



ENGEO

Initial Environmental Investigation

14 Waiu Street

Wainuiomata

Lower Hutt

Submitted to:

Envelope Engineering Limited

Level 1 / 68 Dixon Street

Te Aro

Wellington 6011

ENGEO Limited

Plimmer Towers, Level 18, 2-6 Gilmer Terrace,
Wellington 6011, New Zealand

PO Box 25 047, Wellington 6140, New Zealand

Tel +64 4 472 0820 Fax +64 4 974 5266

www.engeo.co.nz

12.03.2021

18286.000.001_02



Contents

1	Introduction	1
1.1	Objective of the Investigation	1
1.2	Approach	1
1.3	Review of Site Information	1
1.4	Site Assessment	2
2	Site Description and Setting	2
3	Site History.....	4
3.1	Greater Wellington Regional Council Selected Land Use Register	4
3.2	Hutt City Council Property File Review	4
3.3	Anecdotal Evidence	6
3.4	Historical Aerial Photograph Review.....	6
4	Previous Site Investigations.....	8
4.1	Geotechnical Report – ABUILD Consulting Engineers Ltd., 2015.....	8
5	Current Site Conditions	8
6	Potential HAIL Activities.....	11
7	Site Investigation.....	13
7.1	Investigation Methodology	13
7.2	Soil Encountered	15
7.3	Sampling Methodology.....	15
7.4	Quality Assurance and Control	15
8	Regulatory Framework and Assessment Criteria	16
8.1	Resource Management Regulations (NES).....	16
8.2	Greater Wellington Regional Council Regional Plan	16
8.3	Asbestos Criteria	16
8.4	Assessment Criteria	16
8.5	Disposal Criteria	17
9	Results	17

9.1	On Site Observations	17
9.2	Laboratory Analysis.....	17
9.2.1	Ground Gas Potential	2
10	Conceptual Site Model.....	1
11	Conclusions and Recommendations	3
12	References.....	4
13	Limitations.....	5

Tables

Table 1:	Site Information
Table 2:	Site Setting
Table 3:	Historical Aerial Photographs
Table 4:	Current Site Conditions
Table 5:	Site Photographs
Table 6:	Summary of HAIL Categories Surrounding the Site
Table 7:	Summary of Potential HAIL Categories on the Site
Table 8:	Summary of Soil Samples Collected and Requested Analyses
Table 9:	Soil Chemical Contaminant Concentrations for Heavy Metals and Total Petroleum Hydrocarbon Compared to Assessment Criteria
Table 10:	Total organic and degradable organic concentrations
Table 11:	Ground Gas Situation v's TOC (CL:AIRE, 2012)
Table 12:	Conceptual Site Model

Figure

Figure 1:	Site Information
-----------	------------------

Appendices

Appendix 1:	Test Pit Geotechnical Logs
Appendix 2:	Laboratory Results

ENGEO Document Control:

Report Title	Initial Environmental Investigation - 14 Waiu Street, Wainuiomata			
Project No.	18286.000.001	Doc ID	02	
Client	Envelope Engineering Limited	Client Contact	Ryan Rose	
Distribution (PDF)	Ryan Rose			
Date	Revision Details/Status	Author	Reviewer	WP
12/03/2021	Issued to Client	GS / RC	KJ	BK

1 Introduction

ENGEO Ltd was requested by Envelope Engineering Limited to undertake an initial environmental investigation of the property at 14 Waiu Street, Wainuiomata, Lower Hutt (herein referred to as ‘the site’). This work has been carried out in accordance with our signed agreement, reference P2021.000.044_01 dated 27 January 2021.

An initial geotechnical investigation was undertaken by ENGEO in conjunction with this investigation. Findings are reported in a Geotechnical Investigation Report, reference 18286.000.001_01 dated 12 March 2021.

The preliminary site investigation (PSI) component of this report satisfies the requirements of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, herein referred to as the “NES” (NES, 2011) and was undertaken in general accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand (2011). This initial environmental investigation has been certified by a Suitably Qualified and Experienced Practitioner (SQEP). Initial environmental sampling has been undertaken, however to further satisfy the NES, additional investigation and sampling are required.

1.1 Objective of the Investigation

The purpose of the assessment was to determine the potential for contamination at the site to identify whether the site is suitable for the proposed commercial land use.

The objective of this investigation was to identify and evaluate conditions indicative of releases and threatened releases of hazardous substances at, or to the subject property, and report on the associated potential risk posed to future site users and the environment.

1.2 Approach

To satisfy the above objective, ENGEO sought to gather information regarding the following:

- Current and past property uses and occupancies;
- Current and past uses of hazardous substances;
- Waste management and disposal activities that could have caused a release or threatened release of hazardous substances;
- Current and past corrective actions and response activities to address past and ongoing releases of hazardous substances at the subject property; and
- Properties adjoining or located near the subject property that have environmental conditions that could have resulted in conditions indicative of releases or threatened releases of hazardous substances to the subject property.

1.3 Review of Site Information

During this investigation, information relating to the site’s past and present uses were gathered from the following sources:

- The Greater Wellington Regional Council's (GWRC) Selected Land Use Register (SLUR);
- Online and / or archived records held by Hutt City Council (HCC); and
- Readily available online historical aerial photographs and published geological information.

1.4 Site Assessment

A site walkover was undertaken during February 2021 by ENGEO. Objective evidence was collected through observations of conditions of the site and is discussed further in Section 5.

An initial site investigation involving the excavation of six test pits with soil sampling and laboratory analysis was undertaken on 18 February 2021. This is detailed in Section 7.

2 Site Description and Setting

The site is located on an old landfill site which has been consented as a cleanfill site. We understand that it is proposed to place up to approximately 81,000 m³ of additional cleanfill across the site footprint to make it suitable for building on.

ENGEO understands from a geotechnical peer review undertaken during 2015 that there is the presence of materials, such as steel, treated timber and car parts / tyres and the presence of a rusty brown leachate or seepage noted at the base of a south facing west fill batter. It is therefore considered that the waste is not in accordance with the Waste Management Institute New Zealand definition of clean-fill which states (WAMINZ, 2016):

“Virgin excavated natural materials (VENM) such as clay, soil and rock that are free of:

- Combustible, putrescible, degradable or leachable components;*
- Hazardous substances or materials (such as municipal solid waste) likely to create leachate by means of biological breakdown;*
- Products or materials derived from hazardous waste treatment, stabilisation or disposal practices;*
- Materials such as medical and veterinary waste, asbestos (above BRANZ guidelines), or radioactive substances that may present a risk to human health if excavated;*
- Contaminated soil and other contaminated materials; and*
- Liquid waste.*

When discharged to the environment, cleanfill material will not have a detectable effect relative to the background.”

Site information and the setting are summarised in **Error! Reference source not found.** and **Error! Reference source not found.**, respectively. The site location is presented on Figure 1.

Table 1: Site Information

Item	Description
Location	14 Waiu Street, Wainuiomata, Lower Hutt
Legal Description	Lot 3 DP 489061 CT 702724
Property Owner	Kiwi Real Tech Ltd
Current Land Use	The site is currently a cleanfill. The current land use description is “industrial – vacant land.” According to the Hutt City Council District Plan, the site is zoned for “General Business.”
Proposed Land Use	Commercial – business development
Site Area	35,127 m ²
Regional Authority	Greater Wellington Regional Council (GWRC) and Hutt City Council (HCC)

Table 2: Site Setting

Item	Description
Topography	Site elevation ranges from approximately 94 to 103 metres above sea level (m asl) The elevation of the property just south of the site ranges from 88 to 94 m.
Local Setting	The surrounding area is commercial / industrial.
Nearest Surface Water & Use	No rivers are located within 500 m of the site. A small stream has been diverted down the eastern side of the landfill and enters a culvert present in the southeast corner of the site, which conveys surface water to a channel west of Waiu Street. Stormwater channels are present approximately 160 m west of the site, 285 m south of the site, and 280 m east of the site and eventually converge with Black Creek.
Geology (GWRC, GNS, 2000)	“Alluvial fan, Scree and colluvial despoirs consisting of poorly sorted gravels.” This is underlain by the Rakaia Terrane described as “Grey sandstone-mudstone sequences poorly bedded sandstone with minor coloured mudstone conglomerate, basalt, chert, and rare limestone.”
Hydrogeology	There is no known aquifer present beneath the site with the aquifer potential indicated to be poor. Groundwater flow is anticipated to be to the southwest towards Lowry Bay.

Item	Description
Groundwater Abstractions	There are no groundwater abstractions located on the site. There are no known active groundwater abstractions within 250 m of the site.
Discharge Consents	There are no discharge consents located on the site. There are no known active discharge consents within 250 m of the site.

3 Site History

ENGEO obtained and reviewed available environmental and historical information from a number of sources to investigate the past uses of the site and surrounding areas. Information from these searches relevant to the site is summarised below.

3.1 Greater Wellington Regional Council Selected Land Use Register

Potentially hazardous activities are defined on the MfE's Hazardous Activities and Industries List (HAIL) (MfE, 2011). Greater Wellington Regional Council (GWRC) maintains a Selected Land Use Register (SLUR) of past and current land uses within the Wellington region which have had an activity included on the HAIL undertaken on them. The listing of a property on the SLUR triggers the requirement for a contaminated land assessment prior to development if one has not already been undertaken. If a site is not on the SLUR it does not necessarily mean that an activity on the HAIL has not been undertaken, only that it is not known by GWRC to have been undertaken.

The site is not listed on the SLUR.

3.2 Hutt City Council Property File Review

Archived records were viewed by Gabriela Staehle at on 12 February 2021. We note there are a significant number of documents relating to the cleanfill operations of the site, and we believe the following, discussed in detail below, are the most relevant to the environmental aspects of the project. Documents included, but were not limited to, resources consents and construction plans:

- Resource Consent Application (22 June 2006) –
 - “To excavate and stockpile topsoil and to establish and operate a cleanfill that will result in the placement of approximately 300,000 m³ of fill within the 4.13 hectare site.”
 - “The land' that is subject to these proposed activities has not been utilised for any productive activity for many years.”
 - “The depth of fill within Stages 2 and 3 will be approximately 8.4 metres with a finished level 3.5 metres below the top of the surrounding bund, which at its maximum will be 12 metres high. The approximate volume of fill that will be placed within the site will be 300,000 m³”.

- “As part of the proposal the existing watercourse / drain that enters the site at the northern boundary and then flows through the centre of the site will be diverted so that it joins the other watercourse / drain that flows just outside and parallel to the western boundary of the site. These two drains currently enter the Council stormwater main that flows through the southern portion of the site. Drainage channels and subsoil drainage will be laid at the edge of the fill and beneath the surface of the fill as indicated on the attached plan of the proposal and as specified by the engineer supervising the operation of the cleanfill. A detailed erosion and sediment control plan has been compiled to ensure that minimal effects in terms of sediment flow and dust will occur in relation to the watercourse and drains that serve the area and also in relation to adjoining properties.”
- “An existing cleanfill operation is located at No. 7a Waiu Street. Resource consent (RM20-W65-7A) was granted in December 2003 by a Council Committee to allow the establishment and operation of that cleanfill.”
- Resource Consent Decision (RM100291) (1 September 2010) –
 - “The proposal is for the subdivision of 14 Waiu Street creating proposed Lot 3 to be amalgamated with the adjoining Council Reserve allotment. A small boundary adjustment is also proposed transferring approximately 63 m² of the site at 22 Waiu Street into 14 Waiu Street. The proposed allotments comply with the size, shape, access and engineering requirements of the Subdivision Chapter of the City of Lower Hutt District Plan.”
 - “The subject property is not listed as a contaminated site within the Greater Wellington Regional Council - Selected Land Use Register. As such, any potential contamination effects have been remediated to a level that is suitable for industrial and commercial use and any contamination effects on the health and safety of occupiers are considered to be minor.”
 - “On undertaking a history check on the Council’s property files there is no evidence of historical contamination. As such, the subject property is not considered to be a contaminated site.”
 - “The site does not have any water course running through it or near it, as such provision for any esplanade strips or reserves is not considered to be relevant.”
- Resource Consent Decision (RM150061) (27 June 2016) –
 - The applicant, K J Whitley proposes to undertake rehabilitation of a cleanfill including 81,000 m³ of filling to a further depth of 3 m (including a 1.5 m sub-excavation). The works seek to make the site suitable for future development including building platforms for commercial development.”
- Resource Consent Decision (WGN180401) (24 August 2018) –
 - The material has not been compacted sufficiently and there are isolated pockets of loose fill.
 - The presence of unsuitable material, notably concrete protruding rebar, is obvious even at surface.

- The site was irregularly contoured such that the surface water runoff did not appear well controlled.
- Not all material placed is likely to have met the definition of cleanfill (two test pit soil samples taken during the geotechnical investigation of the site (discussed below) show that concentrations of some contaminants exceed likely background concentrations at two locations and therefore most likely also exceed likely background concentrations elsewhere).

3.3 Anecdotal Evidence

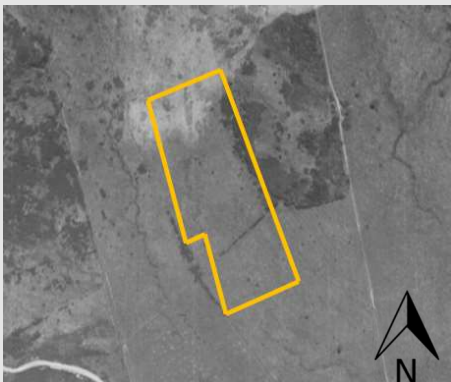
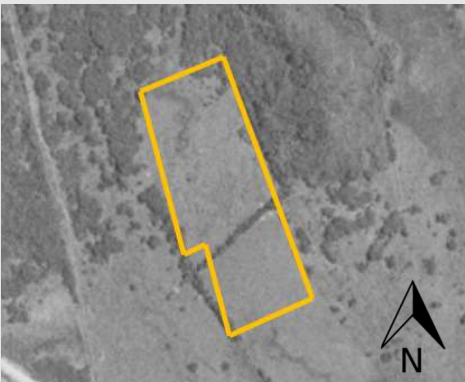
Conversations were had with the neighbour adjacent to the southern entrance of the landfill. He stated that GWRC regularly monitored the stream running along the eastern boundary of the landfill. However, we were not able to obtain these reports.

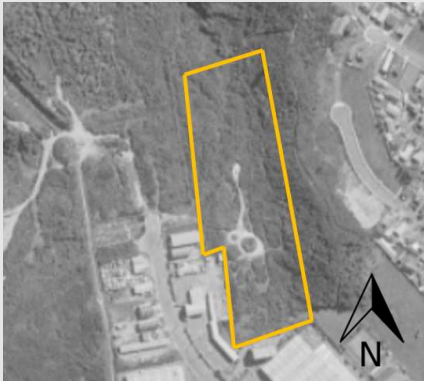
The landfill was apparently operating until 2012 when it was taken into receivership.

3.4 Historical Aerial Photograph Review

Aerial photographs available on Retrolens and Google Earth were viewed on 12 February 2021. The relevant and applicable findings in relation to our investigation are summarised in Table 3.

Table 3: Historical Aerial Photographs

Date	Photographs	Description
1941		The vegetation on the site and surrounding area appears to have been cleared, potentially for farming or animal grazing. No development is visible. The stream is visible within the western boundary.
1961		No significant changes

1974		The site has been cleared and development has taken place to the east over a ridge and to the south of the site. The development east of the site appears to be residential; the development south of the site appears to be commercial / industrial. Waiu Street is visible. Vehicle pathways are visible in the southern portion of the site.
1995		Development has continued on Waiu Street, but the site still remains undeveloped. A building has been constructed south of the site, at 14 Waiu Street. Additional vehicle pathways are visible in the central and southern portions of the site.
2013		Further vegetation has been cleared from the area, with signs of filling having been undertaken. Two buildings are present in the central western portion, use unknown. Uncovered fill is present around the buildings.
2019		The ground surface of the site is uneven, likely due to the deposition of cleanfill material.

4 Previous Site Investigations

A summary of a previous site investigation undertaken within the site footprint and information relevant to this report is provided below.

4.1 Geotechnical Report – ABUILD Consulting Engineers Ltd., 2015

A geotechnical investigation was completed by ABUILD Consulting Engineers Ltd in 2015. The following conclusions are deemed relevant to the environmental aspects of the project as listed in Section 3.2 (Resource Consent Decision (WGN180401) (24 August 2018).

5 Current Site Conditions

A site walkover was completed on 11 February 2021 by Gabriela Staehle, Environmental Engineer and Calum MacRae, Engineering Geologist. Observations of activities and conditions present at the site are summarised in Table 4.

Table 4: Current Site Conditions

Site Conditions	Comments
Visible Signs of Contamination	Metal bars, concrete, metals drums, and other construction debris was visible on the surface. A gravel road crosses the southern half of the site.
Surface Water Appearance	Surface water was visible in a pit in the centre of the property (Photo 3). The water appearance slightly greenish in appearance. No odour noted.
Current Surrounding Land Use	North and east of the site: undeveloped, vegetated land. Southeast of the site: W D Auto Services Ltd and Master Upholstery Experts South of the site: Ko Panel & Paint Autobody Shop West of the site: Wainuiomata Bike Park and Stitch IT: Auto Upholstery
Local Sensitive Environments	None observed.
Visible Signs Of Plant Stress	None observed.
Ground Cover	The site is currently undeveloped and fully vegetated mainly with grass and gorse. The surface of the site is uneven and has large mounds, which is consistent with its previous use as a landfill.
Potential for On or Off Site Migration Of Contaminants	Depth to groundwater has been measured between 1.3 m and 3 m. near the site, indicating potential for leachate production if contamination is present within the cleanfill. A small stream has been diverted down the eastern side of the landfill and enters a culvert present in the southeast corner of the site, which conveys surface water to a channel west of Waiu Street. It is possible that contamination from the site is entering the storm drain; further investigation is required.
Buildings Present	No buildings are present on site.

Photographs taken during the inspection are presented in Table 5.

Table 5: Site Photographs

Photo 1: Overview of property, facing south



Photo 2: Gravel road located on eastern edge of the site, facing north



Photo 3: Old test pit located at centre of site.



Photo 4: Metal drum and wooden pallet debris



Photo 5: Metal scraps



Photo 6: Concrete debris



Photo 7: Property at 16- 24 Waiu Street, east of the site. Concrete and metal storage visible.



Photo 8: Property north of the site. Metal and fire wood storage visible.



Photo 9: Buildings east of Waiu Street. Tom and Luke Ltd is visible across the street and involves food production.



Photo 10: Buildings east of Waiu Street. Two companies, Wainui Self Storage and Auto Maintenance and Marine, are visible.

6 Potential HAIL Activities

Activities included on the HAIL trigger the requirement for an intrusive detailed environmental site investigation (DSI) prior to redevelopment. One HAIL category has been identified on the GWRC SLUR website for one property within 100 m of the site boundary. A summary is provided in Table 6.

Table 6: Summary of HAIL Categories Surrounding the Site

SLUR Property and Direction from Site	HAIL Category	Description	Contaminants of Concern
Tapp Peter Panel and Paint 19 Waiu Street SN/03/313/02 Located 75 m west of the site	Category F - Vehicle Refuelling, Service and Repair, Activity 4 - Motor Vehicle Workshops.	2014: Evidence of the HAIL activity was confirmed from aerial photographs, online directory listing from the yellow pages, and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council [WGN document #1419118] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2012) requirements.	TPH, PAH, heavy metals, VOCs and SVOCs

The impact to the site from the SLUR property in Table 6 is unlikely to impact the site because it is approximately 70 m from the site boundary and stormwater is anticipated to flow southwest away from the site.

The site is not listed on the GWRC SLUR. However, due to the deposition of cleanfill on the site, previous reports and site observations, it is possible that contamination is present on site from deposition of materials not deemed to be cleanfill. Based on the information obtained during this PSI, the following HAIL category has the potential to be associated with this site.

Table 7: Summary of Potential HAIL Categories on the Site

Activity	HAIL Category	Description	Contaminants of Concern
Cleanfill operations / Undocumented fill	Category G3 – Cemeteries and waste recycling, treatment and disposal – Landfill sites	Cleanfilling operations took place on site from 2012-2015. There is potential that other, potentially contaminating, materials were disposed of on site.	Heavy metals, total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAHs), asbestos, Total petroleum hydrocarbons (TPH), Semi-volatile organic compounds (SVOCs), asbestos

7 Site Investigation

ENGEO undertook a site investigation on 18 February 2021. Test pits were excavated by an excavator operated by Keith Bullock Contracting, and a range of soil samples were collected from multiple depths. Concrete, wood, brick, metal, and rubber were encountered during test pitting.

7.1 Investigation Methodology

Information obtained during the desktop study was used to determine sample locations. Six locations, distributed evenly across the site, were selected for test pitting. At each test pit, the depth of sample collection and requested analysis was based on visual and olfactory evidence of contamination. In some locations, multiple samples were collected to capture different soil stratification and fill types. Eleven soil samples were collected during the investigation at depths ranging from 0.2 m to 5.0 m.

Because filling was suspected to not meet cleanfill criteria, ten samples were tested for total organic carbon (TOC). Sample locations were targeted based on where potential organic materials were identified to evaluate the gas formation potential of the site due to the potential degradation of organic material. During the investigation, ENGEO recorded the approximate percentage of organic material in each test pit.

A photoionisation detector (PID) was used on site to determine concentrations of volatiles and aid in the target of sampling of materials.

Table 8 provides a summary of the soil samples collected. Refer to Figure 1 for sample locations.

Table 8: Summary of Soil Samples Collected and Requested Analyses

Sample ID	Soil Type ¹	Sample Depth (m bgl)	Requested Analyses
TP01	SILT with some soil and sand; contains concrete, red brick and domestic waste (Fill)	0.2	Heavy Metals
TP01	Silty sandy fine to coarse GRAVEL with minor cobbles and minor boulders; Contains wood, concrete and domestic waste (Fill)	1.0	Heavy Metals, TOC, Semi-Volatile Organic Compound (SVOC), Polycyclic Aromatic Hydrocarbon (PAH), Total Petroleum Hydrocarbon (TPH), and Semi-Quantitative Asbestos (SQA)
TP02		1.3	Heavy Metals, TOC, SVOC, PAH, TPH, Benzene, Toluene, Ethybenzene, and Xylene (BTEX)
TP02	Contains lenses of PEAT; fibrous, dark brown	4.0	Heavy Metals, TOC, PAH, and TPH
TP02		5.0	TOC
TP03	Gravelly SILT (Fill)	2.1	Heavy Metals, TOC, PAH, TPH, and SQA
TP04	Clayey SILT (Fill)	2.0	Heavy Metals, TOC
TP05	SILT with some gravel, minor cobbles and boulders and trace sand (Fill)	1.8	Heavy Metals, TOC, PAH, TPH, and SQA
TP06	Sandy fine to coarse GRAVEL with minor sand; contains concrete and brick (Fill)	1.0	Heavy Metals, TOC, PAH, TPH
TP06	Gravelly SILT with some sand; contains concrete, wood, brick, metal, and rubber (Fill)	1.8	Heavy Metals, TOC, PAH, TPH, and SQA
TP06		3.4	Heavy Metals, TOC

7.2 Soil Encountered

Natural ground was only encountered in TP01 at a depth of 2.7 m. The remainder of the test pits did not encounter natural ground. Fill encountered across the site was highly variable and contained large amounts of concrete. Variable amounts of domestic waste, treated timber, organic soils, brick, asphalt and metal were present in test pits. Perched water was noted in TP01. The groundwater table was not encountered in any of the test pit holes. Test pit geotechnical logs are included as Appendix 1.

7.3 Sampling Methodology

The following methodology was used for collecting the soil samples:

- All soil samples were screened for visual and olfactory evidence of contamination.
- Following excavation of the test pits, samples were collected by hand from the base or sidewall of the test pit. When the test pits were too deep to access, samples were collected from the centre of the excavator bucket. In both cases, a layer of soil was removed by hand prior to sample collection to avoid cross contamination from the excavator.
- To reduce the potential for cross-contamination, a new pair of disposable nitrile gloves was used for each sample collected and discarded following use.
- All samples collected were placed in tubs and jars supplied by RJ Hill Laboratories (Hills) which were then capped, labelled with a unique identifier placed in chilled containers (chilly bins) prior to transportation to the laboratory. Samples were transported to Hills under standard chain of custody documentation for analysis; these are provided in Appendix 2.
- Geological logging of the soil was completed in general accordance with the New Zealand Geotechnical Society (NZGS) “*Guideline for the Field Classification and Description of Soil and Rock for Engineering purposes*”, December 2005.
- All fieldwork and soil sampling was undertaken in general accordance with the procedures for the appropriate handling of potentially contaminated soils as described in the MfE “*Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils*” (MfE, 2011).
- Following receipt of samples by Hills, the soil samples were scheduled for analysis of the identified contaminants of concern.

7.4 Quality Assurance and Control

The quality assurance / quality control (QA / QC) procedures employed during the works included:

- The use of standard sample registers and chain of custody records for all samples collected.
- Each soil sample was given a unique identification number.
- Hills is an International Accreditation New Zealand (IANZ) laboratory for the analyses performed. To maintain their IANZ accreditation, Hills undertakes rigorous cross checking and routine duplicate sample testing to ensure the accuracy of their results.
- During the site investigation, every attempt was made to ensure that cross contamination did not occur through the use of procedures outlined in this document.

8 Regulatory Framework and Assessment Criteria

The regulatory frameworks and rules relating to the management and control of contaminated sites in the Wellington Region are specified in two documents: the NES and a GWRC Regional Plan.

8.1 Resource Management Regulations (NES)

The Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES) came into effect on 1 January 2012 (MfE, 2011).

8.2 Greater Wellington Regional Council Regional Plan

Regional Plan for Discharges to Land for the Wellington Region

Under the GWRC regional plans, policies and strategies (Greater Wellington Regional Council, 2014), specifically “*Regional Plan for Discharges to Land for the Wellington Region*” (Plan) Rules 1, 2, 21 and 22 potentially apply to the site. In accordance with the Plan “*Unless specifically stated otherwise, the rules in the Plan apply to discharges to land irrespective of the source of the discharge... The rules apply throughout the Region. With the exception of Rules 1 and 2, which are the default rules in the Plan, all rules are specific in their application.*”

8.3 Asbestos Criteria

The fieldwork and reporting for this site have been undertaken in general accordance with The Building Research Association New Zealand (BRANZ) New Zealand Guidelines for Assessing and Managing Asbestos in Soil (BRANZ, 2017) (herein referred to as ‘The BRANZ Guideline’). The BRANZ Guidelines have been developed based on the WA DOH Guidelines but with the New Zealand regulatory environment in mind.

8.4 Assessment Criteria

Proposed future use includes bulk earthworks followed by land development for commercial business. To cover potential earthworks and future use activities, contaminant concentrations in soil were compared to human health criteria based on the Commercial / Industrial land use (unpaved) (based on an outdoor worker scenario for site workers).

The land use scenarios for commercial / industrial outdoor worker (unpaved) use are relevant to the likely future use of the site as a subdivision and commercial / industrial land use are being used as a surrogate to assess short-term risks to on site workers during construction works and development.

The NES methodology document notes that the exposure parameters assumed for the maintenance / excavation scenario in other New Zealand guidelines are unrealistic (perhaps by a factor of 10 or more). The technical committee preparing the NES decided that a maintenance / excavation worker scenario should not be included in the NES as sites would not be cleaned up to this standard. It was considered more appropriate that exposure to these workers be limited through the use of site-specific controls that are required under health and safety legislation. However, this report uses commercial / industrial outdoor worker criteria to get a general sense of potential risks to excavation workers during the works.

Note that commercial / industrial outdoor worker criteria are based on personnel carrying out activities involving soil exposure to surface soil for example during landscaping activities and occasional shallow excavation for routine underground service maintenance. Exposure to soil is less intensive than would occur during installation works but occurs over a longer period.

For a construction worker developing the site, the soil exposure is limited when compared to a large earthworks project (e.g. for a residential subdivision or industrial development).

As such, the commercial / industrial outdoor worker criteria are considered suitable for obtaining a high-level understanding of potential risks to excavation workers during site redevelopment and confirming the need for site controls.

The soil analysis results have been compared to NES SCSs, National Environment Protection Measure (NEPM) investigation levels, MfE soil acceptance criteria, and Regional Background levels for heavy metals, PAH, TPH, and OCP, where available. The soil analysis results have been compared to BRANZ guidance criteria for asbestos.

Contaminant concentrations in soil have been compared to the residential and commercial / industrial outdoor worker (unpaved) based on the proposed development.

8.5 Disposal Criteria

An assessment of potential off-site disposal options for materials generated during site remediation works has been conducted. Dependent on the contamination conditions of the materials, off-site disposal options range from disposal to “cleanfill” sites to licensed Class A and B landfills. As outlined in the Waste Management Institute New Zealand (WasteMINZ) publication “Technical Guidelines for Disposal to Land”; refer to Section 2.

9 Results

9.1 On Site Observations

The site was in a similar condition as previously outlined during the preliminary site walkover. ENGEO did not conduct an interview with the current site owner during the walkover.

Excavation revealed subsurface inorganic materials, including red brick, rebar, metal, and concrete. Refer to Appendix 1 for photographs.

9.2 Laboratory Analysis

Soil analytical results and the relevant adopted soil assessment criteria are presented in Tables 9 and 10. Certified laboratory reports are included in Appendix 2. BTEX, PAH and SVOC concentrations have not been included in the tables as the majority of concentrations were below laboratory Limits of Detection (LOD). The analytical results can be summarised as follows:

Human Health Criteria

- All heavy metals concentrations were reported to be below commercial / industrial human health criteria.
- The majority of TPH concentrations were reported below LOD. The maximum TPH concentration was reported for C15-C36 at a concentration of 240 mg/kg. All results were below commercial / industrial human health criteria.

- All BTEX concentrations were below LOD.
- A number of PAHs were detected above LOD. All were reported below commercial / industrial human health criteria.
- The majority of SVOCs were reported below LOD and all were below commercial / industrial human health criteria. The LOD concentrations for organochlorine pesticides (OCPs) (alpha HCH, heptachlor epoxide and hexachlorobenzene) able to be obtained by the laboratory exceed the commercial / industrial concentration criteria. However, as all other results were below LOD, it is considered unlikely for OCPs to be present.

Regional Background Criteria

- Regional background criteria was exceeded for chromium, lead and zinc in most of the samples analysed for heavy metals.
- Regional background criteria was exceeded for anthracene, benzo[a]pyrene, fluoranthene, naphthalene, phenanthrene and pyrene in test pit locations TP02, TP03, TP05 and TP06.

Landfill Acceptance Criteria

- Landfill Class A criteria was exceeded for lead in three locations (TP01, TP05 and TP06).
- All BTEX concentrations were below LOD and therefore below Landfill Class A criteria.
- No landfill Class A criteria exists for TPH and PAH with the exception of naphthalene; this concentration was below the landfill criteria.

Asbestos

- No asbestos was reported to be present in the samples analysed.

Table 9: Soil Chemical Contaminant Concentrations for Heavy Metals and Total Petroleum Hydrocarbon Compared to Assessment Criteria

Sample ID	TP01	TP01	TP02	TP02	TP03	TP05	TP06	TP06	Human Health Criteria Commercial / Industrial Outdoor worker (unpaved)	Human Health Criteria Inhalation of Indoor Air	Landfill Class A Disposal Criteria ^(C)	Regional background for Wellington Region – Main Soil Type 2 (Greywacke) ^(D)
Soil Type	SILT	GRAVE L	GRAVE L	PEAT	SILT	SILT	SILT	SILT				
Sample Depth (m)	0.2	1.0	1.3	4.0	2.1	1.8	1.0	1.8				
Total Recoverable Heavy Metals in Soil (mg/kg)												
Arsenic	18	25	5	6	6	6	18	8	70 ^(A)	---	100	<2 - 7
Cadmium	0.16	0.11	< 0.1	0.17	0.1	0.21	0.22	0.11	1300 ^(A)	---	20	<0.1 - 0.1
Chromium	14	19	14	22	15	15	18	17	6300 ^(A)	---	100	6-16
Copper	29	22	21	15	14	22	26	18	10000 ^(A)	---	100	3-25
Lead	<u>173</u>	53	46	52	46	<u>123</u>	<u>122</u>	49	3300 ^(A)	---	100	5.9-78.6
Nickel	10	11	16	13	11	11	13	14	6000 ^(B)	---	200	4-13
Zinc	153	106	94	97	108	147	172	108	400000 ^(B)	---	200	24-105
Total Petroleum Hydrocarbons (TPH) in soil (mg/kg)												
C7-C9	-	<8	<8	<8	<8	<8	<8	<8	500 ^(E)	NA	---	<40-260
C10-C14	-	<20	<20	<20	<20	<20	<20	<20	1,700 – 2,200 ^(E)	NA	---	<40-260
C15-C36	-	59	210	84	71	95	240	46	NA	NA	---	<40-260
Total hydrocarbons (C7-C36)	-	<70	210	93	78	102	240	<70	---	---	---	<30-190

Notes:

A Methodology for Deriving Soil Guideline Values Protective of Human Health (NES, 2011). No Exceedances were noted.

B National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 2013). No Exceedances were noted.

C Class A Landfill disposal criteria based on leachability limits (MfE, 2014). Exceedances are underlined.

D Determination of Common Pollutant Background Soil Concentrations for the Wellington Region (URS 2003). Exceedances are italicised.

E Human health criteria for TPH commercial/industrial use all pathways for sandy silt for all pathways. No criteria for gravels exist. NA indicates estimated criterion exceeds 20,000 mg/kg.

At 20,000 mg/kg residual separate phase is expected to have formed in soil matrix. Some aesthetic impact maybe noted (MfE, 1999).

Sample ID	TP01	TP02	TP02	TP03	TP05	TP06	TP06	Regional background for Wellington Region – Main Soil Type 2 (Greywacke) ^(A)
Soil Type	GRAVEL	GRAVEL	PEAT	SILT	SILT	GRAVEL	SILT	
Sample Depth (m)	1.0	1.3	4.0	2.1	1.8	1.0	1.8	
Anthracene	<0.013	0.57	0.025	0.155	0.085	0.57	0.013	<0.002-0.05
Benzo[a]pyrene	0.034	1.4	0.111	0.36	0.29	2.3	0.045	<0.002-0.27
Fluoranthene	0.049	3.3	0.176	0.83	0.54	3.3	0.085	<0.002-0.55
Naphthalene	<0.07	0.06	<0.07	<0.06	<0.07	<0.06	<0.06	<0.002-0.01
Phenanthrene	0.014	1.13	0.068	0.49	0.34	1.76	0.070	<0.002-0.26
Pyrene	0.045	3.3	0.183	0.081	0.51	3.7	0.089	<0.002-0.57

Notes:

A Determination of Common Pollutant Background Soil Concentrations for the Wellington Region (URS 2003). Exceedances are italicised.

9.2.1 Ground Gas Potential

As we have evaluated the contents of the fill material from the site with the excavation of test pits, the gas generating potential can be assessed. We did observe organic matter in the test pits, including wood and peat, but the fill is predominately anthropogenic.

Ten samples of the fill material were collected and analysed for TOC, with concentrations ranging from 0.22 percent (%) at TP06 to 6.0 % at TP02. Using a conversion factor to calculate the degradable amount of organic carbon, the available degradable organic content (DOC) is between 0.17 % and 4.51 %.

Table 10: Total Organic and Degradable Organic Concentrations

Sample ID	TP01 – 1.0 m		TP02 – 1.3 m		TP02 – 4 m		TP02 – 5 m		TP03 – 2.1 m		TP04 – 2.0 m		TP05 – 1.8 m		TP06 – 1 m		TP06 – 1.8 m		TP06 – 3.4 m	
Parameter	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC
%	1.34	1.0	0.48	0.36	0.90	0.68	6.00	4.51	1.37	1.03	1.76	1.26	1.46	1.10	1.28	0.96	2.1	1.57	0.22	0.17

Below 5% DOC is considered a low amount while above 15% is considered high and more likely than not to produce substantial ground gas volumes as it degrades. Table 4 presents an initial screening and gas generation potential of the TOC with a potential characteristic situation (CS).

Table 11: Ground Gas Situation v's TOC (CL:AIRE, 2012)

Characteristic situation (BS 8485 and CIRIA C665)	Thickness of Made Ground (m)	Maximum total organic carbon content of Made Ground - TOC (%) see note 1, 2 and 3		Comments
		Made Ground	Made Ground in place for > 20 years	
CS1	Maximum 5m Average < 3m	≤1.0	≤1.0	Limiting values based on reported soil organic matter (SOM) content of natural soils up to about 1%
CS2	Maximum 5m Average < 3m	≤1.5	≤3	Limiting values based on gas generation modelling assuming slow degradation Equilibrium methane concentration in building above <0.01%
CS3	Maximum 5m Average < 3m	≤4	≤6	Limiting values based on gas generation modelling assuming slow degradation Equilibrium methane concentration in building above <0.01%
This method can only be used to define characteristic situations up to 3.	Gas monitoring required where TOC is greater than 4% (or 6% in old Made Ground). Gas monitoring results will show whether the high TOC is available and conditions are suitable to generate ground gas.			

Note 1: TOC = DOC x 1.33 (Hesse, 1971).

Note 2: TOC of soil tested in accordance with the method described in "Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures," Environment Agency (2005) and combined with estimate of discrete organic material from forensic description (Appendix C).

Note 3: Where TOC of soil is not representative of degradability (e.g. where it is predominantly ash or clinker) the TOC value used in the assessment should be reduced based on the fraction of degradable organic carbon.

According to Table , TP01, TP03, and TP05 fall within CS2, TP04 and TP06 fall within CS3, and TP02 exceeds CS3. The cleanfill material at this site has been in place for less than 20 years, and therefore, gas monitoring is required where TOC is greater than 4% (TP02).

Six test pits were excavated on the site; based on the large area of the landfill and the waste identified, we cannot rule out other areas having the potential to generate gas.

10 Conceptual Site Model

A conceptual site model (CSM) has been developed to assess the potential exposure pathways present at the site. A contamination CSM consists of three primary components. For a contaminant to present a risk to human health or an environmental receptor, all three components are required to be present and connected. The three components of a CSM are:

- Source of contamination;
- An exposure route, where the receptor and contaminants come into contact (e.g. ingestion, inhalation, dermal contact); and
- Receptor(s) that may be exposed to the contaminants.

The potential source, pathway and receptor linkages at this subject site are provided in Table 12.

Table 12: Conceptual Site Model

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Undocumented fill material	Direct contact Ingestion of soil Inhalation of volatile contaminants, gases or windblown dust Surface water run-off or leaching of contaminants into groundwater	Future site users / site redevelopment workers Surrounding residents and environment, including the adjacent stream	No All concentrations were below human health concentrations and gas generating potential was identified in one location. However, only limited sampling was undertaken and due to the size of the area a number of additional investigations and samples are required. Based on the nature of the waste, this does not meet cleanfill standards. Access to the stream was not possible, therefore further investigation and testing is required to assess stream impact.

11 Conclusions and Recommendations

ENGEO Ltd was requested by Envelope Engineering Limited to undertake an initial environmental assessment of the property at 14 Waiu, Wainuiomata, Lower Hutt. The site is proposed to be developed for commercial / industrial use.

The objective of this initial environmental investigation was to evaluate and identify conditions indicative of releases and threatened releases of hazardous substances at, or to the subject property, and report on the associated potential risk posed to future site users and the environment.

The initial environmental investigation included a desktop study and an intrusive site investigation. Assessment of the information collected as part of the desktop assessment has identified one HAIL category for the site, this is listed below:

- HAIL ID G3 – Cemeteries and waste recycling, treatment and disposal; Landfill Sites

ENGEO undertook an initial intrusive site investigation during February 2021. Information obtained during the desktop study was used to determine sample locations. Six locations, distributed evenly across the site, were selected for test pitting. Test pits were excavated and a range of soil samples were collected from multiple depths. Concrete, wood, brick, metal, and rubber were encountered during test pitting.

Laboratory results from the intrusive site investigation reported no exceedances of commercial / industrial human health criteria. However, laboratory reports indicate that degradable and / or leachable components are present at the site and contaminated soil and other contaminated materials (i.e. those above background levels) are present.

Based on the evidence from the initial environmental investigation, the WasteMINZ cleanfill definition as stated in Section 8.5 is not considered to have been met.

One test pit location (TP02) identified the presence of TOC that exceeded CS3 criteria for potential gas generation. This requires further investigation and monitoring in accordance with CL:AIRE, 2012.

Leachate has been reported at the base of the landfill batter. A stream runs along the western boundary of the site. It is understood that the stream is being monitored by GWRC. Reports have been requested from GWRC, however these reports were not available and therefore sampling of the stream to identify whether there is leachate present is required unless these reports can be obtained that shows that contamination is not present.

Due to the size of the site, the laboratory results showing that the materials present cannot be classed as cleanfill, and the potential for the production of gas, a full detailed site investigation (DSI) is required prior to any development works being undertaken.

12 References

BRANZ, 2017. The Building Research Association New Zealand (BRANZ) New Zealand Guidelines for Assessing and Managing Asbestos in Soil.

CL:AIRE, 2012. A Pragmatic Approach to Ground Gas Risk Assessment.

ENGEO, 2021. Geotechnical Investigation Report.

GWRC, 2014. Regional Plan for Discharges to Land for the Wellington Region.

MfE, 2011a. Ministry for the Environment. (2011). Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand

MfE, 2011b. Ministry for the Environment. (2011). Hazardous Activities and Industries List (HAIL).

MfE, 2011b. Ministry for the Environment. (2011). Contaminated Land Management Guidelines (CLMG) No.2: Hierarchy and Application in New Zealand of Environmental Guideline Values.

MfE, 2012. Ministry for the Environment. (2012). Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

NES, 2011. The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations (2011).

RetroLens Historical Image Resource <[https:// http://retrolens.nz/](https://http://retrolens.nz/)>.

URS, 2003. Determination of Common Pollutant Background Soil Concentrations for the Wellington Region.

WasteMINZ, 2018 "Technical Guidelines for Disposal to Land." August. 2018.

Wellington City Council website

<<https://gis.wcc.govt.nz/LocalMaps/Viewer/?map=d576440c16dd48628d96839f8f0c90be&account=1117115>>

13 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Envelope Engineering Limited, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (04) 472 0820 if you require any further information.

Report prepared by



Gabriela Staehle

Environmental Engineer

Report reviewed by



Karen Jones, CEnvP

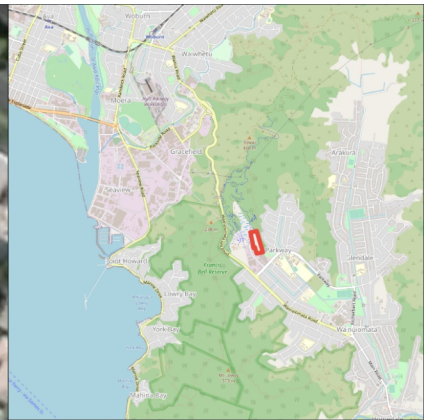
Principal Engineering Geologist



Roz Cox

Senior Environmental Scientist

FIGURES



- Legend**
- Site Boundary
 - Test Pit Locations
 - Approximate stream location



Produced by **Evalu8.earth**

Title: Site Information			
Client: Envelope Engineering Limited		Figure No: 1 Size: A4	
Project: 14 Waiu Street	Drawn: GS		
Date: 09-02-2021	Checked: KJ		
Proj No: 18286		Version: draft	

APPENDIX 1: Test Pit Geotechnical Logs

LOG OF TEST PIT TP01

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd Shear Vane No : N/A
Date : 22/02/2021 Logged By : CM
Max Test Pit Depth : 3.1 m Reviewed By : CC
Digger Type/Size : Bucket Excavator Latitude : -41.251057
Bucket Type/Size : 60 cm Longitude : 174.930127

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	SILT with some gravel and some sand; greyish brown. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains concrete, red brick and domestic waste. [FILL]					Medium Dense to Dense		
1.0			GM	Silty sandy fine to coarse GRAVEL with minor cobbles and minor boulders; bluish grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are angular to subrounded; boulders are subangular, up to 210 mm. Contains wood, concrete and domestic waste. [FILL]					Loosely packed		
1.5								M	Loose to Medium Dense		
2.0									Dense		
2.5									Loosely packed		



Bucket excavator met target depth at 3.1 m. at 3.1 m.
Scala Penetrometer met practical refusal at 1.7 m depth.
Standing groundwater was not encountered.

LOG OF TEST PIT TP01

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.1 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.251057
Bucket Type/Size : 60 cm **Longitude** : 174.930127

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	ALLUVIUM		GM	Sandy SILT with trace gravel; light grey mottled orange. Low plasticity; sand is fine to medium; gravel is fine to medium, subangular, greywacke.				M	-		
			ML								
3.5											
4.0											
4.5											
5.0											
Depth of Excavation: 3.1 m Termination Condition: Target depth											



Bucket excavator met target depth at 3.1 m. at 3.1 m.
 Scala Penetrometer met practical refusal at 1.7 m depth.
 Standing groundwater was not encountered.

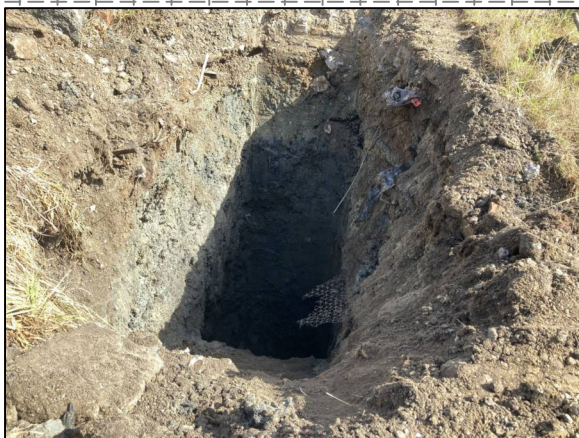
LOG OF TEST PIT TP02

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No :** N/A
Date : 22/02/2021 **Logged By :** CM
Max Test Pit Depth : 5 m **Reviewed By :** CC
Digger Type/Size : Bucket Excavator **Latitude :** -41.249159
Bucket Type/Size : 60 cm **Longitude :** 174.929204

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]				M	-		
			GM	Silty fine to coarse GRAVEL with some sand and some gravel; grey mixed brown. Well graded, angular to rounded, greywacke; sand is fine to coarse. Contains brick, asphalt and domestic waste. [FILL]					Dense		
1.0			GM	Silty sandy fine to coarse GRAVEL with minor cobbles and minor boulders; bluish grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are angular to subrounded; boulders are subangular, up to Contains wood, concrete and domestic waste. [FILL]					Loosely packed		
1.5				1.3 m - Perched water inflow.							
2.0				1.5 m - Colour changes to dark grey.				W	Medium Dense		
2.5									Dense		
									Loosely packed		



Bucket excavator met target depth at 5.0 m. at 5 m.
Scala Penetrometer met practical refusal at 2.1 m depth.
Perched groundwater encountered at 1.3 m.

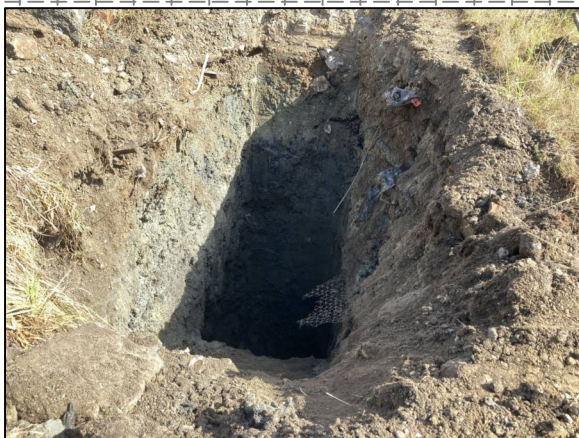
LOG OF TEST PIT TP02

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 5 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.249159
Bucket Type/Size : 60 cm **Longitude** : 174.929204

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL										
3.5											
4.0											
4.5				4.2 m - Contains lenses of PEAT; fibrous, dark brown.				W	Loosely packed		
5.0				Depth of Excavation: 5 m Termination Condition: Target depth							



Bucket excavator met target depth at 5.0 m. at 5 m.
 Scala Penetrometer met practical refusal at 2.1 m depth.
 Perched groundwater encountered at 1.3 m.

LOG OF TEST PIT TP03

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.3 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.248728
Bucket Type/Size : 60 cm **Longitude** : 174.929364

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5			ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]					Firm to Stiff		
			GW	Sandy fine to coarse GRAVEL with some silt; brown. Well graded, angular to subangular, greywacke; sand is fine to coarse. Contains brick, concrete and wood. [FILL]					Medium Dense to Dense		
1.0			ML	Gravelly SILT with minor sand; grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains brick, wood, concrete and metal. [FILL]				M			
1.5									Loosely packed		
2.0			ML	Gravelly SILT; light brown. Low plasticity; gravel is fine to moderate, subrounded to rounded. [FILL]							
2.5			ML	Gravelly SILT with minor sand; grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains brick, wood, concrete and metal. [FILL]							



Bucket excavator met practical refusal at 3.3 m. at 3.3 m depth .
 Scala Penetrometer met practical refusal at 0.4 m depth.
 Standing groundwater was not encountered.

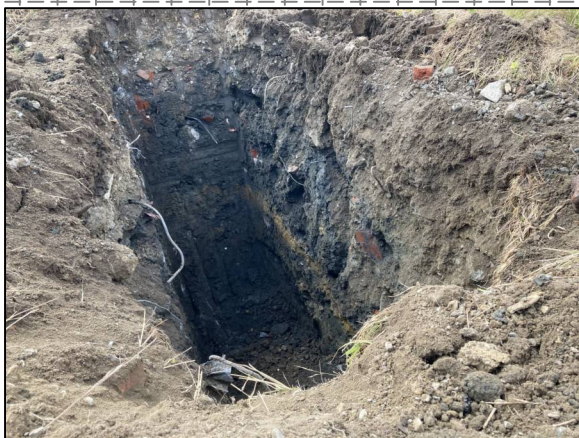
LOG OF TEST PIT TP03

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.3 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.248728
Bucket Type/Size : 60 cm **Longitude** : 174.929364

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL		ML	Gravelly SILT with minor sand; grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains brick, wood, concrete and metal. [FILL]				M	Loosely packed		
3.5	Depth of Excavation: 3.3 m Termination Condition: Practical refusal										
4.0											
4.5											
5.0											



Bucket excavator met practical refusal at 3.3 m. at 3.3 m depth .
 Scala Penetrometer met practical refusal at 0.4 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP04

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.8 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.249375
Bucket Type/Size : 60 cm **Longitude** : 174.929875

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5			ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]					-		
				Sandy fine to coarse GRAVEL with some silt; brown. Well graded, angular to subangular, greywacke; sand is fine to coarse. Contains brick, concrete and wood. [FILL]					Hard		
			GW	1.4 m - Colour changes to grey.				M	Medium Dense to Dense		
1.5			ML	Clayey SILT; light brown. Moderate plasticity. [FILL]					Loosely packed		
2.0				1.8 m - Colour changes to grey.							
2.5			GW	Fine to coarse GRAVEL with some silt, minor sand, minor cobbles and minor boulders; grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles and boulders are rounded to subrounded, up to 210 mm. Contains concrete. [FILL]			W				



Bucket excavator met practical refusal at 3.8 m. at 3.8 m depth .
 Scala Penetrometer met practical refusal at 0.4 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP04

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.8 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.249375
Bucket Type/Size : 60 cm **Longitude** : 174.929875

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL		GW	Fine to coarse GRAVEL with some silt, minor sand, minor cobbles and minor boulders; grey. Well graded, angular to subangular, grewacke; sand is fine to coarse; cobbles and boulders are rounded to subrounded, up to 210 mm. Contains concrete. [FILL]			W	Loosely packed			
3.5											
4.0				Depth of Excavation: 3.8 m Termination Condition: Practical refusal							
4.5											
5.0											



Bucket excavator met practical refusal at 3.8 m. at 3.8 m depth .
 Scala Penetrometer met practical refusal at 0.4 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP05

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 2.9 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.250066
Bucket Type/Size : 60 cm **Longitude** : 174.929783

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]					Hard Dense		
			GW	Sandy fine to coarse GRAVEL with minor sand; brown mixed grey. Well graded, angular to subangular; sand is fine to coarse. Contains brick, ceramics, concrete, metal and wood. [FILL]				M	Loosely packed		
1.0									Very Loose to Loose		
1.5			ML	Clayey SILT; light brown. Moderate plasticity. [FILL]					Soft		
			ML	SILT with some gravel, minor cobbles and boulders and trace sand; blueish grey. Low plasticity; gravel is fine to medium, subrounded to rounded, greywacke; cobbles and boulders are subrounded to rounded, up to 200 mm. [FILL]				W	Stiff to Very Stiff		
2.0											
2.5			GW	Fine to coarse GRAVEL with some silt, minor sand and minor cobbles; grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are subrounded to rounded, up to 140 mm. [FILL]				M	Dense		



Bucket excavator met practical refusal 2.9 m. at 2.9 m depth .
 Scala Penetrometer met practical refusal at 2.3 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP05

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 2.9 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.250066
Bucket Type/Size : 60 cm **Longitude** : 174.929783

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
	FILL	Easier Harder	GW					M			2 4 6 8 10 12
3.0				Depth of Excavation: 2.9 m Termination Condition: Practical refusal							
3.5											
4.0											
4.5											
5.0											



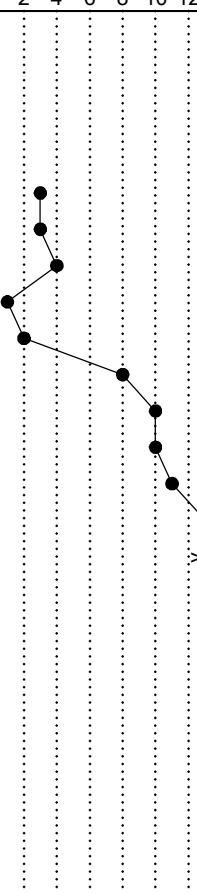
Bucket excavator met practical refusal 2.9 m. at 2.9 m depth .
 Scala Penetrometer met practical refusal at 2.3 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP06

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No :** N/A
Date : 22/02/2021 **Logged By :** CM
Max Test Pit Depth : 5 m **Reviewed By :** CC
Digger Type/Size : Bucket Excavator **Latitude :** -41.250222
Bucket Type/Size : 60 cm **Longitude :** 174.930289

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder									2 4 6 8 10 12
0.5	FILL			ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]				M	Loosely packed		
				GW	Sandy fine to coarse GRAVEL with minor sand; greyish brown. Well graded, angular to subangular, greywacke; sand is fine to coarse. Contains concrete and brick. [FILL]					Loose to Medium Dense		
				Dense								
				Hard								
				ML	Gravelly SILT with some sand; bluish grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains concrete, wood, brick, metal and rubber. [FILL]					W		
2.0												
2.5												



Bucket excavator met target depth at 5.0 m. at 5 m.
 Scala Penetrometer met practical refusal at 1.5 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP06

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 5 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.250222
Bucket Type/Size : 60 cm **Longitude** : 174.930289

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL			Gravelly SILT with some sand; bluish grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains concrete, wood, brick, metal and rubber. [FILL]							
3.5											
4.0			ML								
4.5											
5.0				Depth of Excavation: 5 m Termination Condition: Target depth							



Bucket excavator met target depth at 5.0 m. at 5 m.
 Scala Penetrometer met practical refusal at 1.5 m depth.
 Standing groundwater was not encountered.

APPENDIX 2: Laboratory Results



Certificate of Analysis

Page 1 of 8

Client:	Engeo Limited	Lab No:	2530834	SPv2
Contact:	Roz Cox	Date Received:	17-Feb-2021	
	C/- Engeo Limited	Date Reported:	26-Feb-2021	(Amended)
	PO Box 25047	Quote No:	82742	
	Wellington 6146	Order No:		
		Client Reference:	18286.000.001	
		Submitted By:	Roz Cox	

Sample Type: Soil

Sample Name:		TP1 - 0.2m 17-Feb-2021	TP1 - 1m 17-Feb-2021	TP2 - 1.3m 17-Feb-2021	TP2 - 4m 17-Feb-2021	TP2 - 5m
Lab Number:		2530834.1	2530834.2	2530834.3	2530834.4	2530834.5
Individual Tests						
Dry Matter	g/100g as rcvd	-	81	87	80	-
Total Organic Carbon*	g/100g dry wt	-	1.34	0.48	0.90	6.0
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	18	25	5	6	-
Total Recoverable Cadmium	mg/kg dry wt	0.16	0.11	< 0.10	0.17	-
Total Recoverable Chromium	mg/kg dry wt	14	19	14	22	-
Total Recoverable Copper	mg/kg dry wt	29	22	21	15	-
Total Recoverable Lead	mg/kg dry wt	173	53	46	52	-
Total Recoverable Nickel	mg/kg dry wt	10	11	16	13	-
Total Recoverable Zinc	mg/kg dry wt	153	106	94	97	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	-	-	< 0.05	-	-
Toluene	mg/kg dry wt	-	-	< 0.05	-	-
Ethylbenzene	mg/kg dry wt	-	-	< 0.05	-	-
m&p-Xylene	mg/kg dry wt	-	-	< 0.10	-	-
o-Xylene	mg/kg dry wt	-	-	< 0.05	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	0.4	14	1.3	-
1-Methylnaphthalene	mg/kg dry wt	-	< 0.013	0.074	< 0.013	-
2-Methylnaphthalene	mg/kg dry wt	-	< 0.013	0.054	< 0.013	-
Acenaphthylene	mg/kg dry wt	-	< 0.013	0.57	0.021	-
Acenaphthene	mg/kg dry wt	-	< 0.013	0.064	< 0.013	-
Anthracene	mg/kg dry wt	-	< 0.013	0.57	0.025	-
Benzo[a]anthracene	mg/kg dry wt	-	0.030	1.72	0.096	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	0.034	1.40	0.111	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	0.05	2.2	0.17	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	0.05	2.2	0.17	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	0.040	1.74	0.129	-
Benzo[e]pyrene	mg/kg dry wt	-	0.019	0.78	0.066	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	0.023	0.72	0.090	-
Benzo[k]fluoranthene	mg/kg dry wt	-	0.016	0.77	0.047	-
Chrysene	mg/kg dry wt	-	0.028	1.53	0.089	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	< 0.013	0.22	0.020	-
Fluoranthene	mg/kg dry wt	-	0.049	3.3	0.176	-
Fluorene	mg/kg dry wt	-	< 0.013	0.132	< 0.013	-



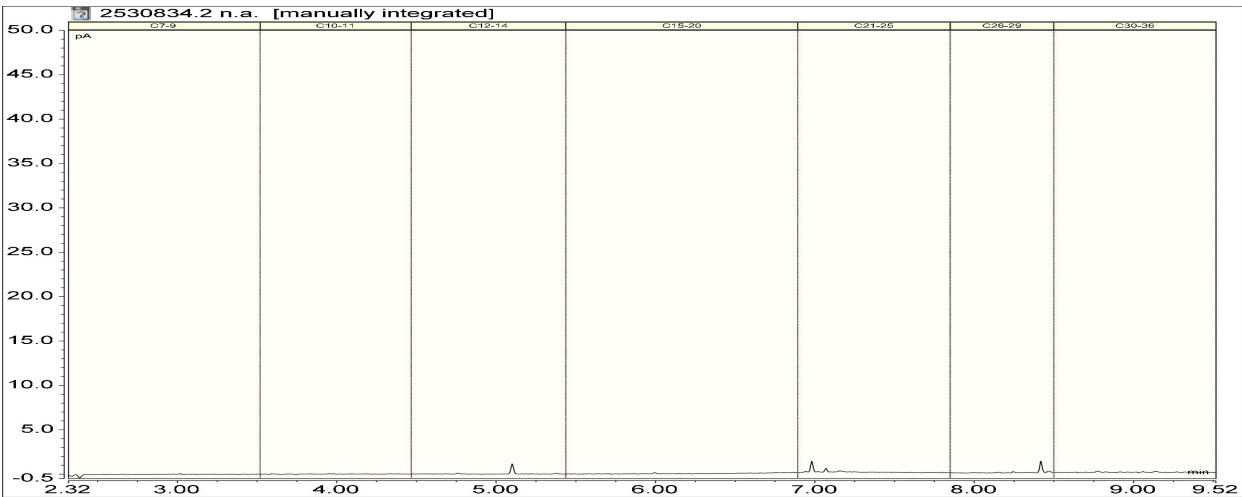
This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Sample Type: Soil						
Sample Name:		TP1 - 0.2m 17-Feb-2021	TP1 - 1m 17-Feb-2021	TP2 - 1.3m 17-Feb-2021	TP2 - 4m 17-Feb-2021	TP2 - 5m
Lab Number:		2530834.1	2530834.2	2530834.3	2530834.4	2530834.5
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	0.023	0.91	0.090	-
Naphthalene	mg/kg dry wt	-	< 0.07	0.06	< 0.07	-
Perylene	mg/kg dry wt	-	< 0.013	0.35	0.066	-
Phenanthrene	mg/kg dry wt	-	0.014	1.13	0.068	-
Pyrene	mg/kg dry wt	-	0.045	3.3	0.183	-
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Bis(2-chloroethyl)ether	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Bis(2-chloroisopropyl)ether	mg/kg dry wt	-	< 0.5	< 0.5	-	-
4-Bromophenyl phenyl ether	mg/kg dry wt	-	< 0.4	< 0.4	-	-
4-Chlorophenyl phenyl ether	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	-	< 1.0	< 1.0	-	-
2,6-Dinitrotoluene	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Nitrobenzene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
N-Nitrosodi-n-propylamine	mg/kg dry wt	-	< 0.8	< 0.7	-	-
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	-	< 0.8	< 0.7	-	-
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	-	< 0.5	< 0.5	-	-
alpha-BHC	mg/kg dry wt	-	< 0.5	< 0.5	-	-
beta-BHC	mg/kg dry wt	-	< 0.5	< 0.5	-	-
delta-BHC	mg/kg dry wt	-	< 0.5	< 0.5	-	-
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.5	< 0.5	-	-
4,4'-DDD	mg/kg dry wt	-	< 0.5	< 0.5	-	-
4,4'-DDE	mg/kg dry wt	-	< 0.5	< 0.5	-	-
4,4'-DDT	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Dieldrin	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Endosulfan I	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Endosulfan II	mg/kg dry wt	-	< 2	< 2	-	-
Endosulfan sulphate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Endrin	mg/kg dry wt	-	< 0.8	< 0.7	-	-
Endrin ketone	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Heptachlor	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Heptachlor epoxide	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Hexachlorobenzene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Acenaphthylene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Anthracene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Benzo[a]anthracene	mg/kg dry wt	-	< 0.5	0.7	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	< 0.5	0.8	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	< 0.5	0.8	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
1&2-Chloronaphthalene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Chrysene	mg/kg dry wt	-	< 0.5	0.7	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Fluoranthene	mg/kg dry wt	-	< 0.5	1.7	-	-
Fluorene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
2-Methylnaphthalene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Naphthalene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Phenanthrene	mg/kg dry wt	-	< 0.5	0.7	-	-

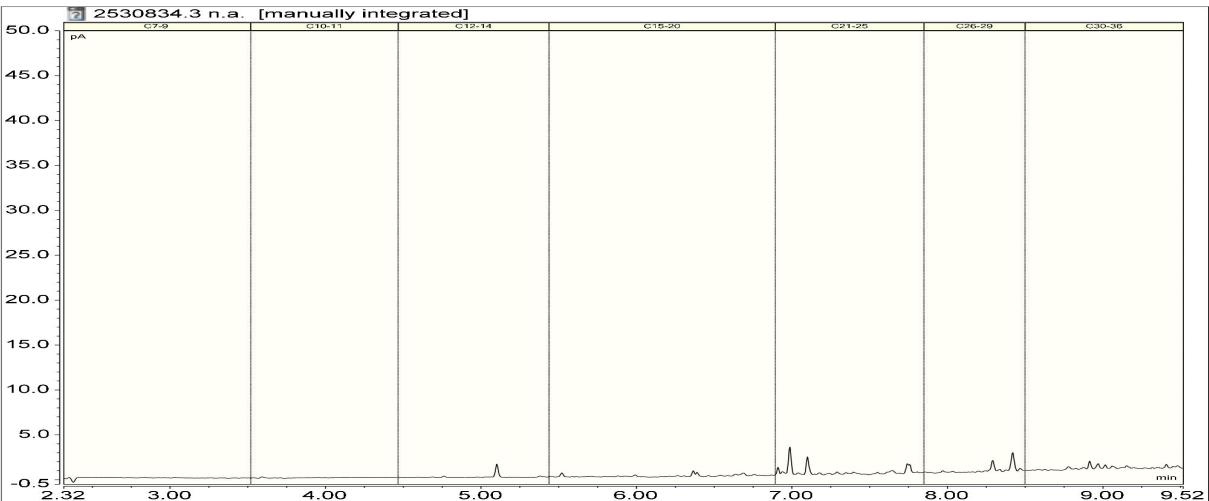
Sample Type: Soil						
Sample Name:		TP1 - 0.2m 17-Feb-2021	TP1 - 1m 17-Feb-2021	TP2 - 1.3m 17-Feb-2021	TP2 - 4m 17-Feb-2021	TP2 - 5m
Lab Number:		2530834.1	2530834.2	2530834.3	2530834.4	2530834.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Pyrene	mg/kg dry wt	-	< 0.5	1.8	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	< 1.3	< 1.3	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	< 1.3	< 1.3	-	-
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	-	< 5	< 5	-	-
2-Chlorophenol	mg/kg dry wt	-	< 1.0	< 1.0	-	-
2,4-Dichlorophenol	mg/kg dry wt	-	< 1.0	< 1.0	-	-
2,4-Dimethylphenol	mg/kg dry wt	-	< 3	< 3	-	-
3 & 4-Methylphenol (m- + p- cresol)	mg/kg dry wt	-	< 3	< 3	-	-
2-Methylphenol (o-Cresol)	mg/kg dry wt	-	< 1.0	< 1.0	-	-
2-Nitrophenol	mg/kg dry wt	-	< 5	< 5	-	-
Pentachlorophenol (PCP)	mg/kg dry wt	-	< 30	< 30	-	-
Phenol	mg/kg dry wt	-	< 1.0	< 1.0	-	-
2,4,5-Trichlorophenol	mg/kg dry wt	-	< 1.0	< 1.0	-	-
2,4,6-Trichlorophenol	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	-	< 5	< 5	-	-
Butylbenzylphthalate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Di(2-ethylhexyl)adipate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Diethylphthalate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Dimethylphthalate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Di-n-butylphthalate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Di-n-octylphthalate	mg/kg dry wt	-	< 1.0	< 1.0	-	-
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	-	< 0.8	< 0.7	-	-
1,3-Dichlorobenzene	mg/kg dry wt	-	< 0.8	< 0.7	-	-
1,4-Dichlorobenzene	mg/kg dry wt	-	< 0.8	< 0.7	-	-
Hexachlorobutadiene	mg/kg dry wt	-	< 0.8	< 0.7	-	-
Hexachloroethane	mg/kg dry wt	-	< 0.8	< 0.7	-	-
1,2,4-Trichlorobenzene	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	-	< 10	< 10	-	-
Carbazole	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Dibenzofuran	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Isophorone	mg/kg dry wt	-	< 0.5	< 0.5	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	< 8	< 8	< 8	-
C10 - C14	mg/kg dry wt	-	< 20	< 20	< 20	-
C15 - C36	mg/kg dry wt	-	59	210	84	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	< 70	210	93	-
Sample Name:		TP3 - 2.1m 17-Feb-2021	TP4 - 2m 17-Feb-2021	TP5 - 1.8m 17-Feb-2021	TP6 - 1m 17-Feb-2021	TP6 - 1.8m 17-Feb-2021
Lab Number:		2530834.6	2530834.7	2530834.8	2530834.9	2530834.10
Individual Tests						
Dry Matter	g/100g as rcvd	88	-	83	82	87
Total Organic Carbon*	g/100g dry wt	1.37	1.76	1.46	2.1	1.28
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	6	-	6	18	8
Total Recoverable Cadmium	mg/kg dry wt	0.10	-	0.21	0.22	0.11
Total Recoverable Chromium	mg/kg dry wt	15	-	15	18	17
Total Recoverable Copper	mg/kg dry wt	14	-	22	26	18
Total Recoverable Lead	mg/kg dry wt	46	-	123	122	49

Sample Type: Soil						
Sample Name:		TP3 - 2.1m 17-Feb-2021	TP4 - 2m 17-Feb-2021	TP5 - 1.8m 17-Feb-2021	TP6 - 1m 17-Feb-2021	TP6 - 1.8m 17-Feb-2021
Lab Number:		2530834.6	2530834.7	2530834.8	2530834.9	2530834.10
Heavy Metals, Screen Level						
Total Recoverable Nickel	mg/kg dry wt	11	-	11	13	14
Total Recoverable Zinc	mg/kg dry wt	108	-	147	172	108
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	5.2	-	3.7	25	0.7
1-Methylnaphthalene	mg/kg dry wt	0.021	-	0.014	0.013	0.017
2-Methylnaphthalene	mg/kg dry wt	0.018	-	0.015	0.014	0.020
Acenaphthylene	mg/kg dry wt	0.032	-	0.066	0.50	< 0.011
Acenaphthene	mg/kg dry wt	0.103	-	0.030	0.016	< 0.011
Anthracene	mg/kg dry wt	0.155	-	0.085	0.57	0.013
Benzo[a]anthracene	mg/kg dry wt	0.39	-	0.26	2.3	0.044
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.36	-	0.29	2.3	0.045
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	0.56	-	0.44	3.5	0.07
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	0.55	-	0.44	3.4	0.07
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.45	-	0.36	2.4	0.055
Benzo[e]pyrene	mg/kg dry wt	0.21	-	0.170	1.40	0.033
Benzo[g,h,i]perylene	mg/kg dry wt	0.24	-	0.195	1.37	0.032
Benzo[k]fluoranthene	mg/kg dry wt	0.175	-	0.134	0.95	0.022
Chrysene	mg/kg dry wt	0.37	-	0.26	2.0	0.044
Dibenzo[a,h]anthracene	mg/kg dry wt	0.065	-	0.050	0.39	< 0.011
Fluoranthene	mg/kg dry wt	0.83	-	0.54	3.3	0.085
Fluorene	mg/kg dry wt	0.098	-	0.058	0.073	0.013
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.26	-	0.20	1.43	0.031
Naphthalene	mg/kg dry wt	< 0.06	-	< 0.07	< 0.06	< 0.06
Perylene	mg/kg dry wt	0.099	-	0.075	0.52	0.013
Phenanthrene	mg/kg dry wt	0.49	-	0.34	1.76	0.070
Pyrene	mg/kg dry wt	0.81	-	0.51	3.7	0.089
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	-	< 8	< 8	< 8
C10 - C14	mg/kg dry wt	< 20	-	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	71	-	95	240	46
Total hydrocarbons (C7 - C36)	mg/kg dry wt	78	-	102	240	< 70
Sample Name:		TP6 - 3.4m 17-Feb-2021				
Lab Number:		2530834.11				
Individual Tests						
Total Organic Carbon*	g/100g dry wt	0.22	-	-	-	-

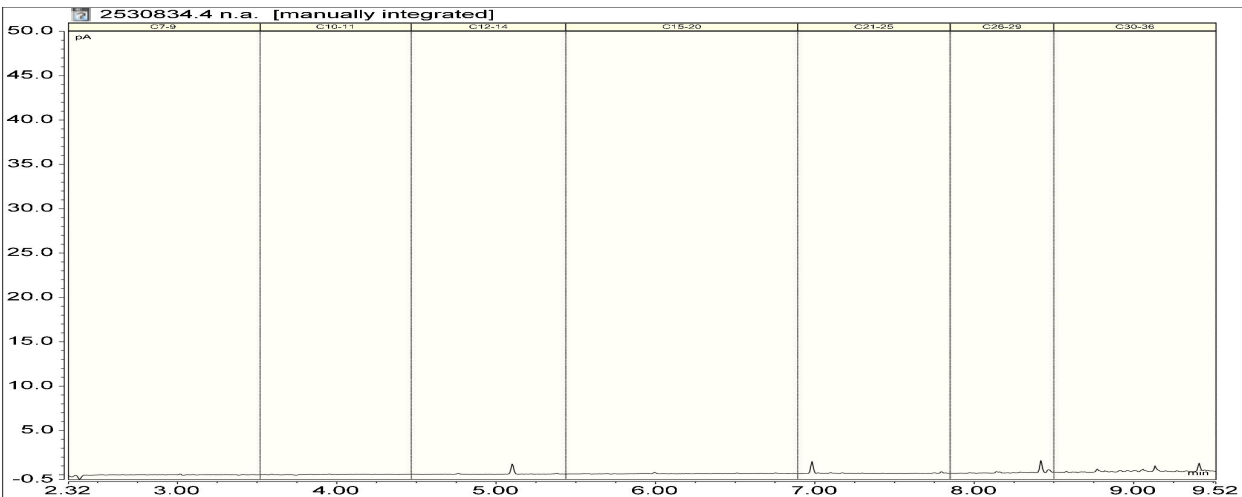
2530834.2
TP1 - 1m 17-Feb-2021
Client Chromatogram for TPH by FID



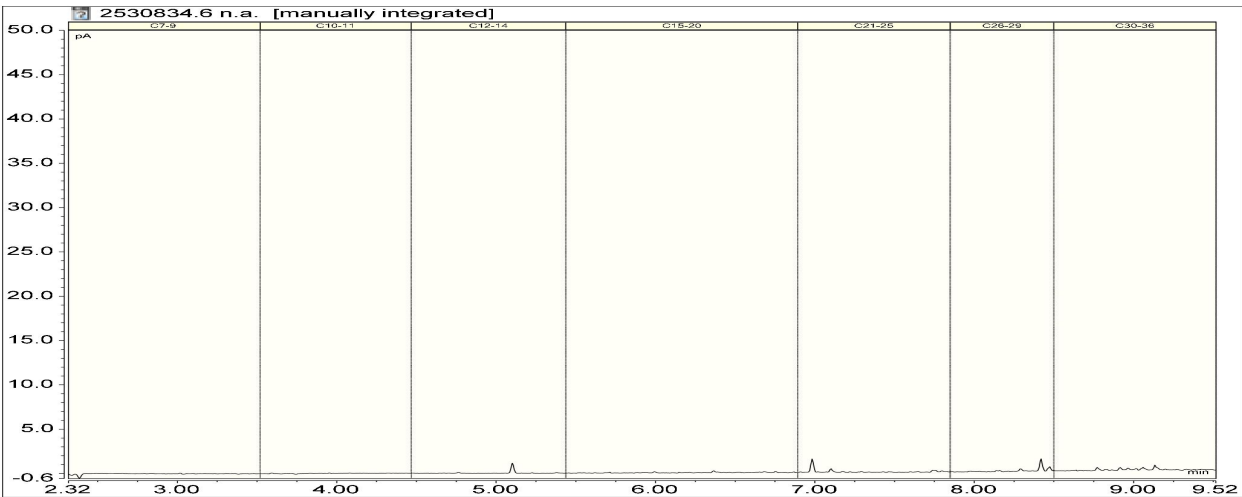
2530834.3
TP2 - 1.3m 17-Feb-2021
Client Chromatogram for TPH by FID



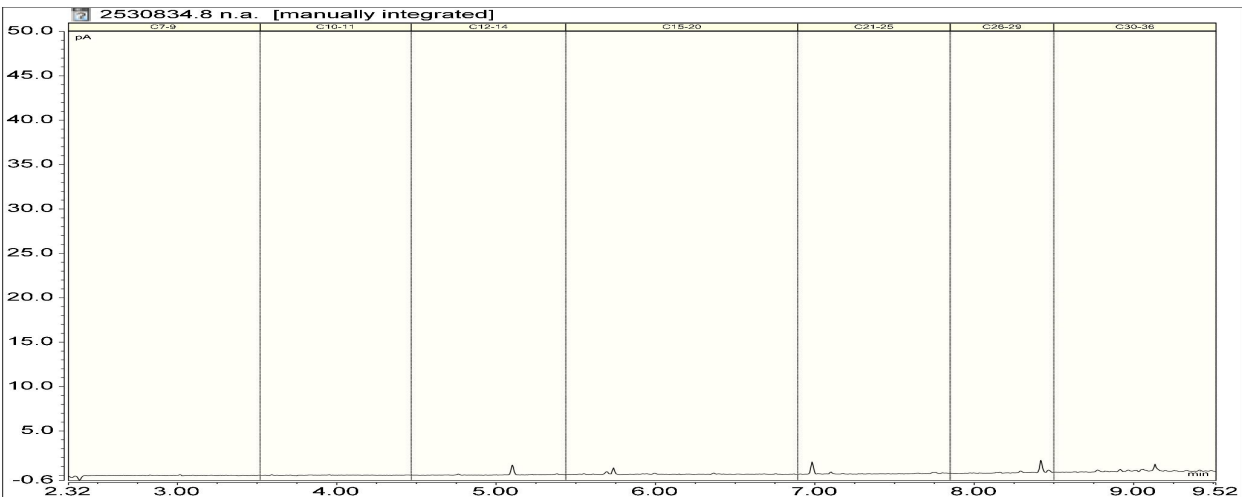
2530834.4
TP2 - 4m 17-Feb-2021
Client Chromatogram for TPH by FID



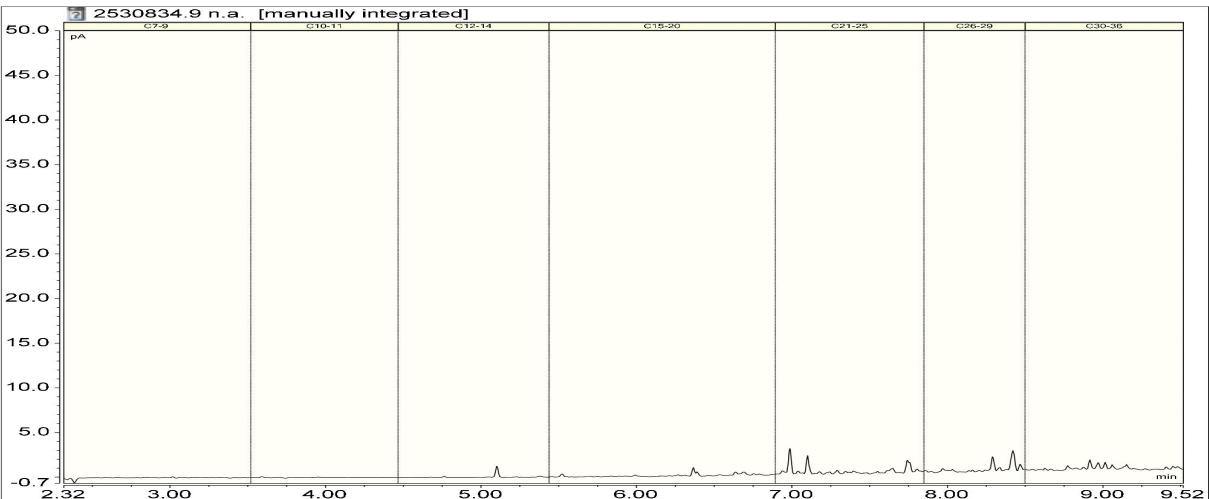
2530834.6
TP3 - 2.1m 17-Feb-2021
Client Chromatogram for TPH by FID



2530834.8
TP5 - 1.8m 17-Feb-2021
Client Chromatogram for TPH by FID



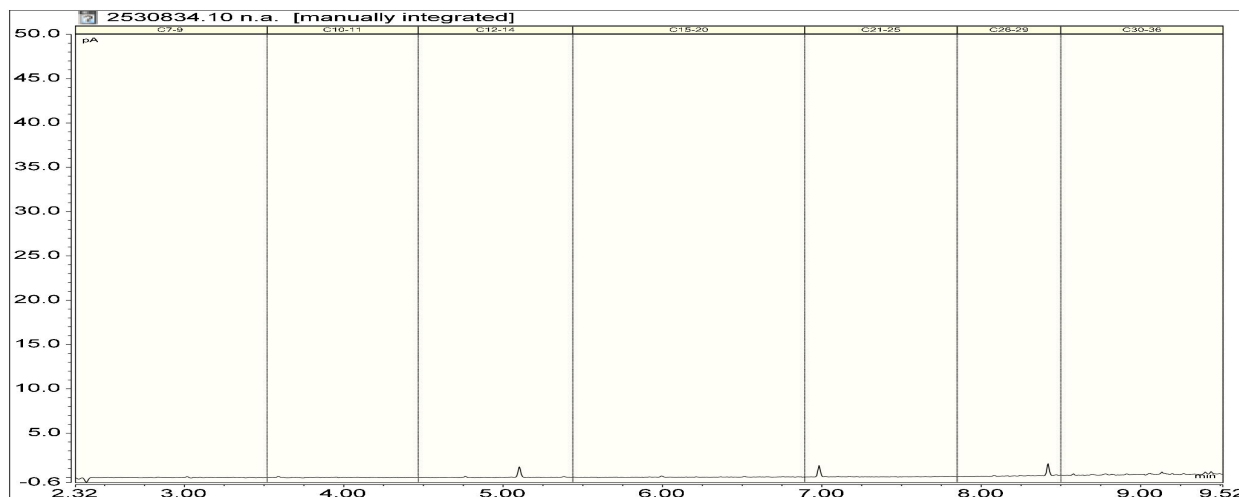
2530834.9
TP6 - 1m 17-Feb-2021
Client Chromatogram for TPH by FID



2530834.10

TP6 - 1.8m 17-Feb-2021

Client Chromatogram for TPH by FID



Analyst's Comments

Amended Report: This certificate of analysis replaces report '2530834-SPv1' issued on 25-Feb-2021 at 2:45 pm. Reason for amendment: PAH calculations on sample 2530834.3 fixed as were missing originally.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-11
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation May contain a residual moisture content of 2-5%.	-	5, 7, 11
Total of Reported PAHs in Soil	Sonication extraction, GC-MS analysis. In-house based on US EPA 8270.	0.03 mg/kg dry wt	2-4, 6, 8-10
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	2-4, 6, 8-10
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	2-11
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	BaP Potency Equivalence calculated from; Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1.0 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	2-4, 6, 8-10
Benzo[a]pyrene Toxic Equivalence (TEF)*	Benzo[a]pyrene Toxic Equivalence (TEF) calculated from; Benzo[a]pyrene x 1.0 + Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg dry wt	2-4, 6, 8-10
TPH Oil Industry Profile + PAHscreen	Sonication extraction, GC-FID and GC-MS analysis. Tested on as received sample. In-house based on US EPA 8015 and US EPA 8270.	0.002 - 70 mg/kg dry wt	2, 4, 6, 8-10
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-4, 6, 8-10

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis. Tested on as received sample. In-house based on US EPA 8260 and 5021.	0.05 - 0.10 mg/kg dry wt	3
Polycyclic Aromatic Hydrocarbons Screening in Soil*	Sonication extraction, GC-MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.002 - 0.05 mg/kg dry wt	3
Semivolatile Organic Compounds Screening in Soil by GC-MS	Sonication extraction, GC-MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.002 - 30 mg/kg dry wt	2-3
TPH + PAH + BTEX profile	Sonication extraction, GC-FID and GC-MS analysis. Tested on as received sample. In-house based on US EPA 8015 and US EPA 8270.	0.002 - 70 mg/kg dry wt	3
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	2-4, 6, 8-10
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	8 mg/kg dry wt	2-4, 6, 8-10
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	2-4, 6, 8-10
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	2-4, 6, 8-10
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	2-4, 6, 8-10

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 22-Feb-2021 and 25-Feb-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Kim Harrison MSc
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 3

Client:	Engeo Limited	Lab No:	2530839	A2Pv1
Contact:	Roz Cox	Date Received:	17-Feb-2021	
	C/- Engeo Limited	Date Reported:	22-Feb-2021	
	PO Box 25047	Quote No:	82742	
	Wellington 6146	Order No:		
		Client Reference:	14 Waiu St	
		Submitted By:	Roz Cox	

Sample Type: Soil

Sample Name:	TP1 - 1m 17-Feb-2021	TP3 - 2.1m 17-Feb-2021	TP5 - 1.8m 17-Feb-2021	TP6 - 1.8m 17-Feb-2021	
Lab Number:	2530839.1	2530839.3	2530839.5	2530839.7	
Asbestos Presence / Absence	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	-
Description of Asbestos Form	-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	-
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	-
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	-
Asbestos as Asbestos Fines as % of Total Sample*	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	% w/w < 0.001	-
As Received Weight	g 811.3	g 723.4	g 870.2	g 864.5	-
Dry Weight	g 685.3	g 647.9	g 726.8	g 781.9	-
Moisture	% 16	% 10	% 16	% 10	-
Sample Fraction >10mm	g dry wt 220.0	g dry wt 210.0	g dry wt 116.4	g dry wt 254.8	-
Sample Fraction <10mm to >2mm	g dry wt 249.2	g dry wt 265.9	g dry wt 284.3	g dry wt 311.6	-
Sample Fraction <2mm	g dry wt 215.3	g dry wt 171.7	g dry wt 325.2	g dry wt 215.5	-
<2mm Subsample Weight	g dry wt 55.6	g dry wt 55.2	g dry wt 57.6	g dry wt 58.4	-
Weight of Asbestos in ACM (Non-Friable)	g dry wt < 0.00001	g dry wt < 0.00001	g dry wt < 0.00001	g dry wt < 0.00001	-
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt < 0.00001	g dry wt < 0.00001	g dry wt < 0.00001	g dry wt < 0.00001	-
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt < 0.00001	g dry wt < 0.00001	g dry wt < 0.00001	g dry wt < 0.00001	-

Glossary of Terms

- Loose fibres (Minor) - One or two fibres/fibre bundles identified during analysis by stereo microscope/PLM.
- Loose fibres (Major) - Three or more fibres/fibre bundles identified during analysis by stereo microscope/PLM.
- ACM Debris (Minor) - One or two small (<2mm) pieces of material attached to fibres identified during analysis by stereo microscope/PLM.
- ACM Debris (Major) - Large (>2mm) piece, or more than three small (<2mm) pieces of material attached to fibres identified during analysis by stereo microscope/PLM.
- Unknown Mineral Fibres - Mineral fibres of unknown type detected by polarised light microscopy including dispersion staining. The fibres detected may or may not be asbestos fibres. To confirm the identities, another independent analytical technique may be required.
- Trace - Trace levels of asbestos, as defined by AS4964-2004.

For further details, please contact the Asbestos Team.

Please refer to the **BRANZ New Zealand Guidelines for Assessing and Managing Asbestos in Soil.**
<https://www.branz.co.nz/asbestos>

The following assumptions have been made:

1. Asbestos Fines in the <2mm fraction, after homogenisation, is evenly distributed throughout the fraction
2. The weight of asbestos in the sample is unaffected by the ashing process.

Results are representative of the sample provided to Hill Laboratories only.



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Wgt of Asbestos as Asbestos Fines in <10mm >2mm Fraction*	Measurement on analytical balance, from the <10mm >2mm Fraction. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.00001 g dry wt	1, 3, 5, 7
New Zealand Guidelines Semi Quantitative Asbestos in Soil			
As Received Weight	Measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1, 3, 5, 7
Dry Weight	Sample dried at 100 to 105°C, measurement on balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1, 3, 5, 7
Moisture	Sample dried at 100 to 105°C. Calculation = (As received weight - Dry weight) / as received weight x 100.	1 %	1, 3, 5, 7
Sample Fraction >10mm	Sample dried at 100 to 105°C, 10mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g dry wt	1, 3, 5, 7
Sample Fraction <10mm to >2mm	Sample dried at 100 to 105°C, 10mm and 2mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g dry wt	1, 3, 5, 7
Sample Fraction <2mm	Sample dried at 100 to 105°C, 2mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g dry wt	1, 3, 5, 7
Asbestos Presence / Absence	Examination using Low Powered Stereomicroscopy followed by 'Polarised Light Microscopy' including 'Dispersion Staining Techniques'. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples.	0.01%	1, 3, 5, 7
Description of Asbestos Form	Description of asbestos form and/or shape if present.	-	1, 3, 5, 7
Weight of Asbestos in ACM (Non-Friable)	Measurement on analytical balance, from the >10mm Fraction. Weight of asbestos based on assessment of ACM form. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1, 3, 5, 7
Asbestos in ACM as % of Total Sample*	Calculated from weight of asbestos in ACM and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1, 3, 5, 7
Weight of Asbestos as Fibrous Asbestos (Friable)	Measurement on analytical balance, from the >10mm Fraction. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1, 3, 5, 7
Asbestos as Fibrous Asbestos as % of Total Sample*	Calculated from weight of fibrous asbestos and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1, 3, 5, 7
Weight of Asbestos as Asbestos Fines (Friable)*	Measurement on analytical balance, from the <10mm Fractions. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1, 3, 5, 7
Asbestos as Asbestos Fines as % of Total Sample*	Calculated from weight of asbestos fines and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1, 3, 5, 7
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	Calculated from weight of fibrous asbestos plus asbestos fines and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1, 3, 5, 7

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed on 22-Feb-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Rhodri Williams BSc (Hons)
Technical Manager - Asbestos