APPENDIX B – HYDROGEOLOGICAL RISK ASSESSMENT REPORT

Lehaunstown Neighbourhood Road

IE01T23A67-REP-GEO0001

P01

Preliminary

HYDROGEOLOGICAL RISK ASSESSMENT – LEHAUNSTOWN NEIGHBOURHOOD ROAD

SYSTRA

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MODIFICATIONS SINCE PREVIOUS VERSION

Table 1. Modifications since previous version

PAGE	MODIFICATION	COMMENTS
	N/A – first version	

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REFERENCES:

- British Standard BS5930: 1999+A2:2010 Code of Practice for Site Investigations
- Eurocode 7: Part 1: Geotechnical Design: General Rules BS EN 1997-1:2004 incorporating corrigendum February 2009
- Eurocode 7: Geotechnical Design: Part 2 Ground Investigation and Testing, 2007
- Preene, M, Roberts, T O L, Powrie, W and Dyer, M R (2000). Groundwater Control – Design and Practice. Construction Industry Research and Information Association, CIRIA Report C515, London
- The Ireland Geological Survey Geological Survey Ireland Spatial Resources (arcgis.com)

APPENDICES

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1. INTRODUCTION

1.1 Project History

SYSTRA have been appointed by Dun Laoghaire Rathdown County Council (DLRCC) to provide engineering design services to support proposed development of the Cherrywood Strategic Development Zone (CSDZ) located near Lehaunstown.

As part of the planning process DLRCC have commissioned a series of hydrogeological Risk Assessments to assess the potential impacts of development on groundwater and sensitive groundwater dependent receptors. The focus of these assessments has been on considering potential impacts on groundwater fed 'Tufa' springs located at and in close proximity to the CSDZ.

One aspect of the development is the proposed construction of the 'Lehaunston Neighbourhood Road' (LNR) located in the north of the CSDZ.

On the basis of the above, the objective of this hydrogeological risk assessment is to assess the potential impact of hardstanding/low permeability coverage associated with the LNR footprint on the supply of catchment water to the Tufa springs.

1.2 Site Location

The LNR is located to the west of Lehaunstown and east of the M50 Motorway approximately 12km south of Dublin and centred around grid reference 323350 (easting) and 223838 (northing).

1.3 Road Scheme Design

The LNR will cover an approximate area of 5,500m^2, it will be excavated to approximately 0.7mbgl and backfilled/compacted to near surface with a competent subbase and reinstated to surface with asphalt. To manage rainwater, the road will incorporate a 'closed' drainage system that will comprise of a series of kerbs and gullies what will divert runoff waters into an attenuation pond via a network of underground drains located to the northeast of the road. The road drains will be located on the north side of the on part of the extreme northern margin of the catchment with a design invert level of up to 1.4mbgl. The attenuation pond located about 80m east of the LNR will discharge to a neighbouring surface water channel (Carrickmines Stream) located approximately 35m north east of the pond.

Figure 1 and 2 shows the location of the LNR, drainage features and the attenuation pond.

Figure 1. Location of LNR and associated design features

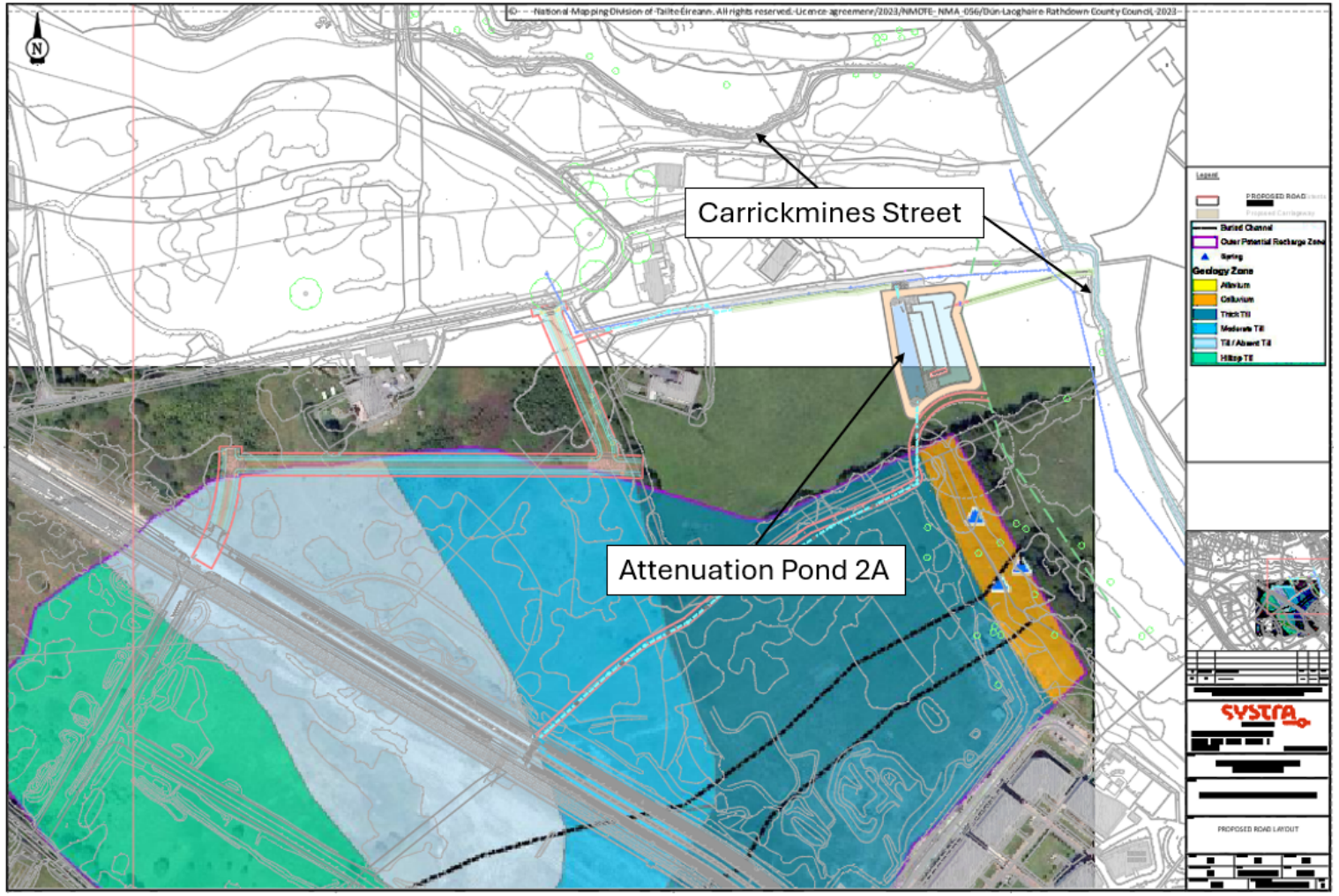
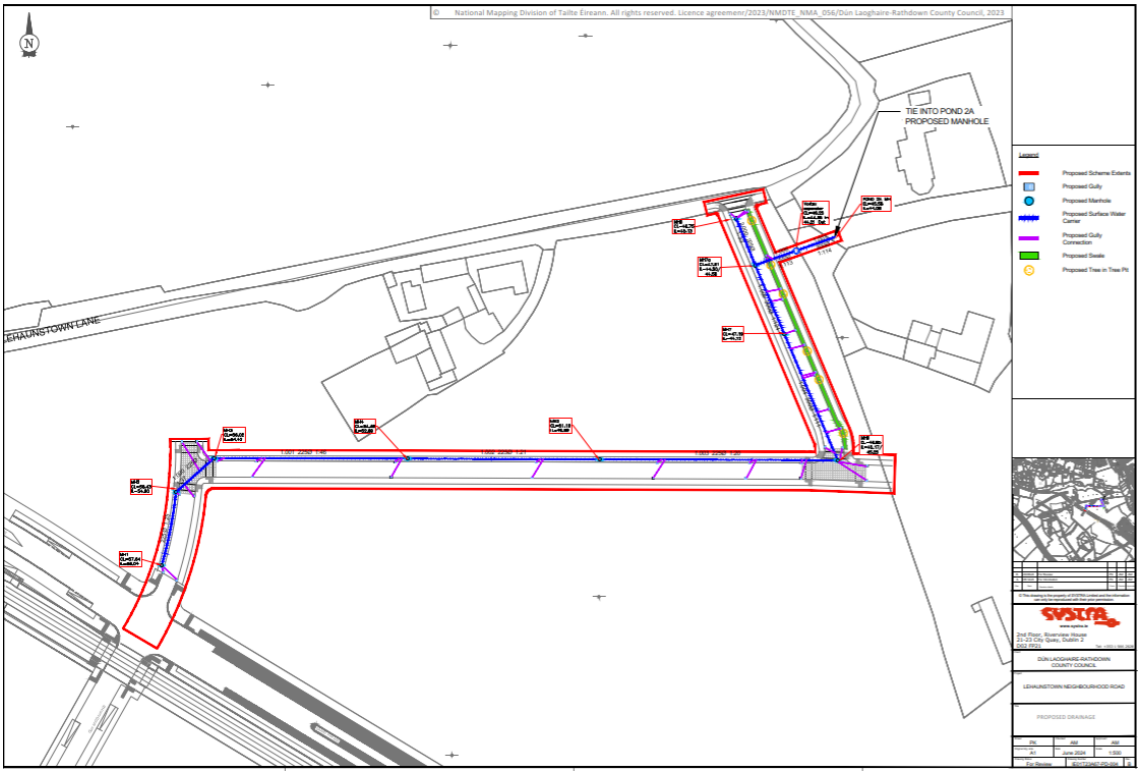


Figure 2. Drainage features associated with LNR



1.4 Scope of Works

To meet the assessment objective the following scope of works were completed:

- Review the existing area wide hydrogeological assessments reports provided by the DLRCC.
- Summarise pertinent geological and hydrogeological information (published and ground investigation) contained in the previous area wide reports to develop a conceptual ground model of the area.
- Summarise information contained in previous ground investigation reports relative to the footprint of the LNR.
- Provide a summary qualitative assessment of the potential impact and identify any mitigation measures, if required, to minimise the impact on Tufa springs water supply associated with the construction of the LNR.

It should be noted that the SYSTRA assessment is based on the existing information presented in previous hydrogeological reports completed for the Tufa spring catchment area.

1.5 Information Provided

At the time of reporting the following reports were provided by DLRCC:

- *RPS Group report entitled* "Cherrywood Hydrogeology, Phase 1 Hydrogeological Assessment of the Cherrywood SDZ"*, September 2011, reference MDE1047Rp0001.*
- JBA Consulting report entitled "Tufa Catchment Study", May 2019, reference 2018s1302.
- Ground Investigations Ireland report entitled "Lehaunstown Cabinteely Neighbourhood Road, DLR County Council, Factual Ground Investigation Report ", November 2023, reference 12914-06-23.

1.6 Report Limitations

All information given in this report is based on the ground conditions as reported by publicly available information and obtained with 3rd party reports provided by the Client. Conditions may exist on site however, which cannot be taken into account at this stage; these could include unpredictable soil strata and water conditions. It should also be noted that groundwater levels will vary due to seasonal or other effects, groundwater levels in particular within areas of flood potential, can have large impacts on the final design.

This report was prepared by SYSTRA for the sole use by Dun Laoghaire Rathdown County Council. Any other parties using the information contained within this report do so at their own risk and duty of care to those parties is excluded.

1.7 Report Version Control

Details of the revision are presented within Table 2.

Table 2. Summary of Version Control

VERSION	DESCRIPTION
P01	Initial preliminary version for review and comment before report finalisation

2. GROUND MODEL

The production of a ground model is an important step in developing a conceptual understanding of the geological and hydrogeological characteristics including (groundwater movements, recharge zones and water dependent interactions) at and in the vicinity of the LNR.

The LNR area has been subject to various ground investigations between 2001 and 2019. The culmination of these investigations (as documented in the JBA Consulting, May 2019 report) have been completed to characterise the ground conditions, and develop/refine ground models to inform the hydrogeological assessments of the wider catchment area. In 2023, an additional ground investigation (as documented in the Ground Investigation Ireland, November 2023 report) was also completed to characterise the ground conditions at and within the footprint of the LNR. Pertinent ground investigation collected between 2001 and 2023 and finding documented in previous interpretative reports have been used to support the development of the ground model in this report.

The Ground Investigation Ireland, November 2023 factual report along with exploratory logs from the JBA Consulting 2019 (JBA) report are presented in Appendix A. Extracts of figures presented in previous reports have also been used in this report to support the hydrogeological assessment associated with the LNR.

2.1 Geology

Between 2018 and 2019 JBA oversaw the completion of twenty trial pits and seven boreholes completed as groundwater monitoring wells in the footprint of the groundwater catchment that supplies water to the Tufa springs. The 2018 and 2019 JBA concluded that the catchment geology composed of the following:

- Alluvium and Colluvium – till located adjacent/below the Tufa springs in the east of the catchment.
- Thick Till – an area of thick till (up to 17m) which forms a plateau above the Tufa springs to their west.
- Moderate Till – an area of moderately (2.5 to 5m thick) thick till in the centre of the catchment.
- Thin/absent Till – to the west of the Moderate Till. Till thickness (up to 2.5m) lessens as the topography rises to the west as the bedrock lies closer to the surface.
- Hilltop Till – contains till of a relatively high sand and gravel content located in the west of the catchment
- A suspected buried valley infilled with silty sandy deposits (6+ to 14m+ thick) which passes southwest to northeast through the centre of the catchment.
- The entire catchment is underlain by granite bedrock which is characterised by a weathered upper surface.

Figure 3 shows the location of exploratory holes formed during the JBA investigation. A plan showing the spatial extent of the geological units and a cross section produced by JBA is shown in Figure 4 and 5 respectively.

Figure 3. **Exploratory Hole location Plan for 2018 and 2019 Ground Investigation (Source - Pg 3 of the JBA, May 2019 report)**

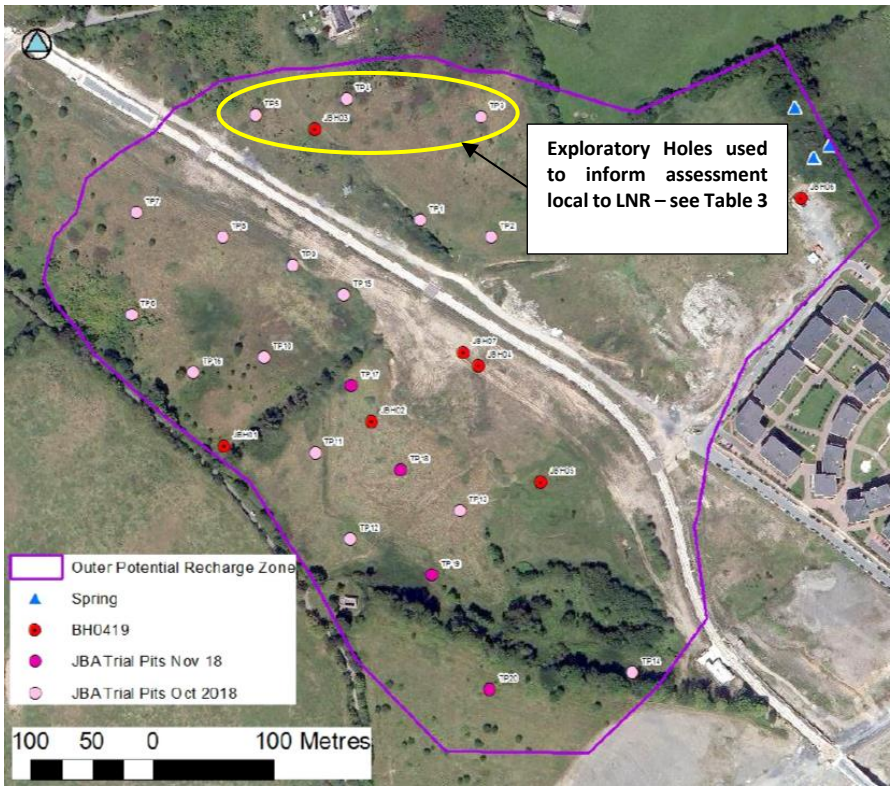


Figure 4. **Spatial extent of geological deposits within catchment (Source - Pg 5 of the JBA, May 2019 report)**

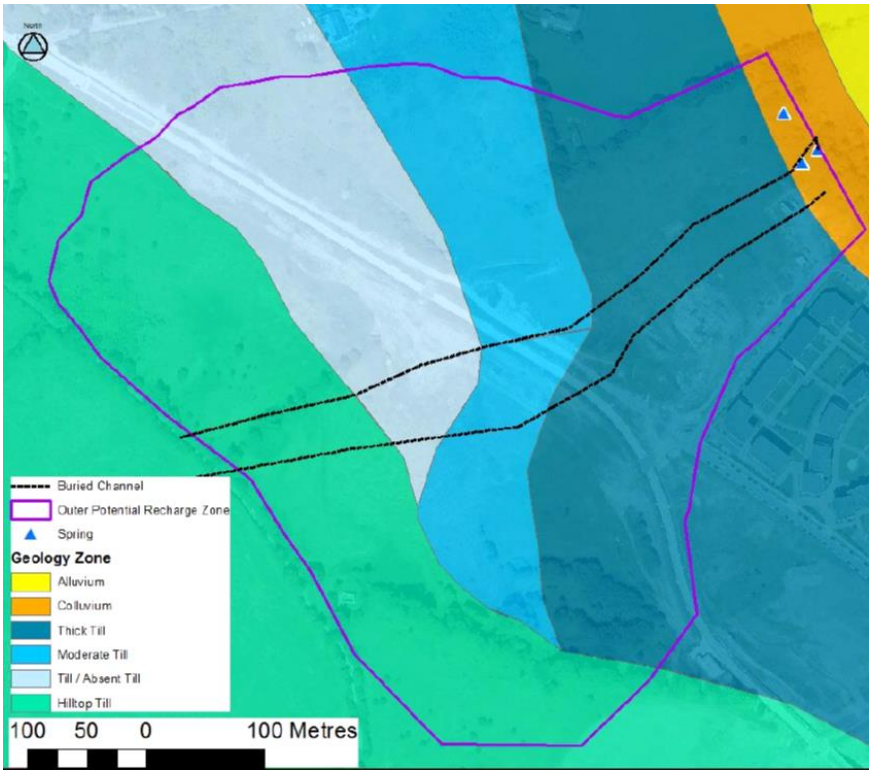
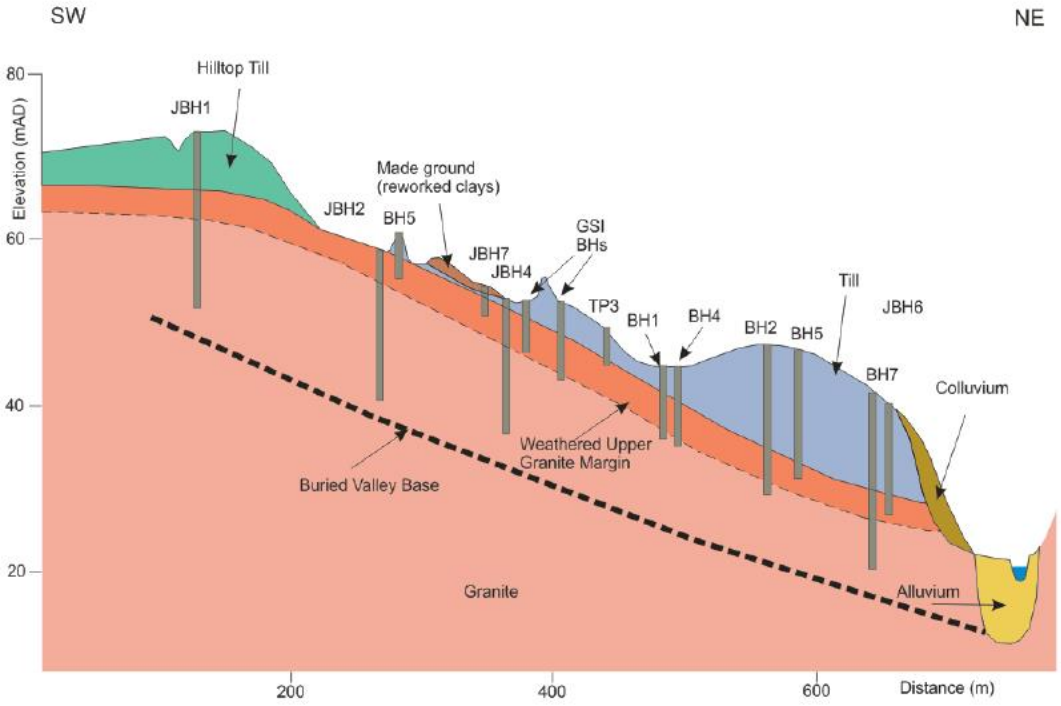


Figure 5. Geological cross section within catchment (Source - Pg 16 of the JBA, May 2019 report)



In November 2023, Ground Investigation Ireland (GII) completed three trial pits (SA01, TP/DP01 and TP/DP02) to 3.6mbgl and three cable percussive boreholes (BH01, BH02 and BH03) to 4mbgl. BH02 was completed as a monitoring well. Figure 6 shows the location of exploratory holes formed during the Ground Investigation Ireland investigation.

Figure 6. Exploratory hole location plan for 2023 ground investigation (Source App. A of the GII, Nov 2023 report)

A review of exploratory records produced during both the JBA 2018 and 2019 (TP3, TP4, TP5 and JBH03) and from the GII 2023 investigation was completed to form a more localised understanding on ground conditions at and in the vicinity of the LNR. A summary of encountered ground conditions is presented in Table 3. A summary of groundwater monitoring well completion details local to the LNR are presented in Table 4.

Table 3. Summary of geology encountered at and near to the LNR

STRATA NAME	STRATA DESCRIPTION	TOP OF STRATA (M BGL)	MAX. BASE OF STRATA (M BGL)	STRATA THICKNESS (M)
Topsoil	Clayey silt. (Note that tarmacadam reported at BH03 from 0 to 0.05mbgl).	0.00	0.7	0.1 to 0.7
Made Ground/ possible Made Ground	Slightly sandy fine to coarse angular to sub rounded crushed rock fill with plastic and gravelly clay fill.	0.05	1.5	0.2 to 1.45
Till (cohesive)	Clayey silt and silty clay with sub angular to sub rounded gravel and soft becoming firm to very stiff slightly sandy gravelly clay. Gravel fine to coarse sub rounded to sub angular with medium sub angular cobbles.	0.1	3.7	0.2 to 3.4
Till (granular)	Fine to coarse sand with cobbles of granite and medium dense slightly clayey sub	1.5	6.8	1.0 to 5.3

STRATA NAME	STRATA DESCRIPTION	TOP OF STRATA (M BGL)	MAX. BASE OF STRATA (M BGL)	STRATA THICKNESS (M)
	angular to sub rounded fine to coarse gravel.			
Weathered Granite	Medium strong granite and weathered granite.	1.2	9.8+	0.1 to 3.0+

Table 4. Monitoring well completion details at and near to the LNR

BOREHOLE ID	INSTALLATION DEPTH/RESPONSE ZONE (M BGL)	INSTALLATION DEPTH/REPONSE ZONE (MAOD)	SCREENED GEOLOGY
JBH03	5.5 to 9.8	49.24 to 44.94	Lower Till and Granite.
BH02	1 to 3.7	53.63 to 50.93	Till and possible weathered Granite.

A review of geological data at and in the vicinity of the LNR indicated that ground conditions were generally consistent, comprising of mainly a cohesive till over a granite bedrock. The findings are also consistent with online geological mapping (Geological Survey Ireland Spatial Resources (arcgis.com) which described the geology as till (derived from limestone and granite bedrock) over granite. The following exceptions were noted:

- Localised granular till encountered at TP02 and JBH03 located to the southeast and south of the LNR area respectively.
- The base depth and thickness of till overburden (granular till) at JBH03 was much greater than at the other exploratory locations. The upper part of the log was based on “Drillers Descriptions” using rotary drilling which can present challenges when logging the arising (chippings). It is possible that the interface between base of the overburden and the upper highly weathered granite is shallower than reported.

For both BH02 and JBH03, the screens were completed across two lithologies (Till and Granite) so a more conclusive determination on the relative contributions made by the geological units on groundwater production is no possible, however, it is suspected that the majority of groundwater will originate from the till/weathered bedrock interface.

2.2 Hydrogeology

With reference to online mapping Geological Survey Ireland Spatial Resources (arcgis.com), the bedrock geology is described as a “Poor Aquifer, Bedrock is generally Unproductive except for Local Zones”. No specific information was available on the aquifer properties of the till.

To aid in CSM development and understanding potential groundwater interactions with the LNR, a review of groundwater data from two monitoring wells (BH03 and JBH03) installed at and near the LNR

was completed. At the time of reporting two and one rounds of monitoring had been completed at BH03 and JBH03 respectively as follows:

- BH02 – 0.67mbgl (53.96mAoD) and 0.25mbgl (54.38mAoD) on 17th October and 9th November 2023 respectively.
- JBH03 – 1.13mbgl (53.61mAoD) 12th April 2019.

As part of the data review, the water strikes and rise levels encountered during drillings were also reviewed at BH01, BH02, TP02 and JBH03, as follows:

- BH01– strike 3.8mbgl (53.72mAoD) at the interface between cohesive till and granite, rose to 3.5mbgl (54.02mAoD) after 20 minutes.
- BH02 – strike 3.7mbgl (50.93mAoD) at the interface between cohesive till and granite, rose to 3.5mbgl (51.13mAoD) after 20 minutes.
- TP02 – "moderate" groundwater flow encountered at 2.2mbgl (44.26mAoD), trial was terminated at 2.6mbgl (43.86mAoD) due to pit collapse.
- JBH03 - strike 1.50mbgl (53.24mAoD) at the interface between cohesive and granular till, did not rise after 10 minutes of observation.

From a review of strike and groundwater data, the data suggests that groundwater was encountered at the interface between the till and the weathered surface of the granite bedrock. Two possible exceptions to this trend were observed:

- For JBH03, a strike was observed at the granular and cohesive till interface, however, the description is based on a drillers description using a drilling method that can present a challenge when trying to accurately determine descriptions and changes in lithological units. It is suspected that granular till at 1.5mbgl is a weathered granite or becoming a weathered granite. This would be consistent with other depths in the area and the medium strong (partially to moderately weathered) description reported at 6.8mbgl where a transition in weathering above this depth would be expected.
- For BH02, no water strikes were observed on day one of drilling to a depth of 3mbgl. At the start of shift on day two, water was recorded at 1mbgl. Although ingress from the cohesive till cannot be fully ruled out, it is more likely that the water originated from the interface between the base of the till and the surface of the weathered granite. Water was likely evacuated during drilling due to method adopted. A strike was encountered at 3.7mbgl which then rose to 3.5mbgl after 20 minutes, but rose to 1mbgl by the end of shift. It is suspected that under undisturbed conditions, the cohesive till is confining the water at the interface between the base of the till and surface of the weathered granite. The confining (pressurised) element is reflected in the groundwater elevation data at BH02 where groundwater elevations were recorded significantly above the strike levels.

In terms of groundwater flow direction, based on a review of field data and topography the horizontal gradient is considered to be easterly/north-easterly towards the Carrickmines Stream.

A rising head test was completed at BH02 recorded a hydraulic conductivity of 1.89 x 10^{-5}ms which would equate to a more granular sandy material as opposed to a stiff to very stiff clay as described in

the borehole log. The recorded conductivity likely reflects porosity and water contained at the surface of the weathered granite.

A soakaway test completed at SA01 to 2.1m bgl (a trial pit located in approximate west of the LNR) was terminated as the soil infiltration rate (fall in water levels) was too slow, and therefore the location would be unsuitable for the design and installation of system that relied upon relatively high inherent permeability to drain surface waters.

2.3 Hydrology

With reference to online geological mapping (Geological Survey Ireland Spatial Resources (arcgis.com) a review of surface water features was completed. At its nearest point, the Carrickmines Stream is located approximately 120m to the north/northeast of the LNR. Carrickmines Stream flows easterly and then south/south easterly eventually merging with Shanganagh (a watercourse) located approximately 1.2 km south east of the LNR. The tuff springs appears to be located above the west bank of Carrickmines Stream.

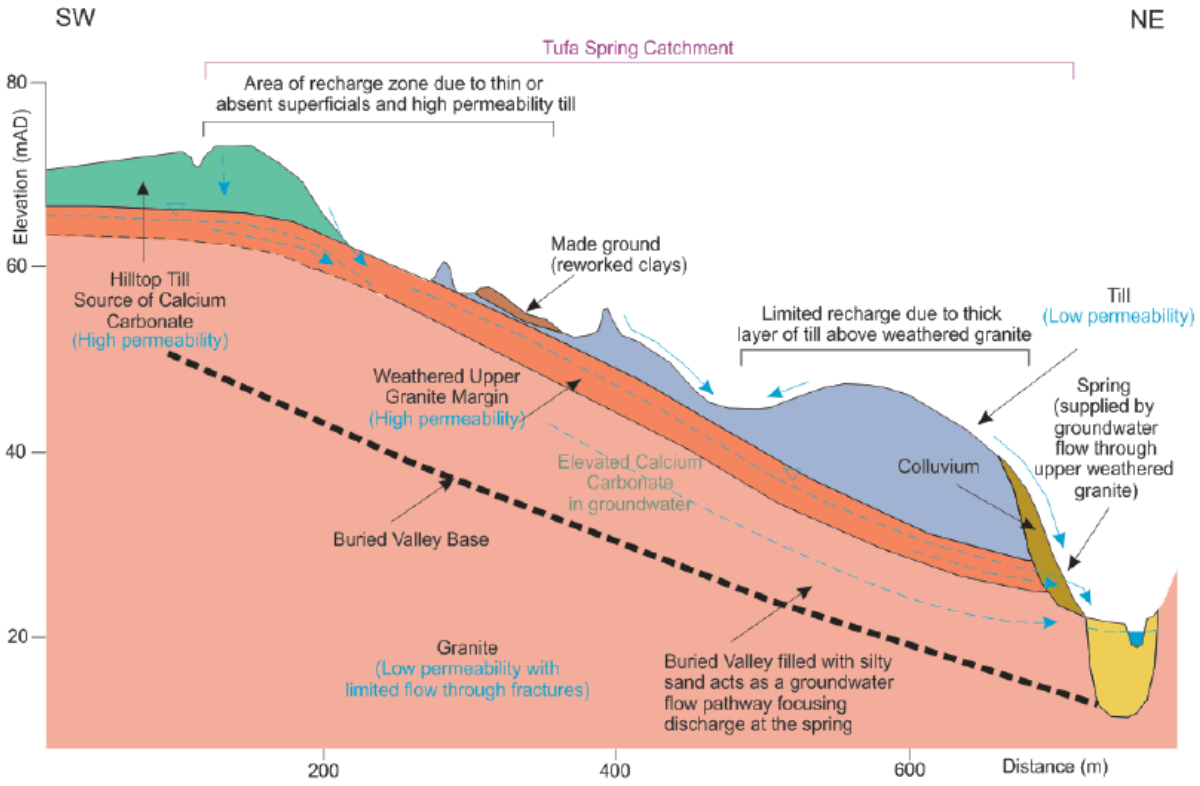
2.4 Conceptual Site Model

With reference to the baseline and field data presented in various phases of ground investigation a conceptual understanding was developed focused on recharge zones, groundwater movements and interactions as follows:

- The LNR is located within a catchment that contains five main recharge zones (named Alluvium, Colluvium, Thick Till, Moderate Till, Till/Absent Till and Hilltop Till) with different geological and hydraulic characteristics and abilities to supply sustained water to the tuff springs. Figure 4 illustrates the location of the recharge areas.
- The main recharge areas are the Hilltop Till (containing between approximately 1 to 5 m thick of sand and gravel), and Till/Absent Till (containing a thin layer of till or outcropping bedrock) located to the west and below the western half of the LNR respectively.
- Precipitation falling within the catchment is more likely in infiltrate through the Hilltop Till and Till/Absent Till recharge areas and migrate easterly along the upper margins of the weathered granite and below more cohesive deposits towards the tuff springs.
- The buried channel located to the south of the LNR containing silty sand is likely to act as a conduit and promote the movement of groundwater within the catchment towards buried channel and focus discharge to the tuff springs.

The conceptual understanding of groundwater movement is illustrated by Figure 7.

Figure 7. Conceptual understanding of groundwater movement within the catchment (Source Pg 8 of the JBA, May 2019 report



3. LNR ASSESSMENT

On the basis of the conceptual understanding described in Section 2, a qualitative assessment of potential impacts to catchment hydrogeology associated with the LNR construction was undertaken. This assessment was broadly focused on the impact mechanisms requiring consideration when assessing impact on water supply to the tuff springs as identified by the JBA 2018 Report. The appropriate potential impact mechanisms are as follows:

- Reduced ground permeability resulting from the construction of hardstanding areas and the resultant impact on catchment/tuff spring recharge.
- Excavation or the installation of drainage systems below the water table that act as a conduit by intercepting and diverting groundwater away and out of the catchment could impact catchment/tuff spring recharge.
- The presence of physical barriers that will inhibit and/or alter the existing groundwater flow direction through the subsurface and buried channel, e.g. foundations.

Based on catchment sensitivity, the potential for recharge and flow impacts is likely to be more associated more with the Hilltop Till and Till/Absent Till areas.

The potential impact mechanisms associated with recharge, conduits and barriers specific to the LNR have been considered by assessing, 1) the spatial extent of the LNR, 2) the underlying geology, and 3) potential groundwater interactions with LNR and its associated drainage system as discussed below.

3.1 LNR catchment coverage

A review of the LNR and geological coverage within the catchment was undertaken as summarised in Table 5. With reference to the JBA report the Till/Absent Till and Hilltop Till areas represent the geological units characterised by relatively high permeability.

Table 5. Approximate spatial extent of the LNR and geological areas

LOCATION	TOTAL COVERGE (M^2)
Total catchment area (defined by JBA)	250,000
Total area of Till/Absent Till	47,056
Total area of Moderate Till	45,677
Total area of Hilltop Till	76,335
Total LNR catchment coverage	5,500
Area of the LNR covering Till/Absent Till	1,086
Area of the LNR covering Moderate Till	1,500

With reference to Table 5 and Figure 1 the coverage of the LNR on the northern margins of the catchment represents about 2% of the total catchment, and is only located above the Till/Absent Till and Moderate Till areas. Due to the nature of geology, the Moderate Till area was ruled out by JBA as an unlikely to effect recharge and groundwater flow. The LNR is not located above the Hilltop Till area, which represents one of the two areas more likely contributing to catchment recharge. Therefore the LNR is considered only to impact the Till/Absent Till area; however, the LNR footprint skirts its northern extent and covers about 2% of the Till/Absent Till area and <1% of the combined Till/Absent Till and Hill Top Till area.

Given the low surface coverage compared to the full extent of the individual geological units contributing to recharge, and its marginal location within the catchment, it is considered unlikely that the LNR would significantly affect catchment recharge and therefore would not have a detrimental effect on water supply to the tuff springs.

3.2 Underlying Geology

A review of borehole logs used to generate the information presented in Table 3 was undertaken. With the exception of BH03, all the other exploratory holes (SA01, TP/DP01, TP/DP02 BH01, BH02 , BH03 TP3, TP4, TP5 and JBH03) reported cohesive till at thickness ranging from 0.95 to 3.8m (average of 2.01m thick) from surface or near surface (directly below topsoil and Made Ground/possible Made Ground) above some localised granular till and/or directly above weathered granite. Moreover, no water strikes were reported in any of the cohesive till deposits. For BH03, located in the Moderate Till area, a cohesive Made Ground (described as gravelly clay fill) was reported between 0.05 and 1.5mbgl (1.45m thick).

Due to the low permeability nature of the cohesive till/localised Made Ground across the Till/Absent Till and Moderate Till area in proximity of the LNR it is considered that these deposits specific to the LNR area would already limit groundwater recharge and near surface groundwater movement and therefore would be unlikely to be contributing significantly to recharge with precipitation more likely to flow as surface runoff. The low permeability nature of the cohesive till is further characterised by the failure of the soakaway test in the till deposits at SA01. Therefore, the inclusion of the impermeable road surface associated with the LNR proposals in the location identified is considered unlikely to pose a risk of reducing recharge.

3.3 Groundwater interactions

A review of the LNR design and groundwater data was completed to understand the potential for groundwater interactions and impediment to groundwater movement.

Water strikes were encountered at depths between 1.5 and 3.8mbgl and likely associated with the till and weathered granite interface. Groundwater elevations were reported between 0.25 and 1.13mbgl, however, based on a conceptual understanding of the geology, screened lithologies the water is likely associated with the lower till and weathered granite interface rather than being present at the shallower depths under undisturbed conditions.

The design base depth of the LNR will be about 0.7mbgl, which would be above the productive weathered granite unit (saturated zone), therefore road construction is unlikely to create an obstruction to groundwater flow within the catchment and to the tuff springs. The LNR is also located

to the north buried channel and is therefore considered unlikely to present a direct barrier to groundwater movement.

With respect to drainage, the maximum invert level of the drainage pipes associated with the system will be approximately 1.4mbgl and located on the north side of the LNR on the extreme northern margin of the catchment, with approximately 30% of the total drainage length located in the Till/Absent Till area. Given the presence of largely cohesive till, a likely absence of a complete granular till in the footprint of the LNR and the presence of a saturated below 1.4m, it is unlikely that the drainage system would present a barrier to groundwater movement and/or alter the flow of groundwater in the vicinity of the LNR footprint. Therefore, the drainage solution for LNR proposals are considered unlikely to provide a conduit for groundwater movement to be directed away from the subsurface and channel.

4. CONCLUSIONS

SYSTRA have been commissioned to complete a hydrogeological risk assessment to support a planning application for the proposed design and construction of the Lehaunstown Neighbourhood Road (LNR) in the Cherrywood Strategic Development Zone.

The aim of the assessment was to determine if the construction of the road would effect the supply of water to the catchment and the tufa springs.

From a review of design, geological and hydrogeology information it was concluded that the construction of the road is likely to present a low to negligible risk on catchment and tufa spring water supply, accordingly no specific design mitigation measures are required. The conclusion is based on the following:

- Reduced ground permeability from the construction of the LNR and the resultant impact on catchment/tuff spring recharge is considered unlikely to occur.
- The drainage design is considered unlikely to significantly interact with water table, therefore drainage is unlikely to act as a conduit by intercepting and diverting groundwater away and out of the catchment.
- Based on the design depth of the LNR and drainage system, it is considered unlikely that either feature will present a physical barrier that will inhibit and/or alter the existing groundwater flow direction through the subsurface.

APPENDIX A : GEOTECHNICAL GROUND INVESTIGATION IRELAND REPORT AND JBA EXPLORATORY HOLE EXTRACTS

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Ground Investigations Ireland

Lehaunstown Cabinteely Neighbourhood Road

DLR County Council

Interpretative Ground Investigation Report

November 2023

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DOCUMENT CONTROL SHEET

Project Title	Lehaunstown Cabinteely Co. Dublin Neighbourhood Road
Client	DLR
Project No	12914-06-23
Document Title	Interpretative Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Final	A Molloy	S Kealy	C Finnerty	Dublin	17 November 2023

Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.

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APPENDICES

1.0 Preamble

On the instructions of DLRD County Council, a site investigation was carried out by Ground Investigations Ireland Ltd., between July and August 2023 at the site of the proposed neighbourhood road in Lehaunstown as per the Cherrywood Planning Scheme.

2.0 Overview

2.1. Background

It is also proposed to construct a new neighbourhood road with associated services, access roads and car parking at the proposed site. as part of the development. The site is currently greenfield. The proposed construction is envisaged to consist of conventional road and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 2 No. Trial Pits to a maximum depth of 3.60m BGL
- Carry out 1 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Carry out 2 No. Dynamic Probes to determine soil strength/density characteristics
- Carry out 2 No. Plate Bearing Tests to determine the modulus of subgrade reaction and equivalent CBR value
- Carry out 3 No. Cable Percussion boreholes to a maximum depth of 4.0m BGL
- Carry out 1 No. Rising Head Permeability Test
- Installation of 1 No. Groundwater monitoring wells
- Geotechnical & Environmental Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.

The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Soakaway Testing

The soakaway testing was carried out in selected trial pits at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 3 of this Report.

3.4. Dynamic Probing (DPH)

The dynamic probe tests (DPH) were carried out at the locations shown in the location plan in Appendix 1 in accordance with B.S. 1377: Part 9 1990. The test consists of mechanically driving a cone with a 50kg weight in 100mm intervals and monitoring the number of blows required. An equivalent Standard Penetration Test (SPT) 'N' value may be calculated by dividing the total number of blows over a 300mm drive length by 1.5. The dynamic probe logs are provided in Appendix 4 of this Report.

3.1. Insitu Plate Bearing Test

The plate bearing tests were carried out using a 300mm diameter plate at the locations shown on the site plan in Appendix 1. The plate was loaded in increments using a hydraulic jack and an excavator to provide a reaction and the displacement was monitored in accordance with BS1377 Part 9 using independently mounted digital strain gauges. The constrained modulus and equivalent CBR are calculated in accordance with HD29/75 and are provided on the test reports in Appendix 5 of this Report.

3.2. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.
The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire

cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata. Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60º cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 6 of this Report.

3.3. Surveying

The exploratory hole locations have been recorded using a KQ GEO Technologies KQ-M8 System which records the coordinates and elevation of the locations to ITM as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.4. Groundwater Monitoring Installations

Groundwater Monitoring Installation were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm uPVC/HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

3.5. Rising Head Permeability Testing

Rising head permeability testing was carried out in the standpipe at BH03 to determine the permeability of the ground. The initial water level was recorded. The borehole was purged prior to the test being carried out. On completion of the purging the depth of the water was recorded. The rise in water was then monitored over specific intervals. The recorded test data was interpreted to calculate the permeability value based on the methods outlined in B.S. 5930:2015 and IS EN ISO 22282-2:2012. The results of this testing are provided in Appendix 7 of this Report.

3.6. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.
Environmental & Chemical testing as required by the specification, including the Engineers Ireland Suite I pH, sulphate and total sulphur testing was carried out by Element Materials Technology Laboratory in the UK.
Geotechnical testing consisting of moisture content, Atterberg limits, Particle Size Distribution (PSD) and hydrometer tests were carried out in NMTL's Geotechnical Laboratory in Carlow
The results of the laboratory testing are included in Appendix 8 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and generally comprised;

- Topsoil/Surfacing
- Fill
- Made Ground
- Cohesive Deposits
- Granular Deposits
- Weathered Bedrock

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.50m BGL.

FILL: Crushed rock fill was encountered beneath the Topsoil at the location of SA01 and TP01 to a maximum depth 0.40m BGL. The fill was typically described as a dark grey slightly sandy fine to coarse angular to subangular crushed Rock FILL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil at the location of TP02 and BH03. These deposits were present to a maximum depth of 1.50m. These deposits were described generally as *brown sandy slightly gravelly CLAY with frequent cobbles and contained occasional fragments of plastic.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground or Crushed Rock Fill and were described typically as *soft brown sandy gravelly CLAY with occasional cobbles and boulders*

overlying a *firm brown sandy gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. The strength of the cohesive deposits typically increased with depth and was firm to stiff or stiff below 1.5m BGL in the majority of the exploratory holes. These deposits had some, occasional or frequent cobble and boulder content, where noted on the exploratory hole logs.

GRANULAR DEPOSITS: Granular deposits were encountered at the base and within the cohesive deposits at the location of TP02 to a maximum depth of 2.60m BGL and were typically described as grey *brown clayey sandy sub rounded to sub angular fine to coarse GRAVEL with occasional cobbles and rare boulders.* The secondary sand/gravel and silt/clay constituents varied across the site and with depth while occasional or frequent cobble and boulder content also present where noted on the exploratory hole logs. Based on the SPT N values the deposits are typically dense. It should be noted that many of the trial pits where granular deposits or groundwater were encountered, experienced instability. This was described either as side wall spalling or as side wall collapse in the remarks section at the base of the trial pit logs. A significant groundwater strike was noted in the boreholes on encountering the granular deposits and the driller noted blowing sands or gravels during drilling.

WEATHERED BEDROCK: Weathered rock was encountered in BH03 to a maximum depth of 2.0m BGL. This material was recovered typically as weathered Granite recovered as a *White/pink slightly gravelly SAND.*

4.2. Insitu Strength Testing

The correlated DPH blow counts indicate that the overburden deposits are soft or firm to a depth of 1.60m to 2.10m BGL and become stiff with depth.

4.3. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed in BH02, BH04 and BH06 to allow the equilibrium groundwater level to be determined. The groundwater monitoring is included in Appendix 6 of this Report.

4.4. Laboratory Testing

4.4.1. Geotechnical Laboratory Testing

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded

with percentages of sands and gravels ranging between 31% and 38% generally with fines contents of 25.4 to 36%.

4.4.1. Chemical Laboratory Testing

The pH and sulphate testing carried out indicate that pH results are near neutral and that the water soluble sulphate results is low when compared to the guideline values from BRE Special Digest 1:2005. The samples tested classify the soil as a Design Sulphate Level DS-1.

4.4.2. Environmental Laboratory Testing

A number of samples were analysed for a suite of parameters which allows for the assessment of the sampled material in terms of total pollutant content for classification of materials as *hazardous* or *non-hazardous*. The suite also allows for the assessment of the sampled material in terms of suitability for placement at licenced landfills (inert, stable non-reactive, hazardous etc.). The parameter list for the suite includes analysis of the solid samples for arsenic, barium, cadmium, chromium, copper, cyanide, lead, nickel, mercury, zinc, speciated aliphatic and aromatic petroleum hydrocarbons, pH, sulphate, sulphide, moisture content, soil organic matter and an asbestos screen.

The suite also includes those parameters specified in the EU Council Decision establishing criteria for the acceptance of waste at Landfills (Council Decision 2003/33/EC), which for the solid samples are total organic carbon (TOC), speciated aliphatic and aromatic petroleum hydrocarbons, BTEX, phenol, polychlorinated biphenyls (PCB) and PAH.

As part of the suite a leachate is generated from the solid sample which is analysed for antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, chloride, fluoride, soluble sulphate, sulphide, phenols, dissolved organic carbon (DOC) and total dissolved solids (TDS).

While the laboratory report provides a comparison with the waste acceptance criteria limits it does not provide a waste classification of the material sampled nor does it comment on any potentially hazardous properties of the materials tested. The possibility for contamination, not revealed by the testing undertaken should be borne in mind particularly where Made Ground deposits are present or the previous site use or location indicate a risk of environmental variation. A waste classification report is recommended to be carried out to provide an interpretation of the laboratory data should any material be required to be disposed of off site.

The results from the completed laboratory testing are included in Appendix 8 of this report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

Should foundations be required we would recommend an allowable bearing capacity of 80, 100,150 and 200 kN/m^2 for conventional strip or pad foundations on the firm, firm to stiff and the stiff cohesive deposits or the dense granular at the depths outlined in the table below.

The possibility for variation in the depth of the made ground in the vicinity of these foundations should be considered and foundation inspections should be carried out. Any soft spots encountered at the proposed foundation depths should be excavated and replaced with lean mix concrete.

	Allowable Bearing Capacities (ABC) kN/m^2						
Trial Pit	**ABC**	**Depth**	**Comment**	**Trial Pit**	**ABC**	**Depth**	**Comment**
No.	**kN/m^2**	**m BGL**		**No.**	**kN/m^2**	**m BGL**	
TP01/DP01	80	1.0	**Cohesive**	**BH01**	100	2.0	**Cohesive**
TP01/DP01	100	2.10	**Cohesive**	**BH01**	200	3.0	**Cohesive**
TP01/DP01	200	2.40	**Cohesive**	**BH02**	80	1.0	**Cohesive**
TP02/DP02	80	1.50	**Cohesive**	**BH02**	100	2.0	**Cohesive**
TP02/DP02	100	1.8	**Cohesive**	**BH02**	200	3.0	**Cohesive**
TP02/DP02	200	2.50	**Granular**	**BH03**	150	1.5	**Granular**
BH01	80	1.0	**Cohesive**				

A ground bearing floor slab is recommended to be based on the firm cohesive deposits with an appropriate depth of compacted hardcore specified by the consulting engineer and in accordance with the limits and guidelines in SR21:2014+A1:2016 and/or NRA SRW CL808 Type E granular stone fill.

The possibility for variation in the depth to cohesive and granular deposits across the site should be considered and all foundations should be founded on similar material to avoid differential settlement.

Alternatively to reduce the cost and avoid digging down to the deeper stratum, reinforcement in the foundations is proposed to prevent problems with differential settlement.

The pH and sulphate testing completed on samples recovered from the exploratory holes indicates the pH results are near neutral and the sulphate results are low, when compared to the guideline values from BRE Special Digest 1:2005. No special precautions are required for concrete foundations to prevent sulphate attack. The samples tested were below the limits of DS1 in the BRE Special Digest 1:2005.

5.3. External Pavements

The proposed pavements are recommended to be designed in accordance with the CBR test results included in the Appendices of this Report. The low CBR test results indicate that a capping layer or a sufficient depth of crushed stone fill may be required. Plate bearing tests are recommended at the time of construction to verify the design assumptions for the proposed pavement make up and to verify adequate compaction has been achieved.
The use of a geogrid and separation membrane may improve the performance of the proposed pavement and enable a more economical pavement design to be achieved, a specialist supplier is recommended to advise of the required strength, depth and type of geotextile for the proposed design.

5.4. Excavations

Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.
Excavations in the Made Ground soft Cohesive Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits.
Any excavations which penetrate the granular deposits will require to be appropriately battered or the sides supported and are likely to require dewatering due to the groundwater seepages noted in the exploratory hole logs in the Appendices of this Report.
The groundwater and stability noted on the trial pit logs should be consulted when determining the most appropriate construction methods for excavations.

Any waste material to be removed off site should be disposed of to a suitably licenced landfill.

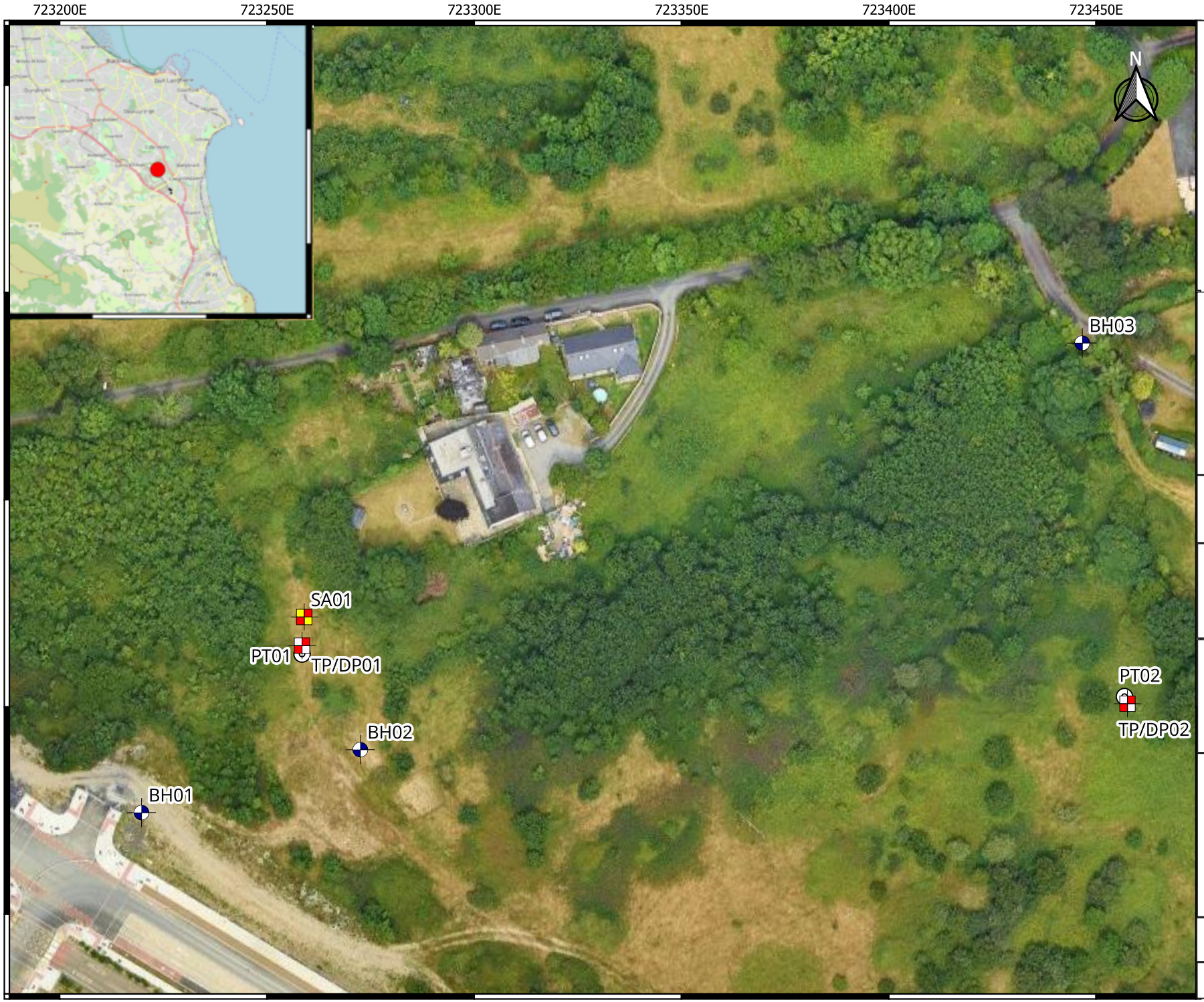
5.5. Soakaway Design and Permeability Testing

At the locations of SA01 the water level dropped too slowly to allow calculation of ‘f’ the soil infiltration rate. These locations are therefore not recommended as suitable for soakaway design and construction.
A Permeability rate of $k=1.89 \times 10^{-5}$ m/s was calculated for the rising head test at BH02.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable

settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan



Trial Pit
Soakaway
Plate Test
CP Borehole

Client:

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Project Code:
12914-06-12

Project Title:
Lehaunstown Housing Site

Drawing Title:
Figure 1 Location Plan

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental
Ground Investigations Ireland Ltd.
Catherinstown House,
Hazelhatch Road,
Newcastle, Co. Dublin
www.gii.ie 01-6015175/5176

0 10 20 30 40 m

Drawn By:	Date:
SK	12-10-23

APPENDIX 2 – Trial Pit Records

Ground Investigations Ireland Ltd
www.gii.ie

Site Lehaunstown			**Trial Pit Number** SA01
Machine : 3CX **Method :** Trial Pit	**Dimensions** 2.50m x 0.50m x 2.10m (L x W x D)	**Ground Level (mOD)** 54.91	**Client** DLRD	**Job Number** 12914-06-23
	Location 723258.9 E 723871.4 N	**Dates** 01/07/2023	**Project Contractor** GII	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				54.81	(0.10) 0.10	Dark brown TOPSOIL with rootlets and high subangular to subrounded cobbles.		
					(0.30)	Dark grey slightly sandy fine to coarse angular to subrounded crushed rock FILL.		
				54.51	0.40	Firm brown slightly sandy slightly gravelly CLAY. Gravels are fine to coarse subangular to subrounded with medium subangular to subrounded cobbles.		
					(1.70)			
				52.81	2.10	Complete at 2.10m		

Plan

Remarks

No groundwater encountered.
Trial pit sidewalls stable.
Trial pit backfilled upon completion.

Scale (approx)	Logged By	Figure No.
1:25	AM	12914-06-23.SA01

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Lehaunstown	TP01

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	2.4m x 0.6m 3.7m (LxWxD)	54.94	DLRD	12914-06-23
	Location	**Dates**	**Project Contractor**	**Sheet**
	723258.4 E 723864.4 N	01/07/2023	GII	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				54.84	(0.10) 0.10	Brown TOPSOIL with rootlets.		
					(0.20)	Grey fine to coarse subangular to subrounded crushed rock FILL.		
				54.64	0.30	Soft brown slightly sandy gravelly CLAY. Gravels are fine to coarse angular to subrounded with medium subangular cobbles.		
					(0.70)			
				53.94	1.00	Firm brown slightly sandy gravelly CLAY. Gravels are fine to coarse angular to subrounded with medium subangular cobbles.		
1.20	B1				(0.40)			
				53.54	1.40	Firm brown sandy gravelly CLAY. Gravels are fine to coarse subangular to subrounded, with medium subangular to subrounded cobbles and low subangular to subrounded boulders.		
					(0.60)			
				52.94	2.00	Stiff brown sandy gravelly CLAY. Gravels are fine to coarse subangular to subrounded, with medium subangular to subrounded cobbles and low subangular to subrounded boulders.		
					(0.60)			
2.60	B2			52.34	2.60	Very stif brown sandy gravelly CLAY. Gravels are fine to coarse subangular to subrounded, with medium subangular to subrounded cobbles and medium to high subangular to subrounded boulders.		
					(1.00)			
3.50	B3			51.34	3.60	Complete at 3.70m		

Plan

Remarks

No groundwater encountered.
Trial pit sidewalls stable.
Trial pit backfilled upon completion.

Scale (approx)	Logged By	Figure No.
1:25	AM	12914-06-23.TP01

Ground Investigations Ireland Ltd
www.gii.ie

Site Lehaunstown			**Trial Pit Number** TP02
Machine : 3CX **Method :** Trial Pit	**Dimensions** 2.10m x 0.70m x 1.80m (LxWxD)	**Ground Level (mOD)** 46.46	**Client** DLRD	**Job Number** 12914-06-23
	Location 723457.6 E 723850.4 N	**Dates** 01/07/2023	**Project Contractor** GII	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				46.36	(0.10) 0.10	Brown TOPSOIL with rootlets and tree roots.		
					(0.50)	MADE GROUND: Slightly sandy slightly gravelly Clay. Gravels are subangular to subrounded fine to coarse with plastic fragments.		
0.50	B1			45.86	0.60	Soft brown sandy gravelly CLAY. Gravels are subangular to subrounded fine to coarse with medium subangular to subrounded cobbles.		
1.10	B2				(1.00)			
			Moderate Inflow(1) at 2.40m.	44.86	1.60	Medium dense brown slightly clayey subangular to subrounded fine to coarse GRAVEL.		▽1
					(1.00)			
2.60	B3			43.86	2.60	Complete at 2.60m		

Plan

Remarks

Groundwater encountered at 2.20m with moderate inflow.
Trial pit sidewalls collapsing.
Trial Pit terminated at 2.60m due to groundwater and sidewall collapse.

Scale (approx)	Logged By	Figure No.
1:25	ED	12914-06-23.TP02

Lehaunstown, Cabinteely Trial Pit Photographs

TP01

TP01

Lehaunstown, Cabinteely Trial Pit Photographs

TP01

TP02

Lehaunstown, Cabinteely Trial Pit Photographs

TP02

TP02

APPENDIX 3 – Soakaway Records

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

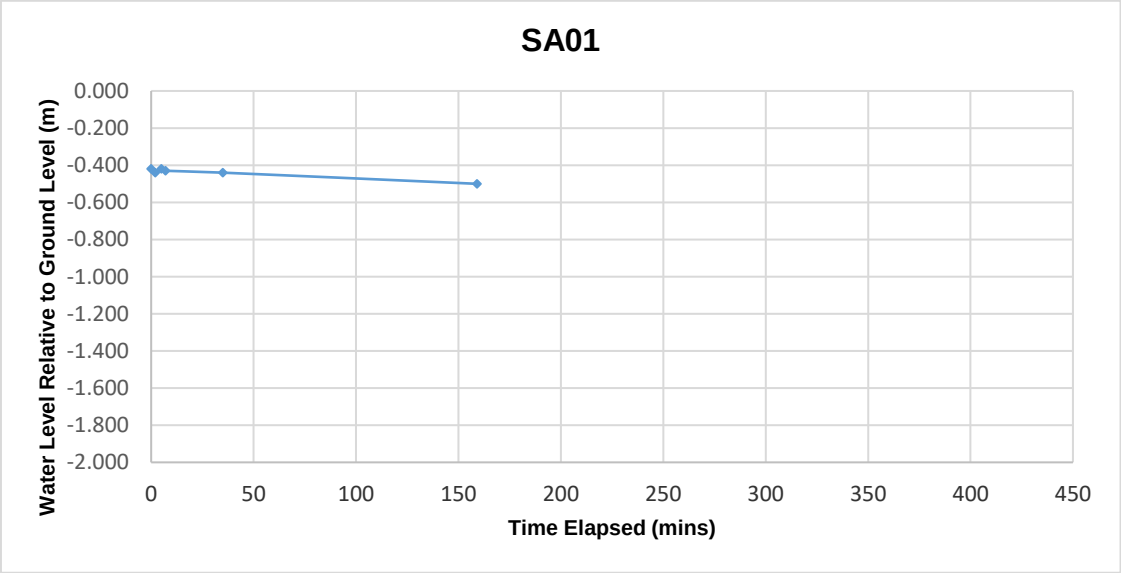
SA01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.5m x 0.50m x 2.1m (L x W x D)

Date	Time	Water level (m bgl)
13/07/2023	0	-0.420
13/07/2023	2	-0.440
13/07/2023	5	-0.420
13/07/2023	7	-0.430
13/07/2023	35	-0.440
13/07/2023	159	-0.500

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.42	2.100	1.680	0.84	1.68



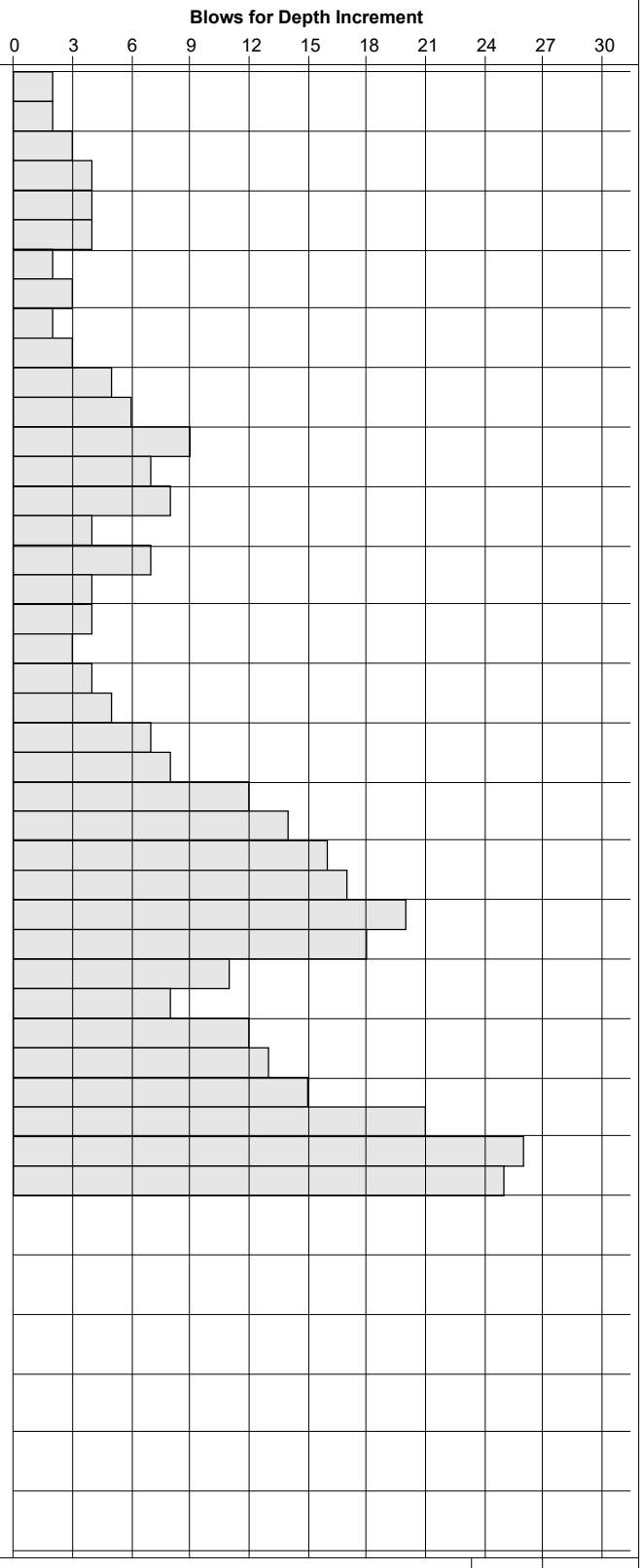
APPENDIX 4 – Dynamic Probe Records

Ground Investigations Ireland Ltd

www.gii.ie

Site Lehaunstown				**Probe Number** DP01
Machine : Tecop Tec 10 **Method :** Dynamic Probe	**Cone Dimensions** Diameter 47.3mm, Angle 90°	**Ground Level (mOD)** 54.94	**Client** DLRD	**Job Number** 12914-06-23
	Location 723258.4 E 723864.4 N	**Dates** 14/08/2023	**Engineer**	**Sheet** 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)	Depth (m)
0.00-0.10	2		54.94	0.00
0.10-0.20	2			
0.20-0.30	3			
0.30-0.40	4			
0.40-0.50	4			
0.50-0.60	4		54.44	0.50
0.60-0.70	2			
0.70-0.80	3			
0.80-0.90	2			
0.90-1.00	3			
1.00-1.10	5		53.94	1.00
1.10-1.20	6			
1.20-1.30	9			
1.30-1.40	7			
1.40-1.50	8			
1.50-1.60	4		53.44	1.50
1.60-1.70	7			
1.70-1.80	4			
1.80-1.90	4			
1.90-2.00	3			
2.00-2.10	4		52.94	2.00
2.10-2.20	5			
2.20-2.30	7			
2.30-2.40	8			
2.40-2.50	12			
2.50-2.60	14		52.44	2.50
2.60-2.70	16			
2.70-2.80	17			
2.80-2.90	20			
2.90-3.00	18			
3.00-3.10	11		51.94	3.00
3.10-3.20	8			
3.20-3.30	12			
3.30-3.40	13			
3.40-3.50	15			
3.50-3.60	21		51.44	3.50
3.60-3.70	26			
3.70-3.80	25			
			50.94	4.00
			50.44	4.50
			49.94	5.00



Remarks
Refusal at 3.80m BGL 25 blows

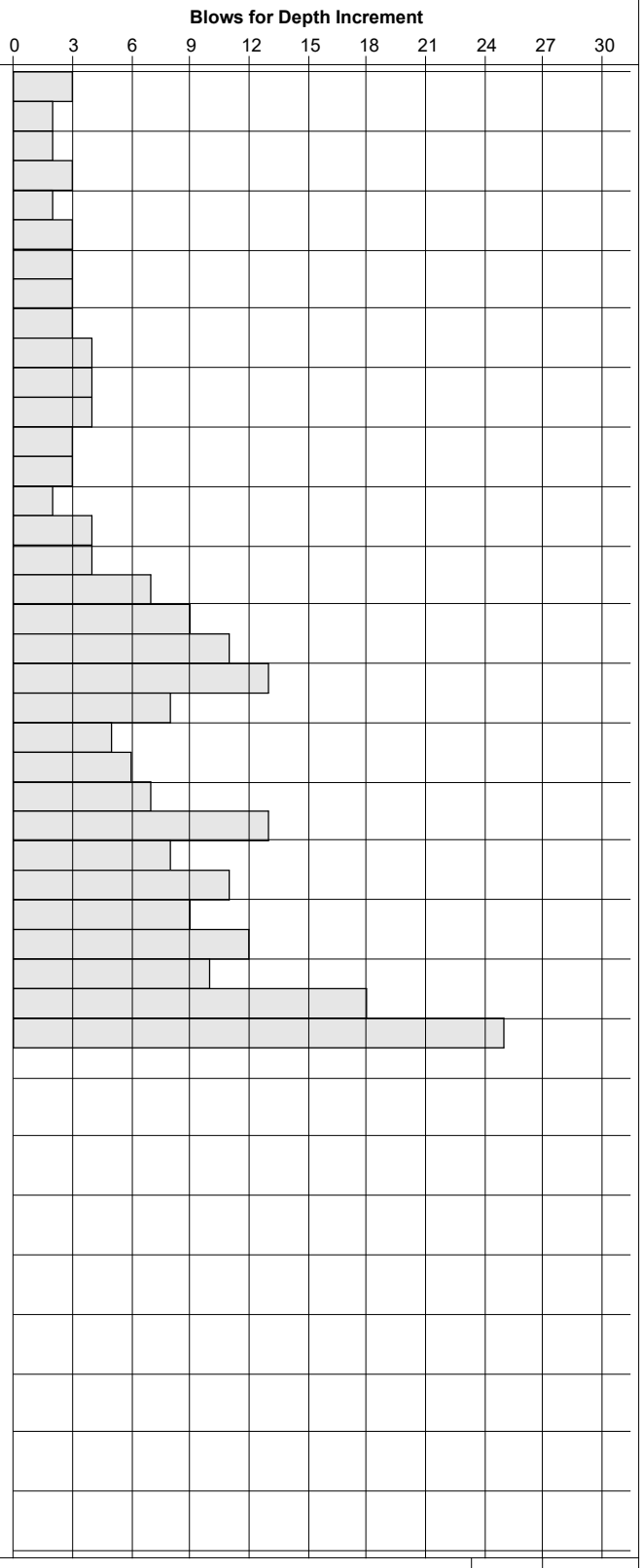
Scale (approx)	Logged By
1:25	S Kealy

Figure No. 12914-06-23.DP01

Ground Investigations Ireland Ltd
www.gii.ie

Site Lehaunstown				**Probe Number** DP02
Machine : Tecop Tec 10 **Method :** Dynamic Probe	**Cone Dimensions** Diameter 47.3mm, Angle 90°	**Ground Level (mOD)** 46.46	**Client** DLRD	**Job Number** 12914-06-23
	Location 723457.6 E 723850.4 N	**Dates** 14/08/2023	**Engineer**	**Sheet** 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)	Depth (m)
0.00-0.10	3		46.46	0.00
0.10-0.20	2			
0.20-0.30	2			
0.30-0.40	3			
0.40-0.50	2			
0.50-0.60	3		45.96	0.50
0.60-0.70	3			
0.70-0.80	3			
0.80-0.90	3			
0.90-1.00	4			
1.00-1.10	4		45.46	1.00
1.10-1.20	4			
1.20-1.30	3			
1.30-1.40	3			
1.40-1.50	2			
1.50-1.60	4		44.96	1.50
1.60-1.70	4			
1.70-1.80	7			
1.80-1.90	9			
1.90-2.00	11			
2.00-2.10	13		44.46	2.00
2.10-2.20	8			
2.20-2.30	5			
2.30-2.40	6			
2.40-2.50	7			
2.50-2.60	13		43.96	2.50
2.60-2.70	8			
2.70-2.80	11			
2.80-2.90	9			
2.90-3.00	12			
3.00-3.10	10		43.46	3.00
3.10-3.20	18			
3.20-3.30	25			
			42.96	3.50
			42.46	4.00
			41.96	4.50
			41.46	5.00



Remarks
Refusal at 3.30m BGL 25 blows

Scale (approx)	Logged By
1:25	S Kealy

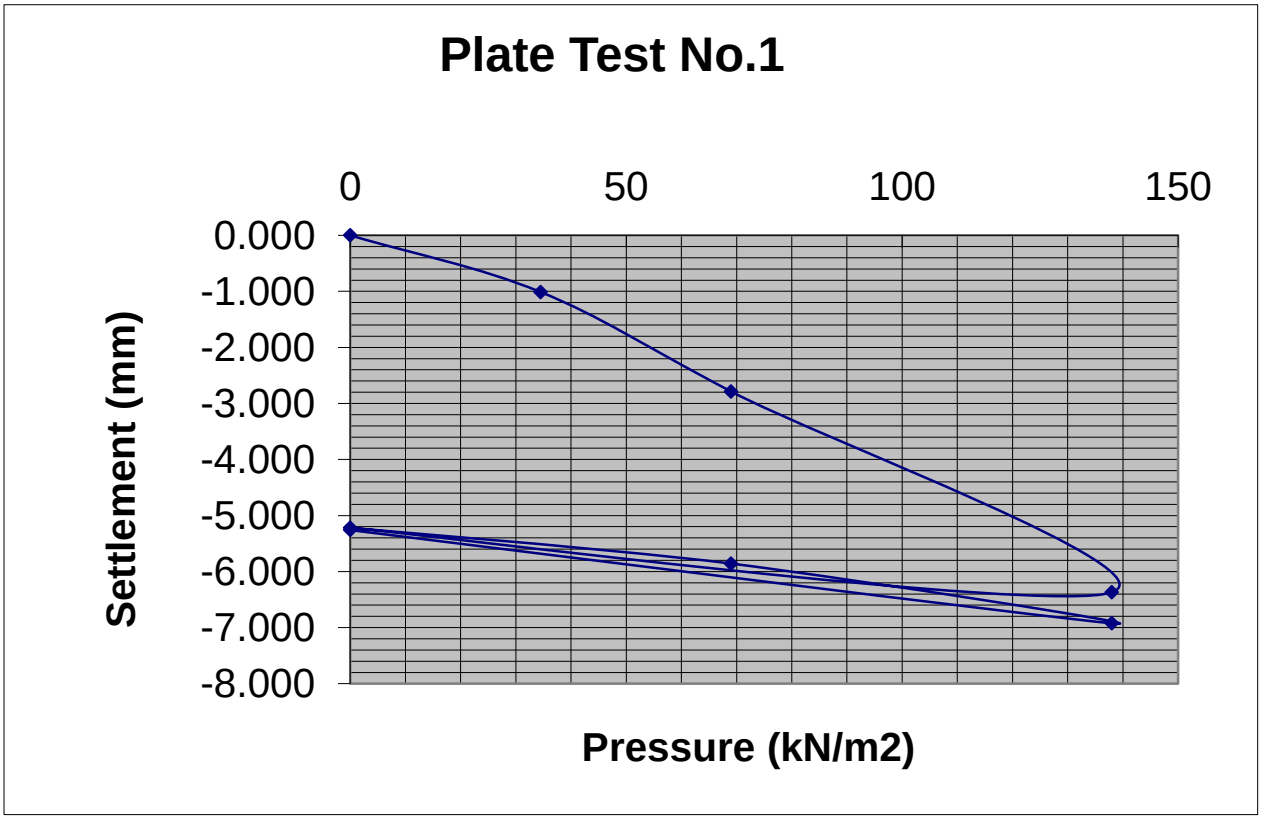
Figure No.
12914-06-23.DP02

APPENDIX 5 – Plate Test Records

Applied Load	Gauge settlement
0	**0.000**
34.5	-1.012
69	-2.7865
138	-6.37
0	-5.219
69	-5.8575
138	-6.923
0	-5.2595

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

LOCATION	Lehaunstown, Cabinteely	**MATERIAL**	
CONTRACT NO.	12914-06-23	Brown slightly sandy	
DATE	13/07/2023	gravelly CLAY	
CLIENT	DLR COCO	**DEPTH**	0.50m
PLATE DIAMETER	305mm	**NOTES**	
TEST NO.	Test 1	**SAMPLES**	



Modulus of subgrade reaction, K (Initial) = **11.25 MN/m2/m**

Modulus of subgrade reaction, K (Reload) = **49.12 MN/m2/m**

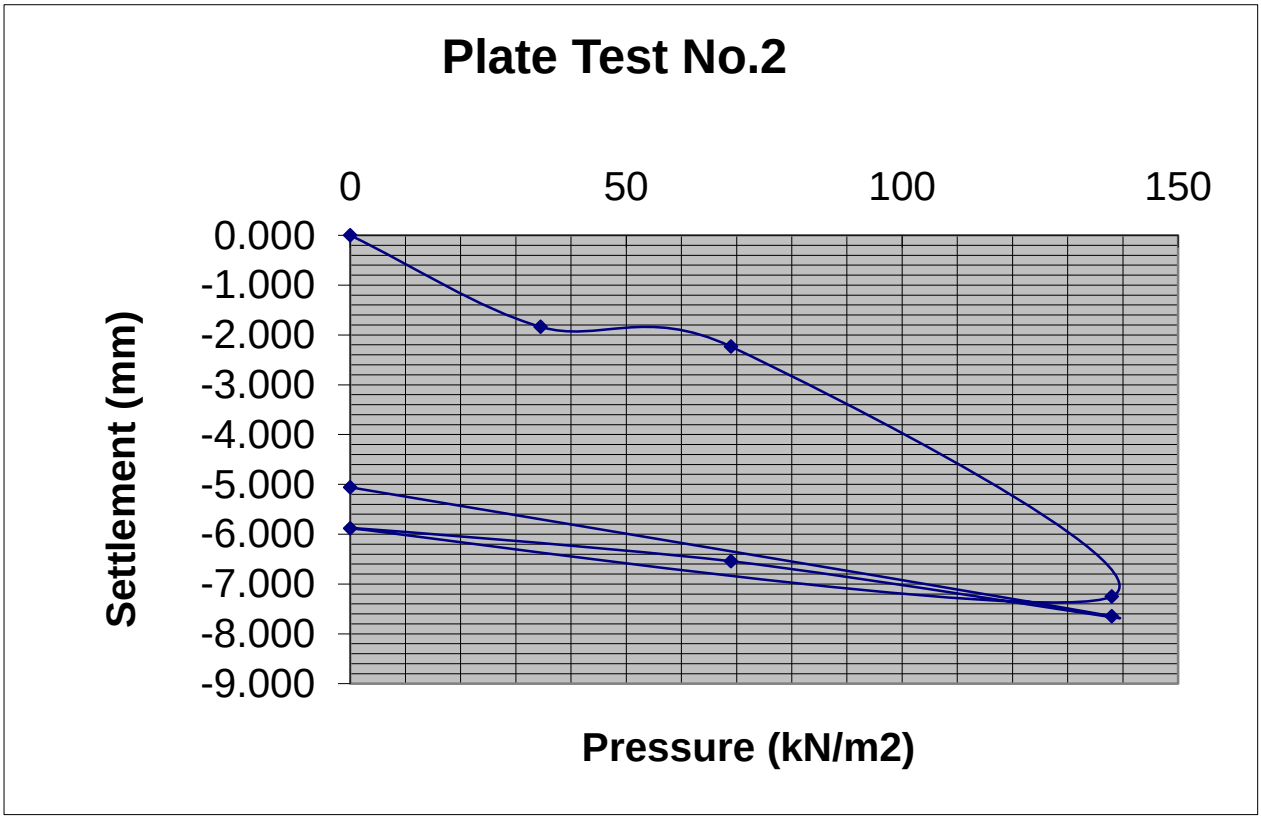
Equivalent CBR(initial)in accordance with HD25/94 volume7 section2 = **0.64 %**

Equivalent CBR(reload)in accordance with HD25/94 volume7 section2 = **8.23 %**

Applied Load	Gauge settlement
0	**0.000**
34.5	-1.838
69	-2.2345
138	-7.249
0	-5.8815
69	-6.5425
138	-7.6495
0	-5.0585

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

LOCATION	Lehaunstown, Cabinteely	**MATERIAL**	
CONTRACT NO.	12914-06-23	Brown sandy gravelly	
DATE	13/07/2023	CLAY	
CLIENT	DLR COCO	**DEPTH**	0.60m
PLATE DIAMETER	305mm	**NOTES**	
TEST NO.	Test 2	**SAMPLES**	



Modulus of subgrade reaction, K (Initial) = **14.03 MN/m2/m**

Modulus of subgrade reaction, K (Reload) = **47.44 MN/m2/m**

Equivalent CBR(initial)in accordance with HD25/94 volume7 section2 = **0.94 %**

Equivalent CBR(reload)in accordance with HD25/94 volume7 section2 = **7.75 %**

APPENDIX 6 – Cable Percussion Borehole Records

Ground Investigations Ireland Ltd
www.gii.ie

Site Lehaunstown			**Borehole Number** BH01
Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 200mm to 4m	**Ground Level (mOD)** 57.52	**Client** DLRD	**Job Number** 12914-06-23
	Location 723219.7 E 723824.3 N	**Dates** 10/08/2023	**Project Contractor** GII	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	B1					(1.00)	Brown gravelly CLAY with Granite cobbles. Gravels are fine to coarse angular to subangular.		
1.00-1.45 1.00	SPT(C) N=13 B2			1,3/3,3,4,3	56.52	1.00 (0.50)	Firm gravelly CLAY with Granite cobbles. Gravels are fine to coarse angular to subangular.		
2.00-2.45 2.00	SPT(C) N=9 B3			1,2/1,2,3,3	56.02	1.50 (1.10)	Firm brown gravelly CLAY with traces of Granite. Gravels are fine to coarse angular to subangular.		
3.00-3.45 3.00	SPT(C) N=45 B4			4,8/8,9,14,14	54.92	2.60 (0.40)	Firm brown sandy gravelly CLAY. Gravels are fine to coarse angular to subangular.		
					54.52	3.00 (0.80)	Very stiff brown sandy gravelly CLAY. Gravels are fine to coarse angular to subangular.		▼1
				Water strike(1) at 3.80m, rose to 3.50m in 20 mins.	53.72	3.80 (0.20)			▽1
4.00 4.00-4.05	B5 SPT(C) 50*/50 50/0			25,25/50	53.52	4.00	WEATHERED ROCK of Granite. Complete at 4.00m		

Remarks
Groundwater encountered at 3.8m BGL.
Borehole backfilled upon completion.

Scale (approx)	Logged By
1:50	LF

Figure No. 12914-06-23.BH01

Ground Investigations Ireland Ltd
www.gii.ie

Site	Borehole Number
Lehaunstown	BH02

Machine	Casing Diameter	Ground Level (mOD)	Client	Job Number
Dando 2000	200mm to 3.7m	54.63	DLRD	12914-06-23
Method : Cable Percussion	**Location** 723272.5 E 723839.4 N	**Dates** 10/08/2023-11/08/2023	**Project Contractor** GII	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.70)	Brown gravelly TOPSOIL.			
0.50	B1				53.93	0.70				
						(0.30)	Brown slightly sandy gravelly CLAY with low large cobble content. Gravels are fine to coarse angular to subangular.			
1.00	B2			Water strike(1) at 1.00m, fell to 3.50m in 20 mins.	53.63	1.00			▽1	
1.00-1.45	SPT(C) N=34			3,4/5,5,4,20			Stiff brown slightly sandy gravelly CLAY with low large cobble content. Gravels are fine to coarse angular to subangular.			
						(2.00)				
2.00-2.45	SPT(C) N=17			1,1/3,3,5,6						
2.00	B3									
3.00	B4			10/08/2023:NONE	51.63	3.00				
				11/08/2023:1.00m			Very stiff brown slightly sandy gravelly CLAY with low large cobble content. Gravels are fine to coarse angular to subangular.			
3.00-3.45	SPT(C) N=39			4,5/8,8,12,11		(0.60)			▼	
					51.03	3.60				
					50.93	3.70	Obstruction; possible rock or boulder.		▽2	
3.70	B5			Water strike(2) at 3.70m, rose to 3.50m in 20 mins. 11/08/2023:1.00m			Complete at 3.70m			
3.70-4.15	SPT(C)			25,25/50						

Remarks
Groundwater encountered at 1.0m and 3.5m BGL.
Standpipe installed in borehole upon completion. Slotted from 2.7m BGL to 1.0m BGL with gravel surround and plain from 1.0m BGL to GL with bentonite seal and raised cover.

Scale (approx)	Logged By
1:50	LF

Figure No. 12914-06-23.BH02

Ground Investigations Ireland Ltd
www.gii.ie

Site Lehaunstown			**Borehole Number** BH03
Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 200mm to 2.0m	**Ground Level (mOD)** 46.05	**Client** DLRD	**Job Number** 12914-06-23
	Location 723446.6 E 723937.5 N	**Dates** 15/08/2023	**Project Contractor** GII	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					46.00	0.05	TARMACADAM		
						(0.55)	POSSIBLE MADE GROUND: Brown gravelly clay Fill with limestone and granite cobbles. Gravels are fine to coarse angular to subangular.		
0.50	B1				45.45	0.60	POSSIBLE MADE GROUND: Loose gravelly clay Fill. Gravels are fine to coarse angular to subangular.		
1.00-1.45 1.00	SPT(C) N=14 B2			2,2/2,3,4,5		(0.90)			
					44.55	1.50	POSSIBLE WEATHERED ROCK: Recovered as white/pink slightly gravelly Sand (Medium dense).		
						(0.50)			
2.00-2.15 2.00	SPT(C) 50/0 B3			25,25/50	44.05	2.00	Complete at 2.00m		

Remarks
No groundwater encountered.
Borehole backfilled upon completion.

Scale (approx)	Logged By
1:50	AM

Figure No. 12914-06-23.BH03

APPENDIX 7 – Rising Head Permeability Test Records

RISING HEAD TEST

Test in standpipe to BS5930 2010

Borehole No. 02		**Job Name**	**Lehaunstown Cabinteely Co. Dublin**
Test Zone		**Standpipe Details:**	
Depth from (m bgl)	11.1	Height above Ground Level	0
Depth to (m bgl)	11.4	Depth to	11.4
Length of Test Zone (m)	2.7	Depth (mbgl)	n/a
Hole Diameter (m)	0.2	Diameter (m)	n/a
Standpipe Diameter	0.05		
CSA of Filter Zone (m2)	0.031	**Water Level Prior to Start of Test (Ws)**	
		WS mBGL	0.67

Test No. Test 1

Time (mins)	Water Level (W) (m below top)	Head H (W-Ws)	H/H0
0	3.14	2.47	1.000
0.25	3.14	2.47	1.000
0.5	2.95	2.28	0.923
0.75	2.85	2.18	0.883
1	2.66	1.99	0.806
1.5	2.53	1.86	0.753
2	2.43	1.76	0.713
2.5	2.3	1.63	0.660
3	2.2	1.53	0.619
3.5	2.0	1.37	0.555
4	1.96	1.29	0.522
4.5	1.87	1.2	0.486
5	1.78	1.11	0.449
7	1.45	0.78	0.316
10	1.1	0.42	0.170
15	0.69	0.02	0.008

Ho
2.47

Intake Factor (F)		**Basic Time Factor**	
L	2.7	H/Ho	0.37
L/D	1.5	T (mins)	**7** at H/Ho = 0.37
F	3.96	T(Seconds)	420

Intake Factor (F): Figure 7 BS5930

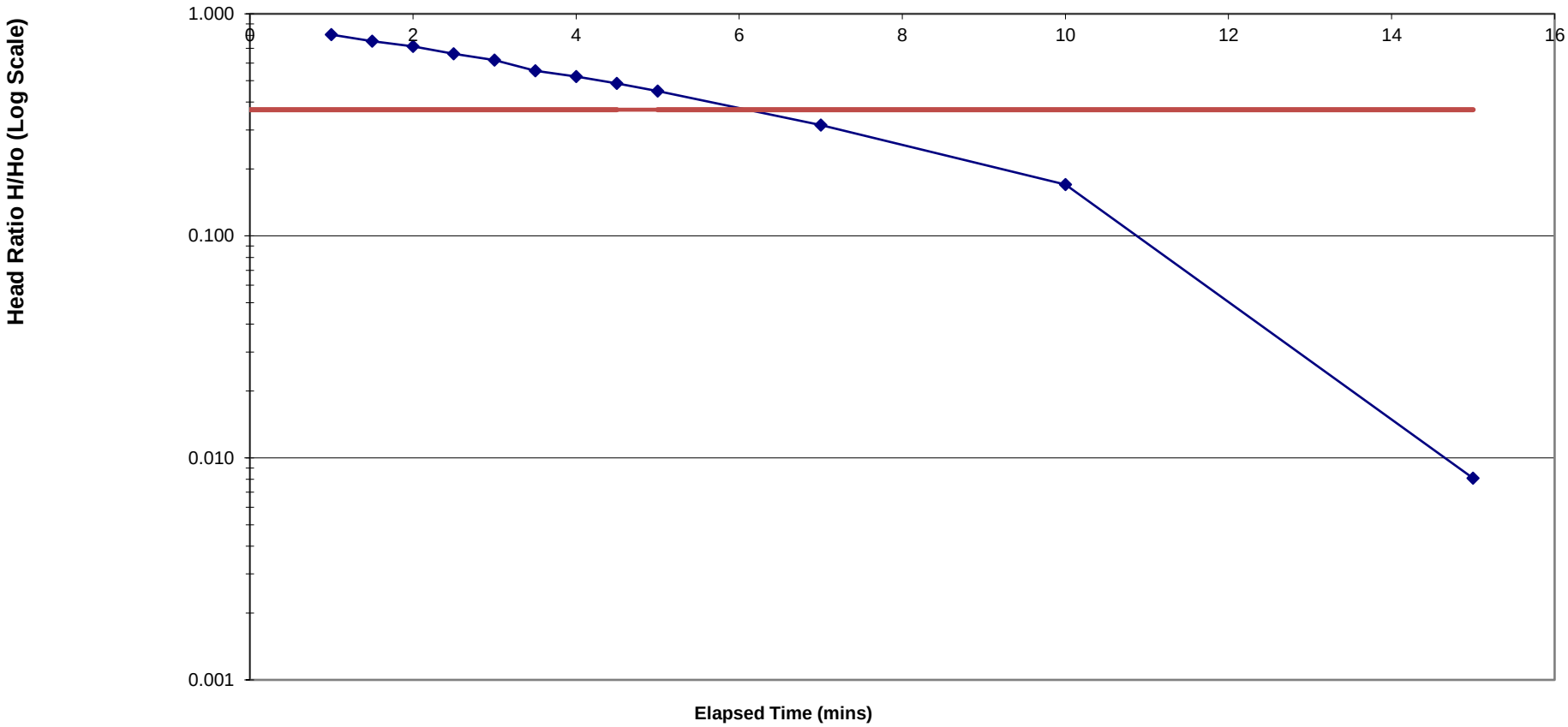
F = (2.32*Pi*L/D) / Ln (L/D + SQRT((1.1(L/D) + SqRt(1+1.1*(L/D)*(L/D))))

Permeability

Note: Diameter of filter zone used in calculation of area in permeability calculation below;

k = A / (F x T) **1.89E-05** m/secs

Lehaunstown Cbinteely BH02 Rising Head Test



APPENDIX 8 – Laboratory Test Records

National Materials Testing Laboratory Ltd.

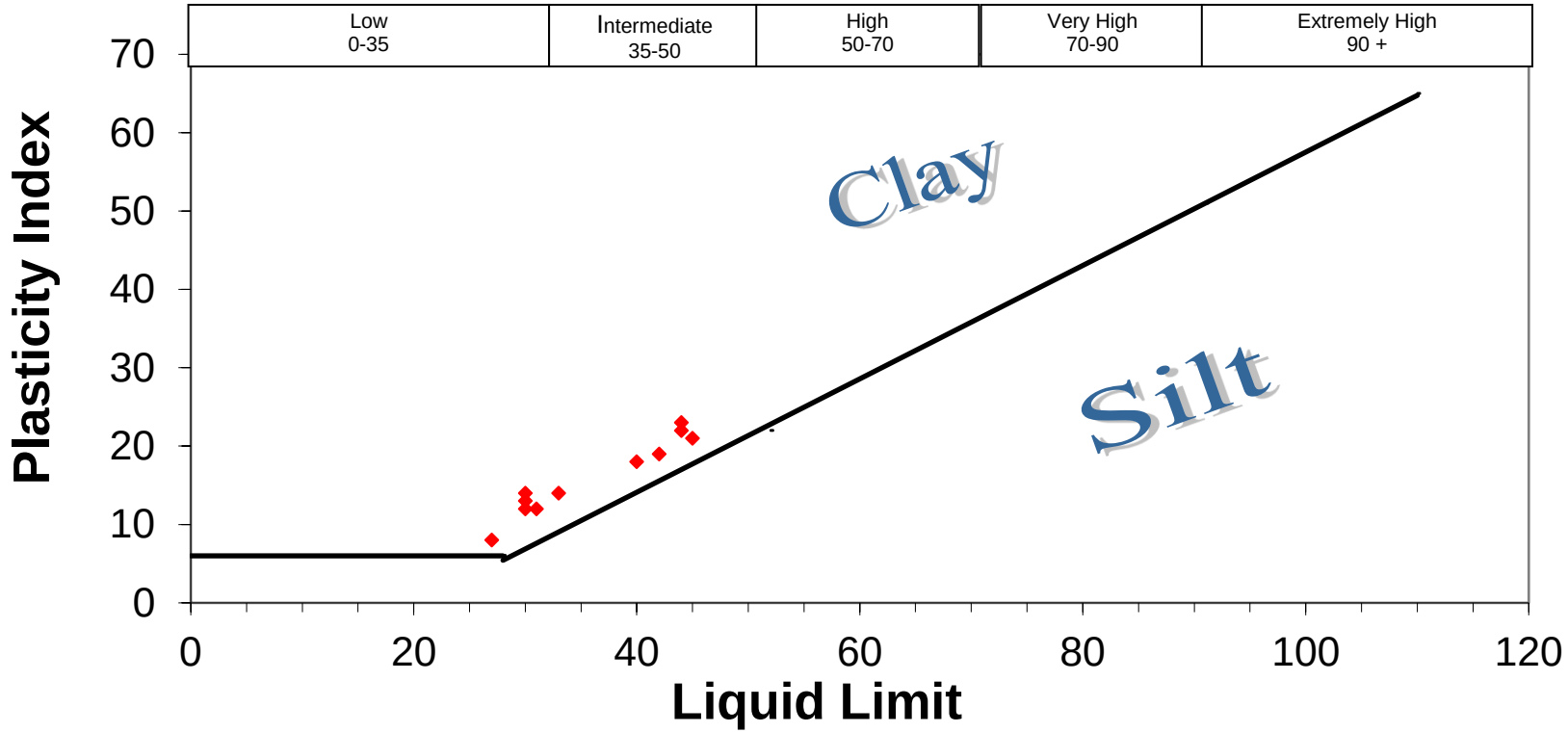
SUMMARY OF TEST RESULTS

				Particle			Index Properties		Bulk	Cell	Undrained Triaxial Tests		Lab	
BH/TP	Depth	sample	Moisture	Density	<425um	LL	PL	PI	Density	Presssure	Compressive	Strain at	Vane	Remarks
No	m	No.	%	Mg/m3	%	%	%	%	Mg/m3	kPa	Stress kPa	Failure %	kPa	
TP01	1.20	B	12.5		40.2	31	19	12						
TP01	2.60	**B**	12.0		53.2	40	22	18						
TP02	1.10	**B**	11.7		9.0	27	19	8						
TP03	0.60	**B**	17.7		47.1	33	19	14						
TP03	1.10	**B**	18.0		88.4	44	21	23						
TP03	3.20	**B**	23.5		93.3	44	22	22						
TP04	1.50	**B**	21.7		88.9	45	24	21						
TP04	2.50	**B**	27.8		87.6	42	23	19						
TP05	1.00	**B**	16.7		64.6	30	17	13						
TP05	2.00	**B**	11.1		54.3	30	18	12						
TP05	3.50	**B**	12.6		48.8	30	16	14						
NMTL		Notes :									Job ref No.	NMTL 3652	GII Project ID:	12914-06-23
		1. All BS tests carried out using preferred (definitive) method unless otherwise stated.									Location	Lehaunstown, Cabinteely		

Revision-02

NMTL LTD
Unit 18c, Tullow Industrial Estate
Tullow
County Carlow
Tel: 00353 59 9180822
Mob: 00353 872575508
billa@nmtl.ie

Contract:	**Lehaunstown, Cabinteely**		
Client:	**Ground Investigations Ireland Ltd**		
Engineer:	**Stephen Kealy**		
GII Project ID	**12914-06-23**		
Date:	**06/09/2023**		
Tested By:	**Js/Dk**	**Checked:**	**Bc**
Job ref No.	**NMTL 3652**		



NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	96.1
28.000	93.1
20.000	89.9
14.000	82.8
10.000	80.7
6.300	76.5
5.000	74.5
3.350	71.1
2.000	64.0
1.180	56.5
0.600	46.3
0.425	40.2
0.300	35.4
0.212	32.4
0.150	30.1
0.063	25.4
0.055	24.1
0.039	21.4
0.020	18.1
0.011	13.8
0.008	12.4
0.005	10.1
0.004	9.5
0.002	7.3

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
7.3		18.1			38.6			36.0		0.0	0.0

Sample Description	Brown gravelly sandy silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP01
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	1.20m

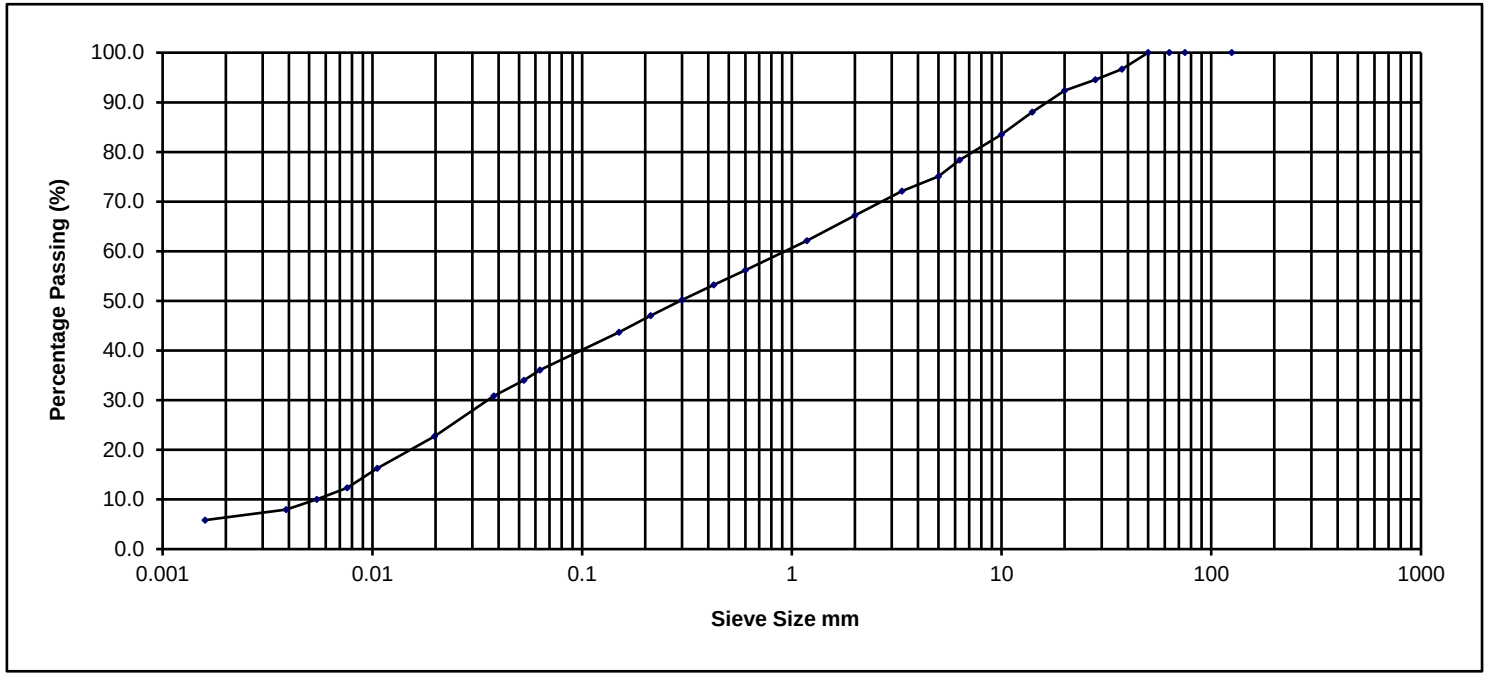
NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	96.7
28.000	94.6
20.000	92.3
14.000	88.1
10.000	83.5
6.300	78.4
5.000	75.1
3.350	72.1
2.000	67.2
1.180	62.1
0.600	56.2
0.425	53.2
0.300	50.2
0.212	47.0
0.150	43.7
0.063	36.1
0.053	34.0
0.038	30.9
0.020	22.7
0.011	16.3
0.008	12.3
0.005	10.0
0.004	7.9
0.002	5.8



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
5.8		30.2			31.1			32.8		0.0	0.0

Sample Description	Brown slightly sandy slightly gravelly silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP01
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	2.60m

NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	87.2
37.500	78.0
28.000	68.7
20.000	56.8
14.000	49.8
10.000	44.1
6.300	37.5
5.000	34.4
3.350	31.2
2.000	25.3
1.180	18.7
0.600	10.9
0.425	9.0
0.300	8.2
0.212	7.7
0.150	7.2
0.063	6.0
0.055	5.7
0.039	5.1
0.020	4.3
0.011	3.3
0.008	2.9
0.005	2.4
0.004	2.3
0.002	1.7

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
1.7		4.3			19.3			74.7		0.0	0.0

Sample Description	Brown silty sandy fine to coarse GRAVEL.					Project No.	NMTL 3652
						BH/TP No.	TP02
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	1.10m

NMTL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	76.9
37.500	72.7
28.000	69.5
20.000	67.6
14.000	66.0
10.000	64.2
6.300	61.1
5.000	59.5
3.350	57.8
2.000	54.9
1.180	52.1
0.600	48.8
0.425	47.1
0.300	45.1
0.212	42.7
0.150	39.9
0.063	33.8
0.053	31.8
0.038	29.8
0.020	23.6
0.010	20.2
0.007	18.6
0.005	16.6
0.004	14.2
0.002	11.6

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
11.6		22.2			21.0			45.1		0.0	0.0

Sample Description	Brown slightly sandy gravelly silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP03
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	0.60m

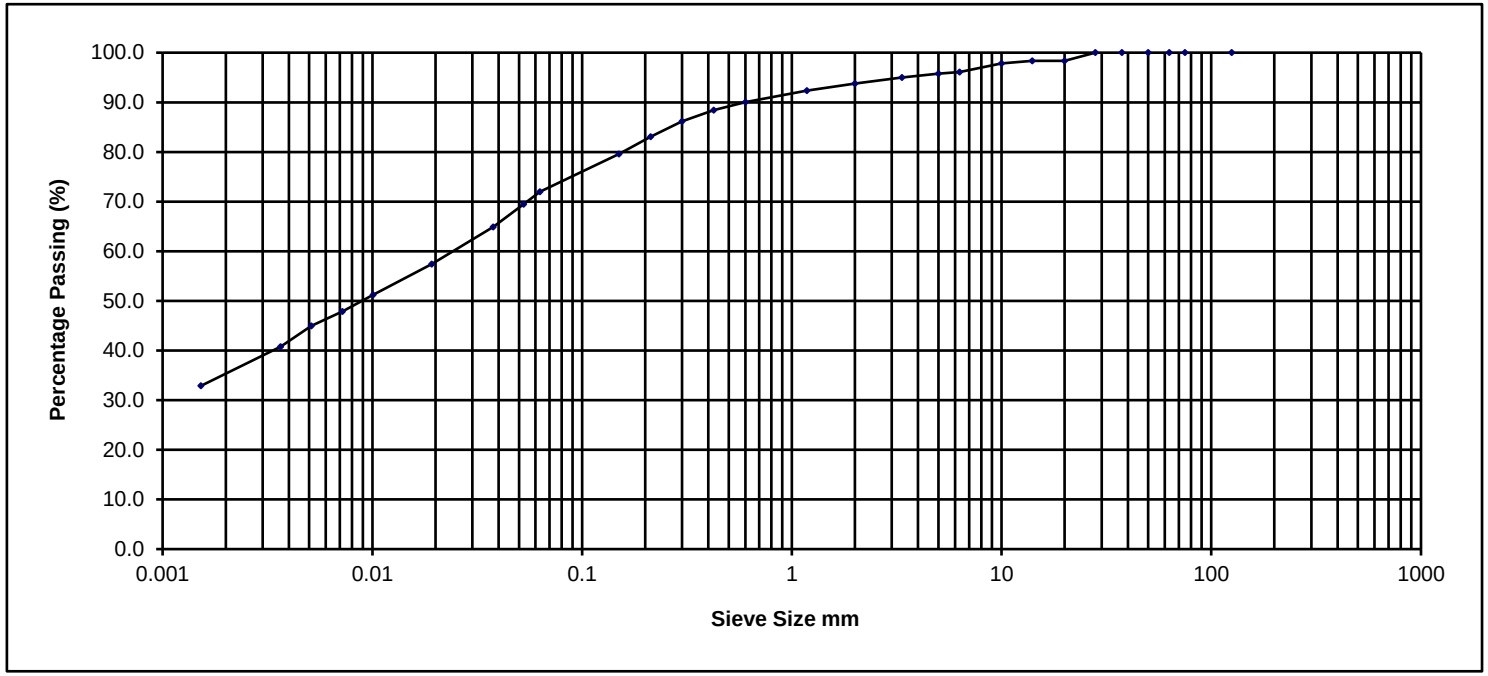
NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	98.4
14.000	98.4
10.000	97.8
6.300	96.1
5.000	95.8
3.350	95.0
2.000	93.8
1.180	92.3
0.600	90.0
0.425	88.4
0.300	86.1
0.212	83.0
0.150	79.6
0.063	72.0
0.053	69.5
0.038	64.9
0.019	57.4
0.010	51.2
0.007	47.9
0.005	44.9
0.004	40.8
0.002	32.9



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
32.9		39.1			21.8			6.2		0.0	0.0

Sample Description	Red/brown slightly gravelly slightly sandy silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP03
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	1.10m

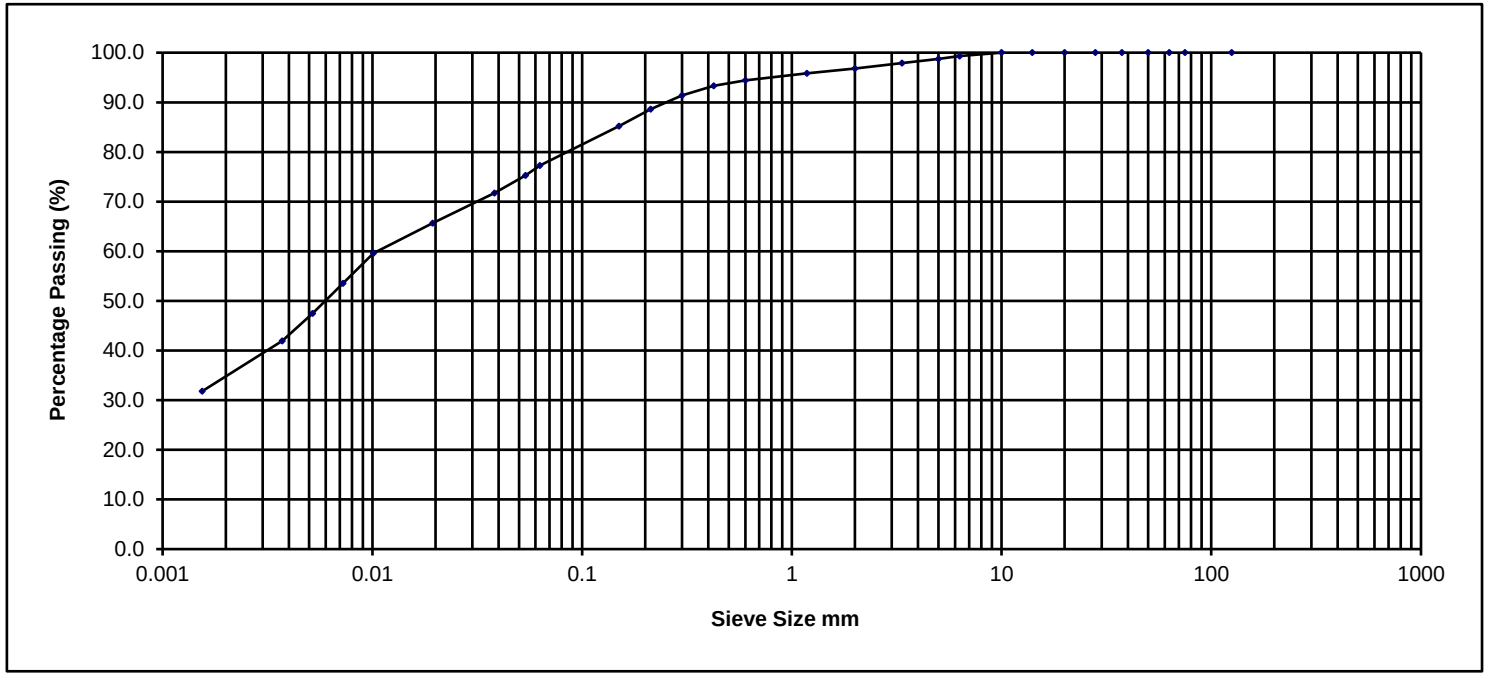
NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	99.3
5.000	98.7
3.350	97.9
2.000	96.8
1.180	95.8
0.600	94.4
0.425	93.3
0.300	91.4
0.212	88.6
0.150	85.2
0.063	77.3
0.054	75.2
0.038	71.7
0.019	65.6
0.010	59.6
0.007	53.5
0.005	47.5
0.004	41.9
0.002	31.8



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
31.8		45.4			19.5			3.2		0.0	0.0

Sample Description	Brown/grey slightly gravelly slightly sandy silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP03
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Depth	3.20m
				Date sample tested	31/08/2023		

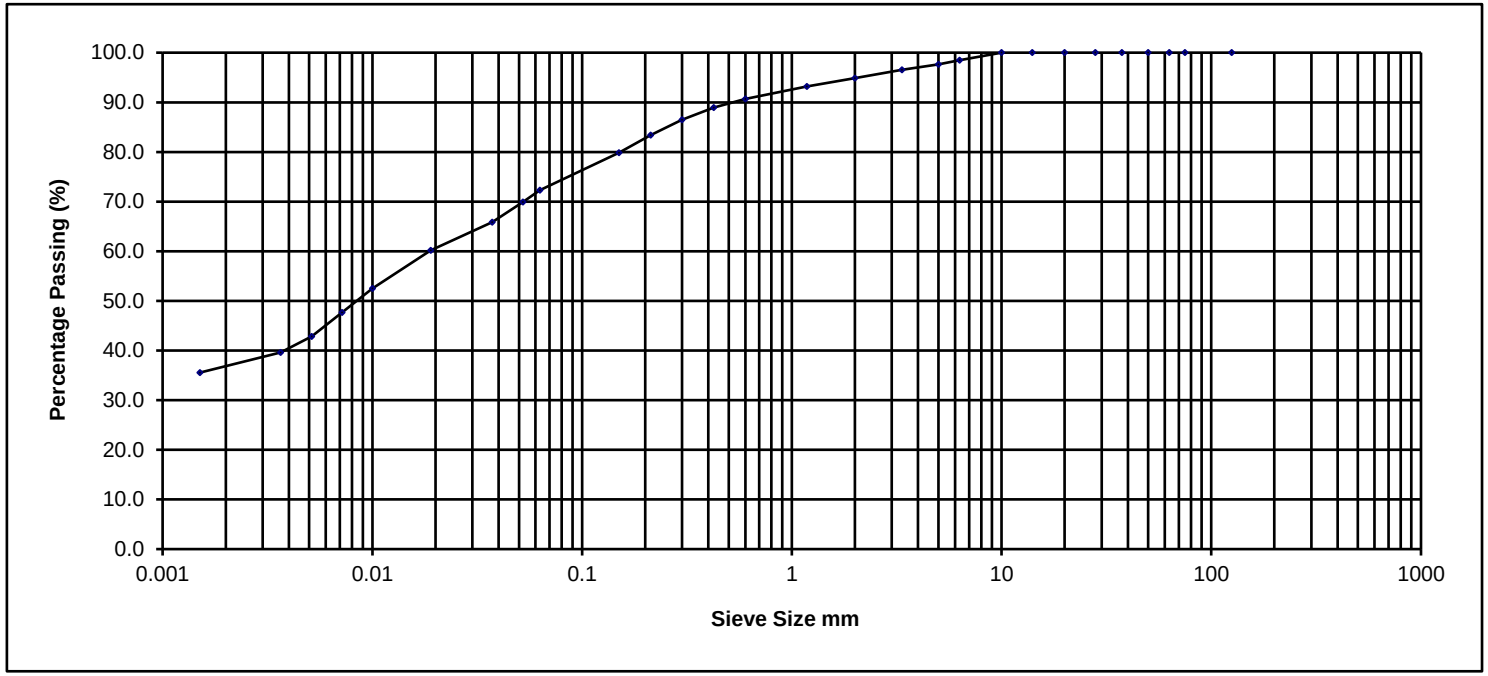
NMTL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	98.5
5.000	97.7
3.350	96.6
2.000	94.9
1.180	93.2
0.600	90.7
0.425	88.9
0.300	86.5
0.212	83.4
0.150	79.8
0.063	72.3
0.052	69.9
0.037	65.9
0.019	60.2
0.010	52.5
0.007	47.7
0.005	42.8
0.004	39.6
0.002	35.6



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
35.6		36.8			22.5			5.1		0.0	0.0

Sample Description	Orange/brown slightly gravelly slightly sandy silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP04
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	1.50m

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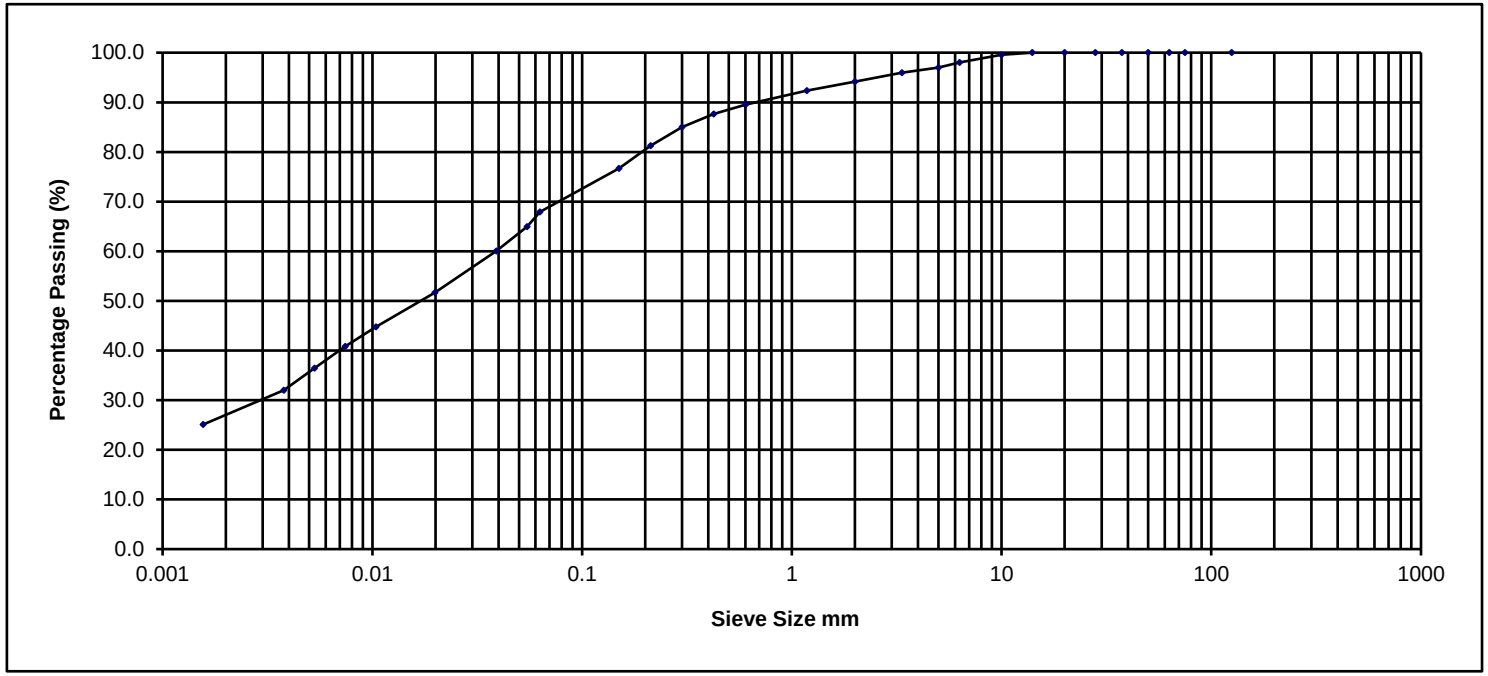
Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	99.6
6.300	98.0
5.000	97.0
3.350	96.0
2.000	94.1
1.180	92.4
0.600	89.5
0.425	87.6
0.300	85.0
0.212	81.2
0.150	76.7
0.063	67.9
0.055	65.0
0.039	60.1
0.020	51.7
0.010	44.8
0.007	40.9
0.005	36.4
0.004	32.0
0.002	25.1



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
25.1		42.8			26.2			5.9		0.0	0.0

Sample Description	Red/brown slightly gravelly slightly sandy silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP04
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	2.50m

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Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	97.4
14.000	91.9
10.000	89.6
6.300	84.3
5.000	81.2
3.350	78.7
2.000	74.9
1.180	71.3
0.600	66.9
0.425	64.6
0.300	61.9
0.212	58.3
0.150	54.0
0.063	44.6
0.054	42.1
0.039	37.9
0.020	32.6
0.010	26.7
0.007	23.3
0.005	20.5
0.004	17.7
0.002	14.9

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
14.9		29.8			30.2			25.1		0.0	0.0

Sample Description	Brown slightly gravelly slightly sandy silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP05
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	1.00m

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Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	94.9
37.500	88.8
28.000	83.3
20.000	79.5
14.000	75.8
10.000	74.7
6.300	70.5
5.000	68.5
3.350	66.1
2.000	62.8
1.180	59.7
0.600	56.1
0.425	54.3
0.300	52.1
0.212	49.5
0.150	46.3
0.063	39.5
0.051	38.1
0.037	34.6
0.019	26.9
0.010	19.4
0.007	17.2
0.005	15.2
0.004	13.6
0.002	10.7

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
10.7		28.8			23.3			37.2		0.0	0.0

Sample Description	Brown slightly sandy gravelly silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP05
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Depth	2.00m
				Date sample tested	31/08/2023		

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Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	87.4
37.500	78.1
28.000	75.9
20.000	73.0
14.000	66.7
10.000	65.1
6.300	61.6
5.000	60.0
3.350	58.5
2.000	55.7
1.180	53.1
0.600	50.3
0.425	48.8
0.300	46.9
0.212	44.6
0.150	41.8
0.063	35.6
0.053	33.7
0.038	30.5
0.020	23.1
0.010	17.6
0.007	15.5
0.005	13.4
0.004	12.3
0.002	10.2

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
10.2		25.4			20.0			44.3		0.0	0.0

Sample Description	Brown slightly sandy gravelly silty CLAY.					Project No.	NMTL 3652
						BH/TP No.	TP05
Project	Lehaunstown, Cabinteely			GII PROJECT ID:12914-06-23		Sample No.	B
Operator	Sb	Checked	Nc	Approved	Bc	Date sample tested	31/08/2023	Depth	3.50m

NM TL Ltd

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Hazelhatch Road
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Ireland
D22 K5P8

Attention :	Stephen Kealy
Date :	31st August, 2023
Your reference :	12914-06-23
Our reference :	Test Report 23/13545 Batch 1
Location :	Lehaunstown Cabinteely
Date samples received :	16th August, 2023
Status :	Final Report
Issue :	1

Sixteen samples were received for analysis on 16th August, 2023 of which sixteen were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Phil Sommerton BSc
Senior Project Manager

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40	LOD/LOR	Units	Method No.
Sample ID	TP01	TP01	TP02	TP02	TP02	TP03	TP03	TP03	TP03	TP04			
Depth	1.20	2.60	0.50	1.10	2.60	0.60	1.10	2.40	3.20	1.50			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023			
Antimony	1	2	3	<1	-	2	1	2	-	2	<1	mg/kg	TM30/PM15
Arsenic #	9.0	9.9	13.0	13.6	-	12.5	8.6	7.2	-	11.6	<0.5	mg/kg	TM30/PM15
Barium #	32	57	119	42	-	71	89	104	-	80	<1	mg/kg	TM30/PM15
Cadmium #	1.0	2.0	0.9	1.0	-	1.0	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM30/PM15
Chromium #	47.8	12.9	83.6	39.9	-	56.9	60.3	70.4	-	67.2	<0.5	mg/kg	TM30/PM15
Copper #	16	27	18	17	-	25	21	23	-	23	<1	mg/kg	TM30/PM15
Lead #	10	16	20	13	-	19	12	13	-	12	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	-	<0.1	0.2	<0.1	-	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum #	3.5	2.4	4.0	2.7	-	3.6	1.7	2.2	-	1.9	<0.1	mg/kg	TM30/PM15
Nickel #	19.6	35.5	33.1	20.5	-	42.4	34.0	40.6	-	37.4	<0.7	mg/kg	TM30/PM15
Selenium #	<1	2	1	<1	-	<1	<1	<1	-	<1	<1	mg/kg	TM30/PM15
Sulphur as S	0.02	-	-	-	0.02	-	0.02	-	-	-	<0.01	%	TM30/PM15
Total Sulphate as SO4 BRE	-	0.02	-	0.02	-	-	-	-	0.02	-	<0.01	%	TM50/PM29
Zinc #	49	90	123	51	-	80	56	64	-	58	<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	-	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	-	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	-	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	-	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	<0.06	<0.06	-	<0.06	<0.06	<0.06	-	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	-	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	<0.07	<0.07	-	<0.07	<0.07	<0.07	-	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	<0.22	<0.22	<0.22	-	<0.22	<0.22	<0.22	-	<0.22	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64	<0.64	<0.64	-	<0.64	<0.64	<0.64	-	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	-	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	-	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(j)fluoranthene	<1	<1	<1	<1	-	<1	<1	<1	-	<1	<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	97	103	98	107	-	102	102	94	-	102	<0	%	TM4/PM8
Mineral Oil (C10-C40) (EH_CU_1D_AL)	<30	<30	<30	<30	-	<30	<30	<30	-	<30	<30	mg/kg	TM5/PM8/PM16

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40	LOD/LOR	Units	Method No.
Sample ID	TP01	TP01	TP02	TP02	TP02	TP03	TP03	TP03	TP03	TP04			
Depth	1.20	2.60	0.50	1.10	2.60	0.60	1.10	2.40	3.20	1.50			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023			
TPH CWG													
Aliphatics													
>C5-C6 (HS_1D_AL)#	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8 (HS_1D_AL)#	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10 (HS_1D_AL)	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 (EH_CU_1D_AL)#	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	-	<0.2	<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 (EH_CU_1D_AL)#	<4	<4	<4	<4	-	<4	<4	<4	-	<4	<4	mg/kg	TM5/PM8/PM16
>C16-C21 (EH_CU_1D_AL)#	<7	<7	<7	<7	-	<7	<7	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>C21-C35 (EH_CU_1D_AL)#	<7	<7	<7	<7	-	<7	<7	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>C35-C40 (EH_CU_1D_AL)	<7	<7	<7	<7	-	<7	<7	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-40 (EH+HS_CU_1D_AL)	<26	<26	<26	<26	-	<26	<26	<26	-	<26	<26	mg/kg	TM5/TM36/PM8/PM12/PM16
>C6-C10 (HS_1D_AL)	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C25 (EH_1D_AL)	<10	<10	<10	<10	-	<10	<10	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
>C25-C35 (EH_1D_AL)	<10	<10	<10	<10	-	<10	<10	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
Aromatics													
>C5-EC7 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR)#	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	-	<0.2	<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 (EH_CU_1D_AR)#	<4	<4	<4	<4	-	<4	<4	<4	-	<4	<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 (EH_CU_1D_AR)#	<7	<7	<7	<7	-	<7	<7	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 (EH_CU_1D_AR)#	<7	<7	<7	<7	-	<7	<7	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>EC35-EC40 (EH_CU_1D_AR)	<7	<7	<7	<7	-	<7	<7	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-40 (EH+HS_CU_1D_AR)	<26	<26	<26	<26	-	<26	<26	<26	-	<26	<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-40) (EH+HS_CU_1D_Total)	<52	<52	<52	<52	-	<52	<52	<52	-	<52	<52	mg/kg	TM5/TM36/PM8/PM12/PM16
>EC6-EC10 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC25 (EH_1D_AR)	<10	<10	<10	<10	-	<10	<10	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
>EC25-EC35 (EH_1D_AR)	<10	<10	<10	<10	-	<10	<10	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
MTBE#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM36/PM12
Benzene#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM36/PM12
Toluene#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM36/PM12
Ethylbenzene#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM36/PM12
m/p-Xylene#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM36/PM12
o-Xylene#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM36/PM12
PCB 28#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 52#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 101#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 118#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 138#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 153#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 180#	<5	<5	<5	<5	-	<5	<5	<5	-	<5	<5	ug/kg	TM17/PM8
Total 7 PCBs#	<35	<35	<35	<35	-	<35	<35	<35	-	<35	<35	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40	LOD/LOR	Units	Method No.
Sample ID	TP01	TP01	TP02	TP02	TP02	TP03	TP03	TP03	TP03	TP04			
Depth	1.20	2.60	0.50	1.10	2.60	0.60	1.10	2.40	3.20	1.50			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023			
Natural Moisture Content	10.0	12.1	10.0	16.8	-	19.5	16.0	20.2	-	21.0	<0.1	%	PM4/PM0
Moisture Content (% Wet Weight)	17.4	10.3	9.1	14.9	-	16.3	14.4	16.8	-	17.4	<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	-	<0.3	<0.3	<0.3	-	<0.3	<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	-	0.0028	-	0.0117	-	-	-	-	0.0056	-	<0.0015	g/l	TM38/PM20
Chromium III	47.8	12.9	83.6	39.9	-	56.9	60.3	70.4	-	67.2	<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	0.12	0.33	0.51	0.22	-	0.25	0.21	0.42	-	0.15	<0.02	%	TM21/PM24
pH #	8.70	8.79	7.99	-	8.73	-	8.66	-	8.80	8.61	<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	41-44	45-48	49-52	53-56	57-60	61-64					LOD/LOR	Units	Method No.
Sample ID	TP04	TP04	TP05	TP05	TP05	TP05							
Depth	2.50	3.10	0.50	1.00	2.00	3.50							
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023							
Antimony	-	-	2	1	1	-					<1	mg/kg	TM30/PM15
Arsenic #	-	-	12.4	9.0	10.0	-					<0.5	mg/kg	TM30/PM15
Barium #	-	-	59	39	43	-					<1	mg/kg	TM30/PM15
Cadmium #	-	-	0.8	0.9	0.7	-					<0.1	mg/kg	TM30/PM15
Chromium #	-	-	61.4	33.1	54.8	-					<0.5	mg/kg	TM30/PM15
Copper #	-	-	28	21	20	-					<1	mg/kg	TM30/PM15
Lead #	-	-	19	15	16	-					<5	mg/kg	TM30/PM15
Mercury #	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM30/PM15
Molybdenum #	-	-	3.9	2.1	3.6	-					<0.1	mg/kg	TM30/PM15
Nickel #	-	-	43.5	30.3	30.9	-					<0.7	mg/kg	TM30/PM15
Selenium #	-	-	<1	<1	<1	-					<1	mg/kg	TM30/PM15
Sulphur as S	-	0.02	-	-	0.02	-					<0.01	%	TM30/PM15
Total Sulphate as SO4 BRE	0.02	-	-	0.02	-	-					<0.01	%	TM50/PM29
Zinc #	-	-	83	65	68	-					<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Acenaphthylene	-	-	<0.03	<0.03	<0.03	-					<0.03	mg/kg	TM4/PM8
Acenaphthene #	-	-	<0.05	<0.05	<0.05	-					<0.05	mg/kg	TM4/PM8
Fluorene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Phenanthrene #	-	-	<0.03	<0.03	<0.03	-					<0.03	mg/kg	TM4/PM8
Anthracene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Fluoranthene #	-	-	<0.03	<0.03	<0.03	-					<0.03	mg/kg	TM4/PM8
Pyrene #	-	-	<0.03	<0.03	<0.03	-					<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	-	-	<0.06	<0.06	<0.06	-					<0.06	mg/kg	TM4/PM8
Chrysene #	-	-	<0.02	<0.02	<0.02	-					<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	-	-	<0.07	<0.07	<0.07	-					<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
Coronene	-	-	<0.04	<0.04	<0.04	-					<0.04	mg/kg	TM4/PM8
PAH 6 Total #	-	-	<0.22	<0.22	<0.22	-					<0.22	mg/kg	TM4/PM8
PAH 17 Total	-	-	<0.64	<0.64	<0.64	-					<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	-	-	<0.05	<0.05	<0.05	-					<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	-	-	<0.02	<0.02	<0.02	-					<0.02	mg/kg	TM4/PM8
Benzo(j)fluoranthene	-	-	<1	<1	<1	-					<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	-	-	87	97	94	-					<0	%	TM4/PM8
Mineral Oil (C10-C40) (EH_CU_1D_AL)	-	-	<30	<30	<30	-					<30	mg/kg	TM5/PM8/PM16

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	41-44	45-48	49-52	53-56	57-60	61-64					LOD/LOR	Units	Method No.
Sample ID	TP04	TP04	TP05	TP05	TP05	TP05							
Depth	2.50	3.10	0.50	1.00	2.00	3.50							
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023							
TPH CWG													
Aliphatics													
>C5-C6 (HS_1D_AL)#	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>C6-C8 (HS_1D_AL)#	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>C8-C10 (HS_1D_AL)	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>C10-C12 (EH_CU_1D_AL)#	-	-	<0.2	<0.2	<0.2	-					<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 (EH_CU_1D_AL)#	-	-	<4	<4	<4	-					<4	mg/kg	TM5/PM8/PM16
>C16-C21 (EH_CU_1D_AL)#	-	-	<7	<7	<7	-					<7	mg/kg	TM5/PM8/PM16
>C21-C35 (EH_CU_1D_AL)#	-	-	<7	<7	<7	-					<7	mg/kg	TM5/PM8/PM16
>C35-C40 (EH_CU_1D_AL)	-	-	<7	<7	<7	-					<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-40 (EH+HS_CU_1D_AL)	-	-	<26	<26	<26	-					<26	mg/kg	TM5/TM36/PM8/PM12/PM16
>C6-C10 (HS_1D_AL)	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>C10-C25 (EH_1D_AL)	-	-	<10	<10	<10	-					<10	mg/kg	TM5/PM8/PM16
>C25-C35 (EH_1D_AL)	-	-	<10	<10	<10	-					<10	mg/kg	TM5/PM8/PM16
Aromatics													
>C5-EC7 (HS_1D_AR)#	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>EC7-EC8 (HS_1D_AR)#	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>EC8-EC10 (HS_1D_AR)#	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR)#	-	-	<0.2	<0.2	<0.2	-					<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 (EH_CU_1D_AR)#	-	-	<4	<4	<4	-					<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 (EH_CU_1D_AR)#	-	-	<7	<7	<7	-					<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 (EH_CU_1D_AR)#	-	-	<7	<7	<7	-					<7	mg/kg	TM5/PM8/PM16
>EC35-EC40 (EH_CU_1D_AR)	-	-	<7	<7	<7	-					<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-40 (EH+HS_CU_1D_AR)	-	-	<26	<26	<26	-					<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-40) (EH+HS_CU_1D_Total)	-	-	<52	<52	<52	-					<52	mg/kg	TM5/TM36/PM8/PM12/PM16
>EC6-EC10 (HS_1D_AR)#	-	-	<0.1	<0.1	<0.1	-					<0.1	mg/kg	TM36/PM12
>EC10-EC25 (EH_1D_AR)	-	-	<10	<10	<10	-					<10	mg/kg	TM5/PM8/PM16
>EC25-EC35 (EH_1D_AR)	-	-	<10	<10	<10	-					<10	mg/kg	TM5/PM8/PM16
MTBE#	-	-	<5	<5	<5	-					<5	ug/kg	TM36/PM12
Benzene#	-	-	<5	<5	<5	-					<5	ug/kg	TM36/PM12
Toluene#	-	-	<5	<5	<5	-					<5	ug/kg	TM36/PM12
Ethylbenzene#	-	-	<5	<5	<5	-					<5	ug/kg	TM36/PM12
m/p-Xylene#	-	-	<5	<5	<5	-					<5	ug/kg	TM36/PM12
o-Xylene#	-	-	<5	<5	<5	-					<5	ug/kg	TM36/PM12
PCB 28#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
PCB 52#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
PCB 101#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
PCB 118#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
PCB 138#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
PCB 153#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
PCB 180#	-	-	<5	<5	<5	-					<5	ug/kg	TM17/PM8
Total 7 PCBs#	-	-	<35	<35	<35	-					<35	ug/kg	TM17/PM8

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	41-44	45-48	49-52	53-56	57-60	61-64					LOD/LOR	Units	Method No.
Sample ID	TP04	TP04	TP05	TP05	TP05	TP05							
Depth	2.50	3.10	0.50	1.00	2.00	3.50							
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023							
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1	1							
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023							
Natural Moisture Content	-	-	19.5	13.4	13.1	-					<0.1	%	PM4/PM0
Moisture Content (% Wet Weight)	-	-	16.3	12.2	13.1	-					<0.1	%	PM4/PM0
Hexavalent Chromium #	-	-	<0.3	<0.3	<0.3	-					<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	0.0050	-	-	0.0048	-	-					<0.0015	g/l	TM38/PM20
Chromium III	-	-	61.4	33.1	54.8	-					<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	-	-	0.25	0.18	0.17	-					<0.02	%	TM21/PM24
pH #	8.69	-	8.65	8.78	-	8.75					<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-4	5-8	9-12	13-16	21-24	25-28	29-32	37-40	49-52	53-56	LOD/LOR	Units	Method No.
Sample ID	TP01	TP01	TP02	TP02	TP03	TP03	TP03	TP04	TP05	TP05			
Depth	1.20	2.60	0.50	1.10	0.60	1.10	2.40	1.50	0.50	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023			
Dissolved Antimony #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium #	<0.003	<0.003	0.007	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015	<0.0015	0.0017	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	0.017	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.011	<0.007	<0.007	<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.11	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.004	0.006	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.04	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003	<0.003	0.009	<0.003	<0.003	<0.003	<0.003	0.007	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03	<0.03	0.09	<0.03	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	mg/l	TM61/PM0
Mercury Dissolved by CVAF #	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	mg/kg	TM61/PM0
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	<0.3	<0.3	0.3	<0.3	<0.3	0.3	<0.3	0.4	<0.3	<0.3	<0.3	mg/l	TM173/PM0
Fluoride	<3	<3	3	<3	<3	3	<3	4	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	<0.5	<0.5	1.8	2.1	<0.5	0.6	1.6	0.5	<0.5	0.6	<0.5	mg/l	TM38/PM0
Sulphate as SO4 #	<5	<5	18	21	<5	6	16	5	<5	6	<5	mg/kg	TM38/PM0
Mass of raw test portion	0.1069	0.1002	0.1057	0.1071	0.1083	0.1065	0.1133	0.1118	0.1087	0.1064		kg	NONE/PM17
Chloride #	<0.3	<0.3	0.5	<0.3	0.3	0.4	0.7	<0.3	<0.3	<0.3	<0.3	mg/l	TM38/PM0
Chloride #	<3	<3	5	<3	3	4	7	<3	<3	<3	<3	mg/kg	TM38/PM0
Mass of dried test portion	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		kg	NONE/PM17
Dissolved Organic Carbon	<2	<2	4	<2	<2	<2	3	<2	<2	<2	<2	mg/l	TM60/PM0
Dissolved Organic Carbon	<20	<20	40	<20	<20	<20	30	<20	<20	<20	<20	mg/kg	TM60/PM0
Total Dissolved Solids #	43	<35	37	<35	43	56	58	47	46	45	<35	mg/l	TM20/PM0

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-4	5-8	9-12	13-16	21-24	25-28	29-32	37-40	49-52	53-56	LOD/LOR	Units	Method No.
Sample ID	TP01	TP01	TP02	TP02	TP03	TP03	TP03	TP04	TP05	TP05			
Depth	1.20	2.60	0.50	1.10	0.60	1.10	2.40	1.50	0.50	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023			
Total Dissolved Solids #	430	<350	370	<350	430	560	580	470	460	450	<350	mg/kg	TM20/PM0

Please see attached notes for all abbreviations and acronyms

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	57-60										LOD/LOR	Units	Method No.
Sample ID	TP05												
Depth	2.00												
COC No / misc													
Containers	V J T												
Sample Date	14/08/2023												
Sample Type	Soil												
Batch Number	1												
Date of Receipt	16/08/2023												
Dissolved Antimony #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025										<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025										<0.025	mg/kg	TM30/PM17
Dissolved Barium #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005										<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005										<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015										<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015										<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007										<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07										<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005										<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05										<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.002										<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.02										<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001										<0.00001	mg/l	TM61/PM0
Mercury Dissolved by CVAF #	<0.0001										<0.0001	mg/kg	TM61/PM0
Phenol	<0.01										<0.01	mg/l	TM26/PM0
Phenol	<0.1										<0.1	mg/kg	TM26/PM0
Fluoride	<0.3										<0.3	mg/l	TM173/PM0
Fluoride	<3										<3	mg/kg	TM173/PM0
Sulphate as SO4 #	<0.5										<0.5	mg/l	TM38/PM0
Sulphate as SO4 #	<5										<5	mg/kg	TM38/PM0
Mass of raw test portion	0.1057											kg	NONE/PM17
Chloride #	<0.3										<0.3	mg/l	TM38/PM0
Chloride #	<3										<3	mg/kg	TM38/PM0
Mass of dried test portion	0.09											kg	NONE/PM17
Dissolved Organic Carbon	<2										<2	mg/l	TM60/PM0
Dissolved Organic Carbon	<20										<20	mg/kg	TM60/PM0
Total Dissolved Solids #	<35										<35	mg/l	TM20/PM0

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	57-60										Please see attached notes for all abbreviations and acronyms		
Sample ID	TP05												
Depth	2.00												
COC No / misc													
Containers	V J T												
Sample Date	14/08/2023												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	16/08/2023												
Total Dissolved Solids #	<350										<350	mg/kg	TM20/PM0

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Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : EN12457_2

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4	5-8	9-12	13-16	21-24	25-28	29-32	37-40	49-52	53-56						
Sample ID	TP01	TP01	TP02	TP02	TP03	TP03	TP03	TP04	TP05	TP05						
Depth	1.20	2.60	0.50	1.10	0.60	1.10	2.40	1.50	0.50	1.00						
COC No / misc																
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T						
Sample Date	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023	14/08/2023						
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Batch Number	1	1	1	1	1	1	1	1	1	1						
Date of Receipt	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	16/08/2023	Inert	Stable Non-reactive	Hazardous	LOD LOR	Units	Method No.
Solid Waste Analysis																
Total Organic Carbon #	0.12	0.33	0.51	0.22	0.25	0.21	0.42	0.15	0.25	0.18	3	5	6	<0.02	%	TM21/PM24
Sum of BTEX	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	6	-	-	<0.025	mg/kg	TM36/PM12
Sum of 7 PCBs #	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	1	-	-	<0.035	mg/kg	TM17/PM8
Mineral Oil	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	500	-	-	<30	mg/kg	TM5/PM8/PM16
PAH Sum of 6 #	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-	-	-	<0.22	mg/kg	TM4/PM8
PAH Sum of 17	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	100	-	-	<0.64	mg/kg	TM4/PM8
CEN 10:1 Leachate																
Arsenic #	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.5	2	25	<0.025	mg/kg	TM30/PM17
Barium #	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	20	100	300	<0.03	mg/kg	TM30/PM17
Cadmium #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.04	1	5	<0.005	mg/kg	TM30/PM17
Chromium #	<0.015	<0.015	0.017	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.5	10	70	<0.015	mg/kg	TM30/PM17
Copper #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.11	<0.07	<0.07	2	50	100	<0.07	mg/kg	TM30/PM17
Mercury #	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.2	2	<0.0001	mg/kg	TM61/PM0
Molybdenum #	0.04	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.5	10	30	<0.02	mg/kg	TM30/PM17
Nickel #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.4	10	40	<0.02	mg/kg	TM30/PM17
Lead #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5	10	50	<0.05	mg/kg	TM30/PM17
Antimony #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.06	0.7	5	<0.02	mg/kg	TM30/PM17
Selenium #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.1	0.5	7	<0.03	mg/kg	TM30/PM17
Zinc #	<0.03	<0.03	0.09	<0.03	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	4	50	200	<0.03	mg/kg	TM30/PM17
Total Dissolved Solids #	430	<350	370	<350	430	560	580	470	460	450	4000	60000	100000	<350	mg/kg	TM20/PM0
Dissolved Organic Carbon	<20	<20	40	<20	<20	<20	30	<20	<20	<20	500	800	1000	<20	mg/kg	TM60/PM0
Mass of raw test portion	0.1069	0.1002	0.1057	0.1071	0.1083	0.1065	0.1133	0.1118	0.1087	0.1064	-	-	-		kg	NONE/PM17
Dry Matter Content Ratio	83.8	89.4	85.4	83.7	83.2	84.6	79.6	80.8	82.8	84.9	-	-	-	<0.1	%	NONE/PM4
Leachant Volume	0.883	0.889	0.885	0.883	0.882	0.884	0.877	0.879	0.881	0.884	-	-	-		l	NONE/PM17
Moisture Content 105C (% Dry Weight)	19.3	11.9	17.1	19.4	20.2	18.2	25.7	23.7	20.7	17.8	-	-	-	<0.1	%	PM4/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	-	-	<0.1	mg/kg	TM26/PM0
Fluoride	<3	<3	3	<3	<3	3	<3	4	<3	<3	10	150	500	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	<5	<5	18	21	<5	6	16	5	<5	6	1000	20000	50000	<5	mg/kg	TM38/PM0
Chloride #	<3	<3	5	<3	3	4	7	<3	<3	<3	800	15000	25000	<3	mg/kg	TM38/PM0

All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy
EMT Job No: 23/13545

Report : **EN12457_2**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	57-60																
Sample ID	TP05																
Depth	2.00																
COC No / misc																	
Containers	V J T																
Sample Date	14/08/2023																
Sample Type	Soil																
Batch Number	1																
Date of Receipt	16/08/2023																
												Inert	Stable Non-reactive	Hazardous	LOD LOR	Units	Method No.
Solid Waste Analysis																	
Total Organic Carbon #	0.17											3	5	6	<0.02	%	TM21/PM24
Sum of BTEX	<0.025											6	-	-	<0.025	mg/kg	TM36/PM12
Sum of 7 PCBs #	<0.035											1	-	-	<0.035	mg/kg	TM17/PM8
Mineral Oil	<30											500	-	-	<30	mg/kg	TM5/PM8/PM16
PAH Sum of 6 #	<0.22											-	-	-	<0.22	mg/kg	TM4/PM8
PAH Sum of 17	<0.64											100	-	-	<0.64	mg/kg	TM4/PM8
CEN 10:1 Leachate																	
Arsenic #	<0.025											0.5	2	25	<0.025	mg/kg	TM30/PM17
Barium #	<0.03											20	100	300	<0.03	mg/kg	TM30/PM17
Cadmium #	<0.005											0.04	1	5	<0.005	mg/kg	TM30/PM17
Chromium #	<0.015											0.5	10	70	<0.015	mg/kg	TM30/PM17
Copper #	<0.07											2	50	100	<0.07	mg/kg	TM30/PM17
Mercury #	<0.0001											0.01	0.2	2	<0.0001	mg/kg	TM61/PM0
Molybdenum #	0.02											0.5	10	30	<0.02	mg/kg	TM30/PM17
Nickel #	<0.02											0.4	10	40	<0.02	mg/kg	TM30/PM17
Lead #	<0.05											0.5	10	50	<0.05	mg/kg	TM30/PM17
Antimony #	<0.02											0.06	0.7	5	<0.02	mg/kg	TM30/PM17
Selenium #	<0.03											0.1	0.5	7	<0.03	mg/kg	TM30/PM17
Zinc #	<0.03											4	50	200	<0.03	mg/kg	TM30/PM17
Total Dissolved Solids #	<350											4000	60000	100000	<350	mg/kg	TM20/PM0
Dissolved Organic Carbon	<20											500	800	1000	<20	mg/kg	TM60/PM0
Mass of raw test portion	0.1057											-	-	-		kg	NONE/PM17
Dry Matter Content Ratio	84.8											-	-	-	<0.1	%	NONE/PM4
Leachant Volume	0.884											-	-	-		l	NONE/PM17
Moisture Content 105C (% Dry Weight)	17.9											-	-	-	<0.1	%	PM4/PM0
Phenol	<0.1											1	-	-	<0.1	mg/kg	TM26/PM0
Fluoride	<3											10	150	500	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	<5											1000	20000	50000	<5	mg/kg	TM38/PM0
Chloride #	<3											800	15000	25000	<3	mg/kg	TM38/PM0

Client Name: Ground Investigations Ireland

Reference: 12914-06-23

Location: Lehaunstown Cabinteely

Contact: Stephen Kealy

Matrix : Solid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	EPH Interpretation
23/13545	1	TP01	1.20	1-4	No interpretation possible
23/13545	1	TP01	2.60	5-8	No interpretation possible
23/13545	1	TP02	0.50	9-12	No interpretation possible
23/13545	1	TP02	1.10	13-16	No interpretation possible
23/13545	1	TP03	0.60	21-24	No interpretation possible
23/13545	1	TP03	1.10	25-28	No interpretation possible
23/13545	1	TP03	2.40	29-32	No interpretation possible
23/13545	1	TP04	1.50	37-40	No interpretation possible
23/13545	1	TP05	0.50	49-52	No interpretation possible
23/13545	1	TP05	1.00	53-56	No interpretation possible
23/13545	1	TP05	2.00	57-60	No interpretation possible

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Asbestos sub-samples are retained for not less than 6 months from the date of analysis unless specifically requested.

The LOQ of the Asbestos Quantification is 0.001% dry fibre of dry mass of sample.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Where trace asbestos is reported the amount of asbestos will be <0.1%.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analyst Name	Date Of Analysis	Analysis	Result
23/13545	1	TP01	1.20	4	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown soil wtih stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP01	2.60	8	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Soil with stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP02	0.50	12	Simon Postlewhite	24/08/2023	**General Description (Bulk Analysis)**	Brown soil/stones
					Simon Postlewhite	24/08/2023	**Asbestos Fibres**	NAD
					Simon Postlewhite	24/08/2023	**Asbestos ACM**	NAD
					Simon Postlewhite	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP02	1.10	16	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Soil with stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP03	0.60	24	Simon Postlewhite	24/08/2023	**General Description (Bulk Analysis)**	Brown soil/stones
					Simon Postlewhite	24/08/2023	**Asbestos Fibres**	NAD
					Simon Postlewhite	24/08/2023	**Asbestos ACM**	NAD
					Simon Postlewhite	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP03	1.10	28	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Soil with stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP03	2.40	32	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Clay
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP04	1.50	40	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Soil with stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analyst Name	Date Of Analysis	Analysis	Result
23/13545	1	TP05	0.50	52	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Soil with stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP05	1.00	56	Bart Kuznicki	24/08/2023	**General Description (Bulk Analysis)**	Brown Loose soil wtih stones
					Bart Kuznicki	24/08/2023	**Asbestos Fibres**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos ACM**	NAD
					Bart Kuznicki	24/08/2023	**Asbestos Type**	NAD
23/13545	1	TP05	2.00	60	Simon Postlewhite	24/08/2023	**General Description (Bulk Analysis)**	Brown soil/stones
					Simon Postlewhite	24/08/2023	**Asbestos Fibres**	NAD
					Simon Postlewhite	24/08/2023	**Asbestos ACM**	NAD
					Simon Postlewhite	24/08/2023	**Asbestos Type**	NAD

Client Name: Ground Investigations Ireland
Reference: 12914-06-23
Location: Lehaunstown Cabinteely
Contact: Stephen Kealy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/13545						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/13545

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Preparation of Soil and Marine Sediment Samples for Total Organic Carbon.	Yes		AD	Yes

EMT Job No: 23/13545

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM17	Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013I	PM0	No preparation is required.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013I	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013I	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	A hot hydrochloric acid digest is performed on a dried and ground sample, and the resulting liquor is analysed.			AD	Yes

EMT Job No: 23/13545

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes
TM61	Determination of Mercury by Cold Vapour Atomic Fluorescence - WATERS: Modified USEPA Method 245.7, Rev 2, Feb 2005. SOILS: Modified USEPA Method 7471B, Rev.2, Feb 2007	PM0	No preparation is required.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248 Second edition (2021)	PM42	Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998)	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	NONE	No Method Code			AD	Yes
NONE	No Method Code	PM17	Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.			AR	

APPENDIX 9 – Groundwater Monitoring Records

Ground Investigations Ireland Ltd
www.gii.ie

Site	Borehole Number
Lehaunstown	BH02

Installation Type	Dimensions	Client	Job Number
		DLRD	12914-06-23

Location	Ground Level (mOD)	Project Contractor	Sheet
723272.5 E 723839.4 N	54.63	GII	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			53.63	1.00	Cement/Bentonite Grout
	▽1				
					Slotted Standpipe
	▼*		50.93	3.70	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
		1.00 3.70						3.50 3.50	

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)
10/08/23 11/08/23		3.00		None 1.00	53.63		3.00 3.70		None 1.00	53.63

Instrument Groundwater Observations

Inst. [A] Type :

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks
17/10/23 09/11/23	12:20 15:20	0.67 0.25	53.96 54.38	

Remarks

SITE INVESTIGATION LOGS

JBA Project Code	2018s1298
Contract	Domville Catchment Site Investigation
Client	Dun Laoghaire Rathdown County Council
Day, Date and Time	09/10/18
Author	D Casey
Reviewer / Sign-off	A Jones
Subject	Tufa Spring Catchment Trial Pits

Equipment & Methods JCB Backhoe	Pit No TP3		Ground level (mAOD) N/A		Date 09/10/18	
Logged by: D Casey	GRID REFERENCE					
Description	Level BGL	Reduced level	Lithology	Samples/tests		Notes
				Depth	No	
Light Brown Clayey Silt Topsoil Loose, soft	0-0.3					
Very Light Brown Clayey Silt Dry, Loose Sub-round gravels	0.3 - 0.5					
Brown Silty CLAY Dry Some subangular gravels	0.5-1.5					
Dark Brown silty CLAY Sticky, slightly moist Sub-angular gravels	1.5-2.8					
Weathered Bedrock	2.8-2.9					
END AT	2.9					
Notes						

SITE INVESTIGATION LOGS

JBA Project Code	2018s1298
Contract	Domville Catchment Site Investigation
Client	Dun Laoghaire Rathdown County Council
Day, Date and Time	09/10/18
Author	D Casey
Reviewer / Sign-off	A Jones
Subject	Tufa Spring Catchment Trial Pits

Equipment & Methods JCB Backhoe	Pit No TP4		Ground level (mAOD) N/A		Date 09/10/18	
Logged by: D Casey	GRID REFERENCE					
Description	Level BGL	Reduced level	Lithology	Samples/tests		Notes
				Depth	No	
Light Brown Clayey Silt Topsoil	0-0.1					
Brown Silty CLAY Sub-angular Gravels Dry, crumbly Texture	0.1 – 1.25 Becoming dark brown after 0.6					
Broken Bedrock Dry	1.25 – 1.7					
Bedrock	1.7					
END AT	1.7					
Notes						

SITE INVESTIGATION LOGS

JBA Project Code	2018s1298
Contract	Domville Catchment Site Investigation
Client	Dun Laoghaire Rathdown County Council
Day, Date and Time	09/10/18
Author	D Casey
Reviewer / Sign-off	A Jones
Subject	Tufa Spring Catchment Trial Pits

Equipment & Methods JCB Backhoe	Pit No TP5		Ground level (mAOD) N/A			Date 09/10/18
\	GRID REFERENCE					
Description	Level BGL	Reduced level	Lithology	Samples/tests		Notes
				Depth	No	
Brown Sandy Silt Topsoil	0 - 0.25					
Brown Silty CLAY Dry, loose Sub-angular Gravels Sub-round gravels	0.25 – 1.2					
Broken Bedrock Silty clay Sub-round /angular cobbles	1.2-2.8					
Fracture Bedrock Sandy Silty CLAY Sub-round cobbles, Gravels Dry	2.8-3.5					
Bedrock	3.5					
END AT						
Notes Groundwater encountered at 3.5mbgl, slow seepage.						

- **Fluvioglacial deposits/weathered granite:** typically, grey/brown silty sands and gravels with cobbles of granite encountered across all holes down to 20mbgl in JBH01 and JBH06.

- **Bedrock (Granite):** Rockhead was encountered at depths ranging from 5.50m in JBH05 to 6.80m in JBH03.

5.3 Groundwater

Groundwater was encountered during percussion boring and rotary drilling through soil and rock as water strikes as shown in Table 1 below.

Table 1: Groundwater strikes encountered during the ground investigation

GI Ref.	Water level (mbgl)	Comments
BH02	11.20	Rose to 10.00mbgl after 5mins
BH02	14.00	No rise after 5 mins
BH03	1.50	Seepage
BH04	11.00	Seepage
BH06	2.70	Rose to 2.00m after 20mins
BH06	9.20	Rose to 6.00m after 10mins

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was not noted during drilling at any of the other borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any/additional groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

It should be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 2: Groundwater monitoring

GI Ref	Water level (mbgl)
	12/04/2019
JBH01	11.78
JBH02	10.02
JBH03	1.13
JBH04	2.88
JBH05	5.37
JBH06	4.50
JBH07	2.00

Seasonal variation in groundwater levels should also be factored into design considerations, and continued monitoring of the seven installed standpipes will give an indication of the seasonal variation in groundwater level.

6 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Rotary Drilling	Hanjin 8D	0.00	6.80
Rotary Coring	Hanjin 8D	6.80	9.80

Project No.: 19-0148

Project Name: Cherrywood, Co. Dublin

Borehole No.: JBH03

Coordinates: 323363.69 E 223785.37 N

Client: Dun Laoghaire - Rathdown County Council

Sheet 1 of 1

Client's Representative: JBA Consulting

Scale: 1:50

Driller: KW

Ground Level: 54.74 mOD

Dates: 22/03/2019 - 25/03/2019

Logger: RS

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
					54.44	(0.30) 0.30		TOPSOIL
						(1.20)		Firm brown sandy gravelly CLAY with cobbles. (Driller's description).
				Water Strike at 1.50m	53.24	1.50		Light greyish brown fine to coarse SAND with cobbles of granite. (Driller's description)
		5.50	3.00	22-03-2019				
		5.50	3.00	25-03-2019				
						(5.30)		
					47.94	6.80		Medium strong white phaneritic GRANITE. Partially to moderately weathered. Discontinuities: 1. 60 degree fracture closely spaced (45/85/350) planar, rough, open, orange staining present on surface. 2. 80 - 90 degree joint, probably medium spaced, planar, rough, open, orange staining present on most surfaces.
7.80	100 71 56							
	100 56 40		6			(3.00)		
8.80				25-03-2019				
	100 65 48							
9.80					44.94	9.80		End of Borehole at 9.80m
	TCR SCR RQD		FI					

Water: Backfill

Remarks

Hand dug inspection pit excavated to 1.20m.

Terminated at scheduled depth.

Core Barrel

T2-101

Flush Type

Water

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.50	1.50	10	1.50

Water Added

From (m)	To (m)
6.80	9.80

Casing Details

To (m)	Diam (mm)
6.80	200

Chiselling Details

From (m)	To (m)	Time (hh:mm)

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