Tonkin & Taylor

Job No: 85778.001
26 February 2015

Willis Bond Ltd
by email

Attention: Rosalind Luxford

Dear Ros

Site 10 ground contamination: response to s92 request

This letter provides responses to Wellington City Council (WCC)'s s92 request for information dated 5 February 2015, which in turn references a letter prepared by URS dated 16 January 2014 (subject: *Contaminated land and HSNO Advice Related to Land Use Consent Application at 10 Waterloo Quay SR No. 309386*). We have prepared this report in accordance with our existing engagement, dated 8 April 2015.

1 Structure of this response

URS's letter addresses contaminated land and the proposed fuel storage facilities. We have only responded to ground contamination aspects.

Section 2 of our report provides point-by-point responses to URS's comments and questions regarding contaminated land as follows:

- Table 1: summary comments
- Table 2: comments on *Ground Contamination Assessment Wellington Waterfront Sites 8, 9, and 10*, October 2014 (GCA)
- Table 3: comments on *Sites 8, 9, 10 Contaminated Site Management Plan (Draft),* October 2014 (Draft CSMP).

Where the comments have resulted in clarifications or additions to the Draft CSMP, we have shown these in the attached Revised Draft CSMP, which has the changes highlighted (underscored additions, strikethrough deletions).

Section 3 provides comments on the proposed conditions of consent.

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2 Responses to comments

Table 1: Summary comments

URS comment	Response
There is sufficient detail in the GCA, provided basement and foundation soils are removed off-site for disposal	Removal and off-site disposal of basement soils is the intended approach.
There is sufficient detail in the GCA provided a method is implemented to address soils from 3 to 3.7 m depth and from deeper than 1.2 m beneath the concrete slab at the southern end of the site.	These soils will be removed from site and subject to the controls set out in the draft CSMP (i.e., disposed to landfill unless testing shows they are clean). Specifically, Section 4.1 of the Draft CSMP requires soil beneath the slab to be tested and the appropriate disposal location selected based on the results of testing. Section 4.1 includes a specific requirement for testing for asbestos. Section 4, paragraph 1 acknowledges that earthworks in potentially contaminated soil includes excavation to 3.7 m depth for the basement. The Draft CSMP has been updated to reflect that additional testing would be required if deep soil is to be segregated for disposal to clean fill.
There is sufficient detail in the GCA provided confirmation sampling and laboratory analysis of samples is undertaken at the Site 10 basement excavation and sidewalls to demonstrate that remaining soils are suitable for the proposed land use.	Confirmation testing is proposed to demonstrate that asbestos containing soils have been removed within the building footprint (Section 10.2). No confirmation testing is proposed for the remainder of the basement floor or sidewalls. The proposed land use is a paved basement. Contaminated reclamation fill will remain in place around the excavation. Short term exposure of contaminated fill during construction shall be managed by the CSMP controls. Long term, paving on the basement floor and walls will prevent contact by site users with the walls and base of the excavation, and no significant volatile contaminants have been identified. There is, therefore, no pathway for exposure of commercial site users to inorganic contaminants in the fill. Potential risk to maintenance workers (e.g., future excavations for service repair works) could be managed via a management plan requiring appropriate controls for any works in the contaminated fills, if there is potential for such works to occur. The proposed works are not expected to change long-term potential risk to the environment from this fill material.
We do not consider there is sufficient detail in the GCA to allow for separation of soils suitable for direct disposal at a cleanfill site from those requiring disposal at landfill.	We agree. The soil disposal procedure in the Draft CSMP requires disposal to landfill unless testing shows the material is clean. Specifically, Section 3.3 bullet 2, requires that if material is to be disposed as clean fill, it should be tested to confirm it is clean (either before excavation or on stockpiled material). We have revised “should” to “must” to provide further clarity here. We have revised Table 2 and Section 5.2 to further clarify that the zones where no contamination was identified in limited testing are potentially not contaminated. We have updated language in the GCA to further clarify this (e.g., GCA Section 6.4). Additional testing requirements are noted at Sections 4.1 and 4.2 (beneath concrete slab – soil above slab assumed to be contaminated), 4.3 (public space areas). Section 5.5 notes that controls for contaminated soil apply in areas where testing shows contaminated soil will be disturbed. We have added a note to the soil sampling procedures at Appendix A of the Draft CSMP to clarify this.

URS comment	Response
	Note: disposal permitting referred to at Section 5.10 refers to disposal to landfill only (not clean fill), as implied by requirement at paragraph 2 to provide test information to the receiving landfill. The revised Draft CSMP has been updated to further clarify this.
We also do not consider that Site 10 shallow soils (less than 1m deep) have been adequately assessed for the presence of asbestos containing material (ACM).	We agree. The Draft CSMP requires additional testing of this material. Section 3.3, bullet 1 acknowledges that only limited testing has been done in Zone 3. We have added text to bullet 1 of Section 3.3 of the Draft CSMP to clarify that the extent of the indicative area in which asbestos is present may decrease or increase as a result of this testing.

Table 2: Comments on Ground Contamination Assessment (GCA)

URS comment on GCA	Response
Section 2.2 comments: QA/QC	
Duplicates of soil results not presented.	Duplicate results have been added to the GCA (Tables C7 and C8)
The analytical results are generally low and omission is unlikely to have a material effect on the assessment unless they were duplicates of those samples that were considered to be "clean".	For metals, the only duplicate pairs with relative percent difference greater than 50% were in the more highly contaminated layer of fill (WS5 2.65 m/Dup 2 and WS6 1.5 m/Dup 3). The variability in PAH concentrations was much higher, as expected in fill. The variability in the results does not have a material effect on the proposed management of this material (landfill disposal). The variability in the duplicate pair of samples considered "clean" (WS9 2.75 m/ Duplicate 4) was less than 50% for metals, but ranged up to 67% for PAH. The PAH concentrations were low in both samples of the pair, and therefore the variability does not materially affect the proposed management of this material (disposal to landfill, or cleanfill only after testing confirms the material is clean).
We recommend that the duplicate and original sample results are identified and considered in the assessment	Duplicate results have been added to the GCA (Tables C7 and C8). The discussion above has been added to Section 6.3.
Section 2.3 Soil Management	
We do not consider there is sufficient detail presented in the GCA to fully determine whether the assigned zones or depth horizons are appropriate.	We agree that the zones are not "determined". They are indicative, and indicate where clean material may potentially be present, based on limited testing. The soil disposal procedure in the Draft CSMP requires disposal to landfill unless testing shows the material is clean. Specifically, Section 3.3 bullet 2, requires that if material is to be disposed as clean fill, it should be tested to confirm it is clean (either before excavation or on stockpiled material). We have revised "should" to "must" to provide further clarity here. The Applicant wishes to retain the concept of zones to inform site management, because it provides the opportunity for material to be managed as clean if it is, indeed, clean. The text of the CMP and Draft CSMP has been strengthened to clarify that confirming whether material is clean must be based on further testing. The depth horizons are discussed in more detail below.

URS comment on GCA	Response
We also consider that some of the conclusions drawn in this section are not correct or without substantiation	Individual points are discussed below. In general, we note that interpretation was based on review of bore logs and selected samples tested within horizons identified in the logs. The additional detail provided below has been added to the GCA to describe this assessment process.
Zone 1 (WS8 and WS9) 0-1m depth is described as clean, however no samples of this material were collected or analysed	The upper 0.5 m of fill at WS8 and WS9 was visually consistent with material at the same depth at WS5, and the sample from 0.45 m depth at WS5 was consistent with expected background. Below 0.5 m and to approximately 1.5 m, material at WS8 is sand with gravels and some silt, yellowish brown, and containing brick fragments (cement fragments become present only below 1.5 m). This fill at WS8 was tested at 1.2 m and was consistent with expected background. The material at WS9 is similar to WS8 to 1.5 m depth. (Below 1.9 m depth at WS9 soil is sand with some gravel, and has elevated PAH, as characterised by WS9 1.5 m.) We have therefore conservatively assumed that up to 1 m within this area is potentially clean. We have added text to clarify that due to the potential variability of materials, confirmatory testing must be carried out if this material is to be segregated and disposed to clean fill.
Zone 2 (sampling locations WS2, WS4, WS5, WS6, WS7) 0-0.75 m depth is described as clean, however only one sample of this material was collected and analysed (WS2 and 0.6 m) and PAH and metals concentrations greater than background were reported.	This area has 0.1-0.2 m of asphalt and basecourse underlain by sand fill with some silt and greywacke gravel to 1.6-1.9 m deep. This fill is characterised by samples WS4 0.85 m and WS5 0.45 m. While some results were slightly higher than background, given the variability demonstrated by the QA results, the fill is considered to potentially be generally consistent with background. Some brick fragments are present in some of the fill (at WS2, WS4, and WS6). Sample WS2 0.6 m was collected from this material. PAH and zinc in this sample are higher than background (other metals are considered generally consistent with background). Due to the presence of more brick material at WS6 below 0.75 m depth, we conservatively assigned a depth to this potentially clean layer of 0.75 m. We have updated the GCA to include this detail and clarify that due to the potential variability of materials, confirmatory testing must be carried out if this material is to be segregated and disposed to clean fill.
Zone 2 2.75 to 3m depth is described as clean, however both samples analysed from this depth range exhibited PAH concentrations greater than background.	A yellow, coarse sand layer was present at depth at some locations (WS2 below 2.7 m, WS4 below 2.5 m; WS5 below 2.75 m). This material was also present at WS9 (from 2.55 m). Samples characterising this yellow sand are WS2 2.9 m, WS5 2.85 m, and WS9 2.75 m. All of these are generally consistent with background. At WS4, a grey silty sand is present below 2.5 m, and at WS6, a coarse dark reddish brown sand is present below 1.9 m. These materials are characterised by WS4 2.7m and WS6 2.5 m, which are generally consistent with background. At WS7, a dark silty sand with coarse brick fragments is present below 2.6 m. This material contains elevated PAH. We have conservatively selected a depth of 2.75 m as the top of the potentially clean material. We have updated the GCA to include this detail and clarify that due to the potential variability of materials, confirmatory testing must be carried out if this material is to be segregated and disposed to clean fill.

URS comment on GCA	Response
We do not consider there is sufficient density of samples or targeting of shallow soils to identify asbestos contamination from demolition of the former shed. Given the site is currently covered by asphalt, it is not possible to visually identify potential ACM in surface soils. As a result it may be better to defer assessment of shallow soils until such time as asphalt is removed and a visual assessment of the surface soils can be undertaken, with focussed sampling and analysis of suspect ACM.	We agree. We note that the Draft CSMP requires additional testing of soil in the area of the former shed. Section 3.3, bullet 1 of the Draft CSMP acknowledges that only limited testing has been done in this area. We have added text to that section to clarify that the extent of the indicative area in which asbestos is present may be increased or decreased based on the results of testing. We have added text to Section 4.1 of the Draft CSMP to clarify the process for identifying the extent of asbestos contamination.
Section 2.4 comments: Appendix C	
Background concentrations are inconsistent. This is possibly due to selection of different soil types for the background concentrations presented in Table C.2.	We have added text to Section 4.2.1 of the GCA and the footnote to Table C.2 to clarify that because the source of fill is unknown, results have been compared with the full range of expected background concentrations for the Wellington Region. We note that if soil is to be disposed to clean fill, the guidelines for the clean fill site or expected background at the location of the clean fill site are most relevant.
The identification of concentrations greater than background via bold formatting is inconsistent with a number of concentrations greater than background not identified correctly.	We have amended the formatting so that all values that exceed the stated background concentration are bold. Based on the variability indicated by the QA results, the assessment considers whether the results appear to be "generally consistent" with expected background concentrations (e.g., within 5-10% of the stated value).
Although unlikely to have a material effect on the overall GCA, we recommend these tables be updated.	Tables have been updated. We confirm there is no material effect on the GCA.

Table 3: Comments on Draft CSMP

URS Comment on Draft CSMP	Response
Section 3.3: We do not consider dividing the site into three soil management zones has been substantiated. We recommend this section of the Draft CSMP be modified accordingly.	The assessment was based on review of soil strata in borelogs, as described above. The intention is to identify where layers of clean soil may potentially be present. The Draft CSMP requires further testing before any material is disposed to clean fill. We have revised Table 2 and Section 5.2 to clarify this material is "potentially" clean (note, we have also updated Section 6.4 of the GCA to clarify that material is potentially clean, pending confirmatory testing).
Section 4.1: we do not consider there has been sufficient assessment for the presence of ACM in shallow soils (less than 1 m deep). We recommend this section be modified to require assessment of surface soils when the asphalt is removed.	We agree. Text added to Section 4.1 to clarify the process for this.

URS Comment on Draft CSMP	Response
Section 4.2: We recommend this section is modified to provide for further characterisation either by additional in-ground sampling or stockpiling, sampling and analysis of soils prior to off-site disposal at cleanfill.	The intention was that any soil to be disposed to clean fill could only be disposed to clean fill if further testing confirmed it was indeed clean (refer Section 3.3, bullet 2). We have updated Section 4.2 to be consistent with this.
Section 4.2: there has been no characterisation of soil at depths greater than 3 m deep and we recommend that this section be modified to require that soils excavated from this depth be stockpiled and characterised for offsite disposal.	We have added the following text to Section 4.2*: Material from 3 to 3.7 m has not been tested. Based on results for fill from 2.75 to 3 m, this deeper material is potentially clean. However, it may only be disposed to clean fill if testing is done (before or after excavation) that confirms it is clean.*
Section 4.2: we recommend this section be modified to require validation sampling of the excavation base and sidewalls to assess/confirm the suitability of the remaining soil for the proposed land use.	Contaminated reclamation fill will remain in place around the entire excavation. Therefore, it is not appropriate to do confirmation testing to confirm contaminated fill has been removed. The proposed land use is paved commercial use. The contaminants of concern are inorganic or semi-volatile organics. On completion of the works, there will be no potential for regular site users (office workers, public) to contact contaminated soil. Future works carried out in the reclamation fills (e.g., excavations for maintenance of services) will be subject to controls under contaminated land regulations (NES Soil, District Plan rules).
Section 5.2: We recommend this section be modified to specifically address encountering unforeseen ACM.	We have updated this.
Section 5.4: We recommend this section be modified to cover shallow soils (less than 1m deep) across the whole site, until such time as the presence or absence of ACM in shallow soils outside Zone 3 has been assessed.	The basis for Zone 3 is the demolition of a shed that was built with materials containing asbestos. There is no evidence for asbestos being present outside Zone 3, therefore testing for asbestos outside this zone has not been proposed. We have added text to reflect that these procedures apply to anywhere on site where potentially asbestos-containing materials are identified.
Section 5.5: we recommend that reference to soil management zones be removed	We have also added to Section 5.5 of the Draft CSMP that additional controls are required for Zone 3 (i.e., wherever asbestos-contaminated soil is encountered). We have clarified at Sections 4.2 and 5.10 of the Draft CSMP that if soil from potentially clean areas is to be managed as clean fill, it must be tested before being disposed to clean fill.
Section 5.10: we do not consider that there has been sufficient characterisation of soils for disposal at cleanfill nor has there been characterisation of soils at depths greater than 3 m. We recommend that the first sentence of this section be	The reference to “disposal permitting” in Section 5.10 was intended to refer to disposal to landfill only. We have added text and a reference to Section 3.3 to clarify this.

URS Comment on Draft CSMP	Response
deleted and the remainder of the section modified accordingly.	
Section 6.1: dust control procedures. We recommend this section be modified to remove the references to soil management zones.	We have revised text to clarify that discharge of airborne fibres could potentially occur if dust is generated from soil containing friable asbestos, and that contaminants could be transported offsite if dust is generated from contaminated soil generally.
Section 7: we recommend that this section be developed further to reflect the actual conditions and method used to remove ACM contaminated soil from the site. We recommend this updated plan be reviewed by a suitably qualified and experienced approved asbestos remover or consultant. This plan should be submitted to Council for review and approval prior to conducting the ACM contaminated soil removal.	We agree that this section should be updated when the conditions and method to remove ACM from the site are known. This will be after removal of asphalt from the site, visual inspection of surface soil, and targeted testing for potential ACM. We have added a text box to Section 7 to this effect.
Section 10.2: we recommend this section be modified to require post excavation validation sampling of the base and sidewalls of excavations deeper than 3 m.	Because contaminated reclamation fill will remain in place around the excavation, and based on the proposed site use (paved, commercial use) we do not propose validation testing of the base and sidewalls of the excavation, unless unexpected conditions are encountered. We have added the following text to Section 10.2: *No validation testing is proposed on the walls and base of the basement excavation, unless unexpected conditions are encountered. Contaminated reclamation fill is expected to remain in place around the excavation, and the proposed works will pave and prevent exposure to the contaminated fill. Validation sampling may be needed if unexpected conditions are encountered. The need for this would be assessed by the contaminated land specialist (see Section 9).*

3 Comments on proposed conditions

The proposed conditions (a) to (i) relate to contaminated land. We have not reviewed the conditions related to the fuel storage facilities.

We note that all of the proposed conditions relating to contaminated land could be replaced by a single condition requiring that the works are conducted in accordance with the approved CSMP.

Our comments relating to the specific conditions are as follows:

- We agree the proposed conditions (a), (b), (e), (h) are appropriate.
- We agree that the content of conditions (c), (d), and (f) refer to compliance with other legislation (i.e., outside the RMA). Therefore, we suggest it would be more appropriate that they be advice notes rather than consent conditions in a land use consent. We note that Condition (c) refers to Land Transport Rule 45001/1, which may be overly onerous for transport of contaminated soil, and it is not clear that the materials proposed to be excavated fall within the scope of this rule.

- Condition (g) requires characterisation of materials that are to remain on site. We do not agree this is appropriate given that contaminated fill will remain in areas of the reclamation beyond the basement, and the walls and floor of the basement will be paved, preventing any contact of site users with potentially contaminated soil.
- We agree that Condition (i) is appropriate, with the exception of bullet point 1, which refers to Condition (g) (see above).

4 Applicability

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

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Penny Kneebone	Stuart Palmer
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Appendix A: Updated reports with tracked changes

- **Revised Ground Contamination Assessment**
- **Revised Draft Contamination Site Management Plan**

REPORT

Willis Bond Ltd

Ground Contamination Assessment
Wellington Waterfront Sites 8, 9, 10

Report prepared for:

WILLIS BOND LTD

Report prepared by:

Tonkin & Taylor Ltd

Distribution:

WILLIS BOND LTD	**1 pdf copy**
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February 2014

T&T Ref: 85778.001

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1 Introduction

Tonkin & Taylor (T&T) has been engaged by Willis Bond Ltd (WBL) to undertake a contamination investigation of Site 10, and to compile the results of that investigation with the results of an assessment of Sites 8 and 9 that was done in 2009 for Wellington Waterfront Ltd. Sites 8, 9, and 10 cover most of the area proposed to be developed (Figure 1). The results of assessments at Sites 8, 9, and 10 provide a basis for developing contamination management measures for the proposed development area.

1.1 Proposed site development

An overview of the site development is provided in Figure 1 (see Appendix A for larger version).

WBL proposes to develop Site 10 by constructing a multistorey building. The proposed works are likely to comprise of basement excavations to 3.7 m depth, and possibly deeper foundation excavations.

Landscaping works are proposed in the Landscape Areas (except Site 9 which will remain as a carpark) to create public open space areas (refer Figure 1). We understand approximately 1,000 m^3 of cut material may need to be removed from Site 8 (if it is geotechnically unsuitable), with cuts a maximum of 1 m deep. No significant cut is proposed elsewhere in the proposed Landscape Area, however, it is expected that limited soil disturbance will be required for surface preparation works. The public space areas shall be finished with either paving underlaid by imported fill or imported clean landscaping fill materials.

Previous desk studies at Site 10 (2008, 2011) and limited investigations at Sites 8 and 9 (2009) have identified potential sources of ground contamination (reclamation fill).

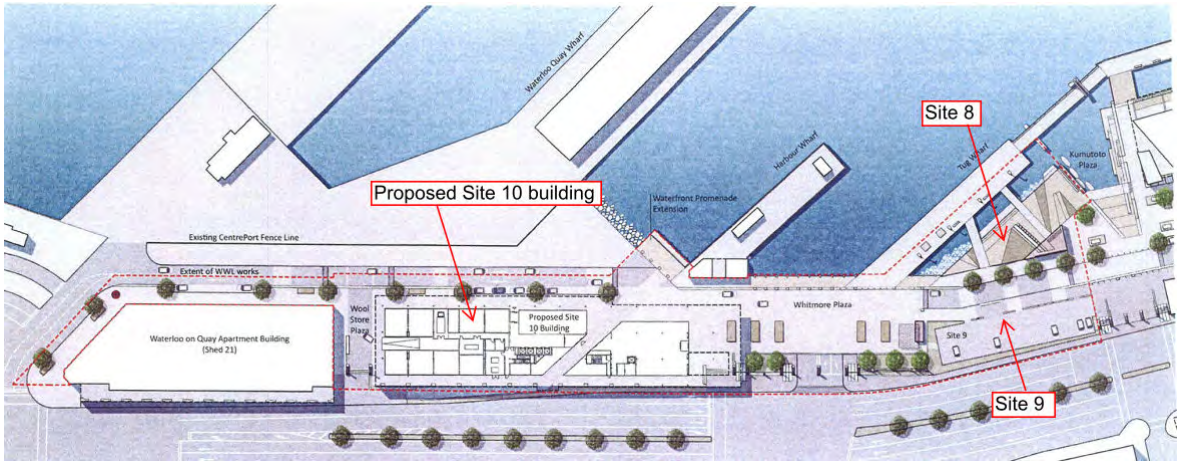

Figure 1: development master plan (Source: Isthmus)

1.2 Objective

The objective of this report is to combine the results of the Site 10 investigations with results from 2009 investigations at Sites 8 and 9 to develop a draft Contamination Site Management Plan (CSMP) for the works (see Appendix D). The objective of the Site 10 investigations is to characterise potentially contaminated material that is proposed to be excavated for the Site 10 building basement.

1.3 Scope of work

We have undertaken the following scope of works:

- Reviewed draft desk study report and limited site investigations carried out for Sites 8 and 9 in 2009 (T&T reference 84496.001, *Sites 8 and 9 Geotechnical and Ground Contamination Investigation: DRAFT*, prepared for Wellington Waterfront Ltd, July 2009).
- Requested information on historical pollution incidents for Sites 8, 9, and 10 from Greater Wellington Regional Council.
- Reviewed Wellington City Council (WCC) Archives files and historical aerial photographs to identify historical building locations at Site 10;
- Obtained underground service plans;
- Selected positions for 9 window sampler boreholes at Site 10;
- Collected soil samples to 3 m depth at each location to characterise the material that will be excavated to form the proposed basement;
- Tested selected samples for potential contaminants based on the site history;
- Compared laboratory results with expected background concentrations and landfill disposal criteria; and
- Provide recommendations on management and disposal method for excavated soil, including a draft Contamination Site Management Plan for the works (see Appendix D).

2 Site description

2.1 Site location

The outline of the proposed Landscape Area is shown in the development plan (Figure 1 Appendix A).

Site 10 is located to the east of Waterloo Quay in Wellington, as shown on Figure 2 (Appendix A). It is roughly rectangular in shape and has an area of approximately 0.25 ha. It covers most of Lot 102 DP 65083 and extends approximately 14.4 m into the northern end of Lot 1 DP 363596 and 3 m into the southern end of Lot 9 DP 65083.

2.2 Site description

The Landscape Areas are currently surfaced with asphalt and used as public open space, parking and access roads.

Site 10 is currently used as a car park and motor home park. It is essentially flat and entirely paved. An amenities block is located on the eastern boundary of Site 10. Access is via a paved road immediately to the south of the amenities block.

Waterloo Quay is west of the site, beyond a metal fence. To the east are access roads and further car parking areas. Shed 21 is located immediately to the north of Site 10.

2.3 Geology and hydrogeology

Based on published information, the land beneath Sites 9 and 10 and the areas between these two sites was reclaimed around 1900. Site 8 was reclaimed in the 1970s. The original seawall forms the boundary between Sites 8 and 9.

According to the published geological map[1], the site is described as reclaimed land, with fill consisting of domestic waste, sand, boulders and rock.

There are no surface water features on the site. Lambton Harbour is adjacent to Site 8, and approximately 11 m southeast of the proposed basement on Site 10 at its closest point. Based on the proximity to the harbour, general shallow groundwater flow direction is expected to be towards the southeast. Groundwater level is expected to fluctuate with the tide.

3 Site history

Site history information has been established from a variety of sources, including published information, T&T records, Wellington City Council (WCC) Archives files, Greater Wellington Regional Council records, and historical aerial photographs. All records viewed are summarised below. Key features for Site 10 are shown on Figure 2.

3.1 WCC Archives files

WCC Archives file for Site 10 was viewed on 28 May 2014. Key features are shown on Figure 2.

An 1892 survey plan indicates that the site location is unreclaimed in 1892. The closest wharf structure is referred to as Wool Wharf (currently known as Waterloo Wharf).

A 1901 contract document (titled *Contract 107*) contained the specification of the construction of a new building named Shed U to be erected on the site. A floor for a wool press was specified. A ground plan drawing for Shed U (Drawing 3) indicates that the wool press floor was located at ground level. This drawing also indicates a railway platform running along the full western length of the building. The purpose of the railway platform is unclear, however it is likely it would have included the movement of goods and cargo from the nearby shipping docks. An office block is located in the north western corner and public toilets in the south western corner.

A plan, dated 1902, titled *Arrangement of patent hydraulic working valves for U Store Wool Presses,* is located on the WCC Archives database. This plan was not viewed, but its title confirms that Shed U was likely to have been used as a wool shed.

In 1921, A Wellington Harbour Board notice was issued, which renumbered the sheds and stores along the Wellington Harbour. Shed U was renumbered Shed 17.

A 1947 contract document (titled *Demolition of Parapet and re-roofing of Shed 17*) contained the specifications for reroofing Shed 17 with asbestos cement roofing product. Super Six corrugated sheets were specified for the whole roof.

A building permit, dated 5 June 1986 is on the WCC Archives database. The building permit was not viewed, however its title *Waterloo Quay, Demolish Wharf Shed No 17,* indicates that the building was removed in 1986.

3.2 Historical certificates of title

Historical certificates of title dating back to 1894 indicate that the site was previously owned by the predecessors of Wellington Waterfront Limited (Lambton Harbour Overview Limited and Wellington Harbour Board).

[1] Begg, J.G., Johnston, M. R., (compilers), 2000, Geology of the Wellington Area, Institute of Geological and Nuclear Sciences, 1:250,000 geological map 10. 1 sheet + 64p. Lower Hutt, New Zealand, Institute of Geological and Nuclear Sciences Limited.

3.3 Historical aerial photographs

Historical aerial photographs reviewed in 2009 indicate that Sites 8 and 9 have been paved and used for car parking and access roads since sometime after 1980.

For Site 10, historical aerial photographs from WCC's GIS, and Alexander Turnbull Library (online collection) were reviewed. The key observations of Site 10 and surroundings are summarised in Table 3.1.

Table 3.1: Summary of historical aerial photographs: Site 10

Date (Source)	Onsite features	Offsite features
1905 (Alexander Turnbull Library oblique)	The corner of a large building (inferred to be Shed 17) can be seen at the inferred site location. On the south side of the site, there appears to be a pedestrian walkway between Shed 17 and the adjacent building.	The wharf structure and Wellington harbour is located east of the site. A multistorey building is located south of the site.
1934 (Alexander Turnbull Library oblique)	The roof of one large building (Shed 17) occupies the entire site, except for a small area at the southern end (inferred to be a pedestrian walkway). The use of this building is unknown, but may have included a wool shed.	No significant change A main road (currently known as Waterloo Quay) is adjacent to the western boundary.
1951 (Alexander Turnbull Library oblique)	No significant change.	No significant change.
1996 (WCC GIS)	The building has been removed. The site is fully paved and is being used as a car park.	The land adjacent to the eastern site boundary has been reclaimed as the Wellington harbour no longer directly adjacent to the eastern site boundary.
2004 (WCC GIS)	No significant change.	No significant change.
2013 (WCC GIS)	The northern half of the site is being used as a motor home park. A small building is present at the eastern side of the site (inferred to be the amenities block).	No significant change.

3.4 Reclamation history

Based on published information[2], the majority of the land beneath Sites 9 and 10 and the area between these two sites was reclaimed in the early 1900s. The source of this reclamation fill is unknown. We understand Site 8 was reclaimed in the 1970s, using quarried gravel.

[2] S.B Semmens (2010). An Engineering Geological Investigation of the seismic subsoil classes in the Central Wellington Commercial Area. Volume One: Thesis.

3.5 Greater Wellington Regional Council files

Site 10 is not listed on GWRC's database of potentially contaminated sites (the Selected Land Use Register (SLUR)).

Small parts of the public space area intersect with part of a "Queens Wharf" area that is listed on GWRC's SLUR database (see purple area marked on Figure 3, below). The Queens Wharf area is listed on the SLUR due to a 10,000 litre aboveground fuel tank used by Rick Lucas Helicopters. No further information regarding the age or condition of the tank is held by GWRC. This is not expected to affect landscaping earthworks.

GWRC does not hold any records of pollution events or ground contamination at the site.

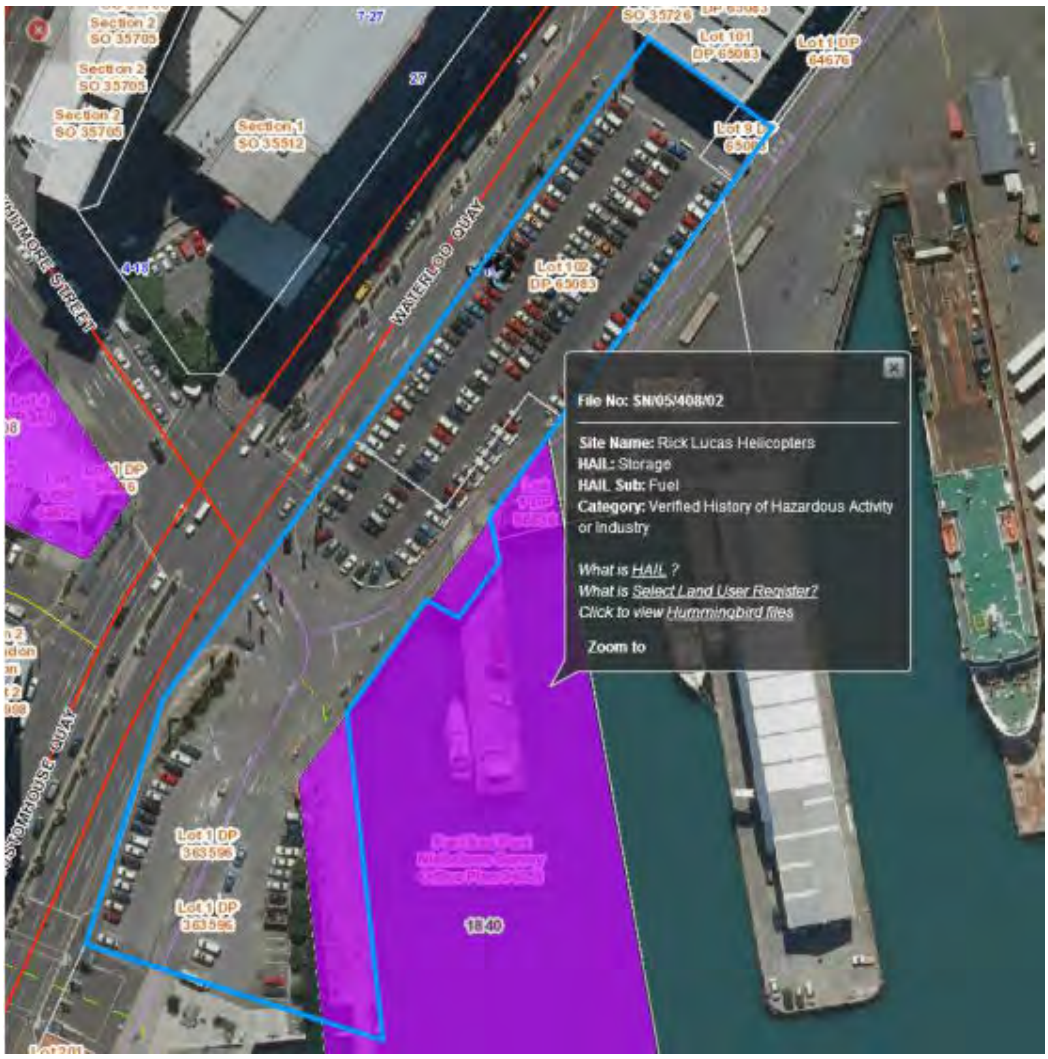

Figure 3: parts of site that intersect the Queens Wharf SLUR listing (purple zone). Source: GWRC

4 Potential for contamination

The source of the reclamation fill at Sites 9 and 10 and the area between is unknown. Contaminants typically associated with reclamation fill encountered elsewhere on the Wellington waterfront include metals, polycyclic aromatic hydrocarbons (PAH) and asbestos.

Site 10 has been used as a wool store. There is potential for hydrocarbon contamination at the base of lift shafts. Asbestos-containing building material was identified in the Shed 17 re-roofing specifications (Super Six corrugated sheets). This building was demolished in 1986, and surface soil contamination from asbestos is possible resulting from the demolition.

4.1 Conceptual site model

For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor). Table 4.1 summarises potential sources, pathways, and receptors in order to assess possible environmental and human health risks associated with the known site conditions.

Table 4.1: Summary of potential effects of proposed site use

	Source	Pathway	Onsite Receptors	Offsite Receptors
During construction works	Contaminated fill	Inhalation (dust), dermal contact, incidental ingestion	Construction workers	Surrounding commercial workers General public –road, pedestrians Discharge via stormwater runoff
	Contaminated groundwater generated during dewatering	Discharge to harbour via stormwater network	Construction workers	Flora and fauna of Wellington Harbour Recreational harbour users
On completion of works	Contaminated soil beneath basement and beneath paving	Inhalation (dust), dermal contact, incidental ingestion	Maintenance workers No other receptors as site is likely to be fully paved.	None - site is likely to be fully paved.

4.2 Relevant guidelines

Guidelines are summarised in the results tables, included in Appendix C. Sources of all guideline values are provided in the footnotes to each table.

4.2.1 Soil

Based on the proposed site use (commercial – Site 10 and public open space – Landscape Areas), soil test results have been compared with:

- Expected background concentrations, selected from *Determination of Common Pollutant Background Soil Concentrations for the Wellington Region*, August 2003, prepared by URS for GWRC (URS 2003). Because the source of fill is unknown, results have been compared with the full range of expected background concentrations for the Wellington Region.
- Human health guidelines for commercial site use (unpaved), selected in accordance with the hierarchy set out in the Ministry for the Environment (MfE)'s *Contaminated Land*

Management Guidelines No. 2 – Hierarchy and Application in New Zealand of Environmental Guideline Values (Revised 2011). The hierarchy requires use of New Zealand risk-based values where these exist. The Soil Contaminant Standards referred to in the *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011* (the NES Soil) take precedence. International risk-based guidelines are used where no New Zealand guidelines exist. There is potential for construction workers to have direct exposure to contaminated material during the construction of building foundations and service trenches. The guidelines for commercial site use is considered appropriate for the period of construction.

Note: There are no guidelines for maintenance workers under the NES Soil. Instead, good health and safety practices are recommended.

- Guidelines for offsite soil disposal:
  - Clean fill: contaminant concentrations must be consistent with expected background concentrations. Greater Wellington Regional Council relies on the interpretation of clean fill provided in the MfE's *Guide to Management of Clean Fills* (2002); concentrations above background or the detection of PAHs precludes waste from disposal at clean fill. We note that Wellington soils do contain a detectable background level of PAH (refer URS 2003).
  - Landfill: MfE's *Waste Acceptance Criteria for Class A Landfills* (2003). If the landfill acceptance criteria are exceeded, material may require pre-treatment, either onsite or at a specialist waste treatment facility (e.g. Transpacific, Seaview) prior to being accepted at landfill.

We are not aware of any defined acceptance value for asbestos fibre in soil. To date no method has been formed that reliably predicts the concentration of asbestos in air given the concentration of asbestos in the source. The approach adopted is to implement health and safety controls when friable asbestos is present in soil and monitor for the presence of asbestos in air during works which could disturb the fibres. If surplus soil containing asbestos has to be disposed off-site, it must be disposed to an appropriately consented landfill. Landfills in the Wellington region that can accept asbestos-containing soil include Southern Landfill and Silverstream Landfill.

4.2.2 Groundwater

Groundwater results are assessed against the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Conservation Council (ANZECC) 2000, Volume 1; Marine water, 80% protection of species. This level of protection is considered appropriate as stormwater discharges to the Wellington Harbour, which is considered to be a moderately disturbed environment.

Based on expected dilution in the harbour, for the purposes of assessing the effects of discharge of groundwater to the harbour via stormwater (e.g., during dewatering), it would be appropriate to apply a dilution factor to results. An appropriate dilution factor can be developed by evaluation of discharge volumes and dispersion by a contaminated land specialist, once discharge volumes are known.

5 Previous investigations: Sites 8 and 9

Limited soil sampling and testing was conducted in 2009 to investigate the potential for contamination in fill material at Sites 8 and 9.

5.1 Sample locations

Samples were collected using clean gloves from SPT samples retrieved during geotechnical investigations. Boreholes for sampling were selected to provide coverage of the site. Sample depths were selected to target specific layers within the fill material. At Site 8, 2 soil samples were collected from 1 borehole (2 samples). At Site 9, 2 soil samples were collected from each of 2 boreholes and 2 window sampler holes (i.e., a total of 8 samples from Site 9). All samples were tested for a suite of 7 metals, and 3 samples were tested for polycyclic aromatic hydrocarbons (PAH).

5.2 Observations

No visual or olfactory evidence of contamination was noted in fill material on Site 8 (1970s fill). Fill materials in Site 8 were consistent across the site, which is consistent with the reclamation history of Site 8 (placement of quarried fill). Fill material on site 9 (1903 fill) was more variable, with some layers having a slight hydrocarbon odour.

5.3 Results: Sites 8 and 9

Results are provided in Table C1 in Appendix C.

All results for Sites 8 and 9 were well below guidelines for commercial use of the site. Therefore, there is no requirement to remove soil from the site due to contamination. However, if fill material is exported from the site, there are implications for management and disposal.

Fill material from Site 8 (1970s fill) can potentially be managed as clean fill. Concentrations of metals and PAH in the two samples of fill material on Site 8 (1970s fill) were consistent with expected background. These results and the consistency of materials observed across Site 8 indicates fill in Site 8 is likely to be suitable to be managed as clean fill. If fill material from Site 8 is to be excavated and disposed offsite, additional testing should be done on excavated material (or prior to excavation, when proposed excavation locations are known), to confirm this.

Fill material from Site 9 (1903 fill) is not clean and would need to be managed at a consented landfill. Metals and PAH exceeded expected background concentrations in 3 of the 6 samples of fill material from Site 9 (1903 fill material), and 2 of the samples exceeded landfill acceptance criteria. Because only limited testing was conducted in the area of 1903 fill, and because of the variability of the fill, it is possible that some of the fill is clean. However, we understand that Site 9 is to continue to operate as a car park and therefore no fill material from Site 9 will be disturbed nor removed from the site.

Remainder of Landscape Area (1903 fill): no testing has been done in the remainder of the Landscape Area, but based on the fill history (1903 fill), materials are expected to be variably contaminated, similar to Site 9. Testing of materials to be disturbed would be required to assess contamination. This testing could be done either before excavation begins, or on materials stockpiled before disposal offsite. If a large quantity of the 1903 fill is to be exported from the site, it may be worthwhile to carry out delineation testing to identify if any of the material is clean. In the absence of further testing, the 1903 fill must be presumed to be non-clean fill, and must be managed at a consented landfill (e.g., Southern Landfill). A formal application to the

landfill would be required. Because some metals exceed landfill acceptance criteria, the landfill manager may require leaching testing to confirm that the fill is acceptable for landfill disposal

6 Site 10 investigations

6.1 Soil sample collection: Site 10

Intrusive investigations were carried out at Site 10 on 23-24 April 2014, at the locations shown on Figure 2 (Appendix A).

The investigations comprised 9 window sampler boreholes (WS1 – WS9) to a maximum depth of 3 m. Samples were collected from each layer of material encountered. WS1 and WS3 refused at depths of 1.2 m and 1.0 m respectively on what appeared to be concrete, and deeper fill was not tested. Window sampler logs are provided in Appendix B.

Samples were collected using a hand trowel and clean gloves. The hand trowel was cleaned between sample locations and fresh gloves were used for each sample. All samples were collected using clean latex gloves and placed into clean jars provided by Hill Laboratories. All samples were placed on ice and transferred to the laboratory under chain of custody documentation.

Based on site history and observations, selected samples of fill were tested for polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), asbestos, and metals.

6.2 Groundwater sample collection: Site 10

Groundwater was encountered at WS2 and in WS49. The depth to groundwater was approximately 1.6m – 2m. A standpipe was installed in WS2 (P2, refer Figure 2 in Appendix A). An existing standpipe (P1, refer Figure 2 in Appendix A) was also sampled.

Groundwater level was measured once the water level had been given time to stabilise. P1 was dipped at approximately high tide on 6 May 2014 at 1.72m and P2 was dipped at mid-tide on 12 May 2014 at 1.55m below ground level. Monitoring groundwater level at different tides would confirm the range of depths to groundwater.

A groundwater sample was collected from P1 on 6 May 2014. The standpipe was purged in 2L intervals using a peristaltic pump, until pH and conductivity stabilised for three consecutive readings. A total of 8L was purged prior to collecting a sample.

A groundwater sample was collected from P2 on 12 May 2014. The standpipe was purged in 2L intervals using a peristaltic pump, until pH and conductivity stabilised for three consecutive readings. A total of 10L was purged prior to collecting a sample.

The groundwater extracted for both samples was clear and no odour or surface sheen was noted.

All samples were placed into clean sample bottles prepared by the laboratory. The sample was sent to Hill Laboratories under chain of custody documentation.

Groundwater samples were filtered at the laboratory and tested for trace metals and PAH. The laboratory report is appended as Appendix C.

6.3 QA/QC: Site 10 sampling

Four duplicate soil samples and one groundwater sample were tested to check the variability of the samples. The results are provided in Tables C6 and C7 (Appendix C). In general, the results agreed well (most within 40%). Those results greater than 40% were generally low concentrations

(typically less than 1 mg/kg), relative to which a large percentage difference was seen. This variability indicates heterogeneity in the fill material, and must be considered when interpreting the data.

For metals, the only duplicate pairs with relative percent difference greater than 50% were in the more highly contaminated layer of fill (WS5 2.65 m/Duplicate 2 and WS6 1.5 m/Duplicate 3). The variability in PAH concentrations was much higher, as expected in fill. The variability in the results does not have a material effect on the proposed management of this material (landfill disposal).

The variability in the duplicate pair of samples considered "clean" (WS9 2.75 m/ Duplicate 4) was less than 50% for metals, but ranged up to 67% for PAH. The PAH concentrations were low in both samples of the pair, and therefore the variability does not materially affect the proposed management of this material (disposal to landfill, or cleanfill only after testing confirms the material is clean).

6.4 Results and implications: Site 10 basement excavation

Soil results are summarised in Tables C2-C3 (Appendix C). Interpretation is based on selected samples from 9 window sampler holes, as shown on Figure 2 (Appendix A). The nature and continuity of subsoil away from the sample locations is inferred but it must be appreciated that actual ground conditions could vary from the assumed model.

Within the Site 10 basement excavation (0-3.7 m depth) we have identified potential zones with different contamination present (see Figure 2, Appendix A). Contamination management methods are provided in the draft Contamination Site Management Plan (Appendix D).

Zone 1:

- 0-1 m depth: potentially clean, pending confirmatory testing (before or after excavation) ~~if any unexpected material is encountered~~.
  - The upper 0.5 m of fill at WS8 and WS9 was visually consistent with material at the same depth at WS5, and the sample from 0.45 m depth at WS5 was consistent with expected background.
  - Below 0.5 m and to approximately 1.5 m, material at WS8 is sand with gravels and some silt, yellowish brown, and containing brick fragments (cement fragments become present only below 1.5 m). This fill at WS8 was tested at 1.2 m and was consistent with expected background.
  - The material at WS9 is similar to WS8 to 1.5 m depth. (Below 1.9 m depth at WS9 soil is sand with some gravel, and has elevated PAH, as characterised by WS9 1.5 m.)
  - We have therefore conservatively assumed that up to 1 m within this area is potentially clean.
- 1-2 m depth: contaminated (metals and PAH). This material cannot be disposed as clean fill. However, all results are within commercial use guidelines, and the material is expected to be acceptable for landfill disposal (at an appropriately consented landfill, e.g., Southern Landfill or Silverstream Landfill) without pre-treatment.
- 2-3 m depth: potentially clean, pending confirmatory testing (before or after excavation) ~~if any unexpected material is encountered~~.
- 3-3.7 m depth: unknown. Potentially clean, pending confirmatory testing.

Zone 2:

- 0-0.75 m depth: potentially clean, pending confirmatory testing (before or after excavation) ~~if any unexpected material is encountered~~.

  - This area has 0.1-0.2 m of asphalt and basecourse underlain by sand fill with some silt and greywacke gravel to 1.6-1.9 m deep. This fill is characterised by samples WS4 0.85 m and WS5 0.45 m. While some results were slightly higher than background, given the variability demonstrated by the QA results, the fill is considered to be generally consistent with background.
  - Some brick fragments are present in some of the fill (at WS2, WS4, and WS6). Sample WS2 0.6 m was collected from this material. PAH and zinc in this sample are higher than background (other metals are considered generally consistent with background).
  - Due to the presence of more brick material at WS6 below 0.75 m depth, we conservatively assigned a depth to this potentially clean layer of 0.75 m.
- 0.75-2.75 m depth: contaminated (metals and PAH). This material is expected to be suitable for disposal to landfill without pre-treatment (e.g., Southern or Silverstream). Most soil in this layer is within commercial use guidelines, with the exception of a layer approximately 50-100mm thick at 1.7-1.8m depth, which had a strong hydrocarbon odour and had the appearance of *cold-mix.* Although total PAH within this layer exceed preliminary landfill screening criteria, because PAH compounds bind strongly to soil, it is expected this material would be acceptable without pre-treatment. The PAH concentrations in this thin layer exceeded the commercial use guidelines. However, as it is to be removed from the site, this is not a constraint for site development.
- 2.75-3 m depth: potentially clean, pending confirmatory testing ~~if any unexpected material is encountered during excavation~~.
  - A yellow, coarse sand layer was present at depth at some locations (WS2 below 2.7 m, WS4 below 2.5 m; WS5 below 2.75 m). This material was also present at WS9 (from 2.55 m). Samples characterising this yellow sand are WS2 2.9 m, WS5 2.85 m, and WS9 2.75 m. All of these are generally consistent with background.
  - At WS4, a grey silty sand is present below 2.5 m, and at WS6, a coarse dark reddish brown sand is present below 1.9 m. These materials are characterised by WS4 2.7m and WS6 2.5 m, which are generally consistent with background.
  - At WS7, a dark silty sand with coarse brick fragments is present below 2.6 m. This material contains elevated PAH.
  - We have conservatively selected a depth of 2.75 m as the top of the potentially clean material.
- 3-3.7 m depth: unknown. Potentially clean, pending confirmatory testing.

Zone 3:

- 0-1.2 m depth: elevated metals, PAH, and asbestos. The asbestos is described as bundles and loose fibres, indicating it is friable. Metals and PAH are above expected background concentrations. This material is expected to be suitable for disposal to landfill, but would have to be disposed as special waste due to the presence of asbestos. Special waste requires special handling at a landfill, and typically attracts a higher disposal rate to reflect this.
- 1.2-3.7 m depth: unknown – could not be accessed, due to a concrete slab. Based on the nature of fill encountered at other locations of the site, we would expect fill below the concrete slab may contain contamination above background, but is unlikely to contain asbestos. This material is expected to be suitable for disposal to landfill. Further testing after removal below the concrete slab would be required to confirm this. It would be appropriate to do this testing during the works after the concrete slab has been removed. This testing is set out in the draft CSMP (Appendix D).

6.5 Groundwater results

Fill around and below groundwater level has elevated metal and PAH concentrations. Therefore there is the potential for elevated concentrations of metals and PAH in groundwater. If groundwater contamination is present on the site, there may be constraints on dewatering during earthworks and the discharge of groundwater to stormwater. PAH and the metals detected in fill are strongly adsorbed to soil, therefore removal of sediment from the water before discharge is typically effective in removing these contaminants. The draft CSMP (Appendix D) includes requirements for confirmatory testing and, if contaminants are potentially present, measures to treat discharges for sediment removal. Preliminary testing in one borehole on site indicates no significant contamination is present in groundwater: all PAHs and most metals are within the ANZECC (2000) guidelines for 80% protection of marine species. Copper and zinc detection limits were above the ANZECC guideline value, but the laboratory reported that lower detection limits were not possible due to the sample matrix.

Sulphate is below the WCC trade waste bylaw guidelines at P1, but exceeds these guidelines at P2. The variability of these results reflects the variability of the fill material located onsite. Further testing of groundwater would be required during dewatering if discharge to trade waste is to occur.

6.6 Groundwater management

Groundwater generated during dewatering at Site 10 is expected to be:

- Suitable for discharge to stormwater, however this would require resource consent from GWRC (for discharge of groundwater to stormwater) and a stormwater permit from WCC.
- Suitable for discharge to trade waste – permit required from WCC.

Controls for discharge of dewatering water are set out in the draft CSMP (Appendix D) and generally include:

- Sampling and testing groundwater collected from shallow piezometers prior to excavation to assess groundwater quality. Samples shall be tested for total and dissolved metals and PAH.
  - To identify appropriate controls for discharge to stormwater, initial results will be compared with ANZECC guidelines for protection of marine species, applying an appropriate dilution factor that should be developed by a contaminated land specialist once discharge volumes are known;
  - To assess whether dewatering discharge can be discharged to trade waste, results shall be compared with trade waste guidelines.
- Good erosion and sediment control measures to minimise:
  - Sediment entrained in dewatering discharge.
  - The amount of stormwater entering the excavation area (i.e., to minimise the volume of water requiring discharge to stormwater).
- Treatment for sediment removal (if required), which may include:
  - Detention to allow sediment to settle before water is decanted off for discharge.
  - Treatment with chemical flocculants (the need for chemical treatment to remove sediment can only be determined when the sediment load of dewatering water is known).
  - Monitoring of suspended sediment prior to discharge.
  - Depending on the results of groundwater testing carried out prior to works beginning, additional laboratory testing for metals and PAH may be required before discharge (this is considered unlikely based on groundwater results to date).

7 Soil management

7.1 Off-site disposal of soil

Material that is consistent with background and does not contain asbestos is expected to be suitable for disposal to clean fill. Material that exceeds background concentrations and/or contains asbestos must be managed as contaminated material. Details for management are set out in the draft CSMP (Appendix D).

At Site 8 (1970 fill) and in some layers within the Site 10 basement, testing indicates fill is clean. However, based on the variability within the fill at Site 10 and limited testing at Site 8, we recommend that if soil at Site 8 or outside the layers identified as clean at Site 10 is to be disposed to clean fill, additional testing (metals and PAH; 1 sample per 100 m^3) should be carried out on potentially clean material to confirm it is indeed clean. Testing could be done in situ before works begin, or on stockpiled material if space is available to hold material pending the results of testing (5-7 working days). Care would be needed to ensure clean material does not become mixed with contaminated material during stockpiling. Requirements for testing and controls are set out in the draft CSMP (Appendix D).

Material that exceeds background should be acceptable to an appropriately consented landfill (e.g., Southern or Silverstream) without pre-treatment. However, acceptance would be the decision of the landfill manager. Approval from the landfill manager should be sought before works begin, using the results of testing carried out as part of this investigation.

The material that contains asbestos should be acceptable at an appropriately consented landfill (e.g., Southern or Silverstream), but would have to be handled as special waste, which would attract a higher disposal fee. Approval from the landfill manager should be sought before works begin, using the results of testing carried out as part of this investigation.

7.2 On-site management

Due to the presence of contamination, procedures will be required during the excavation works to protect site workers, the public, and the environment. This would include works to minimise discharges and prevent contact with contaminants. Procedures are set out in the draft CSMP (Appendix D).

8 Regulatory requirements

8.1 Land use consents

Based on the presence of contamination and the volumes of earthworks required, resource consent is expected to be required from WCC under the National Environmental Standard for Contaminants in Soil to Protect Human Health (NES Soil), for disturbing soil and change of use. Resource consent is also likely required under the Wellington District Plan for works on a contaminated site. This is for both Site 10 (the proposed building) and for the Landscaping Areas.

The NES Soil either allows (as a permitted activity) or controls (through resource consents) these activities on land affected or potentially affected by soil contaminants. The focus of the NES Soil is to protect human health, and therefore only relates to the actual or potential adverse effects of contaminants on human health. It does not address the wider adverse effects of contaminants on the environment, or relate to assessing or managing the actual or potential adverse effects of contaminants on other receptors such as ecology, water and amenity values.

The activity status of activities is then set by the NES depending upon the nature and scale of the activity and its potential risks to human health, and ranges from permitted activities through to discretionary activities. In this instance, site investigations have shown that contaminant concentrations are mostly below guidelines for the proposed site use (commercial).

However at Site 10, a layer of soil exceeds the human health guidelines for polycyclic aromatic hydrocarbons. Therefore, the soil disturbance and change of use at Site 10 would be restricted discretionary activities under the NES Soil.

The investigations at Sites 8 and 9 completed in 2009 do not constitute a DSI for the earthworks in the public space areas. Therefore a discretionary activity consent would be required for the works on Site 8 and the rest of the Landscaping Areas.

Overall for the Project, a discretionary activity consent is required for earthworks under the NES.

The following plans are recommended as a condition of resource consent for the works:

- A Contamination Site Management Plan (CSMP). A draft CSMP is provided in Appendix D. It would sets out controls to minimise discharges during the works, health and safety procedures for site workers, and inspection/monitoring and reporting requirements (e.g., tracking loads of contaminated soil disposed to landfill).
- A Site Validation Report (SVR) to be provided to WCC (and GWRC) on completion of the works, documenting the works carried out, collating inspection and monitoring records, and landfill receipts.

8.2 Regional Council consents

A consent will be required for the potential discharge of contaminants to land, including to the reticulated stormwater system, and for the potential discharge of contaminants to ground water. Consent is required for a discharge permit for a Discretionary Activity under Rule 2 of the Regional Discharges to Land Plan, and Rule 5 of the Regional Freshwater Plan.

If any contaminated soil is discharged offsite anywhere other than a consented landfill, resource consent would be required from GWRC.

8.3 Trade waste and stormwater permits

If groundwater generated during dewatering is to be disposed to stormwater or trade waste, a permit will be required from WCC.

9 Conclusions

The proposed development involves excavation at Site 10 for a basement and foundations. Excavated fill and groundwater extracted during dewatering at Site 10 will be disposed off-site. Soil disturbance will also be required at Site 8 and possibly other parts of the Landscape Areas for landscaping works. We understand approximately 1,000 m^3 of cut material may need to be removed from Site 8 (if it is geotechnically unsuitable), with cuts a maximum of 1 m deep. No significant cut is proposed elsewhere in the public space areas, however, it is expected that limited soil disturbance will be required for surface preparation works. The public space areas shall be finished with either paving underlaid by imported fill or imported clean landscaping fill materials. There will be no earthworks on Site 9.

No contaminated material has been identified at Site 8 (1970s fill), but contaminated fill is present at Sites 9 and 10 (1903 reclamation: metals, polycyclic aromatic hydrocarbons). Similar material is expected to be present in the remainder of the Landscape Areas, which are also on the 1903 reclamation. In addition, asbestos has been identified in part of Site 10. A Contamination Site Management Plan (CSMP) will be implemented to control discharges of contaminants during the works to minimise potential effects on human health and the environment. A draft CSMP is appended (Appendix D).

Investigations have confirmed that *after* removal of the excavated basement material at Site 10, concentrations of contaminants will be below human health guidelines for the proposed site use (commercial, paved site).

As some of the fill to be excavated contains contaminants above background levels (metals, polycyclic aromatic hydrocarbons, asbestos), it must be disposed to an appropriately consented landfill (e.g., Southern Landfill or Silverstream Landfill). This investigation indicates that fill should be acceptable to landfill without pre-treatment, but this would have to be approved by the landfill manager. The draft CSMP (Appendix D) includes controls to minimise discharges during the works (e.g., dust, runoff in stormwater).

Some of the fill to be excavated from Site 10 is clean. If additional areas are to be checked for suitability as clean fill (either at Site 10 or in the Landscape Areas), additional testing would be needed to confirm it is clean. This testing can be done either in situ before excavation, or in stockpiled soil if the excavation programme and space permits. Controls will need to be in place during the works to ensure no cross-contamination of clean material occurs.

Because the excavated fill will be disposed off-site and the site will be paved on completion, there is minimal potential for exposure of future site users to contaminated fill at the site.

Preliminary groundwater testing at two boreholes on the site has not identified significant contamination in shallow groundwater, which is consistent with the type of contaminants present in the fill. Further groundwater testing is required to confirm this for the remainder of the site.

Preliminary groundwater testing at two boreholes on the site has not identified significant contamination in shallow groundwater, which is consistent with the type of contaminants present in the fill. Further groundwater testing is required to confirm this for the remainder of the site. Groundwater extracted during dewatering may need treatment before discharge to stormwater or trade waste. The type of treatment (if any) would be dependent on the results of further testing, as set out in the draft CSMP (Appendix D). Implementing appropriate controls (based on the results of testing) would ensure that effects of the discharge on harbour water quality are less than minor.

10 Applicability

This report has been prepared for the benefit of Willis Bond Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement. The work was undertaken in accordance with our proposal of 8 April 2014.

Tonkin & Taylor LTD

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Sharon Parackal	Stuart Palmer
Environmental Engineer	Project Director

Technical Review: Penny Kneebone, Senior Environmental Scientist

SPP

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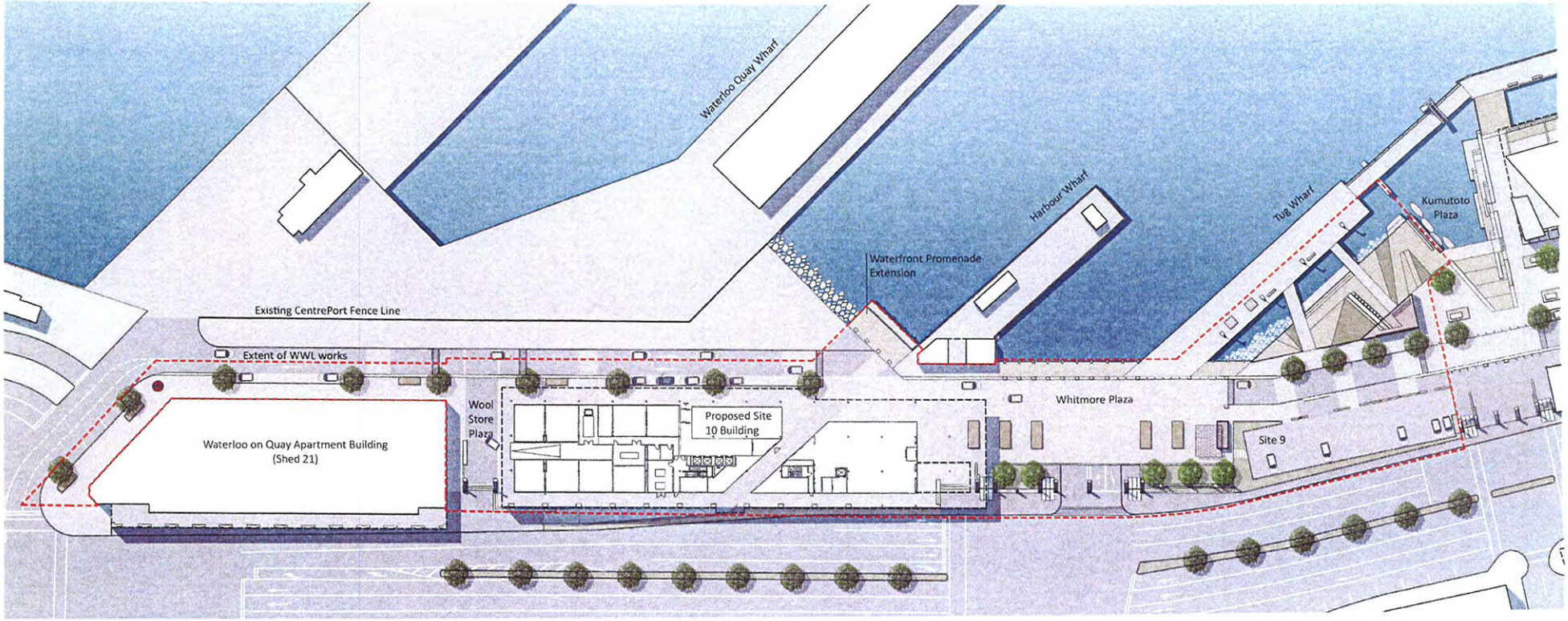
Appendix A: Figures

- **Figure 1: Development Masterplan (Isthmus)**
- **Figure 2: Site 10 Historic Activities, Sample location and Soil Contamination Characterisation**



KUMUTOTO MASTERPLAN

27.08.2014

isthmus

NOTES:

1. Aerial photo sourced from Wellington City Council

ORIGINAL IN COLOUR

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Environmental and Engineering Consultants
Level 4, 2 Hunter St, Wellington
www.tonkin.co.nz

DRAWN	NAT	Jun. 14
DRAFTING CHECKED		
APPROVED		
CADFILE	\\85778.00 10–F02.dwg	
SCALES (AT A3 SIZE)	1:500	
PROJECT No.	85778.00 1	

WILLIS BOND LTD.

GROUND CONTAMINATION ASSESSMENT WELLINGTON WATERFRONT SITE 10

Key Historic Activities, Sample Location and Soil Contamination Characterisation

FIG. No: Figure 2 REV. 0

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Appendix B: Window sampler logs

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS1
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment | LOCATION: Site 10, Wellington Waterfront | JOB No: 85778.001

CO-ORDINATES: Refer Figure 2 for approximate location
R.L.:
DATUM:

DRILL TYPE: Window Sampler
DRILL METHOD: Window Sampler
DRILL FLUID: N/A

HOLE STARTED: 23/4/14
HOLE FINISHED: 23/4/14
DRILLED BY: Geotechnics Ltd
LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 600 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

FILL
RECLAMATION FILL

NA
Not encountered
NA
NA

0.5
1.0

Asphalt
Base course
Silty coarse SAND with some angular gravels. Orange brown. Tightly packed. Dry. Fine to coarse gravel sized brick fragments and white plaster or cement material.
Silty fine to coarse SAND. Dark brown. Moist. Medium to fine gravel size brick fragments present.
Refusal at 1.2m depth

1.5 2.0 2.5 3.0 3.5 4.0 4.5 5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS2
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment	LOCATION: Site 10, Wellington Waterfront	JOB No: 85778.001
CO-ORDINATES: Refer Figure 2 for approximate location	DRILL TYPE: Window Sampler	HOLE STARTED: 23/4/14
	DRILL METHOD: Window Sampler	HOLE FINISHED: 23/4/04
R.L.:		DRILLED BY: Geotechnics Ltd
DATUM:	DRILL FLUID: N/A	LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 600 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
FILL																	Asphalt
																	Base course
RECLAMATION FILL																	Silty fine SAND with some angular medium to coarse greywacke gravel. Dark Brown. Dry. Fine to coarse gravel sized brick fragments. Crushed brick. 0.5
	NA	nferred at time of drilling				NA			0.5				NA				Interbedded silty fine sand. Blue. At 0.75m: 150mm thick lense of organic silt. 1.0
									1.0								SILT with fine sand and fine gravel. Brownish yellow. Moist. Fine gravel sized brick fragments. 1.5
									1.5								
									2.0								2.0
									2.5								SILT with some fine to medium greywacke gravel. Greyish orange and black. Wet 2.5
																	Sandy SILT with fine to coarse gravel. Brown. Wet. Becoming coarse sand. Yellow. Wet.
									3.0								Target depth at 3.0m 3.0
									3.5								3.5
									4.0								4.0
									4.5								4.5
									5								

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS3
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment | LOCATION: Site 10, Wellington Waterfront | JOB No: 85778.001

CO-ORDINATES: Refer Figure 2 for approximate location
R.L.:
DATUM:

DRILL TYPE: Window Sampler
DRILL METHOD: Window Sampler
DRILL FLUID: N/A

HOLE STARTED: 24/4/14
HOLE FINISHED: 24/4/14
DRILLED BY: Geotechnics Ltd
LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

FILL

RECLAMATION FILL

NA

Not encountered

NA

NA

Asphalt

Base course

Lost core

0.5

Coarse silty SAND and coarse greywacke gravel with minor silt. Dark brown. Dry. Coarse to fine gravel sized brick fragments and white plaster or cement material.

1.0

Refusal at 1.0m depth

1.5 2.0 2.5 3.0 3.5 4.0 4.5 5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS4
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment | LOCATION: Site 10, Wellington Waterfront | JOB No: 85778.001

CO-ORDINATES: Refer Figure 2 for approximate location
R.L.:
DATUM:

DRILL TYPE: Window Sampler
DRILL METHOD: Window Sampler
DRILL FLUID: N/A

HOLE STARTED: 24/4/14
HOLE FINISHED: 24/4/14
DRILLED BY: Geotechnics Ltd
LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 600 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

NA

NA

NA

Inferred at time of drilling

FILL

RECLAMATION FILL

Asphalt

Base course

At 0.35m: Fine to medium angular gravel with fine to coarse sand. Grey.

Interbedded fine to coarse angular greywacke GRAVEL and fine to coarse SAND. Some silt. Grey brown. Dry. Fine to medium gravel sized brick fragments.

Coarse SAND with minor silt and greywacke gravel. Light Grey. Dry.

SILT with fine to coarse sand and greywacke gravel. Brown with orange mottling. Fine gravel size crushed brick. Interbedded with fine sand lenses.

BEACH DEPOSITS

Silty fine to coarse SAND and some medium size greywacke gravel. Grey. Wet to saturated. Fine shell fragments present.

Target depth at 3.0m

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS5
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment | LOCATION: Site 10, Wellington Waterfront | JOB No: 85778.001

CO-ORDINATES: Refer Figure 2 for approximate location
R.L.:
DATUM:

DRILL TYPE: Window Sampler
DRILL METHOD: Window Sampler
DRILL FLUID: N/A

HOLE STARTED: 24/4/14
HOLE FINISHED: 24/4/14
DRILLED BY: Geotechnics Ltd
LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

FILL
RECLAMATION FILL

NA

Water inferred at time of drilling

NA

NA

Asphalt
Base course
Silty fine SAND with some greywacke gravel. Yellowish brown and grey. Dry
0.5
Silty medium SAND with medium greywacke gravel. Yellowish brown. Dry. Black organic matter (roots, twigs).
1.0
1.5
Medium rounded gravel. Dark grey black. Moist. Strong hydrocarbon odour.
Silty medium SAND with medium gravel. Yellowish brown. Moist. Black organic matter.
2.0
SILT with some gravel. Grey. Moist to Wet.
SILT with interbedded coarse sand and some greywacke gravel. Grey black. Wet.
2.5
Coarse sand. Orange and mottled black. At 2.65m: Slight hydrocarbon odour.
Coarse Sand. Yellow orange. Saturated.
3.0
Target depth at 3.0m
3.5
4.0
4.5
5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS6
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment	LOCATION: Site 10, Wellington Waterfront	JOB No: 85778.001
CO-ORDINATES: Refer Figure 2 for approximate location	DRILL TYPE: Window Sampler	HOLE STARTED: 24/4/14
	DRILL METHOD: Window Sampler	HOLE FINISHED: 24/4/14
R.L.:		DRILLED BY: Geotechnics Ltd
DATUM:	DRILL FLUID: N/A	LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 600 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

NA

NA

NA

nferred at time of drilling

FILL

RECLAMATION FILL

Asphalt

Base course

Fine SAND with silt and coarse greywacke gravel. Light grey. Dry.

0.5

Silty SAND and fine greywacke gravel. Dark brown Dry.

Sandy SILT and some medium greywacke gravel. Orange and mottled black. Dry to moist. Coarse sand sized brick fragments and black organic matter (twigs, roots).

1.0

Coarse SAND with minor silt. Orange. Moist.

1.5

At 1.5m: Fine powdered cement or plaster material.

At 1.8m: Faint hydrocarbon odour

Coarse SAND. Dark reddish brown.

2.0

At 2.0m: Some coarse round greywacke gravel. Reddish brown with orange and light brown mottling. Saturated.

2.5

3.0

Target depth at 3.0m

3.5

4.0

4.5

5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS7
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment
LOCATION: Site 10, Wellington Waterfront
JOB No: 85778.001

CO-ORDINATES: Refer Figure 2 for approximate location
R.L.:
DATUM:

DRILL TYPE: Window Sampler
DRILL METHOD: Window Sampler
DRILL FLUID: N/A

HOLE STARTED: 24/4/14
HOLE FINISHED: 24/4/14
DRILLED BY: Geotechnics Ltd
LOGGED BY: SPP
CHECKED: NCP

GEOLOGICAL
ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 600 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

FILL
RECLAMATION FILL

NA

Inferred at time of drilling

NA

NA

Asphalt

Base course

Silty coarse SAND with fine to coarse greywacke gravels. Brownish yellow and grey. Dry.

0.5

Sandy SILT with fine to medium graywacke gravel. Yellowish brown. Dry.

At 1.0m: White cement or plaster material

1.0

SAND with some silt and graywacke gravels. Yellowish dark brown. Moist

1.5

2.0

Coarse sand and crushed brick. Red. Moist

2.5

Silty SAND. Dark greyish blue. Wet to saturated. Coarse sand sized brick fragments.

3.0

Target depth at 3m.

3.5

4.0

4.5

5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS8
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment	LOCATION: Site 10, Wellington Waterfront	JOB No: 85778.001
CO-ORDINATES: Refer Figure 2 for approximate location	DRILL TYPE: Window Sampler	HOLE STARTED: 24/4/14
	DRILL METHOD: Window Sampler	HOLE FINISHED: 24/4/14
R.L.:		DRILLED BY: Geotechnics Ltd
DATUM:	DRILL FLUID: N/A	LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL	ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

FILL
RECLAMATION FILL

NA

nferred at time of drilling

NA

NA

Asphalt

Base course

SAND and silt with fine to coarse greywacke gravels. Dark Brown. Dry.

0.5

Silty SAND with fine to coarse greywacke gravels. Yellow brown. Dry. Fine to coarse gravel sized brick fragments.

1.0

1.5

White cement or plaster material. Becoming moist.

2.0

2.5

White cement or plaster material.

Becoming wet.

SILT with coarse sand and fine greywacke gravel. Blue grey and brown. Wet.

3.0

Target depth at 3m.

3.5

4.0

4.5

5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS9
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment	LOCATION: Site 10, Wellington Waterfront	JOB No: 85778.001
CO-ORDINATES: Refer Figure 2 for approximate location	DRILL TYPE: Window Sampler	HOLE STARTED: 24/4/14
	DRILL METHOD: Window Sampler	HOLE FINISHED: 24/4/14
R.L.:		DRILLED BY: Geotechnics Ltd
DATUM:	DRILL FLUID: N/A	LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 600 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

NA

nferred at time of drilling

NA

NA

FILL RECLAMATION FILL	Asphalt
	Base course. Some fine to medium gravel sized brick fragments present.
	Silty fine SAND with medium to coarse greywacke gravel. Brown. Dry
	Coarse SAND with medium greywacke gravel. Grey. Dry 0.5
	SAND with silt and medium angular and rounded greywacke gravels. Yellow and mottled black. Dry. Coarse sand sized brick fragments. 1.0
	SAND with some medium to coarse greywacke gravel. Orange and mottled black. Moist. Becoming wet. 1.5
	2.0 Wet.
	Cobble sized angular greywacke gravel. Weathered. Reddish brown. Wet. 2.5
	Coarse SAND and silt with fine to coarse greywacke gravel. Yellow, brown and black. Saturated.
	Lost core. 3.0
	Target depth at 3.0m.

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:WS9
Hole Location: Refer Figure 2

SHEET 1 OF 1

PROJECT: Site 10 Ground contamination assessment	LOCATION: Site 10, Wellington Waterfront	JOB No: 85778.001
CO-ORDINATES: Refer Figure 2 for approximate location	DRILL TYPE: Window Sampler	HOLE STARTED: 24/4/14
	DRILL METHOD: Window Sampler	HOLE FINISHED: 24/4/14
R.L.:		DRILLED BY: Geotechnics Ltd
DATUM:	DRILL FLUID: N/A	LOGGED BY: SPP CHECKED: NCP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 600 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
FILL									0								Asphalt
RECLAMATION FILL																	Base course. Some fine to medium gravel sized brick fragments present.
																	Silty fine SAND with medium to coarse greywacke gravel. Brown. Dry
																	Coarse SAND with medium greywacke gravel. Grey. Dry 0.5
	NA					NA			0.5								SAND with silt and medium angular and rounded greywacke gravels. Yellow and mottled black. Dry. Coarse sand sized brick fragments.
									1.0								1.0
									1.5				NA				1.5 SAND with some medium to coarse greywacke gravel. Orange and mottled black. Moist. Becoming wet.
									2.0								2.0 Wet.
									2.5								Cobble sized angular greywacke gravel. Weathered. Reddish brown. Wet. 2.5
																	Coarse SAND and silt with fine to coarse greywacke gravel. Yellow, brown and black. Saturated.
									3.0								Lost core. 3.0 Target depth at 3.0m.
									3.5								3.5
									4.0								4.0
									4.5								4.5
									5								

T+T DATATEMPLATE.GDT mirb

Log Scale 1:25

BORELOG WS LOGS.GPJ 26-Feb-2015

Appendix C: Laboratory results

Table C1: Laboratory results Sites 8 and 9 (mg/kg)

ID	BH3 (Site 8)		BH5 (Site 9)		BH9 (Site 9)		WS4 (Site 9)	WS3 (Site 9)	Wellington	Commercial	Landfill
Sample depth	0.5m	2.5m	0.5m	4m	0.5m	4.5m	3.5m	2.1m	Background[2]	<1m/1-4m	Acceptance [5]
Arsenic	**9.7**	**8.3**	6.2	6.1	2.9	3.8	6.3	**11**	7 | 7	70 [3]	100
Cadmium	< 0.10	< 0.10	< 0.10	**0.28**	< 0.10	< 0.10	0.11	**0.44**	0.1 | 0.2	1,300 [3]	20
Chromium	**24**	**21**	15	18	17	19	19	20	16 |21	6,300 [3]	100
Copper	21	25	22	**64**	12	20	21	**1,700**	25 |25	>10,000 [3]	100
Lead	**26**	18	**96**	120	31	46	160	**550**	79 |180	3,300 [3]	100
Nickel	**19**	**17**	13	13	10	**14**	13	**34**	13 | 21	990 [4]	200
Zinc	81	82	100	**250**	56	96	**120**	**900**	105 |201	31,000 [4]	200
Acenaphthene	< 0.026	< 0.027	-	-	-	-	0.035	0.19			
Acenaphthylene	< 0.026	< 0.027	-	-	-	-	0.14	0.21			
Anthracene	< 0.026	< 0.027	-	-	-	-	**0.25**	**0.68**	0.05 | 0.05		
Benzo[a]anthracene	< 0.026	< 0.027	-	-	-	-	0.63	1.5			
Benzo[a]pyrene (BAP)	< 0.026	< 0.027	-	-	-	-	**1.1**	**2.8**	0.27 | 0.033		
Benzo[b]+[j]fluoranthene	< 0.026	< 0.027	-	-	-	-	1.8	4.8			
Benzo[g,h,i]perylene	< 0.026	< 0.027	-	-	-	-	0.63	1.7			
Benzo[k]fluoranthene	< 0.026	< 0.027	-	-	-	-	0.83	1.8			
Chrysene	< 0.026	< 0.027	-	-	-	-	1.2	2.6			
Dibenzo[a,h]anthracene	< 0.026	< 0.027	-	-	-	-	0.28	0.64			
Fluoranthene	< 0.026	< 0.027	-	-	-	-	**2.1**	**3.6**	0.55 | 0.57		
Fluorene	< 0.026	< 0.027	-	-	-	-	0.084	0.14			
Indeno(1,2,3-c,d)pyrene	< 0.026	< 0.027	-	-	-	-	1	2.5			
Naphthalene	< 0.13	< 0.14	-	-	-	-	< 0.16	**0.43**	0.01 | 0.02		200
Phenanthrene	< 0.026	< 0.027	-	-	-	-	**1.1**	**2.1**	0.26 | 0.35		
Pyrene	< 0.026	< 0.027	-	-	-	-	**2.3**	**4.2**	0.57 | 0.60		
Total PAH	<0.52	<0.55					13	30			
BaP(eq) [1]	<0.06	<0.07					1.8	4.5		35 [3]	

Values in bold exceed expected background values. Shaded exceed landfill acceptance guidelines. 1. BaP_{eq} is sum of PAH multiplied by toxicity equivalence factors. 2. URS. 2003. *Determination of common pollutant background soil concentrations for the Wellington region*, Greywacke (applies to Site 8) | maximum in Wellington Region (Site 9; unknown fill source). 3. MfE, 2011, Soil Contaminant Standards, Commercial unpaved. 4. US EPA 2013, Regional Screening Level summary table. 5. MfE. 2004. Hazardous Waste Guidelines - Landfill Waste Acceptance Criteria and Landfill Classification

Table C2: Asbestos and Metals; Site 10

Site 10	Depth (m)	Asbestos	Metals (mg/kg)							TCLP Extract (g/m^3)		
			Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Zinc	Copper	Lead
	0.6	**Present**	< 2	0.18	13	9	166	17	104			
WS1	1.1	-	4	< 0.10	9	7	161	11	110			
	0.6	-	**8**	**0.23**	**23**	**38**	141	15	**300**			
	1.5	-	3	**0.42**	18	19	62	9	**520**	<0.021		
WS2	2.9	-	5	0.18	17	**29**	116	14	**260**			
WS3	0.8	**Present**	7	**0.51**	13	24	**300**	12	**320**			
	0.85	-	5	< 0.10	**22**	18	23	15	77			
	1.8	-	4	0.16	18	**26**	145	14	118			
WS4	2.7	-	3	< 0.10	8	2	8.3	3	8			
	0.45	-	5	< 0.10	15	14	19.1	12	63			
	1.7	-	7	0.16	14	**39**	**360**	11	**460**			
	2.65	-	**9**	**0.51**	17	**87**	**2,800**	13	**500**			
WS5	2.85	-	< 2	< 0.10	< 2	2	14.8	< 2	15			
	1.5	Absent	3	**0.33**	10	**51**	**290**	**21**	125			
	1.8	-	4	0.2	19	**36**	**260**	12	200			
WS6	2.5	-	< 2	< 0.10	3	5	12.7	< 2	18			
WS7	1.25	Absent	6	**0.57**	14	**1,260**	**1,020**	**16**	**2,200**	7.6	2.5	0.062
	2.7	-	7	0.11	17	**35**	94	15	155			
	1.2	-	6	0.12	17	**28**	**186**	14	200			
	1.6	Absent	6	0.14	14	**28**	**230**	**16**	**470**			
WS8	2.5	Absent	5	0.14	12	16	43	13	123			
WS9	1.5	-	3	< 0.10	**22**	10	25	11	64			
	2.75	-	6	0.14	**24**	23	46	**16**	103			
Background [1]			7 | 7	0.1 | 0.2	16 | 21	25 | 25	79 | 180	13 | 21	105 | 201	-	-	-
Landfill Acceptance Criteria [2]			100	20	100	100	100	200	200	10	5	5
Commercial [3]			70	1300	>10,000	>10,000	3300	990 [4]	31000 [4]	-	-	-

Bold exceeds maximum background for Wellington Region. Shaded exceeds human health guidelines. Underline exceeds landfill screening criteria. 1. URS, 2003, *Determination of Common Pollutant Background Soil Concentrations for the Wellington Region*, Greywacke (underlying reclamation) | maximum for Wellington Region (unknown fill source). 2. MfE, 2003, *Waste Acceptance Criteria for Class A Landfills.* 3. MfE, 2011, Soil Contaminant Standards, Commercial unpaved. 4. US EPA 2013, Regional Screening Level summary table

Table C3: PAH & TPH, Site 10

Site 10	Depth (m)	PAH (mg/kg)						TPH (mg/kg)			
		Anthracene	Benzo[a]pyrene	Fluoranthene	Naphthalene	Pyrene	BAP (eq)	C_7 - C_9	C_{10} - C_{14}	C_{15} - C_{36}	Total (C_7 - C_{36})
	0.6	**0.07**	**0.59**	**0.72**	< 0.13	**0.81**	0.9	-	-	-	-
WS1	1.1	**6.1**	**33**	**60**	**1.2**	**67**	48	-	-	-	-
	0.6	**0.29**	**0.84**	**1.52**	**0.12**	**1.6**	1.3	-	-	-	-
	1.5	0.03	0.16	0.23	< 0.14	0.29	< 0.25	-	-	-	-
WS2	2.9	**0.17**	0.28	**0.73**	< 0.13	**0.77**	0.4	-	-	-	-
WS3	0.8	**0.89**	**10.2**	**11.1**	**0.72**	**11.5**	15	-	-	-	-
	0.85	< 0.03	< 0.03	< 0.03	< 0.12	0.02	< 0.07	-	-	-	-
	1.8	**0.17**	**0.59**	**0.97**	< 0.13	**1.29**	0.9	-	-	-	-
WS4	2.7	< 0.03	< 0.03	< 0.03	< 0.14	< 0.03	< 0.07	-	-	-	-
	0.45	< 0.03	< 0.03	< 0.03	< 0.12	< 0.03	< 0.07	-	-	-	-
	1.7	**230**	**270**	**860**	**38**	**800**	406	< 8	163	12,800	**12,900**
	2.65	**0.15**	**0.41**	**0.99**	< 0.15	**0.79**	0.6	-	-	-	-
WS5	2.85	**0.14**	0.18	**0.61**	< 0.14	0.51	< 0.28	-	-	-	-
	1.5	**0.29**	**1.65**	**1.69**	< 0.13	**1.85**	2.4	-	-	-	-
	1.8	**5.9**	**10.1**	**16**	**1.61**	**18**	15	< 8	< 20	320	**320**
WS6	2.5	< 0.03	< 0.03	0.03	< 0.14	0.04	< 0.07	-	-	-	-
	1.25	**0.16**	0.31	**0.79**	< 0.14	**0.75**	0.5	-	-	-	-
WS7	2.7	**0.19**	**0.61**	**1.16**	**0.14**	**1.16**	0.9	-	-	-	-
	1.2	**0.08**	**0.36**	**0.59**	< 0.12	0.55	0.5	-	-	-	-
WS8	2.5	< 0.03	0.05	0.07	< 0.13	0.08	< 0.097	-	-	-	-
	1.5	**0.13**	**1.11**	**1.49**	< 0.13	**1.44**	1.7	-	-	-	-
WS9	2.75	< 0.03	0.07	0.09	< 0.13	0.13	< 0.12	-	-	-	-
Background [1]		0.05 | 0.05	0.27 | 0.33	0.55 | 0.57	0.01 | 0.02	0.57 | 0.60	-	-	-	-	190
Landfill [2]		-	300	-	200	-	300	-	-	-	-
Commercial		-	-	-	270 [4]	NL [4]	35 [3]	500[5]	1,700 [5]	>20,000 [5]	>20,000 [5]

Bold exceeds maximum background for Wellington Region. Shaded exceeds human health guidelines. Underline exceeds landfill screening criteria. 1. URS, 2003, *Determination of Common Pollutant Background Soil Concentrations for the Wellington Region*, Greywacke (underlying reclamation) | maximum for Wellington Region (unknown fill source). 2. MfE, 2003, *Waste acceptance criteria for Class A Landfills*. 3. MfE 2011. Soil Contaminant Standards for commercial use. 4. MfE, 2011, *Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in NZ;* Commercial/Industrial, sandy silt. 5. MfE. 1999. *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, industrial/commercial site use, silty/sand soil, <1m deep

Table C4: Groundwater inorganics: Site 10 (mg/L; dissolved concentrations)

Site 10	pH	Sulphate	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
P1	7.2	750	<0.10	<0.005	<0.05	<0.05 *	<0.010	<0.05	<0.10 *
P2	7.2	3400	<0.10	<0.005	<0.05	<0.05 *	<0.010	<0.05	<0.10 *
ANZECC Guidelines [1]	-	-	0.0045	0.036	0.0906	0.008 *	0.012	0.56	0.043 *
Trade waste [2]	-	1500	-	-	-	-	-		-

Bold exceeds ANZECC guidelines. Underline exceeds trade waste guidelines. *Detection Limits could not be lowered due to matrix effects.

1. ANZECC 80% species protection for marine water. 2. WCC (2004). Trade waste bylaw Table 1 – Sulphate with good mixing.

Table C5: Groundwater organics: Site 10 (mg/L; dissolved concentrations)

Site 10	Anthracene	Benzo(a)pyrene	Fluoranthene	Naphthalene	Phenanthrene
P1	<0.00010	0.00014	0.00022	<0.0005	<0.0004
P2	<0.00010	<0.00010	<0.00010	<0.0005	<0.0004
ANZECC Guidelines: protection of 80% of marine species	0.007	0.0007	0.002	0.05	0.008

Table C6: QA/QC results: Site 10 groundwater

Site 10	pH	Sulphate	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Anthracene	Benzo(a)pyrene	Fluoranthene	Naphthalene	Phenanthrene
P1 (mg/L)	7.2	750	<0.10	<0.005	<0.05	<0.05	<0.010	<0.05	<0.10	<0.00010	0.00014	0.00022	<0.0005	<0.0004
Dup (mg/L)	7.2	740	<0.10	<0.005	<0.05	<0.05	<0.010	<0.05	<0.10	<0.00010	<0.00010	<0.00010	<0.0005	<0.0004
Relative % difference	0	1.3%	-	-	-	-	-	-	-	-	33%	75%	-	-

Table C7: QA/QC results: Site 10 inorganics in soil (mg/kg)

	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Asbestos
WS1 - 0.6m (mg/kg)	< 2	0.18	13	9	166	17	104	Present
Duplicate 1 (mg/kg)	2	0.21	10	9	196	11	144	Present
Relative % difference	*0%*	*15%*	*26%*	*0%*	*17%*	*43%*	*32%*	*0%*
WS5 - 2.65m (mg/kg)	9	0.51	17	87	2,800	13	500	-
Duplicate 2 (mg/kg)	7	0.29	18	60	1,590	11	450	-
Relative % difference	*25%*	*55%*	*5.7%*	*37%*	*55%*	*17%*	*11%*	-
WS6 - 1.5m (mg/kg)	3	0.33	10	51	290	21	125	Absent
Duplicate 3 (mg/kg)	< 2	0.4	8	26	240	18	88	Absent
Relative % difference	*40%*	*19%*	*22%*	*65%*	*19%*	*15%*	*35%*	*0%*
WS9 - 2.75m (mg/kg)	6	0.14	24	23	46	16	103	-
Duplicate 4 (mg/kg)	5	0.2	29	21	34	16	100	-
Relative % difference	*40%*	*35%*	*19%*	*9.1%*	*30%*	*0%*	*3%*	-

Table C8: QA/QC results: Site 10 organics in soil (mg/kg)

	WS1 0.6 m	Dup 1	*RPD (%)*	WS5 2.65 m	Dup 2	*RPD (%)*	WS6 1.5 m	Dup 3	*RPD (%)*	WS9 2.75 m	Dup 4	*RPD (%)*
Acenaphthene	< 0.03	< 0.03	-	0.04	< 0.04	-	< 0.03	< 0.03	-	< 0.03	< 0.03	-
Acenaphthylene	0.07	0.04	*55%*	0.03	< 0.04	-	0.08	0.06	*29%*	< 0.03	< 0.03	-
Anthracene	0.07	0.16	*78%*	0.15	0.11	*31%*	0.29	0.16	*58%*	< 0.03	< 0.03	-
Benzo[a]anthracene	0.41	0.81	*66%*	0.42	0.26	*47%*	1.16	0.49	*81%*	0.06	0.03	*67%*
Benzo[a]pyrene	0.59	0.99	*51%*	0.41	0.23	*56%*	1.65	0.74	*76%*	0.07	0.04	*55%*
Benzo[b]fluoranthene + Benzo[j]fluoranthene	0.66	1.15	*54%*	0.5	0.3	*50%*	1.76	0.83	*72%*	0.08	0.05	*46%*

	WS1 0.6 m	**Dup 1**	***RPD (%)***	**WS5 2.65 m**	**Dup 2**	***RPD (%)***	**WS6 1.5 m**	**Dup 3**	***RPD (%)***	**WS9 2.75 m**	**Dup 4**	***RPD (%)***
Benzo[g,h,i]perylene	0.54	0.91	*51%*	0.28	0.17	*49%*	1.31	0.61	*73%*	0.09	0.07	*25%*
Benzo[k]fluoranthene	0.27	0.47	*54%*	0.2	0.12	*50%*	0.7	0.34	*69%*	0.03	< 0.03	-
Chrysene	0.41	0.72	*55%*	0.39	0.24	*48%*	1.03	0.41	*86%*	0.06	0.03	*67%*
Dibenzo[a,h]anthracene	0.09	0.2	*76%*	0.07	0.05	*33%*	0.3	0.12	*86%*	< 0.03	< 0.03	-
Fluoranthene	0.72	1.47	*68%*	0.99	0.58	*52%*	1.69	0.65	*89%*	0.09	0.05	*57%*
Fluorene	< 0.03	< 0.03	-	0.07	0.03	*80%*	0.03	0.05	*50%*	< 0.03	< 0.03	-
Indeno(1,2,3-c,d)pyrene	0.55	0.69	*23%*	0.22	0.13	*51%*	1.07	0.46	*80%*	0.04	0.03	*29%*
Naphthalene	< 0.13	< 0.13	-	< 0.15	< 0.16	-	< 0.13	< 0.14	-	< 0.13	< 0.12	-
Phenanthrene	0.21	0.51	*83%*	0.76	0.43	*55%*	0.36	0.32	*12%*	0.05	0.03	*50%*
Pyrene	0.81	1.38	*52%*	0.79	0.46	*53%*	1.85	0.78	*81%*	0.13	0.08	*48%*

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ANALYSIS REPORT

Client:	Tonkin & Taylor	**Lab No:**	1267739	SPv2
Contact:	Sharon Parackal	**Date Registered:**	29-Apr-2014	
	C/- Tonkin & Taylor	**Date Reported:**	29-May-2014	
	PO Box 2083	**Quote No:**		
	WELLINGTON 6140	**Order No:**	85788.001	
		Client Reference:	85788.001	
		Submitted By:	Sharon Parackal	

Amended Report

This report replaces an earlier report issued on the 08 May 2014 at 4:10 pm
TCLP testing has been added to 2 samples as requested by the client.

Sample Type: Soil

Sample Name:		WS1 - 0.6m 23-Apr-2014 2:10 pm	WS1 - 1.1m 23-Apr-2014 2:25 pm	WS2 - 0.6m 23-Apr-2014 3:00 pm	WS2 - 1.5m 23-Apr-2014 3:10 pm	WS2 - 2.9m 23-Apr-2014 3:20 pm
Lab Number:		1267739.2	1267739.3	1267739.4	1267739.6	1267739.8
Individual Tests						
Dry Matter	g/100g as rcvd	88	89	87	80	87
TCLP Weight of Sample Taken	g	-	-	-	100	-
TCLP Initial Sample pH	pH Units	-	-	-	7.5	-
TCLP Acid Adjusted Sample pH	pH Units	-	-	-	1.5	-
TCLP Extractant Type*		-	-	-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-
TCLP Extraction Fluid pH	pH Units	-	-	-	4.9	-
TCLP Post Extraction Sample pH	pH Units	-	-	-	5.0	-
Qualitative Identification of Asbestos		See attached report	-	-	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2	4	8	3	5
Total Recoverable Cadmium	mg/kg dry wt	0.18	< 0.10	0.23	0.42	0.18
Total Recoverable Chromium	mg/kg dry wt	13	9	23	18	17
Total Recoverable Copper	mg/kg dry wt	9	7	38	19	29
Total Recoverable Lead	mg/kg dry wt	166	161	141	62	116
Total Recoverable Nickel	mg/kg dry wt	17	11	15	9	14
Total Recoverable Zinc	mg/kg dry wt	104	110	300	520	260
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	0.21	0.05	< 0.03	0.03
Acenaphthylene	mg/kg dry wt	0.07	5.9	0.11	< 0.03	0.03
Anthracene	mg/kg dry wt	0.07	6.1	0.29	0.03	0.17
Benzo[a]anthracene	mg/kg dry wt	0.41	28	0.79	0.14	0.30
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.59	33	0.84	0.16	0.28
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.66	34	1.01	0.17	0.30
Benzo[g,h,i]perylene	mg/kg dry wt	0.54	30	0.61	0.14	0.22
Benzo[k]fluoranthene	mg/kg dry wt	0.27	11.8	0.41	0.08	0.13
Chrysene	mg/kg dry wt	0.41	20	0.65	0.13	0.26
Dibenzo[a,h]anthracene	mg/kg dry wt	0.09	3.4	0.11	< 0.03	0.03
Fluoranthene	mg/kg dry wt	0.72	60	1.52	0.23	0.73
Fluorene	mg/kg dry wt	< 0.03	0.57	0.11	< 0.03	0.05
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.55	30	0.66	0.13	0.22
Naphthalene	mg/kg dry wt	< 0.13	1.20	0.12	< 0.14	< 0.13
Phenanthrene	mg/kg dry wt	0.21	27	0.79	0.09	0.70

Sample Type: Soil						
Sample Name:		WS1 - 0.6m 23-Apr-2014 2:10 pm	WS1 - 1.1m 23-Apr-2014 2:25 pm	WS2 - 0.6m 23-Apr-2014 3:00 pm	WS2 - 1.5m 23-Apr-2014 3:10 pm	WS2 - 2.9m 23-Apr-2014 3:20 pm
Lab Number:		1267739.2	1267739.3	1267739.4	1267739.6	1267739.8
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Pyrene	mg/kg dry wt	0.81	67	1.60	0.29	0.77

Sample Name:		WS3 - 0.8m 24-Apr-2014 9:35 am	WS4 - 0.85m 24-Apr-2014 10:10 am	WS4 - 1.8m 24-Apr-2014 10:30 am	WS4 - 2.7m 24-Apr-2014 10:30 am	WS5 - 0.45m 24-Apr-2014 12:15 pm
Lab Number:		1267739.9	1267739.11	1267739.13	1267739.14	1267739.15
Individual Tests						
Dry Matter	g/100g as rcvd	88	96	86	81	97
Qualitative Identification of Asbestos		See attached report	-	-	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	7	5	4	3	5
Total Recoverable Cadmium	mg/kg dry wt	0.51	< 0.10	0.16	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	13	22	18	8	15
Total Recoverable Copper	mg/kg dry wt	24	18	26	2	14
Total Recoverable Lead	mg/kg dry wt	300	23	145	8.3	19.1
Total Recoverable Nickel	mg/kg dry wt	12	15	14	3	12
Total Recoverable Zinc	mg/kg dry wt	320	77	118	8	63
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	0.07	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	0.75	< 0.03	0.06	< 0.03	< 0.03
Anthracene	mg/kg dry wt	0.89	< 0.03	0.17	< 0.03	< 0.03
Benzo[a]anthracene	mg/kg dry wt	7.9	< 0.03	0.57	< 0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	10.2	< 0.03	0.59	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	13.3	< 0.03	0.66	< 0.03	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt	9.0	< 0.03	0.43	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	4.2	< 0.03	0.28	< 0.03	< 0.03
Chrysene	mg/kg dry wt	6.5	< 0.03	0.46	< 0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt	1.45	< 0.03	0.07	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt	11.1	< 0.03	0.97	< 0.03	< 0.03
Fluorene	mg/kg dry wt	0.08	< 0.03	0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	9.0	< 0.03	0.46	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	0.72	< 0.12	< 0.13	< 0.14	< 0.12
Phenanthrene	mg/kg dry wt	2.7	< 0.03	0.26	< 0.03	< 0.03
Pyrene	mg/kg dry wt	11.5	0.02	1.29	< 0.03	< 0.03

Sample Name:		WS5 - 2.85m 24-Apr-2014 12:40 pm	WS5 - 2.65m 24-Apr-2014 12:30 pm	WS5 - 1.7m 24-Apr-2014 12:25 pm	WS6 - 1.5m 24-Apr-2014 11:40 am	WS6 - 1.8m 24-Apr-2014 11:45 am
Lab Number:		1267739.17	1267739.18	1267739.19	1267739.22	1267739.23
Individual Tests						
Dry Matter	g/100g as rcvd	82	73	90	82	85
Qualitative Identification of Asbestos		-	-	-	See attached report	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2	9	7	3	4
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.51	0.16	0.33	0.20
Total Recoverable Chromium	mg/kg dry wt	< 2	17	14	10	19
Total Recoverable Copper	mg/kg dry wt	2	87	39	51	36
Total Recoverable Lead	mg/kg dry wt	14.8	2,800	360	290	260
Total Recoverable Nickel	mg/kg dry wt	< 2	13	11	21	12
Total Recoverable Zinc	mg/kg dry wt	15	500	460	125	200
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	0.04	0.04	78	< 0.03	0.48
Acenaphthylene	mg/kg dry wt	0.03	0.03	76	0.08	0.82
Anthracene	mg/kg dry wt	0.14	0.15	230	0.29	5.9

Sample Type: Soil						
Sample Name:		WS5 - 2.85m 24-Apr-2014 12:40 pm	WS5 - 2.65m 24-Apr-2014 12:30 pm	WS5 - 1.7m 24-Apr-2014 12:25 pm	WS6 - 1.5m 24-Apr-2014 11:40 am	WS6 - 1.8m 24-Apr-2014 11:45 am
Lab Number:		1267739.17	1267739.18	1267739.19	1267739.22	1267739.23
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Benzo[a]anthracene	mg/kg dry wt	0.22	0.42	300	1.16	9.3
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.18	0.41	270	1.65	10.1
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.22	0.50	290	1.76	10.9
Benzo[g,h,i]perylene	mg/kg dry wt	0.13	0.28	159	1.31	7.7
Benzo[k]fluoranthene	mg/kg dry wt	0.09	0.20	122	0.70	4.7
Chrysene	mg/kg dry wt	0.20	0.39	240	1.03	9.4
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	0.07	34	0.30	1.89
Fluoranthene	mg/kg dry wt	0.61	0.99	860	1.69	16
Fluorene	mg/kg dry wt	0.05	0.07	101	0.03	0.21
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.10	0.22	200	1.07	6.4
Naphthalene	mg/kg dry wt	< 0.14	< 0.15	38	< 0.13	1.61
Phenanthrene	mg/kg dry wt	0.58	0.76	1,170	0.36	1.74
Pyrene	mg/kg dry wt	0.51	0.79	800	1.85	18
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 8	-	< 8
C10 - C14	mg/kg dry wt	-	-	163	-	< 20
C15 - C36	mg/kg dry wt	-	-	12,800	-	320
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	12,900	-	320

Sample Name:		WS6 - 2.5m 24-Apr-2014 11:55 am	WS7 - 1.25m 24-Apr-2014 2:20 pm	WS7 - 2.7m 24-Apr-2014 2:35 pm	WS8 - 1.2m 24-Apr-2014 3:15 pm	WS8 - 1.6m 24-Apr-2014 3:20 pm
Lab Number:		1267739.24	1267739.26	1267739.28	1267739.30	1267739.31
Individual Tests						
Dry Matter	g/100g as rcvd	83	83	85	92	-
TCLP Weight of Sample Taken	g	-	45 #1	-	-	-
TCLP Initial Sample pH	pH Units	-	9.2	-	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	1.7	-	-	-
TCLP Extractant Type*		-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-	-
TCLP Extraction Fluid pH	pH Units	-	4.9	-	-	-
TCLP Post Extraction Sample pH	pH Units	-	6.4	-	-	-
Qualitative Identification of Asbestos		-	-	-	-	See attached report
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2	6	7	6	6
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.57	0.11	0.12	0.14
Total Recoverable Chromium	mg/kg dry wt	3	14	17	17	14
Total Recoverable Copper	mg/kg dry wt	5	1,260	35	28	28
Total Recoverable Lead	mg/kg dry wt	12.7	1,020	94	186	230
Total Recoverable Nickel	mg/kg dry wt	< 2	16	15	14	16
Total Recoverable Zinc	mg/kg dry wt	18	2,200	155	200	470
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	0.05	0.04	0.02	-
Acenaphthylene	mg/kg dry wt	< 0.03	0.05	0.03	< 0.03	-
Anthracene	mg/kg dry wt	< 0.03	0.16	0.19	0.08	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	0.32	0.52	0.31	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	0.31	0.61	0.36	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.03	0.38	0.70	0.43	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	0.23	0.48	0.27	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	0.16	0.27	0.17	-
Chrysene	mg/kg dry wt	< 0.03	0.27	0.44	0.29	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	0.06	0.10	0.06	-
Fluoranthene	mg/kg dry wt	0.03	0.79	1.16	0.59	-

Sample Type: Soil						
Sample Name:		WS6 - 2.5m 24-Apr-2014 11:55 am	WS7 - 1.25m 24-Apr-2014 2:20 pm	WS7 - 2.7m 24-Apr-2014 2:35 pm	WS8 - 1.2m 24-Apr-2014 3:15 pm	WS8 - 1.6m 24-Apr-2014 3:20 pm
Lab Number:		1267739.24	1267739.26	1267739.28	1267739.30	1267739.31
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluorene	mg/kg dry wt	< 0.03	0.07	0.05	< 0.03	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	0.18	0.37	0.21	-
Naphthalene	mg/kg dry wt	< 0.14	< 0.14	0.14	< 0.12	-
Phenanthrene	mg/kg dry wt	< 0.03	0.91	0.57	0.30	-
Pyrene	mg/kg dry wt	0.04	0.75	1.16	0.55	-

Sample Name:		WS8 - 2.5m 24-Apr-2014 3:25 pm	WS9 - 1.5m 24-Apr-2014 4:00 pm	WS9 - 2.75m 24-Apr-2014 4:10 pm	Duplicate 1 24-Apr-2014	Duplicate 2 24-Apr-2014
Lab Number:		1267739.32	1267739.34	1267739.35	1267739.36	1267739.37
Individual Tests						
Dry Matter	g/100g as rcvd	86	88	87	88	74
Qualitative Identification of Asbestos		See attached report	-	-	See attached report	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	5	3	6	2	7
Total Recoverable Cadmium	mg/kg dry wt	0.14	< 0.10	0.14	0.21	0.29
Total Recoverable Chromium	mg/kg dry wt	12	22	24	10	18
Total Recoverable Copper	mg/kg dry wt	16	10	23	9	60
Total Recoverable Lead	mg/kg dry wt	43	25	46	196	1,590
Total Recoverable Nickel	mg/kg dry wt	13	11	16	11	11
Total Recoverable Zinc	mg/kg dry wt	123	64	103	144	450
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04
Acenaphthylene	mg/kg dry wt	< 0.03	0.06	< 0.03	0.04	< 0.04
Anthracene	mg/kg dry wt	< 0.03	0.13	< 0.03	0.16	0.11
Benzo[a]anthracene	mg/kg dry wt	0.04	1.02	0.06	0.81	0.26
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.05	1.11	0.07	0.99	0.23
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.06	1.23	0.08	1.15	0.30
Benzo[g,h,i]perylene	mg/kg dry wt	0.04	0.63	0.09	0.91	0.17
Benzo[k]fluoranthene	mg/kg dry wt	0.03	0.53	0.03	0.47	0.12
Chrysene	mg/kg dry wt	0.04	0.94	0.06	0.72	0.24
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	0.20	< 0.03	0.20	0.05
Fluoranthene	mg/kg dry wt	0.07	1.49	0.09	1.47	0.58
Fluorene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.03	0.57	0.04	0.69	0.13
Naphthalene	mg/kg dry wt	< 0.13	< 0.13	< 0.13	< 0.13	< 0.16
Phenanthrene	mg/kg dry wt	0.03	0.29	0.05	0.51	0.43
Pyrene	mg/kg dry wt	0.08	1.44	0.13	1.38	0.46

Sample Name:		Duplicate 3 24-Apr-2014	Duplicate 4 24-Apr-2014			
Lab Number:		1267739.38	1267739.39			
Individual Tests						
Dry Matter	g/100g as rcvd	81	89	-	-	-
Qualitative Identification of Asbestos		See attached report	-	-	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2	5	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.40	0.20	-	-	-
Total Recoverable Chromium	mg/kg dry wt	8	29	-	-	-
Total Recoverable Copper	mg/kg dry wt	26	21	-	-	-
Total Recoverable Lead	mg/kg dry wt	240	34	-	-	-
Total Recoverable Nickel	mg/kg dry wt	18	16	-	-	-
Total Recoverable Zinc	mg/kg dry wt	88	100	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						

Sample Type: Soil							
Sample Name:		Duplicate 3 24-Apr-2014	Duplicate 4 24-Apr-2014			
Lab Number:		1267739.38	1267739.39			
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Acenaphthylene	mg/kg dry wt	0.06	< 0.03	-	-	-
Anthracene	mg/kg dry wt	0.16	< 0.03	-	-	-
Benzo[a]anthracene	mg/kg dry wt	0.49	0.03	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.74	0.04	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.83	0.05	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.61	0.07	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	0.34	< 0.03	-	-	-
Chrysene	mg/kg dry wt	0.41	0.03	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	0.12	< 0.03	-	-	-
Fluoranthene	mg/kg dry wt	0.65	0.05	-	-	-
Fluorene	mg/kg dry wt	0.05	< 0.03	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.46	0.03	-	-	-
Naphthalene	mg/kg dry wt	< 0.14	< 0.12	-	-	-
Phenanthrene	mg/kg dry wt	0.32	0.03	-	-	-
Pyrene	mg/kg dry wt	0.78	0.08	-	-	-

Sample Type: Miscellaneous						
Sample Name:		WS3 - 0.5m Brick 24-Apr-2014				
Lab Number:		1267739.40				
Individual Tests						
Qualitative Identification of Asbestos		See attached report	-	-	-	-

Sample Type: Aqueous						
Sample Name:		WS2 - 1.5m [TCLP extract]	WS7 - 1.25m [TCLP extract			
Lab Number:		1267739.41	1267739.42			
Individual Tests						
Total Copper	g/m^3	-	2.5	-	-	-
Total Lead	g/m^3	-	0.062	-	-	-
Total Zinc	g/m^3	< 0.021	7.6	-	-	-

Analyst's Comments

[#1] It should be noted that the TCLP extraction has been scaled down because of small sample size. The ratio of solid to extractant has been kept constant (1:20).

Appendix No.1 - Dowdell & Associates Report

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

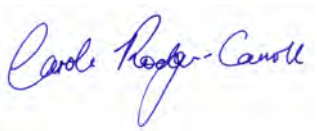
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	2-4, 6, 8-9, 11, 13-15, 17-19, 22-24, 26, 28, 30-32, 34-39
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	2-4, 6, 8-9, 11, 13-15, 17-19, 22-24, 26, 28, 30, 32, 34-39

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	2-4, 6, 8-9, 11, 13-15, 17-19, 22-24, 26, 28, 30-32, 34-39
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	18, 37
Qualitative Identification of Asbestos	150-200g, sealed plastic bag. Polarised Light Microscopy and dispersion staining techniques. Subcontracted to Dowdell & Associates, 4 Cain Road, Penrose, Auckland. AS 4964 (2004) - Method for the Qualitative / Semi-Quantitative Identification of Asbestos in Bulk Samples.	-	2, 9, 22, 31-32, 36, 38, 40
TPH Oil Industry Profile + PAHscreen	Sonication in DCM extraction, SPE cleanup, GC-FID & GC-MS analysis. Tested on as received sample. US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:5786,2805,10734;2695]	0.010 - 60 mg/kg dry wt	19, 23
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	2-4, 6, 8-9, 11, 13-15, 17-19, 22-24, 26, 28, 30-32, 34-39
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.010 - 0.05 mg/kg dry wt	2-4, 6, 8-9, 11, 13-15, 17-18, 22, 24, 26, 28, 30, 32, 34-39
TCLP Profile*	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1311	-	6, 26
TCLP Profile			
TCLP Weight of Sample Taken	Gravimetric. US EPA 1311.	0.1 g	6, 26
TCLP Initial Sample pH	pH meter. US EPA 1311.	0.1 pH Units	6, 26
TCLP Acid Adjusted Sample pH	pH meter. US EPA 1311.	0.1 pH Units	6, 26
TCLP Extractant Type*	US EPA 1311.	-	6, 26
TCLP Extraction Fluid pH	pH meter. US EPA 1311.	0.1 pH Units	6, 26
TCLP Post Extraction Sample pH	pH meter. US EPA 1311.	0.1 pH Units	6, 26

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Total Digestion of Extracted Samples*	Nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	41-42
Total Copper	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.011 g/m^3	42
Total Lead	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0021 g/m^3	42
Total Zinc	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.021 g/m^3	41-42

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

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



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

DOWDELL & ASSOCIATES LTD

OCCUPATIONAL HEALTH ANALYSTS & CONSULTANTS

4 Cain Rd, Penrose, PO Box 112-017 Auckland 1642, Phone (09) 5260-246. Fax (09) 5795-389.

5th May 2014

Hill Laboratories
Private Bag 3205
Waikato Mail Centre
Hamilton 3240

Dear Sir/Madam

Re: **Bulk Fibre Analysis**

Sampled by	**:** Client
Date received	**:** 5th May 2014
Laboratory no.	**:** 55358
Description	**:** 9x soil sample(s)
Reference	**:** 1267739
Purchase order	**:** 138209
Method	**:** AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples

We examined the following sample(s) using Low Powered Stereomicroscopy followed by 'Polarised Light Microscopy' including Dispersion Staining Techniques. The following result(s) relate(s) to the sample(s) as received**:**

Reg no: J1405 **Labelled as:** 2
Sample size: 51g
Result: Chrysotile *(White Asbestos)* detected (loose bundles).

Reg no: J1406 **Labelled as:** 9
Sample size: 50g
Result: Chrysotile *(White Asbestos)* detected (loose bundles + large clumps).

Reg no: J1407 **Labelled as:** 22
Sample size: 38g
Result: Asbestos **NOT** detected.

Reg no: J1408 **Labelled as:** 26
Sample size: 50g
Result: Asbestos **NOT** detected.

Reg no: J1409 **Labelled as:** 31
Sample size: 50g
Result: Asbestos **NOT** detected.

Reg no: J1410 **Labelled as:** 32
Sample size: 49g
Result: Asbestos **NOT** detected.

Reg no: J1411 **Labelled as:** 36
Sample size: 50g
Result: Chrysotile *(White Asbestos)* detected (loose fibre bundles).

Reg no: J1412 **Labelled as:** 38
Sample size: 29g
Result: Asbestos **NOT** detected.

Reg no: J1413 **Labelled as:** 40
Sample size: 45g
Result: Asbestos **NOT** detected.

Yours faithfully
DOWDELL & ASSOCIATES LTD

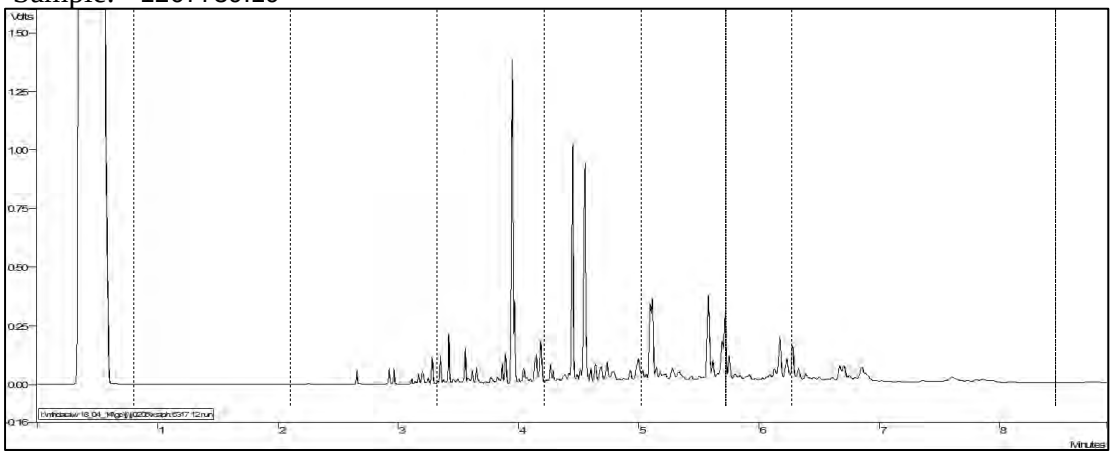
E.Sheldon BSc (Hons)
Analyst

Imtiaz Damani MSc
Analyst

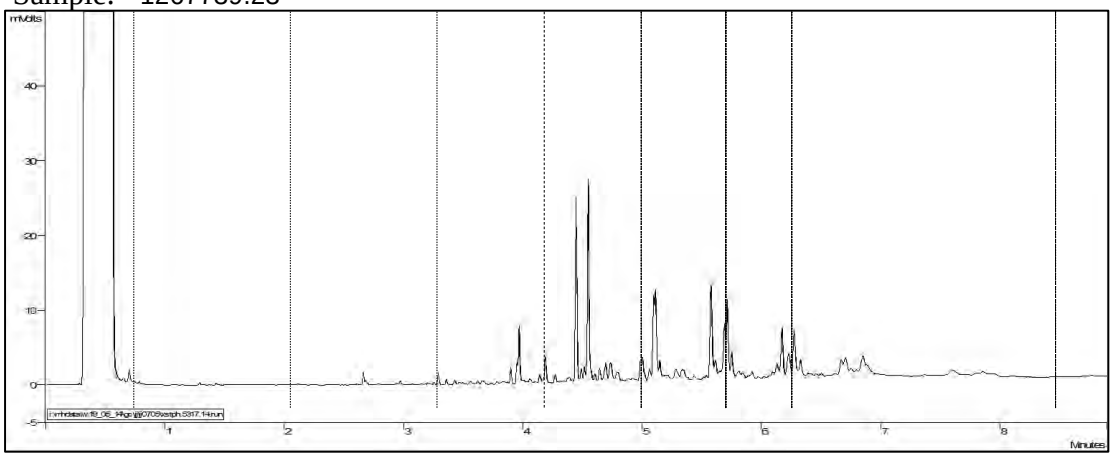
Q.E. Dowdell NZCS MNZMS
Director

NOTE: This report must not be altered, or reproduced except in full.

Sample: 1267739.19



Sample: 1267739.23



C7 C10 C15 C20 C25 C30 C34 C44

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Tonkin & Taylor	**Lab No:**	1274242	SPv1
Contact:	Sharon Parackal	**Date Registered:**	13-May-2014	
	C/- Tonkin & Taylor	**Date Reported:**	20-May-2014	
	PO Box 2083	**Quote No:**		
	WELLINGTON 6140	**Order No:**	85778.001	
		Client Reference:	85778.001	
		Submitted By:	Sharon Parackal	

Sample Type: Aqueous

Sample Name:		P1 06-May-2014 3:20 pm	WS2-P2 12-May-2014 2:15 pm	Dup		
Lab Number:		1274242.1	1274242.2	1274242.3		
Individual Tests						
pH	pH Units	7.2	7.7	7.2	-	-
Sulphate	g/m³	750	3,400	740	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.10	< 0.10	< 0.10	-	-
Dissolved Cadmium	g/m³	< 0.005	< 0.005	< 0.005	-	-
Dissolved Chromium	g/m³	< 0.05	< 0.05	< 0.05	-	-
Dissolved Copper	g/m³	< 0.05	< 0.05	< 0.05	-	-
Dissolved Lead	g/m³	< 0.010	< 0.010	< 0.010	-	-
Dissolved Nickel	g/m³	< 0.05	< 0.05	< 0.05	-	-
Dissolved Zinc	g/m³	< 0.10	< 0.10	< 0.10	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Acenaphthylene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Benzo[a]anthracene	g/m³	0.00014	< 0.00010	< 0.00010	-	-
Benzo[a]pyrene (BAP)	g/m³	0.00014	< 0.00010	< 0.00010	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	0.00024	< 0.00010	< 0.00010	-	-
Benzo[g,h,i]perylene	g/m³	0.00011	< 0.00010	< 0.00010	-	-
Benzo[k]fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Chrysene	g/m³	0.00010	< 0.00010	< 0.00010	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Fluoranthene	g/m³	0.00022	< 0.00010	< 0.00010	-	-
Fluorene	g/m³	< 0.0002	< 0.0002	< 0.0002	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Naphthalene	g/m³	< 0.0005	< 0.0005	< 0.0005	-	-
Phenanthrene	g/m³	< 0.0004	< 0.0004	< 0.0004	-	-
Pyrene	g/m³	0.0003	< 0.0002	< 0.0002	-	-

SUMMARY OF METHODS

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 21st ed. 2005.	0.00005 - 0.0010 g/m³	1-3

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m^3	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
pH	pH meter. APHA 4500-H$^+$ B 22nd ed. 2012.	0.1 pH Units	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 22nd ed. 2012.	-	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m^3	1-3

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

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

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

Appendix D: Draft Contamination Site Management Plan

REPORT

Willis Bond Ltd

Sites 8, 9, and 10
DRAFT Contamination Site Management Plan

Report prepared for:

Willis Bond Ltd

Report prepared by:

Tonkin & Taylor Ltd

Distribution:

Willis Bond Ltd	**2 copies**
RCP	**1 copy**
Tonkin & Taylor Ltd (FILE)	**1 copy**

February 2015

T&T Ref: 85778.001 (rev 1)

Document control

Report Date	Version	Prepared by:
September 2014	1	Penny Kneebone

Report certified by a suitably qualified and experienced practitioner as prescribed under the NES Soil.

.....

Penny Kneebone
Principal Environmental Scientist

Authorised for Tonkin & Taylor Ltd by:

.....

Stuart Palmer
Project Director

pek

t:\wellington\tt projects\85778\85778.0010\issueddocuments\20150226 csmp draft rev1.doc

Table of contents

1 Introduction

Tonkin & Taylor Ltd (T&T) has been commissioned by Willis Bond Ltd to prepare a Contamination Site Management Plan for earthworks in contaminated soil at Site 10, 10 Waterloo Quay Wellington (**Site 10**) and the other open space areas shown within the red line in Figure 1 below (referred to collectively as **Landscape Areas** in this Plan).

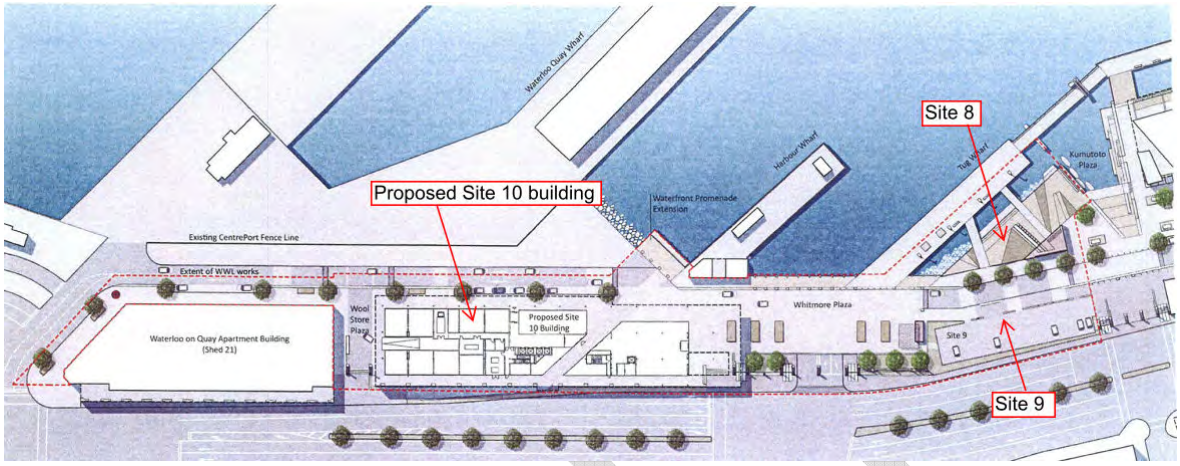

Figure 1: proposed development master plan (Source: Isthmus)

This Contamination Site Management Plan (CSMP) provides Willis Bond and their Contractors with procedures that must be implemented during earthworks in contaminated soil.

1.1 Background

WBL proposes to develop Site 10 by constructing a multistorey building. The proposed Site 10 works are likely to comprise of basement excavations to 3.7 m depth, and possibly deeper foundation excavations. The basement excavation works will generate groundwater which will require disposal offsite (dewatering).

Wellington Waterfront Limited proposes to carry out earthworks and landscaping works within the Landscape Areas (with the exception of the Site 9 space which will not be developed through the Open Space works and will remain as a carpark) to create public open space areas. We understand approximately 1,000 m^3 of cut material may need to be removed from Site 8 (if it is geotechnically unsuitable), with cuts to a maximum of 1 m deep. No significant cut is proposed elsewhere in the public space areas, however it is expected that limited soil disturbance will be required for surface preparation. The public space areas shall be finished with either paving underlaid by imported fill or imported clean landscaping fill materials.

The development area is on reclaimed land, and historical structures were formerly present on some parts of the site. Site investigations have identified some of the material used for the reclamation is contaminated, and asbestos is present in soil on part of Site 10.

This CSMP has been prepared to document excavation procedures, monitoring, management and health and safety requirements during earthworks in contaminated soil at Site 10 and the Landscape Areas.

1.2 Scope of report

It sets out procedures for:

- establishing Site 10 and the Landscape Areas and associated management structures/systems;
- handling and managing contaminated materials, including soil that contains asbestos;
- health and safety controls to augment the Contractor health and safety plans;
- monitoring of the effectiveness of mitigation measures implemented during the works; and
- validation of the site following removal of material containing asbestos.

1.3 Regulatory compliance

Resource consents are required from Wellington City Council (WCC) and Greater Wellington Regional Council (GWRC). It is anticipated that a CSMP would be a requirement of these consents. This draft CSMP has been prepared to support the application for consents, and would need to be updated to reflect any additional requirements of the resource consents.

This CSMP has been prepared in general accordance with Ministry for the Environment Contamination Land Management Guidelines No.1 – *Guidelines for Reporting on Contaminated Sites in New Zealand*. Sampling procedures provided in the plan generally comply with the MfE Contamination Land Management Guidelines No.5 – *Site Investigation and Analysis of Soils*.

The plan is also prepared in general accordance with the soil disturbance related controls referred to in the National Environmental Standards for Contaminants in Soil to Protect Human Health Regulations (NES Soil). The persons preparing and certifying this CSMP are suitably qualified and experienced practitioners as required by the NES Soil and defined in the NES Soil Users' Guide.

1.4 Applicability

This CSMP provides a framework for managing contamination hazards on site by identifying potential hazards and suggesting mitigation measures relevant to site conditions at the time of writing. This CSMP provides information and recommendations to augment this process but is not intended to relieve the controller of the place of work of either their responsibility for the health and safety of their workers, contractors and the public, or their responsibility for protection of the environment.

The provisions of this CSMP are mandatory for all persons (employees, contractor and sub-contractors) who will be involved in undertaking any of the proposed works.

It is recommended that any persons undertaking controlled activities develop a site-specific health and safety plan (SSSP) to complement this CSMP and to address other health and safety requirements that may be applicable to their particular works. This document should also be modified to address any specific health, safety or environmental issues that may arise during the works.

From time to time, statutory requirements, site ownership or occupation, operating procedures or site conditions may vary and will require that this plan be amended or updated.

The plan has been prepared on the basis of information available at the date of preparation, principally data from samples collected by Tonkin & Taylor and based on our observations during investigations in 2009 (Sites 8 and 9) and 2014 (Site 10). The nature and continuity of subsoil away from sample locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

This report has been prepared for the benefit of Willis Bond Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without

our prior review and agreement. This draft CSMP has been prepared in accordance with our proposal of 8 April 2014.

2 Roles and Responsibilities

2.1 Distribution

A copy of the CSMP shall be kept onsite at all times. It is Willis Bond's responsibility to distribute the plan to their Contractor, the person holding a certificate of competence for restricted work involving asbestos under the Health and Safety in Employment (Asbestos) Regulations 1998 (approved asbestos remover), Worksafe, WCC, and GWRC.

It is Willis Bond's responsibility for distribution of the CSMP to any other sub-contractors or parties carrying out the remedial works.

2.2 Review and update

Any variations to the CSMP proposed by the Contractor shall be approved by Willis Bond, WCC and GWRC prior to works commencing, or the variation being implemented if works have already commenced.

It is the responsibility of Willis Bond to distribute any changes to the plan to the relevant parties involved in the remedial works and update the site copy.

2.3 Implementation

Responsibility for the implementation of the CSMP lies with Willis Bond's appointed Contractor.

A contaminated land specialist (i.e., a "suitably qualified and experienced practitioner" as required by the NES Soil regulations) will be required to carry out inspections and provide advice as required during the works (refer Section 5).

The approved asbestos remover must supervise all asbestos management works on Site 10.

2.4 Personnel contact details

Contact details for key staff involved in the works are provided in Table 1. These contact details shall also be provided on the site hazard board as per Section 5.2 and 8.

Table 1: Personnel contact details

Person (Organisation)	Role	Contact number
TBC (Willis Bond)	Project Director	
TBC (TBC)	Project Manager	
TBC (TBC)	Contractor Site Manager	
TBC (TBC)	Operations Manager Managing site and project Certificate of Competence holder (Asbestos Regulations (1998))	
TBC (TBC)	Air monitoring	
TBC (TBC)	Contaminated Land Specialist -Site observation and sampling	

3 Site Condition

The condition of the site described in the following sections has been compiled based on investigations in 2009 (on Sites 8 and 9) and 2014 (Site 10).

3.1 Site identification

The outline of the proposed Landscape Area is shown in the development plan (Figure 1).

The proposed Site 10 basement excavation is roughly rectangular in shape and has an area of approximately 0.25 ha. (as can also be seek on Figure 1)

3.2 Site layout

The Landscape Areas are currently surfaced with asphalt and used as public open space, parking and access roads.

Site 10 is currently used as a car park and motor home park. It is essentially flat and entirely paved. An amenities block is located on the eastern boundary of Site 10. Access is via a paved road immediately to the south of the amenities block.

3.3 Contamination

Contamination has been characterised at Site 10. This CSMP includes detailed requirements for excavation, management and disposal of soil from the Site 10 basement.

Only limited testing has previously been done at Sites 8 and 9, and no testing has been completed specifically in other public space areas (ie, Whitmore Plaza). When the location (area and depth) of earthworks for the Landscape Areas are confirmed, further testing will be carried out in these areas to characterise soil and assess appropriate soil management measures.

Site 8 was reclaimed in the 1970s using quarried fill. Geotechnical investigations in 2009 indicated relatively consistent material across Site 8. Limited laboratory testing indicated the fill is clean, however due to the limited scope of testing in 2009, additional testing is required to confirm this.

Site 9 and Site 10 were reclaimed in the early 1900s. Investigation in Site 9 (2009) and Site 10 (2014) indicate variable fill materials, with variable levels of contamination (metals, polycyclic aromatic hydrocarbons) present. Results from many samples exceed expected background concentrations. Some samples also exceeded human health guidelines for commercial site use, however these were either from deep, subsurface soil (Site 9) that will not be exposed during the works (as Site 9 is to remain as a carpark), or from soil that will be excavated and disposed offsite during construction of the Site 10 basement. Furthermore, some fill at Site 10, where historical buildings were present, contains asbestos.

The Site 10 basement has been divided into three “zones” (see Figure 2 and Table 2).

- Limited testing in Zone 3 indicates asbestos containing fill in the upper 1.2 m. Deeper soil has not been tested (and so may also contain asbestos), and further testing may decrease (or increase) the northward extent of Zone 3.
- A contaminated layer is present in Zones 1 and 2. Limited testing above and below this layer indicates fill is potentially clean. If material is to be disposed as clean fill, it ~~should~~ must be tested to confirm it is clean (either before excavation or on stockpiled material).

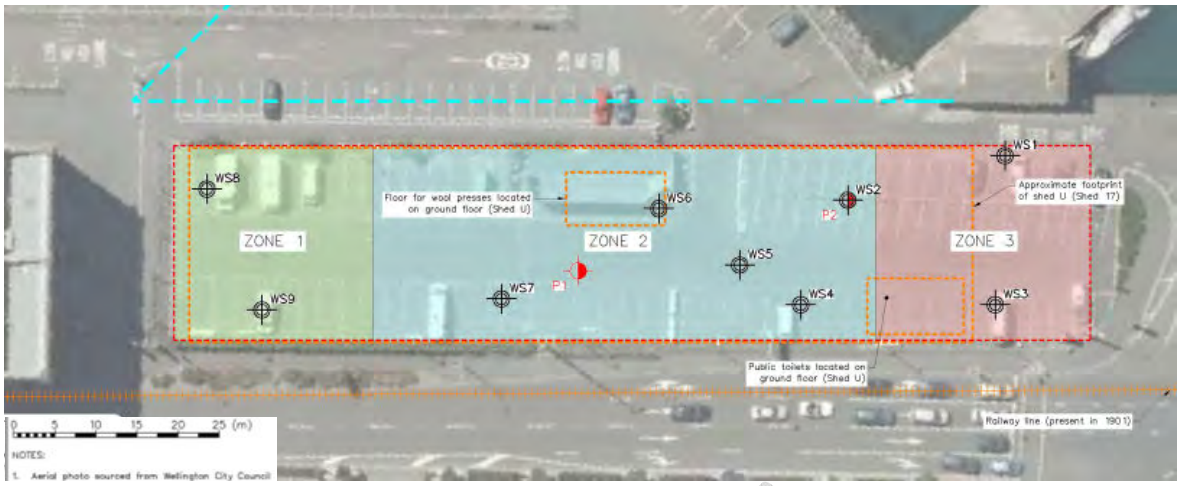

Figure 2: excavation zones within Site 10 basement

Table 2: excavation zones within Site 10 basement

Site 10 zone	Depth to top of layer (m)	Depth to bottom of layer (m)	Thickness of layer (m)	Contamination present?
Zone 1	0	1	1	Potentially clean ~~no~~
	1	2	1	Yes – elevated metals and PAH
	2	3	1	Potentially clean ~~no~~
Zone 2	0	0.75	0.75	Potentially clean ~~no~~
	0.75	2.75	2	Yes – elevated metals and PAH
	2.75	3	0.25	Potentially clean ~~no~~
Zone 3	0	1.2	1.2	Yes – metals, PAH, and asbestos
	1.2	3	1.8	Unknown – not yet tested

4 Proposed works

Proposed earthworks in contaminated (or potentially contaminated) material include excavation of a basement to 3.7 m depth for the Site 10 building and earthworks for landscaping within the public space Landscape Area.

Cut to a maximum of 1 m deep are anticipated on Site 8. The specific areas and depths of earthworks within other parts of the Landscape Area will be finalised at the detailed design stage.

4.1 Removal of asbestos containing material (Site 10)

Willis Bond's appointed Contractor is to remove the asbestos-containing fill from the Site 10 basement. The removal of the asbestos-containing fill and disposal at a licensed landfill will remove the potential for future asbestos related health effects on workers and users of the site. Commercial premises and public walkways are adjacent or close to the site and thus monitoring shall be undertaken to confirm effects are being managed in respect of offsite receptors.

Approximately 700 m^3 of fill has been confirmed to contain asbestos. Deeper soil underlying this was inaccessible (beneath a concrete slab). It is assumed this material does not contain asbestos, but testing must be carried out to confirm this.

The following sets out the method to be used for identification and removal of asbestos containing soil at Site 10. Procedures for undertaking the works are set out in Sections 5 – 9. In summary the materials will be removed by:

- Following removal of the asphalt surface, a visual inspection shall be carried out for potential asbestos containing materials. Suspected asbestos-containing material shall be sampled and tested to confirm the extent of asbestos contaminated surface soil.
- Excavating materials to the concrete slab at 1.2 m depth.
- Following removal of the fill:
  - if intact the underlying concrete slab shall be water blasted; or
  - if the concrete slab is not intact the underlying surface shall be skimmed, with the excavator taking around 50 mm from the underlying surface (the excavator shall not track back onto the cleaned surface); and
- Disposing the excavated materials to a consented landfill (e.g., Southern Landfill) as asbestos-containing waste.

The works will be observed by a person holding an appropriate certificate of competence under the Asbestos Regulations 1998.

4.2 Excavation of remainder of Site 10 basement

Soil beneath the concrete slab in Zone 3 must be tested (metals, asbestos, PAH) and the appropriate disposal location selected based on the results of testing.

The remainder of the Site 10 basement (Zones 1 and 2) shall be excavated and managed based on the contamination identified in Section 3. A contaminated layer is present across Zones 1 and 2. This has been conservatively estimated as 1 m thick in Zone 1 and 2 m thick in Zone 2. The contaminated soil must be disposed to an appropriately consented landfill (e.g., Southern or Silverstream). If clean material either side of the contaminated layer is to be segregated for clean fill disposal, it must be tested before disposal to confirm it is indeed clean. ~~clean material outside the contaminated layer may be disposed to clean fill without further testing, unless any unusually stained or odorous material is encountered that was not encountered during the investigations~~.

Material from 3 to 3.7 m has not been tested. Based on results for soil from 2.75 to 3 m, this deeper material is potentially clean. It may only be disposed to clean fill if testing is done (before or after excavation) that confirms it is clean.

4.3 Excavations in public space area

When details of the proposed earthworks in the public space Landscape Areas are confirmed at the detailed design stage, testing shall be carried out to assess the appropriate management controls for the earthworks and disposal location for any surplus soil (if any).

- Samples shall be collected by the contaminated land specialist in the soil to be disturbed.
- Samples shall be tested for potential contaminants in the fill material (metals and PAH).
- Results shall be compared to expected background concentrations, guidelines for the proposed site use (commercial), and disposal criteria.
- An updated site plan shall be prepared (analogous to Figure 2 for the Site 10 basement) setting out the extent and depth of contaminated material (if any) and any additional management controls (if any) required.

5 Site Management Procedures

The procedures below are procedures for managing dust, sediment and surface water during removal of asbestos-containing fill and contaminated soil from the Site 10 basement excavation, and earthworks in fill at the Landscape Areas. The procedures below include actions to be taken by the Contractor.

These procedures have been developed to provide a framework for managing potential contamination related effects at the site, however, these protocols are not intended to relieve the owner or controller of the place of work of either their responsibility for the health and safety of their workers, contractors and the public, or their responsibility for protection of the environment. The key requirements of site management are summarised on the Contractor checklist in Appendix B.

All procedures employed by the Contractor shall comply with conditions of existing (if any) resource consent(s) held by Willis Bond Ltd.

5.1 Site establishment

The following shall be established prior to works commencement:

- Stabilised site access shall be maintained for the duration of removal of contaminated materials;
- Site sheds containing worker amenities, decontamination facilities and PPE equipment stores shall be as described in Section 8.2.
- Surface water containment on the western and northern sides of the excavation and any material temporarily stockpiled on site.
- Establishment of a bin loading and unloading area in a designated area of the site. The bin loading area shall be maintained so that trucks do not contact contaminated materials. Geotextile bidim cloth shall be lain over the loading area to capture spilt materials.
- A site Hazard Board with information pertaining to the presence of asbestos as detailed in Section 8. The contact details of the contaminated land specialist shall also be provided on the Hazard Board.

WCC and GWRC shall be advised on the works programme, and shall be updated if the programme duration extends beyond the estimated duration.

Willis Bond shall advise staff on the adjacent properties prior to works commencement.

5.2 Unforeseen contamination procedures

Investigations to date have identified layers of contaminated material between potentially clean material in Zones 1 and 2 of Site 10 (and in Site 9 – although no works are proposed on this site). It is possible (albeit unlikely) that unforeseen contamination may be encountered in areas that are assumed to be clean. Visual and olfactory indicators of contamination could include the following:

- Odour (petroleum hydrocarbons, oil);
- Discoloured soil (black, green staining most common);
- Potentially asbestos containing materials (e.g., plasterboard, cement board, lagging);

- Inclusions of deleterious materials not included in Table 4.1 of the MfE Cleanfill Guidelines[1] (refer Appendix C).

The following is a "first response" checklist for the Contractor to follow should visual or olfactory evidence of contamination be encountered during the works onsite to ensure contamination is appropriately contained while decisions about its management are being made by Willis Bond.

First Response Checklist:	
Stop work in the immediate vicinity of the contamination discovery and isolate the area by taping, coning or fencing off.	☐
Advise the Contractor's Site Manager.	☐
Update the site Hazard Board and prevent unnecessary access to the area by personnel.	☐
The Contractor's Site Manager is to contact a contaminated land specialist to inspect, sample and advise of specific controls if appropriate.	☐
The Contractor's Site Manager is to contact Willis Bond.	☐
Contain surface water/ sediment and dust as per **Section 6.**	☐

5.3 Plant and equipment use

Plant and equipment utilised onsite shall be kept to a minimum to minimise post-works decontamination, to lower the potential for tracking and fragmentation of asbestos and contaminated soil around the site and to minimise generation of dust.

5.4 Asbestos-containing soil removal procedures ~~(Zone 3)~~

The removal of asbestos containing soil shall be carried out using an excavator operated by the Contractor. The following shall be adhered in Zone 3, and anywhere else on site where visual inspection (following removal of asphalt) indicates potential presence of asbestos containing materials in surface soil:

- An approved asbestos remover shall inspect the works methods during excavation of asbestos.
- Procedures for handling asbestos-contaminated material (Section 8.1) shall be implemented at all times.
- Project-relevant earthworks controls, including dust control procedures, shall be in place during excavation per Section 6.
- The swale/surface water bund shall be skimmed on a daily basis to remove any asbestos that may have accumulated in it.
- Excavated materials shall be placed directly into clip-bins, loaded and positioned end facing towards the loading zone.
- The bin sides shall be brushed down and covered by well secured tarps before being positioned adjacent to the truck loading area.

[1] Ministry for the Environment, 2002: A Guide to Management of Cleanfills.

- If the bin loads are dry they shall be sprayed with water before securing the tarps.

5.5 Contaminated soil removal

These controls apply to Zones 1 and 2 in the Site 10 basement, and anywhere in the Landscape Area where testing (refer Section 4.3) shows contaminated soil will be disturbed. Additional controls are required for Zone 3 (i.e., wherever asbestos-contaminated soil is encountered).

- Excavated materials shall be placed directly into trucks.
- Loads shall be covered by well secured tarps before transport.
- If the loads are dry they shall be sprayed with water before securing the tarps, taking care not to generate runoff water.

5.6 Transportation procedures

The following procedure shall be used during transportation of contaminated soil and asbestos containing soil:

- Trucks shall be loaded within the loading area of the site. Spills during loading shall be controlled and contained.
- Trucks shall remain within the loading zone or alternatively a vehicle wash can be established for wheel washing if trucks are required to drive onto the site for the purposes of loading.
- Trucks shall have their wheels maintained clean of debris and there shall be no tracking of material (including soil) onto public roads.
- Each truck shall have a tracking document signed out onsite and collected at the landfill to track each load of material. Onsite records shall include the truck registration number, the number of bins per load and the time the truck left site.

5.7 Disposal procedures

All asbestos-containing material and material contaminated with metals and hydrocarbons shall be disposed of offsite at a licensed landfill (e.g., Southern Landfill).

Authority to dispose of the contaminated materials must be obtained from the receiving landfill prior to the works commencing. The landfill may request that further testing is carried out.

5.8 Plant and equipment decontamination

Plant and equipment utilised within the site shall be decontaminated prior to its removal from site and following removal of bidim from the loading area.

A vehicle wash shall be established within the loading area utilising the following method:

- Sweeping of the asphalt surface to remove sharp objects that may rip the geotextile;
- Laying a suitably sized pad of bidim (of sufficient thickness to prevent ripping by the machinery) on the swept surface, minimum of 2.5m wide by 3 m long.
- Placement of sandbags around the perimeter of the geotextile and lapping the geotextile over and fix under the sandbag on the outside to secure the geotextile.
- Placement of two steel plates or timber planks for driving the excavator onto.
- Establishment of a high pressure misting spray truck unit.

The operation of the machinery wash shall be as follows:

- The wash shall only operate in conditions where no or only very light wind prevails.
- The tracks and tyres of machinery entering the ramp shall be inspected for asbestos fragments by Contactor staff and if found removed and bagged for disposal offsite.
- The high pressure water blaster truck shall operate with as little water as possible to prevent overflow of the wash area.
- Cleaned machinery shall drive onto the seal and directly onto awaiting transporters.

On completion of vehicle washing the geotextile shall be bagged and disposed to a suitably consented landfill (e.g., Southern Landfill).

5.9 Reinstatement

Any material imported to the site for the purposes of reinstatement shall be shown to be appropriate for use as cleanfill. Testing at a rate of 1 sample for every 100 m^3, sampled by a contaminated land specialist shall be provided with in-coming material. Hard fill, if sourced directly from a quarry, does not require testing.

5.10 Excavation sampling procedures

There are sufficient test results to characterise the materials for disposal permitting to landfill. However, should additional testing be required by the landfill operator then the methodology indicated in Appendix A shall be used by the contaminated land specialist.

The contaminated land specialist shall report the results of any testing to Willis Bond, WCC, GWRC, and the receiving landfill.

As noted in Section 3.3 (bullet 2), if potentially clean soil is to be segregated for cleanfill disposal, it must be tested to confirm it is clean before it is taken off site. Sampling shall be done at a rate of 1 for every 100 m^3. Results shall be compared with clean fill acceptance criteria.

6 Earthworks Controls

The following earthworks controls shall be put in place by the Contractor prior to and for the duration of the proposed works.

6.1 Dust control procedures

From a human health perspective, any dust generated in Zone 3 (and anywhere else that asbestos containing soil is identified, if anywhere) may have the potential to contain friable asbestos. If not suppressed during windy conditions or during vehicular movement over contaminated soil, discharge of airborne asbestos fibres may occur. In works in contaminated soil, ~~Zones 1 and 2,~~ generation of dust could transport contaminants offsite.

To avoid dust generation in dry conditions and to mitigate against dust generation associated with vehicle movement, the following control and monitoring systems shall be put in place by the Contractor:

- Frequent spraying of water over the excavation and truck loading area to ensure the working surfaces remain damp;
- Wetting of the loaded material once placed in the bins (Zone 3) or trucks (Zones 1 and 2);
- Use of a water truck or portable water sprays in trafficked areas to dampen dust;
- Mesh shall be secured on site fencing to reduce the impact of wind. The contractor shall be responsible for maintaining the fencing for the duration of the contract;
- Works shall cease if the contaminated land specialist deems wind conditions to be too strong to continue in a safe manner;
- Stockpiles awaiting removal of material (if any) shall be covered or wetted; and
- Air monitoring devices shall be monitored as per Section 7.

6.2 Erosion and sediment control

Erosion and sediment control during construction shall be in accordance with the GWRC "*Erosion and Sediment Control Guidelines for the Wellington Region*" (2002). Erosion and sediment control measures shall include:

- Avoid work in heavy rain.
- Keeping the site clean.
- Temporary stockpiles shall be dampened or covered (with bidum geotextile or similar) if left overnight. Any stockpiles shall not be placed in an area where runoff cannot be controlled.
- A stabilised entry/exit point, shall be established so sediment is not tracked on and off the site. This will be made of aggregate and shall be removed off site once work has been completed.
- Bunding shall be placed to prevent clean stormwater running into contaminated areas, and to contain runoff from contaminated areas. Silt fences and runoff diversion bunds shall be utilised where appropriate to capture sediment in surface water runoff. Excess ponded water shall be removed by sucker truck and disposed to an appropriate liquid waste processing facility.

Erosion and sediment controls shall be checked regularly and made sure that are in good working condition.

To ensure good practice:

- The entry/exit point shall be reapplied with aggregate if excessive sediment build up occurs.
- Erosion and sediment control measures shall be upgraded/ modified where necessary. Sediment fences shall be replaced if the fabric is ripped or otherwise damaged. They shall be retrenched if needed.
- The weather conditions along with the performance of the erosion and sediment control measures shall be monitored.

Erosion and sediment control measures shall remain in place until surface reinstatement cover is established.

6.3 Groundwater management

Groundwater extracted during dewatering of the Site 10 basement may require treatment prior to disposal. Preliminary testing from 2 piezometers indicates no contaminants are present in groundwater. If groundwater is to be disposed to stormwater, follow resource consent (GWRC) and stormwater permit (WCC) conditions for discharge of groundwater to stormwater. If groundwater is to be disposed to trade waste, follow conditions of WCC trade waste permit.

The following steps are required before works begin:

- Install 2 additional piezometers to the depth of the proposed basement excavation.
- Collect groundwater samples and test for metals (total and dissolved) and PAH.
- Compare results (dissolved metals only) with ANZECC guidelines for protection of 80% of marine species, applying an appropriate dilution factor, to assess whether treatment is required before discharge. The dilution factor should be determined by the contaminated land specialist once discharge volumes are known.
- Compare results with trade waste guidelines to assess whether discharge can be discharged to trade waste.

If treatment for removal of sediment is required before discharge, it may comprise one or more of the following:

- Good erosion and sediment control to prevent clean stormwater entering the excavation, thereby minimising the volume of water requiring dewatering.
- Appropriate detention to remove sediment. This may be a series of decanting sedimentation containers.
- Chemical treatment with flocculants.
- Monitoring the decant (discharge) for total suspended solids, prior to discharge.
- Laboratory testing for potential contaminants (dissolved metals, PAH) prior to discharge.

7 Air quality monitoring

This section shall be reviewed and updated, if necessary, when the conditions and method to remove ACM from the site are known. This will be after removal of asphalt from the site, visual inspection of surface soil, and targeted testing for potential ACM.

There are workers on site and on adjacent properties in close proximity to the remediation area, thus activity-based sampling shall be undertaken at intervals during the earthworks to confirm asbestos fibre mobilisation in air is negligible.

7.1 Collection method

Stationary air monitoring shall be undertaken on a daily basis for the first 3 days of earthworks involving asbestos materials to establish baseline conditions. Additional monitoring shall be carried out if conditions change significantly on site (e.g., higher winds, larger areas of asbestos contaminated material exposed).

The sampling shall be undertaken at two locations on the perimeter of the site (upwind and downwind).

The monitoring shall utilise a Gilian® BDX-II personal sampling pump calibrated by the laboratory prior to being installed in the field. The before and after flow rates shall be collected and used to determine an average flow rate. The average flow rate shall be recorded on field data documentation.

The sampling shall be undertaken by the contaminated land specialist and shall be in general accordance with *USEPA (5 October 2007) Standard Operating Procedures: Activity-Based Air Sampling for Asbestos, Rev 0.0, SOP 2084.*

7.2 Analytical method

The personal and stationary air monitoring cassettes shall be analysed by Dowdell & Associates (Dowdell). Dowdell shall use an analytical method developed by the National Occupational Health and Safety Commission Australia - NOHSC: 3003(2005) *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* 2nd Edition.

7.3 Reporting

Air monitoring results shall be evaluated on receipt. If asbestos fibres are detected works shall cease until dust and other earthworks controls are reviewed and modified where necessary. Amendments to the earthworks procedures shall be reported to Willis Bond, WCC, and GWRC.

All air monitoring results shall be reported in the validation report (refer Section 10).

8 Health and Safety Plan – Asbestos and contaminated soil

8.1 Introduction

This section provides suggested health and safety plan procedures for Contractor staff removing contaminated soil, including soil containing asbestos, and has been prepared in general accordance with:

- Department of Labour Health and Safety Guidelines on the Cleanup of Contaminated Sites (March 1994);
- Asbestos Regulations (1998); and
- New Zealand Demolition and Asbestos Association (NZDAA), March 2011: *New Zealand Guidelines for the Management and removal of Asbestos*, 3rd Edition.

These procedures have been developed to provide a framework for managing potential asbestos contamination related effects at the site; however, these protocols are not intended to relieve the owner or controller of the place or work of either their responsibility for the health and safety of their workers, contractors and the public, or their responsibility for protection of the environment.

General health & safety procedures based on the requirements of the *Health and Safety in Employment Act*, 1992 are to be covered by the Contractor and Willis Bond's Health and Safety Plans.

The purpose of these contaminated land-related Health and Safety procedures are to:

- Provide and maintain a safe working environment for workers during removal of asbestos contaminated soil and contaminated fill.
- Document safety facilities and procedures to prevent exposure to contaminated material by workers and visitors to the site;
- Identify and ensure awareness of potential contaminated land-related hazards; and
- Describe emergency procedures.

The contaminated land-related Health & Safety procedures shall be implemented while contaminated material is exposed on the site.

8.2 Site establishment (health and safety)

The Contractor shall include the following with respect to contamination-related health and safety during site establishment works set out in Section 5.1:

- Hazard identification signage (hazard board and on eastern access point) to warn sub-Contractors that asbestos containing materials are present; and
- Establishing a change and washing facility for workers;
- Establishing a personal protective equipment (PPE) store for workers; and
- Establish a personnel decontamination process/unit. The decontamination process shall include provision of:
  - Boot wash bins;
  - Hand held spray bottle for wetting down tyvek suits;
  - Bin for disposal of masks and tyvek suits; and
  - Mat for stepping out of the decontamination process onto.

The person holding the certificate of competence under the Asbestos regulations shall ensure the workers are familiar with the decontamination unit and process, and that the process is adequate.

The Contractor is responsible for the implementation these Health and Safety procedures. The key requirements of this plan are summarised on the Contractor checklist in Appendix B.

The health and safety procedures outlined below have been prepared based on differing work areas being established. These are defined as the following:

"Exclusion zone"	Works areas that contain contamination, including a clear area around them; and
"Support zone"	Designated areas including site offices, washing/decontamination areas, toilet facilities, designated lunch and smoking areas and loading area.

8.3 Identification of hazards

Asbestos fragments or free fibres may be identified in soils on site. There is no odour indicator of asbestos contamination.

Hydrocarbon contaminated soils are discoloured (black, blue/green staining) and odorous.

8.3.1 Identification of new hazards

Further hazards may be identified during the course of the works. Potential hazards could include, but are not limited to, contaminated materials with characteristics such as an oily sheen, odours (petroleum, oil), discolouration (black, green/blue staining most common), and/or inclusions of non-cleanfill allowable (refer Appendix C) deleterious materials (i.e. plastic, rubber, metal).

The Contractor is responsible for reviewing any new work element and assessing whether there are any new associated hazards, and whether these can be eliminated, isolated or minimised. The contractor shall advise Willis Bond, the approved asbestos remover and seek review by the contaminated land specialist if necessary. The Contractor shall then instruct all staff on the health and safety procedures associated with the new hazard.

8.3.2 Hazard management

The asbestos, metals, and hydrocarbon contamination hazards shall be managed by the minimisation methods set out in **Section 5**. The primary hazard management method is minimising exposure to contaminated materials and dust during the removal. Maintenance of earthworks controls (**Section 6**) is a key component of contaminated material hazard management.

8.4 General safety requirements and training

8.4.1 Health and safety officer

The Contractor's Site Manager shall be appointed the role of environmental health and safety officer (HSO) for the duration of the works to ensure that contaminated land-related health and safety procedures are adhered to, alongside of those required under the Contractors and Willis Bond's Health and Safety Plans.

The Contractor's Site Manager shall have basic first aid training.

8.4.2 Site induction

All relevant staff shall be required to undergo a contaminated soil safety induction before commencing work. The induction shall be conducted by the Contractor Site Manager/ HSO.

The purpose of the safety induction is to make sure the worker is aware of the hazards related to contaminated soil (asbestos, metals, and hydrocarbons), safe working procedures, safety equipment and requirements, and the action plan in case of an emergency.

The HSO shall ensure that all relevant personnel are familiar with the application and use of the PPE and procedures specified in this CSMP before commencement of site work.

8.4.3 General requirements

The following general safety procedures shall be followed by all staff entering and/or working in the "exclusion zone" (refer Section 8.2 for definition):

- Any incidents shall be reported to the HSO;
- Site workers shall avoid unnecessary contact with contaminated soil or potential contaminated soil; and
- Site workers shall wear gloves, Tyvek suits and dust masks at all times.

8.5 Hazard minimisation procedures

8.5.1 Inhalation of dust

Dust controls shall be in place throughout the works. Dust shall be managed according to procedures set out in Section 6.1.

8.5.2 Inhalation of asbestos fibres

Respiratory protection shall be worn at all times as there is a constant risk of asbestos exposure during the excavation works. The minimum requirement is a P2 dust mask. Half face respirators with asbestos fibre filters may also be required depending on review of the nature and extent of asbestos present by the contaminated land specialist.

P2 dust masks shall be worn within the clean (backfill) zone whilst contaminated soil remains on the balance of the site.

Work involving the excavation of asbestos shall be observed by a person certified under the Asbestos Regulations (1998).

8.5.3 Dermal contact and ingestion

The following shall be implemented to ensure skin contact and ingestion of contaminants is minimised:

- Disposable gloves shall be worn by workers who need to have contact with contaminated material during their work. Gloves shall be replaced regularly.
- Tyvek suits shall be worn to prevent contaminated material contacting other parts of the body, i.e. legs and arms, and preventing asbestos fibres collecting within the folds of clothing.
- Boot covers shall be used to prevent asbestos fibres being tracked offsite on the soles of workers/ visitors boots, or alternatively a boot wash shall be established at the entrance to the contaminated area from the loading area.

- No eating, drinking or smoking in the works area to prevent contaminated material contacting food or being ingested directly via soiled hands.

A key factor in controlling dermal contact and ingestion of contaminated soil is through maintaining good personal hygiene. The following shall be observed for works involving contaminated materials:

- Hand to mouth and hand to face contact shall be avoided during work.
- Hands shall be washed before eating, drinking and smoking.
- Eating, drinking and smoking shall only be permitted where site personnel are offsite or in designated areas.
- Tyvek suits worn within the "works area" shall be removed onsite and disposed of at the end of the working day and replaced with new ones the following day.

8.5.4 Personal protective equipment (PPE) provisions

Based on the hazard minimisation procedures above the Contractor shall ensure availability and supply of the following contaminated land-related PPE:

- P2 dust masks.
- Half face respirators (if required following review by the ccontaminated land sspecialist).
- Tyvek suits.
- Boot covers (or use boot wash as per Section 8.5.3 above).
- Disposable latex/rubber gloves.

Protective equipment shall be replaced as appropriate.

8.6 Emergency procedures

The following procedures apply for incidents involving contaminated soil or groundwater:

- Any incident or potential emergency situation shall be reported to the HSO for immediate assessment and action. To minimise the impact of an emergency situation at least one other field personnel besides the HSO shall have immediate access to a first aid kit.
- If an incident occurs within a contaminated site, immediately isolate and immobilise the relevant equipment.

9 Contingency Measures

In the event that unforseen contamination is identified during the works the first response procedures outlined in Section 5.2 shall be followed. In the event of an uncontrolled discharge of other contaminants or potentially contaminated soil/ hardfill or water to the environment, the following notification process shall be used:

- Cease work immediately and take all practical steps to contain the discharge and prevent further discharge.
- The Contractor shall notify Willis Bond and the contaminated land specialist.
- Willis Bond shall notify WCC and GWRC.
- A strategy to remedy the situation is to be determined by the contaminated land specialist in consultation with Willis Bond, WCC, and GWRC. The agreed strategy shall be implemented by the Contractor.
- All details of the discharge (volume, type, location), and procedures taken to remedy the situation, are to be recorded and included with the SVR to be submitted to all parties at the completion of works.

If there is any doubt as to whether or not a discharge of contaminants has occurred, the Contractor shall contact the contaminated land specialist for further advice.

10 Validation

Validation is the process of confirming the objectives of the works have been achieved, being:

- Contaminated soil from the Site 10 basement is disposed at an appropriate location.
- Potential contamination in earthworks carried out in the Landscape Areas is identified and managed appropriately.
- Confirmation from the Contractor that works were undertaken according to agreed procedures.
- Reporting on any incidents.

10.1 Remediation monitoring requirements

The contaminated land specialist will need to visit the site once daily during the removal of asbestos contaminated soil to check this CSMP is being implemented, to undertake monitoring, and respond to contamination-related queries.

On completion of the works, the contaminated land specialist shall include a log of all visits to the site and actions taken in the validation report described in Section 10.3.

The Contractor shall record all off-site deliveries of contaminated soil, including time, destination, and truck registration, and will perform a cross check against landfill weighbridge receipts to ensure all contaminated material reached the appropriate destination.

10.2 Post-remediation validation

Validation is to be undertaken progressively as asbestos containing fill is removed as follows:

- Before removal: additional testing in north half of Zone 3 to confirm the extent of asbestos contaminated soil, and whether the extent of Zone 3 can be decreased.
- On reaching the concrete slab: testing beneath the concrete slab after it has been removed. If no asbestos is detected, sampling shall be carried out on a 15 x 15 m grid across Zone 3. If asbestos is detected beneath the concrete slab, samples will be collected at depth.
- On reaching the depth where no further asbestos has been detected in pre-excavation samples: sampling on a 15 m x 15 m grid across Zone 3. In the event that a sample returns a positive test for asbestos a further 50 – 100 mm thickness of material shall be removed from the surface of the grid square containing the positive sample (if asphalt is absent) and a second (B) sample collected.

Samples shall be collected from the approximate centre of the grid square and the location confirmed by GPS. Sample locations shall be plotted on a site validation plan. Samples shall be tested for asbestos presence/absence at Dowdell & Associates laboratory.

No validation testing is proposed on the walls and base of the basement excavation, unless unexpected conditions are encountered. Contaminated reclamation fill is expected to remain in place around the excavation, and the proposed works will pave and prevent exposure to the contaminated fill. Validation sampling may be needed if unexpected conditions are encountered. The need for this would be assessed by the contaminated land specialist (see Section 9).

10.3 Validation reporting

The contaminated land specialist shall provide a validation report which includes the following:

- Confirmation that the asbestos removal works are complete.

- Confirmation that works were completed according to this CSMP and documenting any variations to the procedures during the works.
- Confirmation that there were no environmental or human health incidents during the works. If there were any incidents then the letter shall detail the nature of the incidents and the measures taken to mitigate effects.
- Confirmation of the disposal destination of contaminated materials, based on documentation provided by the Contractor.
- Verification test results undertaken for disposal permitting.
- Record of daily site visits and actions taken (as described in Section 7.1).

The validation report shall be provided to Willis Bond, WCC, and GWRC within one month after receipt of the final validation data.

10.4 Ongoing monitoring and management

All asbestos will be removed from the excavation and the site will be paved or covered with imported landscaping fill on completion. Therefore, there will be no ongoing requirement for monitoring or management with respect of ground contamination pertaining to these materials.

11 Applicability

This report has been prepared for the benefit of Willis Bond Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement. The work was undertaken in accordance with our proposal of 8 April 2014.

Tonkin & Taylor LTD

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
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Appendix A: Soil sampling method

- **Methodology**

A.1 Soil sampling procedures

Sampling undertaken by the contaminated land specialist shall be in accordance with requirements of the NES (Soil) Regulations, the Western Australian Guidelines, the "*Australian/ New Zealand Standard AS/NZS 5667 11:1998*" and the MfE Contaminated Land Management Guidelines No.5[2].

This method applies to:

- Potentially asbestos contaminated soil: pre-works delineation and post-works confirmation.
- Potentially clean soil: either in situ before excavation or stockpiled soil pending disposal.
- Soil from below 3 m depth: to confirm appropriate for disposal to landfill.

Samples ~~of potentially asbestos contaminated soil (Zone 3)~~ shall be collected according to the following procedure:

- The materials encountered were described in accordance with the NZ Geotechnical Society "*Guidelines for the classification and field description of soils and rocks for engineering purposes*".
- Visual inspection of the sample and the fill material for the presence of fragments of asbestos containing material.
- Freshly gloved hands shall be used to collect samples and place them immediately into double bagged zip lock plastic bags.
- Samples of fines shall be a 1/3 cup measure in volume for ease of testing by Dowdell & Associates and maintain a consistent sample size.
- The sample position will be recorded using a GPS.
- Equipment used to collect the samples are to be decontaminated between sample locations using clean water and Decon 90 (a phosphate-free detergent) rinses.
- Samples will be shipped to IANZ certified Dowdell & Associates laboratory under chain of custody documentation.
- Samples will be tested for the presence of asbestos.

[2] MfE, revised 2011: Contaminated Land Management Guideline No. 5 – *Site Investigation and Sampling*.

Appendix B: Contractor Checklist

Contractor Checklist:

Sites 8, 9, and 10 - Summary of key CSMP requirements

The Contractor shall undertake the following during the earthworks in potentially contaminated soil at Sites 8, 9, and 10, Waterloo Quay, Wellington:

Timing	Key task	Details
Prior to works commencing	Site set up	• Provide WCC and GWRC and neighbouring property owners notice of works commencement date. • Establish works controls (dust, erosion, sediment, stormwater, groundwater management, odour) controls as per CSMP Section 5 and 6. • Establish fencing site structures, site sheds as per Section 5.1. • Hazard board to state contaminated soil may be present and indicating health and safety requirements for workers. • Obtain PPE: disposal gloves, tyvek suits and P2 dust masks. • Establish the personnel decontamination unit. • Establish air monitoring units. • Arrange disposal permits. • Sweep surface of loading area prior to establishment of site sheds, loading areas and site facilities.
During the works	General CSMP compliance	• Maintain works controls (dust, erosion, sediment, stormwater, groundwater) controls as per CSMP Section 6; • Implement health and safety procedures in Section 8 as required; • Retain all weighbridge and disposal dockets and provide to Willis Bond and the contaminated land specialist.
	Alert contaminated land specialist	If any of the following situations arise: • Contaminated soil is encountered that includes: - Odours (petroleum, oil) - Discolouration (black, green/blue staining most common) - Inclusions of non-cleanfill allowable (refer Table 4.1 MfE Cleanfill Guidelines, Appendix C) deleterious materials (i.e. plastic, rubber, metal) • Materials with an oil sheen, odour or discolouration is encountered. • To collect validation samples <u>before</u> reinstatement.
Within one month of completion of the relevant works	Provide contaminated land-related Information to Willis Bond and contaminated land specialist	• Details of any complaints relating to dust received during the works. • Details of unexpected encounters/events and the action taken. • Details of additional sampling undertaken to characterise materials during the works (if any). • Details of visits made by Council representatives. • Summary of weighbridge information for disposal verification.

Appendix C: MfE Cleanfill Guidelines (acceptable and unacceptable materials)

Table 4.1: Acceptable materials

Material	Discussion
Asphalt (cured)	Weathered (cured) asphalt is acceptable: After asphalt has been exposed to the elements for some time, the initial oily surface will have gone and the asphalt is considered inert.
Bricks	Inert – will undergo no degradation.
Ceramics	Inert.
Concrete – un-reinforced	Inert material. Ensure that other attached material is removed.
Concrete – reinforced	Steel reinforcing bars will degrade. However, bars fully encased in intact concrete will be protected from corrosion by the concrete. Reinforced concrete is thus acceptable provided protruding reinforcing steel is cut off at the concrete face.
Fibre cement building products	Inert material comprising cellulose fibre, Portland cement and sand. Care needs to be taken that the product does not contain asbestos, which is unacceptable.
Glass	Inert, and poses little threat to the environment. May pose a safety risk if placed near the surface in public areas, or if later excavated. The safety risk on excavation should become immediately apparent, so glass is considered acceptable provided it is not placed immediately adjacent to the finished surface.
Road sub-base	Inert.
Soils, rock, gravel, sand, clay, etc	Acceptable if free of contamination (see 4.3.2 for definition of contaminated soil in this context).
Tiles (clay, concrete or ceramic)	Inert.

Table 4.2: Unacceptable waste

Material	Discussion
Abrasive blasting sand/agents	May contain metals, paint and other contaminants.
Asbestos (including asbestos sheeting)	Potentially hazardous. Although an inert compound, future excavation could cause significant health effects.
Asphalt (new)	New asphalt or asphalt that has been ground or pulverised may release oily substances that could leach into the environment.
Bark	Degradable; leaches tannins.
Cables	Metal cables will degrade (see Metals).
Car bodies	Contain metals, oils, plastics, asbestos and other potential contaminants.
Carpet	Degradable. May also contain formaldehyde residue from flooring.
Cesspit/stormwater sump cleanings	Contain various metal contaminants and organics.

Material	Discussion
Containers	To avoid any potential confusion, all containers are considered unacceptable. Containers may degrade or be punctured, releasing their contents or the remnants of their contents. The containers themselves may be detrimental to the environment (see plastics and metal).
Cork tiles	Degradable.
Corrugated iron	Degradable steel and zinc.
Electrical equipment and insulation	For example, fluorescent light tubes could contain PCBs (also see Plastics).
Formica	Generally stable (it is a melamine-formaldehyde polymer), but may be bonded with urea formaldehyde. This is water soluble and may leach formaldehyde compounds into groundwater. Often attached to particleboard.
Foundry sand	Contains metals.
Greenwaste (e.g. grass clippings, tree trimmings)	Will degrade and release contaminants such as ammonia and nitrates into the soil and groundwater, and may generate gases such as methane and carbon dioxide. The resulting leachate may mobilise other contaminants in the fill.
Hardboard	Degradable; contains phenol resorcinol formaldehyde.
Household waste	Typically contains large amounts of putrescible and degradable waste that will degrade and cause odour problems, and create soluble compounds causing leachate. Also contains some hazardous components.
MDF (medium-density fibreboard – customwood)	Degradable; may use urea formaldehyde as a bonding agent. This is water soluble and may leach formaldehyde compounds into groundwater (see Particleboard). Some modern MDF boards use phenol formaldehydes and other resins that may be acceptable, but the board itself is unacceptable.
Medical and veterinary waste	Unsafe if excavated (health hazard); may generate leachate.
Metals	For example, structural steel, roofing, window frames, building components, etc; degradable, can leach into the ground or groundwater. Soluble metals may be toxic depending on the concentration.
Paint	Hazardous waste. Liquid paints may contain significant quantities of volatile organic carbon compounds. These will contaminate soils and groundwater, causing detrimental effects to the environment (e.g. killing aquatic life) and human health. Some paints contain metals. Water-based paints contain preservatives and biocides which may include mercury, or other compounds that can cause dermatological problems.
Painted materials	Lead-based paint is hazardous and must be taken to a hazardous waste facility. Once paint has dried, the potential for contaminants in the paint to migrate through the soil is minimised, so all dried paint other than lead-based is relatively inert. However, to avoid any doubt all painted materials should be rejected.
Paper and cardboard	Paper and cardboard are degradable and present a fire hazard.

Material	Discussion
Particleboard (chipboard)	Contains urea formaldehyde as a bonding agent. This is water soluble and may leach formaldehyde compounds into the groundwater. Formaldehyde is known to cause many adverse health reactions and has been classified as a "probable human carcinogen" by the USEPA.
Plywood – structural / external grade	Uses phenol resorcinol formaldehyde as a bonding agent. This is not water-soluble and is relatively inert. However, the board itself is degradable and the difference between internal and external grade may not be apparent to the cleanfill operator.
Plywood – internal grade	Uses urea formaldehyde glue as a bonding agent. This is water-soluble and may leach formaldehyde compounds into groundwater (see Particleboard).
Road sweepings	Contain various metal contaminants and organics.
Sawdust	Degradable and could contain timber treatment chemicals.
Tar	Can contain a variety of compounds, many of which have been found to be carcinogenic. Many of the compounds do not bind to soil and can migrate directly to groundwater; potential for groundwater contamination with hydrocarbon compounds.
Timber (processed)	All sawn, gauged or dressed timber is considered unacceptable, as the cleanfill operator will not be able to determine easily if it is treated or untreated. Chemicals used for timber treatment can leach out and contaminate soils and groundwater. The chemicals used include copper-chrome-arsenic (CCA), light organic solvent preservatives (LOSP), creosote, boron and pentachlorophenol (PCP). These can all have a detrimental effect on human health and the environment.
Wood chips	Degradable.