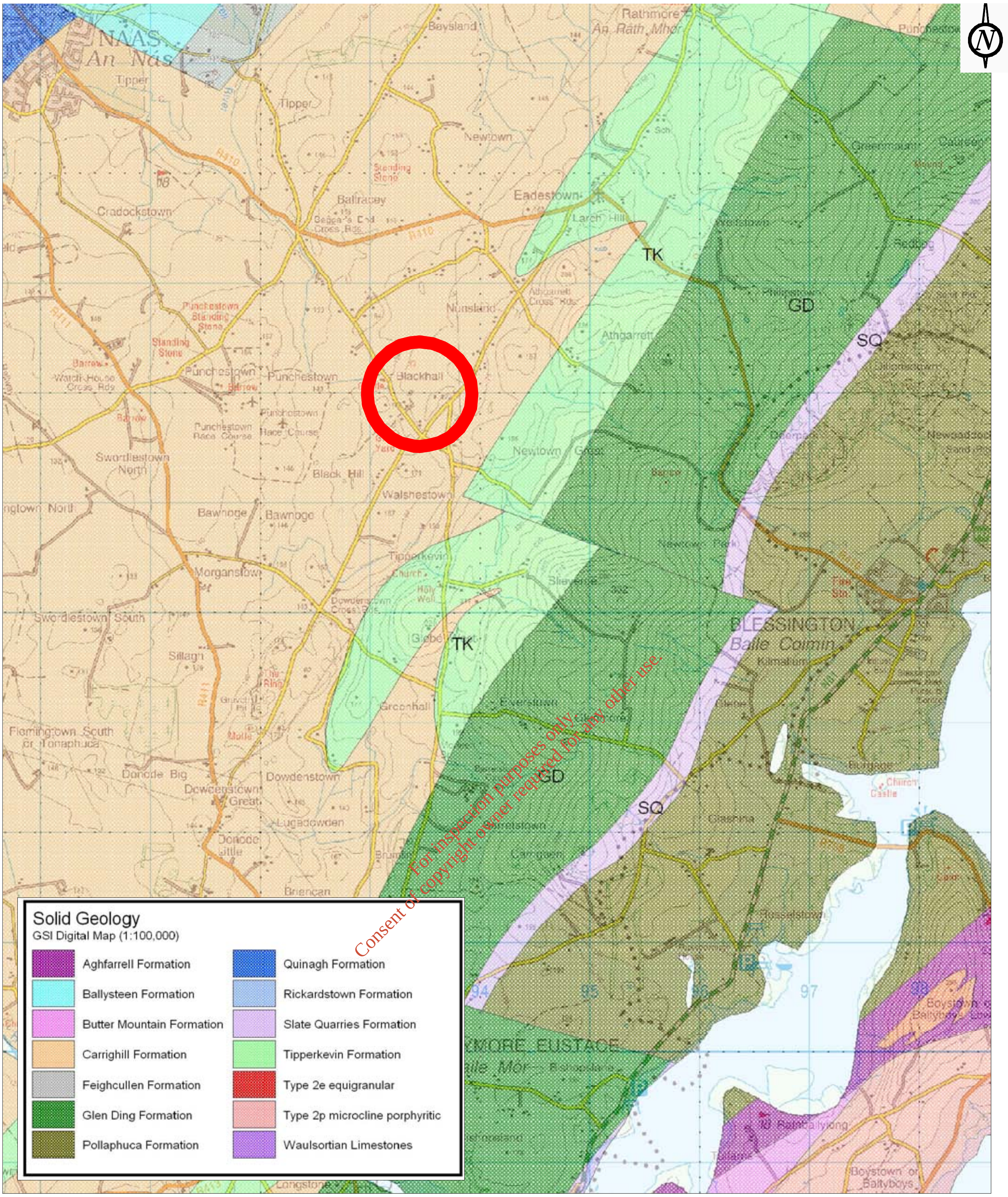
1:50,000

0m 1000m 3000m

JBA

JOHN BARNETT & ASSOCIATES
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14

Site: Blackhall, Punchestown, Naas, Co. Kildare		
Title: Subsoils Map		
Drawn: TP/PM	**Scale: 1: 50,000**	**Figure 5.1**
Job. No: 3746	**Date: March 2008**	



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Location of Site

Extract from 1:50,000 O.S. Discovery Series Map No. 56

1:50,000

0m 1000m 3000m

JBA

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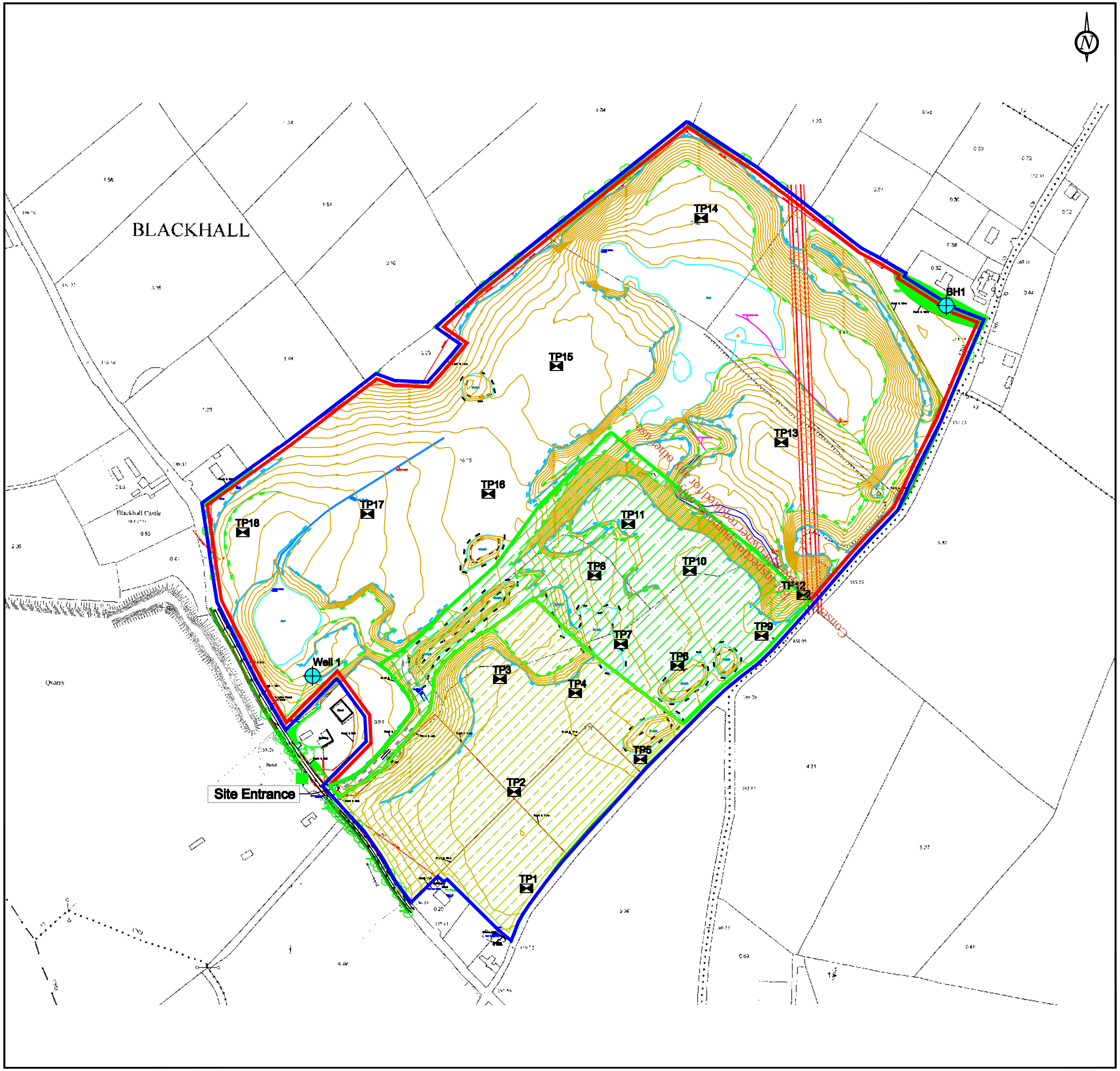
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14

Site:	Blackhall, Punchestown, Naas, Co. Kildare
Title:	**Bedrock Geology**
Drawn: TP/PM	**Scale:** 1: 50,000
Job. No: 3746	**Date:** March 2008

Figure 5.2



Legend

Land Interest (c. 35.6ha)

TP No.	Easting	Northing	Height
TP1	293521.3	215719.1	163.1
TP2	293508.4	215819.2	163.5
TP3	293493.7	215935.9	163.0
TP4	293571.8	215921.4	164.1
TP5	293639.3	215852.7	164.3
TP6	293677.6	215949.9	166.8
TP7	293619.2	215972.3	164.5
TP8	293591.7	216043.4	164.3
TP9	293764.9	215980.7	168.9
TP10	293690.5	216048.3	168.3
TP11	293626.8	216096.5	167.4
TP12	293808.2	216023.1	163.0
TP13	293785.4	216181.3	159.5
TP14	293702.3	216413.8	151.2
TP15	293552.2	216260.3	156.3
TP16	293481.8	216128.0	154.7
TP17	293356.2	216107.1	151.2
TP18	293227.7	216088.1	149.7

BH No.	Easting	Northing	Height
BH1	293956.3	216323.0	164.0
Well 1	293299.5	215939.2	147.5

Topographic Survey Update: August 2007

Scale 1:4,000

0m 75m 300m

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JBA

JOHN BARNETT & ASSOCIATES
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14

Site: Blackhall, Punchestown, Naas, Co. Kildare

Title: Trial Pit Locations

Drawn: TP/PMC	Scale: 1: 4,000	**Figure 5**
Job. No: 3746	Date: March 2008	

PLATES

APPENDIX A

TRIAL PIT LOGS

APPENDIX B

LABORATORY DATA