REPORT

Tonkin+Taylor

Detailed Site Investigation

Frank Kitts Park Redevelopment

Prepared for
Wellington City Council
Prepared by
Tonkin & Taylor Ltd
Date
April 2024
Job Number
1018875.4000 v2

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Document control

Title: Detailed Site Investigation					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
February 2024	1	Draft DSI	M. Lindsay	M. Calder C. Hillman	E. Chin
April 2024	2	Final DSI following client confirmation of site boundary	M. Lindsay	R. Edwards	E. Chin

Distribution:

Wellington City Council	1 PDF copy
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Table of contents

1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by Wellington City Council (WCC) to prepare a Detailed Site Investigation (DSI) report for the redevelopment of Frank Kitts Park (the 'investigation area'), located in the Wellington Queens Wharf area. The location and extent of the investigation area is presented in Figure 1.1 (below).

We understand that redevelopment of Frank Kitts Park is in the consenting phase. The redevelopment includes the demolition of the existing carpark, upgrade to the playground (currently under construction and is excluded from the scope of this investigation), creation of a water garden area, construction of a Fale Malae, development of green spaces, new paving and surfacing of the site, and installing lighting and sculptures. It is important to note that the carpark building was inaccessible during this investigation due to the building's construction and earthquake prone status.

Figure 1.1: Frank Kitts Park – the red outline shows the extent of the investigation area.

This report has been prepared in general accordance with the requirements for a DSI referred to in the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health* (NESCS) regulations[1], and as outlined in the Ministry for the Environment (MfE)

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

Contaminated Land Management Guidelines[2].

The persons undertaking, managing, reviewing, and certifying this investigation are suitably qualified and experienced practitioners (SQEP), as required by the NESCS and defined in the NESCS Users' Guide (April 2012).

This investigation was undertaken in accordance with our Letter of Engagement dated 15 September 2023 (T+T Ref: 1018875.4000).

1.1 Objectives and Scope

The objective of this work is to characterise potential contaminant concentrations in soils and groundwater within the investigation area north of the carpark. The opportunity was also taken to characterise surface soils over the carpark. This report has been completed to assist with a resource consent application for the redevelopment of Frank Kitts Park.

The following scope of work was undertaken:

- Site walkover to determine the appropriate locations for test pitting and soil sampling.
- Intrusive investigation including collecting soil samples from test pits and hand auger locations.
- Groundwater sampling from two groundwater monitoring wells.
- Laboratory analysis of selected soil and groundwater samples.
- Preparation of this DSI.

2 Site Description

2.1 Site Identification

Frank Kitts Park is located on Queens Wharf within Wellington Central. The legal description for the site is Lot 2 DP 436892. The approximately 1 ha investigation area is zoned as "Central Area" under the WCC District Plan and is included in the 'Lambton Harbour' Character Area. Land use surrounding the investigation area is 'Central Area' with the harbour to the east.

2.2 Site Conditions

The investigation area is located within Frank Kitts Park which comprises both paved and grassed areas, a playground, various trees, and several sculptures and memorials. An amphitheatre is located on the harbourside and borders the waterfront footpath, which is mainly grassed with some paved areas. The southern portion of the site comprises a raised area of paved pathways and grassed areas covering an underground carpark that is to be demolished. The playground area was currently under development and at the time of this investigation used by Downer as a laydown yard.

2.3 Geology

Frank Kitts Park is underlain by reclamation fill. The reclamation east of Jervois Street began in the 1970s using earthworks cut material from state highway development (1961).

[2] Ministry for the Environment (MfE), updated 2021, *Contaminated land management guidelines No. 1: Reporting on Contaminated Sites in New Zealand*.

2.4 Hydrogeology

The investigation area is adjacent to Wellington Harbour, so the groundwater levels are expected to be shallow and tidally influenced.

3 Background

3.1 Previous Investigations

A soil investigation of the children's playground was conducted by Aurecon New Zealand Ltd (Aurecon) in 2019[3]. T+T has also completed two investigations associated with the Frank Kitts Park redevelopment, including a Contaminated Land Letter Report (December 2021)[4] and a Geotechnical Investigation (February 2022)[5]. These investigations are summarised below.

3.1.1 Aurecon 2019 Investigation

The Aurecon soil investigation included three test pits completed within the playground area (see Appendix A).

The sub-surface conditions encountered within the test pits comprised variable silty and sandy gravel dominated reclamation fill. Groundwater was encountered at 2.6 m bgl in one test pit.

Soil samples were collected from the test pits at varying depths and were analysed for the following:

- Total heavy metals concentrations.
- Total petroleum hydrocarbons (TPHs).
- Polycyclic aromatic hydrocarbons (PAHs).
- Presence/absence of asbestos.

The results of this investigation are summarised below:

- Chromium, copper, lead, and zinc contamination were above background level and exceeding Class B Waste Acceptance Criteria (WAC) across all sample locations. All sample concentrations were below Class A WAC.
- Nickel concentrations exceeded the typical Wellington background concentrations in all samples except one. Cadmium concentrations exceeded Wellington background concentrations in two locations. PAH concentrations also exceeded background concentrations.
- Sample results were not compared to human health guidelines.

Findings from the Aurecon report indicated that the material could not be disposed as cleanfill material and should be disposed of at a Class A landfill.

3.1.2 Contaminated Land Letter Report

The letter report completed by T+T in December 2021 aimed to assess the potential for hazardous activities and industry list (HAIL) activities to have occurred within the site. The report outlined the following potential sources of contamination:

- Wellington Port-related activities (marine boat docking, warehouses, and storage of goods).

[3] Aurecon, 2019. *Frank Kitts Park Children's Playground Upgrade – Geotechnical Investigation Report*. Prepared for WCC. Ref: 505210.
[4] T+T, 2021. *Frank Kitts Park Contaminated Land Letter Report.* Prepared for WCC. Ref: 1018875.
[5] T+T, 2021. *Geotechnical Factual Report Wellington Waterfront.* Prepared for WCC. Ref: 1018875.

- Reclamation material (earthworks cut with potential for demolition material).
- Asbestos in soil and old structures.

3.1.3 Geotechnical Investigation

The geotechnical investigation of the wider site was undertaken by T+T in November 2021 to determine the subsurface geology and depth to groundwater. The inferred geology from the investigation is summarised below:

- 0 m - 10 m depth: Variable end-tipped reclamation fill; soft silt, loose sand, and gravel.
- 10 m - 12 m depth: Marine deposit; very soft to soft clayey silt interbedded with loose silty sand and shell fragments.
- 12 m - 25 m depth: Alluvium; dense to very dense sand and gravel and occasional stiff silt lenses.
- Below 25 m depth: Rock

During the geotechnical investigation groundwater levels were monitored in two boreholes for a period of one month. In BH102 the groundwater was monitored to vary with the tide between RL 0.0 m and RL +0.7 m. In BH103 groundwater was monitored to vary with the tide between RL -0.3 m to RL +1.0 m

Piezometers were installed during the investigation and details are provided in Table 3.1 below:

Table 3.1: Piezometer details

Borehole ID	Collar RL (m)	Screen depths (m)	Geological Unit over screened depth
BH101	1.9	2 - 8	Reclamation fill
BH102*	2.4	2 - 8	Reclamation fill
BH103*	3.9	2 - 10	Reclamation fill and marine deposits
*Boreholes BH102 and BH103 were sampled during this 2023 investigation.			

4 Investigation Activities

4.1 Site constraints

Ten test pits were originally proposed: however, six test pits were abandoned due to accessibility constraints including the presence of underground services and earthquake risk within the covered carpark. To provide coverage where the test pits were not feasible above the carpark area, hand augering was undertaken to shallow depths. Additionally, in one proposed test pit location the area was being used as the laydown yard for the Downer compound operations and could not be accessed due to operational movements. Another location was covered in a stockpile. It was concluded that sampling completed by Aurecon within the playground area would provide sufficient coverage of the site potential contamination.

The carpark area was also inaccessible during this investigation due to the building's location, construction, and earthquake prone status.

Service location was undertaken by Underground Service Locators (USL). Test pit locations were positioned to avoid services identified during the locate.

4.2 Investigation Scope

The intrusive investigation was undertaken on the 5 December 2023. The investigation comprised:

- A site walkover to determine the most appropriate test pit locations.
- The mechanical excavation of four test pits (TP01 – TP04) advanced to the water table.
- Five hand auger excavations, advanced to depths ranging between surface soils (0.1 m bgl) and 0.3 m bgl, which targeted the areas not accessible by the excavator to provide general coverage for the site.
  - Grassed area above the non-accessible carpark (HA01, HA02, HA03, and HA05).
  - Lower area northwest of the carpark footprint (HA04).
- Collection 28 soil samples total, at approximate 0.5 m intervals (where possible), down to the water table.
- Two groundwater samples were collected from existing piezometers BH102 and BH103 using low flow sampling methods on 19 December 2023.

4.3 Field Observations

4.3.1 Soil Observations

Observations of the material encountered during the test pitting and hand augering are summarised below, with soil logs included in Appendix E:

- The soil profile observed was generally consistent across the investigation area and comprised topsoil overlying medium to coarse gravel fill with some silty clay between 1.0 m and 1.7 m bgl. Location TP01 had a clay layer between 1.65 m and 2.1 m bgl and TP04 had a clay layer between 1.0 m and 2.1 m bgl.
- Anthropogenic demolition material was observed in pockets within the test pits. Material included brick, metal pipping, charcoal, concrete, treated timber, glass, and plates.
- No visual or olfactory evidence of contamination, such as unusually coloured materials or odours, asbestos, or evidence of asbestos was observed.
- Topsoil was observed in the hand auger locations down to 0.3 m bgl, where the hand auger met refusal.

4.3.2 Groundwater Observations

Observations during groundwater sampling are summarised below, with groundwater sampling purge sheets included in Appendix F:

- Groundwater was encountered in all four test pits ranging between 1.65 m bgl and 2.1 m bgl.
- Groundwater was measured in borehole BH102 and BH103 at depths between 2.06 m and 3.36 m below top of casing (bTOC), coinciding with high tide. Details of the measured groundwater levels are provided in Table 4.1.
- The groundwater pH readings ranged between 6.13 and 7.21, BH102 and BH103, respectively.
- During the initial purges, black sediment was flushed from BH103 and becoming clear when the parameters (pH, dissolved oxygen, conductivity, and temperature) stabilised (whereas BH102 was observed to have yellow/brown sediment within the groundwater). The water remained turbid after purge and stabilisation of parameters.

Table 4.1: Measured groundwater levels

Borehole ID	Total measured well depth (m)#	Screen installation depth (m)	Geological unit over screen depth	Ground Surface Elevation[6] RL (m)	Groundwater depth (m bTOC) coinciding with high tide	Groundwater level RL (m)	Date
BH102	6.65	2 - 8	Reclamation fill	2.8	2.06	0.74	19/12/2023
BH103	8.77	2 - 10	Reclamation fill and marine deposits	4.11	3.36	0.75	19/12/2023
#We note that the total measured depth in the field conflicts with the screen installation depth. There is potential that sediment within the wells has impacted the depths.							

4.4 Soil Sampling

Soil sampling was conducted in accordance with NESCS MfE Contaminated Land Management Guidelines[7] and BRANZ Asbestos in Soil Guidelines. Soil samples were collected using the following procedures:

- The material excavated from the test pits and hand auger were kept separated by depth, to prevent the mixing of layers. Samples were collected with newly nitrile-gloved hands from the stockpiles (test pits) or directly from the hand auger.
- Samples were place immediately into laboratory provided containers and kept chilled.
- Stockpiles and samples were visually inspected for the presence of asbestos containing material (ACM) and general demolition debris that could contain ACM.
- Upon completion test pits and hand auger holes were backfilled by putting stockpiles in from deepest to shallowest.
- Soil samples were sent the same day via courier to R J Hill Laboratories in Hamilton (an IANZ accredited laboratory) following standard chain-of-custody procedures.

Test pits:

- Soil samples acquired from the test pits were taken at a depth of 0.1 m bgl and at approximate 0.5 m bgl intervals down to the water table, from depths ranging between surface soils (0.1 m bgl) and 2.1 m bgl.
- Soil samples were obtained at a depth of 0.1 m bgl and where changes in lithology were observed, or at approximate 0.5 m bgl intervals down to the water table.

Hand Augers:

- Soil samples were taken at 0.1 m bgl and at 0.3 m bgl (where possible).
- The hand auger was decontaminated between locations using clean water and Decon90 (a phosphate-free detergent) followed by a clean water rinse.

4.5 Groundwater Sampling

Groundwater samples were collected from the two groundwater bores (BH102 and BH103 - Appendix A), in accordance with the following methodology:

[6] Elevation is based on WVD1953.

[7] Ministry for the Environment (MfE), updated 2021, *Contaminated Land Management Guidelines No. 5. Site Investigation and Analysis of Soils.* Wellington, New Zealand

- Prior to groundwater quality sampling the wells were gauged to determine the depth of groundwater and the total piezometer depth.
- Wells were sampled using low flow methods which involved a Geotech peristaltic pump and single-use tubing dedicated to each well to reduce the potential for cross contamination.
- The volume of water within the well was calculated and a minimum of one well volume was purged prior to assessment of stabilisation criteria.
- Water quality parameters were measured in the field. Sampling was conducted immediately following stabilisation of parameters.
- Samples were collected directly into laboratory supplied containers following stabilisation of the parameters (three consecutive readings) and stored on ice in a chilly bin. Samples were couriered the same day to R J Hill Laboratories Ltd under chain of custody documentation for analysis.
- Non dedicated equipment (including the dip meter) was decontaminated between sampling locations using clean water and Decon90 followed by a clean water rinse.

4.6 Laboratory Analysis

4.6.1 Soil Samples

A total of 28 soil samples across the four test pits and five hand augers were analysed for the following:

- Heavy metals (arsenic, boron, cadmium, chromium, copper, lead, nickel, and zinc).
- Polycyclic Aromatic Hydrocarbons (PAHs).
- Asbestos (semi–quantitative).

The remaining samples were stored at the laboratory on hold cold.

4.6.2 Groundwater Samples

The two groundwater samples were analysed for the following:

- Total Suspended Solids (TSS).
- Dissolved Heavy Metals.
- PAHs.
- pH.
- Chlorides.
- Sulphate and Sulphide.
- Anion/Cations.
- Magnesium.

4.7 Evaluation Criteria

To assess potential effects from contamination on human health and environment, analytical results have been compared against the following soil and groundwater criteria:

- Expected background concentration ranges for the Wellington region[8].

[8] URS, 2003. *Determination of Common Pollutant Background Soil Concentrations for the Wellington Region*, URS New Zealand Limited, August 2003

- NESCS[9] - Soil Contaminant Standards (SCS) for selected contaminants in the context of commercial / industrial outdoor worker and recreational use. This is representative of the site workers developing the park as well as the public accesses of the park during and post construction.
- Health investigation levels for selected contaminants in the National Environment Protection (Assessment of Site Contamination) Measure (NEMP) 1999, updated 2013.
- Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE, 1999-Rev 2011): *Tier 1 soil acceptance criteria for commercial / industrial land use.*
- New Zealand Guidelines for Assessing and Managing Asbestos in Soil (BRANZ, 2017).
- To assess the risk to the nearby marine environment, the groundwater results were compared against the criteria for marine water quality (80% species protection) from the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*[10].

5 Analytical Results

Result tables are presented in Appendix C. Comparison of results to the above evaluation criteria is summarised below.

5.1 Soil Samples

Background concentration ranges for the Wellington region were exceeded in four samples:

- TP04 1.55 exceeded in the PAHs anthracene and phenanthrene.
- TP01 1.65, TP04 1.55m, and HA04 0.1m marginally exceeded in arsenic concentrations.
- Sample TP01 0.5 exceeded the Silverstream Landfill and the Class A landfill acceptance criteria in arsenic concentrations, and the Silverstream acceptance criteria in zinc concentrations.

Asbestos was not detected within the samples analysed.

Laboratory results indicate the samples analysed were below the applicable human health guidelines.

5.2 Groundwater Samples

- The concentration of heavy metal samples in the groundwater samples did not exceed the marine water quality guidelines (for 80% species protection).
- Concentrations of PAHs were below laboratory detection limits.
- The test results for BH103 are close to those expected for harbour water: however, the results for BH102 appear to be brackish water. This was unexpected as BH102 is closer to the harbour than BH103: however, BH103 extends down into the marine sediments and the fill around BH103 could be more permeable landward and therefore forms a preferential pathway for the freshwater.

[9] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NESCS).
[10] ANZG, 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Criteria for Marine Quality (95% species protection).

6 Waste Disposal Assessment

To determine an appropriate offsite disposal location for excavated soil, analytical results have been compared to the following screening criteria from MfE's *Hazardous Waste Guidelines Module 2: Landfill Waste Acceptance Criteria and Landfill Classification* (MfE, 2004):

- Class A landfill screening criteria representing Southern Landfill.
- Class B landfill screening criteria representing Spicer Landfill.
- Silverstream Waste Acceptance Criteria (WAC).

Additionally, the expected background concentration ranges for the Wellington region have been included for comparison. The results are provided in Appendix C Table 2.

Soil sample results indicate the majority of samples were within the background concentration ranges for the Wellington region with the exception of four samples. Sample TP01 0.5m exceeded the Silverstream Landfill and the Class A landfill acceptance criteria in arsenic concentrations. It also exceeded the Silverstream acceptance criteria in zinc concentrations. However, these are only minor and when averaged across the investigation the results are within background concentrations.

Material may be suitable for cleanfill: however, this will need to be further investigated with cleanfill facilities. The laboratory results indicate that the soils meet the acceptance criteria for both the Silverstream and Southern Landfills. However, at the time of writing, Silverstream Landfill is rejecting the vast majority of soil disposal applications. This indicates the following disposal options:

- Apply to Southern Landfill.
- Apply to Silverstream Landfill (on the understanding that there is a good chance that this will be rejected).
- Alternatively, the material could potentially be reused on site, subject to consenting and geotechnical requirements.

7 Conceptual Site Model

A risk can only exist if there is a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor). A conceptual site model (CSM), as defined by MfE in the guidelines[11], sets out known and potential sources of contamination, potential exposure pathways, and potential receptors.

A CSM has been developed for the proposed development, which takes into account the results of the soil and groundwater sampling, and our understanding of the potential effects on human health and the environment. The CSM is presented below in Table 7.1**.**

The main human health receptors are future site users as well as excavation workers during the redevelopment and future site users (the public). Excavation and maintenance workers may come into direct contact with soil via air inhalation, dermal contact, and ingestion pathways, though this is only expected to be for a short duration during redevelopment work.

The investigation showed that heavy metals and PAHs were below the recreation and worker human health guideline criteria. No asbestos was detected in the soil samples analysed. However, given that the site was developed using reclamation fill, there may be pockets of previously unidentified hazardous materials (e.g. pockets of asbestos materials).

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

The only risk to the marine environment would be if sediment is discharged to Wellington Harbour during proposed redevelopments works. Controls to minimise sediment discharge should be by controls set out in a Contamination Site Management Plan (CSMP).

Table 7.1: Conceptual Site Model

Source	Pathway	Receptor	Pathway Assessment
Heavy metal and PAH contamination in site soil	Dermal contact	Excavation workers, and future maintenance workers	**Limited source / incomplete:** Exposure will be for short periods of time only during redevelopment work, and heavy metals and PAH in site soil are below applicable human health guidelines and within the expected background ranges for the Wellington region meaning risk to workers is acceptable.
	Ingestion of soil		
	Inhalation of dust		
	Vapour inhalation		
	Dermal contact	Future site users (public)	**Incomplete:** Heavy metals and PAH in site soil are below applicable human health guidelines and within the expected background ranges for the Wellington region meaning risk to future site users is acceptable.
	Ingestion of soil		
	Inhalation of dust		
	Vapour inhalation		
	Groundwater	Marine ecological receptors	**Incomplete:** Analytes in groundwater were below the applicable guidelines for marine protection meaning the potential to negatively impact marine ecosystems is low.
		Groundwater users	**Incomplete:** No groundwater use in area (reticulated supply).
Asbestos contamination in surface fill	Inhalation of dust	Excavation workers, and future maintenance workers	**Incomplete:** No asbestos was found in fill on site. However, given that the site was developed on reclamation fill there may be pockets of previously unidentified hazardous materials (e.g. pockets of asbestos materials).
		Future site users (public)	

8 Protection of workers

The results show contamination is at or below background levels and is unlikely to present a significant risk to construction workers. However, given that the site was developed on reclamation fill there may be pockets of previously unidentified hazardous materials (e.g. pockets of asbestos materials). These risks are unlikely to present a practical constraint to construction of the upgrade works, provided proper precautions for the protection of human health are incorporated.

It is recommended that a CSMP should be prepared prior to earthworks commencing which will be appropriate for mitigating effects of soil contamination during the proposed earthworks, and to provide procedures for unexpected contamination should it be encountered during the works.

9 Protection of buried concrete and steel

To assist in assessing the potential for chemical attack of buried concrete and corrosion of buried steel, the following laboratory testing was undertaken on groundwater.

Table 9.1: Summary of groundwater chemical analyses

Parameter	BH102	BH103
Sum of anions (meq/L)	90	500
Sum of cations (meq/L)	91	530
pH	6.7	7.7
Electrical conductivity (mS/m)	865	4,460
Total magnesium (mg/L)	220	1,100
Chloride (mg/L)	2,700	16,000
Total sulphide (mg/L)	<0.05	<0.05
Sulphate (mg/L)	380	1,890

The high chlorides and sulphates indicate seawater ingress beneath the site and a **moderate exposure classification** for both steel-reinforced concrete and for steel piles founded below the water table, in accordance with Table 6.4.2 (C) of AS 2159-2009 Piling – Design and Installation. For concrete piles without steel reinforcing, a **mild exposure classification** is indicated.

10 Conclusions

T+T has been engaged by WCC to conduct a DSI within the proposed area of Frank Kitts Park's redevelopment to characterise potential contaminant concentrations in soils and groundwater within investigation area.

Potentially contaminating previous land use was identified within the investigation area, including reclamation filling and port activities.

The sampling investigation comprised:

- Four test pits and five hand augers were complete within the investigation areas. Soil samples were collected from the surface and at intervals down to the groundwater table (where possible). Groundwater was encountered in all four test pits ranging between 1.65 m bgl and 2.1 m bgl.
- Two groundwater samples were collected from geotechnical boreholes.

The key findings of the investigation are:

- The soil profile observed was generally consistent across the investigation area and comprised topsoil and medium to coarse gravel fill with some silty clay towards the base of the test pits. Anthropogenic demolition material was observed in pockets within the test pits. However, no visual or olfactory evidence of contamination or evidence of asbestos was observed.
- Groundwater was encountered within the test pits between 1.65 m bgl and 2.1 m bgl and measured at 0.74 and 0.75 RL (m) within the boreholes.
- All soil samples returned concentrations below the applicable soil contaminant standards for commercial/industrial outdoor workers and recreational land use. Consequently, no significant health risk to future site workers and recreational users is indicated from contaminated soil. Similarly, asbestos was not detected within the soil samples analysed. However, there is the potential for unidentified pockets of hazardous materials (e.g. refuse or

asbestos) to be encountered during the site development works due to the nature of reclamation fill.

- The site investigation results do not indicate an unacceptable risk to human health or the environment for on or offsite receptors (see Section 7). Therefore, we conclude that the presence of the contaminated soil at the site is a permitted activity under Rule R82 (a and b) of the Natural Resources Plan, provided this report is submitted to Greater Wellington Regional Council (GWRC).
- The concentrations in soil meet the acceptance criteria for both the Silverstream and Southern Landfills. However, at the time of writing, Silverstream Landfill is rejecting the vast majority of material. Material may be suitable for cleanfill: however, this will need to be further investigated with cleanfill facilities.
- It is recommended that a Contamination Site Management Plan (CSMP) should be prepared prior to earthworks commencing which will be appropriate for mitigating effects of soil contamination during the proposed earthworks, and to particularly provide procedures for unexpected contamination should it be encountered during the works. It is recommended that once the carpark building has been demolished, a site walkover and further testing should be undertaken to confirm the conclusions within this DSI. Prior to testing, the management protocols outlined in the CSMP should be adhered to.
- The high chlorides and sulphates indicate seawater ingress beneath the site and a moderate exposure classification for both steel-reinforced concrete and for steel piles founded below the water table. For concrete piles without steel reinforcing, a mild exposure classification is indicated.
- Given that groundwater meets the marine water quality guidelines for 80% species protection (this being representative of the adjacent harbour), GWRC may accept disposal of groundwater to stormwater without treatment other than sediment removal. Specific dewatering procedures should be addressed in the CSMP. However, this should be further investigated following the demolition of the carpark building, to address the risk of hotspot contamination beneath this area locally contaminating groundwater.
- The carpark area was inaccessible during this investigation due to the building's location, construction, and earthquake prone status. It is likely that the composition of the fill under the carpark is similar to areas already sampled at Frank Kitts Park: however, there is potential for contamination under the carpark building which may vary from the area already sampled. The CSMP prepared will provide management and mitigation protocols and provide procedures for accidental discovery of contaminants across the whole site, including below the carpark building.

11 Applicability

This report has been prepared for the exclusive use of our client Wellington 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.

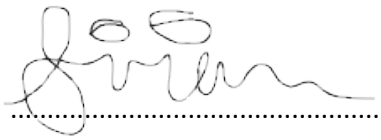
The report has been prepared on the basis of information available at the date of preparation. The nature and continuity of subsoil away from preliminary sample locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

We understand and agree that our client will submit this report as part of an application for resource consent and that Wellington City Council (WCC) and Greater Wellington Regional Council (GWRC) as the consenting authority will use this report for the purpose of assessing that application.

We acknowledge that the Fale Malae Trust will also submit this report as part of an application for resource consent in accordance with the Reliance Statement[12], and that WCC and GWRC as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:



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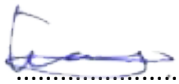
Miriam Lindsay
Environmental Consultant

Authorised for Tonkin & Taylor Ltd by:



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Eng Chin
Project Director

Technical review by: Chris Hillman (Technical Director)

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[12] Tonkin & Taylor Ltd (April 2024), Letter to Fale Malae Trust titled "Reliance Statement – Frank Kitts Park Redevelopment". T+T Ref. 1018875.4.

Appendix A Figure

Source: Tonkin + Taylor Map Viewer (NZ) Date: 15/11/2023 10:58 AM

LEGEND

- Test Pit Locations
- Hand Auger Locations
- Previous Sample Locations (Aurecon 2019)
- Piezometers
- Site Boundary

TP04
TP03
TP01
TP02
HA04
HA01
HA02
HA03
HA05
BH102
BH103

Area previously investigated (Aurecon 2019)

Shaded area indicates area above the inaccessible carpark.

Victoria St
Willeston St
Maning Ln
Jervois Quay
Jervois Quay
Jervois Quay
Frank Kitts Park
Albatross
rris St
rris St

A3 SCALE 1:917
0 10 20 30 40 50 m

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, LINZ, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS

LOCATION PLAN

		APPROVED	DATE
PROJECT No.	1018875.4000		
DESIGNED	ROED		NOV.23
DRAWN	MILI		NOV.23
CHECKED	ROED		NOV.23

CLIENT Wellington City Council
PROJECT Frank Kitts Park Redevelopment
TITLE Sampling Locations
SCALE (A3) 1:917 FIG No. FIGURE 1. REV 0

Appendix B Site Photos


PST94

Appendix C Result Tables

Appendix C Table 1: Test Pit Soil Sampling Results - Frank Kitts Park

Sample ID	TP01 0.1	TP01 0.5	TP01 1.0	TP01 1.65	TP01 2.1	TP02 0.15	TP02 0.6	TP02 1.7	TP03 0.15	TP03 1.1	TP03 1.65	TP04 0.15	TP04 0.5	TP04 1.55	TP04 2.1	Maximums	Typical Background Soil Concentrations for the Wellington Region - RANGE (URS, 2003) [1]	Soil Contaminant Standard for Commercial/Industrial land use [2,3]	Soil Contaminant Standard for Recreational land use [2,3]	Silverstream Landfill [5]	Class A Landfill Screening Criteria (Southern Landfill) [6]	Class B Landfill Screening Criteria [4] (Spicer Landfill)
Laboratory Reference	3422885.1	3422885.2	3422885.3	3422885.5	3422885.6	3422885.7	3422885.8	3422885.10	3422885.20	3422885.22	3422885.23	3422885.24	3422885.25	3422885.27	3422885.28							
Asbestos Laboratory Reference	3422878.1	3422878.2	3422878.3	3422878.5	3422878.6	3422878.7	3422878.8	3422878.10	3422878.20	3422878.22	3422878.23	3422878.24	3422878.25	3422878.27	3422878.28							
Date	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023							
Location	TP01	TP01	TP01 1.0	TP01	TP01	TP02	TP02	TP02	TP03	TP03	TP03	TP04	TP04	TP04	TP04							
Geological unit	TOPSOIL	FILL	FILL	FILL	FILL	TOPSOIL	FILL	FILL	TOPSOIL	FILL	FILL	TOPSOIL	FILL	FILL	FILL							
Heavy Metals																						
Arsenic	5	3	6	**8**	7	4	6	5	4	4	5	3	**9**	5	5	9	< 2 -7	70	80	100	100	10
Cadmium	< 0.10	0.15	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.16	< 0.10	< 0.10	0.14	< 0.10	< 0.10	< 0.10	0.16	< 0.1 - 0.2	1,300	400	20	20	2
Chromium	18	15	18	18	19	15	18	19	17	18	19	12	18	19	18	19	6 - 21	NL [4]	NL [4]	100	100	10
Copper	19	14	13	10	12	14	23	13	23	20	15	13	19	12	13	23	3 - 25	NL [4]	NL [4]	28	100	10
Lead	33	110	55	38	28	23	43	21	57	21	23	21	28	19.7	20	110	4.5 - 180	3,300	880	100	100	10
Nickel	13	11	12	10	11	12	15	13	10	12	14	6	17	13	12	17	4 - 21	6,000	800	40	200	20
Zinc	81	174	77	56	63	69	98	59	77	75	68	52	80	56	55	174	24 - 201	400,000	30,000	160	200	20
Polycyclic Aromatic Hydrocarbons																		Tier 1 Soil Acceptance Criteria: Commercial/Industrial use; ALL PATHWAYS				
																		< 1m SAND	1-4 m SAND			
Total of Reported PAHs in Soil	0.3	1.5	< 0.3	0.6	< 0.3	0.5	1.6	< 0.3	0.4	0.4	< 0.3	< 0.3	0.4	2.6	< 0.3	2.6	-	-		-	-	-
1-Methylnaphthalene	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012	< 0.011	< 0.011	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	0.017	< 0.012	0.017	-	-		-	-	-
2-Methylnaphthalene	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012	< 0.011	< 0.011	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	0.018	< 0.012	0.018	-	-		-	-	-
Acenaphthylene	< 0.011	0.016	< 0.013	< 0.013	< 0.012	< 0.011	0.017	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	0.017	-	-		-	-	-
Acenaphthene	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012	< 0.011	< 0.011	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	0.060	< 0.012	0.06	-	-		-	-	-
Anthracene	< 0.011	0.023	< 0.013	< 0.013	< 0.012	0.013	0.031	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	**0.140**	< 0.012	0.14	<0.002 - 0.05	-		-	-	-
Benzo[a]anthracene	0.023	0.103	< 0.013	0.038	< 0.012	0.035	0.114	< 0.012	0.029	0.031	< 0.012	0.016	0.029	0.151	< 0.012	0.151	-	-		-	-	-
Benzo[a]pyrene (BAP)	0.028	0.135	< 0.013	0.051	< 0.012	0.045	0.152	< 0.012	0.036	0.039	< 0.012	0.020	0.038	0.141	< 0.012	0.152	<0.002 - 0.33	35 [2]	40 [2]	-	300 [7]	30
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	0.042	0.20	< 0.031	0.075	< 0.029	0.067	0.22	< 0.028	0.053	0.057	< 0.027	0.031	0.057	0.21	< 0.029	0.22	-	-		-	300 [7]	30
Benzo[a]pyrene Toxic Equivalence (TEF)	0.042	0.198	< 0.031	0.074	< 0.029	0.067	0.22	< 0.028	0.053	0.056	< 0.027	0.030	0.056	0.21	< 0.029	0.22	-	-		-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	0.028	0.157	< 0.013	0.055	< 0.012	0.05	0.152	< 0.012	0.041	0.041	< 0.012	0.022	0.041	0.152	< 0.012	0.157	-	-		-	-	-
Benzo[e]pyrene	0.018	0.085	< 0.013	0.030	< 0.012	0.028	0.089	< 0.012	0.023	0.024	< 0.012	0.013	0.025	0.079	< 0.012	0.089	-	-		-	-	-
Benzo[g,h,i]perylene	0.023	0.097	< 0.013	0.033	< 0.012	0.036	0.110	< 0.012	0.028	0.023	< 0.012	0.016	0.033	0.086	< 0.012	0.11	-	-		-	-	-
Benzo[k]fluoranthene	0.012	0.062	< 0.013	0.023	< 0.012	0.021	0.068	< 0.012	0.018	0.019	< 0.012	0.012	0.019	0.055	< 0.012	0.068	-	-		-	-	-
Chrysene	0.021	0.118	< 0.013	0.038	< 0.012	0.035	0.116	< 0.012	0.033	0.030	< 0.012	0.016	0.027	0.151	< 0.012	0.151	-	-		-	-	-
Dibenzo[a,h]anthracene	< 0.011	0.02	< 0.013	< 0.013	< 0.012	< 0.011	0.021	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	0.020	< 0.012	0.021	-	-		-	-	-
Fluoranthene	0.040	0.23	< 0.013	0.096	< 0.012	0.062	0.22	< 0.012	0.055	0.061	< 0.012	0.032	0.058	0.42	< 0.012	0.42	<0.002 - 0.57	-		-	-	-
Fluorene	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012	< 0.011	< 0.011	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	0.066	< 0.012	0.066	-	-		-	-	-
Indeno(1,2,3-c,d)pyrene	0.021	0.091	< 0.013	0.036	< 0.012	0.034	0.095	< 0.012	0.024	0.024	< 0.012	0.015	0.027	0.080	< 0.012	0.095	-	-		-	-	-
Naphthalene	< 0.06	< 0.06	< 0.07	< 0.07	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	0	<0.002 - 0.02	(190) [9,n] 10	(230) [9,n] 10	-	1	200	20
Perylene	< 0.011	0.035	< 0.013	< 0.013	< 0.012	0.012	0.039	< 0.012	< 0.012	< 0.011	< 0.012	< 0.012	< 0.011	0.032	< 0.012	0.039	-	-		-	-	-
Phenanthrene	0.014	0.094	< 0.013	0.041	< 0.012	0.024	0.084	< 0.012	0.020	0.028	< 0.012	0.011	0.023	**0.50**	< 0.012	0.5	<0.002 - 0.35	-		-	-	-
Pyrene	0.047	0.24	< 0.013	0.097	< 0.012	0.072	0.25	< 0.012	0.062	0.066	< 0.012	0.035	0.065	0.41	< 0.012	0.41	<0.002 - 0.60	NA [11]		-	-	-
Asbestos in Soil (w/w%)																		BRANZ Tier 1 Human Health Assessment [12]			Mitigation Controls [12]	
Asbestos Presence/Absence	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	-		Commercial and Industrial	Recreational	Unlicensed asbestos work		-
Asbestos Form	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-		-		-
Asbestos as ACM (w/w%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			0.05%	0.02%	≤0.01%		-
Asbestos as AF/FA (w/w%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			0.001%	0.001%	≤0.001%		-

10	Exceeds the background soil concentrations, or above laboratory detection limit for PAH.
174	Exceeds Silverstream Landfill Acceptance Criteria
110	Exceeds Class A Landfill Screening Criteria (Southern Landfill)
110	Exceeds Class B Landfill Screening Crieria (Spicer Landfill)

Notes:
All values in mg/kg (unless otherwise stated)

1. Determination of Common Pollutant Background Soil Concentrations for the Wellington Region, URS New Zealand Limited, August 2003. Full range utilised.
2. Sourced from MfE (2011) Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Commercial/industrial land and Recreational use.
3. Nickel and zinc criteria sourced from Guideline on the Investigation Levels for Soil and Groundwater, NEPM, Australia, updated 2013 (commercial values).
4. NL = No limit. Derived value exceeds 10,000 mg/kg.
5. Criteria sourced from Silverstream Landfill Waste Acceptance Guidelines.
6. Criteria from MfE, 2004. Landfill Waste Acceptance Criteria and Landfill Classification.
7. Derived from the concentration at which free product will be present in leachate.
8. Sourced from MfE (2011) Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy soils at < 1 m and 1-4 m depth under commercial/industrial land use.
9. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, d - Dermal, m - Maintenance/Excavation, x - PAH surrogate, p - Produce.
10. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.
11. NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
12. BRANZ, 2017. New Zealand Guidelines for Assessing and Managing Contaminants in Soil. Commercial and industrial, Recreational, and unlicensed asbestos works criterion utilised.
13. MfE, 2004, Hazardous Waste Guidelines - Landfill WAC & Landfill Classification - Class B

Appendix C Table 2: Hand Auger Soil Sampling Results - Frank Kitts Park

Sample ID	HA01 0.1	HA01 0.3	HA02 0.1	HA02 0.3	HA03 0.1	HA03 0.3	HA04 0.1	HA05 0.1	HA05 0.3	Maximum	Typical Background Soil Concentrations for the Wellington Region - RANGE (URS, 2003) [1]	Soil Contaminant Standard for Commercial/Industrial land use [2,3]		Soil Contaminant Standard for Recreational use	Silverstream Landfill [5]	Class A Landfill Screening Criteria (Southern Landfill) [6]	Class B Landfill Screening Criteria [6] (Spicer Landfill)
Laboratory Reference	3422885.11	3422885.12	3422885.13	3422885.14	3422885.15	3422885.16	3422885.17	3422885.18	3422885.19								
Asbestos Laboratory Reference	3422878.11	3422878.12	3422878.13	3422878.14	3422878.15	3422878.16	3422878.17	3422878.18	3422878.19								
Date	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023	5/12/2023								
Location	HA01	HA01	HA02	HA02	HA03	HA03	HA04	HA05	HA05								
Geological unit	TOPSOIL	FILL	TOPSOIL	FILL	TOPSOIL	FILL	TOPSOIL	TOPSOIL	FILL								
Heavy Metals																	
Arsenic	4	3	4	3	4	3	5	4	3	5	< 2 -7	70		80	100	100	10
Cadmium	0.19	0.12	0.21	0.17	0.18	0.11	0.14	0.18	0.12	0.21	< 0.1 - 0.2	1,300		400	20	20	2
Chromium	14	15	16	15	13	13	15	15	14	16	6 - 21	NL [4]		NL [4]	100	100	10
Copper	16	11	16	10	16	10	**27**	16	17	27	3 - 25	NL [4]		NL [4]	28	100	10
Lead	22	22	16.6	14.4	23	21	50	20	22	50	4.5 - 180	3,300		880	100	100	10
Nickel	9	9	9	8	9	7	9	10	9	10	4 - 21	6,000		800	40	200	20
Zinc	63	48	58	44	62	44	107	77	52	107	24 - 201	400,000		30,000	160	200	20
Polycyclic Aromatic Hydrocarbons												Tier 1 Soil Acceptance Criteria: Commercial/Industrial use: ALL PATHWAYS [8,9,10]					
												< 1m SAND	1-4 m SAND				
Total of Reported PAHs in Soil	< 0.3	< 0.3	< 0.4	< 0.4	< 0.3	< 0.3	0.6	< 0.3	< 0.3	0.6	-	-		-	-	-	-
1-Methylnaphthalene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	-	-		-	-	-	-
2-Methylnaphthalene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	-	-		-	-	-	-
Acenaphthylene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	-	-		-	-	-	-
Acenaphthene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	-	-		-	-	-	-
Anthracene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	<0.002 - 0.05	-		-	-	-	-
Benzo[a]anthracene	0.014	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.044	< 0.012	0.011	0.044	-	-		-	-	-	-
Benzo[a]pyrene (BAP)	0.015	0.015	< 0.015	< 0.014	0.013	0.012	0.055	0.012	0.016	0.055	<0.002 - 0.33	35 [2]		40 [2]	-	300 [7]	30
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	< 0.028	< 0.028	< 0.034	< 0.032	< 0.029	< 0.027	0.082	< 0.027	< 0.027	0.082	-	-		-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	< 0.028	< 0.027	< 0.034	< 0.032	< 0.029	< 0.027	0.081	< 0.027	< 0.027	0.081	-	-		-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	0.017	0.016	< 0.015	< 0.014	0.018	0.013	0.067	0.015	0.015	0.067	-	-		-	-	-	-
Benzo[e]pyrene	0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.040	< 0.012	< 0.011	0.04	-	-		-	-	-	-
Benzo[g,h,i]perylene	< 0.012	< 0.012	< 0.015	< 0.014	0.013	< 0.012	0.045	< 0.012	0.011	0.045	-	-		-	-	-	-
Benzo[k]fluoranthene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.022	< 0.012	< 0.011	0.022	-	-		-	-	-	-
Chrysene	0.013	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.049	< 0.012	0.011	0.049	-	-		-	-	-	-
Dibenzo[a,h]anthracene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	-	-		-	-	-	-
Fluoranthene	0.026	0.021	< 0.015	0.013	0.022	0.015	0.086	0.019	0.017	0.086	<0.002 - 0.57	-		-	-	-	-
Fluorene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013	< 0.012	< 0.011	0	-	-		-	-	-	-
Indeno(1,2,3-c,d)pyrene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.035	< 0.012	0.011	0.035	-	-		-	-	-	-
Naphthalene	< 0.06	< 0.06	< 0.08	< 0.07	< 0.06	< 0.06	< 0.07	< 0.06	< 0.06	0	<0.002 - 0.02	(190) [(t,x) 10]	(230) [(t,x) 10]	-	1	200	20
Perylene	< 0.012	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.014	< 0.012	< 0.011	0.014	-	-		-	-	-	-
Phenanthrene	0.013	< 0.012	< 0.015	< 0.014	< 0.012	< 0.012	0.031	< 0.012	< 0.011	0.031	<0.002 - 0.35	-		-	-	-	-
Pyrene	0.028	0.024	< 0.015	0.014	0.024	0.017	0.101	0.020	0.020	0.101	<0.002 - 0.60	NA [11]		-	-	-	-
Asbestos in Soil												BRANZ Tier 1 Human Health Assessment [12]			Mitigation Controls [12]		
Asbestos Presence/Absence	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	Asbestos NOT Detected	-		Commercial and Industrial		Recreational	Unlicensed asbestos work		-
Asbestos Form	-	-	-	-	-	-	-	-	-			-		-	-		-
Asbestos as ACM w/w%	-	-	-	-	-	-	-	-	-			0.05%		0.02%	≤0.01%		-
Asbestos as AF/FA w/w%	-	-	-	-	-	-	-	-	-			0.001%			≤0.001%		-

10	Exceeds the background soil concentrations, or above laboratory detection limit for PAH.
110	Exceeds Class B Landfill Screening Crieria (Spicer Landfill)

Notes:
All values in mg/kg (unless otherwise stated)

1. Determination of Common Pollutant Background Soil Concentrations for the Wellington Region, URS New Zealand Limited, August 2003. Full range utilised.
2. Sourced from MfE (2011) Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Commercial/industrial land use.
3. Nickel and zinc criteria sourced from Guideline on the Investigation Levels for Soil and Groundwater, NEPM, Australia, updated 2013 (commercial values).
4. NL = No limit. Derived value exceeds 10,000 mg/kg.
5. Criteria sourced from Silverstream Landfill Waste Acceptance Guidelines.
6. Criteria from MfE, 2004. Landfill Waste Acceptance Criteria and Landfill Classification.
7. Total concentration limit.
8. Sourced from MfE (2011) Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy soils at < 1 m and 1-4 m depth under commercial/industrial land use.
9. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, d - Dermal, m - Maintenance/Excavation, x - PAH surrogate, p - Produce.
10. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.
11. NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
12. BRANZ, 2017. New Zealand Guidelines for Assessing and Managing Contaminants in Soil. Commercial and industrial, and unlicensed asbestos works criterion utilised.

Appendix C Table 3: Groundwater Sample Results - Heavy Metals and Hydrocarbons

Sample ID	BH102	BH103	Marine Water Quality Guidelines (for 80 % species protection)[1]
Reference	3433109.1	3433109.2	
Sample Date	19/12/2023	19/12/2023	
Heavy Metals			
Total Arsenic	0.0013	< 0.02	0.14
Total Cadmium	0.00006	< 0.0010	0.036
Total Chromium	< 0.0005	< 0.010	0.085
Total Copper	0.0024	< 0.010	0.008
Total Lead	0.00015	< 0.002	0.0120
Total Nickel	0.0074	< 0.010	0.56
Total Zinc	0.0195	< 0.02	0.043
Polycyclic Aromatic Hydrocarbons			
Acenaphthene	< 0.00010	< 0.00010	-
Acenaphthylene	< 0.00010	< 0.00010	-
Anthracene	< 0.00010	< 0.00010	0.007
Benzo[a]anthracene	< 0.00010	< 0.00010	-
Benzo[a]pyrene (BAP)	< 0.00010	< 0.00010	0.0007
Benzo[b]fluoranthene + Benzo[j]fluoranthene	< 0.00010	< 0.00010	-
Benzo[g,h,i]perylene	< 0.00010	< 0.00010	-
Benzo[k]fluoranthene	< 0.00010	< 0.00010	-
Chrysene	< 0.00010	< 0.00010	-
Dibenzo[a,h]anthracene	< 0.00010	< 0.00010	-
Fluoranthene	< 0.00010	< 0.00010	-
Fluorene	< 0.0002	< 0.0002	0.002
Indeno(1,2,3-c,d)pyrene	< 0.00010	< 0.00010	-
Naphthalene	< 0.0005	< 0.0005	0.12
Phenanthrene	< 0.0004	< 0.0004	-
Pyrene	< 0.0002	< 0.0002	-
Sum of Anions	90	500	-
Sum of Cations	91	530	-
pH	6.7	7.7	-
Total Alkalinity	280	290	-
Bicarbonate	340	350	-
Total Hardness	1,790	5,600	-
Electrical Conductivity (EC)	865	4,460	-
Total Suspended Solids	1,280	7	-
Dissolved Calcium	290	360	-
Dissolved Magnesium	260 [2]	1,150 [2]	-
Total Magnesium	220	1,100	-
Dissolved Potassium	34	350	-
Dissolved Sodium	1,240	9,400	-
Chloride	2,700	16,000	-
Nitrite-N	0.055	0.014	-
Nitrate-N	0.25	0.21	9.8
Nitrate-N + Nitrite-N	0.31	0.22	-
Total Sulphide	< 0.05	< 0.05	-
Sulphate	380	1,890	-

Notes:

290 Concentration exceeds adopted surface water quality guidelines

All values in g/m^3 (apart from pH, Anions and Cations)
- indicates no relevant guidelines

1. Criteria from ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Criteria for Marine water Quality (80% species protection)
2. It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

Appendix D Analytical Laboratory Results

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28 Duke Street Frankton 3204
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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	3422878	A2Pv1
Contact:	Robyn Edwards C/- Tonkin & Taylor PO Box 2083 Wellington 6140	**Date Received:**	06-Dec-2023	
		Date Reported:	21-Dec-2023	
		Quote No:	80842	
		Order No:	1018875.4000P	
		Client Reference:	1018875.4000P	
		Submitted By:	Miriam Lindsay	

Sample Type: Soil

Sample Name:		TP01 0.1 05-Dec-2023 9:00 am	TP01 0.5 05-Dec-2023 9:00 am	TP01 1.0 05-Dec-2023 9:00 am	TP01 1.65 05-Dec-2023 9:00 am	TP01 2.1 05-Dec-2023 9:00 am
Lab Number:		3422878.1	3422878.2	3422878.3	3422878.5	3422878.6
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	623.4	893.2	807.4	785.1	897.3
Dry Weight	g	555.6	818.1	703.9	622.2	737.7
Moisture*	%	11	8	13	21	18
Sample Fraction >10mm	g dry wt	60.2	284.2	112.5	50.0	139.3
Sample Fraction <10mm to >2mm	g dry wt	245.7	277.5	310.0	221.0	321.9
Sample Fraction <2mm	g dry wt	248.0	255.4	279.1	349.1	271.2
<2mm Subsample Weight	g dry wt	58.6	52.7	59.4	58.3	57.5
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		TP02 0.15 05-Dec-2023 9:00 am	TP02 0.6 05-Dec-2023 9:00 am	TP02 1.7 05-Dec-2023 9:00 am	HA01 0.1 05-Dec-2023 9:00 am	HA01 0.3 05-Dec-2023 9:00 am
Lab Number:		3422878.7	3422878.8	3422878.10	3422878.11	3422878.12
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	778.9	897.2	904.1	608.6	508.7
Dry Weight	g	734.2	830.6	789.5	510.2	444.9

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

Sample Type: Soil						
Sample Name:		TP02 0.15 05-Dec-2023 9:00 am	TP02 0.6 05-Dec-2023 9:00 am	TP02 1.7 05-Dec-2023 9:00 am	HA01 0.1 05-Dec-2023 9:00 am	HA01 0.3 05-Dec-2023 9:00 am
Lab Number:		3422878.7	3422878.8	3422878.10	3422878.11	3422878.12
Moisture*	%	6	7	13	16	13
Sample Fraction >10mm	g dry wt	220.8	317.0	396.6	10.9	12.9
Sample Fraction <10mm to >2mm	g dry wt	248.9	298.9	266.8	230.4	147.7
Sample Fraction <2mm	g dry wt	263.5	213.1	123.1	266.0	283.6
<2mm Subsample Weight	g dry wt	53.4	57.4	55.2	50.1	50.9
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		HA02 0.1 05-Dec-2023 9:00 am	HA02 0.3 05-Dec-2023 9:00 am	HA03 0.1 05-Dec-2023 9:00 am	HA03 0.3 05-Dec-2023 9:00 am	HA04 0.1 05-Dec-2023 9:00 am
Lab Number:		3422878.13	3422878.14	3422878.15	3422878.16	3422878.17
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	545.4	492.7	520.7	634.7	495.8
Dry Weight	g	394.8	383.2	434.8	549.5	404.7
Moisture*	%	28	22	17	13	18
Sample Fraction >10mm	g dry wt	< 0.1	59.9	26.1	9.8	119.2
Sample Fraction <10mm to >2mm	g dry wt	120.4	104.8	185.2	176.4	147.9
Sample Fraction <2mm	g dry wt	272.7	217.2	222.0	362.2	135.2
<2mm Subsample Weight	g dry wt	51.8	58.2	55.2	59.7	55.3
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		HA05 0.1 05-Dec-2023 9:00 am	HA05 0.3 05-Dec-2023 9:00 am	TP03 0.15 05-Dec-2023 9:00 am	TP03 1.1 05-Dec-2023 9:00 am	TP03 1.65 05-Dec-2023 9:00 am
Lab Number:		3422878.18	3422878.19	3422878.20	3422878.22	3422878.23
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	496.3	499.2	613.1	844.8	960.0
Dry Weight	g	435.2	444.7	519.5	775.6	842.7
Moisture*	%	12	11	15	8	12
Sample Fraction >10mm	g dry wt	5.8	< 0.1	88.3	403.9	418.1

Sample Type: Soil						
Sample Name:		HA05 0.1 05-Dec-2023 9:00 am	HA05 0.3 05-Dec-2023 9:00 am	TP03 0.15 05-Dec-2023 9:00 am	TP03 1.1 05-Dec-2023 9:00 am	TP03 1.65 05-Dec-2023 9:00 am
Lab Number:		3422878.18	3422878.19	3422878.20	3422878.22	3422878.23
Sample Fraction <10mm to >2mm	g dry wt	213.0	171.0	200.2	242.1	274.7
Sample Fraction <2mm	g dry wt	214.8	272.7	229.4	128.1	147.8
<2mm Subsample Weight	g dry wt	56.0	58.8	55.2	51.3	55.9
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		TP04 0.15 05-Dec-2023 9:00 am	TP04 0.5 05-Dec-2023 9:00 am	TP04 1.55 05-Dec-2023 9:00 am	TP04 2.1 05-Dec-2023 9:00 am
Lab Number:		3422878.24	3422878.25	3422878.27	3422878.28
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	573.3	889.4	890.7	1,026.6
Dry Weight	g	493.8	842.4	770.9	901.1
Moisture*	%	14	5	13	12
Sample Fraction >10mm	g dry wt	2.0	319.4	338.5	449.8
Sample Fraction <10mm to >2mm	g dry wt	174.8	324.8	248.4	293.2
Sample Fraction <2mm	g dry wt	315.8	196.8	182.1	155.8
<2mm Subsample Weight	g dry wt	56.8	53.2	51.5	52.6
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Glossary of Terms

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

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

The following assumptions have been made:

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

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

Summary of Methods

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

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
New Zealand Guidelines Semi Quantitative Asbestos in Soil			
As Received Weight	Measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch.	0.1 g	1-3, 5-8, 10-20, 22-25, 27-28
Dry Weight	Sample dried at 100 to 105°C, measurement on balance. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch.	0.1 g	1-3, 5-8, 10-20, 22-25, 27-28
Moisture*	Sample dried at 100 to 105°C. Calculation = (As received weight - Dry weight) / as received weight x 100.	1 %	1-3, 5-8, 10-20, 22-25, 27-28
Sample Fraction >10mm	Sample dried at 100 to 105°C, 10mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch.	0.1 g dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Sample Fraction <10mm to >2mm	Sample dried at 100 to 105°C, 10mm and 2mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch.	0.1 g dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Sample Fraction <2mm	Sample dried at 100 to 105°C, 2mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch.	0.1 g dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Asbestos Presence / Absence	Examination using Low Powered Stereomicroscopy followed by 'Polarised Light Microscopy' including 'Dispersion Staining Techniques'. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch. AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples.	0.01%	1-3, 5-8, 10-20, 22-25, 27-28
Description of Asbestos Form	Description of asbestos form and/or shape if present.	-	1-3, 5-8, 10-20, 22-25, 27-28
Weight of Asbestos in ACM (Non-Friable)	Measurement on analytical balance, from the >10mm Fraction. Weight of asbestos based on assessment of ACM form. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Asbestos in ACM as % of Total Sample*	Calculated from weight of asbestos in ACM and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-3, 5-8, 10-20, 22-25, 27-28
Weight of Asbestos as Fibrous Asbestos (Friable)	Measurement on analytical balance, from the >10mm Fraction. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Asbestos as Fibrous Asbestos as % of Total Sample*	Calculated from weight of fibrous asbestos and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-3, 5-8, 10-20, 22-25, 27-28
Weight of Asbestos as Asbestos Fines (Friable)*	Measurement on analytical balance, from the <10mm Fractions. Analysed at Hill Laboratories - Asbestos; Unit 1, 17 Print Place, Middleton, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Asbestos as Asbestos Fines as % of Total Sample*	Calculated from weight of asbestos fines and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-3, 5-8, 10-20, 22-25, 27-28
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	Calculated from weight of fibrous asbestos plus asbestos fines and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-3, 5-8, 10-20, 22-25, 27-28

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

Testing was completed on 21-Dec-2023. For completion dates of individual analyses please contact the laboratory.

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

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

Rhodri Williams BSc (Hons)
Technical Manager - Asbestos

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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	3422885 SPv1
Contact:	Robyn Edwards C/- Tonkin & Taylor PO Box 2083 Wellington 6140	**Date Received:**	06-Dec-2023
		Date Reported:	12-Dec-2023
		Quote No:	80842
		Order No:	1018875.4000P
		Client Reference:	1018875.4000P
		Submitted By:	Miriam Lindsay

Sample Type: Soil

Sample Name:		TP01 0.1 05-Dec-2023	TP01 0.5 05-Dec-2023	TP01 1.0 05-Dec-2023	TP01 1.65 05-Dec-2023	TP01 2.1 05-Dec-2023
Lab Number:		3422885.1	3422885.2	3422885.3	3422885.5	3422885.6
Individual Tests						
Dry Matter	g/100g as rcvd	89	91	78	79	82
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	3	6	8	7
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.15	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	18	15	18	18	19
Total Recoverable Copper	mg/kg dry wt	19	14	13	10	12
Total Recoverable Lead	mg/kg dry wt	33	110	55	38	28
Total Recoverable Nickel	mg/kg dry wt	13	11	12	10	11
Total Recoverable Zinc	mg/kg dry wt	81	174	77	56	63
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	0.3	1.5	< 0.3	0.6	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012
Acenaphthylene	mg/kg dry wt	< 0.011	0.016	< 0.013	< 0.013	< 0.012
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012
Anthracene	mg/kg dry wt	< 0.011	0.023	< 0.013	< 0.013	< 0.012
Benzo[a]anthracene	mg/kg dry wt	0.023	0.103	< 0.013	0.038	< 0.012
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.028	0.135	< 0.013	0.051	< 0.012
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	0.042	0.20	< 0.031	0.075	< 0.029
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	0.042	0.198	< 0.031	0.074	< 0.029
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.028	0.157	< 0.013	0.055	< 0.012
Benzo[e]pyrene	mg/kg dry wt	0.018	0.085	< 0.013	0.030	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	0.023	0.097	< 0.013	0.033	< 0.012
Benzo[k]fluoranthene	mg/kg dry wt	0.012	0.062	< 0.013	0.023	< 0.012
Chrysene	mg/kg dry wt	0.021	0.118	< 0.013	0.038	< 0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	0.020	< 0.013	< 0.013	< 0.012
Fluoranthene	mg/kg dry wt	0.040	0.23	< 0.013	0.096	< 0.012
Fluorene	mg/kg dry wt	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.021	0.091	< 0.013	0.036	< 0.012
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.07	< 0.07	< 0.06
Perylene	mg/kg dry wt	< 0.011	0.035	< 0.013	< 0.013	< 0.012
Phenanthrene	mg/kg dry wt	0.014	0.094	< 0.013	0.041	< 0.012
Pyrene	mg/kg dry wt	0.047	0.24	< 0.013	0.097	< 0.012

Sample Type: Soil						
Sample Name:		TP02 0.15 05-Dec-2023	TP02 0.6 05-Dec-2023	TP02 1.7 05-Dec-2023	HA01 0.1 05-Dec-2023	HA01 0.3 05-Dec-2023
Lab Number:		3422885.7	3422885.8	3422885.10	3422885.11	3422885.12
Individual Tests						
Dry Matter	g/100g as rcvd	94	91	86	84	86
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	6	5	4	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.19	0.12
Total Recoverable Chromium	mg/kg dry wt	15	18	19	14	15
Total Recoverable Copper	mg/kg dry wt	14	23	13	16	11
Total Recoverable Lead	mg/kg dry wt	23	43	21	22	22
Total Recoverable Nickel	mg/kg dry wt	12	15	13	9	9
Total Recoverable Zinc	mg/kg dry wt	69	98	59	63	48
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	0.5	1.6	< 0.3	< 0.3	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.012	< 0.012	< 0.012
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.012	< 0.012	< 0.012
Acenaphthylene	mg/kg dry wt	< 0.011	0.017	< 0.012	< 0.012	< 0.012
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	< 0.012	< 0.012	< 0.012
Anthracene	mg/kg dry wt	0.013	0.031	< 0.012	< 0.012	< 0.012
Benzo[a]anthracene	mg/kg dry wt	0.035	0.114	< 0.012	0.014	< 0.012
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.045	0.152	< 0.012	0.015	0.015
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	0.067	0.22	< 0.028	< 0.028	< 0.028
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	0.067	0.22	< 0.028	< 0.028	< 0.027
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.050	0.152	< 0.012	0.017	0.016
Benzo[e]pyrene	mg/kg dry wt	0.028	0.089	< 0.012	0.012	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	0.036	0.110	< 0.012	< 0.012	< 0.012
Benzo[k]fluoranthene	mg/kg dry wt	0.021	0.068	< 0.012	< 0.012	< 0.012
Chrysene	mg/kg dry wt	0.035	0.116	< 0.012	0.013	< 0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	0.021	< 0.012	< 0.012	< 0.012
Fluoranthene	mg/kg dry wt	0.062	0.22	< 0.012	0.026	0.021
Fluorene	mg/kg dry wt	< 0.011	< 0.011	< 0.012	< 0.012	< 0.012
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.034	0.095	< 0.012	< 0.012	< 0.012
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	0.012	0.039	< 0.012	< 0.012	< 0.012
Phenanthrene	mg/kg dry wt	0.024	0.084	< 0.012	0.013	< 0.012
Pyrene	mg/kg dry wt	0.072	0.25	< 0.012	0.028	0.024

Sample Name:		HA02 0.1 05-Dec-2023	HA02 0.3 05-Dec-2023	HA03 0.1 05-Dec-2023	HA03 0.3 05-Dec-2023	HA04 0.1 05-Dec-2023
Lab Number:		3422885.13	3422885.14	3422885.15	3422885.16	3422885.17
Individual Tests						
Dry Matter	g/100g as rcvd	71	74	83	87	78
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	3	4	3	5
Total Recoverable Cadmium	mg/kg dry wt	0.21	0.17	0.18	0.11	0.14
Total Recoverable Chromium	mg/kg dry wt	16	15	13	13	15
Total Recoverable Copper	mg/kg dry wt	16	10	16	10	27
Total Recoverable Lead	mg/kg dry wt	16.6	14.4	23	21	50
Total Recoverable Nickel	mg/kg dry wt	9	8	9	7	9
Total Recoverable Zinc	mg/kg dry wt	58	44	62	44	107
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.4	< 0.4	< 0.3	< 0.3	0.6
1-Methylnaphthalene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013
2-Methylnaphthalene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013
Acenaphthylene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013
Acenaphthene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013

Sample Type: Soil						
Sample Name:		HA02 0.1 05-Dec-2023	HA02 0.3 05-Dec-2023	HA03 0.1 05-Dec-2023	HA03 0.3 05-Dec-2023	HA04 0.1 05-Dec-2023
Lab Number:		3422885.13	3422885.14	3422885.15	3422885.16	3422885.17
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Anthracene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013
Benzo[a]anthracene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.044
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.015	< 0.014	0.013	0.012	0.055
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.034	< 0.032	< 0.029	< 0.027	0.082
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.034	< 0.032	< 0.029	< 0.027	0.081
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.015	< 0.014	0.018	0.013	0.067
Benzo[e]pyrene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.040
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.015	< 0.014	0.013	< 0.012	0.045
Benzo[k]fluoranthene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.022
Chrysene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.049
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013
Fluoranthene	mg/kg dry wt	< 0.015	0.013	0.022	0.015	0.086
Fluorene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	< 0.013
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.035
Naphthalene	mg/kg dry wt	< 0.08	< 0.07	< 0.06	< 0.06	< 0.07
Perylene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.014
Phenanthrene	mg/kg dry wt	< 0.015	< 0.014	< 0.012	< 0.012	0.031
Pyrene	mg/kg dry wt	< 0.015	0.014	0.024	0.017	0.101

Sample Name:		HA05 0.1 05-Dec-2023	HA05 0.3 05-Dec-2023	TP03 0.15 05-Dec-2023	TP03 1.1 05-Dec-2023	TP03 1.65 05-Dec-2023
Lab Number:		3422885.18	3422885.19	3422885.20	3422885.22	3422885.23
Individual Tests						
Dry Matter	g/100g as rcvd	87	89	84	89	89
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	3	4	4	5
Total Recoverable Cadmium	mg/kg dry wt	0.18	0.12	0.16	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	15	14	17	18	19
Total Recoverable Copper	mg/kg dry wt	16	17	23	20	15
Total Recoverable Lead	mg/kg dry wt	20	22	57	21	23
Total Recoverable Nickel	mg/kg dry wt	10	9	10	12	14
Total Recoverable Zinc	mg/kg dry wt	77	52	77	75	68
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	< 0.3	0.4	0.4	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
2-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Acenaphthylene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Acenaphthene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Benzo[a]anthracene	mg/kg dry wt	< 0.012	0.011	0.029	0.031	< 0.012
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.012	0.016	0.036	0.039	< 0.012
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 0.027	< 0.027	0.053	0.057	< 0.027
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 0.027	< 0.027	0.053	0.056	< 0.027
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.015	0.015	0.041	0.041	< 0.012
Benzo[e]pyrene	mg/kg dry wt	< 0.012	< 0.011	0.023	0.024	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.012	0.011	0.028	0.023	< 0.012
Benzo[k]fluoranthene	mg/kg dry wt	< 0.012	< 0.011	0.018	0.019	< 0.012
Chrysene	mg/kg dry wt	< 0.012	0.011	0.033	0.030	< 0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Fluoranthene	mg/kg dry wt	0.019	0.017	0.055	0.061	< 0.012
Fluorene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012

Sample Type: Soil						
Sample Name:		HA05 0.1 05-Dec-2023	HA05 0.3 05-Dec-2023	TP03 0.15 05-Dec-2023	TP03 1.1 05-Dec-2023	TP03 1.65 05-Dec-2023
Lab Number:		3422885.18	3422885.19	3422885.20	3422885.22	3422885.23
Polycyclic Aromatic Hydrocarbons Screening in Soil*						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.012	0.011	0.024	0.024	< 0.012
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Phenanthrene	mg/kg dry wt	< 0.012	< 0.011	0.020	0.028	< 0.012
Pyrene	mg/kg dry wt	0.020	0.020	0.062	0.066	< 0.012

Sample Name:		TP04 0.15 05-Dec-2023	TP04 0.5 05-Dec-2023	TP04 1.55 05-Dec-2023	TP04 2.1 05-Dec-2023
Lab Number:		3422885.24	3422885.25	3422885.27	3422885.28
Individual Tests					
Dry Matter	g/100g as rcvd	87	92	86	83
Heavy Metals, Screen Level					
Total Recoverable Arsenic	mg/kg dry wt	3	9	5	5
Total Recoverable Cadmium	mg/kg dry wt	0.14	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	12	18	19	18
Total Recoverable Copper	mg/kg dry wt	13	19	12	13
Total Recoverable Lead	mg/kg dry wt	21	28	19.7	20
Total Recoverable Nickel	mg/kg dry wt	6	17	13	12
Total Recoverable Zinc	mg/kg dry wt	52	80	56	55
Polycyclic Aromatic Hydrocarbons Screening in Soil*					
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	0.4	2.6	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	0.017	< 0.012
2-Methylnaphthalene	mg/kg dry wt	< 0.012	< 0.011	0.018	< 0.012
Acenaphthylene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.012
Acenaphthene	mg/kg dry wt	< 0.012	< 0.011	0.060	< 0.012
Anthracene	mg/kg dry wt	< 0.012	< 0.011	0.140	< 0.012
Benzo[a]anthracene	mg/kg dry wt	0.016	0.029	0.151	< 0.012
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.020	0.038	0.141	< 0.012
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	0.031	0.057	0.21	< 0.029
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	0.030	0.056	0.21	< 0.029
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.022	0.041	0.152	< 0.012
Benzo[e]pyrene	mg/kg dry wt	0.013	0.025	0.079	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	0.016	0.033	0.086	< 0.012
Benzo[k]fluoranthene	mg/kg dry wt	0.012	0.019	0.055	< 0.012
Chrysene	mg/kg dry wt	0.016	0.027	0.151	< 0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	< 0.011	0.020	< 0.012
Fluoranthene	mg/kg dry wt	0.032	0.058	0.42	< 0.012
Fluorene	mg/kg dry wt	< 0.012	< 0.011	0.066	< 0.012
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.015	0.027	0.080	< 0.012
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.012	< 0.011	0.032	< 0.012
Phenanthrene	mg/kg dry wt	0.011	0.023	0.50	< 0.012
Pyrene	mg/kg dry wt	0.035	0.065	0.41	< 0.012

Analyst's Comments

The matrix in samples 3422885.11 and .24 has affected the System Monitoring Compounds in the PAH analysis, whereby the recovery ranged between 52% & 54% for sample 11 and 61% & 65% for sample 24. Therefore the results may be underestimated.

Summary of Methods

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

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-3, 5-8, 10-20, 22-25, 27-28
Total of Reported PAHs in Soil	Sonication extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.03 mg/kg dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Polycyclic Aromatic Hydrocarbons Screening in Soil*	Sonication extraction, GC-MS/MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.010 - 0.05 mg/kg dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Dry Matter	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1-3, 5-8, 10-20, 22-25, 27-28
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	BaP Potency Equivalence calculated from; Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1.0 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.024 mg/kg dry wt	1-3, 5-8, 10-20, 22-25, 27-28
Benzo[a]pyrene Toxic Equivalence (TEF)*	Benzo[a]pyrene Toxic Equivalence (TEF) calculated from; Benzo[a]pyrene x 1.0 + Benzo(a)anthracene x 0.1 + Benzo(b) fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.024 mg/kg dry wt	1-3, 5-8, 10-20, 22-25, 27-28

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

Testing was completed between 07-Dec-2023 and 12-Dec-2023. For completion dates of individual analyses please contact the laboratory.

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

Kim Harrison MSc
Client Services Manager - Environmental

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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	3433109	SPv1
Contact:	Robyn Edwards C/- Tonkin & Taylor PO Box 2083 Wellington 6140	**Date Received:**	19-Dec-2023	
		Date Reported:	28-Dec-2023	
		Quote No:	128499	
		Order No:	1018875	
		Client Reference:	1018875	
		Submitted By:	Miriam Lindsay	

Sample Type: Aqueous

		Sample Name:	BH102 19-Dec-2023 12:30 pm	BH103 19-Dec-2023
		Lab Number:	3433109.1	3433109.2
Individual Tests				
Sum of Anions	meq/L		90	500
Sum of Cations	meq/L		91	530
pH	pH Units		6.7	7.7
Total Alkalinity	g/m³ as $CaCO_3$		280	290
Bicarbonate	g/m³ at 25°C		340	350
Total Hardness	g/m³ as $CaCO_3$		1,790	5,600
Electrical Conductivity (EC)	mS/m		865	4,460
Total Suspended Solids	g/m³		1,280	7
Dissolved Calcium	g/m³		290	360
Dissolved Magnesium	g/m³		260 #1	1,150 #1
Total Magnesium	g/m³		220	1,100
Dissolved Potassium	g/m³		34	350
Dissolved Sodium	g/m³		1,240	9,400
Chloride	g/m³		2,700	16,000
Nitrite-N	g/m³		0.055	0.014
Nitrate-N	g/m³		0.25	0.21
Nitrate-N + Nitrite-N	g/m³		0.31	0.22
Total Sulphide	g/m³		< 0.05	< 0.05
Sulphate	g/m³		380	1,890
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Dissolved Arsenic	g/m³		0.0013	< 0.02
Dissolved Cadmium	g/m³		0.00006	< 0.0010
Dissolved Chromium	g/m³		< 0.0005	< 0.010
Dissolved Copper	g/m³		0.0024	< 0.010
Dissolved Lead	g/m³		0.00015	< 0.002
Dissolved Nickel	g/m³		0.0074	< 0.010
Dissolved Zinc	g/m³		0.0195	< 0.02
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq				
Acenaphthene	g/m³		< 0.00010	< 0.00010
Acenaphthylene	g/m³		< 0.00010	< 0.00010
Anthracene	g/m³		< 0.00010	< 0.00010
Benzo[a]anthracene	g/m³		< 0.00010	< 0.00010
Benzo[a]pyrene (BAP)	g/m³		< 0.00010	< 0.00010
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³		< 0.00010	< 0.00010
Benzo[g,h,i]perylene	g/m³		< 0.00010	< 0.00010
Benzo[k]fluoranthene	g/m³		< 0.00010	< 0.00010
Chrysene	g/m³		< 0.00010	< 0.00010
Dibenzo[a,h]anthracene	g/m³		< 0.00010	< 0.00010

Sample Type: Aqueous			
Sample Name:		BH102 19-Dec-2023 12:30 pm	BH103 19-Dec-2023
Lab Number:		3433109.1	3433109.2
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq			
Fluoranthene	g/m^3	< 0.00010	< 0.00010
Fluorene	g/m^3	< 0.0002	< 0.0002
Indeno(1,2,3-c,d)pyrene	g/m^3	< 0.00010	< 0.00010
Naphthalene	g/m^3	< 0.0005	< 0.0005
Phenanthrene	g/m^3	< 0.0004	< 0.0004
Pyrene	g/m^3	< 0.0002	< 0.0002

Analyst's Comments

#1 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

Summary of Methods

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

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m^3	1-2
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.00010 - 0.0005 g/m^3	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E : Online Edition.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E : Online Edition.	0.05 meq/L	1-2
pH	pH meter. APHA 4500-H^+ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m^3 as $CaCO_3$	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D : Online Edition.	1.0 g/m^3 at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m^3 as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	1-2
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) : Online Edition.	3 g/m^3	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1-2
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.021 g/m^3	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1-2
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1-2

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.002 g/m^3	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m^3	1-2
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.002 g/m^3	1-2
Total Sulphide Screen	In-line distillation, segmented flow colorimetry. APHA 4500-S^{2-} E (modified) : Online Edition.	0.05 g/m^3	1-2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1-2

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

Testing was completed between 21-Dec-2023 and 28-Dec-2023. For completion dates of individual analyses please contact the laboratory.

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

Kim Harrison MSc
Client Services Manager - Environmental

Appendix E Bore Logs

EXCAVATION LOG

Excavation Id.: **TP01**

SHEET: 1 OF 1

PROJECT: Frank Kitts - Resource Consent Support	LOCATION: Frank Kitts Park, Wellington	JOB No.: 1018875.4000
CO-ORDINATES: 5427870 mN (NZTM2000) 1748960 mE	METHOD: Sampling Location	EXCAV. STARTED: 05/12/2023
	EQUIPMENT:	EXCAV. FINISHED: 05/12/2023
R.L.: 2m	OPERATOR: Downers	LOGGED BY: MILI
DATUM: WLG1953	DIMENSIONS:	CHECKED BY:

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			TP01 @ 0.10m			0.0	TS	*0.00m:* GRASS AND TOPSOIL.						Top
								0.10m: FILL; brown. Dry, with a sandy matrix, angular gravel.						
			TP01 @ 0.50m			0.5		*0.50m:* FILL, some clay, gravel with sandy matrix; orange and brown. Dry. With anthropogenic material - plates, metal, discarded pipe, brick, burnt material and scrap metal.						Fill
					1	1.0								
			TP01 @ 1.30m					*1.30m:* FILL; greyish purple mottled red, orange and white. Moist. With minor charcoal.						
			TP01 @ 1.65m			1.5		*1.65m:* CLAY. bluish grey clay, mottled orange and black lenses. Moist to wet.						
		05/12/2023 ▼			0	2.0								
			TP01 @ 2.10m					2.1m: END OF TEST PIT						
						2.5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.1m

Scale 1:25

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP02**

SHEET: 1 OF 1

PROJECT: Frank Kitts - Resource Consent Support	LOCATION: Frank Kitts Park, Wellington	JOB No.: 1018875.4000
CO-ORDINATES: 5427849 mN (NZTM2000) 1748948 mE	METHOD: Sampling Location	EXCAV. STARTED: 05/12/2023
	EQUIPMENT:	EXCAV. FINISHED: 05/12/2023
R.L.: 2m	OPERATOR: Downers	LOGGED BY: MILI
DATUM: WLG1953	DIMENSIONS:	CHECKED BY:

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			TP02 @ 0.15m			0.5	TS	*0.00m:* TOPSOIL.				VS 12 S 25 F 50 St 100 VSt 200 H		Top
			TP02 @ 0.60m					*0.15m:* FILL, angular gravel with a sandy matrix. Dry. Brick fragments, concrete and large rocks with concrete and wood fragments present.						Fill
		05/12/2023	TP02 @ 1.00m		1	1.0		*0.60m:* FILL, angular gravel with a lighter brown sandy matrix. Dry. Brick fragments, concrete and large rocks with concrete and wood fragments present.						
			TP02 @ 1.70m			1.5		*1.00m:* FILL, large cobbles with angular gravel in a dark brown sandy matrix. Moist to wet. Brick fragments, concrete and large rocks with concrete and wood fragments present.						
					0	2.0		1.7m: END OF TEST PIT						
						2.5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.7m

Scale 1:25

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP03**

SHEET: 1 OF 1

PROJECT: Frank Kitts - Resource Consent Support	LOCATION: Frank Kitts Park, Wellington	JOB No.: 1018875.4000
CO-ORDINATES: 5427881 mN (NZTM2000) 1748922 mE	METHOD: Sampling Location	EXCAV. STARTED: 05/12/2023
	EQUIPMENT:	EXCAV. FINISHED: 05/12/2023
R.L.: 2m	OPERATOR: Downers	LOGGED BY: MILI
DATUM: NZVD2016	DIMENSIONS:	CHECKED BY:

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			TP03 @ 0.15m			0	TS	*0.00m:* TOPSOIL.						Top
								0.15m: Sandy CLAY, with rock fragments. Tight, dry.						
			TP03 @ 0.60m			0.5		*0.30m:* FILL, medium to coarse sand with large cobble and angular rock; light brown-orange. Moist to wet. With anthropogenic material (glass and brick).						Fill
		05/01/2024	TP03 @ 1.10m		1	1.0								
			TP03 @ 1.65m			1.5		1.65m: END OF TEST PIT						
					0	2.0								
						2.5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.65m

Scale 1:25

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP04**

SHEET: 1 OF 1

PROJECT: Frank Kitts - Resource Consent Support	LOCATION: Frank Kitts Park, Wellington	JOB No.: 1018875.4000
CO-ORDINATES: 5427934 mN (NZTM2000) 1748918 mE	METHOD: Sampling Location	EXCAV. STARTED: 05/12/2023
	EQUIPMENT:	EXCAV. FINISHED: 05/12/2023
R.L.: 2m	OPERATOR: Downers	LOGGED BY: MILI
DATUM: NZVD2016	DIMENSIONS:	CHECKED BY:

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			TP04 @ 0.15m			0.0	TS	*0.00m:* TOPSOIL.						Top
			TP04 @ 0.50m			0.5		*0.15m:* FILL, medium to coarse sand with angular gravel and rootlets; light brown and orange. Dry. With some brick and charcoal fragments.						Fill
			TP04 @ 1.00m		1	1.0		*1.00m:* CLAY, some large, angular cobbles; grey. Dry.						
			TP04 @ 1.55m			1.5		*1.55m:* Moist, light brown sand. *1.55m:* CLAY; dark grey. Tight, moist to wet. Strong organic odour.						
		05/12/2023 ▼			0	2.0								
			TP04 @ 2.10m			2.5		2.1m: END OF TEST PIT						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.1m

Scale 1:25

Rev.: A

Appendix F Groundwater Field Sheets

Tonkin+Taylor

Groundwater Sampling Field Sheet

Site: Frank Kitts Park | Job Number: 1018875400 | Date: 19/12/23

Well ID: BH103 | Well Location: N: E: | Field Staff: ROED, MILJ

EQUIPMENT

Water meter: Interface / dip meter / other _____ Water Quality Meter type: YSI

Pump type: Micropurge / wattera / bailer / downhole submersible / Hydrasleeve / other: Peristaltic

Bailer type: ~~disposable/stainless steel~~

Weather Conditions: Sunny / Cloudy / Rain Warm / Hot / Cold

PRE-PURGE INFORMATION

TOC Stick-up: 0.0

Standing Water Level (m bTOC): 3.36

Total well depth (m bTOC): 8.77 m

Water column (m): 5.41

PURGE VOLUME CALCULATIONS

Well Volume (approximate) _____ (L) x 3 for NZ standards = ... (L)

nb Well volume (L) = Water column (m) x conversion factor (L/m), assuming well screened across water table

Casing diameter	25mm	50mm	100 mm	125m	35mm
Conversion factor (L/m):	0.98	1.96	7.85	31.4	

WATER QUALITY PARAMETERS

Vol (L)	SWL (m bTOC)	Time	DO (mg/L)	Conduct. (SPC)	pH	Redox (mV)	Temp (°C)	Comments (e.g., colour, turbidity, odour)
3L	3.40	13:22	1.87	41757	7.16		16.4	Black sediment, plastic
6L	3.39	13:31	1.48	42383	7.12		15.7	pieces, strong stagnant odour
9L	3.45	13:36	1.22	42344	7.21		15.7	Cloudy
12L		13:40	1.27	~~42484~~ 33521	7.18		16.0	clear, strong odour stagnant, v fine black sediment
15L		13:42	1.13	43126	7.13		15.8	" " " "
18L	3.58	13:48	1.22	43291	7.12		15.8	
		Sampled		@		13:48		
						SWL = 3.58		
Stabilisation Criteria (3 readings)			+/- 3%		+/- 0.1		+/- 0.2	

SAMPLING

Equipment decontaminated prior to use: Yes / No

Samples stored on ice: Yes / No

Metals samples filtered: Yes / No

QC Sample ID (if any):

Containers collected:

- ☑ Organics ☑ Inorganics ☐ Biological
- ☐ VOC (Vial) ☐ Nutrients ☐
- ☑ Metals ☐ Cyanide ☐

MICROPURGE SETTINGS

Depth of pump inlet (mTOC): 3.95 Pump pressure regulator:

Fill timer: Discharge timer:

COMMENTS V strong stagnant odour - floating black sediment, plastic + microbial algae floating

Tonkin+Taylor

Groundwater Sampling Field Sheet

Site: Frank Kitts Park | Job Number: 1018875.4000 | Date: 19/12/23

Well ID: BH102 | Well Location: N: E: | Field Staff: ROED, MIL

EQUIPMENT

Water meter: Interface / dip meter / other _____ Water Quality Meter type: YSI

Pump type: Micropurge / wattera / bailer / downhole submersible / Hydrasleeve / other: Peristaltic

Bailer type: ~~disposable/stainless steel~~

Weather Conditions: Sunny / Cloudy / Rain Warm / Hot / Cold

PRE-PURGE INFORMATION

TOC Stick-up: 0.0

Standing Water Level (m bTOC): 2.06

Total well depth (m bTOC): 6.65

Water column (m): 4.59

PURGE VOLUME CALCULATIONS

Well Volume (approximate) _____ (L) x 3 for NZ standards = _____ (L)

nb Well volume (L) = Water column (m) x conversion factor (L/m), assuming well screened across water table

Casing diameter	25mm	50mm	100 mm	125m
Conversion factor (L/m):	0.98	1.96	7.85	31.4

65 mm

WATER QUALITY PARAMETERS

Vol (L)	SWL (m bTOC)	Time	DO (mg/L)	Conduct. (µS/cm)	pH	Redox (mV)	Temp (°C)	Comments (e.g., colour, turbidity, odour)
3L		12:14	2.57	4975	6.13	102.3	18.6	cloudy, yellowish brown
6L		12:18	4.19	5135	6.31	102.3	19.1	" "
9L		12:27	5.00	5775	6.70	102.4	19.6	cloudy, yellow
12L		12:35	4.83	7395	6.36	102.4	19.3	" "
15L		12:41	5.01	7303	6.38	102.3	19.5	" "
		Sampled @ 12:41						
Stabilisation Criteria (3 readings)				+/- 3%	+/- 0.1		+/- 0.2	

SAMPLING

Equipment decontaminated prior to use: Yes / No

Samples stored on ice: Yes / No

Metals samples filtered: Yes / No

QC Sample ID (if any):

Containers collected:

- ☑ Organics
- ☐ Inorganics
- ☐ Biological
- ☐ VOC (Vial)
- ☐ Nutrients
- ☐
- ☑ Metals
- ☐ Cyanide
- ☐

MICROPURGE SETTINGS

Depth of pump inlet (mTOC): 2.85 Pump pressure regulator:

Fill timer: Discharge timer:

COMMENTS

SWL end = 2:71 Water v cloudy - not clearing -

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