Kyle Park, Hornby Summary Report – Site wide ground contamination assessment

Introduction and objectives

The purpose of this summary report is to provide an overview of ground contamination investigations completed by T+T at Kyle Park. This summary report also identifies what has been done to manage ground contamination-related health risks at Kyle Park.

This summary report is based on the information in the following investigation reports, which should be read for further information:

- Ground Contamination Assessment, Kyle Park, Hornby. T+T reference 1003207.v2 (November 2018).
- Additional asbestos investigation in soil - Kyle Park, Hornby. T+T reference 53404.004 (7 December 2015).
- Asbestos in air sampling results - Kyle Park, Hornby. T+T reference 53404.004 (23 November 2015).
- Kyle Park, Hornby - Investigation of asbestos in landscaped garden areas. T+T reference 53404.003 (18 November 2015).
- Kyle Park, Hornby - Desktop Ground Contamination and Geotechnical Study. T+T reference 53404.002 (September 2015).

Site history

Until the late 1960s Kyle Park was a gravel extraction pit that was purchased by the then Paparua County Council. Paparua County Council then operated the site as a commercial and domestic landfill. Landfilling ceased in the 1980s and the site was then developed as a public park.

1960s Gravel extraction pit.

1980s Public park.

Overview of investigations

In September 2015 T+T completed a desk based assessment of Kyle Park. During a site walkover undertaken as part of that assessment, material that was confirmed to contain asbestos was observed in landscaped areas in the south west of the park.In November 2015 T+T collected samples in the landscaped areas to attempt to identify the source of the asbestos and also to assess how these areas should be managed to reduce the potential for users of the park to be exposed to asbestos.

The samples were collected from mulch materials that were present across the majority of the landscaped areas, from exposed surface soil and from sub surface soil. Asbestos was detected within samples of the mulch, surface soil and subsurface soil. The levels of asbestos detected in the samples was above guideline levels designed to protect human health. This meant that if these materials were disturbed and subsequently generated dust, those exposed to the dust could potentially be exposed to asbestos fibres.

Later in November 2015, T+T completed asbestos in air monitoring within and around the landscaped areas to assess whether asbestos fibres were present in air. The air monitoring indicated that asbestos fibres were not present above guideline values. By this time the landscaped areas had been fenced off to prevent access. Therefore, the air monitoring results indicate that users of the park were unlikely to be exposed to asbestos fibres present in the landscaped areas above guideline levels when using the park.

In December 2015 T+T completed additional soil sampling across the grassed areas of Kyle Park. Soil samples were collected from the soil surface and from subsurface soils to assess whether asbestos was present in soils associated with former landfill activities. Asbestos was identified slightly above guideline values in a small proportion (less than 10%) of surface soil samples.

In November 2018, T+T undertook soil sampling to support an assessment of Kyle Park for the development of a community hub, library and swimming pool. That sampling indicated that the site was covered with a 'cap' of predominantly soil material over mixed landfill waste. The landfill waste contained a range of contaminants including asbestos.

Contamination Risks and Management

The sampling undertaken within landscaped area indicated that controls to minimise contact with mulch and soil in those areas was required. Following the T+T investigation of November 2015, the Christchurch City Council installed temporary fencing around the landscaped areas and applied a dust suppressant polymer to these areas. The temporary fencing was later replaced with permanent fencing. Additional mulch has also been placed in the landscape areas to provide a soft barrier over the pre-existing mulch and soil. With these measures in place, the public would not be expected to be exposed to asbestos present in the landscaped areas during normal use of the park.

Additional health and safety controls have been developed to protect Christchurch City Council contractors and staff that undertake work within the landscaped areas (for example vegetation maintenance). These controls include the use of personal protective equipment and keeping the ground surface damp.

The sampling undertaken within the grassed areas of the parks indicate that there is a low potential for the public to be exposed to asbestos in soils in these areas during normal use of the park. This means that the public do not need to take any special precautions when using the park, including playing sports. However, Christchurch City Council has restricted those activities with the potential to disturb the grass surface and expose underlying soils (for example restricting vehicular access).

In addition, health and safety controls have been developed to protect Christchurch City Council contractors and staff that undertake work within the grassed areas that could disturb and expose soils. These controls include placing barriers around work to prevent public access, keeping the ground surface damp, and making sure that contaminated material is correctly disposed.

REPORT

Tonkin+Taylor

Ground Contamination Assessment - Kyle Park, Hornby

Prepared for
Christchurch City Council
Prepared by
Tonkin & Taylor Ltd
Date
November 2018
Job Number
1003207.v2

Exceptional thinking together
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Document Control

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Nov 2018	1	Draft for CCC review	MDDM/KPS	PEW	-
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This report has been prepared for the exclusive use of our client Christchurch City Council, 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 in this report are based on data from discrete sampling locations and sampled materials. The nature and continuity of subsoil away from the reported locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

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1 Introduction

1.1 General

Tonkin & Taylor Ltd (T+T) was commissioned by the Christchurch City Council (CCC) to carry out a ground contamination assessment for the proposed combined Hornby Library, Customer Services and South West Leisure Facility (*the Centre*). The purpose of the ground contamination assessment is to identify ground contamination-related development issues associated with the site of the centre at Kyle Park, Hornby. This work has been completed in accordance with CCC Statement of Work agreement with T+T dated 17 August 2018 and subsequent variations.

Kyle Park is located immediately north of the Hornby Hub shopping mall, which is in south-west Christchurch.

CCC is considering developing the Centre on the eastern part of Kyle Park, with a preferred option for this to be in the eastern corner of the site. Figure 1 below shows the following areas and terms that are used hereafter in this report:

- Kyle Park – red polygon below.
- The *site* (i.e. subject of this investigation and assessment) – green polygon below.
- The *development area* (i.e. preferred location for the centre) – blue polygon below.

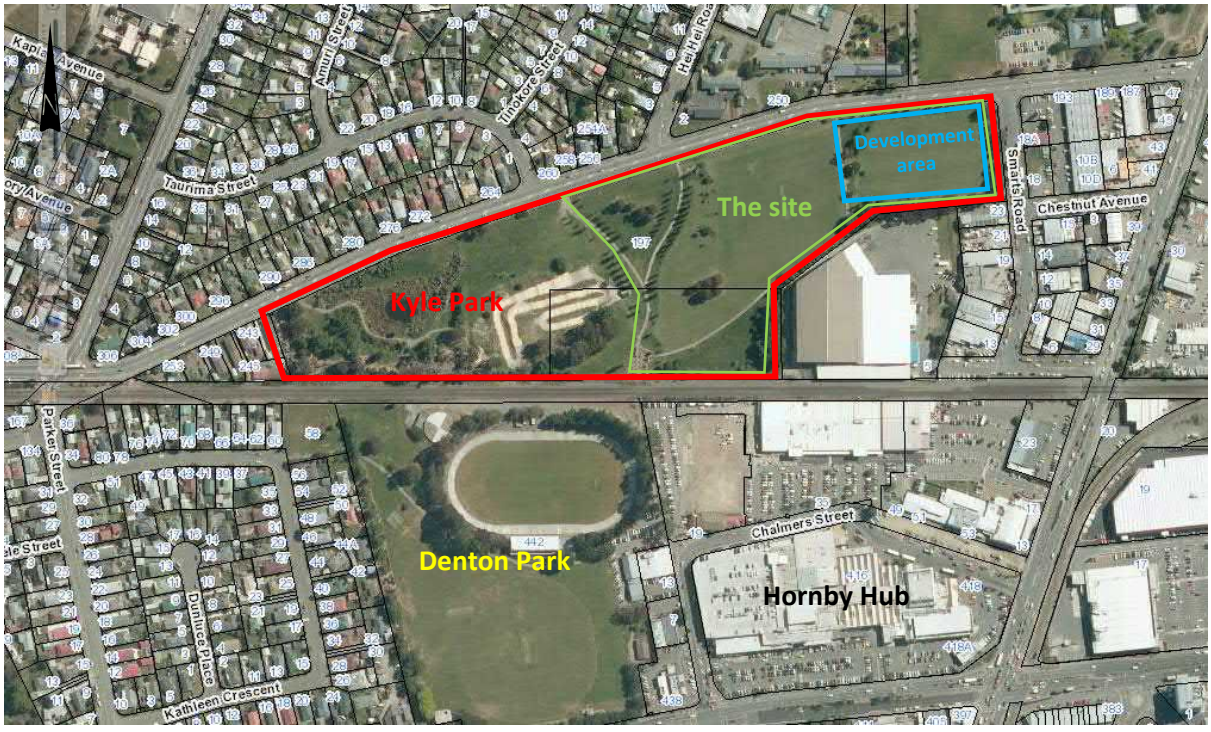

Figure 1 – Kyle Park location (source Canterbury maps - https://apps.canterburymaps.govt.nz/CanterburyHistoricAerialImagery/)

1.2 Project background

Detailed design of the Centre has not been finalised at the time of writing. Concept level design envisages the following:

- Two storey service building and library, including community meeting rooms and offices.
- Leisure facility including swimming pools (fun pool and lane pool), courts and a sport hall (multifunctional).

- Car parking, landscaping areas and footpaths connecting the Centre to the remainder of the park and underpass beneath the railway and connection to the transport links at Hornby Hub.
- Floor level for the Centre will be similar to existing ground levels on the adjacent Waterloo Road.
- Provision of utilities/services to the centre (e.g. water, power, telecommunications) which may include trenching across the current park.
- Based on the design and construction of the QEII recreational centre for CCC, the groundworks for the pool and plant room/services may extend to approximately 3 m depth.

The whole of Kyle Park was formerly a gravel pit (see Section 3) and was backfilled with a mix of uncontrolled fill materials (i.e. domestic, commercial and industrial waste materials). We understand that the CCC requires an understanding of the contaminated land-related implications and constraints associated with developing the Centre here compared to a relatively "clean" site.

A report summarising the findings of a geotechnical investigation of the site, also completed by T+T, has been provided separately to CCC[1].

1.3 Objective and scope of work

The following scope of work has been completed by T+T for the purposes of this ground contamination assessment:

- Review previous T+T reports on the site.
- Review of historical aerial photographs.
- Drilling of 20 boreholes to depths of up to 15.65 m below ground level (bgl).
- Logging the boreholes and collecting representative soil samples for laboratory analysis.
- Laboratory analysis of samples for a range of contaminants of concern based on the historical land use activities on the site.
- Assess the laboratory data against criteria applicable for the development of the Centre including commercial/industrial land use, as well as offsite disposal acceptance criteria.
- Preparation of this report.

1.4 Regulatory compliance

This ground contamination assessment, including the design and supervision of the fieldwork, the investigation management, data assessment and certification have been undertaken by suitably qualified and experienced practitioners (SQEPs) in accordance with the requirements of the NES Soil[2]. The contents of this report constitute a detailed site investigation (DSI) as defined in the NES Soil and described in the NES Users' Guide[3].

[1] T+T – Kyle Park Geotechnical Assessment Report – version 1 (draft) November 2018.
[2] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health Regulations) 2011.
[3] Ministry for the Environment (MfE) – Users' Guide – National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health – April 2012.

2 Site Description

2.1 Site identification

The locations details of Kyle Park, the site and the preferred development area are provided in Table 2.1 below.

Table 2.1 Site details

Street address	197 Waterloo Road, Hornby
Legal description	Lot 1 DP 78681 and Lot DP 34558 (development area located on Lot 1 DP 78681)
Site owner	CCC
Site area	Kyle Park approximately 87 hectares, with the development area being approximately 1.1 hectares within the boundary of Kyle Park
Zoning	Open space community

2.2 Site condition

General photographs of Kyle Park and the development area are presented in Appendix B. In general the whole park comprises grassed open spaces with areas used for cricket and informal football matches, and is crossed by a number of asphalted footpaths. On the western part of Kyle Park (offsite) there is a BMX race track and landscaped areas including a pond/wetland.

Immediately around the site, land uses are:

- Waterloo Road then Hornby High School and residential properties to the north.
- Commercial and industrial properties to the east and south (latter beyond the main south rail line).
- The remainder of Kyle Park and residential properties to the west.

Ground levels within the preferred development area are approximately 2.5 to 3 m lower than Waterloo Road and the rest of Kyle Park to its west. Relative to the 1937 Lyttelton vertical datum (LVD), ground levels for Waterloo Road, the centre of the site and centre of the development area are approximately 39 to 38 mLVD, 38.5 mLVD and 36.2 mLVD, respectively. Spot heights for the site and investigation boreholes (see Section 6) are presented on the CCC survey drawing included in Appendix A.

2.3 Geology, hydrogeology and hydrology

Details of the site setting are summarised below with more detail provided in the T+T Desktop Report[4].

2.3.1 Geology

The published geology[5] of the area indicates that Kyle Park is underlain by alluvial gravel, sand and silt from historic Waimakariri River flood channels. This is collectively referred to as the Yaldhurst Member of the Springston Formation.

[4] T+T reference 53404.002 – Kyle Park, Hornby – Desktop Ground Contamination and Geotechnical Study (September 2015).

[5] Brown, L.J., Weeber, J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological & Nuclear Sciences Geological Map 1. Scale 1:25 000.

In the vicinity of the site the Springston Formation deposits are expected to be underlain by well-graded gravels known as the Riccarton Gravels. These gravels contain artesian groundwater pressures where capped by a low permeability clayey silt or peat layer(s).

Information relating to the filling of the site is discussed in Section 3.

2.3.2 Hydrogeology

The depth to groundwater is approximately 13 m bgl, which corresponds to an elevation of approximately 24 mLvD, as observed from the groundwater contours available on the Environment Canterbury (ECan) website (https://mapviewer.canterburymaps.govt.nz/). The depth to groundwater is expected to fluctuate in response to rainfall and seasonal variability, which could be of the order of ± 2 m.

2.3.3 Hydrology

At the western end of Kyle Park there is a small wetland/retention/stormwater pond with a water level approximately 10 m higher than the groundwater surface elevation. The closest watercourse to the site is approximately 3 km east. Incident rainfall onsite currently infiltrates directly to ground.

3 Site History and Potential for Contamination

The following is summarised from the T+T Desktop Report, which should be referred to for more detailed information.

3.1 Site history

Kyle Park was formerly a gravel pit known as Smart's Pit (after the site owners) that operated until 1968 when it was purchased by Paparua County Council (a predecessor to CCC) and was then used as a rubbish dump (i.e. landfill). The landfill was operational until the early 1970s and the area became known as Kyle Park in the early 1980s.

Historical aerial photographs[6] of the site show the quarry workings expanding in area from the first available photograph from the early 1940s until the early 1960s when it was then progressively infilled into the mid-1970s (i.e. corroborating the ownership and land use information discussed above). Observation of the 1950s and early 1960s aerial photographs (see Photograph 1 below) identifies areas of water within the base of the pit, which suggests that excavation ceased at around the depth when groundwater was encountered. After infilling ceased some regrading/capping of the site occurred and photographs from the early 1980s onwards show much of Kyle Park as at the present day.

Photograph 1 – early 1960s aerial photograph of Kyle Park– approximate site and development areas shown in green and blue polygons, respectively (source https://apps.canterburymaps.govt.nz/CanterburyHistoricAerialImagery/).

[6] https://apps.canterburymaps.govt.nz/CanterburyHistoricAerialImagery/.

Photograph 2 – early 1980s aerial photograph of Kyle Park – approximate site and development areas shown in green and blue polygons respectively (source https://apps.canterburymaps.govt.nz/CanterburyHistoricAerialImagery/).

CCC property file records note that the site was backfilled with uncontrolled waste including domestic and commercial/industrial materials. The park is not a consented or monitored closed landfill with ECan. Groundwater and/or landfill gas monitoring is not undertaken on site by CCC as part of their closed landfill monitoring programme.

The property file also records a 1999 plan for CCC having installed a landfill gas ventilation unit in the BMX club hut building located west of the site.

3.2 Previous ground investigation

Previous T+T ground investigation works at Kyle Park (including the site)[7] [8] identified the presence of asbestos containing material (ACM) in embankment areas by the railway line. This included the ground on the southern margin of the development area that is currently occupied by trees and shrubbery on a bank that rises up to the neighbouring industrial/commercial property (see Figure 2, Appendix A). Sampling and laboratory analysis of embankment surficial soils and mulch materials recorded levels of asbestos fibres ranging from <0.001 to 0.0059 % weight/weight with the presence of asbestos fines and fibrous asbestos (AF and FA, see Section 4.4.2). Some measured levels exceeded the "all site" land uses criterion.

The presence of ACM and asbestos fibres was also encountered within capping materials (see Section 4.3.1 – these are the materials at ground level on the site) at depths ranging from the ground surface to 0.5 m bgl, with the levels of asbestos marginally exceeding the "all sites" land use criterion (see Section 4.4). Across the site, 25 samples were analysed for asbestos in soil as part of the December 2015 investigation and 9 samples recorded positive results for ACM and/or AF/FA. The ACM included non-fibrous materials such as cement sheeting, low density board and corrugated sheeting.

The embankment areas where the ACM and the AF/FA were identified are being managed by CCC. This includes the application of dust suppressant polymer and fencing the areas off from the remainder of the park to restrict access. For the grassed park areas including the sports fields where asbestos was found in capping materials, recommended management measures included the exclusion of activities with the potential to disturb surficial soils (e.g. minimise vehicular use) along

[7] T+T reference 53404.003 - Kyle Park, Hornby – investigation of asbestos in landscaped garden areas (18 November 2015).
[8] T+T reference 53404.004 – Additional asbestos investigation in soil – Kyle Park, Hornby (7 December 2015).

with procedures to reduce the potential exposure of general Park users and CCC maintenance personnel.

3.3 Known and potential contamination

The site is recorded on the ECan Listed Land Use Register (LLUR) as a landfill site (HAIL[9] category G3). ECan currently categorise the site as "contaminated – other".

With the site being a landfill and its current use as a sports turf, Table 3.1 below lists the potential contaminants of concern, HAIL category and potential extent/magnitude of ground contamination.

Table 3.1 – Land use and potential contaminants of concern

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Landfilling	Dependent on original waste composition may include total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), metals, asbestos, pesticides, ammonia, cyanide and volatile organic compounds (VOCs). Potential for landfill gases (including carbon dioxide, methane, depleted oxygen, hydrogen sulphide).	Materials are heterogeneous and the likelihood of ground contamination is high and would likely encompass most of the site. Contamination of the groundwater, via leachate, is also likely. Landfill gas generation possible depending upon composition of waste materials.	Activity G3 – Landfill sites.
Use of pesticides on playing fields.	Metals, herbicides, organophosphates and possibly organochlorides pesticides (OCPs).	The site has been used as a park since the early 1980s and pesticides may have been applied to the playing fields since this time. Low likelihood of contamination, which (if present) would likely to be restricted to surficial soils in the playing field areas. Investigation work for CCC at other parks by T+T have reported low incidence of pesticides in soils associated with this land use.	Activity A10 – Persistent pesticides bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.

3.4 Preliminary conceptual site model

Based on the inferred nature and extent of contamination and indicative development concepts, a preliminary conceptual site model has been developed. This model describes how those involved in the construction of the Centre and future users of the Centre (receptors), may be exposed (pathways) to ground contamination (sources). The model underpins the site investigation rationale set out in Section 4.

[9] Hazardous activities and industries list – MfE updated 2011.

Table 3.2 – Preliminary conceptual site model

Source	Pathway(s)	Receptor(s)	Assumptions
Landfill material (contaminated soils)	• Direct contact. • Inhalation of dust, vapours, gases. • Ingestion of materials.	• Construction and maintenance workers undertaking ground disturbance. • Possibly centre users, staff if allowed to come into contact with landfill material.	• Significant disturbance during earthworks. • Potential for reuse of contaminated material.
Landfill gases (e.g. methane, carbon dioxide), organic vapours	• Inhalation.	• Centre users and staff, maintenance workers.	• Placement of hard cover over currently unsealed ground.
	• Intrusion through foundations, floor slabs, service penetrations.	• CCC asset – damage to building from explosion.	• Potential for creation of preferential pathways (e.g. piles). • Uncertainty of effect of piling on landfill gas regime.
	• Inhalation of odours, discharges during construction works.	• General public (park users).	

This preliminary conceptual site model is typical of closed landfill sites that T+T has worked on in Christchurch and elsewhere in New Zealand.

4 Site investigation, Laboratory Testing and Data Assessment

4.1 Investigation staging and rationale

Investigation of the site was undertaken in two stages, these being:

- *Stage 1* – Boreholes BH101 to BH115 inclusive – general coverage of the site.
- *Stage 2* – BH116 to BH120 inclusive – targeted/focused investigation of the development area only, as required by CCC.

Whilst the density of the investigation locations is considered appropriate to provide coverage of the site, it does not meet the maximum density recommended by the MfE[10] for identifying contamination hotspots of a given diameter. However, it should be noted that the distribution of contaminants in the landfill material is assumed to be effectively random, and as such likely heterogeneity does not support an investigation methodology based on hotspot identification.

The boreholes were drilled using sonic drilling with a water flush to a maximum depth of 15.65 m bgl. Samples for laboratory analysis were selected based on site observations, including field screening with a photo-ionisation detector (PID) to identify potential volatile contaminants. Selected samples of the materials recovered from the boreholes were scheduled for the contaminants of concern (refer Section 3.3) as guided by the preliminary conceptual site model (refer Section 3.4).

The borehole locations were surveyed by CCC to record their reduced level along with the northing and easting coordinates (see Appendix A).

The borehole locations are shown in Figure 2 in Appendix A.

4.2 Sampling procedures

Soil samples for laboratory analysis were collected by the supervising T+T geologist and contaminated land specialist. The soil sampling was undertaken in general accordance with the procedures of CLMG No. 5 and the Asbestos in Soil Guidelines[11]. Samples were collected as follows:

- For metals, hydrocarbons, pesticides etc.:
  - Freshly gloved hands were used to collect a sample, which was placed immediately into laboratory supplied container(s).
  - Any equipment used to collect samples was decontaminated between sampling events using a phosphate-free detergent (Decon 90) and clean water.
  - Samples were shipped in a chilled container under chain of custody (COC) documentation to Analytica Laboratories Ltd; an IANZ-accredited (International Accreditation New Zealand) facility.
- For semi-quantitative asbestos in soil:
  - With freshly gloved hands samples was collected into 500 mL container for laboratory analysis.
  - Remaining borehole arisings were inspected for the presence of man-made materials including ACMs.
  - Samples were shipped under COC documentation to IANZ-accredited Precise Consulting & Laboratory.

[10] Contaminated Land Management Guideline (CLMG) No. 5 – Site investigation and analysis of soils – MfE (updated 2011).
[11] New Zealand Guidelines for the Assessment and Management of Asbestos in Soil – BRANZ (November 2017).

4.3 Field observations

The fieldwork (drilling, logging and sampling) was undertaken between 19 September and 11 October 2018, with Stage 1 and Stage 2 occurring concurrently.

The following report sub-sections summarise the strata encountered, with borehole logs presented in Appendix C. PID field screening results are also tabulated in this appendix. The range in thickness of the materials encountered, and the reduced levels they were encountered at, are summarised in Table 4.1 below and are illustrated on the cross-sections presented in Figures 3 and 4 (Appendix A). Photographs to illustrate the strata encountered are provided in Appendix B.

Table 4.1 – Summary of stratigraphy

	Reduced level (mLVD)		Thickness (m)	
	Top of strata	**Base of strata**	**From**	**To**
Capping	As per ground level	34 to 38	0.4	0.9
Landfill	34 to 38	25 to 28.5	1.25	11
Natural strata	25 to 28.5	Not fully penetrated	Not fully penetrated – maximum thickness recorded 13.05	

4.3.1 Capping materials

Capping materials comprising sandy silt with variable quantities of gravel materials with fibrous organics and rootlets were encountered in boreholes across the site. These materials ranged in thickness from 0.4 to 0.9 m. They generally graded into the underlying landfill materials with an increasing man-made material content and presence of organic materials rather than exhibiting a distinct change of strata. No evidence was observed of a geotextile fabric separating the capping materials from landfill.

No ACM was observed in the capping materials during the two stages of the 2018 investigation. This is different from the 2015 investigation when ACM fragments were recovered (albeit infrequently) in capping materials from ground level to 0.5 m depth.

4.3.2 Landfill

Landfill materials were encountered in all boreholes and exhibited a highly variable content both laterally and vertically, and this is typical of similar sites investigated by T+T where uncontrolled filling has occurred. The landfill materials encountered in the boreholes comprised of a variable matrix of silt, sand and gravel with differing quantities of man-made materials and/or waste including:

- ACM including cement sheet materials.
- Ash.
- Brick and concrete.
- Ceramic.
- Glass.
- Leather (including parts of a child's shoe).
- Paper.
- Plastic, including food wrapping.
- Roots, wood and partly decomposed vegetative matter.

- Rubber/tyre.
- Sawdust.
- Shell.
- Wire and metal.

Photographs 3 to 6 inclusive (refer Appendix B) illustrate some of the landfill materials observed and sampled across the site. In most cases, the landfill materials in the boreholes were noted to have a high vegetative/organic content, in the order of 50% by volume. The landfill materials were also infrequently noted to have a hydrocarbon odour and the PID site screening recorded volatile organic compounds (VOCs) ranging from 0 to 100 ppm, albeit the majority of readings were <10 ppm. The highest screening value was in material with a strong hydrocarbon odour in BH112 at 9.2 m bgl. Other landfill materials had organic/rotten vegetation odours and at BH101 and BH103 at 72 and 7.4 m bgl respectively, a sweet odour.

BH113 was terminated at 7.6 m bgl after refusal on a buried metal object.

4.3.3 Natural strata

Natural strata were encountered in all boreholes (with the exception of BH113) and comprised of sandy fine to coarse gravels with minor cobbles and trace of silt.

4.3.4 Groundwater

Groundwater strikes were encountered in all the boreholes (except for BH113) at depths ranging from 9.2 to 11.3 m bgl (approximately 29 mLVD and 24.5 mLVD, respectively).

With the exception of BH102 and BH106, groundwater was encountered in natural strata. For these two boreholes, the groundwater was encountered in landfill materials and within 1 m of the boundary with the underlying natural materials.

4.4 Laboratory testing

Representative samples of the capping and landfill materials, and a limited number of samples of natural materials were submitted for laboratory analysis. Individual analysis was based on field observations of material composition, odours and the anticipated contaminants of concern (refer Section 3.3).

Soil samples from all of the boreholes and representative of the capping and landfill materials were collected for laboratory analysis to provide a lateral and vertical assessment of these materials. Samples were scheduled for one or more of the parameters described previously in Section 3.3. Analysis for additional parameters based on PID field screening and observations during the material logging were also scheduled.

The laboratory test results are presented in Appendix D and the assessment of the laboratory data in Appendix E.

4.4.1 Assessment criteria

The laboratory test results have been evaluated against the following human health and environmental assessment criteria for different land uses or activities:

- For metals, hydrocarbons and pesticides - industrial and commercial land use NES Soil soil contaminant standards (SCSs) (based on outdoor worker) for:
  - Construction workers and future maintenance workers (e.g. engaged in repairing buried services).

  - Future site users (e.g. service centre staff, visitors) – considered a conservative criteria for this cohort as on development the site will be hard sealed.
- For re-use of materials on the site (for metal, hydrocarbon and pesticides) - recreational land use NES Soil SCS for use as a park with open public access after the development of the Centre.
- Asbestos in Soil Guidelines:
  - All site uses criteria for asbestos in soil criterion of <0.001% weight/weight asbestos fibres and fibrous asbestos (AF and FA, respectively).
  - Recreational land use criterion for bonded ACM of 0.02 % weight/weight (used as a conservative assessment criteria instead of commercial/industrial land use criterion of 0.05 % weight/weight).
- Offsite soil disposal:
  - Generally, to be disposed as cleanfill, soil must meet local background concentrations of contaminants *at the cleanfill site* and be free of certain man-made materials[12]. Data has been assessed against published background levels[13] at the site to provide an *initial* assessment of the potential for surplus soil to be disposed of as cleanfill.
  - Recreational land use criteria used as acceptance criteria by Burwood Resource Recovery Park (managed fill) (BRRP). BRRP does not accept asbestos materials nor asbestos in soil.

4.4.2 Data assessment results

Laboratory data assessment summary tables are presented in Appendix E. In summary, the assessment of the results, including where applicable from previous T+T investigation works (refer Section 3.2) show:

- *Capping material* – isolated exceedances of background concentrations of some metals and PAHs, and infrequent presence of ACMs and low levels of asbestos in soil (above "all site" uses acceptance criteria).
- *Landfill materials*:
  - Presence of ACMs and asbestos fibres as:
    - Chrysotile, amosite and crocidolite fibres (white, brown and blue respectively).
    - ACMs include insulation board, cement sheet and bitumastic materials.
    - Above commercial land use criterion of ACM (up to 3.437 % weight/weight recorded in BH108 at 2.35 m bgl).
    - Above "all site" uses criterion of AF+FA (up to 6.737 % weight/weight recorded in BH108 at 2.35 m bgl).
  - Almost ubiquitous above background concentrations of metals, locally above background levels for PAHs and for the sum of DDT.
  - At a limited number of locations within the mass of landfill materials, above recreational and construction worker criteria for lead and PAHs (expressed as benzo (a) pyrene toxic equivalent).
  - Soil contamination has been identified in landfill materials throughout the vertical and lateral extent of the landfill mass. As uncontrolled fill, the distribution of contamination is essentially random.

[12] MfE - A Guide to the Management of Cleanfills (Section 4) – (2002).
[13] ECan GIS - Trace level 2 - https://mapviewer.canterburymaps.govt.nz/.

- *Natural materials* – the two samples of this stratum that were tested did not record above background levels of metals or PAHs. However, concentrations of TPHs in this material from BH112 at 9.2 m bgl (and coincident with high field screening values) exceeds the construction worker criterion. The chromatograph for this material indicates the TPHs are likely to be a diesel product.
- The contamination of the capping and landfill materials is, based on T+T's experience of investigating other similar sites in New Zealand, generally consistent with that which would be expected for an uncontrolled file site.

4.5 Revised conceptual site model

The preliminary conceptual site model (Section 3.4) has been revised based on the sampling/logging and laboratory testing, and the assessment of the results. The revised model is presented in Table 5.1 below.

Table 4.2 – Conceptual site model

Source	Pathway	Receptor
Capping and landfill materials (contaminated soils – asbestos, lead, PAHs and TPH), all confirmed at concentrations above the relevant assessment criteria. Materials not suitable for disposal as cleanfill.	Direct contact, material ingestion, dust inhalation.	Potentially complete – construction and maintenance workers undertaking ground disturbance activities unless procedures adopted.
		Centre users and staff – pathway potentially complete if contaminated materials reused where direct access is possible.
		Potentially complete for materials disposed offsite to an inappropriate facility and affects to groundwater, workers at the receiving site and public near that site.
	Environmental discharges – odours, dust, sediment, stormwater.	Potentially complete if construction works are not managed so that these materials are retained within the works area.
Landfill gases (e.g. methane, carbon dioxide), organic vapours from fuels. Presence, extent, magnitude not yet known, though presence of landfill gas considered likely.	Inhalation during construction.	Potentially complete for construction and maintenance workers undertaking ground disturbance activities.
		Centre users and staff – pathway complete unless construction includes suitable landfill gas protection and management measures.

	Intrusion through foundations, floor slabs and accumulation in buildings.	CCC asset – damage to building (e.g. from explosion) - pathway complete unless centres design includes suitable landfill gas protection and management measures.

The conceptual site model indicates there are potentially complete source-pathway-receptor linkages for development of the Centre on site. The complete linkages can be managed, in part, by preparing and implementing controls contained in a ground contamination site management plan (GCSMP).

The potentially complete pollutant linkages identified are consistent with those that would be expected at a landfill that has received uncontrolled fill. The earthworks and building controls that would be required to manage exposure to ground contaminants at the site would be similar to those for other contaminated sites and other uncontrolled file sites.

5 Discussion

5.1 Development context

In addition to assessing the potential development implications of constructing the Centre at Kyle Park versus a minimally contaminated site, CCC also wishes to understand whether there are, from a contaminated land perspective, advantages for development in the eastern corner (i.e. the development area) compared to the rest of the site.

The geotechnical assessment of the site indicates that a foundation solution incorporating driven piles is likely to be suitable. This will require excavation for foundations (e.g. ground beams) and some spoil material may be generated during piling (e.g. pre-drilling through obstructions before pile driving). Additional excavation works may be required for the pool and some buried services connecting/servicing the Centre.

The ground investigation works reported in Section 4 have confirmed the capping and landfill materials underlying Kyle Park are significantly contaminated and any development (be it the development area or wider site) is likely to involve contamination-related costs that are greater than those for a relatively "clean" site. For Kyle Park, contamination issues are primarily driven by the presence of asbestos in soils. The most significant contamination-related development issues thus relate to earthworks in these contaminated materials and the controls required to manage the risks posed by the activity(s). Reducing the likely extent of ground disturbance logically reduces the potential for exposure to contamination-related hazards and reduces management related disposal and compliance costs.

Siting the Centre in the eastern corner of the site (i.e. development area), where current ground levels need significant filling to match adjacent ground levels, the earthworks volumes disturbing contaminated capping and landfill materials would be expected to be less than if development were undertaken elsewhere on the site (where a net cut into contaminated material would be expected). Consequently, the contamination-related implications likely be significantly less implications for developing in this area compared to elsewhere on the site. As detailed in Section 5.5, offsite disposal costs for contaminated materials are significant and there are expected to be financial advantages for the development location in this part of the park over elsewhere on the site.

The odorous nature of the landfill material could be a nuisance to neighbours and construction workers. Hence, similarly, limiting the potential disturbance of such material means reducing the potential management of such nuisance. This would suggest that the development area is preferable to elsewhere on the site.

Developing the centre at Kyle Park irrespective of its location on site, is not in T+T's opinion likely to present contamination-related issues that would be considered atypical of a closed uncontrolled fill site. Similar development has occurred on landfill sites in New Zealand and the earthworks and building controls that would be required to manage exposure to ground contaminants at the site would be similar to those for other contaminated sites and other uncontrolled file sites.

5.2 Contaminant distribution

The borehole logs indicate comparable thicknesses of capping and landfill materials across the site. Due to the uncontrolled way in which these materials were deposited, and subsequent regrading works, the distribution of contamination is effectively random. However, soil analytical results indicate that the nature and magnitude of contamination are also broadly similar across the site (i.e. there is no evidence to suggest that contaminant levels within the eastern corner are any higher or lower than elsewhere on the site).

5.3 Remediation or management for future use

Remediation or contamination management is required where contaminant concentrations exceed land use criteria. In the case of developing the centre at Kyle Park, these are commercial/industrial and/or recreational land uses. Remediation and management may include specific actions to reduce, remove or contain contaminants.

Contamination of capping and landfill materials above recreational land use criteria could present a risk to future park users if not properly managed. Capping and landfill materials excavated or brought to ground level through piling and pre-drilling through obstructions should be assumed to be contaminated with asbestos and other contaminants and should not be reused where future park users could have direct contact with them. If materials cannot be retained on site and properly encapsulated, they will need to be disposed offsite at a licensed facility.

Where contaminated materials are re-used on the site or left in situ, a long-term management plan will be required to provide procedures and controls to reduce potential exposure to ground contamination by future maintenance workers disturbing the materials and future site users.

5.4 Construction and maintenance worker health and safety

During the development of the Centre it is likely that construction workers will come into contact with the capping and landfill materials, which presents a human health hazard. The primary hazard is likely to be due to the disturbance of asbestos contaminated materials and the inhalation of asbestos fibres by workers.

Where future development (construction and/or future maintenance) activities will likely involve the disturbance of the capping and landfill materials the following health and safety implications/considerations will apply:

- Disturbance of the contaminated materials, based on the levels of asbestos and ACMs, will need to comply with the Asbestos Regulations[14] as follows:
  - For disturbance of the capping materials, such work will be *asbestos related work* under the Asbestos Regulations. The controls of the GCSMP can include appropriate content to meet with the requirements of the Asbestos Regulations including air monitoring, decontamination of equipment, signage and delineation of working areas etc. Disturbance of these materials would not be notifiable to WorkSafe New Zealand under the Asbestos Regulations.
  - For the landfill materials, the disturbance will be *Class A asbestos works* under the Asbestos Regulations. The work would need to be undertaken by a Class A Licensed Asbestos Removalist following an asbestos removal control plan prepared by them. The works would be notifiable to WorkSafe New Zealand before commencement. This level of control will be applicable during any bulk earthworks with this strata (e.g. trenching for services) as well as pre-drilling for piles where obstructions are encountered.

Undertaking works under the Asbestos Regulations will have cost and time implications for ground disturbance work. The transition from capping to landfill materials is not necessarily visually obvious and implementing asbestos controls will require careful planning and execution. A cautionary approach may be required given the profile of the development within the community, and adoption of Class A controls may be warranted.

[14] Health and Safety at Work (Asbestos) Regulations 2016.

5.5 Soil disturbance, reuse and offsite disposal

The following relates to the reuse of materials for the development of the Centre from a soil contamination perspective, and is based on the reported ground contamination conditions. Based on the materials encountered on site, for reuse:

- *Capping material* and *landfill material* – these materials are not suitable for reuse unless they can be incorporated (encapsulated) into the development where they cannot be disturbed in the future and thus result in direct human contact. Disturbance/contact by future maintenance workers should be avoided, although controls can be communicated via a GCSMP to manage the associated hazards if limited future disturbance cannot be avoided. Retaining (encapsulating) these materials within the landfill mass may be acceptable to CCC and ECan and subject to possible resource consent conditions. Disturbance of the materials should be avoid as far as practicable to avoid odour nuisance.
- *Natural materials* – although highly unlikely to be handled during the development (i.e. based on their considerable depth below the site), these materials are likely to be suitable for reuse.

Materials displaced and not retained on the site will likely require appropriate offsite disposal, such as:

- *Capping and landfill material*
  - Disposal to licensed landfill only.
  - The materials are unsuitable for disposal as cleanfill or to managed fill such as BRRP due to the presence of asbestos and/or metals and hydrocarbons as well as their odorous properties.
  - Based on the levels of asbestos in these materials, disposal offsite to Kate Valley Landfill is the only option available in the general Christchurch area (the levels of non-asbestos parameters precludes their disposal at Plantation Road in Hororata, which is a managed fill that uses residential land use assessment criteria for acceptance purposes).
  - Disposal at Kate Valley Landfill will be contingent on adequate laboratory testing of these materials to demonstrate they comply with this landfill's acceptance criteria, which are based on toxicity characteristic leaching procedure (TCLP) analysis.
  - The requirement for some degree of pre-treatment to stabilise mobile contaminants before being accepted for disposal at Kate Valley Landfill cannot be precluded at this stage.
  - Disposal of asbestos contaminated material costs in the order of $300 tonne (excluding GST and any pre-treatment).
- *Natural materials* – subject to more laboratory testing of these materials, disposal to cleanfill could be possible, although the limited testing to date of this material has reported levels of hydrocarbons that would preclude cleanfill disposal.

The proposed receiving facility (e.g. cleanfill) will require copies of the laboratory data and assessment included in this report for their consideration and approval prior to accepting any materials originating from the site during development of the Centre.

5.6 Consenting

A full ground contamination-related planning assessment should be completed for the development at Kyle Park; however, in principle the following resource consents are likely to be required:

- NES Soil – for soil disturbance and possible offsite disposal of materials (if required).
- City Plan – excavation and disturbance of hazardous materials.

- Land and Water Regional Plan:
  - Discharge of hazardous substances (e.g. encapsulating contaminated landfill materials onsite).
  - Discharge to air (e.g. dust, possibly landfill gases).
  - Construction phase stormwater management.
  - Operational phase stormwater management.
  - Disturbance of hazardous materials and discharge to groundwater.

The planning assessment may identify other consents that will be required.

The preparation of the GCSMP will be required for supporting consent application(s) to demonstrate to the regulatory authorities that the effects of the development can be managed and adequately controlled.

5.7 Further investigation

If construction of the Centre proceeds on the site then a detailed ground gas assessment is required to characterise the landfill gas regime and the potential implications to the development. Good practice requires landfill gas monitoring data is collected over a range of time and atmospheric conditions (in this case at least six months and ideally a year). This assessment will require the drilling of a number of suitable boreholes and installation with landfill gas monitoring standpipes and subsequent monitoring over a period of months. With the monitoring data and characterisation of the landfill gas regime, the assessment of suitable gas protection measures (if any) can be prepared for the Centre.

Further sampling and laboratory analysis of capping and landfill materials by TCLP should be undertaken to determine their suitability for disposal to Kate Valley Landfill.

To aid with selecting and specifying foundation materials (e.g. pile materials) further testing of landfill materials for selected parameters should be undertaken including pH, sulphate and chloride. This information can be used by geotechnical and structural engineers for selection of suitable pile material(s) to work in a landfill environment.

6 Conclusions

Kyle Park is a former gravel pit that was backfilled with uncontrolled landfill materials in the late 1960s and early 1970s. The investigation of the site in 2015 and 2018 confirms that the landfill materials are variable in composition and include a high proportion of organic material. During logging of the samples recovered from the boreholes, landfill materials exhibited organic odours. Laboratory testing of the capping and landfill materials has shown they can contain high levels of asbestos, metals and PAHs and will require controls during ground disturbance activities to protect construction workers and the environment. Options for the offsite disposal of capping and landfill materials are limited and subject to further testing. Presently only disposal to Kate Valley Landfill is suitable (subject to further testing), incurring higher cartage and disposal costs (approximately $300 tonne excluding GST) compared to disposal to other managed fills and/or cleanfill.

The findings of this investigation indicate disturbance of the capping and landfill materials will need to be undertaken as asbestos related or Class A asbestos works under the Asbestos Regulations. Working under the requirements of the Asbestos Regulations will incur additional costs and will effect productivity of ground works.

The high proportion of organic material observed in the landfill materials during this investigation indicates there is a potential for landfill gas generation from this stratum. If development of the centre proceeds on the site, a landfill gas assessment programme should be commenced as early as possible to identify what landfill gas protection and management measures will be needed.

Trenching for services/utilities to the Centre across the site will disturb and displace capping and landfill materials. These will require either encapsulation within the development area or offsite disposal to a suitable landfill. Controls to manage contaminated land-related risks to construction workers, park users and the environment will need to be implemented during this work.

A planning assessment for development on the site for ground contamination-related resource consents will be required; it is likely a number of resource consents specific to the landfilling materials encountered on the site will be necessary. Preparation of a ground contamination site management plan will be needed to support consent application(s) to show that appropriate controls and procedures can be used during construction to appropriately manage risks to human health and the environment.

Locating the Centre on the development area within Kyle Park is considered a preferential option from a contaminated land perspective, compared to elsewhere on the site. Within the development area the future construction work is expected to involve less bulk earthworks disturbing the contaminated capping and landfill materials given that this area requires infilling over the top of the contaminated materials.

Developing the centre at Kyle Park irrespective of its location on site, is not in T+T's opinion likely to present contamination-related issues that would be considered atypical of a closed uncontrolled fill site. Similar development has occurred on landfill sites in New Zealand and the earthworks and building controls that would be required to manage exposure to ground contaminants at the site would be similar to those for other contaminated sites and other uncontrolled file sites.

Appendix A: Figures

- Figure 2 – Site Plan
- Figure 3 – Cross Section A-A’
- Figure 4 – Cross Sections B-B’ and C-C’
- CCC survey drawing reference RPS2301-01 (November 2018)

APPROXIMATE A3 SCALE 1:2,500

0 50 100 150 (m)

Notes:

1. Aerial image sourced from LINZ Data Service, CC-BY 4.0. Imagery date: summer period 2015-16. Copyright Mapbox OpenStreetMap.
2. Cross-section transects: top number refers to Section title, bottom number refers to Figure number.

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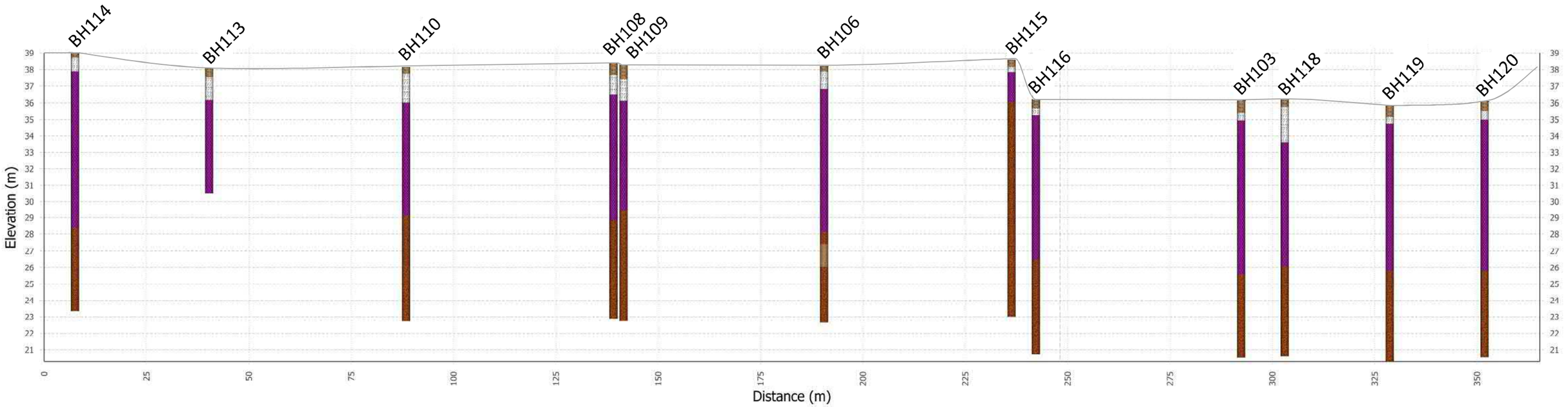
DRAWN	KPS	11/18
DRAFTING CHECKED		
APPROVED		
FILE : 1003207.0000-F2		
APPROX. SCALE (AT A3 SIZE) AS SHOWN		
PROJECT No. 1003207.0000		

CHRISTCHURCH CITY COUNCIL
KYLE PARK
WATERLOO ROAD, HORNBY
INVESTIGATION LOCATION PLAN

FIG. No. Figure 2

REV. 1



Section 1

LEGEND

- Cap material
- Transition material
- Fill
- Natural
- Indicative ground level

Notes:
1. Elevation in metres above Christchurch City Datum.
2. Distance in horizontal metres from southern section start point.

0 10 20 30 40 50 60 70 80 90 100
H (1:1000)
V (1:250)
0 10 20

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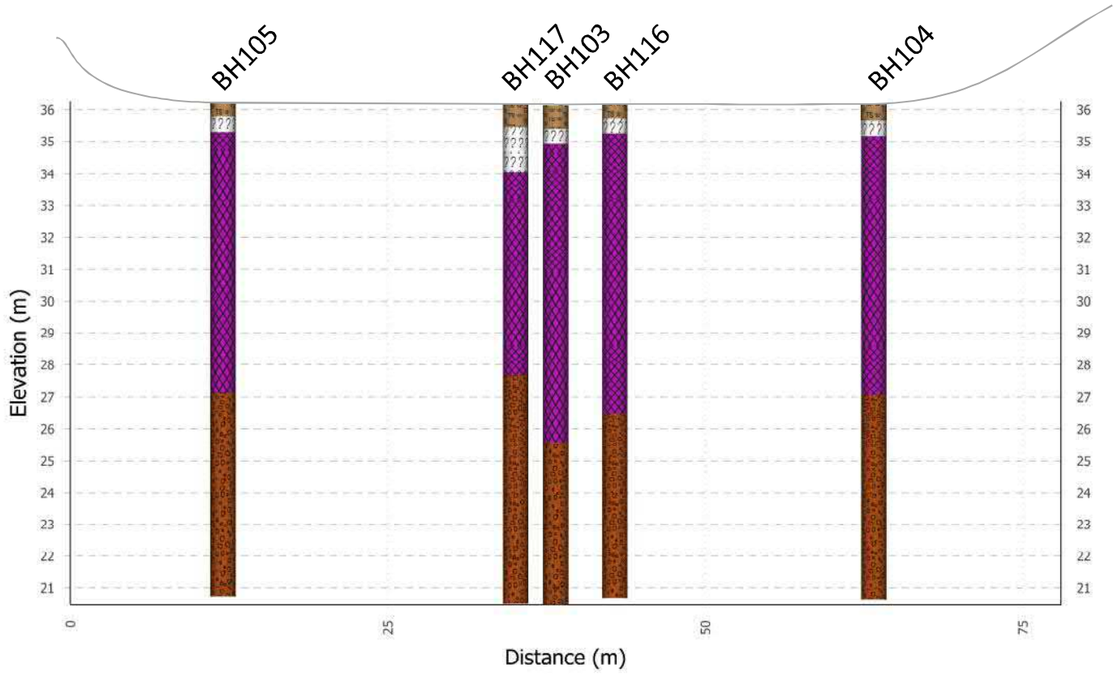
DRAWN	KPS	11/18
DRAFTING CHECKED		
APPROVED		
FILE : 1003207.0000-F3-F4		
APPROX. SCALE (AT A3 SIZE) AS SHOWN		
PROJECT No. 1003207.0000		

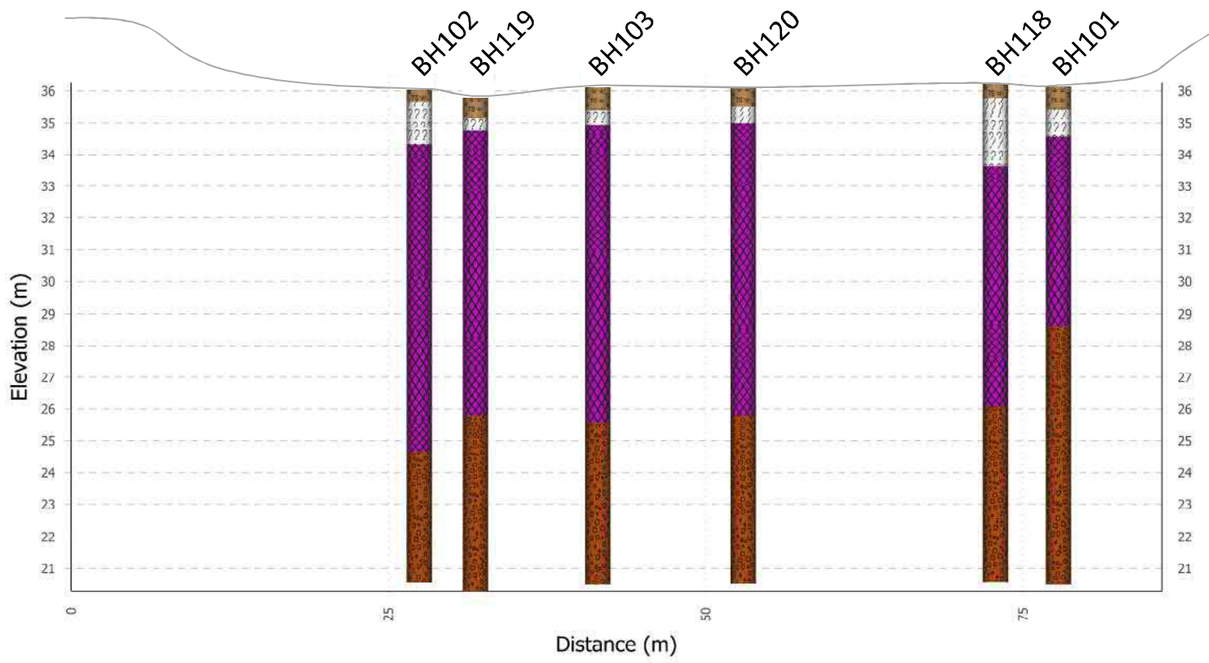
CHRISTCHURCH CITY COUNCIL
KYLE PARK
WATERLOO ROAD, HORNBY
CROSS-SECTION 1

FIG. No. Figure 3
REV. 1

Section 2



Section 3



LEGEND

- Cap material
- Transition material
- Fill
- Natural
- Indicative ground level

Notes:
1. Elevation in metres above Christchurch City Datum.
2. Distance in horizontal metres from southern section start point.

H (1:500)
V (1:200)

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DRAWN	KPS	11/18
DRAFTING CHECKED		
APPROVED		
FILE : 1003207.0000-F3-F4		
APPROX. SCALE (AT A3 SIZE) AS SHOWN		
PROJECT No. 1003207.0000		

CHRISTCHURCH CITY COUNCIL
KYLE PARK
WATERLOO ROAD, HORNBY
CROSS-SECTIONS 2 & 3

FIG. No. Figure 4

REV. 1

Note:
All Survey Data Provided using GPS with Height accuracy +/- 30mm.

WATERLOO RD

SMARTS RD

BH101
X: 383716.40
Y: 805721.78
GL 36.16

BH102
X: 383717.11
Y: 805671.38
GL 36.07

BH103
X: 383658.72
Y: 805685.40
GL 36.14

BH104
X: 383613.65
Y: 805710.53
GL 36.17

BH105
X: 383615.26
Y: 805659.25
GL 36.34

BH106
X: 383558.10
Y: 805667.63
GL 38.23

BH107
X: 383528.95
Y: 805706.23
GL 38.61

BH108
X: 383541.27
Y: 805609.96
GL 38.43

BH109
X: 383509.64
Y: 805643.59
GL 38.31

BH110
X: 383488.74
Y: 805592.17
GL 38.22

BH111
X: 383502.07
Y: 805532.84
GL 38.61

BH112
X: 383443.55
Y: 805664.27
GL 38.48

BH113
X: 383433.87
Y: 805580.73
GL 38.12

BH114
X: 383440.80
Y: 805524.80
GL 39.00

BH115
X: 383579.39
Y: 805712.12
GL 38.66

BH116
X: 383607.74
Y: 805690.14
GL 36.20

BH117
X: 383645.30
Y: 805672.26
GL 36.19

BH118
X: 383668.62
Y: 805716.77
GL 36.23

BH119
X: 383695.26
Y: 805675.80
GL 35.85

BH120
X: 383717.95
Y: 805696.93
GL 36.10

Nail 201
RL 38.195

Nail 202
RL 38.775

Nail 203
RL 38.930

Nail 207
RL 39.300

K 38.33 K 38.39 K 38.54 K 38.72 K 38.82 K 38.88 K 38.95 K 39.00 K 39.05 K 39.12

FP 38.45 FP 38.62 FP 38.79 FP 38.88 FP 39.01 FP 39.06 FP 39.09 FP 39.17

K 38.18 K 38.03

FP 38.20 FP 38.08 FP 38.17 FP 38.11 FP 38.25 FP 38.31 FP 38.30 FP 38.38 FP 38.20 FP 38.48 FP 38.47 FP 38.44 FP 38.36 FP 38.40 FP 38.49 FP 38.63 FP 38.86 FP 38.51 FP 38.14 FP 38.30 FP 38.21 FP 38.34 FP 38.40

Part Lot 4 DP 905m² CB793/52

Lot 1 DP 19287 1017m² CB792/87

Lot 3 DP 306538 30m²

Lot 1 DP 78681 70429m² CB45A/841

Lot 2 DP 38571 504m² CB19A/186

Lot 4 DP 29202 1009m² CB11F/1014

905m² CB26A/486

Lot 2 DP 350640 965m² 207155

CB45/576

Lot 3 DP 350640 2063m² 207156

Lot 1 DP 350640 2063m² 207154

Lot 1 DP 34558 19830m² CB14A/1325 CB48B/948

Lot 2 DP 83523 1043m² CB48B/948

Lot 2 DP 83523 1043m² CB48B/949

Lot 1 DP 50964 1302m² CB29F/842

Lot 2 DP 50964 541m² CB30B/1215 CB30B/1216

GEOSPATIAL REGISTRATION OF AERIAL IMAGERY MAY NOT BE IN TERMS OF LAND XML BOUNDARY DATA
BOUNDARY LOCATIONS SUBJECT TO CADASTRAL SURVEY

12d Working Folder: S:\Project RPS\02301 - Kyle Park\12d\Survey\F11390

ISSUE	AMENDMENT	SIGNED	DATE

Christchurch City Council

TECHNICAL SERVICES & DESIGN

HEIGHT DATUM	CCD Post Jan 2014		NAME	SIGNED	DATE
ORIGIN BM	BM0140 (EHBT)	SURVEYED BY	D Babbage		November 2018
RL	19.342	PROCESSED BY	D Babbage		November 2018
SURVEY LB	GNSS	CHECKED BY			
COORD DATUM	Mt Pleasant 2000	NORTHING		EASTING	
ORIGIN					
SITE TBM					
12D FILE REF	F11390	PRINTED ON	Wed Nov 07 11:50:09 2018		

PROJECT TITLE

Kyle Park

DRAWING TITLE

Bore Locations

SAP/WBS NUMBER: 721/120/9/9/3/3

SCALES: 1:500

FILE NUMBER: RPS2301

ORIGINAL SHEET SIZE: A1

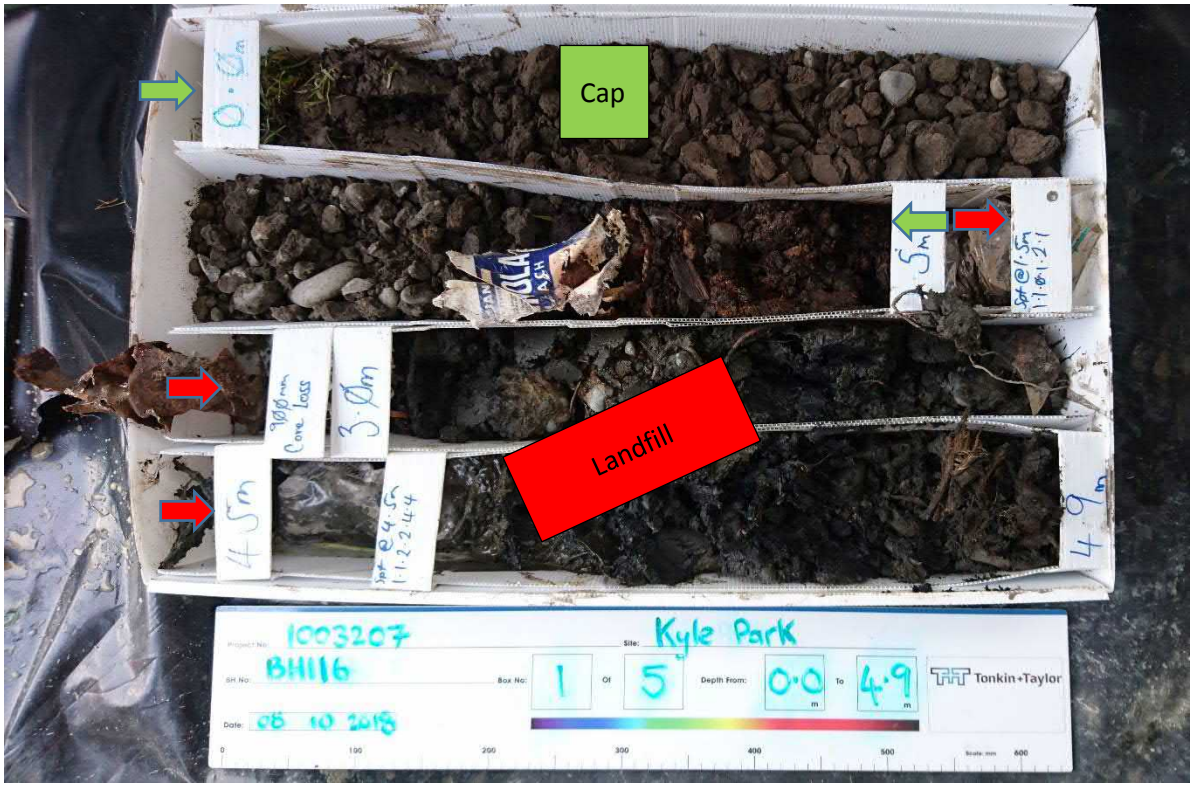
DRAWING NUMBER: RPS2301- 01

SHEET: 1 OF 1

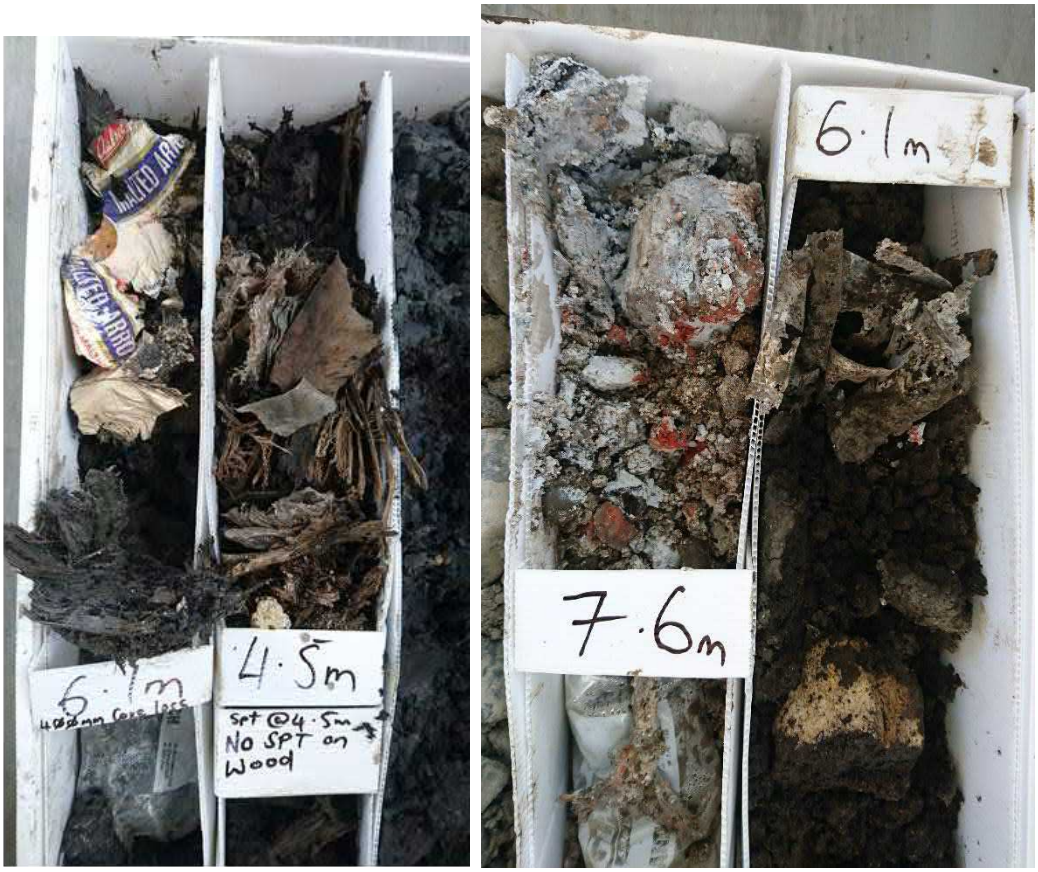
Appendix B: Photographs

Photograph 1 –centre of the site looking south-west.

Photograph 2 – development area looking easterly (Waterloo Road left of frame).

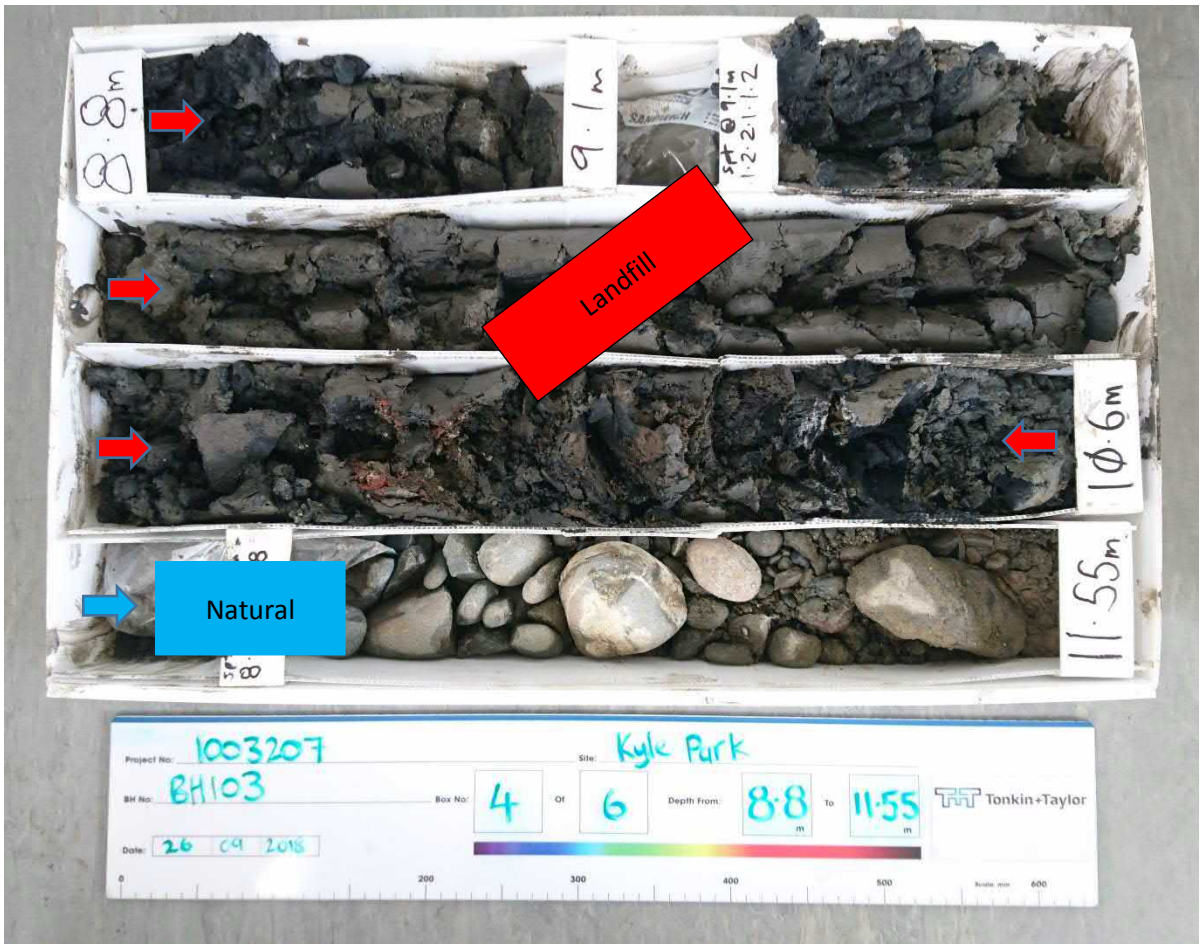


Photograph 3 – example of capping materials and their transition into landfill materials.



Photograph 4 – examples of landfill materials.

Photograph 5 – example of asbestos containing material (cement board materials) (Borehole 111 at 0.7 m bgl).



Photograph 6 - example of landfill and natural material change.

Appendix C: Borehole Logs and Field Screening Data

BOREHOLE LOG

BOREHOLE No.: **BH101**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179231.00 mN 1561662.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 20/09/2018 HOLE FINISHED: 20/09/2018
R.L.:	36.16m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL Box 1, 0.0-3.8m Box 2, 3.8-6.0m			66	PQ HFS				36			M	F				Capping material: Sandy SILT with amorphous organics; dark brown. "Firm", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium.
								35	1		M-W					Transition material: Sandy fine to coarse GRAVEL with minor silt and trace cobbles; brown. Moist to wet, well graded. Contains some coal (0.75 to 0.8m only); gravel, subangular to subrounded; sand, fine to medium.
			73	PQ HFS				34	2		W					1.0 to 1.5m - no recovery.
																No SPT @ 1.5m (bouncing).
			100	SPT		7/8 6/3 2/1 **N=12**		33	3			MD				Fill: organic and/or granular soils mixed with refuse.
			100	PQ HFS				32	4							2.6 to 3.0m - no recovery.
			100	SPT		2/1 4/4 2/2 **N=12**		31	5							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			100	PQ HFS												
			100	SPT		1/3 2/2 3/3 **N=10**		30	6							
			100	PQ HFS				29	7							
NATURAL Box 3, 6.0-8.4m			100	SPT		4/2 2/2 1/2 **N=7**		28	8			L				Silty sandy fine to coarse GRAVEL with trace cobbles; dark brownish grey. Loose, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			71	PQ HFS												8.1 to 8.3m - no recovery.
			100	SPT		13/13 10/12 16/12 for 65mm **N>=50** Bouncing		27	9		M-W	VD				9.1m - grey; moist to wet, very dense.
Box 4, 8.4-10.9m		20/09/2018 10.6 m bgl	100	PQ HFS				26	10							
			100	SPT		7/5 6/6 14/18 **N=34** Solid		25	11		W-S	D				Sandy fine to coarse GRAVEL with minor silt and trace cobbles; brown. Dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			100	PQ HFS												10.6 to 11.05m - no recovery from SPT; sample obtained from overcore.
Box 5, 10.9-13.5m			100	SPT		8/12 16/18 16 for 55mm **N>=50** Solid Bouncing		24	12			VD				12.2m - very dense. 12.2 to 12.56m - no recovery from SPT; sample obtained from overcore.
			100	PQ HFS				23	13							
			100	SPT		4/4 5/6 10/15 **N=36** Solid		22	14							13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
Box 6, 13.5-15.7m			100	PQ HFS												
			0	SPT		3/5 7/9		21	15			D				15.2m - dense. 15.2 to 15.65m - no recovery from SPT.
						15/18 **N=49** Solid		20	16							End of borehole at 15.65 m bgl (target depth).

COMMENTS:

Hole Depth 15.65m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:16 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH102**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179181.00 mN 1561663.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 20/09/2018 HOLE FINISHED: 20/09/2018
R.L.:	36.07m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL			80	PQ HFS				35	1		M	S				Capping material: SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium.
			100	SPT		2/1 2/1 0/0 **N=3**					M-W					Transition material: Sandy fine to medium GRAVEL with some silt, brown to dark brown. "Loose", wet, well graded. Contains minor coal; organic odour; gravel, subangular to subrounded; sand, fine to coarse.
			14	PQ HFS				34	2			F-St				0.7m - sandy SILT with some gravel; brown. "Soft to firm", moist to wet, low plasticity, very slow dilatancy.
			100	SPT		4/4 6/5 17/7 **N=35**		33	3							0.95m - thin rust layer.
			9	PQ HFS				32	4							1.0m - "firm to stiff", trace glass.
			59	PQ HFS				31	5							1.2 to 1.5m - no recovery.
			100	SPT		2/1 1/1 1/1 **N=4**		30	6							1.5 to 1.95m - no recovery from SPT; sample obtained from overcore.
			61	PQ HFS				29	7							1.5m - gravelly, trace cobble.
			100	SPT		1/1 1/1 1/1 **N=4**		28	8							Fill: organic and/or granular soils mixed with refuse.
			100	PQ HFS				27	9							2.1 to 3.0m - no recovery.
			100	SPT		1/1 1/1 0/2 for 65mm **N>=50**		26	10							3.55 to 4.5m - no recovery.
			52	PQ HFS				25	11							No SPT @ 4.5m (wood).
		20/09/2018 11.0 m bgl	100	SPT		7/10 12/18 20 for 65mm **N>=50** Bouncing		24	12							5.9 to 6.1m - no recovery.
NATURAL			100	PQ HFS				23	13		W	VD				Sandy fine to coarse GRAVEL with minor silt and trace cobbles; brownish grey. Very dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			100	SPT		17/33 for 75mm **N>=50** Solid Bouncing		22	14		W-S					7.2 to 7.6m - no recovery.
			100	PQ HFS				21	15							7.6 to 8.05m - no recovery from SPT; sample obtained from overcore.
			0	SPT		8/19 36/14 for 20mm **N>=50** Solid Bouncing		20	16							10.1 to 10.4m - no recovery.
						7/13 19/31 for 75mm **N>=50** Solid Bouncing										Sandy fine to coarse GRAVEL with minor silt and trace cobbles; brownish grey. Very dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
																12.2 to 12.35m - no recovery from SPT; sample obtained from overcore.
																12.7m - brown; wet to saturated.
																13.7 to 13.95m - no recovery from SPT; sample obtained from overcore.
																15.2 to 15.5m - no recovery from SPT.
																End of borehole at 15.5 m bgl (target depth).

Box 1, 0.0-4.5m
Box 2, 4.5-7.6m
Box 3, 7.6-10.4m
Box 4, 10.4-12.7m
Box 5, 12.7-15.5m

For a general description of the landfill materials see the Geotechnical Assessment Report.
Detailed field observations of the landfill material are available on request.

COMMENTS:

Hole Depth 15.5m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:22 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH103**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179195.00 mN 1561605.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 21/09/2018 HOLE FINISHED: 21/09/2018
R.L.:	36.14m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
FILL		93	PQ HFS				36		M	S	Capping material: SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low to moderate plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium.
		100	SPT		2/1 1/1 1/1 **N=4**		35	1		L	Transition material: Sandy fine to coarse GRAVEL with some silt, amorphous organics; dark brown. Loose, moist, well graded; low to moderate plasticity, no dilatancy. Organic odour; gravel, subangular to subrounded; sand, fine to medium.
		71	PQ HFS				34	2	W-S		Fill: organic and/or granular soils mixed with refuse.
Box 1, 0.0-3.5m		100	SPT		2/1 0/1 2/1 **N=4**		33	3			1.4 to 1.5m - no recovery. 2.0m - wet to saturated. 2.7 to 3.0m - no recovery.
		100	PQ HFS				32	4			
		56	PQ HFS				31	5			No SPT @ 4.5m (steel). 4.5 to 5.2m - no recovery.
Box 2, 3.5-6.5m		100	SPT		13/2 2/1 1/1 **N=5**		30	6			For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
		100	PQ HFS				29	7			
Box 3, 6.5-8.8m		100	SPT		2/2 1/1 1/1 **N=4**		28	8			
		100	PQ HFS					9			
		100	SPT		1/2 2/1 1/2 for 65mm **N>=50**		27				
	21/09/2018 10.9 m bgl	100	PQ HFS				26	10			
Box 4, 8.8-11.8m		82	SPT		8/10 12/8 8/8 **N=28**		25	11		D	Sandy fine to coarse GRAVEL with minor cobbles and trace silt; brownish grey. Dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
		100	PQ HFS					12			
NATURAL		33	SPT		8/9 125/10 18/10 for 70mm **N>=50** Bouncing		24		S	VD	12.2m - cobbles absent; brown. Very dense, saturated. 12.2 to 12.65m - no recovery from SPT; sample obtained from overcore.
		100	PQ HFS				23	13			13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
		55	SPT		7/13 14/12 14/10 for 70mm **N>=50** Solid Bouncing		22	14			
Box 5, 11.6-15.6m		100	PQ HFS					15			
		0	SPT		6/11 15/15 10/10 for 50mm **N>=50** Solid Bouncing		21				15.2 to 15.63m - no recovery from SPT.
							20	16			End of borehole at 15.63 m bgl (target depth).

COMMENTS:

Hole Depth 15.63m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:28 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH104**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179220.00 mN 1561559.00 mE

R.L.: 36.17m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 26/09/2018

HOLE FINISHED: 26/09/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Box	WATER	CORE RECOVERY (%)	METHOD	TESTS	RL (m)	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
FILL	Box 1, 0.0-3.0m		80	PQ HFS		36		M	S	Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			44	SPT	2/0 0/1 1/1 **N=3**	35	1			
			61	PQ HFS		34	2	M-W		Transition material: SILT with some sand and trace gravel; brown mottled greyish brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace red plastic; sand, fine to medium; gravel, fine to medium, subangular to subrounded. 0.6 to 0.9m - no recovery.
	Box 2, 3.0-6.0m		100	SPT	3/3 2/2 1/2 **N=7**	33	3			Fill: organic and/or granular soils mixed with refuse.
			61	PQ HFS		32	4			1.7 to 1.95m - no recovery. 2.1m - moist to wet. 2.6 to 3.0m - no recovery.
			100	SPT	1/3 10/40 for 70mm **N>=50** Bouncing	31	5			4.8 to 5.0m - no recovery.
			88	PQ HFS		30	6			For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
	Box 3, 6.0-9.4m		100	PQ HFS		29	7			
			0	SPT	2/1 0/0 1/2 **N=3**	28	8			7.6 to 8.05m - no recovery in SPT.
			47	PQ HFS		27	9			8.55 to 9.1m - no recovery.
NATURAL		26/09/2018 10.4 m bgl	100	SPT	3/2 3/4 5/5 **N=17** Solid			W-S	MD	Sandy fine to coarse GRAVEL with minor cobbles and trace silt; bluish grey. Medium dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			100	PQ HFS		26	10	S	L	9.1 to 9.55m - no recovery from SPT; sample obtained from overcore.
			44	SPT	2/1 2/2 2/2 **N=8**	25	11			10.0m - reddish brown; saturated, loose. 10.8 to 11.05m - no recovery.
	Box 4, 9.4-12.7m		100	PQ HFS		24	12			12.0m - trace to minor silt, trace cobbles; brownish grey.
			100	SPT	9/12 10/10 12/6 **N=38**				D	12.2m - dense.
			100	PQ HFS		23	13			12.7m - sandy, trace to minor silt; brown.
			100	SPT	7/13 19/11 10/10 **N>=50**	22	14		VD	13.7m - very dense.
	Box 5, 12.7-15.6m		100	PQ HFS		21	15			
			0	SPT	9/17 21/23 6 for 70mm **N>=50** Solid Bouncing					15.2 to 15.1m - no recovery from SPT.
						20	16			End of borehole @ 15.51m bgl (target depth).

COMMENTS:

Hole Depth 15.51m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:33 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH105**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179169.00 mN 1561561.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 26/09/2018 HOLE FINISHED: 26/09/2018
R.L.:	36.34m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Box	WATER	CORE RECOVERY (%)	METHOD	TESTS	RL (m)	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
FILL	Box 1, 0.0-3.0m		93	PQ HFS		36	1	M	S	Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded. 0.35m - yellowish brown.
			100	SPT	2/1 0/0 1/0 **N=1**	35			L	
			100	PQ HFS		34	2			Transition material: sandy fine to coarse GRAVEL with minor to some silt, amorphous organics; dark brown. "Loose", moist, well graded. Contains trace glass, white paint/plaster chips; organic odour; gravel, subangular to subrounded; sand, fine to medium.
			100	SPT	1/1 3/2 2/2 **N=9**	33	3			Fill: organic and/or granular soils mixed with refuse. 1.4 to 1.5m - no recovery.
	Box 2, 3.0-6.1m		100	PQ HFS		32	4			
			100	SPT	3/3 2/2 2/2 for 70mm **N>=50**	31	5			For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			100	PQ HFS		30	6			
			100	SPT	1/2 2/2 1/2 **N=7**	29	7	W		6.5m - wet.
	Box 3, 6.1-9.1m		100	PQ HFS		28	8			
			100	SPT	4/4 3/7 3/1 **N=14**	27	9	W-S	VD	Sandy fine to coarse GRAVEL with minor silt and trace cobbles; brown. Very dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
NATURAL		26/09/2018 10.3 m bgl	100	PQ HFS	3/4 4/16 20/10 for 10mm **N>=50** Bouncing	26	10	S		9.7m - greyish brown; saturated.
	Box 4, 9.1-12.2m		100	PQ HFS	20/30 for 70mm **N>=50** Solid Bouncing	25	11			10.6 to 11.05m - no recovery from SPT; sample obtained from overcore. 10.8m - trace silt; bluish grey.
			100	SPT	12/19 25/25 for 70mm **N>=50** Solid Bouncing	24	12			12.0m - brownish grey.
			100	PQ HFS		23	13			12.2m - trace to minor silt; brown. 12.2 to 12.35m - no recovery from SPT; sample obtained from overcore.
			100	SPT	11/17 18/18 14 for 60mm **N>=50** Solid Bouncing	22	14			13.7 to 14.06m - no recovery from SPT; sample obtained from overcore.
	Box 5, 12.2-15.5m		100	PQ HFS		21	15			15.2 to 15.49m - no recovery from SPT.
			0	SPT	13/21 27/23 for 65mm **N>=50** Solid Bouncing	20	16			End of borehole @15.49m bgl (target depth).

COMMENTS:

Hole Depth 15.49m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:38 PM - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH106**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179177.00 mN 1561504.00 mE

R.L.: 38.23m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 27/09/2018

HOLE FINISHED: 27/09/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL			100	PQ HFS			Box 1, 0.0-2.6m	38	0		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		3/2 2/2 2/2 N=8		37	1							
			71	PQ HFS				36	2							Transition material: SILT with some sand and trace gravel; brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace brick; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		2/1 3/2 2/2 N=9		35	3							Fill: organic and/or granular soils mixed with refuse. 2.7 to 3.0m - no recovery.
			76	PQ HFS			Box 2, 2.6-5.8m	34	4							
			100	SPT		1/2 2/1 0/1 N=4		33	5							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			100	PQ HFS				32	6							
			100	SPT		2/4 4/4 6/4 N=18		31	7							
			100	PQ HFS			Box 3, 5.8-8.0m	30	8							
		27/09/2018 9.2 m bgl	100	SPT		2/2 6/4 3/3 N=16		29	9							
			100	PQ HFS				28	10							
			100	SPT		9/9 11/7 5/5 N=28		27	11		S	L				9.9 to 10.1m - no recovery.
			80	PQ HFS			Box 4, 8.0-10.8m	26	12							Fine to coarse GRAVEL with trace sand and silt; brownish grey. Loose, saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 10.3m - sandy.
			100	SPT		10/6 3/3 2/2 N=10		25	13							
NATURAL			4	PQ HFS				24	14							Silty fine to medium SAND; grey. Loose, saturated, poorly graded. 11.1 to 12.2m - no recovery.
			100	SPT		12/12 15/20 15 for 20mm N>=50 Bouncing		23	15			VD				Sandy fine to coarse GRAVEL with trace cobbles and silt; brownish grey. Very dense, saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 12.2 to 12.52m - no recovery from SPT; sample obtained from overcore.
			100	PQ HFS			Box 5, 10.8-14.7m	22	16							
			100	SPT		4/5 8/12 12/12 N=44 Solid						D				13.2m - minor silt; brown. 13.7m - dense. 13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
			100	PQ HFS			Box 6, 14.7-15.6m									
			0	SPT		6/8 15/15 18/2 for 5mm N>=50 Solid Bouncing						VD				15.2m - very dense. 15.2 to 15.58m - no recovery from SPT. End of borehole @ 15.58m bgl (target depth).

COMMENTS:

Hole Depth 15.58m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:43 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH107**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179215.00 mN 1561475.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 27/09/2018 HOLE FINISHED: 27/09/2018
R.L.:	38.61m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	RL (m)	DEPTH (m)	TESTS	SAMPLES	CASING	WATER	FLUID LOSS (%)	CORE RECOVERY (%)	METHOD	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Box 1, 0.0-2.6m FILL	38	1						100	PQ HFS		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
											W	L				
	37	2	2/3 3/2 2/1 **N=8**					100	SPT							Transition material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown mottled light grey and orange. "Soft", moist, low plasticity, very slow dilatancy. Contains trace brick; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
								90	PQ HFS							
	36	3						100	SPT							0.65m - organic sandy fine to coarse GRAVEL with minor to some silt; brown to dark brown. "Loose", wet, well graded. Contains trace brick; organic odour; gravel, angular to subrounded; sand, fine to coarse; organics, amorphous.
			3/3 2/2 1/2 **N=7**													0.9m - trace white paint/plaster chips.
	35	4						85	PQ HFS							1.05m - light grey and orange bands.
	34	5						75	PQ HFS		M	VD				Fill: organic and/or granular soils mixed with refuse.
Box 2, 2.6-6.1m																2.9 to 3.0m - no recovery.
																4.35 to 4.5m - no recovery. No SPT at 4.5m (wood).
	33	6	15/15 12/12 14/12 **N>=50** Bouncing					100	SPT							Sandy fine to coarse GRAVEL with minor to some silt and amorphous organics; dark brownish grey. Very dense, moist, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
								100	PQ HFS							5.2m - trace silt, organics absent; grey.
	32	7									W					5.3m - minor cobbles.
																5.7 to 6.1m - no recovery.
Box 3, 6.1-9.1m	31	8	14/16 16/14 12/8 for 70mm **N>=50** Solid Bouncing					66	SPT							7.0m - trace cobbles; grey, wet.
								100	PQ HFS							7.6 to 7.85m - no recovery from SPT; 200mm sample obtained from overcore. 7.85 to 8.0m - sand and silt absent.
	30	9														
			16/18 18/18 14 for 65mm **N>=50** Solid Bouncing			27/09/2018 10.1 m bgl		2	SPT							9.1 to 9.47m - no recovery from SPT; 170mm sample obtained from overcore. 9.3m - minor silt.
NATURAL	29	10						100	PQ HFS							
																For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
Box 4, 9.1-11.9m	28	11	24/26 for 75mm **N>=50** Solid Bouncing													
	27	12						100	PQ HFS							12.2 to 12.35m - no recovery from SPT; sample obtained from overcore.
			30/20 for 70mm **N>=50** Solid Bouncing													
	26	13														
	25	14	10/10 14/12 14/10 for 70mm **N>=50** Solid Bouncing					100	SPT							13.7m - brown.
Box 5, 11.9-14.6m								100	PQ HFS							13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
Box 6, 14.6-15.5m	24	15	18/27 32/18 for 40mm **N>=50** Solid Bouncing					0	SPT							15.2 to 15.47m - no recovery from SPT.
	23	16														End of borehole @ 15.47m bgl (target depth).

COMMENTS:

Hole Depth 15.47m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:48 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH108**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179119.00 mN 1561487.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 02/10/2018 HOLE FINISHED: 02/10/2018
R.L.:	38.43m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
FILL	Box 1, 0.0-2.6m			100	PQ HFS		8/42 for 50mm **N>=50** Bouncing		38 37	1		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded. 0.3m - brown mottled light yellowish brown.
				100	PQ HFS				36	2		W-S					Transition material: SILT with some sand and trace gravel; brown mottled light yellowish brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace brick, white paint chips, and timber; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
				100	SPT		2/3 3/3 1/2 **N=9**		35	3							Fill: organic and/or granular soils mixed with refuse. 2.4m - wet to saturated.
	Box 2, 2.6-6.5m			100	PQ HFS				34	4							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
				100	SPT		2/1 0/1 1/2 **N=4**		33	5							
				82	PQ HFS				32	6							5.9 to 6.1m - no recovery.
				100	SPT		1/1 3/5 9/3 **N=20**		31	7							6.7 to 7.6m - no recovery (rubbish blocking barrel). No SPT @ 7.6m.
				14	PQ HFS				30	8							
	Box 3, 6.5-10.2m			73	PQ HFS				29	9							8.7 to 9.1m - no recovery.
				100	SPT		8/10 6/5 5/5 **N=21**		28	10			VD				
		02/10/2018 10.7 m bgl		100	PQ HFS				27	11							Sandy fine to coarse GRAVEL with minor cobbles and silt; brownish grey mottled orange. Very dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 9.7m - reddish orange. 9.8m - bluish grey. 11.0m - grey.
				100	SPT		13/13 20/22 8 for 5mm **N>=50** Bouncing		26	12							
NATURAL	Box 4, 10.2-13.1m			100	PQ HFS				25	13							12.2 to 12.43m - no recovery from SPT; sample obtained from overcore. 12.7m - trace silt; bluish grey.
				100	SPT		10/21 26/14 for 5mm **N>=50** Solid Bouncing		24	14							13.7 to 14.15m - no recovery from SPT; sample obtained from overcore. 14.0m - brown. 15.2 to 15.57m - no recovery from SPT.
	Box 5, 13.1-15.6m			100	PQ HFS				23	15							
				0	SPT		4/6 9/7 11/18 **N=45** Solid 5/7 14/16 20 for 65mm **N>=50** Solid Bouncing		22	16							End of borehole @ 15.57m bgl (target depth).

COMMENTS:

Hole Depth 15.57m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:33:54 PM - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH109**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179153.00 mN 1561456.00 mE

R.L.: 38.31m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 28/09/2018

HOLE FINISHED: 28/09/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Box	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
FILL	Box 1, 0.0-2.6m		100	PQ HFS				38	0	M	S	Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		5/4 3/4 3/1 **N=11**		37	1	W		0.6m - orange and black mottles. 0.8m - wet.
			100	PQ HFS				36	2	M-W		Transition material: layered organic silty fine to medium SAND with minor gravel, and organic sandy SILT; dark grey. Wet; sharp organic odour.
	Box 2, 2.6-5.6m		100	SPT		2/4 3/9 38 for 70mm **N>=50** Bouncing		35	3			Fill: organic and/or granular soils mixed with refuse. Moist to wet.
			100	PQ HFS				34	4			
			100	SPT		2/4 4/2 2/4 **N=12**		33	5			
			100	PQ HFS				32	6			
	Box 3, 5.6-8.9m		100	SPT		1/0 1/1 1/1 **N=4**		31	7			
			100	PQ HFS				30	8			
			100	SPT		0/0 1/0 1/1 **N=3**		29	9	S	VD	Sandy fine to coarse GRAVEL with minor silt and amorphous organics; dark grey. Very dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 9.8m - organics absent; greyish brown.
NATURAL		28/09/2018 10.3 m bgl	100	PQ HFS				28	10			
			100	SPT		3/15 20/15 15 for 75mm **N>=50** Bouncing		27	11	W		10.6m - grey; wet. 10.6 to 10.91m - no recovery from SPT; sample obtained from overcore.
	Box 4, 8.9-11.7m		100	PQ HFS				26	12			
			1164	SPT		7/10 15/18 17 for 5mm **N>=50** Solid Bouncing		25	13			12.2 to 12.51m - no recovery from SPT; sample obtained from overcore. 12.3m - greyish brown.
			100	PQ HFS				24	14	S	D	13.7m - trace silt; reddish brown. Saturated, dense. 14.8m - minor silt.
	Box 5, 11.7-14.6m		100	SPT		6/12 15/22 13 for 10mm **N>=50** Solid Bouncing		23	15			
			71	PQ HFS								14.9 to 15.2m - no recovery. 15.2m - very dense. 15.2 to 15.57m - no recovery from SPT.
	Box 6, 14.6-15.6m		0	SPT		4/4 6/9 13/18 **N=46** Solid 5/9 13/17 20 for 65mm **N>=50** Solid Bouncing		22	16			End of borehole @ 15.51m bgl (target depth).

For a general description of the landfill materials see the Geotechnical Assessment Report.
Detailed field observations of the landfill material are available on request.

COMMENTS:

Hole Depth 15.57m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:00 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH110**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179101.00 mN 1561435.00 mE

R.L.: 38.22m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 01/10/2018

HOLE FINISHED: 01/10/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	RL (m)	DEPTH (m)	TESTS	CORE RECOVERY (%)	METHOD	WATER	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
FILL	38	0		100	PQ HFS		M	S	Capping material: SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium.
	37	1					W		0.4m - minor gravel; dry to moist, "firm to stiff". Gravel, fine to coarse, subangular to subrounded.
			2/5 9/7 7/6 **N=29**	100	SPT				Transition material: SILT with some sand, minor gravel, amorphous organics; brown to dark brown. "Firm to stiff", moist, low plasticity, very slow dilatancy. Contains trace brick and timber; organic odour; sand, fine to medium.
Box 1, 0.0-2.8m	36	2		100	PQ HFS				1.0m - interbedded silty fine to medium SAND with minor gravel, fine to medium SAND, and organic sandy SILT. Wet.
			2/1 1/1 2/2 **N=6**	100	SPT				Fill: organic and/or granular soils mixed with refuse. Moist to wet.
	35	3							
	34	4		100	PQ HFS				
			2/1 0/1 2/3 **N=6**	0	SPT				4.5 to 5.0m - no recovery from SPT; sample not recovered from overcore.
Box 2, 2.8-6.1m	33	5							
				100	PQ HFS				For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
	32	6	1/7 4/3 4/3 **N=14**	100	SPT				
	31	7		100	PQ HFS				
			4/2 3/3 3/4 **N=13**	100	SPT				7.6 to 8.05m - no recovery in SPT.
Box 3, 6.1-8.6m	30	8		100	PQ HFS				8.55 to 9.1m - no recovery.
	29	9					S	D	
			3/5 4/5 7/19 **N=50**	100	SPT				Sandy fine to coarse GRAVEL with minor cobbles and trace silt; bluish grey. Dense, saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
	28	10		100	PQ HFS				9.4 to 9.6m - wood pieces.
Box 4, 8.6-11.1m						01/10/2018 11.1 m bgl			9.6m - minor cobbles, trace silt.
	27	11	35/15 for 60mm **N>=50** Solid Bouncing	100	PQ HFS			VD	10.6m - very dense. 10.6 to 10.74m - no recovery from SPT; sample obtained from overcore. 12.0m - minor silt, trace cobbles; greyish brown.
NATURAL	26	12	20/37 50 for 55mm **N>=50** Solid Bouncing	100	SPT				12.2 to 12.41m - no recovery from SPT; sample obtained from overcore. 12.6m - brown. 13.1m - orange-brown.
Box 5, 11.1-13.7m	25	13		100	PQ HFS				
			15/25 20/22 8 for 40mm **N>=50** Solid Bouncing	100	SPT				13.7 to 14.04m - no recovery from SPT; sample obtained from overcore.
	24	14		100	PQ HFS				
Box 6, 13.7-15.5m	23	15	11/17 24/26 for 65mm **N>=50** Solid Bouncing	0	SPT				15.2 to 15.49m - no recovery from SPT.
	22	16							End of borehole @ 15.49m bgl (target depth).

COMMENTS:

Hole Depth 15.49m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:05 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH111**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179042.00 mN 1561448.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 04/10/2018
		DRILL METHOD: SNC	HOLE FINISHED: 04/10/2018
R.L.:	38.61m		DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
									38	0		M	S				Capping material: SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium. 0.35m - trace gravel, fine to medium, subangular to subrounded.
				86	PQ HFS					1		M-W					Fill: organic and/or granular soils mixed with refuse.
				100	SPT		1/1 0/1 2/3 **N=6**		37								1.0m - moist to wet.
	Box 1, 0.0-3.0m			100	PQ HFS					2							1.3 to 1.5m - no recovery.
				83	PQ HFS				36	3							No SPT @ 3.0m (core slipped out of barrel).
				100	SPT		1/2 1/2 3/5 **N=11**		35	4							4.25 to 4.5m - no recovery.
FILL	Box 2, 3.0-5.9m			100	PQ HFS				34	5							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
				100	SPT		2/2 2/6 5/3 **N=16**		33	6							
				100	PQ HFS				32	7							
				100	SPT		4/3 4/6 4/5 **N=19**		31	8		W-S					7.4m - wet to saturated.
	Box 3, 5.9-8.9m			100	PQ HFS				30	9			VD				Sandy fine to coarse GRAVEL with trace to minor silt and trace cobbles; yellowish brown. Very dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			20/09/2018 10.4 m bgl	100	SPT		11/20 50 for 65mm **N>=50** Bouncing		29	10							
				100	PQ HFS				28	11							10.6m - greyish brown. 10.6 to 10.83m - no recovery from SPT; sample obtained from overcore.
	Box 4, 8.8-11.1m			100	SPT		13/27 42/8 for 2mm **N>=50** Solid Bouncing		27	12							
NATURAL				100	PQ HFS				26	13							12.2 to 12.65m - no recovery from SPT; sample obtained from overcore.
	Box 5, 11.1-13.7m			100	SPT		7/7 8/12 15/15 **N>=50** Solid		25	14							13.7m - saturated, medium dense. 13.7 to 14.15m - no recovery from SPT; sample not obtained.
				0	SPT		6/6 8/5 3/3 **N=19** Solid		24	15		S	MD				
	Box 6, 13.7-15.7m			95	PQ HFS				23	16							15.2 to 15.65m - no recovery from SPT; sample obtained from overcore.
				0	SPT		5/4 5/7 7/6 **N=25** Solid										End of borehole @ 15.65m bgl (target depth).

COMMENTS:

Hole Depth 15.65m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:11 PM - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH112**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179173.00 mN 1561390.00 mE

R.L.: 38.48m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 04/10/2018

HOLE FINISHED: 04/10/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL			100	PQ HFS			Box 1, 0.0-2.5m	38	1		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		1/3 3/3 2/2 **N=10**		37	2		D-M	L				Transition material: sandy fine to coarse GRAVEL with trace silt; brown. "Loose", dry, well graded. Gravel, angular to subrounded; sand, fine to coarse. 0.6m - minor to some silt, trace wood fibres; moist. 0.95 to 1.05m - orange mottles. 1.5m - organic; dark brown to black. Organics amorphous and fibrous.
			100	PQ HFS				36	3							
			53	PQ HFS			Box 2, 2.5-6.1m	35	4							Fill: organic and/or granular soils mixed with refuse. No SPT @ 3.0m (wood). 3.8 to 4.5m - no recovery.
			100	SPT		1/1 1/1 1/1 **N=4**		34	5							
			100	PQ HFS				33	6							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			100	SPT		3/4 2/2 2/2 **N=8**		32	7							
			100	PQ HFS				31	8							
			100	SPT		4/6 8/7 6/5 **N=26**		30	9		W-S	VD				
			61	PQ HFS			Box 3, 6.1-9.4m	29	10		S					Sandy fine to coarse GRAVEL with minor cobbles and trace silt, amorphous organics; dark brownish grey. Very dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 8.6m - organics absent.
			100	PQ HFS		7/43 for 65mm **N>=50** Bouncing		28	11							8.7 to 9.1m - no recovery.
		04/10/2018 10.8 m bgl	100	SPT		18/18 25/25 for 75mm **N>=50** Solid Bouncing		27	12							9.2m - silty; golden brown staining, petrol odour. Silt is plastic. 9.3m - trace silt. 9.6 to 9.8m - bluish grey; saturated. Strong petrol odour. 10.5m - bluish grey. 10.6 to 10.9m - no recovery from SPT; sample obtained from overcore. 10.8 to 11.2m - silty; golden brown staining, petrol odour. Silt is plastic. 11.0m - trace silt; bluish grey.
NATURAL			100	PQ HFS			Box 4, 9.4-12.5m	26	13							
			100	SPT		7/10 18/12 14/6 for 25mm **N>=50** Solid Bouncing		25	14							12.2 to 12.6m - no recovery from SPT; sample obtained from overcore. 12.7m - brown.
			100	PQ HFS				24	15							13.7 to 14.08m - no recovery from SPT; sample obtained from overcore.
			100	SPT		10/17 15/10 20/5 for 5mm **N>=50** Solid Bouncing	Box 5, 12.5-15.2m	23	16							SPT not recorded @ 15.2m.
				PQ HFS				22								End of borehole @ 15.2m bgl (target depth).

COMMENTS:

Hole Depth 15.2m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:15 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH113**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179090.00 mN 1561380.00 mE

R.L.: 38.12m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 02/10/2018

HOLE FINISHED: 02/10/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL			100	PQ HFS				37	1		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded. 0.2m - sandy; brown mottled yellowish brown.
Box 1, 0.0-2.5m			100	SPT		1/1 2/2 5/4 **N=13**		36	2			F-St				Transition material: Gravelly sandy SILT; brown. Moist, low plasticity. Contains trace brick; gravel, fine to coarse, subangular to subrounded; sand, fine to coarse. 0.8m - gravel absent; dark brown. "Firm to stiff". 1.2 to 1.4m - trace sand; grey mottled orange and dark brown. Moderate plasticity, no dilatancy. 1.4m - trace gravel, medium to coarse, subangular to subrounded.
			100	PQ HFS				35	3							Fill: organic and/or granular soils mixed with refuse.
			100	SPT		1/1 1/1 1/1 **N=4**		34	4							No SPT @ 4.5m (wood).
			100	PQ HFS				33	5							5.1 to 6.1m - no recovery (timber blocked barrel).
Box 2, 2.5-6.6m			50	PQ HFS				32	6		S					6.1m - saturated. 6.55 to 6.95m - no recovery.
Box 3, 6.6-7.6m			100	SPT		2/1 3/4 4/4 **N=15**		31	7		W					6.95m - wet.
			61	PQ HFS												End of borehole @7.6m bgl (refusal on steel).
								30	8							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
								29	9							
								28	10							
								27	11							
								26	12							
								25	13							
								24	14							
								23	15							
								22	16							

COMMENTS:

Hole Depth 7.6m

Scale 1:83

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH114**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179034.00 mN 1561387.00 mE

R.L.: 39.00m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 03/10/2018

HOLE FINISHED: 03/10/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	RL (m)	DEPTH (m)	TESTS	CORE RECOVERY (%)	METHOD	WATER	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
FILL (Box 1, 0.0-3.0m; Box 2, 3.0-6.1m; Box 3, 6.1-9.3m)	38	1		86	PQ HFS		M	S	Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			3/3 3/2 2/2 **N=9**	100	SPT		M-W		
	37	2		100	PQ HFS				Transition material: gravelly SILT with some sand; brown. "Soft", moist, low plasticity, no dilatancy. Contains trace timber, metal, brick, plastic, white paint/plaster chips.
									0.9 to 1.1m - no recovery.
	36	3	5/8 5/4 5/3 **N=17**	100	SPT				Fill: organic and/or granular soils mixed with refuse.
	35	4		100	PQ HFS				For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			32/2 3/4 4/2 **N=13**	100	SPT				
	34	5		100	PQ HFS				
	33	6	4/11 25/12 5/8 **N>=50** Bouncing	22	SPT				6.1 to 6.55m - no recovery from SPT; 100mm obtained from overcore.
	32	7		80	PQ HFS				7.4 to 7.6m - no recovery.
			3/4 4/4 5/5 **N=18**	100	SPT				
	31	8		100	PQ HFS				
	30	9	10/40 for 75mm **N>=50** Bouncing	0	SPT				9.1 to 9.25m - no recovery from SPT; sample not obtained. 9.1 to 10.6m - drilling equipment damaged; retrieval of equipment lost downhole may have resulted in mixed core.
	29	10		100	PQ HFS	03/10/2018 11.1 m bgl			
NATURAL (Box 4, 9.3-11.9m; Box 5, 11.9-15.7m)			12/16 14/26 10 for 30mm **N>=50** Solid Bouncing	100	SPT		W-S	VD	Sandy fine to coarse GRAVEL with trace silt; greyish brown. Very dense, wet to saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 10.6 to 10.93m - no recovery from SPT; sample obtained from overcore.
	28	11		100	PQ HFS				
	27	12	9/10 10/10 11/11 **N=42** Solid	100	SPT			D	12.2m - dense. 12.2 to 12.65m - no recovery from SPT; sample obtained from overcore.
	26	13		100	PQ HFS				
	25	14	7/5 4/5 5/4 **N=18** Solid	100	SPT			MD	13.7m - medium dense. 13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
	24	15	5/12 19/5 8/9 **N=41** Solid	100	PQ HFS				
				0	SPT				15.2m - dense. 15.2 to 15.65m - no recovery from SPT.
	23	16							End of borehole @ 15.65m bgl (target depth).

COMMENTS:

Hole Depth 15.65m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:25 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH115**

SHEET: 1 OF 1

PROJECT: Kyle Park | LOCATION: Kyle Park, Waterloo Road, Hornby | JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179221.00 mN, 1561525.00 mE

R.L.: 38.66m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 05/10/2018

HOLE FINISHED: 05/10/2018

DRILLED BY: ProDrill

LOGGED BY: KPS | CHECKED: HJB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Description and Additional Observations
FILL	Capping material: SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium. 0.3m - trace gravel, fine to medium, subangular to subrounded.
	Transition material: SILT with some sand and trace gravel, amorphous organics; dark brown mottled light brown and orange. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, medium to coarse, subangular to subrounded. 0.75m - some organics, spongy, brown.
	Fill: organic and/or granular soils mixed with refuse. 0.9 to 1.5m - no recovery. No SPT @ 1.5m (wood). 2.25 to 2.6m - no recovery.
NATURAL	Sandy fine to coarse GRAVEL with trace to minor silt and trace cobbles; grey. Medium dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse. 4.5m - dense. 4.5 to 4.95m - no recovery from SPT; sample obtained from overcore.
	6.1m - very dense. 6.1 to 6.48m - no recovery from SPT; sample obtained from overcore.
	7.6 to 7.97m - no recovery from SPT; sample obtained from overcore.
	8.5 to 9.1m - no recovery.
	9.1m - greyish brown. 9.1 to 9.34m - no recovery from SPT; sample obtained from overcore.
	10.6m - dense. 10.6 to 11.05m - no recovery from SPT; sample obtained from overcore.
	11.9m - brown. 12.2m - saturated. 12.2 to 12.65m - no recovery from SPT; sample obtained from overcore.
	13.3 to 13.7m - no recovery. 13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
	15.2 to 15.65m - no recovery from SPT.
	End of borehole @ 15.65m bgl (target depth).

DEPTH (m)	RL (m)	TESTS	CORE RECOVERY (%)	METHOD	WATER	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION
1	38		60	PQ HFS		M	S
2	37		76	PQ HFS		M-W	
3	36	4/3 5/5 4/4 **N=18**	100	SPT		W	MD
4	35		100	PQ HFS			
5	34	6/17 12/8 12/11 **N=43** Solid	100	SPT			D
6	33		100	PQ HFS			
7	32	14/14 14/16 20 for 75mm **N>=50** Solid Bouncing	100	SPT			VD
8	31		100	PQ HFS			
9	30	12/14 18/18 14 for 70mm **N>=50** Solid Bouncing	46	PQ HFS			
10	29	6/16 35/15 for 15mm **N>=50** Solid Bouncing	100	SPT			
11	28		100	PQ HFS	05/10/2018 11.1 m bgl		D
12	27	8/8 10/10 11/13 **N=44** Solid	100	SPT			
13	26		100	PQ HFS			
14	25	8/16 11/8 8/10 **N=37** Solid	100	SPT		S	
15	24		61	PQ HFS			
	23	5/6 5/8 10/12 **N=35** Solid	100	SPT			
16			100	PQ HFS			
		6/6 5/7 9/13 **N=34** Solid	0	SPT			

Box 1, 0.0-3.9m | Box 2, 3.9-6.4m | Box 3, 6.4-9.6m | Box 4, 9.6-12.2m | Box 5, 12.2-15.7m

COMMENTS:

For a general description of the landfill materials see the Geotechnical Assessment Report.
Detailed field observations of the landfill material are available on request.

Hole Depth 15.65m

Scale 1:83

Rev.: A

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Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH116**

SHEET: 1 OF 1

PROJECT: Kyle Park

LOCATION: Kyle Park, Waterloo Road, Hornby JOB No.: 1003207.0000

CO-ORDINATES: (NZTM2000) 5179199.00 mN 1561554.00 mE

R.L.: 36.20m

DATUM: CCD

DRILL TYPE: MS 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 05/10/2018

HOLE FINISHED: 05/10/2018

DRILLED BY: ProDrill

LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL			76	PQ HFS				36			M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		1/1 0/1 2/1 **N=4**		35	1		W-S					Transition material: SILT with some sand and minor gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace concrete and bark; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			0	PQ HFS				34	2							0.95 to 1.3m - no recovery.
			30	PQ HFS				33	3							Fill: organic and/or granular soils mixed with refuse. Wet to saturated.
			100	SPT		1/1 2/2 4/4 **N=12**		32	4							1.95 to 3.0m - no recovery.
			100	PQ HFS				31	5							No SPT @ 3.0m (metal, core loss).
			100	SPT		5/7 5/4 2/2 **N=13**		30	6							3.45 to 4.5m - no recovery.
Box 1, 0.0-4.9m																For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
Box 2, 4.9-7.1m			100	PQ HFS				29	7							
			33	SPT		2/2 1/2 0/1 **N=4**		28	8							7.6 to 7.9m - no recovery in SPT; 150mm obtained from overcore.
Box 3, 7.1-9.7m			100	PQ HFS				27	9							
			100	SPT		2/0 1/2 12/35 for 70mm **N>=50** Bouncing		26	10		W	D				Sandy fine to coarse GRAVEL with minor silt and trace cobbles; bluish grey. Dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
	05/10/2018 10.6 m bgl	▼														10.4m - brownish grey.
			100	PQ HFS				25	11		S					10.6m - trace silt; saturated, brown.
			100	SPT		7/7 8/10 10/10 **N=38** Solid										10.6 to 11.05m - no recovery from SPT; 50mm obtained from overcore.
Box 4, 9.7-12.7m			100	PQ HFS				24	12			VD				12.2m - very dense.
NATURAL			100	SPT		9/12 14/14 16/6 for 15mm **N>=50** Solid Bouncing		23	13							12.2 to 12.59m - no recovery from SPT; sample obtained from overcore.
			100	PQ HFS				22	14							13.7 to 14.08m - no recovery from SPT; sample obtained from overcore.
			100	SPT		7/10 16/16 16/2 for 5mm **N>=50** Solid Bouncing		21	15							
Box 5, 12.7-15.5m			0	PQ HFS		19/20 25/25 for 75mm **N>=50** Solid Bouncing		20	16							15.2 to 15.5m - no recovery from SPT. End of borehole @ 15.50m bgl (target depth).

COMMENTS:

Hole Depth 15.5m

Scale 1:83

Rev.: A

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH117**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179182.00 mN 1561591.00 mE	DRILL TYPE: Fraste XL1	HOLE STARTED: 06/10/2018 HOLE FINISHED: 06/10/2018
R.L.:	36.19m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL — ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL Box 1, 0.0-3.8m Box 2, 3.8-7.0m			83	PQ HFS				36	0		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			0	SPT		0/0 0/0 0/1 **N=1**		35	1							Transition material: gravelly SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			80	PQ HFS				34	2		M-W					0.75 to 1.0m - no recovery.
			22	SPT		0/1 1/0 1/5 **N=7**		33	3							1.5 to 2.15m - no recovery.
			100	PQ HFS				32	4							Fill: organic and/or granular soils mixed with refuse. Moist to wet.
			44	SPT		4/2 2/1 1/2 **N=6**		31	5							3.1 to 3.45m - no recovery.
			69	PQ HFS				30	6							4.7 to 5.3m - no recovery.
			100	SPT		1/1 1/1 1/2 **N=5**		29	7							For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			100	PQ HFS				28	8							8.05 to 8.3m - no recovery.
NATURAL Box 3, 7.0-9.8m Box 4, 9.8-12.2m Box 5, 12.2-14.4m Box 6, 14.4-15.7m		06/10/2018 11.0 m bgl	76	PQ HFS				27	9		W	VD				Sandy fine to coarse GRAVEL with trace to minor cobbles and silt; dark grey. Very dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			100	SPT		3/4 3/3 2/2 **N=10**		26	10							8.8m - grey.
			100	PQ HFS				25	11		S	MD				10.6m - medium dense, saturated.
			100	SPT		8/10 14/21 15 for 50mm **N>=50** Bouncing		24	12							11.0m - brown.
			100	PQ HFS				23	13							
			100	SPT		4/4 4/4 3/5 **N=16**		22	14							
			100	PQ HFS				21	15							
			0	SPT		5/5 4/4 6/7 **N=21**		20	16							End of borehole @ 15.65m bgl (target depth).
						6/6 7/7 4/5 **N=23**										
						3/4 4/5 5/7 **N=21**										

COMMENTS:

Hole Depth 15.65m

Scale 1:83

Rev.: A

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BOREHOLE LOG

BOREHOLE No.: **BH118**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179226.00 mN 1561614.00 mE	DRILL TYPE: Fraste XL1	HOLE STARTED: 06/10/2018 HOLE FINISHED: 06/10/2018
R.L.:	36.23m	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL																	ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)		Description and Additional Observations
FILL			66	PQ HFS				36	1		M	S					Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		0/0 1/1 0/1 **N=3**		35	2								Transition material: gravelly SILT with some sand, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace clinker; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded. 0.9m - contains trace brick.
			61	PQ HFS				34	3								1.0 to 1.5m - no recovery.
			100	SPT		0/0 0/0 2/2 **N=4**		33	4								2.0 to 2.4m - no recovery.
			100	PQ HFS				32	5								Fill: organic and/or granular soils mixed with refuse.
			100	SPT		1/1 0/1 0/0 **N=1**		31	6								For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			82	PQ HFS				30	7								5.9 to 6.1m - no recovery.
			100	SPT		1/1 1/0 0/0 **N=1**		29	8								
			100	PQ HFS				28	9								
			100	SPT		2/2 1/2 3/4 **N=10**		27	10								
			100	PQ HFS				26	11		W S	D					Sandy fine to coarse GRAVEL with trace to minor silt and trace cobbles; bluish grey. Dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
		06/10/2018 10.8 m bgl	100	SPT		2/3 3/2 3/3 **N=11**		25	12								10.3m - saturated.
NATURAL			100	PQ HFS				24	13								11.0m - brown.
			100	SPT		14/12 10/10 10/12 **N=42**		23	14								11.8m - minor sand, trace silt.
			100	PQ HFS				22	15			VD					12.2m - very dense.
			100	SPT		7/10 12/13 20/5 for 10mm **N>=50** Bouncing		21	16			D					13.7m - dense.
			100	PQ HFS				20									
			0	SPT		7/7 7/7 8/8 **N=30** 6/6 8/9 8/10 **N=35**											End of borehole @ 15.65m bgl (target depth).

Box 1, 0.0-4.0m
Box 2, 4.0-6.9m
Box 3, 6.9-9.1m
Box 4, 9.1-11.4m
Box 5, 11.4-12m
Box 6, 14.2-15.7m

COMMENTS:

Hole Depth 15.65m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:44 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH119**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179185.00 mN 1561641.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 06/10/2018
		DRILL METHOD: SNC	HOLE FINISHED: 06/10/2018
R.L.:	35.85m		DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Box	Water	Core Recovery (%)	Method	Tests	RL (m)	Depth (m)	Moisture Condition / Weathering	Strength/Density Classification	Description and Additional Observations
FILL	Box 1, 0.0-2.8m		100	PQ HFS		35	1	M	S	Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT	3/2 1/0 1/1 **N=3**	34	2			Transition material: SILT with some sand and minor gravel, amorphous organics; brown to dark brown mottled yellowish brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace brick; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	PQ HFS		33	3			Fill: organic and/or granular soils mixed with refuse.
			100	SPT	2/11 8/6 2/2 **N=18**					
	Box 2, 2.8-6.4m		66	PQ HFS		32	4			3.45 to 3.8m - no recovery.
			0	SPT	1/1 0/1 1/2 **N=4**	31	5			4.5 to 5.0m - no recovery.
			100	PQ HFS						
			100	SPT	1/1 2/2 3/8 **N=15**	30	6			For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
	Box 3, 6.4-8.8m		100	PQ HFS		29	7			
			100	SPT	3/1 2/2 3/3 **N=10**	28	8			
			100	PQ HFS		27	9			
			100	SPT	5/4 5/7 5/5 **N=22**	26	10			
NATURAL	Box 4, 8.8-11.2m	06/10/2018 11.3 m bgl	100	PQ HFS				W	VD	Sandy fine to coarse GRAVEL with trace to minor silt and trace cobbles; bluish grey. Very dense, wet, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			100	SPT	18/18 18/18 14 for 55mm **N>=50** Solid Bouncing	25	11	S		10.6m - brownish grey; saturated. 10.6 to 10.96m - no recovery from SPT; sample obtained from overcore. 11.2m - brown.
			100	PQ HFS		24	12			
			100	SPT	10/12 24/26 for 35mm **N>=50** Solid Bouncing					12.2 to 12.46m - no recovery from SPT; sample obtained from overcore.
	Box 5, 11.2-14.8m		100	PQ HFS		23	13			
			100	SPT	5/12 12/9 12/15 **N=48** Solid	22	14			13.7 to 14.15m - no recovery from SPT; sample obtained from overcore.
	Box 6, 14.8-15.6m		100	PQ HFS		21	15			
			0	SPT	7/10 15/15 20 for 65mm **N>=50** Solid Bouncing					15.2 to 15.57m - no recovery from SPT.
						20	16			End of borehole @ 15.57m bgl (target depth).

COMMENTS:

Hole Depth 15.57m

Scale 1:83

Rev.: A

BoreLog - 28/11/2018 2:34:50 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH120**

SHEET: 1 OF 1

PROJECT: Kyle Park		LOCATION: Kyle Park, Waterloo Road, Hornby	JOB No.: 1003207.0000
CO-ORDINATES: (NZTM2000)	5179207.00 mN 1561664.00 mE	DRILL TYPE: MS 1000	HOLE STARTED: 06/10/2018
		DRILL METHOD: SNC	HOLE FINISHED: 06/10/2018
R.L.:	36.10m		DRILLED BY: ProDrill
DATUM:	CCD	DRILL FLUID: WATER	LOGGED BY: KPS CHECKED: HJB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
FILL			93	PQ HFS			Box 1, 0.0-3.0m	35	1		M	S				Capping material: SILT with some sand and trace gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Contains trace rootlets; organic odour; sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	SPT		2/1 2/1 1/1 **N=5**										Transition material: SILT with some sand and minor to some gravel, amorphous organics; brown to dark brown. "Soft", moist, low plasticity, very slow dilatancy. Sand, fine to medium; gravel, fine to medium, subangular to subrounded.
			100	PQ HFS				34	2							Fill: organic and/or granular soils mixed with refuse.
			73	PQ HFS				33	3							1.4 to 1.5m - no recovery.
								32	4							No SPT @ 3.0m (wood). 3.0 to 3.4m - no recovery.
			0	SPT		2/2 1/0 2/2 **N=5**		31	5							4.5 to 5.1m - no recovery.
			86	PQ HFS			Box 2, 3.0-6.9m									For a general description of the landfill materials see the Geotechnical Assessment Report. Detailed field observations of the landfill material are available on request.
			100	SPT		4/2 2/1 2/3 **N=8**		30	6							
			100	PQ HFS				29	7							
			100	SPT		2/2 1/2 1/1 **N=5**		28	8							7.6 to 8.05m - no recovery in SPT.
			100	PQ HFS							W					8.05m - wet.
			0	SPT		7/6 7/5 5/5 **N=22**		27	9							9.1 to 9.7m - no recovery.
			85	PQ HFS			Box 3, 6.9-10.6m	26	10							
		06/10/2018 10.9 m bgl	100	SPT		14/18 15/18 17 for 70mm **N>=50** Solid Bouncing		25	11		S	VD				Sandy fine to coarse GRAVEL with trace to minor silt and trace cobbles; grey. Very dense, saturated, well graded. Gravel, subangular to subrounded; sand, fine to coarse.
			67	PQ HFS												10.6 to 10.97m - no recovery from SPT; sample obtained from overcore. 11.1m - brown.
			100	SPT		14/16 15/15 15/5 for 5mm **N>=50** Solid Bouncing		24	12							11.2 to 11.8m - no recovery.
NATURAL			100	PQ HFS			Box 4, 10.6-13.7m	23	13							12.2 to 12.58m - no recovery from SPT; sample obtained from overcore.
			100	SPT		6/14 16/15 15/4 for 6mm **N>=50** Solid Bouncing		22	14							13.7 to 14.08m - no recovery from SPT; sample obtained from overcore.
			100	PQ HFS			Box 5, 13.7-15.6m	21	15							
			0	SPT		16/16 16/18 16 for 70mm **N>=50** Solid Bouncing		20	16							15.2 to 15.57m - no recovery from SPT.
																End of borehole at 15.57m bgl (target depth).

COMMENTS:

Hole Depth 15.57m

Scale 1:83

Rev.: A

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Appendix C
Ground Contamination Assessment - Kyle Park, Hornby
Field screening records

Borehole	Depth (m bgl)	Stratum	PID (ppm)	Field logging notes
101	0.75	Capping	0.7	Organic odour
	3.5	Landfill	0.8	-
	5.4	Landfill	0.9	-
	7.2	Landfill	1.3	Sweet odour, ashy materials
102	2.9	Landfill	0.9	-
	4.3	Landfill	0.9	-
	6	Landfill	4.6	Organic odour
	7.3	Landfill	1.3	-
	7.8	Landfill	2.3	-
	8.9	Landfill	3	-
	10.2	Landfill	4.4	-
103	2	Landfill	1.9	-
	2.5	Landfill	2.4	-
	5	Landfill	3.2	-
	7.4	Landfill	11.9	Fuel hydrocarbon odour, black staining to strata
	10.5	Landfill	1.5	Sweet, musty odour
104	2.5	Landfill	1.7	-
	4	Landfill	2.2	-
	5.7	Landfill	8.4	-
	7.2	Landfill	3.4	-
105	1.35	Landfill	1.6	-
	2.9	Landfill	2.1	-
	3.4	Landfill	5.8	-
	4.5	Landfill	10.5	-
	4.55	Landfill	5.9	-
	6.1	Landfill	9.5	-
	6.9	Landfill	3.1	-
	7.6	Landfill	5.9	-
106	1.5	Landfill	0.4	-
	2.3	Landfill	0.6	Organic odour
	3	Landfill	0.7	Organic odour
	4.5	Landfill	0.7	-
	6.8	Landfill	1	-
	7.4	Landfill	0.6	-
	7.6	Landfill	1.5	-
	9.3	Landfill	1.2	-
	10.6	Natural	0.1	-
107	1.3	Landfill	2.1	Materials stained black
	1.5	Landfill	0.7	-
	3	Landfill	1.6	-
	3.9	Landfill	2.1	Sharp organic odour
	6.1	Natural	1.1	-
108	3.8	Landfill	1	-
	5.6	Landfill	27.2	Ashy materials
109	1.5	Landfill	2.8	Sharp organic odour
	3	Landfill	19.8	-
	4.5	Landfill	5.3	-
	6.1	Landfill	0.5	-
	7.6	Landfill	0.2	-
	9.1	Natural	0.3	-
110	2.5	Landfill	0.2	Organic odour
	4.25	Landfill	24.7	Grey sheen to materials
	5.7	Landfill	3.3	-
111	1	Landfill	0	-
	5.8	Landfill	0	
112	8.1	Landfill	3.1	Organic odour
	9.2	Natural	125.6	Hydrocarbon (petrol) odour
	9.5	Natural	45	Hydrocarbon (petrol) odour
	9.7	Natural	3	-
	10	Natural	76.8	Hydrocarbon (petrol) odour
	11.5	Natural	82.8	Hydrocarbon (petrol) odour
	11.7	Natural	3	-
113	3.9	Landfill	1.7	-
	7.3	Landfill	2.8	-
114	2.6	Landfill	0.4	-
	3.6	Landfill	2	-
	4.3	Landfill	0.5	-
116	1.4	Landfill	0.2	-
	3.2	Landfill	2.2	Sharp organic odour
	4.65	Landfill	1.7	Organic odour
	7.25	Landfill	2.3	-
117	7.4	Landfill	16.5	-
	8.35	Landfill	11.3	Hydrocarbon (diesel, grease) odour
118	3.8	Landfill	6.1	Sharp organic odour
119	2.45	Landfill	1.7	Burnt odour
	6.3	Landfill	4.6	-

Appendix D: Laboratory Result Transcripts

- Analytica references – 18-30938, 18-31313, 18-32437
- Precise references –S1809281149, S1810011340, S1810151050

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Certificate of Analysis

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Lab Reference: 18-30938
Submitted by: Katie Stephenson
Date Received: 28/09/2018
Date Completed: 5/10/2018
Order Number: 1003207
Reference:

Sampling Site: Kyle Park

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

AMENDED REPORT. This report replaces in full a previous version [R00] sent on 05/10/2018. Previous revision did not contain a signature.

Soil Aggregate Properties and Nutrients

			Client Sample ID	BH101 7.2 7.2	BH103 7.4 7.4
			Date Sampled	20/09/2018	26/09/2018
Analyte	Unit	*Reporting Limit*		18-30938-3	18-30938-11
Total Cyanide*	mg/kg dry wt	*0.2*		2.58	<0.2

Heavy Metals in Soil

			Client Sample ID	BH101 3.45 3.45	BH101 7.2 7.2	BH102 0.5 0.5	BH102 9.6 9.6	BH103 0.3 0.3
			Date Sampled	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018
Analyte	Unit	*Reporting Limit*		18-30938-2	18-30938-3	18-30938-4	18-30938-6	18-30938-7
Arsenic	mg/kg dry wt	*0.125*		17.8	13.7	4.99	13.4	5.93
Cadmium	mg/kg dry wt	*0.005*		5.04	0.69	0.081	0.40	0.097
Chromium	mg/kg dry wt	*0.125*		45.7	17.5	14.4	19.0	15.2
Copper	mg/kg dry wt	*0.075*		270	76.9	9.00	24.3	14.8
Lead	mg/kg dry wt	*0.05*		406	166	28.8	183	20.8
Mercury	mg/kg dry wt	*0.025*		0.45	0.42	0.060	0.29	0.044
Nickel	mg/kg dry wt	*0.05*		112	31.5	11.3	16.9	11.3
Zinc	mg/kg dry wt	*0.05*		417	257	67.7	200	64.5

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.

Heavy Metals in Soil

		Client Sample ID	BH103 10.5 10.5	BH104 1.0 1.0	BH104 7.7 7.7	BH105 0.9 0.9	BH105 6.0 6.0
		Date Sampled	26/09/2018	26/09/2018	26/09/2018	27/09/2018	27/09/2018
Analyte	Unit	*Reporting Limit*	18-30938-10	18-30938-12	18-30938-14	18-30938-15	18-30938-17
Arsenic	mg/kg dry wt	*0.125*	9.56	7.16	30.2	16.5	8.28
Cadmium	mg/kg dry wt	*0.005*	3.07	0.89	2.52	0.29	0.085
Chromium	mg/kg dry wt	*0.125*	26.1	17.3	31.6	17.2	13.5
Copper	mg/kg dry wt	*0.075*	27.5	54.5	108	62.5	9.53
Lead	mg/kg dry wt	*0.05*	77.2	90.2	281	105	32.7
Mercury	mg/kg dry wt	*0.025*	0.44	0.087	0.14	0.20	0.086
Nickel	mg/kg dry wt	*0.05*	31.5	14.3	40.2	17.2	11.4
Zinc	mg/kg dry wt	*0.05*	197	1,300	285	126	113

Semivolatile Organic Compounds - Soil

		Client Sample ID	BH101 3.45 3.45	BH101 7.2 7.2	BH102 0.5 0.5	BH102 9.6 9.6	BH103 0.3 0.3
		Date Sampled	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018
Analyte	Unit	*Reporting Limit*	18-30938-2	18-30938-3	18-30938-4	18-30938-6	18-30938-7
Phenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*	<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*	<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*	<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*	<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*	0.4	<0.1	0.7	0.2	<0.1
2-Methylnaphthalene	mg/kg dry wt	*0.1*	0.1	<0.1	0.8	0.2	<0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*	0.2	<0.1	3.2	<0.1	<0.1
Acenaphthylene	mg/kg dry wt	*0.1*	<0.1	<0.1	1.1	<0.1	<0.1
Fluorene	mg/kg dry wt	*0.1*	0.5	<0.1	6.2	0.2	<0.1
Phenanthrene	mg/kg dry wt	*0.1*	3.7	0.2	92.5	1.3	<0.1
Anthracene	mg/kg dry wt	*0.1*	0.6	0.1	9.9	0.2	<0.1
Fluoranthene	mg/kg dry wt	*0.1*	5.4	0.3	86.0	1.7	<0.1
Benzo[a]anthracene	mg/kg dry wt	*0.1*	2.3	0.1	15.5	0.5	<0.1
Chrysene	mg/kg dry wt	*0.1*	1.7	<0.1	10.5	0.5	<0.1
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*	2.1	<0.1	11.2	0.5	<0.1
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*	0.7	<0.1	4.8	0.3	<0.1
Benzo[a]pyrene	mg/kg dry wt	*0.1*	2.1	<0.1	10.0	0.3	<0.1
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*	1.9	<0.1	7.3	<0.1	<0.1
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*	0.4	<0.1	1.3	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*	1.7	<0.1	5.2	0.4	<0.1
Pyrene	mg/kg dry wt	*0.2*	6.0	0.2	62.9	1.5	<0.2
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*	3.3	0.3	16.2	0.6	0.2
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*	3.3	<0.1	16.2	0.5	<0.1
4,4'-DDD	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	7.0	<0.3

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH101 3.45 3.45	BH101 7.2 7.2	BH102 0.5 0.5	BH102 9.6 9.6	BH103 0.3 0.3
			Date Sampled	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018
4,4'-DDE	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*		1.2	2.4	<0.5	<0.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*		0.8	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	7.0	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	2.2	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH101 3.45 3.45	BH101 7.2 7.2	BH102 0.5 0.5	BH102 9.6 9.6	BH103 0.3 0.3
			Date Sampled	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018
Dibenzofuran	mg/kg dry wt	*0.3*		0.3	<0.3	3.6	<0.3	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		70.4	93.4	109.0	71.2	73.1
2-Fluorophenol (Surrogate)	%	*1*		94.3	126.6	148.5	93.3	101.9
2-Fluorobiphenyl (Surrogate)	%	*1*		163.9	157.8	120.0	144.2	154.0
2,4,6-Tribromophenol (Surrogate)	%	*1*		123.3	124.9	115.7	99.4	88.4
p-Terphenyl-d14 (Surrogate)	%	*1*		156.1	161.4	139.2	140.9	123.9
Nitrobenzene-d5 (Surrogate)	%	*1*		131.6	121.3	120.8	107.0	115.3

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH103 10.5 10.5	BH104 1.0 1.0	BH104 7.7 7.7	BH105 0.9 0.9	BH105 6.0 6.0
			Date Sampled	26/09/2018	26/09/2018	26/09/2018	27/09/2018	27/09/2018
Analyte	Unit	*Reporting Limit*		18-30938-10	18-30938-12	18-30938-14	18-30938-15	18-30938-17
Phenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*		<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	1.1	1.5	16.4
2-Methylnaphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.1	0.9	13.0
2-Chloronaphthalene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.2	1.4	24.6
Acenaphthylene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	2.6	3.9
Fluorene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.3	6.8	61.6
Phenanthrene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.6	75.6	739.4
Anthracene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.1	7.1	80.2
Fluoranthene	mg/kg dry wt	*0.1*		0.2	0.1	0.8	73.2	355.9
Benzo[a]anthracene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.4	17.9	89.9
Chrysene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.3	13.0	62.9
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.6	15.0	68.7
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	5.9	26.9
Benzo[a]pyrene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.4	12.8	66.0
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*		<0.1	<0.1	0.7	11.8	50.0
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	2.0	6.4
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*		<0.1	0.3	0.5	8.7	37.5
Pyrene	mg/kg dry wt	*0.2*		<0.2	<0.2	0.7	61.9	343.7

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH103 10.5 10.5	BH104 1.0 1.0	BH104 7.7 7.7	BH105 0.9 0.9	BH105 6.0 6.0
			Date Sampled	26/09/2018	26/09/2018	26/09/2018	27/09/2018	27/09/2018
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*		0.2	0.2	0.7	20.7	100.2
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*		<0.1	<0.1	0.6	20.7	100.2
4,4'-DDD	mg/kg dry wt	*0.3*		3.5	<0.3	0.5	<0.3	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	0.7	<0.5
Endosulfan I	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	1.3
Butyl benzyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	6.8	38.3
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH103 10.5 10.5	BH104 1.0 1.0	BH104 7.7 7.7	BH105 0.9 0.9	BH105 6.0 6.0
			Date Sampled	26/09/2018	26/09/2018	26/09/2018	27/09/2018	27/09/2018
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	4.6	44.8
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		60.6	65.8	47.3	68.0	70.6
2-Fluorophenol (Surrogate)	%	*1*		80.7	89.0	60.8	96.5	92.0
2-Fluorobiphenyl (Surrogate)	%	*1*		207.6	193.4	169.0	128.4	108.3
2,4,6-Tribromophenol (Surrogate)	%	*1*		97.8	92.5	73.8	111.2	105.8
p-Terphenyl-d14 (Surrogate)	%	*1*		169.8	155.8	152.5	136.1	148.4
Nitrobenzene-d5 (Surrogate)	%	*1*		131.1	124.7	125.9	119.5	105.8

Moisture Content

			Client Sample ID	BH101 3.45 3.45	BH101 7.2 7.2	BH102 0.5 0.5	BH102 9.6 9.6	BH103 0.3 0.3
			Date Sampled	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018
Analyte	Unit	*Reporting Limit*		18-30938-2	18-30938-3	18-30938-4	18-30938-6	18-30938-7
Moisture Content	%	*1*		38	41	13	39	22

Moisture Content

			Client Sample ID	BH103 10.5 10.5	BH103 7.4 7.4	BH104 1.0 1.0	BH104 7.7 7.7	BH105 0.9 0.9
			Date Sampled	26/09/2018	26/09/2018	26/09/2018	26/09/2018	27/09/2018
Analyte	Unit	*Reporting Limit*		18-30938-10	18-30938-11	18-30938-12	18-30938-14	18-30938-15
Moisture Content	%	*1*		39	26	27	52	14

Moisture Content

			Client Sample ID	BH105 6.0 6.0
			Date Sampled	27/09/2018
Analyte	Unit	*Reporting Limit*		18-30938-17
Moisture Content	%	*1*		10

Method Summary

Cyanide	Water extraction followed by acid distillation, distillate measured by colourmetric analysis. APHA Method 4500-CN C and E.
Elements in Soil	Acid digestion followed by ICP-MS analysis. US EPA method 200.8.
SVOC in Soil	Solvent extraction, followed by GC-MS analysis.
Moisture	Moisture content is determined gravimetrically by drying at 103 °C.

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Technologist

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Certificate of Analysis

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Lab Reference: 18-31313
Submitted by: Katie Stephenson
Date Received: 2/10/2018
Date Completed: 17/10/2018
Order Number: 1003207
Reference:

Sampling Site: Kyle Park

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

Heavy Metals in Soil

		Client Sample ID	BH106 2.3 2.3	BH106 7.5 7.5	BH107 0.3 0.3	BH107 4.3 4.3	BH109 5.2 5.2
		Date Sampled	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018
Analyte	Unit	*Reporting Limit*	18-31313-1	18-31313-2	18-31313-4	18-31313-5	18-31313-8
Arsenic	mg/kg dry wt	*0.125*	10.4	36.0	5.99	4.98	15.1
Cadmium	mg/kg dry wt	*0.005*	0.20	0.32	0.13	0.51	0.50
Chromium	mg/kg dry wt	*0.125*	31.7	24.4	15.1	18.6	30.3
Copper	mg/kg dry wt	*0.075*	61.5	29.4	14.2	13.6	36.4
Lead	mg/kg dry wt	*0.05*	137	65.4	33.5	21.0	111
Mercury	mg/kg dry wt	*0.025*	0.077	0.35	0.064	0.20	0.12
Nickel	mg/kg dry wt	*0.05*	22.4	23.4	12.6	16.6	33.8
Zinc	mg/kg dry wt	*0.05*	109	143	74.1	371	149

Heavy Metals in Soil

		Client Sample ID	BH109 8.5 8.5
		Date Sampled	28/09/2018
Analyte	Unit	*Reporting Limit*	18-31313-9
Arsenic	mg/kg dry wt	*0.125*	4.04
Cadmium	mg/kg dry wt	*0.005*	0.033
Chromium	mg/kg dry wt	*0.125*	11.0
Copper	mg/kg dry wt	*0.075*	6.33
Lead	mg/kg dry wt	*0.05*	15.1
Mercury	mg/kg dry wt	*0.025*	0.052
Nickel	mg/kg dry wt	*0.05*	9.55
Zinc	mg/kg dry wt	*0.05*	45.3

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.

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH106 2.3 2.3	BH106 7.5 7.5	BH107 0.3 0.3	BH107 4.3 4.3	BH109 5.2 5.2
			Date Sampled	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018
Analyte	Unit	*Reporting Limit*		18-31313-1	18-31313-2	18-31313-4	18-31313-5	18-31313-8
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*		8.5	0.3	0.2	0.2	2.5
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*		8.5	<0.1	<0.1	<0.1	2.4
Phenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	14.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*		<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	10.9	<0.3
4-Nitrophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	0.4	0.1
2-Methylnaphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*		0.4	<0.1	<0.1	<0.1	0.1
Acenaphthylene	mg/kg dry wt	*0.1*		0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg dry wt	*0.1*		0.9	<0.1	<0.1	<0.1	0.2
Phenanthrene	mg/kg dry wt	*0.1*		5.6	0.1	<0.1	<0.1	0.7
Anthracene	mg/kg dry wt	*0.1*		1.4	<0.1	<0.1	<0.1	0.1
Fluoranthene	mg/kg dry wt	*0.1*		11.7	0.4	0.2	0.3	2.5
Benzo[a]anthracene	mg/kg dry wt	*0.1*		4.5	0.2	<0.1	<0.1	1.0
Chrysene	mg/kg dry wt	*0.1*		3.0	<0.1	0.1	0.1	0.5
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*		6.2	0.2	<0.1	<0.1	1.9
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*		1.9	<0.1	<0.1	<0.1	0.4
Benzo[a]pyrene	mg/kg dry wt	*0.1*		6.5	<0.1	<0.1	<0.1	2.0
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*		2.1	<0.1	<0.1	<0.1	<0.1
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*		0.5	<0.1	<0.1	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*		1.6	<0.1	<0.1	<0.1	0.5
Pyrene	mg/kg dry wt	*0.2*		8.5	0.3	<0.2	<0.2	2.1
4,4'-DDD	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	0.9	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH106 2.3 2.3	BH106 7.5 7.5	BH107 0.3 0.3	BH107 4.3 4.3	BH109 5.2 5.2
			Date Sampled	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018
Endrin ketone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	1.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		0.4	<0.3	<0.3	<0.3	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		109.7	122.7	116.1	108.1	126.6
2-Fluorophenol (Surrogate)	%	*1*		108.8	127.6	124.9	94.4	150.6
2-Fluorobiphenyl (Surrogate)	%	*1*		115.1	138.5	134.6	124.4	106.5
2,4,6-Tribromophenol (Surrogate)	%	*1*		145.2	90.0	92.6	120.4	98.8
p-Terphenyl-d14 (Surrogate)	%	*1*		109.9	136.7	116.1	112.3	104.6
Nitrobenzene-d5 (Surrogate)	%	*1*		108.1	88.2	104.0	82.5	86.9

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH109 8.5 8.5
			Date Sampled	28/09/2018
Analyte		Unit	*Reporting Limit*	18-31313-9
Benzo[a]pyrene TEQ (LOR)		mg/kg dry wt	*0.1*	0.2
Benzo[a]pyrene TEQ (Zero)		mg/kg dry wt	*0.1*	<0.1
Phenol		mg/kg dry wt	*0.3*	<0.3
2-Chlorophenol		mg/kg dry wt	*0.3*	<0.3
2-Methylphenol		mg/kg dry wt	*0.3*	<0.3
2-Nitrophenol		mg/kg dry wt	*1.0*	<1.0
2,4-Dimethylphenol		mg/kg dry wt	*0.3*	<0.3
2,4-Dichlorophenol		mg/kg dry wt	*0.3*	<0.3
2,6-Dichlorophenol		mg/kg dry wt	*0.3*	<0.3
4-Chloro-3-methylphenol		mg/kg dry wt	*0.3*	<0.3
2,4,5-Trichlorophenol		mg/kg dry wt	*5*	<5
2,4,6-Trichlorophenol		mg/kg dry wt	*5*	<5.0
2,3,4,6-Tetrachlorophenol		mg/kg dry wt	*5*	<5
4-Methylphenol		mg/kg dry wt	*0.3*	<0.3
4-Nitrophenol		mg/kg dry wt	*5*	<5
Naphthalene		mg/kg dry wt	*0.1*	<0.1
2-Methylnaphthalene		mg/kg dry wt	*0.1*	<0.1
2-Chloronaphthalene		mg/kg dry wt	*0.3*	<0.3
Acenaphthene		mg/kg dry wt	*0.1*	<0.1
Acenaphthylene		mg/kg dry wt	*0.1*	<0.1
Fluorene		mg/kg dry wt	*0.1*	<0.1
Phenanthrene		mg/kg dry wt	*0.1*	<0.1
Anthracene		mg/kg dry wt	*0.1*	<0.1
Fluoranthene		mg/kg dry wt	*0.1*	0.1
Benzo[a]anthracene		mg/kg dry wt	*0.1*	<0.1
Chrysene		mg/kg dry wt	*0.1*	<0.1
Benzo[b]fluoranthene		mg/kg dry wt	*0.1*	<0.1
Benzo[k]fluoranthene		mg/kg dry wt	*0.1*	<0.1
Benzo[a]pyrene		mg/kg dry wt	*0.1*	<0.1
Indeno(1,2,3-c,d)pyrene		mg/kg dry wt	*0.1*	<0.1
Dibenzo[a,h]anthracene		mg/kg dry wt	*0.1*	<0.1
Benzo[g,h,i]perylene		mg/kg dry wt	*0.1*	<0.1
Pyrene		mg/kg dry wt	*0.2*	<0.2
4,4'-DDD		mg/kg dry wt	*0.3*	<0.3
4,4'-DDE		mg/kg dry wt	*0.3*	<0.3
4,4'-DDT		mg/kg dry wt	*0.5*	<0.5
alpha-BHC		mg/kg dry wt	*0.3*	<0.3
beta-BHC		mg/kg dry wt	*0.3*	<0.3
gamma-BHC		mg/kg dry wt	*0.3*	<0.3
delta-BHC		mg/kg dry wt	*0.3*	<0.3
Aldrin		mg/kg dry wt	*0.3*	<0.3
cis-Chlordane		mg/kg dry wt	*0.3*	<0.3
trans-Chlordane		mg/kg dry wt	*0.3*	<0.3
Dieldrin		mg/kg dry wt	*0.5*	<0.5
Endosulfan I		mg/kg dry wt	*0.3*	<0.3
Endosulfan II		mg/kg dry wt	*0.5*	<0.5
Endosulfan sulphate		mg/kg dry wt	*0.5*	<0.5
Endrin		mg/kg dry wt	*0.5*	<0.5
Endrin aldehyde		mg/kg dry wt	*0.5*	<0.5

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH109 8.5 8.5
			Date Sampled	28/09/2018
Endrin ketone	mg/kg dry wt	*0.5*	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*	<0.3
Heptachlor	mg/kg dry wt	*0.3*	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*	<0.3
Methoxychlor	mg/kg dry wt	*0.5*	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*	<0.3
Azobenzene	mg/kg dry wt	*0.5*	<0.5
Isophorone	mg/kg dry wt	*0.5*	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*	<0.5
Aniline	mg/kg dry wt	*1.0*	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*	<1
Benzyl alcohol	mg/kg dry wt	*1*	<1
Phenol-d5 (Surrogate)	%	*1*	109.2
2-Fluorophenol (Surrogate)	%	*1*	114.7
2-Fluorobiphenyl (Surrogate)	%	*1*	121.6
2,4,6-Tribromophenol (Surrogate)	%	*1*	76.0
p-Terphenyl-d14 (Surrogate)	%	*1*	123.0
Nitrobenzene-d5 (Surrogate)	%	*1*	96.7

Moisture Content

	Client Sample ID		BH106 2.3 2.3	BH106 7.5 7.5	BH107 0.3 0.3	BH107 4.3 4.3	BH109 5.2 5.2
	Date Sampled		28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018
Analyte	Unit	*Reporting Limit*	18-31313-1	18-31313-2	18-31313-4	18-31313-5	18-31313-8
Moisture Content	%	*1*	14	30	18	32	13

Moisture Content

	Client Sample ID		BH109 8.5 8.5
	Date Sampled		28/09/2018
Analyte	Unit	*Reporting Limit*	18-31313-9
Moisture Content	%	*1*	17

Method Summary

Elements in Soil	Acid digestion followed by ICP-MS analysis. (US EPA method 200.8).
SVOC in Soil	Solvent extraction, followed by GC-MS analysis.(In-house based on US EPA 8270).
Moisture	Moisture content is determined gravimetrically by drying at 103 °C.

Sharelle Frank, B.Sc. (Tech)
Technologist

Tom Featonby, M.Sc.
Technologist

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Certificate of Analysis

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Lab Reference: 18-32437
Submitted by: Katie Stephenson
Date Received: 13/10/2018
Date Completed: 19/10/2018
Order Number: 1003207
Reference: Kyle Park

Sampling Site: Kyle Park

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

Heavy Metals in Soil

			Client Sample ID	BH108 0.85	BH108 5.6	BH108 7.8	BH110 0.4	BH110 2.5
			Date Sampled	2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018
Analyte	Unit	*Reporting Limit*		18-32437-1	18-32437-2	18-32437-3	18-32437-5	18-32437-6
Arsenic	mg/kg dry wt	*0.125*		8.58	4.15	3.76	4.86	11.9
Cadmium	mg/kg dry wt	*0.005*		0.82	0.17	0.049	0.10	0.069
Chromium	mg/kg dry wt	*0.125*		17.3	21.2	11.1	16.5	11.7
Copper	mg/kg dry wt	*0.075*		54.9	22.3	9.70	7.96	6.14
Lead	mg/kg dry wt	*0.05*		259	44.7	11.9	18.1	19.9
Mercury	mg/kg dry wt	*0.025*		0.077	0.11	0.75	0.059	<0.025
Nickel	mg/kg dry wt	*0.05*		14.5	31.2	10.7	13.2	7.10
Zinc	mg/kg dry wt	*0.05*		169	76.1	57.5	61.0	30.6

Heavy Metals in Soil

			Client Sample ID	BH111 1.0	BH111 3.5	BH112 1.0	BH112 9.2	BH113 0.2
			Date Sampled	8/10/2018	8/10/2018	5/10/2018	5/10/2018	2/10/2018
Analyte	Unit	*Reporting Limit*		18-32437-11	18-32437-12	18-32437-14	18-32437-15	18-32437-18
Arsenic	mg/kg dry wt	*0.125*		5.12	73.9	6.83	4.73	6.05
Cadmium	mg/kg dry wt	*0.005*		0.13	0.23	0.11	0.046	0.082
Chromium	mg/kg dry wt	*0.125*		4.29	27.9	15.6	15.7	17.5
Copper	mg/kg dry wt	*0.075*		11.3	79.8	13.9	9.18	10.6
Lead	mg/kg dry wt	*0.05*		27.5	71.7	31.8	18.5	28.9
Mercury	mg/kg dry wt	*0.025*		0.041	0.20	0.099	0.092	0.066
Nickel	mg/kg dry wt	*0.05*		4.90	45.4	12.1	13.1	14.4
Zinc	mg/kg dry wt	*0.05*		175	420	76.3	54.7	73.5

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.

Heavy Metals in Soil

Client Sample ID			BH113 2.5	BH114 0.2	BH114 4.1	BH115 1.6	BH115 6.2
Date Sampled			2/10/2018	3/10/2018	3/10/2018	8/10/2018	8/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-19	18-32437-21	18-32437-22	18-32437-25	18-32437-26
Arsenic	mg/kg dry wt	*0.125*	6.82	5.61	13.7	5.97	2.36
Cadmium	mg/kg dry wt	*0.005*	0.13	0.15	0.29	0.094	0.034
Chromium	mg/kg dry wt	*0.125*	16.5	16.1	28.3	17.9	12.6
Copper	mg/kg dry wt	*0.075*	14.0	24.2	159	9.84	5.72
Lead	mg/kg dry wt	*0.05*	45.6	48.6	56.4	28.8	11.3
Mercury	mg/kg dry wt	*0.025*	0.061	0.065	0.19	0.045	0.055
Nickel	mg/kg dry wt	*0.05*	12.3	14.3	41.9	13.3	9.58
Zinc	mg/kg dry wt	*0.05*	82.2	105	105	71.1	37.4

Heavy Metals in Soil

Client Sample ID			BH116 0.7	BH116 5.6	BH117 0.5	BH117 2.4	BH118 0.75
Date Sampled			8/10/2018	8/10/2018	9/10/2018	9/10/2018	9/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-27	18-32437-28	18-32437-30	18-32437-31	18-32437-34
Arsenic	mg/kg dry wt	*0.125*	5.00	27.8	4.08	25.0	5.06
Cadmium	mg/kg dry wt	*0.005*	0.12	0.26	0.057	375	0.28
Chromium	mg/kg dry wt	*0.125*	14.1	20.5	13.7	40.7	14.2
Copper	mg/kg dry wt	*0.075*	26.1	51.4	7.95	129	15.9
Lead	mg/kg dry wt	*0.05*	48.3	33.6	38.1	3,890	71.3
Mercury	mg/kg dry wt	*0.025*	0.063	0.068	0.046	5.2	0.10
Nickel	mg/kg dry wt	*0.05*	11.4	39.3	11.3	63.1	11.2
Zinc	mg/kg dry wt	*0.05*	78.5	64.2	51.5	229	68.0

Heavy Metals in Soil

Client Sample ID			BH118 6.3	BH119 1.0	BH119 6.3	BH120 0.8	BH120 3.8
Date Sampled			9/10/2018	10/10/2018	10/10/2018	9/10/2018	9/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-35	18-32437-37	18-32437-38	18-32437-39	18-32437-40
Arsenic	mg/kg dry wt	*0.125*	14.9	61.9	39.9	8.45	44.2
Cadmium	mg/kg dry wt	*0.005*	26.6	0.14	0.14	0.20	0.41
Chromium	mg/kg dry wt	*0.125*	117	15.4	16.5	12.5	18.8
Copper	mg/kg dry wt	*0.075*	24.8	15.4	15.3	20.7	16.4
Lead	mg/kg dry wt	*0.05*	160	33.1	151	126	87.8
Mercury	mg/kg dry wt	*0.025*	0.43	0.077	0.13	0.097	0.32
Nickel	mg/kg dry wt	*0.05*	34.3	11.2	11.1	10.2	10.5
Zinc	mg/kg dry wt	*0.05*	315	74.1	163	84.7	117

Heavy Metals in Soil

Client Sample ID			DUP 1	DUP 2	DUP 3	DUP 4
Date Sampled						
Analyte	Unit	*Reporting Limit*	18-32437-42	18-32437-43	18-32437-44	18-32437-45
Arsenic	mg/kg dry wt	*0.125*	6.57	4.62	5.70	31.4
Cadmium	mg/kg dry wt	*0.005*	0.14	0.047	0.072	0.14
Chromium	mg/kg dry wt	*0.125*	14.7	16.9	20.2	16.8
Copper	mg/kg dry wt	*0.075*	13.6	9.64	8.16	20.9
Lead	mg/kg dry wt	*0.05*	42.9	26.1	24.5	191
Mercury	mg/kg dry wt	*0.025*	0.055	0.092	0.045	0.28

Heavy Metals in Soil

Client Sample ID			DUP 1	DUP 2	DUP 3	DUP 4
Date Sampled						
Nickel	mg/kg dry wt	*0.05*	11.9	12.4	13.6	11.5
Zinc	mg/kg dry wt	*0.05*	81.4	55.2	60.3	149

Total Petroleum Hydrocarbons - Soil

Client Sample ID			BH112 9.2	BH114 15.0
Date Sampled			5/10/2018	3/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-15	18-32437-24
C7-C9	mg/kg dry wt	*10*	<10	<10
C10-C14	mg/kg dry wt	*15*	2,052	<15
C15-C36	mg/kg dry wt	*25*	6,350	<25
C7-C36 (Total)	mg/kg dry wt	*50*	8,402	<50

Semivolatile Organic Compounds - Soil

Client Sample ID			BH108 0.85	BH108 5.6	BH108 7.8	BH110 0.4	BH110 2.5
Date Sampled			2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-1	18-32437-2	18-32437-3	18-32437-5	18-32437-6
Phenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*	<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*	<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*	<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*	<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*	<0.1	0.4	<0.1	<0.1	<0.1
2-Methylnaphthalene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg dry wt	*0.1*	0.3	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg dry wt	*0.1*	0.4	0.1	<0.1	<0.1	<0.1
Benzo[a]anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg dry wt	*0.1*	0.3	<0.1	<0.1	<0.1	<0.1
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*	0.5	<0.1	<0.1	<0.1	<0.1
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[a]pyrene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*	0.2	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg dry wt	*0.2*	0.5	<0.2	<0.2	<0.2	<0.2

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH108 0.85	BH108 5.6	BH108 7.8	BH110 0.4	BH110 2.5
			Date Sampled	2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*		0.3	0.2	0.2	0.2	0.2
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*		0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDD	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH108 0.85	BH108 5.6	BH108 7.8	BH110 0.4	BH110 2.5
			Date Sampled	2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		104.0	107.3	91.5	95.6	57.5
2-Fluorophenol (Surrogate)	%	*1*		109.2	110.5	108.0	115.7	67.4
2-Fluorobiphenyl (Surrogate)	%	*1*		135.3	110.1	119.0	128.5	158.7
2,4,6-Tribromophenol (Surrogate)	%	*1*		112.1	154.5	103.8	103.5	107.1
p-Terphenyl-d14 (Surrogate)	%	*1*		141.2	131.2	128.9	91.9	186.2
Nitrobenzene-d5 (Surrogate)	%	*1*		146.4	120.3	136.1	143.9	154.5

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH111 1.0	BH111 3.5	BH112 1.0	BH112 9.2	BH113 0.2
			Date Sampled	8/10/2018	8/10/2018	5/10/2018	5/10/2018	2/10/2018
Analyte	Unit	*Reporting Limit*		18-32437-11	18-32437-12	18-32437-14	18-32437-15	18-32437-18
Phenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*		<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
2-Methylnaphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	17.5	<0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	1.0	<0.1
Acenaphthylene	mg/kg dry wt	*0.1*		0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg dry wt	*0.1*		2.9	0.3	<0.1	3.3	0.1
Anthracene	mg/kg dry wt	*0.1*		0.6	0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg dry wt	*0.1*		3.6	0.6	<0.1	<0.1	0.3
Benzo[a]anthracene	mg/kg dry wt	*0.1*		2.0	0.6	<0.1	<0.1	0.5
Chrysene	mg/kg dry wt	*0.1*		0.8	0.3	<0.1	<0.1	0.2
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*		1.4	0.6	<0.1	<0.1	0.5
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*		0.4	0.2	<0.1	<0.1	0.2
Benzo[a]pyrene	mg/kg dry wt	*0.1*		1.4	0.8	<0.1	<0.1	0.4

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH111 1.0	BH111 3.5	BH112 1.0	BH112 9.2	BH113 0.2
			Date Sampled	8/10/2018	8/10/2018	5/10/2018	5/10/2018	2/10/2018
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*		0.3	0.2	<0.1	<0.1	0.2
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*		0.3	0.2	<0.1	<0.1	0.2
Pyrene	mg/kg dry wt	*0.2*		4.1	0.9	<0.2	<0.2	0.5
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*		1.9	1.0	0.2	0.2	0.6
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*		1.8	0.9	<0.1	<0.1	0.5
4,4'-DDD	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH111 1.0	BH111 3.5	BH112 1.0	BH112 9.2	BH113 0.2
			Date Sampled	8/10/2018	8/10/2018	5/10/2018	5/10/2018	2/10/2018
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		104.1	95.4	102.1	91.2	96.5
2-Fluorophenol (Surrogate)	%	*1*		117.5	121.0	128.3	88.4	106.4
2-Fluorobiphenyl (Surrogate)	%	*1*		118.2	124.0	119.7	74.2	127.1
2,4,6-Tribromophenol (Surrogate)	%	*1*		118.2	107.7	98.3	90.5	112.4
p-Terphenyl-d14 (Surrogate)	%	*1*		193.0	186.9	119.6	109.8	178.9
Nitrobenzene-d5 (Surrogate)	%	*1*		138.9	144.4	141.7	97.5	145.6

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH113 2.5	BH114 0.2	BH114 4.1	BH115 1.6	BH115 6.2
			Date Sampled	2/10/2018	3/10/2018	3/10/2018	8/10/2018	8/10/2018
Analyte	Unit	*Reporting Limit*		18-32437-19	18-32437-21	18-32437-22	18-32437-25	18-32437-26
Phenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*		<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
2-Methylnaphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg dry wt	*0.1*		0.3	0.1	<0.1	0.3	<0.1
Anthracene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg dry wt	*0.1*		0.4	0.2	<0.1	0.6	<0.1

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH113 2.5	BH114 0.2	BH114 4.1	BH115 1.6	BH115 6.2
			Date Sampled	2/10/2018	3/10/2018	3/10/2018	8/10/2018	8/10/2018
Benzo[a]anthracene	mg/kg dry wt	*0.1*		0.5	0.2	<0.1	0.6	<0.1
Chrysene	mg/kg dry wt	*0.1*		0.2	0.2	<0.1	0.3	<0.1
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*		0.4	0.4	<0.1	0.4	<0.1
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*		0.2	0.1	<0.1	0.2	<0.1
Benzo[a]pyrene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	0.4	<0.1
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*		0.1	<0.1	<0.1	0.2	<0.1
Pyrene	mg/kg dry wt	*0.2*		0.5	0.3	<0.2	0.9	<0.2
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*		0.3	0.3	0.2	0.7	0.2
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*		0.1	0.1	<0.1	0.6	<0.1
4,4'-DDD	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH113 2.5	BH114 0.2	BH114 4.1	BH115 1.6	BH115 6.2
			Date Sampled	2/10/2018	3/10/2018	3/10/2018	8/10/2018	8/10/2018
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopenta diene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		104.9	89.7	98.0	100.0	101.1
2-Fluorophenol (Surrogate)	%	*1*		120.1	109.3	101.4	108.9	116.4
2-Fluorobiphenyl (Surrogate)	%	*1*		120.1	129.3	99.1	118.4	117.1
2,4,6-Tribromophenol (Surrogate)	%	*1*		104.2	95.9	100.1	101.9	94.2
p-Terphenyl-d14 (Surrogate)	%	*1*		175.0	115.9	138.8	191.1	110.8
Nitrobenzene-d5 (Surrogate)	%	*1*		135.2	149.9	126.0	137.4	139.7

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH116 0.7	BH116 5.6	BH117 0.5	BH117 2.4	BH118 0.75
			Date Sampled	8/10/2018	8/10/2018	9/10/2018	9/10/2018	9/10/2018
Analyte	Unit	*Reporting Limit*		18-32437-27	18-32437-28	18-32437-30	18-32437-31	18-32437-34
Phenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*		<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
Naphthalene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	0.1
2-Methylnaphthalene	mg/kg dry wt	*0.1*		<0.1	0.2	<0.1	<0.1	0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	0.3
Acenaphthylene	mg/kg dry wt	*0.1*		<0.1	<0.1	<0.1	<0.1	<0.1

Semivolatile Organic Compounds - Soil

Client Sample ID			BH116 0.7	BH116 5.6	BH117 0.5	BH117 2.4	BH118 0.75
Date Sampled			8/10/2018	8/10/2018	9/10/2018	9/10/2018	9/10/2018
Fluorene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	0.2	0.3
Phenanthrene	mg/kg dry wt	*0.1*	0.7	0.4	<0.1	0.6	5.3
Anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	0.9
Fluoranthene	mg/kg dry wt	*0.1*	1.3	0.9	<0.1	1.7	6.9
Benzo[a]anthracene	mg/kg dry wt	*0.1*	1.1	0.7	<0.1	1.2	3.7
Chrysene	mg/kg dry wt	*0.1*	0.7	0.4	<0.1	0.6	1.2
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*	0.9	0.9	<0.1	1.3	2.3
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*	0.3	0.4	0.1	0.4	0.7
Benzo[a]pyrene	mg/kg dry wt	*0.1*	0.9	0.9	<0.1	1.2	2.4
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	0.3	0.6
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*	0.2	0.2	<0.1	0.3	0.5
Pyrene	mg/kg dry wt	*0.2*	1.7	1.1	<0.2	1.8	7.6
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*	1.3	1.2	0.2	1.7	3.3
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*	1.2	1.1	<0.1	1.6	3.2
4,4'-DDD	mg/kg dry wt	*0.3*	<0.3	1.5	<0.3	0.5	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*	<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*	<0.3	0.5	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Azobenzene	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH116 0.7	BH116 5.6	BH117 0.5	BH117 2.4	BH118 0.75
			Date Sampled	8/10/2018	8/10/2018	9/10/2018	9/10/2018	9/10/2018
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		97.5	90.2	111.0	87.9	95.2
2-Fluorophenol (Surrogate)	%	*1*		106.1	88.1	154.7	100.4	121.4
2-Fluorobiphenyl (Surrogate)	%	*1*		121.5	89.4	124.5	111.3	106.5
2,4,6-Tribromophenol (Surrogate)	%	*1*		105.0	141.3	104.8	119.9	102.8
p-Terphenyl-d14 (Surrogate)	%	*1*		160.2	134.1	104.4	135.9	212.3
Nitrobenzene-d5 (Surrogate)	%	*1*		148.2	135.7	132.3	108.1	130.1

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH118 6.3	BH119 1.0	BH119 6.3	BH120 0.8	BH120 3.8
			Date Sampled	9/10/2018	10/10/2018	10/10/2018	9/10/2018	9/10/2018
Analyte	Unit	*Reporting Limit*		18-32437-35	18-32437-37	18-32437-38	18-32437-39	18-32437-40
Phenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Chlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2-Nitrophenol	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dichlorophenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloro-3-methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
2,4,5-Trichlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
2,4,6-Trichlorophenol	mg/kg dry wt	*5*		<5.0	<5.0	<5.0	<5.0	<5.0
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5
4-Methylphenol	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Nitrophenol	mg/kg dry wt	*5*		<5	<5	<5	<5	<5

Semivolatile Organic Compounds - Soil

Client Sample ID			BH118 6.3	BH119 1.0	BH119 6.3	BH120 0.8	BH120 3.8
Date Sampled			9/10/2018	10/10/2018	10/10/2018	9/10/2018	9/10/2018
Naphthalene	mg/kg dry wt	*0.1*	<0.1	<0.1	8.2	3.9	0.3
2-Methylnaphthalene	mg/kg dry wt	*0.1*	0.1	<0.1	7.2	2.6	<0.1
2-Chloronaphthalene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Acenaphthene	mg/kg dry wt	*0.1*	0.2	<0.1	2.4	1.3	0.1
Acenaphthylene	mg/kg dry wt	*0.1*	<0.1	<0.1	2.1	6.4	<0.1
Fluorene	mg/kg dry wt	*0.1*	0.3	<0.1	15.5	7.9	0.3
Phenanthrene	mg/kg dry wt	*0.1*	0.7	<0.1	101.7	169.1	1.3
Anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	10.2	111.4	0.4
Fluoranthene	mg/kg dry wt	*0.1*	1.1	0.1	77.2	266.5	2.0
Benzo[a]anthracene	mg/kg dry wt	*0.1*	0.5	0.2	15.3	137.5	1.1
Chrysene	mg/kg dry wt	*0.1*	0.3	<0.1	12.4	86.3	0.5
Benzo[b]fluoranthene	mg/kg dry wt	*0.1*	0.5	<0.1	14.2	93.6	1.0
Benzo[k]fluoranthene	mg/kg dry wt	*0.1*	0.2	<0.1	7.2	41.0	0.4
Benzo[a]pyrene	mg/kg dry wt	*0.1*	0.5	<0.1	14.9	90.3	1.0
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	*0.1*	0.1	<0.1	4.6	12.4	0.2
Dibenzo[a,h]anthracene	mg/kg dry wt	*0.1*	<0.1	<0.1	0.9	4.8	<0.1
Benzo[g,h,i]perylene	mg/kg dry wt	*0.1*	<0.1	<0.1	2.9	8.9	<0.1
Pyrene	mg/kg dry wt	*0.2*	1.2	0.2	83.5	183.4	2.1
Benzo[a]pyrene TEQ (LOR)	mg/kg dry wt	*0.1*	0.8	0.3	20.9	127.0	1.4
Benzo[a]pyrene TEQ (Zero)	mg/kg dry wt	*0.1*	0.7	<0.1	20.9	127.0	1.3
4,4'-DDD	mg/kg dry wt	*0.3*	8.3	<0.3	<0.3	<0.3	<0.3
4,4'-DDE	mg/kg dry wt	*0.3*	0.5	<0.3	<0.3	<0.3	<0.3
4,4'-DDT	mg/kg dry wt	*0.5*	0.6	<0.5	<0.5	<0.5	<0.5
alpha-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
beta-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
gamma-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
delta-BHC	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Aldrin	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
cis-Chlordane	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
trans-Chlordane	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Dieldrin	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan I	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Endosulfan II	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulphate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin ketone	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Heptachlor epoxide	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Methoxychlor	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl) phthalate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Butyl benzyl phthalate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/kg dry wt	*1*	<1	<1	<1	<1	<1
Di-n-octyl phthalate	mg/kg dry wt	*0.5*	<0.5	<0.5	<0.5	<0.5	<0.5
Diethyl phthalate	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
Dimethyl phthalate	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
N-Nitrosodiphenylamine	mg/kg dry wt	*0.3*	0.7	<0.3	<0.3	<0.3	<0.3
N-Nitrosodi-n-propylamine	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,4-Dinitrotoluene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3
2,6-Dinitrotoluene	mg/kg dry wt	*0.3*	<0.3	<0.3	<0.3	<0.3	<0.3

Semivolatile Organic Compounds - Soil

			Client Sample ID	BH118 6.3	BH119 1.0	BH119 6.3	BH120 0.8	BH120 3.8
			Date Sampled	9/10/2018	10/10/2018	10/10/2018	9/10/2018	9/10/2018
Azobenzene	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Bromophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chlorophenyl phenyl ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloro-1-methylethyl) ether	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Bis(2-Chloroethoxy) methane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobutadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorocylopentadiene	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
Hexachloroethane	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
4-Chloroaniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	mg/kg dry wt	*0.3*		<0.3	<0.3	<0.3	<0.3	<0.3
3-Nitroaniline	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Aniline	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
3,3'-Dichlorobenzidine	mg/kg dry wt	*0.5*		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran	mg/kg dry wt	*0.3*		<0.3	<0.3	11.2	4.6	<0.3
Methyl methanesulfonate	mg/kg dry wt	*1.0*		<1.0	<1.0	<1.0	<1.0	<1.0
Ethyl methanesulfonate	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Benzyl alcohol	mg/kg dry wt	*1*		<1	<1	<1	<1	<1
Phenol-d5 (Surrogate)	%	*1*		86.4	90.7	82.9	120.0	124.8
2-Fluorophenol (Surrogate)	%	*1*		100.1	99.5	107.5	155.8	142.0
2-Fluorobiphenyl (Surrogate)	%	*1*		123.1	113.4	82.5	72.9	98.8
2,4,6-Tribromophenol (Surrogate)	%	*1*		116.2	99.0	136.2	136.5	117.2
p-Terphenyl-d14 (Surrogate)	%	*1*		173.7	242.4	117.9	122.3	115.9
Nitrobenzene-d5 (Surrogate)	%	*1*		135.4	133.1	112.8	107.5	94.1

Moisture Content

		Client Sample ID	BH108 0.85	BH108 5.6	BH108 7.8	BH110 0.4	BH110 2.5
		Date Sampled	2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-1	18-32437-2	18-32437-3	18-32437-5	18-32437-6
Moisture Content	%	*1*	20	13	14	11	68

Moisture Content

	Client Sample ID		BH111 1.0	BH111 3.5	BH112 1.0	BH112 9.2	BH113 0.2
	Date Sampled		8/10/2018	8/10/2018	5/10/2018	5/10/2018	2/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-11	18-32437-12	18-32437-14	18-32437-15	18-32437-18
Moisture Content	%	*1*	13	21	16	9	14

Moisture Content

	Client Sample ID		BH113 2.5	BH114 0.2	BH114 4.1	BH114 15.0	BH115 1.6
	Date Sampled		2/10/2018	3/10/2018	3/10/2018	3/10/2018	8/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-19	18-32437-21	18-32437-22	18-32437-24	18-32437-25
Moisture Content	%	*1*	16	11	10	12	17

Moisture Content

	Client Sample ID		BH115 6.2	BH116 0.7	BH116 5.6	BH117 0.5	BH117 2.4
	Date Sampled		8/10/2018	8/10/2018	8/10/2018	9/10/2018	9/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-26	18-32437-27	18-32437-28	18-32437-30	18-32437-31
Moisture Content	%	*1*	5	5	59	14	23

Moisture Content

	Client Sample ID		BH118 0.75	BH118 6.3	BH119 1.0	BH119 6.3	BH120 0.8
	Date Sampled		9/10/2018	9/10/2018	10/10/2018	10/10/2018	9/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-34	18-32437-35	18-32437-37	18-32437-38	18-32437-39
Moisture Content	%	*1*	13	41	21	17	13

Moisture Content

	Client Sample ID		BH120 3.8
	Date Sampled		9/10/2018
Analyte	Unit	*Reporting Limit*	18-32437-40
Moisture Content	%	*1*	16

Method Summary

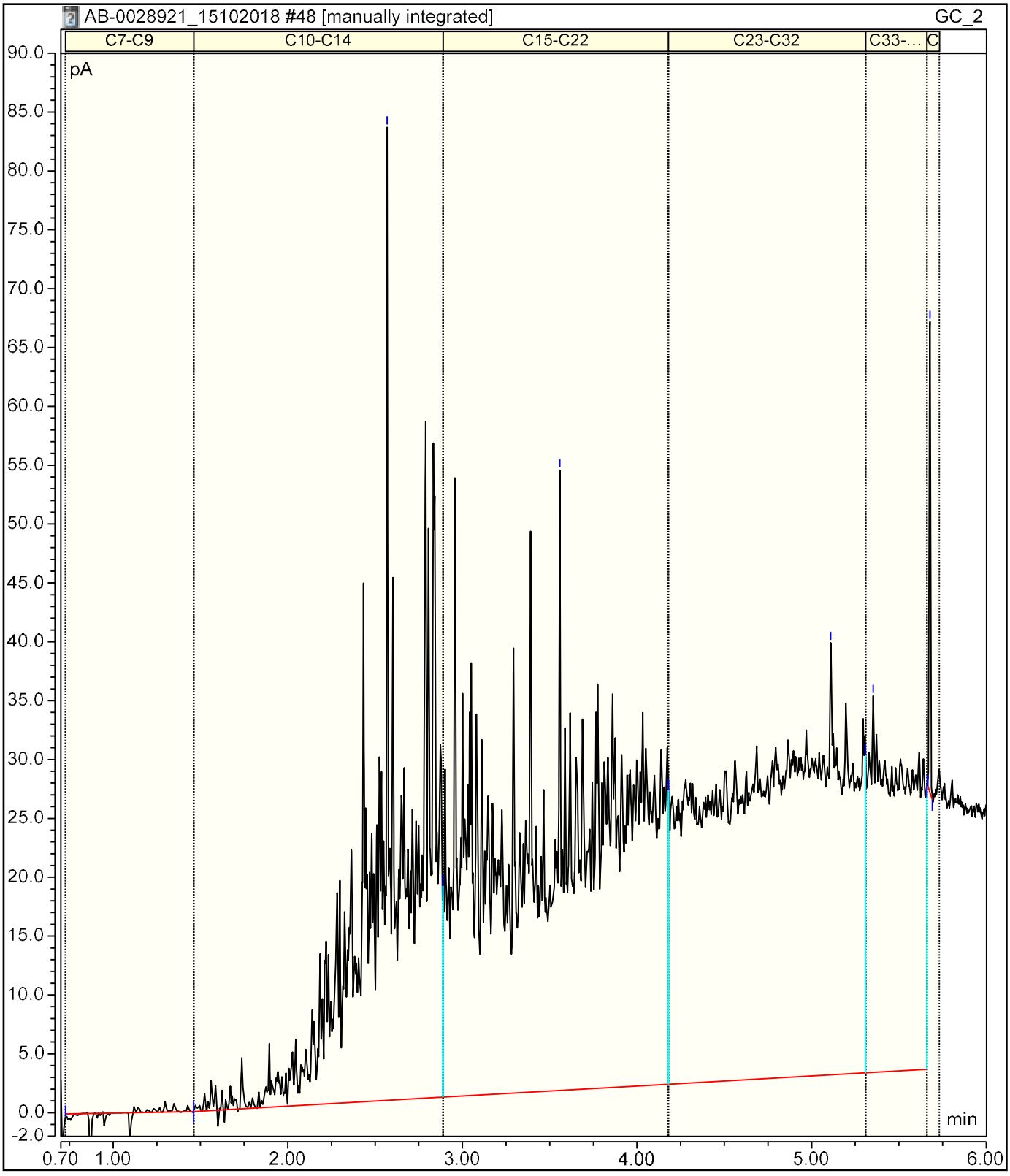
Elements in Soil	Acid digestion followed by ICP-MS analysis. (US EPA method 200.8).
TPH in Soil	Solvent extraction, silica cleanup, followed by GC-FID analysis. (C7-C36)
SVOC in Soil	Solvent extraction, followed by GC-MS analysis.(In-house based on US EPA 8270).
Moisture	Moisture content is determined gravimetrically by drying at 103 °C.

Sharelle Frank, B.Sc. (Tech)
Technologist

Tom Featonby, M.Sc.
Technologist

Chromatogram

18-32437-15



Report Date: 03 Oct 2018

Certificate Number: S1809281149

Analytica Laboratories
Ruakura Research Centre, 10 Bisley Road, Private Bag 3123,

Client Reference: 1003207

Dear Rachael Casey,

Re: Asbestos Soil Identification Analysis – 1003207

10 sample(s) received on 28 Sep 2018 by Victoria Sheppard.

The results of fibre analysis were performed by Nick Wells of Precise Consulting and Laboratory Ltd on 03 Oct 2018.

The sample(s) were stated to be from 1003207.

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 Nick Wells.

Yours sincerely

Nick Wells
PRECISE LABORATORY IDENTIFIER

Sample Analysis Results

Certificate Number: S1809281149
Report Date: 03 Oct 2018
Site Location: 1003207

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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: Nick Wells

Reviewed by:

Key Technical Person: Nick Wells

Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S001	BH101 3.5	BH101 3.5 Non-Homogeneous Soil 720.63g	No Asbestos Detected Organic Fibres Synthetic Mineral Fibres
S002	BH101 7.35	BH101 7.35 Non-Homogeneous Soil 315.43g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Synthetic Mineral Fibres Crocidolite (blue asbestos) Fibres
S003	BH102 2.0	BH102 2.0 Non-Homogeneous Soil 538.80g	No Asbestos Detected Organic Fibres
S004	BH102 9.8	BH102 9.8 Non-Homogeneous Soil 297.26g	No Asbestos Detected Organic Fibres
S005	BH103 7.15	BH103 7.15 Non-Homogeneous Soil 669.61g	Chrysotile (white asbestos) Fibres Organic Fibres
S006	BH103 10.2	BH103 10.2 Non-Homogeneous Soil 380.24g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres

Precise Consulting & Laboratory Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023

P: 03 943 5394 W: www.preciseconsulting.co.nz

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Sample Analysis Results

Certificate Number: S1809281149
Report Date: 03 Oct 2018
Site Location: 1003207

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Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S007	BH104 1.1	BH104 1.1 Non-Homogeneous Soil 643.96g	Chrysotile (white asbestos) Fibres Organic Fibres
S008	BH104 5.5	BH104 5.5 Non-Homogeneous Soil 139.90g	No Asbestos Detected Organic Fibres
S009	BH105 2.2	BH105 2.2 Non-Homogeneous Soil 569.05g	No Asbestos Detected Organic Fibres
S010	BH105 5.1	BH105 5.1 Non-Homogeneous Soil 193.36g	Chrysotile (white asbestos) Fibres Organic Fibres

Precise Consulting & Laboratory Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023

P: 03 943 5394 W: www.preciseconsulting.co.nz

Appendix 1: Soil Analysis Raw Data

Certificate Number: S1809281149
Report Date: 03 Oct 2018
Site Location: 1003207

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Quantitative Results (non IANZ)																	
Sample ID	Client Sample ID	Total 500mL Sub-Sample (g)	ACM (>10mm)*				AF / FA (2-10mm) (100% ACM)*				AF / FA (<2mm) (100% ACM)*				<2mm Excess (g)	Trace Asbestos Detected **	W/W% Asbestos as ACM	W/W% Asbestos as AF / FA
			>10mm Weight (g)	>10mm ACM (g)	ACM Form	Form %***	2-10mm Weight (g)	2-10mm AF/FA (g)	ACM Form	Form %***	<2mm Weight (g)	<2mm AF/FA (g)	ACM Form	Form %***				
S001	BH101 3.5	720.63	210.65	No Asbestos Detected	N/A	N/A	284.87	No Asbestos Detected	N/A	N/A	100.54	No Asbestos Detected	N/A	N/A	124.57	No	<0.001	<0.001
S002	BH101 7.35	315.43	45.01	No Asbestos Detected	N/A	N/A	167.06	0.018	Insulation Board	70%	102.08	0.001	Free Fibres	100%	1.28	Yes	<0.001	0.0043
S003	BH102 2.0	538.80	174.57	No Asbestos Detected	N/A	N/A	178.04	No Asbestos Detected	N/A	N/A	101.13	No Asbestos Detected	N/A	N/A	85.06	No	<0.001	<0.001
S004	BH102 9.8	297.26	59.10	No Asbestos Detected	N/A	N/A	123.55	No Asbestos Detected	N/A	N/A	100.63	No Asbestos Detected	N/A	N/A	13.98	No	<0.001	<0.001
S005	BH103 7.15	669.61	178.59	No Asbestos Detected	N/A	N/A	206.98	0.020	Free Fibres	100%	100.56	0.003	Free Fibres	100%	183.48	Yes	<0.001	0.0043
S006	BH103 10.2	380.24	125.32	16.128	Cement Sheet	20%	114.11	0.240	Cement Sheet	20%	100.08	0.002	Free Fibres	100%	40.73	Yes	0.848	0.0134
S007	BH104 1.1	643.96	136.85	No Asbestos Detected	N/A	N/A	143.99	No Asbestos Detected	N/A	N/A	100.13	0.001	Free Fibres	100%	262.99	Yes	<0.001	<0.001
S008	BH104 5.5	139.90	108.86	No Asbestos Detected	N/A	N/A	14.87	No Asbestos Detected	N/A	N/A	16.17	No Asbestos Detected	N/A	N/A	No Excess	No	<0.001	<0.001
S009	BH105 2.2	569.05	253.88	No Asbestos Detected	N/A	N/A	190.01	No Asbestos Detected	N/A	N/A	100.23	No Asbestos Detected	N/A	N/A	24.93	No	<0.001	<0.001

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023

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Appendix 1: Soil Analysis Raw Data

Certificate Number: S1809281149
Report Date: 03 Oct 2018
Site Location: 1003207

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Quantitative Results (non IANZ)																	
Sample ID	Client Sample ID	Total 500mL Sub-Sample (g)	ACM (>10mm)*				AF / FA (2-10mm) (100% ACM)*				AF / FA (<2mm) (100% ACM)*				<2mm Excess (g)	Trace Asbestos Detected **	W/W% Asbestos as ACM	W/W% Asbestos as AF / FA
			>10mm Weight (g)	>10mm ACM (g)	ACM Form	Form %***	2-10mm Weight (g)	2-10mm AF/FA (g)	ACM Form	Form %***	<2mm Weight (g)	<2mm AF/FA (g)	ACM Form	Form %***				
S010	BH105 5.1	193.36	14.89	No Asbestos Detected	N/A	N/A	82.71	No Asbestos Detected	N/A	N/A	95.76	0.001	Free Fibres	100%	No Excess	Yes	<0.001	<0.001

* These results are raw weighed data presented as per the BRANZ New Zealand Guidelines for Assessing and Managing Asbestos Soil 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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P: 03 943 5394 W: www.preciseconsulting.co.nz

Report Date: 08 Oct 2018

Certificate Number: S1810011340

Analytica Laboratories
Ruakura Research Centre, 10 Bisley Road, Private Bag 3123,

Client Reference: 1003207

Dear Rachael Casey,

Re: Asbestos Soil Identification Analysis – 1003207

6 sample(s) received on 01 Oct 2018 by Victoria Sheppard.

The results of fibre analysis were performed by Nick Wells of Precise Consulting and Laboratory Ltd on 08 Oct 2018.

The sample(s) were stated to be from 1003207.

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 Nick Wells.

Yours sincerely

Nick Wells
PRECISE LABORATORY IDENTIFIER

Sample Analysis Results

Certificate Number: S1810011340
Report Date: 08 Oct 2018
Site Location: 1003207

PRECISE
CONSULTING & LABORATORY

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

Note 2: If mineral fibres of unknown type are detected (UMF), by PLM and dispersion staining, these may or may not be asbestos fibres. To confirm the identity of this fibre, another independent analytical technique such as XRD analysis is advised.

Note 3: The samples in this report are "As Received". The laboratory does not take responsibility for the sampling procedure or accuracy of sample location description. This document may not be reproduced except in full.

Identified by:

Approved Identifier: Nick Wells

Reviewed by:

Key Technical Person: Nick Wells

Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S001	BH106 0.5	BH106 0.5 Non-Homogeneous Soil 547.86g	No Asbestos Detected Organic Fibres
S002	BH106 6.3	BH106 6.3 Non-Homogeneous Soil 42.69g	No Asbestos Detected Organic Fibres
S003	BH107 2.3	BH107 2.3 Non-Homogeneous Soil 540.11g	Chrysotile (white asbestos) Fibres Organic Fibres
S004	BH107 4.6	BH107 4.6 Non-Homogeneous Soil 407.95g	Chrysotile (white asbestos) Fibres Organic Fibres Synthetic Mineral Fibres
S005	BH109 1.3	BH109 1.3 Non-Homogeneous Soil 577.96g	No Asbestos Detected Organic Fibres
S006	BH109 5.4	BH109 5.4 Non-Homogeneous Soil 619.75g	No Asbestos Detected Organic Fibres

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Appendix 1: Soil Analysis Raw Data

Certificate Number: S1810011340
Report Date: 08 Oct 2018
Site Location: 1003207

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Quantitative Results (non IANZ)																	
Sample ID	Client Sample ID	Total 500mL Sub-Sample (g)	ACM (>10mm)*				AF / FA (2-10mm) (100% ACM)*				AF / FA (<2mm) (100% ACM)*				<2mm Excess (g)	Trace Asbestos Detected **	W/W% Asbestos as ACM	W/W% Asbestos as AF / FA
			>10mm Weight (g)	>10mm ACM (g)	ACM Form	Form %***	2-10mm Weight (g)	2-10mm AF/FA (g)	ACM Form	Form %***	<2mm Weight (g)	<2mm AF/FA (g)	ACM Form	Form %***				
S001	BH106 0.5	547.86	No Material Present	N/A	N/A	N/A	143.07	No Asbestos Detected	N/A	N/A	101.37	No Asbestos Detected	N/A	N/A	303.42	No	<0.001	<0.001
S002	BH106 6.3	42.69	No Material Present	N/A	N/A	N/A	3.28	No Asbestos Detected	N/A	N/A	39.41	No Asbestos Detected	N/A	N/A	No Material Present	No	<0.001	<0.001
S003	BH107 2.3	540.11	210.33	No Asbestos Detected	N/A	N/A	215.42	0.085	Bitumastic Material	40%	100.74	0.002	Free Fibres	100%	13.62	Yes	<0.001	0.0067
S004	BH107 4.6	407.95	No Material Present	N/A	N/A	N/A	144.19	0.429	Cement Sheet	20%	102.81	0.004	Free Fibres	100%	160.95	Yes	<0.001	0.0235
S005	BH109 1.3	577.96	27.81	No Asbestos Detected	N/A	N/A	98.40	No Asbestos Detected	N/A	N/A	100.63	No Asbestos Detected	N/A	N/A	351.12	No	<0.001	<0.001
S006	BH109 5.4	619.75	139.91	No Asbestos Detected	N/A	N/A	231.13	No Asbestos Detected	N/A	N/A	100.95	No Asbestos Detected	N/A	N/A	147.76	No	<0.001	<0.001

* These results are raw weighed data presented as per the BRANZ New Zealand Guidelines for Assessing and Managing Asbestos Soil 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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Report Date: 19 Oct 2018

Certificate Number: S1810151050

Analytica Laboratories
Ruakura Research Centre, 10 Bisley Road, Private Bag 3123

Client Reference: Kyle Park / 1003207 / 18-32437

Dear Analytica Laboratories,

Re: Asbestos Soil Identification Analysis – Kyle Park / 1003207

14 sample(s) received on 15 Oct 2018 by Victoria Sheppard.

The results of fibre analysis were performed by Nick Wells of Precise Consulting and Laboratory Ltd on 19 Oct 2018.

The sample(s) were stated to be from Kyle Park / 1003207.

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 Nick Wells.

Yours sincerely

Nick Wells
PRECISE LABORATORY IDENTIFIER

Sample Analysis Results

Certificate Number: S1810151050
Report Date: 19 Oct 2018
Site Location: Kyle Park / 1003207

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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: Nick Wells

Reviewed by:

Key Technical Person: Nick Wells

Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S001	BH108 2.35	BH108 2.35 Non-Homogeneous Soil 735.58g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres
S002	BH117 2.4	BH117 2.4 Non-Homogeneous Soil 529.97g	No Asbestos Detected Organic Fibres
S003	BH110 0.6	BH110 0.6 Non-Homogeneous Soil 767.76g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres
S004	BH111 0.5	BH111 0.5 Non-Homogeneous Soil 847.42g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres
S005	BH111 1.95	BH111 1.95 Non-Homogeneous Soil 802.58g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres
S006	BH112 0.5	BH112 0.5 Non-Homogeneous Soil 1032.32g	No Asbestos Detected Organic Fibres

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Sample Analysis Results

Certificate Number: S1810151050
Report Date: 19 Oct 2018
Site Location: Kyle Park / 1003207

PRECISE
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Sample ID	Client Sample ID	Sample Location/Description/Dimensions	Analysis Results
S007	BH113 2.8	BH113 2.8 Non-Homogeneous Soil 363.91g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Synthetic Mineral Fibres
S008	BH114 0.1	BH114 0.1 Non-Homogeneous Soil 783.91g	No Asbestos Detected Organic Fibres
S009	BH115 0.1	BH115 0.1 Non-Homogeneous Soil 651.17g	No Asbestos Detected Organic Fibres
S010	BH116 3.2	BH116 3.2 Non-Homogeneous Soil 826.54g	No Asbestos Detected Organic Fibres
S011	BH118 0.3	BH118 0.3 Non-Homogeneous Soil 548.18g	No Asbestos Detected Organic Fibres
S012	BH118 2.6	BH118 2.6 Non-Homogeneous Soil 876.55g	Chrysotile (white asbestos) Fibres Organic Fibres Synthetic Mineral Fibres
S013	BH119 1.1	BH119 1.1 Non-Homogeneous Soil 837.21g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres
S014	BH120 2.0	BH120 2.0 Non-Homogeneous Soil 700.56g	Chrysotile (white asbestos) Fibres Organic Fibres Amosite (brown asbestos) Fibres Crocidolite (blue asbestos) Fibres

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Appendix 1: Soil Analysis Raw Data

Certificate Number: S1810151050
Report Date: 19 Oct 2018
Site Location: Kyle Park / 1003207

PRECISE
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Quantitative Results (non IANZ)																		
Sample ID	Client Sample ID	Total 500mL Sub-Sample (g)	ACM (>10mm)*				AF / FA (2-10mm) (100% ACM)*				AF / FA (<2mm) (100% ACM)*				<2mm Excess (g)	Trace Asbestos Detected **	W/W% Asbestos as ACM	W/W% Asbestos as AF / FA
			>10mm Weight (g)	>10mm ACM (g)	ACM Form	Form %***	2-10mm Weight (g)	2-10mm AF/FA (g)	ACM Form	Form %***	<2mm Weight (g)	<2mm AF/FA (g)	ACM Form	Form %***				
S001	BH108 2.35	735.58	276.35	126.421	Cement Sheet	20%	271.80	245.018	Cement Sheet	20%	102.87	0.305	Free Fibres	100%	84.56	Yes	3.437	6.7374
S002	BH117 2.4	529.97	102.53	No Asbestos Detected	N/A	N/A	166.32	No Asbestos Detected	N/A	N/A	102.49	No Asbestos Detected	N/A	N/A	158.63	No	<0.001	<0.001
S003	BH110 0.6	767.76	56.91	No Asbestos Detected	N/A	N/A	349.92	0.035	Free Fibres	100%	101.35	0.005	Free Fibres	100%	259.58	Yes	<0.001	0.0069
S004	BH111 0.5	847.42	163.01	4.284	Cement Sheet	20%	341.58	2.229	Cement Sheet	20%	102.31	0.045	Free Fibres	100%	240.52	Yes	0.101	0.0704
S005	BH111 1.95	802.58	526.13	120.020	Cement Sheet	20%	203.86	9.091	Cement Sheet	20%	72.59	0.205	Cement Sheet	20%	No Excess Present	Yes	2.991	0.2317
S006	BH112 0.5	1032.32	543.27	No Asbestos Detected	N/A	N/A	239.86	No Asbestos Detected	N/A	N/A	100.63	No Asbestos Detected	N/A	N/A	148.56	No	<0.001	<0.001
S007	BH113 2.8	363.91	22.55	No Asbestos Detected	N/A	N/A	135.44	0.014	Free Fibres	100	101.81	0.003	Free Fibres	100%	104.11	Yes	<0.001	0.0055
S008	BH114 0.1	783.91	157.81	No Asbestos Detected	N/A	N/A	307.99	No Asbestos Detected	N/A	N/A	100.65	No Asbestos Detected	N/A	N/A	217.46	No	<0.001	<0.001
S009	BH115 0.1	651.17	17.14	No Asbestos Detected	N/A	N/A	210.81	No Asbestos Detected	N/A	N/A	100.65	No Asbestos Detected	N/A	N/A	322.57	No	<0.001	<0.001
S010	BH116 3.2	826.54	144.45	No Asbestos Detected	N/A	N/A	358.36	No Asbestos Detected	N/A	N/A	101.90	No Asbestos Detected	N/A	N/A	221.83	No	<0.001	<0.001

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Appendix 1: Soil Analysis Raw Data

Certificate Number: S1810151050
Report Date: 19 Oct 2018
Site Location: Kyle Park / 1003207

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Quantitative Results (non IANZ)																	
Sample ID	Client Sample ID	Total 500mL Sub-Sample (g)	ACM (>10mm)*				AF / FA (2-10mm) (100% ACM)*				AF / FA (<2mm) (100% ACM)*				<2mm Excess (g)	Trace Asbestos Detected **	W/W% Asbestos as ACM	W/W% Asbestos as AF / FA
			>10mm Weight (g)	>10mm ACM (g)	ACM Form	Form %***	2-10mm Weight (g)	2-10mm AF/FA (g)	ACM Form	Form %***	<2mm Weight (g)	<2mm AF/FA (g)	ACM Form	Form %***				
S011	BH118 0.3	548.18	No Material Present	N/A	N/A	N/A	79.09	No Asbestos Detected	N/A	N/A	100.11	No Asbestos Detected	N/A	N/A	368.98	No	<0.001	<0.001
S012	BH118 2.6	876.55	151.07	No Asbestos Detected	N/A	N/A	369.34	0.003	Bitumastic Material	40%	102.77	0.002	Fibrous Material	30%	253.37	Yes	<0.001	<0.001
S013	BH119 1.1	837.21	217.71	No Asbestos Detected	N/A	N/A	360.24	0.006	Fibrous Material	40%	101.87	0.001	Free Fibres	100%	157.39	Yes	<0.001	<0.001
S014	BH120 2.0	700.56	367.75	45.715	Cement Sheet	20%	202.42	13.849	Cement Sheet	20%	101.61	0.150	Cement Sheet	20%	28.78	Yes	1.305	0.4009

* These results are raw weighed data presented as per the BRANZ New Zealand Guidelines for Assessing and Managing Asbestos Soil 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 E: Laboratory Results Data Assessment

Table E1 - whole site

		Assessment criteria					Analytical data																					
Sample ID		NES Soil SCS(health) [1]					BH101 3.45	BH101 7.2	BH101 7.35	BH102 0.5	BH102 2.0	BH102 9.6	BH102 9.8	BH103 0.3	BH103 7.15	BH103 7.4	BH103 10.2	BH103 10.5	BH104 1.0	BH104 1.1	BH104 5.5	BH104 7.7	BH105 0.9	BH105 2.2	BH105 5.1	BH105 6.0	BH106 0.5	BH106 2.3	BH106 6.3	BH106 7.5
Depth (m bgl)							3.45	7.2	7.35	0.5	2.0	9.6	9.8	0.3	7.15	7.4	10.2	10.5	1.0	1.1	5.5	7.7	0.9	2.2	5.1	6.0	0.5	2.3	6.3	7.5
Sample date							20/09/2018	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018	21/09/2018	21/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	27/09/2018	27/09/2018	27/09/2018	27/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018
Material type (cap/fill)	**Units**	**Recreational**	**Outdoor worker**	**Burwood [2]**	**Background [3]**	**Maximum concentration**	Fill	Fill	Fill	Cap	Fill	Fill	Fill	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Cap	Fill	Fill	Fill
Metals																														
Arsenic	mg/kg	80	70	80	16.3	36	**17.8**	13.7	-	4.99	-	13.4	-	5.93	-	-	-	9.56	7.16	-	-	**30.2**	**16.5**	-	-	8.28	-	10.4	-	**36**
Cadmium	mg/kg	400	1,300	400	0.2	5.04	**5.04**	**0.69**	-	0.081	-	**0.4**	-	0.097	-	-	-	**3.07**	**0.89**	-	-	**2.52**	**0.29**	-	-	0.085	-	0.2	-	**0.32**
Chromium	mg/kg	2,700	6,300	2,700	20.1	45.7	**45.7**	17.5	-	14.4	-	19	-	15.2	-	-	-	**26.1**	17.3	-	-	**31.6**	17.2	-	-	13.5	-	**31.7**	-	**24.4**
Copper	mg/kg	>10,000	>10,000	>10,000	19.5	270	**270**	**76.9**	-	9	-	**24.3**	-	14.8	-	-	-	**27.5**	**54.5**	-	-	**108**	**62.5**	-	-	9.53	-	**61.5**	-	**29.4**
Lead	mg/kg	880	3,300	880	128.8	406	**406**	**166**	-	28.8	-	**183**	-	20.8	-	-	-	77.2	90.2	-	-	**281**	105	-	-	32.7	-	**137**	-	65.4
Mercury	mg/kg	1,800	4,200	1,800	0.1	0.45	**0.45**	**0.42**	-	0.06	-	**0.29**	-	0.044	-	-	-	**0.44**	0.087	-	-	**0.14**	**0.2**	-	-	0.086	-	0.077	-	**0.35**
Nickel	mg/kg	1,200 [4]	6,000 [4]	600	18	112	**112**	**31.5**	-	11.3	-	16.9	-	11.3	-	-	-	**31.5**	14.3	-	-	**40.2**	17.2	-	-	11.4	-	**22.4**	-	**23.4**
Zinc	mg/kg	30,000 [4]	400,000 [4]	14,000	166.8	1300	**417**	**257**	-	67.7	-	**200**	-	64.5	-	-	-	**197**	**1300**	-	-	**285**	126	-	-	113	-	109	-	143
Cyanide	mg/kg	240 [4]	1,500 [4]	NGV	NGV	2.58	-	2.58	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Semi-Volatile Organic Compounds																														
Benzo[a]pyrene TEQ (LOR)	mg/kg	40	35	40	0.922 [5]	100.2	**3.3**	0.3	-	**16.2**	-	0.6	-	0.2	-	-	-	0.2	0.2	-	-	0.7	**20.7**	-	-	100.2	-	**8.5**	-	0.3
Total Phenols	mg/kg	40,000 [4]	240,000 [4]	40,000	NGV	0	<12	<12	-	<12	-	<12	-	<12	-	-	-	<12	<12	-	-	<12	<12	-	-	<12	-	<12	-	<12
Σ DDT	mg/kg	400	1,000	400	0.431 [9]	7	<0.6	<0.6	-	**7**	-	<0.6	-	<0.6	-	-	-	<0.6	<0.6	-	-	<0.6	<0.6	-	-	<0.6	-	<0.6	-	<0.6
Deildrin	mg/kg	70	160	70	NGV	0.7	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5	<0.5	-	-	<0.5	0.7	-	-	<0.5	-	<0.5	-	<0.5
Asbestos																														
Asbestos presence/absence		N/A	N/A	Not present	Not present	0	NAD	-	**Chrysotile, Amosite, Crocidolite**	-	NAD	-	NAD	-	**Chrysotile**	-	**Chrysotile, Amosite, Crocidolite**	-	-	**Chrysotile**	NAD	-	-	NAD	**Chrysotile**	-	NAD	-	NAD	-
Asbestos form		N/A	N/A			0	-	-	**Insulation board, free fibres**	-	-	-	-	-	**Free fibres**	-	**Cement sheet, free fibres**	-	-	**Free fibres**	-	-	-	-	**Free fibres**	-	-	-	-	-
Weight of asebtos in ACM (non-friable) [6]	%w/w	0.02	0.05			0.848	NAD	-	0	-	NAD	-	NAD	-	0	-	0.848	-	-	0	NAD	-	-	NAD	0	-	NAD	-	NAD	-
Combined FA + AF [8]	%w/w	0.001	0.001			0.0134	NAD	-	0.0043	-	NAD	-	NAD	-	0.0043	-	0.0134	-	-	**<0.001**	NAD	-	-	NAD	**<0.001**	-	NAD	-	NAD	-

		Assessment criteria					Analytical data																					
Sample ID		NES Soil SCS(health) [1]					BH107 0.3	BH107 2.3	BH107 4.3	BH107 4.6	BH109 1.3	BH109 5.2	BH109 5.4	BH109 8.5	BH108 0.85	BH108 2.35	BH108 5.6	BH108 7.8	BH110 0.4	BH110 0.6	BH110 2.5	BH111 0.5	BH111 1.0	BH111 1.95	BH111 3.5	BH112 0.5	BH112 1.0	BH112 9.2	BH113 0.2
Depth (m bgl)							0.3	2.3	4.3	4.6	1.3	5.2	5.4	8.5	0.85	2.35	5.6	7.8	0.4	0.6	2.5	0.5	1	1.95	3.5	0.5	1	9.2	0.2
Sample date							28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	2/10/2018	2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018	1/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	5/10/2018	5/10/2018	5/10/2018	2/10/2018
Material type (cap/fill)	**Units**	**Recreational**	**Outdoor worker**	**Burwood [2]**	**Background [3]**	**Maximum concentration**	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Cap	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Natural	Cap
Metals																													
Arsenic	mg/kg	80	70	80	16.3	73.9	5.99	-	4.98	-	-	15.1	-	4.04	8.58	-	4.15	3.76	4.86	-	11.9	-	5.12	-	73.9	-	6.83	4.73	6.05
Cadmium	mg/kg	400	1,300	400	0.2	0.82	0.13	-	**0.51**	-	-	**0.5**	-	0.033	**0.82**	-	0.17	0.049	0.1	-	0.069	-	0.13	-	**0.23**	-	0.11	0.046	0.082
Chromium	mg/kg	2,700	6,300	2,700	20.1	30.3	15.1	-	18.6	-	-	**30.3**	-	11	17.3	-	**21.2**	11.1	16.5	-	11.7	-	4.29	-	**27.9**	-	15.6	15.7	17.5
Copper	mg/kg	>10,000	>10,000	>10,000	19.5	79.8	14.2	-	13.6	-	-	**36.4**	-	6.33	**54.9**	-	**22.3**	9.7	7.96	-	6.14	-	11.3	-	**79.8**	-	13.9	9.18	10.6
Lead	mg/kg	880	3,300	880	128.8	259	33.5	-	21	-	-	111	-	15.1	**259**	-	44.7	11.9	18.1	-	19.9	-	27.5	-	71.7	-	31.8	18.5	28.9
Mercury	mg/kg	1,800	4,200	1,800	0.1	0.75	0.064	-	**0.2**	-	-	**0.12**	-	0.052	0.077	-	**0.11**	**0.75**	0.059	-	<0.025	-	0.041	-	**0.2**	-	0.099	0.092	0.066
Nickel	mg/kg	1,200 [4]	6,000 [4]	600	18	45.4	12.6	-	16.6	-	-	**33.8**	-	9.55	14.5	-	**31.2**	10.7	13.2	-	7.1	-	4.9	-	**45.4**	-	12.1	13.1	14.4
Zinc	mg/kg	30,000 [4]	400,000 [4]	14,000	166.8	420	74.1	-	**371**	-	-	149	-	45.3	**169**	-	76.1	57.5	61	-	30.6	-	175	-	**420**	-	76.3	54.7	73.5
Semi-Volatile Organic Compounds																													
Benzo[a]pyrene TEQ (LOR)	mg/kg	40	35	40	0.922 [5]	2.5	0.2	-	0.2	-	-	**2.5**	-	0.2	0.3	-	0.2	0.2	0.2	-	0.2	-	**1.9**	-	**1**	-	0.2	0.2	0.6
Total Phenols	mg/kg	40,000 [4]	240,000 [4]	40,000	NGV	25.2	<12	-	25.2	-	-	<12	-	<12	<12	-	<12	<12	<12	-	<12	-	<12	-	<12	-	<12	<12	<12
Σ DDT	mg/kg	400	1,000	400	0.431 [9]	0.9	<0.6	-	**0.9**	-	-	<0.6	-	<0.6	<0.6	-	<0.6	<0.6	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	<0.6	<0.6
Deildrin	mg/kg	70	160	70	NGV	0	<0.5	-	<0.5	-	-	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	<0.5	<0.5	<0.5
Total Petroleum Hydrocarbons																													
C7- C9	mg/kg	500 [7]	500 [8]	500	NGV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10		
C10- C14	mg/kg	510 [7]	510 [8]	510	NGV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,052		
C7- C36	mg/kg	NL [7]	NL [8]	NL	NGV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,350		
C7- C36 (total)	mg/kg	-	-	-	NGV																						8,402		
Asbestos																													
Asbestos presence/absence		N/A	N/A	Not present	Not present	N/A	-	**Chrysotile**	-	**Chrysotile**	NAD	-	NAD	-	-	**Chrysotile, Amosite, Crocidolite**	-	-	-	**Chrysotile, Amosite, Crocidolite**	-	**Chrysotile, Amosite, Crocidolite**	-	**Chrysotile, Amosite, Crocidolite**	-	NAD	-	-	-
Asbestos form		N/A	N/A			N/A	-	**Bitumastic material, free fibres**	-	**Cement sheet, free fibres**	-	-	-	-	-	**Cement sheet, free fibres**	-	-	-	**Free fibres**	-	**Cement sheet, free fibres**	-	**Cement sheet**	-	-	-	-	-
Weight of asebtos in ACM (non-friable) [6]	%w/w	0.02	0.05			3.437	-	0	-	0	NAD	-	NAD	-	-	**3.437**	-	-	-	0	-	**0.101**	-	**2.991**	-	NAD	-	-	-
Combined FA + AF [8]	%w/w	0.001	0.001			6.7374	-	0.0067	-	0.0235	NAD	-	NAD	-	-	6.7374	-	-	-	0.0069	-	0.0704	-	0.2317	-	NAD	-	-	-

		Assessment criteria					Analytical data																					
Sample ID		NES Soil SCS(health) [1]					BH113 2.5	BH113 2.8	BH114 0.1	BH114 0.2	BH114 4.1	BH115 0.1	BH115 1.6	BH115 6.2	BH116 0.7	BH116 3.2	BH116 5.6	BH117 0.5	BH117 2.4	BH118 0.3	BH118 0.75	BH118 2.6	BH118 6.3	BH119 1.0	BH119 1.1	BH119 6.3	BH120 0.8	BH120 2.0	BH120 3.8
Depth (m bgl)							2.5	2.8	0.1	0.2	4.1	0.1	1.6	6.2	0.7	3.2	5.6	0.5	2.4	0.3	0.75	2.6	6.30	1.0	1.1	6.3	0.8	2.0	3.8
Sample date							2/10/2018	2/10/2018	3/10/2018	3/10/2018	3/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	9/10/2018	9/10/2018	9/10/2018	9/10/2018	9/10/2018	9/10/2018	10/10/2018	10/10/2018	10/10/2018	9/10/2018	9/10/2018	9/10/2018
Material type (cap/fill)	**Units**	**Recreational**	**Outdoor worker**	**Burwood [2]**	**Background [3]**	**Maximum concentration**	Fill	Fill	Cap	Cap	Fill	Cap	Fill	Natural	Cap	Fill	Fill	Cap	Fill	Cap	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill
Metals																													
Arsenic	mg/kg	80	70	80	16.3	61.9	6.82	-	-	5.61	13.7	-	5.97	2.36	5	-	**27.8**	4.08	25	-	5.06	-	14.9	**61.9**	-	**39.9**	8.45	-	**44.2**
Cadmium	mg/kg	400	1,300	400	0.2	375	0.13	-	-	0.15	0.29	-	0.094	0.034	0.12	-	**0.26**	0.057	**375**	-	**0.28**	-	**26.6**	0.14	-	0.14	0.2	-	0.41
Chromium	mg/kg	2,700	6,300	2,700	20.1	117	16.5	-	-	16.1	**28.3**	-	17.9	12.6	14.1	-	**20.5**	13.7	**40.7**	-	14.2	-	**117**	15.4	-	16.5	12.5	-	18.8
Copper	mg/kg	>10,000	>10,000	>10,000	19.5	159	14	-	-	24.2	**159**	-	9.84	5.72	**26.1**	-	**51.4**	7.95	**129**	-	15.9	-	**24.8**	15.4	-	15.3	**20.7**	-	16.4
Lead	mg/kg	880	3,300	880	128.8	3890	45.6	-	-	48.6	56.4	-	28.8	11.3	48.3	-	33.6	38.1	3890	-	71.3	-	**160**	33.1	-	**151**	**126**	-	87.8
Mercury	mg/kg	1,800	4,200	1,800	0.1	5.2	0.061	-	-	0.065	**0.19**	-	0.045	0.055	0.063	-	0.068	0.046	**5.2**	-	0.1	-	**0.43**	0.077	-	**0.13**	0.097	-	**0.32**
Nickel	mg/kg	1,200 [4]	6,000 [4]	600	18	63.1	12.3	-	-	14.3	**41.9**	-	13.3	9.58	11.4	-	**39.3**	11.3	**63.1**	-	11.2	-	**34.3**	11.2	-	11.1	10.2	-	10.5
Zinc	mg/kg	30,000 [4]	400,000 [4]	14,000	166.8	315	82.2	-	-	105	105	-	71.1	37.4	78.5	-	64.2	51.5	**229**	-	68	-	**315**	74.1	-	163	84.7	-	117
Semi-Volatile Organic Compounds																													
Benzo[a]pyrene TEQ (LOR)	mg/kg	40	35	40	0.922 [5]	127	0.3	-	-	0.3	0.2	-	0.9	0.2	**1.3**	-	**1.2**	0.2	**1.7**	-	**3.3**	-	0.8	0.3	-	**20.9**	127	-	**1.4**
Total Phenols	mg/kg	40,000 [4]	240,000 [4]	40,000	NGV	0	<12	-	-	<12	<12	-	<12	<12	<12	-	<12	<12	<12	-	<12	-	<12	<12	-	<12	<12	-	<12
Σ DDT	mg/kg	400	1,000	400	0.431 [9]	9.4		-	-	<0.6	<0.6	-	<0.6	<0.6	<0.6	-	**1.5**	<0.6	0.5	-	<0.6	-	**9.4**	<0.6	-	<0.6	<0.6	-	<0.6
Deildrin	mg/kg	70	160	70	NGV	0	<0.5	-	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	<0.5
Asbestos																													
Asbestos presence/absence		N/A	N/A	Not present	Not present	N/A	-	**Chrysotile, Amosite**	NAD	-	-	NAD	-	-	-	NAD	-	-	NAD	NAD	-	**Chrysotile**	-	-	**Chrysotile, Amosite, Crocidolite**	-	-	**Chrysotile, Amosite, Crocidolite**	-
Asbestos form		N/A	N/A			N/A	-	**Free fibres**	-	-	-	-	-	-	-	-	-	-	-	-	-	**Bitumastic material, fibrous material**	-	-	**Fibrous material, free fibres**	-	-	**Cement sheet**	-
Weight of asebtos in ACM (non-friable) [6]	%w/w	0.02	0.05			1.305	-	0	NAD	-	-	NAD	-	-	-	NAD	-	-	NAD	NAD	-	0	-	-	0	-	-	**1.305**	-
Combined FA + AF [8]	%w/w	0.001	0.001			0.4009	-	0.0055	NAD	-	-	NAD	-	-	-	NAD	-	-	NAD	NAD	-	**<0.001**	-	-	**<0.001**	-	-	0.4009	-

Notes:
Bold indicates that published background concentrations are exceeded.
Red indicates that outdoor worker health criteria are exceeded.
Underlined indicates that recreational land use criteria are exceeded.
Highlighted indicates that Burwood acceptance criteria are exceeded.
- indicates sample has not been analysed.
NAD indicates No Asbestos Detected.
NGV indicates No Guideline Value.
N/A indicates Not Applicable.

1- MfE, 2012 - National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (unless otherwise stated).
2- Burwood Resource Recovery Park acceptance criteria, pers. comms. M Morely (CCC), 16.03.2011 and updated with the NES recreational criteria as he instructed in January 2012.
3- ECan GIS, Trace elements Level 2 from "Background concentrations of selected trace elements in Canterbury soils" prepared for Environment Canterbury by Tonkin and Taylor Ltd, July 2006.
4- ASC NEPM Toolbox - Update Febrary 2014 - www.nepc.gov.au/nepms/assessment-site-contamination/toolbox.
5- ECan 2007, Background concentrations of polycyclic aromatic hydrocarbons in Christchurch urban soils.
6- BRANZ 2017, New Zealand Guidelines for Assessing and Managing Asbestos in Soil; ACM- asbetsos containing material, AF- asbestos fines, FA- fibrous asbestos.
7- MfE, June 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Tier 1 Soil ac ceptance criteria: Commercial/ industrial use, sandy silt, <1 m.Residential is used on a conservative basis
8- MfE, June 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Tier 1 Soil a cceptance criteria: residential use, sandy silt, <1 m.

Table E1 - whole site

		Assessment criteria					Analytical data																					
Sample ID		NES Soil SCS(health) [1]					BH101 3.45	BH101 7.2	BH101 7.35	BH102 0.5	BH102 2.0	BH102 9.6	BH102 9.8	BH103 0.3	BH103 7.15	BH103 7.4	BH103 10.2	BH103 10.5	BH104 1.0	BH104 1.1	BH104 5.5	BH104 7.7	BH105 0.9	BH105 2.2	BH105 5.1	BH105 6.0	BH106 0.5	BH106 2.3	BH106 6.3	BH106 7.5
Depth (m bgl)							3.45	7.2	7.35	0.5	2.0	9.6	9.8	0.3	7.15	7.4	10.2	10.5	1.0	1.1	5.5	7.7	0.9	2.2	5.1	6.0	0.5	2.3	6.3	7.5
Sample date							20/09/2018	20/09/2018	20/09/2018	21/09/2018	21/09/2018	21/09/2018	21/09/2018	21/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	27/09/2018	27/09/2018	27/09/2018	27/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018
Material type (cap/fill)	**Units**	**Recreational**	**Outdoor worker**	**Burwood [2]**	**Background [3]**	**Maximum concentration**	Fill	Fill	Fill	Cap	Fill	Fill	Fill	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Cap	Fill	Fill	Fill
Metals																														
Arsenic	mg/kg	80	70	80	16.3	36	**17.8**	13.7	-	4.99	-	13.4	-	5.93	-	-	-	9.56	7.16	-	-	**30.2**	**16.5**	-	-	8.28	-	10.4	-	**36**
Cadmium	mg/kg	400	1,300	400	0.2	5.04	**5.04**	**0.69**	-	0.081	-	**0.4**	-	0.097	-	-	-	**3.07**	**0.89**	-	-	**2.52**	**0.29**	-	-	0.085	-	0.2	-	**0.32**
Chromium	mg/kg	2,700	6,300	2,700	20.1	45.7	**45.7**	17.5	-	14.4	-	19	-	15.2	-	-	-	**26.1**	17.3	-	-	**31.6**	17.2	-	-	13.5	-	**31.7**	-	**24.4**
Copper	mg/kg	>10,000	>10,000	>10,000	19.5	270	**270**	**76.9**	-	9	-	**24.3**	-	14.8	-	-	-	**27.5**	**54.5**	-	-	**108**	**62.5**	-	-	9.53	-	**61.5**	-	**29.4**
Lead	mg/kg	880	3,300	880	128.8	406	**406**	**166**	-	28.8	-	**183**	-	20.8	-	-	-	77.2	90.2	-	-	**281**	105	-	-	32.7	-	**137**	-	65.4
Mercury	mg/kg	1,800	4,200	1,800	0.1	0.45	**0.45**	**0.42**	-	0.06	-	**0.29**	-	0.044	-	-	-	**0.44**	0.087	-	-	**0.14**	**0.2**	-	-	0.086	-	0.077	-	**0.35**
Nickel	mg/kg	1,200 [4]	6,000 [4]	600	18	112	**112**	**31.5**	-	11.3	-	16.9	-	11.3	-	-	-	**31.5**	14.3	-	-	**40.2**	17.2	-	-	11.4	-	**22.4**	-	**23.4**
Zinc	mg/kg	30,000 [4]	400,000 [4]	14,000	166.8	1300	**417**	**257**	-	67.7	-	**200**	-	64.5	-	-	-	**197**	**1300**	-	-	**285**	126	-	-	113	-	109	-	143
Cyanide	mg/kg	240 [4]	1,500 [4]	NGV	NGV	2.58	-	2.58	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Semi-Volatile Organic Compounds																														
Benzo[a]pyrene TEQ (LOR)	mg/kg	40	35	40	0.922 [5]	100.2	**3.3**	0.3	-	**16.2**	-	0.6	-	0.2	-	-	-	0.2	0.2	-	-	0.7	**20.7**	-	-	100.2	-	**8.5**	-	0.3
Total Phenols	mg/kg	40,000 [4]	240,000 [4]	40,000	NGV	0	<12	<12	-	<12	-	<12	-	<12	-	-	-	<12	<12	-	-	<12	<12	-	-	<12	-	<12	-	<12
Σ DDT	mg/kg	400	1,000	400	0.431 [9]	7	<0.6	<0.6	-	**7**	-	<0.6	-	<0.6	-	-	-	<0.6	<0.6	-	-	<0.6	<0.6	-	-	<0.6	-	<0.6	-	<0.6
Deildrin	mg/kg	70	160	70	NGV	0.7	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5	<0.5	-	-	<0.5	0.7	-	-	<0.5	-	<0.5	-	<0.5
Asbestos																														
Asbestos presence/absence		N/A	N/A	Not present	Not present	0	NAD	-	**Chrysotile, Amosite, Crocidolite**	-	NAD	-	NAD	-	**Chrysotile**	-	**Chrysotile, Amosite, Crocidolite**	-	-	**Chrysotile**	NAD	-	-	NAD	**Chrysotile**	-	NAD	-	NAD	-
Asbestos form		N/A	N/A			0	-	-	**Insulation board, free fibres**	-	-	-	-	-	**Free fibres**	-	**Cement sheet, free fibres**	-	-	**Free fibres**	-	-	-	-	**Free fibres**	-	-	-	-	-
Weight of asebtos in ACM (non-friable) [6]	%w/w	0.02	0.05			0.848	NAD	-	0	-	NAD	-	NAD	-	0	-	0.848	-	-	0	NAD	-	-	NAD	0	-	NAD	-	NAD	-
Combined FA + AF [8]	%w/w	0.001	0.001			0.0134	NAD	-	0.0043	-	NAD	-	NAD	-	0.0043	-	0.0134	-	-	**<0.001**	NAD	-	-	NAD	**<0.001**	-	NAD	-	NAD	-

		Assessment criteria					Analytical data																					
Sample ID		NES Soil SCS(health) [1]					BH107 0.3	BH107 2.3	BH107 4.3	BH107 4.6	BH109 1.3	BH109 5.2	BH109 5.4	BH109 8.5	BH108 0.85	BH108 2.35	BH108 5.6	BH108 7.8	BH110 0.4	BH110 0.6	BH110 2.5	BH111 0.5	BH111 1.0	BH111 1.95	BH111 3.5	BH112 0.5	BH112 1.0	BH112 9.2	BH113 0.2
Depth (m bgl)							0.3	2.3	4.3	4.6	1.3	5.2	5.4	8.5	0.85	2.35	5.6	7.8	0.4	0.6	2.5	0.5	1	1.95	3.5	0.5	1	9.2	0.2
Sample date							28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	2/10/2018	2/10/2018	2/10/2018	2/10/2018	1/10/2018	1/10/2018	1/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	5/10/2018	5/10/2018	5/10/2018	2/10/2018
Material type (cap/fill)	**Units**	**Recreational**	**Outdoor worker**	**Burwood [2]**	**Background [3]**	**Maximum concentration**	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Cap	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Natural	Cap
Metals																													
Arsenic	mg/kg	80	70	80	16.3	73.9	5.99	-	4.98	-	-	15.1	-	4.04	8.58	-	4.15	3.76	4.86	-	11.9	-	5.12	-	73.9	-	6.83	4.73	6.05
Cadmium	mg/kg	400	1,300	400	0.2	0.82	0.13	-	**0.51**	-	-	**0.5**	-	0.033	**0.82**	-	0.17	0.049	0.1	-	0.069	-	0.13	-	**0.23**	-	0.11	0.046	0.082
Chromium	mg/kg	2,700	6,300	2,700	20.1	30.3	15.1	-	18.6	-	-	**30.3**	-	11	17.3	-	**21.2**	11.1	16.5	-	11.7	-	4.29	-	**27.9**	-	15.6	15.7	17.5
Copper	mg/kg	>10,000	>10,000	>10,000	19.5	79.8	14.2	-	13.6	-	-	**36.4**	-	6.33	**54.9**	-	**22.3**	9.7	7.96	-	6.14	-	11.3	-	**79.8**	-	13.9	9.18	10.6
Lead	mg/kg	880	3,300	880	128.8	259	33.5	-	21	-	-	111	-	15.1	**259**	-	44.7	11.9	18.1	-	19.9	-	27.5	-	71.7	-	31.8	18.5	28.9
Mercury	mg/kg	1,800	4,200	1,800	0.1	0.75	0.064	-	**0.2**	-	-	**0.12**	-	0.052	0.077	-	**0.11**	**0.75**	0.059	-	<0.025	-	0.041	-	**0.2**	-	0.099	0.092	0.066
Nickel	mg/kg	1,200 [4]	6,000 [4]	600	18	45.4	12.6	-	16.6	-	-	**33.8**	-	9.55	14.5	-	**31.2**	10.7	13.2	-	7.1	-	4.9	-	**45.4**	-	12.1	13.1	14.4
Zinc	mg/kg	30,000 [4]	400,000 [4]	14,000	166.8	420	74.1	-	**371**	-	-	149	-	45.3	**169**	-	76.1	57.5	61	-	30.6	-	175	-	**420**	-	76.3	54.7	73.5
Semi-Volatile Organic Compounds																													
Benzo[a]pyrene TEQ (LOR)	mg/kg	40	35	40	0.922 [5]	2.5	0.2	-	0.2	-	-	**2.5**	-	0.2	0.3	-	0.2	0.2	0.2	-	0.2	-	**1.9**	-	**1**	-	0.2	0.2	0.6
Total Phenols	mg/kg	40,000 [4]	240,000 [4]	40,000	NGV	25.2	<12	-	25.2	-	-	<12	-	<12	<12	-	<12	<12	<12	-	<12	-	<12	-	<12	-	<12	<12	<12
Σ DDT	mg/kg	400	1,000	400	0.431 [9]	0.9	<0.6	-	**0.9**	-	-	<0.6	-	<0.6	<0.6	-	<0.6	<0.6	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	<0.6	<0.6
Deildrin	mg/kg	70	160	70	NGV	0	<0.5	-	<0.5	-	-	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	<0.5	<0.5	<0.5
Total Petroleum Hydrocarbons																													
C7- C9	mg/kg	500 [7]	500 [8]	500	NGV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10		
C10- C14	mg/kg	510 [7]	510 [8]	510	NGV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,052		
C7- C36	mg/kg	NL [7]	NL [8]	NL	NGV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,350		
C7- C36 (total)	mg/kg	-	-	-	NGV																						8,402		
Asbestos																													
Asbestos presence/absence		N/A	N/A	Not present	Not present	N/A	-	**Chrysotile**	-	**Chrysotile**	NAD	-	NAD	-	-	**Chrysotile, Amosite, Crocidolite**	-	-	-	**Chrysotile, Amosite, Crocidolite**	-	**Chrysotile, Amosite, Crocidolite**	-	**Chrysotile, Amosite, Crocidolite**	-	NAD	-	-	-
Asbestos form		N/A	N/A			N/A	-	**Bitumastic material, free fibres**	-	**Cement sheet, free fibres**	-	-	-	-	-	**Cement sheet, free fibres**	-	-	-	**Free fibres**	-	**Cement sheet, free fibres**	-	**Cement sheet**	-	-	-	-	-
Weight of asebtos in ACM (non-friable) [6]	%w/w	0.02	0.05			3.437	-	0	-	0	NAD	-	NAD	-	-	**3.437**	-	-	-	0	-	**0.101**	-	**2.991**	-	NAD	-	-	-
Combined FA + AF [8]	%w/w	0.001	0.001			6.7374	-	0.0067	-	0.0235	NAD	-	NAD	-	-	6.7374	-	-	-	0.0069	-	0.0704	-	0.2317	-	NAD	-	-	-

		Assessment criteria					Analytical data																					
Sample ID		NES Soil SCS(health) [1]					BH113 2.5	BH113 2.8	BH114 0.1	BH114 0.2	BH114 4.1	BH115 0.1	BH115 1.6	BH115 6.2	BH116 0.7	BH116 3.2	BH116 5.6	BH117 0.5	BH117 2.4	BH118 0.3	BH118 0.75	BH118 2.6	BH118 6.3	BH119 1.0	BH119 1.1	BH119 6.3	BH120 0.8	BH120 2.0	BH120 3.8
Depth (m bgl)							2.5	2.8	0.1	0.2	4.1	0.1	1.6	6.2	0.7	3.2	5.6	0.5	2.4	0.3	0.75	2.6	6.30	1.0	1.1	6.3	0.8	2.0	3.8
Sample date							2/10/2018	2/10/2018	3/10/2018	3/10/2018	3/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	8/10/2018	9/10/2018	9/10/2018	9/10/2018	9/10/2018	9/10/2018	9/10/2018	10/10/2018	10/10/2018	10/10/2018	9/10/2018	9/10/2018	9/10/2018
Material type (cap/fill)	**Units**	**Recreational**	**Outdoor worker**	**Burwood [2]**	**Background [3]**	**Maximum concentration**	Fill	Fill	Cap	Cap	Fill	Cap	Fill	Natural	Cap	Fill	Fill	Cap	Fill	Cap	Cap	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill
Metals																													
Arsenic	mg/kg	80	70	80	16.3	61.9	6.82	-	-	5.61	13.7	-	5.97	2.36	5	-	**27.8**	4.08	25	-	5.06	-	14.9	**61.9**	-	**39.9**	8.45	-	**44.2**
Cadmium	mg/kg	400	1,300	400	0.2	375	0.13	-	-	0.15	0.29	-	0.094	0.034	0.12	-	**0.26**	0.057	**375**	-	**0.28**	-	**26.6**	0.14	-	0.14	0.2	-	0.41
Chromium	mg/kg	2,700	6,300	2,700	20.1	117	16.5	-	-	16.1	**28.3**	-	17.9	12.6	14.1	-	**20.5**	13.7	**40.7**	-	14.2	-	**117**	15.4	-	16.5	12.5	-	18.8
Copper	mg/kg	>10,000	>10,000	>10,000	19.5	159	14	-	-	24.2	**159**	-	9.84	5.72	**26.1**	-	**51.4**	7.95	**129**	-	15.9	-	**24.8**	15.4	-	15.3	**20.7**	-	16.4
Lead	mg/kg	880	3,300	880	128.8	3890	45.6	-	-	48.6	56.4	-	28.8	11.3	48.3	-	33.6	38.1	3890	-	71.3	-	**160**	33.1	-	**151**	**126**	-	87.8
Mercury	mg/kg	1,800	4,200	1,800	0.1	5.2	0.061	-	-	0.065	**0.19**	-	0.045	0.055	0.063	-	0.068	0.046	**5.2**	-	0.1	-	**0.43**	0.077	-	**0.13**	0.097	-	**0.32**
Nickel	mg/kg	1,200 [4]	6,000 [4]	600	18	63.1	12.3	-	-	14.3	**41.9**	-	13.3	9.58	11.4	-	**39.3**	11.3	**63.1**	-	11.2	-	**34.3**	11.2	-	11.1	10.2	-	10.5
Zinc	mg/kg	30,000 [4]	400,000 [4]	14,000	166.8	315	82.2	-	-	105	105	-	71.1	37.4	78.5	-	64.2	51.5	**229**	-	68	-	**315**	74.1	-	163	84.7	-	117
Semi-Volatile Organic Compounds																													
Benzo[a]pyrene TEQ (LOR)	mg/kg	40	35	40	0.922 [5]	127	0.3	-	-	0.3	0.2	-	0.9	0.2	**1.3**	-	**1.2**	0.2	**1.7**	-	**3.3**	-	0.8	0.3	-	**20.9**	127	-	**1.4**
Total Phenols	mg/kg	40,000 [4]	240,000 [4]	40,000	NGV	0	<12	-	-	<12	<12	-	<12	<12	<12	-	<12	<12	<12	-	<12	-	<12	<12	-	<12	<12	-	<12
Σ DDT	mg/kg	400	1,000	400	0.431 [9]	9.4		-	-	<0.6	<0.6	-	<0.6	<0.6	<0.6	-	**1.5**	<0.6	0.5	-	<0.6	-	**9.4**	<0.6	-	<0.6	<0.6	-	<0.6
Deildrin	mg/kg	70	160	70	NGV	0	<0.5	-	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	<0.5
Asbestos																													
Asbestos presence/absence		N/A	N/A	Not present	Not present	N/A	-	**Chrysotile, Amosite**	NAD	-	-	NAD	-	-	-	NAD	-	-	NAD	NAD	-	**Chrysotile**	-	-	**Chrysotile, Amosite, Crocidolite**	-	-	**Chrysotile, Amosite, Crocidolite**	-
Asbestos form		N/A	N/A			N/A	-	**Free fibres**	-	-	-	-	-	-	-	-	-	-	-	-	-	**Bitumastic material, fibrous material**	-	-	**Fibrous material, free fibres**	-	-	**Cement sheet**	-
Weight of asebtos in ACM (non-friable) [6]	%w/w	0.02	0.05			1.305	-	0	NAD	-	-	NAD	-	-	-	NAD	-	-	NAD	NAD	-	0	-	-	0	-	-	**1.305**	-
Combined FA + AF [8]	%w/w	0.001	0.001			0.4009	-	0.0055	NAD	-	-	NAD	-	-	-	NAD	-	-	NAD	NAD	-	**<0.001**	-	-	**<0.001**	-	-	0.4009	-

Notes:
Bold indicates that published background concentrations are exceeded.
Red indicates that outdoor worker health criteria are exceeded.
Underlined indicates that recreational land use criteria are exceeded.
Highlighted indicates that Burwood acceptance criteria are exceeded.
- indicates sample has not been analysed.
NAD indicates No Asbestos Detected.
NGV indicates No Guideline Value.
N/A indicates Not Applicable.

1- MfE, 2012 - National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (unless otherwise stated).
2- Burwood Resource Recovery Park acceptance criteria, pers. comms. M Morely (CCC), 16.03.2011 and updated with the NES recreational criteria as he instructed in January 2012.
3- ECan GIS, Trace elements Level 2 from "Background concentrations of selected trace elements in Canterbury soils" prepared for Environment Canterbury by Tonkin and Taylor Ltd, July 2006.
4- ASC NEPM Toolbox - Update Febrary 2014 - www.nepc.gov.au/nepms/assessment-site-contamination/toolbox.
5- ECan 2007, Background concentrations of polycyclic aromatic hydrocarbons in Christchurch urban soils.
6- BRANZ 2017, New Zealand Guidelines for Assessing and Managing Asbestos in Soil; ACM- asbetsos containing material, AF- asbestos fines, FA- fibrous asbestos.
7- MfE, June 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Tier 1 Soil ac ceptance criteria: Commercial/ industrial use, sandy silt, <1 m.Residential is used on a conservative basis
8- MfE, June 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Tier 1 Soil a cceptance criteria: residential use, sandy silt, <1 m.

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Tonkin+Taylor

Job No: 53404.004
7 December 2015

Christchurch City Council
PO Box 73013
Christchurch 8154

Attention: Andrew Rutledge, Unit Manager Parks

Dear Andrew

Additional asbestos investigation in soil - Kyle Park, Hornby

1 Introduction

Tonkin & Taylor Ltd (T+T) has been commissioned by the Christchurch City Council (CCC) to undertake an assessment of asbestos in soils at Kyle Park, Hornby (the site). This assessment was undertaken in accordance with our proposal dated 11th November 2015.

2 Background

Previous investigations undertaken by T+T at the site[1][2] identified the presence of asbestos containing materials (ACM) on the surface and in subsurface soils in landscaped 'garden' areas located on the southern edge of the site. Historical aerial photographs indicate that the entire area of Kyle Park was used as a landfill, where filling was relatively uncontrolled. Fill materials are likely to have been redistributed about the site during re-profiling that occurred in the 1980s and 1990s, and limited topsoil (if any) was applied to help establish the current grassed surface. The potential exists for ACM to be present in fill materials at relatively shallow depths below the current grassed surface.

T+T therefore recommended that investigation of the grassed areas of the site (which are frequently used by the public, including for sports events) should be undertaken to assess for the presence of asbestos in shallow soils and whether additional action may be necessary to minimise the potential for public exposure.

3 Scope

The additional soil investigation comprised:

- A grid-based walkover inspection of the areas not previously investigated by T+T including the grassed fields, stormwater pond area and BMX track;

[1] Kyle Park, Hornby – Desktop Contamination and Geotechnical Study. 53404.002. September 2015.
[2] Kyle Park, Hornby – Investigation of asbestos in landscaped garden areas. 53404.003. 18th November 2015.

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- Hand excavation of 28 test pits to a maximum depth of 0.5 m across the grassed areas of the site;
- Collection and processing of 23 samples in accordance with the Western Australian Guideline[3]; and
- Collection of 6 samples of suspected ACM fragments and analysis for asbestos presence/absence.

4 Results

4.1 Walkover

T+T completed a grid-based walkover of the site on 12th and 16th November 2015. The purpose of the walkover was to identify suspected ACM at the surface, and to note where vegetation cover was poor, exposing the underlying soil. Two passes at 90^{o} were made over each grid square. Fragments of suspected bonded ACM were observed in two areas –

- On unsealed ground immediately outside of the fence line on the eastern side of the site – one fragment was removed from the northern boundary and two were removed from the eastern boundary of the site; and
- Four samples were removed from unsealed ground on the northern side of the BMX track where sections of the track are elevated above the surrounding ground level.

Stressed/thinning vegetation and partly exposed surface soils were observed in a number of locations within the grassed field areas, though no suspected ACM fragments were observed in these areas, or the rest of the grassed areas.

4.2 Test pitting and soil sampling

A total of 28 shallow test pits were excavated by hand on 23rd, 24th and 27th November 2015 (refer Figure 1, attached). Material encountered during excavation typically comprised very firm sandy silts with some gravels and were generally consistent with those previously observed by T+T in the landscaped garden areas. Glass, asphalt, wire and plastic bags were noted in a limited number of locations. Figure 1 shows where suspected ACM fragments were noted, with a distinction drawn between suspected ACM observed in the top 100 mm and suspected ACM observed at greater than 100 mm depth.

Table 1 (attached) presents a summary of analytical results for the samples collected during the test pit investigation. Laboratory analysis certificates are attached to this report.

Analytical results have been compared with:

- The Australian National Environmental Protection Council (Australia, 1999) National Environmental Protection Measures (NEPM), health investigation levels for soil contaminants for:
  - Bonded ACM in Parks, public open spaces, playing field etc; and
  - Friable asbestos (asbestos fines (AF) and fibrous asbestos (FA)) for ‘all uses’.
- Worksafe New Zealand (Worksafe) adopted criterion for restricted work associated with disturbance of soils containing friable asbestos under the Health and Safety in Employment (Asbestos) Regulations 1998 (Asbestos Regulations) (Worksafe New Zealand position statement remediating asbestos contaminated sites October 2014).

[3] Western Australian Department of Health, 2009: Guidelines for the Remediation of Asbestos Containing Soils in Western Australia.

The results indicate that two test pits (TP8 and TP27) contained asbestos with %w/w amounts marginally above the NEPM health investigation level in soils collected from the top 100 mm of the soil profiles. ACM fragments (subsequently confirmed as containing asbestos) were also observed in these test pits. Figures 2 and 3 show the locations of test pits that contained asbestos above and below the NEPM criteria for samples collected from less than 100 mm and deeper than 100 mm, respectively.

The samples collected from TP8 and TP27 also contain friable asbestos above the Worksafe adopted criteria for restricted works.

5 Discussion

Soil sampling completed by T+T within the grassed areas of the site indicate that broadly similar fill materials are present beneath the grassed surface. For the purposes of this assessment T+T has considered samples collected from the top 100 mm of the soil profile, versus samples collected from deeper than 100 mm. The 100 mm depth is consistent with the Worksafe position statement Guidelines and T+T considers it also represents the reasonable maximum anticipated depth of soil disturbance under typical use of the site.

ACM was not detected within the majority of the soil samples collected from the site during this investigation. Friable asbestos was detected marginally above the NEPM risk-based guideline criteria within the top 100 mm of two (TP8 and TP27) of the 20 test pits sampled. TP8 and TP27 are located approximately 250 m apart and are not located in areas where soil is exposed due to absent or thin grass cover. Soil samples and ACM fragments collected from deeper than 0.1 m from TP8 and TP27 also contained asbestos above the NEPM guidelines.

It should be noted that the NEPM risk-based criteria for friable asbestos allow for all site uses, including residential, day care centres, pre -schools etc. These criteria are therefore highly conservative when used in a recreational scenario.

For this reason, T+T considers that the asbestos detected during this investigation, including that detected within samples collected from TP8 and TP27 present a low risk to the public. To provide further confirmatory data, CCC should consider the following additional actions:

- Complete ‘activity-based’ asbestos sampling/monitoring in the vicinity of TP8 and TP27 to assess potential exposure during ‘typical’ use of these areas of the site – for example during mowing and/or additional air monitoring during summer;
- Implement localised controls (if considered necessary) based on the results of the activity-based monitoring;
- Restrict recreational activities at the site to those which have a low potential for soil disturbance or the removal of the grass cover (i.e. minimise vehicular access);
- Implement a site management plan to provide guidance to persons undertaking works at the site which may include soil disturbance (for example drainage works); and
- Provide signage to discourage soil disturbance on the site by members of the public.

6 Applicability

This report has been prepared for the benefit of Christchurch City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Recommendations and opinions in this report are based on data from the sampling locations. The nature and continuity of soil quality away from these locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Paul Walker	Peter Cochrane
Senior Environmental Scientist	Group Manager

7-Dec-15
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Table 1 - Summary of asbestsos analytical results, Kyle Park, Hornby

Sample ID	<2mm+2-7mm asbestos % w/w in sample	7mm asbestos % w/w
TP1-0.0M	NOT DETECTED	
TP1-0.0M	NOT DETECTED	
TP3-0.0M	NOT DETECTED	
TP3-0.5M	0.0002	-
TP3-0.5-S1	-	0.0056
TP4-0.0M	NOT DETECTED	-
TP4 - 0.5M	NOT DETECTED	-
TP5-0.0M	NOT DETECTED	-
TP7-0.0M	NOT DETECTED	-
TP8-0M	0.0011	-
TP8-0-0.1M	-	0.0211
TP9-0.0M	NOT DETECTED	-
TP12-0.0M	NOT DETECTED	-
TP12-0.5M	0.0003	-
TP12-0.5-S1	-	3.6E-05
TP13 - 0.0M	NOT DETECTED	-
TP17-0.0M	NOT DETECTED	-
TP17-0.5M	0.0001	-
TP20-0.0M	NOT DETECTED	-
TP20-0.4M	NOT DETECTED	-
TP21-0.0M	NOT DETECTED	-
TP22-0.0M	NOT DETECTED	-
TP22-0.3-S1	-	0.0012
TP23-WALL	NOT DETECTED	-
TP25 - WALL	0.0001	-
TP26-0.0M	NOT DETECTED	-
TP27-0M	0.0017	-
TP27-0M-S1	-	0.0069
TP27-0.2-0.4M	-	0.0075
TP29-0M	0.0001	-
TP30-0.0M	NOT DETECTED	-
TP34-0.0M	NOT DETECTED	-
Assessment criteria (NEPM all uses)	0.001	
Assessment criteria (Asbestos Regulations - restricted works)	0.001	
NEPM ACM – parks and public open spaces		0.02

Notes

Bold - exceeds Worksafe NZ adopted criterion for restricted work

Highlight - exceeds NEPM 'all uses' criteria

Legend

TP29	Suspected ACM observed in soil >0.1m depth
TP30	Suspected ACM observed in soil<0.1m depth
TP12	Suspected ACM not observed
	Site boundary

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DRAWN	PEW	07/12/15
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FILE :		
APPROX. SCALE (AT A4 SIZE)	NTS	
PROJECT No.	53404.004	

CHRISTCHURCH CITY COUNCIL

KYLE PARK, WATERLOO ROAD, CHRISTCHURCH

Test pit locations – observations of suspected ACM

FIG. No. Figure 1

REV. 0

Legend

TP29	Asbestos detected in soil sample above 0.001% w/w
TP30	Asbestos detected in soil sample below 0.001% w/w
TP12	Asbestos not detected in sample
	Site boundary

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APPROVED		
FILE :		
APPROX. SCALE (AT A4 SIZE)	NTS	
PROJECT No.	53404.004	

CHRISTCHURCH CITY COUNCIL

KYLE PARK, WATERLOO ROAD, CHRISTCHURCH

Test pit locations – sample results (<0.1m depth)

FIG. No. Figure 2

REV. 0

Legend

TP29	Asbestos detected in soil sample above 0.001 % w/w
TP30	Asbestos detected in soil sample below 0.001% w/w
TP12	Asbestos not detected in sample.
	Site boundary

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PROJECT No.	53404.004	

CHRISTCHURCH CITY COUNCIL

KYLE PARK, WATERLOO ROAD, CHRISTCHURCH

Test pit locations – sample results 0.1-0.5m depth

FIG. No. Figure 3

REV. 0

DATE: 1st December 2015

JOB NUMBER: J108825 (1)

PRECISE
CONSULTING & LABORATORY

Tonkin and Taylor (Christchurch)

33 Parkhouse Road
Wigram
Christchurch
8042

Client Reference: 53404.004

Dear Mark Morley,

Re: Asbestos Identification Analysis – 53404.004

Thirty-Two (32) samples received on 25th November 2015 by Luana Piuila-Afitu.

The results of fibre analysis were performed by Adam Maurice of Precise Consulting and Laboratory Ltd on 26th November 2015.

The sample(s) were stated to be from 53404.004 .

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with the guidelines of *AS4964-2004 Method for the qualitative identification of asbestos in bulk samples.*

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

Should you require further information please contact Adam Maurice.

Yours sincerely

Adam Maurice
PRECISE LABORATORY IDENTIFIER

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
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Sample Analysis Results

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Job No: J108825

1 December 2015

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.

Identified by:

Adam Maurice
Approved Identifier

Reviewed by:

Adam Maurice
Key Technical Person

Site Address: 53404.004

Sample ID	Client Sample Number	Sample Location/Description/Dimensions	Analysis Results
BS036105	TP1-0m	Quantitative Asbestos Non-Homogeneous Soil 494.41g	No Asbestos Detected Organic Fibre Type
BS036106	TP1-0.5m	Quantitative Asbestos Non-Homogeneous Soil 577.74g	No Asbestos Detected Organic Fibre Type
BS036108	TP3-0m	Quantitative Asbestos Non-Homogeneous Soil 550.36g	No Asbestos Detected Organic Fibre Type

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Sample Analysis Results

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Job No: J108825

1 December 2015

Site Address: 53404.004			
Sample ID	**Client Sample Number**	**Sample Location/Description/Dimensions**	**Analysis Results**
BS036109	TP3-0.5m	Quantitative Asbestos Non-Homogeneous Soil 739.44g	**Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type**
BS036110	TP3-0.5-S1	>7mm Fragments Low Density Board 3.10g	**Chrysotile + Amosite (White & Brown Asbestos)**
BS036111	TP4-0.0m	Quantitative Asbestos Non-Homogeneous Soil 540.13g	No Asbestos Detected Organic Fibre Type
BS036112	TP4-0.5m	Quantitative Asbestos Non-Homogeneous Soil 682.89g	No Asbestos Detected Organic Fibre Type
BS036113	TP5-0m	Quantitative Asbestos Non-Homogeneous Soil 584.55g	No Asbestos Detected Organic Fibre Type
BS036114	TP7-0m	Quantitative Asbestos Non-Homogeneous Soil 530.27g	No Asbestos Detected Organic Fibre Type
BS036116	TP8-0-0.1m	>7mm Fragments Low Density Board 11.63g	**Chrysotile + Amosite (White & Brown Asbestos)**
BS036117	TP8-0m	Quantitative Asbestos Non-Homogeneous Soil 518.15g	**Chrysotile (White Asbestos) Organic Fibre Type**

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Sample Analysis Results

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Job No: J108825

1 December 2015

Site Address: 53404.004			
Sample ID	**Client Sample Number**	**Sample Location/Description/Dimensions**	**Analysis Results**
BS036118	TP9-0m	Quantitative Asbestos Non-Homogeneous Soil 564.71g	No Asbestos Detected Organic Fibre Type
BS036120	TP12-0m	Quantitative Asbestos Non-Homogeneous Soil 488.59g	No Asbestos Detected Organic Fibre Type
BS036121	TP12-0.5m	Quantitative Asbestos Non-Homogeneous Soil 620.49g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)** **Organic Fibre Type**
BS036122	TP12-0.5-S1	>7mm Fragments Cement Sheet 0.03g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)** **Organic Fibre Type**
BS036123	TP13-0m	Quantitative Asbestos Non-Homogeneous Soil 499.40g	No Asbestos Detected Organic Fibre Type
BS036124	TP17-0m	Quantitative Asbestos Non-Homogeneous Soil 498.40g	No Asbestos Detected Organic Fibre Type
BS036125	TP17-0.5m	Quantitative Asbestos Non-Homogeneous Soil 742.74g	**Chrysotile (White Asbestos)** **Organic Fibre Type**
BS036128	TP20-0m	Quantitative Asbestos Non-Homogeneous Soil 552.88g	No Asbestos Detected Organic Fibre Type

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Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J108825

1 December 2015

Site Address: 53404.004			
Sample ID	**Client Sample Number**	**Sample Location/Description/Dimensions**	**Analysis Results**
BS036129	TP21-0m	Quantitative Asbestos Non-Homogeneous Soil 462.18g	No Asbestos Detected Organic Fibre Type
BS036131	TP22-0m	Quantitative Asbestos Non-Homogeneous Soil 567.61g	No Asbestos Detected Organic Fibre Type
BS036132	TP22-0.3-S1	>7mm Fragments L1 - Vinyl Sheet L2 - Fibrous Backing 2.06g	**Chrysotile (White Asbestos)** **Organic Fibre Type**
BS036133	TP23-Wall	Quantitative Asbestos Non-Homogeneous Soil 549.21g	No Asbestos Detected Organic Fibre Type
BS036134	TP25-Wall	Quantitative Asbestos Non-Homogeneous Soil 667.75g	**Chrysotile (White Asbestos)** **Organic Fibre Type**
BS036135	TP26-0m	Quantitative Asbestos Non-Homogeneous Soil 637.05g	No Asbestos Detected Organic Fibre Type
BS036136	TP27-0m-S1	>7mm Fragments Cement Sheet 7.63g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)** **Organic Fibre Type**
BS036137	TP27-0m	Quantitative Asbestos Non-Homogeneous Soil 486.66g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)** **Organic Fibre Type**

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Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J108825

1 December 2015

Site Address: 53404.004			
Sample ID	**Client Sample Number**	**Sample Location/Description/Dimensions**	**Analysis Results**
BS036138	TP27-0.2-0.4	>7mm Fragments Cement Sheet 8.25g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)** **Organic Fibre Type**
BS036139	TP29-0m	Quantitative Asbestos Non-Homogeneous Soil 551.60g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)** **Organic Fibre Type**
BS036141	TP30-0m	Quantitative Asbestos Non-Homogeneous Soil 538.65g	No Asbestos Detected Organic Fibre Type
BS036143	TP34-0m	Quantitative Asbestos Non-Homogeneous Soil 569.22g	No Asbestos Detected Organic Fibre Type
BS036146	TP20-0.4m	Quantitative Asbestos Non-Homogeneous Soil 692.56g	No Asbestos Detected Organic Fibre Type

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Appendix 1: Soil Analysis Raw Data

Job No: J108825

Tuesday, 1st November 2015

Sample ID	Client Sample Number	Sample Weights						>7mm Asbestos Containing Material (ACM)[1]		Asbestos Fines/Fibrous Asbestos[1]				Trace Asbestos Detected (Y/N)[2]
		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 & %[3]	2-7mm ACM (g)	Form & %[3]	<2mm ACM (g)	Form & %[3]	
BS036105	TP1-0m	-	494.41	-	26.33	102.22	365.86	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036106	TP1-0.5m	-	577.74	-	25.03	102.66	450.05	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036108	TP3-0m	-	550.36	-	9.85	101.16	439.35	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036109	TP3-0.5m	-	739.44	-	11.49	103.78	624.17	-	-	0.004	Low Density Board 30%	No Asbestos Detected	-	No
BS036110	TP3-0.5-S1	-	-	3.10	-	-	-	3.10	Low Density Board 30%	-	-	-	-	-
BS036111	TP4-0.0m	-	540.13	-	135.58	101.08	303.47	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036112	TP4-0.5m	-	682.89	-	18.29	100.64	563.96	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No

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Sample ID	Client Sample Number	Sample Weights						>7mm Asbestos Containing Material (ACM)[1]		Asbestos Fines/Fibrous Asbestos[1]				Trace Asbestos Detected (Y/N)[2]
		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 & %[3]	2-7mm ACM (g)	Form & %[3]	<2mm ACM (g)	Form & %[3]	
BS036113	TP5-0m	-	584.55	-	30.71	101.32	452.52	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036114	TP7-0m	-	530.27	-	44.90	102.32	383.05	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036116	TP8-0-0.1m	-	-	11.63	-	-	-	11.63	Low Density Board 30%	-	-	-	-	-
BS036117	TP8-0m	-	518.15	-	25.61	102.26	390.28	-	-	<0.001	Free Fibres 100%	<0.001	Free Fibres 100%	No
BS036118	TP9-0m	-	564.71	-	1.88	101.49	461.34	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036120	TP12-0m	-	488.59	-	14.85	101.91	371.83	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036121	TP12-0.5m	-	620.49	-	30.75	102.25	487.49	-	-	0.005	Cement Sheet 20%	<0.001	Cement Sheet 20%	No
BS036122	TP12-0.5-S1	-	-	0.03	-	-	-	0.03	Cement Sheet 20%	-	-	-	-	-
BS036123	TP13-0m	-	499.40	-	26.83	101.57	371.00	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036124	TP17-0m	-	498.40	-	36.40	101.47	360.53	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No

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Sample ID	Client Sample Number	Sample Weights						>7mm Asbestos Containing Material (ACM)[1]		Asbestos Fines/Fibrous Asbestos[1]				Trace Asbestos Detected (Y/N)[2]
		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 & %[3]	2-7mm ACM (g)	Form & %[3]	<2mm ACM (g)	Form & %[3]	
BS036125	TP17-0.5m	-	742.74	-	161.49	103.10	478.15	-	-	<0.001	Free Fibre Bundle	No Asbestos Detected	-	No
BS036128	TP20-0m	-	552.88	-	65.46	101.79	385.63	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036129	TP21-0m	-	462.18	-	22.82	101.25	338.11	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036131	TP22-0m	-	567.61	-	132.45	103.47	331.69	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036132	TP22-0.3-S1	-	-	2.06	-	-	-	2.06	Vinyl Sheet 10%	-	-	-	-	-
BS036133	TP23-Wall	-	549.21	-	74.40	102.20	372.61	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036134	TP25-Wall	-	667.75	-	74.94	102.40	490.41	-	-	<0.001	Free Fibres 100%	No Asbestos Detected	-	No
BS036135	TP26-0m	-	637.05	-	99.78	102.36	434.91	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036136	TP27-0m-S1	-	-	7.63	-	-	-	7.63	Cement Sheet 15%	-	-	-	-	-
BS036137	TP27-0m	-	486.66	-	94.24	102.70	289.72	-	-	0.037	Cement Sheet 15%	0.005	Cement Sheet 15%	No

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Sample ID	Client Sample Number	Sample Weights						>7mm Asbestos Containing Material (ACM)[1]		Asbestos Fines/Fibrous Asbestos[1]				Trace Asbestos Detected (Y/N)[2]
		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 & %[3]	2-7mm ACM (g)	Form & %[3]	<2mm ACM (g)	Form & %[3]	
BS036138	TP27-0.2-0.4	-	-	8.25	-	-	-	8.25	Cement Sheet 15%	-	-	-	-	-
BS036139	TP29-0m	-	551.60	-	20.17	100.98	430.45	-	-	0.003	Cement Sheet 15%	No Asbestos Detected	-	No
BS036141	TP30-0m	-	538.65	-	28.54	102.51	407.60	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036143	TP34-0m	-	569.22	-	72.60	102.37	394.25	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No
BS036146	TP20-0.4m	-	692.56	-	177.24	103.58	411.74	-	-	No Asbestos Detected	-	No Asbestos Detected	-	No

1 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
2 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.
3 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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Tonkin+Taylor

Job No: 53404.004
23 November 2015

Christchurch City Council
PO Box 73013
Christchurch 8154

Attention: Andrew Rutledge, Unit Manager Parks

Dear Andrew

Asbestos in air sampling results - Kyle Park, Hornby

1 Introduction

Tonkin & Taylor Ltd (T+T) is pleased to present the results of asbestos in air sampling undertaken at Kyle Park, Hornby (the site) on behalf of the Christchurch City Council (CCC). The air sampling was undertaken in accordance with our proposal of 22 October 2015.

2 Background and objectives

During a previous investigation of landscaped garden areas at the site by T+T in October 2015[1], asbestos was detected in surface mulch and shallow soils at concentrations above current risk-based human health exposure criteria. This indicated that the landscaped areas contained asbestos materials that could if disturbed or degraded present a hazard to human health.

T+T recommended that air sampling should be undertaken to assess potential public exposure to airborne asbestos fibres during general use of the site. This letter report summarises the findings of the sampling undertaken by T+T. Preliminary findings of the air sampling were previously provided to the CCC by email on 5th November 2015.

3 Scope of works

The air monitoring undertaken by T+T comprised:

- The collection of samples from four locations (both upwind and downwind) on a daily basis for a period of 4 days (30th October to 2nd November 2015) using SKC Airchek® XR5000 sample pumps set at an approximate flow rate of 2L/min;
- Submission of samples to Precise Consulting and Laboratories Ltd (Precise) for analysis in accordance with Safe Work Australia's Guidance Note on the Membrane Filter Method for the Estimation of Airborne Asbestos Fibres; 2nd Edition, 2005 (NOHSC:3003(2005));
- Comparison of analytical results against the current asbestos in air guideline value of 0.01 fibre/ml air as per the requirements of the Health and Safety in Employment (Asbestos) Regulations 1998 (in the absence of NZ guidelines for asbestos in air in public spaces); and
- The preparation of this summary report.

[1] Kyle Park, Hornby – Investigation of Asbestos in Landscaped Garden Areas. 53404.003. Tonkin & Taylor Ltd. 12th November 2015.

Tonkin & Taylor Ltd | 33 Parkhouse Rd, Wigram, Christchurch, 8042, New Zealand | PO Box 13-055, Christchurch 8141
P +64-3-363 2440 F +64-9-307 0265 E chc@tonkintaylor.co.nz

4 Results

Table 1 (attached to this report) summarises the analytical results. Laboratory analysis certificates are also attached and include sampling duration and pump flow rate details. Sample locations are shown in Figure 1.

Whilst fibres were detected in two samples collected from downwind sampling locations, none of the samples recorded fibre counts above the current guideline value of 0.01 f/ml. These meet the requirements of the Health and Safety in Employment (Asbestos) Regulations (1998).

5 Discussion

The sampling conducted indicates that airborne fibres did not exceed the current guideline value at the locations sampled and during the weather conditions that occurred during the sampling period. It is noted that the landscaped garden areas were fenced off during the monitoring period. Consequently, there is likely to have been little or no human disturbance of the surface mulch and sub-surface soil during this time.

Additional monitoring is recommended if the landscaped garden areas are left in their current state into the summer, during drier conditions when conditions may allow increased mobilisation of asbestos fibres into the air. Monitoring should also be undertaken during any disturbance of the material – for example during covering of the mulched areas or garden maintenance works.

6 Applicability

This report has been prepared for the benefit of Christchurch City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Recommendations and opinions in this report are based on data from the sampling locations. The nature and continuity of air quality away from these locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Paul Walker	Gordon Ashby
Senior Contaminated Land Specialist	Project Director

\\chcdc\data\rep\live\tt\projects\53404\53404.0040\issueddocuments\53404.004 kyle park asbestos in air report.docx

Appendix A: Figure 1

Key

	Sampling date
KP01	30/10/15
KP01	31/10/15
KP01	1-2/11/15

Tonkin+Taylor
Environmental and Engineering Consultants
www.tonkin.co.nz

DRAWN	PEW	11/15
DRAFTING CHECKED		
APPROVED		
FILE :		
APPROX. SCALE (AT A4 SIZE)	NTS	
PROJECT No.	53404.004	

Christchurch City Council

Air sampling locations

Kyle Park, Waterloo Road, Christchurch

FIG. No. Figure 1

REV. 0

Appendix B: Laboratory certificates

Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

REPORT IDENTIFICATION NUMBER: AA01

CLIENT NAME & ADDRESS:

Tonkin and Taylor (Christchurch)
33 Parkhouse Road
Wigram
Christchurch 8042

SAMPLED BY:

Louise Murphy

JOB NUMBER: J108096

Client Reference: 53404.003

JOB LOCATION:

Hornby

TEST TYPE:

Air Monitoring

TEST METHOD:

- Filters examined in accordance with Safe Work Australia's Guidance Note on the Membrane Filter Method for the Estimation of Airborne Asbestos Fibres, 2nd Edition, 2005 [NOHSC:3003 (2005)].

RESULTS:

Sample locations, sample times, flow rates, fibres/field and results are shown in the appended table.

NOTES:

The results within this test report only relate to the samples tested.

Approved Counter: Julian Staite

Key Technical Person: Julian Staite

Issue Date: April 2015 | Version 9

Precise Consulting & Laboratory Limited
Unit 4, 91 Byron Street, Sydenham Christchurch City, 8023
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Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

JOB NUMBER: J108096

SAMPLED BY: Louise Murphy

Site Address: Hornby,

Sample No / Filter No	Location	Sampling Type	Time		Average Flow Rate L/min	Fibres	Fields	F/mL
			On	Off				
AA001528 / PCL 131	KP 04	Background	12:25	16:25	2.00	0.0	100	<0.01
AA001529 / PCL 035	KP 01	Background	12:35	16:35	1.95	0.0	100	<0.01
AA001530 / PCL 095	KP 02	Background	11:25	15:25	2.00	0.0	100	<0.01
AA001531 / PCL 126	KP 03	Background	12:00	16:00	1.98	0.0	100	<0.01
AA001543 / PCL 086	Field Blank		N/A	N/A	N/A	0.0	100	N/A

Work in progress:
Background Air Monitoring
Date Sampled: 30/10/15

Discussion of results:
The sample results reported in the above table were below the recommended control levels outlined in Section 9 of the Asbestos — New Zealand guidelines for the management and removal of asbestos (3rd Edition), should be compared to the concentrations below:
F/ml Air < 0.01 ***Below recommended control levels***
F/ml Air > 0.01 ***Above recommended control levels***

Control levels refer to respirable airborne asbestos fibre concentrations which, if exceeded, indicate there is a need to review current control measures or take other action.

Issue Date: April 2015 | Version 9
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Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

REPORT IDENTIFICATION NUMBER: AA01

CLIENT NAME & ADDRESS:

Tonkin and Taylor (Christchurch)
33 Parkhouse Road
Wigram
Christchurch 8042

SAMPLED BY:

Louise Murphy

JOB NUMBER: J108094

Client Reference: 53404.003

JOB LOCATION:

Hornby

TEST TYPE:

Air Monitoring

TEST METHOD:

- Filters examined in accordance with Safe Work Australia's Guidance Note on the Membrane Filter Method for the Estimation of Airborne Asbestos Fibres, 2nd Edition, 2005 [NOHSC:3003 (2005)].

RESULTS:

Sample locations, sample times, flow rates, fibres/field and results are shown in the appended table.

NOTES:

The results within this test report only relate to the samples tested.

Approved Counter: Julian Staite

Key Technical Person: Julian Staite

Issue Date: April 2015 | Version 9

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Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

JOB NUMBER: J108094

SAMPLED BY: Louise Murphy

Site Address: Hornby,

Sample No / Filter No	Location	Sampling Type	Time		Average Flow Rate L/min	Fibres	Fields	F/mL
			On	Off				
AA001532 / PCL 104	KP 01	Background	11:30	15:30	2.00	0.0	100	<0.01
AA001533 / PCL 155	KP 02	Background	11:35	15:35	2.03	1.0	100	<0.01
AA001534 / PCL 137	KP 03	Background	11:40	15:40	2.03	1.0	100	<0.01
AA001535 / PCL 174	KP 04	Background	12:00	16:00	2.00	0.0	100	<0.01
AA001541 / PCL 058	Field Blank		N/A	N/A	N/A	0.0	100	N/A

Work in progress:
Background Air Monitoring
Date Sampled: 31/10/15

Discussion of results:
The sample results reported in the above table were below the recommended control levels outlined in Section 9 of the Asbestos — New Zealand guidelines for the management and removal of asbestos (3rd Edition), should be compared to the concentrations below:
F/ml Air < 0.01 ***Below recommended control levels***
F/ml Air > 0.01 ***Above recommended control levels***

Control levels refer to respirable airborne asbestos fibre concentrations which, if exceeded, indicate there is a need to review current control measures or take other action.

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Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

JOB NUMBER: J108095

REPORT IDENTIFICATION NUMBER: AA01

Client Reference: 53404.003

CLIENT NAME & ADDRESS:

JOB LOCATION:

Tonkin and Taylor (Christchurch)
33 Parkhouse Road
Wigram
Christchurch 8042

Hornby

SAMPLED BY:

TEST TYPE:

Louise Murphy

Air Monitoring

TEST METHOD:

- Filters examined in accordance with Safe Work Australia's Guidance Note on the Membrane Filter Method for the Estimation of Airborne Asbestos Fibres, 2nd Edition, 2005 [NOHSC:3003 (2005)].

RESULTS:

Sample locations, sample times, flow rates, fibres/field and results are shown in the appended table.

NOTES:

The results within this test report only relate to the samples tested.

Approved Counter: Julian Staite

Key Technical Person: Julian Staite

Issue Date: April 2015 | Version 9
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IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

JOB NUMBER: J108095

SAMPLED BY: Louise Murphy

Site Address: Hornby,

Sample No / Filter No	Location	Sampling Type	Time		Average Flow Rate L/min	Fibres	Fields	F/mL
			On	Off				
AA001536 / PCL 083	KP 01	Background	09:40	13:40	2.00	0.0	100	<0.01
AA001537 / PCL 141	KP 02	Background	09:45	13:45	2.00	0.0	100	<0.01
AA001538 / PCL 151	KP 03	Background	09:50	13:50	2.03	0.0	100	<0.01
AA001539 / PCL 011	KP 04	Background	10:00	14:00	2.00	0.0	100	<0.01
AA001542 / PCL 170	Field Blank		N/A	N/A	N/A	0.0	100	N/A

Work in progress:
Background Air Monitoring
Date Sampled: 1/11/15

Discussion of results:
The sample results reported in the above table were below the recommended control levels outlined in Section 9 of the Asbestos — New Zealand guidelines for the management and removal of asbestos (3rd Edition), should be compared to the concentrations below:
F/ml Air < 0.01 ***Below recommended control levels***
F/ml Air > 0.01 ***Above recommended control levels***

Control levels refer to respirable airborne asbestos fibre concentrations which, if exceeded, indicate there is a need to review current control measures or take other action.

Precise Consulting & Laboratory Limited
Unit 4, 91 Byron Street, Sydenham Christchurch City, 8023
P: (03) 943 5394 W: www.preciseconsulting.co.nz

Airborne Fibre Analysis

Test Report

REPORT DATE: 3 Nov 2015

REPORT IDENTIFICATION NUMBER: AA01

CLIENT NAME & ADDRESS:

Tonkin and Taylor (Christchurch)
33 Parkhouse Road
Wigram
Christchurch 8042

SAMPLED BY:

Louise Murphy

JOB NUMBER: J108090

Client Reference: 53404.003

JOB LOCATION:

Hornby

TEST TYPE:

Air Monitoring

TEST METHOD:

- Filters examined in accordance with Safe Work Australia's Guidance Note on the Membrane Filter Method for the Estimation of Airborne Asbestos Fibres, 2nd Edition, 2005 [NOHSC:3003 (2005)].

RESULTS:

Sample locations, sample times, flow rates, fibres/field and results are shown in the appended table.

NOTES:

The results within this test report only relate to the samples tested.

Approved Counter: Julian Staite

Key Technical Person: Julian Staite

Issue Date: April 2015 | Version 9

Precise Consulting & Laboratory Limited
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P: (03) 943 5394 W: www.preciseconsulting.co.nz

Airborne Fibre Analysis

Test Report

PRECISE
CONSULTING & LABORATORY

REPORT DATE: 3 Nov 2015

JOB NUMBER: J108090

SAMPLED BY: Louise Murphy

Site Address: Hornby,

Sample No / Filter No	Location	Sampling Type	Time		Average Flow Rate L/min	Fibres	Fields	F/mL
			On	Off				
AA001524 / PCL 149	KP 03	Background	08:40	12:40	2.03	0.0	100	<0.01
AA001525 / PCL 175	KP 02	Background	08:50	12:50	2.00	0.5	100	<0.01
AA001526 / PCL 017	KP 01	Background	08:15	12:15	2.00	0.0	100	<0.01
AA001527 / PCL 101	KP 04	Background	08:30	12:30	2.00	0.0	100	<0.01
AA001540 / PCL 103	Field Blank		N/A	N/A	N/A	0.0	100	N/A

Work in progress:
Background Air Monitoring
Date Sampled: 02/11/15

Discussion of results:
The sample results reported in the above table were below the recommended control levels outlined in Section 9 of the Asbestos — New Zealand guidelines for the management and removal of asbestos (3rd Edition), should be compared to the concentrations below:
F/ml Air < 0.01 ***Below recommended control levels***
F/ml Air > 0.01 ***Above recommended control levels***

Control levels refer to respirable airborne asbestos fibre concentrations which, if exceeded, indicate there is a need to review current control measures or take other action.

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Appendix C: Table 1

Table 1: Summary of asbestos in air monitoring results, 30th October - 2nd November 2015.

Date of Sampling	Weather Conditions	Station/sample	Upwind/downwind	Result	
				Fibres/field	fibres/ml
30th October 2015	Dry, south-easterly wind turning south-west.	KP01	Down	0/100	<0.01
		KP02	Up	0/100	<0.01
		KP03	Down	0/100	<0.01
		KP04	Up	0/100	<0.01
31st October 2015	Sunny, calm, southerly wind.	KP01	Down	0/100	<0.01
		KP02	Down	1/100	<0.01
		KP03	Down	1/100	<0.01
		KP04	Up	0/100	<0.01
1st November 2015	Sunny, calm, north-easterly wind.	KP01	Up	0/100	<0.01
		KP02	Down	0/100	<0.01
		KP03	Down	0/100	<0.01
		KP04	Down	0/100	<0.01
2nd November 2015	Sunny, calm, north-easterly wind.	KP01	Up	0/100	<0.01
		KP02	Down	0.5/100	<0.01
		KP03	Down	0/100	<0.01
		KP04	Down	0/100	<0.01

Tonkin+Taylor

Job No: 53404.003
18 November 2015

Christchurch City Council
PO Box 73013
Christchurch 8154

Attention: Dale McEntee, Resource Consents Compliance Coordinator

Dear Dale

Kyle Park, Hornby - Investigation of asbestos in landscaped garden areas

1 Introduction

Tonkin & Taylor Ltd (T+T) has been commissioned by the Christchurch City Council (CCC) to undertake an investigation of asbestos in soils in landscaped garden areas at Kyle Park, Hornby, Christchurch (the Site). This letter presents the findings of that investigation, which was undertaken in accordance with the T+T proposal dated 25the September 2015.

2 Background

T+T has recently completed a Desktop Ground Contamination and Geotechnical Study[1] of Kyle Park. During the assessment T+T undertook a walkover inspection of the site on 27th August 2015, during which fragments of (what was later confirmed to be) asbestos containing material (ACM) were observed on the ground surface within a landscaped area in the south west of the site.

During our subsequent site meeting on 15th September, we noted the presence of additional fragments in the same publicly accessible landscaped area and these are also suspected to be ACM (and which were removed).

The source of the confirmed and suspected ACM fragments is not known. However it is considered unlikely that it was deposited on the surface of the landscaped areas as fly-tipped demolition materials. It is considered more plausible that it had been exposed over time from subsurface fill materials used in the construction of the landscaped areas, or it was inadvertently imported within mulch material that covers a large extent of the southern boundary of the site.

Given the confirmed presence of ACM, T+T recommended that analysis of mulch materials and surface soils should be undertaken to assess the potential for human exposure to asbestos in the landscaped garden areas of the site.

This report presents the findings of the investigation undertaken by T+T subsequent to the September 2015 reported referred to above and summarises discussions between T+T and the CCC regarding the management of asbestos in soils at the site. Preliminary findings of the investigation were reported by email (27th October 2015).

[1] Kyle Park, Hornby – Desktop Contamination and Geotechnical Study. Job Number 53404.002. September 2015.

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3 Scope

3.1 Field Investigation

The investigation undertaken by T+T comprised:

- A detailed walkover of the landscaped garden areas to identify and remove visible fragments of suspected ACM, to record the approximate location where the fragments were encountered and visually identify the presence of associated waste materials (e.g. building rubble);
- Surface soil and mulch sampling from four locations within the landscaped gardens where surface ACM was identified. Samples were collected and processed from mulch fines and near-surface soil using the Western Australian Guideline[2] risk-based quantitative method for assessing asbestos content in soil (WA Guidelines); and
- Assessment of shallow sub-surface soils from five hand excavated test pits to visually assess subs-surface materials for the presence of suspected ACM, to identify is such soils may be a potential source of ACM observed on the surface. Subsurface soil samples were collected and processed from two of the pits in accordance with the WA Guidelines.

The extent of the T+T walkover and sample locations are shown in Figure 1 attached.

3.2 Laboratory analysis

A total of eight samples of suspected ACM were submitted for asbestos identification analysis. Four samples of mulch fines/surface soils and two samples of sub-surface soils were submitted for analysis for asbestos identification and content.

All asbestos analysis was undertaken by IANZ accredited Precise Consulting and Laboratory Ltd (Precise). Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with the guidelines of *AS4964-2004, Method for the qualitative identification of asbestos in bulk samples*.

4 Results

4.1 Walkover

T+T completed a detailed walkover of the five landscaped garden areas shown in Figure 1 (attached) on 13th and 16th October 2015. Owing to the generally overgrown nature of the garden areas it was not possible to conduct grid-based observation, however each area was inspected in as methodical manner as practicable, with at least two passes made over each area.

Based on topography, location and vegetation growth/extent the five areas are described as:

- Area 1 – the far south-western edge of the site, to the south-west of the stormwater pond, typically sloping ground with dense shrub and tree cover;
- Area 2 – south of the stormwater pond and BMX track, characterised by gently sloping ground containing established eucalypt trees and little mulch or vegetation cover;
- Area 3 – landscaped garden area either side of the underpass to Denton Park, moderately dense shrub growth and mulch cover;
- Area 4 – landscaped garden area bordering an industrial site to the east. Generally flat and with dense shrub growth and mulch cover; and

[2] Western Australian Department of Health, 2099: Guidelines for Remediation of Asbestos Containing Soils in Western Australia.

- Area 5, bordering the sports field on the far east of the Park. Moderate to dense shrub growth and mulch cover on a flat to gently sloping ground surface.

Photographs taken during the walkover at each of the five areas are shown in Photographs 1-10 (appendix C – appended).

Suspected ACM fragments were observed and collected from all five of the above areas. Table 4.1 below summarises the number of suspected ACM fragments observed and removed from each area.

Table 4.1: Summary of suspected ACM fragments removed from landscape garden areas (13 – 16 October)

Garden Area	No. suspect ACM fragments found	No. fragments analysed	No. confirmed asbestos
1	29	3	3
2	94	4	4
3	4	0	
4	0*	0	
5	34	1	1

*- the suspected ACM fragments had been removed during site walkover on 15th September 2015.

% w/w – percentage weight for weight.

Table 4.1 indicates that the suspected ACM samples were identified by Precise as comprising:

- Cement sheet (flat board with dimples);
- Low density board;
- Suspect Super 6 cement sheet; and
- Cement board (discoloured pink).

All suspected fragments submitted to the laboratory were confirmed by Precise to contain asbestos in the form of amosite, chrysotile and/or crocidolite. Laboratory analytical certificates are appended to this report (refer Appendix B).

Generally a mixture of the above types was observed in each of the garden areas. Although no suspected ACM fragments were submitted for analysis from Areas 3 and 4, it is considered that the fragments collected from these areas are consistent with those confirmed as containing asbestos within the other areas sampled.

4.2 Surface soil and mulch sampling

Four samples of mulch fines/surface soils were collected from the garden areas. The sampled locations are shown on Figure 1.

Analytical results are summarised in Table 4.2 below. Laboratory analytical certificates are appended to this report (Appendix B).

Analytical results have been compared with:

- The Australian National Environmental Protection Council (Australia, 1999) National Environmental Protection Measures (NEPM), health investigation levels for soil contaminants for:
  - Bonded ACM in Parks, public open spaces, playing field etc.; and
  - Asbestos fines for ‘all uses’.

- Worksafe New Zealand adopted criterion for restricted work associated with disturbance of soils containing asbestos fines under the Health and Safety in Employment (Asbestos) Regulations 1998 (Asbestos Regulations) (Worksafe New Zealand position statement remediating asbestos contaminated sites October 2014).

The results show that three of the four samples analysed contain asbestos above risk-based guidelines for unrestricted use ('all uses') and above Worksafe NZ 'restricted works' criteria. This indicates that surface soils/mulch in the landscaped areas contain asbestos that could, if disturbed or degraded, result in the release of fibres that may present a hazard to human health.

Table 4.2: Asbestos in mulch fines and surface soils

Garden Area	Sample ID	Asbestos fines (<2 mm+2-7 mm % w/w)	Bonded ACM >7 mm (%w/w)
5	TP1 0.1	0.002	-
2	TP 3 0.1	0.0059	0.166
2	TP4 0.1	0.0009	-
1	TP6 0.1	0.0026	0.006
Assessment criteria (NEPM all uses)		0.001	
Assessment criteria (Asbestos Regulations - restricted works)		0.001	
NEPM ACM – parks and public open spaces			0.02

% w/w – percentage weight for weight.

4.3 Assessment of sub surface soils

Shallow test pits were excavated to between 0.3 and 0.5 m depth within garden areas 5 (TP1, TP5, TP6) and 2 (TP4, TP3). A summary of the material observed in each pit is provided in Table 4.3 below.

Table 4.3: Summary of subsurface materials

Garden area 5	Garden Area 2		Garden Area 1	
TP1	**TP3**	**TP4**	**TP5**	**TP6**
0.0 m-0.2 m sandy silt with gravels. 0.2 m-0.5 m as above with fragments of suspected ACM.	0.0 m-0.1 m, fill material – fragments of suspected ACM, concrete, glass, asphalt, gravels. 0.4 m-0.5 m, as above plus plastic waste.	0.0 m-0.1 m, bark mulch, gravels, sandy silt. 0.1 m-0.5 m, sandy silts with gravels. Trace concrete, brick, asphalt, Fragments of suspected ACM 0.4 m-0.5 m.	0.0 m-0.3 m bark mulch, 0.3 m-0.4 m sandy silt with gravels.	0.0 m-0.1 m bark mulch, sandy silt, gravels, suspect ACM fragments, 0.1 m-0.3 m, yellow brown sands with gravels.

Suspected ACM fragments were observed within three of the five test pits excavated.

Soil samples were collected from two test pits (TP1, TP4) for analysis for asbestos. Table 4.4 summarises the analytical results for these samples.

As with the surface soils, analytical results have been compared with NEPM and Worksafe NZ risk-based criteria.

Table 4.4: Summary of subsurface soil asbestos analysis.

Garden Area	Sample ID	<2 mm+2-7 mm (% w/w)	>7 mm (%w/w)
1	TP1-0.4	0.0869	0.177
2	TP4-0.5	0.0079	0.203
Assessment criteria (all uses)		0.001	
Assessment criteria (asbestos regulations - restricted works)		0.001	
ACM – parks and public open spaces		-	0.02

% w/w – percentage weight for weight.

The results show that subsurface soils in both TP1 and TP 4 contained asbestos above the assessment criteria.

The site is a former landfill which was redeveloped into a public park in the 1980s and further developed in the 1990s. Historical aerial photographs indicate that fill was placed over the entire site area and anecdotal evidence indicates that filling was relatively uncontrolled. Earthworks undertaken during the development of the site in the 1990s is likely to have resulted in the redistribution of fill materials. In addition, fill materials are likely to have been used to form the sloped garden areas in Areas 1 and 5.

Whilst waste materials were not observed in all test pits, all excavations undertaken during the investigations contained fill materials. Therefore the potential for fill materials to exist beneath the wider site and to contain asbestos cannot be discounted.

5 Discussion

In summary, T+T's investigation of asbestos in soils within in landscaped garden areas at Kyle Park has found that:

- ACM fragments were observed on the ground surface and mixed with the surface cover of bark mulch across the landscaped garden areas that are located on the southern edges of the Park;
- ACM fragments were also observed within shallow sub-surface fill materials within three of five shallow test pits excavated in the garden areas;
- On this basis, it would appear that the ACM is derived from pre-existing fill materials that underlie the garden areas (and also expected to be present beneath the wider site) and not imported within the bark mulch as initially thought;
- Asbestos fines and bonded ACM is present within the surface mulch/fines layer at % weight/weight content above risk-based guidelines and could, if disturbed or degraded, result in the release of fibres that may present a hazard to human health;
- The % weight/weight content of asbestos in the samples analysed also exceed the Worksafe NZ criterion for the definition of 'restricted works'. Disturbance of this material, for example during covering, planting and maintenance works, would require notification to Worksafe NZ and overseen by a person holding the appropriate Certificate of Competence;
- CCC has placed fencing around landscaped areas as an interim measure to reduce the potential for public access and disturbance of ACM and asbestos fibres in mulch and soil materials in the garden areas;
- The fencing is considered to be a temporary solution and CCC has sought advice from T+T regarding potentially suitable options to manage long-term hazards associated with asbestos exposure and which might then allow the fencing to be removed. T+T has suggested that the landscaped areas where asbestos has been detected could be covered with geotextile and mulch. However the practicalities of this (including long-term maintenance issues and costs) should be discussed with an experienced asbestos removal contractor;
- Due to the presence of asbestos ongoing monitoring and management will be required as part of the measures installed. This should include monitoring and maintaining the integrity of the measures, and providing procedures to be implemented during future soil disturbing works within the site;
- It is recommended that a site management plan (SMP) should be prepared to document:
  - The containment procedures;
  - Monitoring requirements during and following the containment works;
  - Triggers and contingency actions (for example in the event of dust generations during disturbance works); and
  - Guidance for those undertaking future works on the site that may result in the disturbance of the covering and asbestos containing materials (for example drainage repairs, garden maintenance, planting).

6 Applicability

This report has been prepared for the benefit of Christchurch City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

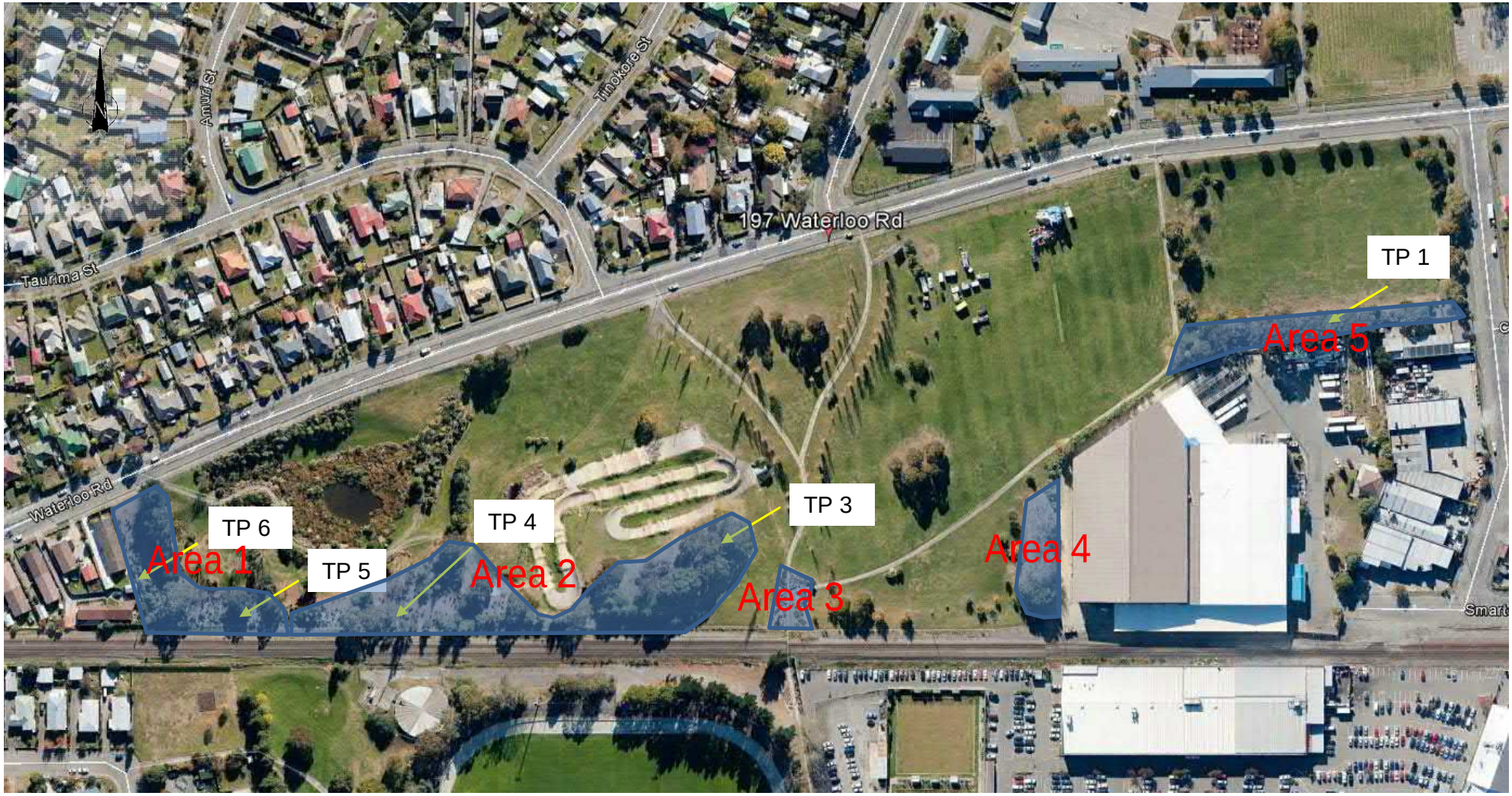
Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Paul Walker	Gordon Ashby
Senior Contaminated Land Specialist	Project Director

\\chcdc\data\rep\live\tt\projects\53404\53404.0030\issueddocuments\20151118 kyle park soil investigation.docx

Appendix A: Figure 1



Tonkin+Taylor
Environmental and Engineering Consultants
www.tonkin.co.nz

DRAWN	PEW	11/15
DRAFTING CHECKED		
APPROVED		
FILE :		
APPROX. SCALE (AT A4 SIZE)	NTS	
PROJECT No.	53404.003	

Christchurch City Council

Landscape Area ACM Assessment

Kyle Park, Waterloo Road, Christchurch

FIG. No. Figure 1

REV. 0

Appendix B: Laboratory certificates

DATE: 16th October 2015

JOB NUMBER: J107654 (1)

PRECISE
CONSULTING & LABORATORY

Tonkin and Taylor (Christchurch)

33 Parkhouse Road
Wigram
Christchurch
8042

Client Reference: 53404.0030

Dear Mark Morley,

Re: Asbestos Identification Analysis – 53404.0030

Eight (8) samples received on 16th October 2015 by Luana Piuila-Afitu.

The results of fibre analysis were performed by Tim Trembath of Precise Consulting and Laboratory Ltd on 16th October 2015.

The sample(s) were stated to be from 53404.0030 .

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with the guidelines of AS4964-2004 Method for the qualitative identification of asbestos in bulk samples.

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

Should you require further information please contact Tim Trembath.

Yours sincerely

Tim Trembath
PRECISE LABORATORY IDENTIFIER

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Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
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Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J107654

16 October 2015

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.

Identified by:

Tim Trembath
Approved Identifier

Reviewed by:

Tim Trembath
Key Technical Person

Site Address: 53404.0030

Sample ID	Client Sample Number	Sample Location/Description/Dimensions	Analysis Results
BS032228	S1	Grid C1 - Flat Board with Laserations Cement Sheet 62 x 40 x 5mm	Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type
BS032229	S2	Grid C1 - Flat Board, Light Cement Sheet 49 x 31 x 5mm	Chrysotile (White Asbestos) Organic Fibre Type

Precise Consulting & Laboratory Ltd Limited
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Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J107654

16 October 2015

Site Address: 53404.0030			
Sample ID	Client Sample Number	Sample Location/Description/Dimensions	Analysis Results
BS032230	S3	Grid B1 - Flat Board, With Dimples Cement Sheet 88 x 63 x 5mm	Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type
BS032231	S4	Grid A6 - Flat Board, Friable at Touch (10mm) Low Density Board 64 x 47 x 10mm	Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type
BS032232	S5	Grid A8 - Suspect Super 6 Cement Sheet 115 x 114 x 6mm	Chrysotile (White Asbestos) Organic Fibre Type
BS032233	S6	Grid B12 - Flat Board, Pink Discolouration Cement Sheet 54 x 47 x 9mm	Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos) Organic Fibre Type
BS032234	S7	Grid B12 - Flat Board, Pink Cement Sheet 36 x 43 x 5mm	Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type
BS032235	S8	Grid F25 - Flat Board, Pink Cement Sheet 47 x 36 x 5mm	Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type

Precise Consulting & Laboratory Ltd Limited
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P: (03) 943 5394 W: www.preciseconsulting.co.nz

DATE: 27th October 2015

JOB NUMBER: J107714 (2)

PRECISE
CONSULTING & LABORATORY

Tonkin and Taylor (Christchurch)

33 Parkhouse Road
Wigram
Christchurch
8042

Client Reference: 53404.003

Dear Mark Morley,

Re: Asbestos Identification Analysis – 53404.003

This report has been reissued as a weight in the appendix was incorrectly reported. This report supersedes the previously issued report 'J107714 (1)'

Thirteen (13) samples received on 19th October 2015 by Luana Piuila-Afitu.

The results of fibre analysis were performed by Julian Staite of Precise Consulting and Laboratory Ltd on 22nd October 2015.

The sample(s) were stated to be from 53404.003 .

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with the guidelines of *AS4964-2004 Method for the qualitative identification of asbestos in bulk samples.*

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

Should you require further information please contact Julian Staite.

Yours sincerely

Julian Staite
PRECISE LABORATORY IDENTIFIER

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Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J107714

27 October 2015

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.

Identified by:

Julian Staite
Approved Identifier

Reviewed by:

Adam Maurice
Key Technical Person

Site Address: 53404.003

Sample ID	Client Sample Number	Sample Location/Description/Dimensions	Analysis Results
BS032553	TP1 0.1	Sieved Onsite, WA Quantitiative Analysis Non-Homogeneous Soil 565.89g	**Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type**
BS032554	TP1 0.4	Sieved Onsite, WA Quantitiative Analysis Non-Homogeneous Soil 603.10g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos) Man-Made Mineral Fibre Organic Fibre Type**
BS032555	TP1 0.4 Bulk	Weigh Only Cement Sheet 145.81g	**Chrysotile (White Asbestos) Organic Fibre Type**

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IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J107714

27 October 2015

Site Address: 53404.003			
Sample ID	**Client Sample Number**	**Sample Location/Description/Dimensions**	**Analysis Results**
BS032556	TP3 0.1	Sieve in the Lab and WA Analysis Non-Homogeneous Soil 524.64g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos) Organic Fibre Type**
BS032557	TP3 0.1 Bulk 1	Weigh Only Cement Sheet 59.92g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos) Organic Fibre Type**
BS032558	TP3 0.1 Bulk 2	Weigh and Absence/Presence ACM Insulation Board 23.61g	**Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type**
BS032559	TP4 0.1	Sieved Onsite, WA Analysis Non-Homogeneous Soil 391.64g	**Chrysotile (White Asbestos) Organic Fibre Type**
BS032560	TP4 0.5	Sieved Onsite, WA Analysis Non-Homogeneous Soil 487.48g	**Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos) Organic Fibre Type**
BS032561	TP4 0.5 Bulk 1	Weigh and Absence/Presence ACM Cement Sheet 8.21g	**Chrysotile + Amosite (White & Brown Asbestos)**
BS032562	TP4 0.5 Bulk 2	Weigh and Absence/Presence ACM Cement Sheet 22.83g	**Chrysotile + Amosite (White & Brown Asbestos)**
BS032563	TP4 0.5 Bulk 3	Weigh and Absence/Presence ACM Cement Sheet 152.14g	**Chrysotile (White Asbestos)**

Precise Consulting & Laboratory Ltd Limited
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Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J107714

27 October 2015

Site Address: 53404.003			
Sample ID	**Client Sample Number**	**Sample Location/Description/Dimensions**	**Analysis Results**
BS032564	TP6 0.1	Sieved Onsite, WA Analysis Non-Homogeneous Soil 466.74g	**Chrysotile + Amosite (White & Brown Asbestos) Organic Fibre Type**
BS032565	TP6 0.1 Bulk 1	Weigh Only Cement Sheet 9.35g	**Chrysotile (White Asbestos) Organic Fibre Type**

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
P: (03) 943 5394 W: www.preciseconsulting.co.nz

Appendix 1: Soil Analysis Raw Data

Job No: J107714

Friday, 23rd October 2015

Sample ID	Client Sample Number	Sample Weights						>7mm Asbestos Containing Material (ACM)[1]		Asbestos Fines/Fibrous Asbestos[1]				Trace Asbestos Detected (Y/N)[2]
		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 & %[3]	2-7mm ACM (g)	Form & %[3]	<2mm ACM (g)	Form & %[3]	
BS032553	TP1 0.1	-	565.89	-	157.02	100.54	308.33	-	-	0.037	Cement Sheet 20%	<0.001	Free Fibre Bundles 100%	No
BS032554	TP1 0.4	-	603.10	-	180.31	101.33	321.46	-	-	0.855	Cement Sheet, Free Fibres 30%	0.214	Cement Sheet, Free Fibres 30%	No
BS032555	TP1 0.4 Bulk	-	-	145.81	-	-	-	145.81	Cement Sheet 20%	-	-	-	-	-
BS032556	TP3 0.1	-	524.64	54.48	111.63	100.83	257.70	No Asbestos Detected	-	0.098	Cement Sheet 30%	<0.001	Cement Sheet 40%	No
BS032557	TP3 0.1 Bulk 1	-	-	59.92	-	-	-	59.92	Cement Sheet 30%	-	-	-	-	-
BS032558	TP3 0.1 Bulk 2	-	-	23.61	-	-	-	23.61	Insulation Board 40%	-	-	-	-	-
BS032559	TP4 0.1	-	391.64	-	171.82	101.14	118.42	-	-	<0.001	Free Fibre Bundles 100%	<0.001	Free Fibre Bundles 100%	No

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Sample ID	Client Sample Number	Sample Weights						>7mm Asbestos Containing Material (ACM)[1]		Asbestos Fines/Fibrous Asbestos[1]				Trace Asbestos Detected (Y/N)[2]
		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 & %[3]	2-7mm ACM (g)	Form & %[3]	<2mm ACM (g)	Form & %[3]	
BS032560	TP4 0.5	-	487.48	-	181.26	100.67	205.55	-	-	0.238	Cement Sheet 15%	<0.001	Free Fibre Bundles 100%	No
BS032561	TP4 0.5 Bulk 1	-	-	8.21	-	-	-	8.21	Cement Sheet 10%	-	-	-	-	-
BS032562	TP4 0.5 Bulk 2	-	-	22.83	-	-	-	22.83	Cement Sheet 10%	-	-	-	-	-
BS032563	TP4 0.5 Bulk 3	-	-	152.14	-	-	-	152.14	Cement Sheet 20%	-	-	-	-	-
BS032564	TP6 0.1	-	466.74	-	87.86	101.53	277.35	-	-	<0.001	Free Fibres 100%	0.010	Cement Sheet, Free Fibres 30%	No
BS032565	TP6 0.1 Bulk 1	-	-	9.35	-	-	-	9.35	Cement Sheet 10%	-	-	-	-	-

1 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

2 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.

3 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 C: Site photographs

Above: Photograph 1 - area 1 viewed from north

Above: Photograph 2 - BMX track and area 2 beyond

Above: Photograph 3 - central southern embankment (area 2) looking north

Above: Photograph 4 - area 2 looking south

Above: Photograph 5 - southwest area (Area 1) looking south

Above: Photograph 6 - south eastern boundary (Area 5)

Above: Photograph 7 - top of south western embankment (Area 1)

Above: Photograph 8 - underpass (Area 3)

Above: Photograph 9 - example of ACM fragment, in-situ (Area 1)

Above: Photograph 10 - example of ACM fragment, in-situ (Area 2)

REPORT

Tonkin+Taylor

Kyle Park, Hornby

Desktop Ground Contamination and Geotechnical Study

Prepared for
Christchurch City Council
Prepared by
Tonkin & Taylor Ltd
Date
September 2015
Job Number
53404.002

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Appendix F : **ECan's LLUR Statement**

Appendix G : **Geotechnical investigations**

1 Introduction

Tonkin & Taylor Ltd (T+T) was commissioned by the Christchurch City Council (CCC) to carry out this initial ground contamination and geotechnical study relating to Kyle Park, which is located in the western Christchurch suburb of Hornby. The mainly desktop-based assessment for this report has been completed in accordance with the existing services agreement between T+T and CCC (Agreement No. 4600001076) and our proposal dated 31 July 2015.

The purpose of this report is to provide information and recommendations to assist CCC in the development of their Master Plan for Hornby. It is expected that further site-specific ground contamination and geotechnical investigation and assessment work will likely be required once particular development plan(s) are identified for the site.

The ground contamination part of our work for this report has been carried out in general accordance with the requirements for a Preliminary Site Investigation (PSI) referred to in the NES Soil regulations[1], and as outlined in the Contaminated Land Management Guidelines[2] published by the Ministry for the Environment (MfE).

1.1 Background

Based on discussions with CCC, T+T understands that both Kyle Park and Denton Park in Hornby (shown on Figure 1.1) are under consideration for the potential development of a new library and service centre along with associated infrastructure and recreational spaces.

T+T carried out desktop-based ground contamination and geotechnical studies on behalf of CCC for Denton Park in 2013[3,4], and this report for Kyle Park complements that work.

1.2 Proposed development

We understand that CCC wishes to develop Kyle Park and / or Denton Park as part of their Master Plan for Hornby and that the development is likely to include the following:

- A New Southwest Library and Service Centre (NSLSC). This building will likely have a footprint area of approximately 1,300 m^2 and may be up to 2 storeys high.
- Carparking and / or associated paved access facilities.
- Sport and recreation areas, which may include sports fields, playground areas and / or paved / astroturfed surfaces.

1.3 Scope of work

The following scope of work has been completed by T+T for the purposes of this mainly desktop-based ground contamination and geotechnical assessment report:

- Review of CCC property files.
- Review of historical aerial photographs.
- Review of historical certificates of title.

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, which are referred to herein as NES Soil.
[2] Ministry for the Environment, updated 2011, Contaminated land management guidelines No. 1: *Reporting on Contaminated Sites in New Zealand*.
[3] New Southwest Library and Service Centre – Geotechnical Desktop Study (Dec 2013) – T+T Ref. 53404
[4] Ground Contamination Desk Study Investigation – New South West Library & Service Centre (Dec 2013) – T+T Ref. 53404

- Review of the Environment Canterbury (ECan) Listed Land Use Register (LLUR) Statement for the site.
- Review of geotechnical data for the site and surrounding area available from the Canterbury Geotechnical Database (CGD).
- Brief site walkover by a ground contamination specialist and a geotechnical engineer.
- Assessment of geotechnical issues associated with the site in relation to the proposed development.
- Assessment of geotechnical aspects associated with likely construction activities relating to the proposed development.
- Recommendations for further investigation / assessment work that may be considered for later stages of site development work.

Figure 1.1: Kyle Park (boundaries shown in red) and Denton Park (boundaries shown in yellow), Hornby (ECan Advanced GIS Web Viewer, 2015)

2 Site description

2.1 General

Kyle Park is located at 197 Waterloo Road, which is approximately 9 km west of the Christchurch Central Business District. The 8.7 hectare site is bounded by:

- Waterloo Road, residential housing and Hornby Primary School to the north.
- Residential housing to the west.
- Rail lines, Denton Park, and "The Hub" shopping centre to the south.
- Varied commercial / industrial properties along Smarts Road to the east.

The site comprises two property parcels with legal titles of Lot 1 DP 78681 and Lot 2 DP 34558.

2.2 Current site usage

Kyle Park currently hosts various uses comprising:

- A pocket of trees surrounding a grassed bank adjacent to the western boundary.
- A stormwater retention pond that is surrounded with vegetation.
- Grassed recreational areas with sporadic trees and a BMX track in the central portion.
- Meandering footpaths that converge at the south into a pedestrian railway underpass link to Denton Park.
- Sports fields and grassed recreational areas with sporadic trees in the eastern portion.

2.3 Topography

The topography of the area surrounding the site is essentially flat. The topography of the site itself has been heavily modified over several decades and comprises a mixture of flat areas (sports fields), undulating terrain (BMX track and area surrounding the stormwater retention pond) and terraces / embankments.

The central area of the site is relatively flat and lies at an elevation of approximately 30 m relative to the 1937 Lyttelton vertical datum (LVD). The stormwater retention pond lies at approximately 27 mLVD, while the eastern end of the site lies at approximately 28 mLVD. The stormwater retention pond is bounded to the west and south by a raised embankment walkway, and to the north and east by grassed embankments (Photograph 1, Appendix A). Generally, the site boundaries along Waterloo Road, Smarts Road and the rail lines comprise grassed embankments (Photograph 2, Appendix A).

2.4 Geological setting

The published geology[5] of the area indicates that the site is underlain by Holocene-age (less than 10,000 years old) alluvial gravel, sand and silt of historic Waimakariri River flood channels. This is collectively referred to as the Yaldhurst Member of the Springston Formation. Prior to human modification these soils would have been the dominant near-surface materials at the site. In this inland area of Christchurch, the Springston Formation deposits are directly underlain by well-graded gravels known as the Riccarton Gravels. These gravels may contain artesian groundwater pressures where capped by a low permeability clayey silt or peat layer.

[5] Brown, L.J., Weeber, J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological & Nuclear Sciences Geological Map 1. Scale 1:25 000.

3 Ground contamination desktop study

Site observations made by an environmental scientist from T+T at the time of the site walkover on 27 August 2015 are summarised below with key areas of interest shown on Figure A1 and Photographs 3 - 7 in Appendix A.

- Observations of the ground surface indicated the sporadic presence of humps and hollows across the site. At the time of the site walkover the cause of these humps and hollows was not apparent.
- The majority of the site was covered with grass. Mature trees are scattered across the area with high density stands in the eastern and western ends of the site. Sporadic patches of what appeared to be stressed vegetation were observed at various locations, with an example shown in Photograph 3 (Appendix A). At the time of the site walkover the cause of the stressed vegetation was not apparent.
- Waste materials (such as concrete fragments, bricks, and glass) were observed along the embankment at the southeastern site boundary.
- Waste materials (such as concrete fragments, bricks, plastic, and glass) were observed along the embankment at the southwestern site boundary (Photograph 5). A fragment of friable fibreboard was found on the ground surface at this location (refer Figure A1 and Photographs 5-6, Appendix A). The fibreboard was tested for asbestos presence/absence at IANZ accredited laboratory. The results indicated that the fibreboard contained amosite, chrysotile and crocidolite (white, brown and blue) asbestos (refer to Appendix B for laboratory test results).
- It is not clear from our brief walkover whether the demolition materials observed at the southeast and southwest embankments were placed on top of the embankment (i.e. fly-tipped) or were exposed due to ground surface disturbance.
- A small pile of refuse materials was observed to the south of the BMX track, which appeared to be recently placed (Photograph 7).

3.1 Site history

Historical information relating to the site has been collected from a variety of sources including the CCC property files, an ECan site contamination enquiry, historic aerial photographs, and current and historical certificates of title (CT). This historical review deals mainly with on-site activities, except for the aerial photograph review where comments are also provided on the readily observable surrounding areas. The information reviewed is summarised in the following sections.

3.1.1 Site ownership

Our review of the post-1870 CTs combined with information obtained from the other historic data sources described in this section, indicates the following progression of site ownership:

- A CT (24/74) for an approximately 8 ha section of the site was issued to John L. Wilson of Christchurch in 1877. The site was subsequently divided and two new CTs were issued:
  - A CT (32/232) was issued for the section at the western corner of the site to K. Burnett in 1878; and
  - A CT (33/76) for the remainder of the land (approximately 6.8 ha) was issued to J. L. Wilson in 1878. The land was subsequently transferred to various proprietors until being transferred to the Smart family in 1919. In 1930 and 1931 the land was transferred to Smart & Sons Ltd. The land was transferred in 1961 to Paparua County Council. Additional information between 1931 and 1961 was documented on the CT, however, it was illegible.

- A CT (23/200) was issued for an approximate 2 ha section at the north-western site boundary to Charles N. Bell in 1877. The land was transferred in 1883 to John L. Lawson and Ann Lawson.
- A CT (92/161) was issued for a section at the northeast corner of the site to a Charles N. Bell in 1883. The land was transferred to different proprietor until 1950 when it was transferred to the Smart family, and subsequently, in 1964 when it was transferred to Paparua County Council.
- A CT (2A/1119) for an approximately 0.11 ha section of the site, designated as RS 38277, was issued to Smart and Sons Ltd in 1960.
- A CT (8A/391) for Lot 2 DP 34558 was issued to Smart and Sons Ltd in 1968. The land was transferred to Paparua County Council in 1974 and a new CT (the current CT) was established (14A/1326).
- A CT (8A/572) for Lot 1 DP 25716 RS 38277 & part of RS 3554 was issued to Paparua County Council in 1968.
- A CT (45A/841) for Lot 1 DP 78681 was issued to CCC in 1998 (the current CT).
- The current CTs confirm that the site is owned by CCC.

No information relating to the actual uses of the land parcels was evident from the historic certificates of title/transfer of interests. However, the CTs indicate that Paparua District Council (subsequently CCC) acquired the site during the 1960s.

A copy of the two current certificates of title are provided in Appendix C.

3.1.2 Aerial photograph review

Historic aerial photographs were obtained from the Canterbury GIS Viewer for this review (these are reproduced as Figures D1 – 9 in Appendix D). Observations relating to the site and surrounds based on our review from each aerial photograph are provided in Table D-1 (refer Appendix D) with the main features summarised below:

- The site was used as a quarry from at least 1941 to the 1960s. The extent of quarrying operations appear to reach the current boundaries of the site, although the depth of excavation is unknown.
- From approximately 1965 to at least 1973, the site was filled and extensive landscaping had occurred.
- From approximately 1984 onwards, the site was used as a recreational park that contained a BMX track at the western end and playing fields at the eastern end of Kyle Park. In the late 1990s / early 2000s, a stormwater retention pond was established at the western end of Kyle Park and the BMX track was relocated further east.

3.1.3 CCC property file review

The CCC property files for the site were reviewed on 27 August 2015. Relevant historical information identified in the property files is summarised below with source information provided in Appendix E:

- In a 1990 CCC "Hazard and Special Site Characteristics" document, it is stated that the site was previously an uncontrolled general refuse landfill run by Paparua County Council until 1981. The exact depth and perimeter of the landfill is unknown.
- In a 1999 Christchurch City Council plan, a landfill gas ventilation unit was installed in the Christchurch BMX Club hut, located at the centre of the site.
- In 1999, a consent to construct a stormwater retention and treatment pond was granted. The construction plans included: cut and fill details around the pond construction area, the

relocation of the BMX track, and the construction of an embankment around the pond. In an assessment of environmental effects by Woodward-Clyde[6] that was attached to the consent, it is stated that:

  - The site was formally owned by the Smart Family and was used as a quarry;
  - Christchurch City Council purchased the site in 1960s and landfilling occurred until 1972, after which, the landfill was compacted and contoured. In 1985/1986, silt was placed on top of the central low area and topsoil was brought in for the playing fields.

- In 2003, a consent was issued to demolish an existing building and construct a public toilet facility that was located at the northern edge of the site. The conditions attached to the tender document stated that the foundations should be excavated to 1 m below ground level, but if fill material was encountered then excavations were to go deeper. The document also stated that all excavated materials were to be removed off-site.

3.1.4 Christchurch City Library heritage records

Christchurch City Library records[7] indicate that Smart's Pit was established at 197 Waterloo Road sometime around 1884. This was a gravel pit and stone-breaking plant which supplied stone and sand for the development of local road and rail infrastructure. Quarrying and associated operations continued at the pit until 1968 when the land was purchased by the Paparua County Council for use as a rubbish dump. In 1973 the dump was shut down. By 1981 the former pit / dump and adjoining land had been named Kyle Park and developed into sports fields used for rugby, cricket and hockey along with a BMX track in the western corner.

3.1.5 ECan contamination enquiry

An enquiry to the ECan Listed Land Use Register (LLUR) was placed by a T+T environmental scientist on 28 August 2015 and a copy of the letter is provided in Appendix F. The LLUR (ID 25086) identified that the site was on a former landfill that operated from pre-1973 to approximately 1984 (note, other historical information, as discussed in this report, document that the landfill was decommissioned in the 1970s). The site is classified as HAIL[8] activity G3 – "Landfill sites" and is categorised as "Not Investigated".

3.2 Potential for ground contamination

Our review of the available information indicates that HAIL activities were 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 3.1 (below).

[6] Woodward-Clyde, 1999. Assessment of Environmental Effects; Stormwater Retention and Treatment Pond, Kyle Park.
[7] Christchurch City Library heritage records, July 2015.
http://christchurchcitylibraries.com/Heritage/PlaceNames/ChristchurchPlaceNames-A-M.pdf
[8] HAIL means the current edition of the Hazardous Activities and Industries List, Wellington, Ministry for the Environment.

Table 3.1 – HAIL activities

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Landfilling	Dependent on original waste composition. Potential contaminants include hydrocarbons, heavy metals, organic acids, landfill gas, and ammonia.	The ECan LLUR suggests the site was previously used as an uncontrolled landfill. Details on the landfill, such as its composition and depth are currently unknown. The likelihood of ground contamination is high and would likely encompass most of the site. Contamination of the groundwater, via leachate, is also likely.	Yes Activity G3 – Landfill sites.
Use of pesticides on playing field areas.	Heavy metals, herbicides, organophosphates and possibly organochlorides.	There has been a playing field located towards the eastern site boundary since at least 1984. Pesticides may have been applied to the playing field during this time. Low likelihood of contamination, which (if present) would likely to be restricted to shallows soils in the playing field areas.	Yes Activity A10 – Persistent pesticides bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.
Surface debris	Asbestos.	During a site walkover, a piece of asbestos fibreboard was observed on an embankment at the northwestern site boundary. It was noted that the same embankment also had visible surface debris typically associated with demolition material (i.e. concrete and brick) on it. As only a brief site walkover was undertaken, there is a potential for more asbestos containing materials to be present on-site.	Yes Activity I – land that has been subject to the intentional or accidental release of hazardous substance in sufficient quantity that it could be a risk to human health or the environment.

3.2.1 Preliminary conceptual site model

A conceptual model as defined by the MfE CLMG No. 5[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 site development activity which takes into account the available information about the site, and our understanding of the potential effects on human health and the environment. The model is presented below.

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

Table 3.2 – Preliminary conceptual site model

Source	Pathway	Current Receptors	Future Receptors
Landfill material	Inhalation of dust, inhalation of landfill gases, dermal contact, and incidental ingestion.	Recreational park users, CCC park maintenance workers, surrounding residents, and commercial property employees and customers.	Construction and excavation workers during possible site development. Future Library and Service Centre users (if applicable).
	Mobilisation of contaminants via groundwater migration.	The Heathcote River aquatic ecosystem and recreational users.	Same as current receptors.
Contaminated soil from pesticide usage	Inhalation of dust, dermal contact, and incidental ingestion.	Recreational park users, CCC park maintenance workers, surrounding residents, and commercial property employees and customers.	Construction and excavation workers during possible site development. Future Library and Service Centre users (if applicable).
Asbestos	Inhalation of asbestos fibres.	Recreational park users, CCC park maintenance workers, surrounding residents, and commercial property employees and customers.	Construction and excavation workers during possible site development. Future Library and Service Centre users (if applicable).

3.3 Regulatory framework and implications

The rules and associated assessment criteria relating to the control of contaminated sites in the Canterbury region are specified in the following documents:

- NES Soil.
- The Christchurch City Plan (City Plan).
- ECan's Land and Water Regional Plan (LWRP), Natural Resources Regional Plan (NRRP) and proposed Canterbury Air Regional Plan (pCARP).

The NES Soil and City Plan contain provisions relating to land use and the protection of human health. The ECan regional plans contain provisions relating to the protection of the general environment including ecological receptors. A summary of potential resource consent requirements under each of these regulatory instruments is set out below.

3.3.1 NES Soil

The NES Soil came into effect on 1 January 2012. The NES Soil sets out nationally consistent planning controls appropriate to district and city councils for assessing contaminants in soil with regard to human health. The NES Soil prevails over the rules in the City Plan, except where the rules permit or restrict effects that are not related to effects on human health. The NES Soil does not apply to any functions of regional councils and does not affect rules in regional plans (Regulation 4(b)).

The NES Soil applies to specific activities on land where a HAIL activity is known to have occurred, or is more likely than not to have occurred. Activities covered under the NES Soil include soil disturbance, soil sampling, fuel systems removal, subdivision and land use change. Table 3.3 (below), which is based on the NES Soil Users Guide (April 2012), confirms that the NES Soil applies to the site.

Table 3.3 – PSI Checklist

NES Soil Requirement	Applicable to site?
Is an activity described on the HAIL currently being undertaken on the piece of land to which this application applies?	Yes
Has an activity described on the HAIL ever been undertaken on the piece of land to which this application applies?	Yes
Is it more likely than not that an activity described on HAIL is being or has been undertaken on the piece of land to which this application applies?	Yes
If 'Yes' to any of the above, then the NES Soil may apply. **The five activities to which the NES applies are:**	
Is the activity you propose to undertake removing or replacing a fuel storage system or parts of it?	No
Is the activity you propose to undertake sampling soil?	No
Is the activity you propose to undertake disturbing soil?	Likely
Is the activity you propose to undertake subdividing land?	No
Is the activity you propose to undertake changing the use of the land?	Likely
Conclusion: The NES Soil likely applies to Kyle Park, 197 Waterloo Road, depending on the nature of the proposed redevelopment works	

3.3.2 NES Soil activity status

Details regarding the proposed development at the site are not yet available. Therefore, we cannot assess the likely resource requirements at this time. Subject to the activities that will be carried out as part of any site development work then the NES Soil Permitted Activity (PA) conditions for soil disturbance and land use change will need to be considered to assess whether resource consent is required under the NES Soil.

3.3.3 Christchurch City Plan

As noted in Section 3.5.1 above, the NES Soil now prevails over the rules in the City Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil. The City Plan contains a rule within the earthworks provisions that relates to contaminants in soil. Part 9, Critical Standard Rule 5.8.1 is as follows:

> *In addition to compliance with the standards relating to the volume and depth of filling and excavation in Clauses 5.2 and 5.3 of these rules, any filling or excavation of land, is a non-complying activity where:*
>
> *a) The fill or excavated material contains putrescible, pollutant, inflammable or hazardous components; and/or*
>
> *b) Fill consists of material other than soil, gravel, sand, silt, or demolition material, and/or has a particle size in excess of 200 mm; and/or*
>
> *c) Fill material consists of vegetation which comprises more than 5% of any load by volume, and/or which is derived from a different site to the rest of the fill material except that this rule shall not apply to any filling or excavation on any land within the Special Purpose*

(Landfill) Zone, and rule 5.4.1 (b) shall not apply to the Rural Quarry Zone in respect to particle size.

This rule seeks to protect water quality as well as human health. Therefore, it applies in addition to the provisions of the NES Soil.

Any excavation on the site will require resource consent as a non-complying activity under this rule if the excavated material contains 'hazardous components', as advised by CCC staff.

3.3.4 Regional Plans

The following regional plans contain objectives, policies and rules that may be relevant to any earthworks, including disturbance of contaminated soil, undertaken on the site:

- The LWRP has been developed to manage the effects of activities on land or water within the Canterbury Region. The LWRP became partially operative on 1 September 2015, and the rules that relate to earthworks and contaminated land at this site are operative.
- The provisions in the NRRP that relate to land and water have been partially superseded by the LWRP. The provisions that relate to air quality remain operative.
- The pCARP seeks to implement a new air quality management framework for Canterbury. The plan was publicly notified in February 2015 and the rules have legal effect as of that date.

The resource consents required will depend on the details of the proposed works (e.g. volume and depth of soil disturbed) and the results of any soil testing. The proposed works may require resource consent from ECan under the rules in the LWRP for the discharge of stormwater from a contaminated site to land or to water, and any discharges of dust may require consent under the NRRP and/or pCARP. Resource consent may also be required for other activities that form part of the site development works e.g. earthworks, dewatering.

3.4 Conclusions

This desktop-based assessment has been undertaken to identify current and historic activities that have occurred at the site and the potential for these activities to have resulted in ground contamination, including implications for the proposed development.

The site was previously used as a quarry since at least 1941. In the 1960s, the site was procured by Paparua County Council and was used as an uncontrolled landfill until 1981. Following the decommissioning of the landfill the site was converted to a recreational park. The site presently contains a stormwater retention pond, a BMX track and playing fields. Debris typically associated with demolition material, such as concrete, bricks and plastic was observed on the ground surface at the southwest and southeast embankments. In addition, a piece of asbestos-containing fibreboard was found on the ground surface on the southwest embankment. It is not clear from our brief walkover whether the observed demolition materials were placed on top of the mulch (i.e. fly-tipped) or exposed due to disturbance of the ground surface. Given the nature of our site walkover it is possible that more asbestos-containing material is present on the site.

The following HAIL activities have been identified at the site:

- Previous landfilling activities.
- Persistent use of pesticides on the playing fields.
- Intentional or accidental release of hazardous substances (i.e. asbestos).

Based on the current information it is likely that any development on the site will require:

- Consideration of resource consent requirements relating to the NES Soil and rules in the Regional Plans.
- The disposal of soils to an appropriate landfill, if required.
- Controls to mitigate possible discharge of contaminants to air and water during earthworks.
- A site management plan to determine the health and safety controls required when conducting earthworks on-site.

3.5 Recommendations

Based on our mainly desktop-based ground contamination assessment it is recommended that a two-part detailed site investigation (DSI) be conducted into the extent of contamination from the identified HAIL activities. The first part of the DSI should be undertaken to assess if more asbestos containing materials (ACM) are present on the site, as soon as possible. The DSI would assist in the identification of management options for any asbestos remaining on site, in the context of the continued recreational use of the site.

Given that the site is currently used as a recreational park then there is a potential for the friable asbestos, if present in further quantities, to be disturbed and for site users to be exposed to the disturbed and surficial asbestos material. As a specific assessment of the site for the presence of asbestos has not been completed, the extent and potential risk associated with further additional asbestos material (if present) on the site cannot be assessed. However, as a precautionary approach, T+T recommends that the embankment areas where building/demolition materials were observed are fenced to prevent public access as a matter of urgency.

The second part of the DSI should be undertaken once more specific development plans are available, which would help identify the resource consents required for the proposed development. This would also help to identify potential cost implications of developing on this site, including, but not limited to the management of fill materials previously disposed of at the site.

4 Geotechnical desktop study

4.1 Site history considerations

Given that the historical gravel pit and landfill footprint occupies almost the entire site, it must be appreciated that there are little to no natural near-surface materials remaining. The depth below ground at which natural materials would be encountered is unknown, but this is expected to be variable across the site and may be in the order of 3 to 8 m. This fill thickness would only be able to be confirmed by intrusive ground investigations at the site itself.

4.2 Existing geotechnical information

4.2.1 Published geological information

Published geology[10] indicates that the site is underlain by Holocene-age (less than 10,000 years old) gravels, sands and silt. These represent the deposition of historic river flood channel sediments from distributaries of the Waimakariri River. These sediments are collectively known as the Yaldhurst Member of the Springston Formation and prior to human modification these soils would have been the dominant near-surface materials at the site. In this inland area of Christchurch, the Springston Formation deposits are directly underlain by well-graded gravels known as the Riccarton Gravels. These gravels may contain artesian groundwater pressures where capped by a low permeability clayey silt or peat layer.

4.2.2 Canterbury Geotechnical Database

A review of the Canterbury Geotechnical Database[11] (CGD) revealed several intrusive ground investigations in the vicinity of the site. Due to fill materials being the dominant near-surface materials at the site itself, only investigations which penetrated more than 3 metres below ground level were considered. Figure G1 (refer Appendix G) shows the locations of the 13 deep borehole investigations which were reviewed in our assessment. These investigations are located between 200 m and 1.3 km away from the site and may not accurately represent the conditions within the upper soil profile underlying the site. Copies of the borehole logs are provided in Appendix G. The naturally occurring stratigraphy observed from the available borehole information is in general agreement with the published geological information for the site area.

4.2.3 Stratigraphy

Based on our review of the published geological information and borehole data, we infer that the general stratigraphy of the site is as summarised in Table 4.1 below.

[10] Brown, L.J., Weeber, J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological & Nuclear Sciences Geological Map 1. Scale 1:25 000.
[11] https://canterburygeotechnicaldatabase.projectorbit.com

Table 4.1 – Inferred generalised subsurface profile

Layer	Geological Unit	Description	Approximate depth to top of layer (m)	Approximate layer thickness (m)
1	Topsoil and fill	Variable FILL. Unknown thickness and composition (likely comprises manmade, organic and locally won ground materials).	0	3 – 8*
2	Yaldhurst Member of the Springston Formation	Sandy fine to coarse GRAVEL, with minor silt. Medium dense to very dense. Occasional sand and / or silt layers (typically <1 m thickness). Loose / soft to dense / stiff.	3 – 8*	10 – 15
3	Riccarton Gravel	Fine to coarse GRAVEL with some sand. Dense to very dense.	15 – 20	>10

* Estimated provisional value based on greatest likely depth of gravel pit from interpretation of historical aerial photographs.

4.2.4 Ground and surface water

Groundwater is likely to be encountered at the site between 10 and 13 metres below ground level. Groundwater levels are likely to vary seasonally (by up to 2 metres), as well as in response to rainfall patterns and flood events in nearby watercourses. Surface water level in the stormwater retention pond at the western end of the site is approximately 7 to 10 metres higher than the level of the natural groundwater level. The closest significant watercourse is at least 3 km to the east of the site.

4.3 Geotechnical considerations

4.3.1 Building foundations

Constructing buildings on former landfills can be very challenging due to the potential for unplanned settlement to occur within the fill. We expect that the landfill material underlying various areas of the site will be highly variable, with random voids, soft spots and organic material that could decompose over time and lead to settlement and subsidence at the ground surface. This provides the potential for unplanned and unpredictable differential settlement and / or loss of bearing capacity that can cause damage to overlying structures that are built on shallow foundations.

Therefore, for any building that is considered as part of any site development, a detailed geotechnical investigation will be required to characterise the materials beneath the proposed structure(s). This would likely comprise machine-drilled boreholes and test pit investigations to observe the materials that are encountered and assess the strength and likely settlement characteristics of the soil profile. The depth and scope of the investigations will need to be sufficient to ensure that the extent of the landfill materials can be clearly established. Depending on the type of structure(s) and associated foundation loads considered for the development then various options can be assessed to address the geotechnical conditions, including:

1 Ground improvement measures, such as dynamic compaction, impact rolling, or construction of a compacted gravel capping layer (which may include geogrid reinforcement). For example, ground improvement using an impact roller followed by the construction of a 1 m thick gravel raft reinforced with 2 layers of geogrid has been used elsewhere to support relatively light-

weight single level buildings located on a former landfill with only minor to moderate amounts of poorer quality fill materials.

2 Pile foundations may be required if ground improvement measures are not practical. Pile design will require careful consideration of potential obstructions in the landfill material which may affect pile driving.

The extent of potential soil excavation associated with a particular foundation system will need to be considered since the cost of disposing of contaminated soil can be significant. In addition, the possible presence of landfill gas will need to be assessed and appropriately considered in the design of any foundation system.

4.3.2 Site subsoil class

The site subsoil category is assessed to be Class D (deep or soft soil sites) in terms of NZS1170.5[12]. A potential library structure would be designed to the serviceability and ultimate limit state (SLS and ULS) earthquake actions as set out in Table 4.2 (below).

Table 4.2 – Design earthquake actions

Design earthquake action*	Magnitude	Peak ground acceleration	Event return period (years)
SLS1	7.5	0.13 g	25
SLS2	6.0	0.19 g	25
ULS	7.5	0.44 g	1,000

* Assuming a 50 year design life and an Importance Level 3 building (i.e. more than 250 occupants)

4.3.3 Liquefaction

Disruption at the ground surface due to liquefaction is not expected to occur at the site. This is due to the expected significant depth to the groundwater table (at least 10 m) and the nature of gravel soils expected to be present at or below this depth. A review of the post-earthquake aerial photography and satellite imagery suggests that no ground disruption or surface expression of liquefaction was observed at, or in the general vicinity of, the site throughout the Canterbury earthquake sequence (CES) of 2010 and 2011[13].

4.3.4 Paved areas

We consider that the construction of pavements and / or carparking areas is likely to be feasible at the site. Consolidation and / or settlement of landfill material, either due to decomposition of organic material within the fill and/or under traffic loads may occur, which could damage overlying pavement. There are two general approaches to deal with this:

1 Accept the pavement damage and make allowance for potential future maintenance / repair costs.

2 Improve initial pavement performance by, for example, increasing pavement thickness, adding geogrid reinforcement to the subgrade, etc.

4.3.5 Sport and recreation areas

Given its current use and performance throughout the CES, we consider that geotechnical considerations do not preclude the future development of recreational areas and sports fields,

[12] Standards New Zealand: NZS1170.5: 2004. Structural Design Actions, Part 5: Earthquake Actions, New Zealand.
[13] Canterbury Geotechnical Database, https://canterburygeotechnicaldatabase.projectorbit.com

provided the potential for future localised subsidence due to decomposition of organic fill material is accepted.

4.4 Further work

If CCC wishes to consider developing the site for building and / or pavement construction then intrusive ground investigations will be required to understand the nature of the underlying man-made fill and natural soils. A geotechnical investigation, assessment and design scope for structures should include:

- Machine-drilled boreholes[14] advanced to approximately 20 m depth (sufficient to establish the thickness of the fill materials and penetrate a significant depth into natural soils). Standard Penetration Tests (SPTs) should be carried out at 1.5 m intervals.
- Test pit investigations to observe and characterise the landfill material.
- Assessment of ground improvement options based on the results of the ground investigations and the nature of the proposed structure(s).
- Ground improvement design, construction and monitoring.
- Detailed foundation design, construction and monitoring.

For new carparking / pavement areas then the scope should include:

- Test pit investigations to characterise the materials underlying the pavement areas. Depending on the materials encountered then Dynamic Cone Penetration (DCP) tests and associated hand auger boreholes may be appropriate to provide soil strength information. The depth of these investigations will depend on the nature of the materials encountered, but should be sufficient to clearly identify the depth of any underlying landfill material.
- Pavement design, construction and monitoring.

The final investigation scope of work should be developed and confirmed based on the specific development plans for the site.

[14] The site is considered to be unsuitable for Cone Penetration Tests (CPTs) due to the expected subsurface soil conditions.

5 Applicability

This report has been prepared for the benefit of Christchurch City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

The purpose of this report is to provide information and recommendations to assist CCC in the development of their Master Plan for Hornby. Further ground contamination and geotechnical work (investigations, analyses, assessments) will be required to complete detailed design work for the chosen development option(s).

Tonkin & Taylor Ltd

Prepared for Tonkin & Taylor Ltd by:

Anna Winkley

Geotechnical Engineer

Prepared for Tonkin & Taylor Ltd by:

Louise Murphy

Environmental Scientist

Reviewed for Tonkin & Taylor Ltd by:

Hayden Bowen

Geotechnical Engineer

Reviewed for Tonkin & Taylor Ltd by:

Paul Walker

Senior Contaminated Land Specialist

Authorised for Tonkin & Taylor Ltd by:

Gordon Ashby

Project Director / Senior Geotechnical Engineer

AMMW
p:\53404\53404.0020\workingmaterial\2015.08.17.ammw.rep.geo+groundcontam.desktop.v04 final.docx

Appendix A: Site layout and photographs

LEGEND

- Property Boundaries
- Raised Path
- Area where topography ≈ 2 m lower than the surrounding area
- Embankment were surface debris was visible
- Site Boundary

A3 SCALE 1: 2500

0 50 100 150 (m)

ORIGINAL IN COLOUR

NOTES:

1. Aerial photo sourced from Linz Data Service <https://data.linz.govt.nz/layer/Christchurch Post-Earthquake 0.1m Urban Aerial Photos (24 February 2011)> , licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence (CC BY 3.0 NZ)
2. Property boundaries sourced from Terralink International (Copyright 2002-2005 Terralink International Limited and its licensors).

Tonkin+Taylor
33 Parkhouse Road, Wigram, Christchurch
www.tonkintaylor.co.nz

DRAWN	NSW	Sep. 15
DRAFTING CHECKED	TGM	9/15
APPROVED	TGM	9/15
CADFILE : \\53404.002-FA 1.dwg		
SCALES (AT A3 SIZE) 1: 2500		
PROJECT No. 53404.002		

CHRISTCHURCH CITY COUNCIL

KYLE PARK
197 WATERLOO ROAD
Site Feature Plan

FIG. No. 53404.002-FA 1 REV. 0

Photograph 1: A stormwater retention pond on the site. Date taken: 27/08/15; photo facing north.

Photograph 2: The different topography of the site to its surrounds. Date taken: 27/08/15; photo facing the northeast.

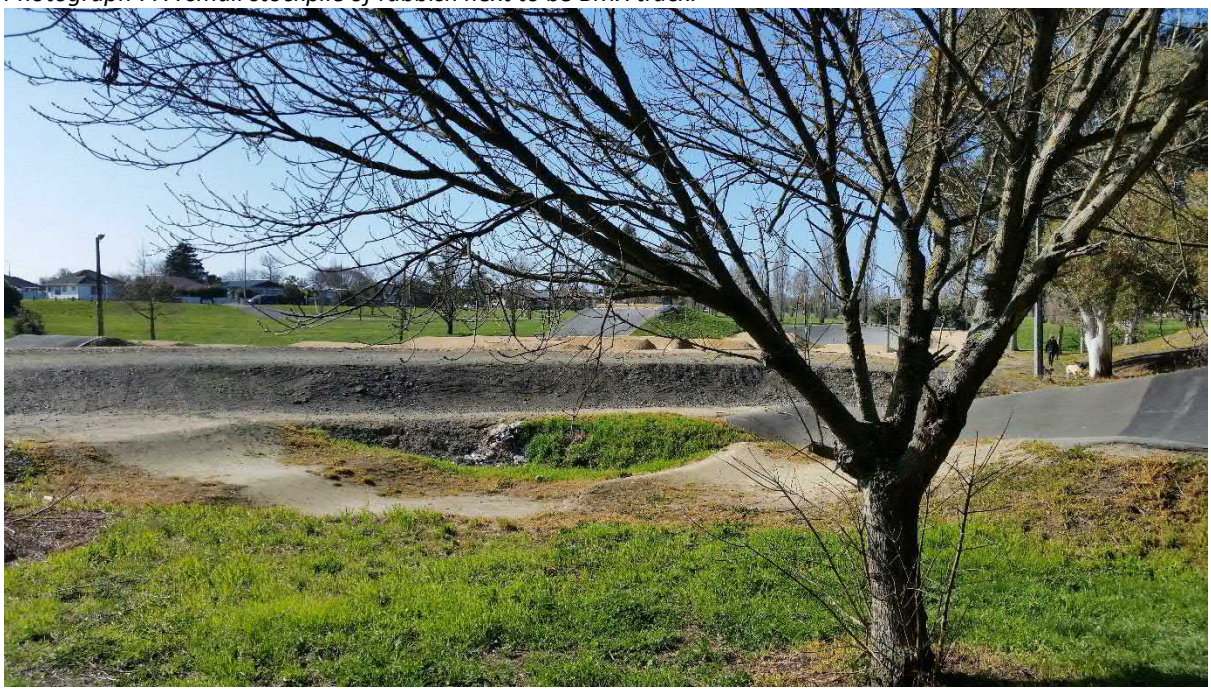
Photograph 3: An area of stressed vegetation is visible on the field. Date taken: 27/08/15; photo facing the east.

Photograph 4: A concrete fragment visible on the ground surface by the southwestern embankment. Date taken: 27/08/15; photo facing west.

Photograph 5: A photograph of the embankment where the asbestos fibreboard was found. Date taken: 27/08/15; photo facing south.

Photograph 6: An asbestos fragment amongst the bark mulch on the embankment. Date taken: 27/08/15.

Photograph 7: A small stockpile of rubbish next to be BMX track.



Appendix B: Asbestos results

DATE: 31st August 2015

JOB NUMBER: J106102 (1)

PRECISE
CONSULTING & LABORATORY

Tonkin and Taylor (Christchurch)

33 Parkhouse Road
Wigram
Christchurch
8042

Client Reference: 53404.002

Dear Mark Morley,

Re: Asbestos Identification Analysis – 197 Waterloo Road, Hornby 8042

One (1) samples received on 28th August 2015 by Luana Piuila-Afitu.

The results of fibre analysis were performed by Julian Staite of Precise Consulting and Laboratory Ltd on 31st August 2015.

The sample(s) were stated to be from 197 Waterloo Road, Hornby 8042.

Sample analysis was performed using polarised light microscopy with dispersion staining in accordance with the guidelines of *AS4964-2004 Method for the qualitative identification of asbestos in bulk samples.*

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

Should you require further information please contact Julian Staite.

Yours sincerely

Julian Staite
PRECISE LABORATORY IDENTIFIER

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
P: (03) 943 5394 W: www.preciseconsulting.co.nz

Sample Analysis Results

PRECISE
CONSULTING & LABORATORY

Job No: J106102

31 August 2015

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:

Julian Staite
Approved Identifier

Reviewed by:

Tim Trembath
Key Technical Person

Site Address: 197 Waterloo Road, Hornby 8042			
Sample ID	Client Sample Number	Sample Location/Description/Dimensions	Analysis Results
BS026014	GS1	Discrete Sample L1 - Cement Sheet 45 x 35 x 6 mm	Amosite + Chrysotile + Crocidolite (Brown,White & Blue Asbestos)

Precise Consulting & Laboratory Ltd Limited
Unit 4, 91 Byron Street, Sydenham, Christchurch 8023
P: (03) 943 5394 W: www.preciseconsulting.co.nz

Appendix C: Current Certificate of Title

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**CB45A/841**
Land Registration District	**Canterbury**
Date Issued	14 July 1998

Prior References
CB8A/572

Estate	Fee Simple
Area	7.0429 hectares more or less
Legal Description	Lot 1 Deposited Plan 78681

Proprietors
The Christchurch City Council

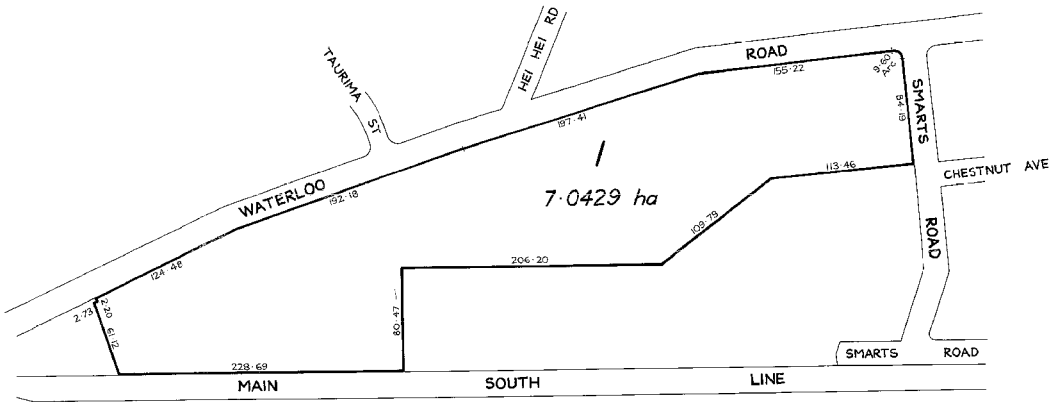
Estate	Fee Simple
Area	7.0429 hectares more or less
Legal Description	Lot 1 Deposited Plan 78681
Purpose	Recreation Reserve

Proprietors
The Christchurch City Council

Interests

Subject to Section 59 Land Act 1948 (affects the part formerly in RS 38277)

Appurtenant hereto is a right to convey water over part Lots 1 and 2 DP 34558 CsT CB14A/1325 and CB14A/1326 coloured blue and sepia on the diagram in and created by Proclamation 466399 - 17.9.1957 at 1.41 pm (affects the part formerly in RS 38277)



NEW CT ALLOCATED : 45A/841

PARCEL	FORMERLY	CT REF
Lot 1	Pt Lot 1 D.P. 25716	8A/572

Reference Plans D.P.'s 25716 & 78499

Total Deduced Area 7·0429 ha

Approved for CT diagram purposes only

Deputy Chief Surveyor

Deposited for CT diagram purposes only

14/1/1999

District Land Registrar

DISTRICT LAND REGISTRAR CANTERBURY N.Z.

LAND DISTRICT CANTERBURY
Survey Blk. & Dist. 1X Christchurch

PLAN OF LOT 1 FOR CT DIAGRAM PURPOSES

TERRITORIAL AUTHORITY Christchurch City
Surveyed by Terralink NZ Ltd
Scale Proportional Date 16 June 1998

Drawn by J.K.R.
Checked by BM

DP 78681

A.J.BEVIN, SURVEYOR GENERAL, LAND INFORMATION NEW ZEALAND

Approved CH 97/3

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**CB14A/1326**
Land Registration District	**Canterbury**
Date Issued	02 October 1974

Prior References
CB8A/391

Estate	Fee Simple
Area	1.6590 hectares more or less
Legal Description	Lot 2 Deposited Plan 34558
Purpose	Reserve

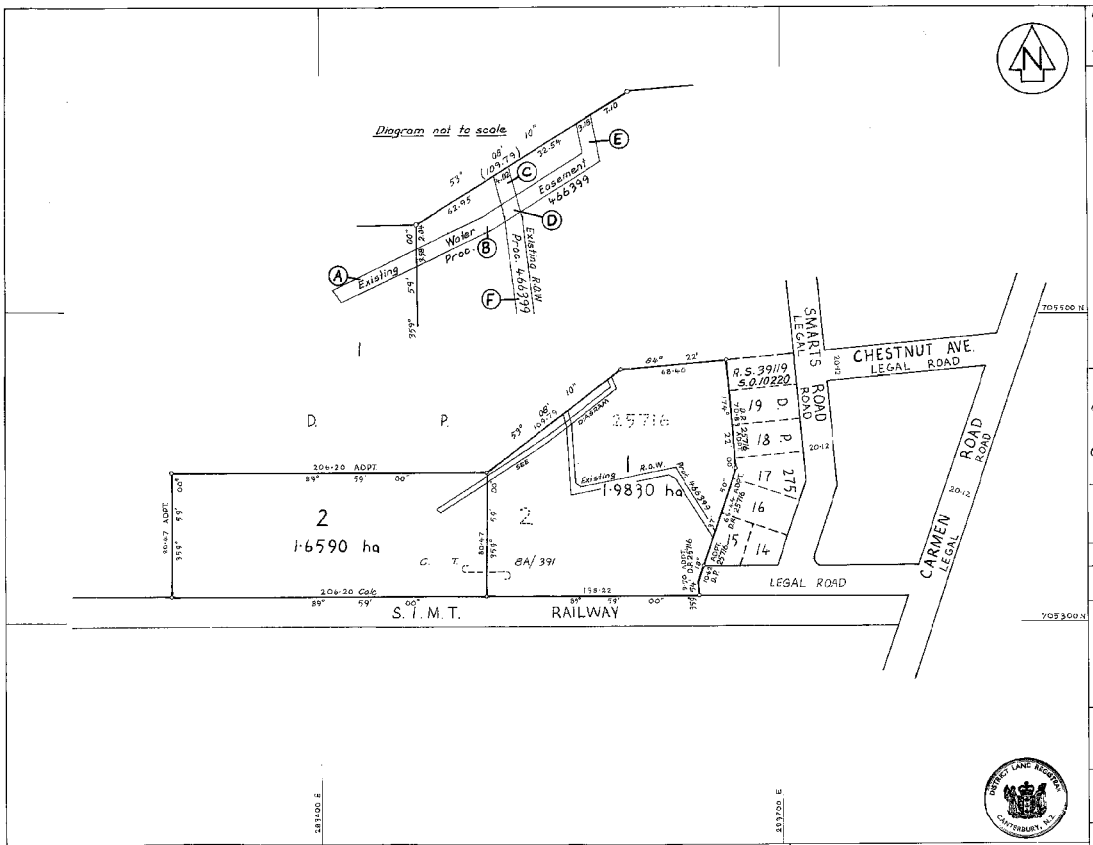
Proprietors
The Paparua County Council

Interests

Subject to the Reserves and Domains Act 1953

466399 Proclamation creating the following easements - 17.9.1957 at 1.41 pm

Type	Servient Tenement	Easement Area	Dominant Tenement
Convey water	Lot 2 Deposited Plan 34558 - herein	Part herein	Rural Section 38277 - CT CB8A/572



Examined

REGISTERED OWNER

The Paparua County Council certifies that there is no operative district scheme under the Town & Country Planning Act 1953 which affects the subdivision shown hereon.

Dated 10:4:74

County Engineer

In pursuance of the Provisions of Section 56 of "The Counties Amendment Act 1961," the Paparua County Council hereby approves of the Plan of Subdivision shown hereon.

IN WITNESS WHEREOF the Common Seal of the Corporation of the County of Paparua was hereto affixed this 11th day of A.D. 19 74, in the presence of

CHAIRMAN

COUNTY CLERK

EXISTING EASEMENTS

Purpose	Shown	Serv. Ten.	Dom. Ten.	Doc.
R.O.W.	C,D+F	Lot 1	P.C.T. 8A/572	Proc. 466319
Convey Water	A,B,D+E	Lots 1 + 2	P.C.T. 8A/572	Proc. 466319

Lot 2 has no legal frontage

Total Area 364.20 ha

Comprised in C.T. 8A/391

I, GRAHAM HARVEY FOWLER of CHRISTCHURCH Registered Surveyor and holder of an annual practising certificate hereby certify that this plan has been made from Surveys executed by me or under my direction; that both plan and Survey are correct and have been made in accordance with the regulations under the Surveyors Act 1966

Dated at CHRISTCHURCH this 4TH day of MARCH 1974 Signature

Field Book p. Traverse Book p.

Reference Plans

Examined KP dms 23/4/74 Correct

Approved as to Survey

22.7.74 Chief Surveyor

Deposited this 26th day of July 1974

District Land Registrar

File 1449

Received 19:4:74

Instructions

DP 34558

LAND DISTRICT CANTERBURY
SURVEY BLK. & DIST. IX CHRISTCHURCH
NZMS 177 SHEET No. S.84

464, 465
CT 2/55

LOTS 1 & 2 BEING SUBD. OF LOT 2 D.P. 25716.

LOCAL AUTHORITY PAPARUA COUNTY
Surveyed by T.E. MILES & ASSOCIATES
Scale 1:1500 Date JAN 74

Printed by Litholytes Instruments Ltd. Wellington, New Zealand.
I.P. Sinclair, Surveyor General, Department of Lands and Survey, Wellington.
Lds 434/14 N 80

Appendix D: Historic aerial photographs

Relevant features of the site and surrounds are summarised in the Table below:

Table D.1 – Summary of aerial photograph review

Aerial photograph (date and source)	Key point identified	Surrounding land features
1941, Source: Canterbury Maps	A significant portion of the site has been excavated, which is likely associated with gravel extraction/quarry activities activity. No excavation appears to have occurred at two sections within the north and east site boundaries.	The majority of the surrounding area appears to be pastoral land with a low density of commercial and residential structures visible. To the east of the site, there appears to be an industrial site with an adjoining storage yard. To the immediate southeast of the site (which appears to have originally been a part of the of the greater Kyle Park area), the land has been excavated and there are four structures visible within this area.
1946, Source: Canterbury Maps	Most of the site has been cut for extraction/quarrying. Some bushes are visible around the centre of the site. At the north site boundary, a cylindrical tank is visible.	The surrounding land remains similar to the previous aerial. To the immediate southeast of the site, the previously identified structures.
1955, Source: Canterbury Maps	The site appears to have been completely cut for extraction. Vegetation now appears throughout the site. Pathways running through the site are now evident. Although the previously identified buildings remain on-site, mining activity on the site is not evident.	Residential development has occurred to the north and northwest of the site (beyond Waterloo Road). To the east of the site (beyond Smarts Road), the previously identified industrial area has been expanded and the storage yard appears to be holding rows of containers.
1965, Source: Canterbury Maps	The northeast of the site appears to have been filled in. More vegetation at the western corner of the site is visible. Pathways, possible vehicle access roads, are now visible at the eastern section of the site.	There has been major residential developments to the north and west of the site. To the south of the site, an oval sports field, a velodrome, in Denton Park is evident. Commercial/industrial development has continued to the south east of the site. Earthworks are evident to the south of the railway lines (east of the current Denton Park). To the immediate southeast of the site, the quarried area has been refilled.
1973, Source: Canterbury Maps	The majority of the site appears to have been filled in and covered. Most of the vegetation from the centre of the site to the west has been cleared. A grassed area (possibly a playing field) is visible at the northeast site boundary.	There has been major residential developments to the southwest of the site. To the south of the site, the residential buildings have been cleared and replaced with commercial buildings.
1984, Source: Canterbury Maps	The site has been covered with grass and what appears to be a BMX park is visible within the northwest section of the site. Two pathways running through the site are evident.	To the immediate southeast of the site, structures have been removed and replaced with a large warehouse. The area appears to have been divided and what appears to be the current boundaries of Kyle Park (the site) are visible. To the south of the site, a circular object (a water reservoir) is visible in Denton Park.
1994, Source: Canterbury Maps	At the eastern section of the site, trees and/or bushes have been planted. The border of the western section of the site has been planted with trees/bushes. The pathways previously identified have been removed and four new pathways running through the site	Similar to the previous aerial. To the immediate southeast of the site, the previously identified warehouse has been replaced and a larger warehouse, which extend closely to the site boundary, is now evident.

	are evident. Three paths run from the north to the south and one path runs from the south to the east.	
2004, Source: Canterbury Maps	The BMX track has been relocated towards the southern site boundary. To the east of the BMX track, a small metallic hut has been constructed. A stormwater retention pond has been constructed towards the northwestern section of the site. A pathway running south of the pond to the BMX track is evident. A high density of trees and/or bushes is evident at the southwestern site boundary.	Similar to the previous aerial. To the south of the site, more commercial structures are evident.
2011, Source: Canterbury Maps	The site remains similar to the last aerial. Bushes appear to have been planted around the stormwater pond. More trees are evident around the site.	Similar to the previous aerial. To the immediate southeast of the site, the left wing of the warehouse has been removed and construction activities are occurring in its place.

Figure D1: 1941 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D2: 1946 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D3: 1955 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D4: 1965 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D5: 1973 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D6: 1984 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D7: 1994 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D8: 2004 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Figure D9: 2011 aerial of the site and surrounds. Red line represents the indicative site location. Source: Canterbury Maps.

Appendix E: Property files

Woodward-Clyde

PRODUCER STATEMENT - CONTROL OF HAZARDOUS SUBSTANCES ON SITE

ISSUED BY: Woodward-Clyde (NZ) Ltd

TO: Christchurch BMX Club Points Hut

(Site Owner)

IN RESPECT OF: Landfill Gas Control Measures for Christchurch BMX Club Points Hut on a Site of Lot DP 78681

(Description of Site)

AT: 197 Waterloo Road, Hornby, Christchurch/Smarts Pit

(Address)

Woodward-Clyde (NZ) Ltd has been engaged by The Christchurch City Council

(Consultant) (Owner/Developer/Contractor)

provide engineering advice on measures required to minimise the effects from landfill gas on the proposed Christchurch BMX Club Points Hut. The design covers only landfill gas control measures to the Christchurch BMX Club Points Hut and does not cover any subsequently constructed out buildings or ancillary structures in respect of the requirements of Clause F1 of the NZ Building Code.

As independent professional engineering and environmental consultants covered by a current policy of Professional Indemnity Insurance to a minimum value of $250,000, we believe on reasonable grounds that the site is suitable for the uses as defined by and in accordance with the following limitations or requirements:

a) Implementation of site use controls as detailed on drawings numbered AA26660087.00001-W-001and defined on attached Site Control Sheet number 1.
b) Implementation of future periodic monitoring as defined on attached Site Control Sheet 1.
c) The opinion expressed herein is based on, and limited to, our understanding of current generally accepted scientific methodologies and regulatory evaluation criteria for landfill gas assessment. Because scientific methodologies and regulatory evaluation criteria may change in the future, concentrations of and types of contaminants currently present, and considered to be acceptable at this time may, in the future, become subject to different regulatory standards which cause them to become unacceptable and require further remedial action for the site to be suitable for existing or proposed activities.
d) This statement is limited to the subject site as defined herein. It does not provide any opinion in relation to contamination of adjacent soil, to the discharge of contaminants offsite or to site conditions which may change substantially from those present now.
e) This statement is limited to the condition of the subject site at the date specified below.
f) Our insurance cover is limited to Professional Indemnity as specified above and does not cover, nor do we accept responsibility for, any commercial loss and/or consequential loss arising from contamination of the subject or adjoining sites or any associated expenses.

M M Evans

(Signed for and on behalf of Woodward-Clyde (NZ) Limited)

Registered Engineer, MIPENZ.

(Professional Qualifications)

Date :- 12th October 1999

ERB Reg No 8389

CHRISTCHURCH CITY COUNCIL
CONSENT DOCUMENT
16 NOV 1999
All building work shall comply with the New Zealand Building Code notwithstanding any inconsistencies which may occur in the drawings and specifications.

Woodward-Clyde (NZ) Ltd
Bank Direct Centre, 13-15 College Hill
PO Box 821, Auckland, New Zealand
Fax : 0-9-355 1333

COPY FOR YOUR INFORMATION

CHRISTCHURCH
THE GARDEN CITY
The city that shines

Resource Management Act 1991/Building Act 1991

Hazards or Special Site Characteristics

SOCKBURN SERVICE CENTRE

Location Waterloo Road. Number: (197) - 239

Legal Description: Lot 1 D.P. 78681 Ward: Wigram

Lot 2 DP 34558. Kyle Park.

Date Recorded 1:4:90 Severity 2 Accuracy A Recorded by George Marsh. Computer Entry 2:11:99.

DETAILS:

Uncontrolled fill - Stormwater Control - Trade Waste

LOCATION OF INFORMATION: SOCKBURN SERVICE CENTRE /197

File No. or Source of Information Drainage & Waste Management Unit

Further Details: File S 54/25

Site is located on a former Paparua County Council rubbish tip - filled with general rubbish - the tip was closed in 1981 - the exact depth and perimeter are not known.

STRUCTURAL ENGINEER'S soil response and bore hole tests are required for any structures on this site. Where necessary, provide design foundation drawings and supporting calculations or a "Producer Statement, Design".

WARNING No certificate of compaction or type of fill material used has been received.

The catchment area your project falls in **allows the option** of returning stormwater (roof areas) to the ground via an approved soakage chambers **or** to the stormwater channel.

A Registered Engineer's Design may be requested.

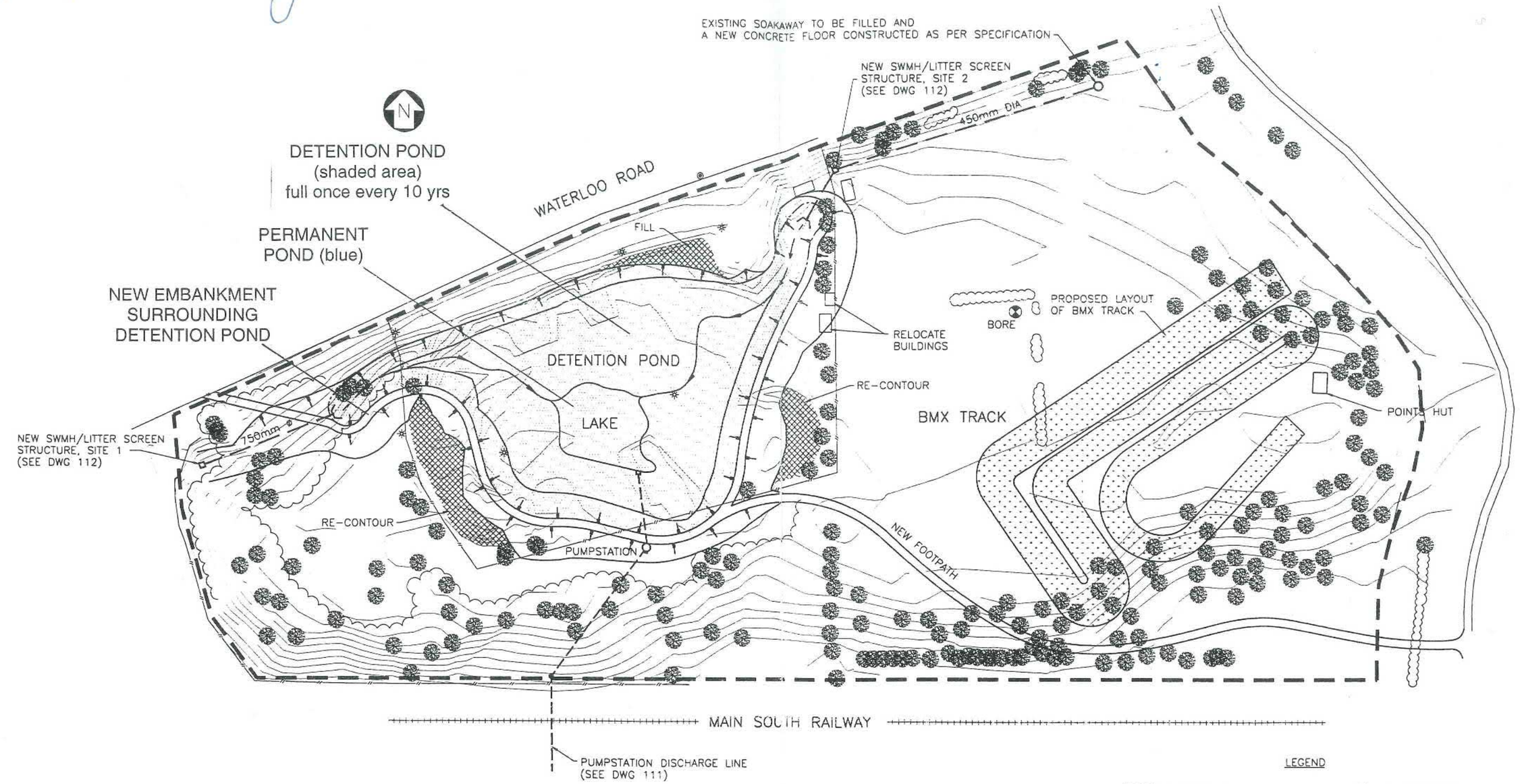
Exception where the site has been identified as contaminated.

Surface water from sealed or hard standing areas via oil interceptor or silt traps to an approved outlet will be required.

Due to the unknown depth or type of material used in the fill, a Registered Engineer's Design for the soakage chamber **must** be provided. The depth and capacity of the chamber will need to ensure that water saturation has no detrimental effect on the fill causing ground slumping.

KEY Severity [1] Low [2] Moderate [3] Extreme [4] Unknown

Accuracy [A] Confirmed [B] Unconfirmed [C] Personal Observation



DENTON PARK

NOTES

1. REMOVE EXISTING TREES WITHIN AND AROUND LIMITS OF BMX TRACK. TO BE CONFIRMED ON SITE BY THE ENGINEER.
2. BMX TRACK WILL BE PEGGED OUT ON SITE BY OTHERS.

LEGEND

- BMX TRACK
- MAXIMUM AREA OF WATER IN DETENTION POND
- RECONTOURED OR FILLED AREAS OUTSIDE OF DETENTION POND
- BORE HOLE
- LAMP POLE
- HEDGE
- TREE
- BUSH LINE
- Existing FENCE to be removed
- EXTENT OF WORKING AREA

0 10 20 30 40 50 60 70 80 90 100m

THIS PLAN DOES NOT SHOW PROPOSED NEW PLANTINGS

REV	DESCRIPTION OF REVISION	BY	CHK	DATE

CHRISTCHURCH CITY COUNCIL

Woodward-Clyde
Woodward-Clyde (NZ) Ltd.
LANDSBOROUGH HOUSE, 287 DURHAM STREET
CHRISTCHURCH NEW ZEALAND
Ph (03) 374 8500
Fax (03) 377 0655

CAD FILE NAME: S:\JOBS\2666\AC27\0001\6400\CC27CH20
VIEW NAME
XREF FILES
SCALES 1:500 (A1) 1:1000 (A3)
DESIGNED WTC, AMI
DRAWN DRF
CHECKED
PROJECT MANAGER
DATE 9/4/99

KYLE PARK STORMWATER

EXTENT OF WORKS
KYLE PARK

STATUS CONSULTATION
REVISION
DRAWING NUMBER AC266627-001

Appendix F: ECan's LLUR Statement

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry in regards to our Listed Land Use Register (LLUR) which holds information about sites that have been used, or are currently used for activities which have the potential to have caused contamination.

The LLUR statement provided indicates the location of the land parcel(s) you enquired about and provides information regarding any LLUR sites within a radius specified in the statement of this land.

Please note that if a property is not currently entered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; other information relevant to potential contamination may be held in other files (for example consent and enforcement files).

If your enquiry relates to a farm property, please note that many current and past activities undertaken on farms may not be listed on the LLUR. Activities such as the storage, formulation and disposal of pesticides, offal pits, foot rot troughs, animal dips and underground or above ground fuel tanks have the potential to cause contamination.

Please contact and Environment Canterbury Contaminated Sites Officer if you wish to discuss the contents of the LLUR statement, or if you require additional information.
For any other information regarding this land please contact Environment Canterbury Customer Services.

Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit www.ecan.govt.nz/HAIL for more information about land uses.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

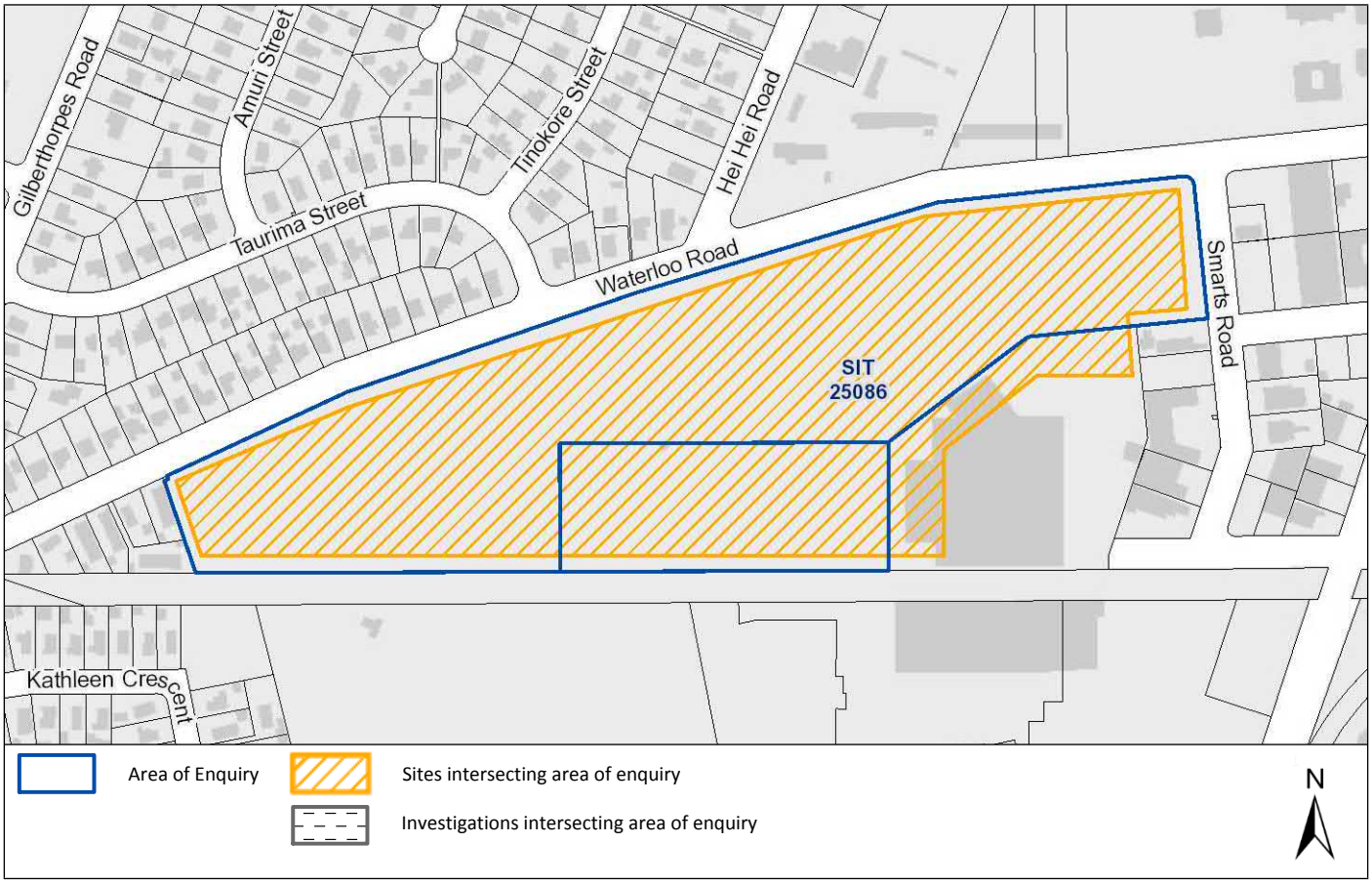
Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Date:	28 August 2015	
Land Parcels:	Lot 1 DP 78681	Valuation No(s): 2343205000
	Lot 2 DP 34558	Valuation No(s): 2343205000



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
25086	Christchurch City Council, Landfill	197 WATERLOO ROAD	G3 - Landfill sites;	Not Investigated

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry only.

Information held about the sites on the Listed Land Use Register

Site 25086: Christchurch City Council, Landfill (Intersects enquiry area.)

Site Address:	197 WATERLOO ROAD
Legal Description(s):	Lot 1 DP 34558,Lot 1 DP 78681,Lot 2 DP 34558

Site Category:	Not Investigated
Definition:	Verified HAIL has not been investigated.

Land Uses (from HAIL):

Period From	Period To	HAIL land use
Pre 1973	Pre 1984	Landfill sites

Notes:

Investigations:

There are no investigations associated with this site.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ106829.

Disclaimer:

The enclosed information is derived from Environment Canterbury's Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987 and Environment Canterbury's Contaminated Land Information Management Strategy (ECan 2009).

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Listed Land Use Register

What you need to know

Everything is connected

What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)[1]. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

[1] The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

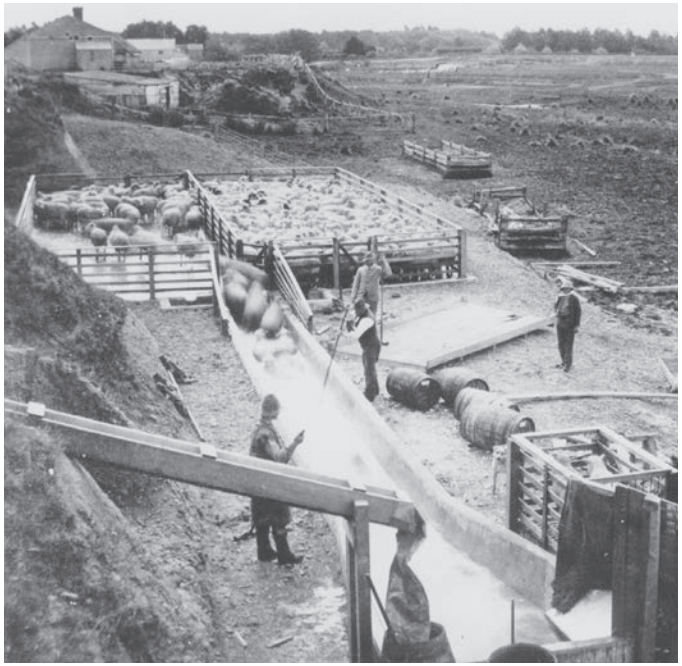
The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.

IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:
Calling from Christchurch: (03) 353 9007
Calling from any other area: 0800 EC INFO (32 4636)

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

Environment Canterbury Regional Council
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Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

E13/102

Appendix G: Geotechnical investigations

Approx Scale

0 100 200 300 400 500 (m)

" Borehole (BH) Location

Aerial photo sourced from Google Earth (Copyright 2012). Imagery Date: April 2012
Borehole data and locations sourced from Canterbury Geotechnical Database (August 2015)

Tonkin+Taylor
www.tonkintaylor.co.nz

DRAWN	AMMW	8/15
DRAFTING CHECKED	GGA	9/15
APPROVED	GGA	9/15
FILE: 53404.002		
APPROX. SCALE (AT A3 SIZE) AS SHOWN		
PROJECT No. 53404.002		

CHRISTCHURCH CITY COUNCIL
GEOTECHNICAL DESKTOP STUDY
KYLE PARK, HORNBY
Nearby Deep Ground Investigation Locations

FIG. No. Figure G1

REV. 0

BH_13850

AECOM

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH1**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469761.2mE 5740417.3mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records (Shear Vane residual - peak 0 - 200 kPa; N Values 0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
ASPHALT FILL	ss 2,1,2,2,2,2 N=8	HQ3 SPT		1		Asphalt Fine to coarse GRAVEL; grey, well graded, subangular to subrounded SW greywacke.	N/A
FILL	ss 1,1,1,1,1,1 N=4	HQ3 SPT		2		Sandy fine to coarse GRAVEL; grey with red staining, brownish red and black, angular to subrounded, SW greywacke, brick fragments and iron slag. Sand; fine to coarse, brownish red.	
	ss 2,2,2,3,8,10 N=23	HQ3 SPT		3			
	ss 11,15,16,13,12,8 N=49	HQ3 SPT		4		3.45m: with minor iron and no brick fragments, less red staining.	
SPRINGSTON FORMATION - YALHURST MEMBER - Alluvial Depost	ss 9,10,34,16,0,0 Refusal, 50 blows for 130mm N=50	HQ3 SPT		5		Sandy fine to coarse GRAVEL with rare cobbles; grey with minor red staining, poorly graded, subangular to subrounded, SW greywacke.	
	ss 1,4,10,15,14,11 Refusal, 50 blows for 270mm N=50	HQ3 SPT		6 7		5.45m: sand becomes reddish brown	
	sc 6,14,14,20,16,0 Refusal, 50 blows for 225mm N=50	HQ3 SPT		8 9			
	sc 6,6,7,8,13,16 N=44	SPT					

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller McNeill Drilling
Started 21/05/212
Drill Rig UDR600
Finished 23/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_13850

AECOM

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH1**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469761.2mE 5740417.3mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records: Shear Vane residual - peak (0 - 200 kPa)	Test Records: N Values (0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift (0 - 100%)	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
SPRINGSTON FORMATION - YALHURST MEMBER - Alluvial Depost			HQ3		11			N/A
		sc 6,8,8,12,14,15 N=49	SPT					
							BH1 terminated at 11.45m Target Depth	
					12			
					13			
					14			
					15			
					16			
					17			
					18			
					19			

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller Started
McNeill Drilling 21/05/212
Drill Rig Finished
UDR600 23/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_13852

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH2**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469839.6mE 5740327.7mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records (Shear Vane residual - peak 0 - 200 kPa; N Values 0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
FILL: ASPHALT / FILL		HQ3		0		Asphalt Fine to coarse GRAVEL; grey, well graded, subangular to subrounded, SW greywacke with trace fine black and red iron slag. 0.28m: becomes clayey	N/A
BURIED SOIL: BURIED SOIL	ss 1,0,1,0,1,2 N=4	SPT		1		Organic SILT with minor sand and gravel; dark brown, dry,	
		HQ3					
SPRINGSTON FORMATION: SPRINGSTON FORMATION - YALDHURST MEMBER - Alluvial Deposit	ss 3,5,6,5,6,6 N=23	SPT		2		Sandy fine to coarse GRAVEL; grey, well graded, Subangular to subrounded SW greywacke. Sand; fine to coarse, light brown.	
		HQ3					
	ss 2,4,16,29,5,0 Refusal, 50 blows for 170mm N=50	SPT		3			
		HQ3					
	ss 2,16,13,15,19,3 Refusal, 50 blows for 245mm N=50	SPT		4			
		PERC					
	sc 3,7,10,9,10,14 N=40	SPT		5			
		PERC		6			
	sc 2,5,12,10,11,9 N=42	SPT					
		PERC		7			
	sc 9,6,12,12,10,9 N=43	SPT		8			
		PERC		9			
	sc 11,11,11,9,9,5 N=34	SPT					

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller McNeill Drilling
Started 23/05/2012
Drill Rig UDR600
Finished 25/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_13852

AECOM

LOG OF DRILLHOLE

HOLE IDENTIFICATION **BH2**

Client Hawkins Construction
Project 27 Foremans Road
Project number 60265497

Co-ordinates 2469839.6mE 5740327.7mN
Orientation -90° Elevation
Location 27 Foremans Road, Christchurch
Feature Car Park

GEOLOGICAL DESCRIPTION	Test Records (Shear Vane residual - peak 0 - 200 kPa; N Values 0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Depth	Graphic Log	MATERIAL DESCRIPTION (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc)	Instrumentation
SPRINGSTON FORMATION - YALDHURST MEMBER - Alluvial Deposit SPRINGSTON FORMATION	sc 3,3,6,6,10,13 N=35	PERC		11		11m: becomes wet, light greyish brown	N/A
		SPT					
		PERC		12			
	sc 2,3,15,16,16,3 Refusal, 50 blows for 250mm N=50	SPT		13			
		PERC		14			
	sc 13,19,18,24,8,0 Refusal, 50 blows for 180mm N=50	SPT					
		PERC		15			
	sc 11,13,16,20,14,0 Refusal, 50 blows for 220mm N=50	SPT		16		BH2 terminated at 15.95m Target Depth	
				17			
				18			
				19			

GROUNDWATER OBSERVATIONS
Depth Piezometer Reading Date

Date logged
Logged KDL
Checked MPN

Casing Details
Depth Diameter

Remarks
1: Coordinates are in NZMG and are approximate.
2: Water table was not observed during drilling.

Hand held Shear Vane

vane shear strength per NZGS guideline

Driller Started
McNeill Drilling 23/05/2012
Drill Rig Finished
UDR600 25/05/2012
Core Boxes 3

Date Printed: 4/07/2012

DRILLHOLE LOG SOIL 60265497_27FOREMANSRD_BH1&2.GPJ BASE.GDT 04/07/12

BH_33829

BOREHOLE LOG

GHD Limited

PO Box 13468
Christchurch 8141

Site Identification: **BH2**

Sheet 1 of

Project:	Main South Rd	**Coordinates:** E 1560 211, N 5178 499	**Datum:**
Client:	Fulton Hogan	**Surface RL (m):**	**Total Depth:** 14.0m
Site:	Main South Rd	**Commenced:** 20-Feb-12	**Contractor:** Prodrill
Job No.:	5130730	**Completed:** 20-Feb-12	**Driller:** Kane

Equipment:	Sonic	**Inclination:** -90	**Logged:** DBS & DW
Shear Vane:	Geo 308	**Comments:**	**Processed:** DBS
Bore Diameter (mm):	80		**Checked:** JM

Depth (m)/ [Elev.]	Classification	Graphic Log	SOIL DESCRIPTION: (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation) / ROCK DESCRIPTION: Weathering, colour, fabric, ROCK NAME (Formation Name)	Moisture Condition	Consistency/ Relative Density	Weathering	Estimated Rock Strength (EW VW W MS S VS ES)	RQD (%)	Defect Spacing (mm) (20 60 200 600 2000)	TESTS & SAMPLES / ROCK MASS DEFECTS: Depth, Type, Inclinations, Roughness, Texture, Aperture, Coating
0.8			Fill, sand.	D						
1.5	GP		Sandy fine to coarse GRAVEL; brown; dry; well graded; sub rounded to sub angular; sand, fine to coarse; well graded. (SPRINGSTON FORMATION).	D						
2.0	GP		Sandy fine to coarse GRAVEL with minor silt; brown; dry to moist; well graded; sub rounded to sub angular; sand, fine to coarse; well graded. (SPRINGSTON FORMATION).	M						
	GP		Sandy fine to coarse GRAVEL; brown; dry; well graded; sub rounded to sub angular; sand, fine to coarse; well graded. (SPRINGSTON FORMATION).	D						N 1 11,8, 6,7, 3,6, [22]
4.3	SM		Silty fine to coarse SAND; brown; wet; well graded (dense). (SPRINGSTON FORMATION).	W						N 2 For 35 mm 15,13, 14,*, *,*, *,*, [14]
5.0	GP		Sandy fine to coarse GRAVEL; brown; moist; well graded; sub rounded to rounded; sand, fine to coarse; cobble present at 8.03m. (SPRINGSTON FORMATION).	M						N 3 For 70 mm 13,14, 21,29, *,*, *,*, [50]
6.0	GP		Sandy fine to coarse GRAVEL with some cobbles; brown; moist; well graded; sub rounded to angular; sand, fine to coarse; cobbles sub rounded. (SPRINGSTON FORMATION).	M						N 4 For 55 mm 17,50, *,*, *,*, *,*, [50]
8.5	GP		Sandy fine to coarse GRAVEL; brown; dry to moist; well graded; sub rounded to angular; sand, fine to coarse. (SPRINGSTON FORMATION).	M						
10										

BOREHOLE LOG NZ ALT 51 30730 FULTON HOGAN.GPJ NZ GINT DATA TEMPLATE VER 1.3.GDT 28/2/12

BH_33829

BOREHOLE LOG

GHD Limited

PO Box 13468
Christchurch 8141

Site Identification: **BH2**

Sheet 2 of

Project:	Main South Rd	**Coordinates:** E 1560 211, N 5178 499	**Datum:**
Client:	Fulton Hogan	**Surface RL (m):**	**Total Depth:** 14.0m
Site:	Main South Rd	**Commenced:** 20-Feb-12	**Contractor:** Prodrill
Job No.:	5130730	**Completed:** 20-Feb-12	**Driller:** Kane

Equipment:	Sonic	**Inclination:** -90	**Logged:** DBS & DW
Shear Vane:	Geo 308	**Comments:**	**Processed:** DBS
Bore Diameter (mm):	80		**Checked:** JM

Depth (m)/ [Elev.]	Drilling Method	Core Run / Recovery (%)	Support / Casing (m)	Water	Geological Fm	Classification	Graphic Log	SOIL DESCRIPTION: (Soil Code), Soil Name [minor MAJOR], colour, structure [zoning, defects, cementing], plasticity or grain size, secondary components, structure. (Geological Formation) / ROCK DESCRIPTION: Weathering, colour, fabric, ROCK NAME (Formation Name)	Moisture Condition	Consistency/ Relative Density	Weathering	Estimated Rock Strength (EW VW W MS S VS ES)	RQD (%)	Defect Spacing (mm) (20 60 200 600 2000)	TESTS & SAMPLES / ROCK MASS DEFECTS: Depth, Type, Inclinations, Roughness, Texture, Aperture, Coating
10.7 [0]						GP		Sandy fine to coarse GRAVEL with minor silt; brown; moist; sub rounded to angular; sand, fine to coarse. (SPRINGSTON FORMATION).	M						N 5 For 75 mm 50,*, [50]
11						GP		Sandy fine to coarse GRAVEL with minor cobbles; grey; wet; sub rounded to angular; sand, fine to coarse. (SPRINGSTON FORMATION).	W						11
12.0 [0]						GP		Sandy fine to coarse GRAVEL with minor clay and occasional cobbles; brown; wet; sub rounded to sub angular; sand, fine to coarse. (SPRINGSTON FORMATION).	W						50,*, N 6 For 55 mm [50]
13															12 13
14.0 [0]								Termination Depth = 14m, refusal							15,*, N 7 Refusal [N=] 14
15															15
16															16
17															17
18															18
19															19
20															20

BOREHOLE LOG NZ ALT 51 30730 FULTON HOGAN.GPJ NZ GINT DATA TEMPLATE VER 1.3.GDT 28/2/12

BH_31454

GEOSCIENCE consulting (NZ) LIMITED

Bore Hole No. *BH01*

Sheet *1 of 1*

Project No. *12096*

Engineering Log - Machine Bore Hole

Client: Mark Brown

Principal: -

Project: 744 Halswell Junction Road, Islington

Bore Hole Location: Refer to Site Location Plan

Date Started: *22/05/2012*

Date Completed: *22/05/2012*

Logged By: *CL*

Checked By: *NC*

Machine Type: Edson

Contractor: Pro-Drill

Diameter (mm): 63

Drilling Method: Rotary Cored

Excavation Information				Material Substance							
Material	Water	Notes, samples, tests etc	Depth (m)	Graphic Log	Classification Symbol	Material Soil - soil type, colour, structure, grading, bedding, plasticity, sensitivity; Secondary and minor components Rock - colour, fabric, rock type; discontinuities; additional information	Moisture Condition	Consistency / Density Index	TCR (%)	SPT N-value (Uncorrected)	
ALLUVIUM			1		GW	Silty sandy fine to coarse GRAVEL with trace cobbles; brown to greyish brown. Well graded; subrounded gravel; medium sand.	M	D	70		
			2						90		SPT 1.5m N=29 450mm pen.
			3		GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded; subrounded gravel; medium sand.	S	VD	90		
			4						100		SPT 3.5m N=50 300mm pen.
			5		GW	Inferred sandy medium to coarse GRAVEL. Fines washed out.	S	VD	60		
			6						40		SPT 5m N=50 435mm pen.
			7								SPT 6.5m N=50 435mm pen.
			8						30		SPT 8m N=50 370mm pen.
			9						30		SPT 9m N=50 375mm pen.

EOH: 9.88 m

Termination: Target depth

Notes:

Borehole terminated at target depth.

Solid SPTs undertaken at 5, 6.5, 8 and 9 m depth.

BH_55322

BOREHOLE No: BH2

MACHINE BOREHOLE LOG

SHEET 1 of 2

PROJECT: Chch EQ 24 Amyes Rd — JOB NUMBER: 5323568

SITE LOCATION: 24 Amyes Road — CLIENT: Elcano Ltd

CIRCUIT: NZTM — BOREHOLE LOCATION: Outside CAT offices on grass verge

COORDINATES: N 5,178,188 m — R L:

E 1,561,744 m — DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
		80 %	Sonic							0		OL	M	'Firm,' SILT, some organics, minor fine to medium sand, trace clay; dark brown, moist, low plasticity. Organics: grass and rootlets. [TOPSOIL]		0
												OL	D	'Firm,' SILT, some fine to coarse sand, some fine to medium gravel, trace organics; brown; dry, non plastic. Gravel: angular to sub angular, SW greywacke. Organics: rootlets. 0.6m: trace fine to medium sand, trace clay.	Fill	
										1		ML	D	'Firm,' fine to medium sandy, SILT, trace clay; light brown; dry, low plasticity.		1
		80 %	SPT					1 2 1 1 0 2 N=4								
		100 %	Sonic							2		CH	M	Firm, clayey SILT, trace fine to medium sand; light brown mottled orange; moist, high plasticity.		2
		90 %	SPT					1 0 1 1 2 2 N=6								
		100 %	Sonic							3		ML	M	Firm, fine to medium sandy, SILT, minor clay; light brown mottled orange; moist, low plasticity, slightly dilatant.		3
		90 %	SPT					3 3 5 4 18 21 N=48		4		SW	M	Loose, fine to medium SAND, some silt, trace clay; brown mottled orange, moist, low plasticity.		4
		100 %	Sonic							5		GP	M	Very dense, fine to coarse sandy, fine to coarse GRAVEL, trace silt; orangish brown, moist, non plastic. Gravel: subangular to subrounded (with rounded clasts), SW greywacke. Becomes greyish brown.	Springston Formation	5
		70 %	SPT					10 9 12 13 15 10 for 60mm N=50+		6						6
		100 %	Sonic											Some cobbles. Cobbles: subrounded to rounded, SW greywacke.		
		70 %	SPT					10 19 20 18 12 for 55mm N=50+		7						7
		100 %	Sonic							8						8
		60 %	SPT					9 11 10 10 10 9 N=39		9						9
	▽	100 %	Sonic													

DATE STARTED: 26/2/14 — DRILLED BY: Land test Ltd

DATE FINISHED: 26/2/14 — EQUIPMENT: Geo 305

LOGGED BY: PYF — DRILL METHOD: Sonic

SHEAR VANE No: N/A — DRILL FLUID: Polyplus and water

DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10mbgl at 2:10pm with all casing stll in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_55322

Beca

BOREHOLE No: BH2

MACHINE BOREHOLE LOG

SHEET 2 of 2

PROJECT: Chch EQ 24 Amyes Rd — JOB NUMBER: 5323568

SITE LOCATION: 24 Amyes Road — CLIENT: Elcano Ltd

CIRCUIT: NZTM — BOREHOLE LOCATION: Outside CAT offices on grass verge

COORDINATES: N 5,178,188 m — R L:

E 1,561,744 m — DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
	26/02/14	100 %	Sonic					6		11		GW	W	Medium dense, fine to coarse GRAVEL, some cobbles, minor fine to medum sand, trace silt; greyish brown; wet, non plastic. Gravel/cobbles: subangular to subrounded, SW greywacke.		11
		60 %	SPT					8 6 7 6 5 N=24								
		90 %	Sonic													
		67 %	SPT					3 5 6 18 17		12		GP	W	Very dense, fine to coarse sandy, fine to coarse GRAVEL, some silt, some cobbles; orange brown, wet, non plastic. Gravel/cobbles: subangular to subrounded, SW greywacke.	Springston Formation (Contd.)	12
		100 %	Sonic					9 for 45mm N=50+		13						13
		60 %	SPT					5 12 7 9 13								
		100 %	Sonic					21 N=50+		14						14
		67 %	SPT					20 19 9 6 4		15				Medium dense.		15
								6 N=25						END OF LOG @ 15.45 m		
										16						16
										17						17
										18						18
										19						19

DATE STARTED: 26/2/14 — DRILLED BY: Land test Ltd

DATE FINISHED: 26/2/14 — EQUIPMENT: Geo 305

LOGGED BY: PYF — DRILL METHOD: Sonic

SHEAR VANE No: N/A — DRILL FLUID: Polyplus and water

DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10mbgl at 2:10pm with all casing stll in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_55321

Beca

BOREHOLE No: BH1

MACHINE BOREHOLE LOG

SHEET 1 of 2

PROJECT: Chch EQ 24 Amyes Rd — JOB NUMBER: 5323568

SITE LOCATION: 24 Amyes Road — CLIENT: Elcano Ltd

CIRCUIT: NZTM — BOREHOLE LOCATION: North of Engineering Building on pavement

COORDINATES: N 5,178,376 m — R L:

E 1,561,605 m — DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
		100 %	Sonic							0		ML	D	Loosely packed, fine to medium sandy, SILT, some fine to medium gravel; brown; dry, non plastic. Gravel: subrounded to rounded, SW greywacke.	Fill	0
										1		ML	M	'Firm,' fine to medium sandy SILT, minor clay; brown mottled orange, moist, low plasticity.		1
		78 %	SPT					2 2 1 2 3 2 N=8		2		SM	M	Loose, fine to medium SAND, some silt, trace clay; light brown; moist, low plasticity.		2
		67 %	Sonic							3		ML	M	Soft-firm, fine to medium sandy SILT, minor clay; brown mottled orange; moist, low plasticity.		3
														3.0m - 3.4m depth: No recovery (possibly washed away during casing advancement).		
		100 %	SPT					1 1 1 0 1 1 N=3		4		ML	M	Soft, fine to medium sandy SILT, minor clay; brown mottled orange; moist, low plasticity, sensitive.		4
		100 %	Sonic									SM	M	Loose, silty, fine to medium SAND, minor clay; orange brown; moist, low plasticity.		
		90 %	SPT					2 8 16 27 7 for 25mm N=50+		5		GW	M	Very dense, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, minor silt; light brown; moist, non plastic. Gravel: sub angular to subrounded, SW greywacke. 5.3 - 5.55m: orange brown mottled dark brown.	Springston Formation	5
		100 %	Sonic							6						6
		75 %	SPT					9 14 14 17 16 3 for 15mm N=50+								
		100 %	Sonic							7						7
		80 %	SPT					16 20 24 22 4 for 15mm N=50+		8						8
		100 %	Sonic													
		80 %	SPT					8 11 11 10 10 10 N=41		9						9
		100 %	Sonic													

DATE STARTED: 25/2/14 — DRILLED BY: Land test Ltd

DATE FINISHED: 25/2/14 — EQUIPMENT: Geo 305

LOGGED BY: PYF — DRILL METHOD: Sonic

SHEAR VANE No: N/A — DRILL FLUID: PolyPlus and water

DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10.3mbgl at 2:45pm with all casing still in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_55321

Beca

BOREHOLE No: BH1

MACHINE BOREHOLE LOG

SHEET 2 of 2

PROJECT: Chch EQ 24 Amyes Rd
JOB NUMBER: 5323568
SITE LOCATION: 24 Amyes Road
CLIENT: Elcano Ltd

CIRCUIT: NZTM
COORDINATES: N 5,178,376 m
E 1,561,605 m
BOREHOLE LOCATION: North of Engineering Building on pavement
R L:
DATUM:

DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	ROD	CASING	IN-SITU TESTS: SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	DEPTH (m)
	25/02/14	100 %	Sonic					6				GW	M	Very dense, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, minor silt; light brown; moist, non plastic. Gravel: sub angular to subrounded, SW greywacke.		
		67 %	SPT					10					W	Very dense, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, minor silt; light brown; moist, non plastic. Gravel: sub angular to subrounded, SW greywacke.		
								13								
								15								
								11		11						11
		100 %	Sonic					11 for 70mm N=50+						10.3m: Becomes wet.		
														10.6m: Some cobbles. Cobbles: subrounded to rounded, SW greywacke.		
								5								
		55 %	SPT					10								
								10								
								13								
								14		12						12
		100 %	Sonic					13 for 60mm N=50+								
								6								
		67 %	SPT					11								
								10								
								12								
								11		13						13
		100 %	Sonic					10								
								N=43								
								5								
		67 %	SPT					9								
								12								
								10								
								7		14						14
								9								
								N=38								
														END OF LOG @ 15.45 m		
										15					Springston Formation (Contd.)	15
										16						16
										17						17
										18						18
										19						19

DATE STARTED: 25/2/14
DATE FINISHED: 25/2/14
LOGGED BY: PYF
SHEAR VANE No: N/A

DRILLED BY: Land test Ltd
EQUIPMENT: Geo 305
DRILL METHOD: Sonic
DRILL FLUID: PolyPlus and water
DIAMETER/INCLINATION: 100 mm / 90°

COMMENTS:
Borehole terminated at target depth. Groundwater: 10.3mbgl at 2:45pm with all casing still in ground.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:50

MACHINE_BOREHOLE P:\5325323568\TGE 2\1. JOB COMISSIONING\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\24 AMYES ROAD.GPJ BECA.GDT 3/4/14

BH_34591

GEOTECH

DRILLHOLE BORELOG

Hole ID:	**BH02**
Sheet:	1 of 1
Date:	9/12/2013

Project No.: 4572 | **Equipment:** VTR 9750 - Track | **G.L R.L:** 0.00m | **Logged By:** YUY

Project: 18 Chalmers Street | **Drilling Co:** McMillan Drilling | **Max Depth:** 3.60m | **Checked By:** IMC

Client: - | **Operator:** C. Nee | **Inclination:** 90° | **Sampled By:** YUY

North (m): 5178825.5 **East (m):** 1561375.9 **Grid:** NZTM **Location:** Please refer to the site plan.

Geological Formation	STRATA DESCRIPTION	Graphic Log	Depth	Classification Symbol	Piezometer & Water Levels	TCR (%)	Drill Method	Samples	Tests	SPT (blows/mm)
	Asphalt.					20%				
	Gravel (FILL).									
	SAND with minor Silt; greyish brown. Very fine to fine Sand. -1.72-1.82m, trace of Gravel. Fine to medium Gravel. Sub-rounded to rounded.		1.0	SP		75%			1.00m SPT (C)	4 2 3 5/262mm
	Silty SAND; greyish brown. Very fine to fine Sand .		2.0	SM						
	Sandy GRAVEL with trace of Silt; brownish grey. Very fine to fine Sand, fine to coarse Gravel. Sub-rounded to rounded. -2.4m, fine to coarse Sand.		3.0	GW		75%			2.40m SPT (C)	22 22 15 37/300mm
	SAND with minor Silt; dark brown. Very fine to fine Sand.			SP						
	Sandy GRAVEL with trace of Silt; brownish grey. Fine to coarse Sand, fine to coarse Gravel. Sub-rounded to rounded.			GW					3.60m SPT (C)	35 24 17 41/300mm
EOH: 3.60m										

Remarks: No Static Water Level Recorded
Safety Auto Trip Hammer #396 used (energy ratio 76.4%)

BH_40710

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Mortlock McElroy Ltd

PROJECT: 1 Brynley Street, Hornby

Machine Borehole No: MB01

Sheet 1 of 2

Drill Type:	Rotary Drilling	Project No:	C14315	Logged By:	MLB/MG
Drilled By:	Speight Drilling Ltd	Coordinates:	1561859 E, 5178723 N	Reviewed By:	PS
Date Started:	22/7/14	Ground Elevation:	28m LYTTHT1937	Surface Conditions:	Near level, grass
Date Finished:	22/7/14	Water Level:	Groundwater Masked by Drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
Topsoil		Dark brown, SILT, trace fine sand, trace fine sub-rounded to rounded gravel, very loose, moist, non-plastic		0.0								
Fill		Grey, sandy fine to coarse sub-rounded to rounded GRAVEL, loose to medium dense, wet to saturated		0.5			Triple T.					
		mottled orange		1.0		3 5 4 N=9	SPT					
Springston Formation		Light brown, sandy SILT, trace fine to medium sub-rounded to sub-angular gravel, medium dense to dense, wet to saturated, non-plastic		1.5			Triple T.					
		Greyish brown, fine sandy fine to coarse sub-rounded to rounded GRAVEL, trace sub-rounded cobble, very dense, saturated		2.0		1 28 31 N=59	SPT					
		grey		2.5			Triple T.					
				3.0		52 34 26 N=60	SPT					
				3.5			Triple T.					
				4.0		31 53 7 N=60	SPT					
		Grey, fine to coarse, sub-rounded to rounded GRAVEL, some fine to coarse sand, trace sub-rounded cobble, dense to very dense, saturated		4.5			Triple T.					
				5.0		8 15 17 N=32	SPT					
				5.5			Triple T.					
				6.0								

MACHINE LOG C14315_MB1.GPJ S+R_2012-AGS - REVISED.GDT 31/7/14

BH_40710

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Mortlock McElroy Ltd

PROJECT: 1 Brynley Street, Hornby

Machine Borehole No: MB01

Sheet 2 of 2

Drill Type:	Rotary Drilling	Project No:	C14315	Logged By:	MLB/MG
Drilled By:	Speight Drilling Ltd	Coordinates:	1561859 E, 5178723 N	Reviewed By:	PS
Date Started:	22/7/14	Ground Elevation:	28m LYTTHT1937	Surface Conditions:	Near level, grass
Date Finished:	22/7/14	Water Level:	Groundwater Masked by Drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
Springston Formation		Grey, fine to coarse, sub-rounded to rounded GRAVEL, some fine to coarse sand, trace sub-rounded cobble, dense to very dense, saturated		6.0		38 59 1 N=60	SPT					
				6.5			Triple T.					
				7.0		20 30 30 N=60	SPT					
				7.5			Triple T.					
				8.0		24 30 30 N=60	SPT					
				8.5			Triple T.					
				9.0		13 21 20 N=41	SPT					
				9.5			Triple T.					
				10.0		23 23 31 N=54	SPT					
		END OF BORE. 10.45 METRES. [Target Depth]		10.5								
				11.0								
				11.5								
				12.0								

MACHINE LOG C14315_MB1.GPJ S+R_2012-AGS - REVISED.GDT 31/7/14

BH_29250

Bore Log

McMILLAN Drilling GROUP

Client: GHD NZ Ltd

Project: 282 Main South Road, Christchurch

Bore No.: BH001

Job No.: 12405

Site Location: 282 Main South Road, Christchurch
Grid Reference: 1562727.48mE, 5178812.75mN (NZTM)
Rig Operator: D. Berger
Rig Model & Mounting: Geoprobe 8140LS

Date Commenced: 29/07/2013
Date Completed: 29/07/2013
Consent: -
Datum: Ground

Description	Method	Drivability (1 2 3 4 5)	Recovery (25 50 75)	Depth	Graphic Log	SPT N-value (Uncorrected) (10 20 30 40 50)	SPT Data (Uncorrected)	Samples	Installation & Resources
TOPSOIL Brown fine to medium Sandy fine to coarse GRAVEL; minor to some cobbles	Sonic core drilling		100%	0.5			N = 60 (C) 1.00m 13, 16 / 15, 16, 14, 15 450mm		Bentonite (4.5 bags)
			100%	1.0					
			100%	1.5			N = 51 (C) 2.00m 17, 17 / 16, 14, 12, 9 450mm		
			100%	2.0					
			100%	2.5			N = 60+ (C) 3.00m 10, 14 / 25, 23, 13 345mm Effective Refusal		3.2m
			100%	3.0					
			100%	3.5			N = 35 (C) 4.00m 12, 11 / 8, 8, 9, 10 450mm		
			100%	4.0					
			100%	4.5			N = 34 (C) 5.00m 4, 4 / 7, 5, 8, 14 450mm		
			100%	5.0					
			100%	5.5			N = 60+ (C) 6.00m 7, 17 / 17, 23, 20 360mm Effective Refusal		Surrounding ground collapse
			100%	6.0					
			100%	6.5			N = 60+ (C) 7.00m 14, 19 / 21, 20, 19 370mm Effective Refusal		
			100%	7.0					
			100%	7.5			N = 60+ (C) 8.00m 30, 30 135mm Effective Refusal		
			100%	8.0					
			100%	8.5			N = 60+ (C) 9.00m 25, 35 125mm Effective Refusal		
			100%	9.0					
			100%	9.5			N = 60+ (C) 10.00m 30, 30 140mm Effective Refusal		10.14m
				10.0					

EOH: 10.14m

Remarks

Geotechnical Investigation Borehole BH001 with SPT Testing

No Static Water Level Recorded
1000 Litres Water Added
Safety Auto Trip Hammer #368 used (energy ratio 99%)

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Additional Resources:

Plastic Liner	**m**	-
Flush Mounted Toby Box		
- Standard	**ea**	
- Environmental	**ea**	
Above Ground Protective Surround	**ea**	
Geotextile Sock	**m**	-
Hand Clear Location	**ea**	
Decontaminate Equipment	**ea**	

120 High Street, Southbridge 7602, Canterbury, New Zealand ph: (03) 324 2571 fax: (03) 324 2431 web: www.drilling.co.nz

Hole Depth: 10.14m

Generated by GEROC Core-GS

Created: 2/08/2013 7:26:24 a.m.

BH_29251

Bore Log

McMILLAN Drilling GROUP

Client: GHD NZ Ltd

Project: 282 Main South Road, Christchurch

Bore No.: BH002

Job No.: 12405

Site Location: 282 Main South Road, Christchurch
Grid Reference: 1562803.56mE, 5178809.26mN (NZTM)
Rig Operator: D. Berger
Rig Model & Mounting: Geoprobe 8140LS

Date Commenced: 30/07/2013
Date Completed: 30/07/2013
Consent: -
Datum: Ground

Description	Method	Drivability (1–5)	Recovery (25–75)	Depth	Graphic Log	SPT N-value (Uncorrected) (10–50)	SPT Data (Uncorrected)	Samples	Installation & Resources
TOPSOIL Brown fine to medium Sandy fine to coarse GRAVEL; minor to some cobbles	Sonic core drilling		100%	0.5			N = 14 (C) 1.00m 10, 6 / 5, 4, 2, 3 450mm		Bentonite (1 bags) 1.3m
			100%	1.0					
			100%	1.5			N = 60+ (C) 2.00m 11, 15 / 16, 15, 16, 13 420mm Effective Refusal		
			100%	2.0					
			100%	2.5			N = 60+ (C) 3.00m 10, 14 / 13, 16, 18, 13 420mm Effective Refusal		
			100%	3.0					
			100%	3.5			N = 47 (C) 4.00m 18, 16 / 13, 13, 10, 11 450mm		
			100%	4.0					
			100%	4.5			N = 60+ (C) 5.00m 16, 21 / 17, 17, 18, 8 405mm Effective Refusal		
			100%	5.0					
			100%	5.5			N = 48 (C) 6.00m 15, 13 / 12, 12, 13, 11 450mm		
			100%	6.0					
			100%	6.5			N = 60+ (C) 7.00m 22, 22 / 21, 21, 18 370mm Effective Refusal		
			100%	7.0					
			100%	7.5			N = 60+ (C) 8.00m 27, 29 / 29, 28, 3 310mm Effective Refusal		
			100%	8.0					
			100%	8.5			N = 60+ (C) 9.00m 16, 18 / 14, 21, 17, 3 385mm Effective Refusal		
			100%	9.0					
			100%	9.5			N = 60+ (C) 10.00m 13, 13 / 15, 14, 21, 10 410mm Effective Refusal		Surrounding ground collapse 10.41m
				10.0					

EOH: 10.41m

Remarks

Geotechnical Investigation Borehole BH002 with SPT Testing

No Static Water Level Recorded
1000 Litres Water Added
Safety Auto Trip Hammer #368 used (energy ratio 99%)

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Additional Resources:

Plastic Liner	**m**	-
Flush Mounted Toby Box		
- Standard	**ea**	
- Environmental	**ea**	
Above Ground Protective Surround	**ea**	
Geotextile Sock	**m**	-
Hand Clear Location	**ea**	
Decontaminate Equipment	**ea**	

120 High Street, Southbridge 7602, Canterbury, New Zealand ph: (03) 324 2571 fax: (03) 324 2431 web: www.drilling.co.nz

Hole Depth: 10.41m

Created: 2/08/2013 7:26:50 a.m.

BH_38385

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Halswell Road Properties Limited

PROJECT: 47 Waterloo Road, Hornby, Christchurch

Machine Borehole No: BH1

Sheet 1 of 2

Drill Type:	Rotary Drilling	Project No:	C13364	Logged By:	JP/AM
Drilled By:	Speight Drilling Ltd	Coordinates:	1562948 E, 5179334 N	Reviewed By:	PS
Date Started:	24/4/14	Ground Elevation:	25m LYTTHT1937	Surface Conditions:	Near Level, asphalt
Date Finished:	24/4/14	Water Level:	Groundwater masked by drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
		Asphalt		0.0								
Fill		Greyish brown, sandy fine to medium sub-rounded to rounded GRAVEL, medium dense to dense, dry to moist [FILL]		0.5			Hand Auger					
Springston Formation		Greyish brown, fine to coarse sub-rounded to rounded GRAVEL, some medium to coarse sand, very dense, saturated [SPRINGSTON FORMATION]		1.0		22 50 10 for 325mm N=60	SPT					
				1.5			Triple T.					
		trace cobbles		2.0		26 27 33 N=60	SPT					
		fine to medium sub-rounded to rounded gravel, trace to minor silt, no cobbles, medium dense		2.5			Triple T.					
				3.0		6 5 8 N=13	SPT					
		fine to coarse sub-rounded to rounded gravel		3.5			Triple T.					
		trace silt, very dense		4.0		24 32 28 for 400mm N=60	SPT					
				4.5			Triple T.					
		Greyish brown, medium to coarse SAND, minor to some fine sub-rounded to rounded gravel, loose, saturated		5.0		1 1 6 N=7	SPT					
				5.5			Triple T.					
				6.0								

MACHINE LOG C13364 BH1 30-4-14.GPJ S+R_2012-AGS - REVISED.GDT 2/5/14

PO Box 5486, Papanui, Christchurch 8542. Phone: (03) 352 4519
www.soilandrock.co.nz

BH_38385

Soil & Rock Consultants
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

CLIENT: Halswell Road Properties Limited

PROJECT: 47 Waterloo Road, Hornby, Christchurch

Machine Borehole No: BH1

Sheet 2 of 2

Drill Type:	Rotary Drilling	Project No:	C13364	Logged By:	JP/AM
Drilled By:	Speight Drilling Ltd	Coordinates:	1562948 E, 5179334 N	Reviewed By:	PS
Date Started:	24/4/14	Ground Elevation:	25m LYTTHT1937	Surface Conditions:	Near Level, asphalt
Date Finished:	24/4/14	Water Level:	Groundwater masked by drilling	Shear Vane Number:	N/A

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	SPT / c_u (kPa) (blows/300mm)	DRILLING METHOD	RECOVERY (%)	TCR SCR RQD	If	WATER CONTENT	Heave (mm)
Springston Formation		Greyish brown, medium to coarse SAND, minor to some fine sub-rounded to rounded gravel, loose, saturated		6.0		5 5 6 N=11	SPT					
				6.5			Triple T.					
		Light brown, SILT, minor to some fine sand, loose, saturated, non-plastic		7.0		2 3 5 N=8	SPT					
		bluish grey, mottled oranges, trace fine sand										
		light brown, mottled grey, minor fine sand		7.5			Triple T.					
				8.0		3 6 5 N=11	SPT					
		Light brown, fine to medium sandy SILT, medium dense, saturated, non-plastic, mottled bluish grey		8.5			Triple T.					
		medium to coarse sandy silt		9.0								
Riccarton Gravel		Greyish brown, sandy fine to coarse sub-rounded to rounded GRAVEL, very dense, saturated [RICCARTON GRAVEL]				20 43 17 for 375mm N=60	SPT					
				9.5			Triple T.					
				10.0		16 16 21 N=37	SPT					
		END OF BORE. 10.45 METRES. [Target Depth]		10.5								
				11.0								
				11.5								
				12.0								

MACHINE LOG C13364 BH1 30-4-14.GPJ S+R_2012-AGS - REVISED.GDT 2/5/14

PO Box 5486, Papanui, Christchurch 8542. Phone: (03) 352 4519
www.soilandrock.co.nz

BH_31223

aurecon
www.aurecongroup.com

BOREHOLE RECORD

HOLE NO. **BH 2**

PROJECT NO. **238331**

PROJECT **Champions' Mile**
Riccarton Racecourse

METHOD **SNC**	CO-ORDINATES (NZTM) **E 1562624 N 5180202**	SHEET **1** of **2**
MACHINE & NO. **AMS**		DATE from **17/09/2013** to **17/09/2013**
FLUSHING MEDIUM **Water**	ORIENTATION **VERTICAL**	GROUND-LEVEL **+26.10** m RL

Drilling Progress	Casing depth/size	Water level (m) shift start/ end	Water Recovery %	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples Type	Ref	Depth	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
											0.00		0.00		
				100								+25.80	0.30		SILT with some sand and occasional rootlets. *Soft*, moist, low plasticity; sand, fine.
															SILT with some sand; yellowish brown. Firm to stiff, moist, low plasticity; sand, fine.
									SNC						
								98 kPa							
								122 kPa							
				22				(1, 3, 2, 2, 2, 1) N = 7	SPT		1.50				
				100							1.95				
								98 kPa	SNC						
								122 kPa				+23.50	2.60		
								(13, 14, 16, 16, 18) N = 50/225 mm	SPT		3.00				Sandy fine to coarse GRAVEL with minor silt; yellowish brown. Very dense, moist; gravel, subangular to subrounded; sand, fine to coarse.
				80							3.38				3.00m Becomes with some sand; brownish grey.
				63					SNC		3.38				
								(9, 10, 18, 14, 18) N = 50/225 mm	SPT		4.50	+21.60	4.50		Fine to coarse GRAVEL with minor sand; grey. Very dense, moist; gravel, subangular to subrounded; sand, fine.
				66							4.87				
				100					SNC						
								(3, 3, 1, 3, 3, 1) N = 8	SPT		6.00				6.00m - 6.45m Becomes medium dense.
				100							6.45				
									SNC						
				100				(2, 3, 2, 4, 5, 5) N = 16	SPT		7.50				7.50m - 7.95m Becomes dense.
				66							7.95				7.80m Becomes with some sand and minor silt
									SNC						
				44				(7, 12, 12, 10, 11, 9) N = 42	SPT		9.00				9.00m - 9.45m Becomes very dense.
				100							9.45				
									SNC						

Report ID: AGS4 BOREHOLE RECORD || Project: CHAMPIONS MILE LOGS.GPJ || Library: AGS 4_0.GLB || Date: 23 October 2013

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **C. WILSON**

DATE **18/09/2013**

CHECKED **A. WELLS**

DATE **23/09/2013**

REMARKS

Co-ordinates from CERA Public Viewer, accurate to +/-5m.

Ground level from LiDAR data, using the Lyttelton vertical datum, accurate to +/-1m.

Groundwater not recorded.

Hammer energy ratio 85.4%

Aurecon New Zealand Ltd, 150 Cavendish Road, Christchurch 8051. Tel: +64 3 375 0761 Fax: +64 3 379 6955 christchurch@aurecongroup.com

BH_31223

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BOREHOLE RECORD

HOLE NO. **BH 2**

PROJECT NO. **238331**

PROJECT **Champions' Mile**
Riccarton Racecourse

METHOD **SNC**	CO-ORDINATES (NZTM) **E 1562624 N 5180202**	SHEET **2** of **2**
MACHINE & NO. **AMS**		DATE from **17/09/2013** to **17/09/2013**
FLUSHING MEDIUM **Water**	ORIENTATION **VERTICAL**	GROUND-LEVEL **+26.10** m RL

Drilling Progress	Casing depth/size	Water level (m) shift start/ end	Water Recovery %	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples Type	Ref	Depth	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
				100									10.00		
				44				(8, 10, 14, 14, 10, 9) N = 47	SNC		10.50				
				85					SPT		10.95				
									SNC						
				44				(8, 7, 10, 12, 12, 13) N = 47	SPT		12.00				
				100							12.45				
									SNC						
				44				(2, 6, 5, 6, 8, 10) N = 29	SPT		13.50				
				100							13.95				14.00m Becomes brownish grey. Saturated
									SNC						
				44				(3, 5, 5, 8, 7, 11) N = 31	SPT		15.00				
											15.45	+10.65	15.45		End of Sonic core drilling at 15.45m, on 17/09/2013 *Termination Reason:* Target depth achieved.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **C. WILSON**

DATE **18/09/2013**

CHECKED **A. WELLS**

DATE **23/09/2013**

REMARKS

Co-ordinates from CERA Public Viewer, accurate to +/-5m.

Ground level from LiDAR data, using the Lyttelton vertical datum, accurate to +/-1m.

Groundwater not recorded.

Hammer energy ratio 85.4%

Report ID: AGS4 BOREHOLE RECORD || Project: CHAMPIONS MILE LOGS.GPJ || Library: AGS 4_0.GLB || Date: 23 October 2013

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BH_33525

GEOSCIENCE
A proud partner of ENGEO

MACHINE BOREHOLE - BH03

32 Roberts Road
Islington
Christchurch

Client	: 1Geotechnical	**Date**	: 20/08/13
Project	: Geotechnical Investigation	**Contractor**	: LandTest
Geoscience Ref.	: 10224.000.011	**Hammer Efficiency**	: 84 %
Drilling Method	: Sonic	**Hole Depth**	: 15.45 m
Core Diameter	: 68 mm	**Logged/Reviewed By**	: EG/LF

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Log	Water Level	Moisture Condition	Consistency / Density Index	TCR (%) 25 50 75	SPT N-Value 0 10 20 30 40 50	
0.0	TS	ML	SILT with some gravel, trace sand and rootlets; brown [TOPSOIL].				S-St			
0.5	ALLUVIUM	GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subrounded to subangular. Sand, fine to coarse, well graded, subrounded to subangular.			N/R	MD-D			SPT: 1.5 m 14,9,7,5,5,6 N =23 450 mm pen.
1.0										
1.5										
2.0										
2.5										
3.0										SPT: 3.0 m 13,17,17,20, 13 N = 50 335 mm pen.
3.5										
4.0										
4.5										SPT: 4.5 m 7,7,6,6,6,8 N = 26 450 mm pen.
5.0										
5.5										
6.0										SPT: 6.0 m 7,16,12,11,12, 14 N = 49 450 mm pen.
6.5										
7.0							L			
7.5										SPT: 7.5 m 2,3,2,1,2,2 N = 7 450 mm pen.
8.0			Sand becomes trace from 8.0 to 8.3 m depth.							
8.5										

BH_33525

GEOSCIENCE
A proud partner of ENGEO

MACHINE BOREHOLE - BH03

32 Roberts Road
Islington
Christchurch

Client	: 1Geotechnical	**Date**	: 20/08/13
Project	: Geotechnical Investigation	**Contractor**	: LandTest
Geoscience Ref.	: 10224.000.011	**Hammer Efficiency**	: 84 %
Drilling Method	: Sonic	**Hole Depth**	: 15.45 m
Core Diameter	: 68 mm	**Logged/Reviewed By**	: EG/LF

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Log	Water Level	Moisture Condition	Consistency / Density Index	TCR (%) 25 50 75	SPT N-Value 0 10 20 30 40 50	
8.5										
9.0	ALLUVIUM	GW	Continued: Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, subrounded to subangular. Sand, fine to coarse, well graded, subrounded to subangular.							SPT: 9.0 m 16,23,26,24 N = 50 300 mm pen.
9.5										
10.0						N/R				
10.5										SPT: 10.5 m 7,12,12,12,14,9 N = 47 450 mm pen.
11.0										
11.5			Becomes saturated at 11.8 m depth.		▼					
12.0							MD-D			SPT: 12.0 m 5,6,5,4,4,3 N = 16 450 mm pen.
12.5										
13.0										
13.5						S				SPT: 13.5 m 3,3,6,9,11,6 N = 32 450 mm pen.
14.0			Cobbles become trace between 14.2 m depth and 14.7 m depth.							
14.5										
15.0										SPT: 15.0 m 7,8,10,6,5,8 N = 29 450 mm pen.
15.5			EOH: 15.45 m							
16.0										
16.5										
17.0										

Termination: Target depth
Machine Borehole met target depth at 15.45 m depth.
Groundwater encountered at 11.8 m depth.
Core lost (due to stone in drill) berween 7.5 m depth and 7.6 m depth.
TS = TOPSOIL, N/R = Not Recorded

www.tonkintaylor.co.nz

Site Management Plan (Ground Contamination) for small scale works

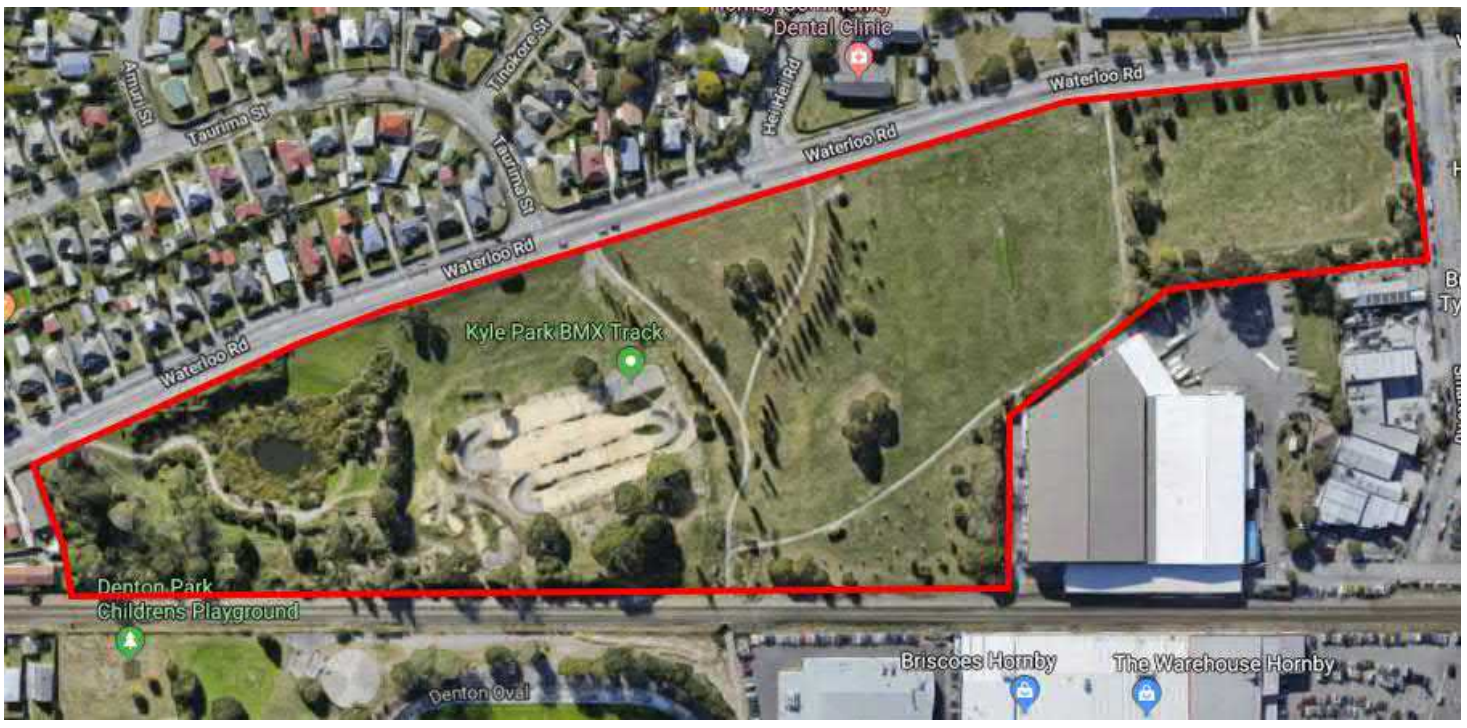
Kyle Park, Hornby

Purpose and Audience

This site management plan for ground contamination (SMP) has been prepared for *small scale works* at Kyle Park, Hornby which is owned and maintained by Christchurch City Council (CCC).

All contractors undertaking maintenance and groundworks activities at Kyle Park that could result in the disturbance or exposure of soil must comply with the controls and procedures of this SMP.

'Kyle Park' is defined by the area bordered in red below.



Small scale works are those that generally involve only shallow ground disturbance and at Kyle Park are likely to include:

- Grass cutting where there is the potential for the blades to cut into the turf and expose the soil underneath. This risk is increased when the grass is cut to less than 100mm in length on a uneven surface;
- Vegetation and landscaping maintenance (weed trimming and removal of vegetation – particularly if using cutting machinery, replanting etc) where soils could be disturbed and/or exposed; and
- Limited excavation works, for example for sign installation, single fence post installation or tree planting where excavation is limited to no more than 1.0m depth, less than $1m^2$ and/or $8m^3$, and which will take less than one day to complete.

This plan is not for use for larger scale ground disturbance works (e.g. digging of multiple fence post holes, trenching for buried services, bulk earthworks for foundations, road construction, pavement construction).

If you think your works will be large scale ground disturbance works, or take longer than one day to complete, you should contact your CCC project manager straight away for further advice. Do not commence any works until you have determined what controls to develop and apply for your specific task.

Roles and Responsibilities

- CCC – site owner and operator; responsible for providing you with details of the works to be undertaken, providing this SMP to help plan your works.
- Contractor(s) – you and your staff; responsible for compliance with the controls and procedures in this SMP.
- Contaminated land specialist – engaged by CCC to provide you with assistance whilst undertaking your work as required. This may include the sampling and analysis of any surplus soils to confirm offsite disposal location facilities. Provide assistance if unexpected ground contamination is encountered.

Regulations

The following contaminated land related regulations apply to your small scale works at Kyle Park:

- Health and Safety at Work Act 2015.
- Health and Safety at Work (Asbestos) Regulations 2016.

Why this SMP?

Kyle Park was a gravel pit that was landfilled with uncontrolled waste during the 1970s by Paparua County Council. The area was capped and then developed into a park and it has been in this use since. T+T has undertaken ground contamination investigations across the site in 2015[1,2,3] and 2018[4], which have identified the presence of asbestos in shallow soils (capping materials over the landfill). Other contaminants, including hydrocarbons and metals may also be present, but the potential for shallow soil to contain asbestos requires particular controls to be implemented to:

- Minimise health risks to contractors on the site.
- Minimise health risks to the pubic using from dust and airborne contaminants during on site works.

Unlicensed asbestos work

Disturbance of the site soils must comply with the Asbestos Regulations 2016. Based on the low levels of asbestos in near surface soils (i.e. less than 0.4 m deep) and the controls in this plan, the small scale works listed above can be undertaken as *unlicensed asbestos work*, with the controls and procedures set out below.

Controls and procedures

The following controls and procedures shall be followed:

Activity	Grass cutting	Vegetation and landscaping maintenance	Limited excavation works
Description	• Grass cutting using mowers or hand-held brush cutter. • Low potential for direct contact with contaminated soil. • Medium potential for dust generation.	• Hand removal or cutting, removal using hand tools, removal using brush cutter. • Medium potential for direct contact with contaminated soil. • Medium potential for dust generation.	• Limited hand or machine excavation of soil to no more than 0.4m depth and generation of no more than 8m^3 spoil (roughly one truck volume) • High potential for direct contact with contaminated soil. • Medium potential for dust generation.
Controls	• Limit cutting to a minimum cutting height of 100mm if possible to avoid ground disturbance. • Mowing should preferably be undertaken in slightly damp conditions, as light drizzle or dew can be beneficial in suppressing dust during mowing. • No specific PPE required. • If cutting results in exposure of soil, record location on map and report to CCC Project Manager.	• Limit cutting to a minimum cutting height of 100mm if possible to avoid ground disturbance. • PPE shall be worn by site workers at all times and shall include boots and disposable gloves to avoid dermal contact with soil. Disposable gloves should be changed regularly and immediately if ripped/damaged. • If necessary use water to dampen excavated surfaces.	• Plan where and on what surface you will place excavated materials at your work area; place them directly onto tarpaulins or if surplus to requirements, straight into a skip or other suitable container for offsite disposal (see below about disposal). • Fence-off your work area to exclude the public and control access to it. • Display appropriate signage to workers and public (see example below). • Any excavations shall be managed to avoid the generation of dust. To achieve this, all excavations shall remain damp. If necessary use water to dampen excavated surfaces. Do not use so much water that runoff happens and sediment laden waters leave your works area. • Any stormwater inlets downstream of the works areas shall be covered or blocked to prevent stormwater from the works area entering the stormwater network. • Any reinstatement details will be part of your work brief from CCC; it is important that clean materials are used to finish your work area at ground level, on no account can contaminated soils be left at ground level when you have finished. • All surplus materials for offsite disposal must be contained in a skip or bagged whilst offsite disposal location facility being confirmed by the contaminated land specialist.
	• Decontamination of people and equipment is required. Personnel must wash their boots off before leaving the works area and clean hands before eating. Equipment used in ground disturbance works or short grass cutting must be washed down before leaving site. • Wash waters from both cleaning boots and equipment must not result in the release of sediment to stormwater drains. • Equipment can be washed over a piece of non-woven geotextile (e.g. Bidim®) to capture washed off soils. • The piece of geotextile will then require appropriate offsite disposal as asbestos contaminated waste.		

Offsite disposal of soil and vegetation material

Before any surplus soils can be sent offsite for disposal the contaminated land specialist will sample them to identify disposal options. You cannot dispose of any surplus soils until you have received advice from the contaminated land specialist on the appropriate disposal location facility including any laboratory test results.

Surplus soils shall be held in a skip and covered or bagged whilst disposal options are confirmed (could take in order of five days). The skip shall be fenced off to prevent unauthorised access.

Vegetation, including grass clippings can be taken offsite for disposal, mulching, composting as normal without any specific restrictions with regards to ground contamination.

Accidental discovery protocol

If you encounter suspect contaminated soils (see example photographs) you should:

- Stop work immediately and isolate the suspect materials.
- Tell the CCC project manager who will notify the contaminated land specialist.
- Update your hazard board (if applicable).
- Follow advice from the contaminated land specialist.

Example hazard warning sign

Example of asbestos cement sheet

Example of ash and clinker fill material

Example of uncontrolled fill

Example of ACM pipe

Useful information

In preparing your task documentation some of the following links could be of help:

- Asbestos - approved code of practice - http://construction.worksafe.govt.nz/topic-and-industry/asbestos/management-and-removal-of-asbestos/ and asbestos in soils guidelines – https://www.branz.co.nz/asbestos
- Erosions and sediment control - http://esccanterbury.co.nz/ and
- WorkSafe New Zealand – http://www.worksafe.govt.nz/

Applicability and revision

This document provides a framework for managing contamination hazards on site by identifying potential hazards and suggesting mitigation measures. It provides information and recommendations to augment this process but is not intended to relieve the person conducting business or undertaking (PCBU) of either their responsibility for the health and safety of their workers, Contractors and the public, or their responsibility for protection of the environment.

All procedures employed by the Contractor shall comply with the relevant Council bylaws and conditions of any resource/building consent(s).

By law, all persons who are supervising controlled activities on site must develop a site-specific safety assessment, such as a job safety analysis (JSA), to complement this SMP and address all other health and safety requirements that may be applicable to their particular works.

This document should also be modified to address any specific health, safety or environmental issues that may arise during the works. Any changes must be agreed with the authors in advance.

From time to time, issues such as revised statutory requirements, site ownership or occupation, operating procedures or site conditions may require that this plan be amended or updated. In this situation, the authors of this document should be immediately contacted and informed of such change in circumstances.

This document has been prepared on the basis of information available at the date of preparation, principally data collated from soil sampling. The nature and continuity of subsoil away from sample locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

This report has been prepared for the benefit of Christchurch City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and written agreement.

References

1. Kyle Park, Hornby. Investigation of asbestos in landscaped areas. Tonkin & Taylor Ltd. 53404.003. 18 November 2015.
2. Asbestos in air sampling results, Kyle Park, Hornby. Tonkin & Taylor Ltd. 53404.004. 23 November 2015.
3. Additional asbestos investigation in soil, Kyle Park, Hornby. Tonkin & Taylor Ltd. 53404.004. 7 December 2015.
4. Ground contamination assessment – Kyle Park, Hornby. Tonkin & Taylor Ltd. 1003207. November 2018.