APPENDIX J

Ground Contamination Assessment of Environmental Effects – Tonkin & Taylor

REPORT

Tonkin+Taylor

Ground Contamination Assessment of Environmental Effects

Ryman Village, Karori, Wellington

Prepared for
Ryman Healthcare Ltd
Prepared by
Tonkin & Taylor Ltd
Date
Aug 2020
Job Number
30309.v3

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1 Executive Summary

Ryman Healthcare Limited proposes to construct and operate a comprehensive care retirement village ("Proposed Village") at 26 Donald Street and 37 Campbell Street, Karori, in Wellington ("Site").

The Site is the former location of the Victoria University Teachers College Campus. Deconstruction of former Teachers College buildings is completed. Three Teachers College buildings will be retained and redeveloped and will be supplemented by a series of new buildings including several with base isolated foundations and single level basements. Cut and fill earthworks and ground retention structures will be required to establish new building platforms.

The Site was first developed as a Teachers College in the mid-1960s, with further development in the 1970s, and a number of minor additions/demolitions since then. Prior to the 1960s, the Site was largely vacant with isolated houses and yards. Based on aerial photographs and the current site condition, there was significant earth working (cut-to-fill operations) during the development of the Teachers College.

Based on the development history of the Site, T+T identified the potential for contamination to be present associated with pesticide use on playing fields and gardens, demolition of residential houses and levelling works of the Site prior to the Teachers College development, and use of asbestos-containing materials in buildings.

In 2017 T+T completed soil sampling at approximate 40 m spacings in accessible areas of the Site to identify contamination associated with historic cut-to-fill activities, while targeted sampling was undertaken to assess contamination from persistent pesticide use in gardens and sports fields. Samples were also collected around buildings for asbestos analysis. Groundwater samples were also collected from three monitoring wells installed on the Site.

The 2017 investigation detected asbestos in a limited number of soil samples. Based on the data available, there is no clear explanation of its source, although plausible sources are (i) loss from existing buildings and/or (ii) historic building demolition and rework of fill during construction. Therefore it is conservatively assumed that asbestos is present across the whole Site to a depth of 0.5 m (assumed depth of historical residential ground disturbance). Based on historic Site use, some areas of the Site (e.g. sports playing fields) have a lower likelihood of containing asbestos that others (e.g. around buildings from degradation). No other contamination creating risks to human health or the environment was identified.

Groundwater sampling did not provide any evidence of discharges of contamination into groundwater at the Site.

With respect to planning matters, the contamination detected at the Site means that:

1 Consent is required under the NES Soil (Regulation 10 - restricted discretionary activity) due to asbestos contamination;

2 Consent is required under the District Plan (Rule 32.2 - restricted discretionary activity) due to contamination above health criteria (asbestos); and

3 No contamination-related consents are required under the current or proposed Regional Plans.

The presence of asbestos creates the potential for health effects on future residents and site workers involved in earthworks. These potential health effects can be managed through the implementation of earthworks controls, and through the encapsulation and/or removal of asbestos-contaminated soil from the Site which are standard industry practices. Measures and controls to

manage contaminated soils will be set out in a Site Management Plan (SMP). This SMP can be revised to provide ongoing control if contaminated materials are retained on Site.

The Site is suitable for the Proposed Village from a contamination perspective provided the recommendations to manage asbestos contamination are implemented.

2 Introduction

2.1 Introduction

Ryman Healthcare Limited ("Ryman") engaged Tonkin & Taylor Ltd ("T+T") to undertake a ground contamination assessment for the construction and operation of a comprehensive care retirement village ("Proposed Village") at 26 Donald Street and 37 Campbell Street, Karori ("Site"). The location of the Site is presented on Figure 2.1 below.

Figure 2.1: Site location plan (source: LINZ).

T+T has undertaken this assessment to assess whether potentially contaminating activities have occurred at the Site, the potential for these activities to have resulted in ground contamination, and the actual ground contamination present. This report also assesses the potential environmental and human health effects of this contamination and hence what (if any) mitigation of ground contamination is required for the proposed use of the Site. This report provides additional detail in support of the Assessment of Environmental Effects (AEE) prepared for resource consent applications for the Proposed Village.

This report has been prepared in general accordance with the requirements for a Preliminary Site Investigation ("PSI") and Detailed Site Investigation ("DSI") referred to in the NES Soil Regulations ("NES Soil")[1], and as outlined in the Ministry for the Environment's (MfE) Contaminated Land Management Guideline 1[2]. The persons undertaking, managing reviewing and certifying this investigation are suitably qualified and experienced practitioners, as defined in the NES Soil.

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.
[2] Ministry for the Environment, updated 2011, Contaminated land management guidelines No. 1: *Reporting on Contaminated Sites in New Zealand*.

The contaminated land, geotechnical engineering, groundwater and civil engineering aspects of design are integrated. This report is to be read together with the Geotechnical Effects Assessment[3], Groundwater Take Effects Report[4] and Civil Design Report[5].

2.2 Proposed Village

A full description of the Proposed Village can be found in the AEE. Broadly, the Proposed Village is to include:

- Refurbishment of the existing Allan Ward VC Hall and Tenant blocks;
- A 3 level apartment building (part B01A) constructed at grade (without significant earth retention near the boundary);
- A 3 level village centre building (part B01A) constructed at grade;
- A 5 level village centre and apartment building (part B01A) with base isolated foundations, which will require earthworks cut and earth retention works;
- Two new 7 level care and apartment buildings with base isolated foundations and a combined single level basement below both buildings (B01B);
- Six new 3 level apartment buildings (B02 to B07), which will be founded on shallow foundations on grade;
- Cut to fill earthworks and ground retention structures, particularly for Buildings B01A and B01B structures, will be required to establish the building platforms. Maximum fill heights are expected to be in the order of 3 m. Maximum cut and retention heights are expected to be in the order of 6 m; and
- Stormwater pipes and detention tanks to be located on the Site are expected to require excavation depths and temporary ground retention heights of up to 6 m.

The Proposed Village layout is shown on the plans in Appendix A of this report.

[3] Assessment of Geotechnical Effects. Care Retirement Village, 26 Donald Street and 37 Campbell Street, Karori, Wellington. Tonkin & Taylor Ltd January 2020. 30309.v1

[4] Bore permit and amenity groundwater take effects. Donald Street, Karori, Wellington. Tonkin & Taylor Ltd. January 2020. 30309.v1

[5] Karori Comprehensive Care Retirement Village – Civil Engineering Design Resource Consent Report. BECA Limited. February 2020.

3 Site Description

3.1 Site identification

The Site is located on the western side of Donald Street, Karori (Figure 3.1). The Site is irregular in shape and covers an area of approximately 3.05 hectares (ha). The surrounding land is primarily residential, with Karori Normal School on the northern boundary. The Wellington City CBD is approximately 2.8 km to the east of the Site. There are no streams or other water bodies in close proximity to the Site.

Table 3.1: Site Identification

Street address	26 Donald Street and 37 Campbell Street, Karori
Legal description	Sec 2 Survey Office Plan 515832, Sec 1 Survey Office Plan 28414
Site area	3.05 ha
Zoning	Outer Residential

Figure 3.1: Site plan (source: LINZ).

3.2 Surrounding land use

The land uses in the area surrounding the Site include:

- North – Karori Normal (Primary) School, Huntleigh Home and Retirement Apartments, Karori Swimming Pool, residential houses, and Campbell Kindergarten;
- South – Residential housing along Scapa Terrace;
- East – Residential housing along Donald Street; and

- West – Residential housing along Campbell Street and Ben Burn Park.

3.3 Site condition

The Site was formerly used by Victoria University of Wellington as the Education/Teacher's College campus (lectures ceased at the Site in 2016). In October 2017, a T+T staff member completed a walkover of the Site as part of a combined geotechnical and ground contamination assessment. Photographs taken during the walkover are included in Appendix B.

At the time of the 2017 walkover, all of the former Teachers College buildings remained, and the Site was used by the public accessing the tennis courts and the lower field/cricket nets, and by a dance class group in the Dance Studio (Theatre Block). The Police Armed Offenders Squad also used some of the buildings for training purposes.

The buildings observed at the Site during the October 2017 Site walkover are shown in Figure 3.2 and comprised:

- Main university buildings constructed with concrete cladding and long-run steel roofing (Photographs 1 and 2);
- Pre-fabricated buildings constructed with plasterboard cladding and long-run steel roofing (Photograph 3);
- A marae (in October 2017 also used as a childcare centre) and storage sheds/workshop constructed with plasterboard and weather board cladding and long-run steel roofing (Photograph 4); and
- A data centre located south of the Alan Ward VC Hall. This was located on a concrete pad with its own generator and diesel supply (in an integrated above ground storage tank). The concrete pad was observed to be in good condition with no fuel staining (Photograph 5).

During the October 2017 Site walkover, the buildings observed appeared to be well maintained, with no flaking paint or significant surface damage evident.

Building deconstruction is now completed. During a site visit by T+T on 26 February 2020, it was noted that the Mackie Gym and Ako Pai Marae building had been removed (Photographs 6 and 7, respectively), and deconstruction of the Malcom Block and Panckhurst Block was underway. The above ground storage tank and data centre generator was removed in October 2018 by RCP Limited on behalf of Victoria University.

During the October 2017 walkover, vegetation was observed across the Site, and predominantly in landscaped garden areas. This vegetation has been partly removed during building deconstruction.

The Site generally slopes downwards from east to west. There are several retaining walls near buildings and access ways on the Site, typically related to building platforms. There is also a level difference between the eastern tennis court (higher) and the western tennis court (lower). A gully is located in the northeast of the Site and slopes down towards the southwest. A second gully is located at the southeast of the Site sloping down towards the west. Both gullies are observed to discharge into stormwater culverts.

No sensitive water bodies were identified on the site or on neighbouring land. The stormwater channels in the south eastern corner and north western corner are not considered to be a sensitive water body as they discharge into the piped stormwater system.

SCALE 1: 2000

0 20 40 60 80 100 (m)

Aerial photo and property boundaries sourced from Linz Data Service, licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence (CC BY 3.0 NZ)

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GROUND CONTAMINATION ASSESSMENT VICTORIA UNIVERSITY KARORI CAMPUS

Site Features

FIG. No. Figure 3.2

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3.4 Geology

A summary of available geological information for the area is presented below.

The published regional geological map for the site[6] indicates that the Site is underlain by alluvial gravels underlain by "grey sandstone-mudstone sequence and poorly bedded sandstone" of Rakaia Terrane. A more detailed description is available in the geotechnical report prepared concurrently with this report[3].

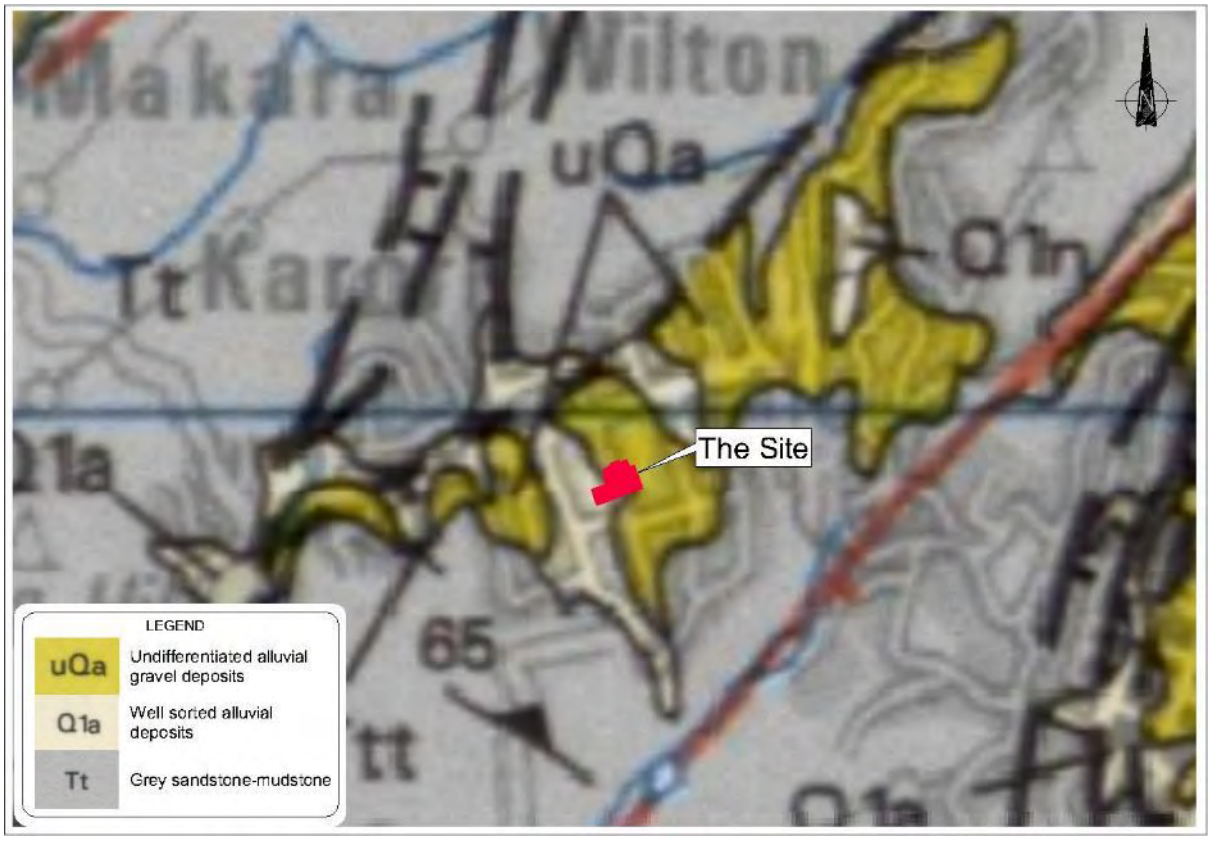


Figure 3.3: Published geology of the site (Source: Begg, J.G and Mazengarb, C, 1996 as per footnote 3).

As detailed in the Geotechnical Report[3], the Site geology generally comprises:

- 0 m to 0.5 m of fill material (generally comprising gravels and minor silt);
- Interbedded alluvial soils on the lower elevations (up a depth of 9.5 m) and outwash fan deposits on the elevated slopes. The base of the outwash fan was not encountered on the north eastern side of the Site (BH03; total depth 29 m below ground). The alluvial soils comprise clayey silts, sands and gravels with some organics and peat; and
- Greywacke bedrock at depths ranging from 5 m below ground to greater than 29 m.

[6] Begg, J.G., Mazengarb, C., 1996. Geology of the Wellington area. Scale 1:50,000. Institute of Geological & Nuclear Sciences geological map 22. 1 sheet + 128 p. Institute of Geological & Nuclear Sciences Ltd., Lower Hutt, New Zealand.

3.5 Hydrogeology and hydrology

The groundwater regime at the Site has been assessed based on monitoring of the piezometers installed around the Site. These show that the hydrostatic groundwater level is typically between 1.1 to 3.5 m below ground level (bgl).

There are no mapped streams or rivers near the Site on the 'River Flows and Rainfall in the Wellington Region' map on the Greater Wellington Regional Council ("GWRC") GIS viewer. The TopoMaps map available in the GWRC GIS viewer indicates several small surface water features in the area surrounding the site, but these surface water features are ephemeral rainfall-fed features.

Groundwater is expected to follow the regional topography and flow toward the southeast. An enquiry made on 7 March 2019 on the GWRC Web Map Viewer indicated no known groundwater users within 400m of the Site.

3.6 Planning context

The planning context for the Site and the Proposed Village is addressed in the AEE. From a ground contamination perspective, the relevant planning matters to be considered include the following.

3.6.1 NES Soil

The NES Soil[7] applies to soil disturbance and land development activities on a site where activities on the Ministry for the Environment's Hazardous Activities and Industries List (HAIL) have occurred or have more likely than not occurred. The Site is recorded on GWRC Selected Land Use Register (SLUR) due to the storage of diesel fuel in an above ground storage tank adjacent to the former data centre. The potential for this HAIL activity to have resulted in ground contamination, and the potential for other HAIL activities to have occurred is assessed in Section 5. The applicability of the NES Soil to the Proposed Village is discussed in Section 7.

3.6.2 Wellington District Plan

The remediation, use and development of any contaminated land, or potentially contaminated land is a restricted discretionary activity under Rule 32.2.1 of the Wellington District Plan. The relevant matters of discretion include:

- The level, nature and extent of contamination in relation to the proposed use or development;
- The methods to address the risks posed by contaminants to public health and safety;
- The effects of contamination on built structures, ecological and amenity values, soil quality and the wider environment; and
- The approach to the remediation and/or on-going management of the contaminated land and the mitigation measures proposed to avoid adverse effects on public health, safety and the environment.

The relevant objectives and policies for the management of contaminated land are 31.2.1.2, 31.2.1.3 and 31.2.1.4 which seek the following outcomes:

- Minimisation and control of the adverse effects that may arise from the use and development of any contaminated or potentially contaminated land;
- The encouragement of remediation and/or ongoing management of contaminated land or potentially contaminated land as is appropriate for any likely future use of the land; and

[7] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations (2011).

- Management of exposure from the ongoing use of land affected by soil contaminants that avoids or mitigates the risk of adverse effects on human health and the environment.

An assessment of the Proposed Village against Rule 32.2.1, the matters of discretion, and the relevant objectives and policies is provided in Section 7.

3.6.3 Regional Plan for Discharges to Land

According to Rule 21 of the Regional Plan for Discharges to Land, the onsite discharge of contaminants into or onto land is a permitted activity providing contaminants concentrations at the site boundary are below background concentrations, and where necessary, monitoring is undertaken to confirm that this condition is met. Where these permitted activity conditions cannot be met, consent for a controlled activity (off-site discharges) is required.

An assessment of site contaminant conditions against this rule is provided in Section 7.

3.6.4 Proposed Natural Resources Plan

Under Rule 54 of the Proposed Natural Resources Plan ("PNRP", which will supersede the Regional Plan for Discharges to Land once operative), the investigation of potentially contaminated land is a permitted activity providing the investigation is undertaken and reported in accordance with the Contaminated Land Management Guidelines, and the report is provided to Greater Wellington Council following the completion of the investigation.

Rule 55 of the PNRP states that the discharge of contaminants to land where they may enter water is a permitted activity providing groundwater concentrations at the site boundary comply with specific water quality guidelines. Where the permitted activity conditions cannot be met, consent for a discretionary activity is required.

An assessment of site contaminant conditions against Rules 54 and 55 is included in Section 7.

4 Site History

4.1 Site History

The history of the Site has been ascertained from the review of:

- Wellington City Council ("WCC") property files;
- GWRC SLUR;
- Selected historical aerial photographs from the T+T Library and the WCC GIS viewer; and
- Current and historical certificates of title.

These sources document on-Site activities, except for the aerial photograph review which also provide information on readily observable surrounding land use. The information that has been reviewed is summarised in this section. A more detailed review of the available information and the corresponding sources is included in Appendix C. Key site history documents are presented in Appendix D.

Prior to the 1960s, the Site had been largely vacant with some houses within the Site near the southern, eastern and western boundaries, and a possible commercial yard area (specific use unknown) on the eastern boundary. Much of the remainder of the Site was vegetated, although the southwest corner appears to have been cleared since at least the 1940s. A clubhouse for the swimming club may have encroached onto the Site near the northern boundary.

The Teachers College was first developed in 1966 with a major extension (development of the northwest corner of the Site) in 1972. Several other extensions, additions and demolitions have since occurred, including the construction of four prefabricated buildings in the south of the Site around 1970 and their removal in the late 1980s. Building plans show that several buildings constructed in the 1960s and 1970s incorporated asbestos-containing materials ("ACM").

The playing fields have existed in the southwest of the Site throughout the Teachers College occupation, along with the tennis courts which were extended in the 1980s. Dangerous goods have likely been stored on the Site since the 1960s (based on property file records for the original construction) but it is not clear what dangerous goods these may have been. At the time of the 2017 T+T site walkover the only fuel tank on the Site was associated with the data centre. This tank has since been removed. T+T understands that this is the only bulk fuel storage to have occurred on the Site, with the former campus boilers having been gas-fuelled. The Site is recorded (reference SN/05/1067/02) on the GWRC SLUR as a Category I Site (Verified History of Hazardous Activity or Industry) due to the presence of this tank, though it is important to note that this does not imply that the Site is contaminated as a result of this activity.

Aerial photographs indicate the Site was originally heavily modified (likely with significant volumes of cut-to-fill material) with a valley running through the Site orientated northwest to southeast. Building plans for the original Teachers College development show areas of cut and fill to achieve appropriate building platforms.

The surrounding land use has been predominantly residential, with the Karori Pool and Karori Normal School on the northern boundary. A former 'landfill' operated approximately 50 m southwest and downstream of the Site at Ben Burn Park, but a recent GHD Limited[8] report indicates that the landfill was filled with clean material and is classed as being low risk for leachate and landfill gas.

[8] GHD Limited, August 2017. Victoria University Wellington. Preliminary Site Investigation. Campbell Street Sports Fields.

4.2 Previous investigations

A preliminary site investigation (PSI)[8] was carried out by GHD Ltd for the sports fields in the southwest corner of the Site in 2017. The following is a summary of the PSI:

- The sports fields have existed since approximately the 1960s (built for the Teachers College), before which they were part of pastoral land that extended over the wider Site;
- The report stated that no HAIL activities were identified to have occurred on the sports fields (but application of persistent pesticides appears not to have been considered); and
- Two HAIL activities were identified in proximity to the sports fields – diesel storage 150 m to the east, and a former closed landfill 50 m to the southwest. As noted above, GHD identified that this landfill was in fact thought to be filled with cleanfill.

No samples were collected as part of the GHD investigation.

Asbestos building surveys undertaken in 2017 by Precise Consulting Limited (refer Appendix C3) indicate that ACM was present in both internal and external parts of buildings and that the ACM was in good condition (not degraded). ACM was identified in following buildings: Ako-Pai Marae, Mackie Gym, Oldershaw, Ward Allan, Tennant, Theatre Block, Panckhurst Block, Malcolm Block, Waghorn Block and Gray Block.

5 Site Characterisation

This section characterises the likely and potential contamination status of the Site based on the available information as presented in Section 4 of this report.

5.1 Potential for contamination

This investigation has identified that HAIL activities may have been undertaken at the Site. The activities, potential contaminants and an assessment of the likelihood, potential magnitude and possible extent of contamination are presented in Table 5.1 below.

Table 5.1: Potential for contamination

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Playing fields and gardens	Arsenic, lead, copper, Organochlorine Pesticides (OCPs).	Pesticides may have been used on the playing fields and gardens. There is a low risk of residual pesticide contamination in shallow soils in these areas, and in any storage areas such as the workshop/storage sheds.	A10 – Persistent pesticide use.
Diesel and petrol storage	Hydrocarbons including PAH, TPH, BTEX.	No bulk fuel storage is understood to have occurred with the exception of an above ground diesel storage tank adjacent to the former communications centre. This tank is understood to have been double-skinned tank and was stored on a concrete plinth. No known leaks from this tank occurred. Accordingly, the potential for ground contamination from this source is negligible. The former workshop/sheds may have stored small quantities of diesel and/or petrol for equipment (i.e. in 20 L jerry cans), but these quantities are unlikely to have resulted in significant ground contamination.	A17 – Storage tanks or drums for fuel. Given negligible potential for contamination from this source to impact the Site, it is not investigated further.

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Earthworks/ contouring of the Site (including imported fill)	Variable depending on source of imported fill (if any), and extent/magnitude of pre-existing site contamination prior to cut/fill activities. Potential contaminants include metals, Polycyclic Aromatic Hydrocarbons (PAHs) and asbestos.	Much of the northern half of the Site appears to have been profiled to allow for buildings to be constructed. It is likely that some or all of this was cut-to-fill, however, fill may have been imported as well. Moderate potential for low levels of contamination.	I – Intentional or accidental release of a hazardous substance (only if contaminant present in sufficient quantity to present a risk to human health or the environment).
Landfills on nearby properties	Variable, but potentially metals, hydrocarbons, volatile organic compounds, asbestos.	It appears that the 'landfill' southwest of the Site was actually a cleanfill, meaning the potential for contamination to have come from this source is negligible. A possible dump site was located north of the Site, but based on the size and downstream location of the dump site, it is unlikely that contamination from the dump site would have impacted the Site. Negligible potential for contamination.	H –Migration of a hazardous substance. Given the negligible potential for contamination from these sources to impact the Site, they are not investigated further.

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Buildings with asbestos containing materials (ACM) and lead based paints	Asbestos, lead and other metals.	There are three potential sources of asbestos contamination in soils at the Site: • Building plans show that asbestos was widely used throughout the buildings at the Site. Some buildings were demolished in the 1970s/1980s (such as near the cricket nets and car park), whilst deconstruction of other buildings is ongoing there is moderate potential for asbestos fibres and ACM fragments to be present in shallow soil from construction and demolition of these and existing buildings. • Degradation of ACM products in existing and previous buildings resulting in release of asbestos fibres to ground in close proximity to buildings. There is low potential for this source to have contributed asbestos fibres to soil. • There is low to moderate potential for asbestos to be present below the ground surface if it was present in buildings that existed prior to the Teachers College and worked into the soil during earthworks for the Teachers College development or the construction of these buildings. The potential sources of lead associated with lead based paints are similar to those associated with asbestos – namely the demolition of former buildings or the degradation of painted exterior surfaces on current and former buildings that may have used lead based paints.	I – Intentional or accidental release of a hazardous substance (only if contaminant present in sufficient quantity to present a risk to human health or the environment).

5.2 Preliminary conceptual site model

A conceptual model, as defined by the Ministry for the Environment in the contaminated land management guidelines[9], sets out known and potential sources of contamination, potential exposure pathways, and potential receptors. For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor).

A preliminary conceptual site model has been developed for the Proposed Village which takes into account the available information about the Site, and our understanding of the potential effects on

[9] Ministry for the Environment, updated 2011, *Contaminated Land Management Guidelines No. 5 Site Investigation and Analysis of Soils.*

human health and the environment. The model is presented below in Figure 5.1. The preliminary conceptual site model formed the basis for planning the site investigation.

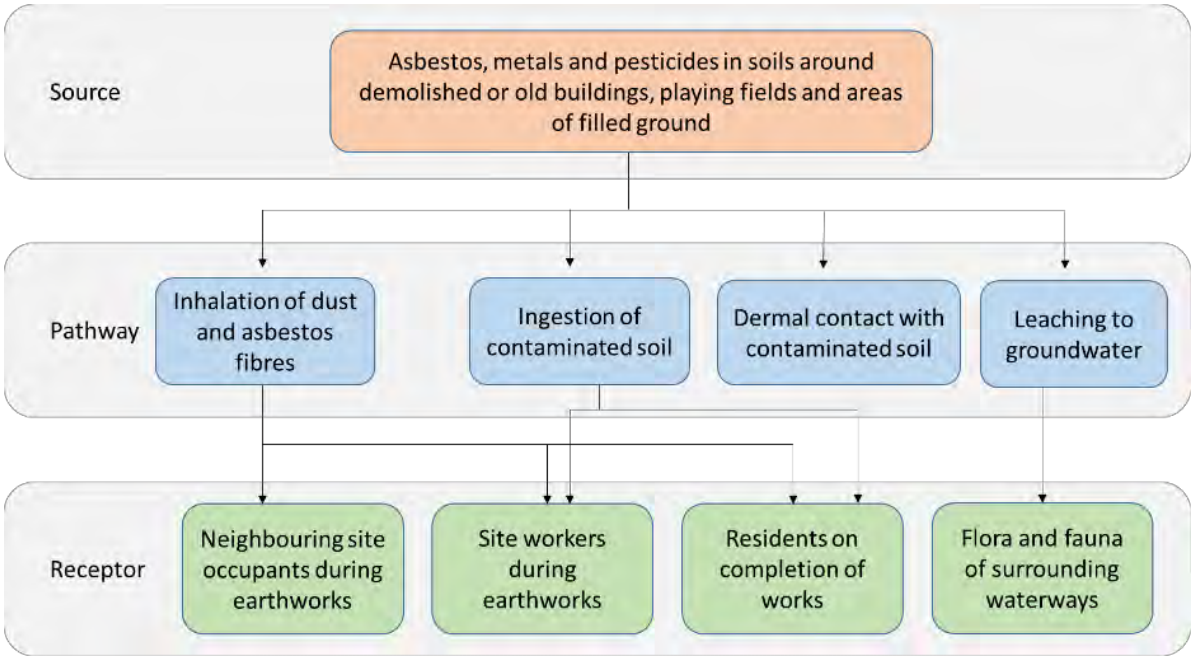


Figure 5.1: Preliminary conceptual site model.

6 Site Investigations

6.1 Investigation approach

6.1.1 Rationale

In October 2017, T+T completed a soil and groundwater investigation at the Site. The principal objectives of that investigation were to:

- Assess soils around existing and former buildings for the presence of asbestos and metals associated with the degradation of asbestos/lead based materials and the demolition of former structures that may have contained those materials;
- Assess soil contaminants within the broader area of cut and fill activities across the Site; and
- Assess the potential presence of persistent pesticides on sports fields and in garden areas.

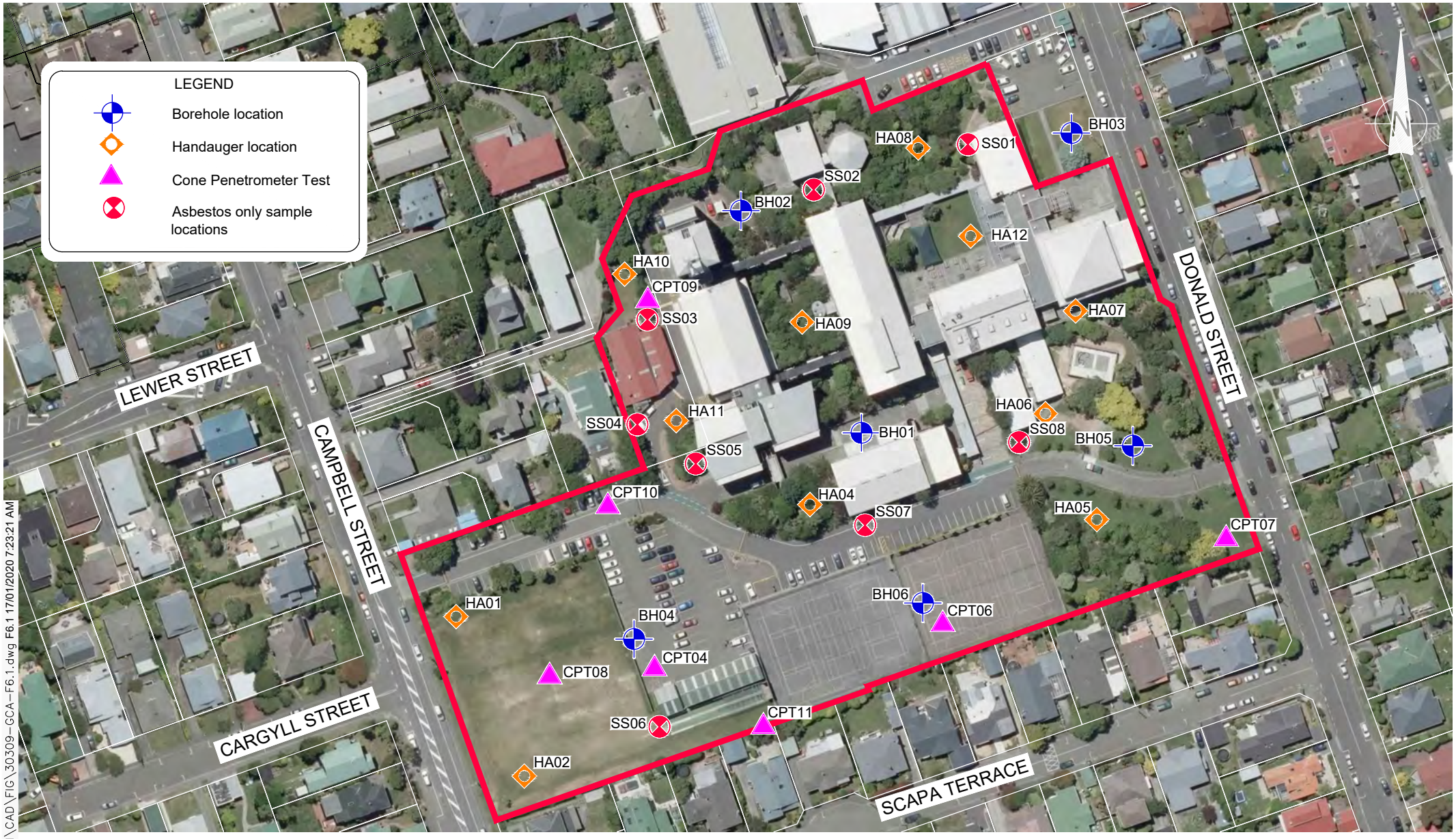
Although the investigation focussed on the assessment of contaminants in soil, groundwater sampling from piezometers installed during a concurrent geotechnical investigation was also completed to provide an indication of groundwater contaminant concentrations at the Site. Refer to the T+T geotechnical report[4] for piezometer construction details.

6.1.2 Scope

Table 6.1 summarises the T+T (2017) investigation scope. The investigation locations are shown on Figure 6.1.

Table 6.1: Summary of T+T (2017) site investigation scope

Contaminant source/area of interest	Investigation scope	T+T (2017) investigation location
Playing fields and gardens	Collection of topsoil samples from across the playing field and garden areas from a combination of hand auger and machine-drilled boreholes. Samples collected from 0.0- 0.1m depth. Samples analysed for metals and OCPs.	Playing fields: HA1, HA2, BH4, CPT11 Gardens: HA05-HA07, BH05, CPT07
Earthworks/ contouring of the Site	Collection of soil samples from across exterior areas of the Site on an approximate 40-50 m sample density. Samples collected from multiple depths and to a maximum depth of 2.6 m. Samples analysed for a range of potential contaminants including metals, PAHs and asbestos.	All samples
Buildings with asbestos containing materials (ACM)	Samples collected using hand tools from near surface (0.1 m depth) and sub-surface soils (0.3 m depth) to assess for the presence of asbestos in shallow soils associated with current and former buildings. All samples analysed for asbestos content on a semi-quantitative basis.	SS01-SS08
Groundwater contamination	Samples collected from three wells installed to 5 m depth (BH01 and BH04) and 6 m depth (BH06) during the T+T geotechnical investigation. Groundwater sampling was completed on two occasions (2 and 13 November 2017). All groundwater samples were analysed for metals, PAHs and OCPs.	BH01, BH03 and BH04



SCALE 1: 1500

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Aerial photo and property boundaries sourced from Linz Data Service, licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence (CC BY 3.0 NZ)

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VICTORIA UNIVERSITY KARORI CAMPUS

Site Investigation Plan

FIG. No. Figure 6.1

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6.1.4 Methodology

Soil samples were collected in general accordance with the MfE's *Contaminated Land Management Guidelines No.5* ("CLMG5"). Soil samples were collected according to the following procedure:

- Surface samples were collected from 0-100 mm depth below ground level;
- Soil samples were then collected from the hand augers and boreholes at approximately 0.5 m depth intervals until natural ground was encountered;
- The materials encountered were logged in accordance with the NZ Geotechnical Society "*Guideline for the classification and field description of soils and rocks for engineering purposes*";
- Freshly gloved hands were used to collect soil samples from the recovered auger/ borehole core. All samples were placed immediately into 300 ml glass jars;
- Any equipment used to collect the samples was decontaminated between sample locations using clean water and Decon 90 (a phosphate-free detergent);
- Samples were shipped in chilled containers to Analytica Laboratories, Hamilton under chain of custody documentation; and
- Asbestos samples were collected as 500 ml grab samples and double-bagged. Each sample was visually inspected for asbestos fragments in the field in accordance with Western Australia guidelines[10] but none were identified.

Groundwater was sampled from three piezometers on the Site according to the following procedure:

- Prior to each sampling round, the depth of each well and the depth to groundwater was recorded;
- Each well was purged using a dedicated bailer until conductivity, pH and temperature measurements were stable;
- Water was collected into laboratory-prepared sample jars;
- Samples were sent to Hill Laboratories, Hamilton, under chain of custody documentation; and
- Non-dedicated equipment was cleaned with Decon90 and fresh water between locations.

6.1.5 Assessment criteria

Soil and groundwater analytical results have been compared to the risk based criteria presented in Table 6.2 below.

[10] Western Australia Department of Health, 2009. Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia. These guidelines were the prevailing guidelines at the time of sampling but have since been superseded by the NZ Guidelines for Assessing and Managing Asbestos in Soils (BRANZ, November 2017).

Table 6.2: Evaluation criteria

Regulatory Rules	Criteria for assessment	Relevance
NES Soil	• NES Soil contaminant standards for high-density residential use. • NZ Guidelines for assessing and managing asbestos in soil ("NZ Asbestos Guidelines").	To assess potential contamination-related risks to future Site occupants.
	• NES Soil contaminant standards for commercial/industrial use. • NZ Asbestos Guidelines.	To assess potential contamination-related risks to Site workers during earthworks.
GWRC Regional Plan for Discharges to Land Rule 21, GWRC Proposed Natural Resources Plan Rule 54 and 55	• Groundwater analytical results have been compared to ANZECC 95% and 90% protection of freshwater species trigger values.	Assessment of ability of groundwater contaminant concentrations to comply with permitted activity rules.
Wellington District Plan Rules 32.1.1, and 32.1.3 and 32.2.1	• NES Soil contaminant standards for high-density residential use and commercial/industrial. • NZ Asbestos Guidelines. • Type 2 Soils for the Wellington Region (background concentrations).	To assess if Site is contaminated (relevant to permitted activity rules 32.1.1 and 32.1.3) and if the development will require consent under Rule 32.2.1.

6.1.6 Data quality

A quality assurance and quality control ("QA/QC") program was implemented as part of field procedures, which included:

- Sampling equipment decontamination between sampling locations;
- Preservation of samples with ice during transport from the field to the laboratory;
- Transportation of samples with accompanying Chain of Custody documentation; and
- Compliance with laboratory sample holding times.

The laboratory testing was undertaken by two laboratories which are accredited and audited annually by International Accreditation New Zealand ("IANZ"). The laboratory's quality control measures include testing of blanks with all batches of samples and frequent replicates and spikes, along with peer review of worksheets. Standard laboratory QA/QC reports were not reviewed for this project, but are available from the laboratory upon request.

In addition to standard laboratory QA/QC, six duplicate soil samples were collected in the field and analysed as part of the investigation. Table 6.3 presents the QA/QC analytical results. In general, the QA duplicate results compared well with the respective samples and generally gave relative percentage differences ("RPD") of less than 30%. Three samples recorded values of 38-41% for cadmium or lead. The MfE Contaminated Land Management Guidelines No. 5 ("CLMG5") – Site Investigation and Analysis of Soils indicates that RPDs of less than 30-50% is acceptable for field

duplicate. The variability in analysis results is likely due to soil heterogeneity but nonetheless is considered acceptable for use in this investigation.

Table 6.3: Summary of QA/QC data

Location / depth	BH02 1 m	Duplicate 1	RPD %	BH03 0 m	Dup 2	RPD %	BH03 1 m	Dup 3	RPD %
Arsenic	2.59	2.75	6	2.73	2.88	5	1.99	2.02	1
Cadmium	0.071	0.07	1	0.089	0.12	30	0.012	0.012	0
Chromium	22	22.1	0	15	14.8	1	14.8	15.5	5
Copper	16.9	17.2	2	8.56	8.52	0	7.73	6.83	12
Lead	22.2	22.4	1	20.2	20.6	2	19	12.5	41
Nickel	13.7	13.7	0	6.84	7.27	6	7.68	9.09	17
Zinc	77.5	75.2	3	47.3	45.9	3	36.2	28.8	23

Location / depth	CPT07 0.5 m	Dup 4	RPD %	CPT10 0.5 m	Dup 5	RPD %	CPT08A 0.5 m	Dup 6	RPD %
Arsenic	32	35.7	11	5.85	5.13	13	6.57	6.14	7
Cadmium	0.11	0.082	29	0.025	0.02	22	0.028	0.019	38
Chromium	20.6	22.6	9	21.6	19.7	9	20.6	19.6	5
Copper	25.4	23.2	9	15.9	15.5	3	28.7	25.1	13
Lead	138	91	41	21.8	20.8	5	27.3	27.1	1
Nickel	14	16.4	16	16.1	15.6	3	23.6	20.2	16
Zinc	130	111	16	68.4	63.3	8	88.5	78.9	11

All results are in mg/kg.

6.2 Investigation findings

6.2.1 Site observations

Investigations encountered natural or reworked alluvial soils with isolated areas of fill (refer to Section 2.4.2 for a description). No fragments of ACM were identified either in hand-augured or machine drilled boreholes or surface samples collected specifically for asbestos testing. No odours or visual signs of potential contamination were identified with the exception of a fragment of brick at 1 m depth in HA08 (located in the north of the Site).

6.2.2 Soil analytical results

Summarised results are presented in Tables 6.4 and 6.5 with laboratory transcripts included in Appendix E.

Asbestos

Asbestos was detected in the form of asbestos fines and fibrous asbestos (AF/FA) (chrysotile and/or amosite) at three locations (Refer Table 6.4):

- One location (SS03) contained AF/FA below 0.001% weight for weight ("w/w"); and
- Two locations contained AF/FA above 0.01% w/w in both surface soils and soil at 0.3 m below ground. These were SS04 (next to the childcare centre on the western boundary of the Site) and SS06 (next to the playing fields where historic buildings have been removed). These concentrations of AF/FA exceed human health criteria for high-density residential land use and commercial/industrial land use (relevant for worker health).

Chemical contaminants

The results generally show low levels of chemical contamination in soils across the Site:

- All metal, PAH and OCP concentrations were below the NES Soil human health standard for high-density residential use;
- All metal, PAH and OCP concentrations were below the NES Soil human health standard for commercial/industrial use;
- Metals were detected above background concentrations in a number of locations throughout the Site, including in soils up to 2.5 m below ground. Concentrations are elevated by up to three- to four-times background and generally higher than the variability indicated by the data quality results (30-40%);
- Allophane testing was undertaken to assess if elevated metal concentrations may be due to volcanic ash being incorporated in sedimentary materials. Results showed low levels of allophane (<5%), meaning the metal concentrations are unlikely to be due to volcanic influences. Therefore the elevated metal concentrations are more likely to be due to historic cut-to-fill operations mixing low levels of historic contamination (e.g. from commercial yards and from domestic fire ash) throughout the upper soil profile;
- Detectable concentrations of OCPs have been identified in topsoil throughout the Site, particularly in the playing fields (to a maximum of 0.5 m below ground) and southeast gardens, but also in topsoil in the general grounds. Concentrations are generally very low with the highest concentration of total DDT being 0.26 mg/kg (topsoil in the southeast gardens). These concentrations are above background levels but below relevant human health guidelines; and

- PAH are present at detectable levels throughout the Site, but only exceed background concentrations in topsoil in isolated samples (in the playing fields and in the very southeast corner of the site – CPT07).

6.2.3 Groundwater analytical results

Groundwater analytical results are summarised in Table 6.6. Laboratory transcripts are provided in Appendix E.

Concentrations of dissolved metals in groundwater were, with one exception, below the ANZECC trigger levels for the protection of 95% and 90% of freshwater species. A concentration of copper was detected in a sample collected from BH03 which marginally exceeds the trigger levels. This well is located in the inferred up-hydraulic gradient area of the Site. PAHs and OCPs were not detected in groundwater.

6.3 Revised conceptual site model

The preliminary conceptual site model provided in Section 5.2 has been revised to reflect the sampling results, which only found asbestos contamination above human health guidelines. The revised model is presented in Figure 6.2 below.

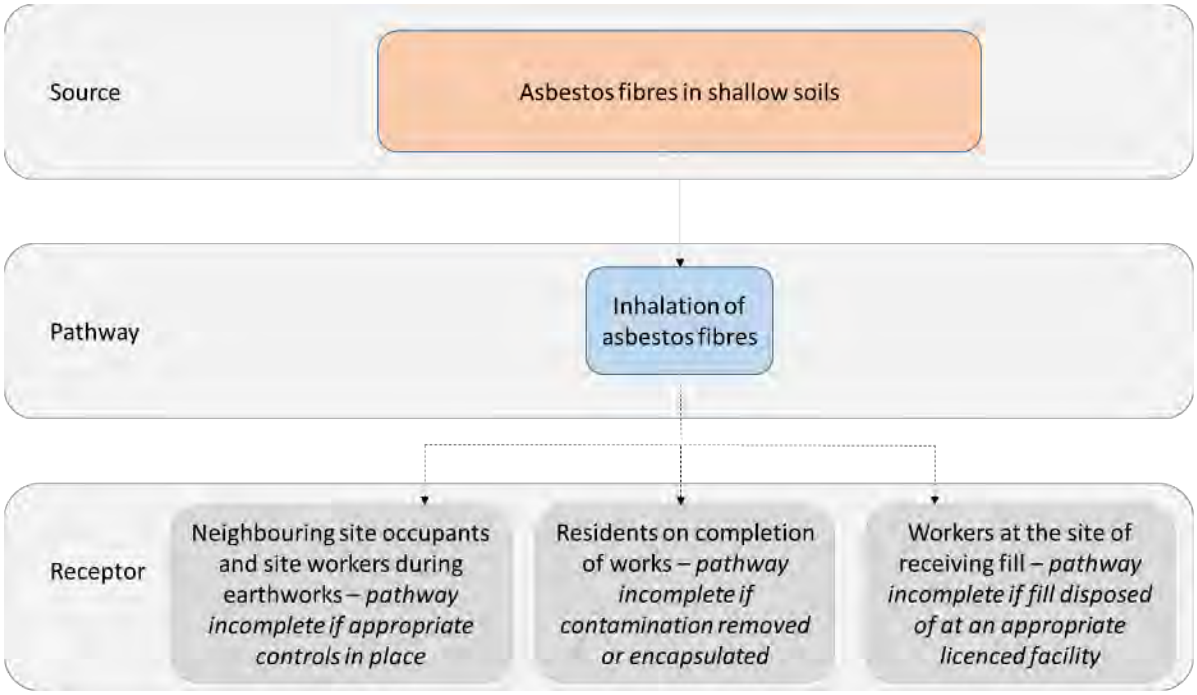

Figure 6.2: Final conceptual site model. Note the dashed lines and grey boxes indicate pathways that are expected to be incomplete based on the recommendations presented in this report.

Table 6.4: Soil analysis summary tables - Asbestos

Sample		SS01-0.1 m	SS01-03 m	SS02-0.1 m	SS02-03 m	SS03-0.1 m	SS03-0.3 m	SS04-0.1 m
Bonded ACM	(> 7 mm)	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Asbestos Fines/Fibrous Asbestos	(<2 mm & 2 -7 mm; or <7 mm)	not detected	not detected	not detected	not detected	not detected	<0.001	0.08%

Sample		SS08-0.3 m	HA08-0.1 m	HA08-1.0 m	HA06-0.1 m	HA06-0.5 m	BH03-0.1 m	HA09-0.1 m
Bonded ACM	(> 7 mm)	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Asbestos Fines/Fibrous Asbestos	(<2 mm & 2 -7 mm; or <7 mm)	not detected	not detected	not detected	not detected	not detected	not detected	not detected

Sample		SS04-0.3 m	SS05-0.1 m	SS05-0.3 m	SS06-0.1 m	SS06-0.3 m	SS07-0.1 m	SS07-0.3 m	SS08-0.1 m
Bonded ACM	(> 7 mm)	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Asbestos Fines/Fibrous Asbestos	(<2 mm & 2 -7 mm; or <7 mm)	0.05%	not detected	not detected	0.03%	0.08%	not detected	not detected	not detected

Sample		CPT06-0.1 m	CPT06-0.5 m	BH02-0.1 m	BH02-0.5 m	BH04-0.1 m	HA12-0.1 m	CPT07-0.1 m	HA02-0.1 m
Bonded ACM	(> 7 mm)	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Asbestos Fines/Fibrous Asbestos	(<2 mm & 2 -7 mm; or <7 mm)	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected

Note:

All values in % asbestos weight/weight in soil.

Red values exceed human health criteria of 0.001% w/w.

Table 6.5: Soil analysis summary tables - Chemical

Sample ID/ date	NES Soil human health criteria		Wellington Regional Council Background Values (main soil type 2 - greywacke)	Maximum		Playing Fields										Southeast Gardens												
						HA01		HA02			BH4			CPT11		HA05			HA06		HA07		BH05			CPT07			
Date	High-density residential land use	Commerical/Industrial land use				11/10/2017	11/10/2017	12/10/2017	12/10/2017	12/10/2017	9/10/2017	9/10/2017	9/10/2017	10/10/2017	10/10/2017	11/10/2017	11/10/2017	11/10/2017	11/10/2017	11/10/2017	11/10/2017	11/10/2017	10/10/2017	10/10/2017	10/10/2017	9/10/2017	9/10/2017	9/10/2017
Depth (m)						0.1	0.5	0.1	0.5	0.9	0.5	1	1.5	0.1	0.5	0.1	0.5	1	0.1	1	0.1	0.5	0.1	0.5	1.5	0.1	0.5	1.5
Geological unit						Topsoil	Natural	Topsoil	Natural	Natural	Natural	Natural	Natural	Topsoil	Natural	Topsoil	Natural	Natural	Topsoil	Natural	Topsoil	Natural	Topsoil	Natural	Natural	Topsoil	Natural	Natural
Metals																												
Arsenic	45	70	7	32	5.2193478	3.66	4.03	4.09	4.8	4.22	6.31	5.07	3.01	6.22	5.32	4.76	2.99	3.64	4	1.6	5.66	3.85	2.89	2.96	3.66	4.45	32	0.855
Cadmium	230	1,300	0.10	0.45	0.0873043	0.055	0.05	0.097	0.023	0.023	0.031	0.019	0.016	0.14	0.047	0.12	0.072	0.45	0.14	0.043	0.15	0.05	0.12	0.073	0.055	0.1	0.11	0.024
Chromium	NL	6,300	16	23.1	17.704348	14.7	18.4	13	17.8	16.3	22.6	18.9	18.6	17.3	14.3	15.9	23.1	16.9	14.7	19.2	19.7	21.5	14	16.1	15.8	17.7	20.6	20.1
Copper	NL	NL	25	108	19.455652	10.1	10.5	12	19	16.1	26.5	18	11.5	14.5	108	27.7	13.9	11.2	14.3	7.69	26.7	13.4	10.6	14.1	12.7	17.7	25.4	5.89
Lead	500	3,300	78.6	367	70.952174	18.8	17.1	83.6	18	17.3	29.3	20.4	16.1	78.7	85.6	367	85.1	35.4	92.6	15.5	120	26.5	72.4	34.9	37.8	204	138	17.8
Nickel	1,200 [1]	6,000 [1]	13	23.2	11.755217	8.69	15.9	7.45	16.1	14.5	23.2	16.4	12.5	10.2	8.16	8.14	11.9	10.8	8.69	10.4	10.1	13.6	7.89	11.8	10.5	10.2	14	9.25
Zinc	60,000 [1]	400,000 [1]	105	327	106.6	51.7	55.4	108	67.8	62.5	92	70	54.7	203	72.5	176	144	327	93.2	56.6	144	68.3	81.8	111	82	160	130	40.3
Metals - TCLP Extract																												
Arsenic	-		-	0		<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-
Cadmium	-		-	0.0009		0.0003	<0.0001	0.0006	0.0001	-	<0.0001	<0.0001	-	0.0004	0.0003	0.0005	0.0004	-	0.0007	-	0.0005	-	0.0005	0.0005	-	0.0009	0.0004	-
Chromium	-		-	0		<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.002	-	<0.002	<0.002	<0.002	<0.002	-	<0.002	-	<0.002	-	<0.002	<0.002	-	<0.002	<0.002	-
Copper	-		-	0.06		<0.002	0.007	<0.002	<0.002	-	<0.002	<0.002	-	<0.002	0.06	0.006	0.005	-	<0.002	-	0.003	-	<0.002	<0.002	-	<0.002	<0.002	-
Lead	-		-	0.115		0.0063	0.0065	0.014	<0.0005	-	0.0025	0.0031	-	0.012	0.043	0.115	0.057	-	0.037	-	0.022	-	0.015	0.0087	-	0.07	0.072	-
Nickel	-		-	0.004		<0.002	0.005	<0.002	0.003	-	<0.002	<0.002	-	<0.002	0.003	<0.002	<0.002	-	<0.002	-	<0.002	-	<0.002	0.003	-	<0.002	0.004	-
Zinc	-		-	0.63		0.45	0.05	0.79	0.08	-	0.06	<0.01	-	0.61	0.16	0.49	0.13	-	0.28	-	0.39	-	0.63	0.24	-	0.48	0.21	-
PAH																												
Acenaphthene	-		-	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	-		-	0.07		<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	0.02	<0.01	0.01	<0.01	<0.01	<0.01	0.02	0.07	0.02	<0.01
Anthracene	-		0.05	0.12		<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.01	0.03	0.12	0.02	<0.01
Benzo[a]anthracene	-		-	0.15		<0.02	<0.02	0.08	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	0.07	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.15	0.04	<0.02
Benzo[a]pyrene (BAP)	-		0.27	0.4		0.01	<0.01	0.22	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.04	0.06	0.04	0.01	0.09	<0.01	0.03	0.03	0.04	0.04	0.09	0.4	0.1	<0.01
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	0.21		0.02	<0.02	0.21	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.1	0.06	0.02	0.14	<0.02	0.05	0.04	0.03	0.02	0.05	0.21	0.06	<0.02
Benzo[g,h,i]perylene	-		-	0.07		<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.07	0.02	<0.02
Benzo[k]fluoranthene	-		-	0.1		<0.01	<0.01	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.02	<0.01	0.05	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.1	0.02	<0.01
Chrysene	-		-	0.1		<0.01	<0.01	0.11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.04	0.02	0.01	0.06	<0.01	0.02	0.02	0.02	0.02	0.05	0.1	0.03	<0.01
Dibenzo[a,h]anthracene	-		-	0		<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	-		0.55	0.5		<0.02	<0.02	0.33	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.04	0.07	0.05	0.03	0.16	<0.02	0.04	0.05	0.06	0.05	0.11	0.5	0.06	<0.02
Fluorene	-		-	0		<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-c,d)pyrene	-		-	0.06		<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	0.03	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.06	0.02	<0.01
Naphthalene	69 [2]	3,100	0.01	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	-		0.26	0.18		<0.01	<0.01	0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.04	0.02	0.06	<0.01	0.02	0.03	0.02	0.02	0.05	0.18	0.02	<0.01
Pyrene	160 [2]		0.57	0.5		<0.02	<0.02	0.31	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.04	0.07	0.05	0.03	0.16	<0.02	0.04	0.05	0.06	0.05	0.11	0.5	0.07	<0.02
B(a)P eq.	24	25	-	0.47		0.03	0.03	0.29	0.03	0.03	0.03	0.03	0.03	0.04	0.06	0.08	0.06	0.03	0.13	0.03	0.05	0.05	0.06	0.06	0.11	0.47	0.12	0.03
Organochlorine Pesticides Screening in Soil																												
Aldrin	45	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
alpha-BHC	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
beta-BHC	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
delta-BHC	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
gamma-BHC (Lindane)	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
cis-Chlordane	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
trans-Chlordane	-	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-
Total Chlordane [(cis+trans)*100/42]	90 [1]	-	<LD	0		<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	-
2,4'-DDD	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
4,4'-DDD	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
2,4'-DDE	-	-	<LD	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	0.01	<0.005	<0.005	<0.005	0.009	<0.005	-	<0.005	<0.005	-
4,4'-DDE	-	-	<LD	0.007		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	0.006	<0.005	<0.005	<0.005	0.007	<0.005	-	<0.005	<0.005	-
2,4'-DDT	-	-	<LD	0.158		<0.005	<0.005	0.005	<0.005	<0.005	-	-	-	0.008	0.013	<0.005	<0.005	-	0.158	<0.005	0.029	<0.005	0.127	<0.005	-	<0.005	<0.005	-
4,4'-DDT	-	-	<LD	0.083		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	0.083	<0.005	0.013	<0.005	0.081	<0.005	-	<0.005	<0.005	-
Total DDT	240	1,000	<LD	0.26		<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	<0.02	-	0.26	<0.02	0.04	<0.02	0.22	<0.02	-	<0.02	<0.02	-
Dieldrin	45	160	<LD	0		<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Endosulfan I	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
Endosulfan II	-	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-
Endosulfan sulphate	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
Endrin	20 [1]	160	<LD	0		<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Endrin Aldehyde	-	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-
Endrin ketone	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
Heptachlor	10 [1]	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
Heptachlor epoxide	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
Hexachlorobenzene	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-
Methoxychlor	500 [1]	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-

Notes:
all results in mg/kg
Red values exceed background levels for Type 2 soils for the Wellington Region
NL = no limit
<LD = below level of laboratory detection
NC = not calculated due to insufficient values above laboratory detection

1 - Guideline on the Investigation Levels for Soil and Groundwater, NEPM, Australia, updated 2013 (high-density residential and commercial values)
2 - MfE Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (silty clay soils, contamination <1 m, residential and commercial values used)

Table 6.5 (continued) : Soil analysis summary tables - Chemical

Sample ID/ date	NES Soil human health criteria		Wellington Regional Council Background Values (main soil type 2 - greywacke)	Maximum		General Grounds																							
						HA04		HA08		HA09		HA11		HA12		BH1		BH2			BH3				CPT8A			CPT9		CPT10	
Date	High-density residential land use	Commerical/Industrial land use				12/10/2017	12/10/2017	11/10/2017	11/10/2017	12/10/2017	12/10/2017	12/10/2017	12/10/2017	12/10/2017	12/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017	11/10/2017	9/10/2017	9/10/2017	9/10/2017	11/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Depth (m)						0.1	1	0.1	1	0.1	0.5	0.1	0.9	0.1	1	1.6	2.6	0	1	2	0	0.45	1	2.5	0.1	0.5	1.5	0.5	1.2	0.5	1.5
Geological unit						Topsoil	Natural	Fill	Fill	Topsoil	Natural	Topsoil	Natural	Topsoil	Natural	Natural	Natural	Topsoil	Natural	Natural	Topsoil	Natural	Natural	Natural	Topsoil	Natural	Natural	Natural	Natural	Natural	Natural
Metals																															
Arsenic	45	70	7	6.77	3.7080769	2.53	4.9	3.94	5.34	3.29	2.65	5.77	6.77	2.32	2.93	3.1	1.01	6.07	2.59	4.12	2.73	2.13	1.99	1.11	4.75	6.57	3.39	3.07	3.62	5.85	3.87
Cadmium	230	1,300	0.10	0.2	0.0597308	0.16	0.078	0.088	0.2	0.045	0.023	0.11	0.083	0.12	0.034	0.044	0.018	0.051	0.071	0.083	0.089	0.011	0.012	0.018	0.061	0.028	0.021	0.049	0.02	0.025	0.011
Chromium	NL	6,300	16	26.7	17.116154	13.1	18.3	17.1	18.3	13.2	16.9	15.2	18.4	10.5	16	16.7	8.92	16.1	22	24.4	15	15.4	14.8	26.7	14.4	20.6	18.1	18.5	19.4	21.6	15.4
Copper	NL	NL	25	44	14.002692	10.7	44	10.1	15.5	7.78	8.32	23.3	24.4	6.27	7.78	6.72	3.74	13.4	16.9	19	8.56	7.81	7.73	8.19	11.7	28.7	18.2	12.7	9.57	15.9	17.1
Lead	500	3,300	78.6	47.4	23.293077	17.1	33.9	47.4	45.2	15.5	30.4	29	30.6	21.8	13.1	17	6.92	18.4	22.2	24.9	20.2	12.3	19	16.5	45.2	27.3	17.2	17.1	16.2	21.8	19.4
Nickel	1,200 [1]	6,000 [1]	13	33.2	11.963077	7.9	13.7	7.36	11.3	4.89	9.17	8.6	16.9	5.86	11	8.5	4.3	13.6	13.7	33.2	6.84	8.97	7.68	14.3	9.07	23.6	16.1	11.8	11.7	16.1	14.9
Zinc	60,000 [1]	400,000 [1]	105	144	63.957692	64.5	83.2	44.4	144	40.8	46.4	104	96.2	43.3	38.7	68.7	22.6	57.3	77.5	80	47.3	30.1	36.2	73.1	69.2	88.5	64.2	60.4	51.3	68.4	62.6
Metals - TCLP Extract																															
Arsenic	-		-	0.011		<0.005	-	<0.005	0.011	<0.005	-	<0.005	-	<0.005	-	-	-	<0.005	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	<0.005	-	<0.005	-
Cadmium	-		-	0.0014		0.0008	-	0.0002	0.0014	0.0005	-	0.0007	-	0.0006	-	-	-	0.0001	-	-	0.0004	<0.0001	-	-	0.0003	<0.0001	-	<0.0001	-	<0.0001	-
Chromium	-		-	0.0021		<0.002	-	<0.002	0.0021	<0.002	-	<0.002	-	<0.002	-	-	-	<0.002	-	-	<0.002	<0.002	-	-	<0.002	<0.002	-	<0.002	-	<0.002	-
Copper	-		-	0.151		0.027	-	<0.002	0.151	<0.002	-	<0.002	-	<0.002	-	-	-	<0.002	-	-	<0.002	<0.002	-	-	<0.002	<0.002	-	<0.002	-	<0.002	-
Lead	-		-	0.043		0.043	-	0.016	<0.0005	0.016	-	0.011	-	0.0017	-	-	-	0.0098	-	-	0.0092	0.0095	-	-	0.014	0.0024	-	0.0085	-	0.01	-
Nickel	-		-	0.013		<0.002	-	<0.002	0.013	<0.002	-	<0.002	-	<0.002	-	-	-	0.007	-	-	<0.002	<0.002	-	-	<0.002	<0.002	-	<0.002	-	<0.002	-
Zinc	-		-	1.05		1.05	-	0.07	0.7	0.63	-	0.87	-	0.68	-	-	-	0.05	-	-	0.76	<0.01	-	-	0.43	0.04	-	<0.01	-	<0.01	-
PAH																															
Acenaphthene	-		-	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	-		-	0.03		<0.01	0.02	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	-		0.05	0.03		<0.01	0.02	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo[a]anthracene	-		-	0.05		<0.02	0.05	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene (BAP)	-		0.27	0.08		<0.01	0.08	<0.01	0.04	<0.01	<0.01	0.03	0.03	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	0.08		<0.02	0.08	<0.02	0.08	<0.02	<0.02	0.04	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	0.03	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	-		-	0.03		<0.02	0.03	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	-		-	0.04		<0.01	0.04	<0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Chrysene	-		-	0.04		<0.01	0.04	<0.01	0.02	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Dibenzo[a,h]anthracene	-		-	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	-		0.55	0.08		<0.02	0.08	<0.02	0.04	<0.02	<0.02	0.08	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	<0.02	<0.02	0.04	<0.02	<0.02	<0.02
Fluorene	-		-	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-c,d)pyrene	-		-	0.02		<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Naphthalene	69 [2]	3,100	0.01	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	-		0.26	0.02		<0.01	0.02	<0.01	0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	160 [2]		0.57	0.08		<0.02	0.08	<0.02	0.04	<0.02	<0.02	0.06	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	<0.02	<0.02	0.04	<0.02	<0.02	<0.02
B(a)P eq.	24	25	-	0.11		0.03	0.11	0.03	0.06	0.03	0.03	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.04	0.03	0.03	0.03
Organochlorine Pesticides Screening in Soil																															
Aldrin	45	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
alpha-BHC	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
beta-BHC	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
delta-BHC	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
gamma-BHC (Lindane)	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
cis-Chlordane	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
trans-Chlordane	-	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-	-	-	-
Total Chlordane [(cis+trans)*100/42]	90 [1]	-	<LD	0		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	<0.02	<0.02	-	-	<0.02	<0.02	-	-	-	-	-
2,4'-DDD	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
4,4'-DDD	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
2,4'-DDE	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
4,4'-DDE	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
2,4'-DDT	-	-	<LD	0.134		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	<0.005	0.006	<0.005	-	-	-	-	-	0.134	<0.005	-	-	0.022	<0.005	-	-	-	-	-
4,4'-DDT	-	-	<LD	0.02		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	<0.005	<0.005	<0.005	-	-	-	-	-	0.02	<0.005	-	-	0.018	<0.005	-	-	-	-	-
Total DDT	240	1,000	<LD	0.15		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	-	-	-	-	-	0.15	<0.02	-	-	0.04	<0.02	-	-	-	-	-
Dieldrin	45	160	<LD	0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	<0.05	<0.05	-	-	<0.05	<0.05	-	-	-	-	-
Endosulfan I	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
Endosulfan II	-	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-	-	-	-
Endosulfan sulphate	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
Endrin	20 [1]	160	<LD	0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	<0.05	<0.05	-	-	<0.05	<0.05	-	-	-	-	-
Endrin Aldehyde	-	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-	-	-	-
Endrin ketone	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
Heptachlor	10 [1]	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
Heptachlor epoxide	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
Hexachlorobenzene	-	-	<LD	0		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	-
Methoxychlor	500 [1]	-	<LD	0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-	-	-	-

Notes:
all results in mg/kg
Red values exceed background levels for Type 2 soils for the Wellington Region
NL = no limit
<LD = below level of laboratory detection
NC = not calculated due to insufficient values above laboratory detection

1 - Guideline on the Investigation Levels for Soil and Groundwater, NEPM, Australia, updated 2013 (high-density residential and commercial values)
2 - MfE Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (silty clay soils, contamination <1 m, residential and commercial values used)

Table 6.6: Groundwater analytical results.

Sample Name:	Unit	ANZECC 95% Freshwater	ANZECC 90% Freshwater	BH1		BH3		BH4	
Date				2/11/2017	13/11/2017	2/11/2017	13/11/2017	2/11/2017	13/11/2017
Sum of Anions	meq/L	-	-	47	-	24	-	8	-
Sum of Cations	meq/L	-	-	4.9	-	7	-	4.1	-
pH (lab)	pH Units	-	-	8.4	7.6	9.2	8.1	7.5	7.5
Total Alkalinity	g/m3 as CaCO3	-	-	2,200	440	1,140	510	320	390
Free Carbon Dioxide	g/m3 at 25°C	-	-	-	25	-	8.8	-	25
Bicarbonate	g/m3 at 25°C	-	-	2,700	-	1,200	-	380	-
Total Hardness	g/m3 as CaCO3	-	-	146	360	88	196	121	430
Electrical Conductivity (EC) (lab)	mS/m	-	-	49	47.9	65.4	60.3	42.1	45.4
Approx Total Dissolved Salts	g/m3	-	-	-	320	-	400	-	300
Dissolved Calcium	g/m3	-	-	33	-	32	-	25	-
Dissolved Magnesium	g/m3	-	-	15.2	-	1.93	-	13.9	-
Dissolved Potassium	g/m3	-	-	1.48	-	2.6	-	2	-
Dissolved Sodium	g/m3	-	-	46	-	120	-	37	-
Chloride	g/m3	-	-	59	58	25	29	53	57
Nitrite-N	g/m3	-	-	0.06	-	< 0.002	-	< 0.002	-
Nitrate-N	g/m3	0.7	3.4	0.076	0.06	< 0.002	< 0.05	0.004	< 0.05
Nitrate-N + Nitrite-N	g/m3	-	-	0.136	-	< 0.002	-	0.004	-
Sulphate	g/m3	-	-	5.3	6.5	20	17.5	7.9	7.4
Escherichia coli	MPN / 100mL	-	-	79	-	920	-	13	-
Total Boron*	g/m3	0.37	0.68	-	0.144	-	0.072	-	0.171
Total Calcium	g/m3	-	-	-	75	-	35	-	92
Total Copper*	g/m3	0.0014	0.0018	-	0.144	-	0.141	-	0.34
Total Iron	g/m3	-	-	-	115	-	93	-	96
Total Magnesium	g/m3	-	-	-	43	-	26	-	47
Total Manganese	g/m3	-	-	-	5.6	-	2.5	-	4.7
Total Potassium	g/m3	-	-	-	17	-	16.6	-	23
Total Sodium	g/m3	-	-	-	51	-	135	-	49
Total Zinc*	g/m3	0.008	0.015	-	0.3	-	0.29	-	0.66
Heavy metals (dissolved)									
Dissolved Arsenic	g/m3	0.024	0.042	0.003	-	0.0051	-	< 0.0010	-
Dissolved Cadmium	g/m3	0.0002	0.0004	< 0.00010	-	< 0.00005	-	< 0.00005	-
Dissolved Chromium	g/m3	0.001	0.006	< 0.0010	-	< 0.0005	-	< 0.0005	-
Dissolved Copper	g/m3	0.0014	0.0018	< 0.0010	-	0.003	-	0.0007	-
Dissolved Lead	g/m3	0.0034	0.0056	< 0.0002	-	0.00019	-	< 0.00010	-
Dissolved Nickel	g/m3	0.011	0.013	< 0.0010	-	0.0033	-	0.0034	-
Dissolved Zinc	g/m3	0.008	0.015	< 0.002	-	< 0.0010	-	< 0.0010	-
Organochlorine Pesticides Screening in Water, By Liq/Liq									
Aldrin	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
alpha-BHC	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
beta-BHC	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
delta-BHC	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
gamma-BHC (Lindane)	g/m3	0.00002	0.00004	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
cis-Chlordane	g/m3	See total	See total	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
trans-Chlordane	g/m3	See total	See total	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
2,4'-DDD	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
4,4'-DDD	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
2,4'-DDE	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
4,4'-DDE	g/m3			< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
2,4'-DDT	g/m3	0.00001	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
4,4'-DDT	g/m3			< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dieldrin	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Endosulfan I	g/m3	0.00002	0.00008	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Endosulfan II	g/m3			< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Endosulfan sulfate	g/m3			< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Endrin	g/m3	0.000002	0.000004	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Endrin aldehyde	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Endrin ketone	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Heptachlor	g/m3	0.000009	0.000025	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Heptachlor epoxide	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Hexachlorobenzene	g/m3	-	-	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008	< 0.0008
Methoxychlor	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Total Chlordane [(cis+trans)*100/42]	g/m3	0.00008	0.00014	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq									
Acenaphthene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00014	0.00018
Acenaphthylene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Anthracene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Benzo[a]anthracene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Benzo[a]pyrene (BAP)	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Benzo[b]fluoranthene + Benzo[j]fluoranth	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Benzo[g,h,i]perylene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Benzo[k]fluoranthene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Chrysene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dibenzo[a,h]anthracene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Fluoranthene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Fluorene	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Indeno(1,2,3-c,d)pyrene	g/m3	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Naphthalene	g/m3	0.016	0.037	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Phenanthrene	g/m3	-	-	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004
Pyrene	g/m3	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002

Note: Laboratory notes that the sum for Anions and Cations were not in good agreement due to the volume of sediment within the samples.

Red values exceed ANZECC 90% and 95% freshwater values

* ANZECC Values are for dissolved metals rather than total, so comparison with total results should be read with caution

7 Ground Contamination Assessment of Effects

7.1 Development context

The construction of the Proposed Village will involve earthworks across the majority of the Site for foundations, basements, infrastructure and pavement areas. It is estimated that approximately 35,000 m^3 will require off-site disposal as excess.

7.2 Overview of contamination conditions

Asbestos has been detected within three soil sample locations, in near surface and subsurface soils. The levels of asbestos detected in two of the three sample locations exceed guideline criteria incorporated by reference into the NES Soil for high-density land use and commercial/industrial land use. Based on the sampling data obtained, it has not been possible to clearly identify the source of asbestos in soil, though it is plausible that it is present due to the degradation of exterior asbestos containing materials on existing buildings and/or the demolition of historic buildings and shallow reworking of soils during the construction of the Teachers College.

The uncertainty regarding the source(s) of the asbestos, means that there is also uncertainty regarding the spatial and vertical extent of asbestos contaminated soil. In advance of additional soil analysis data, it can be conservatively assumed that asbestos could be present across the Site, though with a lower likelihood in the playing fields (which do not appear to have been previously developed or contain buildings) and southeast gardens (which has previously only contained residential buildings). Based on the data available, it can also be assumed that asbestos contaminated soil may be present to 0.5 m depth (a conservative depth to incorporate possible reworking of shallow soils in gardens).

With respect to chemical contaminants in soil, metal, PAH and OCP concentrations are above background levels throughout soils tested, including soils to 2.5 m below ground. However, as all detected concentrations are below NES high-density residential and commercial/industrial land use criteria, there are no contamination-related health and safety requirements for chemical contaminants.

With one minor exception, groundwater concentrations detected in three wells located on the Site comply with the trigger levels for the protection of freshwater species. The concentrations indicate that contaminants are not being discharged to groundwater within the Site.

7.3 Human health effects

7.3.1 NES Soil

The NES Soil manages the human health effects associated with various activities on a site where a HAIL activity has occurred, or has more likely than not occurred.

Asbestos has been detected at levels above high density residential land use and above criteria used to assess potential health risks to workers that could come into contact with soils during earthworks. HAIL category 'I' therefore applies to the Site, and in accordance with Regulation 5(7) of the NES, the provisions of the NES Soil will apply to soil disturbance associated with development earthworks.

Earthworks volumes will exceed the NES Soil permitted activity thresholds and soil consent will be required under the NES Soil. As asbestos concentrations exceed the high-density residential land use guidelines, consent will be required for a restricted discretionary activity to undertake the proposed development earthworks and also to change the site use from educational to residential (a less to more sensitive land use). The matters over which WCC has discretion is restricted and are summarised in Table 7.1 below together with an assessment against these matters.

Table 7.1: NES Soil restricted matters of discretion

Matter of discretion	Assessment
Adequacy of the detailed site investigation.	The investigation documented in this report has been completed in accordance with CLMG5. Although additional investigation is likely to be undertaken to refine the understanding of the distribution of asbestos in soils at the detailed design phase, this investigation adequately characterises soil contaminant conditions at the Site for the purposes of assessing risk to human health and options for the management of this risk.
The suitability of the piece of land for the proposed activity.	The Site is considered suitable for the development of the Proposed Village, as controls regarding the excavation, disposal and reuse of asbestos-containing soils can appropriately manage any risks to human health arising from the contamination.
The approach to the remediation or ongoing management of the piece of land.	Controls will be implemented to mitigate potential health effects on future residents, workers involved in soil disturbance and the general public from exposure to asbestos in soils. These controls will be consistent with industry good practice and will comply with the New Zealand Guidelines for Assessing and Managing Asbestos in Soils (2017) and Health and Safety (Asbestos) Regulations 2016. Asbestos containing materials will be excavated and disposed off-site, encapsulated under buildings or sealed areas, or a combination of disposal and encapsulation. During excavation and handling, dust suppression and earthworks controls will be employed to control the generation of airborne asbestos. In the event that contaminated materials are retained on Site, these will be placed beneath sealed areas or building footprints, and a Long Term Management Plan will be prepared to document ongoing management controls.
The adequacy of the site management plan or the site validation report, or both, as applicable.	A Site Management Plan ("SMP") will be prepared in accordance with CLMG1 that will document the controls and procedures required in the event that asbestos contained on Site and/or removed and disposed off-Site. A framework SMP, which provides a summary of the anticipated SMP controls is included in Appendix F. A Site Validation Report ("SVR") will be prepared to document the completion of asbestos remediation or management works. This report will be prepared in accordance with CLMG1.
The transport, disposal and tracking of soil and other materials taken away in the course of the activity.	All materials removed from the Site will be disposed to a facility that is licensed to accept them. Material disposal and documentation procedures will be set out in the SMP. The SVR will report on the nature, volume and destination of materials disposed off-Site.

7.3.2 Wellington District Plan

The presence of asbestos in soils at the Site means the permitted activity conditions of Rule 32.1.3 of the Wellington District Plan cannot be met. Accordingly, resource consent for the development of the Proposed Village will be required for a restricted discretionary activity in accordance with Rule 32.2.1.

The matters over which WCC has discretion in the granting of that consent are broadly similar to those for the NES Soil and relate to the measures to be taken to avoid effects on public health and the wider environment.

As noted in Table 7.1 and described in Section 7.4 below, remediation/management procedures to mitigate potential contamination risks to human health and the environment will be documented in an SMP. A summary of proposed control measures is presented in the Framework SMP, included in Appendix F.

7.4 Environmental effects

7.4.1 Regional Plan for Discharges to Land

It is noted that soil contaminants are present on the Site above background concentrations. However, based on groundwater sampling and analysis completed at the Site, there is no evidence to indicate that soil contamination present at the Site has adversely affected groundwater quality, or that groundwater discharging from the Site would result in an adverse environmental effect.

Adverse effects that could potentially result from the disturbance of contaminated soil, including, for example discharges to air, and the discharge of contaminated sediment will be mitigated by the procedures to be set out in the SMP and described in brief in Section 7.3. On this basis, it is considered that the contaminant conditions satisfy the permitted activity conditions of Rule 21 of the Regional Plan for Discharges to Land and are consistent with the objectives and policies of the that plan.

7.4.2 Proposed Natural Resource Plan

This investigation and report have been undertaken in accordance with CLMG5 and CLMG1, and therefore meets the permitted activity conditions of rule 54 of the PRNP, subject to being provided to the Greater Wellington Regional Council.

On the basis of the groundwater sampling and analysis completed at the Site, groundwater discharging from the Site is highly unlikely to be a risk to human health or the environment. Detected contaminant concentrations in groundwater inferred to be discharging from the Site comply with the ANZECC Guideline criteria for the protection of 95% of freshwater species. Contaminant conditions therefore comply with the permitted activity conditions of Rule 55 of the plan.

8 Recommendations

Based on the investigation described above, we recommend the following:

- The Site is suitable for the construction and operation of the Proposed Village, subject to the implementation of controls to mitigate risks to human health from exposure to asbestos in soils. These controls include:
  - Unless completely removed prior to or during construction, to protect future residents, asbestos contaminated materials should be placed beneath sealed, or landscaped areas with appropriate thicknesses of soft cover. These controls will not apply if all asbestos contaminated fill is removed from the Site prior to construction;
  - During the disturbance of these materials (to remove off Site or encapsulate on Site) standard earthworks controls supplemented with personnel and equipment decontamination, signage and segregation, personal protective equipment can be implemented to manage the low potential for exposure to asbestos;
  - If asbestos contaminated fill is retained on Site; to protect future workers involved in disturbance of contaminated soil, limited controls should be implemented as applied during disturbance. These controls will not apply if all asbestos contaminated fill is removed from Site prior to construction; and
  - If asbestos contaminated material is retained on Site, potential risks associated with the future disturbance of this material can be managed through the implementation of similar controls to those described above for earthworks. These controls can be documented in a LTMP.
- These controls should be documented in a SMP, the provision of which should be a condition of resource consents related to ground contamination sought from WCC under the NES Soil and Wellington District Plan.

9 Conclusions

This assessment has been undertaken to:

- Assess the potential for ground contamination to be present at the Site,
- Document actual ground contamination present,
- Assess the potential environmental and human health effects of this contamination; and
- Identify the ground contamination management measures required to mitigate risks to human health and the environment.

The key findings of this assessment are:

1 T+T identified the potential for contamination to be present associated with pesticide use on playing fields and gardens, demolition of residential houses and levelling works of the Site prior to the teachers college development, and use of asbestos-containing materials in buildings;

2 Asbestos was detected in a limited number of soil samples. Based on the data available, there is no clear explanation of its source, although plausible sources are (i) loss from existing buildings and/or (ii) historic building demolition and rework of fill during construction. Therefore it is conservatively assumed that asbestos is present across the whole Site to a depth of 0.5 m (assumed depth of historical residential ground disturbance). Based on historic Site use, some areas of the Site (e.g. sports playing fields) have a lower likelihood of containing asbestos that others (e.g. building degradation);

3 The presence of asbestos creates the potential for health effects on future residents and site workers involved in earthworks. These potential health effects can be managed through the implementation of earthworks controls, and through the encapsulation and/or removal of asbestos-contaminated soil from the Site which are standard industry practices. Measures and controls to manage contaminated soils will be set out in an SMP, which can be revised to provide ongoing control if contaminated materials are retained on Site.

4 No other contamination requiring management has been identified through the site investigations.

5 The Site is suitable for the Proposed Village from a contamination perspective provided the recommendations to manage asbestos contamination are implemented.

10 Applicability

This report has been prepared for the exclusive use of our client Ryman Healthcare Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions contained in this report are based on our visual inspection and sampling of material within the site. The nature and continuity of the subsoil away from the test and sample locations is inferred and it must be appreciated that actual conditions may vary from the assumed model.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Paul Walker	Pierre Malan
Technical Director - Contaminated Land	Project Director

Reviewed by a Suitably Qualified and Experienced Practitioner (SQEP) under the NES Soil:

.....

Chris Hillman

11-Mar-20

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[Note that v3 produced by editing pdf of V2]

Appendix A: Proposed Development Plans

PROPOSED SITE PLAN WITH AERIAL

A1 sheet scale = 1 : 500
A3 sheet scale is twice scale shown above

NORTH

SITE INFORMATION

SITE AREA:	**3.056ha (30,563m²)**
SITE ADDRESS:	**26 DONALD STREET, KARORI, WELLINGTON &** **37 CAMPBELL ST, KARORI**
LEGAL DESCRIPTION:	**SECTION 1 SURVEY OFFICE PLAN 28414** **SECTION 2 SURVEY OFFICE PLAN 515832** **COT's 790147, 812554, NA22A/355**

BUILDING REFERENCES:

B01A & B01B	VC or MAIN VILLAGE CENTRE ALS = ASSISTED LIVING SUITES CARE ROOMS
B02-B07	IA - INDEPENDENT APARTMENTS

SITE NOTES:

THIS SITE PLAN IS TO BE READ IN CONJUNCTION WITH THE CIVIL ENGINEERS PLANS & DETAILS

TREES & OTHER LANDSCAPING FEATURES ARE INDICATIVE ONLY, REFER TO THE LANDSCAPE PLANS & SCHEDULES

LEGAL BOUNDARIES

FIRE EXIT

NOTES:

- OVERALL VILLAGE WASTE MANAGEMENT STRATEGY TO BE DEVELOPED IN LATER STAGES BUT GENERALLY OPERATES AS FOLLOWS:
- **VILLAGE CENTRE -** ALL WASTE TO BE TRANSPORTED TO THE WASTE STORE BY STAFF
- **APARTMENTS -** RESIDENTS DISPOSE OF WASTE IN BINS LOCATED IN DEDICATED BIN ROOMS WITHIN UNDERCROFT PARKING AREA. STAFF TO TRANSFER BINS TO WASTE STORE OR TO REFUSE COLLECTION ZONES
- **ALS & CARE** - STAFF TO TRANSFER WASTE TO WASTE STORE

RYMAN HEALTHCARE LTD
92 RUSSLEY ROAD, CHRISTCHURCH, NEW ZEALAND
PH: 64 - 3 - 366 4069

COMPREHENSIVE CARE RETIREMENT VILLAGE - DONALD STREET, KARORI, WELLINGTON

AMENDMENTS:

A	JULY 2020	RESOURCE CONSENT ISSUE

LOCATION: DONALD STREET, KARORI, WELLINGTON

DRAWING TITLE: PROPOSED SITE PLAN WITH AERIAL

BLOCK NO.:	S01	AMENDMENT:	A
PROJECT NO.:	042	STAGE NO.:	RCT
PDF NAME:	042 - RCT _ S01 _ .A0-021 _ A		
SCALE:	As indicated	DRAWING NO.:	
DRAWING STATUS: RC04			.A0-021

200mm
100mm
ORIGINAL SCALE
0mm

_8/07/2020 10:04:40 AM
BIM 360://042 - Karori/042-RCT_401_S01_SITE_OPTION_B.rvt

Appendix B: Site Photographs

Photograph 1: View of the campus buildings looking north-east, taken from carpark at the corner of the field.

Photograph 2: View of the Main Entrance from Donald St.

Photograph 3: A typical pre-fabricated building.

Photograph 4: The rear of the Marae.

Photograph 5: View of the data centre with the independent generator and fuel storage.

Photograph 6: View of footprint of Mackie Gym building following removal.

Photograph 7: Area formerly occupied by Marae building, now temporarily containing demolition materials.

Appendix C: Site History Information

Historical information relating to the Site has been collected from a variety of sources. The information presented documents on-site activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use. The information that has been reviewed is summarised in this appendix.

C 1 Certificates of Title

Current and historical certificates of titles for the Site have been reviewed. A summary of the information reviewed is presented below.

- The Site is currently in two titles. Both titles have been vested to Victoria University of Wellington by Gazette Notice (for the purposes of a Teacher's Training College);
- A series of Gazette Notices dated 1972, 1976, 1977 and 1980 divest the land for the purposes of a Teachers College; and
- A number of private owners are listed on the previous titles, including a baker. Other occupations are illegible.

A number of interests apply to the current titles, including under the Conservation Act and Crown Minerals Act. None of the interests are expected to have significantly impacted on potential for contamination at the site.

C 2 Historical Aerial Photographs

Historical aerial photographs from the T+T library, Retrolens and WCC's GIS viewer have been reviewed as stated in Table C.1. Relevant features of the Site and surrounding land are summarised from each aerial photograph in Table C.1. Copies of the key aerial photographs are included in Appendix D.

Table C.1: Summary of aerial photograph review

Date, run number and source	Key site features	Surrounding land features
1941 163/177/13 (Retrolens)	The Site appears to be largely vacant land, with isolated houses on the western and eastern boundaries, although the photo resolution is unclear. Land appears contoured and appears to have some scrub/ bush cover, although a large area in the southwest corner is vacant.	Surrounding land is predominantly residential with a school located on the northern boundary of the Site. Isolated commercial buildings are present within the residential areas.
1945 373/B13 (Retrolens)	The Site is still largely vacant but tracks can be seen entering the site from both the east and west. Two houses are visible on the eastern boundary, one on the southern boundary and a fenced yard is present on the western boundary (possibly used for storage, although this is unclear). Areas of cleared land can be seen on the southern boundary but the remainder of the site appears to be vegetated with grass or scrub and isolated large trees.	The surrounding land is still predominantly residential and has not changed significantly compared to the previous photograph.
1954	The Site is largely vegetated with a cleared area in the southeast corner.	The surrounding land appears largely unchanged from the previous

Date, run number and source	Key site features	Surrounding land features
847/2392/11 (Retrolens)	The cleared area includes a possible works/ storage yard, and a large house on the southern boundary with storage adjacent. Another cleared area is present in the southwest, with housing immediately to the north. A cliff is present in the centre of the eastern boundary, with land to the north significantly elevated above land to the south. At the northern boundary, buildings from the school encroach on the site. Another house is present on the northern part of the eastern boundary. A house is present at 29 Campbell St.	photograph. A swimming pool is clearly visible north of the Site, within the school complex.
1962 SN1458/D18 (T+T Library)	The western half of the Site is cleared land while the eastern half is largely vegetated. A house is present on the southern boundary, accessed from Donald St. Another two houses and sheds are present on the eastern boundary on Donald St. The house at 29 Campbell Street appears unchanged. There is an area of recently cleared vegetation in the centre of the site. The cleared portion of land appears largely flat, whereas the vegetated eastern half is contoured. Buildings from the school to the north of the Site still encroach on the Site.	No significant changes to surrounding land relative to the previous aerial photograph.
1970 SN2370/R10 (T+T Library)	The Site has been redeveloped into a training college. Playing fields are located in the southwest corner with four large buildings on their eastern side, adjacent to another playing field with two buildings. A carpark is immediately north of this area and there is a garden/ landscaped area in the southeast (which includes a small lake). The northeast quarter of the site is occupied by college buildings. These are arranged in a 'U' shape with a courtyard in the centre and landscaping on the northern side. The buildings from the school that previously encroached onto the Site have been removed. There is a cleared yard/ laydown area west of the college buildings and the house/ building at 29 Campbell Street remains.	No significant changes to surrounding land relative to the previous aerial photograph.
1980 SN5497/C9 (Retrolens)	Further development of the training college has occurred. Some of the buildings in the south (around the	Additional buildings have been constructed at the school north of the

Date, run number and source	Key site features	Surrounding land features
	playing fields) have been removed and new ones constructed. There are now eight or nine sheds located between the playing fields and newly constructed tennis courts (which appear paved) in the centre of the southern boundary. There is a driveway on the northern boundary of the playing fields. The landscaped gardens remain unchanged. Additional buildings have been constructed in the northwest of the Site in what was a yard area in the previous photograph. Buildings across the Site are interconnected with paths and landscaped areas between them. There is small carpark in the northeast corner of the Site. The building at 29 Campbell Street appears unchanged.	Site. Otherwise the surrounding land is largely unchanged.
1982 8111/I1 (Retrolens)	A playing field still occupies the southwest corner of the Site with adjacent buildings and tennis courts unchanged. The southeast corner is still occupied by landscaped gardens. The remainder of the Site is largely unchanged.	Surrounding land remains predominantly residential, with no significant changes at the school.
1996 (Wellington City Council GIS Viewer)	The Site is largely unchanged from the previous photograph although two new buildings are present in the northwest corner of the garden at the southeast of the Site. The buildings along the southern boundary (between the playing fields and tennis courts) have been removed and replaced with additional tennis courts.	The surrounding land appears largely unchanged from the previous photograph. A possible landfill site/ dump site is visible northwest of the swimming pool near the northern boundary of the Site.
2004 (Wellington City Council GIS Viewer)	Part of the playing fields have been converted to a car park, with a shed present on the southern boundary. The tennis courts are paved. A small building/ covered area has been built in a courtyard near the centre of the Site.	The surrounding land appears largely unchanged from the previous photograph. The swimming pool has been covered (now indoor) and a residential building (retirement village) is present on the former possible dump Site.
2010 (Wellington City Council GIS Viewer)	No significant changes to the Site relative to the previous photograph.	The surrounding land appears largely unchanged from the previous photograph.
2013 (Wellington City Council GIS Viewer)	A small structure has been built on the northern boundary of the gardens in the southeast of the Site. No other significant changes on the Site relative to the previous photograph.	The surrounding land appears largely unchanged from the previous photograph.

C 3 Client-Provided Information

The following documents contained information relevant to the potential for ground contamination at the Site:

- Asbestos survey reports and laboratory results for several buildings, prepared by Precise Consulting Ltd; an
- Plantroom Plant Audit, prepared by GHD Ltd.

LIM reports were reviewed but did not provide any additional information with regard to ground contamination above that already identified through other sources. A preliminary site investigation for the sports fields is reviewed in Section C4 below.

The following information was obtained from the above documents:

- The University was first constructed in the 1960s, this confirms the aerial photograph and property file information and suggests that asbestos is likely to have been present in building materials;
- The use of the fields is confirmed as sports fields, and netball and tennis courts are present on the southern boundary;
- Asbestos is present in several buildings across the Site. Asbestos is present in both internal and external parts of buildings, including in wall cladding, soffits, lagging and electrical equipment. Most ACM was noted to be in a good condition; and
- An audit of the plantrooms throughout the campus confirms that all boilers and heaters are currently gas-fired. Some of these are original but some have been more recently installed and it is unclear what the original plant may have been fuelled with.

C 4 Previous Ground Investigations

A preliminary site investigation (PSI) was carried out by GHD Ltd for the sports fields in the southwest corner of the site in 2017. The following is a summary of the PSI:

- The sports fields have existed since approximately the 1960s (built for the Teachers College), before which they were part of pastoral land that extended over the wider site;
- The report stated that no HAIL activities were identified on the sports fields (application of persistent pesticides appears not to have been considered); and
- Two HAIL activities were identified in proximity to the sports fields – diesel storage 150 m to the east, and a former closed landfill 50 m to the southwest.

No samples were collected as part of the investigation.

C 5 Council Property Files

Property files from WCC were received between the 6th and 10th of October 2017. The following is a summary of key files.

<u>29 Campbell Street:</u>

- The property file for this property includes two other titles. The only information included on the file related to the Karori Kids Preschool. From aerial photographs, it appears that this is the building immediately west of the Site, rather than the building on the title Section 1 SO 28414. No information related to Section 1 SO 28414 was identified.

<u>26 Donald Street:</u>

- A list of building consents provided by WCC date from as early as 1917, but some of these appear to be associated with the school to the north of the Site. A dwelling is dated 1924 and

a garage dated 1932. They were located on Donald Street. A swimming pool is dated 1936 – this is likely the pool to the north of the Site. A club house for the swimming club was dated 1946 and was located south of the swimming baths, therefore potentially encroaching on the site. Plans for the club house show it was of timber construction. A teacher's college is first mentioned in 1966 with several alterations and additions since. Key developments are discussed in further detail below.

- A consent application dated 1966 describes the original development of the Teachers College. Key features of the application include:
  - The application states that the Site is flatter in the south and that soils comprise "hard surface layers" with silts and clays and inclusions of organic fragments underlain by greywacke. Buildings were to be piled;
  - Areas of fill are indicated in the northwest of the Site;
  - A Site plan shows a women's hockey field in the southwest of the Site, tennis courts in the centre of the southern boundary and gardens with a pond in the southeast of the Site. Buildings in the northern half include administration, a library, physical education, teaching rooms and a hall. Tennis courts are also shown in the northwest corner of the Site;
  - Fibre plaster is specified on several plans. Given the age of construction, it is likely that this includes asbestos;
  - Plant rooms are included in several buildings. Boiler flues are also indicated in several buildings but fuel sources are not shown; and
  - A dangerous goods letter included with the application implies that dangerous goods are present on the site, but not what classes or types.
- 1967 plans to extend the administration block include geotechnical auger hole logs, which indicate a small area of fill. The exact location of the auger holes could not be determined. Plans for the extension indicate at least one boiler is gas-fired. Cement fibreboard is mentioned in several plans, again this is likely to have included asbestos;
- Temporary classroom buildings were constructed in 1969 and were to be removed once permanent buildings were constructed. Plans show these were the four buildings located immediately east of the playing fields in the 1970 aerial photograph. Possible asbestos-containing building materials are specified in the plans;
- A 1970 building consent application for a new prefab classroom states that the classroom walls will be constructed with asbestos and timber. An associated plan shows the layout for the southern half of the Site at that time. Four classrooms are labelled immediately east of the playing fields. Between these and the tennis courts are two more prefabs (including the one proposed). North of the tennis courts was the gymnasium;
- A 1971 foundation plan shows a Scout Hall on the western boundary of the Site and a number of proposed buildings, although the scale is unclear. It is possible that the Scout Hall is the building at 29 Campbell Street. The topography is indicated as varying by over ten feet in a very irregular pattern over the site;
- 1972 plans for stage 2 of the Teachers College (the buildings in the northwest corner of the Site) include a plan for a 'tank room' to be located between the stairs and a lift on the top floor. The plan shows two tanks but does not specify what they are to store. A kiln house was also included in the plans, with two kilns – one gas fired and one electric;
- 1981 plans for a new 'stackroom' show a plant room and specify asbestos to be used on the roof. The location of the new stackroom is not clear;
- Additional tennis courts were constructed in 1986. These replaced three prefabricated buildings;

- A letter dated 1995 describes storage of dangerous goods (petrol) on the Site. The letter states that the petrol is in 20 L containers and requests that the containers are kept in an approved flammable liquids cabinet. LPG was also stored on the Site. No dangerous goods licence was held at the time;
- A workshop was constructed near the playing fields in 1997;
- A 2003 plan shows the layout of the entire campus. The building at 29 Campbell Street is the Marae. A services workshop is located next to cricket nets and the playing fields in the south of the Site. A new garage was proposed to be constructed next to it. The remainder of the buildings are for teaching and administration; and
- Emails and associated plans/ documents from 2012 includes photographs of the seismic protection system for a new generator and modular data storage centre. Other files also describe the associated diesel fuel tank as being double-skinned and show that the tank will be filled via a hose to a tanker which would be positioned in the service lane north of the centre.

C 6 Council Contamination Enquiry

A contamination enquiry was placed with Greater Wellington Regional Council. The resulting Selected Land Use Register (SLUR) information provided is included in Appendix D and states that Site is listed on the SLUR due to the storage of diesel fuel on the property. Several surrounding properties (within approximately 200 m of the site boundary) are also listed on the SLUR. A summary of relevant SLUR information is included in Appendix D.

Resource consents related to the Site or properties immediately surrounding the Site (including existing, superseded and surrendered consents) are summarised in Table C.2 below. The contaminating activities identified in Table C.2 are considered unlikely to have resulted in soil contamination at the Site. This is because of their location downgradient of the Site, distance from the Site, and/ or nature of potential contamination.

Table C.2: Ground Contamination-Related Resource Consents

Location (and WCC reference)	Type of contaminating activity	Activity description	Potential for contamination at the site
The Site, 26 Donald St (SN/05/1067/02)	Storage of fuel	A 1,430 L diesel tank was described on a resource consent application for a new data protection facility at the University. The property is Category I as a HAIL activity has been verified but it is not known whether or not contamination exists. Attached documentation describes the tank as being an above-ground, double-skin steel tank to power a generator. It was installed in 2012 and was expected to be filled approximately once per year. The tank is located in the northern part of the gardens in the southeast of the Site.	Potential for contamination is considered low given the recent age of installation, testing information available and low use of the tank.
22 Dunthie Street, 280 m east of the Site (SN/05/403/02)	Storage of fuel	Council records show a 2,000 L fuel tank was removed from this property in 2012. It was used for a home heating system. The tank was removed and disposed to landfill along with surrounding bedding material. A decommissioning report prepared by URS states that no contamination above the	Potential for contamination is negligible as the tank has been removed and no significant contamination was

Location (and WCC reference)	Type of contaminating activity	Activity description	Potential for contamination at the site
		relevant human health and environmental acceptance criteria remained at that site.	identified in the tank pit.
50 Campbell Street, 50 m southwest of the Site (SN/05/007/02)	Former landfill	The property is understood to have been a former landfill, likely operational around 1910-1930. Leachate is understood to discharge via groundwater and the stormwater system to the Karori Stream, 600 m north of the former landfill. Council considers the risk of landfill gas generation to be low given the age and size of the landfill. An investigation was undertaken in 2005 and found that no engineered cap was present, with cover materials comprising clay and gravelly clay. Metal and hydrocarbon concentrations in soil were tested and were at background levels. With the exception of one fragment of glass, no evidence of landfill materials was identified, and no groundwater was identified to the maximum depth of investigations at 6 m. The property is now used as playing fields.	Low potential for contamination. Data available suggest it was a cleanfill, but if landfill material existed, leachate may have historically impacted groundwater beneath the Site. Given the likely age of filling operations, risk of further contamination is considered low.
241 Karori Road, 250 m northwest of the Site (SN/05/142/02)	Service station	The property currently operates as a service station. Therefore a HAIL activity has been confirmed, but Council holds no records of any contamination investigations being carried out.	As the service station is downgradient from the site, potential for contamination to have impacted the Site is low to negligible.

Appendix D: Key Site History Documents

Victoria University Wellington

Preliminary Site Investigation

Campbell Street Sports Fields

August 2017

Executive Summary

Victoria University Wellington (VUW) are collating vendor due diligence information for a portion (sports fields) on their property with the legal description Part Section 67 Karori DIST located at 26 Donald Street, Karori, Wellington, that also form the frontage of 35 – 43 Campbell Street. VUW have commissioned GHD Limited (GHD) to carry out a Preliminary Site Investigation (PSI) comprising a desktop investigation of activities that may have resulted in contamination from previous land uses on the sports field area (the site) that fronts Campbell Street. VUW may subdivide and divest the sports field to approach the market in the future.

The site was first developed in the early 1960s, prior to that it was pastoral land surrounded by residential properties. The site was developed into a sports field in the 1960s, which was part of the wider VUW property being developed into a teachers college. The teachers college was opened for use in 1970 and based on the historical aerial photograph review it does not appear that the site has been used for anything other than as a sports field, which remains the current land use.

Based upon the review of available site information and council held records, there are no activities on the site which appear on the Ministry for Environment Hazardous Activities Industries List (HAIL). However there were two HAIL sites identified adjacent to the site:

- Category A17 relating to storage tanks or drums for fuel, chemicals, or liquid waste – located 150 m east of the site.
- Category G3 relating to Ben Burn Park landfill activities occurring approximately 50 m south west of the site.

The Greater Wellington Regional Council (GWRC) Selected Land Use Register (SLUR) search provided information relating to the storage of a 1,400 L diesel tank (still stored on the site) on nearby VUW property, located approximately 150 m to the east of the site. The tank has been installed recently (2012) and there was no evidence of staining surrounding the tank indicating it is unlikely to have impacted the site.

The SLUR search also identified Ben Burn Park as a historic landfill site located approximately 50 m to the south-west of the site. There was limited information regarding the site being used as a landfill; however, it was assessed in 1998 by Purchas[1] (as part of a survey of Landfills in the Wellington Region) as being low risk for leachate and landfill gas if either were present at all. Based on the investigation made by MWH in 2005[2], MWH concluded that Ben Burn Park is likely to have been filled using clean fill materials to level the ground. Groundwater samples could not be collected during the MWH investigation and groundwater is likely to be greater than 6 m deep based on the findings of the investigation.

Based on information collected during this investigation there does not appear to be a source of contamination at the site and the site appears to have been used as sports fields since the VUW property was first developed in the early 1960s. Furthermore the source of nearest potential contamination to the site, Ben Burn Park, has been assessed in previous investigations as being low risk and likely to have been filled with clean fill.

There have been no HAIL activities identified on the site, but two nearby adjacent sites have been identified as HAIL sites. We think it is unlikely that there are impacts on the site from these

[1] Purchas, 1998, *Landfills in the Wellington Region*, Wellington Regional Council Publication No. WRC/RINV-T-98/47

[2] MWH 2005, *Ben Burn Park Closed Landfill Soil Contamination and Leachate Characterisation Project* –July 2005.

off site activities however as a conservative measure VUW could undertake precautionary sampling to confirm soils at the site are at or below background concentrations. This would give developers some preliminary information around soil disposal options.

Overall, based on the information reviewed to date, we consider that it is highly unlikely that there is a risk to human health in relation to subdivision of the land should subdivision consent be sought in the future. As no HAIL activities have been identified on the piece of land the NES Soil does not apply.

This report should be read in accordance with the disclaimer set out in section 1.6.

FULL REPORT AVAILABLE ON REQUEST

Appendix E: Laboratory Transcripts

Analytica Laboratories Limited
Ruakura Research Centre
10 Bisley Road
Hamilton 3214, New Zealand
Ph +64 (07) 974 4740
sales@analytica.co.nz
www.analytica.co.nz

Certificate of Analysis

Tonkin + Taylor
105 Carlton Gore Road, Newmarket
Auckland
Attention: Elyse LaFace
Phone: 027 7051561
Email: elaface@tonkintaylor.co.nz

Lab Reference: 17-25079
Submitted by: Elyse LaFace
Date Received: 16/10/2017
Date Completed: 24/10/2017
Order Number:
Reference: 30309

Sampling Site:

Heavy Metals in Soil

			Client Sample ID	BH4 Depth 0.5	BH4 Depth 1	BH4 Depth 1.5	BH2 Depth 0	BH2 Depth 1
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-1	17-25079-2	17-25079-3	17-25079-4	17-25079-5
Arsenic	mg/kg dry wt	*0.125*		6.31	5.07	3.01	6.07	2.59
Cadmium	mg/kg dry wt	*0.005*		0.031	0.019	0.016	0.051	0.071
Chromium	mg/kg dry wt	*0.125*		22.6	18.9	18.6	16.1	22.0
Copper	mg/kg dry wt	*0.075*		26.5	18.0	11.5	13.4	16.9
Lead	mg/kg dry wt	*0.05*		29.3	20.4	16.1	18.4	22.2
Nickel	mg/kg dry wt	*0.05*		23.2	16.4	12.5	13.6	13.7
Zinc	mg/kg dry wt	*0.05*		92.0	70.0	54.7	57.3	77.5

Heavy Metals in Soil

			Client Sample ID	Duplicate 1	BH3 Depth 0	BH3 Depth 0.45	BH3 Depth 1	Duplicate 2
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-6	17-25079-7	17-25079-8	17-25079-9	17-25079-10
Arsenic	mg/kg dry wt	*0.125*		2.75	2.73	2.13	1.99	2.88
Cadmium	mg/kg dry wt	*0.005*		0.070	0.089	0.011	0.012	0.12
Chromium	mg/kg dry wt	*0.125*		22.1	15.0	15.4	14.8	14.8
Copper	mg/kg dry wt	*0.075*		17.2	8.56	7.81	7.73	8.52
Lead	mg/kg dry wt	*0.05*		22.4	20.2	12.3	19.0	20.6
Nickel	mg/kg dry wt	*0.05*		13.7	6.84	8.97	7.68	7.27
Zinc	mg/kg dry wt	*0.05*		75.2	47.3	30.1	36.2	45.9

Heavy Metals in Soil

			Client Sample ID	Duplicate 3	Duplicate 4	BH1 Depth 1.6	BH1 Depth 2.6	CPT07 Depth 0.1
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-11	17-25079-12	17-25079-13	17-25079-14	17-25079-15
Arsenic	mg/kg dry wt	*0.125*		2.02	35.7	3.10	1.01	4.45
Cadmium	mg/kg dry wt	*0.005*		0.012	0.082	0.044	0.018	0.10

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

			Client Sample ID	Duplicate 3	Duplicate 4	BH1 Depth 1.6	BH1 Depth 2.6	CPT07 Depth 0.1
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Chromium	mg/kg dry wt	*0.125*		15.5	22.6	16.7	8.92	17.7
Copper	mg/kg dry wt	*0.075*		6.83	23.2	6.72	3.74	17.7
Lead	mg/kg dry wt	*0.05*		12.5	91.0	17.0	6.92	204
Nickel	mg/kg dry wt	*0.05*		9.09	16.4	8.50	4.30	10.2
Zinc	mg/kg dry wt	*0.05*		28.8	111	68.7	22.6	160

Heavy Metals in Soil

			Client Sample ID	CPT07 Depth 0.5	CTP07 Depth 1.5	CTP10 Depth 0.5	CTP10 Depth 1.5	Duplicate 5
			Date Sampled	9/10/2017	9/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-16	17-25079-17	17-25079-18	17-25079-19	17-25079-20
Arsenic	mg/kg dry wt	*0.125*		32.0	0.855	5.85	3.87	5.13
Cadmium	mg/kg dry wt	*0.005*		0.11	0.024	0.025	0.011	0.020
Chromium	mg/kg dry wt	*0.125*		20.6	20.1	21.6	15.4	19.7
Copper	mg/kg dry wt	*0.075*		25.4	5.89	15.9	17.1	15.5
Lead	mg/kg dry wt	*0.05*		138	17.8	21.8	19.4	20.8
Nickel	mg/kg dry wt	*0.05*		14.0	9.25	16.1	14.9	15.6
Zinc	mg/kg dry wt	*0.05*		130	40.3	68.4	62.6	63.3

Heavy Metals in Soil

			Client Sample ID	CPT9 Depth 0.5	CPT9 Depth 1.2	BH05 Depth 0.1	BH05 Depth 0.5	BH05 Depth 1.5
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-21	17-25079-22	17-25079-23	17-25079-24	17-25079-25
Arsenic	mg/kg dry wt	*0.125*		3.07	3.62	2.89	2.96	3.66
Cadmium	mg/kg dry wt	*0.005*		0.049	0.020	0.12	0.073	0.055
Chromium	mg/kg dry wt	*0.125*		18.5	19.4	14.0	16.1	15.8
Copper	mg/kg dry wt	*0.075*		12.7	9.57	10.6	14.1	12.7
Lead	mg/kg dry wt	*0.05*		17.1	16.2	72.4	34.9	37.8
Nickel	mg/kg dry wt	*0.05*		11.8	11.7	7.89	11.8	10.5
Zinc	mg/kg dry wt	*0.05*		60.4	51.3	81.8	111	82.0

Heavy Metals in Soil

			Client Sample ID	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT8A Depth 1.5	Duplicate 6	CPT11 Depth 0.1
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-26	17-25079-27	17-25079-28	17-25079-29	17-25079-30
Arsenic	mg/kg dry wt	*0.125*		4.75	6.57	3.39	6.14	6.22
Cadmium	mg/kg dry wt	*0.005*		0.061	0.028	0.021	0.019	0.14
Chromium	mg/kg dry wt	*0.125*		14.4	20.6	18.1	19.6	17.3
Copper	mg/kg dry wt	*0.075*		11.7	28.7	18.2	25.1	14.5
Lead	mg/kg dry wt	*0.05*		45.2	27.3	17.2	27.1	78.7
Nickel	mg/kg dry wt	*0.05*		9.07	23.6	16.1	20.2	10.2
Zinc	mg/kg dry wt	*0.05*		69.2	88.5	64.2	78.9	203

Heavy Metals in Soil

			Client Sample ID	CPT11 Depth 0.5
			Date Sampled	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-31
Arsenic	mg/kg dry wt	*0.125*		5.32
Cadmium	mg/kg dry wt	*0.005*		0.047

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Heavy Metals in Soil

			Client Sample ID	CPT11 Depth 0.5
			Date Sampled	10/10/2017
Chromium	mg/kg dry wt	*0.125*	14.3	
Copper	mg/kg dry wt	*0.075*	108	
Lead	mg/kg dry wt	*0.05*	85.6	
Nickel	mg/kg dry wt	*0.05*	8.16	
Zinc	mg/kg dry wt	*0.05*	72.5	

Trace Elements by TCLP

		Client Sample ID	BH4 Depth 0.5	BH4 Depth 1	BH2 Depth 0	BH3 Depth 0	BH3 Depth 0.45
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-1	17-25079-2	17-25079-4	17-25079-7	17-25079-8
Arsenic	g/m^3	*0.005*	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	g/m^3	*0.0001*	<0.0001	<0.0001	0.0001	0.0004	<0.0001
Chromium	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Copper	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Lead	g/m^3	*0.0005*	0.0025	0.0031	0.0098	0.0092	0.0095
Nickel	g/m^3	*0.002*	<0.002	<0.002	0.007	<0.002	<0.002
Zinc	g/m^3	*0.01*	0.06	<0.01	0.05	0.76	<0.01

Trace Elements by TCLP

		Client Sample ID	CPT07 Depth 0.1	CPT07 Depth 0.5	CTP10 Depth 0.5	CPT9 Depth 0.5	BH05 Depth 0.1
		Date Sampled	9/10/2017	9/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-15	17-25079-16	17-25079-18	17-25079-21	17-25079-23
Arsenic	g/m^3	*0.005*	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	g/m^3	*0.0001*	0.0009	0.0004	<0.0001	<0.0001	0.0005
Chromium	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Copper	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Lead	g/m^3	*0.0005*	0.070	0.072	0.010	0.0085	0.015
Nickel	g/m^3	*0.002*	<0.002	0.004	<0.002	<0.002	<0.002
Zinc	g/m^3	*0.01*	0.48	0.21	<0.01	<0.01	0.63

Trace Elements by TCLP

		Client Sample ID	BH05 Depth 0.5	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT11 Depth 0.1	CPT11 Depth 0.5
		Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-24	17-25079-26	17-25079-27	17-25079-30	17-25079-31
Arsenic	g/m^3	*0.005*	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	g/m^3	*0.0001*	0.0005	0.0003	<0.0001	0.0004	0.0003
Chromium	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Copper	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	0.060
Lead	g/m^3	*0.0005*	0.0087	0.014	0.0024	0.012	0.043
Nickel	g/m^3	*0.002*	0.003	<0.002	<0.002	<0.002	0.003
Zinc	g/m^3	*0.01*	0.24	0.43	0.04	0.61	0.16

TCLP Extraction

		Client Sample ID	BH4 Depth 0.5	BH4 Depth 1	BH2 Depth 0	BH3 Depth 0	BH3 Depth 0.45
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-1	17-25079-2	17-25079-4	17-25079-7	17-25079-8
Extractant Used			1	1	1	1	1
Initial pH			5.0	5.0	5.0	5.0	5.0

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TCLP Extraction

		Client Sample ID	BH4 Depth 0.5	BH4 Depth 1	BH2 Depth 0	BH3 Depth 0	BH3 Depth 0.45
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Final pH			5.0	5.0	5.0	5.0	5.0

TCLP Extraction

		Client Sample ID	CPT07 Depth 0.1	CPT07 Depth 0.5	CTP10 Depth 0.5	CPT9 Depth 0.5	BH05 Depth 0.1
		Date Sampled	9/10/2017	9/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-15	17-25079-16	17-25079-18	17-25079-21	17-25079-23
Extractant Used			1	1	1	1	1
Initial pH			5.0	5.0	5.0	5.0	5.0
Final pH			5.0	5.0	5.0	5.0	5.0

TCLP Extraction

		Client Sample ID	BH05 Depth 0.5	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT11 Depth 0.1	CPT11 Depth 0.5
		Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-24	17-25079-26	17-25079-27	17-25079-30	17-25079-31
Extractant Used			1	1	1	1	1
Initial pH			5.0	5.0	5.0	5.0	5.0
Final pH			5.0	5.0	5.0	5.0	5.0

Polycyclic Aromatic Hydrocarbons - Soil

		Client Sample ID	BH4 Depth 0.5	BH4 Depth 1	BH4 Depth 1.5	BH2 Depth 0	BH2 Depth 1
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-1	17-25079-2	17-25079-3	17-25079-4	17-25079-5
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*	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(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
Anthracene-d10 (Surrogate)	%	*1*	93.9	96.1	97.7	98.2	98.3

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Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	BH3 Depth 0	BH3 Depth 0.45	BH3 Depth 1	BH1 Depth 1.6	BH1 Depth 2.6
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-7	17-25079-8	17-25079-9	17-25079-13	17-25079-14
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
Dibenz(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
Anthracene-d10 (Surrogate)	%	*1*		103.4	102.0	103.1	101.7	104.4

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	CPT07 Depth 0.1	CPT07 Depth 0.5	CTP07 Depth 1.5	CTP10 Depth 0.5	CTP10 Depth 1.5
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-15	17-25079-16	17-25079-17	17-25079-18	17-25079-19
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*		0.07	0.02	<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*		0.12	0.02	<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		0.15	0.04	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		0.40	0.10	<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		0.21	0.06	<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		0.07	0.02	<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		0.10	0.02	<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*		0.10	0.03	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		0.50	0.06	<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*		0.06	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*		0.18	0.02	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		0.50	0.07	<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.47	0.12	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

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Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	CPT07 Depth 0.1	CPT07 Depth 0.5	CTP07 Depth 1.5	CTP10 Depth 0.5	CTP10 Depth 1.5
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	10/10/2017	10/10/2017
Anthracene-d10 (Surrogate)	%	*1*		104.9	104.2	102.9	103.0	102.9

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	CPT9 Depth 0.5	CPT9 Depth 1.2	BH05 Depth 0.1	BH05 Depth 0.5	BH05 Depth 1.5
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-21	17-25079-22	17-25079-23	17-25079-24	17-25079-25
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	0.02
Anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	0.01	0.03
Benz[a]anthracene	mg/kg	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		0.02	<0.01	0.04	0.04	0.09
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		0.03	<0.02	0.03	0.02	0.05
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	0.02
Chrysene	mg/kg	*0.01*		0.02	<0.01	0.02	0.02	0.05
Dibenz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		0.04	<0.02	0.06	0.05	0.11
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	0.02	0.02	0.05
Pyrene	mg/kg	*0.02*		0.04	<0.02	0.06	0.05	0.11
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.04	0.03	0.06	0.06	0.11
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		0.03	<0.01	0.05	0.05	0.10
Anthracene-d10 (Surrogate)	%	*1*		97.7	100.9	103.4	102.4	101.4

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT8A Depth 1.5	CPT11 Depth 0.1	CPT11 Depth 0.5
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-26	17-25079-27	17-25079-28	17-25079-30	17-25079-31
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*		0.05	<0.01	<0.01	0.02	0.04
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		0.03	<0.02	<0.02	<0.02	0.03
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
Dibenz(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	0.04
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

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Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT8A Depth 1.5	CPT11 Depth 0.1	CPT11 Depth 0.5
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		0.02	<0.01	<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		0.05	<0.02	<0.02	0.02	0.04
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.06	0.03	0.03	0.04	0.06
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		0.05	<0.01	<0.01	0.02	0.04
Anthracene-d10 (Surrogate)	%	*1*		104.3	103.3	101.5	103.8	102.9

Organochlorine Pesticides - Soil

			Client Sample ID	BH3 Depth 0	BH3 Depth 0.45	CPT07 Depth 0.1	CPT07 Depth 0.5	BH05 Depth 0.1
			Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-7	17-25079-8	17-25079-15	17-25079-16	17-25079-23
2,4'-DDD	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	0.009
4,4'-DDD	mg/kg dry wt	*0.003*		<0.005	<0.005	<0.005	<0.005	0.007
4,4'-DDE	mg/kg dry wt	*0.005*		0.134	<0.005	<0.005	<0.005	0.127
4,4'-DDT	mg/kg dry wt	*0.005*		0.020	<0.005	<0.005	<0.005	0.081
Total DDT	mg/kg dry wt	*0.02*		0.15	<0.02	<0.02	<0.02	0.22
alpha-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Aldrin	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
beta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Dieldrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan II	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
gamma-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Methoxychlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
TCMX (Surrogate)	%	*1*		99.7	97.9	91.9	96.6	97.9

Organochlorine Pesticides - Soil

			Client Sample ID	BH05 Depth 0.5	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT11 Depth 0.1	CPT11 Depth 0.5
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*		17-25079-24	17-25079-26	17-25079-27	17-25079-30	17-25079-31
2,4'-DDD	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDD	mg/kg dry wt	*0.003*		<0.005	<0.005	<0.005	<0.005	<0.005

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Organochlorine Pesticides - Soil

			Client Sample ID	BH05 Depth 0.5	CPT8A Depth 0.1	CPT8A Depth 0.5	CPT11 Depth 0.1	CPT11 Depth 0.5
			Date Sampled	10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
4,4'-DDE	mg/kg dry wt	*0.005*		<0.005	0.022	<0.005	0.008	0.013
4,4'-DDT	mg/kg dry wt	*0.005*		<0.005	0.018	<0.005	<0.005	<0.005
Total DDT	mg/kg dry wt	*0.02*		<0.02	0.04	<0.02	<0.02	<0.02
alpha-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Aldrin	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
beta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Dieldrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan II	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
gamma-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Methoxychlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
TCMX (Surrogate)	%	*1*		94.3	92.6	94.5	88.6	100.9

Moisture Content

		Client Sample ID	BH4 Depth 0.5	BH4 Depth 1	BH4 Depth 1.5	BH2 Depth 0	BH2 Depth 1
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-1	17-25079-2	17-25079-3	17-25079-4	17-25079-5
Moisture Content	%	*1*	14	21	16	7	31

Moisture Content

		Client Sample ID	BH3 Depth 0	BH3 Depth 0.45	BH3 Depth 1	BH1 Depth 1.6	BH1 Depth 2.6
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	9/10/2017	9/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-7	17-25079-8	17-25079-9	17-25079-13	17-25079-14
Moisture Content	%	*1*	42	20	23	30	41

Moisture Content

		Client Sample ID	CPT07 Depth 0.1	CPT07 Depth 0.5	CTP07 Depth 1.5	CTP10 Depth 0.5	CTP10 Depth 1.5
		Date Sampled	9/10/2017	9/10/2017	9/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-15	17-25079-16	17-25079-17	17-25079-18	17-25079-19
Moisture Content	%	*1*	27	12	19	20	19

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Moisture Content

	Client Sample ID		CPT9 Depth 0.5	CPT9 Depth 1.2	BH05 Depth 0.1	BH05 Depth 0.5	BH05 Depth 1.5
	Date Sampled		10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-21	17-25079-22	17-25079-23	17-25079-24	17-25079-25
Moisture Content	%	*1*	18	20	41	22	21

Moisture Content

	Client Sample ID		CPT8A Depth 0.1	CPT8A Depth 0.5	CPT8A Depth 1.5	CPT11 Depth 0.1	CPT11 Depth 0.5
	Date Sampled		10/10/2017	10/10/2017	10/10/2017	10/10/2017	10/10/2017
Analyte	Unit	*Reporting Limit*	17-25079-26	17-25079-27	17-25079-28	17-25079-30	17-25079-31
Moisture Content	%	*1*	26	19	17	30	28

Method Summary

Elements in Soil Acid digestion followed by ICP-MS analysis. US EPA method 200.8.

TCLP Elements Total recoverable acid digestion of TCLP extracts. US EPA method 200.8.

TCLP Extraction TCLP was performed according to US-EPA method 1311.

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.

OCP in Soil Samples are extracted with hexane, pre-concetrated then analysed by GC-MSMS. In house method.
(Chlordane (sum) is calculated from the main actives in technical Chlordane: Chlordane, Nonachlor and Heptachlor)

Total DDT Sum of DDT, DDD and DDE (4,4' and 2,4 isomers)

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.

Elizabeth Fitzgerald, B.Sc.
Inorganics Team Leader

Tom Featonby, (M.Sc.)
Technologist

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Certificate of Analysis

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Lab Reference: 17-25248
Submitted by: Elyse LaFace
Date Received: 17/10/2017
Date Completed: 25/10/2017
Order Number:
Reference: 30309

Sampling Site:

Heavy Metals in Soil

			Client Sample ID	HA05 0.1	HA05 0.5	HA05 1	HA06 0.1	HA06 1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25248-1	17-25248-2	17-25248-3	17-25248-4	17-25248-5
Arsenic	mg/kg dry wt	*0.125*		4.76	2.99	3.64	4.00	1.60
Beryllium	mg/kg dry wt	*0.013*		0.54	0.65	0.70	0.44	1.72
Boron	mg/kg dry wt	*1.25*		2.46	1.73	3.42	2.77	2.01
Cadmium	mg/kg dry wt	*0.005*		0.12	0.072	0.45	0.14	0.043
Chromium	mg/kg dry wt	*0.125*		15.9	23.1	16.9	14.7	19.2
Copper	mg/kg dry wt	*0.075*		27.7	13.9	11.2	14.3	7.69
Lead	mg/kg dry wt	*0.05*		367	85.1	35.4	92.6	15.5
Mercury	mg/kg dry wt	*0.025*		0.092	0.053	0.059	0.12	<0.025
Nickel	mg/kg dry wt	*0.05*		8.14	11.9	10.8	8.69	10.4
Zinc	mg/kg dry wt	*0.05*		176	144	327	93.2	56.6

Heavy Metals in Soil

			Client Sample ID	HA07 0.1	HA07 0.5	Duplicate 7	HA08 0.1	HA08 1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25248-6	17-25248-7	17-25248-8	17-25248-9	17-25248-10
Arsenic	mg/kg dry wt	*0.125*		5.66	3.85	3.42	3.94	5.34
Beryllium	mg/kg dry wt	*0.013*		0.61	1.01	0.93	0.35	0.69
Boron	mg/kg dry wt	*1.25*		5.13	2.17	2.14	3.00	2.96
Cadmium	mg/kg dry wt	*0.005*		0.15	0.050	0.044	0.088	0.20
Chromium	mg/kg dry wt	*0.125*		19.7	21.5	21.0	17.1	18.3
Copper	mg/kg dry wt	*0.075*		26.7	13.4	11.4	10.1	15.5
Lead	mg/kg dry wt	*0.05*		120	26.5	21.4	47.4	45.2
Mercury	mg/kg dry wt	*0.025*		0.12	0.054	0.044	0.13	0.19
Nickel	mg/kg dry wt	*0.05*		10.1	13.6	14.8	7.36	11.3
Zinc	mg/kg dry wt	*0.05*		144	68.3	63.0	44.4	144

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Heavy Metals in Soil

Client Sample ID			HA01 0.1	HA01 0.5	BH02 2	BH03 2.5
Date Sampled						
Analyte	Unit	*Reporting Limit*	17-25248-11	17-25248-12	17-25248-13	17-25248-14
Arsenic	mg/kg dry wt	*0.125*	3.66	4.03	4.12	1.11
Beryllium	mg/kg dry wt	*0.013*	0.46	0.94	1.92	1.48
Boron	mg/kg dry wt	*1.25*	2.95	2.77	1.95	<1.25
Cadmium	mg/kg dry wt	*0.005*	0.055	0.050	0.083	0.018
Chromium	mg/kg dry wt	*0.125*	14.7	18.4	24.4	26.7
Copper	mg/kg dry wt	*0.075*	10.1	10.5	19.0	8.19
Lead	mg/kg dry wt	*0.05*	18.8	17.1	24.9	16.5
Mercury	mg/kg dry wt	*0.025*	0.081	0.057	0.041	<0.025
Nickel	mg/kg dry wt	*0.05*	8.69	15.9	33.2	14.3
Zinc	mg/kg dry wt	*0.05*	51.7	55.4	80.0	73.1

Trace Elements by TCLP

Client Sample ID			HA05 0.1	HA05 0.5	HA06 0.1	HA07 0.1	HA08 0.1
Date Sampled							
Analyte	Unit	*Reporting Limit*	17-25248-1	17-25248-2	17-25248-4	17-25248-6	17-25248-9
Arsenic	g/m^3	*0.005*	<0.005	<0.005	<0.005	<0.005	<0.005
Beryllium	g/m^3	*0.0001*	<0.0001	0.0003	<0.0001	0.0002	<0.0001
Boron	g/m^3	*0.05*	0.09	<0.05	0.09	0.17	<0.05
Cadmium	g/m^3	*0.0001*	0.0005	0.0004	0.0007	0.0005	0.0002
Chromium	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Copper	g/m^3	*0.002*	0.006	0.005	<0.002	0.003	<0.002
Lead	g/m^3	*0.0005*	0.115	0.057	0.037	0.022	0.016
Mercury	g/m^3	*0.001*	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc	g/m^3	*0.01*	0.49	0.13	0.28	0.39	0.07

Trace Elements by TCLP

Client Sample ID			HA08 1	HA01 0.1	HA01 0.5
Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25248-10	17-25248-11	17-25248-12
Arsenic	g/m^3	*0.005*	0.011	<0.005	<0.005
Beryllium	g/m^3	*0.0001*	0.0004	<0.0001	0.0006
Boron	g/m^3	*0.05*	0.14	0.12	<0.05
Cadmium	g/m^3	*0.0001*	0.0014	0.0003	<0.0001
Chromium	g/m^3	*0.002*	0.0021	<0.002	<0.002
Copper	g/m^3	*0.002*	0.151	<0.002	0.007
Lead	g/m^3	*0.0005*	<0.0005	0.0063	0.0065
Mercury	g/m^3	*0.001*	<0.001	<0.001	<0.001
Nickel	g/m^3	*0.002*	0.013	<0.002	0.005
Zinc	g/m^3	*0.01*	0.70	0.45	0.05

TCLP Extraction

Client Sample ID			HA05 0.1	HA05 0.5	HA06 0.1	HA07 0.1	HA08 0.1
Date Sampled							
Analyte	Unit	*Reporting Limit*	17-25248-1	17-25248-2	17-25248-4	17-25248-6	17-25248-9
Extractant Used			1	1	1	1	1
Initial pH			4.8	4.8	4.8	4.8	4.8
Final pH			4.9	4.9	4.9	4.9	4.9

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TCLP Extraction

	Client Sample ID		HA08 1	HA01 0.1	HA01 0.5
	Date Sampled				
Analyte	Unit	*Reporting Limit*	17-25248-10	17-25248-11	17-25248-12
Extractant Used			1	1	1
Initial pH			5.0	4.8	4.8
Final pH			4.9	4.9	4.9

Polycyclic Aromatic Hydrocarbons - Soil

	Client Sample ID		HA05 0.1	HA05 0.5	HA05 1	HA06 0.1	HA06 1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	17-25248-1	17-25248-2	17-25248-3	17-25248-4	17-25248-5
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	0.02	<0.01	0.02	<0.01
Anthracene	mg/kg	*0.01*	0.01	0.01	<0.01	0.02	<0.01
Benz[a]anthracene	mg/kg	*0.02*	0.04	<0.02	<0.02	0.07	<0.02
Benzo[a]pyrene	mg/kg	*0.01*	0.06	0.04	0.01	0.09	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	0.10	0.06	0.02	0.14	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*	0.02	<0.02	<0.02	0.04	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*	0.03	0.02	<0.01	0.05	<0.01
Chrysene	mg/kg	*0.01*	0.04	0.02	0.01	0.06	<0.01
Dibenz(a,h)anthracene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*	0.07	0.05	0.03	0.16	<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*	0.02	0.02	<0.01	0.03	<0.01
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*	0.02	0.04	0.02	0.06	<0.01
Pyrene	mg/kg	*0.02*	0.07	0.05	0.03	0.16	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.08	0.06	0.03	0.13	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	0.07	0.05	0.02	0.12	<0.01
Anthracene-d10 (Surrogate)	%	*1*	102.4	101.9	100.6	100.7	99.3

Polycyclic Aromatic Hydrocarbons - Soil

	Client Sample ID		HA07 0.1	HA07 0.5	HA08 0.1	HA08 1	HA01 0.1
	Date Sampled						
Analyte	Unit	*Reporting Limit*	17-25248-6	17-25248-7	17-25248-9	17-25248-10	17-25248-11
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	0.03	<0.01
Anthracene	mg/kg	*0.01*	<0.01	<0.01	<0.01	0.03	<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*	0.03	0.03	<0.01	0.04	0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	0.05	0.04	<0.02	0.08	0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*	<0.02	<0.02	<0.02	0.03	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*	0.01	0.01	<0.01	0.02	<0.01
Chrysene	mg/kg	*0.01*	0.02	0.02	<0.01	0.02	<0.01

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Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	HA07 0.1	HA07 0.5	HA08 0.1	HA08 1	HA01 0.1
			Date Sampled					
Dibenz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		0.04	0.05	<0.02	0.04	<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	0.02	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		0.02	0.03	<0.01	0.01	<0.01
Pyrene	mg/kg	*0.02*		0.04	0.05	<0.02	0.04	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.05	0.05	0.03	0.06	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		0.04	0.03	<0.01	0.05	0.01
Anthracene-d10 (Surrogate)	%	*1*		103.3	103.0	104.5	103.7	103.3

Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	HA01 0.5	BH02 2	BH03 2.5
			Date Sampled			
Analyte	Unit	*Reporting Limit*		17-25248-12	17-25248-13	17-25248-14
1-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01
2-Methylnaphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Acenaphthene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Acenaphthylene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Benz[a]anthracene	mg/kg	*0.02*		<0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*		<0.02	<0.02	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*		<0.02	<0.02	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Chrysene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Fluoranthene	mg/kg	*0.02*		<0.02	<0.02	<0.02
Fluorene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Naphthalene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*		<0.01	<0.01	<0.01
Pyrene	mg/kg	*0.02*		<0.02	<0.02	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.03	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		<0.01	<0.01	<0.01
Anthracene-d10 (Surrogate)	%	*1*		105.0	103.4	103.3

Organochlorine Pesticides - Soil

			Client Sample ID	HA05 0.1	HA05 0.5	HA06 0.1	HA06 1	HA07 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25248-1	17-25248-2	17-25248-4	17-25248-5	17-25248-6
2,4'-DDD	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	0.010	<0.005	<0.005
4,4'-DDD	mg/kg dry wt	*0.003*		<0.005	<0.005	0.006	<0.005	<0.005
4,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	0.158	<0.005	0.029
4,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	0.083	<0.005	0.013

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Organochlorine Pesticides - Soil

			Client Sample ID	HA05 0.1	HA05 0.5	HA06 0.1	HA06 1	HA07 0.1
			Date Sampled					
Total DDT	mg/kg dry wt	*0.02*		<0.02	<0.02	0.26	<0.02	0.04
alpha-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Aldrin	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
beta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Dieldrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan II	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
gamma-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Methoxychlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
TCMX (Surrogate)	%	*1*		80.4	79.2	80.5	85.4	76.6

Organochlorine Pesticides - Soil

			Client Sample ID	HA07 0.5	HA08 0.1	HA08 1	HA01 0.1	HA01 0.5
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25248-7	17-25248-9	17-25248-10	17-25248-11	17-25248-12
2,4'-DDD	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDD	mg/kg dry wt	*0.003*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Total DDT	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
alpha-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Aldrin	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
beta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Dieldrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan II	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
gamma-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Methoxychlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01

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Organochlorine Pesticides - Soil

			Client Sample ID	HA07 0.5	HA08 0.1	HA08 1	HA01 0.1	HA01 0.5
			Date Sampled					
trans-nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
TCMX (Surrogate)	%	*1*		83.3	79.6	74.7	86.3	83.4

Moisture Content

		Client Sample ID	HA05 0.1	HA05 0.5	HA05 1	HA06 0.1	HA06 1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25248-1	17-25248-2	17-25248-3	17-25248-4	17-25248-5
Moisture Content	%	*1*	46	19	30	35	16

Moisture Content

		Client Sample ID	HA07 0.1	HA07 0.5	HA08 0.1	HA08 1	HA01 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25248-6	17-25248-7	17-25248-9	17-25248-10	17-25248-11
Moisture Content	%	*1*	34	15	40	20	37

Moisture Content

		Client Sample ID	HA01 0.5	BH02 2	BH03 2.5
		Date Sampled			
Analyte	Unit	*Reporting Limit*	17-25248-12	17-25248-13	17-25248-14
Moisture Content	%	*1*	12	23	14

Method Summary

Elements in Soil Acid digestion followed by ICP-MS analysis. US EPA method 200.8.

TCLP Elements Total recoverable acid digestion of TCLP extracts. US EPA method 200.8.

TCLP Extraction TCLP was performed according to US-EPA method 1311.

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.

OCP in Soil Samples are extracted with hexane, pre-concetrated then analysed by GC-MSMS. In house method.
(Chlordane (sum) is calculated from the main actives in technical Chlordane: Chlordane, Nonachlor and Heptachlor)

Total DDT Sum of DDT, DDD and DDE (4,4' and 2,4 isomers)

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.

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Certificate of Analysis

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Lab Reference: 17-25838
Submitted by: Elyse LeFace
Date Received: 24/10/2017
Date Completed: 27/10/2017
Order Number:
Reference: 30309 URGENT

Sampling Site:

Heavy Metals in Soil

		Client Sample ID	HA04 0.1	HA04 1.0	HA09 0.1	HA09 0.5	HA02 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-1	17-25838-2	17-25838-3	17-25838-4	17-25838-5
Arsenic	mg/kg dry wt	*0.125*	2.53	4.90	3.29	2.65	4.09
Beryllium	mg/kg dry wt	*0.013*	0.33	0.67	0.26	0.54	0.34
Boron	mg/kg dry wt	*1.25*	2.70	2.11	4.48	2.19	2.68
Cadmium	mg/kg dry wt	*0.005*	0.16	0.078	0.045	0.023	0.097
Chromium	mg/kg dry wt	*0.125*	13.1	18.3	13.2	16.9	13.0
Copper	mg/kg dry wt	*0.075*	10.7	44.0	7.78	8.32	12.0
Lead	mg/kg dry wt	*0.05*	17.1	33.9	15.5	30.4	83.6
Mercury	mg/kg dry wt	*0.025*	0.093	0.057	0.13	0.059	0.080
Nickel	mg/kg dry wt	*0.05*	7.90	13.7	4.89	9.17	7.45
Zinc	mg/kg dry wt	*0.05*	64.5	83.2	40.8	46.4	108

Heavy Metals in Soil

		Client Sample ID	HA02 0.5	HA02 0.9	HA11 0.1	HA11 0.9	HA12 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-6	17-25838-7	17-25838-8	17-25838-9	17-25838-10
Arsenic	mg/kg dry wt	*0.125*	4.80	4.22	5.77	6.77	2.32
Beryllium	mg/kg dry wt	*0.013*	0.74	0.84	0.45	1.37	0.29
Boron	mg/kg dry wt	*1.25*	1.28	<1.25	6.12	2.32	2.23
Cadmium	mg/kg dry wt	*0.005*	0.023	0.023	0.11	0.083	0.12
Chromium	mg/kg dry wt	*0.125*	17.8	16.3	15.2	18.4	10.5
Copper	mg/kg dry wt	*0.075*	19.0	16.1	23.3	24.4	6.27
Lead	mg/kg dry wt	*0.05*	18.0	17.3	29.0	30.6	21.8
Mercury	mg/kg dry wt	*0.025*	0.063	0.039	0.069	0.073	0.077
Nickel	mg/kg dry wt	*0.05*	16.1	14.5	8.60	16.9	5.86
Zinc	mg/kg dry wt	*0.05*	67.8	62.5	104	96.2	43.3

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Heavy Metals in Soil

		Client Sample ID	HA12 1.0
		Date Sampled	
Analyte	Unit	*Reporting Limit*	17-25838-11
Arsenic	mg/kg dry wt	*0.125*	2.93
Beryllium	mg/kg dry wt	*0.013*	0.63
Boron	mg/kg dry wt	*1.25*	<1.25
Cadmium	mg/kg dry wt	*0.005*	0.034
Chromium	mg/kg dry wt	*0.125*	16.0
Copper	mg/kg dry wt	*0.075*	7.78
Lead	mg/kg dry wt	*0.05*	13.1
Mercury	mg/kg dry wt	*0.025*	0.038
Nickel	mg/kg dry wt	*0.05*	11.0
Zinc	mg/kg dry wt	*0.05*	38.7

Trace Elements by TCLP

		Client Sample ID	HA04 0.1	HA09 0.1	HA02 0.1	HA02 0.5	HA11 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-1	17-25838-3	17-25838-5	17-25838-6	17-25838-8
Arsenic	g/m^3	*0.005*	<0.005	<0.005	<0.005	<0.005	<0.005
Beryllium	g/m^3	*0.0001*	<0.0001	<0.0001	<0.0001	0.0002	<0.0001
Boron	g/m^3	*0.05*	0.35	0.21	0.26	<0.05	0.25
Cadmium	g/m^3	*0.0001*	0.0008	0.0005	0.0006	0.0001	0.0007
Chromium	g/m^3	*0.002*	<0.002	<0.002	<0.002	<0.002	<0.002
Copper	g/m^3	*0.002*	0.027	<0.002	<0.002	<0.002	<0.002
Lead	g/m^3	*0.0005*	0.043	0.016	0.014	<0.0005	0.011
Mercury	g/m^3	*0.001*	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	g/m^3	*0.002*	<0.002	<0.002	<0.002	0.003	<0.002
Zinc	g/m^3	*0.01*	1.05	0.63	0.79	0.08	0.87

Trace Elements by TCLP

		Client Sample ID	HA12 0.1
		Date Sampled	
Analyte	Unit	*Reporting Limit*	17-25838-10
Arsenic	g/m^3	*0.005*	<0.005
Beryllium	g/m^3	*0.0001*	<0.0001
Boron	g/m^3	*0.05*	0.24
Cadmium	g/m^3	*0.0001*	0.0006
Chromium	g/m^3	*0.002*	<0.002
Copper	g/m^3	*0.002*	<0.002
Lead	g/m^3	*0.0005*	0.0017
Mercury	g/m^3	*0.001*	<0.001
Nickel	g/m^3	*0.002*	<0.002
Zinc	g/m^3	*0.01*	0.68

TCLP Extraction

		Client Sample ID	HA04 0.1	HA09 0.1	HA02 0.1	HA02 0.5	HA11 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-1	17-25838-3	17-25838-5	17-25838-6	17-25838-8
Extractant Used			1	1	1	1	1
Initial pH			4.9	4.9	4.9	4.9	4.9
Final pH			4.9	5.0	4.9	4.9	5.0

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TCLP Extraction

		Client Sample ID	HA12 0.1
		Date Sampled	
Analyte	Unit	*Reporting Limit*	17-25838-10
Extractant Used			1
Initial pH			4.9
Final pH			5.0

Polycyclic Aromatic Hydrocarbons - Soil

		Client Sample ID	HA04 0.1	HA04 1.0	HA09 0.1	HA09 0.5	HA02 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-1	17-25838-2	17-25838-3	17-25838-4	17-25838-5
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	0.02	<0.01	<0.01	0.04
Anthracene	mg/kg	*0.01*	<0.01	0.02	<0.01	<0.01	0.07
Benz[a]anthracene	mg/kg	*0.02*	<0.02	0.05	<0.02	<0.02	0.08
Benzo[a]pyrene	mg/kg	*0.01*	<0.01	0.08	<0.01	<0.01	0.22
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	<0.02	0.08	<0.02	<0.02	0.21
Benzo[g,h,i]perylene	mg/kg	*0.02*	<0.02	0.03	<0.02	<0.02	0.07
Benzo[k]fluoranthene	mg/kg	*0.01*	<0.01	0.04	<0.01	<0.01	0.10
Chrysene	mg/kg	*0.01*	<0.01	0.04	<0.01	<0.01	0.11
Dibenz(a,h)anthracene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	0.03
Fluoranthene	mg/kg	*0.02*	<0.02	0.08	<0.02	<0.02	0.33
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	0.02	<0.01	<0.01	0.06
Naphthalene	mg/kg	*0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	*0.01*	<0.01	0.02	<0.01	<0.01	0.18
Pyrene	mg/kg	*0.02*	<0.02	0.08	<0.02	<0.02	0.31
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.03	0.11	0.03	0.03	0.29
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	<0.01	0.10	<0.01	<0.01	0.29
Anthracene-d10 (Surrogate)	%	*1*	96.5	95.2	96.7	96.0	97.4

Polycyclic Aromatic Hydrocarbons - Soil

		Client Sample ID	HA02 0.5	HA02 0.9	HA11 0.1	HA11 0.9	HA12 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-6	17-25838-7	17-25838-8	17-25838-9	17-25838-10
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	0.03	0.03	0.02
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	<0.02	<0.02	0.04	0.03	<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	0.02	0.01	<0.01

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Polycyclic Aromatic Hydrocarbons - Soil

			Client Sample ID	HA02 0.5	HA02 0.9	HA11 0.1	HA11 0.9	HA12 0.1
			Date Sampled					
Dibenz(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	0.08	0.03	<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	0.02	<0.01	<0.01
Pyrene	mg/kg	*0.02*		<0.02	<0.02	0.06	0.03	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*		0.03	0.03	0.05	0.04	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*		<0.01	<0.01	0.04	0.03	0.02
Anthracene-d10 (Surrogate)	%	*1*		95.2	94.6	99.5	99.6	101.0

Polycyclic Aromatic Hydrocarbons - Soil

		Client Sample ID	HA12 1.0
		Date Sampled	
Analyte	Unit	*Reporting Limit*	17-25838-11
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*	<0.01
Anthracene	mg/kg	*0.01*	<0.01
Benz[a]anthracene	mg/kg	*0.02*	<0.02
Benzo[a]pyrene	mg/kg	*0.01*	<0.01
Benzo[b]&[j] fluoranthene	mg/kg	*0.02*	<0.02
Benzo[g,h,i]perylene	mg/kg	*0.02*	<0.02
Benzo[k]fluoranthene	mg/kg	*0.01*	<0.01
Chrysene	mg/kg	*0.01*	<0.01
Dibenz(a,h)anthracene	mg/kg	*0.01*	<0.01
Fluoranthene	mg/kg	*0.02*	<0.02
Fluorene	mg/kg	*0.01*	<0.01
Indeno(1,2,3-cd)pyrene	mg/kg	*0.01*	<0.01
Naphthalene	mg/kg	*0.01*	<0.01
Phenanthrene	mg/kg	*0.01*	<0.01
Pyrene	mg/kg	*0.02*	<0.02
Benzo[a]pyrene TEQ (LOR)	mg/kg	*0.01*	0.03
Benzo[a]pyrene TEQ (Zero)	mg/kg	*0.01*	<0.01
Anthracene-d10 (Surrogate)	%	*1*	97.4

Organochlorine Pesticides - Soil

			Client Sample ID	HA04 0.1	HA04 1.0	HA09 0.1	HA09 0.5	HA02 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25838-1	17-25838-2	17-25838-3	17-25838-4	17-25838-5
2,4'-DDD	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDD	mg/kg dry wt	*0.003*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	0.005
4,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005

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Organochlorine Pesticides - Soil

			Client Sample ID	HA04 0.1	HA04 1.0	HA09 0.1	HA09 0.5	HA02 0.1
			Date Sampled					
Total DDT	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
alpha-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Aldrin	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
beta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Dieldrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan II	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
gamma-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Methoxychlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
TCMX (Surrogate)	%	*1*		83.3	89.5	80.3	81.6	87.0

Organochlorine Pesticides - Soil

			Client Sample ID	HA02 0.5	HA02 0.9	HA11 0.1	HA11 0.9	HA12 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25838-6	17-25838-7	17-25838-8	17-25838-9	17-25838-10
2,4'-DDD	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDD	mg/kg dry wt	*0.003*		<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDE	mg/kg dry wt	*0.005*		<0.005	<0.005	0.009	<0.005	0.006
4,4'-DDT	mg/kg dry wt	*0.005*		<0.005	<0.005	0.010	<0.005	<0.005
Total DDT	mg/kg dry wt	*0.02*		<0.02	<0.02	0.02	<0.02	<0.02
alpha-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Aldrin	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
beta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Dieldrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan I	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan II	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	mg/kg dry wt	*0.05*		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
gamma-BHC	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*		<0.005	<0.005	<0.005	<0.005	<0.005
Methoxychlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01

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Organochlorine Pesticides - Soil

			Client Sample ID	HA02 0.5	HA02 0.9	HA11 0.1	HA11 0.9	HA12 0.1
			Date Sampled					
trans-nonachlor	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*		<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*		<0.02	<0.02	<0.02	<0.02	<0.02
TCMX (Surrogate)	%	*1*		85.7	87.4	78.9	85.7	84.3

Organochlorine Pesticides - Soil

		Client Sample ID	HA12 1.0
		Date Sampled	
Analyte	Unit	*Reporting Limit*	17-25838-11
2,4'-DDD	mg/kg dry wt	*0.005*	<0.005
2,4'-DDE	mg/kg dry wt	*0.005*	<0.005
2,4'-DDT	mg/kg dry wt	*0.005*	<0.005
4,4'-DDD	mg/kg dry wt	*0.003*	<0.005
4,4'-DDE	mg/kg dry wt	*0.005*	<0.005
4,4'-DDT	mg/kg dry wt	*0.005*	<0.005
Total DDT	mg/kg dry wt	*0.02*	<0.02
alpha-BHC	mg/kg dry wt	*0.005*	<0.005
Aldrin	mg/kg dry wt	*0.005*	<0.005
beta-BHC	mg/kg dry wt	*0.005*	<0.005
cis-Chlordane	mg/kg dry wt	*0.005*	<0.005
cis-Nonachlor	mg/kg dry wt	*0.01*	<0.01
delta-BHC	mg/kg dry wt	*0.005*	<0.005
Dieldrin	mg/kg dry wt	*0.05*	<0.05
Endosulfan I	mg/kg dry wt	*0.005*	<0.005
Endosulfan II	mg/kg dry wt	*0.01*	<0.01
Endosulfan sulphate	mg/kg dry wt	*0.005*	<0.005
Endrin	mg/kg dry wt	*0.05*	<0.05
Endrin aldehyde	mg/kg dry wt	*0.01*	<0.01
Endrin ketone	mg/kg dry wt	*0.005*	<0.005
gamma-BHC	mg/kg dry wt	*0.005*	<0.005
Heptachlor	mg/kg dry wt	*0.005*	<0.005
Heptachlor epoxide	mg/kg dry wt	*0.005*	<0.005
Hexachlorobenzene	mg/kg dry wt	*0.005*	<0.005
Methoxychlor	mg/kg dry wt	*0.01*	<0.01
trans-nonachlor	mg/kg dry wt	*0.01*	<0.01
trans-Chlordane	mg/kg dry wt	*0.01*	<0.01
Chlordane (sum)	mg/kg dry wt	*0.02*	<0.02
TCMX (Surrogate)	%	*1*	87.9

Moisture Content

			Client Sample ID	HA04 0.1	HA04 1.0	HA09 0.1	HA09 0.5	HA02 0.1
			Date Sampled					
Analyte	Unit	*Reporting Limit*		17-25838-1	17-25838-2	17-25838-3	17-25838-4	17-25838-5
Moisture Content	%	*1*		35	18	40	17	39

Moisture Content

		Client Sample ID	HA02 0.5	HA02 0.9	HA11 0.1	HA11 0.9	HA12 0.1
		Date Sampled					
Analyte	Unit	*Reporting Limit*	17-25838-6	17-25838-7	17-25838-8	17-25838-9	17-25838-10
Moisture Content	%	*1*	18	18	42	14	33

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Moisture Content

		Client Sample ID	HA12 1.0
		Date Sampled	
Analyte	Unit	*Reporting Limit*	17-25838-11
Moisture Content	%	*1*	21

Method Summary

Elements in Soil	Acid digestion followed by ICP-MS analysis. US EPA method 200.8.
TCLP Elements	Total recoverable acid digestion of TCLP extracts. US EPA method 200.8.
TCLP Extraction	TCLP was performed according to US-EPA method 1311.
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.
OCP in Soil	Samples are extracted with hexane, pre-concetrated then analysed by GC-MSMS. In house method. (Chlordane (sum) is calculated from the main actives in technical Chlordane: Chlordane, Nonachlor and Heptachlor)
Total DDT	Sum of DDT, DDD and DDE (4,4' and 2,4 isomers)
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.

Sharelle Frank, B.Sc. (Tech)
Technologist

Tom Featonby, (M.Sc.)
Technologist

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ANALYSIS REPORT

Client:	Tonkin & Taylor	**Lab No:**	1871463	SPv1
Contact:	Natalie Pilcher	**Date Received:**	03-Nov-2017	
	C/- Tonkin & Taylor	**Date Reported:**	15-Nov-2017	
	PO Box 2083	**Quote No:**	80842	
	Wellington 6140	**Order No:**	30309	
		Client Reference:	30309	
		Submitted By:	Natalie Pilcher	

Sample Type: Aqueous

Sample Name:		BH1 02-Nov-2017 3:00 pm	BH3 02-Nov-2017 2:45 pm	BH4 02-Nov-2017 3:45 pm	Unlabelled Sample 02-Nov-2017 2:45 pm	
Lab Number:		1871463.1	1871463.2	1871463.3	1871463.4	
Individual Tests						
Sum of Anions	meq/L	47 #1	24 #1	8.0 #1	41 #1	-
Sum of Cations	meq/L	4.9 #1	7.0 #1	4.1 #1	5.1 #1	-
pH	pH Units	8.4	9.2	7.5	8.4	-
Total Alkalinity	g/m³ as $CaCO_3$	2,200	1,140	320	1,980	-
Bicarbonate	g/m³ at 25°C	2,700	1,200	380	2,300	-
Total Hardness	g/m³ as $CaCO_3$	146	88	121	151	-
Electrical Conductivity (EC)	mS/m	49.0	65.4	42.1	48.8	-
Dissolved Calcium	g/m³	33	32	25	35	-
Dissolved Magnesium	g/m³	15.2	1.93	13.9	15.4	-
Dissolved Potassium	g/m³	1.48	2.6	2.0	1.53	-
Dissolved Sodium	g/m³	46	120	37	48	-
Chloride	g/m³	59	25	53	60	-
Nitrite-N	g/m³	0.060	< 0.002	< 0.002	< 0.002	-
Nitrate-N	g/m³	0.076	< 0.002	0.004	< 0.002	-
Nitrate-N + Nitrite-N	g/m³	0.136	< 0.002	0.004	< 0.002	-
Sulphate	g/m³	5.3	20	7.9	5.6	-
Escherichia coli	MPN / 100mL	79	920	13	540	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	0.003	0.0051	< 0.0010	0.0035	-
Dissolved Cadmium	g/m³	< 0.00010	< 0.00005	< 0.00005	< 0.00005	-
Dissolved Chromium	g/m³	< 0.0010	< 0.0005	< 0.0005	< 0.0005	-
Dissolved Copper	g/m³	< 0.0010	0.0030	0.0007	< 0.0005	-
Dissolved Lead	g/m³	< 0.0002	0.00019	< 0.00010	0.00015	-
Dissolved Nickel	g/m³	< 0.0010	0.0033	0.0034	< 0.0005	-
Dissolved Zinc	g/m³	< 0.002	< 0.0010	< 0.0010	< 0.0010	-
Organochlorine Pesticides Screening in Water, By Liq/Liq						
Aldrin	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
alpha-BHC	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
beta-BHC	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
delta-BHC	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
gamma-BHC (Lindane)	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
cis-Chlordane	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
trans-Chlordane	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
2,4'-DDD	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
4,4'-DDD	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
2,4'-DDE	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		BH1 02-Nov-2017 3:00 pm	BH3 02-Nov-2017 2:45 pm	BH4 02-Nov-2017 3:45 pm	Unlabelled Sample 02-Nov-2017 2:45 pm	
Lab Number:		1871463.1	1871463.2	1871463.3	1871463.4	
Organochlorine Pesticides Screening in Water, By Liq/Liq						
4,4'-DDE	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
2,4'-DDT	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
4,4'-DDT	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Dieldrin	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Endosulfan I	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Endosulfan II	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Endosulfan sulfate	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Endrin	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Endrin aldehyde	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Endrin ketone	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Heptachlor	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Heptachlor epoxide	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Hexachlorobenzene	g/m³	< 0.0008	< 0.0008	< 0.0008	< 0.0008	-
Methoxychlor	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Total Chlordane [(cis+trans)*100/42]	g/m³	< 0.0004	< 0.0004	< 0.0004	< 0.0004	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.00010	< 0.00010	0.00014	< 0.00010	-
Acenaphthylene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[a]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[a]pyrene (BAP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[g,h,i]perylene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[k]fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Chrysene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Fluorene	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Naphthalene	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-
Phenanthrene	g/m³	< 0.0004	< 0.0004	< 0.0004	< 0.0004	-
Pyrene	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-

Analyst's Comments

Please interpret this result with caution as the sample was > 8 °C on receipt at the lab. The sample temperature is recommended by APHA to be less than 8 °C on receipt at the laboratory (but not frozen). However, it is acknowledged that samples that are transported quickly to the laboratory after sampling, may not have been cooled to this temperature.

Please interpret this microbiological result with caution as the sample was > 24 hours old at the time of testing in the laboratory. The sample is required to reach the laboratory with sufficient time to allow testing to commence within 24 hours of sampling.

#1 It was observed that the results for 'Sum of Anions' and 'Sum of Cations' were not in good agreement. This was largely attributed to the high level of sediment contained in the sample. The anions and cations analysed, were determined on the filtered sample, with the exception of Alkalinity. The Alkalinity was determined in accordance with APHA 'Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005', which states; 'Do not filter, dilute, concentrate or alter the sample.' The sediment present in the sample may have contributed to the result obtained for Alkalinity and therefore added to the result for 'Sum of Anions'.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-4

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Organochlorine Pesticides Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), dual column GC-ECD analysis	0.00010 - 0.0008 g/m^3	1-4
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m^3	1-4
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-4
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-4
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-4
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-4
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m^3 as $CaCO_3$	1-4
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m^3 at 25°C	1-4
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m^3 as $CaCO_3$	1-4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-4
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 22nd ed. 2012.	-	1-4
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m^3	1-4
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m^3	1-4
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m^3	1-4
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m^3	1-4
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m^3	1-4
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m^3	1-4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-4
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m^3	1-4
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m^3	1-4
Escherichia coli	MPN count in LT Broth at 35°C for 48 hours, EC MUG Broth at 44.5°C for 24 hours. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9221 B, 9221 F 22nd ed. 2012.	2 MPN / 100mL	1-4

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

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED

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W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Tonkin & Taylor	**Lab No:**	1876400	SPv1
Contact:	Natalie Pilcher	**Date Received:**	14-Nov-2017	
	C/- Tonkin & Taylor	**Date Reported:**	21-Nov-2017	
	PO Box 2083	**Quote No:**	80842	
	Wellington 6140	**Order No:**	Reagan MacDonald	
		Client Reference:		
		Submitted By:	Reagan MacDonald	

Sample Type: Aqueous

Sample Name:		BH1 13-Nov-2017 1:10 pm	BH4 12:50-13:00 13-Nov-2017	BH3 13-Nov-2017 1:40 pm		
Lab Number:		1876400.1	1876400.2	1876400.3		
Routine Water Profile						
pH	pH Units	7.6	7.5	8.1	-	-
Total Alkalinity	g/m³ as $CaCO_3$	440	390	510	-	-
Free Carbon Dioxide	g/m³ at 25°C	25	25	8.8	-	-
Total Hardness	g/m³ as $CaCO_3$	360	430	196	-	-
Electrical Conductivity (EC)	mS/m	47.9	45.4	60.3	-	-
Electrical Conductivity (EC)	µS/cm	479	454	603	-	-
Approx Total Dissolved Salts	g/m³	320	300	400	-	-
Total Boron	g/m³	0.144	0.171	0.072	-	-
Total Calcium	g/m³	75	92	35	-	-
Total Copper	g/m³	0.144	0.34	0.141	-	-
Total Iron	g/m³	115	96	93	-	-
Total Magnesium	g/m³	43	47	26	-	-
Total Manganese	g/m³	5.6	4.7	2.5	-	-
Total Potassium	g/m³	17.0	23	16.6	-	-
Total Sodium	g/m³	51	49	135	-	-
Total Zinc	g/m³	0.30	0.66	0.29	-	-
Chloride	g/m³	58	57	29	-	-
Nitrate-N	g/m³	0.06	< 0.05	< 0.05	-	-
Sulphate	g/m³	6.5	7.4	17.5	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	0.0014	0.0011	0.0031	-	-
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	0.00006	-	-
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	-	-
Dissolved Copper	g/m³	< 0.0005	< 0.0005	0.0019	-	-
Dissolved Lead	g/m³	< 0.00010	< 0.00010	0.00021	-	-
Dissolved Nickel	g/m³	< 0.0005	0.0026	0.0031	-	-
Dissolved Zinc	g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
Organochlorine Pesticides Screening in Water, By Liq/Liq						
Aldrin	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
alpha-BHC	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
beta-BHC	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
delta-BHC	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
gamma-BHC (Lindane)	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
cis-Chlordane	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
trans-Chlordane	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
2,4'-DDD	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
4,4'-DDD	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
2,4'-DDE	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		BH1 13-Nov-2017 1:10 pm	BH4 12:50-13:00 13-Nov-2017	BH3 13-Nov-2017 1:40 pm		
Lab Number:		1876400.1	1876400.2	1876400.3		
Organochlorine Pesticides Screening in Water, By Liq/Liq						
4,4'-DDE	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
2,4'-DDT	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
4,4'-DDT	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Dieldrin	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Endosulfan I	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Endosulfan II	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Endosulfan sulfate	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Endrin	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Endrin aldehyde	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Endrin ketone	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Heptachlor	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Heptachlor epoxide	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Hexachlorobenzene	g/m³	< 0.0008	< 0.0008	< 0.0008	-	-
Methoxychlor	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Total Chlordane [(cis+trans)*100/42]	g/m³	< 0.0004	< 0.0004	< 0.0004	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.00010	0.00018	< 0.00010	-	-
Acenaphthylene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Benzo[a]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Benzo[g,h,i]perylene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Benzo[k]fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Chrysene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Fluorene	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Naphthalene	g/m³	< 0.0005	< 0.0005	< 0.0005	-	-
Phenanthrene	g/m³	< 0.0004	< 0.0004	< 0.0004	-	-
Pyrene	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Routine Water Profile		-	1-3
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-3
Organochlorine Pesticides Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), dual column GC-ECD analysis	0.00010 - 0.0008 g/m³	1-3
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m³	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total Digestion	Nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1-3
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-3
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-3
Free Carbon Dioxide	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-3

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	1 µS/cm	1-3
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m³	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 22nd ed. 2012.	-	1-3
Total Boron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.0053 g/m³	1-3
Total Calcium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.053 g/m³	1-3
Total Copper	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012 / US EPA 200.8.	0.00053 g/m³	1-3
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.021 g/m³	1-3
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.021 g/m³	1-3
Total Manganese	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012 / US EPA 200.8.	0.00053 g/m³	1-3
Total Potassium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.053 g/m³	1-3
Total Sodium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.021 g/m³	1-3
Total Zinc	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012 / US EPA 200.8.	0.0011 g/m³	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-3
Nitrate-N	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.05 g/m³	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-3

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

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Report Date: 25 Oct 2017

Certificate Number: W1710160853.2

Tonkin and Taylor Ltd.
105 Carlton Gore Road, Newmarket, Auckland

Client Reference: 30309

Dear Elyse LaFace,

Re: Asbestos Soil Identification Analysis – 30309

This report has been reissued as the previous versions of this report had incorrect WA soil calculations in Appendix 1. This report supersedes the previously issued reports 'W1710160853' and 'W1710160853.1'.

30 sample(s) received on 16 Oct 2017 by Nick Wells.

The results of fibre analysis were performed by Laura Vitali of Precise Consulting and Laboratory Ltd on 19 Oct 2017.

The sample(s) were stated to be from 30309.

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 Vitali.

Yours sincerely

Laura Vitali
PRECISE LABORATORY IDENTIFIER

Sample Analysis Results

Certificate Number: W1710160853.2
Report Date: 25 Oct 2017
Site Location: 30309

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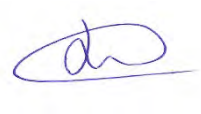
Note 1: The reporting limit for this analysis is 0.1g/kg (0.01%) by application of polarised light microscopy, dispersion staining and trace analysis techniques.

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:



Approved Identifier: Laura Vitali

Reviewed by:

Key Technical Person: Nick Wells

Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S001	SS01-0.1	SS01-0.1 Non-Homogeneous Soil 268.15g	No Asbestos Detected Organic Fibres
S002	SS01-0.3	SS01-0.3 Non-Homogeneous Soil 276.95g	No Asbestos Detected Organic Fibres
S003	SS02-0.1	SS02-0.1 Non-Homogeneous Soil 305.48g	No Asbestos Detected Organic Fibres
S004	SS02-0.3	SS02-0.3 Non-Homogeneous Soil 352.80g	No Asbestos Detected Organic Fibres
S005	SS03-0.1	SS03-0.1 Non-Homogeneous Soil 294.36g	No Asbestos Detected Organic Fibres
S006	SS03-0.3	SS03-0.3 Non-Homogeneous Soil 338.25g	Chrysotile (white asbestos) Fibres Organic Fibres
S007	SS04-0.1	SS04-0.1 Non-Homogeneous Soil 178.82g	Chrysotile (white asbestos) Fibres Organic Fibres
S008	SS04-0.3	SS04-0.3 Non-Homogeneous Soil 383.95g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres

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Sample Analysis Results

Certificate Number: W1710160853.2
Report Date: 25 Oct 2017
Site Location: 30309

PRECISE
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Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S009	SS05-0.1	SS05-0.1 Non-Homogeneous Soil 258.91g	No Asbestos Detected Organic Fibres Synthetic Mineral Fibres
S010	SS05-0.3	SS05-0.3 Non-Homogeneous Soil 370.86g	No Asbestos Detected Organic Fibres
S011	SS06-0.1	SS06-0.1 Non-Homogeneous Soil 233.25g	Chrysotile (white asbestos) Fibres Organic Fibres Synthetic Mineral Fibres
S012	SS06-0.3	SS06-0.3 Non-Homogeneous Soil 282.49g	Chrysotile (white asbestos) Fibres Organic Fibres
S013	SS07-0.1	SS07-0.1 Non-Homogeneous Soil 262.34g	No Asbestos Detected Organic Fibres
S014	SS07-0.3	SS07-0.3 Non-Homogeneous Soil 324.70g	No Asbestos Detected Organic Fibres
S015	SS08-0.1	SS08-0.1 Non-Homogeneous Soil 234.38g	No Asbestos Detected Organic Fibres
S016	SS08-0.3	SS08-0.3 Non-Homogeneous Soil 269.93g	No Asbestos Detected Organic Fibres
S017	HA08-0.1	HA08-0.1 Non-Homogeneous Soil 406.69g	No Asbestos Detected Organic Fibres
S018	HA08-1m	HA08-1m Non-Homogeneous Soil 138.66g	No Asbestos Detected Organic Fibres
S019	HA06-0.1	HA06-0.1 Non-Homogeneous Soil 349.76g	No Asbestos Detected Organic Fibres
S020	HA06-0.5	HA06-0.5 Non-Homogeneous Soil 226.41g	No Asbestos Detected Organic Fibres
S021	BH03-0.1	BH03-0.1 Non-Homogeneous Soil 482.06g	No Asbestos Detected Organic Fibres
S022	HA09-0.1	HA09-0.1 Non-Homogeneous Soil 190.26g	No Asbestos Detected Organic Fibres
S023	CPT06-0.1	CPT06-0.1 Non-Homogeneous Soil 555.00g	No Asbestos Detected Organic Fibres

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Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S024	CPT06-0.5	CPT06-0.5 Non-Homogeneous Soil 453.59g	No Asbestos Detected Organic Fibres
S025	BH02-0.1	BH02-0.1 Non-Homogeneous Soil 832.69g	No Asbestos Detected Organic Fibres
S026	BH02-0.5	BH02-0.5 Non-Homogeneous Soil 506.72g	No Asbestos Detected Organic Fibres
S027	BH04-0.1	BH04-0.1 Non-Homogeneous Soil 679.40g	No Asbestos Detected Organic Fibres
S028	HA12-0.1	HA12-0.1 Non-Homogeneous Soil 329.17g	No Asbestos Detected Organic Fibres
S029	CPT07-0.1	CPT07-0.1 Non-Homogeneous Soil 548.58g	No Asbestos Detected Organic Fibres
S030	HA02-0.1	HA02-0.1 Non-Homogeneous Soil 213.75g	No Asbestos Detected Organic Fibres

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Appendix 1: Soil Analysis Raw Data

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PRECISE
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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 & %***	
S001	SS01-0.1	-	268.15	23.18	44.22	101.30	99.55	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S002	SS01-0.3	-	276.95	42.83	38.04	100.63	95.45	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S003	SS02-0.1	-	305.48	48.38	5.58	100.93	150.59	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S004	SS02-0.3	-	352.80	9.47	1.19	102.24	239.90	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S005	SS03-0.1	-	294.36	37.66	133.52	100.49	22.76	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S006	SS03-0.3	-	338.25	57.04	190.02	91.11	-	No Asbestos Detected	N/A	No Asbestos Detected	N/A	<0.001	Free Fibres 100%	Y
S007	SS04-0.1	-	178.82	26.29	25.57	102.43	24.53	No Asbestos Detected	N/A	No Asbestos Detected	N/A	0.117	Free Fibres 100%	Y
S008	SS04-0.3	-	383.95	65.90	151.57	101.21	57.27	No Asbestos Detected	N/A	0.052	Free Fibres 100%	0.093	Free Fibres 100%	Y
S009	SS05-0.1	-	258.91	90.65	84.57	83.26	-	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N

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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 & %***	
S010	SS05-0.3	-	370.86	140.65	118.72	103.53	-	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S011	SS06-0.1	-	233.25	-	133.80	99.25	-	-	-	0.078 0.023	Insulation Board 60%; Free Fibres 100%	No Asbestos Detected	N/A	Y
S012	SS06-0.3	-	282.49	-	1.67	100.45	180.37	-	-	No Asbestos Detected	N/A	0.077	Free Fibres 100%	Y
S013	SS07-0.1	-	262.34	29.17	53.11	100.45	79.61	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S014	SS07-0.3	-	324.70	167.15	68.09	89.46	-	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S015	SS08-0.1	-	234.38	-	27.85	100.12	106.41	-	-	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S016	SS08-0.3	-	269.93	96.73	58.14	100.22	14.84	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S017	HA08-0.1	-	406.69	12.20	11.28	100.27	282.94	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S018	HA08-1m	-	138.66	9.95	35.41	93.30	-	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N

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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 & %***	
S019	HA06-0.1	-	349.76	11.07	30.56	100.95	207.18	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S020	HA06-0.5	-	226.41	-	-	101.81	124.60	-	-	-	-	No Asbestos Detected	N/A	N
S021	BH03-0.1	-	482.06	3.82	9.02	101.49	367.73	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S022	HA09-0.1	-	190.26	-	-	100.78	89.48	-	-	-	-	No Asbestos Detected	N/A	N
S023	CPT06-0.1	-	555.00	207.10	197.83	101.08	48.99	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S024	CPT06-0.5	-	453.59	-	-	100.00	353.59	-	-	-	-	No Asbestos Detected	N/A	N
S025	BH02-0.1	-	832.69	310.30	325.05	100.52	96.82	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S026	BH02-0.5	-	506.72	-	16.45	101.50	388.77	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S027	BH04-0.1	-	679.40	220.11	269.03	103.20	87.06	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N

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		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 & %***	
S028	HA12-0.1	-	329.17	15.76	-	101.97	211.44	No Asbestos Detected	N/A	-	-	No Asbestos Detected	N/A	N
S029	CPT07-0.1	-	548.58	53.41	80.55	101.54	313.08	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N
S030	HA02-0.1	-	213.75	8.64	11.08	100.59	93.44	No Asbestos Detected	N/A	No Asbestos Detected	N/A	No Asbestos Detected	N/A	N

* 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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Appendix F: Framework SMP

Tonkin+Taylor

Job No: 30309
11 March 2020

Ryman Healthcare Ltd
c/- Mitchell Partnerships Ltd
Via email to Richard.Turner@mitchelldaysh.co.nz

Attention: Richard Turner

Dear Richard

Framework Site Management Plan for Ground Contamination
26 Donald Street and 37 Campbell Street, Karori

Introduction

Ryman Healthcare Ltd (Ryman) is in the process of applying for resource consents to develop a comprehensive care retirement village at 26 Donald Street and 37 Campbell Street, Karori (the site). Tonkin & Taylor Ltd (T+T) have prepared a Ground Contamination Investigation Report[1] to support the consent applications.

This report sets out the basis for and framework of ground contamination-related procedures and controls to be implemented during construction earthworks at the site. It is intended that a Site Management Plan (SMP) for ground contamination will be prepared in accordance with CLMG#1[2] prior to the commencement of earthworks. The procedures and controls set out within the SMP will be based on this framework plan, but will supersede them.

Basis for ground contamination management procedures

The T+T Ground Contamination Investigation identified that:

- The site has historically been used for residential, teaching and horticultural purposes. Ground contamination at the Site may be associated with former and existing buildings and historic activities, the demolition of structures. Cut/fill earthworks undertaken during the college development are likely to have distributed contamination that pre-existed the College.
- The primary ground contamination issue on the site is from asbestos in soils, which may be derived from the degradation of asbestos-containing materials (ACMs) on existing structures, and from the demolition of historic structures which may have contained ACM. The potential for asbestos to be present in soil is the main driver for the procedures outlined below and recommended management approach for the site. It is anticipated that the procedures implemented for asbestos contamination will be sufficient to mitigate risks from low levels of other contaminants present.

[1] Tonkin + Taylor, January 2019. Ground Contamination Investigation, Victoria University Karori Campus. Prepared for Ryman Healthcare Ltd, T+T job number 30309.vB.
[2] Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand. Ministry for the Environment. April 2001 (revised 2011).

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- Soil sampling and analysis has identified the presence of asbestos in soils in a limited number of sample locations at the site. Asbestos has been detected at up to 0.081% weight for weight (w/w). Due to uncertainty regarding how asbestos has come to be present in soils and therefore its distribution on the site, it is currently assumed to be present across the site to a depth of 0.5 m until testing is carried out to better define the extent.
- Metals have also been detected above published background concentrations in soil samples collected from across the site, though detected concentrations are below high density residential land use criteria, and commercial/industrial (outdoor worker) land use criteria used to assess potential contaminant risks to construction workers that may be exposed to contaminated soils.
- The presence of asbestos in soils means that specific health and safety controls and soil management procedures will be required to protect construction workers and the general public from exposure to asbestos during earthworks, and so that asbestos-contaminated soil is appropriately disposed or managed on site. The concentrations of chemical contaminants (e.g. metals) detected to date do not require specific health and safety controls, though procedures are required so that they are appropriately disposed or managed on site.
- The NES Soil regulations[3] will apply to earthworks undertaken during site development/ construction, and NES Soil consent will be required due to the volume of soil disturbance and land use change. As contaminants (asbestos) have been detected above applicable land use standards during the completion of Detailed Site Investigation (DSI) (i.e. the ground contamination investigation), an NES Soil consent application for earthworks and change of land use as a restricted discretionary activity shall be required.
- The NES Soil requires a Site Management Plan (SMP) be provided to show how contamination will be managed during and possibly after earthworks. A framework for the SMP is provided within this letter. It is recommended that a full SMP is prepared (and provided to Wellington City Council) as a condition of consent following confirmation of the earthworks methodology and pre-works testing, and prior to soil disturbances works commencing at the site.
- As contaminants (asbestos) have been detected above applicable land use standards, remediation and/or management of contaminated soils will be required so that future site users are not exposed to unacceptable concentrations of contamination in soil. At this stage, the approach to remediation/management has not been confirmed though it is likely that the approach will include a combination of remediation (i.e. excavation and offsite disposal) and management (e.g. encapsulation on site).

The following provides a summary of the primary ground contamination controls that the Applicant intends to put in place during the works, including asbestos and contingency procedures, these are based on industry good practice including CLMG#1 and New Zealand Asbestos Guidelines[4]:

Pre-works testing

There is uncertainty regarding the extent and magnitude of asbestos contamination in soils at the Site. Pre works testing will be required to clarify the extent of asbestos contamination and confirm our assessment of the level of asbestos-related health and safety controls that will be required. Pre-works testing for asbestos in soils will be completed in general accordance with the CLMG No. 5[5] and New Zealand Asbestos Guidelines across the site with particular focus on the following areas:

[3] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.
[4] New Zealand Guidelines for Assessing and Managing Asbestos in Soil – BRANZ – November 2017
[5] Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils. Ministry for the Environment. February 2004 (revised 2011)

- Around existing buildings where asbestos products are known to be or have been present.
- In the footprints of former buildings, particularly in the current car park and western tennis court.
- Across the general site where historic filling is likely to have occurred.

Asbestos controls

Soil analysis completed to date has detected a maximum concentration of AF/FA in soil of 0.081 % w/w, and it is therefore anticipated that the proposed earthworks will be carried out as Class B asbestos works unless pre-works testing shows that a different level of control is appropriate.

Controls to be put in place for Class B removal works, based on the New Zealand Asbestos Guidelines include but are not necessarily limited to the following:

- The works will need to be overseen by a Class B Licensed Asbestos Removalist who will need to prepare an asbestos removal control plan (ARCP).
- Personal protective equipment (PPE) will need to include disposable coveralls (rated type 5, category 3), nitrile gloves, steel toe capped gumboots or safety footwear with disposable overshoes and a half face P3 respirator fitted with a particulate filter.
- Water and asbestos-encapsulating polymer emulsion product will need to be applied for dust control before starting work and during as required.
- HEPA filters will be required on air conditioning systems of any earthmoving/transport equipment used during the works.
- Spoil for disposal will need to be wrapped with 200 µm heavy-gauge polythene and trucks covered.
- Appropriate facilities for decontamination of personnel and equipment (basic disposable units will suffice) will be required.
- Visual inspection of plant by an independent assessor or independent competent person before demobilisation from site.

General earthworks procedures

Management of soil contamination related health effects

The potential for the exposure of workers and the public to contaminants in soil will be managed principally by controlling dust emissions, avoiding direct contact with soils and ensuring good personal hygiene practices during the works. Where the potential for direct contact (including accidental contact) with soils exists, e.g. during manual handling/excavation activities, then in principle full-length clothing and gloves shall be worn. As discussed above, different/additional PPE will be required for handling asbestos contaminated soils.

Dust controls

The control of dust emissions is important for any earthworks project, though particularly where contaminants are present which could become airborne (for example asbestos). Dust controls will include maintaining damp conditions using water sprays in excavation areas, minimising the size and duration of stockpiles, the covering or stabilisation of stockpiles and regular visual monitoring. Dust controls shall comply with the applicable Council guidelines, regulations and other applicable legislation.

Water discharges:

Separation and diversion of clean stormwater away from areas of ground disturbance is standard practice for any earthworks activity but becomes far more important where contaminants are present. Any contact between clean stormwater and contaminated soils/spoil etc. means the water can no longer be discharged to stormwater without treatment.

It is envisaged that earthworks will include the excavation and segregation/stockpiling of contaminated materials and so there will be little time for contact between stormwater and exposed, in situ contaminated soils. Any stockpiles of contaminated material shall be covered to avoid the generation of contaminated runoff from stockpiles or if not covered the runoff shall be managed such that it discharges to ground from where the stockpiled material was excavated.

Confirmatory testing prior to discharge will be undertaken as required.

Sediment and erosion controls:

Erosion and sediment control shall be managed in accordance with Wellington City Council's guidelines and other applicable legislation, and controls would be expected to include:

- Avoiding work in heavy rain.
- Keeping the site clean.
- Avoiding stockpiles where possible, however where they are required they shall be covered, stabilised other otherwise kept damp if left overnight. Stockpiles will not be placed in an area where runoff cannot be controlled.
- Contractor to ensure that sediment is not tracked on and off the site by vehicle movements.
- The installation of silt fences and runoff diversion bunds where appropriate to capture sediment in surface water runoff.
- Cleaning of entry/exit points to remove sediment and prevent tracking onto roads.
- Regular checking and maintenance of erosion and sediment controls to maintain good working condition.

Spoil management:

The stockpiling of spoil shall be minimised with the preference to load spoil directly onto trucks. Stockpiling of contaminated material may be necessary for these works. Stockpiled material shall be placed on suitable material and covered to minimise dust generation.

Soil reuse and disposal

Topsoil and fill material can remain onsite if it is encapsulated beneath a soil cap (0.5 m thick), hardstanding or buildings and will be subject to ongoing management controls. Underlying natural in situ soils can be reused onsite. If soils are removed from the site, all material to a depth of 2.5 m shall be disposed of to a consented landfill.

Authority to dispose of material offsite will be obtained from the receiving facility prior to the works commencing. The details of each load (e.g. truck registration number) shall be recorded onsite to allow reconciliation against the disposal site weighbridge documentation.

Unexpected contamination and contingency procedures

Contingency measures will be prepared for implementation in the event of the unexpected discovery of contamination, or spills of potential contaminants.

The procedures will include:

- Indications of contamination.
- First response procedures.
- Notification procedures.
- Complaints procedures.
- Actions following exposure to contaminated material.

Monitoring procedures

Monitoring will be undertaken to confirm that the controls being implemented are effective. Monitoring will include:

- Air monitoring for airborne asbestos fibres.
- Visual dust monitoring.
- Monitoring of erosion and sediment controls.

Validation reporting:

A site validation report will be prepared on completion of works. This will outline the works undertaken, any variation to the finalised SMP, and document soils removed from site. The validation report will also specify requirements for ongoing monitoring and management (and associated consents), if required.

Applicability

This report has been prepared for the exclusive use of our client Ryman Healthcare Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions contained in this report are based on our visual inspection and sampling of material within the site. The nature and continuity of the subsoil away from the test and sample locations is inferred and it must be appreciated that actual conditions may vary from the assumed model.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Sami Hutchings	Pierre Malan
Contaminated Site Consultant	Project Director

Report certified by a suitably qualified and experienced practitioner as prescribed under the NES Soil Users Guide (April 2012).

.....

Paul Walker

Senior Consultant

11-Mar-20
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