Ministry for the Environment
Manatū Mō Te Taiao

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19-D-02771

s 9(2)(a)
Reporter
s 9(2)(a) @stuff.co.nz

Dear s 9(2)(a)

Thank you for your emails of 20 December 2019 and 22 January 2020 (clarification) requesting the following under the Official Information Act 1982 (the Act):

> *Can I please request that briefing plus any other documents on the same topic [Christchurch landfill] under the OIA?*
>
> *As far as the OIA request goes, documents relating to just the Christchurch landfill would be great thanks.*

The Ministry for the Environment has identified 42 documents in scope of your request, and released 33 as listed in the attached document schedule.

Nine documents have been withheld in full, and some information within the released documents has been redacted, under the following sections of the Act:

- 9(2)(a) to protect the privacy of natural persons including that of deceased natural persons.
- 9(2)(b)(ii) to protect information where the making available of the information would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information.
- 9(2)(g)(i) to maintain the effective conduct of public affairs through the free and frank expression of opinions.

In terms of section 9(2) of the Act, I am satisfied that, in the circumstances, the withholding of this information is not outweighed by other considerations that render it desirable to make the information available in the public interest.

You have the right to seek an investigation and review by the Office of the Ombudsman of my decision to withhold information relating to this request, in accordance with section 28(3) of the Act. The relevant details can be found on their website at: www.ombudsman.parliament.nz.

Please note that due to the public interest in our work the Ministry for the Environment publishes responses to requests for official information on our OIA responses page shortly after the response has been sent. If you have any queries about this, please feel free to contact our Executive Relations team: ministerials@mfe.govt.nz.

Yours sincerely

Glenn Wigley
Director – Natural & Built System

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Document schedule

Document No.	Document Date	Content	Decisions	OIA sections applied
D01	02/10/2018	CSRF Application Form Part 1 (1)	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D02	18/09/2015	DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D03	02/08/2017	ECan Phase 2 PMP final draft	Released in part	S9(2)(a) – to protect privacy of landowners
D04		CSRF Application Form (Part 1)	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D05	19/07/2019	Letter to ECan CEO re Contaminated Sites	Released in part	S9(2)(a) – to protect privacy of landowners
D06	23/12/1998	LIM Hazard Letter.pdf	Released in part	S9(2)(a) – to protect privacy of landowners
D07	29/07/2013	DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D08	2018	CSRF Application Form (Part 1)	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D09	03/11/2014	DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D10	02/09/2016	SVI Report	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D11	10/05/2015	DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D12	12/11/2015	DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D13	24/09/2015	DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D14	26/02/2016	Additional DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D15	05/04/2016	Further DSI Report	Released in part	S9(2)(a) – to protect privacy of landowners
D16	02/06/2017	Funding Approval Letter Signed	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D17	07/09/2018	CDHB Remediation Fund Support Letter	Released in part	S9(2)(a) – to protect privacy of landowners
D18	21/03/2017	Christchurch City Council Funding Confirmation Memo	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D19	27/09/2018	Contaminated Site Remediation Fund Letter	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information

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Document No.	Document Date	Content	Decisions	OIA sections applied
D20	15/08/2019	CSRF Funding Support Letter	Released in part	S9(2)(a) – to protect privacy of landowners
D21	16/04/2019	ECAN Letter CSRF Invitation to Stage 2	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D22	20/11/2017	ECan Signed CSRF Deed	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D23	16/12/2019	ECan CSRF Refunding Response	Released in part	S9(2)(a) – to protect privacy of landowners
D24	21/03/2017	Environment Canterbury Funding Confirmation Memo	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D25	31/03/2017	Environment Canterbury Application	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D26	28/03/2017	Environment Canterbury Scoping Study Result Tables and Maps	Released in part	S9(2)(a) – to protect privacy of landowners
D27	12/12/2017	FM-HSE-006 Landfill	Released in part	S9(2)(a) – to protect privacy of landowners
D28	01/03/2018	GHD Report DSI Final	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D29	24/11/2017	Phase 2 Deed Signing Memo	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D30	02/06/2017	CSRF Application Approval Letter	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D31	30/08/2019	Request to MfE for 100% funding	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information
D32	12/12/2017	Sampling Plan	Released in part	S9(2)(a) – to protect privacy of landowners
D33	18/11/2019	Review of CSRF Funding – Historical Christchurch Landfill	Released in part	S9(2)(a) – to protect privacy of landowners S9(2)(b)(ii) – to protect commercially sensitive information

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				S9(2)(g)(i) – to maintain the effective conduct of public affairs

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Environment Canterbury

s 9(2)(a) Landfill

Detailed Site Investigation

March 2018

Executive summary

The residential suburb of s 9(2)(a) of Christchurch. Several independent reports related to post-earthquake repairs were received by Environment Canterbury which showed evidence of metal and benzo(a)pyrene contamination in soils beneath properties.

Environment Canterbury undertook an investigation across properties in the area in December 2016 and March 2017. This investigation found buried fill material which comprised of sandy silt with fragments of brick, glass, ceramic, and slag across twenty-three properties. Where laboratory analysis was undertaken, high concentrations of lead and arsenic were reported.

As a result of this initial investigation, Environment Canterbury, in cooperation with Christchurch City Council and the Ministry for the Environment's Contaminated Sites Remediation Fund (CSRF), procured a Detailed Site Investigation (DSI) which was undertaken by GHD limited in January of 2018.

Extent of Fill Material

Delineation of the fill material showed that 11 of the properties were impacted by fill material with fill thickness being up to 3.4 m.

The fill extent is unknown at the properties to the south and southwest of s 9(2)(a), e.g. s 9(2)(a) due to the access limits of the investigation.

Nature of Contamination

Contaminant concentrations were found to be highest within samples taken within the fill material and these sharply decreased when the natural material at the base of the fill was reached.

Heavy metals (a combination of arsenic, cadmium, lead, nickel and zinc) were shown to be present in concentrations above the selected human health and environmental guideline criteria at 14 of the 20 properties investigated by GHD.

Asbestos presence/absence was analysed in 17 samples. Asbestos was only detected in one sample at a depth of 3.5 m bgl. Exposure is unlikely therefore asbestos is not considered to pose a risk.

No cyanide concentrations were detected above relevant guideline criteria.

Benzo(a)pyrene was shown to exceed guideline criteria at nine of the properties investigated.

Leachability testing found that copper, cadmium, lead and zinc were leaching from the fill material at concentrations which exceeded ANZECC guidelines for the protection of surface water.

Risk to Human health and the environment

The primary identified risk to human health is via direct soil ingestion, dermal contact with fill material and ingestion of produce grown in impacted areas.

The results indicate that soil concentrations in areas where the fill has been observed contain concentrations of metals which may affect plant health.

Leachability testing found that the fill material is likely to be leaching certain metals to groundwater that has the potential to migrate and reach nearby surface water.

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Remediation options

Remedial options will require discussion with individual property owners regarding suitable solution(s) that are agreeable to respective parties to be achieved.

Full source removal remediation is deemed to be undesirable due to the significant costs involved and disruption that would be imposed upon not only affected residents but the neighbouring properties as well.

Partial source removal remediation may be implemented in select cases with resident approval as an effective solution to remove areas of gross contamination and may allow areas of impacted gardens to be remediated.

An active management procedure with raised beds and direct guidance from the regulator would allow residents to continue to cultivate produce for personal use in a safe manner however this is a self-regulating approach. Successful restriction of direct contact and ingestion for children and pets would be difficult to manage. Residents have previously been advised to not cultivate produce, yet this practice was observed to be continuing during the 2018 investigation. As a result this approach cannot be relied upon.

Summary of Affected Properties

There are 14 properties that currently contain concentrations of contaminants at levels that exceed the (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Standards 2011 (NESCS) criteria for a residential land use. As these properties exceed the NESCS criteria, the cultivation and consumption of produce is deemed to be potentially hazardous to human health and should cease immediately until remedial measures have been implemented. Ingestion o soil is also deemed a potential risk to human and animal health and contact with soil on sites should be avoided. Pets shall be kept away from areas of exposed soil upon properties until mitigation measures have been implemented.

Of the 20 properties investigated, 11 properties contained fill material and associated soil contaminant guideline exceedances. Four properties contained exceedances of soil contaminant guideline exceedances with no fill identified. On 5 properties fill was not identified and all contaminant concentrations were below guideline criteria.

Based on the samples collected and visual observations by GHD, the following properties have shown evidence of the presence of fill and are considered to be impacted by soil contamination:

- s 9(2)(a)

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Based on the samples collected and visual observations by GHD, the following properties have shown no evidence of the presence of fill but are considered to be impacted by soil contamination:

- s 9(2)(a)
-
-
- (no fill was found in the locations investigated by GHD at s 9(2)(a) but fill was found in a previous investigation by Eliot Sinclair Ltd)

Based on the samples collected and visual observations by GHD, the following properties have shown no evidence of the presence of fill and are considered to be unimpacted by soil contamination:

- s 9(2)(a)
-
-
-
-

This report is subject to, and must be read in conjunction with, the limitations set out in section 1 and the assumptions and qualifications contained throughout the Report.

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1. Introduction

1.1 Background to the Project

The residential suburb of s 9(2)(a) of Christchurch. Several independent reports were received by Environment Canterbury which showed evidence of metal and benzo(a)pyrene contamination in soils beneath properties. Environment Canterbury undertook their own initial investigation across properties in the area in December 2016 and March 2017. This took the form of shallow soil sampling using a hand auger and an X-Ray Fluorescence (XRF) meter. The Environment Canterbury investigation found fill material comprised sandy silt with fragments of brick, glass, ceramic, and slag across twenty-three properties. Where laboratory analysis was undertaken, high concentrations of arsenic and lead were measured.

The fill is thought have been emplaced at some point prior to the 1940s. This is based on the earliest available aerial imagery of the area from the 1940s and more recent imagery which showed no evidence of disturbance relating to filling activities.

As a result of this initial investigation, Environment Canterbury, in cooperation with Christchurch City Council and the Ministry for the Environment's (MfE) Contaminated Sites Remediation Fund (CSRF), procured a Detailed Site Investigation (DSI). This report describes the results of the DSI.

1.2 Overall Project Objectives

The key objectives of the project were:

- To understand the extent of the fill material both laterally and vertically
- To provide further data on the nature of the fill material – historical sampling had generally been spatially limited and shallow. The DSI needed to confirm whether the fill was of a similar type across the area of whether different fill materials exist in different areas
- To measure the soil concentrations within the fill in relation to relevant Soil Contaminant Standards (SCS)
- To confirm the previous premise that no vapour generation is occurring
- To understand the degree of leachability of the fill

This data will be used to:

- Assess potentially complete pollutant linkages and complete a qualitative risk assessment
- Use the risk assessment to inform recommendations including potential site wide management or remedial options

1.3 Purpose of the DSI Component

The production of the DSI is important to Environment Canterbury as it is designed to provide the data required to assess the project site in relation to the protection of site residents and site users. This information will help current and future residents and users of the affected area to manage the risk from fill material.

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1.4 Regulatory Context

The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Standards 2011 (NESCS) are designed to be protective of human health. These cover a number of potential activities including soil disturbance. The NESCS has been used as the principal means of establishing the risk to human health in this investigation.

1.5 Limitations

This report: has been prepared by GHD for Environment Canterbury and *may only be used and relied on by Environment Canterbury for the purpose agreed between GHD and the Environment Canterbury as set out in section 1.3 of this report.*

GHD otherwise disclaims responsibility to any person other than Environment Canterbury arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Environment Canterbury and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The Indicative Disposal Costs in Section 9 is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Indicative Disposal Costs and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that future disposal can or will be undertaken at a cost which is the same or less than the Indicative Disposal Costs.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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1.6 Assumptions

The DSI has been written on the assumption that all recorded data and previous reports pertaining to the site made available to and reviewed by GHD are correct and free from significant error or omission. GHD has accepted in good faith the veracity of this data.

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2. Site Information

2.1 Location

2.1.1 Local Layout

The site is located in the suburb s 9(2)(a) Christchurch, see Figure 1 and 2 of Annex A for site location and layout. It is located within a block of residential properties bordered by s 9(2)(a).

Structures in the area are residential buildings on landscaped sections, comprising gardens and lawns. Parts of the site are sealed with concrete and asphalt used for driveways.

The area rises to two higher platforms, one to the north west and one to the south west of the block, see Figure 3 of Annex A for site topography. The section between them is noticeably lower in elevation than the surrounding land.

Table 1: Council Details

Attribute	Details
Regulatory Authority	Christchurch City Council
Zoning	Residential

Access to properties within the project area was undertaken through Environment Canterbury. Environment Canterbury approached a number of properties in the area to request access for this investigation. The project area was therefore determined by the number of landowners which approved access to their properties. There are 18 land parcels within the investigation area with 20 individual properties (e.g. s 9(2)(a) incorporate dual properties). Those properties which approved access and on which investigations were undertaken were as follows:

s 9(2)(a) *- Eastern Site*

s 9(2)(a)

s 9(2)(a) *– Central Site*

s 9(2)(a)

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s 9(2)(a) **– *Western Site***

s 9(2)(a)

2.1.2 Neighbouring Land Use

Beyond s 9(2)(a) lie further residential properties.

s 9(2)(a)

2.2 Environmental Setting

2.2.1 Soil

According to the local soil map [1], the Site soil is comprised of imperfectly drained Kaiapoi deep loam which consists of mottled-weathered fluvial recent soils such as, gravels, sands and silts.

2.2.2 Published Geology

According to the local geological map[2], the Site is underlain by Holocene age grey river alluvium comprising gravel, sand and silt, in active floodplains. The regional geology of the area is detailed in Figure 4 of Annex A.

A search of the NZ Geotechnical Database identified a number of historical bores in the project area, however only one borelog detailed fill material as being present. This was a bore situated at s 9(2)(a), which was drilled to a depth of 15.95m in 2012. The bore log indicated a fill layer stretching from beneath the topsoil at approximately 0.25m down to 4.0m below ground. The layer was described as a gravelly silt with some brick and organics. This would appear to be the only bore in the area which has measured the actual thickness of the fill material.

2.2.3 Hydrogeology

Geotechnical borelogs[3] obtained by GHD from s 9(2)(a) all extend to depths greater than 7 m. Groundwater at these locations varies from 1 metre below ground level (mbgl) to 2.5 mbgl. These borelogs are included as Annex B.

[1] Canterburymaps.govt.nz (Environment Canterbury Soil Types)
[2] Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compilers) 2008. Geology of the Christchurch area. Institute of Geological and Nuclear Sciences 1:250,000 Geological Map 16. 1 + 67 p. Lower Hutt, New Zealand. GNS Science
3 New Zealand Geotechnical Database (2018): "Geotechnical Investigation Data", Map Layer NZGD0010, retrieved from https://www.nzgd.org.nz/ARCGISMapViewer/mapviewer.aspx

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According to the Environment Canterbury Advanced Maps Viewer Groundwater Wells layer[4], there are 99 well/bore consents recorded within a 500 m radius of the Site.

Eighty three of these wells are listed for geotechnical assessments and 13 are listed for water level observation. There are three groundwater wells, M36/5698 (200 m south of the site), M36/2240 (430 m west of the site) and M36/1894 (200 m east) that are listed as domestic supply bores. These wells are drilled to depths greater than 40 mbgl. Groundwater is therefore being abstracted from deeper confined aquifers, with the shallow aquifer not being used for abstraction purposes.

A full list of the Environment Canterbury Groundwater Wells Database information showing groundwater wells within 500 m of the site are shown in Annex C.

Groundwater is considered likely to be flowing east towards the coast. As groundwater is shallow in the project area, it is deemed likely that some of the fill material is saturated.

Groundwater sampling is not part of the scope of this investigation. Data on groundwater presence, e.g. saturated soil profiles has been noted, however no groundwater monitoring wells have been installed. A number of soil samples were allocated for leachability testing to understand whether contaminated soil is impacting groundwater.

2.2.4 Hydrology

Groundwater is likely to flow to east towards a down grad ent loop of the Heathcote River. Jacksons Creek also cuts across the northern end of the project area. This may have a localised effect on groundwater flow direction in this area. The sampling of surface water is not part of the scope of this project.

2.3 Site History

2.3.1 Historical Aerial Photography Assessment

A review of available aerial photographs between 1940 and 2017 is outlined in Table 2 below. The Site boundary is outlined in blue and key findings are summarised below the image. For ease of viewing, the entire block has been highlighted in the following section.

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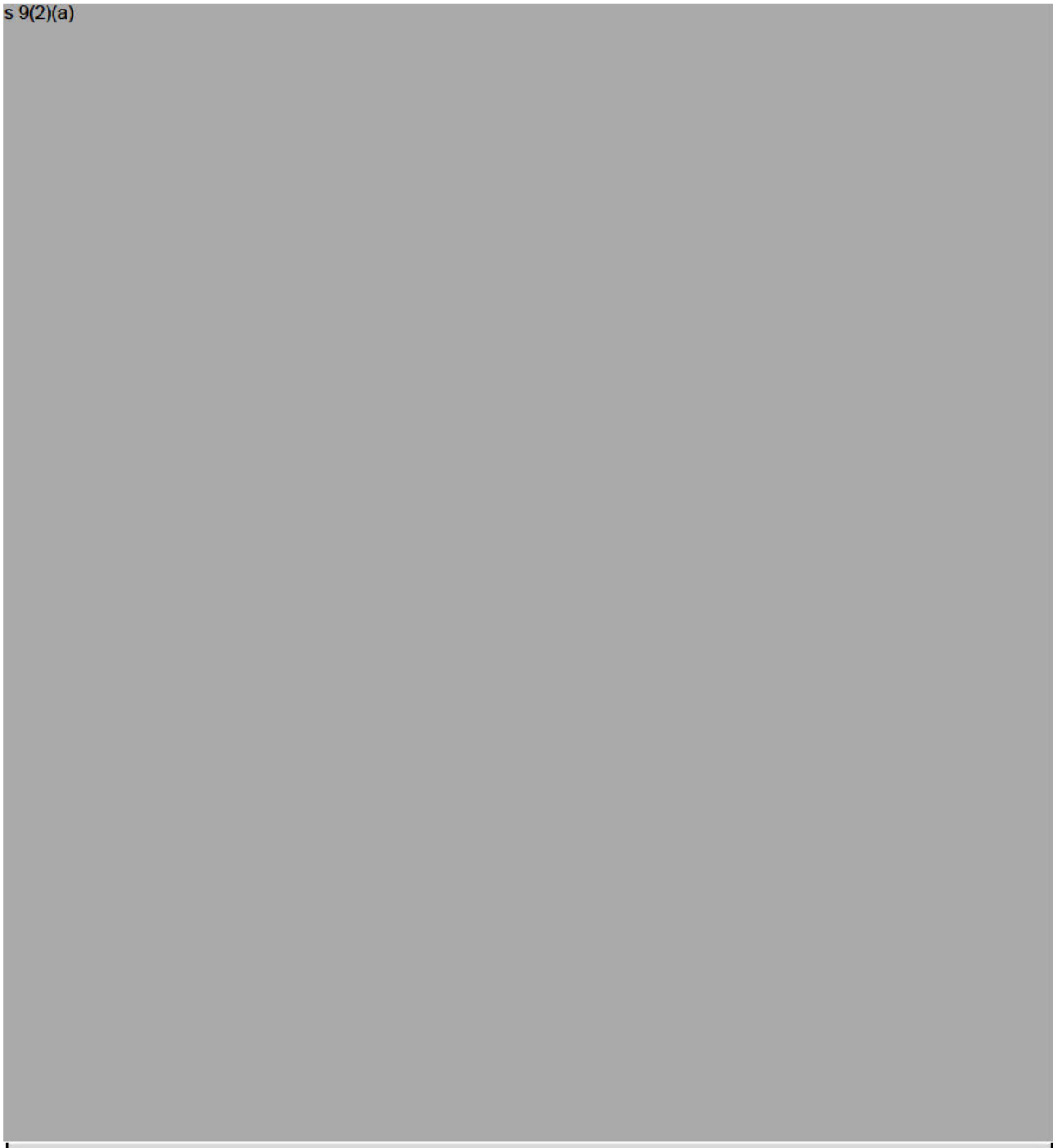
[4] Environment Canterbury Wells Database 2017. Canterbury Maps Advanced Map Viewer.

Table 2: Summary of key findings from historical aerial photographs

s 9(2)(a)



1940-1944 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

Image is poor quality and there appears to be no potential HAIL activities onsite between 1940 and 1944. There are several residential buildings present onsite along s 9(2)(a) . The centre of the Site appears to remain undeveloped. There is minor surrounding residential land development east of the Site and pastoral land use along the western bank of the Heathcote River.

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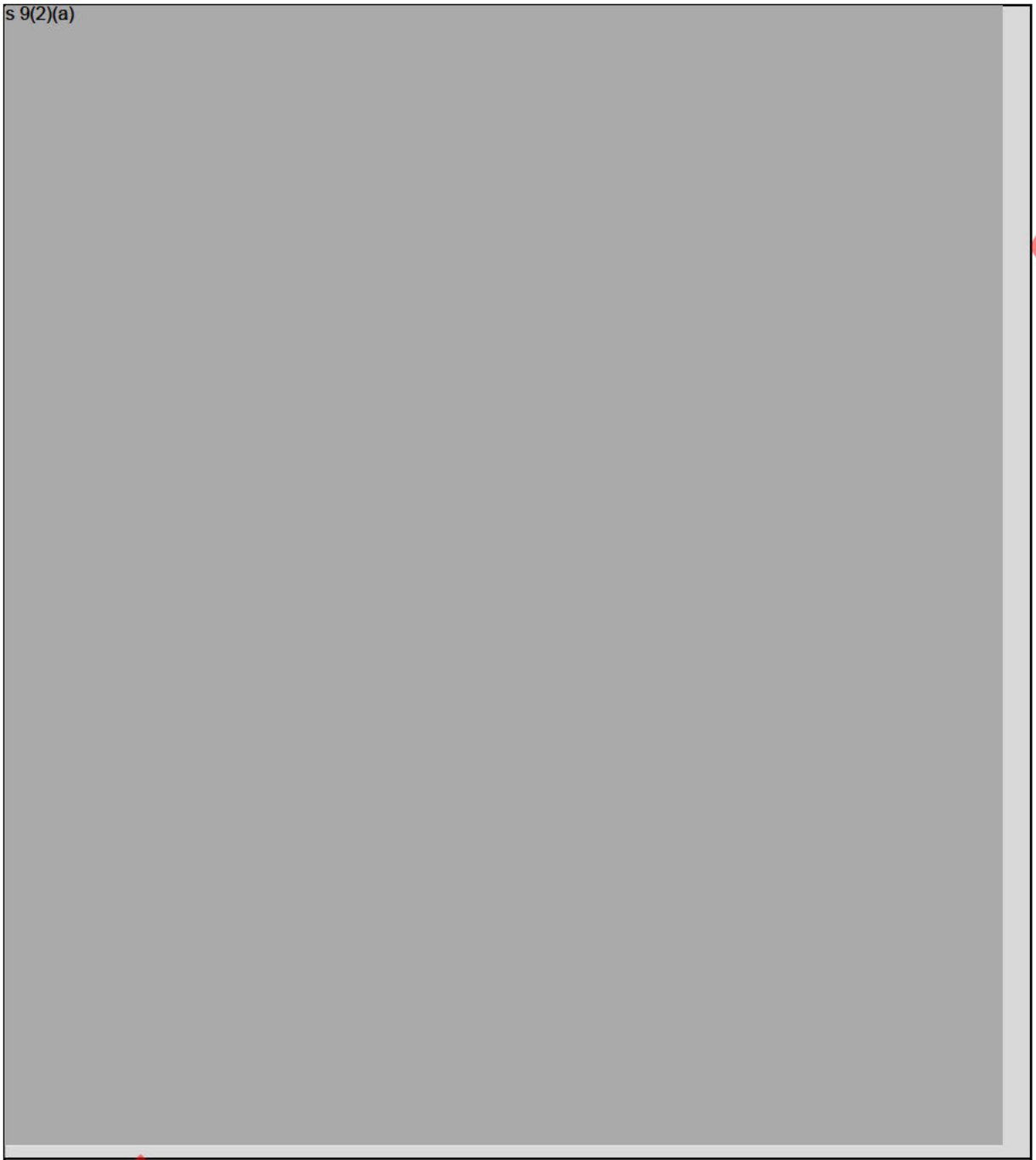

1955-1959 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

This aerial photograph shows that there has been an increase in residential development onsite and the surrounding area post 1940-1944. No potential HAIL activities have been identified onsite between 1955 and 1959. However, any soil disturbed onsite during the earthwork phase of the development may have been subjected to HAIL activities prior to the 1940s.

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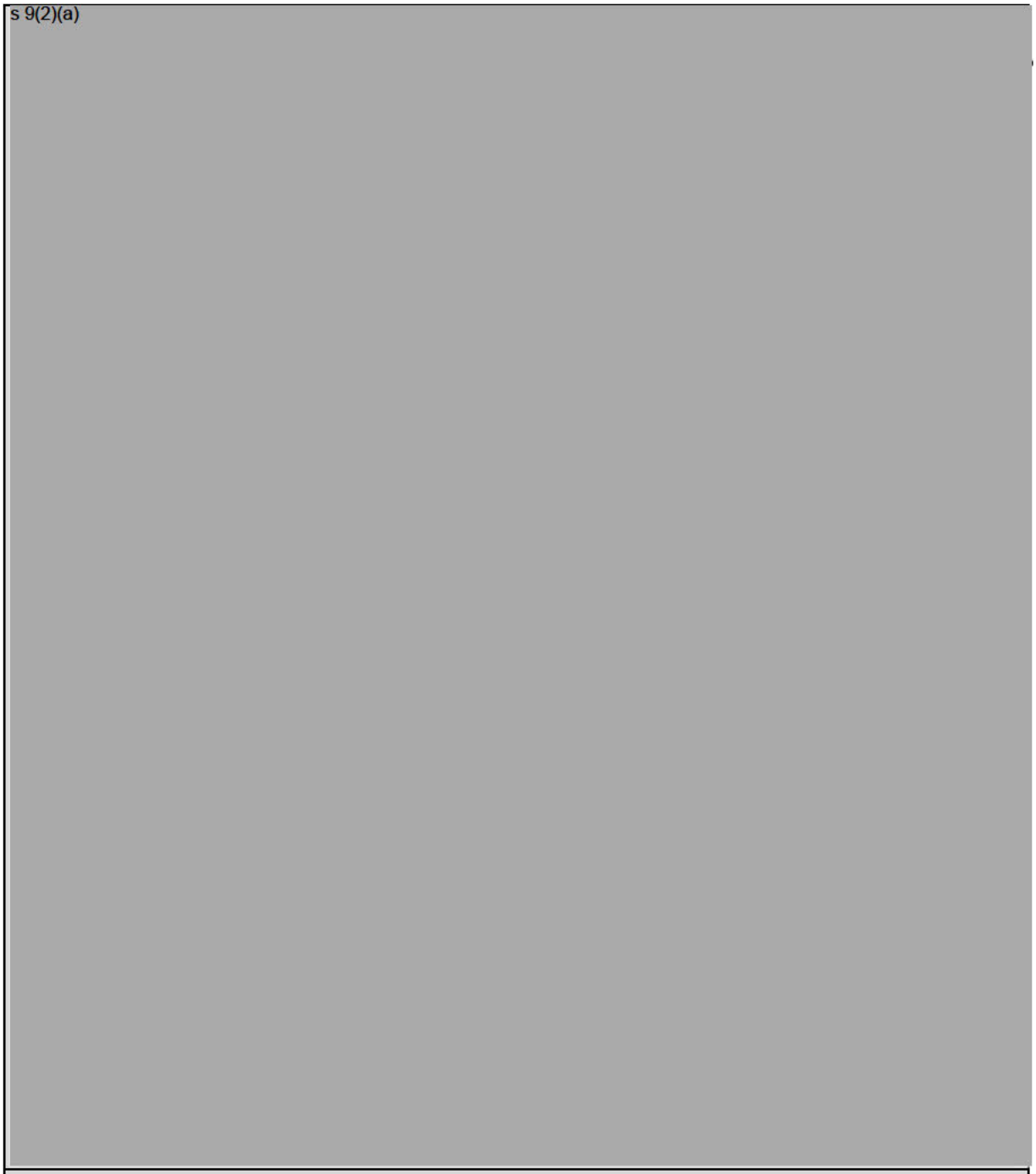
s 9(2)(a)



1965-1969 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

No potential HAIL activities have been identified onsite between 1965 and 1969. There have been minor development of existing properties along s 9(2)(a) **the western boundary of the Site post 1955-1959.**

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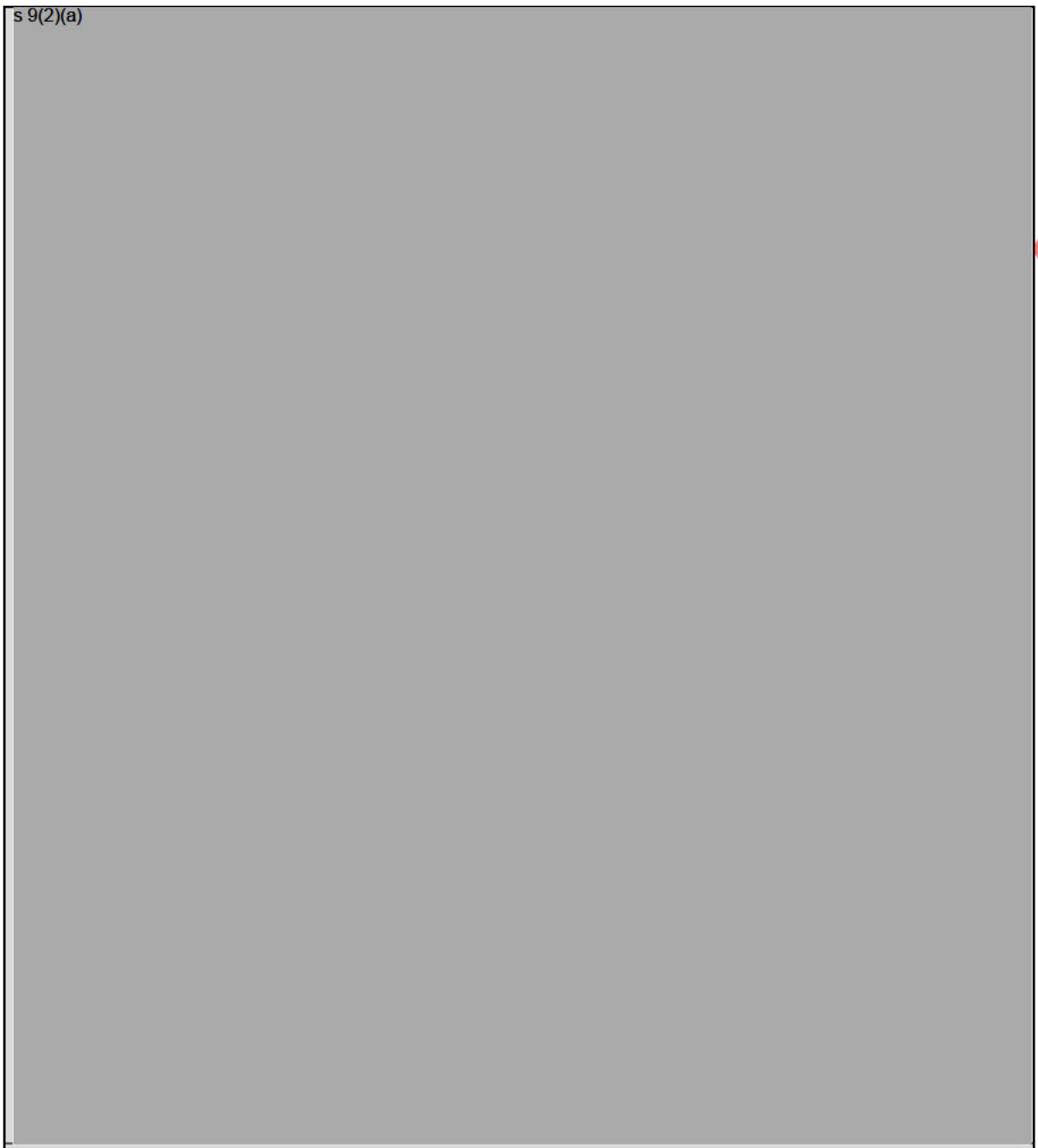
s 9(2)(a)



1970-1974 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

No potential HAIL activities have been identified onsite between 1970 and 1974. There appears to be minor land development onsite (properties at s 9(2)(a) post 1965-1969

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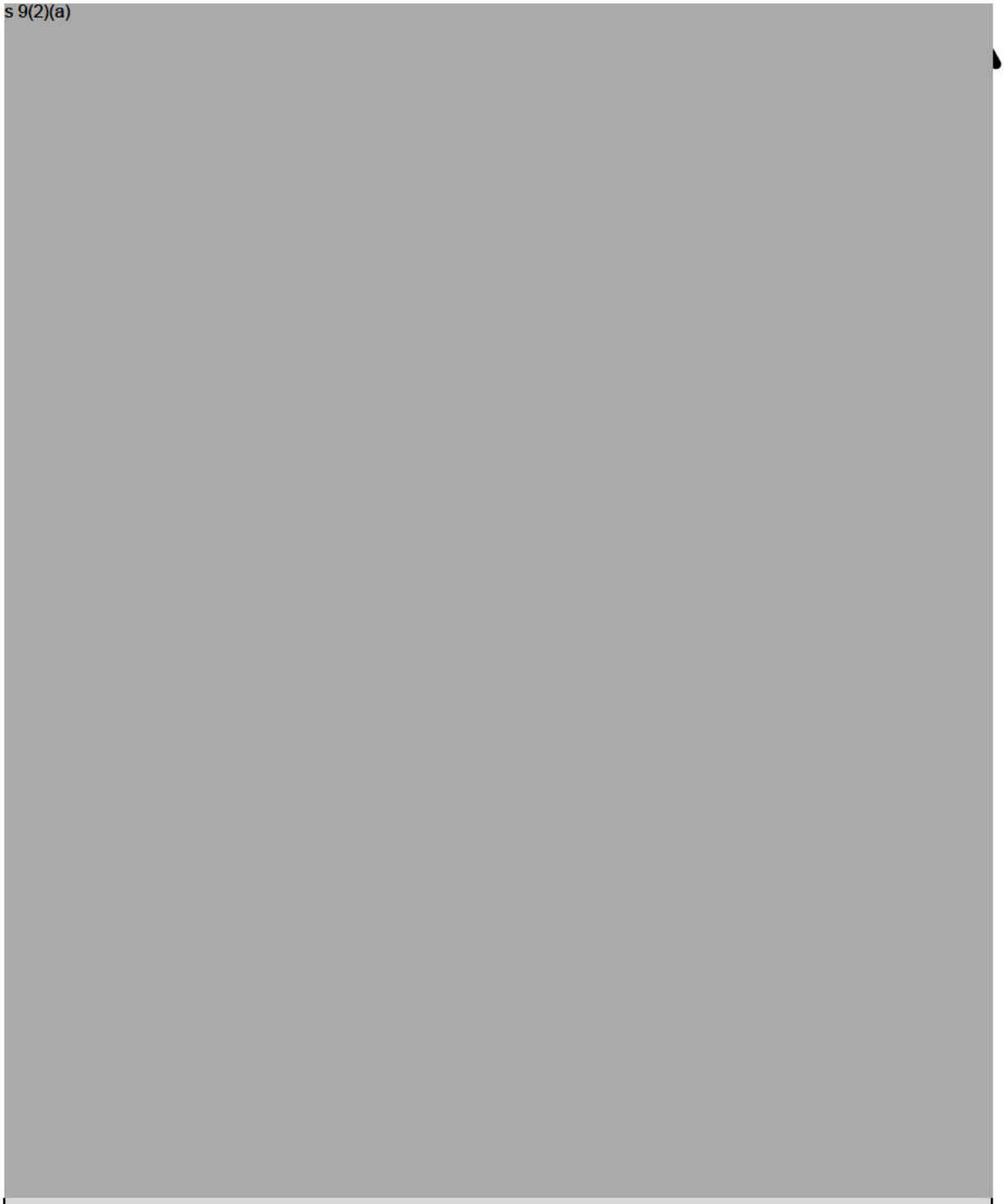
s 9(2)(a)



1980-1984 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

No potential HAIL activities have been identified onsite between 1980 and 1984. There appears to have been no further land development at the Site post 1970-1974.

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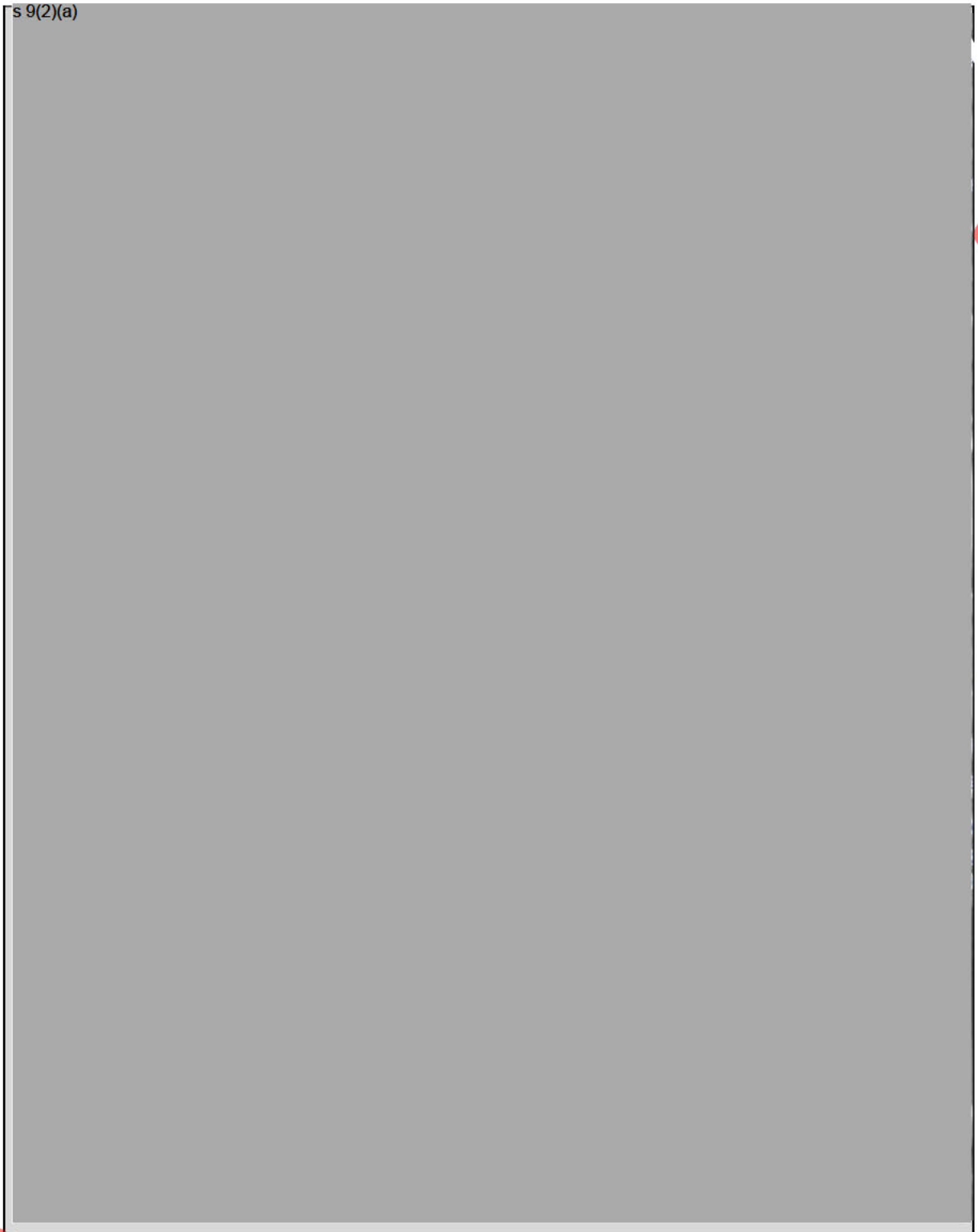
s 9(2)(a)



1990-1994 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

No potential HAIL activities have been identified onsite between 1990 and 1994. There appears to have been no further land development at the Site post 1980-1984.

Relea

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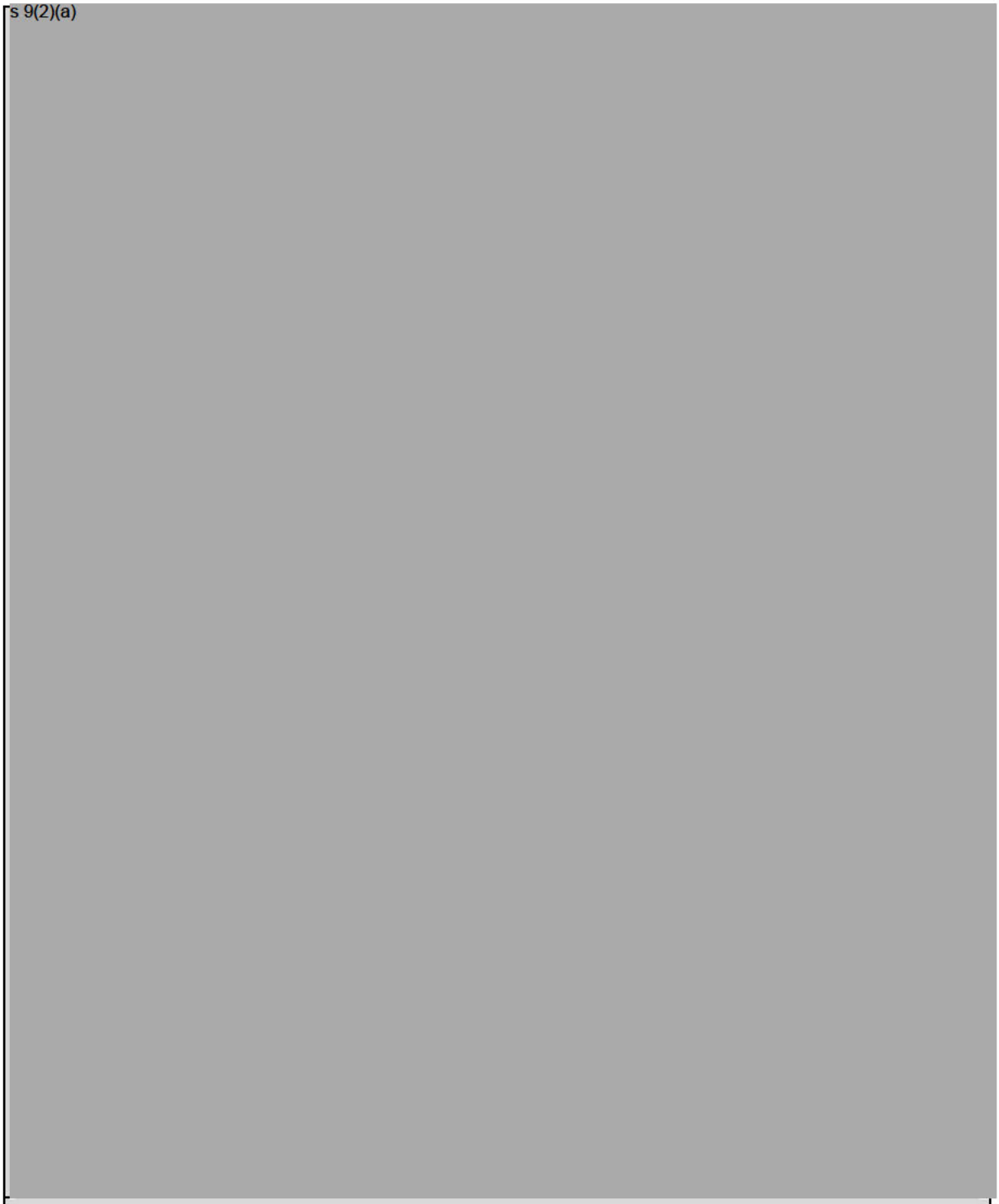
s 9(2)(a)



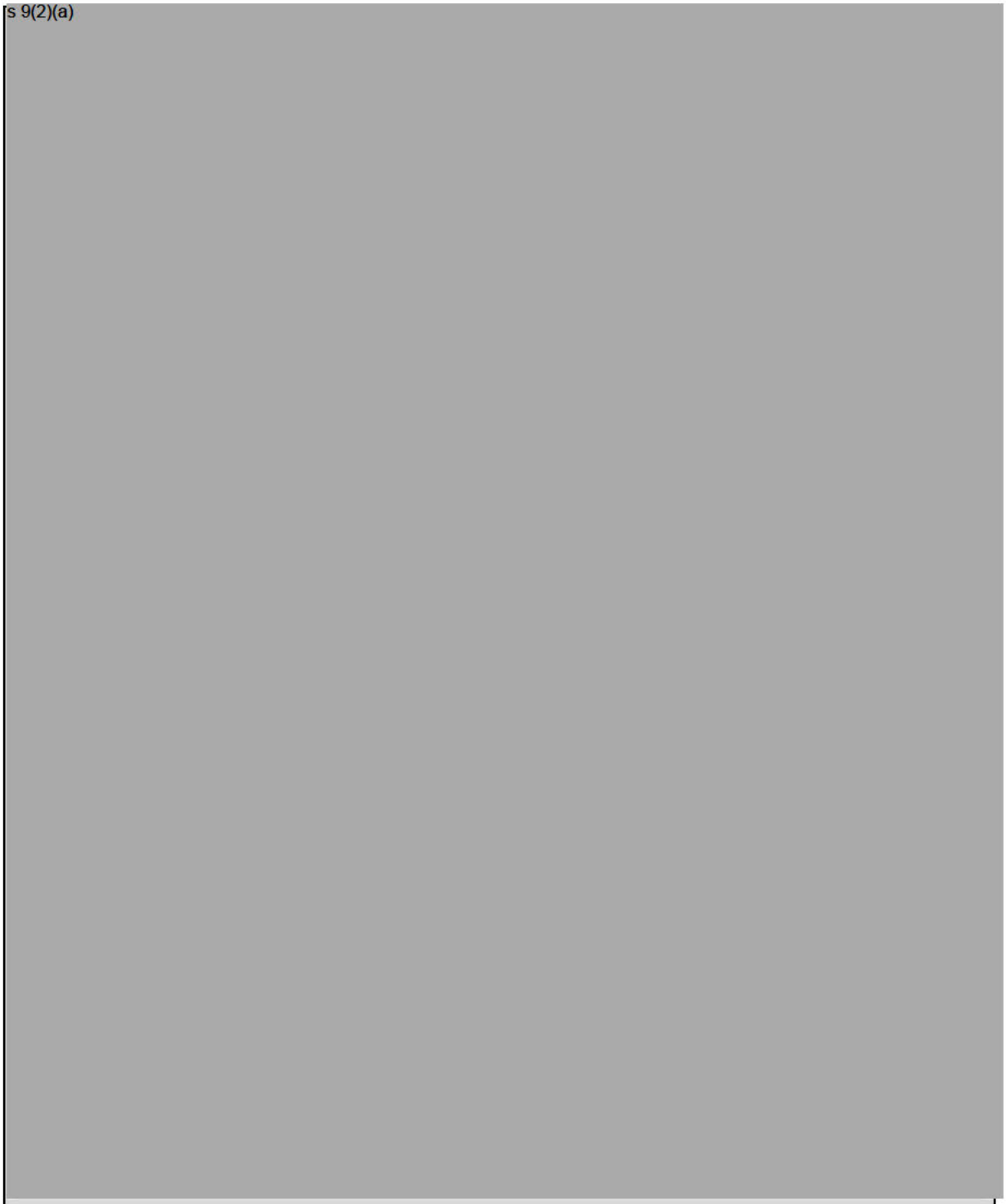
2000-2004 Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

No potential HAIL activities have been identified onsite between 2000 and 2004. No significant change in Site land use post 1990-1994.

Releas

2

s 9(2)(a)



2015-2017: Source: Canterbury Mapviewer (https://mapviewer.canterburymaps.govt.nz)

No potential HAIL activities have been identified onsite between 2015 and 2017. No significant change in Site land use post 2000-2004.

In summary, the site has been predominantly used for residential development since the 1940s. There has been no evidence of potential HAIL activities identified between 1940 and 2017. However, any soil disturbed onsite during earthwork phases of residential development, may have been subjected to potential HAIL activities prior to the 1940s.

Releas

2

2.3.2 Listed Land Use Register Information (LLUR)

Some of the properties under investigation are listed on the Environment Canterbury Listed Land Use Register (LLUR) which identifies properties that have had historic use that falls within the categories in the MfE's Hazardous Activities and Industries List (HAIL).

The following land uses from the HAIL were recorded on the LLUR to have occurred on the properties at the site:

- Uncontrolled fill

The relevant HAIL category relating to this site is as follows:

- G3 – Landfill Sites

The following properties are not currently listed on the LLUR:

- s 9(2)(a)
- [redacted]
- [redacted]
- [redacted]
- [redacted]

The remaining 15 properties are listed are listed on the LLUR under category 'G3 - Landfill Sites'.

2.3.3 Previous Investigations

INV103917 – s 9(2)(a) ***– LIM Hazard – 'Uncontrolled Fill' (Eliot Sinclair)***

A geotechnical investigation was undertaken at s 9(2)(a) in 1998 to assess the hazard posed to the foundations of an existing structure by the presence of uncontrolled fill as listed on the Land Information Memorandum (LIM). The uncontrolled filling inferred on the Council LIM was not identified. The buildings foundations were deemed suitable for the ground conditions.

INV109485 – Preliminary and Detailed Site Investigation Report, s 9(2)(a) ***(Cook Costello Ltd)***

An environmental PSI and DSI was undertaken at s 9(2)(a) in 2015. It was reported that a landfill likely operated at the site between 1900 and 1930 in the area. Shallow soil sampling within the upper 1 m at the site identified concentrations of arsenic, cadmium, lead, nickel and zinc which exceed the NESCS residential guideline criteria and was considered likely to pose a risk to human health and environmental receptors.

INV116002 – Soil Contamination Investigation Report, s 9(2)(a) ***(Tonkin & Taylor)***

A DSI was undertaken in 2015 to assess the risk posed to workers repairing the foundations of an earthquake damaged garage. Three locations were sampled by hand auger to a maximum depth of 1 mgbl. Six soil samples were submitted for analysis. Three of the soil samples submitted exceeded the NESCS commercial land use standards for either lead and/or benzo(a)pyrene (BaP) (eq). All exceedances were from samples collected from 0.4 mbgl or deeper.

Three of the samples analysed tested positive for asbestos.

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INV117351 – Environmental Soil Investigation, s 9(2)(a) ***, Christchurch (ENGEO)***

A DSI was undertaken in 2015 as the site was identified as a former landfill site. Soil testing showed that concentrations of arsenic, cadmium, lead and BaP were present that exceeded the NESCS criteria for a residential land use. Concentrations of lead and BaP also exceeded the NESCS criteria for a recreational and commercial/industrial land use. Due to the commercial/industrial exceedance, it was identified that a complete expose pathway exists between the impacted area of the site and the site redevelopment workers and end users. The material from 0.4 mbgl was deemed not suitable for disposal at either Burwood or Kate Valley Landfill.

INV125390 – Additional Soil Contamination Investigation Report, Drainage Repair Works, s 9(2)(a) ***(Tonkin & Taylor)***

A DSI was undertaken in 2016 after fill was discovered during drainage works. Four hand augers were advanced to a maximum depth of 1.2 mbgl with fill being noted in each location. Analytical testing of obtained soil samples showed that concentrations of heavy metals and polycyclic aromatic hydrocarbons (PAH) above the published background concentrations for the area. Lead within the sample obtained from 0.6 mbgl within “Hand Auger 1” contained concentrations of lead that exceeded the NESCS outdoor worker (unpaved) criteria and shallow samples contained concentrations of asbestos that exceeded the WorkSafe New Zealand criterion.

INV145729 – Soil Sampling Letter Report, s 9(2)(a)

A DSI was undertaken in the driveway close to s 9(2)(a) during 2016 to assess soil disposal options. Three test pits within the upper 0.4 m were dug and two samples submitted for analyses. Concentrations of lead were discovered to be above the Burwood landfill acceptance criteria.

INV28335 – Environmental Soil Investigation at s 9(2)(a) ***, Christchurch. D3464919 (ENGEO)***

A DSI was undertaken in 2013 as the site had been identified as being a historic landfill site. Four shallow surface samples (0.3 mbgl) were collected and submitted for analysis. Arsenic, lead, cadmium, zinc and BaP concentrations were recorded that exceed the NESCS residential criteria. Concentrations of arsenic and lead also exceeded the NESCS guideline criteria for the protection of commercial workers and the NESCS recreational guideline criteria.

INV91018 – Detailed Site Investigation, s 9(2)(a) ***, Christchurch (Coffey Geotechnics)***

A DSI was undertaken in 2015 to characterise the soil at the site due to known contamination on neighbouring properties. Arsenic, cadmium, chromium, copper, lead, nickel and BaP concentrations were reported above the selected NESCS guideline criteria for a residential land use.

INV98475 – Environmental Soil Investigation at s 9(2)(a) ***, Christchurch (D3423475) (ENGEO)***

A DSI was undertaken in 2014 to characterise soil contaminant concentrations as the site has been identified as historically being used for landfill purposes. Four samples were obtained from 0.3 to 1.9 mbgl and submitted for heavy metals and PAH analysis. Arsenic, cadmium, lead and BaP concentrations were reported that exceed the selected NESCS residential guideline criteria. Lead and BaP also exceeded the guideline criteria for the protection of commercial

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workers. A site management plan (SMP) was proposed to protect onsite workers during redevelopment works.

INV146128 – Validation Report for Works Completed at s 9(2)(a) Christchurch (ENGEO)

Concentrations of arsenic, cadmium, lead and BaP were known to be elevated at the site. During redevelopment works a site management plan was imposed and conditions were set out in consent s 9(2)(a). A total of 160 m^3 of soil was removed from site during works and disposed of at Burwood Landfill. No site wide characterisation or remediation of site soils was undertaken.

2016/2017 Environment Canterbury Investigation

In December 2016 and March 2017 Environment Canterbury (Environment Canterbury) undertook a shallow site wide investigation using hand auger methods with supporting analysis using an XRF machine to characterise concentrations of heavy metals within the upper 1m at a number of locations across each identified property. Concentrations or arsenic, chromium and lead were shown to exceed the NESCS residential guideline criteria at a number of sites.

Figure A shows locations that were analysed with exceedances of lead above the NESCS[5] guideline criteria for a residential land use with 10% produce use (NESCS residential) shown in red.

Whilst there is a swathe of red dots representing exceedances in a roughly north west to south east pattern which was thought to represent the area of filling, there are also a number of red dots which don't fit the pattern. Those at s 9(2)(a) are outside the general area of lead exceedances. It was suspected that these lead exceedances may be related to lead paint in the shallow soil. As the Environment Canterbury investigation only focussed on the shallow soil, further assessment could not be made. Therefore part of the purpose of the GHD 2018 investigation was to try and distinguish between shallow lead contamination caused as a result of historical lead paint use versus that from emplaced fill.

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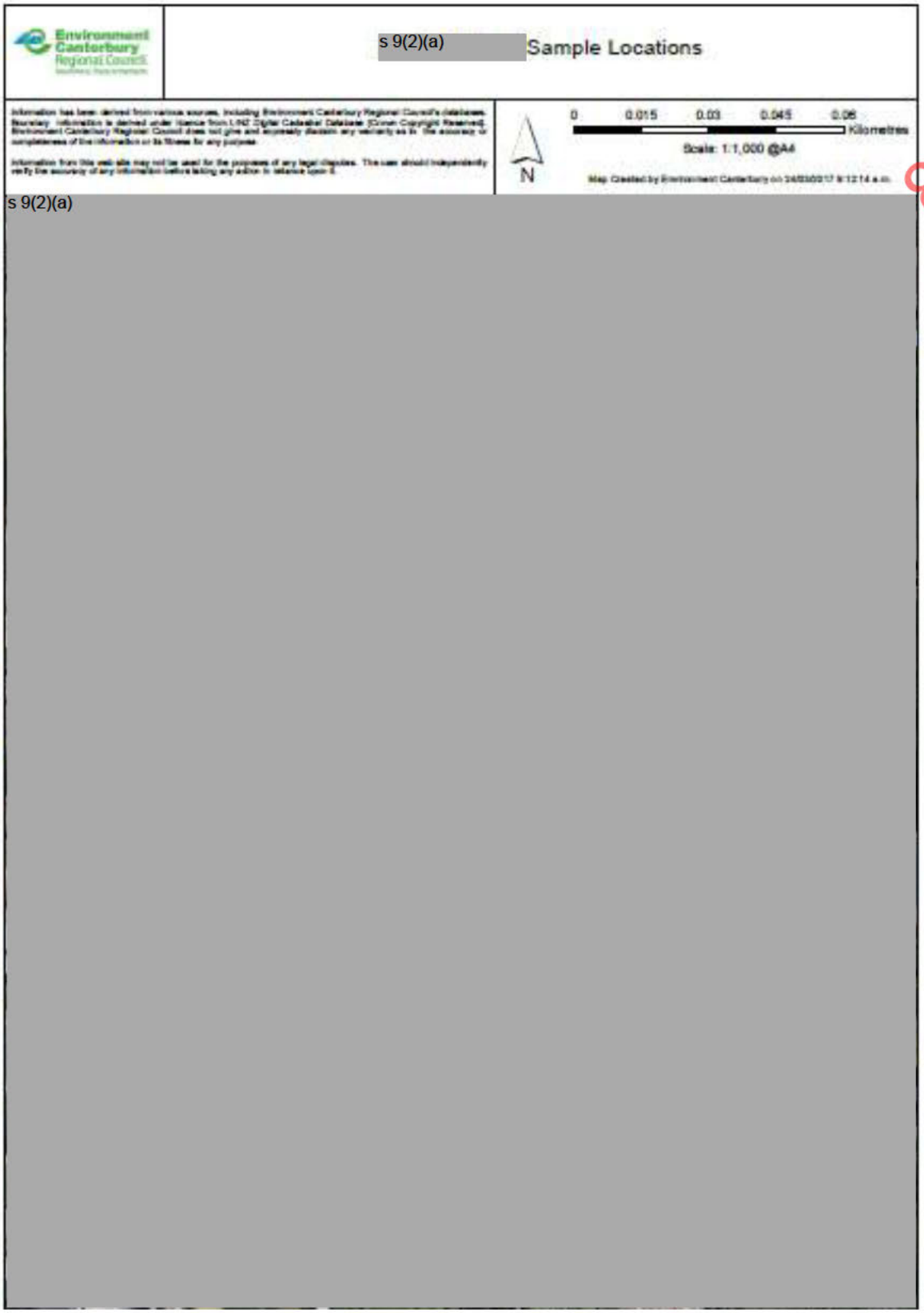
[5] National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (2012).

Figure A: Reproduction of Environment Canterbury Investigation Data



Locations which exceed the NESCS residential criteria of 210 mg/kg are shown in red, those below the NESCS are shown in blue.

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3. Initial Conceptual Site Model

3.1 Context

The project area covers a number of residential properties in the s 9(2)(a) area believed to be impacted by historical landfilling. A number of un-associated investigations have taken place on individual properties, mainly as a result of insurance works after the Canterbury Earthquakes in 2010/11 which identified fill material and exceedances of relevant human health guidelines. Investigations have stated that there is no historical aerial photography evidence of the landfilling activity.

Research indicates that the s 9(2)(a) operated on s 9(2)(a) in the early 20th Century, although on which part of s 9(2)(a) operations occurred is unclear. Anecdotal evidence was provided by an elderly local resident who remembered horse and carts travelling down s 9(2)(a) to dispose of waste from the old gas works at the site. The carts would then take away the sand and gravel from the site. It is considered likely that aggregate extraction has occurred across the project area and that subsequent filling was used to provide a future building platform. The wider area is known to have been affected by such activity. s 9(2)(a) to s 9(2)(a) was formerly a landfill and the nearby s 9(2)(a) was impacted and subsequently remediated under the MfE contaminated site remediation fund (CSRF) in 2014.

An initial conceptual site model (CSM) was considered prior to the 2018 investigation (displayed as Figure 5 within Annex A). The CSM brings together the known information on contaminant sources, receptors and the pathways which may link them. Where a source, pathway and receptor are present, a potential pollutant linkage is said to exist. If one of the components is missing, the linkage is incomplete. Those linkages that are considered potentially complete are defined at the end of the CSM.

The following sections discuss the initial CSM prior to the 2018 investigation.

3.2 Sources

The data obtained by Environment Canterbury in 2016/17, appears to indicate a source solely related with landfill materials. However many of the data points with lead and arsenic exceedances could be related to lead paint as the source, given that many of the exceedances are shallow and appear limited to the surface. In other areas, the presence of slag, brick, bone, ceramics etc. confirms the presence of filling. Anecdotal evidence provided by Environment Canterbury suggested that the fill material was easily distinguishable in the field.

The fill material is characterised by high lead and arsenic concentrations but additionally chromium, copper and zinc appear at high concentrations in the areas of fill material. Polycyclic aromatic hydrocarbon (PAH) analysis has been limited, but exceedances of human health criteria have been noted at several locations. The presence of slag would suggest that foundry waste may have been deposited in the fill material.

The fill material described in previous investigations showed no evidence of household waste or other putrescible waste likely to cause landfill gas. Consultants who have previously investigated individual properties have dismissed the likely presence of landfill gas due to the lack of a putrescible source.

Asbestos was found within soil samples obtained at both of the residential properties in the investigation area (s 9(2)(a)) where asbestos testing was undertaken. Asbestos was not tested during investigations at the other properties within the wider investigation area. As with the lead paint issue, care needs to be taken to understand the

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provenance of the asbestos – i.e. it is important to understand whether the asbestos is a result of the emplaced fill or rather it has come from the housing built after the fill was emplaced. The fill material and its characteristics are the key focus of the investigation rather than deteriorated material from current housing.

Information sourced from the Ministry of Business, Innovation and Employment (MBIE) indicates that prior to World War II asbestos in New Zealand was limited to imported manufactured items. Asbestos-cement based materials were produced since that time, with production in Christchurch commencing in 1943. As the fill material is thought to have been emplaced sometime prior to the 1940s it is considered that the likelihood of asbestos being present within the fill is low. However, as a precaution, limited asbestos testing within the fill across the project area was undertaken.

The primary contaminants of concern are displayed below.

3.2.1 Contaminants of Concern

Contaminants	Potential Source	Likelihood of Presence in Soil
Heavy metals (inc. CrVI)	Uncontrolled filling with industrial waste	High – Identified during previous investigations
Cyanide	Uncontrolled filling with industrial waste	Moderate – Fill known to consist of industrial waste. Anecdotal evidence of disposal from gas works.
Polycyclic Aromatic Hydrocarbons (PAH)	Uncontrolled filling with industrial waste	High – Identified during previous investigations
Asbestos	Uncontrolled filling with industrial waste	Low in emplaced waste, (but may be present in near surface shallow soil associated with deteriorated current building material)

3.3 Receptors

3.3.1 Residents

Site residents are the key receptor. Residents have garden areas and potential contact with soil. Given the number of properties there are likely to be a variety of age ranges including the elderly and young children. Pets should also be considered, e.g. dogs digging into impacted fill material.

3.3.2 Excavation Workers

It is reasonable to assume that below ground works will be required at some stage within the properties. Tasks involving utility placement or repair, building foundation work or any other works disturbing the soil may mean workers come into contact with impacted fill material.

3.3.3 Plant Uptake

The metals present in fill have the potential to be phytotoxic (poisonous to plants) and to be absorbed into plant material. Vegetable gardens may be susceptible to metal uptake.

3.3.4 Groundwater/Surface Water

According to the Canterbury Maps GIS there are no groundwater abstraction wells present in the project area. The area is not in a Community Drinking Water Protection Zone, with the closest zone being s 9(2)(a) . Although groundwater is not used, the shallow aquifer is still likely to be considered as a sensitive receptor. The area lies within s 9(2)(a)

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s 9(2)(a) of the project area and should also be considered a receptor.

3.4 Pathways Connecting Sources to Receptors

We have summarised potentially complete pollutant linkages and those discounted in Table 3: and in the initial CSM, Figure 5 of Annex A.

Table 3: Pollutant Linkages

Source	Pathway	Receptor
Fill – Metals, PAHs	Soil Ingestion/Dermal Contact	Residents/Excavation Workers/Pets
Previous investigations indicate that the fill material may be shallow and there is therefore potential for the residents to come into contact with the contaminated material. This may be through gardening, children playing in impacted dirt, pets digging into impacted areas or excavation workers digging into impacted areas. Previous sampling has indicated exceedances of human health guidelines in shallow soil and therefore this linkage is considered to be potentially complete.		
Fill – Volatile Vapours	Inhalation of landfill gas/volatile vapours	Residents/Excavation Workers/Pets
Previous investigations have found no evidence of putrescible waste or of volatile vapours during sampling. Sampling undertaken to date is spatially limited so the presence of vapours cannot entirely be ruled out, though it is considered unlikely. This is not believed to be a complete pollutant linkage as there appears to be no vapour source, however it was proposed to undertake field vapour screening during the investigation as a precaution.		
Fill - Asbestos	Inhalation of asbestos fibres	Residents/Excavation Workers/Pets
Asbestos has been found during previous site investigations in the soil. There is uncertainty as to the source of the asbestos, whether it be related to the fill, related to the houses built on the site or a combination of the two. This project is focused on the fill material risk and until proven otherwise there is potential for the fill to contain asbestos materials. It is believed that this is unlikely as the date of fill emplacement is earlier than the period of asbestos manufacture and use in New Zealand, however there is potential for this pathway to be potentially complete.		
Fill – Metals	Plant/Vegetable Uptake	Residents
Concentrations of metals are present in the shallow soil at concentrations which exceed human health guidelines including those which include a proportion of produce growth and consumption. The extent of the issue is unknown therefore this is considered to be a potentially complete pathway.		
Fill - Metals	Contact with fill material - phytotoxicity	Plants
The presence of elevated phytotoxic metal concentrations in the soil has the potential to damage plants and cause vegetation die-back. No evidence of vegetation die-back has been noted in historical investigations, however this is considered to be a potentially complete pathway.		
Fill – Metals, PAHs	Leaching of metals and saturation of organic contamination in fill	Groundwater
Contaminants in the fill have the potential to leach to groundwater beneath the project area. The historical investigations undertaken have not included any testing to assess the leachability of the soil. The pathway is potentially complete, however shallow groundwater is not used in the area of the study. Residents are unlikely to come into contact with groundwater. Leachability testing of the fill will be undertaken however given the focus of the investigation on human health impacts to residents we have not considered assessing the groundwater quality itself as part of this assessment.		
Fill – Metals, PAHs	Groundwater flow	Heathcote River
Groundwater may act as a pathway for leachable contaminants associated with the fill to enter the Heathcote River to s 9(2)(a) of the project area. This pathway has not been proven, as leachability and groundwater testing has not been undertaken to date. It is considered that this pathway may be potentially complete, however, given the focus of the investigation on human health impacts to residents, this pathway (including surface water sampling) has not been considered further.		

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4. Scope of Works

4.1 Preliminary Tasks

4.1.1 Site inspection

The site inspection included a walk over to identify areas of potential contamination based on observation of surface conditions and evidence of current or former potentially contaminating activities or site operations. Specifically the site inspection included the following tasks:

- Document site infrastructure and key site features
- Identify evidence of potential contamination including discolouration or staining on the ground surface, disturbed or affected vegetation or notable odours
- Identify surface water on or adjacent to the site (if any)
- Identify surrounding land uses

The site was identified as consisting of residential properties with a variety of associated gardens and vegetation, swimming pools, garages and greenhouses.

No discolouration or staining to the ground surface or vegetation dieback was noted during the site.

s 9(2)(a) .

Neighbouring land use was identified as being primarily residential with the nearest park (s 9(2)(a)) being located approximately s 9(2)(a) of the southern site boundary. No commercial activities were identified.

4.1.2 Utility Scanning

Utility scanning was undertaken by Underground Service Locators Limited on the 19th of December 2017. A cable avoidance tool (CAT) and ground penetrating radar (GPR) was used to confirm the path of onsite underground services at each property. Suspected service pipes and cables were identified and the sampling locations were selected to avoid these services.

4.2 Intrusive Locations

Each sampling location was given a unique identifier to allow fast and clear identification of samples taken. Each location is identified by its street number followed by the sampling method used and the depth that the sample was obtained from. For example (41_WNS_0.1) indicates that the sample was obtained from number s 9(2)(a) using a window sampler at a depth of 0.1 mbgl.

4.3 Summary of Locations

This section provides a summary of the overall sampling and monitoring locations for the DSI followed by a rationale for each one. The sampling has been split as follows:

- 27 shallow hand augers to supplement existing data or fill data gaps
- 10 bores drilled by window sampling methods in less accessible areas
- 13 bores drilled by a Power Probe restricted access drilling rig

Samples locations were selected to confirm areas of contamination identified by the previous investigations and to delineate the presence of fill beneath the Site. Sample locations were also

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selected to provide spatial coverage in areas that had previously not been investigated. A map of the sampling locations is shown as Figure 2 of Annex A.

4.4 Hand Augering

4.4.1 Methodology

A hand auger was used to drive a small core barrel into the soil in order to obtain shallow surface samples to a maximum depth of 2 mbgl. As no monitoring wells were installed during works; the hand auger bores were backfilled with soil arisings before reinstatement of each location using the removed topsoil to return the surface to its original condition.

4.5 Window Sampling

4.5.1 Drilling Methodology

A petrol powered window sampler was used to drive a small core barrel into the soil. Extensions were added to the core barrel allowing the target depth to be reached. This was designed to be a maximum of 5m or until the base of fill had been penetrated and natural ground reached.

As no monitoring wells were installed during works; bores were backfilled with soil arisings. Reinstatement of each location was undertaken using the removed topsoil to return the surface to its original condition.

4.6 Drilling

4.6.1 Drilling Methodology

A drilling rig was used to advance the drill holes in this area to a depth of between 4 and 4.8 mbgl. As no wells were installed during works; bores were backfilled with soil arisings. Reinstatement of each location was undertaken using the removed topsoil to return the surface to its original condition.

4.7 Sample Collection

The soil sampling was undertaken by GHD Environmental Scientists between the 8th of January and the 27th of February at a variety of depths to characterise the soil conditions. Soils were sampled directly from the core into sample jars using clean nitrile gloves and trowels, with cleaning between samples as discussed in Section 4.8.

Samples were submitted to IANZ accredited Analytica Laboratories, for analysis of pH, heavy metals, cyanide, polycyclic aromatic hydrocarbons (PAH) and asbestos.

4.8 Quality Assurance / Quality Control

Quality samples were collected during the soil sampling works. Duplicate sample sets were collected to check for laboratory precision, with rinsates and trip blanks to check for cross contamination and contamination during transport.

The following methodology was put in place in order to prevent cross contamination between the soil samples taken at the site. The drill pieces and hand tools used were decontaminated between locations using deionised water. The HDPE sleeves utilised for sampling with the drill rig and window sampler were replaced between each sample location. The soil was sampled with fresh nitrile gloves for each sample collection and placed into pre-labelled laboratory supplied containers for analysis submission.

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5. Field Observations and Field Data

5.1 Ground Conditions and Geology

The site geology predominantly consisted of a thin layer of top soil underlain by silt, silty sands, and sandy gravels.

Fill material consisted of industrial slag, glass, metal, wood and ceramics. Fill thickness varied across the site from not being present to a maximum identified thickness of 3.4 m at s 9(2) .

Images 1-6 display the typical ground conditions encountered during site works.

Image 1 – Natural Soil Condition

Image 2 – Fill Material

Image 3 – Foundry slag within fill material

Image 4 – Metal fragments within fill material

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Image 5 – Natural soil / fill interface

Image 6 – Shallow fill material

Location and thickness of identified historical fill is displayed below in Table 4 and on Figure 6 of Annex A. Graphical cross sections of fill thickness across the site is presented in Figures 7, 8 and 9 within Annex A and borelogs of all sample locations are presented within Annex D.

Table 4: Fill Thickness by Property

Number	Street	Sample	Fill (depth in m)	Notes
s 9(2)(a)				

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s 9(2)(a) [redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
HA – Hand Auger *WS – Window Sample* *BH – Borehole*				

The emplaced historical fill was observed at 15 sampling locations covering 11 properties (refer to Figure 6). Fill was thickest in the vicinity of s 9(2)(a) [redacted] and thinned towards s 9(2)(a) [redacted]. The main area of fill appears to lie in a north west / south east orientation between s 9(2)(a) [redacted]. The following paragraphs should be read in conjunction with Figure 6.

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5.1.1 Northern Extent

To the north, the fill thins to 1.3m thick at s 9(2)(a) and down to 0.4m thick beneath s 9(2)(a). Fill was not observed in s 9(2)(a). In the eastern half of the site the fill was observed at s 9(2)(a), but not at s 9(2)(a) to the north of it. The fill found to the northwest at s 9(2)(a) would suggest there may be some impacts crossing the western edge of s 9(2)(a)

5.1.2 Western Extent

The western edge of the filling has been identified in an approximate north-south direction with the boundary between filling and non-filling area cutting through s 9(2)(a), where the back gardens contain fill, but the front gardens close to the river contained no fill. s 9(2)(a) contained no fill in either back or front garden locations, however the adjacent s 9(2)(a) to the east contained evidence of fill, suggesting the fill boundary lies close to the eastern edge of s 9(2)(a).

5.1.3 Eastern Extent

To the east there are similar divides between the front and rear of properties. The front gardens of s 9(2)(a) had no observed fill, whilst fill was identified in the back gardens. To the south east the fill boundary could not be determined as fill was encountered at the front (eastern) gardens of both s 9(2)(a).

5.1.4 Southern Extent

To the south, no fill was found at s 9(2)(a). No fill was found by GHD at s 9(however, previous testing by Eliot Sinclair Ltd has identified fill on the northern site boundary in the vicinity of the driveway. Fill was encountered in s 9(2)(a) and the fill boundary is likely to run in a south easterly direction cutting throughout s 9(2)(a). No access was granted to the properties to the south of s 9(2)(a) so the south eastern extent remains unclear.

5.2 Visual Indicators of Contamination

Visual indication of contamination was in the form of fill material (brick, glass, metal and ceramics) and industrial slag. This was present at the locations noted in Table 4.

At s 9(2)(a) contamination was noted between 2.0-3.0 m bgl in the form of a substance with an oily smell and black discolouration. This was not encountered at any other locations in the project area.

5.3 Gas Monitoring Results

5.3.1 Field Headspace Testing

Headspace testing of soil was undertaken throughout works using a photo ionisation detector (PID). Readings were typically below 5 parts per million (PPM). The highest reading was a peak 21.9 ppm taken from sample 231_BH_1.2 which quickly dissipated. Whilst slightly higher than background concentrations, given the depth of reading this is not considered to present an issue.

For full field headspace testing results, please refer to Table A within Annex E.

A lower explosive limit (LEL) gas detector was carried throughout field works. No indication of concentrations of gases above the warning levels of 1% (methane), 0.5% (carbon dioxide) or less than 19.5% (oxygen) was identified during works.

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Overall, the results support the conclusions from previous investigations that there is no evidence of widespread gas/vapours associated with a putrescible waste source.

5.3.2 Groundwater Depth

Groundwater was encountered within the boreholes and window samples at depths that ranged between 0.8 (231_WNS) and 3.9 (233_BH) mgbl. As no piezometers were installed during site works, piezometric contours are unable to be defined. It is expected that shallow groundwater flows westward to the Heathcote River based upon site topography.

Please refer to Table B within Annex E for depths to groundwater.

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6. Soil Sampling Results

6.1 Selection of Guideline Criteria

6.1.1 Metals

The NESCS[6] sets national standards for contaminants in soil to protect human health. It contains a set of soil contaminant standards for 12 priority contaminants for five standard land use scenarios. This includes land on which any activity in the HAIL has occurred. The principal land use category selected for this investigation was 'residential with 10% produce use'. This is based on the exposure of residents to near-surface soil during routine maintenance and gardening activities with low level produce production for personal use. The recreational land use criteria soil contaminant standards (SCS) have been selected as this is the acceptance criteria adopted by Burwood Landfill should the fill be removed from site.

The SCS for the residential land-use scenario are to be used for comparison with the site data.

The intention of the NESCS is to determine whether the land is suitable for its proposed end use when considering prescribed contaminant standards.

In the absence of New Zealand risk based human health criteria for certain contaminants of concern, the Australian National Environment Protection Measure 2013 (NEPM) guidelines[7] have been adopted for this investigation. Contaminants included from the NEPM guidelines are nickel, zinc and beryllium.

The NEPM covers a range of land uses. For the purposes of this assessment, the NEPM Health-based Investigation Levels (Residential A) has been selected based on the land use and site attributes, to best represent likely exposure pathways.

The MfE Class A land fill acceptance criteria[8] has been selected for metal comparison has been selected as this is the acceptance criteria adopted by Kate Valley Landfill should the fill be removed from site and metal concentrations be above the Burwood Landfill acceptance criteria.

The Canterbury Regional Background Soil Concentrations (CRBSC)[9] for a recent earth type have been selected as guidance on the average regional concentrations for the natural soil type identified onsite.

6.1.2 Cyanide

The MfE guidelines for assessing and managing contaminated gasworks sites[10] has been selected as the guideline criteria for cyanide. Values have been obtained from Table 4.2.7.3 (Residential 10% produce home grown) to give a conservative measure for the protection of human health.

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[6] Ministry for the Environment, 2012. Users Guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment

[7] National Environment Protection (Assessment of Site Contamination) Measure. 2013. Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater.

8 The Ministry for the Environment Landfill Waste Acceptance Criteria. Module 2 – Hazardous Waste Guidelines : Landfill waste acceptance criteria and landfill classification

9 Background Concentrations of Trace Elements in the Major Soil Groups of the Canterbury Region, Jarred Pettersson, Vinvent Salomon, Helen Davis.

[10] The Ministry for the Environment Guidelines for assessing and managing contaminated gasworks sites in New Zealand (1997)

6.1.3 Hydrocarbons

The Oil Industry Guidelines[11] (OIG) provide nationally consistent risk based criteria for the assessment of risks from petroleum based contaminants found in typical fuel products (petrol and diesel) to human health and the environment. The OIG can be applied to a range of land uses, environmental settings, and exposure pathways including groundwater.

The guidelines include a range of "generic" land uses to support the development of "tier one" risk based criteria for soil and groundwater quality.

The guidelines selected for this assessment relating to PAH are based upon a residential land use setting for a sand and sandy silt based matrix.

6.1.4 Asbestos

As only asbestos presence / absence analysis was performed, no guideline values have been selected for comparison.

6.1.5 SPLP testing

Leachability testing was undertaken using laboratory SPLP testing. This test is designed to mimic the effects of leaching on the material in question, in this case the emplaced fill material. It was undertaken on selected soil samples identified as having elevated concentrations of heavy metals above the recreational guideline criteria. The ANZECC 2000[12] guideline criteria for the protection of 90% of fresh water species was used to assess the potential impacts on surface water.

6.2 Analytical Results

For full analytical results, refer to the tables presented within Annex F. Laboratory transcripts are presented within Annex G.

6.2.1 Metal

Arsenic

Samples collected from nine of the 20 properties contained concentrations of arsenic that exceeded the NESCS residential criteria of 20 mg/kg. The distribution of exceedances is shown on Figure 10 within Annex A. These properties were s 9(2)(a) .

s 9(2)(a) also exceeded the NESCS recreational guideline criteria of 80 mg/kg.

The highest concentration recorded was 187 mg/kg obtained from the borehole at s 9(2)(a) from a depth of 2.4 mbgl.

All the exceedances are coincident with areas of observed historical fill with depths ranging from near surface 0.1m to 4.2m.

Beryllium

No concentrations of beryllium exceeded the selected guideline criteria.

[11] Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand – Tier 1 soil Screening Criteria

[12] Australia and New Zealand Guidelines for Fresh and Marine Water Quality, 2000

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Boron

No concentrations of boron exceeded the selected guideline criteria.

Cadmium

Samples collected from seven of the 20 properties contained concentrations of cadmium that exceeded the NESCS residential guideline criteria of 3 mg/kg. The distribution of exceedances is shown on Figure 11 within Annex A. These properties were s 9(2)(a)

The highest concentration recorded was 14.1 mg/kg obtained from the borehole at s 9(2)(a) from a depth of 2.4 mbgl. All the exceedances are coincident with areas of observed historical fill.

Chromium

No concentrations of chromium exceeded the selected guideline criteria.

Chromium VI

No concentrations of chromium VI exceeded the selected guideline criteria.

Copper

No concentrations of copper exceeded the selected guideline criteria.

Lead

Samples collected from 14 of the 20 properties contained concentrations of lead that exceeded the NESCS residential guideline criteria of 210 mg/kg. Lead is the most prevalent of the contaminants present in the fill material. The distribution of exceedances is shown on Figure 12 within Annex A. The properties with exceedances of lead criteria s 9(2)(a) .

s 9(2)(a) also exceeded the NESCS recreational guideline criteria of 880 mg/kg.

Many of the properties have concentrations in excess of 5,000 mg/kg – s 9(2)(a) were in excess of 10,000 mg/kg. The highest concentration recorded was 16,500 mg/kg obtained from the window sample at s 9(2)(a) from a depth of 3.5 mbgl.

Of note is that the lead exceedances at s 9(2)(a) and the samples from the western halves of s 9(2)(a) were not coincident with observed fill material. This is discussed further in Section 7.

Mercury

No concentrations of mercury exceeded the selected guideline criteria.

Nickel

Samples collected from 3 of the 20 properties contained concentrations of nickel that exceeded the NEPM Residential 'A' guideline criteria of 400 mg/kg. The distribution of exceedances is shown on Figure 13 within Annex A. These properties were s 9(2)(a)

The highest concentration recorded was 8,980 mg/kg obtained from the window sample at s rom a depth of 3.5 mbgl. All the exceedances are coincident with areas of 9(2) observed historical fill.

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Zinc

Samples collected from 2 of the 20 properties contained concentrations of zinc that exceeded the NEPM Residential 'A' guideline criteria of 8,000 mg/kg. The distribution of exceedances is shown on Figure 14 within Annex A. These properties were s 9(2)(a)

The highest concentration recorded was 11,700 mg/kg obtained from the borehole at s 9(2) om a depth of 2.4 mbgl. Both exceedances are coincident with areas of observed historical fill.

6.2.2 Asbestos

Asbestos analysis was undertaken for presence / absence only. White crystalline asbestos fibres were detected within a single sample within the fill material obtained from the borehole at s 9(2)(a) at a depth of 3.5 mbgl. A shallower sample from 0.4m and a deeper sample from 4.7m at the same location did not detect asbestos fibres.

The remaining sixteen samples analysed did not detect the presence of asbestos fibres.

The asbestos therefore appears to be a small isolated amount buried within the fill at depth in a single location, well below the surface.

6.2.3 Cyanide

No concentrations of cyanide exceeded the selected guideline criteria.

6.2.4 PAH

Naphthalene

No concentrations of naphthalene exceeded the selected guideline criteria.

Pyrene

No concentrations of pyrene exceeded the selected guideline criteria.

Benzo(a)pyrene (BaP)

Samples collected from nine of the 20 properties contained concentrations of BaP that exceeded the NESCS residential guideline criteria of 10 mg/kg. These properties were s 9(2)(a)

s 9(2)(a) also exceeded the NESCS recreational guideline criteria of 40 mg/kg.

The highest concentration recorded was 150.58 mg/kg obtained from the borehole at s 9(2) rom a depth of 1.2 mbgl. The distribution of exceedances is shown on Figure 15 within Annex A. All the exceedances are coincident with areas of observed historical fill.

6.2.5 Soil pH

Soil pH was measured in 11 samples. Soil pH was found to be typically neutral around pH7 and varied between a slightly acidic pH 6.1 and pH 7.4.

6.2.6 SPLP

A total of 17 samples were selected to undergo leachability testing using the SPLP (Synthetic Precipitation Leaching Procedure) method. This simulates the effects of normal weathering on the fill material and provides a concentration in liquid. The samples were chosen based on high metal results in the initial soil samples.

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As we are concerned with groundwater as a potential pathway to the nearby Heathcote River, we have considered concentrations against ANZECC 90th percentile water quality guidelines. There will be notable dilution upon entering the river and the guidelines specify that reasonable mixing should be included. As a result, the potential exceedances of the ANZECC criteria provide a very conservative approach in this instance. A more detailed assessment focused on surface water risks would be required to understand this further. The numbers presented are therefore designed to act as a guide for further investigation.

Of the 17 samples tested, all contained concentrations of leachate which would exceed the ANZECC guidelines. The contaminants which exceeded the guidelines were consistently cadmium, copper, lead and zinc, with one nickel exceedance.

Table 5: SPLP Exceedances

Analyte	ANZECC 90%ile (mg/L)	Range of Site Exceedances (mg/L)
Cadmium	0.0004	0.0005 to 0.0017
Copper	0.0018	0.03 to 0.15
Lead	0.0056	0.0114 to 0.5126
Zinc	0.013	0.10 to 0.53
Nickel	0.015	0.015

6.2.7 Summary of Exceedances

Exceedances of NESCS residential criteria are provided in the table below.

Table 6: Exceedances of NESCS Soil Residential Criteria

s 9(2)(a)	Arsenic	Cadmium	Lead	BAP	Nickel	Zinc
		x	x	x		
			x			
	x	x	x	x		x
	x		x			
	x		x	x		
	x		x	x		
	x	x	x	x	x	
	x	x	x			
			X			
	x		x	x		
			x			
			X			
			X			
			x			
			x			
	x	x	x	x		
			x			
	x	x	x	x	x	
			x			

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s 9(2)(a)						
			x			
			x			
			x			
			x			
	x	x	x			
	x	x	x		x	
	x	x	x			x
	x		x			
	x	x	x	x		
	x		x			
	x		x	x		

The data collected shows contamination closely matches the presence of historical fill material. Chemically the fill is characterised by high lead concentrations, typically associated with cadmium, arsenic and BaP and occasionally associated with isolated nickel and zinc hot spots. There are some differences towards the edges of the project area where there are isolated, lower level lead exceedances, without the associated other metals or BaP (e.g. s 9(2)(a)). These are likely to be a result of a secondary source, most likely lead based paint from house painting.

Leachability testing indicates that the fill material is leaching to groundwater and potentially may be transported to surface water via groundwater flow. Further investigation would be required to understand actual concentrations in groundwater, groundwater flow direction, gradient and concentrations in the river.

6.3 Quality Assurance /Quality Control

Twelve duplicate sample sets were taken during site works.

The relative percentile differential (RPD) varied from 0% to 53.71%. This is likely due to the heterogeneous nature of the soil tested and the small fraction of soil taken from the laboratory during analysis of the heavy metals. GHD considers that the analytical results are acceptable for the purposes of this report.

The Trip and Rinsate Blank detected trace concentrations of some metals within the same order of magnitude as the detection limits for each element. Further discussion with the laboratory indicated that during the deionisation process very low concentrations of elements can persist. Laboratories regularly test batches of deionised water and elements have been proven to persist after treatment due to the degradation of filter membrane from multiple treatment cycles. Therefore, it is considered likely that the elements were present within the supplied deionised water and does not indicate that cross contamination occurred onsite or during sample transit.

For full quality assurance and control results refer to the tables provided within Annex F.

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7. Revised Conceptual Site Model

An updated conceptual site model is presented as Figure 16 within Annex A. Contaminant sources, pathways and receptors are detailed below.

7.1 Sources

7.1.1 Emplaced historical fill

Fill was identified at 11 of the 20 properties investigated during the January 2018 DSI. These properties are identified on Figure 17 of Annex A. Properties with identified fill at each sampling location are shaded as red, properties with partial fill material are shaded orange and properties with no identified fill material are shaded green.

The thickest area of fill (up to 3.4 m) was identified within the window sample taken at s 9(. Neighbouring samples locations at s 9(2)(a) also showed fill thickness in all sample locations of greater than 2 m. A central band of fill runs through these properties with the top of the fill being identified within 0.1 m in most sample locations.

At properties s 9(2)(a) , Fill was identified at one sample location only indicating variance across the properties. At s 9(2)(a) , Fill was identified within two locations at the rear of the property with no fill identified at the front of the property. All of these properties adjoin the properties within the central band of fill that runs through the site.

Consistency with Previous Sampling

s 9(2)(a) - Results confirm the Environment Canterbury testing in 2017 and the Cook Costello Ltd 2015 report which reported high concentrations of arsenic, lead, nickel and zinc above the NESCS residential guideline criteria. All four samples appeared to encounter fill, whereas the GHD sample location WS_17 did not encounter fill material. This would appear to indicate there may be isolated pockets where fill is not present or it becomes patchy towards the edge of the historical filling area.

s 9(2)(a) – Results confirm the Environment Canterbury testing in 2017 and the ENGEO 2014 report which reported high concentrations of arsenic, lead, nickel, zinc and BaP above the NESCS residential guideline criteria within fill material.

s 9(2)(a) – Results confirm the Environment Canterbury testing in 2017 and the Coffey 2015 report which reported high concentrations of arsenic, lead, nickel and BaP above the NESCS residential guideline criteria within fill material. This report also identifies with concentrations of chromium which were not found by the subsequent Environment Canterbury and GHD investigations. The Coffey 2015 investigation shows exceedances in the front (eastern) yard of the property. The GHD sample location in the front yard was further east and close to the eastern edge of the property. This would suggest that the filling is present under the house at this location with the edge of filling ceasing close to the road.

s 9(2)(a) – Results confirm the Environment Canterbury testing in 2017 and the ENGEO 2015 report which reported high concentrations of arsenic, lead and BaP. There is a clear distinction from fill being present to the rear of the property but not in the front of the property.

s 9(2)(a) - Results confirm the Environment Canterbury testing in 2017 and the Tonkin and Taylor 2015 report which reported high concentrations of arsenic, cadmium, lead and BaP

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above the NESCS residential guideline criteria. The Tonkin and Taylor sampling was only in the back yard of the property, no samples from the front were collected.

s 9(2)(a) - Results confirm the Environment Canterbury testing in 2017 and the ENGEO 2013 report which reported high concentrations of arsenic, cadmium, lead, zinc and BaP above the NESCS residential guideline criteria. Fill material was noted within the logs taken during sampling. The samples collected were composited into a single sample for analysis so the exact location of the exceedances is unknown.

s 9(2)(a) – The Environment Canterbury testing in 2017 reported concentrations of lead above the NESCS residential guideline criteria. No other analytes were found to be above the NESCS during the Environment Canterbury sampling. Further investigation by GHD in 2018 did not identify any fill material at this site and analytical testing reported that all analytes were below guideline criteria. This would suggest that the lead encountered during the Environment Canterbury sampling is likely related to a non-fill source, e.g. leaded paint.

s 9(2)(a) – An Eliot Sinclair investigation in 2016 concerned the removal of 100 mm of buried topsoil from under the existing driveway of the property near the garage. Three test pits were excavated to 400 mm and soil composited into a single sample. Analysis found lead at a concentration of 990 mg/kg and exceeds the NES Soil Criteria for residential use. These combined samples were collected from the eastern end of the property. The GHD samples from the western end of the property found no evidence of fill and chemical analysis showed compliant concentrations. This property has therefore been shaded as orange on Figure 17, to reflect that fill was only present on parts of the property, not all of it.

For the most majority of sampling locations, concentrations of contaminants that exceed the selected guideline criteria coincide with the properties that have displayed shallow fill. The highest elevations of the primary contaminants identified that exceed guideline criteria (arsenic, cadmium, lead and BaP) strongly co relate with the fill material encountered at each sample location.

Where the fill has been shown o end at depth, the concentrations of contaminants have sharply decreased within the natural soil to acceptable concentrations.

7.1.2 Other sources

At s 9(2)(a), high concentrations of lead in surface samples were reported during the 2017 Environment Canterbury investigation. Further sampling by analysis by GHD in 2018 did not identify he presence of any fill material and all analytes were below the relevant guideline criteria. As lead was the only analyte identified in elevated concentrations, and due to the shallow location of identified contamination, it is believed that this source is not the fill material typical at other properties across the site. Lead paint was typically used within New Zealand prior to 1965 and it is deemed likely that this is potentially the source of shallow contamination identified during the Environment Canterbury investigation.

Isolated but lower level lead exceedances that are not associated with other contaminants were also encountered by GHD at s 9(2)(a)
9

At s 9(2)(a), no visual evidence of the fill was encountered during sampling and analysis indicated lead exceedances only. Nonetheless, there are lead exceedances at shallow depths on the property at three separate locations. Given its location, it is suspected that s 9(2) may be close to the edge of the former fill edge and the lead exceedances may be related to some overspill of impacted material at the fill edges.

At s 9(2)(a), there is one isolated lead exceedance. Two additional locations located either side of the exceedance had NES-compliant concentrations. There was no evidence of fill

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during the works and the exceedance lies close to a fence. Lead paint from the fence may be the source of the exceedance.

At s 9(2)(a) , there is one isolated lead exceedance. Similar to s 9(2)(a) , the other two locations contain NES-compliant concentrations. The location at s 9(2)(a) also backs onto the same fence at s 9(2)(a) Paint from the fence or remnants from the demolition and removal of a previous dwelling may be the source of the lead contamination.

s 9(2)(a) contains the largest number of sample points. At the front (west) of the property, lead exceedances were found at two shallow locations s 9(2)(a) with other locations in the same area containing compliant concentrations s 9(2)(a)). These exceedances are close to the fence line and given the lack of other contaminants and the relatively lower levels compared to those typically seen in the historical fill; it is thought likely that the fence paint may be the source of the impacts.

Towards the centre of the property, locations at s 9(2)(a) found concentrations of lead which exceeded the NES criteria. This was coincident with some shallow modern fill material which anecdotal evidence indicates is related to the lifting of the dwelling for flood protection. This fill has quite different characteristics to the historical fill. No other contaminants of concern exceeded the criteria. It is likely the exceedances are related to this more modern fill as opposed to the historical fill material.

At the rear of the property both the window sample s 9(2)(a) contained visual evidence of the historical fill material prevalent across other properties. This was confirmed by the laboratory results.

s 9(2)(a) therefore has a more complex mixture of contamination sources, with identified historical fill at the rear of the property and some isolated impacts from modern fill at the south side of the house and lead exceedances close to the fence line at the front of the property.

7.2 Receptors

7.2.1 Residents

As fill material has been shown to be present at shallow depths across a number of properties, Site residents are the key receptor. Residents have garden areas and the likelihood of contact with contamina ed soil is high. Given the number of properties, there are likely to be a variety of age ranges ncluding the elderly and young children. Pets are also considered as being at risk of expose to contaminated soil, e.g. dogs digging into impacted fill material.

7.2.2 Excavation Workers

It is reasonable to assume that below ground works will be required at some stage within the properties. Tasks involving utility placement or repair, building foundation work or any other works disturbing the soil will mean workers come into contact with impacted fill material at the properties identified as having fill material.

7.2.3 Plant Uptake & Plant Damage

The metals present in fill have the potential to be absorbed into plant material and at higher concentrations to be phytotoxic (poisonous to plants). Vegetable gardens may be susceptible to metal uptake.

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Ecological soil guideline values have been proposed by Landcare Research[13]. These are designed to be protective of both plant and animal life. They are designed to be used as a guide in areas such as contaminated land management, but not as absolute thresholds. Exceedances of SGVs are meant to point the assessor to potential further investigation. We have not undertaken a full risk assessment in relation to plant and animal impacts, but rather used the Eco-SGVs to indicate whether there is likely to be issues for plant growth.

The concentrations of the principal contaminants in the fill material (e.g. lead, arsenic, cadmium, BaP) would exceed the ecological SGVs and therefore pose a potential risk to plants in garden areas with impacted fill material. There are many factors to consider, such as type of plant, the depth of plant roots and the exact location of fill material in growing areas, however the potential for plant damage is considered to be plausible given the high concentrations of metals recorded in the subsurface.

7.2.4 Groundwater/Surface Water

According to the Canterbury Maps GIS there are no shallow groundwater abstraction wells present in the project area. The three active groundwater wells are drilled into a deeper confined aquifer at a depth greater than 40 mbgl. The area is not in a Community Drinking Water Protection Zone, with the closest zone being 1km east. Although groundwater is not used within the project area, the shallow aquifer is still likely to be considered as a sensitive receptor by the regulator.

s 9(2)(a)

7.3 Pathways

7.3.1 Dermal Contact and Ingestion

Fill material present in soil has the potential to come into contact with residents and pets in garden areas (e.g. via gardening activities, pets digging or children playing and ingesting soil). Excavation workers also have the potential for contact and ingestion with impacted fill material, if appropriate precautions are not undertaken. Ingestion is also possible through consumption of vegetables grown in impacted areas.

7.3.2 Vapour Inhalation

Monitoring for volatiles with a PID and LEL during site works did not identify any areas with high concentrations of vapour or gas.

There is no evidence to suggest that waste is present which is likely to give rise to landfill gas (or other volatile vapours) beneath the project area. No landfill gas/vapour monitoring points are considered necessary. As a result, vapour issues have not been considered further in the risk assessment.

7.3.3 Leachability and Groundwater Flow

As the fill material is likely saturated in places, leaching of metals to groundwater is likely to have occurred. Groundwater may act as a contaminant transport mechanism (as well as being a receptor). There are no known abstraction wells in the area, s 9(2)(a)

[13] Development of soil guideline values for the protection of ecological receptors (Eco-SGVs): Technical document Envirolink Tools Grant: C09X1402, Landcare Research, June 2016

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s 9(2)(a)

Leachability testing confirmed that the fill material is likely to leach into groundwater. All 17 samples tested from areas of fill found concentrations of leachate containing cadmium, copper, lead and zinc which would exceed ANZECC surface water quality guidelines.

7.4 Risk Assessment

The following table summarises the exposure pathways which are considered to be potentially complete and those which have been ruled out. For a complete exposure pathway there must be a source, pathway and receptor.

Table 7: Risk Assessment

Source	Pathway	Receptor
Fill – Metals, PAHs	Soil Ingestion/Dermal Contact	Residents/Excavation Workers/Pets
The investigation has shown that the fill material is shallow and there is therefore potential for the residents to come into contact with the contaminated material. This may be through gardening, children playing in impacted dirt, pets digging into impacted areas or excavation workers digging into impacted areas. Sampling has indicated exceedances of human health standards in shallow soil and therefore this linkage is considered to be potentially complete.		
Fill - Asbestos	Inhalation of asbestos fibres	Residents/Excavation Workers/Pets
Asbestos was found during the site investigation at one location within fill material at 3.5m. Sixteen others samples did not detect asbestos. The presence of asbestos fibres does not necessarily constitute a human health risk, as the initial testing was a presence/absence test and quantitative analysis would be required to understand the actual concentrations of asbestos fibres. Due to the depth of the asbestos at 3.5m, with shallower asbestos-free samples above it, residents and pets are not considered at risk. It is unlikely that workers undertaking excavation activities (e.g. utility pipe works) would need to reach such a depth so we consider it unlikely this exposure pathway would be realised.		
Fill – Metals	Plant/Vegetable Uptake	Residents
Concentrations of metals are present in the shallow soil at concentrations which exceed the NESCS human health standards. The NESCS include a proportion of produce growth and consumption. This is therefore a potentially complete pathway, as there is shallow contaminated fill material in some properties, with vegetable growing occurring.		
Fill - Metals	Contact with fill material - phytotoxicity	Plants
The presence of elevated metal concentrations in the soil has the potential to damage plants and cause vegetation die-back. No evidence of vegetation die-back has been noted in historical investigations or in the GHD 2018 investigation, however given the concentrations measured in the soil we consider this a potentially complete pathway.		
Fill – Metals, PAHs	Leaching of metals and saturation of organic contamination in fill	Groundwater
Contaminants in the fill have the potential to leach to groundwater beneath the project area. The historical investigations undertaken have not included any testing to assess the leachability of the soil. SPLP testing was undertaken on 17 samples and confirmed that leachate contained elevated levels of cadmium, copper, lead and zinc. The pathway is potentially complete, however shallow groundwater is not used in the area of the study. Residents are unlikely to come into contact with groundwater.		
Fill – Metals, PAHs	Groundwater flow	Heathcote River
Groundwater may act as a pathway for leachable contaminants associated with the fill to enter the Heathcote River s 9(2)(a) Leachability testing indicated that metals are likely to		

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be leaching to groundwater and hence has the potential to reach nearby surface water courses.

We consider that this pathway may be potentially complete, however, further work would be required to understand the hydrogeology and transport mechanisms to the river. This was not part of the scope of this investigation.

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8. Conclusions and Recommendations

8.1 Conclusions

8.1.1 Extent of Fill Material

The area of the site upon which fill was emplaced has been further delineated. Ten of the properties investigated were identified as being impacted by fill material.

A summary of fill conditions is outlined below:

- Depth to fill has shown to be typically within 0.1 m from the surface at all impacted sites.
- Four properties were identified as having fill within all sample locations. These properties were s 9(2)(a) .
- Seven properties were identified as being partially impacted by fill material. These properties were s 9(2)(a)
- At the remaining seven properties, historical fill material was not identified during GHD sampling. These properties were s 9(2)(a) However, at s 9(2)(a) historical fill was identified during sampling by Eliot Sinclair Ltd in 2016 which contained lead contamination.
- Although no historical fill material was noted, shallow lead contamination was noted at three locations at s 9(2)(a)
- The identified thickness of ill varies from 0.5 to 3.4 m. Fill is likely to thin at the edge of emplacement and may be thicker within areas in the vicinity of s 9(2)(a) , where the thickest fill was found.
- The fill contains metal including industrial slag, glass, metal, wood and ceramics. No decomposing vegetation or putrescible waste was identified during site works.
- Vapour monitoring during site works did not identify any locations with high vapour or gas concentrations. The highest reading recorded with a PID was 21.9 ppm taken from sample 231_BH_1.2.

The fill extent is unknown at the following locations:

- The properties to the south and southwest of s 9(2)(a) – access was not granted by property owners.
- To the east of s 9(2)(a) – the easternmost samples at the front of these properties encountered fill. The extent of fill beyond the housing and into the roadside berm is unknown.

8.1.2 Nature of Contamination

Contaminant concentrations were shown to be highest within samples taken within the fill material and these sharply decreased when the natural material at the base of the fill was reached. A summary of contaminant findings is as follows:

Metals

Concentrations of heavy metals were shown to be present in concentrations above the selected guideline criteria at 14 of the 20 properties investigated. The majority of these exceedances are

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coincident with the fill profile that runs in a north west to south east pattern across the area. However, but some properties have isolated metal concentration exceedances that are unrelated to fill material.

Asbestos

Asbestos was identified within one sample at s 9(2)(a) at a depth of 3.5 mbgl. Due to the depth of this sample, there is no identified risk posed to residents from asbestos. If deep excavation were to occur in the future, management procedures would need to be implemented to ensure the safety of excavation workers, however it is unlikely works would extend to 3.5m.

Cyanide

Detected cyanide concentrations were many orders of magnitude below guideline criteria. Therefore, cyanide is not considered to pose a risk to residents or works on the investigated properties.

Polycyclic Aromatic Hydrocarbons

BaP was shown to exceed guideline criteria at nine of the properties investigated. All BaP concentrations that exceed guideline criteria were located within the fill material. Concentrations of naphthalene and pyrene were below guideline criteria within all samples analysed.

Leachability

Leachability testing of samples from the fill found that copper, cadmium, lead and zinc were leaching from the samples at concentrations which exceeded ANZECC guidelines.

8.2 Risks to Human Health

The primary identified risk is via direct soil ingestion, dermal contact with fill material and ingestion of produce grown in impacted areas.

The investigation has shown that the fill material contains elevated concentrations of metals and BaP and as it is located at a shallow depth at properties across across the site, the potential for residents, pets and onsite workers to come into contact with the contaminated material is considered high. This may be through gardening, children playing in impacted dirt, pets digging into impacted areas or excavation workers digging into impacted areas. At several locations, sampling has indicated the concentrations of metals and BaP are many times in excess of the NESCS human health guidelines for a residential property.

As asbestos was positively identified by the laboratory in one location and with sixteen negative samples it is not deemed a typical contaminant associated with the fill material. Given the depth of the one sample at 3.5 m it is not considered to present a risk to human health as exposure is unlikely.

Concentrations of metals and BaP are present in the shallow soil in which plants and vegetables are grown. Concentrations of contaminants exceed the NESCS human health guidelines for residential sites which include a proportion of produce growth and consumption. Therefore there is a risk posed to human health by the ingestion of produce grown at all investigated sites with the exception of s 9(2)(a) where the fill was found to be absent and acceptable concentrations were recorded.

8.3 Risks to the Environment

The results indicate that soil concentrations in areas where the fill has been observed contain concentrations of metals which may affect plant health. As discussed in Section 8.1.1 there are

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also properties containing lead contamination not associated with the historical fill. Metals at high concentrations may be phytotoxic, i.e. poisonous to plants, and plants may exhibit stunted growth or not grow at all. This is highly species dependent and is subject to a number of factors; however the concentrations measured are typically in excess of ecological soil guideline values and suggest that this is a valid risk.

Leachability testing found that the fill material is likely to be leaching certain metals to groundwater. This has the potential to migrate and reach surface water, although this will be subject to attenuation processes and dilution in the receptor. The risk to human health was the focus of this investigation and further work would be required to fully understand the risk to surface water.

8.4 Mitigation of Impacts and Potential Remedial Actions

The scope of this investigation was not to provide a full remedial options study, but to provide general guidance on the types of remediation that may be considered. We have considered three options to mitigate the impact of the contaminated fill material and remediate the impacted properties to a safe level.

8.4.1 Option 1: Full Source Removal

Source removal would involve excavation of the entire fill material, both vertically and laterally from beneath each of the impacted properties. The benefits of this solution are that it fully removes the source, provides some certainty around the residual risk (if any) and reduces the future risk in areas of soil access. However, this is considered impractical as a number of houses would need to be physically removed in order to excavate all of the source material and has not been considered further.

8.4.2 Option 2: Targeted Source Removal

Partial source removal by the excavation of the shallow soil of properties in accessible areas and backfilling with clean topsoil and marker layer/bidim would allow existing structures to remain in place.

The benefits of this solution are that it removes the source to a depth where contact during routine activities will be unlikely. The marker layer would be laid at the base of the cleanfill material to provide visual warning that the remaining impacted fill layer is underneath. This option provides some certainty around the residual risk and reduces the future risk in areas of soil access.

This remedial option would allow the growth of vegetables in designated areas without the need for raised garden beds.

The implications of this mitigation option is that the fill material will be difficult to remove and cause significant disruption to residents. There is currently no engineering access to some back gardens and fences and planted gardens would require removal. This likely would mean some access agreements would need to be made between neighbours. Affected residents may be required to (or wish) relocate during remediation works. Management processes would need to be implemented on affected sites to protect personnel performing deeper excavations in the future.

Many residents are unlikely to be open to this option due to sentimental association with features of their properties and some gardens may have undergone decades of development. However others may welcome the opportunity to have the material removed and redesign their garden. As a result, individual property discussions are recommended.

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8.4.3 Indicative Disposal Costs

Environment Canterbury requested some preliminary information regarding potential costs of impacted soil disposal. At this stage only indicative costs around transport and disposal have been considered, a full remedial options study and costings would be required to more accurately understand costs.

Preliminary discussion with soil contractors has indicated a minimum rate for disposal (transport and landfill fees) is in the order of s 9(2)(b)(i) per tonne of *treated* material. The material would require pre-treatment by a specialist contractor, as the current concentrations are higher than the acceptance criteria for the regional landfill at Kate Valley. There would be additional costs to be considered including (but not limited to) excavation, pre-treatment, costs of clean backfill material, laboratory fees, validation sampling, consenting and reporting.

In estimating the transport and disposal costs for treated soil, we have looked at some potential scenarios, with a summary provided in Table 8:

1. Full fill removal across all properties - Based on conservative estimates of contaminated fill volume (averaged identified fill thickness across site area) for red sites and half this value across orange sites (as shown on Figure 17) an estimated volume of 24,000 m^3 of impacted material was reached. Assuming a bulk density of x 2.0 (due to the high metallic content) this equates to approximately 48,000 tonnes. Excluding the cost of pre-treatment prior to disposal at Kate Valley Landfill, full source removal would incur disposal costs in excess of s 9(2)(b)(i) NZD.
2. Full removal of all impacted areas to a depth of 1m – similar to 1) above this assumes a removal across all properties but with removal limited to a depth of 1m.
3. Full removal of all impacted areas to a depth of 0.5m – similar to 2) above this assumes a removal across all properties but with removal limited to a depth of 0.5m.
4. Targeted removal of garden areas (e.g. excludes driveways/sealed surface) to a depth of 1m – this assumes that only 30-50% of property areas comprise unsealed garden areas, and the top 1m is removed in those garden areas.
5. Targeted removal of garden areas (e.g. excludes driveways/sealed surface) to a depth of 0.5m – similar to 4) above this assumes a removal of the top 0.5m from garden areas.

Table 8: Outline Soil Disposal Estimates

Scenario	Approximate Tonnage	Approximate Transport & Disposal Cost
1. Full Removal of Fill	48,000 t	s 9(2)(b)
2. Full Removal of Top 1m	10,500 t	s 9(2)(b)
3. Full Removal of Top 0.5m	5,250 t	s 9(2)(b)
4. Garden Area - Removal of Top 1m	3,150 t – 5,250 t	s 9(2)(b)(ii)
5. Garden Area - Removal of Top 0.5m	1,575 t – 2,625 t	s 9(2)(b)(ii)
t - tonne M – Million NZD		

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8.4.4 Option 3: Soil Access Restrictions and Management Procedures

An active management procedure could be investigated and would be designed to prevent residents being exposed to the contaminated fill material.

This would effectively mean preventing vegetable growth in soils with impacted fill and instead, would restrict growth to raised beds to prevent root contact with the contaminated material or contaminated groundwater.

The solution would be a lower cost than other approaches and the impact on residents would be minimal when compared to either of the excavation options. However this option is reliant on a self-management approach. Given that vegetables were still being grown in garden areas during the 2018 investigation, despite advice from Environment Canterbury not to grow and consume vegetables, this approach cannot be relied upon.

Residents with children would need to manage children's garden activities in contact with soil areas which still had access to impacted fill material. There would be minimal opportunity for regulators to check and maintain compliance, unless regular compliance checks are undertaken.

8.5 Summary of Affected Properties

There are 14 properties that currently contain concentrations of contaminants at levels that exceed the NESCS criteria for a residential land use. As these properties exceed the NESCS criteria, the cultivation and consumption of produce is deemed to be potentially hazardous to human health and should cease immediately until remedial measures have been implemented. Ingestion of soil is also deemed a potential risk to human and animal health and contact with soil on sites should be avoided. Pets shall be kept away from areas of exposed soil upon properties until mitigation measures have been implemented.

Of the 20 properties investigated by GHD, 11 properties contained evidence of historical fill material and associated soil contaminant guideline exceedances. Three properties contained exceedances of soil contaminant guideline exceedances with no fill identified. On 5 properties fill was not identified and all contaminant concentrations were below guideline criteria.

Based on the samples collected and visual observations made by GHD, the following properties have shown evidence of the presence of fill and are considered to be impacted by soil contamination:

- s 9(2)(a)

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Based on the samples collected and visual observations by GHD, the following properties have shown no evidence of the presence of fill but are considered to be impacted by soil contamination:

- s 9(2)(a)
- [redacted]
- [redacted]
- [redacted] (no fill was found in the locations investigated by GHD at s 9(2)(a) but fill was found in a previous investigation by Eliot Sinclair Ltd)

Based on the samples collected and visual observations made by GHD, the following properties have shown no evidence of the presence of fill and are considered to be unimpacted by soil contamination:

- s 9(2)(a)
- [redacted]
- [redacted]
- [redacted]
- [redacted]

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Released under the Official Information Act 1982

Appendices

Appendix A – Figures

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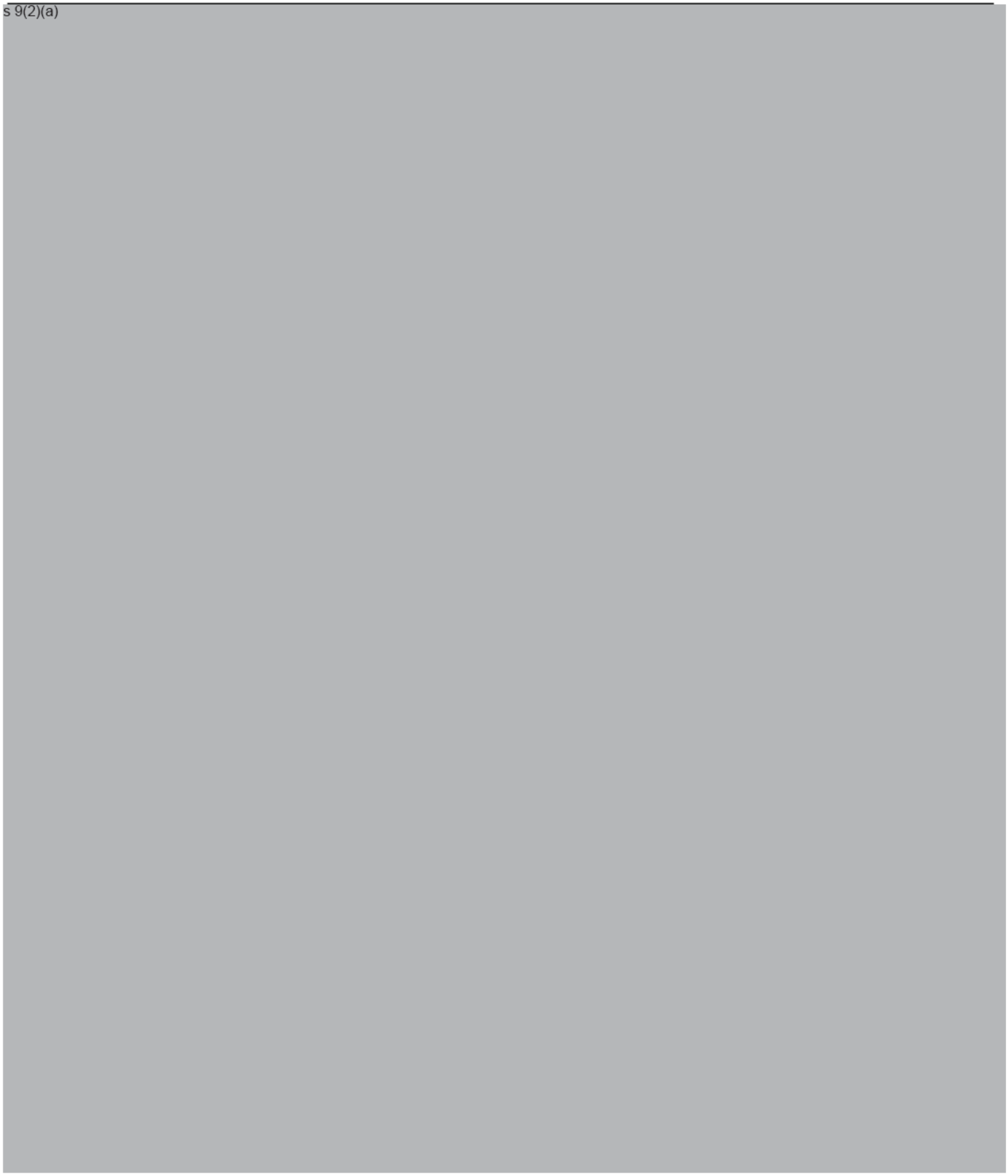
s 9(2)(a)



LEGEND

Site location

State Highways

Paper Size A4

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 21 Mar 2018

Site location

Figure 1

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N:\NZ\Christchurch\Projects\51\37675\GIS\Maps\Deliverables\51_37675_Z003_SiteLocation.mxd

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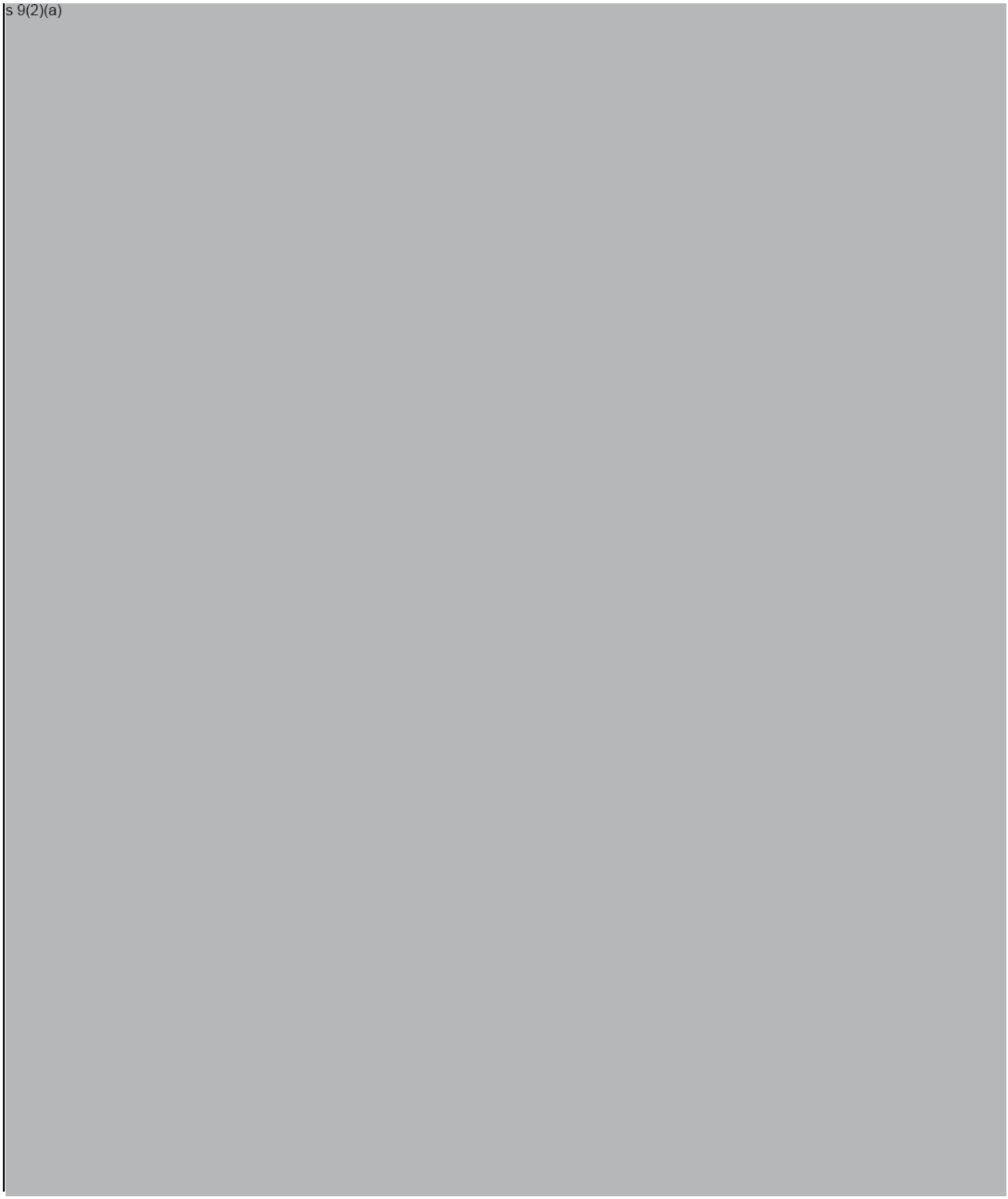
Data source: Base maps - ESRI 2018. Created by:jrprice



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator

Horizontal Datum: NZGD 2000

Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury

s 9(2)(a) DSI

Job Number 51-37675

Revision A

Date 21 Mar 2018

Sampling Locations

Figure 2

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Data source: Aerial imagery - ESRI 2018; General topo - Christchurch City Council. Created by:jrprice

Figure 3 - s 9(2)(a) - Topography

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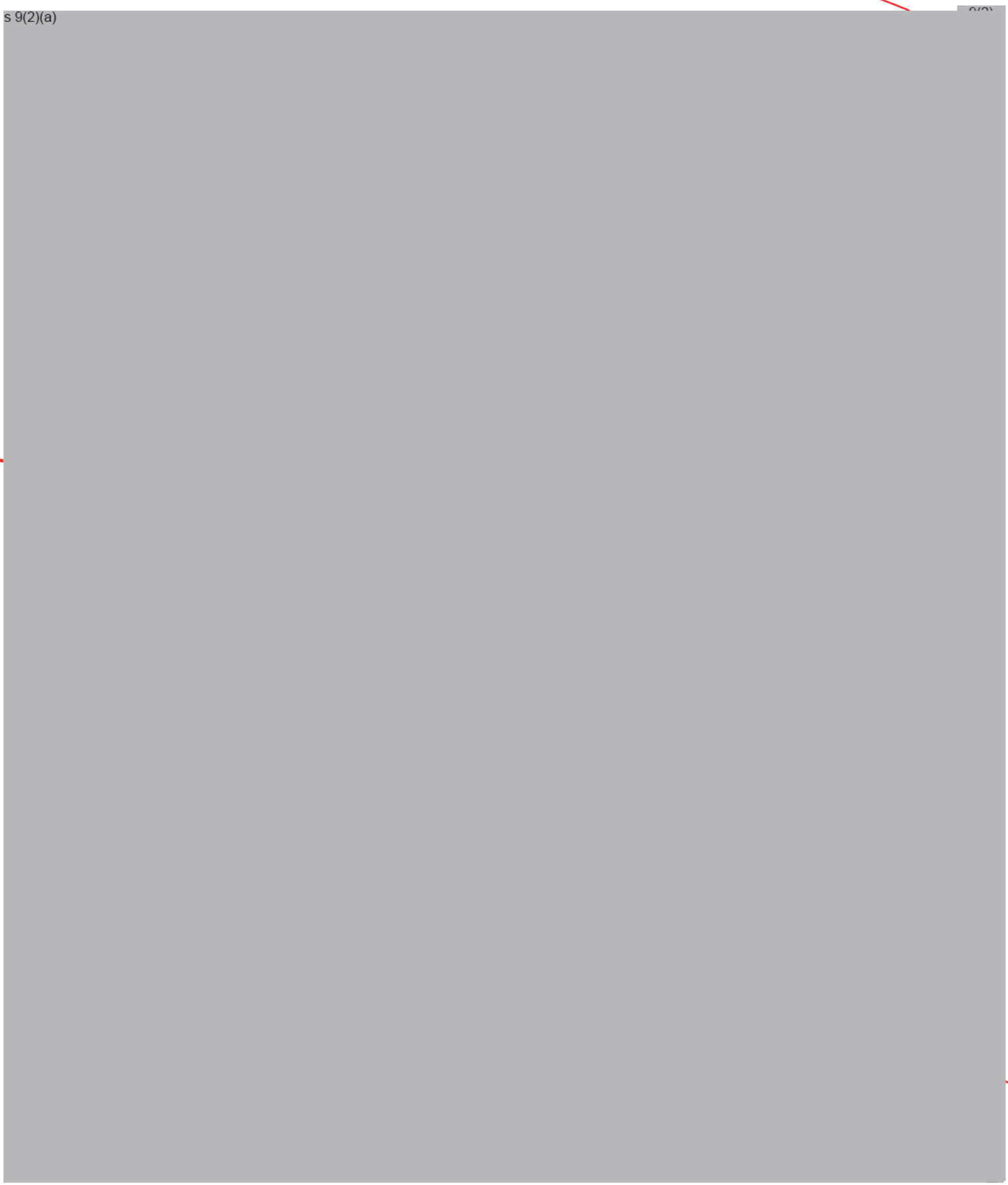
N

0 0.015 0.03 0.045 0.06 Kilometres

Scale: 1:400 @A1

Map Created by Environment Canterbury on 13/03/2017 10:02:05 a.m.

s 9(2)(a)



Paper Size A4

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

Environment Canterbury
s 9(2)(a) SI

Job Number 51-37675
Revision A
Date 21 Mar 2018

Geology

Figure 4

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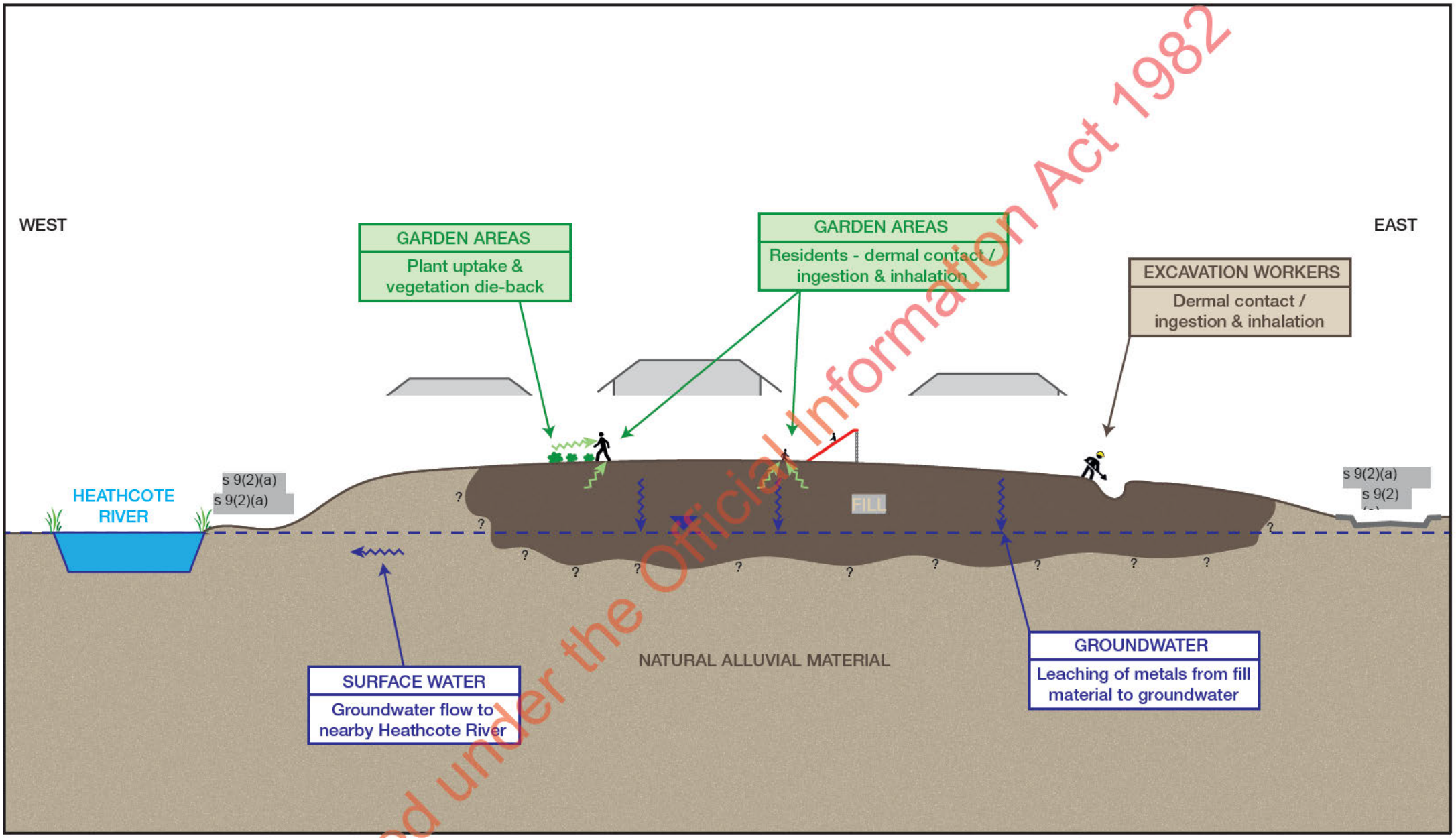
Data source: Geology - GNS; Base maps - ESRI 2018. Created by:jrprice



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DRAWING NOT TO SCALE

Environment Canterbury
s 9(2)(a) Landfill DSI Proposal

Job Number	510908020
Revision	A
Date	15 Nov 2017

Figure 5 - Conceptual Site Model Pre-Investigation

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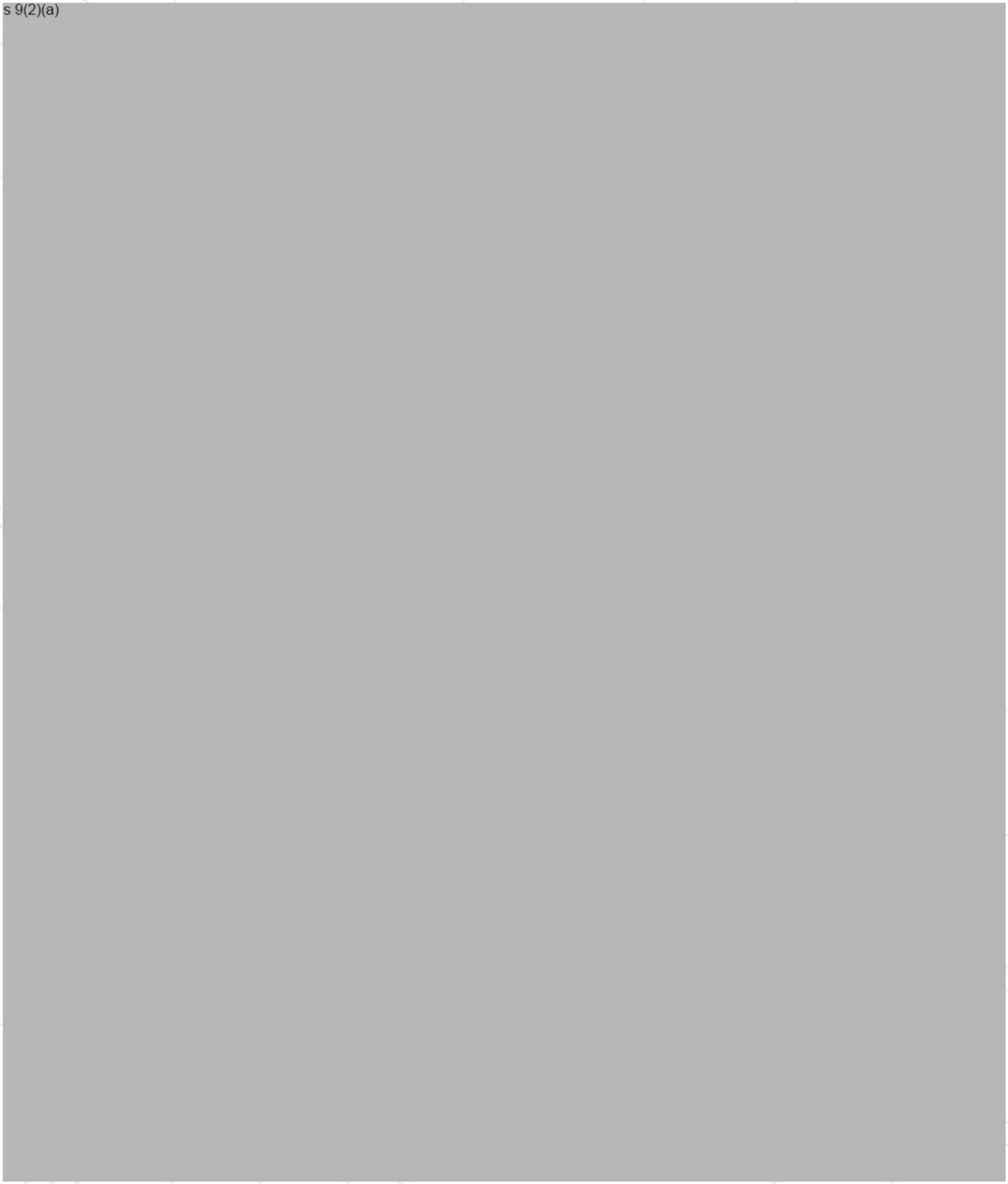
Data source: GHD CSM sketch, November 2017 Created by:jnrice

s 9(2)(a)



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Fill Depth

0.0 m

4.0 m

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 09 Feb 2018

Fill Depth

Figure 6

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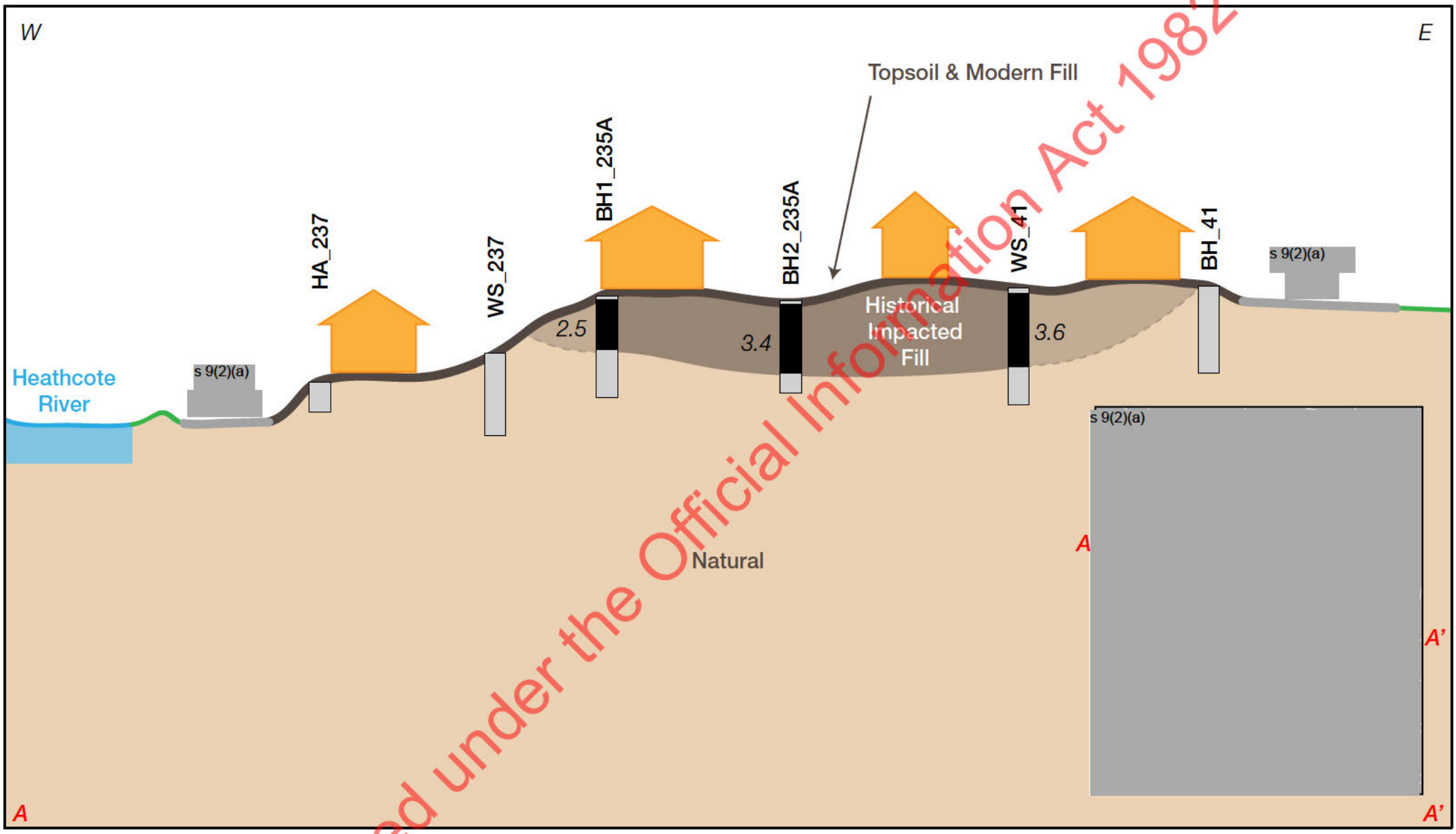

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Paper Size A4

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LEGEND
Sample Locations
Historial Impacted Fill
Natural material

2.5 Base of fill in metres below ground level

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 12 Feb 2018

Cross Section A - A'

Figure 7

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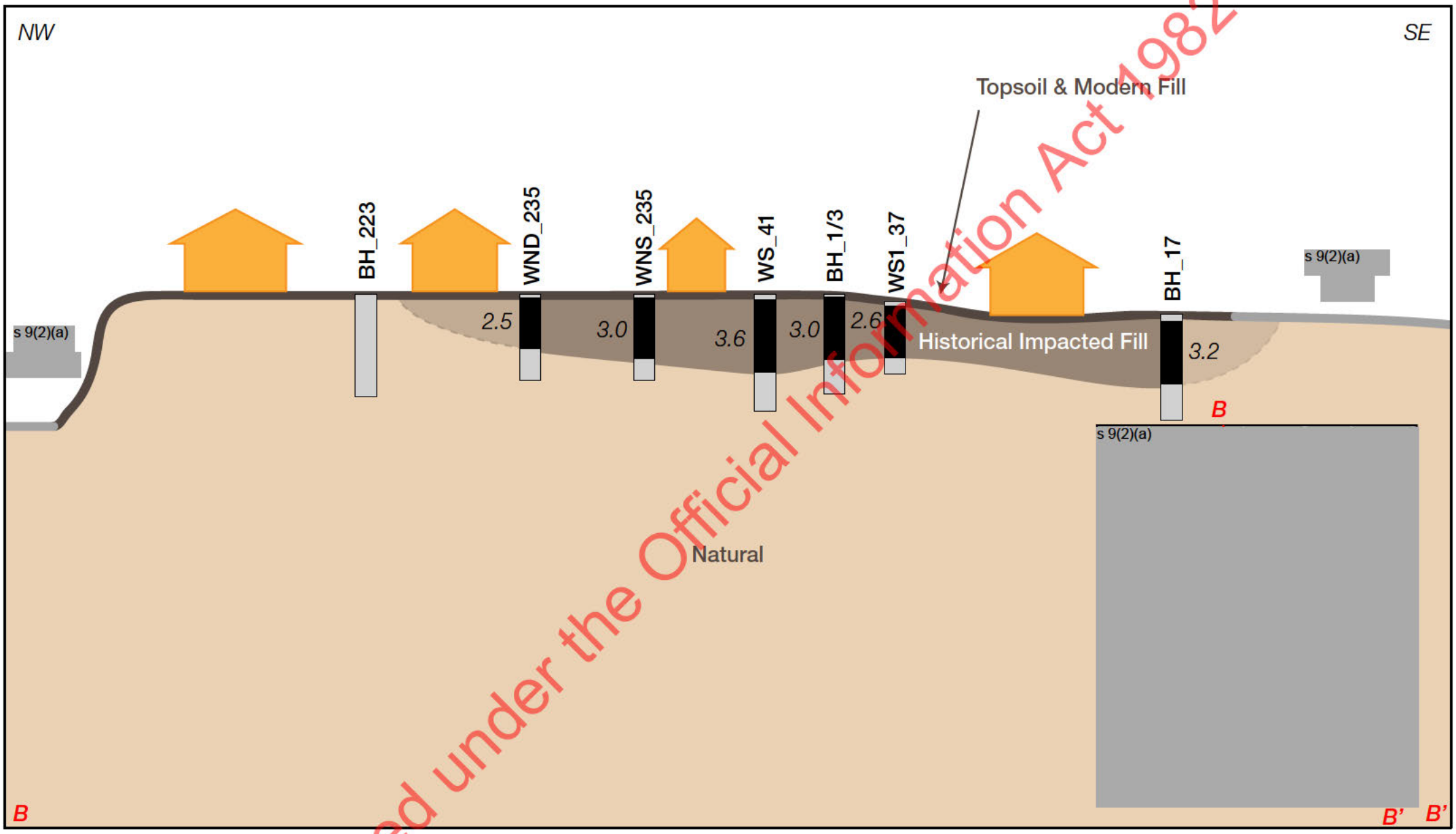

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LEGEND
Sample Locations
Historial Impacted Fill
Natural material

2.5 Base of fill in metres below ground level

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 12 Feb 2018

Cross Section B - B'

Figure 8

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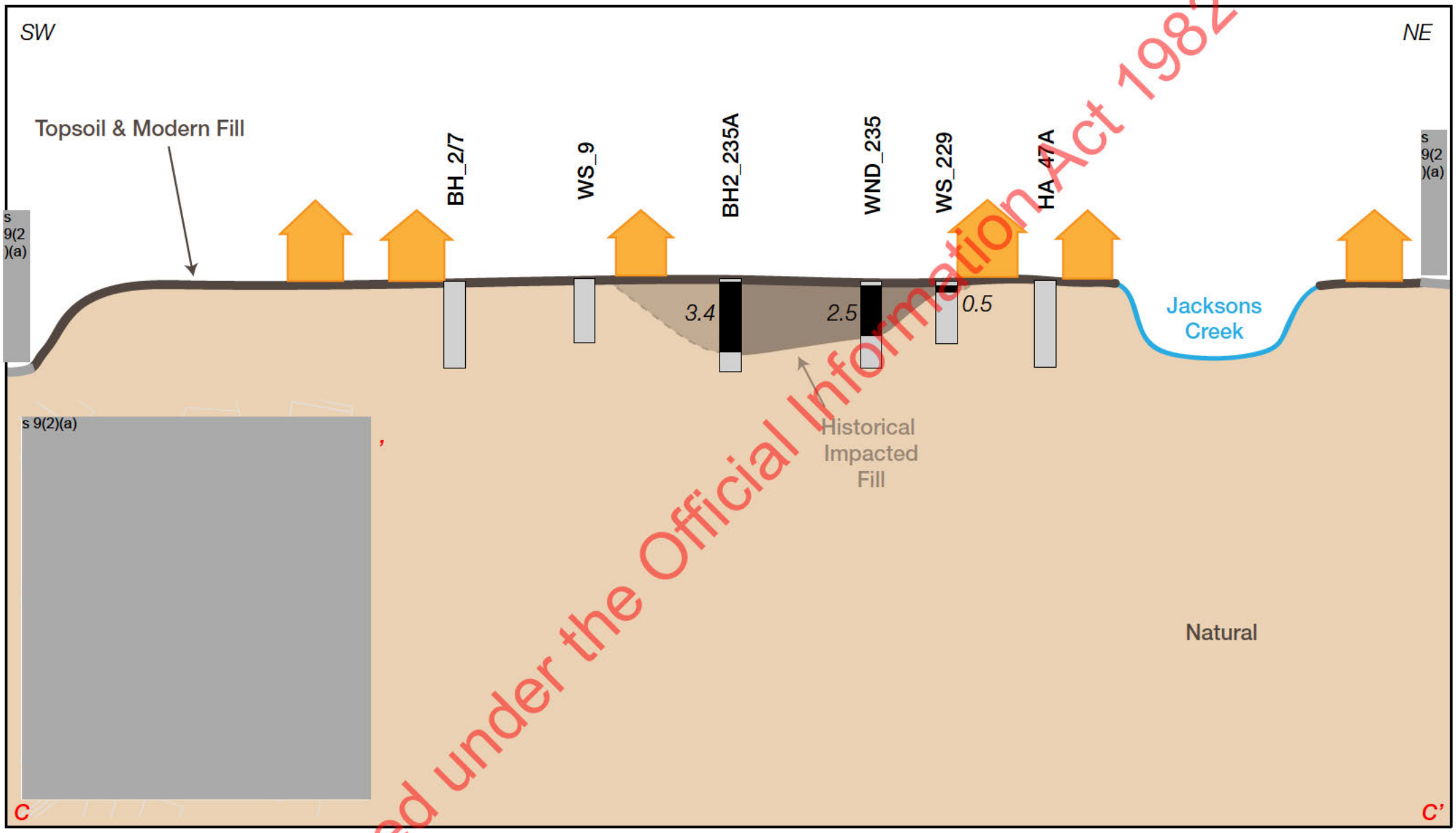

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LEGEND
Sample Locations
Historial Impacted Fill
Natural material

2.5 Base of fill in metres below ground level

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 12 Feb 2018

Cross Section C - C'

Figure 9

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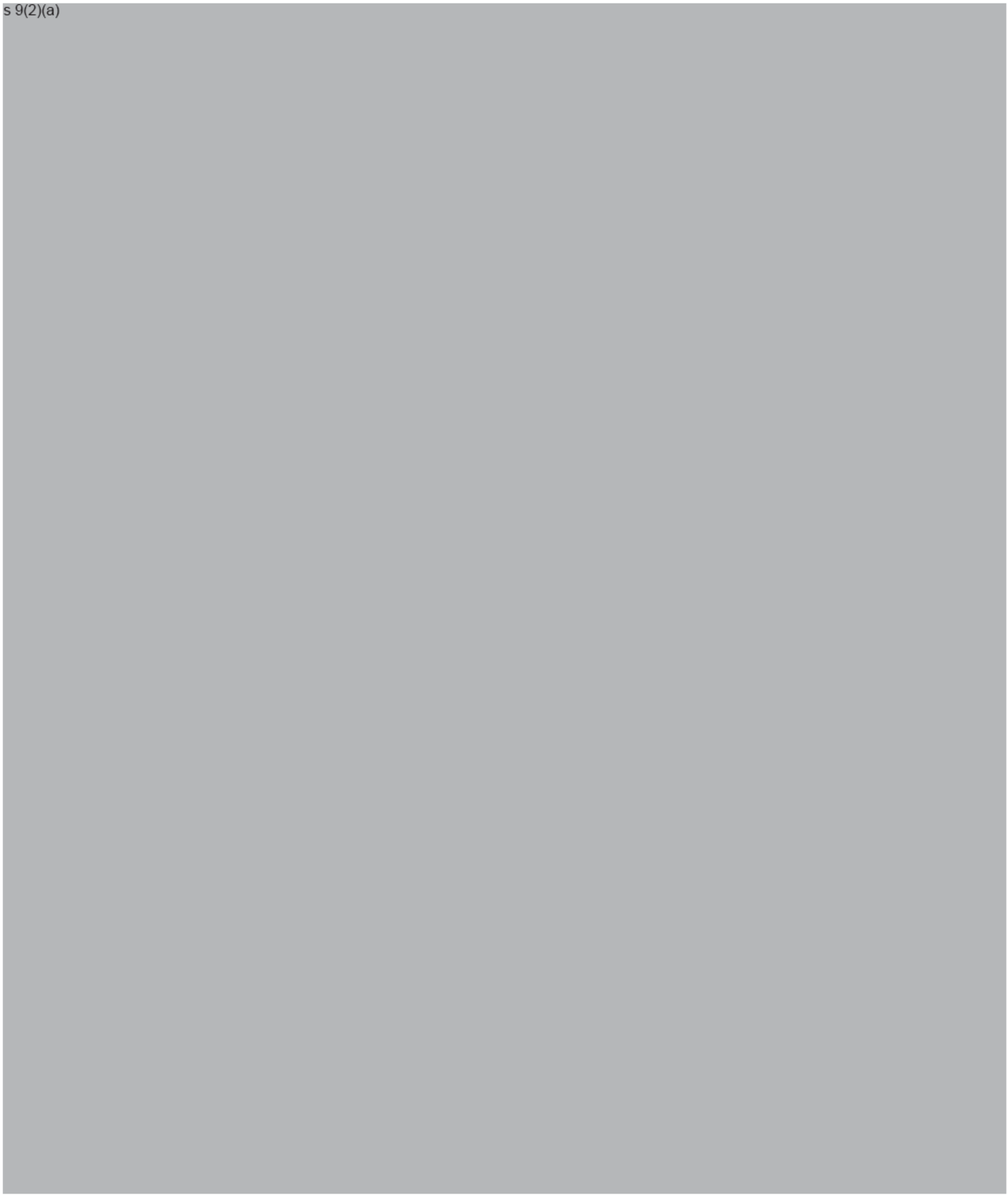

LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Arsenic exceedance (mg/kg)

Values in red exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Residential 10% Produce Consumption) - 20 mg/kg
Values in blue exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Recreational Land Use) - 80 mg/kg

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

Environment Canterbury
s 9(2)(a) DSI

Job Number	51-37675
Revision	A
Date	21 Mar 2018

Arsenic Exceedances

Figure 10

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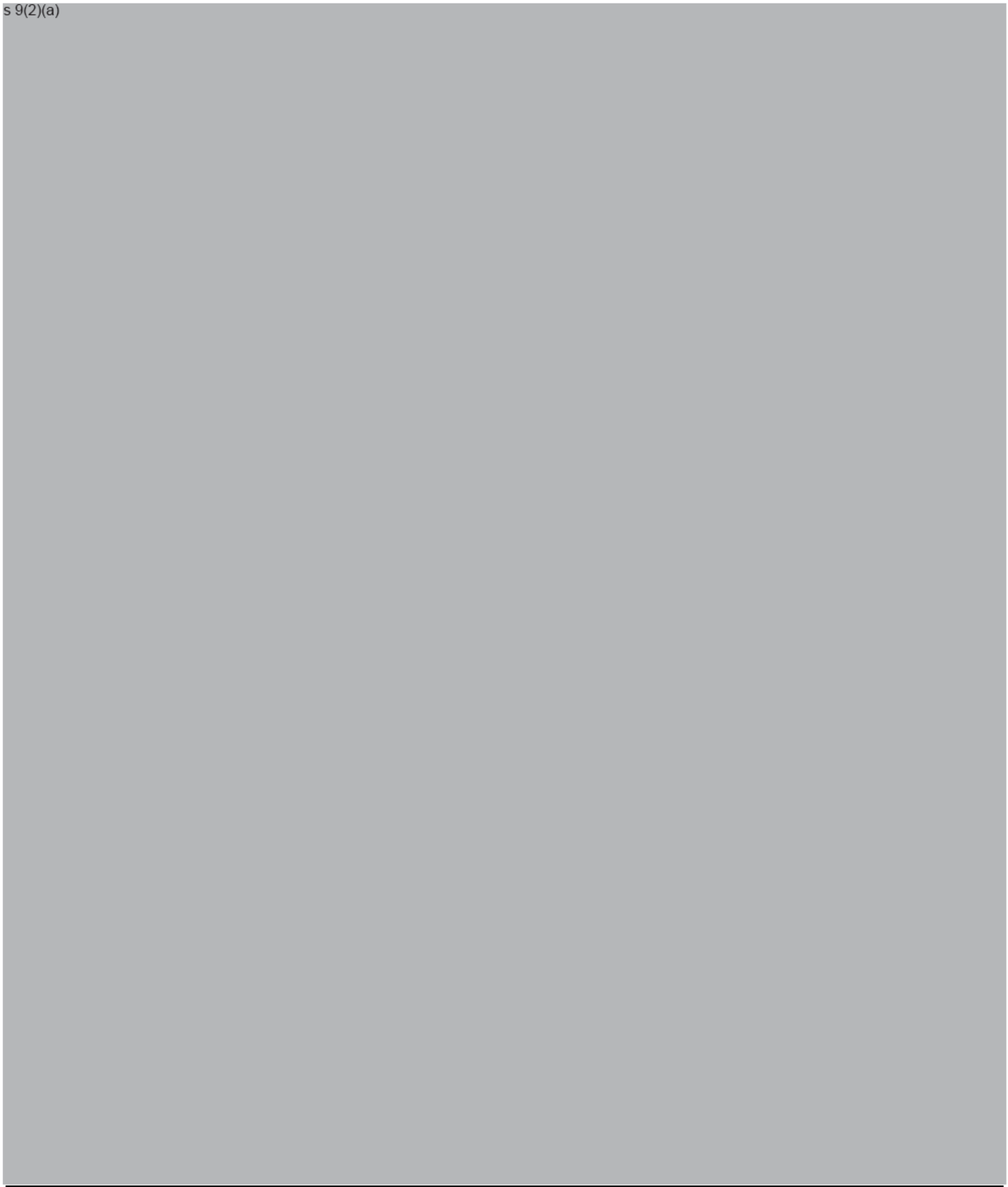
s 9(2)(a)



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Cadmium exceedance (mg/kg)

Values in red exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Residential 10% Produce Consumption) - 3 mg/kg

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 21 Mar 2018

Cadmium Exceedances

Figure 11

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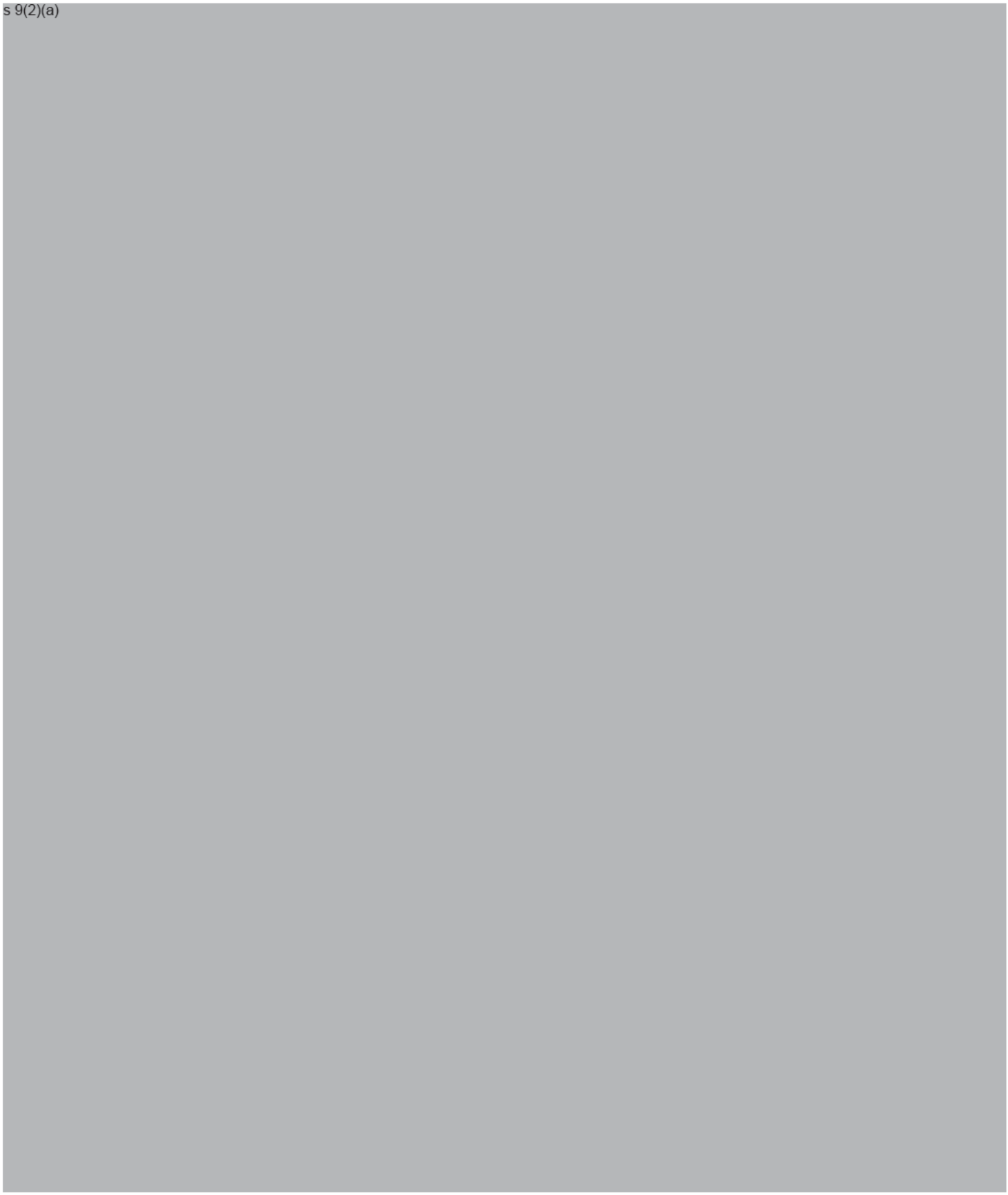

LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Lead exceedance (mg/kg)

Values in red exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Residential 10% Produce Consump ion) - 210 mg/kg
Values in blue exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Recreational Land Use) - 880 mg/kg

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 21 Mar 2018

Lead Exceedances

Figure 12

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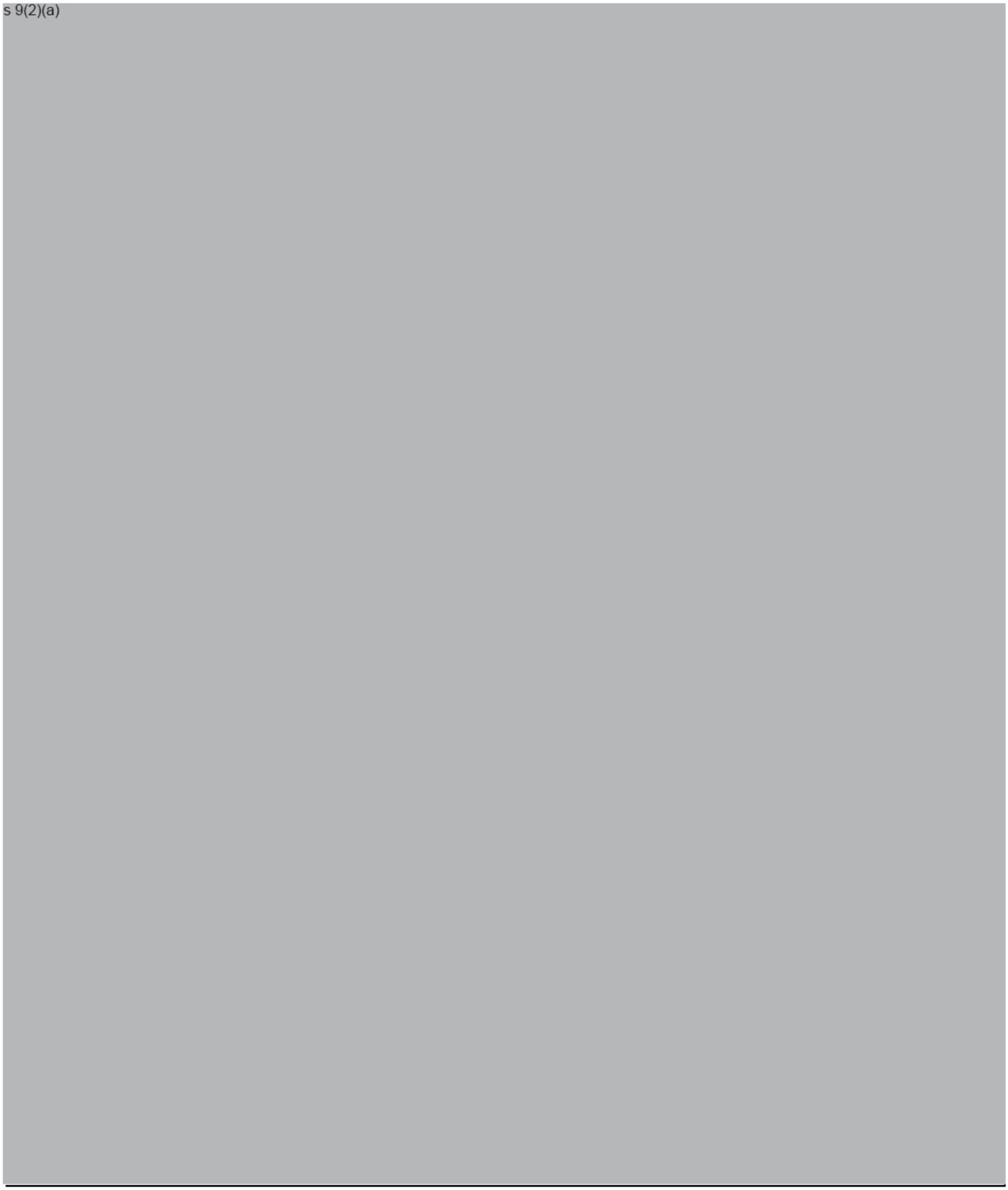
Data source: Aerial imagery - ESRI 2018; General topo - Christchurch City Council. Created by:jrprice

s 9(2)(a)



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Nickel exceedance (mg/kg)

Values exceed the Health investigation levels for soil contaminants of the National Environment Protection (Assessment of Site Contamination) (Residen ial A) - 400 mg/kg

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator

Horizontal Datum: NZGD 2000

Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury

s 9(2)(a) DSI

Job Number 51-37675

Revision A

Date 21 Mar 2018

Nickel Exceedances

Figure 13

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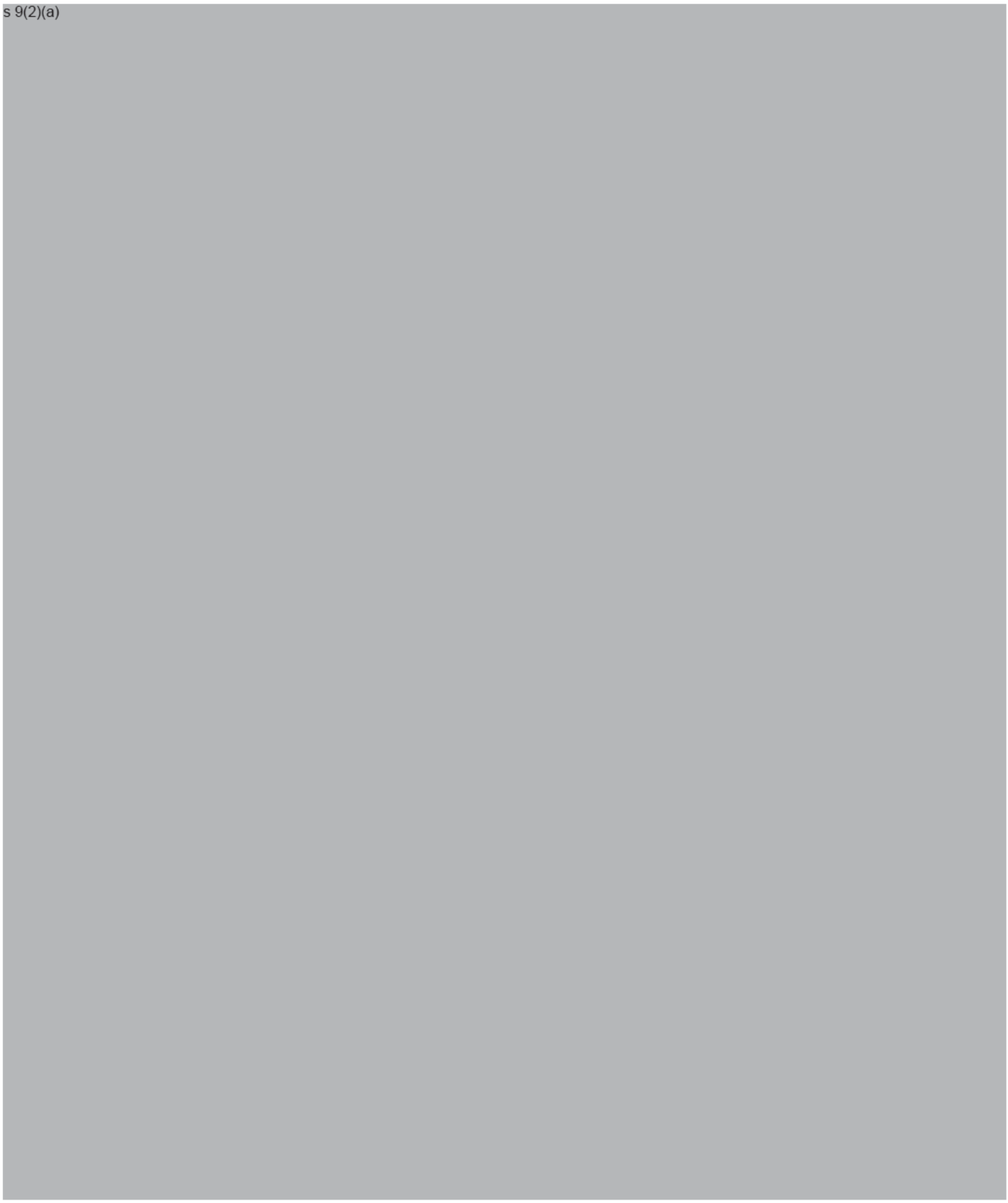
Data source: Aerial imagery - ESRI 2018; General topo - Christchurch City Council. Created by:jrprice



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Zinc exceedance (mg/kg)

Values exceed the Health investigation levels for soil contaminants of the National Environment Protection (Assessment of Site Contamination) (Residen ial A) - 8000 mg/kg

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator

Horizontal Datum: NZGD 2000

Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury

s 9(2)(a) DSI

Job Number 51-37675

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Date 21 Mar 2018

Zinc Exceedances

Figure 14

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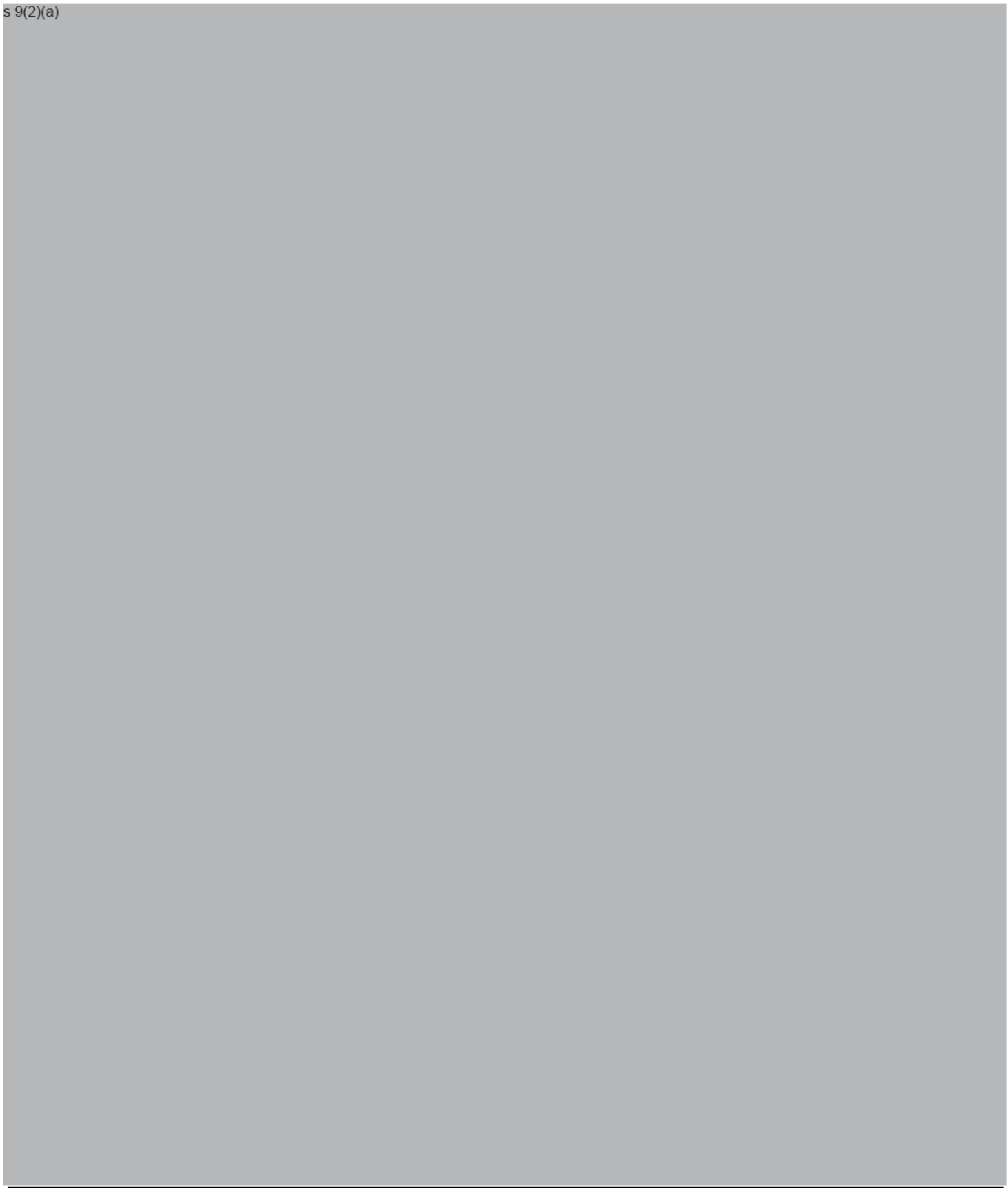
Data source: Aerial imagery - ESRI 2018; General topo - Christchurch City Council. Created by:jrprice

s 9(2)(a)



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

BaP exceedance (mg/kg)

Values in red exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Residential 10% Produce Consump ion) - 10 mg/kg
Values in blue exceed the National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health (Recreational Land Use) - 40 mg/kg

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

GHD

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 21 Mar 2018

BaP Exceedances

Figure 15

GHD Centre, Level 3, 27 Napier Street Freemans Bay Auckland 1011 New Zealand T 64 9 307 7373 F 64 9307 7300 E akmail@ghd.com W www.ghd.com

N:\NZ\Christchurch\Projects\51\37675\GIS\Maps\Deliverables\51_37675_Z010_BaP.mxd

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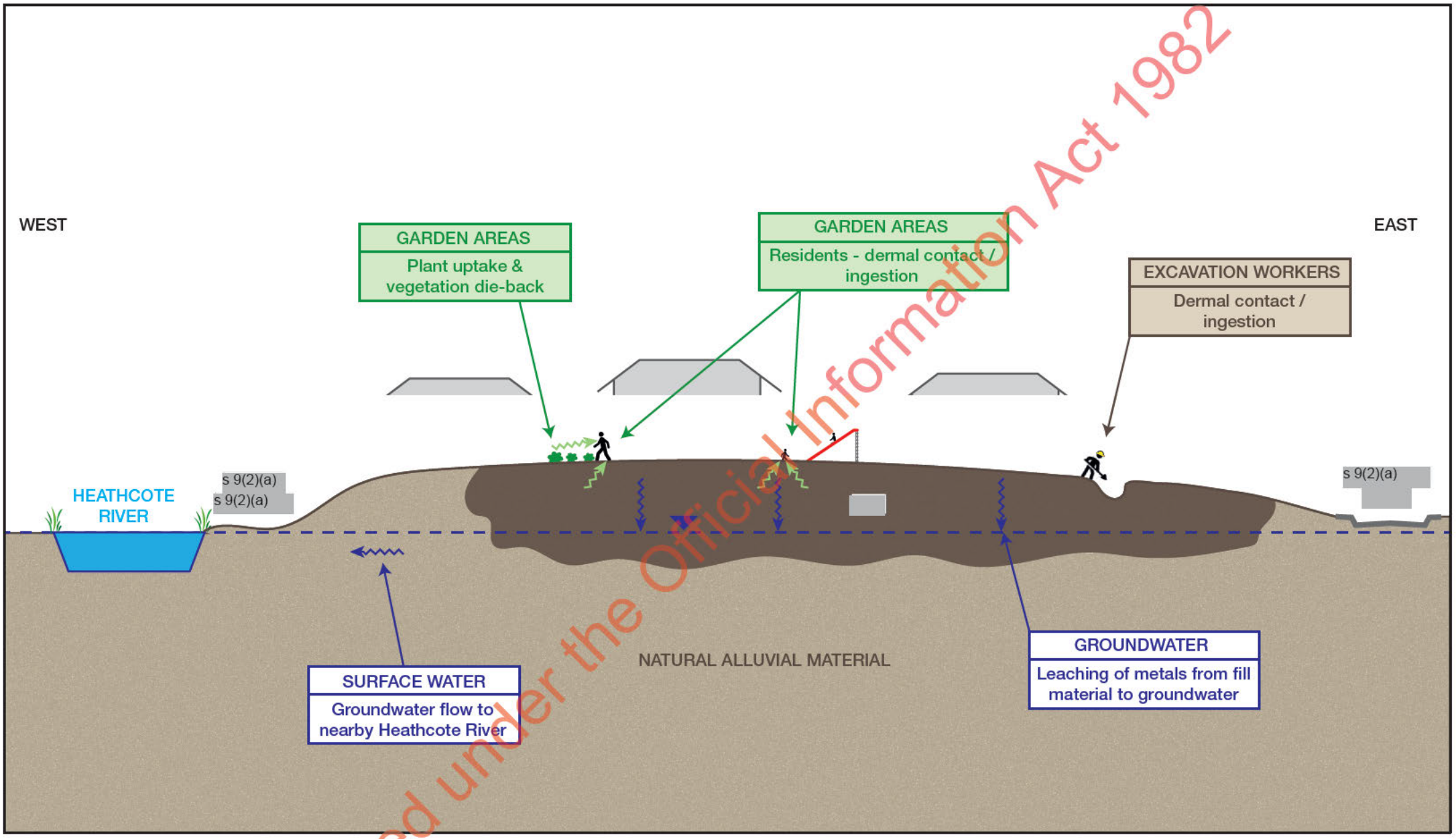
Data source: Aerial imagery - ESRI 2018; General topo - Christchurch City Council. Created by:jrprice



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DRAWING NOT TO SCALE

Environment Canterbury
s 9(2)(a) Landfill DSI Proposal

Job Number	5137675
Revision	A
Date	15 Feb 2018

Figure 16 -Conceptual Site Model Post Investigation

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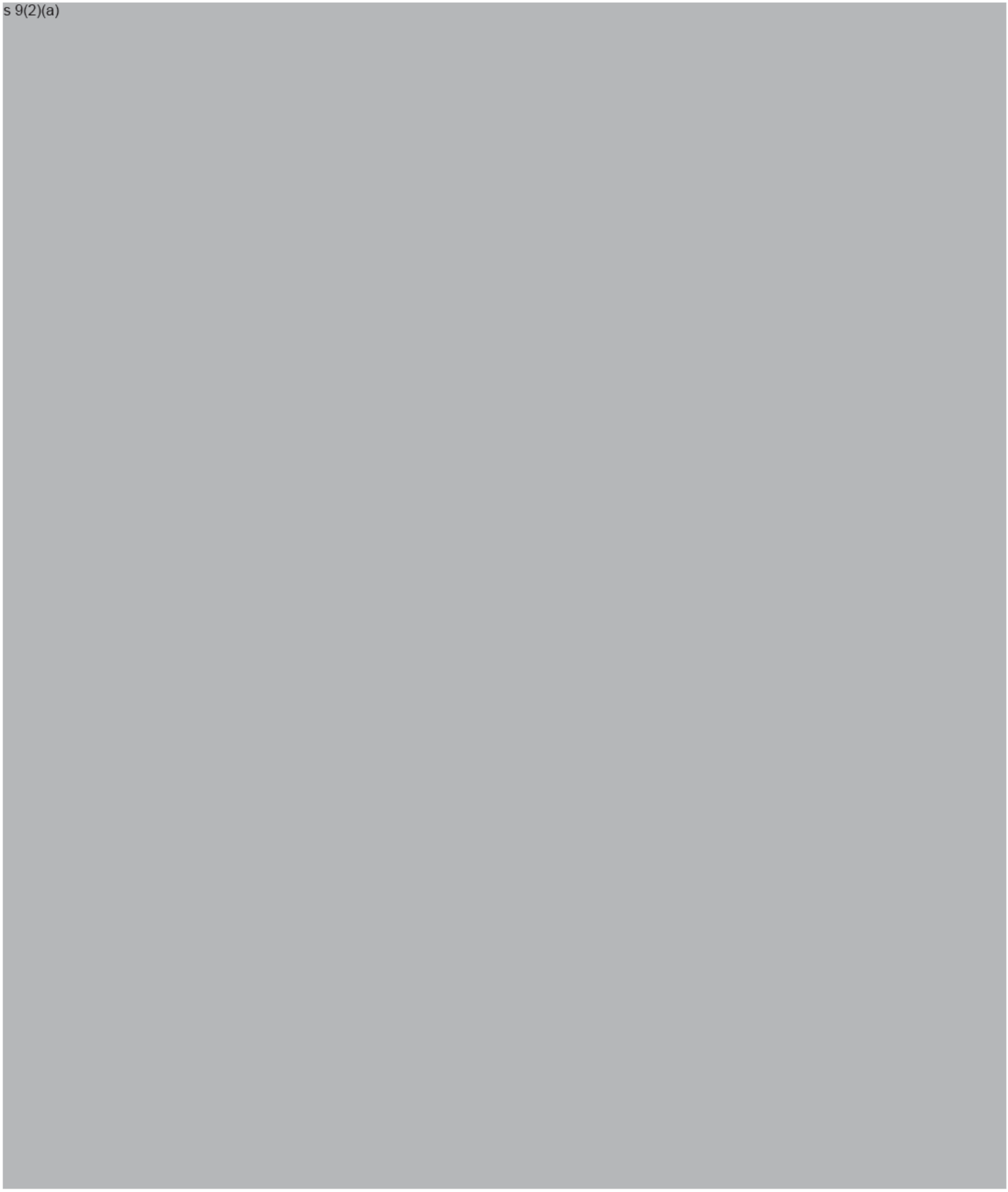
Data source: GHD CSM sketch, November 2017 Created by:jnrice



LEGEND

Investigation area

Property boundary

Sample locations

Borehole

Hand Auger

Window Sampler

Fill encountered

No fill encountered

Fill encountered at parts of property

Fill encountered at all locations of property

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

Environment Canterbury
s 9(2)(a) DSI

Job Number 51-37675
Revision A
Date 21 Mar 2018

Properties with Fill Material

Figure 17

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N:\NZ\Christchurch\Projects\51\37675\GIS\Maps\Deliverables\51_37675_Z004_FillLocations.mxd

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Data source: Aerial imagery - ESRI 2018; General topo - Christchurch City Council. Created by:jrprice

Appendix B – Previous Geological Bores

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Soil Borehole Log

Location: s 9(2)(a) Christchurch

Reference: GA_RO_8493

North (m): s 9(2)(a)
East (m): s 9(2)(a)
Elevation (m): 9
Hole Depth (m): 15.95
Orientation (°): -
Inclination (°): 90

Grid: NZTM
Datum: Ground

Description	USC	Moisture Condition	Consistency / Density	Water Observations	Depth	Samples & In-situ Testing	Backfill & Installation
TS Clayey organic TOPSOIL; dark brown. Soft; moist to wet; low plasticity.	OL	M-W			0.00		
Sandy gravelly S LT with some brick and organics (FILL); dark brown with red. Soft; wet; low plasticity; sand, fine; gravel, subrounded; fine.	ML		S	▼	0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00	SPT N = 9 Depth: 0 50m Type: Solid 60° cone 2, 4 / 3, 2, 2, 2 450mm penetration SPT N = 4 Depth: 2 00m Type: Solid 60° cone 4, 3 / 1, 1, 1, 1 450mm penetration SPT N = 5 Depth: 3 50m Type: Solid 60° cone 11, 5 / 2, 1, 1, 1 450mm penetration	Bentonite 2 00 Gravel
Silty fine SAND with trace organic material; light bluish grey. 'Loose'; wet; poorly graded; organics, fibrous material.	SP		L		4.50		
Sandy fine to coarse GRAVEL; dark greenish grey. Medium dense to dense; wet; well graded; subangular to subrounded; sand, fine to medium.	GW	W	D		5.00 5.50 6.00 6.50 7.00	SPT N = 34 Depth: 5 00m Type: Solid 60° cone 7, 8 / 7, 8, 10, 9 450mm penetration SPT N = 29 Depth: 6 50m Type: Solid 60° cone 5, 7 / 8, 7, 8, 6 450mm penetration	
Fine to medium SAND; dark bluish grey. Medium dense; wet; poorly graded.	SP		MD		7.50		
SILT with minor clay; light bluish grey. Very soft; wet; low plasticity.	ML		VS		8.00 8.50 9.00 9.50	SPT N = 0 Depth: 8 00m Type: Solid 60° cone 1, 0 / 0, 0, 0, 0 450mm penetration SPT N = 0 Depth: 9 50m Type: Solid 60° cone 1, 0 / 0, 0, 0, 0 450mm penetration	8 00 Bentonite
C/L C/L Coreloss					10.00		10.00
Fine to medium SAND with some silt; dark bluish grey. Medium dense to dense; wet; poorly graded.			MD-D		10.50 11.00 11.50 12.00 12.50	SPT N = 30 Depth: 11 00m Type: Solid 60° cone 0, 1 / 2, 8, 10, 10 450mm penetration SPT N = 17 Depth: 12 50m Type: Solid 60° cone 2, 2 / 4, 4, 4, 5 450mm penetration	Surrounding ground collapse
Medium to coarse SAND; light yellowish brown. Dense; wet; poorly graded.	SP	W	D		13.00 13.50 14.00 14.50 15.00 15.50	SPT N = 31 Depth: 14 00m Type: Solid 60° cone 3, 2 / 5, 6, 9, 11 450mm penetration SPT N = 40 Depth: 15 50m Type: Solid 60° cone 2, 2 / 7, 10, 12, 11 450mm penetration	
EOH: 15.95 m							

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Driller Pro-Drill	**Logger** LW	**Remarks** Coordinates and elevation are estimates only.
Drill Method / Rig HQ3		
Start Date 24/07/2012	**Checked By** LC	
End Date 24/07/2012		

Borehole logged in accordance with NZGS guideline "Field description of soil and rock" 2005
Vane tests completed in accordance with NZGS guideline

Hole Depth
15.95m

METHOD OF SOIL DESCRIPTION USED IN BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and descr bed in Reports of Boreholes and Test Pits using the descriptions given in NZGS 2005 Field Description of Soil and Rock. The material properties are assessed by visual/tactile methods.

PARTICLE SIZE – NZGS 2005

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		60 to 200 mm
GRAVEL	Coarse	20 to 60 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.06 to 0.2 mm
SILT		0.002 to 0.006 mm
CLAY		< 0.002 mm

MOISTURE CONDITION – NZGS 2005

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.
S	Saturated	Feels cool, darkened in colour and free water is present on the sample.

CONSISTENCY AND DENSITY – NZGS 2005

Symbol	Term	Undrained Shear Strength
VS	Very Soft	< 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
Vst	Very Stiff	100 to 200 kPa
H	Hard	> 200 kPa

Symbol	Term	Density Index %	SPT "N" Value (blows/300 mm)	Dynamic Cone (blows/300 mm)
VL	Very Loose	< 15	< 4	< 2
L	Loose	15 to 35	4 to 10	1 to 3
MD	Medium Dense	35 to 65	10 to 30	3 to 7
D	Dense	65 to 85	30 to 50	7 to 17
VD	Very Dense	> 85	> 50	> 17

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.
SPT “N-Values” are uncorrected.
No correlation is implied between Standard Penetration Test (SPT) and Dynamic Cone Penetrometer Test values.

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EXPLANATION OF METHOD OF SOIL DESCRIPTION USED IN BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary Blade or Drag Bit	NQ	Diamond Core – 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core – 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core – 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63 mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	NDD	Non-Destructive Digging	EE	Existing Excavation
WB	Washbore or Bailer	SON	Sonic Drilling	HAND	Excavated by Hand Methods

WATER

▼ Water level at date shown

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to NZS4402 Test 6.5.1:1998
2,3 / 3,4,4,4	2,3 / 3,4,4,4 = Blows per 75 mm.
N = 15	N = Blows per 300 mm penetration following 150 mm seating
30/60 mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas sample
W	Water sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength s_v = peak value, s_r = residual value
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U50	Thin walled tube sample – number indicates nominal sample diameter in milimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

SAMPLING AND TESTING

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

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Soil Borehole Log

Location: s 9(2)(a), Christchurch

Reference: GA_18599

North (m): s 9(2)(a)
East (m): s 9(2)(a)
Elevation (m): 6
Hole Depth (m): 16.45
Orientation (°): -
Inclination (°): 90

Grid: NZTM
Datum: MSL

Depth	Description	USC	Moisture Condition	Consistency / Density	Water Observations	TCR (%)	SPT N-value (Uncorrected)	Samples & In-situ Testing
0.00	CONCRETE							
	SILT with trace organics; dark brown. Wet to saturated; low plasticity; organics, rootlets.	ML	W-S					
	Sandy SILT; light brown. Saturated; low plasticity; sand, fine.		S					
	SILT with trace sand; light brown. Wet; low plasticity.		W					
1.00	Silty fine SAND; light brown. Very loose; moist; poorly graded.	SM	M	VL				SPT N = 3 Depth: 1 00m Type: Raymond Split Spoon 1, 0 / 1, 0, 1, 1 450mm penetration
2.00	Becoming loose and saturated below 2.0 metres.							SPT N = 6 Dept 2 00m Type: Raymond Split Spoon 0 / , 2, 1, 2 450mm penetration
2.50	Sandy fine to coarse GRAVEL; grey. Loose; saturated; well graded; sand, fine to coarse; gravel, subrounded to rounded.	GW		L	▼			
3.00	Fine to medium SAND; grey. Medium dense; saturated; poorly graded.	SP						SPT N = 14 Depth: 3 00m Type: Raymond Split Spoon 3, 5 / 4, 3, 3, 4 450mm penetration
4.00	Sandy fine to coarse GRAVEL; grey. Medium dense; saturated; well graded; sand, fine to coarse.	GW		MD				SPT N = 26 Depth: 4 00m Type: Raymond Split Spoon 5, 7 / 7, 7, 6, 6 450mm penetration
5.00								SPT N = 25 Depth: 5 00m Type: Raymond Split Spoon 3, 6 / 6, 6, 7, 6 450mm penetration
6.00	Fine to medium SAND; trace gravel, grey. Medium dense; saturated; poorly graded; gravel, fine to medium, angular to subrounded.	SP						SPT N = 24 Depth: 6 00m Type: Raymond Split Spoon 3, 6 / 5, 6, 7, 6 450mm penetration
7.00	Sandy fine to coarse GRAVEL; grey. Medium dense to dense; saturated; well graded; sand, fine to coarse.	GW		MD-D				SPT N = 32 Depth: 7 00m Type: Raymond Split Spoon 1, 6 / 6, 8, 8, 10 450mm penetration
8.00								SPT N = 23 Depth: 8 00m Type: Raymond Split Spoon 2, 8 / 7, 5, 5, 6 450mm penetration
9.00								SPT N = 29 Depth: 9 00m Type: Raymond Split Spoon 5, 10 / 8, 8, 7, 6 450mm penetration
9.50								SPT N = 15 Depth: 10 00m

Backfill & Installation

Cement	0 20
Bentonite	0 60
Drill cuttings	

Driller
Speight Drilling

Logger
CJA

Drill Method / Rig
HQ3/CS1000

Start Date
01/08/2013

Checked By
NAC

End Date
01/08/2013

Remarks
Coordinates and elevation are estimates only.
Water level reading taken at completion of drilling.
Hammer energy ratio Ce. 0.95

Borehole logged in accordance with NZGS guideline "Field description of soil and rock" 2005
Vane tests completed in accordance with NZGS guideline

Hole Depth
16.45m

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Soil Borehole Log

Location: s 9(2)(a) , Christchurch

Reference: GA_18599

North (m): s 9(2)(a)
East (m): s 9(2)(a)
Elevation (m): 6
Hole Depth (m): 16.45
Orientation (°): -
Inclination (°): 90

Grid: NZTM **Datum:** MSL

Formation	Graphic Log	Description	USC	Moisture Condition	Consistency / Density	Water Observations	Depth	TCR (%)	SPT N-value (Uncorrected)	Samples & In-situ Testing	Backfill & Installation
		Becoming medium dense below 10 0 metres.	GW	S	MD		10.50			Type: Raymond Split Spoon 6, 6 / 5, 5, 3, 2 450mm penetration	Drill cuttings 0.60
		SILT with trace fine gravel; grey. Very soft; saturated; low plasticity.	ML		VS		11.00			SPT N = 0 Depth: 11 00m Type: Raymond Split Spoon 1, 0 / 0, 0, 0, 0 450mm penetration	11.00
		Sandy SILT; grey. Soft to firm; saturated; low plasticity			S-F		11.50				
		Fine SAND with minor silt; grey, Loose to medium dense; saturated; poorly graded.	SP		L-MD		12.00			SPT N = 5 Depth: 12 00m Type: Raymond Split Spoon 0 / 0, 0, 3, 2 450mm penetration	
		SILT minor fine sand; grey. Soft; saturated; low plasticity	MH		S		12.50				
		Silty fine SAND; grey. Loose to medium dense; saturated; poorly graded.	SM		L-MD		13.00			SPT N = 10 Depth: 13 00m Type: Raymond Split Spoon 2, 1 / 2, 2, 2, 4 450mm penetration	
		SILT trace fine sand; grey, Very stiff; saturated; low plasticity.	ML		VST		13.50				
		Fine to medium SAND; light brown. Medium dense; saturated; poorly graded.			MD		14.00			SPT N = 26 Depth: 14 00m Type: Raymond Split Spoon 1, 1 / 6, 7, 8, 5 450mm penetration	
		Becoming dense below 15 0 metres.	SP		D		14.50				
							15.00			SPT N = 41 Depth: 15 00m Type: Raymond Split Spoon 6, 8 / 10, 9, 11, 11 450mm penetration	
							15.50				
							16.00			SPT N = 45 Depth: 16 00m Type: Raymond Split Spoon 6, 8 / 10, 10, 11, 14 450mm penetration	Surrounding ground collapse

EOH: 16.45 m

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Driller Speight Drilling	**Logger** CJA	**Remarks** Coordinates and elevation are estimates only. Water level reading taken at completion of drilling. Hammer energy ratio Ce. 0.95
Drill Method / Rig HQ3/CS1000		
Start Date 01/08/2013	**Checked By** NAC	**Hole Depth** 16.45m
End Date 01/08/2013		Page 2 of 2

Borehole logged in accordance with NZGS guideline "Field description of soil and rock" 2005
Vane tests completed in accordance with NZGS guideline

METHOD OF SOIL DESCRIPTION
USED IN BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and descr bed in Reports of Boreholes and Test Pits using the descriptions given in NZGS 2005 Field Description of Soil and Rock. The material properties are assessed by visual/tactile methods.

PARTICLE SIZE – NZGS 2005

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		60 to 200 mm
GRAVEL	Coarse	20 to 60 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.06 to 0.2 mm
SILT		0.002 to 0.006 mm
CLAY		< 0.002 mm

MOISTURE CONDITION – NZGS 2005

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.
S	Saturated	Feels cool, darkened in colour and free water is present on the sample.

CONSISTENCY AND DENSITY – NZGS 2005

Symbol	Term	Undrained Shear Strength
VS	Very Soft	< 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
Vst	Very Stiff	100 to 200 kPa
H	Hard	> 200 kPa

Symbol	Term	Density Index %	SPT "N" Value (blows/300 mm)	Dynamic Cone (blows/300 mm)
VL	Very Loose	< 15	< 4	< 2
L	Loose	15 to 35	4 to 10	1 to 3
MD	Medium Dense	35 to 65	10 to 30	3 to 7
D	Dense	65 to 85	30 to 50	7 to 17
VD	Very Dense	> 85	> 50	> 17

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.
SPT “N-Values” are uncorrected.
No correlation is implied between Standard Penetration Test (SPT) and Dynamic Cone Penetrometer Test values.

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EXPLANATION OF METHOD OF SOIL DESCRIPTION USED IN BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary Blade or Drag Bit	NQ	Diamond Core – 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core – 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core – 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63 mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	NDD	Non-Destructive Digging	EE	Existing Excavation
WB	Washbore or Bailer	SON	Sonic Drilling	HAND	Excavated by Hand Methods

WATER

▼ Water level at date shown

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to NZS4402 Test 6.5.1:1998
2,3 / 3,4,4,4	2,3 / 3,4,4,4 = Blows per 75 mm.
N = 15	N = Blows per 300 mm penetration following 150 mm seating
30/60 mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas sample
W	Water sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength s_v = peak value, s_r = residual value
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U50	Thin walled tube sample – number indicates nominal sample diameter in milimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

SAMPLING AND TESTING

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

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19-D-02771

coffey

Engineering Log - Borehole

Borehole ID.	**QE_BH1**
sheet:	1 of 3
project no.	**GENZCHRI15217QE**
date started:	**16 Jul 2013**
date completed:	**16 Jul 2013**
logged by:	**C. Harris**
checked by:	**D. Harris**

client: **IAG Insurance**

principal: **-**

project: **IAG Insurance Claims**

location: s 9(2)(a) **, Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Sonic Drill Rig | mounting Track | hole diameter 150 mm

drilling information | **material substance**

method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
HA					0		GP	**ASPHALT**	D			FILL
							ML	**FILL: Sandy GRAVEL** medium grained sub-rounded to sub-angular grey sand is fine to medium brown	M	S		**SPRINGSTON FORMATION** SPRINGSTON FORMATION
								Sandy SILT low plasticity pale brown sand is fine to medium				
					10		SP	**SAND** fine to medium grained pale brown with minor silt at 1.37-1.38m with fibrous material dark brown 30mm long		VL		
			SP 1 0 1 0 1 1 N=3									
					20		GP	**Sandy GRAVEL** fine to medium grained sub-rounded to sub-angular dark grey sand is fine to medium brown		MD		
							SP	**SAND** fine to medium grained brown grey with trace of silt				
		16/07/13	SP 4 7 7 8 6 8 N=29		30		GP	at 3.43-3.66m with gravel fragments up to 50mm dark grey sub-angular to angular				
								Sandy GRAVEL medium to coarse grained sub-rounded to sub-angular grey/dark grey sand is fine to medium brown at 4.05m gravel becoming sub-rounded at 4.2m gravel becoming fine to coarse with minor dark orange iron staining				
					40					D		
			SP 6 7 9 10 12 10 N=41									
					50		SW	**SAND** fine to coarse grained dark grey				
							GW	**Sandy GRAVEL** fine to medium grained sub-rounded dark grey/grey sand is fine to coarse				
					60		SW	**SAND** fine to coarse grained grey		MD		
			SP 3 3 5 6 7 10 N=28									at 6.45m re-drive run 100mm fine to coarse sub-angular to sub-rounded gravel recovered
					70							
			SP 2 5 9 11 9 9 N=38				GW	**Sandy GRAVEL** fine to coarse grained sub-rounded to sub-angular dark grey with trace of quartz gravel sand is fine to coarse		D		

S/HQ3 — C

CDF 9.04AS.GLB Log COF BOREHOLE: NON CORED BH GINT.GPJ <<DrawingFile>> 19/08/2013 14:26

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by suffix
eg AD/

support
M mud
C casing
N nil

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shearpeak/remouded (uncorrected kPa)
R refusal

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	QE_BH1
sheet:	2 of 3
project no.	GENZCHRI15217QE
date started:	16 Jul 2013
date completed:	16 Jul 2013
logged by:	C. Harris
checked by:	D. Harris

client: IAG Insurance

principal: -

project: IAG Insurance Claims

location: s 9(2)(a) , Christchurch

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Sonic Drill Rig | mounting Track | hole diameter 150 mm

drilling information | **material substance**

method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE plasticity or particle characteristic colour secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
S/HQ3 C									M	D	00 200 300 400	SPRINGSTON FORMATION
			SP 9 9 11 9 9 9 N=38		9.0		GW	**GRAVEL** fine to coarse grained rounded to sub-rounded grey/dark grey				
					10.0			at 10.1m with cobbles dark grey sub-rounded to rounded 60mm at 10.2m cobbles absent		MD		
			SP 11 21 13 8 4 2 N=27		11.0		SP	**SAND** fine to medium grained blue grey with trace of silt				
			SP 2 3 2 2 1 1 N=6		12.0					L		
					13.0		ML	**Sandy SILT** low plasticity grey sand is fine		VSt		
			SP 2 5 7 8 10 9 N=34		14.0		SW	**SAND** fine to coarse grained dark grey with trace of silt at 13.8m silt absent becoming brown		D		
			SP 1 3 2 4 6 12 N=24		15.0					MD		

CDF 9.04AS.GLB Log COF BOREHOLE: NON CORED BH GINT.GPJ <<DrawingFile>> 19/08/2013 14:26

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by suffix
eg AD/

support
M mud
C casing
N nil

penetration
no resistance
ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shearpeak/remouded (uncorrected kPa)
R refusal

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Engineering Log - Borehole

Borehole ID.	QE_BH1
sheet:	3 of 3
project no.	GENZCHRI15217QE
date started:	16 Jul 2013
date completed:	16 Jul 2013
logged by:	C. Harris
checked by:	D. Harris

client: IAG Insurance

principal: -

project: IAG Insurance Claims

location: s 9(2)(a) , Christchurch

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Sonic Drill Rig | mounting Track | hole diameter 150 mm

drilling information						material substance						
method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description SOIL TYPE plasticity or particle characteristic colour secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
S/HQ3 C	1 2 3		SP 2 0 2 2 5 8 N=17		17.0		SW	**SAND** fine to coarse grained dark grey with trace of silt *(continued)*	M	MD		**SPRINGSTON FORMATION**
							GP	**Sandy GRAVEL** fine to medium grained sub-rounded pale yellow brown sand is fine to coarse				
							SW	**SAND** fine to coarse grained brown at 17.8m becoming grey brown				
			SP 6 5 8 8 10 9 N=35		18.0					D		
							GP	**Sandy GRAVEL** medium grained dark grey sand is fine to coarse				
							MH	**SILT** high plasticity blue grey with trace of rootlets		VSt		
			SP 2 1 2 1 2 3 N=8		19.0			at 19.5m with trace fine of sand becoming medium plasticity				
					20.0			Borehole QE_BH1 terminated at 20.0 m Target depth				
					21.0							
					22.0							
					23.0							

CDF 9.04AS.GLB Log COF BOREHOLE: NON CORED BH GINT.GPJ <<DrawingFile>> 19/08/2013 14:26

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by suffix
e.g. AD/

support
M mud
C casing
N nil

penetration
no resistance
ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shearpeak/remouded (uncorrected kPa)
R refusal

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	**AQE-BH1**
sheet:	1 of 3
project no.	**GENZCHRI15217AQE**
date started:	**11 Apr 2014**
date completed:	**11 Apr 2014**
logged by:	**C. Harris**
checked by:	**H. Toi**

client: **IAG Insurance**

principal: **-**

project: **IAG Insurance Claims**

location: s 9(2)(a) **, Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Comacchio MC900 Track mounted | casing diameter 150 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description SOIL TYPE plasticity or particle characteristic colour secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
SD CASING		11/04/14 11:00	SP 1 1 0 1 1 1 N*=3		10		GW	**ASPHALT** 20mm thick	M			**PAVEMENT**
							ML	**FILL: Sandy GRAVEL** fine to coarse grained rounded to sub-rounded dark grey-brown sand is fine to coarse grained with some silt				**FILL**
							SM	**FILL: SILT** low liquid limit dark brown with minor fine to medium grained sub-rounded gravel with trace rootlets		VL		**SPRINGSTON FORMATION**
							SP	**Silty SAND** fine to medium grained pale yellow-brown silt is low liquid limit				
								SAND fine to medium grained pale yellow-brown with trace silt at 1 5m becoming grey-brown	W S			
			SP 4 5 8 6 7 8 N*=29		20			at 2 4m with minor silt				
							SM	**Silty SAND** fine to medium grained grey				
							SP	**SAND** fine to medium grained grey with minor silt		MD		
					30		GP	**Sandy GRAVEL** fine to coarse grained rounded to sub-angular dark brown-dark grey sand is fine to coarse grained				
			SP 2 1 2 3 3 3 Nc=11		40							
					50							
			SP 8 8 8 8 7 7 N =30		60			at 6 3m becoming dark grey				
					70							
			SP 8 6 4 6 6 8 Nc=24					at 7 4m single root up to 40mm fresh orange-brown				

CDF 9 04BB.GLB Log COF BOREHOLE: NON CORED 15217AQE GINT LOGS 11-4-2014.GPJ <<DrawingFile>> 27/04/2014 20:30

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by su ix
e g AD/

support
M mud
C casing
N nil

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SP)
N* SP - sample recovered
Nc SP with solid cone
VS vane shear peak/remouded (kPa)
R re usal
HB hammer bouncing

classification symbol & soil description
based on Uni ied Classi ication System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very so t
S so t
F irm
St sti
VSt very sti
H hard
Fb riable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Engineering Log - Borehole

Borehole ID.	**AQE-BH1**
sheet:	2 of 3
project no.	**GENZCHRI15217AQE**
date started:	**11 Apr 2014**
date completed:	**11 Apr 2014**
logged by:	**C. Harris**
checked by:	**H. Toi**

client: **IAG Insurance**

principal: **-**

project: **IAG Insurance Claims**

location: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Comacchio MC900 Track mounted | casing diameter 150 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE plasticity or particle characteristic colour secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
SD / CASING							GP	**Sandy GRAVEL** fine to coarse grained rounded to sub-angular dark brown-dark grey sand is fine to coarse grained *(continued)*	S	MD		**SPRINGSTON FORMATION**
			SP 1 2 2 3 5 2 Nc=12		9.0		GM	**Silty GRAVEL** fine to medium grained sub-rounded to sub-angular grey silt is medium to high liquid limit				
							MH	**SILT** high liquid limit grey with minor clay	W	VS		
			SP 0 0 0 0 0 1 N*=1		10.0				S			
					11.0							
			SP 2 2 2 2 3 3 N*=10		12.0		SM	**Silty SAND** fine to medium grained dark grey		L - MD		
					13.0		ML	**SILT** low to medium liquid limit grey with trace fine grained sand at 12.9m with trace shell fragments (up to 5mm)		St		
			SP 3 4 4 4 6 7 N 21				SP	at 13.4m grading to low liquid limit with some fine grained sand **SAND** fine to medium grained grey with some silt		MD		
					14.0			at 13.8m grading to fine to coarse grained				
							ML	**Sandy SILT** low liquid limit grey sand is fine grained		S		
							SP	**SAND** fine to coarse grained pale yellow-brown with trace silt		MD - D		
			SP 2 4 9 11 12 12 Nc=44		15.0			at 15.0m single coarse grained sub-rounded gravel	W			

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CDF 9.04BB.GLB Log COF BOREHOLE: NON CORED 15217AQE GINT LOGS 11-4-2014.GPJ <<DrawingFile>> 27/04/2014 20:30

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by suffix
eg AD/

support
M mud
C casing
N nil

penetration
no resistance
ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear peak/remoulded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	**AQE-BH1**
sheet:	3 of 3
project no.	**GENZCHRI15217AQE**
date started:	**11 Apr 2014**
date completed:	**11 Apr 2014**
logged by:	**C. Harris**
checked by:	**H. Toi**

client: **IAG Insurance**

principal: **-**

project: **IAG Insurance Claims**

location: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Comacchio MC900 Track mounted | casing diameter 150 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE** plasticity or particle characteristic colour secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
SD CASING SPT			SP 5 7 8 7 8 10 N*=33		17.0		SP	**SAND** fine to coarse grained pale yellow-brown with trace silt *(continued)*	W	MD - D		**SPRINGSTON FORMATION**
								at 17.1m with trace pockets of Clayey S LT (up to 10mm)		D		
					18.0			at 17.85m becoming blue-grey with minor silt trace organics (decomposed fibrous material up to 2mm in thickness)				
			SP 0 0 0 0 0 1 N*=1				ML	**SILT** low to medium liquid limit blue-grey with trace fine grained sand with trace organics (decomposed fibrous material up to 4mm in thickness)	M - W	VS		
					19.0				W			
			SP 2 2 2 2 3 4 N*=11				SM	**Silty SAND** fine grained blue-grey		MD		
					20.0			Borehole AQE-BH1 terminated at 19.95 m Target depth				
					21.0							
					22.0							
					23.0							

CDF 9.04BB.GLB Log COF BOREHOLE: NON CORED 15217AQE GINT LOGS 11-4-2014.GPJ <<DrawingFile>> 27/04/2014 20:30

method
- AD auger drilling*
- AS auger screwing*
- RR roller/tricone
- W washbore
- C cable tool
- HA hand auger
- D diatube
- B blank bit
- V V bit
- C bit
- * bit shown by suffix
- e.g. AD/

support
- M mud
- C casing
- N nil

penetration
- no resistance
- ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Golder Associates

Soil Borehole Log

Location: s 9(2)(a) Christchurch

Reference: GA_RO_4546

North (m): 5177285.2
East (m): 1572622.4
Elevation (m): 0.0
Hole Depth (m): 7.20
Orientation (°): -
Inclination (°): 90

Grid: NZTM **Datum:** MSL

Formation	Graphic Log	Description	USC	Moisture Condition	Consistency / Density	Water Observations	Depth	TCR (%) 25 50 75 100	SPT N-value (Uncorrected) 10 20 30 40	Samples & In-situ Testing	Backfill & Installation
		Fine GRAVEL F LL with minor sand, grey, dry					0.00				
		Fine SAND with minor silt, dark brown, dry, brick fragments at 0.4 m, becoming clayey from 1.4 m					0.50				
							1.00				
							1.50				
		Sandy SILT with minor clay, brown, soft to locally firm, moist, moderate plasticity, trace of rootlets between 1.7 m and 2 m becoming wet at 2.5 m					2.00				
							2.50				
							3.00				
		Clayey silty SAND, brown with orange mottle, saturated, dilatant					3.50				
		Sandy SILT with minor clay, brown, soft to locally firm, wet, moderate plasticity,					4.00				
		Sandy SILT with minor clay, grey, soft to locally firm, wet, high plasticity				▼	4.50				
		Silty fine SAND, grey, saturated, dilatant					5.00				
		Sandy SILT with minor clay, grey, soft to locally firm, wet, high plasticity					5.50				
		Silty fine SAND, grey becoming brown from 5.4 m, saturated, dilatant					6.00				
		Silty sandy fine to medium GRAVEL with minor clay, grey and brown, wet					6.50				
		Silty fine to medium SAND, grey, saturated, becoming coarser from 6.2 m					7.00				
		Fine to medium GRAVEL with some medium to coarse sand and trace silt, grey, saturated, gravel supported									

EOH: 7.2 m

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Driller	Logger	Remarks
Brown Brothers	MF	Groundwater was measured at 4.50 m (bgl) following completion of the borehole.
Drill Method / Rig		
Geoprobe 6620DT		
Start Date	**Checked By**	
28/09/2011	NULL	
End Date		
28/09/2011		

Borehole logged in accordance with NZGS guideline "Field description of soil and rock" 2005
Vane tests completed in accordance with NZGS guideline

Hole Depth 7.20m

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METHOD OF SOIL DESCRIPTION USED IN BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and descr bed in Reports of Boreholes and Test Pits using the descriptions given in NZGS 2005 Field Description of Soil and Rock. The material properties are assessed by visual/tactile methods.

PARTICLE SIZE – NZGS 2005

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		60 to 200 mm
GRAVEL	Coarse	20 to 60 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.06 to 0.2 mm
SILT		0.002 to 0.006 mm
CLAY		< 0.002 mm

MOISTURE CONDITION – NZGS 2005

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.
S	Saturated	Feels cool, darkened in colour and free water is present on the sample.

CONSISTENCY AND DENSITY – NZGS 2005

Symbol	Term	Undrained Shear Strength
VS	Very Soft	< 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
Vst	Very Stiff	100 to 200 kPa
H	Hard	> 200 kPa

Symbol	Term	Density Index %	SPT "N" Value (blows/300 mm)	Dynamic Cone (blows/300 mm)
VL	Very Loose	< 15	< 4	< 2
L	Loose	15 to 35	4 to 10	1 to 3
MD	Medium Dense	35 to 65	10 to 30	3 to 7
D	Dense	65 to 85	30 to 50	7 to 17
VD	Very Dense	> 85	> 50	> 17

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.
SPT “N-Values” are uncorrected.
No correlation is implied between Standard Penetration Test (SPT) and Dynamic Cone Penetrometer Test values.

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EXPLANATION OF METHOD OF SOIL DESCRIPTION USED IN BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary Blade or Drag Bit	NQ	Diamond Core – 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core – 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core – 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63 mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	NDD	Non-Destructive Digging	EE	Existing Excavation
WB	Washbore or Bailer	SON	Sonic Drilling	HAND	Excavated by Hand Methods

WATER

▼ Water level at date shown

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to NZS4402 Test 6.5.1:1998
2,3 / 3,4,4,4	2,3 / 3,4,4,4 = Blows per 75 mm.
N = 15	N = Blows per 300 mm penetration following 150 mm seating
30/60 mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas sample
W	Water sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength s_v = peak value, s_r = residual value
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U50	Thin walled tube sample – number indicates nominal sample diameter in milimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

SAMPLING AND TESTING

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

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coffey geotechnics

Engineering Log - Borehole

Borehole ID.	**BH 1**
sheet:	1 of 3
project no.	**GENZCHRI15217EV**
date started:	**01 Feb 2013**
date completed:	**01 Feb 2013**
logged by:	**J. Byron-Joyce**
checked by:	**F. Haryono**

client: **IAG Insurance**

principal: **D. Sullivan**

project: **IAG Insurance Claim**

location: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Sonic Drill Rig | mounting Track | hole diameter 100 mm

drilling information | **material substance**

method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE plasticity or particle characteristic colour secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
					0		OL	**TOPSOIL** dark brown S LT with some sand and organics (Fill)	M			
							SM	**SILTY SAND** fine dark brown with minor organics and trace gravel (Fill)	W			
								SILTY SAND brown-green-orange with gravel (Fill)				
			SP 1 0 1 0 0 0 N=1		1							at 1 2m deleterious material (brick rubble wire and glass) present until 2 2m
		01/02/13			2		ML	**SILT** low liquid limit grey-brown with minor fine sand (Fill)	S	VS		
			No SP undertaken		3							at 2 8m deleterious material (wire and metal fragments) until 3 6m SPT sunk under own weight (No Recovery)
							GP	[END OF DRILL]	W	VD		
			SP 10 11 13 15 16 6/5mm N=R		4			**Sandy GRAVEL** fine to coarse poorly graded sub rounded to sub-angular grey sand - fine to medium at 4 0m becoming pale brown				
					5		GW	**Sandy GRAVEL** fine to coarse well graded sub-rounded to sub-angular pale brown sand - fine to coarse				
			SP 4 6 8 9 2 6 N=45		6			at 6 0m becoming grey		D		
					7							
			SP 3 6 9 10 10 13 N=42					**WOOD** red-brown lense of decomposed wood				

CDF 9 04AB.GLB Log COF BOREHOLE: NON CORED MACHINE BOREHOLE 1.GPJ <<DrawingFile>> 20/03/2013 14:13

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by suffix
eg AD/

support
M mud
C casing
N nil

penetration
no resistance
ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shearpeak/remouded (uncorrected kPa)
R refusal

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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19-D-02771

coffey geotechnics

Engineering Log - Borehole

Borehole ID.	**BH 1**
sheet:	2 of 3
project no.	**GENZCHRI15217EV**
date started:	**01 Feb 2013**
date completed:	**01 Feb 2013**
logged by:	**J. Byron-Joyce**
checked by:	**F. Haryono**

client: **IAG Insurance**

principal: **D. Sullivan**

project: **IAG Insurance Claim**

location: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Sonic Drill Rig | mounting Track | hole diameter 100 mm

drilling information | **material substance**

method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE plasticity or particle characteristic colour secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
							GW	**Sandy GRAVEL** fine to coarse well graded sub-rounded to sub-angular pale brown sand - fine to coarse	W	D		
							SP		S			
								SAND fine to medium grey with some fine to coarse subrounded gravel dilatant				
			SP 2 1 0 0 0 0 N=0		9		ML	**SILT** low liquid limit grey with minor fine sand	W - S	VS		
			No SP undertaken		10							SPT sunk under own weight (No Recovery)
					11		SP	**SAND** fine to medium blue-grey	M - W	MD		
			SP 2 1 1 3 5 5 N=14		12			at 2 0m sand becoming medium to coarse				
							MH	**SILT** medium to high liquid limit grey with minor clay and organics (wood fragments)		St		
					13		SP	**SAND** medium pale brown		MD		
			SP 1 1 3 5 5 7 N 20		14							
			SP 2 3 2 5 5 5 N=17		15			at 15 0m sand becoming fine to medium				

CDF 9 04AB.GLB Log COF BOREHOLE: NON CORED MACHINE BOREHOLE 1.GPJ <<DrawingFile>> 20/03/2013 14:13

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by su ix
e g AD/

support
M mud
C casing
N nil

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SP)
N* SP - sample recovered
Nc SP with solid cone
VS vane shearpeak/remouded (uncorrected kPa)
R re usal

classification symbol & soil description
based on Uni ied Classi ication System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very so t
S so t
F irm
St sti
VSt very sti
H hard
Fb riable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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19-D-02771

coffey geotechnics

Engineering Log - Borehole

Boreho e ID.	**BH 1**
sheet:	3 of 3
project no.	**GENZCHRI15217EV**
date started:	**01 Feb 2013**
date comp eted:	**01 Feb 2013**
ogged by:	**J. Byron-Joyce**
checked by:	**F. Haryono**

c ent: **IAG Insurance**

pr nc pa : **D. Sullivan**

project: **IAG Insurance Claim**

ocat on: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Sonic Drill Rig | mounting Track | hole diameter 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & ield tests	RL (m)	depth (m)	graphic log	classi ication symbol	material description **SOIL TYPE** plasticity or particle characteristic colour secondary and minor components	moisture condition	consistency / relative density	hand penetro-meter (kPa) 50 00 50 200	struc ure and add tiona observations
			SP 2 2 3 6 8 8 N=25		17		SP	**SAND** medium pale brown *(continued)*	M - W	MD		
								at 17 4m becoming blue-grey				
			SP 1 0 1 0 1 0 N=2		18					VL		
							ML	**SILT** medium liquid limit grey with mino fine sand trace clay and black organic inclusions	M	VS		
			SP 1 2 2 3 2 3 N=10		19			at 19 3m becoming Sandy S LT		St		
					20			Bo ehole BH 1 terminated at 19 95 m Target depth				
					21							
					22							
					23							

CDF 9 04 AB.GLB Log COF BOREHOLE: NON CORED MACHINE BOREHOLE 1.GPJ <<DrawingFile>> 20/03/2013 14:13

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by su ix
e g AD/

support
M mud
C casing
N nil

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SP)
N* SP - sample recovered
Nc SP with solid cone
VS vane shearpeak/remouded (uncorrected kPa)
R re usal

classification symbol & soil description
based on Uni ied Classi ication System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very so t
S so t
F irm
St sti
VSt very sti
H hard
Fb riable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Engineering Log - Borehole

Borehole ID.	**AQF-BH1**
sheet:	1 of 3
project no.	**GENZCHRI15217AQF**
date started:	**26 Mar 2014**
date completed:	**26 Mar 2014**
logged by:	**J. McLennan**
checked by:	**H. Toi**

client: **IAG Insurance**

principal: **-**

project: **IAG Insurance Claims**

location: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Comacchio MC-900 Track mounted | hole diameter 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE plasticity or particle characteristic colour secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HQ3 N		26/03/14 11:10			0		SP	**ROAD SURFACE: ASPHALT**	M			**FILL**
								FILL: Gravelly SAND fine to medium grained brown gravel is fine to coarse grained rounded to sub-rounded				
					10		SP	**SAND** fine to medium grained brown minor silt		VL		**SPRINGSTON FORMATION**
			SP 1 0 0 0 0 0 N*=0		20			at 2 5m silt absent				
			SP 4 7 7 8 7 8 N*=30		30		GP	**Sandy GRAVEL** fine to coarse grained rounded to sub-rounded brown sand is fine to coarse grained	S	MD		
			SP 6 8 8 5 8 5 N*=26		40							
					50							
			SP 7 10 8 9 6 5 N*=28		60			at 5 8m becoming grey				
					70							
			SP 5 10 5 6 5 6 N*=22				SP	**SAND** fine to coarse grained grey with some fine to coarse grained rounded to sub-rounded gravel				

CDF 9 04BB.GLB Log COF BOREHOLE: NON CORED 15217AQF GINT FILE.GPJ <<DrawingFile>> 15/04/2014 15:27

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by suffix
e.g. AD/

support
M mud
C casing
N nil

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear peak/remoulded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Engineering Log - Borehole

Borehole ID.	**AQF-BH1**
sheet:	2 of 3
project no.	**GENZCHRI15217AQF**
date started:	**26 Mar 2014**
date completed:	**26 Mar 2014**
logged by:	**J. McLennan**
checked by:	**H. Toi**

client: **IAG Insurance**

principal: **-**

project: **IAG Insurance Claims**

location: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Comacchio MC-900 Track mounted | hole diameter 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE plasticity or particle characteristic colour secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HQ3 N							SP	at 8 1m with minor wood fragments (up to 50mm)	S	MD		**SPRINGSTON FORMATION**
							ML	**SILT** low to medium liquid limit grey with minor fine to medium grained sand and wood fragments		F		
			SP 3 2 1 2 1 4 N*=8		9 0		SP	**SAND** fine to coarse grained grey		L		
					10 0		ML	**SILT** low liquid limit grey trace organics (wood fragments) at 10 0m organics absent		F		Drill sank from 10 5m to 11 8m
					11 0		SP	**SAND** fine to coarse grained grey		VL		
			SP 0 0 1 0 1 0 N*=2		12 0		ML	**SILT** low liquid limit grey with some fine to medium grained sand trace wood fragments at 12 1m becoming with trace sand		S - F		
			SP 0 0 1 1 2 2 N*=6		13 0		SM	**Silty SAND** fine to medium grained grey		L		
			SP 2 3 2 2 3 4 N 11							MD		
					14 0		SP	**SAND** fine to coarse grained brown				
			SP 1 3 5 5 6 6 N*=22		15 0							

CDF 9 04BB.GLB Log COF BOREHOLE: NON CORED 15217AQF GINT FILE.GPJ <<DrawingFile>> 15/04/2014 15:27

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by su ix
e g AD/

support
M mud N nil
C casing

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SP)
N* SP - sample recovered
Nc SP with solid cone
VS vane shear peak/remouded (kPa)
R re usal
HB hammer bouncing

classification symbol & soil description
based on Uni ied Classi ication System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very so t
S so t
F irm
St sti
VSt very sti
H hard
Fb riable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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19-P 02771

coffey

Engineering Log - Borehole

Boreho e ID.	**AQF-BH1**
sheet:	3 of 3
project no.	**GENZCHRI15217AQF**
date started:	**26 Mar 2014**
date comp eted:	**26 Mar 2014**
ogged by:	**J. McLennan**
checked by:	**H. Toi**

c ent: **IAG Insurance**

pr nc pa : **-**

project: **IAG Insurance Claims**

ocat on: s 9(2)(a) **Christchurch**

position Not Specified | surface elevation Not Specified | angle from horizontal 90°

drill model Comacchio MC-900 Track mounted | hole diameter 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & ield tests	RL (m)	depth (m)	graphic log	classi ication symbol	material description **SOIL TYPE** plasticity or particle characteristic colour secondary and minor components	moisture condition	consistency / relative density	hand penetro-meter (kPa) 100 200 300 400	struc ure and add tiona observations
HQ3 N			SP 3 4 6 6 7 11 N*=30		17 0		SP	**SAND** fine to coarse grained brown *(continued)*	S	MD		**SPRINGSTON FORMATION**
			SP 1 3 4 4 2 2 N*=12		18 0		ML	**Clayey SILT** medium liquid limit grey		St		
					19 0			at 19 0m clay ab ent				
			SP 1 1 2 3 3 3 N*=11				SM	**Silty SAND** fine to medi m grained grey		MD		
					20 0			Bo ehole AQF-BH1 terminated at 19 95 m Target depth				
					21 0							
					22 0							
					23 0							

CDF 9 04BB.GLB Log COF BOREHOLE: NON CORED 15217AQF GINT FILE.GPJ <<DrawingFile>> 15/04/2014 15:27

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
C cable tool
HA hand auger
D diatube
B blank bit
V V bit
C bit
* bit shown by su ix
e g AD/

support
M mud N nil
C casing

penetration
no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SP)
N* SP - sample recovered
Nc SP with solid cone
VS vane shear peak/remouded (kPa)
R re usal
HB hammer bouncing

classification symbol & soil description
based on Uni ied Classi ication System

moisture
D dry
M moist
W wet
S saturated

consistency / relative density
VS very so t
S so t
F irm
St sti
VSt very sti
H hard
Fb riable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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Appendix C – Environment Canterbury Well Search

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WELL_NO	WELL_TYPE_	WELL STATUS	LOCALITY	ROAD/STREET	DEPTH (m)	DIAMETER (mm)	USE CODE	HIGHEST WATER LEVEL	LOWEST WATER LEVEL	INITIAL WATER LEVEL	Link
s	Bore or Well	Active (exist present)	s		0	0	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s		0	0	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s		20	51	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s		0	0	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s		0	32	Domestic Supply	0	0	0	s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		4	76	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		4	76	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		3	76	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		4	76	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		4	76	Water Level Observatio	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		4	76	ater Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		2.9	51	Water Level Observation	0	0		s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		0.2	44	Irrigation	0.97	0.35	0.795	s 9(2)(a)
s	Bore or Well	Active (exist present)	s 9(2)		97	51	Domestic Supply	3.2	1.33	1.39	s 9(2)(a)
s	Bore or Well	Buried / unlikely still exists	s		41.8	150	Domestic Supply	0	0	-0.6	s 9(2)(a)
s	Bore or Well	No Info Expired Boreconsent	s 9(2)	s 9(2)(a)	5	51	Water Level Observation	0	0		s 9(2)(a)

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Appendix D – Borelogs

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WINDOW SAMPLE LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

Ste Ident f cat on: **17-WNS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: E 1572618, N 5177150
Datum: NZTM2000
Total Depth: 3.5m
Commenced: 08 Jan 18
Completed: 08 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT w th m nor sand and trace root ets; dark brown. Mo st.	M			57	17_WNS Depth 0 1	
		0 30			SP	F ne to med um SAND; grey sh brown. Mo st.	M					
1						from 0.9 m: orange mott ng, wet.	W			65	17_WNS Depth 1 5 P D 5 5	1
2						from 1.8 m: grey.						2
						from 2.4 m: brown, saturated.	S			69	17_WNS Depth 2 6 P D 4 5	
3		3 50										3
						Term nat on Depth = 3.5m (C)				66	17_WNS Depth 3 5 P D 3 4	
4												4
5												5

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BOREHOLE LOG

GHD Limited

19-D-03771

PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **17-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 4.8m
Commenced: 16 Jan 18
Completed: 16 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	LP
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT, m nor sand, trace root ets; dark brown. Mo st.	M			24	17_BH Depth 0.4	
		0 50				FILL: SILT, some ceram cs, s ag, g ass and f ne grave ; orange, b ack, brown. Mo st.	M					
1		1 20				No Recovery Inferred FILL.				88	17_BH_1 2	1
2		2 40				FILL: SILT, ome ceram cs, s ag, g ass and f ne grave ; orange, b ack, brown. Mo st.	M					2
3		3 20			OL	Organ c SILT, trace root ets; dark brown/b ack. Mo st. Strong organ c odour.	M			89	17_BH_3 2	3
		3 60				No Recovery dr er states unab e to catch mater a , ke y s ty f ne SAND.						
4		4 80										4
						Term nat on Depth = 4.8m (TD)						
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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HAND AUGER LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

Ste Ident f cat on: **35-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 2.0m
Commenced: 09 Jan 18
Completed: 09 Jan 18
Contractor:

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	TOPSOIL: Sandy SILT, dark brown. Mo st.	M					
		0 50			SP	SAND; ght brown. Mo st.	M			76	35_HA Depth 0 5	
1		1 00				from 0.8 m: orange mott ng.						1
					SP	SAND; brown/grey w th orange mott ng. Wet.	W			71	35_HA Depth 1 5	
		1 80			SP	SAND; brown/grey. Saturated.	S					
2		2 00				Term nat on Depth = 2m (TD)						2
3												3
4												4
5												5

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BOREHOLE LOG

GHD Limited | PO Box 13468, Chr stchurch 8141

Ste Identf cat on: **35-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 4.8m
Commenced: 16 Jan 18
Completed: 16 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	TOPSOIL: Sandy SILT; dark brown. Mo st.	M			20	35_BH_0.3	
		0 50				FILL: SAND w th br ck fragments, ceram cs, grave , s ag; ght brown. Mo st.	M			94	35_BH_1 2	
1												1
										93	35_BH_2 0	
2										92	35_BH_2 4	2
		2 80			OL	Organ c SILT, trace root ets; dark brown/b ack. Wet.	W			91	35_BH_2 8	
3												3
		3 60			SM	S ty f ne SAND; grey. Saturated.	S					
4												4
		4 80				Term nat on Depth = 4.8m (TD)				90	35_BH_4 8	
5												5

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BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

WINDOW SAMPLE LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

19-D-03771

Ste Identfcaton:
37 - WNS (1)
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 3.2m
Commenced: 08 Jan 18
Completed: 08 Jan 18
Contractor: Van Wat

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0.10			ML	TOPSOIL: SILT; brown. Most.	M			53	37_W1_0.1	
						FILL: Brick, ceramics, glass, sand in a SILT matrix; dark brown shiback. Most.	M			54	37_W1_0.5	
1		0.90				VOID No recovery						1
		1.20				FILL: Brick, ceramics, glass, sand in a SILT matrix; dark brown shiback. Most.	M			58	37_W1_1.5	
2						from 2.0 m: blue clay mixed with sag.				61	37_W1_2.2	2
		2.60			GP	Sandy fine to coarse GRAVEL, subrounded, fine to coarse sand; some silt; grey. Saturated.	S			63	37_W1_2.6 PID 3.5	
3		3.20				Termination Depth = 3.2m (TD)						3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZGN DA A EMPLATE VER 1.3 GD 9/2/18

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WINDOW SAMPLE LOG

GHD Limited
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Chr stchurch 8141

S te Ident f cat on:
37 - WNS (2)
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 3.0m

Commenced: 08 Jan 18
Completed: 08 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 10				FILL: Sandy f ne to coarse GRAVEL (dr veway mater a)						
					ML	SILT w th trace f ne sand; brown. Mo st.	M			60	37_W2_0 2	
		0 80										
1					SP	F ne to med um SAND; brown. mo st.	M					1
						from 1.2 m: m nor s t.				68	37_W2_1 5 P D 4 1	
						from 1.8 m: s t absent.						
2		2 20										2
					GP	Sandy f ne to med um GRAVEL; grey. Wet	W			64	37_W2_2 6 P D 3 5	
3		3 00				Term nat on Depth = 3m (R)						3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZ G N DA A EMPLA E VER 1 3 GD 9/2/18

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BOREHOLE LOG

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19-D-03771

Ste Identf cat on: **41-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.8m
Commenced: 18 Jan 18
Completed: 18 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 20			ML	TOPSOIL: SILT, trace root ets.				27	41_BH Depth 0.1	
		0 70				FILL: SILT, some br ck fragments; dark brown. Mo st.	M					
1					SP	SAND; brown. Dry.	D					1
						from 1.2 m: Mo st.	M			7	41_BH_1 2	
2		2 10			GP	Sandy GRAVEL; brown. Mo st. Subangu ar to subrounded greywacke.	M			8	41_BH_2 4	2
3		3 60			SP	F ne SAND; brown. Mo st.	M					3
4	▽ 18/01/2018	4 00			GP	Sandy f ne to med um GRAVEL; brown. Wet. Subrounded to subangu ar greywacke.	W			9	41_BH_4.6	4
		4 80				Term nat on Depth = 4.8m (TD)						
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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WINDOW SAMPLE LOG

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Ste Identf cat on: **41 - WNS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: Es 9(2)(a)
Datum: NZTM2000
Total Depth: 5.2m
Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 20			ML	TOPSOIL: SILT w th trace root ets; brown. Mo st.	M			33	41 _WNS Depth 0 1	
						FILL: SILT; dark brown. Mo st, br ck fragments.	M					
1						from 0.8 m: ceram cs, s ag, grave , g ass, meta .					P D 3 2	1
2										32	41_WNS Depth 2.5 P D 4 1	2
3		3 60								29	41_WNS Depth 3.5 P D 0 9	3
					OL	Organ c SILT w th trace roots and wood; dark brown sh b ack; mo st. Strong organ c odour.	M			28	41_WNS Depth 3.7	
4		4 50								31	41_WNS Depth 4.2 P D 0 5	4
					GP	Sandy f ne to coarse GRAVEL; grey. Wet.	W			35	41_WNS Depth 4.8 P D 2 1	
5		5 20										5
						Term nat on Depth = 5.2m (TD)						
6												6

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HAND AUGER LOG

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Ste Ident f cat on: **43-HA1**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 0.9m
Commenced: 19 Jan 18
Completed: 19 Jan 18
Contractor:

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0.20			ML	TOPSOIL: SILT, some f ne sand; brown. Mo st.	M			19	43_HA_0 1	
		0.90				FILL: SILT, m nor f ne grave ; brown. Mo st. Br ck fragments.	M					
1						Term nat on Depth = 0.9m (R)						1
2												2
3												3
4												4
5												5

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HAND AUGER LOG

GHD Limited
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Ste Identf cat on: **43-HA2**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Commenced: 12 Jan 18
Completed: 12 Jan 18
Contractor:

Datum: NZTM2000
Total Depth: 1.1m

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	SILT; dark brown. Mo st.				3	43_HA Depth 0 1	
		0 30			SP	SAND; ght brown. Mo st.						
1		1 10				from 1.0 m: grave .						1
						Term nat on Depth = 1.1m (R)				4	43_HA Depth 1 2	
2												2
3												3
4												4
5												5

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BOREHOLE LOG

GHD Limited

19-D-03771

PO Box 13468
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Ste Ident f cat on: **43-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.8m

Commenced: 19 Jan 18
Completed: 19 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT; dark brown. Mo st.	M			5	43_BH Depth 0 1	
		0 40									P D 2 1	
1						FILL: SILT, some f ne grave , sand,ceram cs, br ck, g ass; brown. Mo st.	M					1
										20	43_BH_1 2	
						from 1.5 m: Poor recovery poss b e vo ds.						
2												2
	19/01/2018 9 30am					from 2.5 m: Poor recovery poss b e vo ds.						
3		3 50								21	43_BH_3.4	3
					ML	SILT, m nor f ne sand, trace roots, bone and wood dark brown/b ack. Mo st. S ght su phur odour.	M					
4		4 40										4
					ML	F ne sandy SILT, trace roots and wood; brown. Mo st. S ght su phur odour.	M			22	43_BH_4 5	
		4 80									P D 1 3	
5						Term nat on Depth = 4.8m (TD)						5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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WINDOW SAMPLE LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **45 WNS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 4.0m
Commenced: 08 Jan 18
Completed: 08 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	LP
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
						FILL: S ty GRAVEL; grey (poss b e o d pathway mater a).				55	45_WNS Depth 0.1	
		0 40			ML	SILT; dark brown. Mo st.	M					
		0 80			ML	SILT; ye ow sh brown. Mo st to wet.	M					
1		1 20			SP	F ne to med um SAND; brown. Mo st to wet.	M-W			74	45_WNS Depth 1.5 P D 3 2	1
2										78	45_WNS Depth 2 5 P D 2 5	2
		2 80			GP	Sandy f ne to med um GRAVEL, subrounded. Saturated.	S					
3										80	45_WNS Depth 3.5 P D 3 7	3
		4 00				Term nat on Depth = 4m (TD)						
4												4
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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HAND AUGER LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

S te Ident f cat on: **45-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Commenced: 08 Jan 18
Completed: 08 Jan 18
Contractor:

Datum:
Total Depth: 1.5m

Equipment:
Hole Diameter (mm):
Shear Vane:

Logged:	LP
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					GM	FILL: S ty f ne to med um GRAVEL; grey. Rounded.						
		0 40			ML	SILT; dark brown. Mo st.	M			77	45_H Depth 0 5	
		0 80			ML	SILT; ye ow/brown. Mo st to wet.	M-W					
1		1.50										1
						Term nat on Depth = 1.5m (TD)				73	45_H Depth 1.5	
2												2
3												3
4												4
5												5

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2)(a)

HOLE No. HA_A_45

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil	SM	L	
			0.10		SP-SM	Fine sand with minor silt, brown. Moderately packed, dry, homogenous.	SM	MD	PID - 0.4 PPM
		HA_A_45_0.3							PID - 0.3 PPM
			0.80		SP	Silt, grey. Tightly packed, damp, homogenous.	SM	MD-D	
-1		HA_A_45_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.0 PPM

Note: * indicates signatures on original issue of log or last revision of log

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See standard sheets for details of abbreviations & basis of descriptions

GHD Christchurch
Level 3, 1387 Victoria Street, Christchurch, 8013
PH : 03 378 0900 www.ghd.com

Job No. 5137675

TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: ~~10-D-02771~~ Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2)(a)

HOLE No. HA_B_45

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil, dark brown. Damp.	M	L-MD	
		HA_B_45_0.1							PID - 0.1 PPM
			0.40		SM	Silt, grey. Moderately packed, damp, grading to a fine silty sand at 1 m bgl.	M	MD-D	
									PID - 0.1 PPM
-1		HA_B_45_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.1 PPM

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s 9(2) .GPJ GHD GEO_TEMPLATE.GDT 1/3/18 GEO TEST PIT

See standard sheets for details of abbreviations & basis of descriptions

GHD Christchurch
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Job No. 5137675

TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: ~~10-D-02771~~ Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2)(a)

HOLE No. HA_C_45

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil, dark brown. Damp.	M	L	
		HA_C_45_0.1	0.10		SP	Medium Sand, grey. Loose, damp, some brick fragments. Fill.	D	L	PID - 0.1 PPM
			0.20		OL/ OH	Organic soil, dark brown. Moderately packed damp. Suspect previous topsoil layer.	M	MD	PID - 0.5 PPM
			0.60		MH	Silt, grey/brown. Firm, damp, homogenous.	M	F	
-1		HA_C_45_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 1.0 PPM

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s 9(2) .GPJ GHD GEO_TEMPLATE.GDT 1/3/18 GEO TEST PIT

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Job No. 5137675

HAND AUGER LOG

GHD GHD Limited 19-D-03771

PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **47A-HA**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 2.0m

Commenced: 09 Jan 18
Completed: 09 Jan 18
Contractor:

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	TOPSOIL: Sandy SILT; dark brown. Mo st.	M			52	47A-HA Depth 0 1	
		0 40			ML	SILT; brown. Mo st.	M					
1		1 00			SP	SAND; brown. Mo st.	M			1	47A-HA Depth 1 4	1
		1 50			SP	SAND; brown. Wet.	W					
2		2 00				Term nat on Depth = 2m (TD)						2
3												3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZ G N DA A EMPLA E VER 1 3 GD 9/2/18

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2)(a)

HOLE No. HA_A_47A

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil/garden mulch	M	L	
			0.10		SM	Silty medium Sand, grey. Moderately packed, damp, homogenous.	SM	MD	PID - 0.6 PPM
		HA_A_47A_0.3							PID - 2.4 PPM
-1		HA_A_47A_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.5 PPM

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Job No. 5137675

TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2)(a)

HOLE No. HA_B_47A

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil/Garden Mulch			
		HA_B_47A_0.2	0.30						PID - 2.4 PPM
					ML/ MH	Silt, grey. Moderately packed, damp, homogenous. Some natural wood (Roots) 0.9 m bgl			PID - 0.5 PPM
-1		HA_B_47A_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 1.0 PPM

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Job No. 5137675

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s 9(2) .GPJ GHD GEO_TEMPLATE.GDT 1/3/18
GEO TEST PIT

BOREHOLE LOG

GHD GHD Limited 19-D-03771

PO Box 13468
Chr stchurch 8141

Ste Ident f cat on: **223-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.8m

Commenced: 18 Jan 18
Completed: 18 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT w th root ets; dark brown. Mo st.	M					
		0 80			SM	S ty f ne SAND, trace root ets, trace sma b ack nc us ons; brown. Mo st.	M					
1		1 20			SP	F ne SAND, some s t; brown. Mo st to wet.	M-W			10	233-BH-1 2	1
2						from 2.6 m: Saturated.	S					2
3		3 20				from 3.1 m: m nor ron sta n ng.				11	233-BH-3 2	3
					SM	S ty SAND; brown. Saturated.	S					
4	▽ 18/01/2018 3 15pm	4 60			SP	SAND; grey. Saturated. S ght su phur odour.	S			12	233-BH-4 5	4
		4 80				Term nat on Depth = 4.8m (TD)						
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client:	10-D-02771 Environment Canterbury	**HOLE No. HA_A_223**	
Project:	s 9(2)(a) DSI		
Location:	s 9(2	**SHEET** 1 **OF** 1	
Position:	NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration:	Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date:	27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil	SM	L	
			0.10		SM	Fine Silt, brown/black. Tightly packed, damp, homogenous.	SM	MD	PID - 0.3 PPM
		HA_A_223_0.3							PID - 0.5 PPM
			0.70		MH	Silt, Brown. Tightly packed, damp, homogenous.	SM	MD-D	
-1		HA_A_223_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.3 PPM

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Job No. 5137675

TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2

HOLE No. HA_B_223

SHEET 1 OF 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil	SM	L	
		HA_B_223_0.1	0.10		SM	Medium Sand, grey. Loosely packed, damp, homogenous.	SM	MD	PID - 0.3 PPM
									PID - 0.5 PPM
-1		HA_B_223_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.4 PPM

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Job No. 5137675

HAND AUGER LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

S te Ident f cat on: **229-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Commenced: 11 Jan 18
Completed: 11 Jan 18
Contractor:

Datum: NZTM2000
Total Depth: 0.8m

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	SILT w th some grave and trace root ets; brown. Mo st,	M			14 9	229-H Dep h 0 1 229-H Depth 0 2	
		0 80				Glass and gritty material at refusal (Fill)						
						Term nat on Depth = 0.8m (R)						
1												1
2												2
3												3
4												4
5												5

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BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

BOREHOLE LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Ident f cat on: **229-WS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Commenced: 08 Jan 18
Completed: 08 Jan 18

Datum: NZTM2000
Total Depth: 3.0m
Contractor: McMillan Drilling

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT w th m nor sand and trace root ets; dark brown. Mo st.	M				PID 0.9	
		0.30			SP	FILL: SILT, some br ck fragments; dark brown. Mo st.	M					
		0.50				SILT, brown, low plasticity. Wet	M					
1												1
						Silty SAND,brown. Wet to saturated	W-S			13	229_BH Depth 1 5 PID 2.6	
2	▽ 11/01/2018	2.30				From 2.3, becoming F ne to med um SAND, brown. Mo s .	M			12	229_BH Depth 2 5 PID 3.1	2
		3.00										
3						Term nat on Depth = 3.0m (R)						3
4												4
5												5

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BOREHOLE LOG

GHD Limited

19-D-03771

PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **231-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: Es 9(2)(a)

Datum: NZTM2000
Total Depth: 4.0m

Commenced: 19 Jan 18
Completed: 19 Jan 18

Contractor: McM an Dr ng

Equipment: AMS 259

Shear Vane:

Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 20			ML	TOPSOIL: SILT; dark brown. Mo st.	M			8	231_BH Depth 0.1	
1						FILL: SILT, m nor f ne grave , br ck, charcoa ; dark brown. Mo st.	M			23	231-BH-1 2 P D 21 9	1
	19/01/2018 12 15pm	1 50			SP	F ne SAND; brown sh grey. Wet.	W			25	231-BH-2 0	
2										24	231-BH-2.4	2
		2 60			GP	Sandy f ne to med um GRAVEL; grey. Saturated. Sub ounded to subangu ar, sand, f ne to med um.	S					
3												3
4		4 00				Term nat on Depth = 4m (R)						4
5												5

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HAND AUGER LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **231-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 1.5m
Commenced: 11 Jan 18
Completed: 11 Jan 18
Contractor:

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	TOPSOIL: Sandy SILT; ght brown. Dry.	D			50	231_HA_Depth 0.1	
		0 40			SP	SAND; ght brown. Mo st.	M					
1		1.5										1
						Term nat on Depth = 1.5m (R)				47	231_HA_Depth 1.5	
2												2
3												3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZ G N DA A EMPLA E VER 1 3 GD 9/2/18

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WINDOW SAMPLE LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **231-WNS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 1.0m
Commenced: 11 Jan 18
Completed: 11 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 20			ML	TOPSOIL; SILT; dark brown.				70	231_W Depth 0.1	
					SP	S ty f ne to med um SAND; brown sh grey.				7	231_W Dep h 0 5 P D 0 8	
	▽	0 80			GP	F ne to coarse GRAVEL, subrounded; grey. Saturated.	S					
1		1 00				Term nat on Depth = 1m (R)						1
2												2
3												3
4												4
5												5

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2

HOLE No. HA_A_233

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil, dark brown. Damp.	M	L-MD	
			0.10		SM	Silty Sand, brown. Rootlets until 0.3 m bgl then homogenous to base of unit.	SM	MD	PID - 0.6 PPM
		HA_A_233_0.1							PID - 1.3 PPM
			0.80		ML/ MH	silt, grey with orange mottling. Moderately firm, damp.	M	MD-D	
-1		HA_A_233_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.5 PPM

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2

HOLE No. HA_B_233

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments Observations Note: * indicates signatures on original issue of log or last revision of log
						Topsoil, brown. Damp, trace organics.			PID - 0.6 PPM
		HA_B_233_0.3							
			0.40			Gravely Silt, grey/brown. Well packed, damp, subrounded 2-5mm gravels.			PID - 0.6 PPM
		HA_B_233_0.6	0.60			End of hand auger at 0.6 metres. Refusal.			
1									

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 10-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2)

HOLE No. HA_C_233

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Silty Topsoil, brown. Loosely packed, damp, trace organics.	SM	L	
			0.10		ML	Silt, grey/brown. Moderately packed, dry.	D	MD	PID - 0.6 PPM
		HA_C_233_0.3	0.50		ML/ MH	Sandy Silt, grey/brown. Moderatly packed, damp, trace wood.	M	MD	PID - 0.6 PPM
			0.70		SP-SM	Silty Sand with minor gravel, grey. Moderatly packed, damp, 2-5mm rounded gravel increasing with depth.	M	MD	
-1		HA_C_233_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.5 PPM

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2

HOLE No. HA_D_233

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil, brown. Damp.	SM	L-MD	
			0.10		GW-GM	Silty Sand with minor gravel, brown. moderately packed, damp.	SM	MD	PID - 0.3 PPM
		HA_D_233_0.3	0.40		GM	Silt with minor gravel, brown. Moderately packed, damp.	SM	MD-D	PID - 0.3 PPM
			0.60		ML	Silt, brown. Moderately packed, moist.	M	MD-D	
-1		HA_D_233_1.0	1.00			End of hand auger at 1 metres. Target Depth.			PID - 0.3 PPM

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury		**HOLE No. HA_E_233**	
Project: s 9(2)(a) DSI			
Location: s 9(2		**SHEET** 1 **OF** 1	
Position: NA	**Surface RL:** NA		**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm		**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ		**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
					OL/ OH	Topsoil, brown. Damp.			PID - 0.1 PPM
		HA_E_233_0.3	0.30			End of hand auger at 0.3 metres. Refusal.			
1									

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TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: ~~10-D-02771~~ Environment Canterbury

Project: s 9(2)(a) DSI

Location: s 9(2

HOLE No. HA_F_233

SHEET 1 **OF** 1

Position: NA	**Surface RL:** NA	**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm	**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ	**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments Observations
					OL/ OH	Topsoil, brown. Loose, damp, high organic content, rootlets.	M	L	
		HA_F_233_0.1	0.10		ML	Silt, brown. Loosely packed, dry.	D	L	PID - 0.2 PPM
			0.50			Fill in silt matrix. Slag, wood. Poor recovery as loose material.	SM	H	PID - 0.4 PPM
		HA_F_233_0.6				End of hand auger at 0.6 metres. Refusal.			
1									

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Job No. 5137675

TEST PIT LOG SHEET WITH WELL PIEZOMETER

Client: 19-D-02771 Environment Canterbury

Project: s 9(2)(a)

Location: s 9(2

HOLE No. HA_G_233

SHEET 1 OF 1

Position: NA	**Surface RL:** NA		**Processed:** WT
Method of Exploration: Hand Auger	**Hole Size:** 50 mm		**Checked:** MB
Date: 27/02/18	**Logged by:** WT/PJ		**Date:** 2/3/18

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		HA_G_233_0.3	0.40			Fill. Sand with gravel and cobbles.			PID - 0.1 PPM
1						End of hand auger at 0.4 metres. Refusal.			

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Job No. 5137675

HAND AUGER LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Ident f cat on: **233-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 0.6m
Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor:

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	SILT; ght brown. Dry.				48	233_HA Depth 0 1	
		0 50										
		0 60			ML	F ne sandy SILT; ght brown. Mo st.	M					
						Term nat on Depth = 0.6m (R)						
1												1
2												2
3												3
4												4
5												5

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BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

WINDOW SAMPLE LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Identf cat on:
233-WNS
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum:
Total Depth: 3.0m
Commenced: 11 Jan 18
Completed: 11 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 10			ML	TOPSOIL: SILT; dark brown. Mo st.	M			62	233_W Depth 0.1	
						FILL: Br ck, ceram cs, g ass, s ag n a SILT matr x; dark brown sh b ack. Mo st.	M					
1										6	233_W Depth 1 5 P D 1 3	1
		1 80			SP	S ty f ne to med um SAND, some coarse gra ned; grey w th trace orange sta n g. Mo st.	M					
2	▽	2 50			GP	Sandy f ne to med um GRAVEL, subrounded; grey. Satu a ed.	S			11	233_W Depth 2 4 P D 2 7	2
		3 00				Term nat on Depth = 3m (R)						
3												3
4												4
5												5

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BOREHOLE LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Identf cat on:
235A-BH1
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.8m
Commenced: 18 Jan 18
Completed: 18 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)		Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 20			ML	TOPSOIL: SILT; dark brown. Mo st. Hydrocarbon odour.		M			26	235A 01_0 1 P D 0 1	
1						FILL: SILT, some br ck, ceram cs, wood, g ass; Wet.		W			13	235A_01_0.1	1
2		2 50				from 1.8 m: Poor recovery.					14	235A 01-2 4	2
					OL	Organ cs SILT; b ack. Wet. Hydrocarbon odour.		W					
3		3 10			ML	SILT, m nor f ne sand, trace root ets and wood fragments; grey. Wet. S ght su phur odour.		W					3
4		4 50			GP	Sand GRAVEL; grey. Wet. subangu ar to subrounded.		W			15	235A 01_4 8	4
		4 80				Term nat on Depth = 4.8m (TD)							
5													5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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BOREHOLE LOG

GHD Limited

19-D-03771

PO Box 13468
Chr stchurch 8141

Ste Identf cat on:
235A-BH2
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.2m

Commenced: 18 Jan 18
Completed: 18 Jan 18
Contractor: McM an Dr ng

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)		Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0.10			ML	TOPSOIL: SILT; dark brown. Most.		M					
						FILL: SILT, minor sand, grass, brick and ceramics; moist.		M					
1											27	235A_02_1.2 PID 12.0	1
2													2
3		3.40											3
					SP	SAND, minor silt, minor rootlets; grey. Wet.		W			28	235A_02_3.4	
4		4.00			GP	Sandy fine to medium GRAVEL; saturated. Subrounded to subangular.		S			29	235A-BH02-4.1	4
		4.20				Terminated on Depth = 4.2m (R)						PID 2.0	
5													5

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HAND AUGER LOG

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Ste Ident f cat on: **235A-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 0.9m
Commenced: 11 Jan 18
Completed: 11 Jan 18
Contractor:

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0.90				FILL: SILT, some na s and g ass; dark brown. Mo st.	M			19	235A-HA Depth 0 1	
1						Term nat on Depth = 0.9m (R)						1
2												2
3												3
4												4
5												5

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HAND AUGER LOG

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S te Ident f cat on: **235-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor:

Datum: NZTM2000
Total Depth: 0.6m

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0.60			ML	F ne to med um grave y SILT; brown. Mo st.	M			36	235_HA Depth 0 1	
						Term nat on Depth = 0.6m (C)						
1												1
2												2
3												3
4												4
5												5

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WINDOW SAMPLE LOG

GHD Limited
PO Box 13468
Chr stchurch 8141

S te Ident f cat on:
235-WNS
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: Es 9(2)(a)
Datum: NZTM2000
Total Depth: 4.0m
Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 10			ML	TOPSOIL						
						FILL: SILT w th traces of br ck, ceram cs,g ass,s ag,meta . Dry.	D			43	235_WNS Depth 0 5 P D 2 6	
1												1
										40	235_WNS Depth 1 5 P D 0 8	
2												2
										38	235_WNS Depth 2 5 P D 0 2	
		3 00										
3					OL	Organ c SILT w th trace wood; brown. Mo st.	M			37	235_WNS Depth 3.0 P D 4 2	3
						Recovery oss (compressed?)						
										44	235_WNS Depth 3.6 P D 3 6	
		4 00										
4						Term nat on Depth = 4m (R)						4
5												5

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WINDOW SAMPLE LOG

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S te Ident f cat on:
235-WND
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.0m
Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
		0 10			ML	TOPSOIL						
						FILL: SILT w th g ass, br ck chunks (<80mm), ceram cs, s ag, meta .				45	235_WND Depth 0 3	
1												1
										49	235_WND Depth 1.5 P D 2 4	
2												2
		2 50			OL	Organ c SILT, trace root ets; b ack. Wet. Pungent odou .	W			46	235_WND Depth 2.5 P D 10 8	
		3 00			SM	S ty SAND; grey. Wet. Strong organ c odour.	W					
3												3
										51	235_WND Depth 3.5 P D 9 6	
		4 00				Term nat on Depth = 4m (C)						
4												4
5												5

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HAND AUGER LOG

GHD Limited
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Chr stchurch 8141

19-D-03771

Ste Identf cat on: **237-HA**
Sheet1of1

Project: s 9(2)(a)
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 1.3m

Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor:

Equipment: 50 mm hand auger
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	HJ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT; brown. Dry.	D			30	237_HA Depth 0 1	
		0 50			ML	SILT; brown. Mo st.	M					
1		1 00			ML	SILT w th some f ne sand; grey. Wet.	W			42	237_HA Depth 1 2	1
		1 30				Term nat on Depth = 1.3m (R)						
2												2
3												3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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WINDOW SAMPLE LOG

GHD Limited
19-D-03771
PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **237-W**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Datum: NZTM2000
Total Depth: 3.8m
Commenced: 10 Jan 18
Completed: 10 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT, trace f ne sand; dark brown. Mo st.	M			67	237 _W Depth 0.1	
		0 50			SM	S ty SAND; ght brown. Mo st.	M					
1		1 00			ML	SILT, trace f ne sand; dark brown. Mo st.	M					1
		1 20			SM	S ty f ne to med um SAND; greyey brown. Mo st.	M			39	237 _W Depth 1 5	
2						from 1.8 m: mott ed orange				41	237_W Depth 2 5	2
3	▽	3 00			GP	Sandy f ne to coarse GRAVEL, subrounded; grey. Saturated.	S					3
		3 80				Term nat on Depth = 3.8m (R)						
4												4
5												5

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BOREHOLE LOG

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Ste Ident f cat on: **1/3-BH** Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.6m
Commenced: 16 Jan 18
Completed: 16 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	LP
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
0						FILL: S ty f ne SAND, trace br ck, g ass, meta , grave , s ag, ceram cs, wood; dark brown. Dry to mo st.	D-M			18	1/3_BH Depth 0.2	0
1										85	1/3_BH_1.2	1
2	▽					from 2.0 m to 2.4 m: da k b ack, o odour.				-	1/3_BH Depth 2 0	2
3		3 00			SP	F ne SAND; grey. Wet.	W					3
		3 30			GP	Sandy f ne to med um GRAVEL; grey. Wet.	W			-	1/3_BH Depth 3.6	
4		4 00			GP	Sandy GRAVEL; grey. Saturated.	S					4
		4 60				Term nat on Depth = 4.6m (TD)				87	1/3_BH_4.6	
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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BOREHOLE LOG

GHD Limited

19-D-03771

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Ste Identf cat on: **1/5-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.8m

Commenced: 18 Jan 18
Completed: 18 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
0					ML	F ne sandy SILT, trace wood fragments; brown w th b ack mott ng. Mo st.	M				1/5_BH_0.1	0
1										2	1/5_BH_1.2	1
		1 60			SP	SAND, some s t; brown. Mo st.	M					
2	▽ 18/01/2018 11 40am					from 2.25 m: G ey. Wet.	W			1	1/5_BH_2.4	2
						from 2.4 m: Saturated.	S					
		3 30			GP	Sandy f ne to med um GRAVEL; brown. Saturated	S			3	1/5_BH_3.6	3
4		4 80				Term nat on Depth = 4.8m (TD)						4
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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HAND AUGER LOG

GHD Limited
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PO Box 13468
Chr stchurch 8141

Ste Identf cat on: **1/5-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 2.0m
Commenced: 11 Nov 18
Completed: 11 Nov 18
Contractor:

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0 30			ML	TOPSOIL: SILT; dark brown. Mo st.	M			15	1/5_HA Depth 0 1	
		0 60				VOID.						
1		1 10			ML	Sandy SILY; brown. Mo st.	M					1
		2 00			SP	SAND; brown. Wet.	W					
2						Term nat on Depth = 2m (TD)				16	1/5_HA Depth 2.0	2
3												3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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WINDOW SAMPLE LOG

GHD Limited
19-D-03771
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Chr stchurch 8141

Ste Identf cat on: **2/5 - WNS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 2.5m
Commenced: 08 Jan 18
Completed: 08 Jan 18
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	LP
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
				× × × × × × × × ×	ML	TOPSOIL: SILT, trace root ets, trace f ne sand; brown. Mo st.	M			56	5A_WNS Depth 0 2	
		0 30			SP	F ne to med um SAND, some s t; brown. Mo st.	M					
1						from 0.9 m: trace orange mott ng. Wet.	W			75	5A_WNS Depth 1.5	1
2		2.50										2
						Term na on Depth = 2.5m (TD)				72	5A_WNS Depth 2.5	
3												3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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HAND AUGER LOG

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Ste Identf cat on: **7A (1/7)-HA**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 2.0m
Commenced: 11 Jan 18
Completed: 11 Jan 18
Contractor:

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	DJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	SILT; dark brown. Wet.	W			17	7A_HA Depth 0 1	
		0 50			ML	Sandy SILT; grey brown. Wet.	W					
		0 80			SP	SAND; ght brown. Wet.	W					
1										21	7A _HA Depth 1 5	1
		1 70			SP	SAND; ght brown w th some mott ng, ome grey. Wet.	W					
2		2 00				Term nat on Depth = 2m (TD)						2
3												3
4												4
5												5

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BOREHOLE LOG

Ste Identfcaton: **2/7-BH**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Datum: NZTM2000
Total Depth: 4.8m

Commenced: 18 Jan 18
Completed: 18 Jan 18
Contractor: McM an Dr ng

Equipment: AMS 259
Shear Vane:
Hole Diameter (mm):

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
		0 20			ML	TOPSOIL: SILT w th root ets.	D					
					SP	F ne SAND, trace root ets; brown to grey. Dry.	D			25	2/7_BH Depth 0.2	
1										4	2/7_BH_1.2	1
		1 80			SP	SAND, m nor s t, trace root ets; grey w th m nor brown mott ng. Mo st	M					
2	▽ 18/01/2018 10 00am					from 2.2 m: We :	W			5	2/7_BH_2.3	2
		2 40			SM	S ty f ne SAND; grey w th brown mott ng. Saturated	S					
3		3 50			GP	Sandy f ne to med um GRAVEL; grey/brown. Saturated. Grave , subrounded, greywacke.	S					3
4										6	2/7_BH_4.4	4
		4 80				Term nat on Depth = 4.8m (TD)						
5												5

BACKUP NZ BH - V1 GPJ NZG N DA A EMPLA E VER 1 3 GD 9/2/18

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HAND AUGER LOG

GHD Limited

19-D-03771

PO Box 13468
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Ste Ident f cat on: **9-HA**

Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Commenced:
Completed:

Datum: NZTM2000
Total Depth: 2.0m

Contractor:

Equipment: 50 mm hand auger
Hole Diameter (mm):
Shear Vane:

Logged:	HJ
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Records & Comments	Depth Scale (m)
					ML	SILT; dark brown. Wet.	W			22	9_HA Depth 0 1	
		0 30			ML	Sandy SILT; brown. Wet.	W					
		0 80			SP	SAND; ght brown. Wet.	W					
1		1 40			SP	SAND; ght brown. Saturated.	S			23	9_HA Depth 1 6	1
2		2 00				Term nat on Depth = 2m (TD)						2
3												3
4												4
5												5

BACKUP NZ BH - V1 GPJ NZ G N DA A EMPLA E VER 1 3 GD 9/2/18

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WINDOW SAMPLE LOG

GHD Limited
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S te Ident f cat on: **9-WNS**
Sheet1of1

Project: s 9(2)(a) DSI
Client: Environment Canterbury
Site: s 9(2)(a)
Job No.: 51/37675

Coordinates: s 9(2)(a)
Commenced:
Completed:

Datum: NZTM2000
Total Depth: 2.6m
Contractor: Van Wa t

Equipment:
Shear Vane:
Hole Diameter (mm):

Logged:	LP
Processed:	DMcQ
Checked:	MB

Depth (m)	Water	Depth (m)	Geological Unit	Graphic Log	Classification	SOIL DESCRIPTION (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation)	Moisture Condition	Consistency/ Relative Density	Sample Type & Depth	Sample No.	Sample/ Test Reco ds & Comments	Depth Scale (m)
					ML	TOPSOIL: SILT, trace root ets; dark brown. Mo st.	M			59	9_WNS Depth 0 1	
						from 0.2 m: root ets absent.						
		0 50			ML	SILT; trace f ne sand; ye ow brown. Mo st.	M					
1						from 1.0 m: becomes mott ed orange. Wet.	W			81	9_WNS Depth 1.5	1
2		2.6										2
						Term nat on Depth = 2.6m (TD)				79	9_WNS Depth 2.6	
3												3
4												4
5												5

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Appendix E – Field Data

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Headspace Readings

Sample Location	Depth (mbgl)	PID (ppm)
17_WNS	1.5	5.5
	2.6	4.5
	3.5	3.4
223_HA_A	0.1	0.3
	0.5	0.5
	1	0.3
223_HA_B	0.1	0.3
	0.5	0.5
	1	0.4
231_BH	1.2	21.9
231_WNS	0.5	0.8
233_WNS	1.5	1.3
	2.4	2.7
233_HA_A	0.1	0.6
	0.5	1.3
	1	0.5
233_HA_B	0.1	0.6
	0.5	0.6
233_HA_C	0.1	0.6
	0.5	0.6
	1	0.5
233_HA_D	0.1	0.3
	0.5	0.3
	1	0.3
233_HA_F	0.1	0.2
	0.5	0.4
233_HA_G	0.1	0.1
235A_BH1	1.1	0.1
	2.4	6.3
235A_BH2	1.2	12
	4.2	2
235_WNS(1)	0.5	2.6
	1.5	0.8
	2.5	0.2
	3	4.2
	3.8	3.6
235_WNS(2)	1.5	2.4
	2.5	10.8
	3.5	9.6
37_WNS(1)	2.6	3.5
37_WNS(2)	1.5	4.1
	2.6	3.5
41_WNS	1.5	3.2
	2.5	4.1
	3.5	0.9
	4.2	0.5
	4.8	2.1
43_BH	0.4	2.1
	4.7	1.3
45_WNS	1.5	3.2
	2.5	2.5
	3.5	3.7
45_HA_A	0.1	0.4
	0.5	0.3
	1	0
45_HA_B	0.1	0.1
	0.5	0.1
	1	0.1
45_HA_C	0.1	0.1
	0.5	0.5
	1	1
47A_HA_A	0.1	0.6
	0.5	2.4
	1	0.5
47A_HA_B	0.1	2.4
	0.5	0.5
	1	1

mbgl - metre below ground level

ppm - parts per million

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Depth to Groundwater

Street	Location	Depth
s 9(2)(a)	3A-BH	1.9
	5-BH	2.5
	7/2-BH	2.7
	231_WNS	0.8
	237-HA	1
	231_BH	2
	233-WNS	2.5
	235_WNS (2)	2.5
	235A-BH1	2.5
	235A_HA	2.5
	237_WNS	3
	235A-BH2	3.4
	233_BH	3.9
	229_HA	NA
	233-HA	NA
	235_HA	NA
	235_WNS(1)	NA
	235A-HA	NA
	17_BH	NA
	45-HA	1.5
	35_HA	1.8
	37-WNS	2.2
	17-WNS	2.4
	37_WNS(1)	2.6
	35-BH	2.8
	43-BH	2.8
	41-WNS	3.6
	41-BH	3.9
	43-HA2	NA
	43-HA1	NA

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Appendix F – Analytical Results

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Map Identifier				17 Borehole			17 Window Sample								MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]								
															Sand			Sandy Silt					
Reference	Units	LOR	Method	18-01469-24	18-01469-88	18-01469-89	18-01469-57	18-01469-65	18-01469-69	18-01469-66	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	<1m	1-4m	>4m	<1m	1-4m	>4m	Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675													
Sample Description				17_0 Depth 0.4	17_0_1.2	17_0_3.2	17_WNS Depth 0.1	17_WNS Depth 1.5	17_WNS Depth 2.6	17_WNS Depth 3.5													
Sample Date				11/01/2018	16/01/2018	16/01/2018	8/01/2018	9/01/2018	9/01/2018	9/01/2018													
Sample No.				24	88	89	57	65	69	66													
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular													
Depth (m)				0.4	1.2	3.2	0.1	1.5	2.6	3.5													
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil													
Total Cyanide	mg/kg	0.2	Cyanide	-	0.3	-	-	<0.2	<0.2	-	-	-	-	1000							-	-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	12.2	18.9	3.03	13	3.05	5.91	7.84	20	80	-	-	-	-	-	-	-	-	100	13	-
Beryllium	mg/kg dry wt	0.013	Elements in Soil	1.91	4.16	0.39	1.28	0.69	0.6	0.58	-	-	*70*	-	-	-	-	-	-	-	200	-	-
Boron	mg/kg dry wt	1.25	Elements in Soil	38.4	190	203	19.9	3.35	2.49	2.66	>10000	>10000	-	-	-	-	-	-	-	-	400	8	-
Cadmium	mg/kg dry wt	0.005	Elements in Soil	1.24	3.4	0.13	1.05	0.022	0.024	0.021	3	400	-	-	-	-	-	-	-	-	20	0.07	-
Chromium	mg/kg dry wt	0.125	Elements in Soil	27.9	57.1	5.11	28.3	11.2	10.3	11	>10000	>10000	-	-	-	-	-	-	-	-	-	20	-
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	-	-	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-	-
Copper	mg/kg dry wt	0.075	Elements in Soil	123	582	16.3	96.4	6.23	4.86	5.66	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8	-
Lead	mg/kg dry wt	0.05	Elements in Soil	1370 ***	3090 ***	14.9	858 ***	9.42	9.2	9.39	210	880	-	-	-	-	-	-	-	-	100	21.4	-
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.72	0.83	0.14	0.58	0.058	0.026	0.03	310	1,800	-	-	-	-	-	-	-	-	4	0.09	-
Nickel	mg/kg dry wt	0.05	Elements in Soil	29.8	79.9	7.33	26.6	9.72	8.85	9.55	-	-	*400*	-	-	-	-	-	-	-	200	19	-
Zinc	mg/kg dry wt	0.05	Elements in Soil	670	2730	32.1	609	35.5	32	33.3	-	-	*8000*	-	-	-	-	-	-	-	200	84	-
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	110.81	-	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	0.44	-	-	<0.01	<0.01	-	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-	-
Pyrene	mg/kg	0.02	PAH in Soil	-	173.11	-	-	<0.02	<0.02	-	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	150.58	-	-	0.03	0.03	-	10	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	150.58	-	-	<0.01	<0.01	-													-
Asbestos	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	19	-	-	16	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	g/m3	0.005	SPLP Elements	<0.005	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042
Cadmium	g/m3	0.0001	SPLP Elements	0.0004	0.0004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0004
Chromium	g/m3	0.002	SPLP Elements	0.0036	0.0093	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	g/m3	0.002	SPLP Elements	0.032	0.047	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
Lead	g/m3	0.0005	SPLP Elements	0.1525	0.2391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056
Mercury	g/m3	0.001	SPLP Elements	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019
Nickel	g/m3	0.002	SPLP Elements	0.007	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Zinc	g/m3	0.01	SPLP Elements	0.15	0.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
7- Values taken from table 3.4.1 of the Australia and New Zealand Guidelines for Fresh and Marine Water Quality in accordance with Schedule 5 of the Canterbury Land and Water Regional Plan (exceeding cells in blue filling)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

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Map Identifier				35 Borehole						35 Hand Auger		NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
																Sand			Sandy Silt					
Reference	Units	LOR	Method	18-01469-20	18-01469-94	18-01469-93	18-01469-92	18-01469-91	18-01469-90	18-01469-76	18-01469-71					<1m	1-4m	>4m	<1m	1-4m	>4m			
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675													
Sample Description				35_0_0.3	35_0_1.2	35_0_2.0	35_0_2.4	35_0_2.8	35_0_4.8	35_HA Depth 0.5	35_HA Depth 1.5													
Sample Date				11/01/2018	16/01/2018	16/01/2018	16/01/2018	16/01/2018	16/01/2018	9/01/2018	9/01/2018													
Sample No.				20	94	93	92	91	90	76	71													
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular													
Depth				0.3	1.2	2	2.4	2.8	4.8	0.5	1.5													
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil													
Total Cyanide	mg/kg	0.2	Cyanide	0.3	0.4	1.38	<0.2	-	-	0.3	-	-	-	-	1000							-	-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	83.2	80	75.2	187***	4.39	2.33	21.4	3.61	20	80	-	-	-	-	-	-	-	-	100	13	-
Beryllium	mg/kg dry wt	0.013	Elements in Soil	10.4	7.39	8.15	2.35	0.82	0.61	1.83	0.69	-	-	*70*	-	-	-	-	-	-	-	200	-	-
Boron	mg/kg dry wt	1.25	Elements in Soil	498	479	587	274	14.2	10.6	76.5	3.09	>10000	>10000	-	-	-	-	-	-	-	-	400	8	-
Cadmium	mg/kg dry wt	0.005	Elements in Soil	10	4.57	5.45	14.1	0.82	0.16	1.98	0.055	3	400	-	-	-	-	-	-	-	-	20	0.07	*
Chromium	mg/kg dry wt	0.125	Elements in Soil	84.4	84.1	77.5	89.5	19.2	13.7	43.5	11.8	>10000	>10000	-	-	-	-	-	-	-	-	-	20	-
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	-	-	-	-	-	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-	-
Copper	mg/kg dry wt	0.075	Elements in Soil	634	772	1840	595	17.8	8.91	97.3	7.2	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8	-
Lead	mg/kg dry wt	0.05	Elements in Soil	8810***	6010***	*9300****	9300***	71.5	14.4	1300***	14.7	210	880	-	-	-	-	-	-	-	-	100	21.4	-
Mercury	mg/kg dry wt	0.025	Elements in Soil	1.1	8.2	8.4	0.94	0.22	0.11	1.4	0.066	310	1,800	-	-	-	-	-	-	-	-	4	0.09	-
Nickel	mg/kg dry wt	0.05	Elements in Soil	116	165	167	279	18.4	11.3	28.4	9.82	-	-	*400*	-	-	-	-	-	-	-	200	19	-
Zinc	mg/kg dry wt	0.05	Elements in Soil	6240	3090	4480	*11700****	374	68.7	959	43.8	-	-	*8000*	-	-	-	-	-	-	-	200	84	-
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	13.82	8.85	3.91	0.26	-	-	6.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	0.16	0.12	0.02	<0.01	-	-	0.02	-	-	-	-	-	58[v]	70[v]	80[v]	63[v]	83[v]	(130)[**,v]	200	-	-
Pyrene	mg/kg	0.02	PAH in Soil	24.48	33.3	5.77	1.09	-	-	5.5	-	-	-	-	-	(1600)[**,p]	NA[*]	NA[*]	(1600)[**,p]	NA[*]	NA[*]	-	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	25.9	17.76	5.51	0.56	-	-	8.7	-	10	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	25.9	17.76	5.51	0.56	-	-	8.7	-													-
Asbestos	-	-	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	28	19	16	31	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	7.4	7.4	-	-	-	6.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	g/m3	0.005	SPLP Elements	<0.005	0.009	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042
Cadmium	g/m3	0.0001	SPLP Elements	0.0005	0.0007	0.0003	0.0002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0004
Chromium	g/m3	0.002	SPLP Elements	0.0045	0.0095	0.0094	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	g/m3	0.002	SPLP Elements	0.03	0.087	0.007	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
Lead	g/m3	0.0005	SPLP Elements	0.0656	0.4587	0.0114	0.0024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056
Mercury	g/m3	0.001	SPLP Elements	<0.001	0.009	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019
Nickel	g/m3	0.002	SPLP Elements	<0.002	0.005	<0.002	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Zinc	g/m3	0.01	SPLP Elements	0.15	0.31	0.12	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeding values underlined)
7- Values taken from table 3.4.1 of the Australia and New Zealand Guidelines for Fresh and Marine Water Quality in accordance with Schedule 5 of the Canterbury Land and Water Regional Plan (exceeding cells in blue filling)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

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Map Identifier				35 Window Sample 1					35 Window Sample 2														
Reference	Units	LOR	Method	18-01469-53	18-01469-54	18-01469-58	18-01469-61	18-01469-63	18-01469-60	18-01469-68	18-01469-64	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675					Sand			Sandy Silt					
Sample Description				37_W1 Depth 0.1	37_W1 Depth 0.6	37_W1 Depth 1.5	37_W1 Depth 2.2	37_W1 Depth 2.6	37_W2 Depth 0.2	37_W2 Depth 1.5	37_W2 Depth 2.6					<1m	1-4m	>4m	<1m	1-4m	>4m			
Sample Date				8/01/2018	8/01/2018	9/01/2018	9/01/2018	9/01/2018	8/01/2018	9/01/2018	9/01/2018													
Sample No.				53	54	58	61	63	60	68	64													
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular													
Depth				0.1	0.6	1.5	2.2	2.6	0.2	1.5	2.6													
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil													
Total Cyanide	mg/kg	0.2	Cyanide	-	2.96	0.4	<0.2	-	-	<0.2	<0.2	-	-	-	1000							-	-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	13	24.4	92.3	25.2	1.82	7.74	3.89	2.73	20	80	-	-	-	-	-	-	-	-	100	13	-
Beryllium	mg/kg dry wt	0.013	Elements in Soil	1.74	2.67	4.32	1.32	0.86	1.13	0.76	0.61	-	-	*70*	-	-	-	-	-	-	-	200	-	-
Boron	mg/kg dry wt	1.25	Elements in Soil	44.7	149	282	37.7	6.72	6.31	3.65	4.3	>10000	>10000	-	-	-	-	-	-	-	-	400	8	-
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.61	1.15	2.28	0.82	0.028	0.054	0.025	0.042	3	400	-	-	-	-	-	-	-	-	20	0.07	*
Chromium	mg/kg dry wt	0.125	Elements in Soil	36.2	55.3	70.1	23.3	15	18.2	13.8	11.6	>10000	>10000	-	-	-	-	-	-	-	-	-	20	-
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-	-
Copper	mg/kg dry wt	0.075	Elements in Soil	192	1110	1600	496	11	13.5	7.14	9.27	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8	-
Lead	mg/kg dry wt	0.05	Elements in Soil	1220***	2100***	6280***	607***	23.3	49.6	11.5	39.9	210	880	-	-	-	-	-	-	-	-	100	21.4	-
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.17	0.37	0.81	0.12	0.072	0.091	0.059	0.06	310	1,800	-	-	-	-	-	-	-	-	4	0.09	-
Nickel	mg/kg dry wt	0.05	Elements in Soil	34.6	87.5	146	29.1	12.7	15.6	12	9.99	-	-	*400*	-	-	-	-	-	-	-	200	19	-
Zinc	mg/kg dry wt	0.05	Elements in Soil	784	1910	3410	725	57.3	76.5	40	50.5	-	-	*8000*	-	-	-	-	-	-	-	200	84	-
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	46.45	28.25	0.69	-	-	<0.01	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	0.13	0.09	<0.01	-	-	<0.01	<0.01	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-	-
Pyrene	mg/kg	0.02	PAH in Soil	-	31.91	27.67	0.78	-	-	<0.02	0.05	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	66.18	42.61	0.97	-	-	0.03	0.04	10	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	66.18	42.61	0.97	-	-	<0.01	0.03					-	-	-	-	-	-	-	-	-
Asbestos	-	-	-	-	-	-	-	-	-	No asbestos detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	10	11	27	-	-	15	11	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	7.2	-	-	-	6.1		-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	g/m3	0.005	SPLP Elements	0.008	0.009	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	0.042
Cadmium	g/m3	0.0001	SPLP Elements	0.0017	0.0005	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	0.0004
Chromium	g/m3	0.002	SPLP Elements	0.0063	0.0093	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	g/m3	0.002	SPLP Elements	0.036	0.093	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
Lead	g/m3	0.0005	SPLP Elements	0.4472	0.2211	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056
Mercury	g/m3	0.001	SPLP Elements	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019
Nickel	g/m3	0.002	SPLP Elements	0.005	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Zinc	g/m3	0.01	SPLP Elements	0.53	0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
7- Values taken from table 3.4.1 of the Australia and New Zealand Guidelines for Fresh and Marine Water Quality in accordance with Schedule 5 of the Canterbury Land and Water Regional Plan (exceeding cells in blue filling)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				41 Borehole				41 Window Sample																		
Reference	Units	LOR	Method	18-01469-27	18-02509	18-02509	18-02509	18-01469-33	18-01469-32	18-01469-29	18-01469-28	18-01469-31	18-01469-35	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
																		Sand			Sandy Silt					
																		<1m	1-4m	>4m	<1m	1-4m	>4m			
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675													
Sample Description				41_0 Depth 0.1	41_0_1.2	41_0_2.4	41_0_4.6	41_WNS Depth 0.1	41_WNS Depth 2.5	41_WNS Depth 3.5	41_WNS Depth 3.7	41_WNS Depth 4.2	41_WNS Depth 4.8													
Sample Date				10/01/2018	18/01/2018	18/01/2018	18/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018													
Sample No.				27	7	8	9	33	32	29	28	31	35													
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular													
Depth				0.1	1.2	2.4	4.6	0.1	2.5	3.5	3.7	4.2	4.8													
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil													
Total Cyanide	mg/kg	0.2	Cyanide	-	<0.2	<0.2	-	-	0.3	1.98	-	-	-	-	-	-	1000							-	-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	5.88	4.38	3.34	2.81	25.8	61.7	49.3	49.7	29.4	7.2	20	80	-	-	-	-	-	-	-	-	100	13	-
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.82	-	-	-	4.98	9.7	2.26	0.9	1.05	0.73	-	-	*70*	-	-	-	-	-	-	-	200	-	-
Boron	mg/kg dry wt	1.25	Elements in Soil	7.06	-	-	-	198	694	174	139	60.9	24.3	>10000	>10000	-	-	-	-	-	-	-	-	400	8	-
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.059	0.024	0.023	0.021	6.33	4.32	6.89	10.5	1.98	0.14	3	400	-	-	-	-	-	-	-	-	20	0.07	*
Chromium	mg/kg dry wt	0.125	Elements in Soil	16.6	14.4	11.6	11.5	44	68.9	64.2	29.9	19	13.1	>10000	>10000	-	-	-	-	-	-	-	-	-	20	-
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-	-
Copper	mg/kg dry wt	0.075	Elements in Soil	11.6	6.81	5.58	5.75	489	4250	933	361	166	34.6	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8	-
Lead	mg/kg dry wt	0.05	Elements in Soil	28.3	13.3	10.2	8.02	4410***	7180***	16500***	3250***	2500***	117	210	880	-	-	-	-	-	-	-	-	100	21.4	-
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.084	0.07	0.059	0.051	8.2	0.62	49	7.7	3.1	0.38	310	1,800	-	-	-	-	-	-	-	-	4	0.09	-
Nickel	mg/kg dry wt	0.05	Elements in Soil	13.8	12.4	9.41	9.63	56.7	250	*8980****	301	106	24.2	-	-	*400*	-	-	-	-	-	-	-	200	19	-
Zinc	mg/kg dry wt	0.05	Elements in Soil	64	41.3	32.8	36.5	2990	4880	4280	6890	1220	148	-	-	*8000*	-	-	-	-	-	-	-	200	84	-
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	-	0.07	19.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	-	<0.01	0.27	-	-	-	-	-	-	-	58[v]	70[v]	80[v]	63[v]	83[v]	(130)[**,v]	200	-	-
Pyrene	mg/kg	0.02	PAH in Soil	-	<0.02	<0.02	<0.02	-	0.15	53.06	-	-	-	-	-	-	-	(1600)[**,p]	NA[*]	NA[*]	(1600)[**,p]	NA[*]	NA[*]	-	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	0.03	0.03	0.03	-	0.11	30.03	-	-	-	10	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	-	0.11	30.03	-	-	-													-
Asbestos	-	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	14	3	15	-	15	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	6.4	-	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	g/m3	0.005	SPLP Elements	-	-	-	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042
Cadmium	g/m3	0.0001	SPLP Elements	-	-	-	-	0.0009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0004
Chromium	g/m3	0.002	SPLP Elements	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	g/m3	0.002	SPLP Elements	-	-	-	-	0.042	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
Lead	g/m3	0.0005	SPLP Elements	-	-	-	-	0.1271	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056
Mercury	g/m3	0.001	SPLP Elements	-	-	-	-	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019
Nickel	g/m3	0.002	SPLP Elements	-	-	-	-	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Zinc	g/m3	0.01	SPLP Elements	-	-	-	-	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015
									Shown on lab report as 41_ WND Depth 2.5		Shown on lab report as 41_ WND Depth 3.7															

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
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5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
7- Values taken from table 3.4.1 of the Australia and New Zealand Guidelines for Fresh and Marine Water Quality in accordance with Schedule 5 of the Canterbury Land and Water Regional Plan (exceeding cells in blue filling)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				43 Borehole				43 Hand Auger 1	43 Hand Auger 2						MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]								
															Sand			Sandy Silt					
Reference	Units	LOR	Method	18-01469-5	18-02509	18-02509	18-02509	18-02509	18-01469-3	18-01469-4	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	<1m	1-4m	>4m	<1m	1-4m	>4m	Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675													
Sample Description				43_0 Depth 0.1	43_0_1.2	43_0_3.4	43_0_4.5	43_HA2_0.1	43_HA Depth 0.1	43_HA Depth 1.2													
Sample Date				12/01/2018	19/01/2018	19/01/2018	19/01/2018	12/01/2018	12/01/2018	12/01/2018													
Sample No.				5	20	21	22	19	3	4													
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular													
Depth				0.1	1.2	3.4	4.5	0.1	0.1	1.2													
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil													
Total Cyanide	mg/kg	0.2	Cyanide	-	0.2	-	-		<0.2	<0.2	-	-	-	1000									
Arsenic	mg/kg dry wt	0.125	Elements in Soil	15	5.41	66.8	2.19	18.6	4.68	3.56	20	80	-	-	-	-	-	-	-	-	100	13	-
Beryllium	mg/kg dry wt	0.013	Elements in Soil	3.23	-	-	-	-	0.8	0.62	-	-	*70*	-	-	-	-	-	-	-	200	-	-
Boron	mg/kg dry wt	1.25	Elements in Soil	106	-	-	-	-	4.78	1.9	>10000	>10000	-	-	-	-	-	-	-	-	400	8	-
Cadmium	mg/kg dry wt	0.005	Elements in Soil	1.98	0.75	1.68	0.069	2.38	0.089	0.022	3	400	-	-	-	-	-	-	-	-	20	0.07	*
Chromium	mg/kg dry wt	0.125	Elements in Soil	34.9	40.3	78.1	14.2	40.7	14.4	11	>10000	>10000	-	-	-	-	-	-	-	-	-	20	-
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-	-
Copper	mg/kg dry wt	0.075	Elements in Soil	282	185	2730	11.9	275	7.94	5.76	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8	-
Lead	mg/kg dry wt	0.05	Elements in Soil	1810***	747***	5170***	15.9	2520***	28.6	10.1	210	880	-	-	-	-	-	-	-	-	100	21.4	-
Mercury	mg/kg dry wt	0.025	Elements in Soil	2.5	0.68	3.4	0.09	1.9	0.062	0.048	310	1,800	-	-	-	-	-	-	-	-	4	0.09	-
Nickel	mg/kg dry wt	0.05	Elements in Soil	42.7	64.5	161	11.9	53.7	11.8	10.4	-	*400*	-	-	-	-	-	-	-	-	200	19	-
Zinc	mg/kg dry wt	0.05	Elements in Soil	1290	429	2220	52.2	1560	65.3	35.8	-	-	*8000*	-	-	-	-	-	-	-	200	84	-
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	67.18	2.88	0.01	6.36	0.06	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	0.36	0.03	<0.01	0.05	<0.01	<0.01	-	-	-	-	58(v)	70(v)	80(v)	63(v)	83(v)	(130)(**,v)	200	-	-
Pyrene	mg/kg	0.02	PAH in Soil	-	57.24	4.24	<0.02	7.84	0.23	<0.02	-	-	-	-	(1600)(**,p)	NA(*)	NA(*)	(1600)(**,p)	NA(*)	NA(*)	-	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	105.63	4.01	0.03	8.74	0.1	0.03	40	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	105.63	4.01	0.01	8.74	0.09	<0.01													-
Asbestos	-	-	-	No Asbestos Detected (0.4)	-	Chrysotile (White Asbestos) Fibres (3.5)	No Asbestos Detected (4.7)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	8	18	41	22	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	g/m3	0.005	SPLP Elements	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042
Cadmium	g/m3	0.0001	SPLP Elements	0.0007	0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0004
Chromium	g/m3	0.002	SPLP Elements	0.0045	0.0064	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	g/m3	0.002	SPLP Elements	0.031	0.081	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
Lead	g/m3	0.0005	SPLP Elements	0.1156	0.3104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056
Mercury	g/m3	0.001	SPLP Elements	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019
Nickel	g/m3	0.002	SPLP Elements	<0.002	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Zinc	g/m3	0.01	SPLP Elements	0.14	0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015

Official Information Act 1982

Released under the

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
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TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Map Identifier				45 Hand Auger 1		45 Hand Auger A	45 Hand Auger B	45 Hand Auger C	45 Window Sample				NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
																	Sand			Sandy Silt				
Reference	Units	PQL	Method	18-01469-77	18-01469-73	18-06896	18-06896	18-06896	18-01469-55	18-01469-74	18-01469-78	18-01469-80					<1m	1-4m	>4m	<1m	1-4m	>4m		
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675												
Sample Description				45_H Depth 0.5	45_H Depth 1.5	HA_A_45_0.3	HA_B_45_0.1	HA_C_45_0.1	45_WNS Depth 0.1	45_WNS Depth 1.5	45_WNS Depth 2.5	45_WNS Depth 3.5												
Sample Date				9/01/2018	9/01/2018	27/02/2018	27/02/2018	27/02/2018	8/01/2018	9/01/2018	9/01/2018	9/01/2018												
Sample No.				77	73	9	12	13	55	74	78	80												
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular												
Depth				0.5	1.5	0.3	0.1	0.1	0.1	1.5	2.5	3.5												
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	<0.2	<0.2	-	-	-	-	<0.2	<0.2	-	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	6.3	3.87	5.17	18.5	9.17	10.7	4.75	2.76	3.43	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.87	0.68	-	-	-	0.83	0.89	0.64	0.6	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	3.9	2.34	-	-	-	12	2.32	1.89	1.61	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.15	0.024	0.13	0.39	0.41	0.26	0.021	0.02	0.023	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	15.4	12.9	16.5	20.4	19	17.7	15.1	10.2	11.1	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	-	<0.4	-	-	-	-	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	19.8	5.89	14.9	45.1	42.5	31.8	9.08	5.7	5.44	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	124	13	93.7	324***	215***	269***	14.4	8.38	11.4	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.11	0.042	-	-	-	0.23	0.064	0.047	0.051	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	12.3	10.8	12.6	13.9	12.3	14.1	13.3	9.07	9.12	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	127	38.3	105	237	290	199	45.7	35.2	37	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	0.51	<0.01	-	-	-	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	1.24	0.03	-	-	-	-	<0.02	<0.02	-	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	0.69	0.03	-	-	-	-	0.03	0.03		10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	0.68	<0.01	-	-	-	-	<0.01	<0.01													
Asbestos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	13	14	-	-	-	-	14	11	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Shown on lab report as 45_WW Depth 2.5

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Official Information Act 1982
Released under the

Map Identifier				47A Hand Auger 1		47A Hand Auger A	47A Hand Auger B														
Reference	Units	LOR	Method	18-01469-52	18-01469-1	18-06896	18-06896	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
Description				5137675	5137675	5137675	5137675					Sand			Sandy Silt				
Sample Description				47_HA Depth 0.1	47A_HA Depth 1.4	HA_A_47A_0.3	HA_B_47A_0.2					<1m	1-4m	>4m	<1m	1-4m	>4m		
Sample Date				8/01/2018	12/01/2018	27/02/2018	27/02/2018												
Sample No.				52	1	8	17												
QC Type				Regular	Regular	Regular	Regular												
Depth				0.1	1.4	0.3	0.2												
Submitted Sample Type				Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	0.4	<0.2	-	-	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	11.8	5.98	7.67	5.75	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	1.11	0.78	-	-	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	27.6	4.6	-	-	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.22	0.18	0.18	0.083	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	19.4	15.9	16.7	14.2	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	-	-	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	149	16.7	27.5	15	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	249***	113	104	40.9	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.094	0.081	-	-	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	27.3	12.4	15.1	11.6	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	246	134	141	77.7	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	1.63	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	<0.01	<0.01	-	-	-		-	-	58(v)	70(v)	80(v)	63(v)	83(v)	(130)(**,v)	200	-
Pyrene	mg/kg	0.02	PAH in Soil	1.75	0.39	-	-	-		-	-	(1600)(**,p)	NA(*)	NA(*)	(1600)(**,p)	NA(*)	NA(*)	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	2.19	0.23	-	-	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	2.19	0.23	-	-												
Asbestos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	18	21				-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Shown on lab report as 47A_W_Depth 0.1	Shown on lab report as 47A_WS_Depth 1.4														

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				223 Borehole				223 Hand Auger A	223 Hand Auger B				MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]							
													Sand			Sandy Silt				
Reference	Units	LOR	Method	18-01469-10	18-02509	18-02509	18-02509	18-06896	18-06896	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	<1m	1-4m	>4m	<1m	1-4m	>4m	Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
Description				5137675	5137675	5137675	5137675	5137675	5137675												
Sample Description				233_0 Depth 0.1	223_0_1.2	223_0_3.2	223_0_4.5	HA_A_223_0.3	HA_B_233_0.1												
Sample Date				10/01/2018	18/01/2018	18/01/2018	18/01/2018	27/02/2018	27/02/2018												
Sample No.				10	10	11	12	10	11												
QC Type				Regular	Regular	Regular	Regular	0.3	0.1												
Depth				0.1	1.2	3.2	4.5														
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	<0.2	<0.2	-	-	-	-	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	4.67	5.86	6.43	1.34	8.47	7.75	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.75	-	-	-	-	-	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	10.3	-	-	-	-	-	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.07	0.032	0.034	0.027	0.41	0.14	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	14.5	15.9	12.5	12.6	18.1	16.1	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	-	-	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	15.4	7.42	6.02	5.28	46.7	12	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	32.8	15.3	10.8	8.65	386***	58.6	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.068	0.069	0.051	0.047	-	-	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	11.8	13.4	10.6	10	15	12.5	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	71.2	49.7	38.7	38.5	331	117	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	0.02	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	0.08	<0.02	<0.02	<0.02	-	-	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	0.04	0.03	0.03	0.03	-		10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	0.03	<0.01	<0.01	<0.01	-													
Asbestos	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	20	18	21	19			-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				229 Window Sample			229 Hand Auger						MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]							
													Sand			Sandy Silt				
Reference	Units	LOR	Method	18-01469-9	18-01469-13	18-01469-12	18-01469-14	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	<1m	1-4m	>4m	<1m	1-4m	>4m	Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
Description				5137675	5137675	5137675	5137675													
Sample Description				229_H Depth 0.2	229_0 Depth 1.5	229_0 Depth 2.5	229_H Depth 0.1													
Sample Date				11/01/2018	11/01/2018	11/01/2018	11/01/2018													
Sample No.				9	13	12	14													
QC Type				Regular	Regular	Regular	Regular													
Depth				0.2	1.5	2.5	0.1													
Submitted Sample Type				Soil	Soil	Soil	Soil													
Total Cyanide	mg/kg	0.2	Cyanide	<0.2	<0.2	<0.2	0.4	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	42	3.8	5.4	25.1	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	6.75	0.73	0.75	4.73	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	438	5.36	5.9	284	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	1.25	0.025	0.035	4.32	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	79.1	12.8	14.1	56.8	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	-	-	-	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	6080	7.2	8.33	559	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	3400***	10.5	11.5	3840***	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.36	0.051	0.064	6.6	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	182	11.7	12.1	74.3	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	1990	38.2	44	3100	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	0.54	<0.01	<0.01	8.2	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	<0.01	<0.01	<0.01	0.05	-	-	-	-	58(v)	70(v)	80(v)	63(v)	83(v)	(130)(**,v)	200	-
Pyrene	mg/kg	0.02	PAH in Soil	1.29	<0.02	<0.02	12.23	-	-	-	-	(1600)(**,p)	NA(*)	NA(*)	(1600)(**,p)	NA(*)	NA(*)	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	0.81	0.03	0.03	12.05	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	0.81	<0.01	<0.01	12.05					-	-	-	-	-	-	-	-
Asbestos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	9	12	18	24	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				231 Borehole				231 Hand Auger		231 Window Sample															
Reference	Units	LOR	Method	18-01469-8	18-02509	18-02509	18-02509	18-01469-50	18-01469-47	18-01469-70	18-01469-7														
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675														
Sample Description				231_0 Depth 0.1	231_0_1.2	231_0_2.0	231_0_2.4	231_HA Depth 0.1	231_HA Depth 1.5	231_W Depth 0.1	231_W Depth 0.5														
Sample Date				11/01/2018	19/01/2018	19/01/2018	19/01/2018	10/01/2018	10/01/2018	9/01/2018	11/01/2018														
Sample No.				8	23	25	24	50	47	70	7														
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular														
Depth				0.1	1.2	2	2.4	0.1	1.5	0.1	0.5														
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil														
Total Cyanide	mg/kg	0.2	Cyanide	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	1000								-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	11	9.38	4.75	2.54	5.71	2.14	6.33	4.9	20	80	-	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.85	-	-	-	0.79	0.89	0.82	0.78	-	-	*70*	-	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	9.6	-	-	-	10.6	8.97	4.61	6.21	>10000	>10000	-	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.29	0.33	0.03	0.026	0.1	0.029	0.14	0.027	3	400	-	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	15.9	17.7	15.4	15.3	17.1	14.8	14.9	15.6	>10000	>10000	-	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	36	470	8.49	8.15	17	8.33	25.7	10.8	>10000	>10000	-	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	183	339***	12.6	12.7	61.5	19.7	94.7	16	210	880	-	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.18	0.23	0.085	0.072	0.08	0.087	0.086	0.11	310	1,800	-	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	13.1	15.1	13.1	12.1	13	11.8	12.3	12.2	-	-	*400*	-	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	172	231	41.7	32	69.9	42.9	88.2	40.9	-	-	*8000*	-	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	5.39	<0.01	<0.01	0.5	<0.01	1.74	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	58[v]	70[v]	80[v]	63[v]	83[v]	(130)[**,v]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	-	10.91	<0.02	<0.02	1.44	0.03	3.29	<0.02	-	-	-	-	(1600)[**,p]	NA[*]	NA[*]	(1600)[**,p]	NA[*]	NA[*]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	7.55	0.03	0.03	0.77	0.03	2.47	0.03	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	7.55	<0.01	<0.01	0.77	<0.01	2.47	<0.01														
Asbestos	-	-	-	-	No Asbestos Detected	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	14	23	20	18	18	8	20	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-

NES 2011 Residential 10% produce[1]

NES 2011 Recreation[1]

NEPM 2013 Residential A[2]

MfE Gasworks Guidelines Residential 10% produce[3]

MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]

Sand: <1m | 1-4m | >4m

Sandy Silt: <1m | 1-4m | >4m

Class A Landfill Acceptance Criteria[5]

Canterbury Regional Background Soil Concentrations[6]

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

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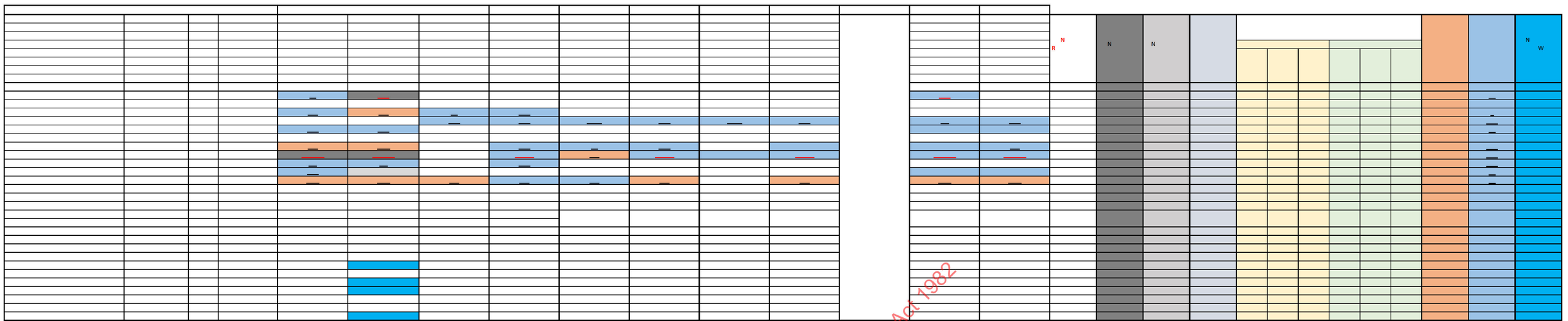
D



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Map Identifier				235 Hand Auger	235 Window Sample D				235 Window Sample S																		
Reference	Units	LOR	Method	18-01469-36	18-01469-45	18-01469-49	18-01469-46	18-01469-51	18-01469-43	18-01469-40	18-01469-38	18-01469-37	18-01469-44	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675					Sand			Sandy Silt						
Sample Description				235_HA Depth 0.1	235_WND Depth 0.3	235_WND Depth 1.5	235_WND Depth 2.5	235_WND Depth 3.5	235_WNS Depth 0.5	235_WNS Depth 1.5	235_WNS Depth 2.5	235_WNS Depth 3.0	235_WNS Depth 3.6					<1m	1-4m	>4m	<1m	1-4m	>4m					
Sample Date				10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018															
Sample No.				36	45	49	46	51	43	40	38	37	44															
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular															
Depth				0.1	0.3	1.5	2.5	3.5	0.5	1.5	2.5	3	3.6															
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil															
Total Cyanide	mg/kg	0.2	Cyanide	-	3.06	-	<0.2	-	0.4	-	<0.2	-	-	-	-	-	1000							-	-	-		
Arsenic	mg/kg dry wt	0.125	Elements in Soil	32.2	83	68.4	4.71	2.95	93.2	118***	26.3	68.2	11	20	80	-	-	-	-	-	-	-	-	-	100	13	-		
Beryllium	mg/kg dry wt	0.013	Elements in Soil	4.42	8.51	4.96	0.75	0.63	7.97	7.39	3.27	1.71	0.39	-	-	*70*	-	-	-	-	-	-	-	-	200	-	-		
Boron	mg/kg dry wt	1.25	Elements in Soil	256	529	435	26.4	9.19	533	576	200	345	115	>10000	>10000	-	-	-	-	-	-	-	-	-	400	8	-		
Cadmium	mg/kg dry wt	0.005	Elements in Soil	5.94	3.84	7.49	0.14	0.062	2.39	1.24	12.5	1.28	0.22	3	400	-	-	-	-	-	-	-	-	-	20	0.07	*		
Chromium	mg/kg dry wt	0.125	Elements in Soil	76.4	131	107	15.2	13	131	108	45.6	90.5	9.03	>10000	>10000	-	-	-	-	-	-	-	-	-	-	20	-		
Chromiun VI	mg/kg dry wt	1.125	Elements in Soil	<0.4	-	-	-	-	-	-	-	-	-	460	2700	-	-	-	-	-	-	-	-	-	100	-	-		
Copper	mg/kg dry wt	0.075	Elements in Soil	640	1870	5430	94.4	16.1	3030	3620	708	4870	31.9	>10000	>10000	-	-	-	-	-	-	-	-	-	100	18.8	-		
Lead	mg/kg dry wt	0.05	Elements in Soil	5490***	8730***	11500***	90.6	22.5	7620***	4630***	6290***	1630***	64.4	210	880	-	-	-	-	-	-	-	-	-	100	21.4	-		
Mercury	mg/kg dry wt	0.025	Elements in Soil	6.2	1.5	0.3	0.083	0.079	1.8	0.27	0.75	0.34	0.068	310	1,800	-	-	-	-	-	-	-	-	-	4	0.09	-		
Nickel	mg/kg dry wt	0.05	Elements in Soil	81.3	178	213	14.4	12.1	155	321	126	*3510****	9.78	-	-	*400*	-	-	-	-	-	-	-	-	200	19	-		
Zinc	mg/kg dry wt	0.05	Elements in Soil	3260	5860	11700***	133	50.7	6360	3120	7100	1400	114	-	-	*8000*	-	-	-	-	-	-	-	-	200	84	-		
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	0.25	-	0.02	-	0.13	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Naphthalene	mg/kg	0.01	PAH in Soil	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	-	-	-	-	-	58[v]	70[v]	80[v]	63[v]	83[v]	(130)[**,v]	200	-	-		
Pyrene	mg/kg	0.02	PAH in Soil	-	0.6	-	0.07	-	0.17	-	<0.02	-	-	-	-	-	-	(1600)[**,p]	NA[*]	NA[*]	(1600)[**,p]	NA[*]	NA[*]	-	-	-		
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	0.51	-	0.04	-	0.22	-	0.03	-	-	10	40	-	-	-	-	-	-	-	-	-	-	-	-		
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	0.51	-	0.03	-	0.22	-	<0.01	-	-																
Asbestos				-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Moisture Content	%	1	Moisture	-	16	-	26	-	11	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
pH	pH	1	pH in Soil	-	-	-	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Arsenic	g/m3	0.005	SPLP Elements	-	<0.005	<0.005	-	-	0.01	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042		
Cadmium	g/m3	0.0001	SPLP Elements	-	0.0003	0.0002	-	-	0.0004	-	0.0003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0004		
Chromium	g/m3	0.002	SPLP Elements	-	<0.002	0.0051	-	-	0.011	-	0.0026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Copper	g/m3	0.002	SPLP Elements	-	0.003	0.058	-	-	0.15	-	0.019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018		
Lead	g/m3	0.0005	SPLP Elements	-	0.0084	0.0495	-	-	0.257	-	0.0539	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056		
Mercury	g/m3	0.001	SPLP Elements	-	<0.001	<0.001	-	-	<0.001	-	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019		
Nickel	g/m3	0.002	SPLP Elements	-	<0.002	<0.002	-	-	<0.002	-	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013		
Zinc	g/m3	0.01	SPLP Elements	-	0.12	0.05	-	-	0.21	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015		

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
7- Values taken from table 3.4.1 of the Australia and New Zealand Guidelines for Fresh and Marine Water Quality in accordance with Schedule 5 of the Canterbury Land and Water Regional Plan (exceeding cells in blue filling)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				235A Hand Auger	235A Borehole 1				235A Borehole 2			NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]	ANZECC 90% Fresh Water Schedule 5[7]
																Sand			Sandy Silt				
Reference	Units	PQL	Method	18-01469-19	18-02509	18-02509	18-02509	18-02509	18-02509	18-02509	18-02509					<1m	1-4m	>4m	<1m	1-4m	>4m		
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675												
Sample Description				235A_HA Depth 0.1	235A_01_0.1	235A_01_1.1	235A_01_2.4	235A_01_4.8	235A_02_1.2	235A_02_3.4	235A_02_4.1												
Sample Date				11/01/2018	19/01/2018	18/01/2018	18/01/2018	18/01/2018	19/01/2018	19/01/2018	19/01/2018												
Sample No.				19	26	13	14	15	27	28	29												
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular												
Depth				0.1	0.1	1.1	2.4	4.8	1.2	3.4	4.1												
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	0.5	0.4	<0.2	0.3	-	<0.2	-	-	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	22.6	30.5	43.8	21.1	2.5	89.4	7.22	7.77	20	80	-	-	-	-	-	-	-	-	100	13	-
Beryllium	mg/kg dry wt	0.013	Elements in Soil	4.23	-	-	-	-	-	-	-	-	-	*70*	-	-	-	-	-	-	-	200	-	-
Boron	mg/kg dry wt	1.25	Elements in Soil	195	-	-	-	-	-	-	-	>10000	>10000	-	-	-	-	-	-	-	-	400	8	-
Cadmium	mg/kg dry wt	0.005	Elements in Soil	2.98	5.71	2.04	0.87	0.067	0.87	0.99	0.88	3	400	-	-	-	-	-	-	-	-	20	0.07	*
Chromium	mg/kg dry wt	0.125	Elements in Soil	40.7	79.3	68.9	23.6	13.9	72.4	17.2	30.1	>10000	>10000	-	-	-	-	-	-	-	-	-	20	-
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-	-
Copper	mg/kg dry wt	0.075	Elements in Soil	387	902	2150	136	11.2	3390	32.7	153	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8	-
Lead	mg/kg dry wt	0.05	Elements in Soil	2430***	6870***	9540***	1300***	21.6	7200***	54.1	192	210	880	-	-	-	-	-	-	-	-	100	21.4	-
Mercury	mg/kg dry wt	0.025	Elements in Soil	3.6	1.9	0.38	0.087	0.085	0.19	0.1	0.17	310	1,800	-	-	-	-	-	-	-	-	4	0.09	-
Nickel	mg/kg dry wt	0.05	Elements in Soil	60.2	82.9	201	34.3	10.7	183	17.7	39.3	-	-	*400*	-	-	-	-	-	-	-	200	19	-
Zinc	mg/kg dry wt	0.05	Elements in Soil	1760	3560	2780	504	57.7	2450	404	333	-	-	*8000*	-	-	-	-	-	-	-	200	84	-
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	2.77	29.32	22.6	0.06	<0.01	0.03	0.07	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	0.02	0.22	0.11	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-	-
Pyrene	mg/kg	0.02	PAH in Soil	6.2	47.65	21.03	0.12	<0.02	0.04	0.14	0.25	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	4.1	42.08	30.66	0.09	0.03	0.05	0.11	0.22	10	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	4.1	42.08	30.66	0.08	<0.01	0.03	0.1	0.22													-
Asbestos	-	-	-	-	-	No Asbestos Detected (1.2)	-	No Asbestos Detected (4.6)	No Asbestos Detected (1.2)	-	No Asbestos Detected (4.2)	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	25	17	14	24	7	10	21	20	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	6.8	6.6	-	-	-	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	g/m3	0.005	SPLP Elements	0.006	0.009	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042
Cadmium	g/m3	0.0001	SPLP Elements	0.0005	0.0008	0.0008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0004
Chromium	g/m3	0.002	SPLP Elements	0.0092	0.011	0.0053	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	g/m3	0.002	SPLP Elements	0.029	0.061	0.134	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
Lead	g/m3	0.0005	SPLP Elements	0.1145	0.5126	0.3965	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0056
Mercury	g/m3	0.001	SPLP Elements	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019
Nickel	g/m3	0.002	SPLP Elements	<0.002	<0.002	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Zinc	g/m3	0.01	SPLP Elements	0.19	0.34	0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015
					Shown on lab report as 235_HA2_01_0.1				Shown on lab report as 235A_0_1.2	Shown on lab report as 235A_0_3.4	Shown on lab report as 235A_0_4.1													

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
7- Values taken from table 3.4.1 of the Australia and New Zealand Guidelines for Fresh and Marine Water Quality in accordance with Schedule 5 of the Canterbury Land and Water Regional Plan (exceeding cells in blue filling)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				237 Window Sample			237 Hand Auger															
Reference	Units	PQL	Method	18-01469-67	18-01469-39	18-01469-41	18-01469-30	18-01469-42	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]							Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
													Sand			Sandy Silt					
													<1m	1-4m	>4m	<1m	1-4m	>4m		
Description				5137675	5137675	5137675	5137675	5137675														
Sample Description				237_W Depth 0.1	237_W Depth 1.5	237_WND Depth 2.5	237_HA Depth 0.1	237_HA Depth 1.2														
Sample Date				9/01/2018	10/01/2018	10/01/2018	10/01/2018	10/01/2018														
Sample No.				67	39	41	30	42														
QC Type				Regular	Regular	Regular	Regular	Regular														
Depth				0.1	1.5	2.5	0.1	1.2														
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil														
Total Cyanide	mg/kg	0.2	Cyanide	-	<0.2	<0.2	<0.2	<0.2	-	-	-	1000									-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	14.1	4.15	3.25	6.03	6.7	20	80	-	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.93	0.81	0.69	0.76	0.83	-	-	*70*	-	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	12.4	3.6	9.98	9.75	6.42	>10000	>10000	-	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.64	0.032	0.021	0.26	0.054	3	400	-	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	20.6	13.6	12.7	15.4	14.3	>10000	>10000	-	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	38.5	5.92	8.7	18.5	7.16	>10000	>10000	-	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	153	14.3	13.2	63	17.8	210	880	-	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.11	0.06	0.059	0.24	0.068	310	1,800	-	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	16.4	11.7	11.1	20.7	10.9	-	-	*400*	-	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	248	45.2	42.1	148	53.9	-	-	*8000*	-	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	0.29	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	<0.01		-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	-	<0.02	<0.02	1.33	0.06		-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	0.03	0.03	0.46	0.03	10	40	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	0.46	<0.01														
Asbestos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	17	23	20	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released under the Official Information Act 1982

Map Identifier				1/3 Borehole															
Reference	Units	LOR	Method	18-01469-18	18-01469-85	18-01469-87	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
											Sand			Sandy Silt				
Description				5137675	5137675	5137675					<1m	1-4m	>4m	<1m	1-4m	>4m		
Sample Description				1/3_0 Depth 0.2	1/3_0_1.2	1/3_0_4.6												
Sample Date				11/01/2018	16/01/2018	16/01/2018												
Sample No.				18	85	87												
QC Type				Regular	Regular	Regular												
Depth				0.2	1.2	4.6												
Submitted Sample Type				Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	-	<0.2		-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	7.71	20.1	13.5	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.96	3.53	0.61	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	11.7	173	5.68	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.26	2.91	0.041	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	17.1	62.3	11.9	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	-	-	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	47	333	5.95	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	237 ***	2330 ***	60.7	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.12	2.4	0.063	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	17.3	97.7	9.92	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	187	1500	39.6	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	46.17	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	0.4	-	-	-	-	-	58(v)	70(v)	80(v)	63(v)	83(v)	(130)(**,v)	200	-
Pyrene	mg/kg	0.02	PAH in Soil	-	70.55	-	-	-	-	-	(1600)(**,p)	NA(*)	NA(*)	(1600)(**,p)	NA(*)	NA(*)	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	63.89	-	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	63.89	-												
Asbestos	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Released Under the Official Information Act 1982

Map Identifier				1/5 Borehole				1/5 Hand Auger		2/5 Window Sample														
Reference	Units	LOR	Method	18-01469-2	18-02509	18-02509	18-02509	18-01469-15	18-01469-16	18-01469-56	18-01469-75	18-01469-72	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
Description				5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675	5137675					Sand			Sandy Silt				
Sample Description				1/5_0_0.1	1/5_0_1.2	1/5_0_2.4	1/5_0_3.6	1/5_HA Depth 0.1	1/5_HA Depth 2.0	5A_WNS Depth 0.2	5A_WNS Depth 1.5	5A_WNS Depth 2.5					<1m	1-4m	>4m	<1m	1-4m	>4m		
Sample Date				12/01/2018	18/01/2018	18/01/2018	18/01/2018	11/01/2018	11/01/2018	8/01/2018	9/01/2018	9/01/2018												
Sample No.				-	2	1	3	15	16	56	75	72												
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular												
Depth				0.1	1.2	2.4	3.6	0.1	2	0.2	1.5	2.5												
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	-	<0.2	<0.2		<0.2	<0.2		<0.2	<0.2	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	10.4	5.71	0.983	3.13	10.2	3.56	7.41	6.59	2.82	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	1.07	-	-	-	0.73	0.69	0.79	0.88	0.58	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	17.9	-	-	-	8.62	6.42	7.91	2.32	1.77	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.19	0.02	0.028	0.025	0.12	0.022	0.18	0.026	0.021	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	17.4	17.4	11.6	11.8	15.4	12	15.9	14.5	10.8	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium (VI)	mg/kg dry wt	0.4	Cr6+ in Soil	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	157	7.51	5.48	5.8	11.1	7.52	15.6	8.21	5.11	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	209	17.2	8.85	7.42	35.3	10.5	97.3	12.3	9.19	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.095	0.088	0.043	0.039	0.065	0.067	0.12	0.068	0.043	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	29.1	14.8	10.1	9.74	12.9	10.6	12.2	12.2	9.08	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	213	51.7	36.7	36	82.9	38.5	119	44.6	34.1	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	<0.01	0.01	<0.01	0.05	<0.01	-	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	-	<0.02	0.05	<0.02	0.15	<0.02	-	<0.02	<0.02	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	0.03	0.03	0.03	0.09	0.03	-	0.03	0.03	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	<0.01	0.01	<0.01	0.08	<0.01	-	<0.01	<0.01												
Asbestos	-	-	-	-	No Asbestos Detected (1.4)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	16	21	20	22	20	-	22	23	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

Official Information Act 1982
Released under the

Map Identifier				2/7 Borehole				1/7 Hand Auger		NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]						Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
														Sand			Sandy Silt				
Reference	Units	LOR	Method	18-01469-25	18-02509	18-02509	18-02509	18-01469-17	18-01469-21					<1m	1-4m	>4m	<1m	1-4m	>4m		
Description				5137675	5137675	5137675	5137675	5137675	5137675												
Sample Description				2/7_0 Depth 0.2	2/7_0_1.2	2/7_0_2.3	2/7_0_4.4	1/7_HA Depth 0.1	1/7_HA Depth 1.5												
Sample Date					18/01/2018	18/01/2018	18/01/2018	11/01/2018	11/01/2018												
Sample No.				25	4	5	6	17	21												
QC Type				Regular	Regular	Regular	Regular	Regular	Regular												
Depth				0.2	1.2	2.3	4.4	0.1	1.5												
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	-	-	-	-	0.2	<0.2	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	4.48	3.8	4.83	4.49	5.7	4.93	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.72	-	-	-	0.76	0.91	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	5.94	-	-	-	8.21	8.98	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.12	0.037	0.029	0.026	0.2	0.036	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	13.6	12.8	16.4	14.4	15	15.9	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	-	<0.4	<0.4	<0.4	-	-	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	-	5.48	9.46	5.38	11.2	9.55	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	69	12.5	14.4	10.2	108	18.7	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.06	0.045	0.089	0.049	0.069	0.076	310	1,800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	12.3	11.3	12.9	9.72	12.7	13.5	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	90.6	40.7	46.2	36.9	157	54.5	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	0.13	<0.01	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	-	<0.02	<0.02	<0.02	0.38	144.19	-	-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	0.03	0.03	0.03	0.19	0.03	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	0.19	<0.01												
Asbestos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	3	19	9	17	19	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	6.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

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Map Identifier				9 Window Sample			9 Hand Auger					MfE Tier 1 Soil Acceptance Criteria Residential All Pathways[4]							
												Sand			Sandy Silt				
Reference	Units	LOR	Method	18-01469-59	18-01469-81	18-01469-79	18-01469-22	18-01469-23	NES 2011 Residential 10% produce[1]	NES 2011 Recreation[1]	NEPM 2013 Residential A[2]	MfE Gasworks Guidelines Residential 10% produce[3]	<1m	1-4m	>4m	<1m	1-4m	>4m	Class A Landfill Acceptance Criteria[5]	Canterbury Regional Background Soil Concentrations[6]
Description				5137675	5137675	5137675	5137675	5137675												
Sample Description				9_WNS Depth 0.1	9_WNS Depth 1.5	9_WNS Depth 2.6	9_HA Depth 0.1	9_HA Depth 1.6												
Sample Date				8/01/2018	9/01/2018	9/01/2018	11/01/2018	11/01/2018												
Sample No.				59	81	79	22	23												
QC Type				Regular	Regular	Regular	Regular	Regular												
Depth				0.1	1.5	2.6	0.1	1.6												
Submitted Sample Type				Soil	Soil	Soil	Soil	Soil												
Total Cyanide	mg/kg	0.2	Cyanide	-	<0.2	<0.2	<0.2	<0.2	-	-	-	1000							-	-
Arsenic	mg/kg dry wt	0.125	Elements in Soil	4.67	5.18	4.82	4.67	5.58	20	80	-	-	-	-	-	-	-	-	100	13
Beryllium	mg/kg dry wt	0.013	Elements in Soil	0.72	0.91	0.87	0.76	1	-	-	*70*	-	-	-	-	-	-	-	200	-
Boron	mg/kg dry wt	1.25	Elements in Soil	7.9	2.4	2.32	8.11	7.93	>10000	>10000	-	-	-	-	-	-	-	-	400	8
Cadmium	mg/kg dry wt	0.005	Elements in Soil	0.16	0.027	0.029	0.071	0.028	3	400	-	-	-	-	-	-	-	-	20	0.07
Chromium	mg/kg dry wt	0.125	Elements in Soil	14.3	15.1	14.1	16	16.4	>10000	>10000	-	-	-	-	-	-	-	-	-	20
Chromium(VI)	mg/kg	0.4	Cr6+ in Soil	<0.4	<0.4	<0.4	<0.4	<0.4	460	2700	-	-	-	-	-	-	-	-	100	-
Copper	mg/kg dry wt	0.075	Elements in Soil	12.9	9.09	8.52	7.18	10.4	>10000	>10000	-	-	-	-	-	-	-	-	100	18.8
Lead	mg/kg dry wt	0.05	Elements in Soil	94.6	13.9	12.8	24.6	16.1	210	880	-	-	-	-	-	-	-	-	100	21.4
Mercury	mg/kg dry wt	0.025	Elements in Soil	0.063	0.092	0.067	0.057	0.075	310	1 800	-	-	-	-	-	-	-	-	4	0.09
Nickel	mg/kg dry wt	0.05	Elements in Soil	10.6	13.1	12.5	13.1	14.2	-	-	*400*	-	-	-	-	-	-	-	200	19
Zinc	mg/kg dry wt	0.05	Elements in Soil	111	51.2	49.1	73.7	53	-	-	*8000*	-	-	-	-	-	-	-	200	84
Benzo[a]pyrene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	0.02	<0.01		-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	<0.01	<0.01		-	-	-	58[(v)]	70[(v)]	80[(v)]	63[(v)]	83[(v)]	(130)[(**,v)]	200	-
Pyrene	mg/kg	0.02	PAH in Soil	-	<0.02	<0.02	0.13	<0.02		-	-	-	(1600)[(**,p)]	NA[(*)]	NA[(*)]	(1600)[(**,p)]	NA[(*)]	NA[(*)]	-	-
Benzo[a]pyrene TEQ (LOR)	mg/kg	0.01	PAH in Soil	-	0.03	0.03	0.05	0.03	10	40	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	mg/kg	0.01	PAH in Soil	-	<0.01	<0.01	0.04	<0.01												
Asbestos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture Content	%	1	Moisture	-	18	22	21	22	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH	1	pH in Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
						Shown on lab report as 9_W Depth 2.6														

Notes

1 - Values taken from tables B2 and B3 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (exceeding values in bold red or dark grey filling)
2- Values taken from table 1A(1) 'Health investigation levels for soil contaminants' of the National Environment Protection (Assessment of Site Contamination) Schedule B1. Investigation Levels For Soil and Groundwater (exceeding cells in light grey filling)
3- Values taken from table 4.2.7.3 of the Ministry for the Environment Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (exceeding cells in light blue filling)
4- Values taken from table 4.10 of the Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (exceeding cells in light yellow filling or light green filling)
5- Values taken from Appendix A : Total concentration and leachability limits for Class A and Class B landfills of Module 2 - Hazardous waste guidelines : Landfill waste acceptance criteria and landfill classification (exceeding cells in light orange filling)
6- Values taken from Table 1 of the Canterbury Regional Background Soil Concentrations for a recent soil type (exceeeding values underlined)
v - volatilisation
p - produce
* - NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
** - Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
*** - Concentrations also exceed the Class A Landfill Acceptance Criteria
TEQ - Toxic Equivalent Quotient
LOR - Limit of Reporting

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Reference	18-02509	18-02509	RPD*	18-02509	18-02509	RPD*	18-01469-1	18-01469-1	RPD*	18-01469-14	18-01469-14	RPD*	18-01469-28	18-01469-28	RPD*	18-06896	18-06896	RPD*
Description	5137675	5137675		5137675	5137675		5137675	5137675		5137675	5137675		5137675	5137675		5137675	5137675	
Sample Description	231_0_2.4	231_0_2.4		41_0_1.2	41_0_1.2		47A_WS_Depth 1.4	47A_WS_Depth 1.4		229_H Depth 0.1	229_H Depth 0.1		41_WND Depth 3.7	41_WND Depth 3.7		HA_B_233_0.1	HA_B_233_0.1	
Depth	2.4	2.2		1.2	1.2		1.4	1.4		0.1	0.1		3.7	3.7		0.2	0.2	
Submitted Sample Type	Soil	Soil		Soil	Soil		Soil	Soil		Soil	Soil		Soil	Soil		Soil	Soil	
Arsenic	2.54	2.58	2%	4.38	4.48	2%	<0.2	<0.2	-	0.40	-	-	-	-	-	7.75	7.54	3%
Cadmium	0.03	0.03	7%	0.02	0.03	12%	5.98	-	-	25.10	25.90	3%	49.70	57.70	15%	0.14	0.14	0%
Chromium	15.30	14.60	5%	14.40	15.00	4%	0.78	-	-	4.73	4.90	4%	0.90	0.95	5%	16.1	16.2	1%
Copper	8.15	7.44	9%	6.81	7.23	6%	4.60	-	-	284.00	274.00	4%	139.00	112.00	22%	12	12	0%
Lead	12.70	12.50	2%	13.30	14.10	6%	0.18	-	-	4.32	4.40	2%	10.50	12.50	17%	58.6	58.7	0%
Mercury	0.07	0.07	6%	0.07	0.08	7%	15.90	-	-	56.80	57.80	2%	29.90	35.10	16%	12.5	12.6	1%
Nickel	12.10	11.70	3%	12.40	12.50	1%	16.70	-	-	559.00	593.00	6%	361.00	380.00	5%	117	122	4%
Zinc	32.00	29.10	9%	41.30	42.20	2%	113.00	-	-	3840.00	6660.00	54%	3250.00	4050.00	22%	-	-	-
Chromium(VI)	<0.4	-	-	<0.4	-	-	0.08	-	-	6.60	7.20	9%	7.70	10.00	26%	-	-	-
Total Cyanide	<0.2	-	-	<0.2	-	-	12.40	-	-	74.30	71.20	4%	301.00	245.00	21%	-	-	-
Benzo[a]pyrene	<0.01	-	-	<0.01	-	-	0.14	0.18	25%	6.34	-	-	-	-	-	-	-	-
Naphthalene	<0.01	-	-	<0.01	-	-	0.10	0.12	18%	6.58	-	-	-	-	-	-	-	-
Pyrene	<0.02	-	-	<0.02	-	-	0.12	0.18	40%	4.14	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (LOR)	0.03	-	-	0.03	-	-	0.39	0.54	32%	12.23	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	<0.01	-	-	<0.01	-	-	0.23	-	-	12.05	-	-	-	-	-	-	-	-
pH	-	-	-	-	-	-	21.00	20.00	5%	24.00	-	-	-	-	-	-	-	-

Reference	18-01469-38	18-01469-38	RPD*	18-01469-50	18-01469-50	RPD*	18-01469-52	18-01469-52	RPD*	18-01469-76	18-01469-76	RPD*	18-01469-66	18-01469-66	RPD*	18-06896	18-06896	RPD*
Description	5137675	5137675		5137675	5137675		5137675	5137675		5137675	5137675		5137675	5137675		5137675	5137675	
Sample Description	135_WNS Depth 2.5	135_WNS Depth 2.5		231_HA Depth 0.1	231_HA Depth 0.1		47_A_W Depth 0.1	47_A_W Depth 0.1		35_H Depth 0.5	35_H Depth 0.5		17_WNS Depth 3.5	17_WNS Depth 3.5		HA_B_47A_0.2	HA_B_47A_0.2	
Depth	2.5	2.5		0.1	0.1		0.1	0.1		0.5	0.5		3.5	3.5		0.1	0.1	
Submitted Sample Type	Soil	Soil		Soil	Soil		Soil	Soil		Soil	Soil		Soil	Soil		Soil	Soil	
Arsenic	<0.2	-	-	<0.2	-	-	0.40	-	-	0.30	-	-	-	-	-	17	17	0%
Cadmium	26.30	23.40	12%	5.71	-	-	11.80	13.00	10%	21.40	20.00	7%	7.84	8.14	4%	5.75	5.63	2%
Chromium	3.27	3.29	1%	0.79	-	-	1.11	1.23	10%	1.83	1.70	7%	0.58	0.55	5%	0.083	0.078	6%
Copper	200.00	195.00	3%	10.60	-	-	27.60	32.30	16%	76.50	88.60	15%	2.66	2.27	16%	14.2	14.3	1%
Lead	12.50	11.50	8%	0.10	-	-	0.22	0.26	17%	1.98	2.03	2%	0.02	0.02	5%	15	15.1	1%
Mercury	45.60	44.10	3%	17.10	-	-	19.40	19.80	2%	43.50	48.20	10%	11.00	10.70	3%	40.9	40.3	1%
Nickel	708.00	649.00	9%	17.00		-	149.00	161.00	8%	97.30	96.10	1%	5.66	5.28	7%	11.6	11.7	1%
Zinc	6290.00	7440.00	17%	61.50		-	249.00	280.00	12%	1300.00	1120.00	15%	9.39	8.30	12%	77.7	78.4	1%
Chromium(VI)	0.75	0.65	14%	0.08	-	-	0.09	0.10	4%	1.40	1.40	0%	0.03	0.03	18%	-	-	-
Total Cyanide	126.00	121.00	4%	13.00	-	-	27.30	28.70	5%	28.40	29.90	5%	9.55	9.80	3%	-	-	-
Benzo[a]pyrene	<0.02	-	-	0.55	0.61	10%	1.26	-	-	4.15	-	-	-	-	-	-	-	-
Naphthalene	<0.01	-	-	0.34	0.34	0%	0.71	-	-	3.26	-	-	-	-	-	-	-	-
Pyrene	<0.01	-	-	0.60	0.52	14%	0.79	-	-	1.63	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (LOR)	<0.02	-	-	1.4	1.40	3%	1.75	-	-	5.50	-	-	-	-	-	-	-	-
Benzo[a]pyrene TEQ (Zero)	0.03	-	-	0.77	-	-	2.19	-	-	8.70	-	-	-	-	-	-	-	-
pH	21.00	-	-	18.00	-	-	18.00	-	-	19.00	-	-	-	-	-	-	-	-

RPD* - Relative Percentage Difference

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Analyte	Units	PQL	18-01469-82	18-01469-83
			5137675	5137675
			Rinsate 1	Trip Blanks
			Clean Water	Clean Water
Arsenic	g/m3	0.0005	<0.0005	<0.0005
Beryllium	g/m3	0.00001	<0.00001	<0.00001
Boron	g/m3	0.005	<0.005	**0.007**
Cadmium	g/m3	0.00001	<0.00001	<0.00001
Chromium	g/m3	0.0002	<0.0002	<0.0002
Copper	g/m3	0.0002	**0.0004**	<0.0002
Lead	g/m3	0.00005	**0.00008**	<0.00005
Mercury	g/m3	0.0001	<0.0001	<0.0001
Nickel	g/m3	0.0002	<0.0002	<0.0002
Zinc	g/m3	0.001	<0.001	**0.003**

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Appendix G – Laboratory Transcripts

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19-D-02771

ANALYTICA LABORATORIES

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Certificate of Analysis

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Lab Reference: 18-01469
Submitted by: David Jackson
Date Received: 17/01/2018
Date Completed: 30/01/2018
Order Number:
Reference: 5137675

Sampling Site:

Soil Aggregate Properties and Nutrients

	Client Sample ID		47A WS Depth 1.4	43_HA Depth 0.1	43_HA Depth 1.2	233_W Depth 1.5	231_W Depth 0.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-1	18-01469-3	18-01469-4	18-01469-6	18-01469-7
pH*	pH	*1*				7.3	6.6
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	<0.2	0.5	<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		229_H Depth 0.2	233_0 Depth 0.1	229_0 Depth 2.5	229_0 Depth 1.5	229_H Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-9	18-01469-10	18-01469-12	18-01469-13	18-01469-14
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	<0.2	<0.2	0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		5_HA Depth 0.1	5_HA Depth 2.0	7A_HA Depth 0.1	235A_HA Depth 0.1	35_0 Depth 0.3
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-15	18-01469-16	18-01469-17	18-01469-19	18-01469-20
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	0.2	0.5	0.3

Soil Aggregate Properties and Nutrients

	Client Sample ID		7A_HA Depth 1.5	9_HA Depth 0.1	9_HA Depth 1.6	235_HA Dup	41_WNS Depth 3.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-21	18-01469-22	18-01469-23	18-01469-26	18-01469-29
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	<0.2	<0.2	1.98

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Soil Aggregate Properties and Nutrients

19-D-02771

	Client Sample ID		237 HA Depth 0.1	41 WND Depth 2.5	135 WNS Depth 2.5	237_W Depth 1.5	237 WND Depth 2.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-30	18-01469-32	18-01469-38	18-01469-39	18-01469-41
pH*	pH	*1*		7.2			
Total Cyanide*	mg/kg	*0.2*	<0.2	0.3	<0.2	<0.2	<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		237_HA Depth 1.2	135_WNS Depth 0.5	135_WND Depth 0.3	135_WND Depth 2.5	231_HA Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-42	18-01469-43	18-01469-45	18-01469-46	18-01469-47
pH*	pH	*1*				6.8	
Total Cyanide*	mg/kg	*0.2*	<0.2	0.4	3.06	<0.2	<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		233 HA Depth 0.1	231 HA Depth 0.1	47 A W Depth 0.1	37_W1 Depth 0.6	37_W1 Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-48	18-01469-50	18-01469-52	18-01469-54	18-01469-58
pH*	pH	*1*					7.2
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	0.4	2.96	0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		37_W1 Depth 2.2	37_W2 Depth 2.6	17_WNS Depth 1.5	37_W2 Depth 1.5	17_WNS Depth 2.6
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-61	18-01469-64	18-01469-65	18-01469-68	18-01469-69
pH*	pH	*1*			6.8	6.1	
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	<0.2	<0.2	<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		231_W Depth 0.1	5A_WNS Depth 2.5	45_H Depth 1.5	45_WNS Depth 1.5	5A_WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-70	18-01469-72	18-01469-73	18-01469-74	18-01469-75
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	<0.2	<0.2	<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		35_H Depth 0.5	45_H Depth 0.5	45 WW Depth 2.5	9_W Depth 2.6	9 WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-76	18-01469-77	18-01469-78	18-01469-79	18-01469-81
pH*	pH	*1*	6.3				
Total Cyanide*	mg/kg	*0.2*	0.3	<0.2	<0.2	<0.2	<0.2

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Soil Aggregate Properties and Nutrients

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Client Sample ID			3A_0_1.2	17_0_1.2	35_0_2.4	35_0_2.0	35_0_1.2
Date Sampled							
Analyte	Unit	*Reporting Limit*	18-01469-85	18-01469-88	18-01469-92	18-01469-93	18-01469-94
pH*	pH	*1*	7.0			7.4	7.4
Total Cyanide*	mg/kg	*0.2*	<0.2	0.3	<0.2	1.38	0.4

Total Heavy Metals in Water

Client Sample ID			Rinsate 1	Trip Blanks
Date Sampled				
Analyte	Unit	*Reporting Limit*	18-01469-82	18-01469-83
Arsenic	g/m³	*0.0005*	<0.0005	<0.0005
Beryllium	g/m³	*0.00001*	<0.00001	<0.00001
Boron	g/m³	*0.005*	<0.005	0.007
Cadmium	g/m³	*0.00001*	<0.00001	<0.00001
Chromium	g/m³	*0.0002*	<0.0002	<0.0002
Copper	g/m³	*0.0002*	0.0004	<0.0002
Lead	g/m³	*0.00005*	0.00008	<0.00005
Mercury	g/m³	*0.0001*	<0.0001	<0.0001
Nickel	g/m³	*0.0002*	<0.0002	<0.0002
Zinc	g/m³	*0.001*	<0.001	0.003

Heavy Metals in Soil

Client Sample ID			47A WS Depth 1.4	5_0 Depth 0.1	43_HA Depth 0.1	43_HA Depth 1.2	43_0 Depth 0.1
Date Sampled							
Analyte	Unit	*Reporting Limit*	18-01469-1	18-01469-2	18-01469-3	18-01469-4	18-01469-5
Arsenic	mg/kg dry wt	*0.125*	5.98	10.4	4.68	3.56	15.0
Beryllium	mg/kg dry wt	*0.013*	0.78	1.07	0.80	0.62	3.23
Boron	mg/kg dry wt	*1.25*	4.60	17.9	4.78	1.90	106
Cadmium	mg/kg dry wt	*0.005*	0.18	0.19	0.089	0.022	1.98
Chromium	mg/kg dry wt	*0.125*	15.9	17.4	14.4	11.0	34.9
Copper	mg/kg dry wt	*0.075*	16.7	157	7.94	5.76	282
Lead	mg/kg dry wt	*0.05*	113	209	28.6	10.1	1,810
Mercury	mg/kg dry wt	*0.025*	0.081	0.095	0.062	0.048	2.5
Nickel	mg/kg dry wt	*0.05*	12.4	29.1	11.8	10.4	42.7
Zinc	mg/kg dry wt	*0.05*	134	213	65.3	35.8	1,290

Heavy Metals in Soil

Client Sample ID			233_W Depth 1.5	231_W Depth 0.5	231_0 Depth 0.1	229_H Depth 0.2	233_0 Depth 0.1
Date Sampled							
Analyte	Unit	*Reporting Limit*	18-01469-6	18-01469-7	18-01469-8	18-01469-9	18-01469-10
Arsenic	mg/kg dry wt	*0.125*	97.1	4.90	11.0	42.0	4.67
Beryllium	mg/kg dry wt	*0.013*	5.68	0.78	0.85	6.75	0.75
Boron	mg/kg dry wt	*1.25*	472	6.21	9.60	438	10.3
Cadmium	mg/kg dry wt	*0.005*	5.20	0.027	0.29	1.25	0.070
Chromium	mg/kg dry wt	*0.125*	80.3	15.6	15.9	79.1	14.5
Copper	mg/kg dry wt	*0.075*	5,300	10.8	36.0	6,080	15.4
Lead	mg/kg dry wt	*0.05*	6,580	16.0	183	3,400	32.8
Mercury	mg/kg dry wt	*0.025*	1.1	0.11	0.18	0.36	0.068
Nickel	mg/kg dry wt	*0.05*	680	12.2	13.1	182	11.8
Zinc	mg/kg dry wt	*0.05*	5,420	40.9	172	1,990	71.2

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Heavy Metals in Soil

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		Client Sample ID	233_W Depth 2.4	229_0 Depth 2.5	229_0 Depth 1.5	229_H Depth 0.1	5_HA Depth 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-01469-11	18-01469-12	18-01469-13	18-01469-14	18-01469-15
Arsenic	mg/kg dry wt	*0.125*	1.69	5.40	3.80	25.1	10.2
Beryllium	mg/kg dry wt	*0.013*	0.64	0.75	0.73	4.73	0.73
Boron	mg/kg dry wt	*1.25*	10.0	5.90	5.36	284	8.62
Cadmium	mg/kg dry wt	*0.005*	0.18	0.035	0.025	4.32	0.12
Chromium	mg/kg dry wt	*0.125*	13.1	14.1	12.8	56.8	15.4
Copper	mg/kg dry wt	*0.075*	9.41	8.33	7.20	559	11.1
Lead	mg/kg dry wt	*0.05*	20.7	11.5	10.5	3,840	35.3
Mercury	mg/kg dry wt	*0.025*	0.077	0.064	0.051	6.6	0.065
Nickel	mg/kg dry wt	*0.05*	17.0	12.1	11.7	74.3	12.9
Zinc	mg/kg dry wt	*0.05*	287	44.0	38.2	3,100	82.9

Heavy Metals in Soil

		Client Sample ID	5_HA Depth 2.0	7A_HA Depth 0.1	3A_0 Depth 0.2	235A_HA Depth 0.1	35_0 Depth 0.3
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-01469-16	18-01469-17	18-01469-18	18-01469-19	18-01469-20
Arsenic	mg/kg dry wt	*0.125*	3.56	5.70	7.71	22.6	83.2
Beryllium	mg/kg dry wt	*0.013*	0.69	0.76	0.96	4.23	10.4
Boron	mg/kg dry wt	*1.25*	6.42	8.21	11.7	195	498
Cadmium	mg/kg dry wt	*0.005*	0.022	0.20	0.26	2.98	10.0
Chromium	mg/kg dry wt	*0.125*	12.0	15.0	17.1	40.7	84.4
Copper	mg/kg dry wt	*0.075*	7.52	11.2	47.0	387	634
Lead	mg/kg dry wt	*0.05*	10.5	108	237	2,430	8,810
Mercury	mg/kg dry wt	*0.025*	0.067	0.069	0.12	3.6	1.1
Nickel	mg/kg dry wt	*0.05*	10.6	12.7	17.3	60.2	116
Zinc	mg/kg dry wt	*0.05*	38.5	157	187	1,760	6,240

Heavy Metals in Soil

		Client Sample ID	7A_HA Depth 1.5	9_HA Depth 0.1	9_HA Depth 1.6	17_0 Depth 0.4	7B_0 Depth 0.2
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-01469-21	18-01469-22	18-01469-23	18-01469-24	18-01469-25
Arsenic	mg/kg dry wt	*0.125*	4.93	4.67	5.58	12.2	4.48
Beryllium	mg/kg dry wt	*0.013*	0.91	0.76	1.0	1.91	0.72
Boron	mg/kg dry wt	*1.25*	8.98	8.11	7.93	38.4	5.94
Cadmium	mg/kg dry wt	*0.005*	0.036	0.071	0.028	1.24	0.12
Chromium	mg/kg dry wt	*0.125*	15.9	16.0	16.4	27.9	13.6
Copper	mg/kg dry wt	*0.075*	9.55	7.18	10.4	123	27.0
Lead	mg/kg dry wt	*0.05*	18.7	24.6	16.1	1,370	69.0
Mercury	mg/kg dry wt	*0.025*	0.076	0.057	0.075	0.72	0.060
Nickel	mg/kg dry wt	*0.05*	13.5	13.1	14.2	29.8	12.3
Zinc	mg/kg dry wt	*0.05*	54.5	73.7	53.0	670	90.6

Heavy Metals in Soil

		Client Sample ID	235_HA Dup	41_0 Depth 0.1	41 WND Depth 3.7	41 WNS Depth 3.5	237 HA Depth 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-01469-26	18-01469-27	18-01469-28	18-01469-29	18-01469-30
Arsenic	mg/kg dry wt	*0.125*	17.5	5.88	49.7	49.3	6.03
Beryllium	mg/kg dry wt	*0.013*	2.96	0.82	0.90	2.26	0.76

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Heavy Metals in Soil

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			Client Sample ID	235_HA Dup	41_0 Depth 0.1	41_WND Depth 3.7	41_WNS Depth 3.5	237_HA Depth 0.1
			Date Sampled					
Boron	mg/kg dry wt	*1.25*		118	7.06	139	174	9.75
Cadmium	mg/kg dry wt	*0.005*		2.06	0.059	10.5	6.89	0.26
Chromium	mg/kg dry wt	*0.125*		33.3	16.6	29.9	64.2	15.4
Copper	mg/kg dry wt	*0.075*		225	11.6	361	933	18.5
Lead	mg/kg dry wt	*0.05*		1,740	28.3	3,250	16,500	63.0
Mercury	mg/kg dry wt	*0.025*		2.0	0.084	7.7	49	0.24
Nickel	mg/kg dry wt	*0.05*		46.1	13.8	301	8,980	20.7
Zinc	mg/kg dry wt	*0.05*		1,210	64.0	6,890	4,280	148

Heavy Metals in Soil

			Client Sample ID	41 WNS Depth 4.2	41 WND Depth 2.5	41 WNS Depth 0.1	QC1	41 WNS Depth 4.8
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-31	18-01469-32	18-01469-33	18-01469-34	18-01469-35
Arsenic	mg/kg dry wt	*0.125*		29.4	61.7	25.8	126	7.20
Beryllium	mg/kg dry wt	*0.013*		1.05	9.70	4.98	7.14	0.73
Boron	mg/kg dry wt	*1.25*		60.9	694	198	567	24.3
Cadmium	mg/kg dry wt	*0.005*		1.98	4.32	6.33	3.33	0.14
Chromium	mg/kg dry wt	*0.125*		19.0	68.9	44.0	83.4	13.1
Copper	mg/kg dry wt	*0.075*		166	4,250	489	3,420	34.6
Lead	mg/kg dry wt	*0.05*		2,500	7,180	4,410	5,340	117
Mercury	mg/kg dry wt	*0.025*		3.1	0.62	8.2	0.36	0.38
Nickel	mg/kg dry wt	*0.05*		106	250	56.7	201	24.2
Zinc	mg/kg dry wt	*0.05*		1,220	4,880	2,990	4,010	148

Heavy Metals in Soil

			Client Sample ID	235_HA Depth 0.1	135_WNS Depth 3.0	135_WNS Depth 2.5	237_W Depth 1.5	135_WNS Depth 1.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-36	18-01469-37	18-01469-38	18-01469-39	18-01469-40
Arsenic	mg/kg dry wt	*0.125*		32.2	68.2	26.3	4.15	118
Beryllium	mg/kg dry wt	*0.013*		4.42	1.71	3.27	0.81	7.39
Boron	mg/kg dry wt	*1.25*		256	345	200	3.60	576
Cadmium	mg/kg dry wt	*0.005*		5.94	1.28	12.5	0.032	1.24
Chromium	mg/kg dry wt	*0.125*		76.4	90.5	45.6	13.6	108
Copper	mg/kg dry wt	*0.075*		640	4,870	708	5.92	3,620
Lead	mg/kg dry wt	*0.05*		5,490	1,630	6,290	14.3	4,630
Mercury	mg/kg dry wt	*0.025*		6.2	0.34	0.75	0.060	0.27
Nickel	mg/kg dry wt	*0.05*		81.3	3,510	126	11.7	321
Zinc	mg/kg dry wt	*0.05*		3,260	1,400	7,100	45.2	3,120

Heavy Metals in Soil

			Client Sample ID	237_WND Depth 2.5	237_HA Depth 1.2	135_WNS Depth 0.5	135_WNS Depth 3.6	135_WND Depth 0.3
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-41	18-01469-42	18-01469-43	18-01469-44	18-01469-45
Arsenic	mg/kg dry wt	*0.125*		3.25	6.70	93.2	11.0	83.0
Beryllium	mg/kg dry wt	*0.013*		0.69	0.83	7.97	0.39	8.51
Boron	mg/kg dry wt	*1.25*		9.98	6.42	533	115	529
Cadmium	mg/kg dry wt	*0.005*		0.021	0.054	2.39	0.22	3.84

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Heavy Metals in Soil

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			Client Sample ID	237_WND Depth 2.5	237_HA Depth 1.2	135_WNS Depth 0.5	135_WNS Depth 3.6	135_WND Depth 0.3
			Date Sampled					
Chromium	mg/kg dry wt	*0.125*		12.7	14.3	131	9.03	131
Copper	mg/kg dry wt	*0.075*		8.70	7.16	3,030	31.9	1,870
Lead	mg/kg dry wt	*0.05*		13.2	17.8	7,620	64.4	8,730
Mercury	mg/kg dry wt	*0.025*		0.059	0.068	1.8	0.068	1.5
Nickel	mg/kg dry wt	*0.05*		11.1	10.9	155	9.78	178
Zinc	mg/kg dry wt	*0.05*		42.1	53.9	6,360	114	5,860

Heavy Metals in Soil

			Client Sample ID	135 WND Depth 2.5	231 HA Depth 1.5	233 HA Depth 0.1	135 WND Depth 1.5	231 HA Depth 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-46	18-01469-47	18-01469-48	18-01469-49	18-01469-50
Arsenic	mg/kg dry wt	*0.125*		4.71	2.14	7.31	68.4	5.71
Beryllium	mg/kg dry wt	*0.013*		0.75	0.89	1.02	4.96	0.79
Boron	mg/kg dry wt	*1.25*		26.4	8.97	14.7	435	10.6
Cadmium	mg/kg dry wt	*0.005*		0.14	0.029	0.25	7.49	0.10
Chromium	mg/kg dry wt	*0.125*		15.2	14.8	17.2	107	17.1
Copper	mg/kg dry wt	*0.075*		94.4	8.33	26.2	5,430	17.0
Lead	mg/kg dry wt	*0.05*		90.6	19.7	232	11,500	61.5
Mercury	mg/kg dry wt	*0.025*		0.083	0.087	0.24	0.30	0.080
Nickel	mg/kg dry wt	*0.05*		14.4	11.8	15.9	213	13.0
Zinc	mg/kg dry wt	*0.05*		133	42.9	161	11,200	69.9

Heavy Metals in Soil

			Client Sample ID	135_WND Depth 3.5	47_A_W Depth 0.1	37_W1 Depth 0.1	37_W1 Depth 0.6	45_WNS Depth 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-51	18-01469-52	18-01469-53	18-01469-54	18-01469-55
Arsenic	mg/kg dry wt	*0.125*		2.95	11.8	13.0	24.4	10.7
Beryllium	mg/kg dry wt	*0.013*		0.63	1.11	1.74	2.67	0.83
Boron	mg/kg dry wt	*1.25*		9.19	27.6	44.7	149	12.0
Cadmium	mg/kg dry wt	*0.005*		0.062	0.22	0.61	1.15	0.26
Chromium	mg/kg dry wt	*0.125*		13.0	19.4	36.2	55.3	17.7
Copper	mg/kg dry wt	*0.075*		16.1	149	192	1,110	31.8
Lead	mg/kg dry wt	*0.05*		22.5	249	1,220	2,100	269
Mercury	mg/kg dry wt	*0.025*		0.079	0.094	0.17	0.37	0.23
Nickel	mg/kg dry wt	*0.05*		12.1	27.3	34.6	87.5	14.1
Zinc	mg/kg dry wt	*0.05*		50.7	246	784	1,910	199

Heavy Metals in Soil

			Client Sample ID	5A WNS Depth 0.2	17 WNS Depth 0.1	37_W1 Depth 1.5	9_WNS Depth 0.1	37_W2 Depth 0.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-56	18-01469-57	18-01469-58	18-01469-59	18-01469-60
Arsenic	mg/kg dry wt	*0.125*		7.41	13.0	92.3	4.67	7.74
Beryllium	mg/kg dry wt	*0.013*		0.79	1.28	4.32	0.72	1.13
Boron	mg/kg dry wt	*1.25*		7.91	19.9	282	7.90	6.31
Cadmium	mg/kg dry wt	*0.005*		0.18	1.05	2.28	0.16	0.054
Chromium	mg/kg dry wt	*0.125*		15.9	28.3	70.1	14.3	18.2
Copper	mg/kg dry wt	*0.075*		15.6	96.4	1,600	12.9	13.5

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Heavy Metals in Soil

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			Client Sample ID	5A_WNS Depth 0.2	17_WNS Depth 0.1	37_W1 Depth 1.5	9_WNS Depth 0.1	37_W2 Depth 0.2
			Date Sampled					
Lead	mg/kg dry wt	*0.05*		97.3	858	6,280	94.6	49.6
Mercury	mg/kg dry wt	*0.025*		0.12	0.58	0.81	0.063	0.091
Nickel	mg/kg dry wt	*0.05*		12.2	26.6	146	10.6	15.6
Zinc	mg/kg dry wt	*0.05*		119	609	3,410	111	76.5

Heavy Metals in Soil

			Client Sample ID	37_W1 Depth 2.2	233_W Depth 0.1	37_W1 Depth 2.6	37_W2 Depth 2.6	17_WNS Depth 1.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-61	18-01469-62	18-01469-63	18-01469-64	18-01469-65
Arsenic	mg/kg dry wt	*0.125*		25.2	15.0	1.82	2.73	3.05
Beryllium	mg/kg dry wt	*0.013*		1.32	3.34	0.86	0.61	0.69
Boron	mg/kg dry wt	*1.25*		37.7	143	6.72	4.30	3.35
Cadmium	mg/kg dry wt	*0.005*		0.82	2.29	0.028	0.042	0.022
Chromium	mg/kg dry wt	*0.125*		23.3	34.8	15.0	11.6	11.2
Copper	mg/kg dry wt	*0.075*		496	685	11.0	9.27	6.23
Lead	mg/kg dry wt	*0.05*		607	2,100	23.3	39.9	9.42
Mercury	mg/kg dry wt	*0.025*		0.12	1.4	0.072	0.060	0.058
Nickel	mg/kg dry wt	*0.05*		29.1	42.3	12.7	9.99	9.72
Zinc	mg/kg dry wt	*0.05*		725	1,750	57.3	50.5	35.5

Heavy Metals in Soil

			Client Sample ID	17 WNS Depth 3.5	237_W Depth 0.1	37_W2 Depth 1.5	17 WNS Depth 2.6	231_W Depth 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-66	18-01469-67	18-01469-68	18-01469-69	18-01469-70
Arsenic	mg/kg dry wt	*0.125*		7.84	14.1	3.89	5.91	6.33
Beryllium	mg/kg dry wt	*0.013*		0.58	0.93	0.76	0.60	0.82
Boron	mg/kg dry wt	*1.25*		2.66	12.4	3.65	2.49	4.61
Cadmium	mg/kg dry wt	*0.005*		0.021	0.64	0.025	0.024	0.14
Chromium	mg/kg dry wt	*0.125*		11.0	20.6	13.8	10.3	14.9
Copper	mg/kg dry wt	*0.075*		5.66	38.5	7.14	4.86	25.7
Lead	mg/kg dry wt	*0.05*		9.39	153	11.5	9.20	94.7
Mercury	mg/kg dry wt	*0.025*		0.030	0.11	0.059	0.026	0.086
Nickel	mg/kg dry wt	*0.05*		9.55	16.4	12.0	8.85	12.3
Zinc	mg/kg dry wt	*0.05*		33.3	248	40.0	32.0	88.2

Heavy Metals in Soil

			Client Sample ID	35_H Depth 1.5	5A_WNS Depth 2.5	45_H Depth 1.5	45_WNS Depth 1.5	5A_WNS Depth 1.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-71	18-01469-72	18-01469-73	18-01469-74	18-01469-75
Arsenic	mg/kg dry wt	*0.125*		3.61	2.82	3.87	4.75	6.59
Beryllium	mg/kg dry wt	*0.013*		0.69	0.58	0.68	0.89	0.88
Boron	mg/kg dry wt	*1.25*		3.09	1.77	2.34	2.32	2.32
Cadmium	mg/kg dry wt	*0.005*		0.055	0.021	0.024	0.021	0.026
Chromium	mg/kg dry wt	*0.125*		11.8	10.8	12.9	15.1	14.5
Copper	mg/kg dry wt	*0.075*		7.20	5.11	5.89	9.08	8.21
Lead	mg/kg dry wt	*0.05*		14.7	9.19	13.0	14.4	12.3
Mercury	mg/kg dry wt	*0.025*		0.066	0.043	0.042	0.064	0.068

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Heavy Metals in Soil

19-D-02771

			Client Sample ID	35_H Depth 1.5	5A_WNS Depth 2.5	45_H Depth 1.5	45_WNS Depth 1.5	5A_WNS Depth 1.5
			Date Sampled					
Nickel	mg/kg dry wt	*0.05*		9.82	9.08	10.8	13.3	12.2
Zinc	mg/kg dry wt	*0.05*		43.8	34.1	38.3	45.7	44.6

Heavy Metals in Soil

			Client Sample ID	35_H Depth 0.5	45_H Depth 0.5	45 WW Depth 2.5	9_W Depth 2.6	45 WNS Depth 3.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-76	18-01469-77	18-01469-78	18-01469-79	18-01469-80
Arsenic	mg/kg dry wt	*0.125*		21.4	6.30	2.76	4.82	3.43
Beryllium	mg/kg dry wt	*0.013*		1.83	0.87	0.64	0.87	0.60
Boron	mg/kg dry wt	*1.25*		76.5	3.90	1.89	2.32	1.61
Cadmium	mg/kg dry wt	*0.005*		1.98	0.15	0.020	0.029	0.023
Chromium	mg/kg dry wt	*0.125*		43.5	15.4	10.2	14.1	11.1
Copper	mg/kg dry wt	*0.075*		97.3	19.8	5.70	8.52	5.44
Lead	mg/kg dry wt	*0.05*		1,300	124	8.38	12.8	11.4
Mercury	mg/kg dry wt	*0.025*		1.4	0.11	0.047	0.067	0.051
Nickel	mg/kg dry wt	*0.05*		28.4	12.3	9.07	12.5	9.12
Zinc	mg/kg dry wt	*0.05*		959	127	35.2	49.1	37.0

Heavy Metals in Soil

			Client Sample ID	9_WNS Depth 1.5	3A_0_1.2	3A_0_4.6	17_0_1.2	17_0_3.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-81	18-01469-85	18-01469-87	18-01469-88	18-01469-89
Arsenic	mg/kg dry wt	*0.125*		5.18	20.1	13.5	18.9	3.03
Beryllium	mg/kg dry wt	*0.013*		0.91	3.53	0.61	4.16	0.39
Boron	mg/kg dry wt	*1.25*		2.40	173	5.68	190	203
Cadmium	mg/kg dry wt	*0.005*		0.027	2.91	0.041	3.40	0.13
Chromium	mg/kg dry wt	*0.125*		15.1	62.3	11.9	57.1	5.11
Copper	mg/kg dry wt	*0.075*		9.09	333	5.95	582	16.3
Lead	mg/kg dry wt	*0.05*		13.9	2,330	60.7	3,090	14.9
Mercury	mg/kg dry wt	*0.025*		0.092	2.4	0.063	0.83	0.14
Nickel	mg/kg dry wt	*0.05*		13.1	97.7	9.92	79.9	7.33
Zinc	mg/kg dry wt	*0.05*		51.2	1,500	39.6	2,730	32.1

Heavy Metals in Soil

			Client Sample ID	35_0_4.8	35_0_2.8	35_0_2.4	35_0_2.0	35_0_1.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-90	18-01469-91	18-01469-92	18-01469-93	18-01469-94
Arsenic	mg/kg dry wt	*0.125*		2.33	4.39	187	75.2	80.0
Beryllium	mg/kg dry wt	*0.013*		0.61	0.82	2.35	8.15	7.39
Boron	mg/kg dry wt	*1.25*		10.6	14.2	274	587	479
Cadmium	mg/kg dry wt	*0.005*		0.16	0.82	14.1	5.45	4.57
Chromium	mg/kg dry wt	*0.125*		13.7	19.2	89.5	77.5	84.1
Copper	mg/kg dry wt	*0.075*		8.91	17.8	595	1,840	772
Lead	mg/kg dry wt	*0.05*		14.4	71.5	9,300	9,300	6,010
Mercury	mg/kg dry wt	*0.025*		0.11	0.22	0.94	8.4	8.2
Nickel	mg/kg dry wt	*0.05*		11.3	18.4	279	167	165
Zinc	mg/kg dry wt	*0.05*		68.7	374	11,700	4,480	3,090

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

	Client Sample ID		47A WS Depth 1.4	43_HA Depth 0.1	43_HA Depth 1.2	233_W Depth 1.5	231_W Depth 0.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-1	18-01469-3	18-01469-4	18-01469-6	18-01469-7
1-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*	<0.01	<0.01	<0.01	0.03	<0.01
Acenaphthylene	mg/kg	*0.01*	0.03	0.01	<0.01	0.56	<0.01
Anthracene	mg/kg	*0.01*	0.02	0.01	<0.01	0.39	<0.01
Benz[a]anthracene	mg/kg	*0.02*	0.14	0.07	<0.02	4.97	<0.02
Benzo[a]pyrene	mg/kg	*0.01*	0.15	0.06	<0.01	7.04	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	0.23	0.10	<0.02	8.62	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*	0.11	0.05	<0.02	6.63	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*	0.09	0.03	<0.01	3.18	<0.01
Chrysene	mg/kg	*0.01*	0.21	0.10	<0.01	4.20	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*	0.02	<0.01	<0.01	1.16	<0.01
Fluoranthene	mg/kg	*0.02*	0.38	0.23	<0.02	8.00	<0.02
Fluorene	mg/kg	*0.01*	<0.01	<0.01	<0.01	0.04	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	0.10	0.04	<0.01	6.48	<0.01
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	0.04	<0.01
Phenanthrene	mg/kg	*0.01*	0.12	0.09	<0.01	0.98	<0.01
Pyrene	mg/kg	*0.02*	0.39	0.23	<0.02	9.62	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.23	0.10	0.03	10.65	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	0.23	0.09	<0.01	10.65	<0.01
Anthracene-d10 (Surrogate)	%	*1*	99.5	104.9	101.8	102.5	101.9

Polycyclic Aromatic Hydrocarbons - Soil

	Client Sample ID		229_H Depth 0.2	233_0 Depth 0.1	229_0 Depth 2.5	229_0 Depth 1.5	229_H Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-9	18-01469-10	18-01469-12	18-01469-13	18-01469-14
1-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	0.04
2-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	0.03
Acenaphthene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	0.17
Acenaphthylene	mg/kg	*0.01*	0.07	<0.01	<0.01	<0.01	0.59
Anthracene	mg/kg	*0.01*	0.08	<0.01	<0.01	<0.01	0.80
Benz[a]anthracene	mg/kg	*0.02*	0.58	0.03	<0.02	<0.02	6.34
Benzo[a]pyrene	mg/kg	*0.01*	0.54	0.02	<0.01	<0.01	8.20
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	0.76	0.04	<0.02	<0.02	9.69
Benzo[g,h,i]perylene	mg/kg	*0.02*	0.35	<0.02	<0.02	<0.02	6.70
Benzo[k]fluoranthene	mg/kg	*0.01*	0.26	0.01	<0.01	<0.01	3.68
Chrysene	mg/kg	*0.01*	0.54	0.04	<0.01	<0.01	5.30
D benz(a,h)anthracene	mg/kg	*0.01*	0.07	<0.01	<0.01	<0.01	1.05
Fluoranthene	mg/kg	*0.02*	1.27	0.08	<0.02	<0.02	11.37
Fluorene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	0.18
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	0.35	0.02	<0.01	<0.01	6.58
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	0.05
Phenanthrene	mg/kg	*0.01*	0.37	0.04	<0.01	<0.01	4.14
Pyrene	mg/kg	*0.02*	1.29	0.08	<0.02	<0.02	12.23
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.81	0.04	0.03	0.03	12.05
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	0.81	0.03	<0.01	<0.01	12.05

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	229_H Depth 0.2	233_0 Depth 0.1	229_0 Depth 2.5	229_0 Depth 1.5	229_H Depth 0.1
			Date Sampled					
Anthracene-d10 (Surrogate)	%	*1*		102.3	102.8	102.4	101.2	104.5

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	5_HA Depth 0.1	5_HA Depth 2.0	7A_HA Depth 0.1	235A_HA Depth 0.1	35_0 Depth 0.3
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-15	18-01469-16	18-01469-17	18-01469-19	18-01469-20
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.01	0.16
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	0.13
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.06	0.25
Acenaphthylene	mg/kg	*0.01*		<0.01	<0.01	0.02	0.21	1.37
Anthracene	mg/kg	*0.01*		<0.01	<0.01	0.02	0.39	2.23
Benz[a]anthracene	mg/kg	*0.02*		0.06	<0.02	0.13	2.79	24.10
Benzo[a]pyrene	mg/kg	*0.01*		0.05	<0.01	0.13	2.77	13.82
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		0.09	<0.02	0.19	3.52	32.96
Benzo[g,h,i]perylene	mg/kg	*0.02*		0.04	<0.02	0.10	1.69	10.36
Benzo[k]fluoranthene	mg/kg	*0.01*		0.03	<0.01	0.07	1.22	6.30
Chrysene	mg/kg	*0.01*		0.07	<0.01	0.18	2.22	38.42
D benz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	0.01	0.31	2.49
Fluoranthene	mg/kg	*0.02*		0.15	<0.02	0.37	6.19	179.91
Fluorene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.08	0.36
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		0.04	<0.01	0.08	1.81	10.73
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.02	0.16
Phenanthrene	mg/kg	*0.01*		0.05	<0.01	0.14	2.33	12.95
Pyrene	mg/kg	*0.02*		0.15	<0.02	0.38	6.20	24.48
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.09	0.03	0.19	4.10	25.90
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		0.08	<0.01	0.19	4.10	25.90
Anthracene-d10 (Surrogate)	%	*1*		104.5	108.0	103.6	104.9	104.0

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	7A_HA Depth 1.5	9_HA Depth 0.1	9_HA Depth 1.6	235_HA Dup	41 WNS Depth 3.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-21	18-01469-22	18-01469-23	18-01469-26	18-01469-29
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	0.27
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	0.21
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.03	0.63
Acenaphthylene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.20	2.91
Anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.25	10.01
Benz[a]anthracene	mg/kg	*0.02*		<0.02	0.03	<0.02	2.42	19.82
Benzo[a]pyrene	mg/kg	*0.01*		<0.01	0.02	<0.01	2.51	19.39
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		<0.02	0.05	<0.02	3.28	21.97
Benzo[g,h,i]perylene	mg/kg	*0.02*		<0.02	0.02	<0.02	1.60	11.89
Benzo[k]fluoranthene	mg/kg	*0.01*		<0.01	0.01	<0.01	1.17	9.59
Chrysene	mg/kg	*0.01*		<0.01	0.07	<0.01	2.14	18.35
D benz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.25	3.46
Fluoranthene	mg/kg	*0.02*		<0.02	0.13	<0.02	5.15	57.68
Fluorene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.04	3.98

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	7A_HA Depth 1.5	9_HA Depth 0.1	9_HA Depth 1.6	235_HA Dup	41_WNS Depth 3.5
			Date Sampled					
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		<0.01	0.02	<0.01	1.51	12.81
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.02	0.27
Phenanthrene	mg/kg	*0.01*		<0.01	0.06	<0.01	1.38	43.24
Pyrene	mg/kg	*0.02*		144.19	0.13	<0.02	5.25	53.06
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.05	0.03	3.67	30.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		<0.01	0.04	<0.01	3.67	30.03
Anthracene-d10 (Surrogate)	%	*1*		103.1	100.9	97.9	102.5	106.4

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	237 HA Depth 0.1	41 WND Depth 2.5	135 WNS Depth 2.5	237_W Depth 1.5	237 WND Depth 2.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-30	18-01469-32	18-01469-38	18-01469-39	18-01469-41
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		0.02	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		0.05	0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*		0.13	0.02	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		0.40	0.06	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		0.29	0.07	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		0.45	0.13	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		0.23	0.08	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		0.16	0.04	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*		0.43	0.11	<0.01	<0.01	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*		0.03	0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		1.32	0.12	<0.02	<0.02	<0.02
Fluorene	mg/kg	*0.01*		0.04	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		0.19	0.06	<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		0.70	0.07	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		1.33	0.15	<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.46	0.11	0.03	0.03	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		0.46	0.11	<0.01	<0.01	<0.01
Anthracene-d10 (Surrogate)	%	*1*		104.8	103.8	101.6	97.6	104.1

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	237_HA Depth 1.2	135_WNS Depth 0.5	135_WND Depth 0.3	135_WND Depth 2.5	231_HA Depth 1.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-42	18-01469-43	18-01469-45	18-01469-46	18-01469-47
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		<0.01	0.02	0.11	<0.01	<0.01
Anthracene	mg/kg	*0.01*		<0.01	0.01	0.04	0.03	<0.01
Benz[a]anthracene	mg/kg	*0.02*		<0.02	0.07	0.36	0.03	<0.02

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	237_HA Depth 1.2	135_WNS Depth 0.5	135_WND Depth 0.3	135_WND Depth 2.5	231_HA Depth 1.5
			Date Sampled					
Benzo[a]pyrene	mg/kg	*0.01*		<0.01	0.13	0.25	0.02	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		<0.02	0.31	0.82	0.04	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		<0.02	0.24	0.50	0.03	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		<0.01	0.10	0.29	0.05	<0.01
Chrysene	mg/kg	*0.01*		0.03	0.17	0.46	0.03	0.02
D benz(a,h)anthracene	mg/kg	*0.01*		<0.01	0.03	0.06	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		0.06	0.19	0.56	0.08	0.03
Fluorene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		<0.01	0.18	0.42	0.02	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		0.03	0.08	0.13	0.03	<0.01
Pyrene	mg/kg	*0.02*		0.06	0.17	0.60	0.07	0.03
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.22	0.51	0.04	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		<0.01	0.22	0.51	0.03	<0.01
Anthracene-d10 (Surrogate)	%	*1*		98.5	100.8	100.7	108.6	97.9

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	233 HA Depth 0.1	231 HA Depth 0.1	47 A W Depth 0.1	37_W1 Depth 0.6	37_W1 Depth 1.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-48	18-01469-50	18-01469-52	18-01469-54	18-01469-58
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	0.01	0.04	0.03
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.04	0.03
Acenaphthene	mg/kg	*0.01*		0.02	0.02	0.02	0.19	0.10
Acenaphthylene	mg/kg	*0.01*		0.10	0.06	0.08	1.81	1.28
Anthracene	mg/kg	*0.01*		0.09	0.10	0.16	1.95	1.41
Benz[a]anthracene	mg/kg	*0.02*		0.74	0.55	1.26	29.07	21.38
Benzo[a]pyrene	mg/kg	*0.01*		0.74	0.50	1.63	46.45	28.25
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		1.05	0.66	1.51	42.15	28.19
Benzo[g,h,i]perylene	mg/kg	*0.02*		0.59	0.37	0.75	23.72	11.78
Benzo[k]fluoranthene	mg/kg	*0.01*		0.40	0.31	0.56	17.87	16.52
Chrysene	mg/kg	*0.01*		0.75	0.55	0.56	14.52	12.16
D benz(a,h)anthracene	mg/kg	*0.01*		0.07	0.07	0.14	7.86	6.12
Fluoranthene	mg/kg	*0.02*		1.99	1.44	1.74	33.04	28.03
Fluorene	mg/kg	*0.01*		0.03	0.03	0.03	0.33	0.21
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		0.47	0.34	0.71	24.87	12.28
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.13	0.09
Phenanthrene	mg/kg	*0.01*		0.63	0.60	0.79	7.78	7.18
Pyrene	mg/kg	*0.02*		2.01	1.44	1.75	31.91	27.67
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		1.10	0.77	2.19	66.18	42.61
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		1.10	0.77	2.19	66.18	42.61
Anthracene-d10 (Surrogate)	%	*1*		99.0	98.8	102.9	103.3	105.8

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

	Client Sample ID		37_W1 Depth 2.2	37_W2 Depth 2.6	17 WNS Depth 1.5	37_W2 Depth 1.5	17 WNS Depth 2.6
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-61	18-01469-64	18-01469-65	18-01469-68	18-01469-69
1-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*	0.05	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*	0.05	<0.01	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*	0.54	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*	0.69	0.02	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	0.83	0.04	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*	0.37	0.02	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*	0.32	0.01	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*	0.43	0.03	<0.01	<0.01	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*	0.06	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*	0.83	0.05	<0.02	<0.02	<0.02
Fluorene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	0.35	0.02	<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*	0.17	0.01	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*	0.78	0.05	<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.97	0.04	0.03	0.03	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	0.97	0.03	<0.01	<0.01	<0.01
Anthracene-d10 (Surrogate)	%	*1*	105.8	99.8	100.9	103.3	100.5

Polycyclic Aromatic Hydrocarbons - Soil

	Client Sample ID		231_W Depth 0.1	5A_WNS Depth 2.5	45_H Depth 1.5	45_WNS Depth 1.5	5A_WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-70	18-01469-72	18-01469-73	18-01469-74	18-01469-75
1-Methylnaphthalene	mg/kg	*0.01*	0.02	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*	0.15	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*	0.07	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*	0.58	<0.01	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*	1.93	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*	1.74	<0.01	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	1.84	<0.02	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*	0.70	<0.02	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*	0.83	<0.01	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*	1.00	<0.01	0.01	<0.01	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*	0.15	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*	3.46	<0.02	0.03	<0.02	<0.02
Fluorene	mg/kg	*0.01*	0.15	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	0.73	<0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*	2.33	<0.01	0.02	<0.01	<0.01
Pyrene	mg/kg	*0.02*	3.29	<0.02	0.03	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	2.47	0.03	0.03	0.03	0.03

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	231_W Depth 0.1	5A_WNS Depth 2.5	45_H Depth 1.5	45_WNS Depth 1.5	5A_WNS Depth 1.5
			Date Sampled					
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		2.47	<0.01	<0.01	<0.01	<0.01
Anthracene-d10 (Surrogate)	%	*1*		102.4	104.3	100.3	91.3	95.3

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	35_H Depth 0.5	45_H Depth 0.5	45_WW Depth 2.5	9_W Depth 2.6	9_WNS Depth 1.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-76	18-01469-77	18-01469-78	18-01469-79	18-01469-81
1-Methylnaphthalene	mg/kg	*0.01*		0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		0.03	0.02	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		0.32	0.04	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*		0.31	0.13	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		4.15	0.47	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		6.42	0.51	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		6.09	0.61	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		3.11	0.27	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		2.66	0.27	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*		2.28	0.45	<0.01	<0.01	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*		0.59	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		5.51	1.29	<0.02	<0.02	<0.02
Fluorene	mg/kg	*0.01*		0.05	0.0	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		3.26	0.24	<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*		0.02	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		1.63	0.98	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		5.50	1.24	<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		8.70	0.69	0.03	0.03	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		8.70	0.68	<0.01	<0.01	<0.01
Anthracene-d10 (Surrogate)	%	*1*		99.8	103.5	102.0	99.4	102.2

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	3A_0_1.2	17_0_1.2	35_0_2.4	35_0_2.0	35_0_1.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-85	18-01469-88	18-01469-92	18-01469-93	18-01469-94
1-Methylnaphthalene	mg/kg	*0.01*		0.17	0.18	<0.01	0.01	0.04
2-Methylnaphthalene	mg/kg	*0.01*		0.15	0.12	<0.01	<0.01	0.05
Acenaphthene	mg/kg	*0.01*		0.53	0.79	<0.01	0.04	0.14
Acenaphthylene	mg/kg	*0.01*		3.66	5.53	0.02	0.24	1.56
Anthracene	mg/kg	*0.01*		4.38	6.03	0.04	0.38	2.07
Benz[a]anthracene	mg/kg	*0.02*		46.52	91.83	0.80	4.65	26.98
Benzo[a]pyrene	mg/kg	*0.01*		46.17	110.81	0.26	3.91	8.85
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		56.08	112.93	1.12	5.11	28.87
Benzo[g,h,i]perylene	mg/kg	*0.02*		16.49	31.60	0.15	0.86	5.49
Benzo[k]fluoranthene	mg/kg	*0.01*		26.66	58.21	0.46	2.69	10.91
Chrysene	mg/kg	*0.01*		35.37	54.03	0.48	2.36	14.65
D benz(a,h)anthracene	mg/kg	*0.01*		2.16	4.69	0.03	0.14	0.99

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	3A_0_1.2	17_0_1.2	35_0_2.4	35_0_2.0	35_0_1.2
			Date Sampled					
Fluoranthene	mg/kg	*0.02*		74.49	184.75	1.11	6.27	34.16
Fluorene	mg/kg	*0.01*		1.26	1.47	0.01	0.07	0.32
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		15.41	63.99	0.25	1.23	7.61
Naphthalene	mg/kg	*0.01*		0.40	0.44	<0.01	0.02	0.12
Phenanthrene	mg/kg	*0.01*		27.81	43.88	0.11	2.29	7.24
Pyrene	mg/kg	*0.02*		70.55	173.11	1.09	5.77	33.30
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		63.89	150.58	0.56	5.51	17.76
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		63.89	150.58	0.56	5.51	17.76
Anthracene-d10 (Surrogate)	%	*1*		109.0	112.3	102.7	107.5	114.5

Moisture Content

			Client Sample ID	47A_WS_Depth 1.4	43_HA Depth 0.1	43_HA Depth 1.2	233_W Depth 1.5	231_W Depth 0.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-1	18-01469-3	18-01469-4	18-01469-6	18-01469-7
Moisture Content	%	*1*		21	20	10	9	20

Moisture Content

			Client Sample ID	229_H Depth 0.2	233_0 Depth 0.1	229_0 Depth 2.5	229_0 Depth 1.5	229_H Depth 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-9	18-01469-10	18-01469-12	18-01469-13	18-01469-14
Moisture Content	%	*1*		9	20	18	12	24

Moisture Content

			Client Sample ID	5_HA Depth 0.1	5_HA Depth 2.0	7A_HA Depth 0.1	235A HA Depth 0.1	35_0 Depth 0.3
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-15	18-01469-16	18-01469-17	18-01469-19	18-01469-20
Moisture Content	%	*1*		22	20	17	25	28

Moisture Content

			Client Sample ID	7A_HA Depth 1.5	9_HA Depth 0.1	9_HA Depth 1.6	235_HA Dup	41 WNS Depth 3.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-21	18-01469-22	18-01469-23	18-01469-26	18-01469-29
Moisture Content	%	*1*		19	21	22	25	32

Moisture Content

			Client Sample ID	237_HA Depth 0.1	41_WND Depth 2.5	135_WNS Depth 2.5	237_W Depth 1.5	237_WND Depth 2.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-01469-30	18-01469-32	18-01469-38	18-01469-39	18-01469-41
Moisture Content	%	*1*		20	15	21	17	23

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Moisture Content

19-D-02771

	Client Sample ID		237 HA Depth 1.2	135 WNS Depth 0.5	135 WND Depth 0.3	135 WND Depth 2.5	231 HA Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-42	18-01469-43	18-01469-45	18-01469-46	18-01469-47
Moisture Content	%	*1*	21	11	16	26	18

Moisture Content

	Client Sample ID		233_HA Depth 0.1	231_HA Depth 0.1	47_A_W Depth 0.1	37_W1 Depth 0.6	37_W1 Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-48	18-01469-50	18-01469-52	18-01469-54	18-01469-58
Moisture Content	%	*1*	10	18	18	10	11

Moisture Content

	Client Sample ID		37_W1 Depth 2.2	37_W2 Depth 2.6	17_WNS Depth 1.5	37_W2 Depth 1.5	17_WNS Depth 2.6
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-61	18-01469-64	18-01469-65	18-01469-68	18-01469-69
Moisture Content	%	*1*	27	11	16	15	23

Moisture Content

	Client Sample ID		231_W Depth 0.1	5A WNS Dept 2.5	45_H Depth 1.5	45 WNS Depth 1.5	5A WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-70	18-01469-72	18-01469-73	18-01469-74	18-01469-75
Moisture Content	%	*1*	8	23	14	14	22

Moisture Content

	Client Sample ID		35_H Depth 0.5	45_H Depth 0.5	45 WW Depth 2.5	9_W Depth 2.6	9 WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-76	18-01469-77	18-01469-78	18-01469-79	18-01469-81
Moisture Content	%	*1*	19	13	11	22	18

Moisture Content

	Client Sample ID		3A_0_1.2	17_0_1.2	35_0_2.4	35_0_2.0	35_0_1.2
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-01469-85	18-01469-88	18-01469-92	18-01469-93	18-01469-94
Moisture Content	%	*1*	13	19	31	16	19

Method Summary

pH in Soil	1:2.5 extraction with 0.1M calcium chloride followed by pH probe determination. Department of Sustainable Natural Resources.
Cyanide	Water extraction followed by acid distillation, distillate measured by colourmetric analysis. APHA Method 4500-CN C and E.
Recoverable Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following an acid digestion. US EPA method 200.8.
Elements in Soil	Acid digestion followed by ICP-MS analysis. US EPA method 200.8.

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Method Summary

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PAH in Soil	Solvent extraction, silica cleanup, followed by GC-MS analysis. **Benzo[a]pyrene TEQ (LOR)**: The most conservative TEQ estimate, where a result is reported as less than the limit of reporting (LOR) the LOR value is used to calculate the TEQ for that PAH. **Benzo[a]pyrene TEQ (Zero)**: The least conservative TEQ estimate, PAHs reported as less than the limit of reporting (LOR) are not included in the TEQ calculation. Benzo[a]pyrene toxic equivalence (TEQ) is calculated according to *'Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health'*. Ministry for the Enivronment. 2011.
Moisture	Moisture content is determined gravimetrically by drying at 103 °C.

Report Comments

Samples were received by Analytica Laboratories in acceptable condition unless otherwise noted on this report.

Sample 18-01469-29 (41_WNS Speth 3.5) demonstrated poor recovery for a matrix spike with cyanide analysis (<10%). The analysis was repeated and confirmed.
The method involves an acid distillation procedure which is a vigourous extraction protocol, hence a poor recovery would indicate either the formation of a highly insoluble cyanide complex or some form of breakdown of cyanide through the extraction procedure as a result of the sample matrix constitution.

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Order Number:
Reference: 5137675

Sampling Site: s 9(2)(a)

Heavy Metals in Soil

			Client Sample ID	5_0_2.4	5_0_1.2	5_0_3.6	7/2_0_1.2	7/2_0_2.3
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-02509-1	18-02509-2	18-02509-3	18-02509-4	18-02509-5
Arsenic	mg/kg dry wt	*0.125*		0.983	5.71	3.13	3.80	4.83
Cadmium	mg/kg dry wt	*0.005*		0.028	0.020	0.025	0.037	0.029
Chromium	mg/kg dry wt	*0.125*		11.6	17.4	11.8	12.8	16.4
Copper	mg/kg dry wt	*0.075*		5.48	7.51	5.80	5.48	9.46
Lead	mg/kg dry wt	*0.05*		8.85	17.2	7.42	12.5	14.4
Mercury	mg/kg dry wt	*0.025*		0.043	0.088	0.039	0.045	0.089
Nickel	mg/kg dry wt	*0.05*		10.1	14.8	9.74	11.3	12.9
Zinc	mg/kg dry wt	*0.05*		36.7	51.7	36.0	40.7	46.2

Heavy Metals in Soil

			Client Sample ID	7/2_0_4.4	41_0_1.2	41_0_2.4	41_0_4.6	223_0_1.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-02509-6	18-02509-7	18-02509-8	18-02509-9	18-02509-10
Arsenic	mg/kg dry wt	*0.125*		4.49	4.38	3.34	2.81	5.86
Cadmium	mg/kg dry wt	*0.005*		0.026	0.024	0.023	0.021	0.032
Chromium	mg/kg dry wt	*0.125*		14.4	14.4	11.6	11.5	15.9
Copper	mg/kg dry wt	*0.075*		5.38	6.81	5.58	5.75	7.42
Lead	mg/kg dry wt	*0.05*		10.2	13.3	10.2	8.02	15.3
Mercury	mg/kg dry wt	*0.025*		0.049	0.070	0.059	0.051	0.069
Nickel	mg/kg dry wt	*0.05*		9.72	12.4	9.41	9.63	13.4
Zinc	mg/kg dry wt	*0.05*		36.9	41.3	32.8	36.5	49.7

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Heavy Metals in Soil

19-D-02771

			Client Sample ID	223_0_3.2	223_0_4.5	235A_01_1.1	235A_01_2.4	235A_01_4.8
			Date Sampled					
Analyte		Unit	*Reporting Limit*	18-02509-11	18-02509-12	18-02509-13	18-02509-14	18-02509-15
Arsenic		mg/kg dry wt	*0.125*	6.43	1.34	43.8	21.1	2.50
Cadmium		mg/kg dry wt	*0.005*	0.034	0.027	2.04	0.87	0.067
Chromium		mg/kg dry wt	*0.125*	12.5	12.6	68.9	23.6	13.9
Copper		mg/kg dry wt	*0.075*	6.02	5.28	2,150	136	11.2
Lead		mg/kg dry wt	*0.05*	10.8	8.65	9,540	1,300	21.6
Mercury		mg/kg dry wt	*0.025*	0.051	0.047	0.38	0.087	0.085
Nickel		mg/kg dry wt	*0.05*	10.6	10.0	201	34.3	10.7
Zinc		mg/kg dry wt	*0.05*	38.7	38.5	2,780	504	57.7

Heavy Metals in Soil

			Client Sample ID	43_HA_0.1	43_0_1.2	43_0_3.4	43_0_4.5	231_0_1.2
			Date Sampled					
Analyte		Unit	*Reporting Limit*	18-02509-19	18-02509-20	18-02509-21	18-02509-22	18-02509-23
Arsenic		mg/kg dry wt	*0.125*	18.6	5.41	66.8	2.19	9.38
Cadmium		mg/kg dry wt	*0.005*	2.38	0.75	1.68	0.069	0.33
Chromium		mg/kg dry wt	*0.125*	40.7	40.3	78.1	14.2	17.7
Copper		mg/kg dry wt	*0.075*	275	185	2,730	11.9	470
Lead		mg/kg dry wt	*0.05*	2,520	747	5,170	15.9	339
Mercury		mg/kg dry wt	*0.025*	1.9	0.68	3.4	0.090	0.23
Nickel		mg/kg dry wt	*0.05*	53.7	64.5	161	11.9	15.1
Zinc		mg/kg dry wt	*0.05*	1,560	429	2,220	52.2	231

Heavy Metals in Soil

			Client Sample ID	231_0_2.4	231_0_2.0	235A_HA2_0.1	235A_0_1.2	235A_0_3.4
			Date Sampled					
Analyte		Unit	*Reporting Limit*	18-02509-24	18-02509-25	18-02509-26	18-02509-27	18-02509-28
Arsenic		mg/kg dry wt	*0.125*	2.54	4.75	30.5	89.4	7.22
Cadmium		mg/kg dry wt	*0.005*	0.026	0.030	5.71	0.87	0.99
Chromium		mg/kg dry wt	*0.125*	15.3	15.4	79.3	72.4	17.2
Copper		mg/kg dry wt	*0.075*	8.15	8.49	902	3,390	32.7
Lead		mg/kg dry wt	*0.05*	12.7	12.6	6,870	7,200	54.1
Mercury		mg/kg dry wt	*0.025*	0.072	0.085	1.9	0.19	0.10
Nickel		mg/kg dry wt	*0.05*	12.1	13.1	82.9	183	17.7
Zinc		mg/kg dry wt	*0.05*	32.0	41.7	3,560	2,450	404

Heavy Metals in Soil

			Client Sample ID	235A_0_4.1
			Date Sampled	
Analyte		Unit	*Reporting Limit*	18-02509-29
Arsenic		mg/kg dry wt	*0.125*	7.77
Cadmium		mg/kg dry wt	*0.005*	0.88
Chromium		mg/kg dry wt	*0.125*	30.1
Copper		mg/kg dry wt	*0.075*	153
Lead		mg/kg dry wt	*0.05*	192
Mercury		mg/kg dry wt	*0.025*	0.17
Nickel		mg/kg dry wt	*0.05*	39.3
Zinc		mg/kg dry wt	*0.05*	333

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Soil Aggregate Properties and Nutrients

19-D-02771

	Client Sample ID		5_0_2.4	5_0_1.2	5_0_3.6	7/2_0_1.2	7/2_0_2.3
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-02509-1	18-02509-2	18-02509-3	18-02509-4	18-02509-5
pH*	pH	*1*			6.0		
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2		<0.2	<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		7/2_0_4.4	41_0_1.2	41_0_2.4	41_0_4.6	223_0_1.2
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-02509-6	18-02509-7	18-02509-8	18-02509-9	18-02509-10
pH*	pH	*1*	6.4			6.4	
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4
Total Cyanide*	mg/kg	*0.2*		<0.2	<0.2		<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		223_0_3.2	223_0_4.5	235A_01_1.1	235A_01_2.4	235A_01_4.8
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-02509-11	18-02509-12	18-02509-13	18-02509-14	18-02509-15
pH*	pH	*1*			6.6		
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4
Total Cyanide*	mg/kg	*0.2*			<0.2	0.3	

Soil Aggregate Properties and Nutrients

	Client Sample ID		43_HA_0.1	43_0_1.2	43_0_3.4	43_0_4.5	231_0_1.2
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-02509-19	18-02509-20	18-02509-21	18-02509-22	18-02509-23
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4
Total Cyanide*	mg/kg	*0.2*		0.2			<0.2

Soil Aggregate Properties and Nutrients

	Client Sample ID		231_0_2.4	231_0_2.0	235A_HA2_0.1	235A_0_1.2	235A_0_3.4
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-02509-24	18-02509-25	18-02509-26	18-02509-27	18-02509-28
pH*	pH	*1*			6.8		6.7
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4
Total Cyanide*	mg/kg	*0.2*	<0.2	<0.2	0.4	<0.2	

Soil Aggregate Properties and Nutrients

	Client Sample ID		235A_0_4.1
	Date Sampled		
Analyte	Unit	*Reporting Limit*	18-02509-29
Chromium(VI)*	mg/kg	*0.4*	<0.4

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	5_0_2.4	5_0_1.2	5_0_3.6	7/2_0_1.2	7/2_0_2.3
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-02509-1	18-02509-2	18-02509-3	18-02509-4	18-02509-5
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*		0.01	<0.01	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		0.01	<0.01	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*		0.02	<0.01	<0.01	<0.01	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		0.05	<0.02	<0.02	<0.02	<0.02
Fluorene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		0.05	<0.01	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		0.05	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.03	0.03	0.03	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		0.01	<0.01	<0.01	<0.01	<0.01
Anthracene-d10 (Surrogate)	%	*1*		103.1	103.5	103.2	102.5	102.5

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	7/2_0_4.4	41_0_1.2	41_0_2.4	41_0_4.6	223_0_1.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-02509-6	18-02509-7	18-02509-8	18-02509-9	18-02509-10
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.03	0.03	0.03	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	7/2_0_4.4	41_0_1.2	41_0_2.4	41_0_4.6	223_0_1.2
			Date Sampled					
Anthracene-d10 (Surrogate)	%	*1*		103.4	102.8	104.5	102.5	102.7

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	223_0_3.2	223_0_4.5	235A_01_1.1	235A_01_2.4	235A_01_4.8
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-02509-11	18-02509-12	18-02509-13	18-02509-14	18-02509-15
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	0.04	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	0.03	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	0.14	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		<0.01	<0.01	1.30	0.01	<0.01
Anthracene	mg/kg	*0.01*		<0.01	<0.01	1.41	0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		<0.02	<0.02	12.42	0.05	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		<0.01	<0.01	22.60	0.06	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		<0.02	<0.02	17.26	0.06	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		<0.02	<0.02	13.77	0.05	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		<0.01	<0.01	6.06	0.01	<0.01
Chrysene	mg/kg	*0.01*		<0.01	<0.01	11.26	0.06	<0.01
D benz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	2.73	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		<0.02	<0.02	20.84	0.13	<0.02
Fluorene	mg/kg	*0.01*		<0.01	<0.01	0.22	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		<0.01	<0.01	14.40	0.04	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	0.11	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		<0.01	<0.01	5.66	0.05	<0.01
Pyrene	mg/kg	*0.02*		<0.02	<0.02	21.03	0.12	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.03	30.66	0.09	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		<0.01	<0.01	30.66	0.08	<0.01
Anthracene-d10 (Surrogate)	%	*1*		103.6	101.0	103.8	106.2	102.8

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	43_HA_0.1	43_0_1.2	43_0_3.4	43_0_4.5	231_0_1.2
			Date Sampled					
Analyte	Unit	*Reporting Limit*		18-02509-19	18-02509-20	18-02509-21	18-02509-22	18-02509-23
1-Methylnaphthalene	mg/kg	*0.01*		0.02	0.10	0.01	<0.01	0.03
2-Methylnaphthalene	mg/kg	*0.01*		0.02	0.09	<0.01	<0.01	0.02
Acenaphthene	mg/kg	*0.01*		0.06	0.21	0.01	<0.01	0.08
Acenaphthylene	mg/kg	*0.01*		0.49	4.72	0.22	<0.01	0.37
Anthracene	mg/kg	*0.01*		0.44	2.41	0.47	<0.01	1.26
Benz[a]anthracene	mg/kg	*0.02*		4.63	50.59	2.21	<0.02	5.25
Benzo[a]pyrene	mg/kg	*0.01*		6.36	67.18	2.88	0.01	5.39
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		5.46	90.67	2.57	<0.02	4.40
Benzo[g,h,i]perylene	mg/kg	*0.02*		4.20	38.59	1.80	<0.02	3.01
Benzo[k]fluoranthene	mg/kg	*0.01*		1.58	80.37	0.67	<0.01	1.30
Chrysene	mg/kg	*0.01*		3.30	28.24	1.72	<0.01	3.33
D benz(a,h)anthracene	mg/kg	*0.01*		0.63	12.25	0.32	<0.01	0.56
Fluoranthene	mg/kg	*0.02*		7.92	52.31	3.96	<0.02	10.76
Fluorene	mg/kg	*0.01*		0.08	0.37	0.06	<0.01	0.19
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		4.76	32.27	2.11	<0.01	3.61

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

	Client Sample ID		43_HA_0.1	43_0_1.2	43_0_3.4	43_0_4.5	231_0_1.2
	Date Sampled						
Naphthalene	mg/kg	*0.01*	0.05	0.36	0.03	<0.01	0.09
Phenanthrene	mg/kg	*0.01*	2.17	6.24	2.30	<0.01	5.54
Pyrene	mg/kg	*0.02*	7.84	57.24	4.24	<0.02	10.91
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	8.74	105.63	4.01	0.03	7.55
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	8.74	105.63	4.01	0.01	7.55
Anthracene-d10 (Surrogate)	%	*1*	105.2	104.0	105.1	106.7	103.8

Polycyclic Aromatic Hydrocarbons - Soil

	Client Sample ID		231_0_2.4	231_0_2.0	235A_HA2_0.1	235A_0_1.2	235A_0_3.4
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-02509-24	18-02509-25	18-02509-26	18-02509-27	18-02509-28
1-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	0.09	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*	<0.01	<0.01	0.08	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*	<0.01	<0.01	0.26	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*	<0.01	<0.01	1.80	<0.01	<0.01
Anthracene	mg/kg	*0.01*	<0.01	<0.01	2.17	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*	<0.02	<0.02	19.04	<0.02	0.08
Benzo[a]pyrene	mg/kg	*0.01*	<0.01	<0.01	29.32	0.03	0.07
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	<0.02	<0.02	22.04	0.03	0.09
Benzo[g,h,i]perylene	mg/kg	*0.02*	<0.02	<0.02	21.13	<0.02	0.05
Benzo[k]fluoranthene	mg/kg	*0.01*	<0.01	<0.01	8.72	<0.01	0.02
Chrysene	mg/kg	*0.01*	<0.01	<0.01	15.80	0.02	0.08
D benz(a,h)anthracene	mg/kg	*0.01*	<0.01	<0.01	4.86	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*	<0.02	<0.02	47.30	0.03	0.15
Fluorene	mg/kg	*0.01*	<0.01	<0.01	0.42	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	<0.01	<0.01	22.92	0.02	0.05
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	0.22	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*	<0.01	<0.01	11.20	<0.01	0.01
Pyrene	mg/kg	*0.02*	<0.02	<0.02	47.65	0.04	0.14
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.03	0.03	42.08	0.05	0.11
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	<0.01	<0.01	42.08	0.03	0.10
Anthracene-d10 (Surrogate)	%	*1*	104.0	103.5	102.9	103.6	103.8

Polycyclic Aromatic Hydrocarbons - Soil

	Client Sample ID		235A_0_4.1
	Date Sampled		
Analyte	Unit	*Reporting Limit*	18-02509-29
1-Methylnaphthalene	mg/kg	*0.01*	<0.01
2-Methylnaphthalene	mg/kg	*0.01*	<0.01
Acenaphthene	mg/kg	*0.01*	<0.01
Acenaphthylene	mg/kg	*0.01*	0.02
Anthracene	mg/kg	*0.01*	0.02
Benz[a]anthracene	mg/kg	*0.02*	0.13
Benzo[a]pyrene	mg/kg	*0.01*	0.15
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	0.16
Benzo[g,h,i]perylene	mg/kg	*0.02*	0.13

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Polycyclic Aromatic Hydrocarbons - Soil

19-D-02771

			Client Sample ID	235A_0_4.1
			Date Sampled	
Benzo[k]fluoranthene	mg/kg	*0.01*	0.04
Chrysene	mg/kg	*0.01*	0.13
D benz(a,h)anthracene	mg/kg	*0.01*	0.02
Fluoranthene	mg/kg	*0.02*	0.23
Fluorene	mg/kg	*0.01*	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	0.13
Naphthalene	mg/kg	*0.01*	<0.01
Phenanthrene	mg/kg	*0.01*	0.05
Pyrene	mg/kg	*0.02*	0.25
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.22
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	0.22
Anthracene-d10 (Surrogate)	%	*1*	103.1

Moisture Content

		Client Sample ID	5_0_2.4	5_0_1.2	5_0_3.6	7/2_0_1.2	7/2_0_2.3
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-02509-1	18-02509-2	18-02509-3	18-02509-4	18-02509-5
Moisture Content	%	*1*	21	16	20	3	19

Moisture Content

		Client Sample ID	7/2_0_4.4	41_0_1.2	41_0_2.4	41_0_4.6	223_0_1.2
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-02509-6	18-02509-7	18-02509-8	18-02509-9	18-02509-10
Moisture Content	%	*1*	9	14	3	15	18

Moisture Content

		Client Sample ID	223_0_3.2	223_0_4.5	235A_01_1.1	235A_01_2.4	235A_01_4.8
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-02509-11	18-02509-12	18-02509-13	18-02509-14	18-02509-15
Moisture Content	%	*1*	21	19	14	24	7

Moisture Content

		Client Sample ID	43_HA_0.1	43_0_1.2	43_0_3.4	43_0_4.5	231_0_1.2
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-02509-19	18-02509-20	18-02509-21	18-02509-22	18-02509-23
Moisture Content	%	*1*	22	8	18	41	14

Moisture Content

		Client Sample ID	231_0_2.4	231_0_2.0	235A_HA2_0.1	235A_0_1.2	235A_0_3.4
		Date Sampled					
Analyte	Unit	*Reporting Limit*	18-02509-24	18-02509-25	18-02509-26	18-02509-27	18-02509-28
Moisture Content	%	*1*	20	23	17	10	21

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Moisture Content

19-D-02771

		Client Sample ID	235A_0_4.1
		Date Sampled	
Analyte	Unit	*Reporting Limit*	18-02509-29
Moisture Content	%	*1*	20

Method Summary

Elements in Soil	Acid digestion followed by ICP-MS analysis. US EPA method 200.8.
pH in Soil	1:2.5 extraction with 0.1M calcium chloride followed by pH probe determination. Department of Sustainable Natural Resources.
Cr6+ in Soil	Extraction with 1.0M potassium dihydrogen phosphate solution followed by colourmetric analysis. Timber industry guidelines (1982).
Cyanide	Water extraction followed by acid distillation, distillate measured by colourmetric analysis. APHA Method 4500-CN C and E.
PAH in Soil	Solvent extraction, silica cleanup, followed by GC-MS analysis. **Benzo[a]pyrene TEQ (LOR)**: The most conservative TEQ estimate, where a result is reported as less than the limit of reporting (LOR) the LOR value is used to calculate the TEQ for that PAH. **Benzo[a]pyrene TEQ (Zero)**: The least conservative TEQ estimate. PAHs reported as less than the limit of reporting (LOR) are not included in the TEQ calculation. Benzo[a]pyrene toxic equivalence (TEQ) is calculated according to *'Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health'*. Ministry for the Enivronment. 2011.
Moisture	Moisture content is determined gravimetrically by drying at 103 °C.

Report Comments

Samples were received by Analytica Laboratories in acceptable condition unless otherwise noted on this report.

Sample 18-02509-27 (235A_0_1.2) demonstrated poor recovery for a matrix spike with cyanide analysis (<25%).

The method involves an acid distillation procedure which is a vigourous extraction protocol, hence a poor recovery would indicate either the formation of a highly insoluble cyanide complex or some form of breakdown of cyanide through the extraction procedure as a result of the sample matrix constitution.

Sharelle Frank, B.Sc. (Tech)
Technologist

Tom Featonby, (M.Sc.)
Technologist

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19-D-02771

ANALYTICA LABORATORIES

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Certificate of Analysis

GHD - Christchurch
138 Victoria Street
Christchurch
Attention: Hannah Galloway
Phone: 03 3780918
Email: david.jackson@ghd.com

Lab Reference: 18-03089
Submitted by: David Jackson
Date Received: 31/01/2018
Date Completed: 7/02/2018
Order Number:
Reference: 5137675

Sampling Site: s 9(2)(a)

Soil Aggregate Properties and Nutrients

	Client Sample ID		47A_WS_Depth 1.4	5_0 Depth 0.1	43_HA Depth 0.1	43_HA Depth 1.2	43_0 Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-1	18-03089-2	18-03089-3	18-03089-4	18-03089-5
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		233_W Depth 1.5	231_W Depth 0.5	231_0 Depth 0.1	229_H Depth 0.2	233_0 Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-6	18-03089-7	18-03089-8	18-03089-9	18-03089-10
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		233_W Depth 2.4	229_0 Depth 2.5	229_0 Depth 1.5	229_H Depth 0.1	5_HA Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-11	18-03089-12	18-03089-13	18-03089-14	18-03089-15
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		5_HA Depth 2.0	7A_HA Depth 0.1	3A_0 Depth 0.2	235A_HA Depth 0.1	35_0 Depth 0.3
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-16	18-03089-17	18-03089-18	18-03089-19	18-03089-20
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

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Soil Aggregate Properties and Nutrients

	Client Sample ID		7A_HA Depth 1.5	9_HA Depth 0.1	9_HA Depth 1.6	17_0 Depth 0.4	7B_0 Depth 0.2
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-21	18-03089-22	18-03089-23	18-03089-24	18-03089-25
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		235_HA Dup	41_0 Depth 0.1	41 WND Depth 3.7	41 WNS Depth 3.5	237 HA Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-26	18-03089-27	18-03089-28	18-03089-29	18-03089-30
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		41 WNS Depth 4.2	41 WND Depth 2.5	41 WNS Depth 0.1	QC1	41 WNS Depth 4.8
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-31	18-03089-32	18-03089-33	18-03089-34	18-03089-35
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		235 HA Depth 0.1	135 WNS Depth 3.0	135 WNS Depth 2.5	237_W Depth 1.5	135 WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-36	18-03089-37	18-03089-38	18-03089-39	18-03089-40
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		237 WND Depth 2.5	237 HA Depth 1.2	135 WNS Depth 0.5	135 WNS Depth 3.6	135 WND Depth 0.3
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-41	18-03089-42	18-03089-43	18-03089-44	18-03089-45
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		135 WND Depth 2.5	231 HA Depth 1.5	233 HA Depth 0.1	135 WND Depth 1.5	231 HA Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-46	18-03089-47	18-03089-48	18-03089-49	18-03089-50
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		135 WND Depth 3.5	47 A W Depth 0.1	37_W1 Depth 0.1	37_W1 Depth 0.6	45 WNS Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-51	18-03089-52	18-03089-53	18-03089-54	18-03089-55
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

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Soil Aggregate Properties and Nutrients

	Client Sample ID		5A WNS Depth 0.2	17 WNS Depth 0.1	37_W1 Depth 1.5	9_WNS Depth 0.1	37_W2 Depth 0.2
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-56	18-03089-57	18-03089-58	18-03089-59	18-03089-60
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		37_W1 Depth 2.2	233_W Depth 0.1	37_W1 Depth 2.6	37_W2 Depth 2.6	17 WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-61	18-03089-62	18-03089-63	18-03089-64	18-03089-65
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		17 WNS Depth 3.5	237_W Depth 0.1	37_W2 Depth 1.5	17 WNS Depth 2.6	231_W Depth 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-66	18-03089-67	18-03089-68	18-03089-69	18-03089-70
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		35_H Depth 1.5	5A WNS Depth 2.5	45_H Depth 1.5	45 WNS Depth 1.5	5A WNS Depth 1.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-71	18-03089-72	18-03089-73	18-03089-74	18-03089-75
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		35_H Depth 0.5	45_H Depth 0.5	45 WW Depth 2.5	9_W Depth 2.6	45 WNS Depth 3.5
	Date Sampled						
Analyte	Unit	*Reporting Limit*	18-03089-76	18-03089-77	18-03089-78	18-03089-79	18-03089-80
Chromium(VI)*	mg/kg	*0.4*	<0.4	<0.4	<0.4	<0.4	<0.4

Soil Aggregate Properties and Nutrients

	Client Sample ID		9 WNS Depth 1.5
	Date Sampled		
Analyte	Unit	*Reporting Limit*	18-03089-81
Chromium(VI)*	mg/kg	*0.4*	<0.4

Method Summary

Cr6+ in Soil	Extraction with 1.0M potassium dihydrogen phosphate solution followed by colourmetric analysis. Timber industry guidelines (1982).

Report Comments

Samples were received by Analytica Laboratories in acceptable condition unless otherwise noted on this report.

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19-D-02771

Sharelle Frank, B.Sc. (Tech)
Technologist

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PRECISE
CONSULTING & LABORATORY

Report Date: 13 Feb 2018

Certificate Number: P1802121326

Analytica Laboratories
Ruakura Research Centre, 10 Bisley Road, Private Bag 3123,

Client Reference: 18-01469

Dear Hariata Anderson,

Re: Asbestos Soil Identification Analysis – 18-01469

8 sample(s) received on 12 Feb 2018 by Karleen Glen.

The results of fibre analysis were performed by Laura Liu of Precise Consulting and Laboratory Ltd on 13 Feb 2018.

The sample(s) were stated to be from 18-01469.

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with *AS4964-2004 Method for the qualitative identification of asbestos in soil samples.*

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

Should you require further information please contact Laura Liu .

Yours sincerely

Laura Liu
PRECISE LABORATORY IDENTIFIER

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19-D-02771

Sample Analysis Results

Certificate Number: P1802121326
Report Date: 13 Feb 2018
Site Location: 18-01469

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Note 1: The reporting limit for this analysis is 0.1g/kg (0.01%) by application of polarised light microscopy, dispersion staining and trace analysis techniques.

Note 2: If mineral fibres of unknown type are detected (UMF), by PLM and dispersion staining, these may or may not be asbestos fibres. To confirm the identity of this fibre, another independent analytical technique such as XRD analysis is advised.

Note 3: The samples in this report are "As Received". The laboratory does not take responsibility for the sampling procedure or accuracy of sample location description. This document may not be reproduced except in full.

Identified by:

Reviewed by:

Approved Identifier: Laura Liu

Key Technical Person: Laura Liu

Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S001	233_W_1.5	233_W_1.5 Non-Homogeneous Soil 124.5g	No Asbestos Detected Organic Fibres
S002	231_ W_0.5	231_ W_0.5 Non-Homogeneous Soil 63.0g	No Asbestos Detected Organic Fibres
S003	41_WND _ 2.5	41_WND _ 2.5 Non-Homogeneous Soil 68.5g	No Asbestos Detected Organic Fibres
S004	135_WND_2.5	135_WND_2.5 Non-Homogeneous Soil 52.5g	No Asbestos Detected Organic Fibres
S005	17_WNS_1.5	17_WNS_1.5 Non-Homogeneous Soil 69.5g	No Asbestos Detected Organic Fibres
S006	37_W2_1.5	37_W2_1.5 Non-Homogeneous Soil 66.0g	No Asbestos Detected Organic Fibres
S007	35_H_0.5	35_H_0.5 Non-Homogeneous Soil 67.0g	No Asbestos Detected Organic Fibres
S008	3H_0_1.2	3H_0_1.2 Non-Homogeneous Soil 64.0g	No Asbestos Detected Organic Fibres

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Appendix 1: Soil Analysis Raw Data

Certificate Number: P1802121326
Report Date: 13 Feb 2018
Site Location: 18-01469

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Sample ID	Client Sample ID	Total Sample Weight (g)	ACM Approximate Dimensions (g)*	Form	Trace Asbestos Detected**
S001	233_W-1.5	124.5	No Asbestos Detected	N/A	N
S002	231_ W_0.5	63.0	No Asbestos Detected	N/A	N
S003	41_WND _ 2.5	68.5	No Asbestos Detected	N/A	N
S004	135_WND_2.5	52.5	No Asbestos Detected	N/A	N
S005	17_WNS_1.5	69.5	No Asbestos Detected	N/A	N
S006	37_W2_1.5	66.0	No Asbestos Detected	N/A	N
S007	35_H_0.5	67.0	No Asbestos Detected	N/A	N
S008	3H_0_1.2	64.0	No Asbestos Detected	N/A	N

* The reporting limit for this standard is 0.1g/kg
** Trace asbestos present is indicative that freely liberated respirable fibres are present and dust control measures should be implemented or increased

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Precise Consulting & Laboratory Limited
Unit 1, 30 Greenpark Road Penrose, Auckland 8023

P: 09 282 3886 W: www.preciseconsulting.co.nz

PRECISE
CONSULTING & LABORATORY

Report Date: 02 Feb 2018

Certificate Number: W1801301134

Analytica Laboratories
Ruakura Research Centre, 10 Bisley Road, Private Bag 3123,

Client Reference: 18-02509

Dear Hariata Anderson,

Re: Asbestos Soil Identification Analysis – 18-02509

9 sample(s) received on 30 Jan 2018 by Karleen Glen.

The results of fibre analysis were performed by Laura Liu of Precise Consulting and Laboratory Ltd on 02 Feb 2018.

The sample(s) were stated to be from 18-02509.

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with *AS4964-2004 Method for the qualitative identification of asbestos in soil samples.*

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

Should you require further information please contact Laura Liu .

Yours sincerely

Laura Liu
PRECISE LABORATORY IDENTIFIER

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19-D-02771

Sample Analysis Results

Certificate Number: W1801301134
Report Date: 02 Feb 2018
Site Location: 18-02509

PRECISE
CONSULTING & LABORATORY

Note 1: The reporting limit for this analysis is 0.1g/kg (0.01%) by application of polarised light microscopy, dispersion staining and trace analysis techniques.

Note 2: If mineral fibres of unknown type are detected (UMF), by PLM and dispersion staining, these may or may not be asbestos fibres. To confirm the identity of this fibre, another independent analytical technique such as XRD analysis is advised.

Note 3: The samples in this report are "As Received". The laboratory does not take responsibility for the sampling procedure or accuracy of sample location description. This document may not be reproduced except in full.

Identified by:

Reviewed by:

Approved Identifier: Laura Liu

Key Technical Person: Laura Liu

Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
5-0-1.4	5-0-1.4	- Non-Homogeneous Soil 516.0g	No Asbestos Detected Organic Fibres
235A-0.1-4.6	235A-0.1-4.6	- Non-Homogeneous Soil 587.5g	No Asbestos Detected Organic Fibres
235A-0.1-1.2	235A-0.1-1.2	- Non-Homogeneous Soil 305.0g	No Asbestos Detected Organic Fibres
231-0-1.2	231-0-1.2	- Non-Homogeneous Soil 337.0g	No Asbestos Detected Organic Fibres
43-0-0.4	43-0-0.4	- Non-Homogeneous Soil 350.5g	No Asbestos Detected Organic Fibres
43-0-4.7	43-0-4.7	- Non-Homogeneous Soil 290.5g	No Asbestos Detected Organic Fibres
235A-0.2-1.2	235A-0.2-1.2	- Non-Homogeneous Soil 404.5g	No Asbestos Detected Organic Fibres
235A-02-4.2	235A-02-4.2	- Non-Homogeneous Soil 416.5g	No Asbestos Detected Organic Fibres
43-0-3.5	43-0-3.5	- Non-Homogeneous Soil 114.0g	Chrysotile (white asbestos) Fibres Organic Fibres

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Appendix 1: Soil Analysis Raw Data

Certificate Number: W1801301134
Report Date: 02 Feb 2018
Site Location: 18-02509

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Sample ID	Client Sample ID	Sample Weights						>7mm Asbestos Containing Material (ACM)*		Asbestos Fines/Fibrous Asbestos*				Trace Asbestos Detected**
		Total 10L (Kg)	Total 500mL Sub-Sample (g)	>7mm Fraction (g)	2-7mm Fraction (g)	<2mm Sub Sample (g)	<2mm Excess (g)	>7mm ACM (g)	Form & %***	2-7mm ACM (g)	Form & %***	<2mm ACM (g)	Form & %***	
5-0-1.4	5-0-1.4	-	516.0	-	11.0	95.5	407.0	-	-	-	-	-	-	No
235A-0.1-4.6	235A-0.1-4.6	-	587.5	323.5	66.0	104.0	91.5	-	-	-	-	-	-	No
235A-0.1-1.2	235A-0.1-1.2	-	305.0	106.5	77.5	98.0	22.5	-	-	-	-	-	-	No
231-0-1.2	231-0-1.2	-	337.0	-	9.5	102.0	225.5	-	-	-	-	-	-	No
43-0-0.4	43-0-0.4	-	350.5	60.0	42.5	95.5	162.0	-	-	-	-	-	-	No
43-0-4.7	43-0-4.7	-	290.5	-	14.5	97.0	179.0	-	-	-	-	-	-	No
235A-0.2-1.2	235A-0.2-1.2	-	404.5	146.0	99.0	96.5	62.5	-	-	-	-	-	-	No
235A-02-4.2	235A-02-4.2	-	416.5	315.0	57.5	43.5	-	-	-	-	-	-	-	No
43-0-3.5	43-0-3.5	-	114.0	36.0	78.0	-	-	1.6106	100% Free Fibres	5.0120	100% Free Fibres	-	-	Yes

* These results are raw weighed data presented as per the Western Australian Guidelines and may be under the reporting limit for guidelines AS4964 of 0.1g/kg
** Trace asbestos detected is indicative that freely liberated respirable fibres are present and dust control measures should be implemented or increased on site. This is not the sole indicator for the friable nature of the asbestos present.
*** Asbestos percentage is determined using EPA-600-R-93-116: Method for the Determination of Asbestos in Bulk Building Materials and are outside of IANZ accreditation #1097 and is therefore not endorsed by IANZ.

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19-D-02771

ANALYTICA LABORATORIES

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Certificate of Analysis

GHD - Christchurch
138 Victoria Street
Christchurch
Attention: William Terry
Phone:
Email: william.terry@ghd.com

Lab Reference: 18-06896
Submitted by: William Terry
Date Received: 28/02/2018
Date Completed: 5/03/2018
Order Number:
Reference: 5137675

Sampling Site:

Heavy Metals in Soil

		Client Sample ID	HA_A_233_0.3	HA_B_233_0.3	HA_C_233_0.3	HA_D_233_0.3	HA_F_233_0.6
		Date Sampled	27/02/2018	27/02/2018	27/02/2018	27/02/2018	27/02/2018
Analyte	Unit	*Reporting Limit*	18-06896-1	18-06896-2	18-06896-3	18-06896-4	18-06896-7
Arsenic	mg/kg dry wt	*0.125*	7.02	5.78	8.03	7.66	36.1
Cadmium	mg/kg dry wt	*0.005*	0.091	0.51	0.098	0.42	2.50
Chromium	mg/kg dry wt	*0.125*	16.8	17.8	18.0	18.0	45.6
Copper	mg/kg dry wt	*0.075*	27.0	34.4	13.9	47.0	747
Lead	mg/kg dry wt	*0.05*	108	248	81.5	429	2,470
Nickel	mg/kg dry wt	*0.05*	13.7	13.2	12.1	15.9	69.3
Zinc	mg/kg dry wt	*0.05*	102	228	78.1	289	2,350

Heavy Metals in Soil

		Client Sample ID	HA_A_47A_0.3	HA_A_45_0.3	HA_A_223_0.3	HA_B_233_0.1	HA_B_45_0.1
		Date Sampled	27/02/2018	27/02/2018	27/02/2018	27/02/2018	27/02/2018
Analyte	Unit	*Reporting Limit*	18-06896-8	18-06896-9	18-06896-10	18-06896-11	18-06896-12
Arsenic	mg/kg dry wt	*0.125*	7.67	5.17	8.47	7.75	18.5
Cadmium	mg/kg dry wt	*0.005*	0.18	0.13	0.41	0.14	0.39
Chromium	mg/kg dry wt	*0.125*	16.7	16.5	18.1	16.1	20.4
Copper	mg/kg dry wt	*0.075*	27.5	14.9	46.7	12.0	45.1
Lead	mg/kg dry wt	*0.05*	104	93.7	386	58.6	324
Nickel	mg/kg dry wt	*0.05*	15.1	12.6	15.0	12.5	13.9
Zinc	mg/kg dry wt	*0.05*	141	105	331	117	237

Heavy Metals in Soil

		Client Sample ID	HA_C_45_0.1	HA_G_233_0.4	HA_B_47A_0.2
		Date Sampled	27/02/2018	27/02/2018	27/02/2018
Analyte	Unit	*Reporting Limit*	18-06896-13	18-06896-16	18-06896-17
Arsenic	mg/kg dry wt	*0.125*	9.17	12.9	5.75
Cadmium	mg/kg dry wt	*0.005*	0.41	1.74	0.083

IANZ ACCREDITED LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation, with the exception of tests marked *, which are not accredited.

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Heavy Metals in Soil

19-D-02771

			Client Sample ID	HA_C_45_0.1	HA_G_233_0.4	HA_B_47A_0.2
			Date Sampled	27/02/2018	27/02/2018	27/02/2018
Chromium	mg/kg dry wt	*0.125*		19.0	25.5	14.2
Copper	mg/kg dry wt	*0.075*		42.5	167	15.0
Lead	mg/kg dry wt	*0.05*		215	1,350	40.9
Nickel	mg/kg dry wt	*0.05*		12.3	24.7	11.6
Zinc	mg/kg dry wt	*0.05*		290	1,220	77.7

Total Heavy Metals in Water

		Client Sample ID	RB 27/2	TB2 27/2
		Date Sampled	27/02/2018	27/02/2018
Analyte	Unit	*Reporting Limit*	18-06896-14	18-06896-15
Arsenic	g/m³	*0.0005*	<0.0005	<0.0005
Cadmium	g/m³	*0.00001*	0.00002	<0.00001
Chromium	g/m³	*0.0002*	0.00031	<0.0002
Copper	g/m³	*0.0002*	<0.0002	<0.0002
Lead	g/m³	*0.00005*	<0.00005	<0.00005
Nickel	g/m³	*0.0002*	<0.0002	<0.0002
Zinc	g/m³	*0.001*	<0.001	<0.001

Method Summary

Elements in Soil	Acid digestion followed by ICP-MS analysis. US EPA method 200.8.
Recoverable Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following an acid digestion. US EPA method 200.8.

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

Elizabeth Fitzgerald, B.Sc.
Inorganics Team Leader

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Document3

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
01	WT	MB		Mark Ballard		21/03/2018
				CEnvP #0739		

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Ministry for the Environment
Manatū Mō Te Taiao

DOCUMENT 29

Memo

To: Shaun Lewis

File ref: 20/04/03/60312/03

From: Kim Wepasnick

Date: 24 November 2017

CC: Bruce Croucher

Re: Approval of the Contaminated Sites Remediation Fund Deed of Funding for Canterbury Regional Council's s 9(2)(a) Landfill Investigation project.

Purpose

1. To seek your approval of the Canterbury Region Council (Environment Canterbury (ECan)) Deed of Funding (the Deed) with a total Contaminated Sites Remediation Fund (CSRF) contribution of s 9(2)(b)(ii) (excl. GST) for their project entitled 's 9(2)(a) Landfil Investigation' (the Project).

2. The purpose of this project is for ECan to investigate and delineate the Hawford Road former landfill site and assess the risks to residents and the environment.

Background

3. The s 9(2)(a) Landfill (the Site) is located in s 9(2)(a) Christchurch within a residential area and was subject to landfilling in the 1900's.

4. Landowners were unaware of the contamination in the soil when the bought their properties. The landfill only came to the attention of ECan following the submission of detailed site investigations in 2015 for repair work from the 2011 Canterbury Earthquake.

5. The source of the fill is unknown, but initial investigations have found concentrations of lead, arsenic, chromium, copper, zinc and asbestos that exceed residential soil guideline values for the protection of human health.

6. On 30 May 2017, the Minister for the Environment approved ECan for up to s 9(2)(a), s 9(2)(b)(ii) (70% of total project costs) to be invited to Stage II (Project Planning) for their project. Stage II involves the development of a Project Management Plan (PMP) which includes agreeing to project objectives, milestone deliverables and a detailed budget. The PMP forms part of the Deed.

Project Management Plan

1. The Project has the following objectives:

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a. The assessment of the s 9(2)(a) Landfill is undertaken in manner that minimises any risk from the contaminants present to site workers and owner/occupiers

b. Determine the lateral and vertical extent of the s 9(2)(a) Landfill and characterise the contaminants within the fill materials.

c. Quantify the risk presented to human health and the environment from contamination associated with the historical landfilling activities.

d. Provide landowners and property occupants with information on the extent and severity of the contamination at their property.

2. The key task of the project is to conduct a Detailed Site Investigation that will enable the objectives above to be achieved. Therefore the PMP has one milestone claim for the project with the final Detailed Site Investigation report as the key deliverable as well as other standard Ministry reporting requirements.

Deed of Funding

3. Typically the landowner of the affected site would be party to the Deed; however, as the area of investigation is located across a number of residential properties, the Ministry allowed ECan seek permission from the land owners via a permission form rather than require them to be a signatory to the Deed. The permission form, which replaces Section 6 of the Deed and waives any liability from the Ministry, has been incorporated to the Deed (Annexure 2). .

4. The Deed and a Project Management Plan were drafted and on 2 November 2017, Adrienne Ellingham, Senior Solicitor, Ministry for the Environment, confirmed via email that she had reviewed this Deed and that it was in order for signing.

5. ECan have now successfully completed project planning and signed the Deed.

6. The Ministry is now requested to sign the Deed of Funding.

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Recommendations / Actions

I recommend that you:

a) **Approve** this funding by signing this memorandum and the attached Deed of Funding with a total Contaminated Sites Remediation Fund contribution of s 9(2)(b)(ii) (Excl. GST) between the Ministry for the Environment and Canterbury Regional Council for their project entitled 's 9(2)(a) Landfill Investigation.'

Recommended: **Yes / No**

Bruce Croucher
Manager (Acting)
Hono Kaupapa Here

Date:……..

Approved: **Yes / No**

Shaun Lewis
Director
Mana Honohono

Date:……..

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20-04-03-60306-01

2 June 2017

Conor Parker
Environment Canterbury
PO Box 345
Christchurch 8140

Tēnā koe Conor Parker

Ngā mihi I ngā tini āhuatanga o te wā,

Funding approval for s 9(2)(a) **project**

Thank you for your application to the Contaminated Sites Remediation Fund (CSRF). I am pleased to tell you that the Minister for the Environment has approved your application and granted you s 9(2)(b)(ii) from the fund.

The Ministry expects that the residents will be kept fully informed of the progress and findings of the project. The landfill will need be delineated as part of the project and a robust sampling plan will need to be developed in conjunction with setting good data quality objectives.

You will be required to submit a Project Management Plan (Project Plan) to the Ministry. The Ministry will supply you with a Project Plan template, but you are welcome to use your own as long as it shows how the outcomes from your application will be delivered.

Your Project Plan should also include sufficient detail on how you will manage:

- Risk management
- Health and Safety
- Quality Assurance
- Communication strategies with project stakeholders including a reporting schedule.

The project plan should also contain a schedule that clearly identifies the project milestones, and for each milestone the following details:

- the tasks to be completed
- the expected deliverables
- the completion dates, and
- the financial contributions (total and CSRF).

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After an acceptable Project Plan has been delivered to the Ministry we will contact you to discuss the development of a project funding agreement (funding deed) to outline the work that will be funded. Expenses incurred before the deed is signed by both parties are not eligible for reimbursement.

Funding is not guaranteed until you have a signed funding deed with the Ministry.

David Jackson has been assigned as your main point of contact during the Project Plan's development. David will provide you with support, but cannot provide specific advice on writing your Project Plan.

Next steps
The table below illustrates the next steps required from you to proceed.

Step No.	
1	Read the *Guide for Grantees* thoroughly as it contains information about what happens at deed and Project Plan development stages.
2	Commence drafting your Project Plan The information in the guide will also be useful when drafting your Project Plan. Your Project Plan is due to the Ministry by 30 June 2017.

Please contact David Jackson at David.Jackson@mfe.govt.nz if you have any queries.

Please note that this letter does not constitute a binding agreement.

Nāku noa, nā,

Hinemoa Awatere
Manager, Hono Tātaki – Resource Efficiency and Innovation

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19-D-02771

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636
200 Tuam Street
PO Box 345
Christchurch 8140
www.ecan.govt.nz/contact

30 August 2019

Ministry for the Environment
Attn: Vicky Robertson
Chief Executive
PO Box 10362
Wellington 6143
Via email: Vicky.Robertson@mfe.govt.nz

Dear Vicky,

Request for 100% funding from the Contaminated Site Remediation Fund (CSRF) for s 9(2)(a) **Landfill remediation works**

Thank you for your offer to fund 70% of the costs associated with the remediation of the s 9(2)(a) Landfill. The grant was offered in April this year to remediate 20 properties which were discovered to have been built on a landfill that existed before 1940.

Environment Canterbury and the Christchurch City Council have undertaken a significant amount of work on the project to date, including jointly funding the initial investigation, and undertaking extensive consultation with landowners and residents throughout the CSRF process.

The CSRF funding application for remediation resulted in s 9(2)(b)(ii) being awarded towards the total estimated cost of s 9(2)(b)(i). The landowners are grateful for the offer to fund 70% of the cost, and Environment Canterbury has spent a significant amount of time discussing the proposed remedial options with residents, as well as potential payment options. However, despite the effort that has been put into progressing this project, it appears as though only one or two of the landowners can afford to pay the remaining 30% of the cost, which ranges from $s 9(2)(b)(ii) per property.

We believe that this creates a high risk that remediation will not be completed due to it being unaffordable for the landowners. The Christchurch City Council and the Canterbury District Health Board have both written letters to Environment Canterbury requesting that the Ministry reconsider its funding decision and agree to meet 100% of the cost. We would be keen to engage with the Ministry over how this could be achieved.

We consider that the CSRF was created for those sites where residents cannot afford to remediate their property, particularly in the circumstances where they have inherited the liability through no fault of their own. The existence of the landfill was only discovered during earthquake rebuild works, adding further strain to residents during an already stressful time. The Canterbury District Health Board letter notes that in addition to the physical risk of exposure to contamination

Our ref: IN7C/3738
Your ref: s 9(2)(a) Landfill
Contact: Graham Aveyard (graham.aveyard@ecan.govt.nz)

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at their properties, the financial pressure and stress of living on contaminated land may contribute negatively to residents' health.

We consider that the s 9(2)(a) Landfill is exactly the scenario envisaged for the CSRF to secure meaningful remediation for the landowners. We would be disappointed and concerned if remediation did not take place considering the high levels of contamination, and the sensitive residential nature of the site.

Yours sincerely,

Bill Bayfield
Chief Executive

Encl:

1. Christchurch City Council letter to Bill Bayfield, 19 July 2019
2. Canterbury District Health Board letter to Ministry for the Environment, 15 August 2019

CC: Bruce Croucher (by email bruce.croucher@mfe.govt.nz)

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19-D-02771

DOCUMENT 32

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Environment Canterbury

s 9(2)(a) Landfill DSI

Sampling Plan

December 2017

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Figure index

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1. Introduction

1.1 The Issue

A Detailed Site Investigation (DSI) is required in a residential area of s 9(2)(a) n Christchurch. The project area contains a number of residential properties which lie on the site of a former landfill. Previous investigations on individual properties as part of earthquake repairs have found concentrations of metals and PAHs in the shallow soil in excess of human health guidelines. Fill material is thought to have been emplaced beneath the project area after aggregate extraction at some point in the early 20th Century prior to the 1940s. The fill comprises brick, bone, china and slag. No putrescible waste has been identified to date.

The DSI is required to understand the extent and thickness of the fill, the concentrations of contaminants within it and the potential risk to identified receptors, principally the residents of the affected properties.

The project is being managed by Environment Canterbury with funding from the Ministry for Environment Contaminated Sites Remediation Fund, Christchurch City Council (CCC) and Environment Canterbury.

As part of the tender submission a Sampling Plan is required explaining the nature of the DSI and how it will be completed. This document forms the Sampling Plan.

1.2 Purpose of this report

The purpose of this report is to detail the manner in which site specific data will be obtained in order to satisfy the aims of the project.

1.3 Scope and limitations

The scope of the investigation is to complete a DSI that will provide information on soil and groundwater conditions in order to update the Conceptual Site Model and assess the associated risks to human health and the environment.

The works will include:

- Engagement of an Underground Service Locator Specialist
- Obtain service plans for the area through B4UDig and private service plans from CCC (note private service plans are excluded from tender price)
- Liaison with residents to obtain access for sampling
- Coring of 13 bores, using a small drilling rig, located across the main area of filling, to drill through the fill to a depth of approximately 5m
- Coring of 10 bores, using a window sampler, across the area believed to be at the edge of filling and in areas of restricted access, to a depth of 4-5m
- Hand augering of 13 shallow bores to fill data gaps and to access difficult areas
- Sampling of soil from all locations
- Laboratory analysis of soils for metals, PAH, asbestos and pH
- Leachability testing (TCLP) for metals
- GHD field supervision

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- Completion of a draft DSI report including details in fieldwork, analytical results, comparison with guidelines, updated conceptual site model, human health and environmental risk assessment and recommendations for future work.
- Completion of a final DSI report (after one set of consolidated comments from Environment Canterbury
- Completion of approximately 23 individual letter reports for the properties in the project area for Environment Canterbury
- Attendance at a post-works residents meeting to discuss the findings

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This report: has been prepared by GHD for Environment Canterbury and *may only be used and relied on by Environment Canterbury for the purpose agreed between GHD and the Environment Canterbury as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than Environment Canterbury arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s)1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Environment Canterbury and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.4 Assumptions

This sampling plan is based on access to the properties as informed by Environment Canterbury during the tender period. These properties are shown in Table 1 and Figure 4. Properties excluded are:

- s 9(2)(a)

The property at s 9(2)(a) has been included on the basis that access can be negotiated. It is noted that the property is currently vacant and is for sale.

We have solely focussed our design on the risks from soil to human health and the potential for leaching from the fill material. We have therefore not included piezometers or surface water sampling. We considered that trying to include investigation of such environmental pathways would detract from the main focus and consume too much of the limited budget. The net result potentially being a number of half-investigated pathways. We consider these pathways should be comprehensively investigated, as a secondary phase, if required.

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2. Site Setting

2.1 Site Location & Layout

The site is located in the suburb of s 9(2)(a) Christchurch. The project area is currently a residential area. It comprises a block bounded by s 9(2)(a) allows access into the centre of the block

Figure 1: The Project Area (red) and surrounding streets

The topography of the area shows the Heathcote River on the western boundary which rises sharply to two slightly higher platforms around the north west (see Figure 2) and south west of the block. The area between them along the western boundary with s 9(2)(a) is notably lower in elevation. The area has a slight slope otherwise to the east.

The s 9(2)(c) which is culverted under s 9(2)(a) hen runs between s 9(2)(a) and appears to run easterly before discharging into the Heathcote River (see Figure 3).

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Figure 2: View of the Project Area from the low point on s 9(2)(a), looking north

Figure 3: Jackson's Creek culverted under s 9(2)(a), looking north west

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Release

3. Health & Safety

Previous investigations have found evidence of fill material in the soil beneath residential properties in the area therefore it is expected that these contaminants will be encountered during this investigation.

These chemicals are most likely to be (but not limited to):

- Heavy metals, principally lead and arsenic, but also chromium, copper and zinc have been found at high concentrations. Chromium speciation has not been tested for in historical analysis however Chromium VI may be present.
- Polycyclic Aromatic Hydrocarbons (PAH), with benzo(a)pyrene being the principal contaminant of concern

With some potential for the following:

- Asbestos (associated with former buildings) – asbestos has been found in the two properties encountered. The source of this is to be determined as it may be related to the fill or the later houses built on top.

The contaminants of concern are discussed further in the Conceptual Site Model section of the main tender document. Details on laboratory analysis are provided in Section 7 of this Sampling Plan.

A standalone HSE Plan will be developed as part of the project which will discuss:

- Underground Services
- Contaminants of Concern
- Key Exposure Pathways
- Mitigation & Management Measures
- Emergency Planning
- Required Monitoring
- Waste Disposal

All contractors will be required to attend a health and safety induction before works commence. A GHD staff member will be present throughout the site woks. The GHD Project Director will also undertake a HSE Audit during the works.

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4. Proposed Sampling Locations

4.1 Summary of Locations

This section provides a summary of the overall sampling and monitoring locations for the DSI followed by a rationale for each one. The sampling has be split as follows:

- **Rig Drilled Bores** – Coring of 13 bores, using a small drilling rig, located across the main area of filling, to drill through the fill to a depth of approximately 5m (see Figure 4)
- **Window Sampling** – Coring of 13 bores, using a window sampler, across the area believed to be at the edge of filling and in areas of restricted access, to a depth of 4-5m (see Figure 4)
- **Hand Augers** – Advancement of 13 hand augers to depths of approximately 1-2m. These have been used to fill in data gaps in areas where little or no previous analysis has been undertaken. These are designed to obtain shallow soil samples in order to assess the risk from shallow fill material to residents (see Figure 4)

4.2 Rationale

The rationale for the well locations is discussed in Table 1 below and proposed locations are shown on Figure 5.

We have included the proposed location type (borehole (BH), window sample (WS) or hand auger (HA)), proposed data and pre-existing data. The proposed data and pre-existing data is listed in Table 1 in terms of number of lab tests. For example at s 9(2)(a) we will analyse soils for relevant contaminants from 3 depths from the window sample location and 2 depths in the hand auger, making a total of 5 testing depths.

Locations were chosen on the basis of a combination of the following factors:

1. To provide a spread of deeper bores across the project area to enable cross sections to be drawn.
2. To fill the data gaps where coverage was sparse and further data was required with more mobile sampling methods
3. On the ability of the locations to be accessed by rig
4. On the ability of the locations to be accessed by more mobile methods
5. On the basis of aerial photography study followed by a street walkover of the area

We recommend that Table 1 should be read in conjunction with Figure 4.

Table 1 Proposed Sampling Locations and Rationale

Property	Proposed Locations	Proposed Data	Pre-Existing Data	Notes
s 9(2)(a)	1 Window Sample (WS), 1 Hand Auger (HA)	5x Lab Tests	5x XRF Tests	XRF data only but some high readings, may be edge of fill area. No bore as access appears restricted for rig entry.
s 9(2)(a)	1 Rig-driven Bore (BH), 1 WS	7x Lab Tests	5x Lab Tests, 5x XRF Tests	Good existing data set. In area of likely filling.
s 9(2)(a)	1 BH, 1 HA	6x Lab Tests	5x Lab Tests, 3x XRF Tests	Good existing data set. In area of likely filling. House being rebuilt with limited garden area.

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Property	Proposed Locations	Proposed Data	Pre-Existing Data	Notes
s 9(2)(a)	2 BH	8x Lab Tests	4x Lab Tests	Area of likely filling – House appears to be being rebuilt.
s 9(2)(a)	1 BH	4x Lab Tests	5x Lab Tests on lane to north, 14x XRF Tests	Good XRF data. One bore to establish fill thickness and provide extra chemical data
s 9(2)(a)	1 BH, 1 WS, 1 HA	9x Lab Tests	1x Lab Test, 13x XRF Tests	Lack of lab data on this property. XRF suggests this may be less impacted property.
s 9(2)(a)	1 BH, 1 HA	6x Lab Tests	3x Lab Tests, 11x XRF Tests	This property may be outside area of filling. Important deli eation site.
s 9(2)(a)	1 WS, 1 HA	5x Lab Tests	2x Lab Tests, 11x XRF Tests	Similar to s 9(2)(a) , this may be outside of area of filling and is impo tant for delineation. No bo e as access to grassed area appears too restrictive for rig.
s 9(2)(a)	1 BH, 1 WS	7x Lab Tests	5x Lab Tests, 6 XRF Tests	Key site, western half appears impacted, eastern half does not.
s 9(2)(a)	1 BH, 1 HA	6x Lab Tests	5x Lab Tests, 7 XRF	Similar to s 9(2)(a) with an apparently impacted western half and less impacted eastern half.
s 9(2)(a)	1 HA	2x Lab Tests	None	This site has very little garden area to access. s 9(2)(a) and those house beyond suggest this may be the edge of filling.
s 9(2)(a)	1BH	4x lab tests	None	Surrounding historical data suggests this property may be outside the area of filling.
s 9(2)(a)	1 BH	4x Lab Tests	2x Lab Tests, 11x XRF Tests	Good XRF data but lack of deep data. Uncertain if this property remains vacant. Key property in establishing northern extent of fill.
s 9(2)(a)	1 BH, 1 HA	6x Lab Tests	12x XRF Tests	Good XRF data but lack of depth data. XRF suggests this may be a fill-impacted site.
s 9(2)(a)	1 BH, 1 WS, 1 HA	9x Lab Tests	2x Lab Tests, 5x XRF Tests	Key site for delineation. Western half of site appears unimpacted, eastern half shows evidence of fill.
s 9(2)(a)	1 WS, 1 HA	5x Lab Tests	1x XRF	High quality garden with terraces at front. Access likely limited. Lack of XRF suggests residents may not be keen on disturbance. WS located in same area as historical XRF test.
s 9(2)(a)	1 WS, 1 HA	5x Lab Tests	4x Lab Tests – All Composited	One of the more difficult sites to access. Lack of accessible locations. Historical sampling suggests fill present.
s 9(2)(a)	2 BH, 1 HA	10x Lab Tests	5x XRF Tests	Good driveway access. Lack of deep data and a key property which cuts across the likely area of filling.

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Property	Proposed Locations	Proposed Data	Pre-Existing Data	Notes
s 9(2)(a)	Access Unconfirmed 1 WS, 1 HA allowed for	5x Lab Tests	No Data	House appears vacant as is for sale. Forms south-western edge of project area. Locations appear to be accessible.

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s 9(2)(a)

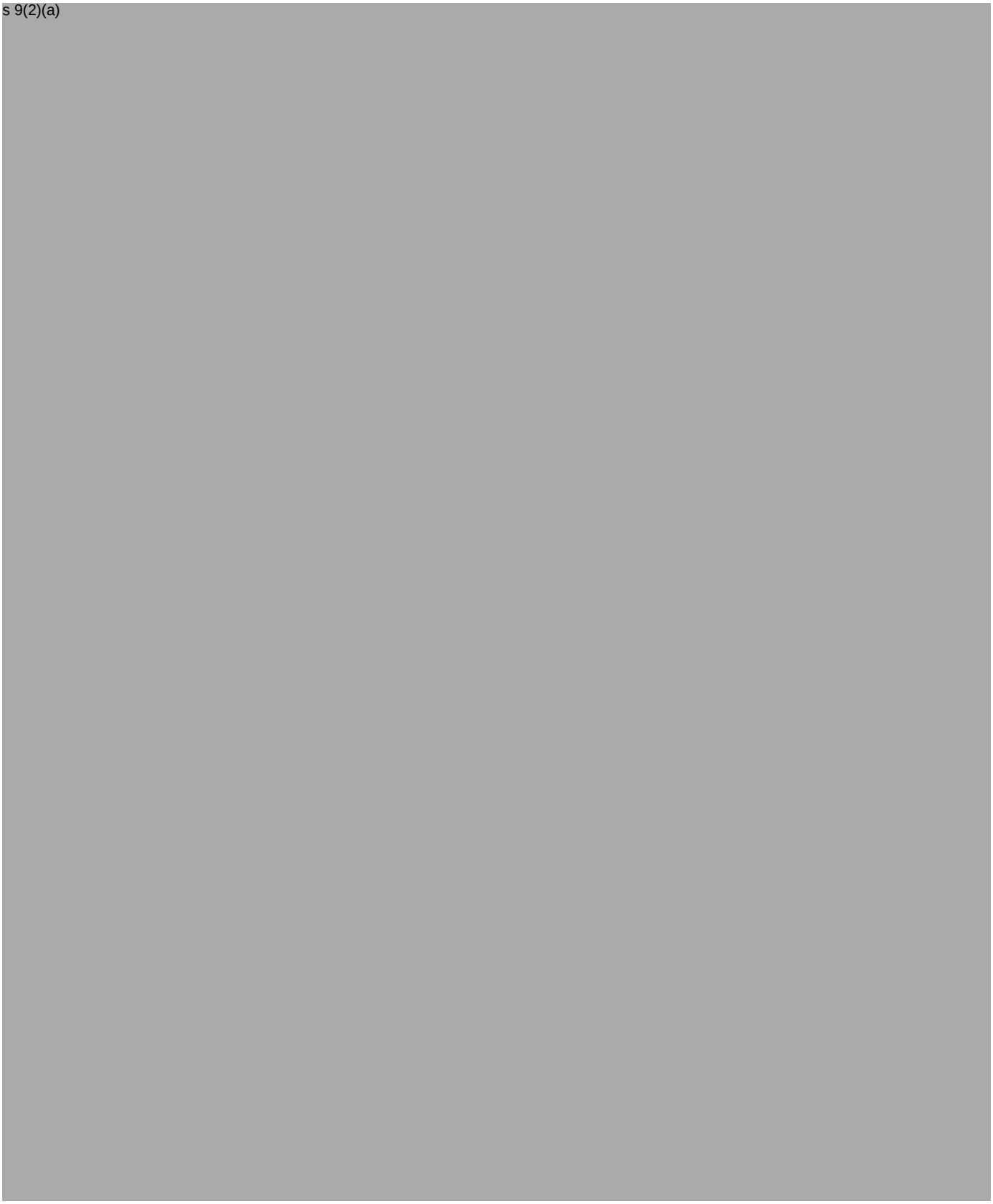

Figure 4: Proposed Investigation Locations and Pre-Existing Data

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5. Pre-Drilling Works

5.1 Underground Service Assessment

5.1.1 Obtaining Service Plans

As with any intrusive investigation, we undertake a thorough pre-assessment of utility risk involving a dial-b4-u-dig request to obtain service plans followed by on site scanning of potential intrusive locations. However, these service plans typically stop at the property boundary therefore private property drainage plans will need to be obtained from CCC. We have not included these plans within our costings, as CCC are part of the project we have assumed that these will be able to be provided to the successful tenderer at no cost.

5.1.2 Specialist Cable Locators

We intend to use Underground Services Locators Ltd (USL) to utilise cable scanning and GPR techniques.

During the utility services assessment we will not spray-paint utility lines on the ground but rather assess where these run relative to our proposed sample location. For sampling locations we will endeavour to use areas on soil first, followed by grass areas. We do not propose to disturb tarmac or concrete drive-ways. We will use a small amount of spray-paint to mark a cross on the location of drilling that has been cleared for services. This will be washed off (if it remains) immediately after sampling.

We have allowed 10 hours for this task, noting that this may have to been done over different days due to restrictions on property access.

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6. Intrusive Works & Monitoring

6.1 Drilling Methodology

6.1.1 Site Establishment

At each property we will discuss our intended access/egress route with the owner. Ground around the location will be covered with impermeable materials, e.g. tarpaulins so that core barrels can be lain down, inspected, photographed and sampled without soil spilling on the surrounding areas. We intend to avoid tracking the Power Probe across grassed areas, but if this is necessary, and with the residents permission, we can use boarding as shown in Figure 5 to reduce the impact on the surface.

6.1.2 Rig-drilled Boreholes

A Power Probe VTR9100 drilling rig will be used to advance 13 drill holes in the project area. This is a limited access rig ideal for residential properties (see Figure 5). The method will produce a cored sample enabling soil sampling throughout the profile.

s 9(2)(a)

Figure 5: Power Probe Drilling Rig

Bore logs from the local area are limited but one bore showed a fill thickness of 4m at s 9(2)(a). We therefore have based our investigation on drilling to a depth of 5m. The locations of rig-drilled bores are highlighted in Figure 6 below.

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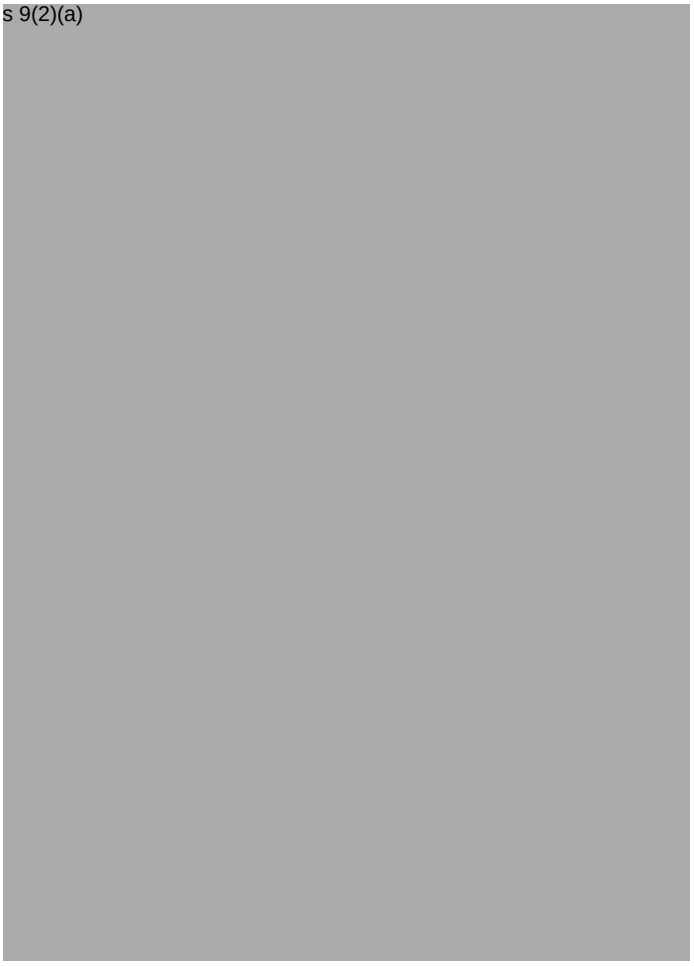

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6.1.3 Window Sampling

We will use a window sampler to advance 13 bores and collect soil samples. The window sampler drives hollow steel tubes into the ground using a small petrol driven percussion hammer (see Figure 7). These locations are sited in areas of more difficult access for the rig as the window sampler is very mobile and can be carried onto sites.

Figure 7: Window Sampling Equipment and Cores

The window samples aim to reach a target depth of 5m. The locations of window samples are highlighted in Figure 8 below

s 9(2)(a)

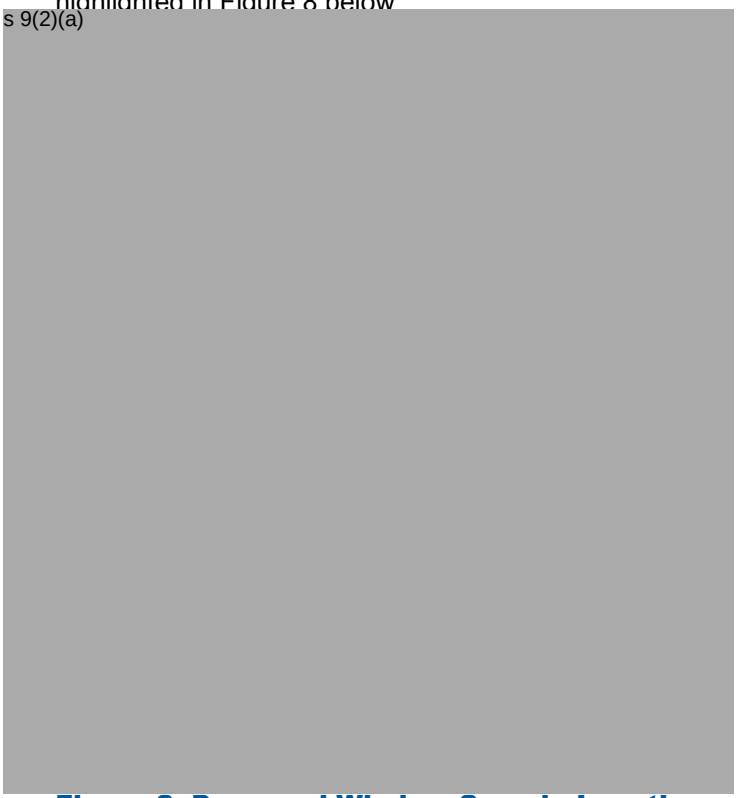

Figure 8: Proposed Window Sample Locations

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6.1.4 Hand Augering

Hand augering has shown mixed success in the area based on historical investigation bore logs. This is mainly as it has met with obstructions in the fill in trying to advance to depths beyond 1.5-2.0m. However there is still value in this as a method of providing shallow soil samples. This is particularly important for the shallow soil areas in which residents or excavation workers are mostly likely to dig and be exposed to potential contaminants. We have proposed to advance 13 hand augers in areas where data is currently limited or access constraints are in place. We propose these augers will be advanced to a maximum of 2m, but many will likely terminate in the top 1m of soil due to obstructions. The locations of the auger samples are highlighted in Figure 9 below.

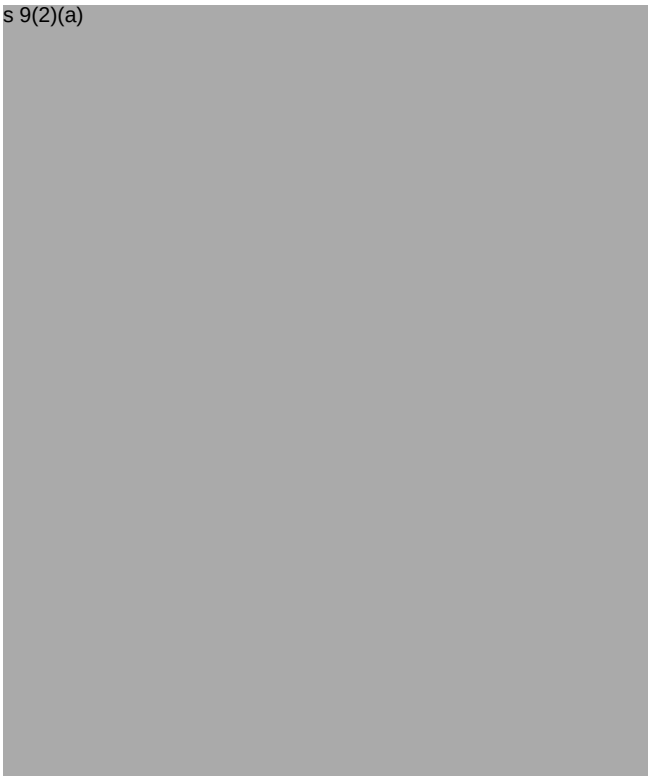

Figure 9: Proposed Hand Auger Locations

6.2 Sample Collection and Decontamination Procedures

Soil samples will be collected from the bores and augers at a variety of depths and sent for laboratory analyses. This is proposed to be as follows:

- Rig-drilled bores – 4 sample depths – ideally in top 0.1m, in the fill above water table, in the fill below the water table and below the fill layer
- Window samples – 3 samples depths – ideally in the top 0.1m, in the fill and below the fill
- Hand augers – 2 sample depth – in the top 0.1m and in the 1.0-1.5m range in the fill

These sample depths are approximate and may vary depending upon the depth to groundwater and obvious signs of contamination. Soils will be collected by GHD staff from the cores provided using clean nitrile gloves and a stainless steel trowel. Clean gloves and a clean trowel will be used at each location to avoid cross contamination. Materials will be decontaminated with Decon-90 or similar detergents.

The core liners from each method can be removed and soil samples extracted from the lined sampling barrel. We will then sample directly from the core into sample jars using clean nitrile gloves and trowels, with cleaning between samples as discussed previously.

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6.3 Vapour Monitoring

GHD undertakes vapour monitoring during all field works. We will have PID and LEL monitors available during the works for safety purposes. We will also collect soil samples for PID headspace testing during the investigation. Samples will be collect in sample bags, left for 3 minutes and then tested with the PID.

6.4 Post-Sampling Demobilisation

At each property we will take a photographic record of the access route(s) taken to the sample locations before and after drilling. We will also take photographs of each sampling location to show that holes have been backfilled and left in a safe condition.

At each hole, if on grassed areas, a neat square of turf will be carefully cut and laid to one side. At the end of sampling, each hole will be backfilled with arisings, supplemented by additional soil or bentonite if required and the grass square neatly replaced.

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7. Laboratory Analysis

7.1 Nominated Laboratory

Our analysis will be undertaken at the Analytica Laboratory in Hamilton. Analytica is an IANZ accredited laboratory.

7.2 Total Sample Numbers

The rationale for the suite chosen is discussed in the Methodology part of the tender in the 'Contaminants of Concern' section. **In total, our sampling will result in approximately 117 soil samples from 39 different locations**, in addition to the existing data to provide a comprehensive coverage across the project area.

7.3 Soils Analysis

Soil analysis has been broken down into component analytes in Table 2.

Table 2 Soil Analysis

Location	Heavy Metals (inc CrVI)	PAH	Soil pH	Asbestos Full WA
Rig-drilled Bores (13 No.)	52 (4 per bore)	39 (3 per bore)	20 (10 shallow, 10 deep spread across project area)	20 (10 shallow, 10 deep spread across project area)
Window Samples (13 No.)	39 (3 per bore)	26 (2 per bore)		
Hand Augers (13 No.)	26 (2 per bore)	26 (2 per bore)		
Total Analyses	**117**	**91**	**20**	**20**

7.4 Leachability Analysis

We have included a cost for undertaking some initial testing on the leachability of the fill materials. We have allowed for 26 samples to be tested for TCLP testing. This equates to two samples from each of the 13 rig-drilled bores. One from a shallow depth and one from within the deeper fill material.

Metals are considered to be the only contaminant of concern for TCLP analysis. In the PAH family, naphthalene is considered to most mobile of the PAHs in terms of leachability and is the only PAH included in the MfE Landfill Waste Acceptance Criteria. As naphthalene concentrations in the soil samples measured to date were below guideline levels there is no justification for leachability testing.

7.5 Quality Control Samples

Quality samples will be collected during the sampling period. Duplicate sample sets will be collected to check for laboratory precision, with rinsates and trip blanks to check for cross contamination of equipment and contamination during transport.

Based on the total sample numbers the following QA/QC samples will be taken:

- Trip Blank (1 per batch) – allow 3 – to ensure volatiles aren't introduced in transport (and influencing PAH results)

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- Duplicate Set (1 per 20 samples) – allow 5 – to check lab repeatability
- Rinsate – allow 3 – to check appropriate decontamination of sampling equipment is occurring

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft	H Galloway	M.Ballard		M.Ballard		12/12/17

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Ministry for the Environment
Manatū Mō Te Taiao

Making Aotearoa New Zealand the most liveable place in the world
Aotearoa – he whenua mana kura mō te tangata

Review of CSRF funding - Historical Christchurch Landfill

Date Submitted:		Tracking #: 2019-B-06025	
Security Level	In confidence	MfE Priority:	Non-Urgent

	Action sought:	Response by:
To Hon David Parker, Minister for the Environment	Decision on request for review of funding.	18 November 2019

Actions for Minister's Office Staff	**Return** the signed report to MfE.
Number of appendices and attachments: Appendices: 2 Attachments: 4	1. Letters of support: Environment Canterbury Christchurch City Council Canterbury District Health Board 2. Briefing Note: 2018-B-05203 Contaminated Site Remediation Fund – Round 2 2018/19 Funding Recommendations
Note any feedback on the quality of the report	

Ministry for the Environment contacts

Position	Name	Cell phone	1st contact
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Responsible Manager	Scott Priestley	022 083 3594	✓
Director	Glenn Wigley	027 491 7806	

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Review of CSRF funding - Historical Christchurch Landfill

Key Messages

1. The purpose of this briefing is to seek your response to Environment Canterbury's (ECan) request for a review of your previous Contaminated Sites Remediation Fund (CSRF) decision on funding for their Historic Christchurch Landfill remediation project (the Project).
2. ECan submitted an application to the CSRF seeking 100 percent funding for their Project to the second funding round 2018/19. On 1 April 2019, you approved CSRF funding totalling s 9(2)(b)(ii) which is 70 percent of the total project costs.
3. On 6 May 2019, ECan accepted the offer of funding from the CSRF. Since then ECan have been discussing the gap in the project funding with the individual landowners and the Christchurch City Council (CCC).
4. On 19 July 2019, CCC requested that ECan approach the Ministry for the Environment (the Ministry) and ask we reconsider their CSRF application. ECan, CCC and the Canterbury District Health Board (CDHB) all consider that without 100 percent CSRF funding that the majority of landowners will not be able to afford the remediation of their property and will therefore remain exposed to contaminated soils.
5. We recommend that you decline ECan's request to increase the percentage of funding for the project. We consider that your existing funding offer is appropriate and is consistent with the CSRF's assessment criteria, which consider where the benefits are realised and ability to pay of both the landowners and councils.

Background

6. The historic Christchurch landfill that forms this project appears to have been operational around the early 1900s as the filling pre-dates houses that were built in the area in the 1940s. Key contaminants of concern are the heavy metals lead, arsenic, chromium, copper and zinc and also polycyclic aromatic hydrocarbons. Lead contamination is the greatest concern, with concentrations at the site exceeding the residential soil contaminant standard of 210 parts per million by 28 times.
7. The purpose of the Project is to remediate soil contamination discovered during earthquake repair works on a number of residential properties in a Christchurch suburb following the 2010/2011 earthquakes. The area was not identified on ECan's Listed Land Use Register (LLUR) prior to receiving earthquake repair reports and therefore the LLUR details would not have been on any Land Information Memoranda provided to residents by the Christchurch City Council when residents purchased their properties.
8. In June 2018, with assistance of 70 percent of the total project costs from the CSRF s 9(2)(b)(ii) ECan and CCC completed the Phase 2 – detailed site investigation. The investigation determined that 23 properties are affected by contamination. In September 2018, ECan submitted an application to the CSRF for the remediation of these properties.
9. ECan submitted an application to the CSRF's second funding round for 2018/19. They sought 100 percent funding s 9(2)(b)(ii) for their Project to assist 21 landowners to remediate their properties. On 1 April 2019, you approved 70 percent funding s 9(2)(b)(ii) of the total project costs in Briefing note 2018-B-05203 attached as Appendix 2.

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10. On 16 April, we informed ECan of your decision and on 6 May 2019, ECan accepted the offer of funding from the CSRF. Since then ECan and CCC have been discussing the project and how the gap in the funding may be addressed with the individual landowners. Until the balance of the funding is confirmed, a deed of funding with ECan cannot be finalised.

Contaminated Sites Remediation Fund

11. The CSRF is a contestable fund administered by the Ministry with an annual appropriation of $2.63 million. It is intended to assist regional councils, unitary authorities and territorial authorities to fulfil their obligations for contaminated land management under the Resource Management Act 1991. Regional councils and unitary authorities submit applications for contaminated sites that they consider priorities for investigation or remediation.

12. The CSRF is a non-departmental appropriation and you, rather than the Ministry, make decisions regarding funding from the CSRF. The usual starting position for cost sharing of CSRF projects is 50:50 funding.

13. There has been no allocation of funds from the CSRF appropriation ($2.45 million) for the Out of Scope

ECan's request to reconsider the CSRF funding

14. On 6 September, the Ministry received a letter from Bill Bayfield, ECan Chief Executive, requesting the Ministry reconsider the CSRF funding for the remediation of the historic Christchurch landfill. Letters of support from CCC and CDHB accompanied the ECan letter. These letters are attached as Appendix 1.

15. ECan state that there is a high risk that they will be unable to complete the project as the cost of remediation is unaffordable for the majority of the landowners. CCC, in their letter to ECan requesting the Ministry review the funding decision, note that there are significant levels of contamination on the properties and that neither they nor the landowners can afford to remediate the properties. CDHB consider there is a potentially significant health risk to the residents and the ongoing financial pressure and stress experienced by the landowners could negatively affect their health.

16. The councils and CDHB considered that intent of the CSRF was to help landowners in this situation, i.e. they found out there land is contaminated through no fault of their own after already having purchased the property. They also consider that 100 percent funding is appropriate in this circumstance as the landowners will not benefit from the funding as it will, at best, only return the value of their property to the value immediately prior to the discovery of the contamination.

Analysis

17. Investigation funded by the CSRF has demonstrated that the level of contamination on some of these properties is high and unmanaged exposure to these soils could potentially present a health risk. The landowners include families with young children for whom exposure to the contaminants will be of great concern, especially for lead as infants and young children are the most susceptible and the effects irreversible.

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18. These landowners were not aware of the contamination when they bought the properties. ECAN have advised that in most cases, these landowners would struggle to raise the funding required to cover their percentage of the costs for their properties remediation. The landowners may not financially gain from the remediation of their properties. The contamination found on these properties will have decreased their value and the proposed remediation is unlikely to increase the property's value with respect to the original purchase price. This is because the contaminated materials on site will be capped with a geotextile layer and clean soil. Therefore, contaminated materials will remain on the properties and following the conclusion of the remedial works, the landowners will become responsible for maintenance of the capping layer.

19. The base policy position for the CSRF is 50 percent funding of projects. This reflects that the landowner, irrespective of whether they caused the contamination or not, are responsible for the contamination on their land. If the landowner were the polluter, but were unable to pay the full costs for an investigation or remediation, a lower percentage of funding may be offered. In this case, no one was aware of the contamination until the Christchurch earthquakes and therefore we consider the percentage funding originally offered is consistent with the base policy position.

20. Whilst national assistance is available, any funding provided should reflect the stakeholders' ability to pay and balance both the regional and national benefits gained. This project's benefits only apply at the local/regional level. Regional councils and territorial authorities have no obligations to fund CSRF projects on private land, but for many CSRF projects, they have provided both project leadership and financial support. To demonstrate this we have provided examples of different funding scenarios in Table 1- CSRF funding percentages for remediation projects.

Table 1. CSRF funding percentages for remediation projects

Project Name	Crown (%)	Regional Council (%)	Others (%)
Out of Scope	25	0	75 Out of Scope
Out of Scope	50	0 (In kind project management)	50 (Landowner)
Out of Scope	50	17.5 (Including project management)	32.5 Out of Scope

21. Therefore, although ECan are providing project management services and both councils have expended a significant amount of time discussing options with the landowners, we considered it appropriate that the councils, and where possible the landowners, provide a funding contribution towards the project costs.

22. When you determined that 70 percent funding was appropriate for this project, you noted that these two large councils should be able to provide their residents with some support. [page 16 of Briefing note 2018-B-05203]. We consider that your decision is consistent with the assessment criteria of the fund regarding the ability to pay of both the landowners and councils and recommend that the funding offer does not change.

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23. In your draft Cabinet paper "Landfills vulnerable to the effects of climate change" [2019-C-05889], you affirm your position that landowners are responsible for these legacy landfills and central government should only provide financial assistance where compelling reasons exist. We consider that declining ECan's request for an increase in their CSRF funding would be consistent with this position.

24. Should you wish to increase the percentage funding, the CSRF would be able to accommodate the increased funding. However, this would reduce the funding available for the following:

Out of Scope

Next Steps

25. Following your decision on whether or not to reconsider ECan's request to increase the funding available to the Project, we will write to ECan and inform them of your decision.

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Recommendations

26. We recommend that you:

either decline Environments Canterbury's request to increase the funding for their Historic Christchurch Landfill project. (recommended)

Yes/No

or agree to change the funding percentage for Environment Canterbury's Historic Christchurch Landfill project to …….. percent of the total project cost.

Yes/No

agree that this briefing and appendices will be released proactively on the Ministry for the Environment's website once a Deed of Funding is in place with Environment Canterbury and the landowners.

Yes/No

Signature

5/11/19

Glenn Wigley
Director
Natural and Built System

s 9(2)(g)(i)

Hon David Parker
Minister for the Environment

Date 14/11/19

s 9(2)(g)(i)

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Appendix 1

Letters from:

Environment Canterbury – Request for 100% funding from the Contaminated Sites Remediation Fund (CSRF) for s 9(2)(a) Landfill remediation works

Canterbury District Health Board – Re: s 9(2)(a) Contaminated Land Remediation – proposal for funding from the Contaminated sites Remediation Fund (CSRF)

Christchurch City Council – Contaminated Residential Sites, s 9(2)(a)

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