ENGEO

Expect Excellence

Detailed Environmental Site Investigation

Te Rangihaeata, 30 Benmore Crescent

Manor Park

Lower Hutt

Submitted to:

Rosco Investments
218 Willis 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

04.02.2022
17709.000.000_19

ACENZ

Contents

Tables

Figures (appended)

Figure 1: Site Location and DSI Zones

Figure 2: Proposed Future Development Site (for Reference)

Figure 3: Sample Locations

Appendices

Appendix 1: Laboratory Reports

ENGEO Document Control:

Report Title	Detailed Environmental Site Investigation - Te Rangihaeata, 30 Benmore Crescent, Manor Park			
Project No.	17709.000.000	Doc ID	19	
Client	Rosco Investments	Client Contact	Richard Burrell	
Distribution (PDF)	Richard Burrell (Rosco Investments)			
Date	Revision Details/Status	WP	Author	Reviewer
06/11/2020	Issued to Client	DF	CM	KJ/GO
04/06/2021	Updated with additional investigation - Issued to Client	DF	RC/GS	KJ
25/06/2021	Updated – Rev 2	DF	RC/GS	KJ
01/07/2021	Updated – Rev 3	DF	KJ	KJ
04/02/2022	Updated – Rev 4	DF	GS	KJ

1 Introduction

ENGEO Ltd was requested by Rosco Investments to undertake a Detailed Environmental Site Investigation (DSI) for the property at Te Rangihaeata, 30 Benmore Crescent, Manor Park, Lower Hutt (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement, reference P2020.001.841_01 dated 27 August 2020.

The site is currently a mixture of commercial, industrial, farmland, and scrub land with some open grassed areas and it is proposed to undertake bulk earthworks over the site in preparation for future land development for likely mixed use activities; some of the earthworks have already begun, this includes remedial works of an area close to Area 3. Additional fill will be imported to various portions of the site to increase its elevation above the flood plain.

Additional sampling has been undertaken following results from the original DSI (issued November 2020).

This DSI has been undertaken to satisfy the requirements of the Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, herein referred to as the "NES" (NES, 2011). The investigation provides information regarding the presence of soil impacts from site uses that may pose a potential human health risk to future site users and demolition / construction workers during earthworks and construction and also to the surrounding environment. The results of this investigation have been used to evaluate whether remediation is necessary prior to site redevelopment, and to further assess the resource consents required under the NES.

This investigation has been undertaken in general accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guidelines No. 1: Reporting on Contaminated Sites in New Zealand (MfE, 2011), MfE Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils (MfE, 2011) and Building Research Association of New Zealand (BRANZ) (2017) New Zealand Guidelines for Assessing and Managing Asbestos in Soil. This DSI has been reviewed by a Suitably Qualified and Experienced Practitioner (SQEP).

2 Objectives of the Assessment

This DSI provides information on:

- The nature of samples collected and the sampling procedures including quality assurance and quality control requirements.
- The analyses undertaken, methodologies used and laboratory quality assurance and quality control procedures.
- The type, potential extent and level of soil impact identified.

The DSI was undertaken to assess:

- The potential extent and concentrations of contaminants in soil at the site.
- Where applicable, the location and magnitude of on-site or off-site impacts on soil.
- Where contaminants of concern identified present an unacceptable risk to human health or identified environmental receptors and structures.

- The adequacy and completeness of information used in decisions on remedial options.
- If remediation, management or ongoing monitoring is required at the site.
- Disposal options for the potentially impacted soil that may be required to be removed from site during redevelopment.
- The requirement for resource consent under the NES.

The soil sampling locations were positioned to target areas highlighted in the Preliminary Environmental Site Investigation (PSI) (ENGEO, 2020).

3 Site Description and Setting

The site at Te Rangihaeata, 30 Benmore Crescent is located on commercial / industrial and agricultural / scrub land in Manor Park, Lower Hutt. The site was originally divided into four zones based on potential site activities; it has now been subdivided into 14 areas based on future developments (see Figures 1 and 2). Reference will be made to the Zones for consistency in this updated DSI. Zone 1 (Site 1) includes the southern tip of the site, where concrete batching and quarrying activities may have occurred. Zone 2 (Site 2) is in the centre of the site, where concrete batching and quarrying, horticulture, and a clean filling may have occurred. Zone 3 (Sites 3, 4, 5, 6 and 7) includes the north-western edge of the site, where the majority of the buildings were located. Zone 4 (Sites 7, 8, 12, 13 and 14) includes the north-eastern portion of the site, where timber may have been stored. Sites 9, 10 and 11, located in the north-eastern portion of the site no longer form part of the commercial subdivision.

The site has multiple buildings and building remnants present consisting of two paintball bases, a shed and a nursery building. These structures are located predominantly on the Zone 1 and Zone 2 areas of the site. Multiple concrete slabs were noted in Zone 3. The majority of the buildings and concrete slabs have been removed since the original DSI was undertaken.

The site consists of predominantly open areas of scrub and marshland with industrial and commercial activities in the southern and northern portions of the site.

Site information, the setting and current site conditions are summarised in Tables 1, 2, 3, 4 and 5 respectively.

Table 1: Site Information

Item	Description
Location	Te Rangihaeata, 30 Benmore Crescent, Manor Park, Lower Hutt
Legal Description	Section 1 SO 493901 RT 738229
Property Owner	Rosco Investments
Current Land Use	Visual investigations indicate commercial / industrial, agricultural and general scrub land is present on-site. Hutt City Council District plan and online maps indicates the site is multi-use at primary level – vacant or intermediate, and that the site is zoned for general rural use. A portion of the site lies within the fault line study zone and secondary river corridor for Hutt River.
Proposed Land Use	Bulk earthworks followed by land development for likely mixed use activities.
Site Area	132,121 m^2 (13.2 ha)
Regional Authority	Greater Wellington Regional Council (GWRC) and Hutt City Council (HCC)

Table 2: Site Setting

Item	Description
Topography and Hydrology (GWRC GIS, HCDC GIS)	The site is irregular in shape with areas of undulating ground. The site is at an elevation of approximately 20 – 30 m above sea level (asl) Surface water is presumed to flow (naturally) in a southerly direction towards Hutt River. The majority of the site is located within the 0.23% Annual Exceedance Probability (AEP) flood hazard.
Local Setting	North – Rural and Commercial / Industrial East – Residential and General Recreational South – Hutt River is located on the southern boundary, residential land-use is located beyond Hutt River West – Immediately west is Western Hutt Road, beyond which is general recreation land.
Nearest Surface Water & Use (GWRC GIS, HCDC GIS)	Hutt River is located less than 30 m to the south of the site, HCC indicates that a small unnamed tributary to the Hutt River runs through the site along the north-western boundary.
Geology (GNS Online Webmap)	Late Quaternary alluvium and colluvium *Unconsolidated and poorly consolidated mud, sand, gravel and peat*
Hydrogeology	All wells / bores listed within a 250 m radius of the site do not list groundwater depth. However based on the proximity of Hutt River to the south of the site groundwater is assumed to be relatively shallow. Based on the local topography and the location of both Hutt River and Wellington Harbour to the south / southwest of the site, groundwater is assumed to flow in a south / south-western direction.

There are no groundwater abstractions identified on the site, four active abstractions are identified within 250 m of the site, these are summarised in Table 3.

Table 3: Recorded Groundwater Abstractions

Consent ID	Location from site	Details
30326	North of site	To take, use, dam, and divert water, including surface water, stormwater and groundwater for construction, operation, maintenance and repair activities including: Damming water and diverting water during road works, in stream works and other construction activities; Diverting water into and from culverts, including those in water courses; Taking of water from temporary silt ponds for use during construction activities; primarily for dust suppression
31406	Site located approx. 180 m north of site	To take and use groundwater from a spring for dust suppression and quarry associated activities.
20598	Site located approx. 180 m north of site	To take, use, dam and divert water, including surface water, stormwater and groundwater, for construction, operation, maintenance and repair activities.
20597	Site located approx. 180 m north of site	To take, use, dam, and divert water, including surface water, stormwater and groundwater for construction, operation, maintenance and repair activities including: Damming water and diverting water during road works, in stream works and other construction activities. Diverting water into and from culverts, including those in water courses. Taking of water from temporary silt ponds for use during construction activities; primarily for dust suppression and washing vehicles. Diverting stormwater.

Active discharge consents have been identified within 250 m of the site are summaries in Table 4.

Table 4: Recorded Active Discharge Consents

Consent ID	Location from site	Details
33527	Western Boundary	To construct a bridge over an un-named tributary of the Hutt River including any associated disturbance, discharge or deposition of material into the bed of that stream during construction
27423	Site located approx. 180 m North of site	To discharge cement dust into the air during transfer of cement to and from storage silos
36912	Site located approx. 180 m North of site	To discharge cleanfill material and sediment laden water to land where it may enter an unnamed tributary of the Hutt River; and to discharge dust to air associated with the ongoing operation of a cleanfill site.
36801	Site located approx. 180 m North of site	To discharge cleanfill material and sediment laden water to land where it may enter an unnamed tributary of the Hutt River; and to discharge dust to air associated with the ongoing operation of a cleanfill site.

A site walkover was completed on 14 September 2020 by Calum MacRae. Observations of activities and conditions present at the site are summarised in Table 5. Subsequent walkovers have been undertaken during progression of works by Roz Cox, Gabbi Staehle, Calum MacRae and Matt Ryan for assessment of potential asbestos containing materials on-site and remedial works being undertaken. These are detailed throughout the report.

Table 5: Current Site Conditions

Site Conditions	Comments
Visible Signs of Contamination	Areas of illegal dumping of both general (household rubbish) and industrial (gravels, fill, building materials) waste. Items of potentially asbestos containing materials (PACM) identified across the site as well as multiple burn-off areas with surface staining of soils. Lead paint was potentially identified on the remaining remnants of former Nursery buildings. Asbestos cement sheeting was identified following vegetation clearance next to the unnamed stream, near the southern end of Zone 3; some of the material was also crushed following clearance works (at the time of writing this report, remediation was being undertaken).
Surface Water Appearance	Surface water, where present, appeared clear with no obvious sheens and / or staining. Rubbish across site was noted in marshy areas.
Current Surrounding Land Use	North: Industrial works including quarrying and State Highway 2 (SH2). East: Train tracks run along the eastern boundary of the site, further east residential buildings and recreational areas (golf course and Hutt River) are present. South: Hutt River (recreational land) is located along the southern boundary of the site, on the far side of the river residential properties are present. West: Recreational Land.
Local Sensitive Environments	An unnamed tributary for the Hutt River is located through the centre of the site and the Hutt River is located directly south of the site. Marshlands were noted in the southeast of site and along the boundary.
Visible Signs Of Plant Stress	None noted.
Ground Cover	Ground cover is a combination of hardstand gravel / fill, concrete cover and grassed / scrub and marshland areas.
Potential for On or Off Site Migration Of Contaminants	SH2 is located up-gradient of the site. The unnamed tributary flows through the site and joins the Hutt River, which is down-gradient of site.
Buildings Present	Multiple dilapidated buildings were noted including the two paintball bases, shed and nursery buildings. Multiple concrete slabs were noted across the site. A number of these buildings have been removed since the initial DSI.

4 Previous Site Investigations

A PSI was completed by ENGEO in September 2020, report reference 17709.000.000_02. The report identified eight potential site activities included on the Hazardous Activities and Industries List (HAIL) (MfE, 2011b):

- Horticulture/ nursery activities
- Potential fuel storage for quarrying
- Timber storage yard
- Metal blasting and protective coating
- Uncontrolled demolition of former buildings
- Concrete truck storage, quarrying vehicles and equipment
- Clean-fill operations, undocumented fill
- Burn-off Areas

The report identified nine categories included on the Hazardous Activities and Industries List (HAIL) (MfE, 2011); these are summarised below:

- HAIL ID A10 – Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass house or spray sheds; Chemical manufacture, application and bulk storage;
- HAIL ID A17 – Storage tanks or drums for fuel, chemicals or liquid waste; Chemical manufacture, application and bulk storage;
- HAIL ID A18 - Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling or bulk storage of treated timber outside; Chemical manufacture, application and bulk storage;
- HAIL ID D1 – Abrasive blasting including abrasive blast cleaning (excluding cleaning carried out in fully enclosed booths) or the disposal of abrasive blasting material); Metal extraction, refining and reprocessing, storage and use;
- HAIL ID D3 – Metal treatment or coating including polishing, anodizing, galvanizing, pickling, electroplating, or heat treatment or finishing cyanide compounds; Metal extraction, refining and reprocessing, storage and use;
- HAIL ID E1 – Asbestos products manufacture or disposal including site with building containing asbestos products known to be in a deteriorated condition; Mineral extraction, refining and reprocessing, storage and use;
- HAIL ID E8 – Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances; Mineral extraction, refining and reprocessing, storage and use;
- HAIL ID G5 – Waste disposal to land (excluding where biosolids have been used as soil conditioners); Cemeteries and waste recycling, treatment and disposal; and

- HAIL ID I – Any land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment

A land use change, soil disturbance and subdivision on sites where an activity included on the HAIL is, has, or is more likely than not to have occurred, requires an environmental assessment under the NES. Due to the above listed HAIL categories associated with the site, an intrusive environmental investigation is required.

5 Initial Conceptual Site Model

An initial CSM was developed during the PSI to assess the potential contaminants of concern and exposure pathways present at the site. A contamination conceptual site model 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 conceptual site model are:

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

The potential source, pathway and receptor linkages at this subject site are provided in Table 6.

Table 6: Conceptual Site Model

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Undocumented fill material *Heavy metals (including mercury), polycyclic aromatic hydrocarbons (PAHs), and asbestos fibres*	Direct contact Ingestion of soil Inhalation of volatile contaminants or windblown dust	Future site users / site redevelopment workers	**No** Significant volumes of undocumented fill including illegal dumping of waste has been identified over numerous locations at the site, including identification of PACM.
		Surrounding residents	
	Surface water run-off or leaching of contaminants into groundwater	Groundwater	

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Timber Storage *Cu, Cr, As, Boron, Pentachlorophenol (PCP)*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**No** Evidence of historical stockpiling of timber across the northern section of the site. Further assessment of potential impacts associated with this activity is required.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Use of asbestos and lead-based paint on former buildings *Lead and asbestos fibres*	Ingestion of soil Inhalation of windblown dust	Future site users / site redevelopment workers	**No** Historical aerials indicate previously demolished structures over the site, building material associated with structure removal may be present in sub surface soils. Additionally PACM material has been identified during ENGEO's PSI walk over.
		Surrounding residents	
Application of persistent pesticides *Heavy metals (including mercury), Organochlorine Pesticides (OCP)*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**No** Historical aerials indicate extensive horticultural and greenhouse activities at the site. Further analysis of site soils is required to assess the potential concentrations of heavy metals and persistent pesticides within the subject area.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Burn-off areas *Heavy Metals, PAHs, Asbestos*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**No** Evidence of historical / recent burning of waste materials has been identified at the site. Further analysis of site soils is required to assess the potential concentrations of heavy metals, asbestos and PAHs is required.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Metal blasting and coating *Heavy Metals, Acids, Cyanide*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**No** Available council records indicate this activity has taken place at the site, further investigation into location and coating types required
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Potential fuel storage for quarrying *Heavy metals, BTEX, TPH, PAH*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**No** Potential fuel storage requires more investigation.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Waste disposal to land Depends on waste (heavy metals, PAHs, SVOC, VOCs, asbestos, TPH, TOC)	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**No** The type of waste disposed of is unknown. Potential for leaching to groundwater and surface water and also gas generation.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	

6 Site Investigations

ENGEO undertook a site investigation between 5 to 6 October 2020 by ENGEO Staff Calum MacRae and Gabriela Staehle. Investigation locations were initially cleared at the surface using a 13 tonne excavator operated by Roil Contracting and a range of soil samples from multiple depths were taken using a trowel.

An additional investigation was undertaken by Gabbi Staehle between 29 and 30 April 2021 on Zones 1 and 2 following recommendation in the original DSI report. The investigation was changed from what was originally recommended due to the presence of asbestos in Zone 3 (adjacent to the stream). Other vegetated areas that were previously inaccessible were explored and sampled to determine potential for ACM and other contaminants of concern (COCs).

Based on the age of the landfill and the fact that the gas criteria are generally conservative, the landfill was further investigated through sampling of total organic carbon and other COCs to determine the need for borehole installations and the potential for leachate and gas. No evidence of leachate has been noted around the landfill or in the stream to date. It is understood that the area surrounding the landfill will be filled and that there will be no construction on the landfill itself. The results from this investigation will determine the need for further works or remediation.

6.1 Investigation Methodology October 2020

Information obtained during the PSI was used to determine sample locations. The site was divided into four zones based on potential site use (see Section 3), and the associated contaminants were targeted in each zone. Some areas on the eastern half of the site were inaccessible due to dense vegetation.

Additionally, because landfilling occurred on-site, five samples were tested for total organic carbon (TOC) to evaluate the gas formation potential of the site due to the potential degradation of organic material.

Thirty-six sample locations were sampled during the investigation at depths ranging from 0.0 m to 1.5 m. Some sample locations were moved slightly during the sampling if concrete was encountered that the excavator could not break through. In some locations, multiple samples were collected to capture different soil stratification.

Table 7 provides a summary of the soil samples collected. Refer to Figure 3 for sample locations.

Table 7: Summary of Soil Samples Collected and Requested Analyses – October 2020

Sample ID	Zone	Soil Type	Sample Depth (m bgl)	Requested Analyses
L01	1	Gravelly SAND (Fill)	0.2 – 0.3	Heavy metals, Semi-Quantitative Asbestos (SQA)
L02	1	Sandy GRAVEL (Fill)	0.4	Not tested
L03	1		0.3	Heavy metals
L04	1	Sandy SILT (Fill)	Surface (stockpile)	Heavy metals, SQA
L05A	1		0.2 – 0.3	Heavy metals, cyanide, pH

Sample ID	Zone	Soil Type	Sample Depth (m bgl)	Requested Analyses
L05B	1	Gravelly SAND (Fill)	0.5	SQA
L06A	1		0.3	PAH
L06B	1	Silty gravelly SAND (Fill)	1.0	Heavy metals, SQA
L07	1	Silty SAND (Fill)	0.1 – 0.2	Not tested
L08	1	Sandy GRAVEL (Fill)	0.3 – 0.4	Heavy metals
L09	2	Silty SAND (Fill)	0.4	Heavy metals, OCP, SQA
L10	2	Sandy SILT (Fill)	0.3 – 0.4	OCP, SQA
L11	2	SAND (Fill)	0.3	Heavy metals, OCP, TOC
L12A	2	Gravelly SAND (Fill)	0.4	Heavy metals, SQA, cyanide, pH
L12B	2		1.0	TOC
L12C	2	Silty SAND (FILL)	1.5	Heavy metals, Total Petroleum Hydrocarbons (TPH)
L13	2	Organic SILT (FILL)	0.1	Not tested
L14A	2	Gravelly SAND (Fill)	0.5 – 0.6	SQA, TOC
L14B	2		1.5	Heavy metals
L15	3	Gravelly SAND (Fill)	0.4	Not tested
L16	3		0.5	Heavy metals

Sample ID	Zone	Soil Type	Sample Depth (m bgl)	Requested Analyses
L17	3	Silty SAND (Fill)	0.3	Not tested
L18	3		0.4	Heavy metals, SQA
L19	3		0.4	Heavy metals
L20	3		0.3	Heavy metals, SQA
L21A	3	Sandy SILT (Fill)	0.2	SQA
L21B	3	Silty SAND (Fill)	0.4	Heavy metals, PAH
L22	3	Gravelly silty SAND (Fill)	0.5	SQA, TPH
L23	3	Sandy GRAVEL (Fill)	0.4	Not tested
L24	4		0.4	Heavy metals
L25	4		0.4	SQA
L26	4	Sandy silty GRAVEL (Fill)	0.2	Heavy metals
L27	4	Sandy GRAVEL (Fill)	0.3	Heavy metals
L28A	4		0.4	Boron, SQA
L28B	4	Silty sandy GRAVEL (Fill)	1	SQA, TOC, TPH
L28C	4	SILT (FILL)	1.4	Boron, Heavy metals, PCP

Sample ID	Zone	Soil Type	Sample Depth (m bgl)	Requested Analyses
L29	4	SAND (Fill)	0.3	SQA
L30	4	Sandy GRAVEL (Fill)	0.1	PAH, SQA
L31	4		0.3	Boron, Heavy metals, PCP
L32	4		0.1	Heavy metals
L33A	4	Gravelly SAND (Fill)	0.2	Boron, PCP, SQA
L33B	4	Sandy GRAVEL (Fill)	1.4	Boron, Heavy metals, OCP, TOC
L34	4	Silty SAND (Fill)	0.6	SQA
L35A	4	Gravelly SAND (Fill)	0.4	PAH, SQA
L35B	4	SILT (Fill)	1.1	Heavy metals, TPH, cyanide, pH
L36	4	Gravelly SAND (Fill)	0.4	Heavy metals

6.2 Site Investigation April 2021

An additional site investigation was conducted on 29 April 2021 based on information obtained during the first DSI. The objective of the investigation was to target areas within Zones 1 and 2 (Sites 1 and 2) that were inaccessible due to dense vegetation during the previous investigation and to collect additional TOC data to evaluate gas formation potential within Zone 2.

An excavator, operated by ROIL Contracting Ltd, was used to clear vegetation and dig test pits for soil sample collection. Nineteen samples were collected from sixteen locations during the investigation at depths ranging from 0.2 m to 5.0 m. In some locations, multiple samples were collected to capture different soil stratification.

Table 8 provides a summary of the soil samples collected. Refer to Figure 3 for sample locations.

Table 8: Summary of Soil Samples Collected and Requested Analyses – April 2021

Sample ID	Zone	Soil Type	Sample Depth (m bgl)	Requested Analyses
L101	1	Silty SAND (Fill)	0.4	Heavy metals, SQA, pH, OCP
L102	1		0.3	Heavy metals, SQA, PAH
L103	1		0.4	Heavy metals, SQA, pH
L104	1	Gravelly SAND (Natural)	0.4	Heavy metals, SQA, pH
L104	1	Sandy SILT (Natural)	0.6	Heavy metals, SQA, TPH, boron
L105	1	Gravelly SAND (Natural)	0.4	Heavy metals, SQA, pH, OCP
L106	2		0.6	TOC, Heavy metals, SQA, PAH
L107	1	Gravelly SAND (Fill)	0.2	Heavy metals, SQA, pH
L107	1	Clayey SILT (Natural)	0.7	Heavy metals, SQA, PAH
L108	1	Sandy SILT (FILL)	0.4	Heavy metals, SQA, pH, OCP
L109	1	Gravelly SAND (Natural)	0.4	Heavy metals, SQA, TPH, boron
L110	2	Sandy GRAVEL (Fill)	2.0	TOC, heavy metals, SQA, PAH, OCP
L111	2		1.5	TOC, Heavy metals, SQA, TPH, boron
L112	2		2.0	TOC, Heavy metals, SQA, PAH, OCP

Sample ID	Zone	Soil Type	Sample Depth (m bgl)	Requested Analyses
L113	2		0.9	TOC, Heavy metals, SQA, TPH
L113	2		5.0	TOC, Heavy metals, SQA, PAH, OCP
L114	2		1.5	TOC, Heavy metals, SQA, TPH, boron
L115	2	Gravelly SAND (Fill)	1.0	TOC, heavy metals, SQA, PAH, OCP
L116	2		2.5	TOC, Heavy metals, SQA, TPH

6.3 Soil Encountered

The soil encountered comprised fill material throughout the site; however fill material characteristics varied. In Zone 1, the majority of soil encountered within the first 0.5 m below the ground surface (bgs) was sandy-gravel fill material and the majority of soil encountered between 0.5 and 1 m bgs was natural silty-sand and sandy-silt; in Zones 2 and 3, the majority of soil encountered was gravelly-sand fill material; in Zone 4, the majority of soil encountered was sandy-gravel fill material.

6.4 Sample Methodology

The following methodology was used for taking the samples:

6.4.1 Soil

- All soil samples were screened for visual and olfactory evidence of contamination.
- Samples were collected directly from each location using a 13 tonne excavator. When required, the excavator removed the dense, gravelly material from the surface and then a trowel to remove the soil from the base or sidewall of the test pit 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.
- After the collection of each soil sample, the sampling equipment was decontaminated by brushing off any soil attached to the sampling equipment, washing with a solution of Decon90 and rinsing with tap water followed by high purity analytical grade deionised water.
- 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 1.

- 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.

6.4.2 Potentially Asbestos Containing Materials

- Any suspected pieces of bulk PACM were placed into a plastic sample bag which was then placed inside a larger plastic bag and labelled with a unique identifier.
- A new pair of disposable nitrile gloves was used for each sample collected and discarded following use.
- Bulk PACM samples were transported to Environmental & Industrial Analysis Group (EIAG) Laboratory under standard chain of custody documentation for analysis; these are provided in Appendix 1.

6.5 Quality Assurance and Quality 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 and EIAG are International Accreditation New Zealand (IANZ) laboratories for the analyses performed. To maintain their IANZ accreditation, Hills and EIAG undertake rigorous cross checking and routine duplicate sample testing to ensure the accuracy of their results.
- Asbestos in soil samples analysed by Hills are undertaken in accordance with AS4964-2004: Method for the Qualitative Identification of Asbestos in Bulk Samples for the analysis of suspected asbestos in soil samples, and to international standard NZS ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories in accordance with The Building Research Association New Zealand (BRANZ) New Zealand Guidelines for Assessing and Managing Asbestos in Soil, 2017.
- 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.

7 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. A summary of each and its implications for the site are provided in the section below. Values relating to these stated criteria can be found in Tables 9 and 10.

7.1 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).

Soil Contaminant Standards

The NES introduced soil contaminant standards (SCSs) for 12 priority contaminants for the protection of human health under five land use scenarios.

The NES requires the Contaminated Land Management Guidelines (CLMG) No.2: *Hierarchy and Application in New Zealand of Environmental Guideline Values (Revised 2011), (MfE, 2003)* to be used for the selection of a guideline value for a contaminant where a NES SCS is not available.

The NES does not consider environmental receptors; accordingly, the application of guidelines relevant to environmental receptors shall be implemented according to the MfE CLMG No. 2 and any relevant rules in the Regional Plan.

In addition, local background levels in soil have been referenced to establish consenting implications under the NES and disposal requirements. Background levels for contaminants in soils in the area were obtained from the URS document – *"Determination of Common Pollutant Background Soil Concentrations for the Wellington Region*" (2003) prepared for GWRC.

Relevant criteria have been outlined with laboratory result summary tables for both Human Health and Regional Background. Human health criteria screening for future industrial / commercial use. Human health criteria screening for commercial / industrial have also been undertaken based on the short term works involved in construction and installation of services.

Disturbing Soil

Soil disturbance on sites with potentially contaminated soils are covered by the NES.

If the limits of soil disturbance or soil disturbance or soil removal exceed the permitted activity criteria, then a resource consent will be required for the works. The permitted activity criteria are given in Regulation 8(3) of the NES and are as follows:

"*Disturbing the soil of the piece of land is a permitted activity while the following requirements are met:*

(a) controls to minimise the exposure of humans to mobilised contaminants must –

(i) be in place when the activity begins:

(ii) be effective while the activity is done:

(iii) be effective until the soil is reinstated to an erosion-resistant state:

(b) the soil must be reinstated to an erosion-resistant state within 1 month after the serving of the purpose for which the activity was done:

(c) the volume of the disturbance of the soil of the piece of land must be no more than 25 m^3 per 500 m^2:

(d) soil must not be taken away in the course of the activity, except that, -

(i) for the purpose of laboratory analysis, any amount of soil may be taken away as samples:

(ii) for all other purposes combines, a maximum of 5 m^3 per 500 m^2 of soil may be taken away per year:

(e) soil taken away in the course of the activity must be disposed of at a facility authorised to receive soil of that kind:

(f) the duration of the activity must be no longer than 2 months:

(g) the integrity of a structure designed to contain contaminated soil or other contaminated materials must not be compromised."

7.2 Greater Wellington Regional Council Regional Plan

Under the GWRC Proposed Natural Resources Plan (Greater Wellington Regional Council, 2021), Rule R55 potentially applies to the site.

Rule R55: Discharges from contaminated land – permitted activity

The discharge of a contaminants from contaminated land where a contaminant may enter water is a permitted activity provided the following conditions are met:

(a) a detailed site investigation has been undertaken, reported and provided to Wellington Regional Council in accordance with Rule R54, and

(b) the results of the detailed site investigation indicates that the discharge does not pose unacceptable risks to human health or the environment – on-site or off-site, or

(c) the discharge from SLUR Category III land or SLUR Category IV land does not, or is not likely to, result in:

(i) water quality exceeding the maximum acceptable value (MAV) in the Drinking-Water Standards New Zealand 2005 (Revised 2008) or 50% of the MAV in a community drinking water supply protection area shown on Maps 26, 27a, 27b or 27c at the following locations:

1. at the property boundary, or within 50m from the source of the discharge, whichever is the lesser distance, or

2. in an existing bore within the property boundary or within 50m from the source of the discharge, whichever is the lesser distance, used to abstract water for any use other than water quality monitoring,

(ii) water quality in a surface water body within the property boundary or within 50m from the source of the discharge, whichever is the lesser distance, exceeding a value in Schedule W for the protection of 95% of species.

7.3 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.

The BRANZ guideline criteria have been adopted as investigation criteria for this assessment and are presented in Table 9.

Table 9: Adopted Asbestos Investigation Criteria

Form of Asbestos		Soil guideline values for asbestos (w/w)			
		Residential[1]	High-density residential[2]	Recreational[3]	Commercial and Industrial[4]
ACM (bonded)		0.01%	0.04%	0.02%	0.05%
FA and / or AF[5]		0.001%			
All forms of asbestos – surface		No visible asbestos on surface soil[6]			
Capping requirements for residual contamination above selected soil guideline value					
Depth[7]	Hard cap	No depth limitation, no controls – except for long-term management			
	Soft cap	≥0.5 m			≥0.2 m

Notes:

ACM: "*Any material or item that, by its design, contains asbestos (typically comprising bonded cement board). The concentration of ACM in soil can either be quantified using an IANZ accredited laboratory or in the field using less-reliable field techniques.*"
FA: "*Fibrous asbestos, as per WA Guidelines, is "friable asbestos material, such as severely weathered ACM, and asbestos in the form of loose fibrous material such as insulation products". FA can be detected visually, but to quantify the concentration of FA in soil, an accredited laboratory should be used.*"
AF: "*Asbestos fines. Includes free fibres of asbestos, fibrous asbestos, small fibre bundles and also ACM fragments that pass through a 7 x 7 mm sieve for field screening and 10 x 10 mm sieve in the laboratory. The measurement of AF in soil is completed by an IANZ accredited laboratory.*"
"***1. Residential:*** *Single dwelling site with garden and / or accessible soil. Also includes daycare centres, preschools, primary and secondary schools and rural residential."*
2. High-density residential*: Urban residential site with limited exposed soil / soil contact, including small gardens. Applicable to urban townhouses, flats and ground-floor apartments with small ornamental gardens but not high-rise apartments (with very low opportunity for soil contact).*
3. Recreational*: Public and private green areas and sports and recreation reserves. Includes playing fields, suburban reserves where children play frequently and school playing fields.*
4. Commercial and industrial*: Includes accessible soils within retail, office, factory and industrial sites. Many commercial and industrial properties are well paved with concrete pavement and buildings that will adequately cover / cap any contaminated soils.*
5. FA and / or AF*: Where free fibre is present at concentrations at or below 0.001% w/w, a proportion of these samples should be analysed using the laboratory analysis method described in section 5.4.4*" of the BRANZ Guideline "*(≥10% of samples). This is due to limitations in the AS 4964-2004 and WA Guidelines 500 ml sample method for free fibre (see section 5.4" of the BRANZ guideline "for more information).*

*6. **Surface:** Effective options include raking / tilling the top 100 mm of asbestos-contaminated soil (or to clean soil / fill if shallower to avoid contaminating clean material at depth) and hand picking to remove visible asbestos and ACM fragments or covering with a soft cap of virgin natural material (VNM) 100 mm thick delineated by a permeable geotextile marker layer or hard cap. Near-surface fragments of ACM can become exposed in soft soils such as sandy pumiceous soils after periods of rain.*
*7. **Depth**: Capping is used where contamination levels exceed soil guideline values. Considerations of depth need to incorporate the type and likelihood of future disturbance activities at the site and site capping requirements (see section 6.1" of the BRANZ guideline). "Ideally, any capping layer should be delineated by a permeable geotextile marker layer between the cap and underlying asbestos / contaminated material. Institutional controls must be used to manage long-term risks, particularly where the cap may be disturbed (see section 7*" of the BRANZ guideline). "*Two forms of capping are typically used:*
a. Hard cap comprises surfaces that are difficult to penetrate and isolate the asbestos contamination, such as tar seal or concrete driveway cover. This would typically not include pavers or decking due to maintenance and coverage factors.
b. Soft cap consists of a layer(s) of material which either comprise virgin natural material or soils that meet the asbestos residential soil guideline value from an on-site source. Use of on-site soils may require resource consent."

7.4 Regulatory Requirements

The BRANZ Asbestos in Soil Guidelines (2017) introduce varying controls commensurate with the risk level based on the amount of asbestos identified in soil, and if applicable, air. Table 10 summarises the BRANZ Guideline site classification and controls recommended. As the BRANZ Guideline is referenced in the WorkSafe approved code of practice (ACOP), the Guideline or a higher level of controls are required to be adhered to.

Table 10: Asbestos Related Controls

Controls	Proposed Earthwork Situation			
Licensed Removal Contractor	Class A	Class B	Asbestos-Related Work	Unlicensed Asbestos Work
Asbestos in air	≥0.01 f/mL in air	≥0.01 f/mL in air	<0.01 f/mL in air	<0.01 f/mL in air
FA/AF % w/w in soil	>1	>0.01	>0.001	≤0.001
ACM % w/w	-	>1	>0.01	≤0.01
Scale, soil volume	-	-	>NES-CS	≤NES-CS

NOTE: NES-CS – Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

7.5 Assessment Criteria

Proposed future use includes bulk earthworks followed by land development for likely mixed use activities. To cover potential earthworks and future use activities, contaminant concentrations in soil were compared to human health criteria based on a 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, United States (US) Environmental Protection Agency (EPA) screening level, and Regional Background levels for heavy metals, PAH, TPH, OCP, PCP, Cyanide, and Boron, where available. The soil analysis results have been compared to BRANZ guidance criteria for asbestos.

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

7.6 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 “clean fill” 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” (2016) clean fill material is:

“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, 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, clean fill material will not have a detectable effect relative to the background."

8 Results

8.1 On-site Observations

8.1.1 October 2020

The site was in a similar condition as previously outlined during the preliminary site walkover. Areas of dumping of both general (household rubbish) and industrial (gravel, fill, building materials) waste were identified. Pieces of PACM identified across the site as well as multiple burn-off areas with surface staining of soils.

Excavation revealed subsurface inorganic materials, including red brick, rebar, metal, and concrete. In Zone 4, multiple test pits contained layers of glass approximately 0.5 m below ground surface.

Table 11: Site Photographs

	
Photo 1: Location L06 - location of asbestos fibre detection (below human health criteria) (Zone 1).	Photo 2: Location L09, next to nursery (Zone 2).
	
Photo 3: Location L14 – visible red brick and concrete debris (Zone 2)	Photo 4: Location – L19 fill material (Zone 3)

Photo 5: Location L35 – location of asbestos fibre detection (below human health criteria) (Zone 4)

Photo 6: Location L31 – glass layer visible (Zone 4)

8.1.2 April 2021

Extensive clearing had taken place in the eastern portion of Zone 1 since the October 2021 investigation, which allowed for better access for sampling. New soil stockpiles were identified on the western borders of Zones 1 and 2. The stockpiles did not appear to contain waste material.

8.2 Laboratory Analysis

8.2.1 October 2020 and April 2021

Soil analytical results and the relevant adopted soil assessment criteria are presented in Tables 12, 13, 14 and 15 for the October 2020 site investigation and Tables 16, 17 and 18 for the April 2021 site investigation. Certified laboratory reports are included in Appendix 1. OCP, PCP and Boron have not been included in the tables as all of the laboratory results were below laboratory Limits of Detection (LOD) with the exception of one OCP result. The analytical results from both soil investigations can be summarised as follows:

Human Health Criteria

- All heavy metals were reported to be below and commercial / industrial human health criteria.
- PAHs were reported to be below commercial / industrial human health criteria.
- TPH was reported to be below commercial / industrial human health criteria.
- Cyanide was reported to be below commercial / industrial human health criteria.
- PCP and Boron concentrations were reported to be below laboratory LOD.
- An OCP (dieldrin) was detected above laboratory LOD in one sample (L115), but not at a concentration that exceeds human health criteria.

Regional Background Criteria

- Regional background criteria was exceeded for heavy metals in 24 of the 66 samples analysed for heavy metals.
- Regional background criteria was exceeded for PAHs for benzo[a]pyrene, anthracene, fluoranthene, phenanthrene and pyrene in five of the 14 samples analysed for PAH.

Landfill Acceptance Criteria

- Landfill Class A criteria was exceeded for heavy metals in six of the 44 samples analysed for heavy metals.
- No landfill Class A criteria exists for TPH and PAH with the exception of naphthalene; this concentration was below the landfill criteria.

Asbestos

- Crocidolite (blue asbestos) was detected in four of the 39 soil samples analysed for SQA by Hills (L06B, L33A, L34, L35A); no additional asbestos concentrations were detected during the 2021 investigation. No exceedances of the BRANZ guidelines were reported.
- Two of the five bulk PACM samples (SA01b and SA02) collected in October 2020 and sent to EIAG Laboratory contained chrysotile (white asbestos). Samples were analysed for presence or absence.
- During the April 2021 site investigation, no PACM was identified.

pH

- pH was reported as 5.3 at L12A, which is more acidic than is typical of background soil concentrations.

8.2.2 Laboratory Results – October 2020

Table 12: Soil Chemical Contaminant Concentrations (Heavy Metals) Compared to Assessment Criteria – October 2020

Sample ID	L01	L03	L04	L05A	L06B	L08	L09	L11	L12A	L12C	L14B	L16	L18	L19	L20	L21B	L24	L26	L27	L28C	L31	L32	L33B	L35B	L36	Human health Criteria	Landfill Class A Disposal Criteria	Wellington Regional Background for Main Soil Type 3 (Hutt Alluvium)
Sample Date	5 October 2020																6 October 2020											
Sample Depth (m)	0.2-0.3	0.3	0.0	0.2-0.3	1.0	0.3-0.4	0.4	0.3	0.4	1.5	1.5	0.5	0.4	0.4	0.3	0.4	0.4	0.2	0.3	1.4	0.3	0.1	1.4	1.1	0.4	Commercial Outdoor worker (unpaved)		
Arsenic (mg/kg)	6	3	3	3	5	3	4	6	5	5	6	4	4	5	2	< 2	6	4	5	4	6	5	**9**	6	6	70 (B)	100	2 - 7
Cadmium (mg/kg)	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	0.23	<0.10	<0.10	0.12	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.29**	<0.10	**0.27**	0.13	0.16	1,300 (B)	20	< 0.1 - 0.2
Chromium (mg/kg)	13	11	15	12	**21**	**21**	16	**17**	**19**	15	**19**	**18**	15	**19**	13	15	16	**20**	13	11	**21**	**18**	**19**	**22**	**19**	6,300 (B)	100	6 – 16
Copper (mg/kg)	8	8	11	7	**27**	15	12	**22**	**28**	13	17	10	8	10	5	6	16	12	8	7	**41**	**21**	**55**	**34**	**20**	10,000 (B)	100	5 - 19
Lead (mg/kg)	15.7	10.3	25	11.7	***720***	18.9	20	**87**	**80**	30	53	16.9	13.6	15.1	8.8	10.7	34	22	12.9	19	69	16.7	***157***	***105***	57	3,300 (B)	100	16.7 - 73.3
Mercury (mg/kg)	N/A	<0.10	N/A	N/A	N/A	N/A	0.1	0.18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<0.10	N/A	N/A	N/A	<0.10	0.18	N/A	N/A	4,200 (A)	4	<0.1 – 2.6
Nickel (mg/kg)	12	9	12	10	14	14	13	12	12	12	13	11	7	12	6	7	11	13	12	7	14	12	**32**	13	11	6,000 (D)	200	5.0 – 14
Zinc (mg/kg)	46	43	181	44	107	68	96	131	92	68	75	61	43	61	74	47	82	142	50	34	153	62	***240***	108	146	400,000 (D)	200	38 - 201

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:
A - Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, 1999)
B - NES Methodology for Deriving Soil Guideline Values Protective of Human Health
D - National Environment Protection (Assessment of Site Contamination) Measure

Table 13: Soil Chemical Contaminant Concentrations (TPH & PAH) Compared to Assessment Criteria – October 2020

Sample ID	L06A	L12C	L21B	L22	L28B	L30	L35A	L35B	Commercial Outdoor worker (unpaved)	Wellington Regional Background for Main Soil Type 3 (Hutt Alluvium)
Sample Date	5 October 2020				6 October 2020					
Sample Depth (m)	0.3	1.5	0.4	0.5	1.0	0.1	0.4	1.1		
C7-C9 (mg/kg)	N/A	< 8	N/A	< 8	< 8	N/A	N/A	< 8	120 (E)	--
C10-C14 (mg/kg)	N/A	< 20	N/A	< 20	< 20	N/A	N/A	< 20	1,500 (E)	--
C15-C36 (mg/kg)	N/A	< 40	N/A	< 40	< 40	N/A	N/A	104	NA (E)	--
Total Hydrocarbons (mg/kg)	N/A	< 70	N/A	< 70	< 70	N/A	N/A	106	--	<40 - 260
Total of Reported PAHs in Soil (mg/kg)	< 0.3	N/A	< 0.3	N/A	N/A	< 0.3	8.3	N/A	4000 (B)	--
2-Methylnaphthalene (mg/kg)	< 0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.021	N/A	3000 (C)	--
Acenaphthylene (mg/kg)	< 0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.098	N/A	--	--
Acenaphthene (mg/kg)	< 0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.015	N/A	45000 (C)	--
Anthracene (mg/kg)	< 0.012	N/A	< 0.013	N/A	N/A	< 0.011	**0.187**	N/A	230000 (C)	< 0.002 – 0.04
Benzo[a]anthracene (mg/kg)	0.014	N/A	< 0.013	N/A	N/A	< 0.011	0.52	N/A	21 (C)	--
Benzo[a]pyrene (BAP) (mg/kg)	0.016	N/A	< 0.013	N/A	N/A	< 0.011	**0.68**	N/A	10 (D)	0.004 - 0.33
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES (mg/kg)	< 0.03	N/A	< 0.03	N/A	N/A	< 0.03	1	N/A	35 (A)	--
Benzo[g,h,i]perylene (mg/kg)	0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.51	N/A	--	--
Chrysene (mg/kg)	0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.61	N/A	2100 (C)	--
Dibenzo[a,h]anthracene (mg/kg)	< 0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.094	N/A	2.1 (C)	--
Fluoranthene (mg/kg)	0.023	N/A	< 0.013	N/A	N/A	< 0.011	**1.19**	N/A	30000 (C)	0.0071 - 0.39
Fluorene (mg/kg)	< 0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.032	N/A	30000 (C)	--
Indeno(1,2,3-c,d)pyrene (mg/kg)	0.012	N/A	< 0.013	N/A	N/A	< 0.011	0.53	N/A	21 (C)	--
Phenanthrene (mg/kg)	0.014	N/A	< 0.013	N/A	N/A	< 0.011	**0.61**	N/A	--	0.005 - 0.12

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:
A - Methodology for Deriving Soil Guideline Values Protective of Human Health (NES, 2011),
B - National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 2013)
C - Regional Screening Levels Targeted Hazard Quotient 1.0 (US EPA, 2020)
D - Users' Guide to the Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (MfE, 1997)
E - Identifying, Investigating and Managing Risks Associated with Former Sheep-dip Sites (MfE, 2006)
F - Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, 1999). Human health criteria provided for indoor air pathway provided for surface samples collected from sandy soil.

Table 14: Soil Chemical Contaminant Concentrations (Cyanide and pH) Compared to Assessment Criteria - October 2020

Sample ID	L05A	L12A	L35B	Human health Criteria Commercial Outdoor worker (unpaved)
Sample Date	5 October 2020		6 October 2020	
Sample Depth (m)	0.2-0.3	0.4	1.1	
Cyanide (mg/kg)	< 0.10	0.22	0.9	11000 (A)
pH	9	5.3	8.5	N/A

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:
A - Users' Guide to the Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (MfE, 1997)

Table 15: Soil Chemical Contaminant Concentration (Asbestos) Compared to Assessment Criteria - October 2020

Sample Name	Depth (m bgl)	Asbestos Presence / Absence	Asbestos Form	Weight of Asbestos in ACM (Non-Friable) (g dry weight)	Asbestos in ACM as % of total sample (% w/w)	Weight of Asbestos as Fibrous Asbestos (Friable) (g dry weight)	Asbestos as Fibrous Asbestos as % of Total Sample (% w/w)	Weight of Asbestos as Asbestos Fines (Friable) (g dry wt)	Asbestos as Asbestos Fines as % of Total Sample (% w/w)	Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample (% w/w)
L01	0.2-0.3	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L04	0.0	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L05B	0.5	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L06B	1.0	Crocidolite (Blue Asbestos) detected	Loose fibres	< 0.00001	< 0.001	< 0.00001	<0.001	0.00006	<0.001	<0.001
L09	0.4	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001

Sample Name	Depth (m bgl)	Asbestos Presence / Absence	Asbestos Form	Weight of Asbestos in ACM (Non-Friable) (g dry weight)	Asbestos in ACM as % of total sample (% w/w)	Weight of Asbestos as Fibrous Asbestos (Friable) (g dry weight)	Asbestos as Fibrous Asbestos as % of Total Sample (% w/w)	Weight of Asbestos as Asbestos Fines (Friable) (g dry wt)	Asbestos as Asbestos Fines as % of Total Sample (% w/w)	Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample (% w/w)
L10	0.3 – 0.4	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L12A	0.4	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L14A	0.5 – 0.6	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L18	0.4	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L20	0.3	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L21A	0.2	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L22	0.5	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L25	0.4	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L28A	0.4	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L28B	1	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L29	0.3	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L30	0.1	Asbestos not detected	NA	< 0.00001	< 0.001	< 0.00001	<0.001	< 0.00001	<0.001	<0.001
L33A	0.2	Crocidolite (Blue Asbestos) detected	Loose fibres	< 0.00001	< 0.001	< 0.00001	<0.001	0.00005	<0.001	<0.001
L34	0.6	Crocidolite (Blue Asbestos) detected	Loose fibres	< 0.00001	< 0.001	< 0.00001	<0.001	0.00004	<0.001	<0.001
L35A	0.4	Crocidolite (Blue Asbestos) detected	ACM debris and loose fibres	< 0.00001	< 0.001	< 0.00001	<0.001	0.0016	<0.001	<0.001

8.2.3 Laboratory Results April 2021

Table 16: Soil Chemical Contaminant Concentrations (Heavy Metals) Compared to Assessment Criteria – April 2021

Sample ID	L101	L102	L103	L104	L104	L104	L105	L106	L107	L107	L108	L109	L110	L111	L112	L113	L113	L114	L115	L116	Human health Criteria	Landfill Class A Disposal Criteria	Wellington Regional Background for Main Soil Type 3 (Hutt Alluvium)
Sample Date	29 April 2021																				Commercial Outdoor worker (unpaved)		
Sample Depth (m)	0.4	0.3	0.4	0.4	0.6	0.6	0.4	0.6	0.2	0.7	0.4	0.4	2	1.5	2	0.9	5	1.5	1	2.5			
Arsenic (mg/kg)	**10**	**11**	4	4	-	4	4	4	**8**	3	5	4	**8**	**8**	6	5	5	**8**	**8**	7	70 (B)	100	2 - 7
Cadmium (mg/kg)	**0.32**	**0.24**	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	**0.34**	0.12	< 0.1	< 0.1	0.17	**0.24**	< 0.1	1,300 (B)	20	< 0.1 - 0.2
Chromium (mg/kg)	**21**	16	14	15	-	14	12	16	**24**	13	15	16	15	**17**	16	**18**	**19**	**17**	**18**	**18**	6,300 (B)	100	6 – 16
Copper (mg/kg)	10	**24**	8	11	-	10	9	14	**31**	9	13	**23**	18	**47**	19	15	17	**23**	**34**	**25**	10,000 (B)	100	5 - 19
Lead (mg/kg)	22	***210***	16.6	14.2	-	15.7	16	21	38	12.7	53	***103***	47	***190***	56	16.4	52	52	**85**	**78**	3,300 (B)	100	16.7 - 73.3
Nickel (mg/kg)	14	14	11	13	-	13	13	14	11	7	10	10	12	12	13	13	11	13	12	12	6,000 (D)	200	5.0 – 14
Zinc (mg/kg)	59	188	49	54	-	56	48	57	77	38	101	124	101	***280***	107	67	82	95	151	117	400,000 (D)	200	38 - 201

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:
A - Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, 1999)
B - NES Methodology for Deriving Soil Guideline Values Protective of Human Health
D - National Environment Protection (Assessment of Site Contamination) Measure

Table 17: Soil Chemical Contaminant Concentrations (TPH & PAH) Compared to Assessment Criteria- April 2021

Sample ID	L104	L109	L111	L113	L114	L116	Human Health Criteria	Wellington Regional Background for Main Soil Type 3 (Hutt Alluvium)
Sample Date	29 April 2021						Commercial Outdoor worker (unpaved)	
Sample Depth (m)	0.6	0.4	1.5	0.9	1.5	2.5		
C7-C9 (mg/kg)	<8	<8	<8	<8	<8	<8	120 (A)	--
C10-C14 (mg/kg)	<20	<20	<20	<20	<20	<20	1,500 (A)	--
C15-C36 (mg/kg)	<40	<40	81	<40	84	61	NA (A)	--
Total Hydrocarbons (mg/kg)	<70	<70	84	<70	84	71	--	<40 - 260

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:
A -
Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, 1999). Human health criteria provided for indoor air pathway provided for surface samples collected from sandy soil.

Table 18: Soil Chemical Contaminant Concentrations (TPH & PAH) Compared to Assessment Criteria – April 2021

Sample ID	L102	L107	L110	L112	L113	L115	Human Health Criteria	Wellington Regional Background for Main Soil Type 3 (Hutt Alluvium)
Sample Date	29 April 2021						Commercial Outdoor worker (unpaved)	
Sample Depth (m)	0.3	0.7	2.0	2.0	5	1.0		
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg								
Total of Reported PAHs in Soil	12.9	<0.3	1.6	2.7	2.9	4.2	4000 (B)	--
1-Methylnaphthalene	0.012	< 0.013	< 0.013	< 0.011	< 0.012	0.012	110 (C)	
2-Methylnaphthalene	0.015	< 0.013	< 0.013	< 0.011	< 0.012	0.013	3000 (C)	--
Acenaphthylene	0.085	< 0.013	0.023	< 0.011	0.024	0.032	--	--
Acenaphthene (mg/kg)	< 0.012	< 0.013	< 0.013	0.011	< 0.012	0.019	45000 (C)	--
Anthracene (mg/kg)	**0.172**	< 0.013	0.034	**0.042**	0.04	**0.066**	230000 (C)	< 0.002 – 0.04

Benzo[a]anthracene (mg/kg)	0.89	< 0.013	0.116	0.168	0.22	0.34	21 (C)	--
Benzo[a]pyrene (BAP) (mg/kg)	**1.15**	< 0.013	0.114	0.29	0.28	**0.36**	10 (D)	0.004 - 0.33
Benzo[a]pyrene Toxic Equivalence (TEF)	1.67	< 0.03	0.17	0.43	0.41	0.54	1500 (B)	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES (mg/kg)	1.69	< 0.03	0.17	0.43	0.41	0.54	35 (A)	--
Benzo[b]fluoranthene + Benzo[j]fluoranthene	1.33	< 0.013	0.122	0.31	0.32	0.42	-	
Benzo[e]pyrene	0.76	< 0.013	0.066	0.165	0.187	0.24	-	
Benzo[g,h,i]perylene (mg/kg)	0.89	< 0.013	0.057	0.25	0.22	0.25	-	--
Benzo[k]fluoranthene	0.5	< 0.013	0.054	0.114	0.125	0.168	210 (C)	
Chrysene (mg/kg)	0.92	< 0.013	0.117	0.175	0.21	0.32	2100 (C)	--
Dibenzo[a,h]anthracene (mg/kg)	0.151	< 0.013	0.016	0.049	0.039	0.054	2.1 (C)	--
Fluoranthene (mg/kg)	**1.99**	< 0.013	0.24	0.28	0.34	**0.62**	30000 (C)	0.0071 - 0.39
Fluorene (mg/kg)	0.025	< 0.013	0.02	0.013	0.014	0.016	30000 (C)	--
Indeno(1,2,3-c,d)pyrene (mg/kg)	0.9	< 0.013	0.067	0.27	0.22	0.26	21 (C)	--
Naphthalene	<0.06	<0.07	<0.07	<0.06	<0.06	<0.06	--	<0.002 – 0.01
Phenanthrene (mg/kg)	**0.79**	< 0.013	**0.24**	0.119	0.12	**0.33**	--	0.005 - 0.12
Perylene (mg/kg)	0.27	< 0.013	0.023	0.107	0.073	0.089	--	--
Pyrene	**2.0**	<0.013	0.23	0.30	0.41	**0.59**	--	0.008 – 0.46

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:
A - Methodology for Deriving Soil Guideline Values Protective of Human Health (NES, 2011),
B - National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 2013)
C - Regional Screening Levels Targeted Hazard Quotient 1.0 (US EPA, 2020)
D - Users' Guide to the Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (MfE, 1997)

Table 19: Soil Chemical Contaminant Concentrations (pH) Compared to Assessment Criteria – April 2021

Sample ID	L101	L103	L104	L105	L107	L108	Human health Criteria
Sample Date	29 April 2021						Commercial Outdoor worker (unpaved)
Sample Depth (m)	0.4	0.4	0.4	0.4	0.2	0.4	
pH	8.4	5.9	6.3	7.2	7.8	5.8	N/A

General Notes:
This table does not represent the full analytical results; please refer to the laboratory results for full details.
Values underlined exceed the adopted human health criteria. Values in bold exceed the adopted background concentrations. Values in italics exceed Landfill Class A criteria.
Guideline Notes:

Table 20: Soil Chemical Contaminant Concentration (Asbestos) Compared to Assessment Criteria – April 2021

Sample Name	Depth (m bgl)	Asbestos Presence / Absence	Asbestos Form	Asbestos in ACM as % of total sample (% w/w)	Asbestos as Fibrous Asbestos as % of Total Sample (% w/w)	Asbestos as Asbestos Fines as % of Total Sample (% w/w)	Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample (% w/w)
L101	0.4	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L102	0.3	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L103	0.4	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L104	0.4	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L104	0.6	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L105	0.4	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L106	0.6	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L107	0.2	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L107	0.7	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L108	0.4	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L109	0.4	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001

Sample Name	Depth (m bgl)	Asbestos Presence / Absence	Asbestos Form	Asbestos in ACM as % of total sample (% w/w)	Asbestos as Fibrous Asbestos as % of Total Sample (% w/w)	Asbestos as Asbestos Fines as % of Total Sample (% w/w)	Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample (% w/w)
L110	2.0	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L111	1.5	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L112	2.0	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L113	0.9	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L113	5.0	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L114	1.5	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L115	1.0	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001
L116	2.5	Asbestos not detected	NA	< 0.001	<0.001	<0.001	<0.001

8.2.4 Ground Gas Potential

As we have evaluated the contents of the fill material of the site with the excavation of test pits, the potential source strength can be assessed. We not did observe a significant amount of organic matter. The fill is predominately anthropogenic.

Five samples of the fill material were collected during October 2020 and nine during the April 2021 visit. These were analysed for TOC, with concentrations ranging from 0.23 percent (%) at L113 at 0.9 m to 2.3 % at L12B. As shown in Tables 21 and 22, using a conversion factor to calculate the degradable amount of organic carbon, the available degradable organic content (DOC) is between 0.17 % and 1.73 %.

Table 21: Ground Gas Potential (TOC and DOC) Results – October 2020

Sample ID	L11		L12B		L14A		L28B		L33B	
Sample Date	5 October 2020						6 October 2020			
Parameter	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC
%	2.00	1.50	2.20	1.65	0.95	0.71	1.49	1.12	2.10	1.58

Table 22: Ground Gas Potential (TOC and DOC) Results – April 2021

Sample ID	L106		L110		L111		L112		L113		L113		L114		L115		L116	
Sample Date	29 April 2021																	
Parameter	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC	TOC	DOC
%	0.3	0.23	1.59	1.2	2.3	1.73	1.22	0.9	0.23	0.17	1.01	0.76	1.76	1.32	1.77	1.33	1.28	0.96

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 23 presents an initial screening and gas generation potential of the TOC with a potential characteristic situation (CS).

Table 213: 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 23, the site falls within CS2 and CS3. However, the percentage of degradable organic carbon is below 5% and therefore has a low gassing potential. Given the age of the waste as being more than 17 years old (from historical aerial photographs it appears waste was deposited between 2000-2004), the more intensive gas generation period is likely to have passed and a declining ground gas volume is typically expected.

9 Updated Conceptual Site Model

The initial CSM presented in Section 5, has been updated based on the laboratory analysis results and is presented in Table 224.

Table 224: Updated Conceptual Site Model

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Undocumented fill material *Heavy metals (including mercury), PAH, and asbestos fibres*	Direct contact Ingestion of soil Inhalation of volatile contaminants or windblown dust	Future site users / site redevelopment workers	**Yes** There were no exceedances of human health reported. However, two of the five bulk PACM samples (SA01b and SA02) contained asbestos, and PACM was identified site wide.
		Surrounding residents	
	Surface water run-off or leaching of contaminants into groundwater	Groundwater	

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Timber Storage *Cu, Cr, As, Boron, PCP*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers	**Yes** Cu, Cr, As, Boron, and PCP were not detected at concentrations exceeding human health criteria for redevelopment and future use.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Use of asbestos and lead-based paint on former buildings *Lead and asbestos fibres*	Ingestion of soil Inhalation of windblown dust	Future site users / site redevelopment workers	**Yes** Heavy metals were not detected at concentrations exceeding human health criteria for redevelopment and future use in areas occupied by former buildings; however, PACM was identified site wide. Two of the five bulk PACM samples (SA01b and SA02) contained asbestos which were in locations of former buildings.
		Surrounding residents	
Application of persistent pesticides *Heavy metals (including mercury). OCP*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers and residents Surrounding residence and environment	**Yes** Heavy metals were not detected at concentrations exceeding human health criteria for redevelopment and future use in the area where horticulture activities occurred (Zone 2). All OCP concentrations were reported below laboratory LOD.
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	

Potential Source	Exposure Pathway	Potential Receptor	Acceptable Risk?
Burn-off areas *Heavy Metals* *PAHs* *Asbestos*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers and residents	**Yes** Heavy metals, asbestos, and PAHs were not detected at concentrations exceeding human health criteria for redevelopment and future use in the area in the area where burning of waste material was identified (Zone 4).
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Metal blasting and coating *Heavy Metals* *Acids* *Cyanide*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers and residents	**Yes** The location of the metal blasting and coating is unknown. pH was reported as 5.3 at L12A, which is more acidic than is typical of background soil concentrations..
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	
Potential fuel storage for quarrying *Heavy metals, BTEX, TPH, PAH*	Soil ingestion, inhalation of dust, and / or dermal contact	Future site users / site redevelopment workers and residents Surrounding residence and environment	**Yes** No exceedances of human health criteria were reported
		Surrounding residents	
	Leaching of contaminants into groundwater	Groundwater	

Impact of any contaminants to groundwater is unknown, however, heavy metals concentrations detected from the samples taken on the landfill are marginally above background concentrations and are below landfill criteria concentrations and therefore leachability and subsequent contamination impact on the Hutt Aquifer is considered to be low.

The results of the detailed site investigation indicate that the discharge does not pose unacceptable risks to human health or the environment – on-site or off-site.

10 Conclusions and Recommendations

ENGEO Ltd was requested by Rosco Investments to undertake a Detailed Environmental Site Investigation (DSI) for the property at 30 Benmore Crescent, Manor Park, Lower Hutt to assess the potential for contamination within the existing in situ soil prior to works being undertaken.

A number of HAIL categories were identified at the site and include:

- HAIL ID A10 – Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass house or spray sheds;
- HAIL ID A17 – Storage tanks or drums for fuel, chemicals or liquid waste;
- HAIL ID A18 - Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling or bulk storage of treated timber outside;
- HAIL ID D1 – Abrasive blasting including abrasive blast cleaning (excluding cleaning carried out in fully enclosed booths) or the disposal of abrasive blasting material);
- HAIL ID D3 – Metal treatment or coating including polishing, anodizing, galvanizing, pickling, electroplating, or heat treatment or finishing cyanide compounds;
- HAIL ID E1 – Asbestos products manufacture or disposal including site with building containing asbestos products known to be in a deteriorated condition;
- HAIL ID E8 – Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances;
- HAIL ID G5 – Waste disposal to land (excluding where biosolids have been used as soil conditioners); and
- HAIL ID I – Any land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment

Due to activities included on the HAIL historically and currently undertaken at the site, intrusive investigations were undertaken to assess whether these activities had impacted the soil at the site and whether the impact is likely to affect the proposed development works. ENGEO's site investigation works comprised the use of test pits to collect 66 soil samples from 52 locations. Sixty-six samples were analysed for a range of heavy metals, PAH, TPH, OCP, PCP, TOC, Boron, cyanide, pH, and semi-quantitative Asbestos. Additionally, five bulk PACM samples were sent to EIAG for analysis.

No human health criteria was exceeded. Two of the five bulk PACM samples sent to EIAG contained chrysotile (white asbestos), albeit below the human health criteria.

The results of the detailed site investigation indicate that the discharge does not pose unacceptable risks to human health or the environment – on-site or off-site.

Regarding potential gas generation, TOC concentrations indicate that the site falls into the categories CS2 and CS3. According to BS 8485:2015X, sites that fall within these categories require gas protection measures during construction. However, this site model and initial assessment of ground gas potential is conservative. Given the age of the waste, the more intensive gas generation period is likely to have passed and a declining ground gas volume is typically expected. Therefore, gas monitoring is not required, unless a structure is proposed to be built on top the fill material.

Site observations and results of asbestos testing indicate that soil management is required due to the presence of ACM and PACM across the site. Areas in which ACM was identified during the initial DSI has been or is currently being managed on issue of this updated DSI in accordance with remedial action plans (RAPs) provided; no further ACM was identified. Prior to any earthworks in zones 1 and 2, a Site Management Plan (SMP) is needed to protect human health and the environment during construction works and for future use due to the potential for unknown contamination.

Due to the location of the site and proximity to the Hutt River, lack of evidence of leachate from the landfill, and concentrations of heavy metals reported, it is anticipated that the risk to groundwater in the Hutt Aquifer is low and therefore no groundwater investigation is required. Any soil imported to the site should be cleanfill and may require testing prior to being imported to site if it is not already certified as cleanfill.

Following management of areas containing PACM identified during the DSI, validation sampling should be conducted after PACM removal and a validation report should be prepared.

Resource consent under the NES may be required for the disturbance of soil depending on volumes to be disturbed / removed. Should any soil require disposing off-site during the redevelopment works, the results indicate that these are suitable for disposal to Class A landfill subject to approval from the landfill manager due to the exceedance of heavy metals in three locations. Toxicity characteristic leaching procedure (TCLP) tests may be required on soils from this location.

11 References

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

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

ENGEO, 2020. Preliminary Environmental Site Investigation.

Google Maps & Google Earth Pro

GWRC website (http://mapping.gw.govt.nz/)

GWRC, 2013. Greater Wellington Regional Council. Regional Policy Statement for the Wellington Region.

GWRC, 2014. Greater Wellington Regional Council Regional Plan for Discharges to Land.

Institute of Geological and Nuclear Sciences, (2000). 1:250000 Geological Map 10, Wellington

Institute of Geological and Nuclear Sciences Website New Zealand Aquifer Potential Maps (https://www.gns.cri.nz/Home/Our-Science/Environment-and-Climate/Groundwater/Database-and-tools/Maps)

MfE, 1997. Users' Guide to the Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand.

MfE, 1999. Ministry for the Environment. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand.

MfE, 2006. Identifying, Investigating and Managing Risks Associated with Former Sheep-dip Sites

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

MfE, 2011. Ministry for the Environment. Contaminated Land Management Guidelines No.2: Hierarchy and Application in New Zealand of environmental guideline values.

MfE, 2011. Ministry for the Environment. Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils.

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

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

MfE, 2011f. Ministry for the Environment. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health.

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

NEPM, 2013. Australian National Environmental Protection Council. National Environmental Protection (Assessment of Site Contamination) Measure 1999, Schedule B(1): Guideline on the Investigation Levels for Soil and Groundwater.

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

US EPA. Regional Screening Levels. May 2019.

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

12 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, Rosco Investments, 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

Roz Cox

Senior Environmental Scientist

Gabriela Staehle

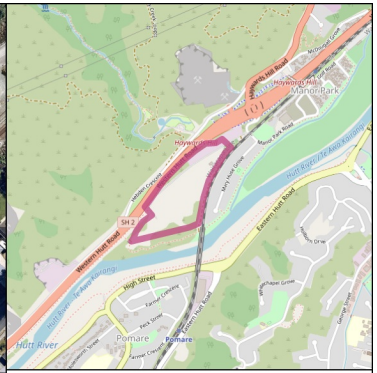
Environmental Engineer

Report reviewed by

Karen Jones, CEnvP

Principal Engineering Geologist

FIGURES



Legend

- Site Boundary
- Zone 1 - Former Quarry and Concrete Batching
- Zone 2 - Horticulture and Undocumented Fill
- Zone 3 - Former Housing
- Zone 4 - Former Timber Storage and Horticulture

10m 0 10 20 30 40 50m

ENGEO

Produced by **Evalu8.earth**

Title: Site Location and Zones		
Client: Rosco Investments		Figure No: 1 Size: A4
Project: Te Rangihaeata, Benmore Crescent	Drawn: GS	
Date: 15-06-2021	Checked: KJ	
Proj No: 17709.000.000	Scale: 1:3555	Version: draft

Legend

- DSI Zone 1
- DSI Zone 2
- DSI Zone 3
- DSI Zone 4

50m 0 50 100m

ENGEO

Produced by **Evalu8.earth**

Title: Proposed Future Development Sites (for Reference)		
Client: Rosco Investments		Figure No: 2 Size: A4
Project: Te Rangihaeata	Drawn: GS	
Date: 04-05-2021	Checked: KJ	
Proj No: 17709	Scale: 1:4247	Version: Final

Legend

- Site Boundary
- Zone 1 - Former Quarry and Concrete Batching
- Zone 2 - Horticulture and Undocumented Fill
- Zone 3 - Former Housing
- Zone 4 - Former Timber Storage and Horticulture
- October 2020 Sample Location
- October 2020 - ACM Sample Location
- October 2020 Sample Location - Contains Asbestos Fibres BELOW Human Health Criteria
- April 2021 Sample Location

10m0 10 20 30 40 50m

ENGEO

Produced by **Evalu8.earth**

Title: Sample Location Plan		
Client: Rosco Investments		Figure No: 3 Size: A4
Project: Te Rangihaeata, Benmore Crescent	Drawn: GS	
Date: 15-06-2021	Checked: KJ	
Proj No: 17709.000.000	Scale: 1:3122	Version: draft

APPENDIX 1:

Laboratory Reports

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Engeo Limited	**Lab No:**	2449644	SPv2
Contact:	Roz Cox	**Date Received:**	05-Oct-2020	
	C/- Engeo Limited	**Date Reported:**	02-Nov-2020	**(Amended)**
	PO Box 25047	**Quote No:**	82742	
	Wellington 6146	**Order No:**		
		Client Reference:	BENMORE	
		Submitted By:	Calum MacRae	

Sample Type: Soil

Sample Name:		L01 05-Oct-2020	L03 05-Oct-2020	L04 05-Oct-2020	L05A 05-Oct-2020	L06A 05-Oct-2020
Lab Number:		2449644.1	2449644.3	2449644.4	2449644.5	2449644.7
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	95	88
Total Recoverable Mercury	mg/kg dry wt	-	< 0.10	-	-	-
Total Cyanide*	mg/kg dry wt	-	-	-	< 0.10	-
pH*	pH Units	-	-	-	9.0	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	6	3	3	3	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	13	11	15	12	-
Total Recoverable Copper	mg/kg dry wt	8	8	11	7	-
Total Recoverable Lead	mg/kg dry wt	15.7	10.3	25	11.7	-
Total Recoverable Nickel	mg/kg dry wt	12	9	12	10	-
Total Recoverable Zinc	mg/kg dry wt	46	43	181	44	-
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	-	-	-	< 0.3
1-Methylnaphthalene	mg/kg dry wt	-	-	-	-	< 0.012
2-Methylnaphthalene	mg/kg dry wt	-	-	-	-	< 0.012
Acenaphthylene	mg/kg dry wt	-	-	-	-	< 0.012
Acenaphthene	mg/kg dry wt	-	-	-	-	< 0.012
Anthracene	mg/kg dry wt	-	-	-	-	< 0.012
Benzo[a]anthracene	mg/kg dry wt	-	-	-	-	0.014
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	-	-	0.016
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	-	-	-	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	-	-	-	< 0.03
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	-	-	0.016
Benzo[e]pyrene	mg/kg dry wt	-	-	-	-	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	-	-	0.012
Benzo[k]fluoranthene	mg/kg dry wt	-	-	-	-	< 0.012
Chrysene	mg/kg dry wt	-	-	-	-	0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	-	-	< 0.012
Fluoranthene	mg/kg dry wt	-	-	-	-	0.023
Fluorene	mg/kg dry wt	-	-	-	-	< 0.012
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	-	-	0.012
Naphthalene	mg/kg dry wt	-	-	-	-	< 0.06
Perylene	mg/kg dry wt	-	-	-	-	< 0.012
Phenanthrene	mg/kg dry wt	-	-	-	-	0.014

Sample Type: Soil						
Sample Name:		L01 05-Oct-2020	L03 05-Oct-2020	L04 05-Oct-2020	L05A 05-Oct-2020	L06A 05-Oct-2020
Lab Number:		2449644.1	2449644.3	2449644.4	2449644.5	2449644.7
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Pyrene	mg/kg dry wt	-	-	-	-	0.024

Sample Name:		L06B 05-Oct-2020	L08 05-Oct-2020	L09 05-Oct-2020	L10 05-Oct-2020	L11 05-Oct-2020
Lab Number:		2449644.8	2449644.10	2449644.11	2449644.12	2449644.13
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	77	77	80
Total Recoverable Mercury	mg/kg dry wt	-	-	0.10	-	0.18
Total Organic Carbon*	g/100g dry wt	-	-	-	-	2.0
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	3	4	-	6
Total Recoverable Cadmium	mg/kg dry wt	0.14	< 0.10	< 0.10	-	0.23
Total Recoverable Chromium	mg/kg dry wt	21	21	16	-	17
Total Recoverable Copper	mg/kg dry wt	27	15	12	-	22
Total Recoverable Lead	mg/kg dry wt	720	18.9	20	-	87
Total Recoverable Nickel	mg/kg dry wt	14	14	13	-	12
Total Recoverable Zinc	mg/kg dry wt	107	68	96	-	131
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
alpha-BHC	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
beta-BHC	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
delta-BHC	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
gamma-BHC (Lindane)	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
cis-Chlordane	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
trans-Chlordane	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
2,4'-DDD	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
4,4'-DDD	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
2,4'-DDE	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
4,4'-DDE	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
2,4'-DDT	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
4,4'-DDT	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Total DDT Isomers	mg/kg dry wt	-	-	< 0.08	< 0.08	< 0.08
Dieldrin	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Endosulfan I	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Endosulfan II	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Endosulfan sulphate	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Endrin	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Endrin aldehyde	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Endrin ketone	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Heptachlor	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Heptachlor epoxide	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Hexachlorobenzene	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013
Methoxychlor	mg/kg dry wt	-	-	< 0.013	< 0.013	< 0.013

Sample Name:		L12A 05-Oct-2020	L12B 05-Oct-2020	L12C 05-Oct-2020	L14A 05-Oct-2020	L14B 05-Oct-2020
Lab Number:		2449644.14	2449644.15	2449644.16	2449644.18	2449644.19
Individual Tests						
Dry Matter	g/100g as rcvd	80	-	85	-	-
Total Cyanide*	mg/kg dry wt	0.22	-	-	-	-
pH*	pH Units	5.3	-	-	-	-
Total Organic Carbon*	g/100g dry wt	-	2.2	-	0.95	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	-	5	-	6
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	< 0.10	-	0.12
Total Recoverable Chromium	mg/kg dry wt	19	-	15	-	19
Total Recoverable Copper	mg/kg dry wt	28	-	13	-	17

Sample Type: Soil						
Sample Name:		L12A 05-Oct-2020	L12B 05-Oct-2020	L12C 05-Oct-2020	L14A 05-Oct-2020	L14B 05-Oct-2020
Lab Number:		2449644.14	2449644.15	2449644.16	2449644.18	2449644.19
Heavy Metals, Screen Level						
Total Recoverable Lead	mg/kg dry wt	80	-	30	-	53
Total Recoverable Nickel	mg/kg dry wt	12	-	12	-	13
Total Recoverable Zinc	mg/kg dry wt	92	-	68	-	75
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 8	-	-
C10 - C14	mg/kg dry wt	-	-	< 20	-	-
C15 - C36	mg/kg dry wt	-	-	< 40	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	< 70	-	-

Sample Name:		L16 05-Oct-2020	L18 05-Oct-2020	L19 05-Oct-2020	L20 05-Oct-2020	L21B 05-Oct-2020
Lab Number:		2449644.21	2449644.23	2449644.24	2449644.25	2449644.26
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	-	80
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	4	5	2	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.11	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	18	15	19	13	15
Total Recoverable Copper	mg/kg dry wt	10	8	10	5	6
Total Recoverable Lead	mg/kg dry wt	16.9	13.6	15.1	8.8	10.7
Total Recoverable Nickel	mg/kg dry wt	11	7	12	6	7
Total Recoverable Zinc	mg/kg dry wt	61	43	61	74	47
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	-	-	-	< 0.3
1-Methylnaphthalene	mg/kg dry wt	-	-	-	-	< 0.013
2-Methylnaphthalene	mg/kg dry wt	-	-	-	-	< 0.013
Acenaphthylene	mg/kg dry wt	-	-	-	-	< 0.013
Acenaphthene	mg/kg dry wt	-	-	-	-	< 0.013
Anthracene	mg/kg dry wt	-	-	-	-	< 0.013
Benzo[a]anthracene	mg/kg dry wt	-	-	-	-	< 0.013
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	-	-	< 0.013
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	-	-	-	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	-	-	-	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	-	-	-	-	< 0.013
Benzo[e]pyrene	mg/kg dry wt	-	-	-	-	< 0.013
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	-	-	< 0.013
Benzo[k]fluoranthene	mg/kg dry wt	-	-	-	-	< 0.013
Chrysene	mg/kg dry wt	-	-	-	-	< 0.013
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	-	-	< 0.013
Fluoranthene	mg/kg dry wt	-	-	-	-	< 0.013
Fluorene	mg/kg dry wt	-	-	-	-	< 0.013
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	-	-	< 0.013
Naphthalene	mg/kg dry wt	-	-	-	-	< 0.07
Perylene	mg/kg dry wt	-	-	-	-	< 0.013
Phenanthrene	mg/kg dry wt	-	-	-	-	< 0.013
Pyrene	mg/kg dry wt	-	-	-	-	< 0.013

Sample Name:		L22 05-Oct-2020				
Lab Number:		2449644.28				
Individual Tests						
Dry Matter	g/100g as rcvd	90	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-

Sample Type: Soil						
Sample Name:		L22 05-Oct-2020				
Lab Number:		2449644.28				
Total Petroleum Hydrocarbons in Soil						
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-	-

Analyst's Comments

Amended Report: This certificate of analysis replaces report '2449644-SPv1' issued on 13-Oct-2020 at 3:41 pm.
Reason for amendment: Additional testing added.

Appendix No.1 - Chain of Custody

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, 3-5, 8, 10-11, 13-16, 18-19, 21, 23-26
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%.	-	15, 18
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	5, 14
Total of Reported PAHs in Soil	Sonication extraction, GC-MS analysis. In-house based on US EPA 8270.	0.03 mg/kg dry wt	7, 26
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	5, 7, 11-14, 16, 26, 28
Total Cyanide Distillation*	Distillation of sample as received. APHA 4500-CN^- C (modified) 23rd ed. 2017.	-	5, 14
Total Recoverable Mercury	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.10 mg/kg dry wt	3, 11, 13
Total Cyanide*	Distillation, colorimetry. APHA 4500-CN^- C (modified) 23rd ed. 2017 & Skalar Method I295-004(+P14). ISO 14403:2012(E).	0.10 mg/kg dry wt	5, 14
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH. In-house.	0.1 pH Units	5, 14
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	13, 15, 18
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	7, 26
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	7, 26
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, 3-5, 8, 10-11, 13-14, 16, 19, 21, 23-26
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	11-13
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	7, 26

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Petroleum Hydrocarbons in Soil			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	8 mg/kg dry wt	16, 28
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	16, 28
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	16, 28
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	16, 28

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

Testing was completed between 09-Oct-2020 and 02-Nov-2020. 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.

Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED

ANALYSIS REQUEST

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job No: **244 9644**
Date Recv: 05-Oct-20 16:08
Received by: Charlotte O'Leary

3124496447

Quote No ~~82742~~
Primary Contact Roz Cox
Submitted By CALUM MACRAE
Client Name ENGEO
Address
Postcode
Phone Mobile
Email
Charge To Engeo Limited 160117
Client Reference BENMORE
Order No

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☑ Email Primary Contact ☑ Email Submitter ☐ Email Client
☐ Email Other
☐ Other

Dates of testing are not routinely included in the Certificates of Analysis. Please inform the laboratory if you would like this information reported.

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories
☐ Tick if you require COC to be emailed back
Date & Time:
Name:
Signature:

Received at Hill Laboratories
15.9°C in WIG
Date & Time: 5/10/20
Name: Tyler R
Signature:

Condition ☐ Room Temp ☐ Chilled ☐ Frozen
Temp:

☐ Sample & Analysis details checked
Signature:

ADDITIONAL INFORMATION / KNOWN HAZARDS

Priority ☐ Low ☐ Normal ☑ High
☐ Urgent (ASAP, extra charge applies, please contact lab first)

NOTE: The estimated turnaround time for the types and number of samples and analyses specified on this quote is by 4:30 pm, 5 working days following the day of receipt of the samples at the laboratory.

Requested Reporting Date:

Quoted Sample Types

Soil (Soil), Ground Water (GW), Surface Water (SW), TCLP Extract (TCLP), Building Material (BM), 25mm cellulose ester membrane, 0.8µm gridded (cASF25CE), Miscellaneous Wipe (cMiscWipe)

No.	Sample Name	Sample Date/Time	Sample Type	Tests Required
1	L01	5/10/20	SOIL	H & C
2	L02	"	"	"
3	L03	"	"	"
4	L04	"	"	"
5	L05A	"	"	"
6	L05B	"	"	"
7	L06A	"	"	"
8	L06B	"	"	"
9	L07	"	"	"
10	L08	"	"	"

No.	Sample Name	Sample Date/Time	Sample Type	Tests Required
L09	11	5/10/20	Soil	H & C
L10	12	—	—	—
L11	13	—	—	—
L12A	14	—	—	—
L12B	15	—	—	—
L12C	16	—	—	—
L13	17	—	—	—
L14A	18	—	—	—
L14B	19	—	—	—
L15	20	—	—	—
L16	21	—	—	—
L17	22	—	—	—
L18	23	—	—	—
L19	24	—	—	—
L20	25	—	—	—
L21B	26	—	—	—
L21A	27	—	—	—
L22	28	—	—	—
L23	29	—	—	—

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
101C Waterloo Road
Hornby
Christchurch 8042 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Engeo Limited	**Lab No:**	2449917	A2Pv1
Contact:	Roz Cox	**Date Received:**	06-Oct-2020	
	C/- Engeo Limited	**Date Reported:**	12-Oct-2020	
	PO Box 25047	**Quote No:**	82742	
	Wellington 6146	**Order No:**		
		Client Reference:	Benmore	
		Submitted By:	Calum MacRae	

Sample Type: Soil

Sample Name:		L01 05-Oct-2020	L04 05-Oct-2020	L05B 05-Oct-2020	L06B 05-Oct-2020	L09 05-Oct-2020
Lab Number:		2449917.1	2449917.4	2449917.6	2449917.8	2449917.11
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Crocidolite (Blue Asbestos) detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	Loose fibres	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	906.5	947.9	933.9	1,116.8	825.9
Dry Weight	g	776.3	836.7	845.0	1,043.6	641.5
Moisture	%	14	12	10	7	22
Sample Fraction >10mm	g dry wt	238.7	71.8	73.0	426.0	4.4
Sample Fraction <10mm to >2mm	g dry wt	280.2	192.9	130.6	387.2	19.9
Sample Fraction <2mm	g dry wt	256.3	571.0	640.8	229.2	616.4
<2mm Subsample Weight	g dry wt	57.3	59.6	56.7	54.8	54.6
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	0.00006	< 0.00001

Sample Name:		L10 05-Oct-2020	L12A 05-Oct-2020	L14A 05-Oct-2020	L18 05-Oct-2020	L20 05-Oct-2020
Lab Number:		2449917.12	2449917.14	2449917.16	2449917.20	2449917.22
Asbestos Presence / Absence		Asbestos NOT detected.	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	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	829.7	972.6	779.6	810.7	900.9
Dry Weight	g	655.8	824.8	679.2	653.4	751.6
Moisture	%	21	15	13	19	17

Sample Type: Soil						
Sample Name:		L10 05-Oct-2020	L12A 05-Oct-2020	L14A 05-Oct-2020	L18 05-Oct-2020	L20 05-Oct-2020
Lab Number:		2449917.12	2449917.14	2449917.16	2449917.20	2449917.22
Sample Fraction >10mm	g dry wt	14.9	226.6	69.1	89.5	185.4
Sample Fraction <10mm to >2mm	g dry wt	116.6	202.0	247.9	256.0	175.2
Sample Fraction <2mm	g dry wt	523.2	394.6	361.2	306.8	389.7
<2mm Subsample Weight	g dry wt	56.2	57.0	57.9	51.6	51.8
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		L21A 05-Oct-2020	L22 05-Oct-2020			
Lab Number:		2449917.24	2449917.25			
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	-	-	-
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	-	-	-
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	-	-	-
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	-	-	-
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	-	-	-
As Received Weight	g	851.2	1,083.7	-	-	-
Dry Weight	g	776.8	984.7	-	-	-
Moisture	%	9	9	-	-	-
Sample Fraction >10mm	g dry wt	71.1	281.8	-	-	-
Sample Fraction <10mm to >2mm	g dry wt	305.0	333.1	-	-	-
Sample Fraction <2mm	g dry wt	399.6	368.5	-	-	-
<2mm Subsample Weight	g dry wt	57.0	58.4	-	-	-
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	-	-	-
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	-	-	-
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 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.

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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
Moisture	Sample dried at 100 to 105°C. Calculation = (As received weight - Dry weight) / as received weight x 100.	1 %	1, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
Description of Asbestos Form	Description of asbestos form and/or shape if present.	-	1, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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, 4, 6, 8, 11-12, 14, 16, 20, 22, 24-25

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

Testing was completed on 12-Oct-2020. 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.

Rhodri Williams BSc (Hons)
Technical Manager - Asbestos

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Engeo Limited	**Lab No:**	2450283	SPv2
Contact:	Roz Cox	**Date Received:**	06-Oct-2020	
	C/- Engeo Limited	**Date Reported:**	02-Nov-2020	**(Amended)**
	PO Box 25047	**Quote No:**	82742	
	Wellington 6146	**Order No:**		
		Client Reference:		
		Submitted By:	Calum MacRae	

Sample Type: Soil

Sample Name:		L24 06-Oct-2020	L26 06-Oct-2020	L27 06-Oct-2020	L28A 06-Oct-2020	L28B 06-Oct-2020
Lab Number:		2450283.1	2450283.3	2450283.4	2450283.5	2450283.6
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	-	84
Total Recoverable Boron	mg/kg dry wt	-	-	-	< 20	-
Total Recoverable Mercury	mg/kg dry wt	-	< 0.10	-	-	-
Total Organic Carbon*	g/100g dry wt	-	-	-	-	1.49
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	6	4	5	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	16	20	13	-	-
Total Recoverable Copper	mg/kg dry wt	16	12	8	-	-
Total Recoverable Lead	mg/kg dry wt	34	22	12.9	-	-
Total Recoverable Nickel	mg/kg dry wt	11	13	12	-	-
Total Recoverable Zinc	mg/kg dry wt	82	142	50	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	-	-	< 8
C10 - C14	mg/kg dry wt	-	-	-	-	< 20
C15 - C36	mg/kg dry wt	-	-	-	-	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	-	-	< 70

Sample Name:		L28C 06-Oct-2020	L30 06-Oct-2020	L31 06-Oct-2020	L32 06-Oct-2020	L33A 06-Oct-2020
Lab Number:		2450283.7	2450283.9	2450283.10	2450283.11	2450283.12
Individual Tests						
Dry Matter	g/100g as rcvd	75	92	89	-	89
Total Recoverable Boron	mg/kg dry wt	< 20	-	< 20	-	< 20
Total Recoverable Mercury	mg/kg dry wt	-	-	-	< 0.10	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	-	6	5	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	0.29	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	11	-	21	18	-
Total Recoverable Copper	mg/kg dry wt	7	-	41	21	-
Total Recoverable Lead	mg/kg dry wt	19.0	-	69	16.7	-
Total Recoverable Nickel	mg/kg dry wt	7	-	14	12	-
Total Recoverable Zinc	mg/kg dry wt	34	-	153	62	-
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	< 0.3	-	-	-
1-Methylnaphthalene	mg/kg dry wt	-	< 0.011	-	-	-
2-Methylnaphthalene	mg/kg dry wt	-	< 0.011	-	-	-
Acenaphthylene	mg/kg dry wt	-	< 0.011	-	-	-

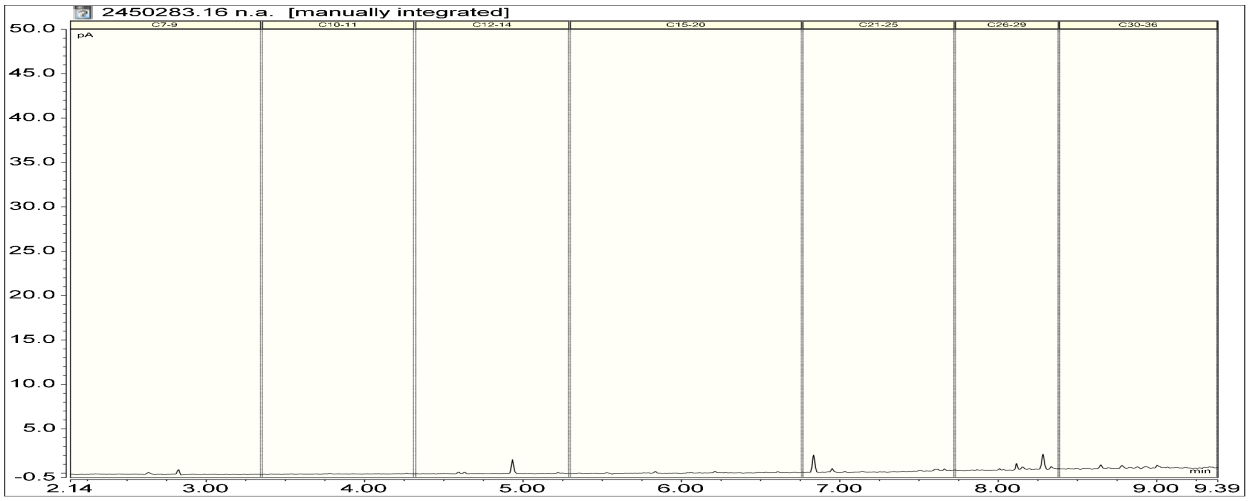
This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported 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:		L28C 06-Oct-2020	L30 06-Oct-2020	L31 06-Oct-2020	L32 06-Oct-2020	L33A 06-Oct-2020
Lab Number:		2450283.7	2450283.9	2450283.10	2450283.11	2450283.12
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Acenaphthene	mg/kg dry wt	-	< 0.011	-	-	-
Anthracene	mg/kg dry wt	-	< 0.011	-	-	-
Benzo[a]anthracene	mg/kg dry wt	-	< 0.011	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	< 0.011	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	< 0.03	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	< 0.011	-	-	-
Benzo[e]pyrene	mg/kg dry wt	-	< 0.011	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	< 0.011	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	< 0.011	-	-	-
Chrysene	mg/kg dry wt	-	< 0.011	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	< 0.011	-	-	-
Fluoranthene	mg/kg dry wt	-	< 0.011	-	-	-
Fluorene	mg/kg dry wt	-	< 0.011	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	< 0.011	-	-	-
Naphthalene	mg/kg dry wt	-	< 0.06	-	-	-
Perylene	mg/kg dry wt	-	< 0.011	-	-	-
Phenanthrene	mg/kg dry wt	-	< 0.011	-	-	-
Pyrene	mg/kg dry wt	-	< 0.011	-	-	-
Pentachlorophenol Screening in Soil by LCMSMS						
Pentachlorophenol (PCP)	mg/kg dry wt	< 0.05	-	< 0.05	-	< 0.05
2,3,4,6-Tetrachlorophenol (TCP)	mg/kg dry wt	< 0.05	-	< 0.05	-	< 0.05

Sample Name:		L33B 06-Oct-2020	L35A 06-Oct-2020	L35B 06-Oct-2020	L36 06-Oct-2020	
Lab Number:		2450283.13	2450283.15	2450283.16	2450283.17	
Individual Tests						
Dry Matter	g/100g as rcvd	89	92	86	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.18	-	-	-	-
Total Cyanide*	mg/kg dry wt	-	-	0.19	-	-
pH*	pH Units	-	-	8.5	-	-
Total Organic Carbon*	g/100g dry wt	2.1	-	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	9	-	6	6	-
Total Recoverable Cadmium	mg/kg dry wt	0.27	-	0.13	0.16	-
Total Recoverable Chromium	mg/kg dry wt	19	-	22	19	-
Total Recoverable Copper	mg/kg dry wt	55	-	34	20	-
Total Recoverable Lead	mg/kg dry wt	157	-	105	57	-
Total Recoverable Nickel	mg/kg dry wt	32	-	13	11	-
Total Recoverable Zinc	mg/kg dry wt	240	-	108	146	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.011	-	-	-	-
alpha-BHC	mg/kg dry wt	< 0.011	-	-	-	-
beta-BHC	mg/kg dry wt	< 0.011	-	-	-	-
delta-BHC	mg/kg dry wt	< 0.011	-	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.011	-	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.011	-	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.011	-	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.011	-	-	-	-
4,4'-DDD	mg/kg dry wt	< 0.011	-	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.011	-	-	-	-
4,4'-DDE	mg/kg dry wt	< 0.011	-	-	-	-

Sample Type: Soil						
Sample Name:		L33B 06-Oct-2020	L35A 06-Oct-2020	L35B 06-Oct-2020	L36 06-Oct-2020	
Lab Number:		2450283.13	2450283.15	2450283.16	2450283.17	
Organochlorine Pesticides Screening in Soil						
2,4'-DDT	mg/kg dry wt	< 0.011	-	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.011	-	-	-	-
Total DDT Isomers	mg/kg dry wt	< 0.07	-	-	-	-
Dieldrin	mg/kg dry wt	< 0.011	-	-	-	-
Endosulfan I	mg/kg dry wt	< 0.011	-	-	-	-
Endosulfan II	mg/kg dry wt	< 0.011	-	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.011	-	-	-	-
Endrin	mg/kg dry wt	< 0.011	-	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.011	-	-	-	-
Endrin ketone	mg/kg dry wt	< 0.011	-	-	-	-
Heptachlor	mg/kg dry wt	< 0.011	-	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.011	-	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.011	-	-	-	-
Methoxychlor	mg/kg dry wt	< 0.011	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	8.3	-	-	-
1-Methylnaphthalene	mg/kg dry wt	-	0.018	-	-	-
2-Methylnaphthalene	mg/kg dry wt	-	0.021	-	-	-
Acenaphthylene	mg/kg dry wt	-	0.098	-	-	-
Acenaphthene	mg/kg dry wt	-	0.015	-	-	-
Anthracene	mg/kg dry wt	-	0.187	-	-	-
Benzo[a]anthracene	mg/kg dry wt	-	0.52	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	0.68	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	1.00	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	0.99	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	0.74	-	-	-
Benzo[e]pyrene	mg/kg dry wt	-	0.48	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	0.51	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	0.31	-	-	-
Chrysene	mg/kg dry wt	-	0.61	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	0.094	-	-	-
Fluoranthene	mg/kg dry wt	-	1.19	-	-	-
Fluorene	mg/kg dry wt	-	0.032	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	0.53	-	-	-
Naphthalene	mg/kg dry wt	-	< 0.06	-	-	-
Perylene	mg/kg dry wt	-	0.181	-	-	-
Phenanthrene	mg/kg dry wt	-	0.61	-	-	-
Pyrene	mg/kg dry wt	-	1.47	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 8	-	-
C10 - C14	mg/kg dry wt	-	-	< 20	-	-
C15 - C36	mg/kg dry wt	-	-	104	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	106	-	-

2450283.16
L35B 06-Oct-2020
Client Chromatogram for TPH by FID



Analyst's Comments

Amended Report: This certificate of analysis replaces report '2450283-SPv1' issued on 14-Oct-2020 at 2:23 pm.
Reason for amendment: Additional testing added.

Appendix No.1 - Chain of Custody

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, 3-7, 10-13, 16-17
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%.	-	5-6, 12
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	16
Soil Prep Dry for Organics,Trace*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	7, 10, 12
Total of Reported PAHs in Soil	Sonication extraction, GC-MS analysis. In-house based on US EPA 8270.	0.03 mg/kg dry wt	9, 15
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	6-7, 9-10, 12-13, 15-16
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	5, 12
Total Cyanide Distillation*	Distillation of sample as received. APHA 4500-CN^- C (modified) 23rd ed. 2017.	-	16
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	5, 7, 10, 12-13
Total Recoverable Mercury	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.10 mg/kg dry wt	3, 11, 13
Total Cyanide*	Distillation, colorimetry. APHA 4500-CN^- C (modified) 23rd ed. 2017 & Skalar Method I295-004(+P14). ISO 14403:2012(E).	0.10 mg/kg dry wt	16
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH. In-house.	0.1 pH Units	16
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	6, 13

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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	9, 15
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	9, 15
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, 3-4, 7, 10-11, 13, 16-17
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	13
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	9, 15
Pentachlorophenol Screening in Soil by LCMSMS	Solvent extraction, LC-MS/MS analysis. Tested on dried sample. In-house.	0.010 mg/kg dry wt	7, 10, 12
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.	-	16
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	8 mg/kg dry wt	6, 16
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	6, 16
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	6, 16
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	6, 16

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

Testing was completed between 09-Oct-2020 and 02-Nov-2020. 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.

Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED

ANALYSIS REQUEST

R J Hill Laboratories Limited
Ground Floor, 28 Heather Street
Parnell
Auckland 1052, New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job No: **245 0283**

Date Recv: 06-Oct-20 13:05

Received by: Tyler Ritchie

3124502834

Quote No

Primary Contact ROZ COX

Submitted By CALUM MACRAE

Client Name ENGEO

Address

Postcode

Phone *Mobile*

Email

Charge To ENGEO

Client Reference

Order No

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☒ Email Primary Contact ☑ Email Submitter ☐ Email Client

☐ Email Other

☐ Other

ADDITIONAL INFORMATION

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories *Date & Time:*

Name:

☐ *Tick if you require COC to be emailed back*

Signature:

Samples will be processed at a Hill Laboratories site with the appropriate testing capability and capacity. Please inform the Laboratory if you wish samples to be retained and analysed at the site of receipt.

Received at Hill Laboratories *Date & Time:*

Name:

Signature:

Priority ☐ Low ☒ Normal ☐ High

☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

Requested Reporting Date:

Please ensure all asbestos samples are individually double bagged upon submission to the laboratory

No.	Sample Name	Sample Material	Sample Location	Sample Date	Tests Required (if not as per Quote)
1	L24	SOIL	—	6/10/20	H&C
2	L25	"	—	"	"
3	L26	"	—	"	"
4	L27	"	—	"	"
5	L28A	"	—	"	"
6	L28B	"	—	"	"
7	L28C	"	—	"	"
8	L29	"	—	"	"
9	L30	"	—	"	"
10	L31	"	—	"	"
11	L32	"	—	"	"
12	L33A	"	—	"	"

No.	Item	material	Location	Date	Test
3	L33B	SOIL	—	6/10/20	H & C
4	L34	"	—	"	"
15	L35A	"	—	"	"
16	L35B	"	—	"	"
17	L36	"	—	"	"

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
101C Waterloo Road
Hornby
Christchurch 8042 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Engeo Limited	**Lab No:**	2450299 A2Pv1
Contact:	Roz Cox	**Date Received:**	06-Oct-2020
	C/- Engeo Limited	**Date Reported:**	12-Oct-2020
	PO Box 25047	**Quote No:**	82742
	Wellington 6146	**Order No:**	
		Client Reference:	
		Submitted By:	Calum MacRae

Sample Type: Soil

Sample Name:		L25 06-Oct-2020	L28 A 06-Oct-2020	L28 B 06-Oct-2020	L29 06-Oct-2020	L30 06-Oct-2020
Lab Number:		2450299.2	2450299.5	2450299.6	2450299.8	2450299.9
Asbestos Presence / Absence		Asbestos NOT detected.	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	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	870.3	1,087.7	977.8	1,009.0	1,112.7
Dry Weight	g	676.4	994.2	824.1	901.4	1,035.0
Moisture	%	22	9	16	11	7
Sample Fraction >10mm	g dry wt	58.4	228.2	182.7	163.1	321.7
Sample Fraction <10mm to >2mm	g dry wt	154.9	482.0	271.9	255.2	453.2
Sample Fraction <2mm	g dry wt	461.0	283.1	368.6	481.9	259.5
<2mm Subsample Weight	g dry wt	53.0	60.0	50.6	58.5	56.6
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		L33 A 06-Oct-2020	L34 06-Oct-2020	L35A 06-Oct-2020		
Lab Number:		2450299.12	2450299.14	2450299.15		
Asbestos Presence / Absence		Chrysotile (White Asbestos) detected.	Chrysotile (White Asbestos) detected.	Chrysotile (White Asbestos) detected.	-	-
Description of Asbestos Form		Loose fibres	Loose fibres	ACM debris and Loose fibres	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	-	-
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	-	-
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	-	-
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	-	-
As Received Weight	g	896.0	1,036.0	892.0	-	-
Dry Weight	g	832.1	888.3	804.1	-	-

Sample Type: Soil						
Sample Name:		L33 A 06-Oct-2020	L34 06-Oct-2020	L35A 06-Oct-2020		
Lab Number:		2450299.12	2450299.14	2450299.15		
Moisture	%	7	14	10	-	-
Sample Fraction >10mm	g dry wt	198.2	151.7	117.2	-	-
Sample Fraction <10mm to >2mm	g dry wt	357.0	198.4	279.5	-	-
Sample Fraction <2mm	g dry wt	276.0	536.6	406.5	-	-
<2mm Subsample Weight	g dry wt	54.7	54.7	54.7	-	-
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	-	-
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	-	-
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	0.00005	0.00004	0.00160	-	-

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.

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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
Dry Weight	Sample dried at 100 to 105°C, measurement on balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	2, 5-6, 8-9, 12, 14-15
Moisture	Sample dried at 100 to 105°C. Calculation = (As received weight - Dry weight) / as received weight x 100.	1 %	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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%	2, 5-6, 8-9, 12, 14-15

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Description of Asbestos Form	Description of asbestos form and/or shape if present.	-	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15
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	2, 5-6, 8-9, 12, 14-15

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

Testing was completed on 12-Oct-2020. 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.

Rhodri Williams BSc (Hons)
Technical Manager - Asbestos

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Engeo Limited	**Lab No:**	2598304	SPv1
Contact:	Roz Cox	**Date Received:**	29-Apr-2021	
	C/- Engeo Limited	**Date Reported:**	11-May-2021	
	PO Box 25047	**Quote No:**	82742	
	Wellington 6146	**Order No:**		
		Client Reference:	Benmore Cresent	
		Submitted By:	Gabriela Staehle	

Sample Type: Soil

Sample Name:		L101 29-Apr-2021	L102 29-Apr-2021	L103 29-Apr-2021	L104 @ 0.4 29-Apr-2021	L104 @ 0.6 29-Apr-2021
Lab Number:		2598304.1	2598304.2	2598304.3	2598304.4	2598304.5
Individual Tests						
Dry Matter	g/100g as rcvd	55	87	-	-	80
Total Recoverable Boron	mg/kg dry wt	-	-	-	-	< 20
pH*	pH Units	8.4	-	5.9	6.3	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	10	11	4	4	4
Total Recoverable Cadmium	mg/kg dry wt	0.32	0.24	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	21	16	14	15	14
Total Recoverable Copper	mg/kg dry wt	10	24	8	11	10
Total Recoverable Lead	mg/kg dry wt	22	210	16.6	14.2	15.7
Total Recoverable Nickel	mg/kg dry wt	14	14	11	13	13
Total Recoverable Zinc	mg/kg dry wt	59	188	49	54	56
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.018	-	-	-	-
alpha-BHC	mg/kg dry wt	< 0.018	-	-	-	-
beta-BHC	mg/kg dry wt	< 0.018	-	-	-	-
delta-BHC	mg/kg dry wt	< 0.018	-	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.018	-	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.018	-	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.018	-	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.018	-	-	-	-
4,4'-DDD	mg/kg dry wt	< 0.018	-	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.018	-	-	-	-
4,4'-DDE	mg/kg dry wt	< 0.018	-	-	-	-
2,4'-DDT	mg/kg dry wt	< 0.018	-	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.018	-	-	-	-
Total DDT Isomers	mg/kg dry wt	< 0.11	-	-	-	-
Dieldrin	mg/kg dry wt	< 0.018	-	-	-	-
Endosulfan I	mg/kg dry wt	< 0.018	-	-	-	-
Endosulfan II	mg/kg dry wt	< 0.018	-	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.018	-	-	-	-
Endrin	mg/kg dry wt	< 0.018	-	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.018	-	-	-	-
Endrin ketone	mg/kg dry wt	< 0.018	-	-	-	-
Heptachlor	mg/kg dry wt	< 0.018	-	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.018	-	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.018	-	-	-	-
Methoxychlor	mg/kg dry wt	< 0.018	-	-	-	-

Sample Type: Soil						
Sample Name:		L101 29-Apr-2021	L102 29-Apr-2021	L103 29-Apr-2021	L104 @ 0.4 29-Apr-2021	L104 @ 0.6 29-Apr-2021
Lab Number:		2598304.1	2598304.2	2598304.3	2598304.4	2598304.5
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	12.9	-	-	-
1-Methylnaphthalene	mg/kg dry wt	-	0.012	-	-	-
2-Methylnaphthalene	mg/kg dry wt	-	0.015	-	-	-
Acenaphthylene	mg/kg dry wt	-	0.085	-	-	-
Acenaphthene	mg/kg dry wt	-	< 0.012	-	-	-
Anthracene	mg/kg dry wt	-	0.172	-	-	-
Benzo[a]anthracene	mg/kg dry wt	-	0.89	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	1.15	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	1.69	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	1.67	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	1.33	-	-	-
Benzo[e]pyrene	mg/kg dry wt	-	0.76	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	0.89	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	0.50	-	-	-
Chrysene	mg/kg dry wt	-	0.92	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	0.151	-	-	-
Fluoranthene	mg/kg dry wt	-	1.99	-	-	-
Fluorene	mg/kg dry wt	-	0.025	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	0.90	-	-	-
Naphthalene	mg/kg dry wt	-	< 0.06	-	-	-
Perylene	mg/kg dry wt	-	0.27	-	-	-
Phenanthrene	mg/kg dry wt	-	0.79	-	-	-
Pyrene	mg/kg dry wt	-	2.0	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	-	-	< 8
C10 - C14	mg/kg dry wt	-	-	-	-	< 20
C15 - C36	mg/kg dry wt	-	-	-	-	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	-	-	< 70

Sample Name:		L105 29-Apr-2021	L106 29-Apr-2021	L109 29-Apr-2021	L108 29-Apr-2021	L107 @ 0.2 29-Apr-2021
Lab Number:		2598304.6	2598304.7	2598304.8	2598304.9	2598304.10
Individual Tests						
Dry Matter	g/100g as rcvd	95	94	87	84	-
Total Recoverable Boron	mg/kg dry wt	-	-	< 20	-	-
pH*	pH Units	7.2	-	-	5.8	7.8
Total Organic Carbon*	g/100g dry wt	-	0.30	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	4	4	5	8
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	12	16	16	15	24
Total Recoverable Copper	mg/kg dry wt	9	14	23	13	31
Total Recoverable Lead	mg/kg dry wt	16.0	21	103	53	38
Total Recoverable Nickel	mg/kg dry wt	13	14	10	10	11
Total Recoverable Zinc	mg/kg dry wt	48	57	124	101	77
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
alpha-BHC	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
beta-BHC	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
delta-BHC	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
cis-Chlordane	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
trans-Chlordane	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-

Sample Type: Soil						
Sample Name:		L105 29-Apr-2021	L106 29-Apr-2021	L109 29-Apr-2021	L108 29-Apr-2021	L107 @ 0.2 29-Apr-2021
Lab Number:		2598304.6	2598304.7	2598304.8	2598304.9	2598304.10
Organochlorine Pesticides Screening in Soil						
2,4'-DDD	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
4,4'-DDD	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
2,4'-DDE	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
4,4'-DDE	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
2,4'-DDT	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
4,4'-DDT	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Total DDT Isomers	mg/kg dry wt	< 0.07	< 0.07	-	< 0.07	-
Dieldrin	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Endosulfan I	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Endosulfan II	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Endosulfan sulphate	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Endrin	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Endrin aldehyde	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Endrin ketone	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Heptachlor	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Heptachlor epoxide	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Hexachlorobenzene	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Methoxychlor	mg/kg dry wt	< 0.011	< 0.011	-	< 0.012	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 8	-	-
C10 - C14	mg/kg dry wt	-	-	< 20	-	-
C15 - C36	mg/kg dry wt	-	-	< 40	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	< 70	-	-

Sample Name:		L107 @ 0.7 29-Apr-2021	L115 @ 1m 29-Apr-2021	L113 @ 0.9 29-Apr-2021	L113 @ 5.0 29-Apr-2021	L114 29-Apr-2021
Lab Number:		2598304.11	2598304.12	2598304.13	2598304.14	2598304.15
Individual Tests						
Dry Matter	g/100g as rcvd	80	91	91	85	80
Total Recoverable Boron	mg/kg dry wt	-	-	-	-	< 20
Total Organic Carbon*	g/100g dry wt	-	1.77	0.23	1.01	1.76
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	8	5	5	8
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.24	< 0.10	< 0.10	0.17
Total Recoverable Chromium	mg/kg dry wt	13	18	18	19	17
Total Recoverable Copper	mg/kg dry wt	9	34	15	17	23
Total Recoverable Lead	mg/kg dry wt	12.7	85	16.4	52	52
Total Recoverable Nickel	mg/kg dry wt	7	12	13	11	13
Total Recoverable Zinc	mg/kg dry wt	38	151	67	82	95
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	< 0.011	-	< 0.012	-
alpha-BHC	mg/kg dry wt	-	< 0.011	-	< 0.012	-
beta-BHC	mg/kg dry wt	-	< 0.011	-	< 0.012	-
delta-BHC	mg/kg dry wt	-	< 0.011	-	< 0.012	-
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.011	-	< 0.012	-
cis-Chlordane	mg/kg dry wt	-	< 0.011	-	< 0.012	-
trans-Chlordane	mg/kg dry wt	-	< 0.011	-	< 0.012	-
2,4'-DDD	mg/kg dry wt	-	< 0.011	-	< 0.012	-
4,4'-DDD	mg/kg dry wt	-	< 0.011	-	< 0.012	-
2,4'-DDE	mg/kg dry wt	-	< 0.011	-	< 0.012	-
4,4'-DDE	mg/kg dry wt	-	< 0.011	-	< 0.012	-
2,4'-DDT	mg/kg dry wt	-	< 0.011	-	< 0.012	-
4,4'-DDT	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Total DDT Isomers	mg/kg dry wt	-	< 0.07	-	< 0.07	-
Dieldrin	mg/kg dry wt	-	0.014	-	< 0.012	-
Endosulfan I	mg/kg dry wt	-	< 0.011	-	< 0.012	-

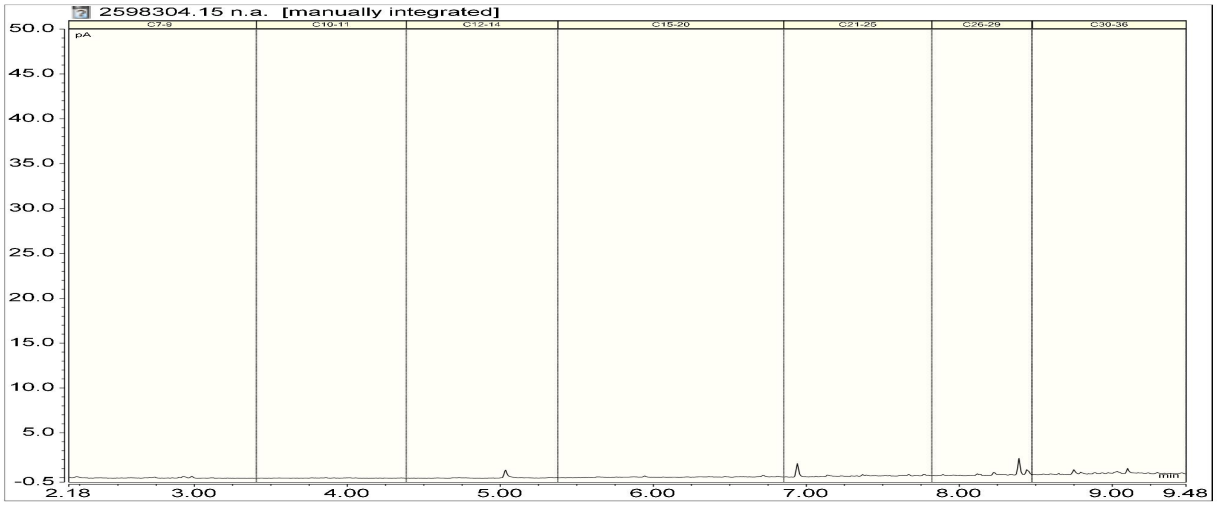
Sample Type: Soil						
Sample Name:		L107 @ 0.7 29-Apr-2021	L115 @ 1m 29-Apr-2021	L113 @ 0.9 29-Apr-2021	L113 @ 5.0 29-Apr-2021	L114 29-Apr-2021
Lab Number:		2598304.11	2598304.12	2598304.13	2598304.14	2598304.15
Organochlorine Pesticides Screening in Soil						
Endosulfan II	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Endosulfan sulphate	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Endrin	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Endrin aldehyde	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Endrin ketone	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Heptachlor	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Heptachlor epoxide	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Hexachlorobenzene	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Methoxychlor	mg/kg dry wt	-	< 0.011	-	< 0.012	-
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	4.2	-	2.9	-
1-Methylnaphthalene	mg/kg dry wt	< 0.013	0.012	-	< 0.012	-
2-Methylnaphthalene	mg/kg dry wt	< 0.013	0.013	-	< 0.012	-
Acenaphthylene	mg/kg dry wt	< 0.013	0.032	-	0.024	-
Acenaphthene	mg/kg dry wt	< 0.013	0.019	-	< 0.012	-
Anthracene	mg/kg dry wt	< 0.013	0.066	-	0.040	-
Benzo[a]anthracene	mg/kg dry wt	< 0.013	0.34	-	0.22	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.013	0.36	-	0.28	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.03	0.54	-	0.41	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.03	0.54	-	0.41	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.013	0.42	-	0.32	-
Benzo[e]pyrene	mg/kg dry wt	< 0.013	0.24	-	0.187	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.013	0.25	-	0.22	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.013	0.168	-	0.125	-
Chrysene	mg/kg dry wt	< 0.013	0.32	-	0.21	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.013	0.054	-	0.039	-
Fluoranthene	mg/kg dry wt	< 0.013	0.62	-	0.34	-
Fluorene	mg/kg dry wt	< 0.013	0.016	-	0.014	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.013	0.26	-	0.22	-
Naphthalene	mg/kg dry wt	< 0.07	< 0.06	-	< 0.06	-
Perylene	mg/kg dry wt	< 0.013	0.089	-	0.073	-
Phenanthrene	mg/kg dry wt	< 0.013	0.33	-	0.120	-
Pyrene	mg/kg dry wt	< 0.013	0.59	-	0.41	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 8	-	< 8
C10 - C14	mg/kg dry wt	-	-	< 20	-	< 20
C15 - C36	mg/kg dry wt	-	-	< 40	-	84
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	< 70	-	84

Sample Name:		L116 @ 2.5 29-Apr-2021	L112 29-Apr-2021	L111 29-Apr-2021	L110 29-Apr-2021	
Lab Number:		2598304.16	2598304.17	2598304.18	2598304.19	
Individual Tests						
Dry Matter	g/100g as rcvd	84	93	86	82	-
Total Recoverable Boron	mg/kg dry wt	-	-	< 20	-	-
Total Organic Carbon*	g/100g dry wt	1.28	1.22	2.3	1.59	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	7	6	8	8	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.12	0.34	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	18	16	17	15	-
Total Recoverable Copper	mg/kg dry wt	25	19	47	18	-
Total Recoverable Lead	mg/kg dry wt	78	56	190	47	-
Total Recoverable Nickel	mg/kg dry wt	12	13	12	12	-

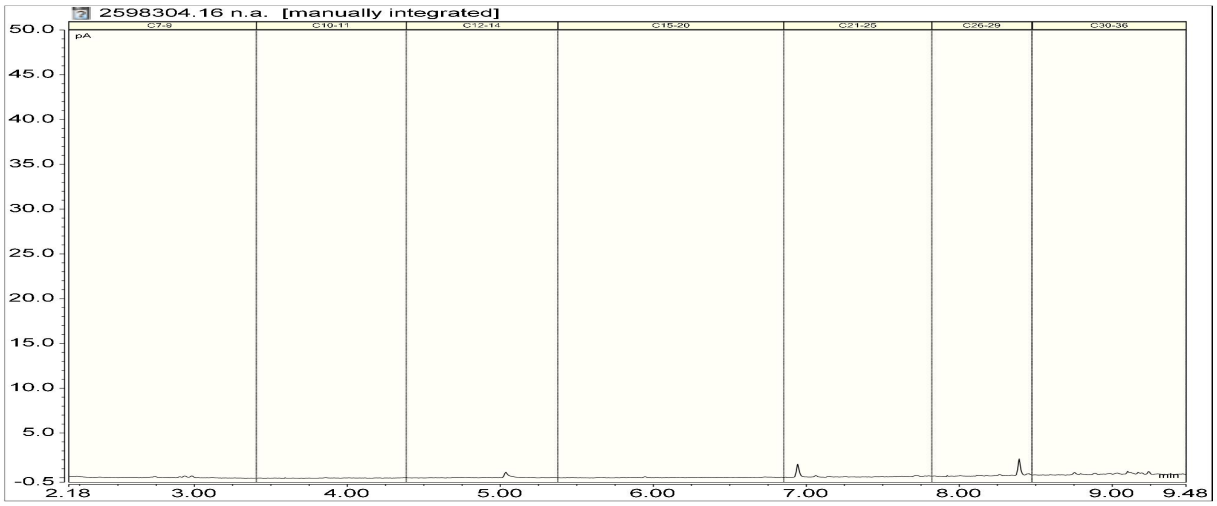
Sample Type: Soil						
Sample Name:		L116 @ 2.5 29-Apr-2021	L112 29-Apr-2021	L111 29-Apr-2021	L110 29-Apr-2021	
Lab Number:		2598304.16	2598304.17	2598304.18	2598304.19	
Heavy Metals, Screen Level						
Total Recoverable Zinc	mg/kg dry wt	117	107	280	101	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	< 0.011	-	< 0.013	-
alpha-BHC	mg/kg dry wt	-	< 0.011	-	< 0.013	-
beta-BHC	mg/kg dry wt	-	< 0.011	-	< 0.013	-
delta-BHC	mg/kg dry wt	-	< 0.011	-	< 0.013	-
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.011	-	< 0.013	-
cis-Chlordane	mg/kg dry wt	-	< 0.011	-	< 0.013	-
trans-Chlordane	mg/kg dry wt	-	< 0.011	-	< 0.013	-
2,4'-DDD	mg/kg dry wt	-	< 0.011	-	< 0.013	-
4,4'-DDD	mg/kg dry wt	-	< 0.011	-	< 0.013	-
2,4'-DDE	mg/kg dry wt	-	< 0.011	-	< 0.013	-
4,4'-DDE	mg/kg dry wt	-	< 0.011	-	< 0.013	-
2,4'-DDT	mg/kg dry wt	-	< 0.011	-	< 0.013	-
4,4'-DDT	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Total DDT Isomers	mg/kg dry wt	-	< 0.07	-	< 0.08	-
Dieldrin	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Endosulfan I	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Endosulfan II	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Endosulfan sulphate	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Endrin	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Endrin aldehyde	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Endrin ketone	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Heptachlor	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Heptachlor epoxide	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Hexachlorobenzene	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Methoxychlor	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	-	2.7	-	1.6	-
1-Methylnaphthalene	mg/kg dry wt	-	< 0.011	-	< 0.013	-
2-Methylnaphthalene	mg/kg dry wt	-	< 0.011	-	< 0.013	-
Acenaphthylene	mg/kg dry wt	-	< 0.011	-	0.023	-
Acenaphthene	mg/kg dry wt	-	0.011	-	< 0.013	-
Anthracene	mg/kg dry wt	-	0.042	-	0.034	-
Benzo[a]anthracene	mg/kg dry wt	-	0.168	-	0.116	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	0.29	-	0.114	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	0.43	-	0.17	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	0.43	-	0.17	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	0.31	-	0.122	-
Benzo[e]pyrene	mg/kg dry wt	-	0.165	-	0.066	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	0.25	-	0.057	-
Benzo[k]fluoranthene	mg/kg dry wt	-	0.114	-	0.054	-
Chrysene	mg/kg dry wt	-	0.175	-	0.117	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	0.049	-	0.016	-
Fluoranthene	mg/kg dry wt	-	0.28	-	0.24	-
Fluorene	mg/kg dry wt	-	0.013	-	0.020	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	0.27	-	0.067	-
Naphthalene	mg/kg dry wt	-	< 0.06	-	< 0.07	-
Perylene	mg/kg dry wt	-	0.107	-	0.023	-
Phenanthrene	mg/kg dry wt	-	0.119	-	0.24	-
Pyrene	mg/kg dry wt	-	0.30	-	0.23	-

Sample Type: Soil						
Sample Name:		L116 @ 2.5 29-Apr-2021	L112 29-Apr-2021	L111 29-Apr-2021	L110 29-Apr-2021	
Lab Number:		2598304.16	2598304.17	2598304.18	2598304.19	
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	-	< 8	-	-
C10 - C14	mg/kg dry wt	< 20	-	< 20	-	-
C15 - C36	mg/kg dry wt	61	-	81	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	71	-	84	-	-

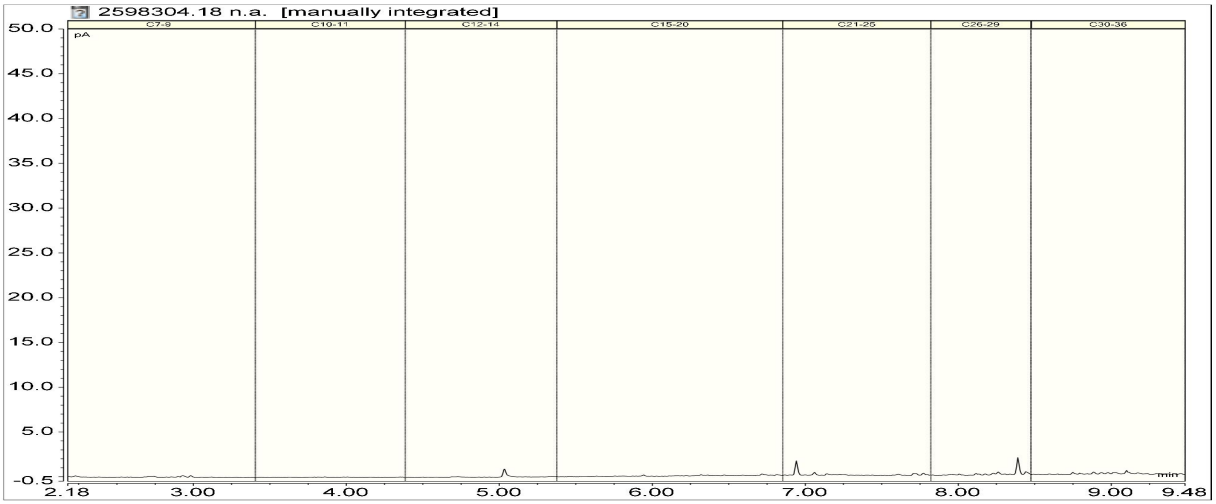
2598304.15
L114 29-Apr-2021
Client Chromatogram for TPH by FID



2598304.16
L116 @ 2.5 29-Apr-2021
Client Chromatogram for TPH by FID



2598304.18
L111 29-Apr-2021
Client Chromatogram for TPH by FID



Analyst's Comments

Appendix No.1 - Chain of Custody

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%.	-	1-19
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1, 3-4, 6, 9-10
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, 11-12, 14, 17, 19
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	1-2, 5-9, 11-19
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	5, 8, 15, 18
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH. In-house.	0.1 pH Units	1, 3-4, 6, 9-10
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	7, 12-19
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, 11-12, 14, 17, 19
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, 11-12, 14, 17, 19
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	1-19

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	1, 6-7, 9, 12, 14, 17, 19
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	2, 11-12, 14, 17, 19
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.	-	15-16, 18
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	8 mg/kg dry wt	5, 8, 13, 15-16, 18
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	5, 8, 13, 15-16, 18
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	5, 8, 13, 15-16, 18
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	5, 8, 13, 15-16, 18

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

Testing was completed between 07-May-2021 and 11-May-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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED

ANALYSIS REQUEST

R J Hill Laboratories Limited
28 Duke Street, Hamilton 3204
Private Bag 3205
Hamilton 3240, New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job No: **259 8304**
Date Recv: 29-Apr-21 15:27
Received by: Kelsey Rohloff
3125983047

Quote No

Primary Contact Roz Cox

Submitted By

Client Name ENGEO

Address

Postcode

Phone *Mobile*

Email

Charge To

Client Reference 17709 - Benmore

Order No

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☑ *Email Primary Contact* ☐ *Email Submitter* ☐ *Email Client*

☐ *Email Other*

☐ *Other*

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories *Date & Time:*

Name:

☐ *Tick if you require COC to be emailed back* *Signature:*

Received at Hill Laboratories *Date & Time:*

Name:

Signature:

Condition ☐ *Room Temp* ☐ *Chilled* ☐ *Frozen* Temp:

☐ *Sample and Analysis details checked*

Signature:

ADDITIONAL INFORMATION

SQA- semi-quantitative asbetsos

Priority ☐ **Low** ☑ **Normal** ☐ **High**
☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

Requested Reporting Date:

No.	Sample Name	Sample Date	Sample Time	Sample Type	Tests Required (if not as per Quote)
1	L101	29/04/21		Soil	Heavy metals, SQA, pH, OCP
2	L102	29/04/21		Soil	Heavy metals, SQA, PAH
3	L103	29/04/21		Soil	Heavy metals, SQA, pH
4	L104 @ 0.4m	29/04/21		Soil	Heavy metals, SQA, pH
5	L104 @ 0.6m	29/04/21		Soil	Heavy metals, SQA, TPH, boron
6	L105	29/04/21		Soil	Heavy metals, SQA, pH, OCP
7	L106	29/04/21		Soil	TOC, Heavy metals, SQA, OCP
8	L107@0.2m	29/04/21		Soil	Heavy metals, SQA, pH
9	L107@0.7m	29/04/21		Soil	Heavy metals, SQA, PAH
10	L108	29/04/21		Soil	Heavy metals, SQA, pH, OCP
11	L109	29/04/21		Soil	Heavy metals, SQA,TPH, boron
12	L110	29/04/21		Soil	TOC, Heavy metals, SQA, PAH, OCP

Continued on next page

No.	Sample Name	Sample Date	Sample Time	Sample Type	Tests Required (if not as per Quote)
13	L111	29/04/21		Soil	TOC, Heavy metals, SQA, TPH, boron
14	L112	29/04/21		Soil	TOC, Heavy metals, SQA, PAH, OCP
15	L113@0.9 m	29/04/21		Soil	TOC, Heavy metals, SQA, TPH
16	L113@5 m	29/04/21		Soil	TOC, Heavy metals, SQA, PAH, OCP
17	L114	29/04/21		Soil	TOC, Heavy metals, SQA, TPH, Boron
18	L115@1m	29/04/21		Soil	TOC, Heavy metals, SQA, PAH, OCP
19	L116@2.5m	29/04/21		Soil	TOC, Heavy metals, SQA, TPH
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
101C Waterloo Road
Hornby
Christchurch 8042 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Engeo Limited	**Lab No:**	2604311 A2Pv1
Contact:	Roz Cox C/- Engeo Limited PO Box 25047 Wellington 6146	**Date Received:**	05-May-2021
		Date Reported:	18-May-2021
		Quote No:	82742
		Order No:	
		Client Reference:	Benmore Cresent
		Submitted By:	Gabriela Staehle

Sample Type: Soil

Sample Name:		L101 29-Apr-2021	L102 29-Apr-2021	L103 29-Apr-2021	L104 @ 0.4 29-Apr-2021	L104 @ 0.6 29-Apr-2021
Lab Number:		2604311.1	2604311.2	2604311.3	2604311.4	2604311.5
Asbestos Presence / Absence		Asbestos NOT detected.	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	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	683.8	1,122.8	769.1	1,227.2	910.4
Dry Weight	g	390.2	1,010.3	688.0	1,101.8	743.3
Moisture	%	43	10	11	10	18
Sample Fraction >10mm	g dry wt	1.1	237.7	166.3	224.1	< 0.1
Sample Fraction <10mm to >2mm	g dry wt	7.4	324.6	255.4	326.8	9.0
Sample Fraction <2mm	g dry wt	380.8	447.0	265.3	549.8	733.2
<2mm Subsample Weight	g dry wt	53.5	58.5	56.3	53.5	57.3
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		L105 29-Apr-2021	L106 29-Apr-2021	L109 29-Apr-2021	L108 29-Apr-2021	L107 @ 0.2 29-Apr-2021
Lab Number:		2604311.6	2604311.7	2604311.8	2604311.9	2604311.10
Asbestos Presence / Absence		Asbestos NOT detected.	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	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	939.0	911.9	744.3	875.2	971.0
Dry Weight	g	900.4	866.2	651.4	757.0	862.5
Moisture	%	4	5	12	14	11

Sample Type: Soil						
Sample Name:		L105 29-Apr-2021	L106 29-Apr-2021	L109 29-Apr-2021	L108 29-Apr-2021	L107 @ 0.2 29-Apr-2021
Lab Number:		2604311.6	2604311.7	2604311.8	2604311.9	2604311.10
Sample Fraction >10mm	g dry wt	280.2	123.2	22.3	101.2	215.6
Sample Fraction <10mm to >2mm	g dry wt	314.5	356.4	193.5	204.9	283.0
Sample Fraction <2mm	g dry wt	304.9	385.7	434.5	449.8	362.5
<2mm Subsample Weight	g dry wt	55.6	58.6	58.6	57.8	59.2
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		L107 @ 0.7 29-Apr-2021	L115 @ 1m 29-Apr-2021	L113 @ 0.9 29-Apr-2021	L113 @ 5.0 29-Apr-2021	L114 29-Apr-2021
Lab Number:		2604311.11	2604311.12	2604311.13	2604311.14	2604311.15
Asbestos Presence / Absence		Asbestos NOT detected.	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	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	770.5	747.6	912.6	908.5	982.4
Dry Weight	g	630.4	697.4	858.2	772.8	804.0
Moisture	%	18	7	6	15	18
Sample Fraction >10mm	g dry wt	11.0	183.2	345.1	151.0	66.0
Sample Fraction <10mm to >2mm	g dry wt	177.0	237.5	375.3	272.6	256.2
Sample Fraction <2mm	g dry wt	440.9	275.7	136.5	347.3	480.2
<2mm Subsample Weight	g dry wt	57.1	56.8	56.3	53.6	60.0
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		L116 @ 2.5 29-Apr-2021	L112 29-Apr-2021	L111 29-Apr-2021	L110 29-Apr-2021	
Lab Number:		2604311.16	2604311.17	2604311.18	2604311.19	
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	< 0.001	< 0.001	< 0.001	-
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
As Received Weight	g	774.9	986.5	1,028.1	1,007.4	-
Dry Weight	g	651.8	894.8	899.3	844.7	-
Moisture	%	16	9	13	16	-
Sample Fraction >10mm	g dry wt	113.6	293.8	287.3	165.7	-
Sample Fraction <10mm to >2mm	g dry wt	184.6	349.7	321.5	256.0	-
Sample Fraction <2mm	g dry wt	352.0	250.3	289.4	421.1	-
<2mm Subsample Weight	g dry wt	57.2	57.7	55.7	55.0	-

Sample Type: Soil						
Sample Name:		L116 @ 2.5 29-Apr-2021	L112 29-Apr-2021	L111 29-Apr-2021	L110 29-Apr-2021	
Lab Number:		2604311.16	2604311.17	2604311.18	2604311.19	
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	-
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	-
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 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.

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	1-19
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	1-19
Dry Weight	Sample dried at 100 to 105°C, measurement on balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1-19
Moisture	Sample dried at 100 to 105°C. Calculation = (As received weight - Dry weight) / as received weight x 100.	1 %	1-19
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	1-19
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	1-19
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	1-19
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%	1-19
Description of Asbestos Form	Description of asbestos form and/or shape if present.	-	1-19
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	1-19

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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	1-19
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	1-19
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	1-19
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	1-19
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	1-19
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	1-19

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

Testing was completed on 18-May-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.

Rhodri Williams BSc (Hons)
Technical Manager - Asbestos

Issue Date: Tuesday, 13th October 2020

Client Reference: 17709.000.000 - 48hr

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

EIAG Reference No: WH02115.1

For the Attention of: Matt Ryan

Dear Matt,

Re: Benmore, Manor Park

Test Method – EIAG001: Polarised light microscopy including dispersion staining in accordance with the Australian Standard AS4964-2004 "Method for the qualitative identification of asbestos in bulk samples".

The samples in this report are reported 'As Received'. The Environmental and Industrial Analysis Group does not take responsibility for the sampling procedure or accuracy of sample location description as these have been provided by the client and is not IANZ endorsed.

Five samples were received on Tuesday, 13th October 2020. The samples were taken from Benmore, Manor Park.

The fibre identification analysis results are presented in the appended table.

Should you require further information please contact Julian Staite.

Yours sincerely,

Julian Staite (*BSc*)
Wellington Laboratory Manager
ENVIRONMENTAL AND INDUSTRIAL ANALYSIS GROUP

EIAG
ENVIRONMENTAL & INDUSTRIAL ANALYSIS GROUP

IANZ
ACCREDITED LABORATORY
Accreditation No. 1298

ASBESTOS ANALYSIS REPORT

Analysis Date: Tuesday, 13th October 2020 **Reference No: WH02115.1**

Laboratory Reference No.	Client Sample No.	Sampling Address/Sampling Location/Description/Dimensions	Fibre Identification Analysis Results
WH02115.1.1	SA01b	Benmore, Manor Park SA01b White painted cement sheeting Sample weight: 86.86 g	**Chrysotile (White Asbestos)** Organic Fibres
WH02115.1.2	SA02	Benmore, Manor Park SA02 Unpainted cement sheeting Sample weight: 29.89 g	**Chrysotile (White Asbestos)**
WH02115.1.3	SA03	Benmore, Manor Park SA03 Unpainted cement sheeting Sample weight: 69.83 g	Organic Fibres No Asbestos Detected
WH02115.1.4	SA04	Benmore, Manor Park SA04 Brown fibrous board with adhesive attached Sample weight: 150.25 g	Organic Fibres No Asbestos Detected
WH02115.1.5	SA05b	Benmore, Manor Park SA05b Concrete Sample weight: 266.38 g	Organic Fibres Synthetic Mineral Fibres No Asbestos Detected

Note: The results contained in this report relate specifically to the samples submitted.

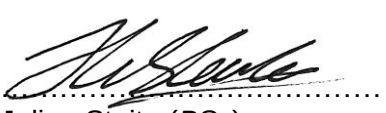
Positive samples have been highlighted.

An "a" suffix at the end of the EIAG Reference Number indicates a reissued report.

Identified By:

Julian Staite (*BSc*)
Approved Analyst

Reviewed By:



Julian Staite (*BSc*)
Key Technical Person