Greenhithe Bridge Watermain Duplication and Causeway

Technical Report B – Soil, Sediment and Groundwater Contamination

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Watercare
An Auckland Council Organisation

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EXECUTIVE SUMMARY

This technical report presents the findings of the potential soil, sediment and groundwater contamination effects related to the construction, operation and maintenance of Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway project (Project). It supports the *Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment* report ("the AEE") prepared by AECOM Consulting Service (NZ) Ltd (AECOM) and Jacobs New Zealand Ltd (Jacobs).

This report provides the following:

a) A brief overview of the proposed works.

b) Outline of the statutory framework relevant to soil, sediment and groundwater contamination.

c) The purpose, objectives and scope of work for the soil, sediment and groundwater contamination assessment in relation to the Project.

d) A desk top study to assess if current or historical activities at the Project site have or had the potential to cause ground contamination.

e) Fieldwork and laboratory testing of the soil, sediment and groundwater to provide an environmental baseline for the site.

f) An assessment of the actual or potential effects on the environment (construction, operation and maintenance), having reference to the statutory framework and any other environmental factors considered relevant.

g) Recommended mitigation and management measures.

Conclusions

No activity or industry listed on the Hazardous Activities Industries List (HAIL) was identified within the Project site. It is therefore considered that the requirements of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES Soil) do not apply to the Project site.

The Project site's soil, sediment and groundwater contaminant levels have been assessed against the requirements of the contaminated land rules of the Auckland Council Regional Plan: Air, Land and Water (ALW Plan) and the Proposed Auckland Unitary Plan (PAUP).

<u>Sediment Contamination Assessment</u>

a) A Detailed Site Investigation (DSI) shows that the sediment contaminant levels are:

   i. Below the laboratory level of detection for organic parameters except for minor amounts of Polycyclic Aromatic Hydrocarbons.

   ii. Below the Auckland background concentrations for inorganic soils except for Arsenic.

   iii. Below the soil contaminant criteria specified in Rule 5.5.41 of the ALW Plan and below the soil contaminant criteria specified in provision H.4.5.2.1.3 of the PAUP.

b) Off-site sediment disposal may be at a licensed managed fill site or licensed solid waste landfill, i.e. not to a licensed cleanfill site. On-site disposal of the sediment or reuse of the sediment in, for example, mudcrete is permitted, from a contamination perspective.

c) The sediment contamination levels are below the Interim Sediment Quality Guidelines- Low Trigger Values (ANZECC, 2000), when using the 95% Upper Confidence Limit of the test results.

d) Technical Report D contained in Volume 2 of the AEE provides an ecological assessment for the Project.

Soil Contamination Assessment

e) No resource consent is required under the ALW Plan since the requirements of Rule 5.5.41 are met, i.e. the soil contaminant levels are below the Schedule 10 contaminant criteria and other criteria referenced in Rule 5.5.41.

f) No resource consent is required under the PAUP since the requirements of provision H.4.5.2.1.1 are met.

g) The soil contaminant levels meet the Auckland background soil quality for non-volcanic soils and therefore spoil can be removed off-site to a licensed cleanfill site, if required. Equally the spoil can be reused on-site

Groundwater

h) No resource consent is required under the ALW Plan since the requirements of Rules 5.5.41(e) and 5.5.58(c) are met, i.e. the discharge of groundwater contaminant levels, after reasonable mixing, are below the ANZECC (2000) Freshwater criteria for 95% level of protection of species.

i) No resource consent is required under the PAUP since the requirements of provision H.4.18.2.1.1.2 are met.

j) If temporary groundwater disposal is required during construction of the proposed valve chambers and other excavations it may be disposed of as stormwater.

Assessment of Effects: Potential Soil, Sediment and Groundwater Contamination

k) It is considered that the potential soil, sediment and groundwater contamination effects related to the construction, operation and maintenance of the Project are less than minor.

l) It is considered that potential adverse effects on the environment arising from unforeseen/unknown ground contamination at the Project site can be avoided, mitigated and remedied by ensuring that the contractor adheres to the protocols listed in a Project Construction Management Plan (CMP). The CMP will be prepared once the contractor has been appointed and the CMP will be submitted to Council prior to construction as discussed in Section 2.3.4 of the AEE.

1 INTRODUCTION

Jacobs New Zealand Ltd (Jacobs) has been commissioned by Watercare Services Limited (Watercare) to assess the potential soil, sediment and groundwater contamination effects related to the construction, operation and maintenance of Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway project (Project).

The Project comprises:

a) The construction of a new watermain on the northern side of the Greenhithe Bridge to duplicate the existing North Harbour 1 Watermain already located on the southern side of the bridge, and.

b) Widening along the northern side of the existing State Highway 18 motorway causeway to accommodate the new watermain, as well as wastewater pipelines and associated facilities which form part of Watercare's proposed Northern Interceptor project.

The proposed water and wastewater infrastructure is required in order to maintain water and wastewater service levels and to provide for future growth.

The proposed Greenhithe Bridge Watermain Duplication and Causeway project requires various resource consents under the Resource Management Act 1991 ("RMA"). This technical report provides specialist input for the *Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment* report (AEE) report prepared by AECOM and Jacobs which supports the resource consent application. The works described in the AEE have been considered in the technical assessment presented in this report.

This report provides the following:

a) A brief overview of the proposed works (Section 2).

b) The purpose, objectives and scope of work for the soil, sediment and groundwater contamination assessment in relation to the Project (Section 3).

c) Outline of the statutory framework relevant to soil, sediment and groundwater contamination (Section 4).

d) A desk top study to assess if current or historical activities at the Project site have or had the potential to cause ground contamination (Sections 5-7)

e) Fieldwork and laboratory testing of the soil, sediment and groundwater to provide an environmental baseline for the site (Sections 8-10).

f) An assessment of the actual or potential effects on the environment (construction, operation and maintenance), having reference to the statutory framework and any other environmental factors considered relevant (Sections 11 and 12).

g) Recommended mitigation and management measures (Section 13).

The new watermain will eventually form part of Watercare's future North Harbour 2 (NH2) Watermain project. The proposed widening of the motorway causeway will also incorporate wastewater pipelines and associated facilities which form part of Watercare's proposed Northern Interceptor (NI) project.

Separate technical reports have or will be prepared for the future NH2 Watermain project and for the balance of the NI project.

2 GREENHITHE BRIDGE WATERMAIN DUPLICATION AND CAUSEWAY PROPOSED WORKS

The proposed Greenhithe Bridge Watermain Duplication and Causeway works assessed in this report are the construction, operation and maintenance of:

a) The proposed watermain from Station Street in Hobsonville, under the motorway to the coastal edge – this will involve open trenching from Station Street to the motorway, and trenchless construction under the motorway;

b) Proposed causeway widening to accommodate the proposed watermain and wastewater pipelines – the proposed widening is approximately 860 metres in length and 15-50 metres in width along the northern side of the existing motorway causeway;

c) The proposed watermain attached to the underside of the Greenhithe Bridge; and

d) A proposed watermain cross connection chamber close to the eastern abutment of the Greenhithe Bridge.

The proposed works are described in detail in the AEE. The works described in section 2.3.4 of the AEE and shown on the drawings are provided in Volume 3 of the AEE.

3 PURPOSE, OBJECTIVES AND SCOPE OF WORK

3.1 Purpose

The purpose of this report is to assess the potential effects on soil, sediment and groundwater contamination and how it may potentially affect the construction, operation and maintenance of the Project. It is one of a series of technical reports which supports the AEE for the Project.

3.2 Objectives

The objectives of the report are to:

a) Identify relevant regulatory considerations;

b) Assess the potential effects that construction, operation, maintenance or decommissioning of the Project may have on soil, sediment and groundwater contamination; and

c) Identify appropriate control measures to minimise potential risks associated with soil, sediment and groundwater contamination on construction, operation, maintenance or decommissioning of the Project.

3.3 Scope of Work

In order to achieve the objectives a statutory assessment was undertaken followed by a soil, sediment and groundwater contamination assessment. The latter was carried out in two phases.

The first phase involved a desk top study to assess if current or historical activities at the site have or had the potential to cause ground contamination. The second phase comprised subsurface investigations to establish the soil, sediment and groundwater quality at the site.

The Phase 1 scope of work comprised:

a) Historical aerial photograph review.

b) Site contamination enquiry with Auckland Council (Council).

The Phase 2 scope of work consisted of:

a) Soil sampling near the locations of the proposed excavations for:

   i. New Watermain to NH1 pipe connection- west end: the jacking and receiving pits located north and south of SH18.

   ii. Watermain to NH1 pipe connection- east end: the pit to form the valve chamber.

b) Sediment sampling of the existing sediments located within the footprint of the proposed causeway widening and NI ‘tab’ area.

c) Groundwater sampling at one of the proposed valve chamber excavation sites located west of Greenhithe Bridge

d) Laboratory testing of soil, sediment and groundwater samples for a range of organic and inorganic parameters.

e) Assessing the soil, groundwater and sediment test results against relevant regulatory and off-site disposal requirements.

f) Preparing this soil, sediment and groundwater contamination report.

3.4 Other Relevant Reports

This report should be read in conjunction with the following reports:

a) AEE- Greenhithe Bridge Watermain Duplication and Causeway, Volume 1.

b) AEE- Greenhithe Bridge Watermain Duplication and Causeway, Volume 3 - Drawings

c) Technical Report C - Groundwater, Greenhithe Bridge Watermain Duplication and Causeway, Volume 2.

d) Technical Report D - Ecology, Greenhithe Bridge Watermain Duplication and Causeway, Volume 2.

4 STATUTORY REQUIREMENTS: CONTAMINATED LAND ASSESSMENT CRITERIA

This section discusses the national and Auckland assessment criteria, in terms of soil, sediment and groundwater.

4.1 National and Auckland Criteria

The contaminated land assessment criteria in the Auckland region are covered by:

a) The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, commonly referred to as the NES Soil.

b) The Auckland Council Regional Plan: Air, Land & Water (ALW Plan).

c) The Proposed Auckland Unitary Plan (PAUP)

The PAUP was notified on 30 September 2013. The PAUP is currently going through the public notification and submissions process. The existing district and regional plans remain operative until superseded by the provisions of the PAUP as they are made operative.

However, section 86B(3) of the RMA states that a rule in a proposed plan has immediate legal effect from the date of notification if the rule:

a) protects or relates to water, air, or soil (for soil conservation); or

b) protects areas of significant indigenous vegetation; or

c) protects areas of significant habitats of indigenous fauna; or

d) protects historic heritage; or

e) provides for or relates to aquaculture activities.

A number of rules in the PAUP have immediate legal effect as at 30 September 2013, and thus must be considered in relation to the proposed works, along with the operative plans. The contaminated soil, groundwater and landfill rules under the PAUP are very similar to those in the ALW Plan, and the permitted activity (PA) soil acceptance criteria in provision H.4.5.2.1.3 are the same as the Schedule 10 levels in the ALW Plan. PAUP rule H.4.5.2.3.1 is further discussed in Section 4.4.

4.2 NES Soil

On 1st January 2012 the NES Soil came into effect. All territorial authorities (district and city councils) are required to give effect to and enforce the requirements of the NES.

Section 4 of the NES sets out the relationship of the regulations with territorial and regional council functions. The NES Soil relates to territorial authority functions (as set out in section 31 of the RMA), but does not apply to regional council functions under section 30 of the RMA. Accordingly, the NES Soil does not relate to the Coastal Marine Area, which falls within regional council jurisdiction.

The policy objective of the NES Soil is to ensure land affected by contaminants in soils is appropriately identified and assessed when soil disturbance and/or land development activities take place and, if necessary, remediated or the contaminant contained to make the land safe for human use.

The NES Soil achieves its policy objective through a mix of allowing (permitting) and controlling (through resource consents) certain activities on land affected or potentially affected by soil contaminants. Under the regulations, land is considered to be actually or potentially contaminated if an activity or industry on the HAIL has been, is, or is more likely than not to have been, undertaken on that land.

The NES Soil provides selected soil guideline values (SGVs) for human health protection for a range of land uses and these SGVs are derived from the NES Soil soil contamination standards (SCSs) for twelve priority contaminants or other referenced guidelines for non-priority contaminants. Nine of the twelve priority contaminants have been assessed as part of this study, the remaining three contaminants, Boron, Pentachlorophenol and Dioxin, were not considered a contaminant of potential concern. The soil laboratory test results have been assessed against the appropriate SGVs in Section 11.

This contaminated land assessment report is considered to meet the requirements of a Detailed Site Investigation (DSI) and demonstrates that the priority contaminants were found to be below the background concentrations.

If a DSI exists and the soil contaminant levels are below background concentrations then the NES does not apply, as covered by NES Regulation 5(9).

4.3 ALW Plan

The ALW Plan contains a number of contaminated land rules, Rules 5.5.40 to 5.5.45, that specify whether earthworks or soil disturbing activities are a Permitted Activity, Controlled Activity, Restricted Discretionary Activity or a Discretionary Activity.

There are two Permitted Activity Rules relevant to the project, Rule 5.5.41 (for soil) and Rule 5.5.57 (for temporary discharge of uncontaminated groundwater).

The are two other Permitted Activity rules related to soil contamination, Rule 5.4.40 is a Permitted Activity rule for trenching, small scale disturbance and intrusive investigations and the criteria require a relatively low soil disturbance volume (<200 m^3) and limited duration of excavation work (< 1 month). These criteria will be exceeded by the proposed works and have therefore not been considered further. Rule 5.5.42 is relevant for petroleum underground storage tanks and therefore not relevant to the project.

4.3.1 Rule 5.5.41- Soil and Sediment

Rule 5.5.41 allows for soil contaminant levels to be less than 95% of the Upper Confidence Limit (UCL), as described in the Ministry for the Environment (MfE) document *Contaminated Land Management Guidelines No. 5- Site Investigation and Analysis of Soils* (MfE, 2004) using the greater of (i) or (ii) below:

i. For in situ soil and material imported and/or deposited onto the land:

    1. The criteria specified in Schedule 10 of the ALW Plan. Note, the discharge values have been applied in this report and it is understood that the human health values in Schedule

10 are superseded by the SGVs in the NES. For contaminants not included in Schedule 10;

2. The Tier 1 soil acceptance criteria for the current land use or, in the case of a proposed change in land use, the proposed land use for the more stringent of either the protection of human health or sensitive groundwater specified in the MfE document *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand* (MfE, 1999), of for contaminants not included in Schedule 10 or the Petroleum Hydrocarbon guidelines;

3. The soil quality guidelines for the current land use or , in the case of a proposed change in land use, the proposed land use in *the Canadian Environmental Quality Guidelines*, prepared by the Canadian Council of Ministers of the Environment (CCME, 1991), updated 2002, for the currently zoned land use, or for contaminants not included in Schedule 10, the Petroleum Hydrocarbon guidelines or the CCME guidelines;

4. For dieldrin and lindane only, the soil quality guidelines in the MfE document *Identifying, Investigating and Managing Risks Associated with Former Sheep-Dip Sites- A Guide for Local Authorities* (MfE, 2006).

ii. For in situ soil and material imported and/or deposited onto the land the natural background levels for that soil or material or the relevant background levels specified in the Auckland Regional Council (ARC) Technical Publication (TP) *Background concentrations of inorganic elements in soils from the Auckland region* (TP153) (ARC, 2001).

Rule 5.5.41 also requires that soil or material historically imported shall not contain separate phase liquid contaminants including separate phase hydrocarbons.

It is inferred that where sediment is excavated and disposed off-site onto land it becomes a soil and hence Rule 5.5.41 applies to sediment (for off-site disposal purposes).

4.3.2 Rule 5.5.47- Groundwater

In terms of assessing the contaminants in the groundwater for the project it is considered that Rule 5.5.57 applies:

"The discharge of water from the following is a Permitted Activity: ……

e) Temporary and permanent discharge of diverted uncontaminated groundwater;"

Uncontaminated groundwater, in terms of its contaminant level is defined in Rule 5.5.58 which states that:

"The activities in Rule 5.5.47 are subject to the following conditions: ….

c) "The contaminants discharged shall not either by itself or in combination with other contaminants after reasonable mixing exceed the greater of the 95 percent trigger values for freshwater (groundwater) specified in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000), or the natural background level, with the exception …"

It is understood that with respect to the term 'reasonable mixing' Auckland Council can accept up to ten times (10x) the threshold criteria, i.e. the ANZECC 95% protection trigger level multiplied by ten.

The ecological report, contained in Appendix D, Volume 2 will address the ecological aspects of the sediment quality at the site.

For completeness the sediment laboratory test results have been assessed against the Interim Sediment Quality Guidelines (ISQG)- Low trigger values and ISQG- High trigger values in Section 11 of this report.

4.4 PAUP

4.4.1 Provision H.4.5.2.1.3

In the contaminated land section of the PAUP, provision H.4.5, an activity table is provided for discharge rules under Section 15 of the RMA. The table *"specifies the activity status for the discharge of contaminants to land and/or water from containing elevated levels of contaminants."*

Within the PAUP table it is considered that the activity described as *"Discharges of contaminants from land not used for primary production"* is most relevant to the Project works, and the PAUP table classifies this as a Permitted Activity.

Auckland Council manages the potential discharges from a Permitted Activity with a number of controls and the controls applicable to the *"Discharges of contaminants from land not used for primary production"* are specified in provision H.4.5.2.1.3 of the PAUP and are paraphrased below:

1. *"For in-situ soil and material imported or deposited onto land, the concentrations of target contaminants, or 95 per cent upper confidence limit of the mean, determined in accordance with 'Contaminated Land Management Guidelines- No. 5- Site Investigation and Analysis of Soils', Ministry for the Environment (2011), must not exceed the greater of a. or b. below:*

    a) *For in-situ soil and material imported and/or deposited onto the land*

        i. *the criteria specified in Table 1; or for contaminants not listed in Table 1:*

        ii. *the tier 1 soil acceptance criteria for the protection of groundwater quality specified in Table 4.20 of the 'Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand', Ministry for the Environment (October 2011); or for contaminants not included in Table 1 or Table 4.20:*

        iii. *the soil quality guidelines for the current land use or, in the case of a proposed change in land use, the proposed land use in the 'Canadian Environmental Quality Guidelines', Canadian Council of Ministers of the Environment (2013):*

        iv. *for dieldrin and lindane only, the soil guideline values in Table A.5 of the report 'Identifying, Investigating and Managing Risks Associated with Former Sheep Dip Sites: A Guide for Local Authorities', Ministry for the Environment (2006).*

    b) *The natural background levels for that soil or material or the relevant background levels specified in Table 2.*

2. *The land and the discharge must not contain separate phase liquid contaminants including separate phase hydrocarbons.*

Table 1: Permitted activity soil acceptance criteria

Contaminant	*Permitted activity criteria (mg/kg)*
Arsenic	*100.0*
Benzo (a) pyrene (equivalent)	*2.15*
Cadmium	*7.5*
Chromium (total)	*400.0*
Copper	*325.0*
Total DDT	*12.0*
Lead	*250.0*
Mercury	*0.75*
Nickel	*105.0*
Zinc	*400.0*

Total DDT includes the sum of DDT, DDD and DDE.

Table 2: Background ranges of trace elements in Auckland soils (Auckland Council TP153, 2001)

Element (total recoverable)	*Non-volcanic range*	*Volcanic range*
Arsenic (As)	*0.4 – 12*	
Boron (B)	*2 – 45*	*<2 - 260*
Cadmium (Cd)	*<0.1 – 0.65*	
Chromium (Cr)	*2 – 55*	*3 – 125**
Copper (Cu)	*1 – 45*	*20 – 90*
Lead (Pb)	*<5 – 65**	
Mercury (Hg)	*<0.03 – 0.45*	
Nickel (Ni)	*0.9 – 35*	*4 – 320*
Zinc (Zn)	*9 – 180*	*54 – 1160*

Therefore the controls of provision H.4.5.2.1.3 of the PAUP are, in terms of maximum allowable soil contaminant criteria, the same as those specified in Rule 5.5.41 of the ALW Plan (see Section 4.3.1).

4.4.2 Provision H.4.18.2.1.1.2

Provision H.4.18 of the PAUP allows for *" …discharges of contaminants onto or into land that are not otherwise covered by the plan, and that are identified as occurring or needing to occur for recognised purposes."*

An activity table is provided for provision H.4.18 and the activity described as *"discharge of water from … temporary and permanent discharge of diverted uncontaminated groundwater.."* has a Permitted Activity status.

The controls relevant to contaminant criteria relevant to a permitted activity are specified in provision H.4.18.2.1.1.2 of the PAUP and are paraphrased below:

> "*The contaminant discharged must not either by itself or in combination with other contaminants after reasonable mixing exceed the greater of the 95 percent trigger values for freshwater (groundwater) specified in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000), or the natural background level".*

Therefore the controls of provision H.4.18.2.1.1.2 of the PAUP are the same as those specified in Rule 5.5.58(c) of the ALW Plan (see Section 4.3.2).

4.5 Adopted Site Assessment Criteria

4.5.1 Soil and Sediment: Site Assessment Criteria

Based on the NES Soil, ALW Plan and PAUP soil guideline values described above, the appropriate soil and sediment contamination values used to assess the site are presented in Table 1 below. The ANZECC ISQG-Low and ISQG-High concentrations have been presented for comparative purposes only.

Table 1: Soil and Sediment Contamination Values (all in mg/kg dry weight)

Parameter (mg/kg dry weight)	ALW Plan Permitted Activity Limits[2]		SGVs Commercial/industrial outdoor worker/maintenance[1]	TP 153[8] (cleanfill criteria)		ANZECC Sediment Quality[9]	
	Schedule 10	Other discharge		Non-volcanic	Volcanic	ISQG-Low	ISQG-High
Arsenic	100	-	70	12	12	20	70
Cadmium	7.5	-	1300 (at pH =5)	0.65	0.65	1.5	10
Chromium	400	-	6300	55	125	80	370
Copper	325	-	>10,000	45	90	65	270
Lead	250	-	3300	65	65	50	220
Mercury	0.75	-	4200[7]	0.45	0.45	0.15	1
Nickel	105	-	1500[3]	35	320	21	52
Zinc	400	-	23000[3]	180	1160	200	410
Naphthalene	-	69[4]	-	-	-	0.16	2.1
BaP (equiv)	2.15		35	-	-	0.43	1.6
Pyrene	-	1.3[4] – 1600[4]	-	-	-	0.665	2.6
C7 – C9	-	710[4] – 2700[4]	-	-	-	-	-
C10 – C14	-	560[4] – 1500[4]	-	-	-	-	-
C15 – C36	-	>20000[4]	-	-	-	-	-
DDT- total	0.7[6]	-	1000	-	-	0.0016	0.046
Dieldrin	-	190[5]	160	-	-	0.00002	0.008
Lindane		14,000[5]	-	-	-	0.00032	0.001
Tributyltin	-	-	-	-	-	0.005	0.07

Notes:

[1] MfE, 2011, Tables 54 & 55, Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health.

[2] ALW Plan (Operative in Part, 21 October 2010). It may be inferred from Note 3 of Schedule 10 that where the heavy metal limit for human health is not shown then the limit is equal or higher than the discharge limit.

[3] United States Environmental Protection Agency (USEPA), Human Health Medium – Regional Screening Levels (RSL, May 2013) – International risk – based SGVs for residential land use, non-cancer endpoint, all pathways.

[4] MfE, Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011) Module 4 – Tier 1 Soil Screening Criteria Residential land use, all pathways, for silty clay soil with surface (<1m) depth of contamination (Table 4.10) and for the protection of groundwater quality for potable use (Table 4.20) with surface contamination (<1 m) and depth to groundwater as 4 m.

[5] MfE, Identifying, Investigating and Managing Risks Associated with Former Sheep-dip Sites, November 2006 – SGVs for human health for commercial/industrial (unpaved) land use (Table 4).

[6] Note 2 of Schedule 10 states that this value applies to the redevelopment phase. Upon completion of the land development the PA limit is 12 mg/kg, which is the same value as in the Proposed Auckland Unitary Plan (PAUP).

[7] Inorganic mercury compounds.

[8] ARC (2001), Background concentrations of inorganic elements in soils from the Auckland region, TP 153.

[9] ANZECC (2000), Table 3.5.1- ISQG, Low trigger values and High trigger values.

4.5.2 Groundwater: Site Assessment Criteria

The appropriate groundwater guideline values are presented in Table 2 below and were used to assess groundwater at the site. These values are based on Rules 5.5.57(e) and 5.5.58 (c) of the ALW Plan, and controls of provision H.4.18.2.1.1.2 of the PAUP, see Section 4.3.2. We note that the marine values are presented for comparative purposes as Rule 5.5.42A (i) refers to freshwater trigger level, however, the site is located in the CMA and the groundwater is likely to discharge to the marine environment and therefore the marine values are considered.

Table 2: Guideline values for selected groundwater contaminants.

Parameter	95% level of protection of species' ANZECC (2000)		Adopted Groundwater Site Assessment Criteria
	Freshwater	Marine	
Arsenic	0.024	ID [2]	0.240
Cadmium	0.0002	0.0055	0.055
Chromium	0.001	0.0044	0.044
Copper	0.0014	0.0013	0.013
Lead	0.0034	0.0044	0.044
Mercury	0.0006	0.0004	0.004
Nickel	0.011	0.070	0.7
Zinc	0.008	0.015	0.150
Naphthalene	0.016	0.070	0.7
BaP (equiv)	0.0002 [3]	ID	0.002
Pyrene	-	-	-
C7 – C9	-	-	-
C10 – C14	-	-	-
C15 – C36	-	-	-

Notes:

[1] All units are in mg/L (=g/m^3, as reported by Hill Laboratories, see Appendix E).

[2] ID means insufficient data to derive a reliable trigger value.

[3] A low reliability trigger value of 0.2 µg/L was derived for benzo[a]pyrene using the statistical distribution method (95% protection). This chemical has the potential to bio-accumulate but this has not been accounted for in this figure. Alternative protection levels were 99% 0.1 µg/L, 90% 0.4 µg/L, 80% 0.7 µg/L. The 99% figure is recommended if no data are available on bioaccumulation effects at specific sites. This is applicable to both fresh and marine waters and should only be used as an indicative interim working level. Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 2 Aquatic Ecosystems - Rationale and Background Information (Chapter 8) October 2000.

5 HISTORICAL AERIAL PHOTOGRAPH REVIEW

A review of historical aerial photography was carried out to determine current and past land uses that had the potential to cause soil, sediment or groundwater contamination. The following two sources were used:

a) Council Geographical Information System (GIS), using their publicly available website.

b) The aerial photographic archive held by Tonkin & Taylor Ltd (T&T) at their offices in Newmarket, Auckland.

The historical aerial photographs reviewed covered the period 1940, 1950, 1960, 1970, 1980, 1990 and 2000. The review was conducted for the whole of Watercare's future NH2 Watermain project and therefore includes the Project site.

Table 3 provides a summary of the historical aerial photograph review. Appendix A provides a detailed review of the historical aerial photographs.

Table 3: Summary of Historical Aerial Photograph Review

Section	Description
Fred Taylor Road to Greenhithe Bridge	All roads for Fred Taylor/Hobsonville road exist in 1950s. Surrounded by farmland and mixed agricultural uses. Port facilities to the south of proposed Greenhithe bridge area in 1970s. Greenhithe bridge built by 1980s. Residential development increasing over time, increasing mostly after 1980s. In the 1920s Hobsonville peninsula became an airfield and was occupied by the Royal New Zealand Air Force (RNZAF), see also Section 3.1 for a brief history of the air base. The historical aerial photographs show that buildings such as aircraft hangers and the grass airfield were located at least 100 m east to south-east from the preferred route, located near the western portion of Buckley Ave. Therefore there is low risk that former RNZAF activities have contaminated the ground near the preferred route. A large part of Hobsonville peninsula was used by the Ministry of Defence for housing, especially near the end (eastern end) of Buckley Ave. The preferred route only uses a relatively small portion of the western side of Buckley Ave and there is no reason to suspect that HAIL activities were carried out in the western portion of Buckley Ave.
Greenhithe to Tauhinus Road, Pounamu Avenue, Sunny View Road, Kyle Road and Bush Road	Most roads exists in 1950's, land use is predominantly rural residential with some farmland, residential development increasing over time, particularly from 1980s. Sunnyview Road built by 1970s, Pounamu Road constructed during 1990s.
Greenhithe to Bush Road (Upper Harbour Drive)	Albany Highway exists in 1950s. Upper harbour highway is just through farmland and bush, built in 2000s. Residential development increases particularly from 1990s.

5.1 Brief History of Hobsonville Airbase

In 1925 an airfield was established on the Hobsonville land and the Royal New Zealand Air Force (RNZAF) moved to the base in 1928. It occupied a flying field and seaplane slipway and established itself as a RNZAF primary flying boat base until 1967.

In 1965 the RNZAF Base Hobsonville and nearby RNZAF Base Whenuapai merge as RNZAF Base Auckland and Hobsonville became base primarily for helicopters.

In 2002 the Government decommissioned Hobsonville and the remaining operation moved to Ohakea.

Table 3 and the brief history of Hobsonville Airbase do not indicate that activities or industries presented on the Hazardous Activities and Industries List (HAIL) are located within the Project site. A copy of the HAIL is presented in Appendix B.

We note that item H of the HAIL states that:

> *"Any land that has been subject to the migration of hazardous substances from adjacent land in sufficient quantity that it could be a risk to human health or the environment".*

It is possible that the sediments located within the causeway works area, forming part of the overall Project site area, have become contaminated from run-off from surrounding land uses. Therefore the sediment contaminant levels have been tested as part of this report, primarily for off-site disposal options.

6 COUNCIL SITE CONTAMINATION ENQUIRY

A site contamination enquiry was lodged with Council on 26 February 2014. The site contamination enquiry was for the whole of Watercare's future NH2 Watermain project and therefore includes the Project site.

Council's response to the site contamination enquiry is contained in Appendix C. It shows that there are no pollution incident files or resource consents, such as contaminated site discharge consents, issued at or near the Project site.

There are no groundwater users within 500 m of the the Project site. The site is located over the Kumeu Waitemata Aquifer, as identified on Map Series 2, Map 7 of the ALW Plan planning maps, and this is a High Use Aquifer Management Area. However, this is a deep aquifer and the shallow groundwater that may be affected by the proposed valve chamber excavation work, is likely to be perched groundwater and the shallow perched groundwater quality has been assessed as part of this study (see Section 11.3).

In addition to the site contamination enquiry Council's Environmental Control, Licensing & Compliance Services (ECLCS) was also contacted in the period 24 February to 11 March 2014 to assess if there are HAIL sites located on or immediately adjacent to the whole NH2 Watermain project.

No specific information was received from ECLCS in this period, however, considering that both the historical aerial photograph review and the site contamination enquiry did not indicate that HAIL activities were or are carried out on the Project site, it is considered reasonable to assume that Council ECLCS also does not classify the Project site as a HAIL site.

7 POTENTIAL FOR CONTAMINATION

The potential for soil and groundwater contamination is considered low since the desk study review indicate that no activities or site uses listed on the HAIL were carried out on or within the Project site.

Sediments located in the Project site have the potential to be contaminated from run-off from surrounding land uses, as previously discussed in Section 5.1. The likely contaminants are heavy metals, organic hydrocarbons and pesticides.

The effects of potential sediment contamination are:

a) Environmental effects, in terms of ecology.

b) Human health effects in terms of construction workers and environmental effects in terms of on-site reuse in mudcrete or where off-site disposal to land is required (when sediment becomes a soil).

The ecological effects of sediment contamination are presented in the Technical Report D- Ecology, Greenhithe Bridge Watermain Duplication and Causeway, Volume 2.

In order to enable construction work to be undertaken in an efficient manner with minimal delays to the construction programme testing of the sediment was undertaken to determine the existing sediment contaminant levels and to determine sediment spoil disposal options. This was carried out as Phase 2 of the scope of work, see Section 3.4, and is further discussed in Section 8 below.

Similarly soil and groundwater sampling and testing was carried out at the proposed jacking and receiving pits (west end of Project area) and proposed pit for the east end valve chamber (east end of Project area) as this would enable the future site contractor with the preparation of site specific Health & Safety Plans (to protect excavation workers) and assist with soil and groundwater disposal options during the construction works. This work was also carried out as the Phase 2 scope of work and is further discussed in Section 8 below.

8 SITE INVESTIGATION WORKS

8.1 Objective

The objective of the site investigation works was to assess the soil, groundwater and sediment contaminant levels in the areas of the Project site that would be disturbed during the earthworks. The data obtained from the site investigation works, and field observations in terms of visual or olfactory evidence of ground contamination, would be used to establish the implications of the proposed works.

8.2 Sampling Methodology: Soil, Sediment and Groundwater

Watercare engaged Jacobs to prepare a sampling methodology for soil, groundwater and sediment sampling in April 2014. The sampling methodology provided Watercare's site investigation contractor Opus International Consultants Ltd (Opus) with the proposed sample locations and method of obtaining samples. A copy of the sampling methodology is presented in Appendix D.

8.3 Fieldwork

The fieldwork was undertaken by Opus in the period May to June 2014 in accordance with the sampling methodology.

The locations of the soil, sediment and groundwater samples obtained within the site are presented in Table 1 of the report *Environmental Sampling and Testing Report, NH2 Watermain, Greenhithe and Stream Crossings*, reference GS14/091 (Opus, 2014). Relevant pages of this report are contained within Appendix E. We note that the fieldwork included sampling at a number of stream crossings located outside the Project site but forming part of the remainder of the whole of Watercare's future NH2 Watermain project and these pages have been removed from the Opus report.

All samples were couriered to R J Hills Laboratory Ltd (Hills Laboratory) by Opus using appropriate contaminated land documentation such as chain of custody and request for analysis forms.

Copies of the borehole logs of the environmental sampling locations are contained within Appendix F (note, these borehole logs are also contained within Appendix B of the Opus Geotechnical Factual Report GS14/089).

None of the boreholes recorded visual or olfactory evidence of ground contamination.

8.4 Additional Fieldwork

An additional three sediment samples were taken in the area of the proposed construction platform of the NI project on 21 November 2014. The location of the three sediment samples is shown on Drawing 2010674.004 contained in Appendix J. The approximate location of the proposed construction platform is also shown on Drawings 2010673.851 and 2010674.001. Volume 3 Drawings- Greenhithe Bridge Watermain Duplication and Causeway also provides drawings showing the location of the Northern Interceptor Project Proposed Construction Platform.

The three sediment samples were obtained by staff from T&T and no visual or olfactory evidence of ground contamination was observed. The sediment samples were couriered to Hill Laboratories by T&T using appropriate contaminated land documentation such as chain of custody and request for analysis forms. The three sediment samples were tested for similar contaminants as those obtained in the period May to June 2014 (see Section 8.3).

9 LABORATORY TESTING

The laboratory testing comprised the testing of soil, sediment and groundwater samples for the following parameters:

a) Suite of heavy metals: Arsenic, Cadmium, Chromium (total), Copper, Lead, Nickel, Zinc and Mercury.

b) Total Petroleum Hydrocarbons (TPH).

c) Polycyclic Aromatic Hydrocarbons (PaH).

d) Organochlorine Pesticides (OCP).

e) Tributyl Tin (TBT) (sediment samples only).

f) Total Organic Carbon (TOC) (sediment samples only).

g) For ecological report- the heavy metals extractable Copper, Lead and Zinc, as per Technical Publication TP 168, revised edition, *Blueprint for Monitoring Urban Receiving Environments* (ARC, 2004).

For the May to June fieldwork the samples tested and laboratory testing regime is presented in Table 3 of the environmental sampling and testing report contained in Appendix E.

For the additional fieldwork the laboratory test results are presented in Appendix J.

For the Project site a total of fourteen sediment samples were tested (including one duplicate), seven soil samples and one groundwater sample.

An assessment of the test results is presented in Section 11 of this report.

10 OFF-SITE DISPOSAL OF SOIL AND SEDIMENT

Off-site disposal of soil and sediment is typically at one of three facilities:

a) A licensed cleanfill site.

b) A licensed managed fill site.

c) A licensed solid waste landfill.

Disposal at a cleanfill site requires soil contaminant levels to be below local background levels of inorganic contaminants and have no organic or hydrocarbon contamination. The local background levels used in this report are those presented in the ARC TP 153 (ARC, 2001), previously discussed in Section 4.4.1. Slightly contaminated soils, for example, soils with contaminant levels above background levels but typically below ALW-Plan Schedule 10 criteria, may be disposed of at a licensed managed fill if the site soil/sediment contaminant levels meet the resource consent criteria that the licensed managed fill site operates under. There are several licensed managed fill sites within the greater Auckland area including Puketutu Island, Greenmount, Three Kings and Whangarata Quarry at Ridge Road in Pokeno. The Redvale landfill, a licensed solid waste landfill, can also accept managed fill at a discounted rate.

Typical managed fill criteria for a range of soil contaminants are listed in Table 4 below, however, it is recommended that the future contractor contacts the relevant licensed managed fill operator to check what their managed fill acceptance criteria are.

Table 4: Range of Typical Managed Fill Contaminant Acceptance Criteria

Parameter	Concentration (mg/kg)
Arsenic	30 - 100
Cadmium	0.65 - 10
Chromium (total)	125 - 400
Copper	90 - 325
Mercury	0.45 – 0.75
Nickel	105 – 320
Lead	65 – 250
Zinc	400 - 1160
TPH: C7-C9	20 - 300
TPH: C10-C14	5 - 500
TPH: C15-C36	500 - 10,000
BaP(equiv)	0.1 - 25
DDT (total)	0.35 - 12

Fill not accepted by a licensed managed fill site must be disposed of at a licensed solid waste landfill such as the Redvale landfill, Hampton Downs landfill or the Whitford landfill. A licensed solid waste landfill also operates under resource consent criteria stating maximum allowable soil contaminant concentrations and/or maximum leachable contaminant concentrations, typically specified via a Toxic Characteristic Leaching Procedure (TCLP) test. If the soil contaminant concentrations exceed the solid waste landfill TCLP criteria the soil may require treatment such as cement or lime stabilisation prior to acceptance by a licensed solid waste landfill.

It is recommended that the contractor contacts the appropriate off-site disposal site prior to earthworks starting at the site. The soil and sediment laboratory test results presented in the report may assist the contractor in obtaining the appropriate off-site soil and sediment disposal location(s).

11 ASSESSMENT OF SITE TEST RESULTS

The assessment of the site test results has been made against national and Auckland regulatory criteria and against the off-site disposal criteria, for soil, sediment and groundwater. This is discussed Sections 11.1 to 11.3 below.

11.1 Soil Contamination Assessment

The table in Appendix G provides an assessment of the seven soil samples against the SGVs from the NES, the Schedule 10 criteria of the ALW Plan and the TP 153 Auckland cleanfill criteria.

All TPH, PaH and OCP test results were below the laboratory limit of detection (LOD) testing (except for pyrene at three samples where it was at the LOD).

All heavy metals were below the SGVs and Schedule 10 criteria. Therefore no resource consents from Council under the ALW Plan or the NES Soil are required.

All heavy metals were also below the TP153 non-volcanic criteria. Therefore the spoil from the proposed valve chamber excavation locations can be disposed off-site as cleanfill, or it can be reused on-site.

11.2 Sediment Contamination Assessment

The table in Appendix H provides an assessment of the fourteen sediment samples against the Schedule 10 criteria of the ALW Plan, TP 153 Auckland background soil concentration (typically used as cleanfill criteria) and the ANZECC sediment quality guidelines.

All TPH, OCP and TBT test results were below the laboratory LOD.

Benzo(a)pyrene (BaP), one of the PaHs, was reported in four out of fourteen samples, the highest at sample location HA214a, where the Benzo(a)pyrene (BaP) equivalent concentration was 0.27 mg/kg. The HA214a BaP concentration of 0.27 mg/kg is well below the NES-SGV of 35 mg/kg, also below the ALW Plan Schedule 10 criteria of 2.15 mg/kg and also below the ANZECC ISQG-Low value of 0.43 mg/kg. Another PaH parameter, Phenanthrene, was slightly elevated in two sediment samples (0.33 mg/kg and 0.25 mg/kg) when assessed against the ISQG-Low value (0.24 mg/kg) but both samples were well below the ISQG-High value (1.5 mg/kg).

All heavy metals were below the Schedule 10 criteria.

All heavy metals, PaH and OCP test results were below the Schedule 10 criteria (and therefore also below the criteria listed in provision H.4.5.2.1.3 of the PAUP, see Section 4.4).

Arsenic was slightly elevated in eight out of fourteen sediment samples when compared to the Auckland background values for non-volcanic (12 mg/kg). In three of the eight samples Arsenic exceeded the ANZECC ISQG-Low criteria.

The 95% UCL of the eleven Arsenic sediment test results is 19.98 mg/kg, say 20 mg/kg (see Appendix I), above the 12 mg/kg concentration of Arsenic in Auckland background soils (for volcanic and non-volcanic soils). Therefore if the sediment requires off-site disposal during future earthworks at the site, it should not be disposed of at a licensed cleanfill site, but to a licensed managed fill site or a licensed solid waste landfill.

Since the 95% UCL of Arsenic is 20 mg/kg, i.e. the same as the ISQG-Low value, it is considered that the sediment can remain at its current location, or be reused on-site using, for example, mudcrete.

At one of the eleven sample locations Mercury was slightly elevated (0.20 mg/kg), compared to the ISQG-Low criteria of 0.15 mg/kg, but below the Auckland background value for Mercury (0.45 mg/kg).

The 95% UCL of Mercury is 0.12 mg/kg (see Appendix I) which is less than the ISQG-Low of 0.15 mg/kg. It is considered that the sediment can remain at its current location, or be reused on-site using, for example, mudcrete.

11.3 Groundwater Contamination Assessment

The groundwater test results from borehole BH201, located near the proposed receiving pit located south of SH18, see site plan contained in Appendix E, have been presented in Table 5, together with the assessment criteria from Section 9.4.2.

Table 5 shows that all test results are less than the laboratory LOD and less than the PA criteria for Freshwater and less than the PA criteria for Marine water. Therefore no resource consent is required under the ALW Plan.

If it is required to temporarily remove groundwater during the construction of the receiving pit located south of SH18, it may be discharged to the stormwater system.

Table 5: Groundwater Test Results and Guideline Values for Groundwater Contaminants.

Parameter	Groundwater Test Results, BH201	ALW Plan Permitted Activity Limits- Schedule 11-Table 3.4.1 ANZECC (2000)[1]		Adopted Groundwater Site Assessment Criteria
		Freshwater	Marine	
Arsenic	<0.011	0.024	ID [2]	0.240
Cadmium	<0.00053	0.0002	0.0055	0.055
Chromium	<0.0053	0.001	0.0044	0.044
Copper	<0.0053	0.0014	0.0013	0.013
Lead	<0.0011	0.0034	0.0044	0.044
Mercury	<0.00008	0.0006	0.0004	0.004
Nickel	<0.0053	0.011	0.070	0.7
Zinc	<0.011	0.008	0.015	0.150
Naphthalene	<0.0005	0.016	0.070	0.7
BaP (equiv)	<0.00010	0.0002 [3]	ID	0.002
Pyrene	<0.0002	-	-	-
C7 – C9	<0.10	-	-	-
C10 – C14	<0.2	-	-	-
C15 – C36	<0.4	-	-	-

Notes:

[1] All units are in mg/L (=g/m^3, as reported by Hill Laboratories, see Appendix E).

[2] ID means insufficient data to derive a reliable trigger value.

[3] A low reliability trigger value of 0.2 µg/L was derived for benzo[a]pyrene using the statistical distribution method (95% protection). This chemical has the potential to bio-accumulate but this has not been accounted for in this figure. Alternative protection levels were 99% 0.1 µg/L, 90% 0.4 µg/L, 80% 0.7 µg/L. The 99% figure is recommended if no data are available on bioaccumulation effects at specific sites. This is applicable to both fresh and marine waters and should only be used as an

indicative interim working level. Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 2 Aquatic Ecosystems - Rationale and Background Information (Chapter 8) October 2000.

12 ASSESSMENT OF ENVIRONMENTAL EFFECTS

12.1 Conceptual Model Development

A typical conceptual model for soil and groundwater contamination includes three items and their linkages:

a) Sources.

b) Pathways.

c) Receptors.

12.2 Sources

The conceptual site model source can be classified into one of three groups:

a) Known contamination.

b) Unknown contamination.

c) Future Project construction activity related contamination.

Known contamination areas have not been identified for the Project site, both in terms of the desktop study (see Sections 5 and 6) and the actual soil, sediment and groundwater testing at the site (see Section 11).

Unknown contamination areas are those that may be discovered during future excavation works associated with the Project, both in trench excavation and micro-tunnelling. Unknown contamination will be addressed in the CMP, including, as a minimum:

a) Guidance for site staff on how to recognise ground contamination during excavation works;

b) Procedures on how to deal with unforeseen ground contamination such as discovery protocols;

c) Potential ground contamination resulting from construction activities such as inadvertent spillages of fuel while refuelling construction plant and equipment.

12.3 Pathways

Pathways are the routes that move contaminants from the source to the receptors. Exposure routes are also considered pathways.

Contaminant pathways that have been considered in the preparation of this report are:

a) Ingestion of soil.

b) Dermal contact with soil.

c) Inhalation of vapours and dust.

d) Groundwater movement.

e) Overland flow of contaminated water.

f) Movement of contaminated sediments.

12.4 Receptors

Receptors are the elements that could be adversely affected by the contaminants and include:

a) People, in particular excavation and construction workers for the Project.

b) Ecological receptors, such as flora and fauna.

c) Groundwater.

d) Surface water.

e) Land quality.

12.5 Conclusion: Assessment of Human Health and Environmental Effects

The linkages between source, target and receptor are important in assessing the ground contamination risk during the construction of the proposed pipeline, both in terms of human health and environmental risks.

Soil, sediment and groundwater testing have shown that the potential risk to the receptors, in particular the construction workers, general public and future site users during and following the proposed works will be less than minor.

A conservative approach to manage unforeseen/unknown ground contamination is to use protocols that are designed to avoid, mitigate and remedy the potential for adverse effects on the environment, for example, the erosion and sediment management practices and the CMP. The CMP will be prepared will be once the contractor has been appointed and the CMP will be submitted to Council prior to construction as discussed in Section 2.3.4 of the AEE.

It is therefore considered that potential adverse effects on the environment arising from unforeseen/unknown ground contamination at the Project site can be avoided, mitigated and remedied by ensuring that the contractor adheres to the protocols listed in the CMP.

13 CONCLUSIONS

13.1 Conclusions

13.1.1 Statutory Assessment

a) No activity or industry listed on the HAIL was identified within the Project site and priority contaminants are shown to be below background levels. It is therefore considered that the requirements of the NES do not apply to the Project site.

b) The Project site's soil, sediment and groundwater contaminant levels have been assessed against the requirements of the contaminated land rules of the ALW Plan and the PAUP.

13.1.2 Sediment Contamination Assessment

c) The DSI shows that the sediment contaminant levels are:

   i. Below the laboratory level of detection for organic parameters except for minor amounts of PaHs.

   ii. Below the Auckland background concentrations for inorganic soils except for Arsenic.

   iii. Below the soil contaminant criteria specified in Rule 5.5.41 of the ALW Plan and below the soil contaminant criteria specified in provision H.4.5.2.1.3 of the PAUP.

d) Off-site sediment disposal may be at a licensed managed fill site or licensed solid waste landfill, i.e. not to a licensed cleanfill site. On-site disposal of the sediment or reuse of the sediment in, for example, mudcrete is permitted, from a contamination perspective.

e) The sediment contamination levels are below the Interim Sediment Quality Guidelines- Low Trigger Values (ANZECC, 2000), when using the 95% Upper Confidence Limit of the test results.

f) An ecological assessment for the Project is provided in Technical Report D- Ecology, Greenhithe Bridge Watermain Duplication and Causeway, Volume 2.

13.1.3 Soil Contamination Assessment

g) No resource consent is required under the ALW Plan since the requirements of Rule 5.5.41 are met, i.e. the soil contaminant levels are below the Schedule 10 contaminant criteria and other criteria referenced in Rule 5.5.41. Equally no resource consent in required under provision H.4.5.2.1.3 of the PAUP since the Schedule 10 criteria are the same as those listed in Table 1 of provision H.4.5.2.1.3, see Section 4.4.

h) The soil contaminant levels meet the Auckland background soil quality for non-volcanic soils and therefore spoil can be removed off-site to a licensed cleanfill site, if required. Equally the spoil can be reused on-site.

13.1.4 Groundwater

i) No resource consent is required under the ALW Plan since the requirements of Rules 5.5.57(e) and 5.5.58(c) are met, i.e. the discharge of groundwater contaminant levels, after

reasonable mixing, are below the ANZECC (2000) Freshwater criteria for 95% level of protection of species. No resource consent is required under the PAUP since the requirements of provision H.4.18.2.1.1.2 are met.

j) If temporary groundwater disposal is required during construction of the proposed valve chambers it may be disposed of as stormwater.

13.1.5 Assessment of Effects: Potential Soil, Sediment and Groundwater Contamination

k) It is considered that the potential soil, sediment and groundwater contamination effects related to the construction, operation and maintenance of the Project are less than minor.

l) It is considered that potential adverse effects on the environment arising from unforeseen/unknown ground contamination at the Project site can be avoided, mitigated and remedied by ensuring that the contractor adheres to the protocols listed in a Project CMP. The CMP will be prepared once the contractor has been appointed and the CMP will be submitted to Council prior to construction as discussed in Section 2.3.4 of the AEE.

14 LIMITATIONS

The sole purpose of this report is to present the findings of a Soil, Sediment and Groundwater Contamination Assessment carried out by Jacobs for the Client in connection with the Greenhithe Bridge Watermain Duplication and Causeway project. This report was produced in accordance with and is limited to the scope of services set out in the contract between Jacobs and the Client (Watercare Services Limited). That scope of services, as described in this report, was developed with the Client.

Sampling techniques, by definition, cannot determine the conditions between the sample points and so this report cannot be taken to be a full representation of the sub-surface conditions. This report only provides an indication of the likely sub surface conditions.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

15 REFERENCES

References that were considered in the preparation of the AEE were:

a) MfE, 2011, *Contaminated Land Management Guidelines No. 5, Site Investigation and Analysis of Soils, Revised 2011*, First published February 2004, Publication reference ME 1073.

b) Opus, 2014a, *Environmental Sampling & Testing Report- NH2 Watermain Greenhithe and Stream Crossings*, for Watercare Services Ltd, August 2014, reference GS14/091.

c) Opus, 2014b, *Geotechnical Factual Report, NH2 Advanced Works*, for Watercare Services Ltd, August 2014, reference GS14/089.

d) Jacobs (2014), *Sampling Methodology- Ground Contamination- North Harbour No. 2 Watermain*, by Jacobs/SKM, for Watercare Services Ltd, revision 1 final, 05 May 2014, ref. AE04521.

e) Jacobs/URS (2014), *Preliminary Design Report- Greenhithe Bridge Watermain Duplication*, draft final- October 2014, for Watercare Services Ltd.

16 ABBREVIATIONS

- AC: Auckland Council
- AEE: Assessment of Environmental Effects
- ALW Plan: Auckland Council Regional Plan: Air, Land & Water
- ANZECC: Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines (2000 version)
- ARC: Auckland Regional Council (now AC)
- BMP: Best Management Practices
- CLS: Concrete lined steel
- CMP: Construction Management Plan
- DSI: Detailed Site Investigation
- GBWD: Greenhithe Bridge Watermain Duplication
- GIS: Geographical Information System
- HAIL: Hazardous Activities and Industries List
- HM: Heavy Metals
- ISQG: Interim Sediment Quality Guidelines (as per ANZECC)
- Jacobs: Jacobs New Zealand Ltd
- km: kilometre
- ECLCS: Environmental Control, Licensing & Compliance Services
- LOD: Limit of Detection (analytical testing)
- m: metre
- MfE: Ministry for the Environment
- mm: millimetre
- NES: Resource Management (National Environmental Standard for Assessing & Managing Contaminants in Soil to Protect Human Health) Regulations 2011
- NH2: North Harbour No. 2 (watermain)
- NI: Northern Interceptor
- no.: number

- OCP: Organochlorine Pesticides
- Opus: Opus International Consultants Ltd
- PA: Permitted Activity
- PaH Polycyclic Aromatic Hydrocarbons
- PAUP: Proposed Auckland Unitary Plan
- PE: polyethylene
- PSI: Preliminary Site Investigation
- RMA: Resource Management Act
- RNZAF: Royal New Zealand Air Force
- SCS: Soil Contaminant Standard
- SGV: Soil Guideline Value
- SKM: Sinclair Knight Merz Ltd (now part of Jacobs)
- T&T: Tonkin & Taylor Ltd
- TBT: Tributyl Tin
- TCLP: Toxic Characteristic Leaching Procedure
- TOC: Total Organic Carbon
- TP: Technical Publication
- TPH: Total Petroleum Hydrocarbons
- UCL: Upper Confidence Limit (as per MfE Guideline No. 5, 2004)
- URS: URS New Zealand Ltd
- Watercare: Watercare Services Ltd

APPENDIX A HISTORICAL AERIAL PHOTOGRAPH REVIEW

no.	Section	Decade	notes	additional information
4	Fred Taylor to Greenhithe bridge	1940	no photo	
4	Fred Taylor to Greenhithe bridge	1950	road exists, surrounded by mixed agriculture and farming. Alternate route through motorway is farmland. No bridge. A large part of Hobsonville peninsula was used by the Ministry of Defence for housing, especially near the end (eastern end) of Buckley Ave. The preferred route only uses a relatively small portion of the western side of Buckley Ave and there is no reason to suspect that HAIL activities were carried out in the western portion of Buckley Ave.	photos from 1959
4	Fred Taylor to Greenhithe bridge	1960	no notes	
4	Fred Taylor to Greenhithe bridge	1970	still farmland on alternate routes. Port and possibly factories south of the Greenhithe bridge. Hobsonville road exists. Some houses have been buil ton hobsonville road/Brigham creek. New circular building near Brigham Creek	run 4598 1972
4	Fred Taylor to Greenhithe bridge	1980	no real changes, more residentual development on hobsonville road. Greenhithe bridge exists	run 5783 1981
4	Fred Taylor to Greenhithe bridge	1990	no notes	
4	Fred Taylor to Greenhithe bridge	2000	more houses. Motorway for alternate route built lates 2000s	
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	1940	no photo	
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	1950	no bridge. Pounapu road doesn't exist - pipeline corsses reserve/farmland. Other roads exist. Photo ends at kyle road. land use is rural residential	photos from 1959
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	1960	no notes	
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	1970	no Pounamu Road, farmland. Sunnyview road now existis	
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	1980	greenhithe bridge exists. No kyle/orwell road exists and crosses farmland, no structures. Kyle road east exists	photo SN 5783
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	1990	kyle road exists. Pounamu road not yet fully constructed	
5	Greenhithe to Tauhinus Road, Pounamu Ave, Sunny View, Kyle Road and Bush Road	2000	new subdivisions, more housing development	
6	Greenhithe to Bush Road (upper harbour Dr)	1940	no photo	
6	Greenhithe to Bush Road (upper harbour Dr)	1950	road exists mostly through reserve and some farm land. Albany highway exists	photos from 1959
6	Greenhithe to Bush Road (upper harbour Dr)	1960	no notes	
6	Greenhithe to Bush Road (upper harbour Dr)	1970	all reserve bush and same farm land around roads. Concrete pad east of William pitcher place - to be checked	run 4598/7 1972
6	Greenhithe to Bush Road (upper harbour Dr)	1980	concrete pad east of William pitcher place has building on it	SN5783
6	Greenhithe to Bush Road (upper harbour Dr)	1990	more housing development in the area	
6	Greenhithe to Bush Road (upper harbour Dr)	2000	Upper harbour highawy built.	

APPENDIX B HAZARDOUS ACTIVITIES AND INDUSTRIES LIST

Ministry for the Environment
Manatū Mō Te Taiao

Hazardous Activities and Industries List (HAIL)

October 2011

A Chemical manufacture, application and bulk storage

1. Agrichemicals including commercial premises used by spray contractors for filling, storing or washing out tanks for agrichemical application
2. Chemical manufacture, formulation or bulk storage
3. Commercial analytical laboratory sites
4. Corrosives including formulation or bulk storage
5. Dry-cleaning plants including dry-cleaning premises or the bulk storage of dry-cleaning solvents
6. Fertiliser manufacture or bulk storage
7. Gasworks including the manufacture of gas from coal or oil feedstocks
8. Livestock dip or spray race operations
9. Paint manufacture or formulation (excluding retail paint stores)
10. Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds
11. Pest control including the premises of commercial pest control operators or any authorities that carry out pest control where bulk storage or preparation of pesticide occurs, including preparation of poisoned baits or filling or washing of tanks for pesticide application
12. Pesticide manufacture (including animal poisons, insecticides, fungicides or herbicides) including the commercial manufacturing, blending, mixing or formulating of pesticides
13. Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground
14. Pharmaceutical manufacture including the commercial manufacture, blending, mixing or formulation of pharmaceuticals, including animal remedies or the manufacturing of illicit drugs with the potential for environmental discharges
15. Printing including commercial printing using metal type, inks, dyes, or solvents (excluding photocopy shops)
16. Skin or wool processing including a tannery or fellmongery, or any other commercial facility for hide curing, drying, scouring or finishing or storing wool or leather products
17. Storage tanks or drums for fuel, chemicals or liquid waste
18. Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

B Electrical and electronic works, power generation and transmission

1. Batteries including the commercial assembling, disassembling, manufacturing or recycling of batteries (but excluding retail battery stores)

2. Electrical transformers including the manufacturing, repairing or disposing of electrical transformers or other heavy electrical equipment
3. Electronics including the commercial manufacturing, reconditioning or recycling of computers, televisions and other electronic devices
4. Power stations, substations or switchyards

C Explosives and ordinances production, storage and use

1. Explosive or ordinance production, maintenance, dismantling, disposal, bulk storage or re-packaging
2. Gun clubs or rifle ranges, including clay targets clubs that use lead munitions outdoors
3. Training areas set aside exclusively or primarily for the detonation of explosive ammunition

D Metal extraction, refining and reprocessing, storage and use

1. Abrasive blasting including abrasive blast cleaning (excluding cleaning carried out in fully enclosed booths) or the disposal of abrasive blasting material
2. Foundry operations including the commercial production of metal products by injecting or pouring molten metal into moulds
3. Metal treatment or coating including polishing, anodising, galvanising, pickling, electroplating, or heat treatment or finishing using cyanide compounds
4. Metalliferous ore processing including the chemical or physical extraction of metals, including smelting, refining, fusing or refining metals
5. Engineering workshops with metal fabrication

E Mineral extraction, refining and reprocessing, storage and use

1. Asbestos products manufacture or disposal including sites with buildings containing asbestos products known to be in a deteriorated condition
2. Asphalt or bitumen manufacture or bulk storage (excluding single-use sites used by a mobile asphalt plant)
3. Cement or lime manufacture using a kiln including the storage of wastes from the manufacturing process
4. Commercial concrete manufacture or commercial cement storage
5. Coal or coke yards
6. Hydrocarbon exploration or production including well sites or flare pits
7. Mining industries (excluding gravel extraction) including exposure of faces or release of groundwater containing hazardous contaminants, or the storage of hazardous wastes including waste dumps or dam tailings

F Vehicle refuelling, service and repair

1. Airports including fuel storage, workshops, washdown areas, or fire practice areas
2. Brake lining manufacturers, repairers or recyclers
3. Engine reconditioning workshops
4. Motor vehicle workshops
5. Port activities including dry docks or marine vessel maintenance facilities

6. Railway yards including goods-handling yards, workshops, refuelling facilities or maintenance areas
7. Service stations including retail or commercial refuelling facilities
8. Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances

G Cemeteries and waste recycling, treatment and disposal

1. Cemeteries
2. Drum or tank reconditioning or recycling
3. Landfill sites
4. Scrap yards including automotive dismantling, wrecking or scrap metal yards
5. Waste disposal to land (excluding where biosolids have been used as soil conditioners)
6. Waste recycling or waste or wastewater treatment

H Any land that has been subject to the migration of hazardous substances from adjacent land in sufficient quantity that it could be a risk to human health or the environment

I Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment

APPENDIX C COUNCIL SITE CONTAMINATION ENQUIRY

Auckland Council
Te Kaunihera o Tāmaki Makaurau

18 March 2014

Sinclair Knight Merz Ltd
PO Box 9806
Newmarket
Auckland 1023

Attention: Walter Starke

Dear Walter

Site Contamination Enquiry – Watercare Proposed North Harbour No. 2 Watermain, various sites from Titirangi to Albany

This letter is in response to your enquiry requesting available site contamination information for the sites stated on your route plans. The following details are based on information available from the former Auckland Regional Council records system and information currently held by the Auckland Council Natural Resources and Specialist Input Unit. The details provided below exclude any property information held by the former district/city councils.

The tables in Attachment A outline the reference for the site-specific files and pollution incident files available for the subject sites.

The general catchment files and site visit files were not searched. These files contain pollution incidents where the source of pollution was not traced to a particular site, site visits where no follow-up correspondence was required and some information from archived files.

If the above sites are coastal or beside a river, it is possible that historic, unconsented reclamation may have occurred. The Auckland Council, Natural Resources and Specialist Input, Coastal Team may be able to provide further information.

The records reviewed as part of this Site Contamination Enquiry search do not identify individual horticultural sites in the region. However, there is a possibility that horticultural activities may have occurred at the sites. The local Auckland Council customer service centre, specific to the area of the site may be able to provide relevant information where former horticultural sites have been mapped.

If you are concerned that a historic land use (such as filling) may have caused the underlying soils to become contaminated, it is recommended that you obtain an independent environmental assessment of the sites. Staff from the Auckland Council Earthworks and Contaminated Land Team can provide advice on the results of any evaluation in terms of site remediation and/or potential consent requirements.

The former Auckland Regional Council and current Natural Resources and Specialist Input Unit databases were searched for records of landfill, bore, air discharge, industrial and trade process consents, contaminated site discharge consents, and environmental assessments for the properties adjacent to the sites. Relevant details of the identified consents are appended to this letter (Attachment B).

The details provided are in accordance with the obligation to make information publicly available upon request. While the Auckland Council has carried out the search using its best practical endeavours, it does not warrant its completeness or accuracy and disclaims any responsibility or liability in respect of the information. If you or any other person wishes to act or to rely on this information, or make any financial commitment based upon it, it is recommended that you seek appropriate technical and/or professional advice.

In addition, it is recommended that you contact the local customer service centre of the Auckland Council, specific to the sites being investigated: 50 Centreway Road, Orewa, 1 The Strand, Takapuna and 6 Henderson Valley Road, Henderson as they also may hold files with relevant information.

I trust that this answers your query. If you wish to discuss the matter further, please contact Andrew Kalbarczyk on 301 0101. Should you wish to request any of the files listed above for viewing, please contact the Auckland Council Call Centre on 301 0101 and note you are requesting former Auckland Regional Council records (the records department requires three working days' notice to ensure files will be available).

Please note: the Auckland Council cost recovers officer's time for all site enquiries. A basic enquiry takes approximately 1 - 2.5 hours to search the files and databases in which information is held. As such an invoice for the time involved in this enquiry will follow shortly.

Yours sincerely

pp. Gone

David Hampson
Team Leader - Earthworks and Contaminated Land
Natural Resources and Specialist Input

Attachment A

File Reference	5-21-3923		
File Name	165A Glengarry Road		
Site Occupier Name	Home Improvements Ltd		
Pollution Date	18/8/06	**Comment**	Concrete cutting waste entering SW drain
Pollution Date	15/8/06	**Comment**	Exposed aggregate wastewater to stormwater

File Reference	5-11-4459		
File Name	149 Glengarry Road		
Pollution Date	7/1/11	**Comment**	Wastewater- Sewer overflow

File Reference	5-11-4459 & W096-00-S		
File Name	471-479 West Coast Road (Parks)		
Pollution Date	21/9/11	**Comment**	Wastewater- Sewer overflow
Pollution Date	13/6/08	**Comment**	Wastewater- Sewer overflow

File Reference	5-11-4650		
File Name	109 Parrs Cross Road		
Pollution Date	14/7/13	**Comment**	Wastewater- Sewer overflow
Pollution Date	14/4/13		Wastewater- Sewer overflow

File Reference	5-11-4650		
File Name	117-119 Parrs Cross Road		
Pollution Date	12/4/12	**Comment**	Wastewater- Sewer overflow

File Reference	W224-21-SV		
File Name	1-3 Forest Hill Road		
Site Occupier Name	Gull Petroleum (NZ) Ltd		
Pollution Date	14/11/06	**Comment**	Diesel in SW ditch, outside petrol station

File Reference	5-41-3653		
File Name	69 Palomino Drive		
Pollution Date	1/3/13	**Comment**	Milky colour in the Opanuku stream

File Reference	5-11-4459		
File Name	61 Palomino Drive		
Pollution Date	1/7/11	**Comment**	Manhole overflowing and going into Opanuku stream

File Reference	5-21-2499S		
File Name	Munroe Road		
Pollution Date	16/2/06	**Comment**	Wastewater – Sewage Overflow

File Reference	5-22-1300		
File Name	Metcalf Road		
Pollution Date	31/1/01	Comment	Spill of oil from rear ended bus

File Reference	5-22-1429		
File Name	Metcalf Road		
Pollution Date	27/1/98	Comment	Stream turns to sewage in Summer and looks grey

File Reference	5-10-2564 & W224-10		
File Name	393-397 Don Buck Road		
Site Occupier Name	Mobil Oil NZ Ltd		
Pollution Date	8/9/13	Comment	Petrol spill around 8 litres into the storm drain
Pollution Date	21/12/10	Comment	Diesel spill
Pollution Date	21/1/03	Comment	Spill from Mobil forecourt contained in blocked drain. Approx. 10L to land

File Reference	5-10-1316		
File Name	Corner Don Buck and Triangle Roads		
Pollution Date	26/3/09	Comment	Diesel spill – small amount of 91 petrol having potentially entered S/W system

File Reference	5-22-1429		
File Name	Metcalf Road		
Pollution Date	27/1/98	Comment	Stream turns to sewage in Summer and looks grey

File Reference	5-10-0739		
File Name	1 Don Buck Road		
Site Occupier Name	PCL Feeds Ltd		
Pollution Date	28/9/09	Comment	Odour
Pollution Date	27/1/09	Comment	White dust from PCL Feeds
Pollution Date	5/3/07	Comment	Odour
Pollution Date	31/1/07	Comment	Animal feed smell

File Reference	5-11-4459		
File Name	2/41 Don Buck Road		
Pollution Date	20/5/11	Comment	Wastewater – Sewer overflow

File Reference	5-10-0739		
File Name	1 Red Hills Road		
Site Occupier Name	Mainfeeds Ltd/PCL Industries Ltd		
Pollution Date	Jan-Jun 2013	Comment	Odour complaints

File Reference	5-10-0900		
File Name	Buckley Ave		
Pollution Date	1/8/02	Comment	Sand contaminated with lead dumped near Kumeu river
Pollution Date	31/1/01	Comment	Stormwater abuse – chemicals - inorganic

File Reference	5-11-4459		
File Name	5 Pounamu Ave		
Pollution Date	17/8/11	Comment	Wastewater – Sewer overflow

File Reference	5-11-4450		
File Name	4 Sunnyview Road		
Pollution Date	5/12/12	Comment	Wastewater – Sewer overflow

File Reference	5-40-2271		
File Name	177 Kyle Road		
Pollution Date	30/8/05	Comment	Possible concrete to creek from road
Pollution Date	16/10/99	Comment	Wash off of burnt lime to a stream resulting from a burst water main

File Reference	5-11-4650		
File Name	End of Kyle Road		
Pollution Date	4/6/12	Comment	Wastewater – Sewer overflow

File Reference	5-11-4459		
File Name	93 Kyle Road		
Pollution Date	22/11/10	Comment	Wastewater – Sewer overflow

File Reference	5-11-3938		
File Name	12 Schnapper Rock Road		
Pollution Date	8/5/09	Comment	Waste to stormwater – concrete cutting without controls

File Reference	5-11-2423		
File Name	25 Schnapper Rock Road		
Pollution Date	21/1/13	Comment	Waste pollution – waste to stormwater

File Reference	5-21-3878		
File Name	2/27 Rhinevale Close		
Pollution Date	26/8/11	Comment	Solvent Odour
Pollution Date	19/8/11	Comment	Strong solvent odour smell

File Reference	5-10-1863		
File Name	119 Fred Taylor Drive		
Pollution Date	9/5/13	Comment	Strong Odour

File Reference	5-10-1038		
File Name	122 Hobsonville Road		
Pollution Date	24/8/94	Comment	Pollution incident

File Reference	5-11-1275		
File Name	70 Upper Harbour Drive		
Pollution Date	18/9/98	Comment	Spill of 2000 litres of diesel while fill

File Reference	7-37-2787		
File Name	Upper Harbour Drive		
Pollution Date	30/5/02	Comment	Truckload of batteries on Upper Harbour Drive

File Reference	5-10-0900		
File Name	WCC side of Upper Harbour Drive		
Pollution Date	31/1/01	Comment	Bright green discharge in water

File Reference	5-11-4650		
File Name	33 Greenhithe Road		
Pollution Date	7/12/12	Comment	Wastewater – Sewer overflow

File Reference	5-11-4457		
File Name	75 Greenhithe Road		
Pollution Date	19/10/12	Comment	Wastewater – Sewer overflow

File Reference	5-11-3680		
File Name	Greenhithe Road		
Pollution Date	26/10/06	Comment	Hydraulic oil in stream from crushed truck

File Reference	6-20-3007		
File Name	Greenhithe Road		
Pollution Date	25/11/05	Comment	White milky discharge into roadside gutter

File Reference	5-11-1272		
File Name	100 Bush Road		
Pollution Date	13/12/00	Comment	Discharge carpet cleaning waste
Pollution Date	31/7/99	Comment	Discharge wastewater to S/W

File Reference	5-11-1366		
File Name	169 Bush Road		
Pollution Date	28/11/08	Comment	Transformer oil spill
Pollution Date	4/07	Comment	Oil spill
Pollution Date	26/9/06	Comment	11000 switch valve electrical unit exploded
Pollution Date	16/1/06	Comment	Diesel spill from truck
Pollution Date	18/12/05	Comment	Vehicle collision with transformer

Pollution Date	24/6/05	Comment	Transformer oil going to stream
Pollution Date	8/3/04	Comment	Drilling done and sediment is going into stormwater
Pollution Date	10/2/04	Comment	Sediment running off site to stormwater
Pollution Date	20/10/03	Comment	Transformers onsite, bunded area going to interceptor system

File Reference	5-11-2860		
File Name	191 Bush Road		
Site Occupier Name	Clifton Rentals Ltd		
Pollution Date	24/8/02	Comment	Foam at small weir in Alexandra stream under bridge on Rosedale Road

File Reference	P270-04-18		
File Name	232 Bush Road		
Site Occupier Name	Accent Tools Ltd		
Pollution Date	31/8/02	Comment	Washing cars on yard

File Reference	5-11-0315		
File Name	Bush Road		
Site Occupier Name	NSCC Depot		
Pollution Date	26/9/94	Comment	Washing rubbish trucks and street cleaners, water running overland and into creeks

Attachment B

1. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	File ref: 5-21-3869. Investgtn of Gull site that had a previous pollution incident where hydrocarbons were entering stormwater.
ACTIVITY ID:	20797
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Under Assessment
EASTING:	1744312
EXPIRY DATE:	Null
FILE REFERENCE:	5-21-3869
GRANTED DATE:	Null
LOC TYPE:	Area
NORTHING:	5915668
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	51723
PROCESSING OFFICER:	John Earley
PROPERTY ADDRESS:	1-3 Forest Hill Road Henderson Waitakere
PURPOSE:	File ref: 5-21-3869. Investgtn of Gull site that had a previous pollution incident where hydrocarbons were entering stormwater.
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	TPH, BTEX, PAH found in soils on site above relevant G/L's. Remed reqrd.

2. ACTIVITY DESCRIPTION:	To authorise the construction of Eight bores for groundwater monitoring purposes.
ACTIVITY ID:	22185
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Toll NZ Consolidated Ltd C/- Arrow International Limited
CONSENT NUMBER:	29767
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20050912
FILE REFERENCE:	C512-12-3378*
GRANTED DATE:	20040910
LOC TYPE:	Point
PROCESSING OFFICER:	Trent Sunich
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of Eight bores for groundwater monitoring purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	North Auckland Railway & Metcalfe Road, Henderson, Waitakere City
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of Eight 50mm diameter bores to an approximate depth of 6m. Installation of class E, PVC casing.

3. ACTIVITY DESCRIPTION:	Discharge of contaminants associated with developing and operating an earth fill site.
ACTIVITY ID:	20342
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	NZ Railways Corp t/a Ontrack Infrastructure Ltd
CONSENT NUMBER:	31216
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20401231
FILE REFERENCE:	17432
GRANTED DATE:	20051125
LOC TYPE:	Point
PROCESSING OFFICER:	_Sarah Pinkerton
PROPERTY ADDRESS:	0 Pooks Road Ranui Waitakere
PURPOSE:	To authorise the ongoing diffuse discharge of contaminants to ground and groundwater in accordance with Section 15 of the Resource Management Act 1991.
REVIEW DATE:	20060430
SITE DESCRIPTION:	Null
SITE NAME:	NZRC - Ranui Fill site
WORKS DESCRIPTION:	Null

4. ACTIVITY DESCRIPTION:	To authorise the discharge of contaminats to air from the manufacture and processing of stock feed and farm supplies.
ACTIVITY ID:	20426
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Discharge To Air
CONSENT HOLDER:	Mainfeeds Limited
CONSENT NUMBER:	37270
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20141130
FILE REFERENCE:	17169
GRANTED DATE:	20131128
LOC TYPE:	Point
PROCESSING OFFICER:	Nicholas Browne
PROPERTY ADDRESS:	3-5 Red Hills Road Massey Waitakere
PURPOSE:	The discharge of contaminants into air from an animal feed mill and an 11.25 kW diesel fuelled boiler.
REVIEW DATE:	Null
SITE DESCRIPTION:	Stock feed manufacturer with diesel boiler
SITE NAME:	PCL - Mainfeeds Limited
WORKS DESCRIPTION:	Null

5. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	determine ALWP compliance
ACTIVITY ID:	20422
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1742962
EXPIRY DATE:	Null

FILE REFERENCE:	5-10-2564
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5922224
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	51293
PROCESSING OFFICER:	_Guy Sowry
PROPERTY ADDRESS:	397 Don Buck Road Massey Waitakere
PURPOSE:	determine ALWP compliance
REVIEW DATE:	Null
SITE DESCR:	397 Don Buck Road Lot 1 DP 211902
SITE NAME:	Mobil Don Buck
WORKS DESCRIPTION:	ust replacement. site remaining as a service station.

6. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of four bores for contaminated site investigation.
ACTIVITY ID:	23522
ACTIVITY STATUS:	Drilled
CONSENT STATUS:	Assessment Completed
EASTING:	1743052
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4552*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5922294
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52336
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	5 2 Triangle Road Massey Waitakere
PURPOSE:	To authorise the construction of four bores for contaminated site investigation.
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Challenge Massey
WORKS DESCRIPTION:	The construction of four 50mm diameter bores to a maximum depth of 6m. Installation of PVC casing material to an approximate depth of 6m.

7. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	4891
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Pattle Delamore Partners Limited
CONSENT NUMBER:	14066
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	19960810
FILE REFERENCE:	C512-12-1604*
GRANTED DATE:	19950810
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of three (3)

	piezometers for groundwater level and/or Chemistry investigations
REVIEW DATE:	Null
SITE DESCRIPTION:	Don Buck Road & Triangle Road, Massey West
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of three (3) 50mm dia. piezometers to approx 6m depth. Installation of PVC casing to approx 3m and PVC screen from approx. 3m to 6m if required.

8. ACTIVITY DESCRIPTION:	Change appl # 41419 - Condition 15 of LUC-2012-1026 to amend working hours to include Sundays. Consent # 40896 - To discharge contaminants to land or water from land undergoing disturbance, as part of the proposed bulk earthworks to create suitable build
ACTIVITY ID:	21331
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Auckland Transport (for regional consents) *
CONSENT NUMBER:	40896
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20180430
FILE REFERENCE:	23392
GRANTED DATE:	20121204
LOC TYPE:	Point
PROCESSING OFFICER:	Samuel Woolley
PROPERTY ADDRESS:	17-19 23, 35-39 Fred Taylor Drive Massey, Waitakere
PURPOSE:	To undertake earthworks, vegetation removal and discharge of contaminants to land and water.
REVIEW DATE:	20130530
SITE DESCRIPTION:	Null
SITE NAME:	17-19,23,35-39 Fred Taylor Dr, Massey
WORKS DESCRIPTION:	Null

8. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Change appl # 41419 - Condition 15 of LUC-2012-1026 to amend working hours to include Sundays. Consent # 40896 - To discharge contaminants to land or water from land undergoing disturbance, as part of the proposed bulk earthworks to create suitable build
ACTIVITY ID:	21331
ACTIVITY STATUS:	Occurring
APPLICANT:	Null
APPLICATION:	41419
APPLICATION STATUS:	Withdrawn
EASTING:	1743354
FILE REFERENCE:	23392
LOC TYPE:	Point
LODGED DATE:	20130222
NORTHING:	5923760
PROCESSING OFFICER:	Helen Caley

PROPERTY ADDRESS:	17-19 23, 35-39 Fred Taylor Drive Massey, Waitakere
PURPOSE:	To undertake earthworks, vegetation removal and discharge of contaminants to land and water.
SITE DESCRIPTION:	Null
SITE NAME:	17-19,23,35-39 Fred Taylor Dr, Massey
WORKS DESCRIPTION:	Null

9. ACTIVITY DESCRIPTION:	Consent is sought to undertake approximately 41.1 hectares of earthworks, reclaimation/ filling in of W21 & W22 watercourse (as identified in the Totara Creek ICMP) and management & development of a contaminated site.
ACTIVITY ID:	20975
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Cannuck Holdings Limited
CONSENT NUMBER:	36294
CONSENT STATUS:	Superseded
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20141231
FILE REFERENCE:	20865
GRANTED DATE:	20091006
LOC TYPE:	Area
PROCESSING OFFICER:	Andrew Kalbarczyk
PROPERTY ADDRESS:	1 2 Kedgley Drive Massey Waitakere
PURPOSE:	To authorise approximately the discharge of contaminants to groundwater or surface water from a closed solid waste landfill at 1/2A Kedgley Drive, associated with a proposed new town centre, State Highway 16 and Kedgley Drive, (opposite Westgate Shopping
REVIEW DATE:	20131030
SITE DESCRIPTION:	Null
SITE NAME:	Massey North Town Centre Development
WORKS DESCRIPTION:	Null

9. ACTIVITY DESCRIPTION:	Consent is sought to undertake approximately 41.1 hectares of earthworks, reclaimation/ filling in of W21 & W22 watercourse (as identified in the Totara Creek ICMP) and management & development of a contaminated site.
ACTIVITY ID:	20975
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Westgate Town Centre Limited
CONSENT NUMBER:	38886
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20141230
FILE REFERENCE:	20865
GRANTED DATE:	20110105
LOC TYPE:	Area
PROCESSING OFFICER:	Graham Hooper
PROPERTY ADDRESS:	1 2 Kedgley Drive Massey Waitakere

PURPOSE:	To authorise approximately the discharge of contaminants to groundwater or surface water from a closed solid waste landfill at 1/2A Kedgley Drive, associated with a proposed new town centre, State Highway 16 and Kedgley Drive, (opposite Westgate Shop
REVIEW DATE:	20111031
SITE DESCRIPTION:	Null
SITE NAME:	Massey North Town Centre Development
WORKS DESCRIPTION:	Null

9. ACTIVITY DESCRIPTION:	Consent is sought to undertake approximately 41.1 hectares of earthworks, reclaimation/ filling in of W21 & W22 watercourse (as identified in the Totara Creek ICMP) and management & development of a contaminated site.
ACTIVITY ID:	21072
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Westgate Town Centre Limited
CONSENT NUMBER:	37114
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20441231
FILE REFERENCE:	20865
GRANTED DATE:	20091006
LOC TYPE:	Point
PROCESSING OFFICER:	Andrew Kalbarczyk
PROPERTY ADDRESS:	1 2 Kedgley Drive Massey Waitakere
PURPOSE:	To discharge of contaminants to land and water from land containing elevated levels of contaminants that is undergoing remediation, all associated with a proposed new town centre, State Highway 16 and Kedgley Drive, (opposite Westgate Shopping Centre), M
REVIEW DATE:	20111231
SITE DESCRIPTION:	Null
SITE NAME:	Massey North Town Centre Development
WORKS DESCRIPTION:	Null

10. ACTIVITY DESCRIPTION:	To authorise the construction of 2 bores for geotechnical investigation.
ACTIVITY ID:	23219
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	URS New Zealand Limited
CONSENT NUMBER:	36319
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20091001
FILE REFERENCE:	C512-12-4292*
GRANTED DATE:	20081002
LOC TYPE:	Point
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	13 Holmes Drive South Massey Waitakere

PURPOSE:	To authorise the construction of 2 bores for geotechnical investigation.
REVIEW DATE:	Null
SITE DESCRIPTION:	On the eastern and western side of the Auckland Kumeu Motorway. On the grass verges in front of 13 Holmes Drive Lot 36 DP 87398 and Neon & Boron Limited Lot 1 DP 20568. Both sites owned by NZ Transport Agency
SITE NAME:	URS New Zealand Limited
WORKS DESCRIPTION:	The construction of two 100mm diameter bores to a maximum depth of 15m. Installation of Grade D slotted PVC screening material to an approximate depth of 15m to the bottom of screen and 5m to top of screen. Proposed grouting to 5m.

11. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	The construction of two bores for Geological investigation, Geotechnical investigation & Groundwater investigation purposes.
ACTIVITY ID:	28758
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Assessment Completed
EASTING:	1745051.08
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-5015*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5924442.81
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52841
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	74 Hobsonville Road West Harbour Waitakere
PURPOSE:	The construction of two bores for Geological investigation, Geotechnical investigation & Groundwater investigation purposes.
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Auckland Council
WORKS DESCRIPTION:	The construction of two 100mm diameter bores to an approximate depth of 15m. Installation of steel socketed and screwed casing material to an approximate depth of 10m. Proposed grouting to full length.

12. ACTIVITY DESCRIPTION:	Approx 1.5 cmpd.
ACTIVITY ID:	4809
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	MR GD WALKER HJ MATHEWS JM MATHEWS PS WALKER
CONSENT NUMBER:	13844
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	19960426
FILE REFERENCE:	C512-12-1566

GRANTED DATE:	19950426
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for the extraction of groundwater for stock and domestic supply
REVIEW DATE:	Null
SITE DESCRIPTION:	124 Hobsonville Road, Hobsonville
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx 200m depth and installation of steel casing to approx. 65m.

13. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of one bore for groundwater and contaminated site investigation.
ACTIVITY ID:	23447
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Assessment Completed
EASTING:	1747145
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4484
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5926265
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52267
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	12 Clark Road Hobsonville Waitakere
PURPOSE:	To authorise the construction of one bore for groundwater and contaminated site investigation.
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	BP Oil New Zealand Limited
WORKS DESCRIPTION:	Work done by Fuel Installations. Contact Bryce Bacon - 021 948623

14. ACTIVITY DESCRIPTION:	Discharge of contaminants from air force base land
ACTIVITY ID:	20490
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Hobsonville Land Company Limited
CONSENT NUMBER:	32584
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20411231
FILE REFERENCE:	19067
GRANTED DATE:	20070813
LOC TYPE:	Point
PROCESSING OFFICER:	_John Earley
PROPERTY ADDRESS:	Buckley Avenue Hobsonville Waitakere
PURPOSE:	To authorise the ongoing diffuse discharge of contaminants to ground and groundwater in

	accordance with Section 15 of the Resource Management Act 1991.
REVIEW DATE:	20070930
SITE DESCRIPTION:	Null
SITE NAME:	NZDF - Sludge Bed Remediation
WORKS DESCRIPTION:	Null

15. ACTIVITY DESCRIPTION:	To authorise the construction of up to three bores for monitoring purposes.
ACTIVITY ID:	22018
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	New Zealand Defence Force - Environmental Services
CONSENT NUMBER:	28653
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20041210
FILE REFERENCE:	C512-12-3217*
GRANTED DATE:	20031209
LOC TYPE:	Point
PROCESSING OFFICER:	_Amy Boulton
PROPERTY ADDRESS:	0 Buckley Avenue Hobsonville Waitakere
PURPOSE:	To authorise the construction of up to three bores for monitoring purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of up to three bores to a depth of approximately 5m. Installation of PVC casing to a depth of approximately 2.6m.

16. ACTIVITY DESCRIPTION:	New consent application
ACTIVITY ID:	21183
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Westgate Town Centre Limited
CONSENT NUMBER:	38794
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20151231
FILE REFERENCE:	20865
GRANTED DATE:	20110105
LOC TYPE:	Point
PROCESSING OFFICER:	Graham Hooper
PROPERTY ADDRESS:	9-11 State Highway 16 Massey Waitakere
PURPOSE:	To authorise approximately the discharge of contaminants to groundwater or surface water from a closed solid waste landfill at 1/2A Kedgley Drive, associated with a proposed new town centre, State Highway 16 and Kedgley Drive, (opposite Westgate Shop
REVIEW DATE:	20111031
SITE DESCRIPTION:	Null
SITE NAME:	Massey North

WORKS DESCRIPTION:	Null

17. ACTIVITY DESCRIPTION:	To authorise the construction of 56 bores for a new motorway development.
ACTIVITY ID:	22461
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	NZ Transport Agency ****use 5781****
CONSENT NUMBER:	31774
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20061130
FILE REFERENCE:	C512-12-3611*
GRANTED DATE:	20051128
LOC TYPE:	Point
PROCESSING OFFICER:	_Daryl Henehan
PROPERTY ADDRESS:	23-25 Trig Road Whenuapai Waitakere
PURPOSE:	To authorise the construction of 56 bores for a new motorway development.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	Null

18. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	5253
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	TUXFORD PROPERTIES LTD
CONSENT NUMBER:	15154
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	19970506
FILE REFERENCE:	C512-12-1766
GRANTED DATE:	19960506
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for the extraction of groundwater for stock and domestic supply
REVIEW DATE:	Null
SITE DESCRIPTION:	100 Hobsonville Road, Hobsonville
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx. 150m depth and installation of PVC casing to approx. 50m.

19. ACTIVITY DESCRIPTION: (duplicate of 12)	Approx 1.5 cmpd.
ACTIVITY ID:	4809
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	MR GD WALKER HJ MATHEWS JM MATHEWS PS WALKER
CONSENT NUMBER:	13844
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	19960426
FILE REFERENCE:	C512-12-1566
GRANTED DATE:	19950426
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for the extraction of groundwater for stock and domestic supply
REVIEW DATE:	Null
SITE DESCRIPTION:	124 Hobsonville Road, Hobsonville
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx 200m depth and installation of steel casing to approx. 65m.

20. ACTIVITY DESCRIPTION:	Discharge of contaminants associated with earthworks involved with the development of a proposed retirement village complex.
ACTIVITY ID:	21295
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Summerset Villages (Hobsonville) Limited
CONSENT NUMBER:	40426
CONSENT STATUS:	Issued
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20231101
FILE REFERENCE:	23091
GRANTED DATE:	20131101
LOC TYPE:	Point
PROCESSING OFFICER:	Helen Caley
PROPERTY ADDRESS:	22-24 Upper Harbour Drive Hobsonville Waitakere
PURPOSE:	To discharge contaminants associated with the development and operation of a retirement village.
REVIEW DATE:	20141101
SITE DESCRIPTION:	Null
SITE NAME:	1-2 Squadron Drive, Hobsonville
WORKS DESCRIPTION:	Null

21. ACTIVITY DESCRIPTION:	Stock and domestic and to supply a restaurant. Will require a Permitted Activity.
ACTIVITY ID:	21079
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	MICHAEL RONALD EVANS & ANN KATHLEEN EVANS
CONSENT NUMBER:	23230
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20020201
FILE REFERENCE:	C512-12-2485
GRANTED DATE:	20010201
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	22-24 Upper Harbour Drive Hobsonville Waitakere
PURPOSE:	Authorise the construction of a bore for stock and domestic supply and to supply a restaurant.
REVIEW DATE:	Null
SITE DESCRIPTION:	5 Upper Harbour Drive, Hobsonville.
SITE NAME:	MR & AK Evans
WORKS DESCRIPTION:	Construction of a 100mm diameter bore to a depth of approximately 200m and installation of PVC casing to approximately 65m depth.

22. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	To discharge contaminants to land or water from land undergoing disturbance as part of the proposal to create development lots to facilitate future development of the Hobsonville Sunderland Precinct Buckley Avenue East.
ACTIVITY ID:	21441
ACTIVITY STATUS:	Occurring
APPLICANT:	Hobsonville Land Company Limited
APPLICATION:	42393
APPLICATION STATUS:	Processing
EASTING:	1748353
FILE REFERENCE:	24188
LOC TYPE:	Point
LODGED DATE:	20131118
NORTHING:	5927369
PROCESSING OFFICER:	Helen Caley
PROPERTY ADDRESS:	Buckley Avenue Hobsonville Waitakere
PURPOSE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Hobsonville Sunderland Precinct Buckley Ave East
WORKS DESCRIPTION:	Null

23. ACTIVITY DESCRIPTION:	Authorise the construction of a bore for the extraction of groundwater for domestic supply.
ACTIVITY ID:	20150
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	MR K MAREVICH
CONSENT NUMBER:	21320
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	19990408
FILE REFERENCE:	C512-12-2172
GRANTED DATE:	19980407
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	74 Upper Harbour Drive Greenhithe North Shore
PURPOSE:	Authorise the construction of a bore for the extraction of groundwater for domestic supply.
REVIEW DATE:	Null
SITE DESCRIPTION:	74 Upper Harbour Drive, Greenhithe
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm diameter bore to a depth of approximately 200m and installation of PVC casing to approximately 60m depth.

24. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	21855
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Kerrie Cleverdon Orton, John William Orton & Anthony Charles Horrocks
CONSENT NUMBER:	27736
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20040312
FILE REFERENCE:	C512-12-3069
GRANTED DATE:	20030311
LOC TYPE:	Point
PROCESSING OFFICER:	_Michelle Ip
PROPERTY ADDRESS:	124 Upper Harbour Drive Albany North Shore
PURPOSE:	Authorise the construction of a bore for domestic supply.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm diameter bore to a depth of approximately 200m. Installation of PVC casing to a depth of approximately 70m.

25. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	21191
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	MARK GORDON HILLIS GAYLE KATHLEEN HILLIS MARY ELLEN COLE
CONSENT NUMBER:	23881
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20010329
FILE REFERENCE:	C512-12-2555
GRANTED DATE:	20000328
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	175 Upper Harbour Drive Greenhithe North Shore
PURPOSE:	Authorise the construction of a bore for the extraction of groundwater for domestic supply
REVIEW DATE:	Null
SITE DESCRIPTION:	175 Upper Harbour Drive, Greenhithe
SITE NAME:	MG & GK Hollis
WORKS DESCRIPTION:	Construction of a 100mm diameter bore to a depth of approximately 200m and installation of PVC casing to adepth of approximately 60m.

26. ACTIVITY DESCRIPTION:	Construction of a 100mm dia. bore to approx. 150m depth and installation of P.V.C. casing to approx. 60m.
ACTIVITY ID:	503
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	J WYATT
CONSENT NUMBER:	10675
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	19910122
FILE REFERENCE:	14/17/437
GRANTED DATE:	19900118
LOC TYPE:	Point
PROCESSING OFFICER:	Andrew Millar
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for the extraction of groundwater for stock and domestic supply.
REVIEW DATE:	Null
SITE DESCRIPTION:	260 Upper Harbour Drive,, Greenhithe,
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx. 150m depth and installation of P.V.C. casing to approx. 60m.

27. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	21375
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	NZ Transport Agency Attn: Tammy Muharemi
CONSENT NUMBER:	25014
CONSENT STATUS:	Expired
DATE CREATE:	13/03/2014 7:18:58 p.m.
EXPIRY DATE:	20020319
FILE REFERENCE:	C512-12-2702*
GRANTED DATE:	20010319
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	Upper Harbour Motorway Auckland
PURPOSE:	Authorise the construction of twenty six (26) bores for geotechnical investigation.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Upper Harbour Corridor
WORKS DESCRIPTION:	Construction of twenty six (26) 100mm diameter bores to a depth of approximately 25m. Installation of PVC casing.

28. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	The construction of three 100mm diameter bores to a maximum depth of 20m.
ACTIVITY ID:	27946
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Assessment Completed
EASTING:	1752320.96
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4816*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5930368.16
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52624
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	The construction of three 100mm diameter bores to a maximum depth of 20m.
REVIEW DATE:	Null
SITE DESCR:	Three locations along Albany Highway road reserve between Upper Harbour Drive and Sunset Road.
SITE NAME:	Albany Highway Widening
WORKS DESCRIPTION:	Null

29. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Caltex Schnapper Rock 178 Old Albany Highway
ACTIVITY ID:	20311
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1751932
EXPIRY DATE:	Null
FILE REFERENCE:	5-01-3451
GRANTED DATE:	Null
LOC TYPE:	Area
NORTHING:	5930776
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	51104
PROCESSING OFFICER:	_Sarah Pinkerton
PROPERTY ADDRESS:	
PURPOSE:	complete tank pull
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Caltex Schnapper Rock
WORKS DESCRIPTION:	PO peter KAvanagh

30. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Proposed res dev't on site with fill from road scrapings. Elevated PAH.
ACTIVITY ID:	20856
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1751661
EXPIRY DATE:	Null
FILE REFERENCE:	5-11-3938
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5930876
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	51793
PROCESSING OFFICER:	Andrew Kalbarczyk
PROPERTY ADDRESS:	12 Schnapper Rock Road Schnapper Rock North Shore
PURPOSE:	File ref: 5-11-3938. Proposed res dev't on site with fill from road scrapings. Elevated PAH.
REVIEW DATE:	Null
SITE DESCR:	Proposed res dev't on site with fill from road scrapings. Elevated PAH.
SITE NAME:	12 Schnapper Rock Rd
WORKS DESCRIPTION:	Removal of 40-60 cubic metres of soil. Site validation.

31. ACTIVITY DESCRIPTION:	An application for a contaminated site discharge consent associated with the proposed development of the site into a resource recovery facility
ACTIVITY ID:	21190
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Contaminated Site Discharge
CONSENT HOLDER:	Atlas Concrete Limited
CONSENT NUMBER:	39060
CONSENT STATUS:	Surrendered
DATE CREATE:	14/03/2014 7:22:39 p.m.
EXPIRY DATE:	20160430
FILE REFERENCE:	22398
GRANTED DATE:	20110523
LOC TYPE:	Point
PROCESSING OFFICER:	Andrew Kalbarczyk
PROPERTY ADDRESS:	8 Paul Matthews Road Rosedale North Shore
PURPOSE:	To discharge contaminants to land or water associated with land disturbance during the proposed site development works. This is for a short term discharge consent for the initial site development works for a resource recovery facility.
REVIEW DATE:	20120531
SITE DESCRIPTION:	Null
SITE NAME:	8 Paul Matthews Road, Rosedale
WORKS DESCRIPTION:	See also Air: 38988 (file no 22352), Stormwater 39058 file no 22397) & ITP: 39059 (file no 22397).

31. ACTIVITY DESCRIPTION:	To discharge contaminants onto or into land or water from an industrial trade process associated with the crushing of recycled concrete(including other ancillary processes).
ACTIVITY ID:	230
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Industrial or Trade Process
CONSENT HOLDER:	Atlas Concrete Limited
CONSENT NUMBER:	39059
CONSENT STATUS:	Issued
DATE CREATE:	14/03/2014 7:22:39 p.m.
EXPIRY DATE:	20460513
FILE REFERENCE:	22397
GRANTED DATE:	20110516
LOC TYPE:	Point
PROCESSING OFFICER:	Jacqueline Anthony
PROPERTY ADDRESS:	8 Paul Matthews Road Rosedale North Shore
PURPOSE:	To discharge contaminants onto or into land or water from an industrial trade process associated with the crushing of recycled concrete(including other ancillary processes).
REVIEW DATE:	20120630
SITE DESCRIPTION:	Null
SITE NAME:	8 Paul Matthews Road, Rosedale
WORKS DESCRIPTION:	See also Air: 38988 (file no. 22398), Stormwater 39058 (file no 22397) & Contaminated Land

	discharge 39060 (file no 22352).

31. ACTIVITY DESCRIPTION:	To discharge contaminants to air from activities which are associated with the crushing of recycled concrete and other ancillary processes
ACTIVITY ID:	20482
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge To Air
CONSENT HOLDER:	Atlas Concrete Limited
CONSENT NUMBER:	38988
CONSENT STATUS:	Issued
DATE CREATE:	14/03/2014 7:22:39 p.m.
EXPIRY DATE:	20260513
FILE REFERENCE:	22352
GRANTED DATE:	20110516
LOC TYPE:	Point
PROCESSING OFFICER:	Mike Harvey
PROPERTY ADDRESS:	8 Paul Matthews Road Rosedale North Shore
PURPOSE:	To discharge contaminants to air from activities which are associated with the crushing of recycled concrete and other ancillary processes
REVIEW DATE:	20120630
SITE DESCRIPTION:	Concrete crushing facility
SITE NAME:	8 Paul Matthews Road
WORKS DESCRIPTION:	See also ITP: 39059 (file no 22397), Stormwater 39058 (file no 22397) & Contaminated Land discharge 39060 (file no. 22398).

32. ACTIVITY DESCRIPTION:	Discharge of contaminants to land from an industrial trade process associated with commercial offices and storage depot for an electricity servicing operation.
ACTIVITY ID:	99
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Industrial or Trade Process
CONSENT HOLDER:	Siemens (NZ) Limited
CONSENT NUMBER:	32849
CONSENT STATUS:	Surrendered
DATE CREATE:	14/03/2014 7:22:39 p.m.
EXPIRY DATE:	20271231
FILE REFERENCE:	2343
GRANTED DATE:	20071108
LOC TYPE:	Point
PROCESSING OFFICER:	_Chris Bailey
PROPERTY ADDRESS:	169 Bush Road Rosedale North Shore
PURPOSE:	To authorise the discharge of contaminants onto or into land from an industrial or trade process in accordance with Section 15 of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Administration and servicing of electrical and gas utilities
SITE NAME:	Siemens Energy Services
WORKS DESCRIPTION:	Works Catchment area- impervious Catchment area- pervious Design Standard

	Triple Interceptor Tank (existing) 0.1134 ha Compliant with ARC TP10 (1992) oil/water separation Mixed media (sand and peat) filter 0.2650 ha Compliant with ARC TP10 (July 2003)

33. ACTIVITY:	Industrial or Trade Process
ACTIVITY DESCRIPTION:	Discharge of contaminants to land from an industrial trade process associated with commercial offices and storage depot for an electricity servicing operation.
ACTIVITY ID:	99
ACTIVITY STATUS:	Proposed
APPLICANT:	Null
APPLICATION:	32646
APPLICATION STATUS:	Not Accepted For Pro
EASTING:	1752370
FILE REFERENCE:	2343
LOC TYPE:	Point
LODGED DATE:	20060526
NORTHING:	5931780
PROCESSING OFFICER:	Null
PROPERTY ADDRESS:	169 Bush Road Rosedale North Shore
PURPOSE:	Null
SITE DESCRIPTION:	Administration and servicing of electrical and gas utilities
SITE NAME:	Siemens Energy Services
WORKS DESCRIPTION:	Null

34. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	21705
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	North Shore City Council
CONSENT NUMBER:	26744
CONSENT STATUS:	Expired
DATE CREATE:	14/03/2014 7:22:39 p.m.
EXPIRY DATE:	20030526
FILE REFERENCE:	C512-12-2926
GRANTED DATE:	20020524
LOC TYPE:	Point
PROCESSING OFFICER:	Roger Bannister
PROPERTY ADDRESS:	0066 BUSH RD NORTH HARBOUR INDUSTRIAL
PURPOSE:	Authorise the construction of a bore for groundwater monitoring purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm diameter bore to a depth of approximately 10m.

35. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	5695
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Maunsell Limited
CONSENT NUMBER:	16024
CONSENT STATUS:	Expired
DATE CREATE:	14/03/2014 7:22:39 p.m.
EXPIRY DATE:	19980320
FILE REFERENCE:	C512-12-1957
GRANTED DATE:	19970320
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for groundwater level and/or Chemistry investigations
REVIEW DATE:	Null
SITE DESCRIPTION:	SPENCER RD, ALBANY,
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx 20m depth. Installation of PVC casing to approx 15m and PVC screen from approx. 15m to 20m if required.

36. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	The construction of a 100mm diameter bore to an approximate depth of 16.95m for geotechnical investigation purposes.
ACTIVITY ID:	27905
ACTIVITY STATUS:	Drilled
CONSENT STATUS:	Assessment Completed
EASTING:	1753072
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4812
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5933811
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52621
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	69 Corinthian Drive Albany North Shore
PURPOSE:	The construction of a 100mm diameter bore to an approximate depth of 16.95m.
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Corinthian Drive, Albany.
WORKS DESCRIPTION:	Null

36. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	The construction of a 100mm diameter bore to an approximate depth of 16.95m for geotechnical investigation purposes.
ACTIVITY ID:	27905
ACTIVITY STATUS:	Drilled
APPLICANT:	Null
APPLICATION:	39146
APPLICATION STATUS:	Invalid
EASTING:	1753072
FILE REFERENCE:	C512-12-4812
LOC TYPE:	Point
LODGED DATE:	20110411
NORTHING:	5933811
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	69 Corinthian Drive Albany North Shore
PURPOSE:	To authorise the construction of a bore for water level monitoring and geotechinical purposes. no abstaction intended.
SITE DESCRIPTION:	Null
SITE NAME:	Corinthian Drive, Albany.
WORKS DESCRIPTION:	the construction of a 100mm diameter bore to an approximate depth of 16.95m

APPENDIX D SAMPLING METHODOLOGY: SOIL, SEDIMENT & GROUNDWATER

Sampling Methodology: Ground Contamination

By: Walter Starke, Jacobs SKM

Date: 5th May 2014

Revision: 1- final issue

1) Introduction

Watercare Services Ltd (Watercare) is the primary distributer of potable water in the Auckland Region. Watercare require a second pipeline, the North Harbour No. 2 Watermain, to accommodate growth and development in the north and western areas of the Auckland region. It is also required in order to provide redundancy in the Watercare network supplying Waitakere, North Shore, the Whangaparoa Peninsula and Orewa.

The North Harbour No. 2 Watermain will extend between the future Titirangi No. 3 (Manuka Road) Reservoir at the Huia Water Treatment Plant (WTP) and the Albany Reservoir.

In summary the North Harbour No. 2 Watermain Project incorporates:

a) a pipeline length of approximately 33 km;

b) a nominal pipeline internal diameter of 1200 mm between Manuka Road Reservoir and the Swanson Watermain (a pipe length of approximately 10-11 km);

c) a nominal pipeline internal diameter of 910 mm between the Swanson Watermain and the Albany Reservoirs (a pipe length of approximately 22 km);

d) Associated works including pipe bridges, coastal crossings, chambers and operational features such as air, line and scour valves.

To assess if ground contamination would adversely affect the proposed pipeline Watercare engaged Jacobs SKM to carry out an initial fatal flaw assessment in early 2014. This work is presented in the report titled *Initial Fatal Flaw Assessment- Soil & Groundwater Contamination*, revision 3, dated 3rd April 2014 (Jacobs SKM, 2014).

One of the recommendations of the report was to prepare a Sampling & Analysis Plan (SAP) to obtain site specific soil and groundwater quality data for the preferred route and to obtain this data, where practical, during future geotechnical and hydrogeological fieldwork for the proposed pipeline.

The first stage of the geotechnical and hydrogeological fieldwork is presented in the URS New Zealand Ltd (URS) report titled *"Specification, North Harbour No. 2 Watermain, Advanced Works Greenhithe and Stream Crossing, Geotechnical Investigation Updated Scope"*, ref. 42073300/S001/B, status- final, dated 27th March 2014. This report contained the proposed geotechnical investigation locations.

On 15th April 2014 Jacobs SKM prepared a Draft Sampling & Analysis Plan (SAP), with respect to soil and groundwater contamination, based on the geotechnical specification by URS. The draft SAP provided proposed soil, sediment and groundwater sample locations and depths, and the proposed laboratory testing regime.

On 30th April URS, Watercare and Tonkin & Taylor Ltd (T&T) provided comments on the draft SAP. Their comments have been included in the attached updated version of the SAP, revision 1.

This document/memorandum provides the sampling methodology for the attached SAP, revision 1.

It is assumed that the reader of this document is familiar with the above-mentioned reports.

2) General: Soil, Sediment and Groundwater

It is anticipated that all soil, sediment and groundwater samples will be taken during the geotechnical and hydrogeological fieldwork for the Advanced Works Greenhithe and Stream Crossings.

3) Soil Sampling

Soil samples will be collected from the strata and/or depth ranges:

a) The near surface soils, described as 0.0-0.2 metres below ground level (m bgl).

b) At a change in strata/geology.

c) Where there is visual or olfactory evidence of ground contamination

d) At the groundwater table.

The attached SAP, rev. 1, has allowed for soil samples to be taken from the following three depth ranges: 0.0-0.2 m, 0.9-1.1m and 1.9-2.1 m. These are indicative depths only and items a) to d) above will take precedence of these three depth ranges.

The following items shall be recorded and/or undertaken during the soil sampling fieldwork:

e) The fieldstaff taking the soil samples shall maintain a daily site log, including, as a minimum, the date, person carrying out the work, weather conditions and that the actual sample locations match those presented on the SAP. If the sample locations have changed Jacobs-SKM shall be notified immediately (for example, via mobile telephone) and the newly agreed locations shall be clearly reported by the fieldstaff in the daily site logs.

f) All soil samples shall be labelled, as a minimum, with a unique sample number part referencing the borehole number, the depth the sample was collected at, date and time of sampling, project number and name of initial of person sampling.

g) All soil samples shall be placed in laboratory cleaned sample containers/jars.

h) Avoid cross contamination between sample locations by, for example, using stainless steel tools to obtain the sample, decontaminate the sampling tools using Decon 90 or a similar industrial type material, use fresh and disposable latex glove when taking each sample and ensuring the drilling rig is decontaminated appropriately.

i) In the field place all sample containers in a cooled chilly-bin or similar insulated container(s) and be couriered to the laboratory the same day. If samples are to be kept overnight they shall be refrigerated at 4C and couriered to the chemical testing laboratory the following day.

j) The chemical testing laboratory shall be one that is certified by International Accreditation New Zealand (IANZ).

k) A field replicate sample shall be taken every ten samples.

l) The fieldstaff shall report the absence or presence of visual and/or olfactory evidence of contamination in the sample.

4) Sediment Sampling

The sediment sample locations shall be obtained from the locations identified on the attached SAP, rev. 1.

Sediment samples will be collected from the following depth ranges:

a) From 0.0-0.1 m depth.

b) From 0.9-1.0 m depth.

c) From 1.9-2.0 m depth.

d) If the sediment depth is less than 0.9 m than the sediment sample shall be taken from the lowest 100 mm of sediment. For example, if the sediment depth is 800 mm below ground level the sediment sample shall be taken from 0.7-0.8 m depth.

e) If the sediment depth is less than 0.5 m, the only sediment sample shall be from 0.0-0.1 m.

f) The same sediment sampling philosophy applies for sediment depths greater than 1.0 m.

All samples will be obtained by a sediment sampler such as a piston push probe sampler. The surface sample will be collected from the top of the core. The items to be recorded and/or undertaken during the sediment sampling fieldwork shall be the same as that for the soil sampling fieldwork described above.

5) Groundwater: Boreholes & Monitoring Well Installation

The boreholes and monitoring well installation shall be constructed in accordance with New Zealand Standard (NZS) 4411; 2001, titled *"Environmental Standard for Drilling of Soil and Rock".*

The boreholes shall be logged in accordance with the document titled *"Field Description of Soil and Rock, Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes"* published by the New Zealand Geotechnical Society (NZGS) in 2005.

The drilling rig shall be appropriately cleaned prior to the drilling works starting, between borehole locations and when there is visual and/or olfactory evidence of ground contamination during drilling. All cleaning procedures shall be recorded in the daily field-log by the fieldstaff.

The monitoring well installation shall be as described in Jacobs-SKM hydrogeological part of the project.

For those piezometers scheduled for groundwater sampling (see item 6 below) the minimum piezometer diameter shall be a minimum of 32 mm and the screen depth shall be at least 1 m above the highest groundwater table level and be 1 m below the lowest groundwater table level.

All monitoring wells shall be 'developed' by removing the sediment within the well (as far as is reasonably practical), for example, using compressed air to clear the well or suspended sediments located within the well. This work shall be carried out prior to moving to the next borehole location.

6) Groundwater: Sampling

The groundwater samples shall be collected from the locations identified on the attached SAP, rev. 1.

The groundwater samples shall be collected in accordance with good guidance practice such as the AS/NZS 5667.11:1998 document titled *"Water quality—Sampling. Part 11: Guidance on Sampling of Groundwaters."*

Groundwater samples shall be collected as follows:

a) Record the condition of the well/piezo head.

b) After removing the cap from the well head record the presence or absence of odours emanating from the well.

c) Measure depth the groundwater table and depth to the base of the monitoring well and record.

d) Calibrate the portable field testing parameter kit which must contain, as a minimum, pH-Value, Electrical Conductivity and Temperature.

e) Collect groundwater samples using low flow portable peristaltic pumps.

f) Clean sampling equipment using distilled water with Decon 90 or similar and/or use dedicated tubing for the groundwater sampling.

g) Purge a minimum of three well volumes prior to sampling.

h) During purging record the field parameters (see item d above).

i) Continue purging until field parameters have stabilised: pH-Value ± 0.1, Electrical Conductivity ± 3% and temperature ±0.2%.

j) During purging record the groundwater table depth in the well.

k) Label groundwater sample bottles appropriately (see Section 3-f above).

l) Collect groundwater sample for which field filtering is not required and place into appropriate sample bottle.

m) Field filter (0.45 µm) groundwater sample for dissolved metals using laboratory supplied filter kit and place into appropriate sample bottle.

n) Record the depth to the groundwater table immediately after the groundwater samples have been taken.

o) All groundwater samples shall be labelled, as a minimum, with a unique sample location number part referencing the borehole number, date and time of sampling, project number and name of initial of person sampling

p) The additional item to be recorded and/or undertaken during the groundwater sampling fieldwork shall be the same as that for the soil sampling fieldwork described above.

7) Chain of Custody /Request for Analysis Form

A Chain of Custody/Request for Analysis Form shall be maintained for all soil, sediment and groundwater samples. An example of a suitable form is the standard Chain of Custody/Request for Analysis form from R J Hill Laboratories in Hamilton.

8) Laboratory Testing

All laboratory testing shall be carried out using an IANZ certified laboratory such as R J Hill Laboratories in Hamilton.

The proposed laboratory testing regime is indicated on the attached Excel Spreadsheet. To clarify: for sediment laboratory testing two types of 'metal' testing has been scheduled, see attached Excel Spreadsheet:

a) Metals (1): this testing is scheduled to provide an assessment should the sediment be removed off-site to an appropriate landfill disposal site.

b) Ecology Metals (7): this testing is scheduled to provide an ecological assessment of the sediment, in particular the Environmental Response Criteria (ERC), in accordance with the document Auckland Regional Council Technical Publication (TP) No. 168, August 2004. For example, the ERC for heavy metals are assessed against the test results of a weak acid digestion of the mud fraction (<63µm) or a strong acid digestion of the total sediment fraction (<500µm). Testing should be carried out on the uppermost (surface) 2 cm of sediment only, as per TP168.

The detection limits for the proposed laboratory testing shall be, as a minimum, those presented in Table 1 below. These detection limits are broadly those provided by R J Hill Laboratories Ltd.

9) Quality Control

All soil, sediment and groundwater samples shall be obtained in accordance with good practices for contaminated land investigations. Key items are as follows:

a) Decontaminate all sampling equipment between sampling locations.

b) Obtain one replicate sample for every ten samples taken.

c) Only use laboratory cleaned sample jars/containers.

d) Label each sample so that it can be uniquely identified.

e) Record all sampling and fieldwork undertaken, including any deviations from this Sampling Methodology document.

f) Use appropriate Chain of Custody/Request for Analysis Forms.

g) Use an IANZ certified laboratory for the contaminant testing.

h) All soil, sediment and groundwater samples that are not scheduled for laboratory testing shall be sent to Watercare Services Ltd within 1 week of the samples being taken. It is envisaged that the samples will be kept for a period of six months after the fieldwork has been completed.

Table 1: Minimum Detection Limits: Laboratory Testing

Parameter	Soil & Sediment (mg/kg)	Sediment (mg/kg), ARC extraction	Groundwater (g/m3)
Arsenic	2	1	0.001
Cadmium	0.1	0.05	0.00005
Chromium	2	1	0.0005
Copper	2	1	0.0005
Lead	0.4	0.2	0.0001
Nickel	2	1	0.0005
Zinc	4	2	0.001
Mercury	0.1	0.05	0.00008
TPH:		n/a	
C7--C9	8		0.1
C10-C14	20		0.2
C15-C36	30		0.4
C7-C36 (total)	60		0.7
PaH	0.03-0.1	n/a	0.0001-0.0005
OCP	0.01	n/a	No test required
TBT	0.05	n/a	No test required
TOC	0.05 gram/100 gram	n/a	No test required

Notes:

a) n/a = not applicable

10) Abbreviations

AC:	Auckland Council
ARC:	Auckland Regional Council (now part of AC)
AS:	Australian Standard
EC:	Electrical Conductivity
g/m^3:	grams per cubic metre = parts per billion = ppb
IANZ:	International Accreditation New Zealand
Jacobs SKM:	SKM became part of Jacobs in December 2013.
km:	kilometre.
m:	metre
mg/kg:	milligram per kilogram = parts per million = ppm
µm:	micrometre (= 1×10^{-6} m)
NZGS:	New Zealand Geotechnical Society
NZS:	New Zealand Standard
µm:	micro-metre
OCP:	Organochlorine Pesticides
PaH:	Polycyclic Aromatic Hydrocarbons
SAP:	Sampling & Analysis Plan
SKM:	Sinclair Knight Merz Ltd (now part of Jacobs)
TBT:	Tributyl tin
TOC:	Total Organic Carbon
TP:	Technical Publication
TPH:	Total Petroleum Hydrocarbons
T&T:	Tonkin & Taylor Ltd
URS:	URS New Zealand Ltd

Watercare:	Watercare Services Ltd
WMNH2:	North Harbour No. 2 Watermain
WTP:	Water Treatment Plant

Title: Proposed Soil, Sediment & Groundwater Sampling & Analysis Programme, Revision 1- Final

By: Walter Starke (Jacobs SKM)

Date: 05 May 2014

Note: Locations of boreholes presented in Specification North Harbour No. 2 Watermain, Advanced Works Greenhithe & Stream Crossings- Geotechnical Investigation Updated Scope- DRAFT, prepared by URS for Watercare, dated 27 March 2014

Note: The Proposed Soil, Sediment and Groundwater Sampling & Analysis Programme. Rev. 1- Final should not be read in isolation but together with the Jacobs-SKM Sampling Methodology- rev. 1- final, for Watercare Services Ltd, Dated 05 May 2014.

1. Soil, Sediment & Groundwater Sampling Programme

Item	Machine	Hand Auger	Hand Auger	Piezo	Gw sample?	Soil Samples			Sediment Samples		
	Boreholes	Boreholes	Boreholes			Depth (m bgl)			Depth (m bgl)		
			+ Scalas						Note: it is possible that the depth of sediment is		
									less than 1.0 m at the proposed sediment sample		
A- Advanced Works									locations and therefore the depths below are		
									indicative only		
1	BH-201			Y	Y	0.0-0.2	0.9-1.1	1.9-2.9			
2	BH-202			Y	-	0.0-0.2	0.9-1.1	1.9-2.9			
3	BH-203										
4	BH-204			Y	-	0.0-0.2	0.9-1.1	1.9-2.9			
5		HA-201				0.0-0.2	0.9-1.1	1.9-2.9			
6		HA-202				0.0-0.2	0.9-1.1	1.9-2.9			
7			HAS-203						0.0-0.1	0.9-1.0	1.9-2.0
8			HAS-204						0.0-0.1	0.9-1.0	1.9-2.0
9			HAS-205						0.0-0.1	0.9-1.0	1.9-2.0
10			HAS-206						0.0-0.1	0.9-1.0	1.9-2.0
11			HAS-206a						0.0-0.1	0.9-1.0	1.9-2.0
12			HAS-207						0.0-0.1	0.9-1.0	1.9-2.0
13			HAS-207a						0.0-0.1	0.9-1.0	1.9-2.0
14			HAS-208						0.0-0.1	0.9-1.0	1.9-2.0
15			HAS-208a						0.0-0.1	0.9-1.0	1.9-2.0
16			HAS-209						0.0-0.1	0.9-1.0	1.9-2.0
17			HAS-209a						0.0-0.1	0.9-1.0	1.9-2.0
18			HAS-210						0.0-0.1	0.9-1.0	1.9-2.0
19			HAS-210a						0.0-0.1	0.9-1.0	1.9-2.0
20			HAS-211						0.0-0.1	0.9-1.0	1.9-2.0
21			HAS-211a						0.0-0.1	0.9-1.0	1.9-2.0
22			HAS-212						0.0-0.1	0.9-1.0	1.9-2.0
23			HAS-212a						0.0-0.1	0.9-1.0	1.9-2.0
24			HAS-213						0.0-0.1	0.9-1.0	1.9-2.0
25			HAS-213a						0.0-0.1	0.9-1.0	1.9-2.0
26			HAS-214						0.0-0.1	0.9-1.0	1.9-2.0
27			HAS-214a						0.0-0.1	0.9-1.0	1.9-2.0
28			HAS-215						0.0-0.1	0.9-1.0	1.9-2.0
29			HAS-215a						0.0-0.1	0.9-1.0	1.9-2.0
30			HAS-216						0.0-0.1	0.9-1.0	1.9-2.0
31			HAS-216a						0.0-0.1	0.9-1.0	1.9-2.0
32			HAS-217						0.0-0.1	0.9-1.0	1.9-2.0

33			HAS-217a						0.0-0.1	0.9-1.0	1.9-2.0
B- Stream Crossings											
B1- Oratia Bridge											
34	BH-251			Y	-	0.0-0.2	0.9-1.1	1.9-2.9			
35	BH-252			Y	-	0.0-0.2	0.9-1.1	1.9-2.9			
B2- Opanuku Stream Bridge											
36	BH-253					0.0-0.2	0.9-1.1	1.9-2.9			
37		HA-254				0.0-0.2	0.9-1.1	1.9-2.9			
38		HA-255				0.0-0.2	0.9-1.1	1.9-2.9			
39	BH-256					0.0-0.2	0.9-1.1	1.9-2.9			
B3- Paremuka Bridge											
40	BH-257			Y	-	0.0-0.2	0.9-1.1	1.9-2.9			
41	BH-258	(possible HA)				0.0-0.2	0.9-1.1	1.9-2.9			
42		HA-259				0.0-0.2	0.9-1.1	1.9-2.9			
43		HA-260				0.0-0.2	0.9-1.1	1.9-2.9			
44	BH-261					0.0-0.2	0.9-1.1	1.9-2.9			
45		HA-262				0.0-0.2	0.9-1.1	1.9-2.9			
B4- Don Buck & Woodside Bridge											
46	BH-263			Y	-	0.0-0.2	0.9-1.1	1.9-2.9			
47	BH-264					0.0-0.2	0.9-1.1	1.9-2.9			
B5- Bush Road Stream											
48	BH-265			Y	Y	0.0-0.2	0.9-1.1	1.9-2.9			
49		HA-266				0.0-0.2	0.9-1.1	1.9-2.9			
50		HA-267				0.0-0.2	0.9-1.1	1.9-2.9			
Total Piezos				8							
Total groundwater samples					2						
Total soil samples						66					
Total sediment samples									81		

2- Laboratory Testing Programme: SOIL

Item	Machine	Hand Auger				Soil Samples		Parameters to be tested (see Sampling Methodology Document)			
	Boreholes	Boreholes				Depth (m bgl)					
								Metals (1)	TPH (2)	PaH (3)	OCP (4)
A- Advanced Works											
1a	BH-201					0.0-0.2		Y	Y	Y	Y
1b							0.9-1.1	Y	Y	Y	
2a	BH-202					0.0-0.2		Y	Y	Y	Y
2b							0.9-1.1	Y	Y	Y	

4a	BH-204					0.0-0.2		Y	Y	Y	Y
4b							0.9-1.1	Y	Y	Y	
B- Stream Crossings											
B1- Oratia Bridge											
34a	BH-251					0.0-0.2		Y	Y	Y	Y
B2- Opanuku Stream Bridge											
37a		HA-254				0.0-0.2		Y	Y	Y	Y
37b							0.9-1.1	Y	Y	Y	Y
38a		HA-255				0.0-0.2		Y	Y	Y	Y
B3- Paremuka Bridge											
42a		HA-259				0.0-0.2		Y	Y	Y	Y
43a		HA-260				0.0-0.2		Y	Y	Y	Y
							0.9-1.1	Y	Y	Y	Y
B4- Don Buck & Woodside Bridge											
46a	BH-263					0.0-0.2		Y	Y	Y	Y
B5- Bush Road Stream											
49a		HA-266				0.0-0.2		Y	Y	Y	Y
Total soil samples for Testing						**15**					

Notes:
1) Metals: Arsenic, Cadmium, Chromium (total), Copper, Lead, Nickel and Zinc, plus Mercury
2) TPH = Total Petroleum Hydrocarbons
3) PaH = Polycyclic Aromatic Hydrocarbons
4) OCP = Organochlorine Pesticides

3- Laboratory Testing Programme: SEDIMENT

Item	Machine	Hand Auger	Hand Auger		Sediment Sample			Parameters to be Tested (see Sampling Methodology Document)						
	Boreholes	Boreholes	Boreholes			Depth (m bgl)								Ecology
			+ Scalas					Metals (1)	TPH (2)	PaH (3)	OCP (4)	TBT (5)	TOC (6)	Metals (7)
A- Advanced Works														
10a			HAS-206			0.0-0.1		Y	Y	Y	Y	Y	Y	Y
19a			HAS-210a			0.0-0.1		Y	Y	Y	Y	Y	Y	Y
19b							0.9-1.0	Y	Y	Y				
20a			HAS-211			0.0-0.1		Y	Y	Y			Y	Y
23a			HAS-212a			0.0-0.1		Y	Y	Y	Y	Y	Y	Y
23b							0.9-1.0	Y	Y	Y	Y	Y		
24a			HAS-213			0.0-0.1		Y	Y	Y			Y	Y
27a			HAS-214a			0.0-0.1		Y	Y	Y	Y	Y	Y	Y
27b							0.9-1.0	Y	Y	Y	Y	Y		

28a			HAS-215			0.0-0.1		Y	Y	Y			Y	Y
31a			HAS-216a			0.0-0.1		Y	Y	Y	Y	Y	Y	Y
31b							0.9-1.0	Y	Y	Y	Y	Y		
32a			HAS-217			0.0-0.1		Y	Y	Y			Y	Y
Total sediment samples for testing						**13**								

Notes:
1) Metals: Arsenic, Cadmium, Chromium (total), Copper, Lead, Nickel and Zinc, plus Mercury
2) TPH = Total Petroleum Hydrocarbons
3) PaH = Polycyclic Aromatic Hydrocarbons
4) OCP = Organochlorine Pesticides
5) TBT = Tributyl Tin
6) TOC = Total Organic Carbon
7) Ecology Metals: These shall be in accordance with the document Auckland Regional Council Technical Publication (TP) No. 168, August 2004.
(this publication uses Environmental Response Criteria and R J Hill Laboratories in Hamilton can undertake these tests accordingly)

4- Laboratory Testing Programme: GROUNDWATER

Item	Machine	Hand Auger	Hand Auger	Piezo	Gw sample?	Parameters to be tested		
	Boreholes	Boreholes	Boreholes					
			+ Scalas			Dissolved	TPH	PaH
						Metals (1)		
A- Advanced Works								
1	BH-201			Y	Y	Y	Y	Y
48	BH-265			Y	Y	Y	Y	Y
Total groundwater samples for testing					**2**			

Notes:
1) Dissolved metals: Arsenic, Cadmium, Chromium (total), Copper, Lead, Nickel and Zinc, plus Mercury
2) The level of detection limit, for dissolved metals, shall be 'trace' level as offered by R J Hill Laboratories in Hamilton

APPENDIX E ENVIRONMENTAL SAMPLING AND TESTING REPORT (OPUS, 2014A)

OPUS

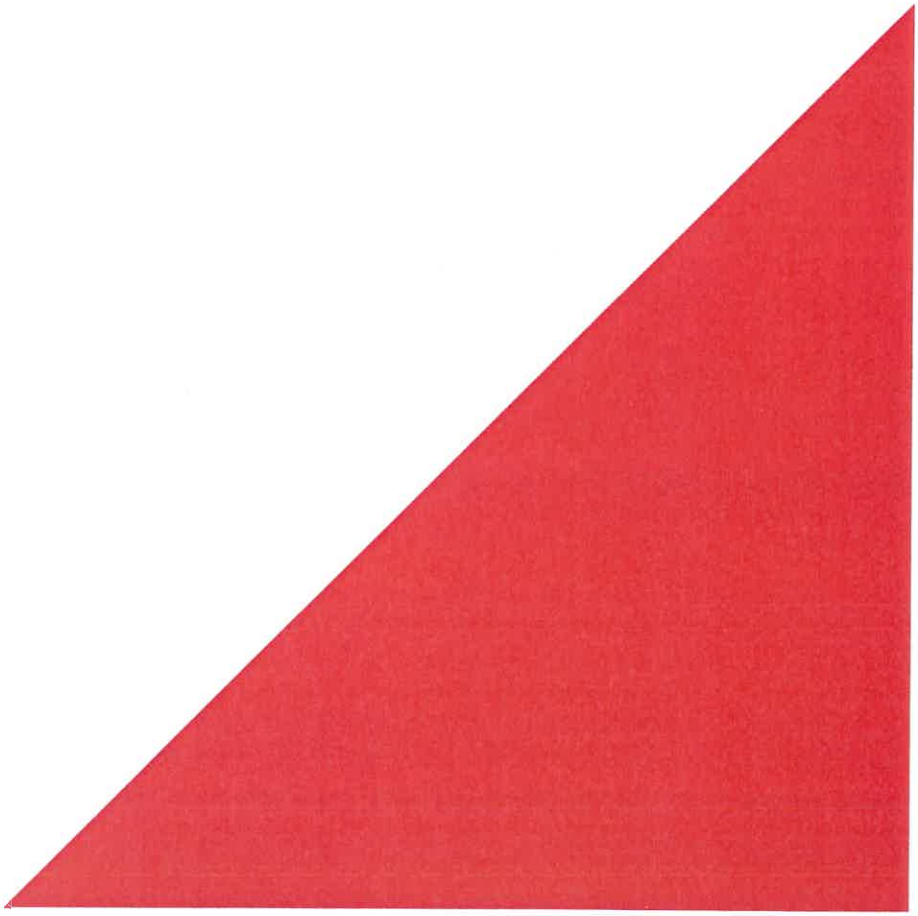
Watercare
An Auckland Council Organisation

Watercare

NH2 Watermain Greenhithe and Stream Crossings

Environmental Sampling and Testing Report

August 2014



Watercare

NH2 Watermain

Greenhithe and Stream Crossings

Environmental Sampling and Testing Report

August 2014

Prepared By

Tom Van Deelen
Engineering Geologist

Roger High
Engineering Geologist

Reviewed By

Roger High
Principal – Engineering Geology

Approved for Release By

Michael Fox
Project Manager

Opus International Consultants Ltd
Auckland Civil

The Westhaven, 100 Beaumont St
PO Box 5848, Auckland 1141
New Zealand

Telephone: +64 9 355 9500
Facsimile: +64 9 355 9585

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1 Introduction

Watercare are proposing construction of the North Harbour No 2 watermain in the Greenhithe and Albany areas. Opus was engaged by Watercare to undertake geotechnical investigations of the new pipeline route in these areas. This report describes the sampling and environmental testing of materials obtained during these geotechnical investigations.

The work was briefed under the Geotechnical Professional Services Contract Co826, with reference to the URS/SKM Memorandum "NH2-Ground Contamination Sampling and Analysis" dated 7th May 2014.

This brief was slightly amended a number of times as a result of email correspondence with Walter Starke (Jacobs SKM Environmental Engineer) and Brett Ogilvie (Tonkin and Taylor) prior to the start of works, and a number of interactive decisions made by Walter Starke during the field works.

2 Scope of this Investigation

The scope of this investigation was to sample and test contaminant levels in soil, intertidal sediment and groundwater samples. The sampling and testing was briefed by Jacobs SKM and Tonkin and Taylor during the geotechnical investigation of NH2 watermain in the Greenhithe and Albany areas.

The sampling and testing plans were provided in the URS/SKM Memorandum "NH2-Ground Contamination Sampling and Analysis" dated 7th May 2014.

This report describes the samples able to be obtained during the field works and presents the contaminant test results of those samples selected for testing. Many samples were not tested and are presently held in cold storage at Hill Laboratories.

Logs of the bores and augers where environmental samples were obtained during the geotechnical field works are contained in Appendix B of the Opus Geotechnical Factual Report (GS14/089).

3 Sampling Methodology

The location of the field tests from which the samples were obtained are shown on the site plans in Appendix 1.

Table 1 at the end of this report (the Sampling Plan) describes the samples obtained during the investigation and details of sampling as briefed by URS/SKM.

Table 2 at the end of this report (the Sample Action Inventory) describes the sampling inventory and sampling dates; dates samples were sent to Hill Laboratories and whether samples were tested or held in cold storage.

Table 3 at the end of this report (the Laboratory Testing Schedule) details the samples selected for testing and the contaminant tests required for each sample.

Table 4 at the end of this report (the Soil Contamination Test Inventory) describes the soils, Hill Laboratories reference and testing undertaken.

3.1 Soil Sampling Methodology

Soil samples were obtained from rig bores and hand augers.

Sampling from bores involved removal of the outer part of the core using a clean stainless steel knife and placing the inner part of the core into sampling containers.

Sampling from hand augers involved auguring using a 70mm diameter head down to the target depth and then obtaining the sample using a dedicated 50mm diameter head, in order to minimize the potential for cross contamination caused by contact of the auger head with soils other than at the target sampling depth. The 50mm head was washed with Decon 90™ and water prior to sampling.

The soil samples were placed into Hill Laboratories supplied sample containers and stored in a cooled chilly bin. The sample jars were then stored in a fridge prior to courier overnight to Hill Laboratories.

3.2 Sediment Sampling Methodology

A number of methods were used to obtain samples of the inter-tidal sediments:

- The 0.00-0.02m sediment sample for "Ecology Metals" was obtained using a stainless steel trowel in broad accordance with the recommendations in ARC TP 168 (2004) "Blueprint for monitoring urban receiving environments". Replication and sub-sampling were not undertaken;
- Deeper samples in non-collapsing sediment were obtained using a 50mm diameter hand auger as described for the soil samples above;
- Deeper samples in collapsing sediment were obtained using a piston sampler.

All sediment samples were placed into Hill Laboratories supplied sample containers and stored in a cooled chilly bin. The sample jars were then stored in a fridge prior to courier overnight to Hill Laboratories.

3.3 Groundwater Sampling Methodology

The groundwater in each borehole was sampled using a hand-held Waterra footvalve with a dedicated 16mm diameter tube.

Prior to sampling the groundwater, the boreholes were purged of three times the water volume of the bore, in order to ensure that the groundwater sample taken was representative of the groundwater aquifer.

After purging, samples were poured into laboratory supplied sample jars, field filtered for heavy metals, placed in a cooled chilly bin, and then transferred to a fridge prior to over-night courier transport to Hill Laboratories.

4 Sample Testing

The samples selected for testing and those held in cold storage at Hill Laboratories are shown in Table 2 at the end of this report. Departures of the testing from the original brief are shown in Table 3 at the end of this report and descriptions of samples and tests undertaken are shown on the test inventory in Table 4 at the end of this report.

Most tests were undertaken to comply with the original brief in the URS/SKM Memorandum "NH2-Ground Contamination Sampling and Analysis" dated 7th May 2014. A notable exception is the tests for "Ecology Metals". Hill Laboratories are not IANZ certified for this test, as required by the brief, and testing was not undertaken as per TP 168[1], again as required by the brief. The main departures of the test method to that described in TP 168 are:

- Total recoverable HM, PAH and TOC tests were undertaken on the whole sample as received, and not the <500µm faction[2];
- Quantification of the >500µm, 500-250µm, 250-125µm, 125-63µm and <63µm fractions of the sediment samples were not determined[3];
- The whole sample was air-dried at 35°C overnight and not freeze dried before testing[4].

It is acknowledged that Brett Ogilvie verbally advised that TOC, PAH, and TBT should be undertaken on each sediment sample tested for "Ecology metals", however TBT was only undertaken on 5 of the 9 samples tested for "Ecology metals" (Table 4), as per the original URS/SKM brief (Table 3).

[1] ARC TP 168: "Blueprint for monitoring urban receiving environments", August 2004

[2] In fact most samples are less than 500 microns, other than for some shell particles.

[3] PSD plots of marine sediments, reported in Opus Report GS 14/089, at the same site as some of the samples obtained for "ecology metal" tests are included in Appendix 3. Note that the depth of sampling differs from that for the ecology metal tests.

[4] Hill Laboratories do not undertake freeze drying. The former ARC considered air drying as an acceptable alternative.

Soil test results are shown in the Hill Laboratories Analysis Report Nos 1280093, 1283722, 1289075, 1293375, and 1297663 in Appendix 2. Groundwater test results are shown in the Hill Laboratories Analysis Report 1308993 in Appendix 2.

5 Quality Assurance and Quality Control (QA/QC)

Sampling was undertaken by Tom Van Deelen (Engineering Geologist) between May and July 2014. All samples were couriered overnight to Hill Laboratories in Hamilton. A Chain of Custody Record was received.

RJ Hill Laboratories is an IANZ accredited laboratory and undertakes its own QA. This lab is IANZ accredited to undertake all tests undertaken for this investigation with the exception of the ecology metals and total organic carbon tests.

5.1 Field Replicate Sample

The sampling and testing brief required sampling and testing of a field replicate at a rate of one every ten samples tested. Subsequently Brett Ogilvie (Tonkin and Taylor) verbally advised that replicates for the samples obtained from 0.0 – 0.02m depth were not required (in contrast to the 3 replicates per site required in Figure 3.3 of TP168). Walter Starke (Jacobs) was advised of this matter by email dated the 9th May 2014.

A total of 17 samples were tested other than the sediment from 0.0m – 0.02m depth (Table 4). Accordingly 1 field replicate was tested: BH201 – 1.0m depth (Hill Lab Ref 1289075.7) and replicate labelled 10m depth (Hill Lab Ref 1289075.7).

5.2 Laboratory Replicate Testing

The brief did not require laboratory replicate testing, therefore no laboratory replicate tests were undertaken for this project.

6 Limitations

This report has been prepared solely for the use of Watercare and their agents. This report is not suitable for any other circumstances than the purpose for which it was prepared. This report has been prepared for the purpose of providing sampling and testing results for the NH2 project.

Opus accepts no responsibility or liability for:

- The consequences of this document being used for purposes other than for which it was commissioned and,
- This report being used by any other party other than the organisation by whom it was commissioned.

The sampling and testing requirements were determined by other parties. The results presented in the report are relevant to the date that the work was undertaken, and should not be relied on to represent conditions at later dates. Conditions of the site may change over time due to natural processes and anthropogenic activities.

Opus International Consultants shall not be liable for any loss or damage, directly or indirectly arising out of, resulting from, in consequence of, contributed to or aggravated by asbestos in whatever form or quality.

Table 1: NH2 Sampling Plan

Field Test Undertaken
Sample Obtained from Proposed Depth Range
Proposed Sample not Obtained

Item	Rig Bores	Hand Augers	Soil Samples Depth (m bgl)			Sediment Samples Depth (m bgl)		
A- Advanced Works								
1	BH-201		0.0-0.2	0.9-1.1	1.9-2.9			
2	BH-202		0.0-0.2	0.9-1.1	1.9-2.9			
3	BH-203							
4	BH-204		0.0-0.2	0.9-1.1	1.9-2.9			
5		HA-201	0.0-0.2	0.9-1.1	1.9-2.9			
6		HA-202	0.0-0.2	0.9-1.1	1.9-2.9			
7		HAS-203		not sediment		0.0-0.1	0.9-1.0	1.9-2.0
8		HAS-204		lower sample not sediment		0.0-0.1	0.9-1.0	1.9-2.0
9		HAS-205				0.0-0.1	0.9-1.0	1.9-2.0
10		HAS-206				0.0-0.1	0.9-1.0	1.9-2.0
11		HAS-206a				0.0-0.1	0.9-1.0	1.9-2.0
12		HAS-207				0.0-0.1	0.9-1.0	1.9-2.0
13		HAS-207a		site under water at all tides		0.0-0.1	0.9-1.0	1.9-2.0
14		HAS-208				0.0-0.1	0.9-1.0	1.9-2.0
15		HAS-208a				0.0-0.1	0.9-1.0	1.9-2.0
16		HAS-209				0.0-0.1	0.9-1.0	1.9-2.0
17		HAS-209a				0.0-0.1	0.9-1.0	1.9-2.0
18		HAS-210				0.0-0.1	0.9-1.0	1.9-2.0
19		HAS-210a				0.0-0.1	0.9-1.0	1.9-2.0
20		HAS-211				0.0-0.1	0.9-1.0	1.9-2.0
21		HAS-211a				0.0-0.1	0.9-1.0	1.9-2.0
22		HAS-212				0.0-0.1	0.9-1.0	1.9-2.0
23		HAS-212a				0.0-0.1	0.9-1.0	1.9-2.0
24		HAS-213				0.0-0.1	0.9-1.0	1.9-2.0
25		HAS-213a				0.0-0.1	0.9-1.0	1.9-2.0
26		HAS-214				0.0-0.1	0.9-1.0	1.9-2.0
27		HAS-214a				0.0-0.1	0.9-1.0	1.9-2.0
28		HAS-215				0.0-0.1	0.9-1.0	1.9-2.0
29		HAS-215a				0.0-0.1	0.9-1.0	1.9-2.0
30		HAS-216				0.0-0.1	0.9-1.0	1.9-2.0
31		HAS-216a				0.0-0.1	0.9-1.0	1.9-2.0
32		HAS-217				0.0-0.1	0.9-1.0	1.9-2.0
33		HAS-217a				0.0-0.1	0.9-1.0	1.9-2.0
			13			36		
B- Stream Crossings								
B1- Oratia Bridge								
34	BH-251		0.0-0.2	0.9-1.1	1.9-2.9	deep samples not obtained - hydroexcavated		
35	BH-252		0.0-0.2	0.9-1.1	1.9-2.9	deep samples not obtained - hydroexcavated		
B2- Opanuku Stream Bridge								
36	BH-253		0.0-0.2	0.9-1.1	1.9-2.9			
37		HA-254	0.0-0.2	0.9-1.1	1.9-2.9			
38		HA-255	0.0-0.2	0.9-1.1	1.9-2.9			
39	BH-256		0.0-0.2	0.9-1.1	1.9-2.9			
B3- Paremuka Bridge								
40	BH-257		0.0-0.2	0.9-1.1	1.9-2.9			
41	BH-258	(possible HA)	0.0-0.2	0.9-1.1	1.9-2.9			
42		HA-259	0.0-0.2	0.9-1.1	1.9-2.9			
43		HA-260	0.0-0.2	0.9-1.1	1.9-2.9			
44	BH-261		0.0-0.2	0.9-1.1	1.9-2.9			
45		HA-262	0.0-0.2	0.9-1.1	1.9-2.9			
B4- Don Buck & Woodside Bridge								
46	BH-263		0.0-0.2	0.9-1.1	1.9-2.9			
47	BH-264		0.0-0.2	0.9-1.1	1.9-2.9			
B5- Bush Road Stream								
48	BH-265		0.0-0.2	0.9-1.1	1.9-2.9			
49		HA-266	0.0-0.2	0.9-1.1	1.9-2.9			
50		HA-267	0.0-0.2	0.9-1.1	1.9-2.9			
			46					

Table 2: Watercare NH2 Sample Action Inventory

I.D	Sample Depth	Date Sampled	Time Sampled	Date to Lab	Reference Number	Results Received
BH263	0.1	19/05/2014	10am	26/05/2014	1280093.4	see Table 4
	1.0	19/05/2014	10.10am		1280093.14	HELD
	2.5	19/05/2014	12.30pm		1280093.15	
BH264	0.1	20/05/2014	12.05pm	26/05/2014	1280093.5	HELD
	1.0	20/05/2014	12.07pm		1280093.6	
	2.2	20/05/2014	12.09pm		1280093.7	
BH253	0.1	22/05/2014	2.35pm	26/05/2014	1280093.11	HELD
	1.0	22/05/2014	2.36pm		1280093.12	
	2.0	22/05/2014	2.38pm		1280093.13	
HA254	0.1	22/05/2014	3.37pm	26/05/2014	1280093.1	see Table 4
	1.1	22/05/2014	3.38pm		1280093.2	see Table 4
	2.2	22/05/2014	3.39pm		1280093.8	HELD
HA255	0.1	23/05/2014	12.20pm	26/05/2014	1280093.3	see Table 4
	1.1	23/05/2014	12.21pm		1280093.5	HELD
	2.2	23/05/2014	12.22pm		1280093.5	
BH256	0.1	26/05/2014	9.52am	30/06/2014	1293375.1	HELD
	1.0	26/05/2014	9.59am		1293375.2	
	2.5	26/05/2014	11.45am		1293375.3	
BH202	0.1	28/05/2014	2.30pm	4/06/2014	1283722.1	see Table 4
	1.0	28/05/2014	2.31pm		1283722.2	see Table 4
	2.1	28/05/2014	2.33pm		1283722.3	HELD
HA219	0.1	28/05/2014	2.52pm	additional samples obtained - not in **sampling plan**		HELD at Opus
	1.0	28/05/2014	2.53pm			
	2.0	28/05/2014	2.53pm			
HA218	0.1	28/05/2014	3.13pm	additional samples obtained - not in sampling plan		HELD at Opus
	1.0	28/05/2014	3.14pm			
	2.0	28/05/2014	3.15pm			
HA201	0.1	29/05/2014	12.41pm	4/06/2014	1283722.4	HELD
	1.0	29/05/2014	12.42pm		1283722.5	
	2.0	29/05/2014	12.43pm		1283722.6	
HA203	0.1	29/05/2014	12.43pm	4/06/2014	1283722.7	HELD
	1.0	29/05/2014	12.44pm		1283722.8	
	2.0	29/05/2014	12.45pm		1283722.9	
HA202	0.1	30/05/2014	12.03pm	4/06/2014	1283722.10	HELD
BH204	0.1	5/06/2014	1.28pm	17/06/2014	1289075.1	see Table 4
	1.0	5/06/2014	1.29pm		1289075.2	see Table 4
	2.0	5/06/2014	1.30pm		1289075.3	HELD
BH201	0.1 (x2 Dup)	9/06/2014	10.34am	17/06/2014	1289075.4, 7	see Table 4
	1.0	9/06/2014	10.36am		1289075.5	see Table 4
	2.0	9/06/2014	10.37am		1289075.6	HELD
HA211	0.0 (x2)	11/06/2014	9.55am	17/06/2014	1289075.17, 30	see Table 4
HA211a	0.0 (x2)	11/06/2014	10.00am	17/06/2014	1289075.18	HELD
BH265	0.1	11/06/2014	2.00pm	17/06/2014	1289075.8	HELD
	1.0	11/06/2014	2.01pm		1289075.9	
	1.9	11/06/2014	2.03pm		1289075.10	
HA204	0.0 (x2)	11/06/2014	3.10pm	17/06/2014	1289075.19	HELD
	0.8	12/06/2014	11.25am		1289075.20	
HA205	0.0 (x2)	12/06/2014	9.45am	17/06/2014	1289075.21	HELD
	0.6	12/06/2014	11.45am		1289075.22	
HA206	0.0 (x2)	12/06/2014	12.15pm	17/06/2014	1289075.23, 31	see Table 4
	0.6	12/06/2014	12.35pm		1289075.24	HELD
HA206a	0.0 (x2)	12/06/2014	2.35pm	17/06/2014	1289075.25	HELD
	0.6	12/06/2014	2.57pm		1289075.26	
	0.9	12/06/2014	2.55pm		1289075.27	
HA212a	0.0 (x2)	13/06/2014	11.00am	17/06/2014	1289075.28, 32	see Table 4
HA212	0.0 (x2)	13/06/2014	11.05am	17/06/2014	1289075.29	HELD
BH257	0.1	13/06/2014	3.00pm	17/06/2014	1289075.11	HELD
	1.0	13/06/2014	3.01pm		1289075.12	
	2.0	13/06/2014	3.02pm		1289075.13	

HA213a	0.0 (x2)	13/06/2014	10.45am	30/06/2014	1293375.4	HELD
HA213	0.0 (x2)	13/06/2014	2.30pm	30/06/2014	1293375.5, 22	see Table 4
BH258	0.1	17/06/2014	10.38am	17/06/2014	1289075.14	HELD
	1.0	17/06/2014	10.40am		1289075.15	
	2.0	17/06/2014	10.41am		1289075.16	
HA259	0.1	23/06/2014	12.50pm	30/06/2014	1293375.6	see Table 4
	1.0	23/06/2014	12.51pm		1293375.7	HELD
HA260	0.1	23/06/2014	1.56pm	30/06/2014	1293375.8	see Table 4
	1.0	23/06/2014	1.58pm		1293375.9	see Table 4
	2.0	23/06/2014	1.59pm		1293375.10	HELD
HA217a	0.0 (x2)	24/06/2014	10.06am	30/06/2014	1293375.12	HELD
HA217	0.0 (x2)	24/06/2014	10.10am	30/06/2014	1293375.11, 23	see Table 4
HA210a	0.0 (x2)	24/06/2014	11.30am	30/06/2014	1293375.13	see Table 4
	0.5	24/06/2014	11.30am		1293375.14	see Table 4
HA210	0.0 (x2)	24/06/2014	12.35pm	30/06/2014	1293375.15	HELD
HA215	0.0 (x2)	25/06/2014	10.10am	30/06/2014	1293375.16, 25	see Table 4
HA215a	0.0 (x2)	25/06/2014	10.15am	30/06/2014	1293375.17	HELD
HA207	0.0 (x2)	25/06/2014	11.45am	30/06/2014	1293375.18	HELD
HA214	0.0 (x2)	25/06/2014	12.10pm	30/06/2014	1293375.19	HELD
HA214a	0.0 (x2)	25/06/2014	12.21pm	30/06/2014	1293375.20, 26	see Table 4
HA209a	0.0 (x2)	26/06/2014	2.45pm	10/07/2014	1297663.6	HELD
	0.9	26/06/2014	2.45pm		1297663.7	
HA209	0.0 (x2)	26/06/2014	3.37pm	10/07/2014	1297663.5	see Table 4
HA213a	0.8	27/06/2014	2.30pm	10/07/2014	1297663.10	HELD
HA216	0.0 (x2)	30/06/2014	2.30pm	10/07/2014	1297663.8	HELD
HA216a	0.0 (x2)	30/06/2014	2.35pm	10/07/2014	1297663.9	HELD
HA208	0.0 (x2)	1/07/2014	8.41am	10/07/2014	1297663.1, 25	see Table 4
	0.7	1/07/2014	9.10am		1297663.2	HELD
HA208a	0.0 (x2)	1/07/2014	8.42am	10/07/2014	1297663.3	HELD
BH261	0.1	1/07/2014	2.31pm	10/07/2014	1297663.18	HELD
	1.0	1/07/2014	2.33pm		1297663.19	
	2.0	1/07/2014	2.34pm		1297663.20	
HA266	0.1	2/07/2014	11.15am	10/07/2014	1297663.11	see Table 4
	1.0	2/07/2014	11.16am		1297663.12	HELD
	2.0	2/07/2014	11.17am		1297663.13	
HA267	0.1	2/07/2014	11.41am	10/07/2014	1297663.14	HELD
	1.0	2/07/2014	11.49am		1297663.15	
	2.0	2/07/2014	11.50am		1297663.16	
HA262	0.1	3/07/2014	10.43am	10/07/2014	1297663.21	HELD
	1.0	3/07/2014	10.44am		1297663.22	
	2.0	3/07/2014	10.45am		1297663.23	
BH251	0.1	3/07/2014	11.00am	10/07/2014	1297663.17	see Table 4
BH252	0.1	3/07/2014	11.10am	10/07/2014	1297663.24	HELD

Table 3- Laboratory Testing

SOIL

Field Test Undertaken
Sample Obtained from Proposed Depth Range
Proposed Sample not Obtained and/or Tested
Alternative Field Test / Sample to Brief

Item	Rig Bores	Hand Augers	Soil Samples Depth (m bgl)		Tested Parameters Metals (1)	TPH (2)	PaH (3)	OCP (4)
A- Advanced Works								
1a	BH-201		0.0-0.2		Y	Y	Y	Y
1b				0.9-1.1	Y	Y	Y	
2a	BH-202		0.0-0.2		Y	Y	Y	Y
2b				0.9-1.1	Y	Y	Y	
4a	BH-265		0.0-0.2		Y	Y	Y	Y
4b				0.9-1.1	Y	Y	Y	
B- Stream Crossings								
B1- Oratia Bridge								
34a	BH-253		0.0-0.2		Y	Y	Y	Y
B2- Opanuku Stream Bridge								
37a		HA-254	0.0-0.2		Y	Y	Y	Y
37b				0.9-1.1	Y	Y	Y	Y
38a		HA-255	0.0-0.2		Y	Y	Y	Y
B3- Paremuka Bridge								
42a		HA-259	0.0-0.2		Y	Y	Y	Y
43a		HA-260	0.0-0.2		Y	Y	Y	Y
				0.9-1.1	Y	Y	Y	Y
B4- Don Buck & Woodside Bridge								
46a	BH-263		0.0-0.2		Y	Y	Y	Y
B5- Bush Road Stream								
49a		HA-268	0.0-0.2		Y	Y	Y	Y
Total soil samples for Testing			15					

SEDIMENT

Item	Rig Bores	Hand Augers	Sediment Samples Depth (m bgl)		Parameters to be Tested (see Sampling Methodology Document) Metals	TPH	PaH	OCP	TBT	TOC	Ecology Metals
A- Advanced Works											
10a		HAS 206	0.0-0.1		Y	Y	Y	Y	Y	Y	Y
31a		HAS 208	0.0-0.1		Y	Y	Y	Y	Y	Y	Y
		HAS 209	0.0-0.1		Y	Y	Y	Y	Y		
19a		HAS 210a	0.0-0.1		Y	Y	Y	Y	Y	Y	Y
19b				0.9-1.0	Y	Y	Y				
20a		HAS 211	0.0-0.1		Y	Y	Y			Y	Y
23a		HAS 212a	0.0-0.1		Y	Y	Y	Y	Y	Y	Y
23b				0.9-1.0							
24a		HAS 213	0.0-0.1		Y	Y	Y			Y	Y
27a		HAS 214a	0.0-0.1		Y	Y	Y	Y	Y	Y	Y
27b				0.9-1.0							
28a		HAS 215	0.0-0.1		Y	Y	Y			Y	Y
31a		HAS 216a	0.0-0.1								
31b				0.9-1.0							
32a		HAS 217	0.0-0.1		Y	Y	Y			Y	Y
Total sediment samples for testing			11								

GROUNDWATER

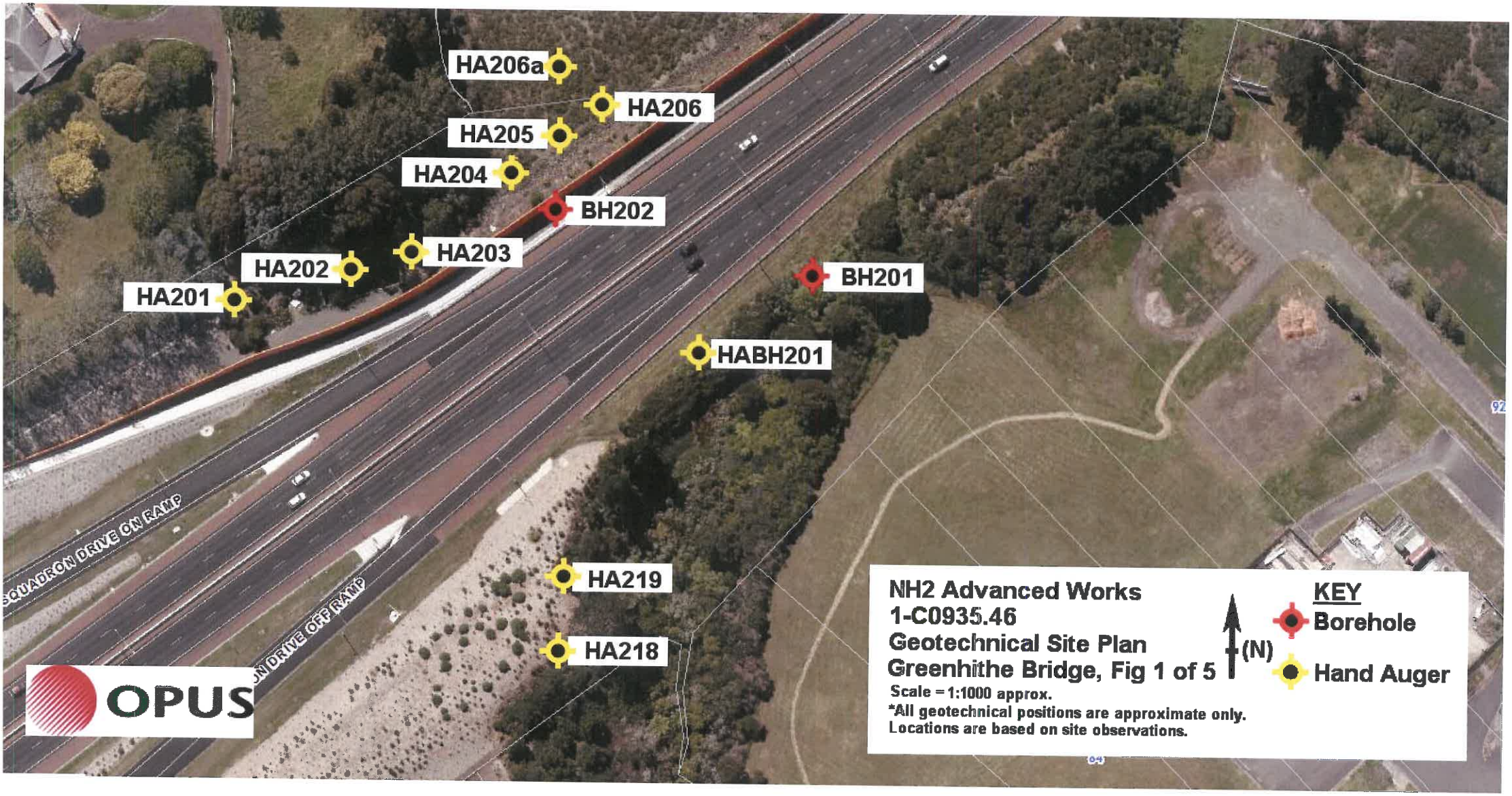
Item	Rig Bores	Piezometer Depth	Parameters to be tested Sol Metals$_t$	TPH	PaH
A- Advanced Works					
1	BH-201		Y	Y	Y
48	BH-265		Y	Y	Y
Total groundwater samples for testing			2		

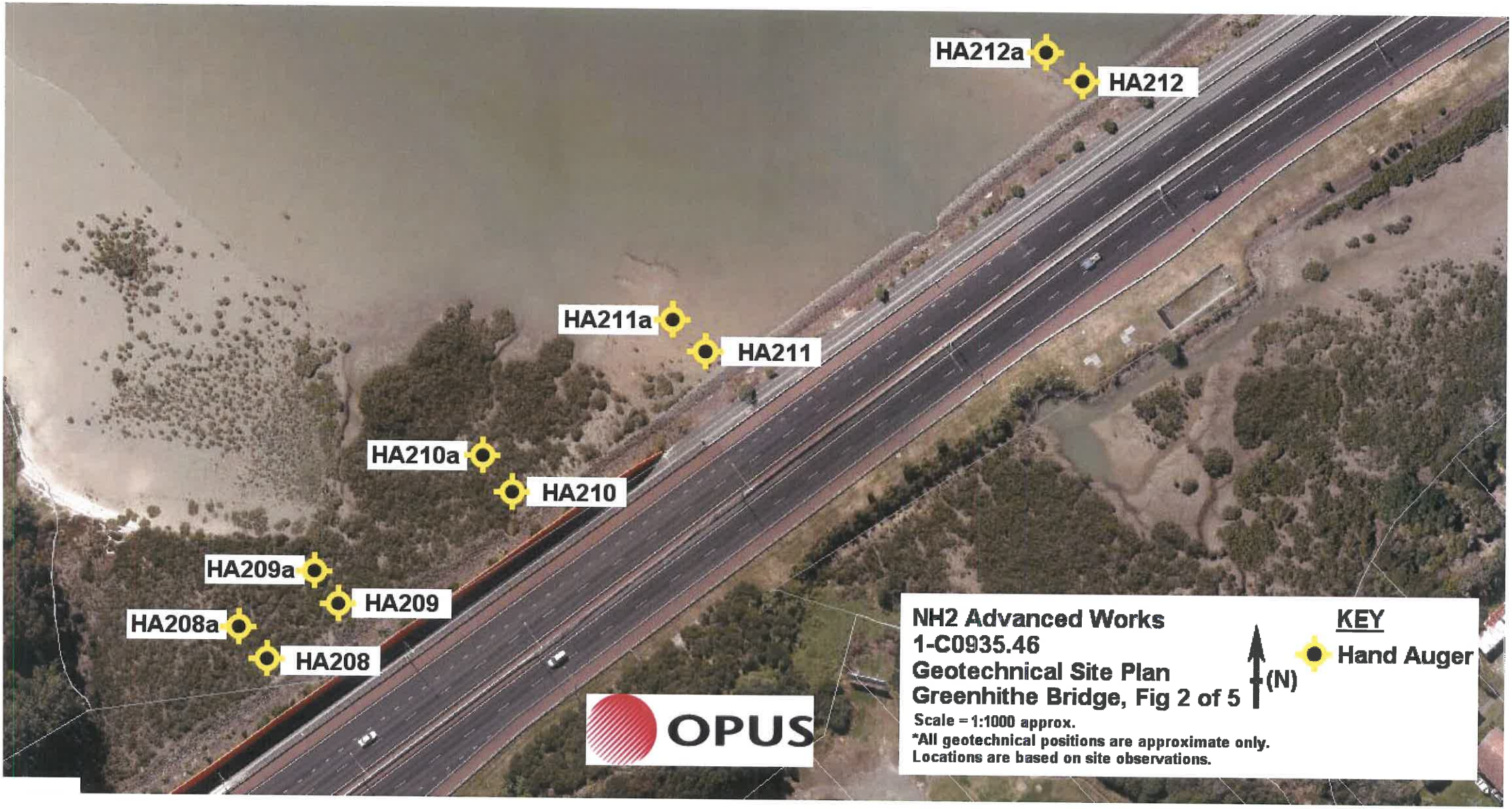
Table 4: Watercare NH2 Soil Contamination Test Inventory

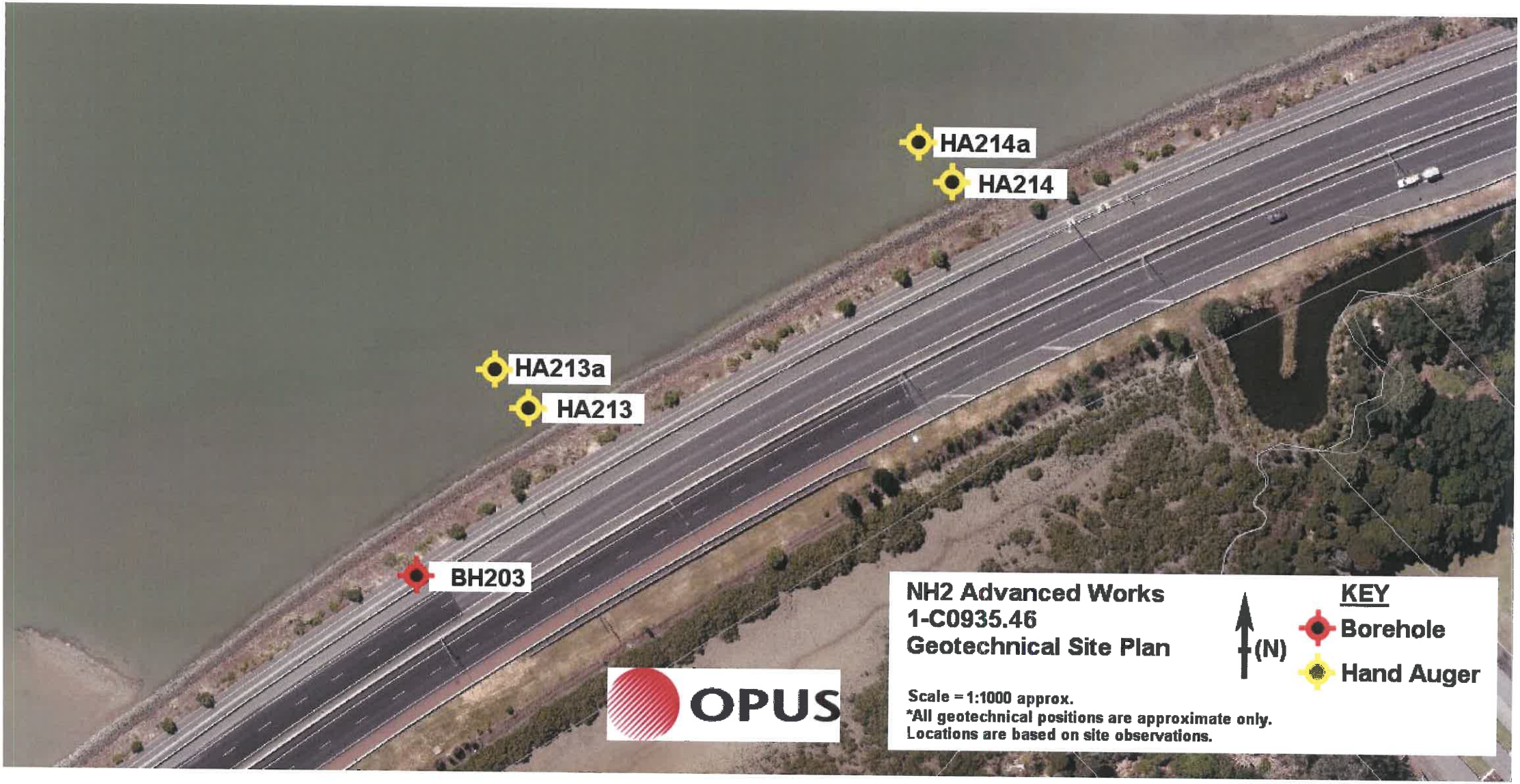
ID	Hill Ref	Report Date	Unit	Soil Description	HM+Hg	OCP	PAH	TPH	Ecology metals	TOC	TBT
BH201-0.1	1289075.4	18/07/2014	Fill	clayey silt	●	●	◍	●			
BH201-1.0	1289075.5	18/07/2014	Fill	silty clay	●		◍	●			
BH201-1.0[1]	1289075.7	18/07/2014	Fill	silty clay	●	●	◍	●			
BH202-0.1	1283722.1	18/06/2014	Fill	silt matrix in gravel	●	●	◍	●			
BH202-1.0	1283722.2	18/06/2014	Fill	silt	●	●	◍	●			
BH204-0.1	1289075.1	18/07/2014	Fill	clayey silt	●	●	◍	●			
BH204-1.0	1289075.2	18/07/2014	Fill	silty clay	●		◍	●			
BH251-0.1	1297663.17	4/08/2014	Fill	silt matrix in gravel	●	●	◍	●			
BH263-0.1	1280093.4	9/06/2014	Fill	silt	●	●	◍	●			
HA206-0.0	1289075.23, 31	18/07/2014	Sediment	sandy silt	●	●	◍	●	●	●	●
HA208-0.0	1297663.1, 25	4/08/2014	Sediment	silt	●	●	◍	●	●	●	●
HA209-0.0	1297663.5	4/08/2014	Sediment	silt	●	●	◍	●			●
HA210a-0.0	1293375.13, 24	21/07/2014	Sediment	silty clay	●	●	◍	●	●	●	●
HA210a-0.5	1293375.14	21/07/2014	Sediment	silty clay	●		◍	●			
HA211-0.0	1289075.17, 30	18/07/2014	Sediment	fine - med sand	●		◍	●	●	●	
HA212a-0.0	1289075.28, 32	18/07/2014	Sediment	silty clay	●	●	◍	●	●	●	●
HAS213-0.0	1293375.5, 22	21/07/2014	Sediment	silt	●		◍	●	●	●	
HA214a-0.0	1293375.20, 26	21/07/2014	Sediment	clayey silt	●	●	◍	●	●	●	●
HA215-0.0	1293375.16, 25	21/07/2014	Sediment	clayey silt	●		◍	●	●	●	
HA217-0.0	1293375.11, 23	21/07/2014	Sediment	silty clay	●		◍	●	●	●	
HA254-0.1	1280093.1	9/06/2014	Puketoka	silty clay	●	●	◍	●			
HA254-1.1	1280093.2	9/06/2014	Puketoka	silty clay	●	●	◍	●			
HA255-0.1	1280093.3	9/06/2014	Fill	silty clay	●	●	◍	●			
HA259-0.1	1293375.6	21/07/2014	Puketoka	silty clay	●	●	◍	●			
HA260-0.05	1293375.8	21/07/2014	Puketoka	silt	●	●	◍	●			
HA260-1.0	1293375.9	21/07/2014	Puketoka	silty clay	●	●	◍	●			
HA266-0.1	1287663.11	4/08/2014	Alluvium	silty clay	●	●	◍	●			
				TOTAL	27	20	27	27	9	9	6

[1]Duplicate labelled 10m (Hill Labs Ref #1289075.7)

Appendix 1 –Plans


HA206a
HA206
HA205
HA204
BH202
HA203
HA202
HA201
BH201
HABH201
HA219
HA218
SQUADRON DRIVE ON RAMP
JN DRIVE OFF RAMP
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 1 of 5
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.
(N)
KEY
Borehole
Hand Auger


HA212a
HA212
HA211a
HA211
HA210a
HA210
HA209a
HA209
HA208a
HA208
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 2 of 5
(N)
KEY
Hand Auger
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.


HA214a
HA214
HA213a
HA213
BH203
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
(N)
KEY
Borehole
Hand Auger
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.


HA215a
HA215
HA216a
HA216
HA217a
HA217
HA207a
HA207
UPPER HARBOUR MOTORW
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 4 of 5
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.
(N)
KEY
Hand Auger

OPUS

NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 5 of 5

Scale = 1:1000 approx.

*All geotechnical positions are approximate only. Locations are based on site observations.

(N)

KEY

Borehole

Appendix 2 – Hill Labs Analysis Records

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	OPUS International Consultants	**Lab No:**	1283722	SPv1
Contact:	Mr Roger High	**Date Registered:**	05-Jun-2014	
	C/- OPUS International Consultants	**Date Reported:**	18-Jun-2014	
	PO Box 5848	**Quote No:**	61048	
	AUCKLAND 1141	**Order No:**		
		Client Reference:		
		Submitted By:	Mr Roger High	

Sample Type: Soil

		Sample Name:	BH202 - 0.1m 28-May-2014 3:38 pm	BH202 - 1.0m 28-May-2014 3:39 pm			
		Lab Number:	1283722.1	1283722.2			
Individual Tests							
Dry Matter	g/100g as rcvd		84	74	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		< 2	< 2	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt		6	7	-	-	-
Total Recoverable Copper	mg/kg dry wt		24	7	-	-	-
Total Recoverable Lead	mg/kg dry wt		7.2	16.5	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	< 0.10	-	-	-
Total Recoverable Nickel	mg/kg dry wt		5	4	-	-	-
Total Recoverable Zinc	mg/kg dry wt		71	16	-	-	-
Organochlorine Pesticides Screening in Soil							
Aldrin	mg/kg dry wt		< 0.010	< 0.010	-	-	-
alpha-BHC	mg/kg dry wt		< 0.010	< 0.010	-	-	-
beta-BHC	mg/kg dry wt		< 0.010	< 0.010	-	-	-
delta-BHC	mg/kg dry wt		< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt		< 0.010	< 0.010	-	-	-
cis-Chlordane	mg/kg dry wt		< 0.010	< 0.010	-	-	-
trans-Chlordane	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt		< 0.04	< 0.04	-	-	-
2,4'-DDD	mg/kg dry wt		< 0.010	< 0.010	-	-	-
4,4'-DDD	mg/kg dry wt		< 0.010	< 0.010	-	-	-
2,4'-DDE	mg/kg dry wt		< 0.010	< 0.010	-	-	-
4,4'-DDE	mg/kg dry wt		< 0.010	< 0.010	-	-	-
2,4'-DDT	mg/kg dry wt		< 0.010	< 0.010	-	-	-
4,4'-DDT	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Dieldrin	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endosulfan I	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endosulfan II	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endosulfan sulphate	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endrin	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endrin aldehyde	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endrin ketone	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Heptachlor	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Heptachlor epoxide	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Hexachlorobenzene	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Methoxychlor	mg/kg dry wt		< 0.010	< 0.010	-	-	-

Sample Type: Soil						
Sample Name:		BH202 - 0.1m 28-May-2014 3:38 pm	BH202 - 1.0m 28-May-2014 3:39 pm			
Lab Number:		1283722.1	1283722.2			
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Anthracene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Chrysene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Fluoranthene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Fluorene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Naphthalene	mg/kg dry wt	< 0.14	< 0.16	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Pyrene	mg/kg dry wt	< 0.03	< 0.04	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 10	-	-	-
C10 - C14	mg/kg dry wt	< 20	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 40	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	-	-	-

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**
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%.	-	1-2
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	1-2
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1-2
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082).. Tested on dried sample	0.010 - 0.04 mg/kg dry wt	1-2
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	1-2
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-2

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	OPUS International Consultants	**Lab No:**	1289075	SPv1
Contact:	Mr Roger High	**Date Registered:**	19-Jun-2014	
	C/- OPUS International Consultants	**Date Reported:**	18-Jul-2014	
	PO Box 5848	**Quote No:**	61048	
	AUCKLAND 1141	**Order No:**		
		Client Reference:		
		Submitted By:	Mr Roger High	

Sample Type: Soil

Sample Name:		BH204 0.1m 05-Jun-2014 1:28 pm	BH204 1.0m 05-Jun-2014 1:29 pm	BH201 0.1m 09-Jun-2014 10:34 am	BH201 1.0m 09-Jun-2014 10:36 am	BH201 10m 09-Jun-2014 10:50 am
Lab Number:		1289075.1	1289075.2	1289075.4	1289075.5	1289075.7
Individual Tests						
Dry Matter	g/100g as rcvd	79	78	77	75	77
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	3	3	3	3	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	0.11	< 0.10	0.11
Total Recoverable Chromium	mg/kg dry wt	17	14	7	14	9
Total Recoverable Copper	mg/kg dry wt	15	10	10	15	15
Total Recoverable Lead	mg/kg dry wt	40	7.0	14.2	8.3	16.1
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	17	8	6	9	11
Total Recoverable Zinc	mg/kg dry wt	25	16	31	17	33
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
alpha-BHC	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
beta-BHC	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
delta-BHC	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
cis-Chlordane	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
trans-Chlordane	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	-	< 0.04	-	< 0.04
2,4'-DDD	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
4,4'-DDD	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
2,4'-DDE	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
4,4'-DDE	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
2,4'-DDT	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
4,4'-DDT	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Dieldrin	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endosulfan I	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endosulfan II	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endosulfan sulphate	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endrin	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endrin aldehyde	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endrin ketone	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Heptachlor	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Heptachlor epoxide	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Hexachlorobenzene	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Methoxychlor	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010

Sample Type: Soil						
Sample Name:		BH204 0.1m 05-Jun-2014 1:28 pm	BH204 1.0m 05-Jun-2014 1:29 pm	BH201 0.1m 09-Jun-2014 10:34 am	BH201 1.0m 09-Jun-2014 10:36 am	BH201 10m 09-Jun-2014 10:50 am
Lab Number:		1289075.1	1289075.2	1289075.4	1289075.5	1289075.7
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]anthracene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt	0.03	< 0.03	0.03	< 0.03	< 0.03
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	< 0.03	< 0.03	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	< 0.14	< 0.14	< 0.14	< 0.15	< 0.15
Phenanthrene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	mg/kg dry wt	0.04	< 0.03	0.04	< 0.03	0.04
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	< 9	< 9	< 9	< 9
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	< 70	< 70	< 70

Sample Type: Sediment						
Sample Name:		HA211 0.0m 11-Jun-2014 9:55 am	HA206 0.0m 12-Jun-2014 12:15 pm	HA212a 0.0m 13-Jun-2014 11:00 am	HA211 0.0m [63um Fraction]	HA206 0.0m [63um Fraction]
Lab Number:		1289075.17	1289075.23	1289075.28	1289075.30	1289075.31
Individual Tests						
Dry Matter	g/100g as rcvd	53	40	55	-	-
Extractable Copper*	mg/kg dry wt	-	-	-	22	20
Extractable Lead*	mg/kg dry wt	-	-	-	24	27
Extractable Zinc*	mg/kg dry wt	-	-	-	89	110
Total Organic Carbon*	g/100g dry wt	0.99	4.0	1.56	-	-
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	15.8	7.3	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.031	0.089	-	-	-
Total Recoverable Chromium	mg/kg dry wt	11.4	14.5	-	-	-
Total Recoverable Copper	mg/kg dry wt	11.7	19.6	-	-	-
Total Recoverable Lead	mg/kg dry wt	15.9	22	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.081	0.117	-	-	-
Total Recoverable Nickel	mg/kg dry wt	4.9	8.7	-	-	-
Total Recoverable Zinc	mg/kg dry wt	58	97	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	-	-	18	-	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	-	-	22	-	-
Total Recoverable Copper	mg/kg dry wt	-	-	18	-	-
Total Recoverable Lead	mg/kg dry wt	-	-	29	-	-
Total Recoverable Mercury	mg/kg dry wt	-	-	0.10	-	-
Total Recoverable Nickel	mg/kg dry wt	-	-	7	-	-
Total Recoverable Zinc	mg/kg dry wt	-	-	95	-	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	< 0.010	< 0.010	-	-
alpha-BHC	mg/kg dry wt	-	< 0.010	< 0.010	-	-

Sample Type: Sediment						
	Sample Name:	HA211 0.0m 11-Jun-2014 9:55 am	HA206 0.0m 12-Jun-2014 12:15 pm	HA212a 0.0m 13-Jun-2014 11:00 am	HA211 0.0m [63um Fraction]	HA206 0.0m [63um Fraction]
	Lab Number:	1289075.17	1289075.23	1289075.28	1289075.30	1289075.31
Organochlorine Pesticides Screening in Soil						
beta-BHC	mg/kg dry wt	-	< 0.010	< 0.010	-	-
delta-BHC	mg/kg dry wt	-	< 0.010	< 0.010	-	-
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.010	< 0.010	-	-
cis-Chlordane	mg/kg dry wt	-	< 0.010	< 0.010	-	-
trans-Chlordane	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	< 0.04	< 0.04	-	-
2,4'-DDD	mg/kg dry wt	-	< 0.010	< 0.010	-	-
4,4'-DDD	mg/kg dry wt	-	< 0.010	< 0.010	-	-
2,4'-DDE	mg/kg dry wt	-	< 0.010	< 0.010	-	-
4,4'-DDE	mg/kg dry wt	-	< 0.010	< 0.010	-	-
2,4'-DDT	mg/kg dry wt	-	< 0.010	< 0.010	-	-
4,4'-DDT	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Dieldrin	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endosulfan I	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endosulfan II	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endosulfan sulphate	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endrin	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endrin aldehyde	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endrin ketone	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Heptachlor	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Heptachlor epoxide	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Hexachlorobenzene	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Methoxychlor	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Acenaphthylene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Anthracene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Chrysene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Fluoranthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Fluorene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Naphthalene	mg/kg dry wt	< 0.3	< 0.6	< 0.3	-	-
Phenanthrene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Pyrene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	-	< 0.005	< 0.005	-	-
Monobutyltin (as Sn)	mg/kg dry wt	-	< 0.007	< 0.007	-	-
Tributyltin (as Sn)	mg/kg dry wt	-	< 0.004	< 0.004	-	-
Triphenyltin (as Sn)	mg/kg dry wt	-	< 0.003	< 0.003	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 13	< 40	< 13	-	-
C10 - C14	mg/kg dry wt	< 30	< 70	< 30	-	-
C15 - C36	mg/kg dry wt	< 50	< 140	< 50	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 90	< 300	< 90	-	-

Sample Type: Sediment						
Sample Name:		HA212a 0.0m [63um Fraction]				
Lab Number:		1289075.32				
Individual Tests						
Extractable Copper*	mg/kg dry wt	19.0	-	-	-	-
Extractable Lead*	mg/kg dry wt	28	-	-	-	-
Extractable Zinc*	mg/kg dry wt	105	-	-	-	-

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**
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%.	-	1-2, 4-5, 7, 17, 23, 28
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	1-2, 4-5, 7, 17, 23, 28
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1-2, 4-5, 7, 28
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082).. Tested on dried sample	0.010 - 0.04 mg/kg dry wt	1, 4, 7, 23, 28
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	1-2, 4-5, 7, 17, 23, 28
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-2, 4-5, 7, 17, 23, 28

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	17, 23
Tributyl Tin Trace in Soil samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis. Tested on dried sample	0.003 - 0.007 mg/kg dry wt	23, 28
ARC 2M HCl Extraction*	<63µm Sieved Fraction, extracted with 2M HCl. Solid:Liquid 1:50 w/v. ARC Tech Publication No. 47, 1994.	-	30-32
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	17, 23, 28
Extractable Copper*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	1.0 mg/kg dry wt	30-32
Extractable Lead*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	0.2 mg/kg dry wt	30-32
Extractable Zinc*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	2 mg/kg dry wt	30-32
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	17, 23, 28

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	OPUS International Consultants	**Lab No:**	1293375	SPv1
Contact:	Mr Roger High	**Date Registered:**	01-Jul-2014	
	C/- OPUS International Consultants	**Date Reported:**	21-Jul-2014	
	PO Box 5848	**Quote No:**	61048	
	AUCKLAND 1141	**Order No:**		
		Client Reference:		
		Submitted By:	Mr Roger High	

Sample Type: Soil

		Sample Name:	HA 259 0.1m 23-Jun-2014 12:50 pm	HA260 0.01-0.05m 23-Jun-2014 1:56 pm	HA260 1.0m 23-Jun-2014 1:58 pm		
		Lab Number:	1293375.6	1293375.8	1293375.9		
Individual Tests							
Dry Matter	g/100g as rcvd		65	62	72	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		3	4	5	-	-
Total Recoverable Cadmium	mg/kg dry wt		< 0.10	< 0.10	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt		8	8	17	-	-
Total Recoverable Copper	mg/kg dry wt		12	12	25	-	-
Total Recoverable Lead	mg/kg dry wt		12.7	11.4	14.6	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	< 0.10	< 0.10	-	-
Total Recoverable Nickel	mg/kg dry wt		3	3	27	-	-
Total Recoverable Zinc	mg/kg dry wt		25	35	32	-	-
Organochlorine Pesticides Screening in Soil							
Aldrin	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
alpha-BHC	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
beta-BHC	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
delta-BHC	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
gamma-BHC (Lindane)	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
cis-Chlordane	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
trans-Chlordane	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt		< 0.04	< 0.04	< 0.04	-	-
2,4'-DDD	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
4,4'-DDD	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
2,4'-DDE	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
4,4'-DDE	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
2,4'-DDT	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
4,4'-DDT	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Dieldrin	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Endosulfan I	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Endosulfan II	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Endosulfan sulphate	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Endrin	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Endrin aldehyde	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Endrin ketone	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Heptachlor	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Heptachlor epoxide	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-
Hexachlorobenzene	mg/kg dry wt		< 0.010	< 0.010	< 0.010	-	-

Sample Type: Soil						
Sample Name:		HA 259 0.1m 23-Jun-2014 12:50 pm	HA260 0.01-0.05m 23-Jun-2014 1:56 pm	HA260 1.0m 23-Jun-2014 1:58 pm		
Lab Number:		1293375.6	1293375.8	1293375.9		
Organochlorine Pesticides Screening in Soil						
Methoxychlor	mg/kg dry wt	< 0.010	< 0.010	< 0.010	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Acenaphthylene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Anthracene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Chrysene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Fluoranthene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Fluorene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Naphthalene	mg/kg dry wt	< 0.18	< 0.17	< 0.16	-	-
Phenanthrene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Pyrene	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 11	< 11	< 10	-	-
C10 - C14	mg/kg dry wt	< 30	< 30	< 20	-	-
C15 - C36	mg/kg dry wt	< 50	< 50	< 40	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	< 70	-	-

Sample Type: Sediment						
Sample Name:		HA/S213 0.0m 13-Jun-2014 2:30 pm	HA217 0.0m 24-Jun-2014 10:10 am	HA210a 0.0m 24-Jun-2014 11:30 am	HA210a 0.5m 24-Jun-2014 11:30 am	HA215 0.0m 25-Jun-2014 10:10 am
Lab Number:		1293375.5	1293375.11	1293375.13	1293375.14	1293375.16
Individual Tests						
Dry Matter	g/100g as rcvd	50	43	37	68	52
Total Organic Carbon*	g/100g dry wt	1.26	1.41	2.2	-	1.31
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	11	19	8	< 2	16
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	16	20	18	8	17
Total Recoverable Copper	mg/kg dry wt	17	19	19	7	17
Total Recoverable Lead	mg/kg dry wt	27	30	24	4.6	29
Total Recoverable Mercury	mg/kg dry wt	0.10	0.11	0.11	< 0.10	0.11
Total Recoverable Nickel	mg/kg dry wt	7	7	7	2	8
Total Recoverable Zinc	mg/kg dry wt	98	106	91	14	101
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	< 0.010	-	-
alpha-BHC	mg/kg dry wt	-	-	< 0.010	-	-
beta-BHC	mg/kg dry wt	-	-	< 0.010	-	-
delta-BHC	mg/kg dry wt	-	-	< 0.010	-	-
gamma-BHC (Lindane)	mg/kg dry wt	-	-	< 0.010	-	-
cis-Chlordane	mg/kg dry wt	-	-	< 0.010	-	-
trans-Chlordane	mg/kg dry wt	-	-	< 0.010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	-	< 0.04	-	-
2,4'-DDD	mg/kg dry wt	-	-	< 0.010	-	-
4,4'-DDD	mg/kg dry wt	-	-	< 0.010	-	-
2,4'-DDE	mg/kg dry wt	-	-	< 0.010	-	-

Sample Type: Sediment						
Sample Name:		HA/S213 0.0m 13-Jun-2014 2:30 pm	HA217 0.0m 24-Jun-2014 10:10 am	HA210a 0.0m 24-Jun-2014 11:30 am	HA210a 0.5m 24-Jun-2014 11:30 am	HA215 0.0m 25-Jun-2014 10:10 am
Lab Number:		1293375.5	1293375.11	1293375.13	1293375.14	1293375.16
Organochlorine Pesticides Screening in Soil						
4,4'-DDE	mg/kg dry wt	-	-	< 0.010	-	-
2,4'-DDT	mg/kg dry wt	-	-	< 0.010	-	-
4,4'-DDT	mg/kg dry wt	-	-	< 0.010	-	-
Dieldrin	mg/kg dry wt	-	-	< 0.010	-	-
Endosulfan I	mg/kg dry wt	-	-	< 0.010	-	-
Endosulfan II	mg/kg dry wt	-	-	< 0.010	-	-
Endosulfan sulphate	mg/kg dry wt	-	-	< 0.010	-	-
Endrin	mg/kg dry wt	-	-	< 0.010	-	-
Endrin aldehyde	mg/kg dry wt	-	-	< 0.010	-	-
Endrin ketone	mg/kg dry wt	-	-	< 0.010	-	-
Heptachlor	mg/kg dry wt	-	-	< 0.010	-	-
Heptachlor epoxide	mg/kg dry wt	-	-	< 0.010	-	-
Hexachlorobenzene	mg/kg dry wt	-	-	< 0.010	-	-
Methoxychlor	mg/kg dry wt	-	-	< 0.010	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Acenaphthylene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Anthracene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Benzo[a]anthracene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	0.04
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	0.05
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	0.05
Benzo[k]fluoranthene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Chrysene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Fluoranthene	mg/kg dry wt	0.05	< 0.06	< 0.06	< 0.04	0.09
Fluorene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	< 0.05
Naphthalene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.16	< 0.3
Phenanthrene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.04	0.06
Pyrene	mg/kg dry wt	0.06	0.07	0.07	< 0.04	0.12
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	-	-	< 0.005	-	-
Monobutyltin (as Sn)	mg/kg dry wt	-	-	< 0.007	-	-
Tributyltin (as Sn)	mg/kg dry wt	-	-	< 0.004	-	-
Triphenyltin (as Sn)	mg/kg dry wt	-	-	< 0.003	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 14	< 16	< 18	< 10	< 13
C10 - C14	mg/kg dry wt	< 30	< 40	< 40	< 20	< 30
C15 - C36	mg/kg dry wt	< 60	< 70	< 80	< 40	< 50
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 100	< 110	< 130	< 70	< 90

Sample Name:		HA214a 0.0m 25-Jun-2014 12:21 pm	HA/S213 0.0m [63um Fraction]	HA217 0.0m [63um Fraction]	HA210a 0.0m [63um Fraction]	HA215 0.0m [63um Fraction]
Lab Number:		1293375.20	1293375.22	1293375.23	1293375.24	1293375.25
Individual Tests						
Dry Matter	g/100g as rcvd	47	-	-	-	-
Extractable Copper*	mg/kg dry wt	-	16.3	18.2	15.7	19.5
Extractable Lead*	mg/kg dry wt	-	26	27	24	29
Extractable Zinc*	mg/kg dry wt	-	93	101	84	110
Total Organic Carbon*	g/100g dry wt	1.54	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	23	-	-	-	-

Sample Type: Sediment						
	Sample Name:	HA214a 0.0m 25-Jun-2014 12:21 pm	HA/S213 0.0m [63um Fraction]	HA217 0.0m [63um Fraction]	HA210a 0.0m [63um Fraction]	HA215 0.0m [63um Fraction]
	Lab Number:	1293375.20	1293375.22	1293375.23	1293375.24	1293375.25
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	21	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	19	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	32	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.13	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	8	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	119	-	-	-	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	-	-	-	-
alpha-BHC	mg/kg dry wt	< 0.010	-	-	-	-
beta-BHC	mg/kg dry wt	< 0.010	-	-	-	-
delta-BHC	mg/kg dry wt	< 0.010	-	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	-	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.010	-	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.010	-	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	-	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDD	mg/kg dry wt	< 0.010	-	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDE	mg/kg dry wt	< 0.010	-	-	-	-
2,4'-DDT	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.010	-	-	-	-
Dieldrin	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan I	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan II	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.010	-	-	-	-
Endrin	mg/kg dry wt	< 0.010	-	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.010	-	-	-	-
Endrin ketone	mg/kg dry wt	< 0.010	-	-	-	-
Heptachlor	mg/kg dry wt	< 0.010	-	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.010	-	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.010	-	-	-	-
Methoxychlor	mg/kg dry wt	< 0.010	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.05	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.05	-	-	-	-
Anthracene	mg/kg dry wt	0.06	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	0.13	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.19	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.21	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.15	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	0.10	-	-	-	-
Chrysene	mg/kg dry wt	0.19	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.05	-	-	-	-
Fluoranthene	mg/kg dry wt	0.43	-	-	-	-
Fluorene	mg/kg dry wt	< 0.05	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.08	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.3	-	-	-	-
Phenanthrene	mg/kg dry wt	0.33	-	-	-	-
Pyrene	mg/kg dry wt	0.50	-	-	-	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	< 0.005	-	-	-	-

Sample Type: Sediment						
Sample Name:		HA214a 0.0m 25-Jun-2014 12:21 pm	HA/S213 0.0m [63um Fraction]	HA217 0.0m [63um Fraction]	HA210a 0.0m [63um Fraction]	HA215 0.0m [63um Fraction]
Lab Number:		1293375.20	1293375.22	1293375.23	1293375.24	1293375.25
Tributyl Tin Trace in Soil samples by GCMS						
Monobutyltin (as Sn)	mg/kg dry wt	< 0.007	-	-	-	-
Tributyltin (as Sn)	mg/kg dry wt	< 0.004	-	-	-	-
Triphenyltin (as Sn)	mg/kg dry wt	< 0.003	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 14	-	-	-	-
C10 - C14	mg/kg dry wt	< 30	-	-	-	-
C15 - C36	mg/kg dry wt	< 60	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 100	-	-	-	-

Sample Name:		HA214a 0.0m [63um Fraction]				
Lab Number:		1293375.26				
Individual Tests						
Extractable Copper*	mg/kg dry wt	18.7	-	-	-	-
Extractable Lead*	mg/kg dry wt	28	-	-	-	-
Extractable Zinc*	mg/kg dry wt	105	-	-	-	-

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
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082).. Tested on dried sample	0.010 - 0.04 mg/kg dry wt	6, 8-9, 13, 20

Sample Type: Sediment

Test	Method Description	Default Detection Limit	Sample No
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%.	-	5-6, 8-9, 11, 13-14, 16, 20
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	5-6, 8-9, 11, 13-14, 16, 20
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	5-6, 8-9, 11, 13-14, 16, 20
Tributyl Tin Trace in Soil samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis. Tested on dried sample	0.003 - 0.007 mg/kg dry wt	13, 20
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	5-6, 8-9, 11, 13-14, 16, 20
ARC 2M HCl Extraction*	<63µm Sieved Fraction, extracted with 2M HCl. Solid:Liquid 1:50 w/v. ARC Tech Publication No. 47, 1994.	-	22-26
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	5-6, 8-9, 11, 13-14, 16, 20
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	5, 11, 13, 16, 20
Extractable Copper*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	1.0 mg/kg dry wt	22-26
Extractable Lead*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	0.2 mg/kg dry wt	22-26
Extractable Zinc*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	2 mg/kg dry wt	22-26
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	5, 11, 13, 16, 20

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	OPUS International Consultants	**Lab No:**	1297663 SPv1
Contact:	Mr Roger High	**Date Registered:**	11-Jul-2014
	C/- OPUS International Consultants	**Date Reported:**	04-Aug-2014
	PO Box 5848	**Quote No:**	61048
	AUCKLAND 1141	**Order No:**	
		Client Reference:	
		Submitted By:	Tom Van Deelen

Sample Type: Soil

		Sample Name:	HA266 0.1m 02-Jul-2014 11:15 am	BH251 0.1m 03-Jul-2014 11:00 am			
		Lab Number:	1297663.11	1297663.17			
Individual Tests							
Dry Matter	g/100g as rcvd		56	78	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg							
Total Recoverable Arsenic	mg/kg dry wt		11	6	-	-	-
Total Recoverable Cadmium	mg/kg dry wt		0.24	0.37	-	-	-
Total Recoverable Chromium	mg/kg dry wt		18	55	-	-	-
Total Recoverable Copper	mg/kg dry wt		32	67	-	-	-
Total Recoverable Lead	mg/kg dry wt		24	130	-	-	-
Total Recoverable Mercury	mg/kg dry wt		< 0.10	< 0.10	-	-	-
Total Recoverable Nickel	mg/kg dry wt		26	42	-	-	-
Total Recoverable Zinc	mg/kg dry wt		200	123	-	-	-
Organochlorine Pesticides Screening in Soil							
Aldrin	mg/kg dry wt		< 0.010	< 0.010	-	-	-
alpha-BHC	mg/kg dry wt		< 0.010	< 0.010	-	-	-
beta-BHC	mg/kg dry wt		< 0.010	< 0.010	-	-	-
delta-BHC	mg/kg dry wt		< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt		< 0.010	< 0.010	-	-	-
cis-Chlordane	mg/kg dry wt		< 0.010	< 0.010	-	-	-
trans-Chlordane	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt		< 0.04	< 0.04	-	-	-
2,4'-DDD	mg/kg dry wt		< 0.010	< 0.010	-	-	-
4,4'-DDD	mg/kg dry wt		< 0.010	< 0.010	-	-	-
2,4'-DDE	mg/kg dry wt		< 0.010	< 0.010	-	-	-
4,4'-DDE	mg/kg dry wt		< 0.010	< 0.010	-	-	-
2,4'-DDT	mg/kg dry wt		< 0.010	< 0.010	-	-	-
4,4'-DDT	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Dieldrin	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endosulfan I	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endosulfan II	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endosulfan sulphate	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endrin	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endrin aldehyde	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Endrin ketone	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Heptachlor	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Heptachlor epoxide	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Hexachlorobenzene	mg/kg dry wt		< 0.010	< 0.010	-	-	-
Methoxychlor	mg/kg dry wt		< 0.010	< 0.010	-	-	-

Sample Type: Soil						
Sample Name:		HA266 0.1m 02-Jul-2014 11:15 am	BH251 0.1m 03-Jul-2014 11:00 am			
Lab Number:		1297663.11	1297663.17			
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Anthracene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Chrysene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Fluoranthene	mg/kg dry wt	< 0.04	0.03	-	-	-
Fluorene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Naphthalene	mg/kg dry wt	< 0.2	< 0.15	-	-	-
Phenanthrene	mg/kg dry wt	< 0.04	< 0.03	-	-	-
Pyrene	mg/kg dry wt	< 0.04	0.04	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 12	< 9	-	-	-
C10 - C14	mg/kg dry wt	< 30	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 50	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 90	< 70	-	-	-

Sample Type: Sediment						
Sample Name:		HA208 0.0m 01-Jul-2014 8:41 am	HA209 0.0m 26-Jun-2014 3:37 pm	HA208 0.0m [63um Fraction]		
Lab Number:		1297663.1	1297663.5	1297663.25		
Individual Tests						
Dry Matter	g/100g as rcvd	28	30	-	-	-
Extractable Copper*	mg/kg dry wt	-	-	18.8	-	-
Extractable Lead*	mg/kg dry wt	-	-	32	-	-
Extractable Zinc*	mg/kg dry wt	-	-	99	-	-
Total Organic Carbon*	g/100g dry wt	4.2	-	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	8	8	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	25	28	-	-	-
Total Recoverable Copper	mg/kg dry wt	26	27	-	-	-
Total Recoverable Lead	mg/kg dry wt	31	34	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	0.20	-	-	-
Total Recoverable Nickel	mg/kg dry wt	10	10	-	-	-
Total Recoverable Zinc	mg/kg dry wt	117	125	-	-	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	< 0.010	-	-	-
alpha-BHC	mg/kg dry wt	< 0.010	< 0.010	-	-	-
beta-BHC	mg/kg dry wt	< 0.010	< 0.010	-	-	-
delta-BHC	mg/kg dry wt	< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	< 0.010	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.010	< 0.010	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	< 0.04	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.010	< 0.010	-	-	-
4,4'-DDD	mg/kg dry wt	< 0.010	< 0.010	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.010	< 0.010	-	-	-

Sample Type: Sediment						
Sample Name:		HA208 0.0m 01-Jul-2014 8:41 am	HA209 0.0m 26-Jun-2014 3:37 pm	HA208 0.0m [63um Fraction]		
Lab Number:		1297663.1	1297663.5	1297663.25		
Organochlorine Pesticides Screening in Soil						
4,4'-DDE	mg/kg dry wt	< 0.010	< 0.010	-	-	-
2,4'-DDT	mg/kg dry wt	< 0.010	< 0.010	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Dieldrin	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endosulfan I	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endosulfan II	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endrin	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endrin ketone	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Heptachlor	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Methoxychlor	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Anthracene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Chrysene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Fluoranthene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Fluorene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Naphthalene	mg/kg dry wt	< 0.4	< 0.4	-	-	-
Phenanthrene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Pyrene	mg/kg dry wt	< 0.08	< 0.08	-	-	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	< 0.005	< 0.005	-	-	-
Monobutyltin (as Sn)	mg/kg dry wt	< 0.007	< 0.007	-	-	-
Tributyltin (as Sn)	mg/kg dry wt	< 0.004	< 0.004	-	-	-
Triphenyltin (as Sn)	mg/kg dry wt	< 0.003	< 0.003	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 30	< 30	-	-	-
C10 - C14	mg/kg dry wt	< 50	< 50	-	-	-
C15 - C36	mg/kg dry wt	< 100	< 90	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 170	< 160	-	-	-

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: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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%.	-	1, 5, 11, 17
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	1, 5, 11, 17

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1, 5, 11, 17
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082).. Tested on dried sample	0.010 - 0.04 mg/kg dry wt	1, 5, 11, 17
Tributyl Tin Trace in Soil samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis. Tested on dried sample	0.003 - 0.007 mg/kg dry wt	1, 5
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	1, 5, 11, 17
ARC 2M HCl Extraction*	<63µm Sieved Fraction, extracted with 2M HCl. Solid:Liquid 1:50 w/v. ARC Tech Publication No. 47, 1994.	-	25
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1, 5, 11, 17
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	1
Extractable Copper*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	1.0 mg/kg dry wt	25
Extractable Lead*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	0.2 mg/kg dry wt	25
Extractable Zinc*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	2 mg/kg dry wt	25
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	1

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	OPUS International Consultants	**Lab No:**	1308993	SPv1
Contact:	Josh Burton	**Date Registered:**	07-Aug-2014	
	C/- OPUS International Consultants	**Date Reported:**	19-Aug-2014	
	PO Box 5848	**Quote No:**		
	AUCKLAND 1141	**Order No:**		
		Client Reference:	NH2 - 1-C0846.20	
		Submitted By:	Josh Burton	

Sample Type: Aqueous

		Sample Name:	BH201 06-Aug-2014	BH265 29-Jul-2014			
		Lab Number:	1308993.1	1308993.2			
Individual Tests							
Dissolved Mercury	g/m³		< 0.00008	< 0.00008	-	-	-
Heavy metals, dissolved, digested, trace As,Cd,Cr,Cu,Ni,Pb,Zn							
Dissolved Arsenic	g/m³		< 0.011	< 0.0011	-	-	-
Dissolved Cadmium	g/m³		< 0.00053	< 0.000053	-	-	-
Dissolved Chromium	g/m³		< 0.0053	< 0.00053	-	-	-
Dissolved Copper	g/m³		< 0.0053	< 0.00053	-	-	-
Dissolved Lead	g/m³		< 0.0011	< 0.00011	-	-	-
Dissolved Nickel	g/m³		< 0.0053	0.00142	-	-	-
Dissolved Zinc	g/m³		< 0.011	0.0011	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq							
Acenaphthene	g/m³		< 0.00010	< 0.00010	-	-	-
Acenaphthylene	g/m³		< 0.00010	< 0.00010	-	-	-
Anthracene	g/m³		< 0.00010	< 0.00010	-	-	-
Benzo[a]anthracene	g/m³		< 0.00010	< 0.00010	-	-	-
Benzo[a]pyrene (BAP)	g/m³		< 0.00010	< 0.00010	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³		< 0.00010	< 0.00010	-	-	-
Benzo[g,h,i]perylene	g/m³		< 0.00010	< 0.00010	-	-	-
Benzo[k]fluoranthene	g/m³		< 0.00010	< 0.00010	-	-	-
Chrysene	g/m³		< 0.00010	< 0.00010	-	-	-
Dibenzo[a,h]anthracene	g/m³		< 0.00010	< 0.00010	-	-	-
Fluoranthene	g/m³		< 0.00010	< 0.00010	-	-	-
Fluorene	g/m³		0.0005	< 0.0002	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³		< 0.00010	< 0.00010	-	-	-
Naphthalene	g/m³		< 0.0005	< 0.0005	-	-	-
Phenanthrene	g/m³		0.0005	< 0.0004	-	-	-
Pyrene	g/m³		< 0.0002	< 0.0002	-	-	-
Total Petroleum Hydrocarbons in Water							
C7 - C9	g/m³		< 0.10	< 0.10	-	-	-
C10 - C14	g/m³		< 0.2	< 0.2	-	-	-
C15 - C36	g/m³		< 0.4	< 0.4	-	-	-
Total hydrocarbons (C7 - C36)	g/m³		< 0.7	< 0.7	-	-	-

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, digested, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, followed by Nitric acid digestion, ICP-MS, trace level	0.000053 - 0.0011 g/m³	1-2
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m³	1-2
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m³	1-2
Total Digestion after Filtration	Sample filtration through 0.45µm membrane filter followed by boiling nitric acid digestion. Required for samples which precipitate after filtration. APHA 3030 E 22nd ed. 2012 (modified).	-	1-2
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-2

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

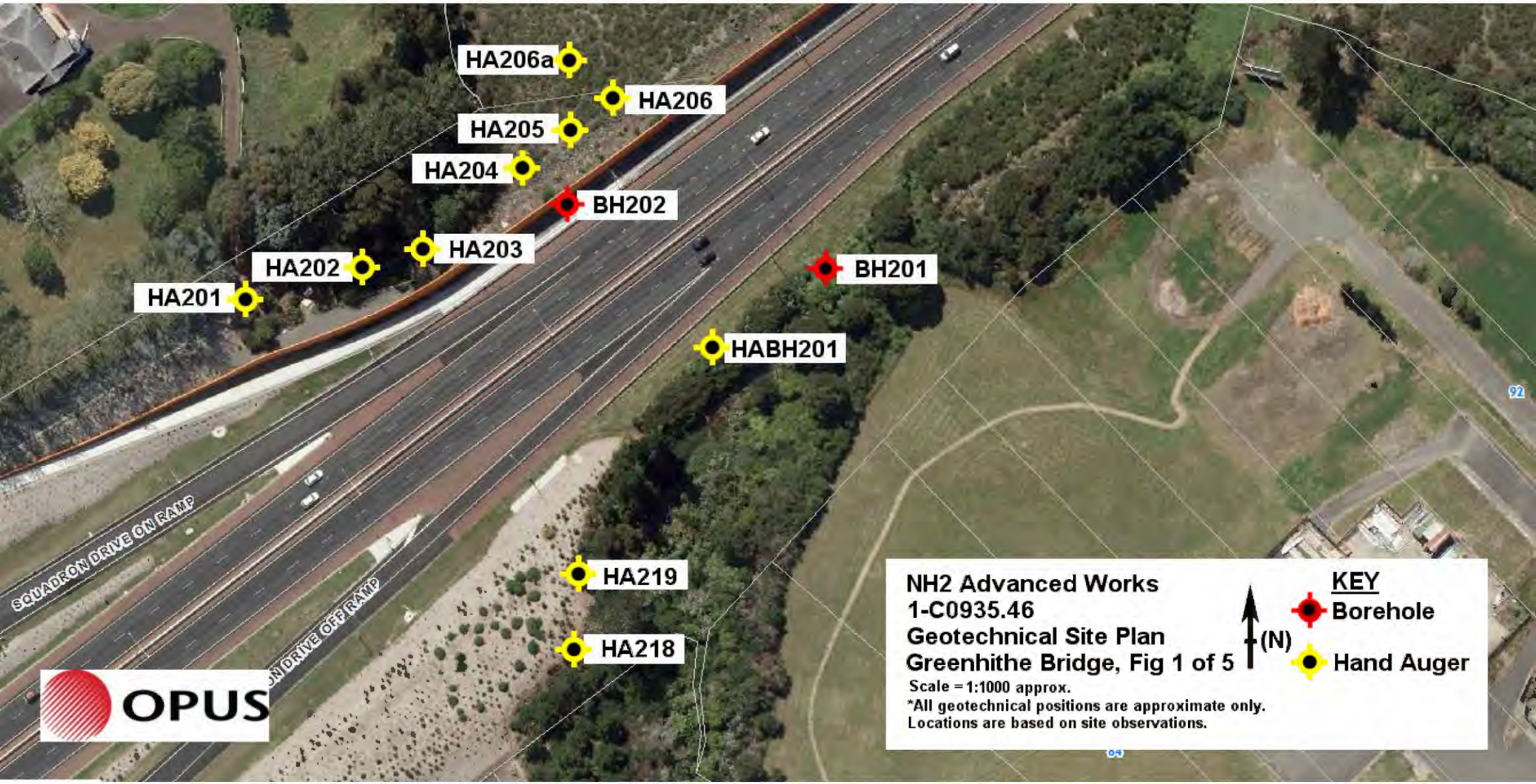
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

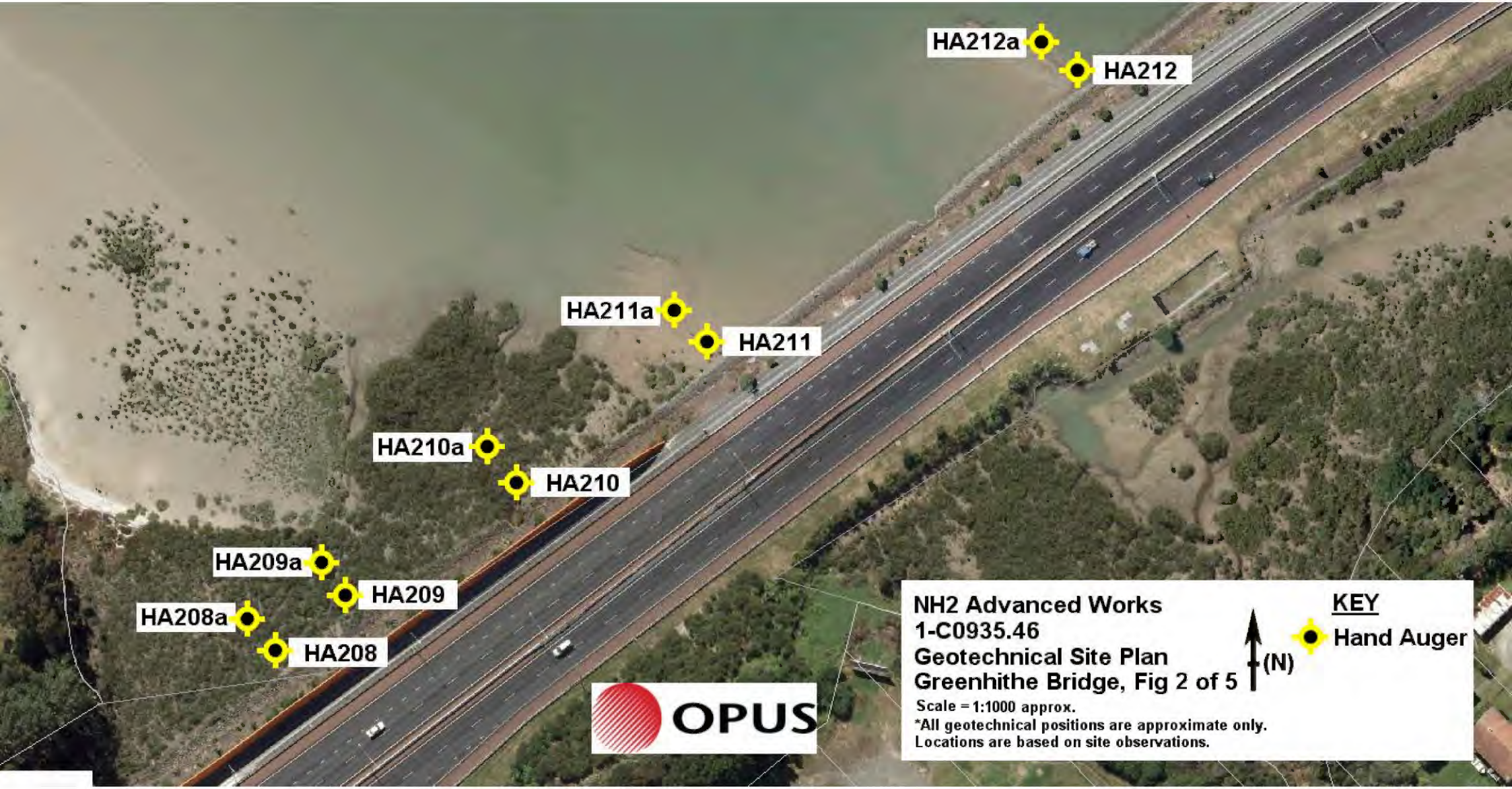
Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

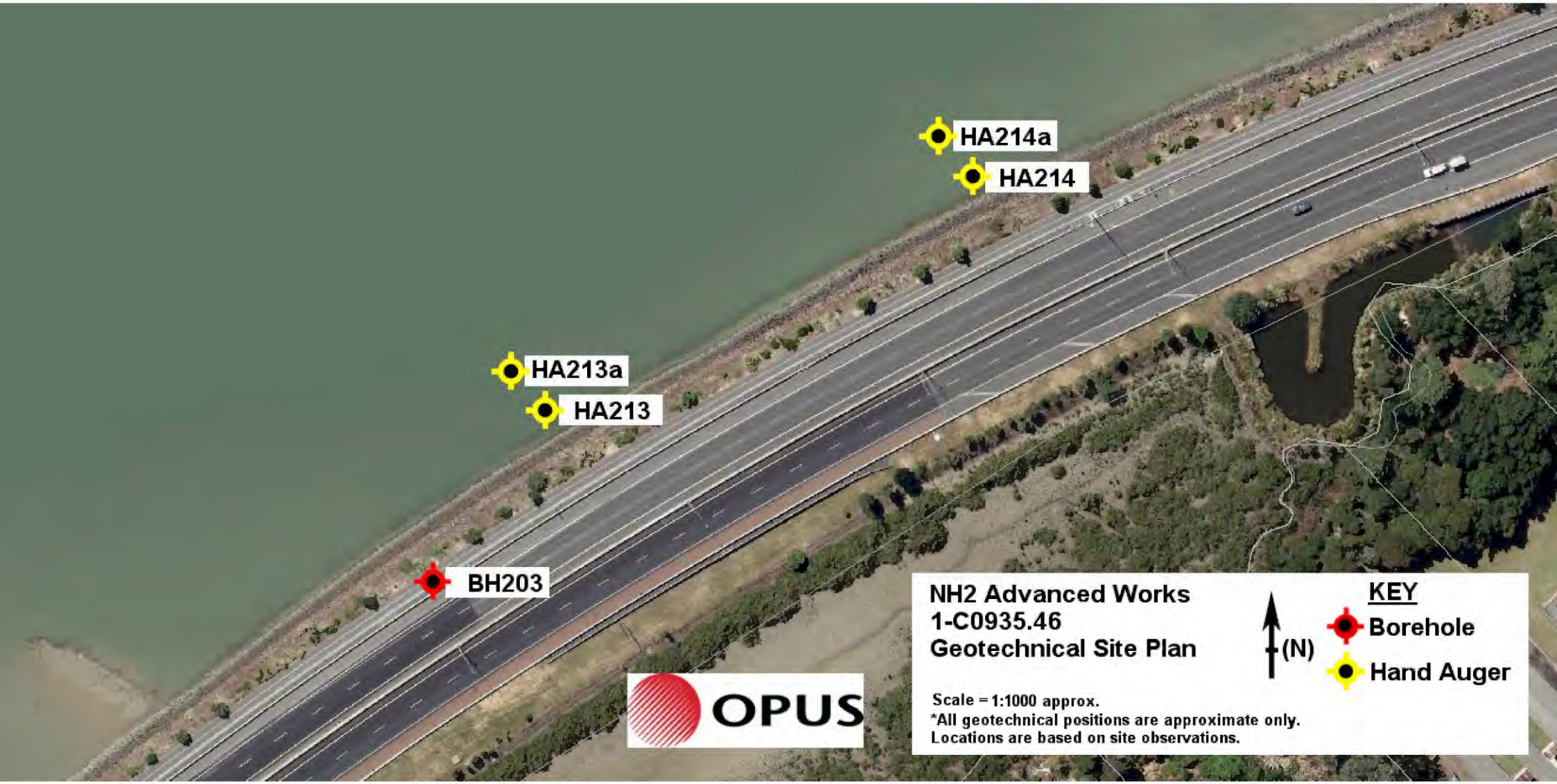
Opus International Consultants Ltd
The Westhaven, 100 Beaumont St
PO Box 5848, Auckland 1141
New Zealand

t: +64 9 355 9500
f: +64 9 355 9585
w: www.opus.co.nz

APPENDIX F BOREHOLE LOGS: GEOTECHNICAL FACTUAL REPORT (OPUS, 2014B)


HA206a
HA206
HA205
HA204
BH202
HA203
HA202
HA201
BH201
HABH201
HA219
HA218
SQUADRON DRIVE ON RAMP
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 1 of 5
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.
(N)
KEY
Borehole
Hand Auger


HA212a
HA212
HA211a
HA211
HA210a
HA210
HA209a
HA209
HA208a
HA208
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 2 of 5
(N)
KEY
Hand Auger
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.


HA214a
HA214
HA213a
HA213
BH203
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
(N)
KEY
Borehole
Hand Auger
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.


HA215a
HA215
HA216a
HA216
HA217a
HA217
HA207a
HA207
UPPER HARBOUR MOTORWAY
OPUS
NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 4 of 5
Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.
(N)
KEY
Hand Auger

OPUS

NH2 Advanced Works
1-C0935.46
Geotechnical Site Plan
Greenhithe Bridge, Fig 5 of 5

(N)

KEY
Borehole

Scale = 1:1000 approx.
*All geotechnical positions are approximate only.
Locations are based on site observations.

Appendix B
Borehole Logs & Core Photographs

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH201**			
PROJECT: **NH2**	CO-ORD.: **1747971 E 5927253 N**	R.L.: **4.47 m**	SHEET: **1 of 2**
LOCATION: **See site plan, SH16, Hobsonville**	REF. GRID:	DATUM: **MSL**	HOLE LENGTH: **10.61 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Fill	Clayey SILT; with trace fine sand and traces of fine angular gravel and rootlets, brown, stiff, moist, slightly plastic, trace rootlets.	4										100	HA	HA				P1	
	Silty CLAY; with trace fine sand and trace fine to 2cmØ gravels, greyish brown mottled orange, stiff, moist, plastic.																		
	Fine to 5cmØ GRAVELS; with trace silt, medium dense, moist, brittle.	1										18	HQ						
	Poor recovery from 0.95m to 1.4m. Inferred 'silty clay'. Material washed away during drilling due to gravel interference.																		
	Silty CLAY; with trace fine to 1cmØ angular gravels, orange mottled brownish orange, hard, plastic. Trace organics, trace pockets of brown silty clay.			10	2//2/3/3/2							82	SPT						
		2																	
	Inclusions of larger 3 to 6cmØ angular gravels at 2.8m. No recovery from 3.0m to 3.45m. Inferred 'clay'. Material not obtained in SPT due to gravel interference.											52	HQ						
		3		1	4//0/0/0/1							0	SPT						
	Push tube attempted at 3.5m. No recovery and material becomes too hard to penetrate at 3.7m.																		
	Poor recovery from 3.7m to 4.4m. Clayey SILT; with some fine sand, grey, stiff, plastic.	4				CW						17	HQ						
	Fine sandy SILT; with minor clay, grey, hard, brittle but slightly plastic once reworked.	0		60+	13//14/16/22/8 for 25mm	CW						100	SPT						
	Muddy fine grained SANDSTONE; grey, extremely weak, moderately weathered.	5				EW	MW												
	Alternating sequence of moderately thick to thick bedded muddy fine grained SANDSTONE (50%); grey, extremely weak, slightly weathered with MUDSTONE (50%); grey, very weak, slightly weathered. Moderately inclined bedding planes, planar to undulating.				UCS: 1600 kPa	EW	SW			Fracture, 11° dip; undulating, rough, no coating at 5.1m. Shattered segment of core from 5.2m to 5.25m. Two fractures, 44° and 48° dips; undulating, rough, no coating at 5.5m and 5.55m. Fracture, 16° dip; planar, smooth, trace clay coating at 5.6m. Fracture, 58° dip; undulating, smooth, no coating at 5.8m. Shattered segment of core from 5.85m and 6.0m.	63	100	HQ							
		6		60+	25//29/29/2 for 5mm								SC	SPT						
		-2								Two fractures, 10° and 16° dips; undulating, smooth, no coating at 6.4m and 6.55m.	78	100	HQ						
	MUDSTONE; grey, very weak, unweathered to slightly weathered. 1cm thick bed of 'soft' MUDSTONE; extremely weak, highly weathered.	7		60+	60 for 140mm	VW	SW			Shattered core. 51° dip fracture; planar, smooth, no coating cross cut by a 73° dip fracture; undulating, smooth, no coating from 6.9m to 7.1m.			SC	SPT						
	Fine grained SANDSTONE; grey, extremely weak, moderately weathered.	8				EW	MW			Fracture, 38° dip; planar, smooth, trace clay coating. Shattered segment of core from 7.95m to 8.15m. Fracture, 70° dip; undulating, smooth, no coating at 8.3m.	74	100	HQ							
		-4			UCS: 3200 kPa								SC	SPT						
	MUDSTONE; grey, very weak, slightly weathered.					VW	SW												
	Muddy fine grained SANDSTONE; grey, extremely weak, slightly weathered.	9		60+	60 for 100mm	VW	SW			Fracture, 68° dip; undulating/ stepped, smooth, no coating at 9.5m. Fracture, 26° dip; undulating, smooth, no coating at 9.6m.	71	100	HQ							
Waitemata Group						VW	SW												

HQTT

NOTES

SWL 9-6-2014 = 1.9m (5pm)
SWL 10-6-2014 = 2.2m (8am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.0m.

STARTED: 6-06-2014	FINISHED: 10-06-2014
DRILLER: Billy	DRILLING CO.: DF
INCLINATION/ AZIMUTH: -90°	DRILLING RIG: CAT
LOGGED: T Van Deelen	CHECKED: G Knocker
CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46

BH201

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH201**			
PROJECT **NH2**	CO-ORD. **1747971 E 5927253 N**	R.L. **4.47 m**	SHEET **2 of 2**
LOCATION **See site plan, SH16, Hobsonville**	REF. GRID	DATUM **MSL**	HOLE LENGTH **10.61 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
	Fine grain sandy MUDSTONE; very weak, slightly weathered.	-6		60+	60 for 110mm	VW	SW			Two cross-cut fractures, 26° and 41° dips; undulating, smooth, no coating at 9.95m. Shattered segment of core from 9.9m to 10.0m.	71	100	HQ	HQTT				P1	
												SC	SPT						
	End of Borehole at 10.61m.	11 / -8 / 12 / 13 / -10 / 14 / 15 / -12 / 16 / 17 / -14 / 18 / 19																	

NOTES

SWL 9-6-2014 = 1.9m (5pm)
SWL 10-6-2014 = 2.2m (8am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.0m.

STARTED 6-06-2014	FINISHED 10-06-2014
DRILLER Billy	DRILLING CO. DF
INCLINATION/ AZIMUTH -90°	DRILLING RIG CAT
LOGGED T Van Deelen	CHECKED G Knocker
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46

BH201

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 201

0.00m – 4.90m **Box 1 of 3**

4.9m – 7.70m **Box 2 of 3**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 201

7.70m – 10.61m EOH	**Box 3 of 3**

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH202**			
PROJECT: **NH2**	CO-ORD.: **1747902 E 5927258 N**	R.L.: **5.25 m**	SHEET: **1 of 2**
LOCATION: **See site plan, SH16, Hobsonville**	REF. GRID:	DATUM: **MSL**	HOLE LENGTH: **18.1 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Fill	Fine to 10cmØ angular GRAVELS in a SILT matrix; with trace clay, brown, dense, brittle, moist.																		P1	
	SILT: with some clay and some hard 2cmØ angular silt fragments, grey mottled bluish grey very stiff, slightly plastic, moist.		1										100	HA	HA					
	CLAY; with some silt, greyish brown, very stiff, plastic, moist.	4																		
	Fine to 3cmØ angular BASALT fragments in a CLAY matrix; some silt, greyish brown, very stiff, plastic, moist.		2		34	12//11/7/7/9							24	SPT		40%				
	Large angular BASALT BOULDERS; dark grey, 'strong', slightly weathered.												100	HQ		100%				
Alluvium	Fine sandy CLAY; with some silt, light greyish brown, firm to stiff, plastic, trace rootlets.	2	3										80	HQ					15-7-2014	
Waitemata Gorup	Silty CLAY; dark grey, stiff, plastic.		4										100	PT						
	SILT; with some clay, grey, stiff, slightly plastic.	0			4	0//1/1/1/1							78	SPT						
	Fine sandy SILT; grey, stiff, brittle.		5										100	HQ	HQTT					
			6										100	PT						
	Silty fine SAND; grey, loose, brittle.				10	2//2/2/3/3							100	SPT						
	Fine SAND; with some silt, grey, loose, brittle.	-2	7		9	2//2/2/3/2							100	HQ						
	SILT; with some clay and trace fine sand, grey, stiff, slightly plastic. Gently inclined bedding plane at 7.9m.		8					CW					100	SPT						
	SILT; with some fine sand and trace clay, grey, very stiff, brittle but slightly plastic once reworked.	-4	9		16	4//3/4/3/6		HW			Moderately inclined, laminae, carbonaceous organic streaks at 9.2m.		68	HQ						
													67	SPT						
								EW	HW			4	57	HQ						

NOTES

SWL 28-5-2014 = 3.5m (5pm)
SWL 29-5-2014 = 3.5m (8.30am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.1m.

STARTED: 27-05-2014		FINISHED: 29-05-2014	
DRILLER: Billy		DRILLING CO.: DF	
INCLINATION/ AZIMUTH: -90°		DRILLING RIG: CAT	
LOGGED: T Van Deelen		CHECKED: G Knocker	**BH202**
CLIENT: Watercare Services Limited		JOB NO.: 1-C0935.46	

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH202**			
PROJECT: **NH2**	CO-ORD.: **1747902 E 5927258 N**	R.L.: **5.25 m**	SHEET: **2 of 2**
LOCATION: **See site plan, SH16, Hobsonville**	REF. GRID:	DATUM: **MSL**	HOLE LENGTH: **18.1 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Waitemata Gorup	MUDSTONE; grey, extremely weak, highly weathered.				EW	HW			Two fractures, 12° and 14° dips; undulating, smooth, trace sand coating at 10.05m and 10.10m.	4	57	HQ					P1	
	CLAY; with some silt, grey, 'very soft', plastic.					CW												
	MUDSTONE; grey, extremely weak, highly weathered.		27	5//6/8/8/5							100	SPT						
		11 / -6		UCS: 810 kPa	EW	HW			Two fractures, 57° and 21° dips; planar, smooth, trace clay coating at 11.10m and 11.15m.	90	100	HQ						
									Two fractures, 31° and 24° dips; planar, smooth, trace clay coating at 11.50m and 11.55m.									
	Alternating sequence of moderately thick bedded MUDSTONE (65%); grey, extremely weak, moderately weathered with fine to medium SAND (35%); with some silt, dense, brittle, weakly cemented. Moderately inclined bedding planes, planar to undulating.	12	60+	38//31/29 for 75mm					Shattered segment of core from 11.8m to 11.9m. Moderately inclined, very thin, carbonaceous organic streak at 11.95m.		SC	SPT						
					EW	HW												
		13							Shattered segment of core from 12.8m to 12.95m.	71	100	HQ						
	MUDSTONE; grey, extremely weak to very weak, slightly weathered.	-8	60+	60 for 120mm UCS: 1500 kPa	VW	SW			Shattered segment of core from 13.3m to 13.4m. Fracture, 35° dip; planar, smooth, no coating at 13.4m.		SC	SPT						
		14								71	100	HQ						
	Fine grained SANDSTONE; very weak, moderately weathered.				VW	MW												
	MUDSTONE; grey, extremely weak to very weak, highly weathered.								Shattered core from 14.4 to 15.0m.									
		15 / -10	60+	35//41/19 for 25mm	EW	HW					SC	SPT						
	MUDSTONE; grey, extremely weak, highly weathered.								Shattered core from 15.3 to 15.6m.	68	100	HQ						
	Fine sandy MUDSTONE; grey, weak concretion, slightly weathered.				W	SW												
	Muddy fine grained SANDSTONE; very weak, slightly weathered. Becomes very weak from 16.2m.	16							Shattered segment of core from 16.05m to 16.15m. Fracture, 42° dip; planar, smooth, trace clay coating at 16.15m.									
	MUDSTONE; grey, very weak, slightly weathered.		60+	60 for 140mm					Shattered core from 16.45m to 17.0m.		SC	SPT						
		17 / -12			VW	SW												
	Muddy fine grained SANDSTONE; very weak, slightly weathered.								Shattered segment of core from 17.3m to 17.4m.	30	100	HQ						
		18	60+	60 for 100mm					Shattered segment of core from 17.9m to 17.95m.		SC	SPT						
	End of Borehole at 18.1m.	19 / -14																

HQTT

NOTES

SWL 28-5-2014 = 3.5m (5pm)
SWL 29-5-2014 = 3.5m (8.30am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.1m.

STARTED: 27-05-2014	FINISHED: 29-05-2014		
DRILLER: Billy	DRILLING CO.: DF		
INCLINATION/ AZIMUTH: -90°	DRILLING RIG: CAT		
LOGGED: T Van Deelen	CHECKED: G Knocker	**BH202**	
CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46		

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 202

0.00m – 3.10m **Box 1 of 6**

3.10m – 6.00m **Box 2 of 6**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 202

6.00m – 9.45m **Box 3 of 6**

9.45m – 13.00m **Box 4 of 6**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 202

13.00m – 16.00m **Box 5 of 6**

16.00m – 18.10m EOH **Box 6 of 6**

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH203**			
PROJECT: **NH2**	CO-ORD.: **1748181 E 5927462 N**	R.L.: **4.90 m**	SHEET: **1 of 2**
LOCATION: **See site plan, SH16, Hobsonville**	REF. GRID:	DATUM: **MSL**	HOLE LENGTH: **15.12 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Fill	Fine to 10cmØ angular GRAVELS in a SILT matrix; brown, dense, brittle, moist, trace rootlets.	4	1										100	HA	HA					
	CLAY; with trace silt and trace 1cmØ to 3cmØ angular gravels, orangish brown, stiff, plastic, moist. No more gravel from 0.6m.																			
	Becomes brownish grey streaked orange from 1.0m.												100	SPT						
	CLAY; with some silt and trace fine sand, light grey mottled orangish brown, very stiff, plastic.		2		9	2//1/2/3/3							100	HQ						
	Silty fine SAND; dark brownish grey, medium dense, brittle.	2	3		34	11//10/6/9/9							60	SPT						
	Poor recovery from 3.45m to 4.0m due to gravel interference with the core barrel. Inferred 'large gravels in a sand matrix'.												5	HQ						
	No recovery from 4.0m to 4.5m. Inferred 'fine sand', very loose.		4													100%				
	1cm to 3cmØ angular GRAVELS in a SILT matrix; brown, dense, brittle, moist, trace rootlets.	0			14	9//4/3/3/4							53	SPT						
	Poor recovery from 4.95m to 6.4m due to gravel interference with the core barrel. Large angular gravels in an inferred 'sand matrix'.		5										22	HQ	HQTT					
			6										100	Push Tube						
	Silty fine SAND; with trace clay, light grey, loose, brittle but slightly plastic once reworked.	-2											100	HQ						
Waitemata Group	Silty CLAY; grey mottled orange, very stiff, plastic.		7		14	3//2/3/4/5		RS					100	Push Tube						
	Silty fine SAND; grey mottled orange, medium dense, brittle.												100	SPT						
	Silty fine SAND; grey, dense, brittle, weakly cemented.							CW												
	Alternating sequence of moderately thin to moderately thick bedded fine to medium grained SANDSTONE (80%); grey, very weak, slightly weathered with MUDSTONE (20%); grey, very weak, slightly weathered. Gently inclined bedding planes, planar.	-4	8								Relict fracture, 24° dip; planar, rough, no coating at 7.8m.	90	100	HQ						
			9		60+	60 for 130mm		VW			Shattered core from 8.7m to 8.8m.		100	SPT						
								SW			Fracture, 29° dip; stepped, smooth, no coating at 9.2m.	100	100	HQ						

NOTES

SWL 30-5-2014 = 6.8m (3.30pm)
SWL 3-6-2014 = 5.3m (8am)
Borehole backfilled.

STARTED: 29-05-2014	FINISHED: 3-06-2014
DRILLER: Billy	DRILLING CO.: DF
INCLINATION/AZIMUTH: -90°	DRILLING RIG: CAT
LOGGED: T Van Deelen	CHECKED: G Knocker
CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46

BH203

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH203**			
PROJECT: **NH2**	CO-ORD.: **1748181 E 5927462 N**	R.L.: **4.90 m**	SHEET: **2 of 2**
LOCATION: **See site plan, SH16, Hobsonville**	REF. GRID:	DATUM: **MSL**	HOLE LENGTH: **15.12 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Waitemata Group	Alternating sequence of moderately thin to moderately thick bedded fine to medium grained SANDSTONE (80%); grey, very weak, slightly weathered with MUDSTONE (20%); grey, very weak, slightly weathered. Gently inclined bedding planes, planar.	11		60+	60 for 120mm	VW	SW			Gently inclined, very thin, carbonaceous organic streaks at 9.9m.	100	100	HQ	HQTT					
												SN	SPT						
		-6			UCS: 3600 kPa					Fracture, 22° dip; stepped, smooth, no coating at 10.8m.									
	Fine to medium grained SANDSTONE; grey, very weak, unweathered.					VW	UW				100	100	HQ						
	MUDSTONE; grey, very weak, slightly weathered.	12				VW	SW			Two fractures, 55° and 61° dips; undulating, rough, no coating at 11.7m and 11.9m.									
	Fine to medium grained SANDSTONE; grey, very weak, unweathered.			60+	60 for 100mm	VW	UW					SN	SPT						
	Alternating sequence of thin to moderately thick bedded fine to medium grained SANDSTONE (75%); grey, very weak, slightly weathered with MUDSTONE (25%); grey, very weak, slightly weathered. Gently inclined bedding planes, planar.									Fracture, 6° dip; planar, smooth, fine sand filling at 12.2m.									
		-8								Fracture, 46° dip; undulating, rough, no coating at 12.7m.	75	100	HQ						
		13		60+	29//27/27/6 for 10mm					Shattered core from 13.25m to 13.5m.									
						VW	SW					SN	SPT						
		14								Fracture, 15° dip; undulating, smooth, no coating at 14.1m.									
										Shattered core from 14.4m to 14.5m.	89	100	HQ						
		-10			UCS: 3600 kPa					Gently inclined, closely spaced, laminae, carbonaceous organic streaks from 14.65m to 15.0m.									
		15		60+	60 for 120mm							SN	SPT						
	End of Borehole at 15.12m.	16																	
		-12																	
		17																	
		18																	
		-14																	
		19																	

NOTES

SWL 30-5-2014 = 6.8m (3.30pm)
SWL 3-6-2014 = 5.3m (8am)
Borehole backfilled.

STARTED: 29-05-2014	FINISHED: 3-06-2014
DRILLER: Billy	DRILLING CO.: DF
INCLINATION/ AZIMUTH: -90°	DRILLING RIG: CAT
LOGGED: T Van Deelen	CHECKED: G Knocker
CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46

BH203

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

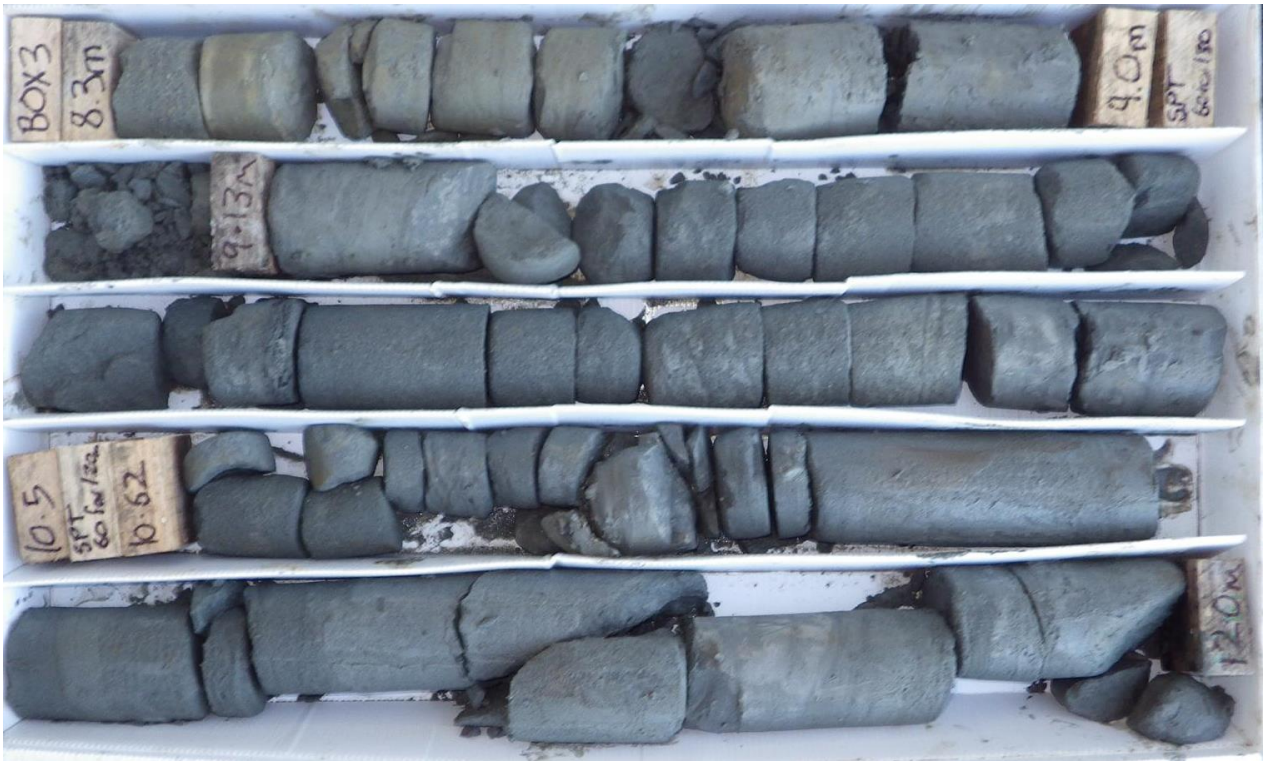
Scale 1:33.33

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 203

0.00m – 3.45m **Box 1 of 4**

3.45m – 8.30m **Box 2 of 4**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 203



8.30m – 12.00m **Box 3 of 4**

12.00m – 15.12m EOH **Box 4 of 4**

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH204**			
PROJECT **NH2**	CO-ORD. **1749087 E 5927788 N**	R.L. **26.58 m**	SHEET **1 of 3**
LOCATION **See site plan, SH16, Greenhithe**	REF. GRID	DATUM **MSL**	HOLE LENGTH **22.57 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK WEATHERING	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Fill	Clayey SILT; brown, stiff, plastic, dry, trace rootlets.						100	HA	HA				P1	
	Silty CLAY; with trace fine to 4cmØ angular gravels and trace fine pockets of fine sandy silt, greyish brown, stiff, plastic, moist.	26												
	SILT; with some clay and trace fine to 2cmØ angular gravels, dark greyish brown, stiff, plastic, trace fibrous wood.	1	6	1//2/1/1/2			47	SPT						
Waitemata Group	Silty fine SAND; light grey mottled orange, loose, brittle.	2			RS		100	HQ						
	SILT; with some clay, grey mottled orange, hard, plastic.	24												
	Silty fine SAND; grey streaked orange, medium dense, brittle.	3	20	4//4/5/5/6			100	SPT						
	Silty fine SAND; light greyish brown mottled orange, medium dense, brittle.	4					49	HQ					15-7-2014	
		22	21	5//3/5/6/7			100	SPT						
		5					59	HQ	HQTT					
	Trace clay and slightly plastic once reworked from 5.8m.													
	Silty fine SAND; orange brown mottled light greyish brown, medium dense, brittle.	6	24	6//4/6/6/8	CW		100	SPT						
		20												
	Trace carbonaceous organics from 7.0m.	7					100	HQ						
	Fine sandy SILT; grey, hard, slightly plastic.		31	6//6/6/9/10			100	SPT						
	Silty fine SAND; grey, medium dense, brittle.	8												
	Fine sandy SILT; grey, very stiff, brittle. Gently inclined bedding plane, planar.	18					23	HQ						
		9	27	6//5/6/7/9			100	SPT						
	Silty fine SAND; medium dense, brittle.													
	Becomes weakly cemented from 9.8m.						48	HQ						

NOTES

SWL 4-6-2014 = 3.9m (4.30pm)
SWL 5-6-2014 = 5.75m (7.30am), 3.5m (4.30pm)
SWL 6-6-2014 = 4.9m (8am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.0m.

STARTED 3-06-2014	FINISHED 5-06-2014
DRILLER Billy	DRILLING CO. DF
INCLINATION/ AZIMUTH -90°	DRILLING RIG CAT
LOGGED T Van Deelen	CHECKED G Knocker
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46

BH204

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

Scale 1:33.33

BOREHOLE LOG

OPUS GEOTECHNICAL

PROJECT: NH2	CO-ORD.: 1749087 E 5927788 N	R.L.: 26.58 m	HOLE NO.: BH204
LOCATION: See site plan, SH16, Greenhithe	REF. GRID:	DATUM: MSL	SHEET: 2 of 3
			HOLE LENGTH: 22.57 m

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Waitemata Group	Silty fine SAND; medium dense, brittle.	16		27	5//4/7/7/9		CW			Relict fracture, 61° dip; planar, rough, no coating at 9.9m.		48	HQ					P1	
	Occasional very thin layers of SILT; with some clay, hard, slightly plastic from 10.5m.											SC	SPT						
	Becomes dense from 11.5m.	11										100	HQ						
		12		60+	33//60 for 70mm							SC	SPT						
	Fine grained SANDSTONE; grey, very weak, slightly weathered.					VW	SW												
	MUDSTONE; grey, very weak, unweathered.	14								Gently inclined, lamanae, carbonaceous organic streaks at 12.4m.									
	Muddy fine grained SANDSTONE; grey, very weak, unweathered.	13								Fracture, 19° dip; planar, smooth, no coating at 12.75m.	100	100	HQ						
				60+	60 for 90mm UCS: 3900 kPa	VW	UW			Fracture, 8° dip; undulating, rough, no coating at 13.2m. Gently inclined, lamanae, carbonaceous organic streaks at 13.3m.		SC	SPT						
		14									100	100	HQ						
	Fine grained SANDSTONE; grey, very weak, unweathered.	12								Gently inclined, lamanae, carbonaceous organic streaks from 14.5m to 14.6m.									
		15		60+	60 for 80mm UCS: 490 kPa							SC	SPT						
	Silty fine SAND; very dense, brittle, weakly cemented.						HW				8	100	HQ						
		16										SC	SPT						
	Alternating sequence of moderately thick bedded fine grained SANDSTONE (80%); grey, very weak, unweathered with thin bedded MUDSTONE (20%); grey, very weak, unweathered. Gently inclined bedding planes, planar to undulating.	10		60+	49//60 for 30mm					Gently inclined, lamanae, carbonaceous organic streaks from 16.8m to 16.85m. Fracture, 9° dip; undulating, rough, 1cm thick clay gouge at 16.95m. Gently inclined, closely spaced, very thin, carbonaceous organic streaks from 17.2m to 17.5m. Moderately inclined, closely spaced, very thin, carbonaceous organic streaks from 17.6m to 17.7m.	100	100	HQ						
		17										SC	SPT						
				60+	60 for 110mm	VW	UW				100	100	HQ						
	MUDSTONE; grey, very weak, unweathered.	18										SC	SPT						
	Fine grained SANDSTONE; very weak, unweathered, massive.	8									100	100	HQ						
		19		60+	60 for 70mm							SC	SPT						
											100	100	HQ						

HQTT

NOTES

SWL 4-6-2014 = 3.9m (4.30pm)
SWL 5-6-2014 = 5.75m (7.30am), 3.5m (4.30pm)
SWL 6-6-2014 = 4.9m (8am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.0m.

STARTED: 3-06-2014		FINISHED: 5-06-2014	
DRILLER: Billy		DRILLING CO.: DF	
INCLINATION/ AZIMUTH: -90°		DRILLING RIG: CAT	
LOGGED: T Van Deelen		CHECKED: G Knocker	BH204
CLIENT: Watercare Services Limited		JOB NO.: 1-C0935.46	

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

BOREHOLE LOG

OPUS GEOTECHNICAL

HOLE NO. **BH204**			
PROJECT: **NH2**	CO-ORD.: **1749087 E 5927788 N**	R.L.: **26.58 m**	SHEET: **3 of 3**
LOCATION: **See site plan, SH16, Greenhithe**	REF. GRID:	DATUM: **MSL**	HOLE LENGTH: **22.57 m**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	CORE: RQD (%)	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: METHOD	DRILLING: FLUID LOSS	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	OTHER INSTRUMENTATION
Waitemata Group	Fine grained SANDSTONE; very weak, unweathered, massive.	6 / 21		60+	60 for 90mm	VW	UW			Gently inclined, moderately thick, carbonaceous organic streaks at 20.7m.	100	100	HQ	HQTT				P1	
												SC	SPT						
	Fine to coarse grained SANDSTONE; very weak, unweathered, massive.	22									100	100	HQ						
		4		60+	60 for 70mm							SC	SPT						
	End of Borehole at 22.57m.	23 / 24 / 2 / 25 / 26 / 0 / 27 / 28 / -2 / 29																	

NOTES

SWL 4-6-2014 = 3.9m (4.30pm)
SWL 5-6-2014 = 5.75m (7.30am), 3.5m (4.30pm)
SWL 6-6-2014 = 4.9m (8am)
Single piezometer installed upon completion.
Contamination samples taken at 0.1m, 1.0m and 2.0m.

STARTED: 3-06-2014	FINISHED: 5-06-2014
DRILLER: Billy	DRILLING CO.: DF
INCLINATION/ AZIMUTH: -90°	DRILLING RIG: CAT
LOGGED: T Van Deelen	CHECKED: G Knocker
CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46

BH204

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 (&PHOTO PAGE) 1-C0935.46 NH2.GPJ OPUS CHCH DEC12.GDT 1-8-14

Scale 1:33.33

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 204

0.00m – 3.45m **Box 1 of 7**

3.45m – 7.50m **Box 2 of 7**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 204

7.50m – 11.90m **Box 3 of 7**

11.90m – 14.80m **Box 4 of 7**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 204

14.80m – 17.80m **Box 5 of 7**

17.80m – 20.80m **Box 6 of 7**

North Harbour No 2 Watermain
1-C0935.46
Watercare Services Limited
Borehole 204

20.80m – 22.57m EOH	**Box 7 of 7**

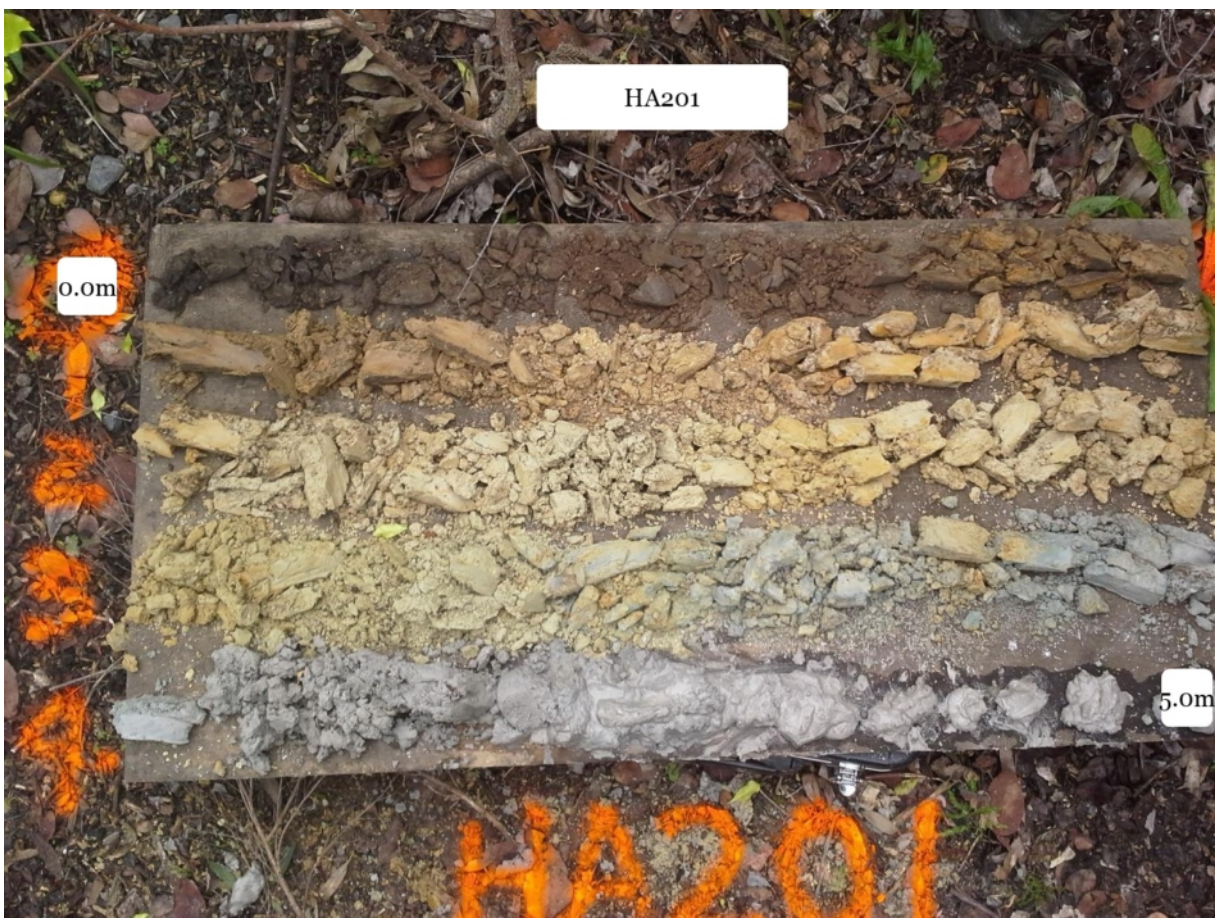
Appendix D
Hand Auger Logs

LOG OF AUGER HOLE

HOLE NO. **HA201**			
PROJECT **NH2**	CO-ORD. **1747839 E 5927246 N**	R.L. **7.52 m**	SHEET **1 of 1**
LOCATION **See site plan, SH16, Hobsonville**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **5 m**

GEOLOGY/UNIT	DESCRIPTION	DEPTH (m)	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Topsoil	Silty CLAY; brown, very stiff, moderate plasticity, trace rootlets,				Contamination sample at 0.0m	
Fill	Clayey SILT; brown mottled light brown with black flecks, very stiff, low plasticity, sensitive, with trace organics (fresh wood).			186/25		
	Silty CLAY; light brown streaked orange (limonite staining), very stiff, moist, moderate plasticity, sensitive, with trace organics (fresh wood).	1		103/8		
	Becomes very sensitive at 1.0m.					
	Becomes dry with trace fine sand at 1.4m.	6		219+		Bulk sample at 1.5m
Alluvium	Silty CLAY; brownish grey streaked brownish orange, hard, moist, moderate plasticity, traces organics (rootlets).	2		219+		
	Silty CLAY; brownish grey with orange streaks, hard, moist, high plasticity.	3		219+	Contamination sample at 3.0m	Bulk sample at 3.0m
Waitemate Group	Clayey SILT with trace fine sand, greyish brown mottled greyish blue with orange limonite streaks, hard, moist, low plasticity.	4		219+		
	Becomes greyish blue mottled greyish brown at 3.6m.					
	Becomes grey at 4.0m.	4		219+	Contamination sample at 4.0m	Bulk sample at 4.0m
	Silty fine to medium SAND; grey, medium dense, saturated, uniformly graded. Water table at 4.3m			UTP		
	End of Hand Auger at 5.0m. Too hard to auger. No scala-penetrometer test undertaken.	5		UTP		

SKETCH OF EXPOSURE



NOTES

Shear vane 1559
Correction factor = 1.563
Contamination samples taken at 0.1m, 1.0m and 2.0m
Bulk samples taken at 1.5m, 3.0m and 4.0m

LOGGED S Farquhar	DATE EXCAVATED 29-05-2014		
CHECKED BY:	EXCAVATOR		
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA201**

LOG OF AUGER HOLE

				HOLE NO. **HA202**
	PROJECT **NH2**	CO-ORD. **1747864 E 5927250 N**	R.L. **4.83 m**	SHEET **1 of 1**
	LOCATION **See site plan, SH16, Hobsonville**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **1.5 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Fill	Clayey SILT; with some fine sand, brown mottled greyish brown and orangey brown, hard, moist, low plasticity, trace rootlets.							
	Silty CLAY; grey, hard, moist, moderate plasticity.							
	Clayey SILT; with some fine sand, brown mottled greyish brown and orange brown, hard, dry, low plasticity.					UTP	Contamination sample at 0.1m	
	Trace fine to medium angular gravel at 0.7m.	4						Bulk sample at 0.7m
	SILT; with some fine sand and minor clay and traces of gravel, brown, hard, dry, low plasticity with water added. Gravel is fine-medium, angular.	1				UTP		
	End of Hand Auger at 1.5m. Too hard to auger. Multiple attempts. No scala-penetrometer test undertaken due to underground services uncertainty.							

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination sample taken at 0.1m
Bulk sample taken at 0.7m

	LOGGED S Farquhar	DATE EXCAVATED 30-05-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA202**

LOG OF AUGER HOLE

HOLE NO. **HA203**			
PROJECT: **NH2**	CO-ORD.: **1747877 E 5927253 N**	R.L.: **3.72 m**	SHEET: **1 of 1**
LOCATION: **See site plan, CH -168:8L (from edge of noise wall)**	REF. GRID:	DATUM: **MSL**	TOTAL DEPTH: **5.5 m**

GEOLOGY/UNIT	DESCRIPTION	DEPTH (m)	SCALA PENETROMETER Blows per 100 mm	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Fill	Silty CLAY; with some coarse sand, fine gravel, boulders, brown, stiff, moist, low plasticity, trace rootlets.					
	Silty CLAY; with some fine sand, brown, stiff, moist, moderate plasticity, trace rootlets.					
	Silty CLAY; with some coarse sand and trace fine sand, light brown mottled orange, moist, moderate plasticity.				Contamination sample at 0.0m	
	Becomes stiff, moderately sensitive at 0.5m.			67/20		
Waitemata Group	Fine SAND; with some clay, light brown, loose, moist, brittle. Becomes medium dense at 1.0m.	1		203+	Contamination sample at 1.0m	
	Becomes light grey streaked orange at 1.2m.					Bulk sample at 1.5m
	Fine sandy CLAY; light grey, hard, moist, moderate plasticity.	2		203+		
	Orange staining at 1.9m.			UTP	Contamination sample at 2.0m	
	Becomes dark bluish grey at 2.1m.					
	CLAY; dark bluish grey, stiff, moist, high plasticity, moderately sensitive.			87/35		
	Fine sandy CLAY; dark bluish grey, stiff, moist, high plasticity, moderately sensitive.	3		145/55		Bulk sample at 3.0m
	CLAY; with trace silt, dark bluish grey, very stiff, moist, high plasticity, moderately sensitive.			107/41		
	Fine sandy CLAY; dark bluish grey, very stiff, moist, low plasticity, moderately sensitive.	4		178/65		Bulk sample at 4.0m
				UTP		
	Becomes hard at 5.5m.	5		138/81		
	End of Hand Auger at 5.5m. Gravel blocking hole. No scala-penetrometer test undertaken.			203+		

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.1m, 1.0m, 2.0m
Bulk samples taken at 1.5m, 3.0m, 4.0m

LOGGED: J Burton	DATE EXCAVATED: 29-05-2014		
CHECKED BY:	EXCAVATOR		
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	**HA203**

LOG OF AUGER HOLE

HOLE NO. **HA204**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 1.1 m**	SHEET **1 of 1**
LOCATION **See site plan, CH-150:9L (from noise wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
M Alluvium	Clayey SILT; brown, soft, saturated, low plasticity, some rootlets. SILT; with some fine sand and minor clay, light brown, soft, saturated, low plasticity. No rootlets, and a pungent sulphurous odour at 0.2m.	0				20/12	Contamination sample at 0.0m	
Waitemata Group	Silty CLAY; grey, very stiff, wet, moderate plasticity, sensitive.	1				136/23 130/22		
	End of Hand Auger at 2.0m. Too hard to auger. Scala-penetrometer test undertaken from 2.0 m to 2.5 m.	2			>>			

SKETCH OF EXPOSURE

NOTES Shear vane 1558 Correction factor = 1.449 Contamination samples taken at 0.0m (x2), 0.8m Bulk samples taken at 0.5m, 1.5m M = Marine Sediment	LOGGED S Farquhar	DATE EXCAVATED 11-06-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA204**

LOG OF AUGER HOLE

HOLE NO. **HA205**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 0.6 m**	SHEET **1 of 1**
LOCATION **See site plan, CH -140:10L (from noise wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2.4 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sediment	Fine sandy SILT; light brownish grey, very loose, saturated, brittle, some rootlets and organics. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
	Clayey SILT; with minor fine sand, light grey, firm, saturated, low plasticity, sensitive, trace rootlets.	0				37/7	Contamination sample at 0.6m	Bulk sample at 0.5m
All.	Silty CLAY; grey, stiff, wet, moderate plasticity, sensitive, trace rootlets.							
Waitemata Group	Silty CLAY; grey, stiff, wet, moderate plasticity, sensitive.	1				89/12		
	Becomes moist, very stiff, sensitive at 1.5m.					110/17		Bulk sample at 1.5m
	Becomes grey, streaked blackish grey at 1.9m.	2				UTP		
	End of Hand Auger at 2.4m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and 2.40m to 3.45m.	-2						
		3						

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction Factor = 1.449
Contamination samples taken at 0.0m (x2), 0.6m
Bulk samples taken at 0.3m, 1.5m
All. = Alluvium

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOGGED S Farquhar	DATE EXCAVATED 12-06-2014		
CHECKED BY:	EXCAVATOR		
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA205**	

LOG OF AUGER HOLE

HOLE NO. **HA206**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 0.4 m**	SHEET **1 of 1**
LOCATION **See site plan, CH -122:13L (from noise wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **3 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sediment	Fine sandy SILT; light brownish grey, very soft, saturated, brittle, some organics. Groundwater level at 0.0m (surface).	0					Contamination sample at 0.0m	Bulk sample at 0.4m
	Trace clay, low plasticity at 0.5m. Moderate plasticity at 0.6m.					14/3	Contamination sample at 0.6m	
Waitemata Group	Silty CLAY; grey, stiff, wet, low plasticity, sensitive, some rootlets. Trace rootlets at 0.75m.	1				72/12		
	No rootlets at 1.3m.					148/23		Bulk sample at 1.5m
		2				203+		
		-2				203+		Bulk sample at 2.5m
	End of Hand Auger at 3.0m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and 3.0m to 3.8m.	3						

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0. m (x2), 0.6m
Bulk samples taken at 0.4m, 1.5m and 2.5m

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOGGED S Farquhar	DATE EXCAVATED 12-06-2014		
CHECKED BY:	EXCAVATOR		
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA206**	

LOG OF AUGER HOLE

HOLE NO. **HA206A**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 0.5 m**	SHEET **1 of 1**
LOCATION **See site plan, CH -122:22L (from noise wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **3 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sediment	SILT; with some fine sand, greyish brown, soft, saturated, brittle, some rootlets. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
	Fine to medium SAND; minor silt and trace clay, grey, loose, saturated, brittle but low plasticity on remould, trace rootlets.							Bulk sample at 0.4m
	SILT; with minor fine sand, and minor clay, firm, saturated, low plasticity, sensitive, minor rootlets.	0				42/9	Contamination sample at 0.6m	
Waitemata Group	Clayey SILT; with minor fine sand, grey, stiff, wet, low plasticity, sensitive. Becomes stiff at 1.0m.	1				58/14	Contamination sample at 0.9m	
	Silty CLAY; with trace fine sand, grey, very stiff, wet, moderate plasticity, moderately sensitive.					100/29		Bulk sample at 1.5m
	Silty CLAY; grey, very stiff, moist, moderate plasticity, sensitive.	2				119/29		
		-2				156/43		Bulk sample at 2.5m
	Becomes hard at 3.0m.	3				203+		
	End of Hand Auger at 3.0m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and 3.0m to 3.9m.							

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction Factor 1.449
Contamination samples at 0. m (x2), 0.6m
Bulk samples at 0.4m, 1.5m 2.5m

	LOGGED S Farquhar	DATE EXCAVATED 12-06-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA206A**

LOG OF AUGER HOLE

HOLE NO. **HA207**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -0.7 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 590:4L (from bridge rail)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2.5 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sed.	Clayey SILT; with trace fine sand, brownish grey, very soft, saturated, low plasticity, trace shells. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
Alluvium	Silty fine SAND; with some clay, light grey, very stiff, saturated, low plasticity, sensitive. Becomes very stiff, sensitive at 0.5m.					162/39		Bulk sample at 0.5m
	Silty CLAY; with trace fine sand, light reddish brown, very stiff, saturated, low plasticity, sensitive, trace organics. Becomes stiff at 1.0m.							Bulk sample at 1.5m
	Silty fine to coarse SAND; with some clay, reddish brown, stiff, saturated, poorly graded. Becomes firm, moderately sensitive at 1.5m.	1 -2				58/14 43/16		
	Becomes very stiff, sensitive at 2.0m.	2				136/29		
	Silty CLAY; with trace fine sand, dark grey, very stiff, saturated, low plasticity, sensitive. CLAY; with minor silt and trace fine sand very stiff, saturated, low plasticity, sensitive, and trace fibrous organics. Becomes hard at 2.5m							Bulk sample at 2.5m
	End of Hand Auger at 2.5m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and 2.5m to 2.9m.					UTP		

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.5m, 2.5m
Sed. = Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

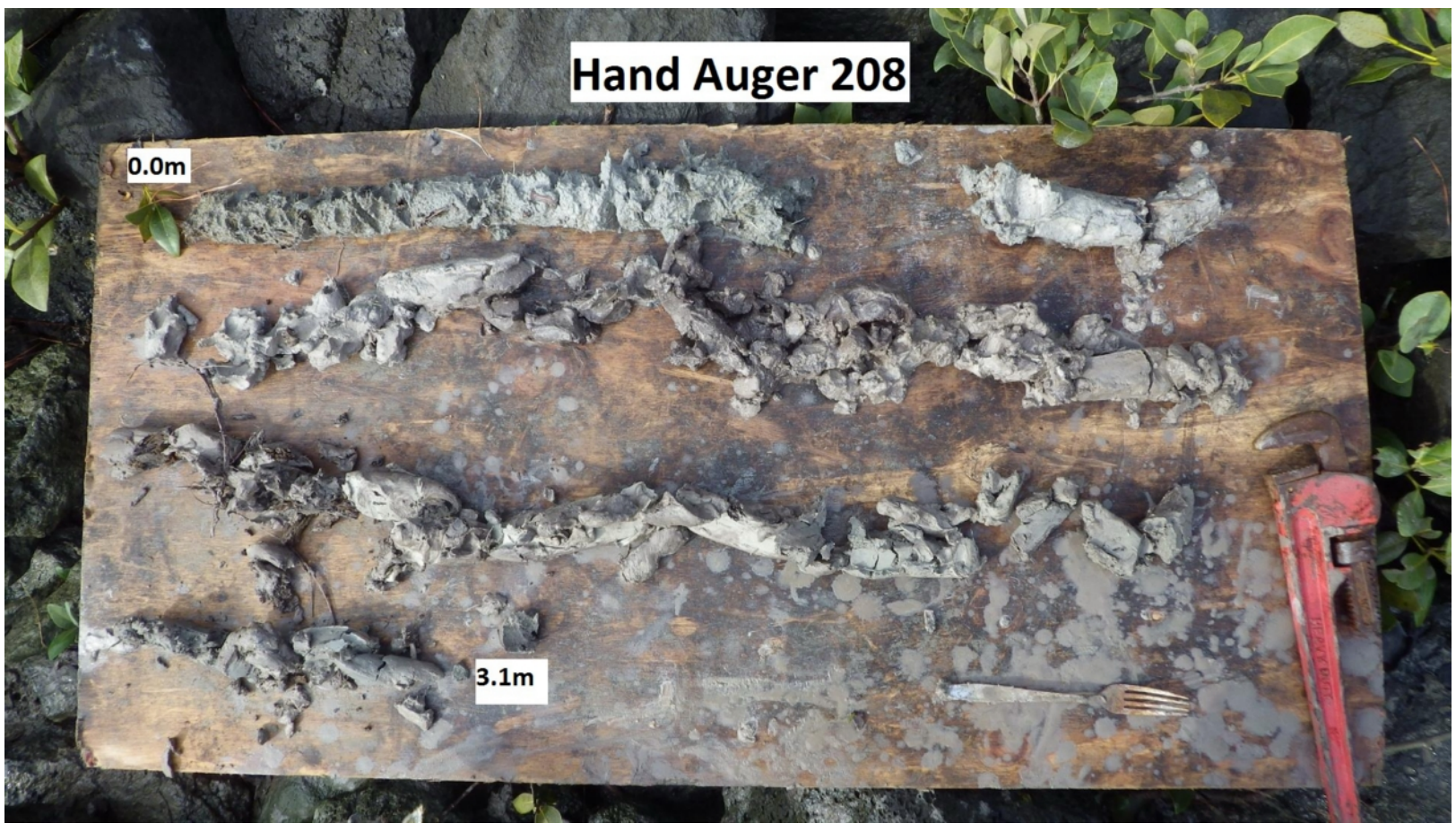
LOGGED B Mason	DATE EXCAVATED 27-06-2015		
CHECKED BY:	EXCAVATOR		
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA207**	

LOG OF AUGER HOLE

HOLE NO. **HA208**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 0.4 m**	SHEET **1 of 1**
LOCATION **See site plan, CH -100:11L (from noise wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **3.1 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sediment	SILT; trace fine sand, greyish brown, very soft, saturated, brittle, some rootlets. Groundwater level at 0.0m (surface). Becomes light grey with trace clay and low plasticity at 0.1m. Some fine sand at 0.3m.	0					Contamination sample at 0.0m	
	Clayey SILT; with some fine sand, light grey, very loose, saturated, low plasticity, moderately sensitive, minor rootlets.					20/12		Bulk sample at 0.5m
	Silty sandy CLAY; light brown, stiff, saturated, moderate plasticity, moderately sensitive, minor rootlets.						Contamination sample at 0.7m	
	Silty CLAY; trace fine sand, greyish brown, stiff, saturated, moderately plasticity, moderately sensitive, minor rootlets. With pungent sulphurous smell at 1.3m. Becomes dark brown mottled grey with trace organics at 1.5m.	1				81/26		Bulk sample at 1.0m
	Silty CLAY; with trace fine sand, dark brown, stiff, saturated, high plasticity, sensitive, trace rootlets and trace organics.					65/17		Bulk sample at 1.5m
Alluvium	Sandy CLAY; brown mottled grey, stiff, saturated, high plasticity, sensitive, trace fibrous organics. Silty CLAY; with trace fine sand, dark brown, stiff, saturated, high plasticity, sensitive, trace fibrous organics.							
	Sandy CLAY; with traces of rootlets and fibrous organics, brown mottled grey, stiff, saturated, high plasticity, sensitive. Becomes hard at 2.0m. Large decayed wood fragments at 2.05m	2				203+		Bulk sample at 2.0m
	CLAY; trace fine sand, greyish brown, hard, saturated, high plasticity, some fibrous organics. Becomes light grey and sensitive at 2.5m.	-2				107/14		Bulk sample at 2.5m
	Silty CLAY; trace fine sand, grey, hard, saturated, brittle but moderate plasticity on remould, some fibrous wood organics.	3				203+		Bulk sample at 3.0m
	End of Hand Auger at 3.1m. Too hard to auger. Scala-penetrometer test undertaken from 3.15m to 3.65m.				>>			

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2), 0.7m
Bulk samples at 0.5m, 1.0m, 1.5m, 2.0m, 2.5m, 3.0m

LOGGED J Burton	DATE EXCAVATED 1-07-2014		
CHECKED BY:	EXCAVATOR		
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA208**

LOG OF AUGER HOLE

HOLE NO. **HA208A**

PROJECT	CO-ORD.	R.L.	SHEET
NH2		Approx. 0.5 m	1 of 1
LOCATION	**REF. GRID**	**DATUM**	**TOTAL DEPTH**
See site plan, CH-100:16L (from noise wall)		MSL	3.65 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sed.	SILT; trace clay and fine sand, greyish brown, very soft, saturated, trace rootlets. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
	Clayey SILT; trace fine sand, greyish brown, saturated, low plasticity, some rootlets.							
	Silty CLAY; with some fine sand, brownish grey, stiff, saturated, high plasticity, sensitive, minor fibrous organics.	0				87/9	Contamination sample at 0.4m	Bulk sample at 0.5m
	Trace fine sand at 0.8m.							
Alluvium	Sandy silty CLAY; greyish brown, stiff, saturated, high plasticity, sensitive, trace rootlets and trace fibrous organics.	1				75/12		Bulk sample at 1.0m
	Silty CLAY; with some fine sand, dark brown with black streaks, stiff, saturated, high plasticity, sensitive, minor fibrous organics.							
	Fine SAND; with some clay, light brown mottled white, loose, saturated.					67/20		Bulk sample at 1.5m
	Fine sandy SILT; with some clay, light grey mottled orange, stiff, saturated, moderate plasticity.							
	Fine sandy CLAY; light brown with light grey streaks, stiff, saturated, low plasticity, moderately sensitive, trace fibrous organics.							
	Silty CLAY; with trace fine sand, light grey mottled brown, stiff, saturated, high plasticity, moderately sensitive, trace fibrous organics.	2				58/20		Bulk sample at 2.0m
	Some fine sand at 2.5m. Trace fine sand at 2.6m.	-2				81/43		Bulk sample at 2.5m
	Becomes very stiff at 3.0m. Becomes brittle but plastic on remould with white specks at 3.1m.	3				142/41		Bulk sample at 3.0m
						119/35		Bulk sample at 3.5m
	End of Hand Auger at 3.65m. Target depth achieved. Scala-penetrometer test undertaken from 3.65m to 4.55m.	4 -4						

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2), 0.4m
Bulk samples taken at 0.5m, 1.0m, 1.5m, 2.0m, 2.5m, 3.0m, 3.5m
Push tube sample taken from 1.0m to 1.5m, 2.0m to 2.4m
Marine Sed. = Marine Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

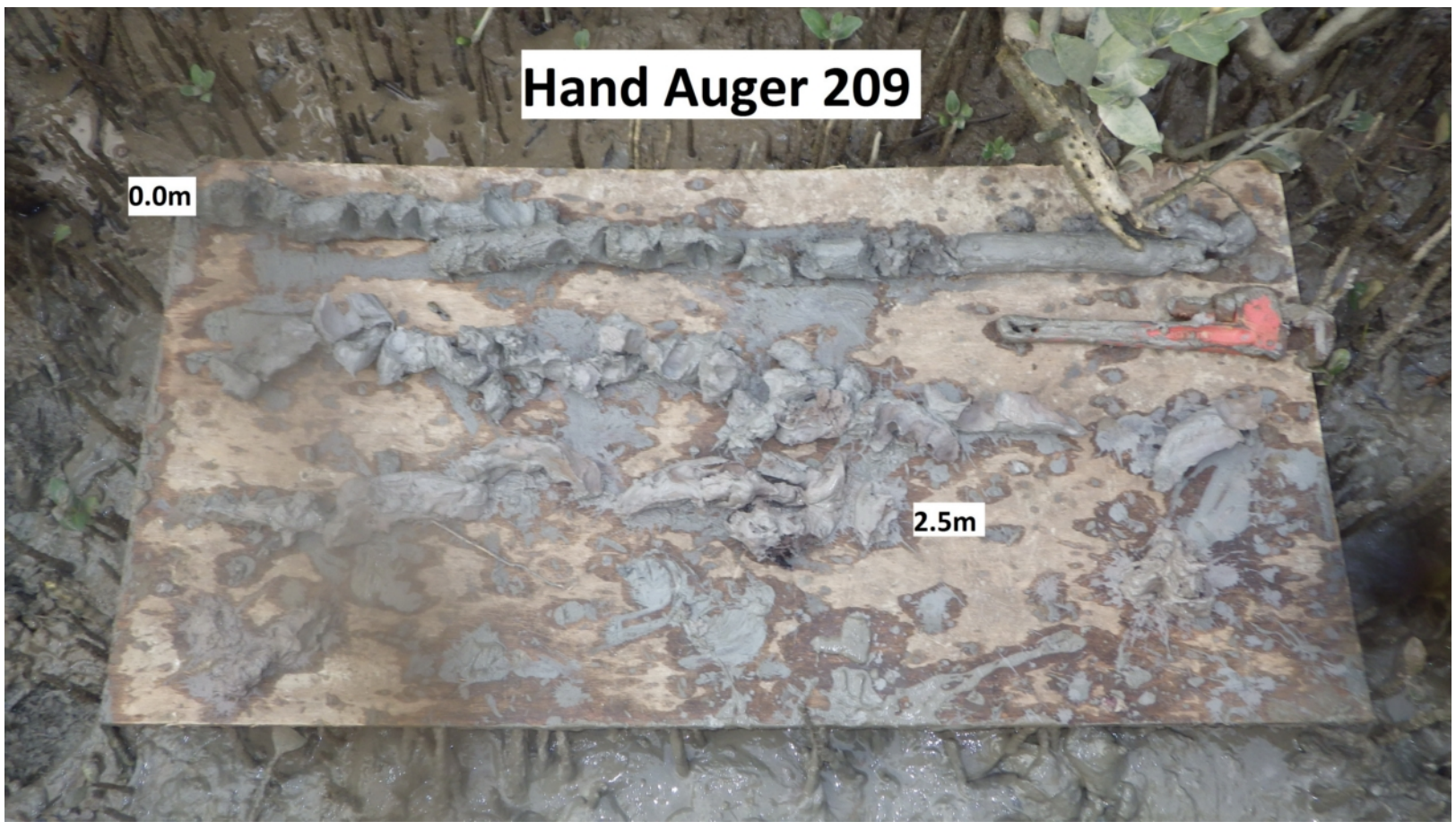
LOGGED	DATE EXCAVATED	
J Burton	1-07-2014	
CHECKED BY:	EXCAVATOR	
CLIENT	JOB NO.	HA208A
Watercare Services Limited	1-C0935.46	

LOG OF AUGER HOLE

PROJECT: NH2	CO-ORD.	R.L.: Approx. 1.1 m	HOLE NO.: HA209
LOCATION: See site plan, CH -82:12L (from noise wall)	REF. GRID	DATUM: MSL	SHEET: 1 of 1
			TOTAL DEPTH: 3.5 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sed.	SILT; with minor clay, trace fine sand, dark grey, very soft, saturated, pungent hydrocarbon odour, some rootlets. Groundwater level at 0.0m (surface). Becomes soft at 0.5m.	0				43/17	Contamination sample at 0.0m	Bulk sample at 0.5m
Alluvium	Silty CLAY; with trace fine sand, grey, stiff, moist, high plasticity.	1				58/29		Bulk sample at 1.0m
						84/41		Bulk sample at 1.5m
		2				72/41		Bulk sample at 2.0m
	Poor recovery from 2.5m to 3.5m. Minor organics (fibrous wood and plant material) at 2.5m.					75/43		Bulk sample at 2.5m
	Becomes hard at 3.0m Minor organics (fibrous wood and plant material) at 3.1m.	3 -2				203+		
	Becomes very stiff at 3.5m.							
	End of Hand Auger at 3.5m. Target depth achieved. Scala-penetrometer test undertaken from 3.65m to 4.05m.	4			>>	81/32		

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.0m, 1.5m, 2.0m, 2.5m

	LOGGED: J Burton	DATE EXCAVATED: 26-06-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	HA209

LOG OF AUGER HOLE

HOLE NO. **HA209A**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 0.9 m**	SHEET **1 of 1**
LOCATION **See site plan, CH -82:18L (from noise wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **3.6 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
M.	SILT; fine sand, and trace clay, greyish brown, very soft, saturated, some rootlets. Groundwater level at 0.0m (surface).	0					Contamination sample at 0.0m	
Alluvium	Sandy CLAY; greyish brown, stiff, saturated, low plasticity, sensitive, minor fibrous organics.	1				96/9		
						43/9		
	Silty CLAY; with trace fine sand, grey, stiff, saturated, high plasticity, trace rootlets.	2				72/14		
						58/29		
	Dark brown streaks, trace gravel and some organics at 2.8m. Becomes reddish brown at 2.9m.	-2				72/38		
		3				130/43		
	Silty CLAY; trace fine sand, reddish brown, stiff, low plasticity, moderately sensitive, some fibrous organics. Some fine sand at 3.4m.					203+		
	End of Hand Auger at 3.6m. Target depth achieved. Scala-penetrometer test undertaken from 3.6m to 4.3m.	4						
		-4						

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2), 0.9m
Bulk samples not taken due to low recovery
M. = Marine Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

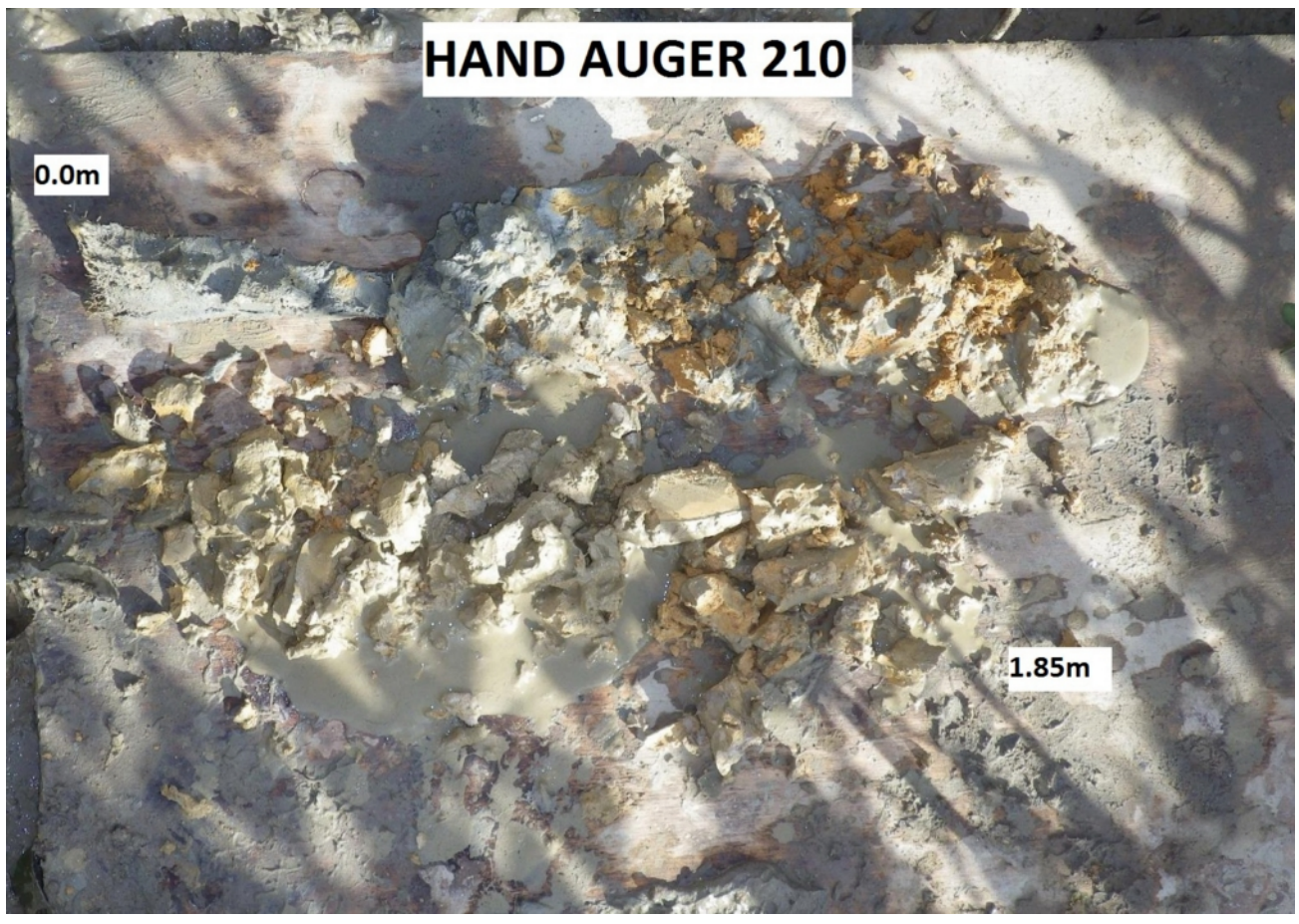
LOGGED J Burton	DATE EXCAVATED 1-07-2014		
CHECKED BY:	EXCAVATOR		
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA209A**	

LOG OF AUGER HOLE

HOLE NO. **HA210**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -1.6 m**	SHEET **1 of 1**
LOCATION **See site plan, CH -42:5L (from edge of sea wall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **1.85 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sed.	Clayey SILT; grey, very soft, wet, low plasticity, some rootlets. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
Waitemata Group	Silty fine SAND; with trace clay, brownish orange mottled grey, medium dense, brittle but low plasticity on remould.	-2				203+		Bulk sample at 0.5m
	Fine SAND; with some silt, orange, medium dense, saturated, poorly graded.							
	Poor recovery from 0.7m to 1.2m.	1				UTP		Bulk sample at 1.0m
	Fine sandy SILT; with trace clay, grey mottled orange, hard, saturated, low plasticity.							
	Fine sandy SILT; orange, medium dense, saturated, brittle.					UTP		
	End of Hand Auger at 1.85m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.95m and 1.65 m to 2.05 m.	2						

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m 1.0m
Sed. = Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOGGED T Van Deelen	DATE EXCAVATED 24-06-2014		
CHECKED BY:	EXCAVATOR		
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA210**	

LOG OF AUGER HOLE

HOLE NO. **HA210A**

PROJECT	CO-ORD.	R.L.	SHEET
NH2		Approx. -1.6 m	1 of 1
LOCATION	**REF. GRID**	**DATUM**	**TOTAL DEPTH**
See site plan, CH -42:10L (from edge of sea wall)		MSL	3.15 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sed.	Silty CLAY; grey, soft, wet, low plasticity, sensitive, some rootlets. Groundwater level at 0.2m.	-2					Contamination sample at 0.0m	
Waitemata Group	Silty fine SAND; with trace clay, medium dense, wet, brittle but low plasticity on remould, sensitive.					119/14	Contamination sample at 0.5m	Bulk sample at 0.5m
	Silty fine SAND; grey mottled orange, medium dense, saturated, poorly graded.							
	Poor recovery from 1.0m to 1.3m.	1						
	Fine SAND; with some silt, orange brown, medium dense, saturated, poorly graded.							Bulk sample at 1.5m
	Silty fine SAND; medium dense, orange, saturated, poorly graded. Trace fine, weakly cemented, angular gravel at 1.8m.	2				133/20		
	Clayey SILT; orange with grey streaks, very stiff, wet, plastic, sensitive. Some fine sand at 2.4m.	-4				203+		Bulk sample at 2.5m
	SILT; with minor clay and trace fine sand, hard, grey, saturated, low plasticity.	3				203+		
	End of Hand Auger at 3.15m. Target depth achieved. No scala undertaken due to hole collapse.							

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2), 0.5m
Bulk samples taken at 0.5m, 1.5m, 2.5m
Sed. = Sediment

LOGGED	DATE EXCAVATED	
T Van Deelen	24-06-2014	
CHECKED BY:	EXCAVATOR	
CLIENT	JOB NO.	HA210A
Watercare Services Limited	1-C0935.46	

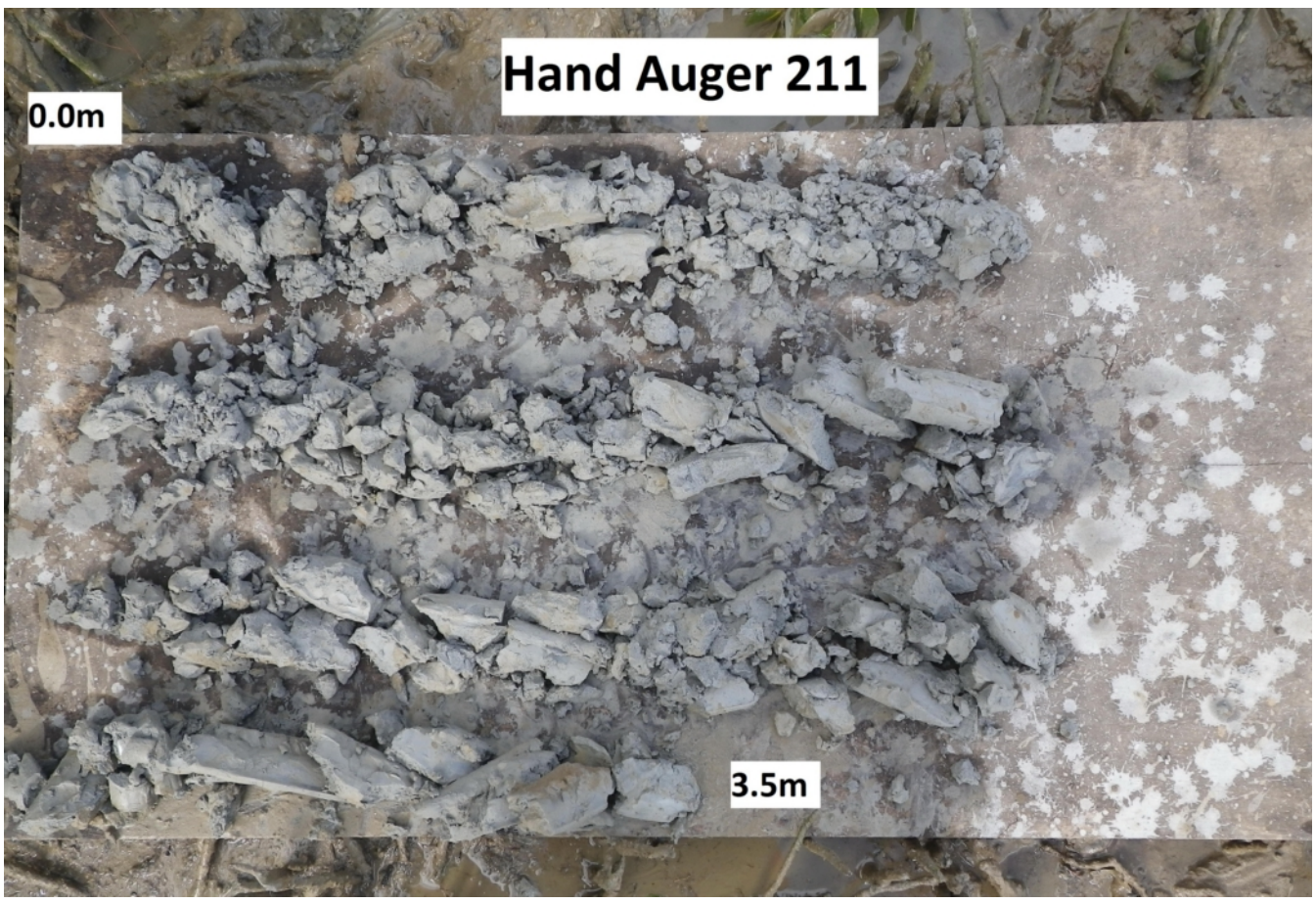
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOG OF AUGER HOLE

HOLE NO. **HA211**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. .7 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 18:16L (from cycle lane left kerb)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **3.5 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sed.	Fine to medium SAND; with minor silt, soft, orange brown, saturated, brittle. Groundwater level at 0.0m (surface).	0					Contamination sample at 0.0m	
	Clayey fine SAND; with minor silt, grey, soft, saturated, brittle but low plasticity on remould.							
	Silty CLAY; with trace fine sand, grey, stiff, wet, moderate plasticity, moderate sensitivity.							Bulk sample at 0.5m
Waitemata Group	Fine sandy CLAY; with minor silt, grey, soft, wet, moderate plasticity.					22/7		
	Becomes very stiff, sensitive at 1.0m.	1				201/13		
	Silty CLAY; with trace fine sand, grey, very stiff, wet, moderate plasticity, moderate sensitivity.							Bulk sample at 1.5m
	Fine sandy CLAY; with minor silt, grey, very stiff, wet, moderate plasticity, sensitive.					172/32		
	Silty CLAY; with trace fine sand, grey, very stiff, wet, moderate plasticity, moderate sensitivity.	2						
	Silty fine SAND; with minor clay, grey streaked black, medium dense, wet, brittle.					167/29		
		-2				203+		Bulk sample at 2.5m
	Silty CLAY; with trace fine sand, grey, hard, wet, moderate plasticity, moderate sensitivity. Becomes hard at 3.0m.	3				UTP		
	End of Hand Auger at 3.5m. Target depth achieved. Scala-penetrometer test undertaken from 0.0m to 0.9m and 3.5m to 3.6m.					UTP		Bulk sample at 3.5m

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.5m, 2.5m, 3.5m
Sed. = Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOGGED S Farquhar		DATE EXCAVATED 11-06-2014	
CHECKED BY:		EXCAVATOR	
CLIENT Watercare Services Limited		JOB NO. 1-C0935.46	**HA211**

LOG OF AUGER HOLE

HOLE NO. **HA211A**

PROJECT	CO-ORD.	R.L.	SHEET
NH2		Approx. .6 m	1 of 1
LOCATION	**REF. GRID**	**DATUM**	**TOTAL DEPTH**
See site plan, CH 18:24L (from cycle lane left kerb)		MSL	3 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
MS	Fine to medium SAND; with minor silt, orange brown, loose, saturated, brittle, poorly graded. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
Waitemata Group	Fine sandy SILT; with minor clay, grey with orange streaks, very stiff, wet, brittle but low plasticity on remould. Becomes hard at 0.5m.					203+		
	Clayey SILT; with trace fine sand, grey with black streaks, hard, moist, low plasticity.	0						
	Silty CLAY; with trace fine sand, light grey, hard, moist, moderate plasticity.	1				UTP		
	Clayey SILT; with some fine sand, grey mottled orange, hard, moist, moderate plasticity.	2				UTP		
	Clayey fine SAND; orange mottled grey, hard, moist, brittle but low plasticity on remould.	-2				UTP		
	End of Hand Auger at 3.0m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and from 3.0m to 3.6m.	3				UTP		

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples at 0.5m, 1.5m, 2.5m
MS = Marine Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

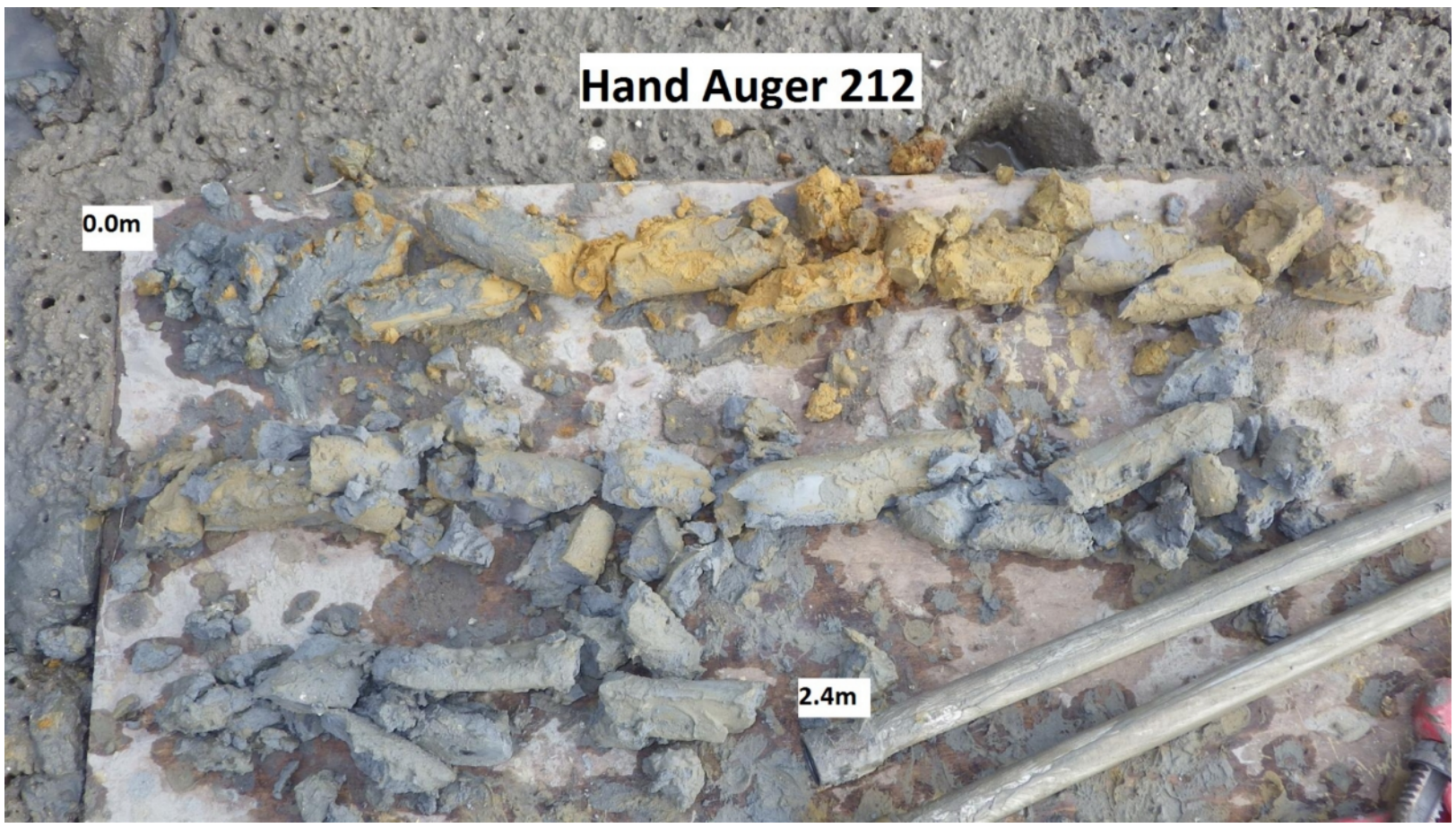
LOGGED	DATE EXCAVATED	
S Farquhar	11-06-2014	
CHECKED BY:	EXCAVATOR	
CLIENT	JOB NO.	HA211A
Watercare Services Limited	1-C0935.46	

LOG OF AUGER HOLE

HOLE NO. **HA212**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. 1.2 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 130:13L (from cycle lane left kerb)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2.4 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sed.	Silty fine SAND; orange brown, loose, saturated, poorly graded. Groundwater level at 0.0m (surface).							
	Silty fine SAND; with trace clay, orange brown, loose, saturated, slightly plastic.					65/14	Contamination sample at 0.0m	
	Silty CLAY, brown mottled grey, hard, moist, moderate plasticity. Becomes grey at 0.9m.							
Waitemata Group	Clayey SILT; with trace fine sand, grey, medium dense, wet, low plasticity.	1 0				UTP		Bulk sample at 1.0m
		2				UTP		
	End of Hand Auger at 2.4m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.75m.							

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 1.0m
Sed. = Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOGGED **S Farquhar**		DATE EXCAVATED **30-05-2014**	
CHECKED BY:		EXCAVATOR	
CLIENT **Watercare Services Limited**		JOB NO. **1-C0935.46**	**HA212**

LOG OF AUGER HOLE

HOLE NO. **HA212A**

PROJECT	CO-ORD.	R.L.	SHEET
NH2		**Approx. 0.1 m**	**1 of 1**
LOCATION	**REF. GRID**	**DATUM**	**TOTAL DEPTH**
See site plan, CH 130:21L (from cycle lane left kerb)		**MSL**	**1.8 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
MS	Silty CLAY; orange mottled grey, very soft, moist, moderate plasticity. Groundwater level at 0.0m (surface).	0						
Waitemata Group	Fine sandy SILT; with minor clay, grey mottled orange, hard, moist, brittle but low plasticity on remould. Becomes hard at 0.5m.					UTP	Contamination sample at 0.0m	
	CLAY; with some silt, orange streaked grey, hard, moist, high plasticity. Becomes grey at 1.1m.	1				UTP		Bulk sample at 1.0m
	Fine sandy SILT; with minor clay, grey, hard, moist, brittle but low plasticity on remould.					UTP		
	End of Hand Auger at 1.8m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m.	2 -2						

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 1.0m
MS = Marine Sediment

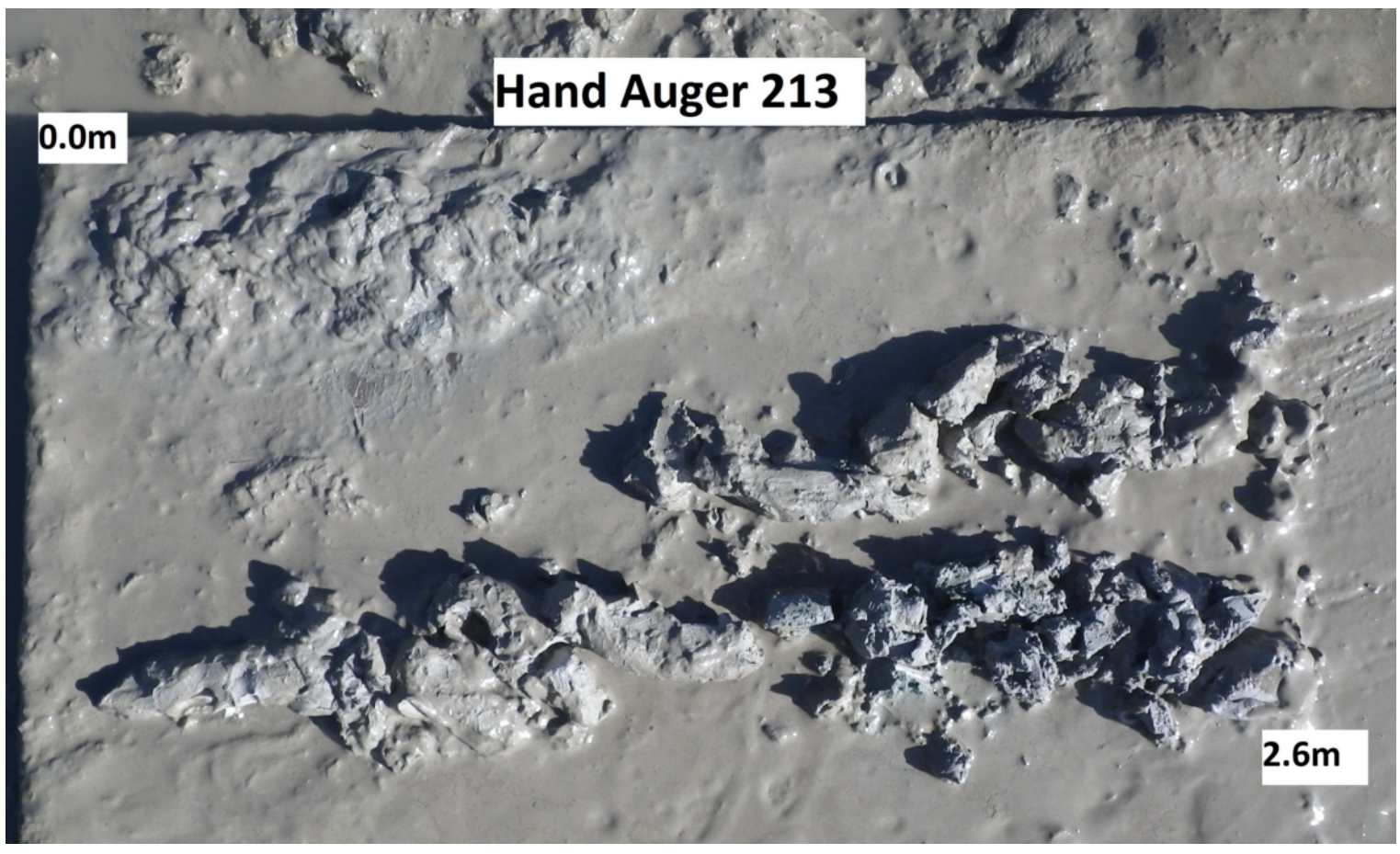
	LOGGED: S Farquhar	DATE EXCAVATED: 30-05-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	**HA212A**

LOG OF AUGER HOLE

HOLE NO. **HA213**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -1.7 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 230:17L (from cycle lane left kerb)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2.6 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sediment	SILT; with some fine sand, greyish brown, very soft, saturated, brittle. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
	SILT; with some fine sand and clay, brownish grey, very soft, saturated, low plasticity. No recovery from 0.2m to 1.0m.	-2				13/9		
Alluvium	No recovery from 1.0m to 1.7m.	1				SV sinking under own weight		
	Silty CLAY; grey, stiff, wet, moderate plasticity.					Hole collapse		Bulk sample at 1.8m
	Silty CLAY; with some fine to medium sand, greenish grey, hard, wet, moderate plasticity.	2 -4				Hole collapse UTP		Bulk sample at 2.3m
	End of Hand Auger at 2.6m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and 2.6m to 2.9m.				>>			

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 1.8m and 2.3m

LOGGED S Farquhar		DATE EXCAVATED 13-06-2014	
CHECKED BY:		EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA213**

LOG OF AUGER HOLE

OPUS			HOLE NO. **HA213A**
PROJECT: **NH2**	CO-ORD.	R.L.: **Approx. -1.9 m**	SHEET: **1 of 1**
LOCATION: **See site plan, CH 230:26L (from cycle lane left kerb)**	REF. GRID	DATUM: **MSL**	TOTAL DEPTH: **3.65 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sediment	Clayey SILT; with trace fine sand, dark grey, very soft, saturated, low plasticity trace shells. Groundwater level at 0.0m (surface).	-2					Contamination sample at 0.0m	Bulk sample at 0.5m
Alluvium	Silty sandy CLAY; grey, soft, saturated, low plasticity, trace shells.	1						
	No recovery from 1.5m to 3.0m. Inferred 'silty sandy clay'.	2 -4						
	Silty CLAY; with trace fine sand, grey, hard, saturated, high plasticity.	3					UTP	
	End of Hand Auger at 3.65m. Target depth achieved. Scala-penetrometer undertaken from 0.0m to 2.0m and 3.65m to 3.95m.							

SKETCH OF EXPOSURE

NOTES

No shear vane readings due to hole collapse.
Scala double bouncing at 3.95m
Contamination samples taken at 0.0m (x2), 0.8m
Bulk sample taken at 0.5m
Push tube sample from 1.0m - 1.5m

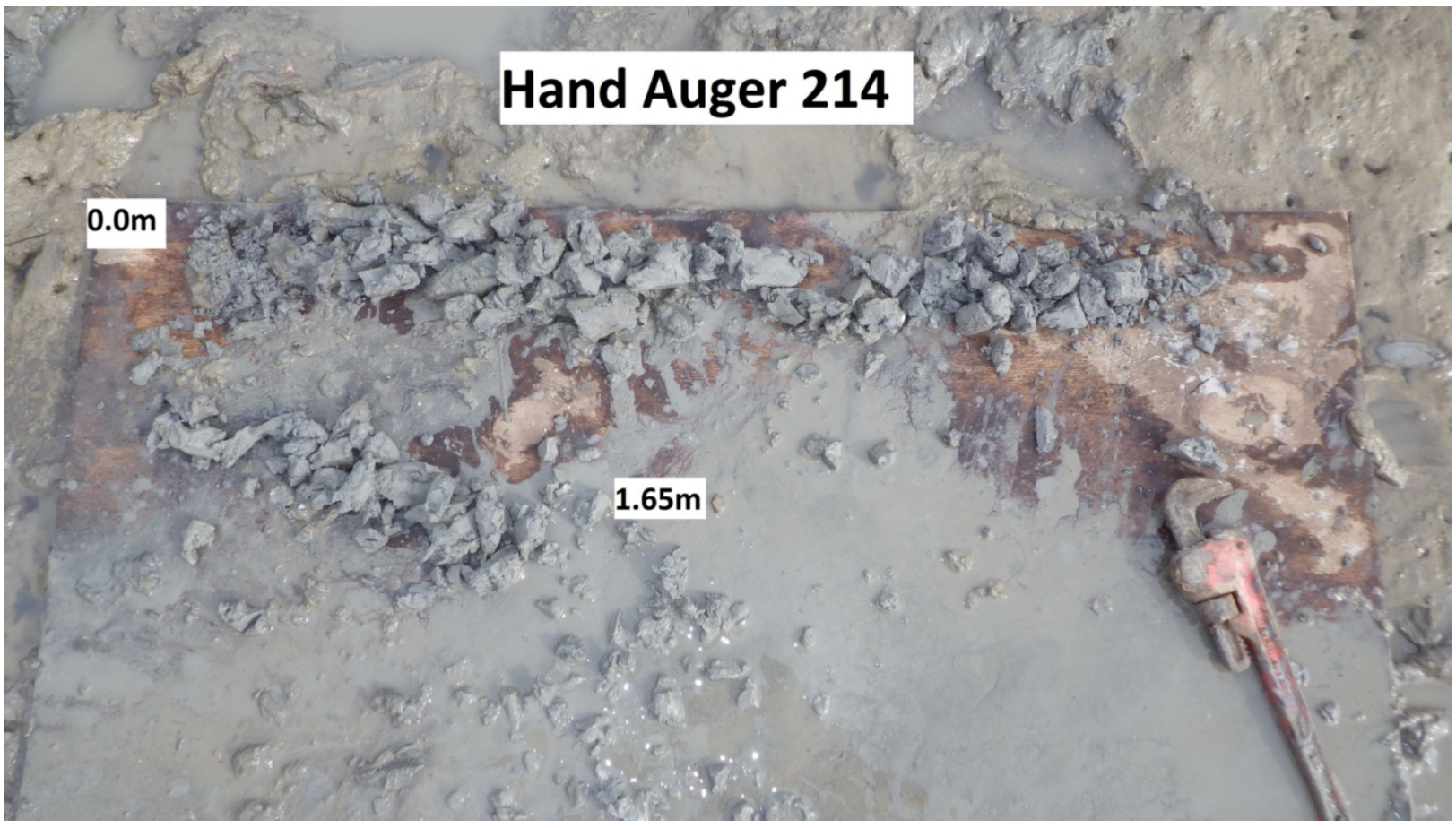
	LOGGED: J Burton	DATE EXCAVATED: 27-06-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	**HA213A**

LOG OF AUGER HOLE

HOLE NO. **HA214**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -1.5 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 335:16L (from cycle lane left kerb)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **1.65 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
MS	Clayey SILT; with some fine sand, greyish brown, very soft, saturated, moderate plasticity, trace shells.						Contamination sample at 0.0m	
Alluvium	Clayey SILT; grey, very soft, wet, low plasticity, trace shells.							
	Silty CLAY; with trace fine sand, grey, hard, wet, low plasticity, trace shells.	-2				203		Bulk sample at 0.5m
Waitemata Group	Sandy CLAY; with trace silt, grey, hard, moist, moderate plasticity.							
	Silty CLAY; with trace fine sand, grey, hard, moist, high plasticity.							
	Silty CLAY; with trace fine sand, grey, hard, wet, low plasticity, trace shells.	1				UTP		Bulk sample at 1.0m
	Silty CLAY; with trace fine sand, grey, hard, moist, high plasticity.					UTP		
	End of Hand Auger at 1.65m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.85m and 1.65m to 1.7m.							

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.0m
MS = Marine Sediment

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

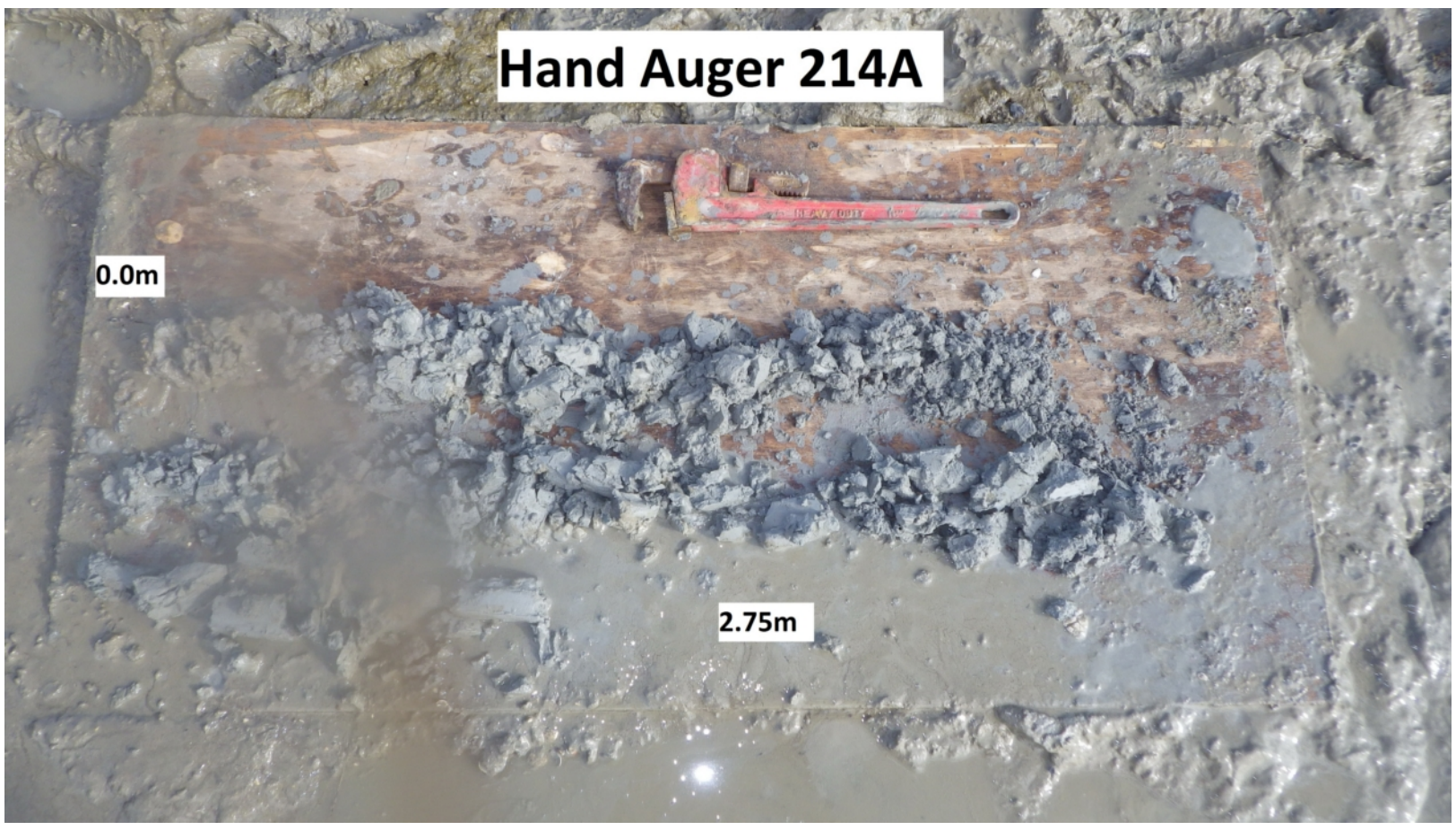
LOGGED J Burton	DATE EXCAVATED 27-06-2014		
CHECKED BY:	EXCAVATOR		
CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA214**	

LOG OF AUGER HOLE

HOLE NO. **HA214A**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -2.1 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 335:24L (from cycle lane left kerb)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2.75 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
M Alluvium	Clayey SILT; with trace fine sand, greyish brown, soft, saturated, moderate plasticity, trace shells. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
	Silty sandy CLAY; grey, hard, saturated, moderate plasticity.							
	SAND; with some clay, grey, medium dense, saturated, low plasticity.							Bulk sample at 0.5m
	Silty CLAY; with trace fine sand, grey, hard, wet, high plasticity, trace shells.					UTP		
	Fine sandy CLAY; grey, hard, moist, moderate plasticity.	1				UTP		Bulk sample at 1.0m
Waitemata Group	Silty CLAY; grey, hard, moist, high plasticity.	-4				UTP		Bulk sample at 1.5m
	Becomes very stiff at 2.0m.	2				145/26		Bulk sample at 2.0m
								Bulk sample at 2.5m
	End of Hand Auger at 2.75m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.9m and 2.75m to 2.8m.							

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.0m, 1.5m, 2.0m, 2.5m
M = Marine Sediment

	LOGGED J Burton	DATE EXCAVATED 27-06-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA214A**

LOG OF AUGER HOLE

HOLE NO. **HA215**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -1.0 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 490:5L (from edge of seawall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
MS	Clayey SILT; dark grey, soft, saturated, low plasticity, trace shells, trace organics. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
Alluvium	Silty CLAY; with some fine sand, grey, hard, saturated, low plasticity, trace shells and trace organics.					203+		Bulk sample at 0.5m
	With some medium to coarse sand and organics from 1.1m to 1.3m.	-2 1				203+		Bulk sample at 1.0m
Waitemata Group	Fine sandy SILT; light grey, medium dense, saturated, brittle.					UTP		
	End of Hand Auger at 2.0m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.65m and from 2.0m to 2.3m.	2				UTP		

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.0m
MS = Marine Sediment

LOGGED B Mason	DATE EXCAVATED 25-06-2014		
CHECKED BY:	EXCAVATOR		
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA215**

LOG OF AUGER HOLE

PROJECT: NH2	CO-ORD.	R.L.: Approx. -1.0 m	HOLE NO.: HA215A
LOCATION: See site plan, CH 490:10L (from edge of sea wall)	REF. GRID	DATUM: MSL	SHEET: 1 of 1
			TOTAL DEPTH: 2 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Marine Sed.	Clayey SILT; dark grey, very soft, saturated, moderate plasticity, trace shells. Groundwater level at 0.0m (surface).						Contamination sample at 0.0m	
Alluvium	Silty fine SAND; with minor clay, light grey, hard, saturated, low plasticity, trace shells.					UTP		Bulk sample at 0.5m
	CLAY; with trace silt, light grey, very stiff, saturated, low plasticity, sensitive.	-2 1				136/35		Bulk sample at 1.0m
	Silty fine SAND; with trace clay, dark grey, medium dense, saturated, poorly graded. Trace organics (fibrous wood) at 1.4m.					UTP		
WG	Silty CLAY; with minor fine sand, light grey, hard, saturated, low plasticity.							
	End of Hand Auger at 2.0m. Too hard to auger. Scala-penetrometer test undertaken from 0.0 m to 0.7 m and from 1.9 m to 2.2 m	2						

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk samples taken at 0.5m, 1.0 m
Sed. = Sediment, WG = Waitemata Group

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOGGED	DATE EXCAVATED	
B Mason	25-06-2014	
CHECKED BY:	EXCAVATOR	
CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	HA215A

LOG OF AUGER HOLE

HOLE NO. **HA216**

PROJECT	CO-ORD.	R.L.	SHEET
NH2		**Approx. -0.6 m**	**1 of 1**
LOCATION	**REF. GRID**	**DATUM**	**TOTAL DEPTH**
See site plan, CH 530:5L (from edge of seawall)		**MSL**	**0.6 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sediment	SILT; with some fine sand, greyish brown, very soft, saturated, brittle. Groundwater level at 0.0m (surface). Becomes blackish grey, very stiff at 0.1m.						Contamination sample at 0.1m	
Waitemata Group	Clayey SILT; with some fine sand, brownish orange, very stiff, moist, moderate plasticity.							
	Silty CLAY; grey, very stiff, moist, moderate plasticity.					UTP		
	End of Hand Auger at 0.6m. Too hard to auger. Scala-penetrometer test undertaken from 0.6m to 1.0m.	1						

SKETCH OF EXPOSURE

NOTES

Shear vane 1559
Correction factor = 1.563
Contamination sample taken at 0.0m (x2)

LOGGED	DATE EXCAVATED	
S Farquhar	29-05-2014	
CHECKED BY:	EXCAVATOR	
CLIENT	JOB NO.	HA216
Watercare Services Limited	1-C0935.46	

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

LOG OF AUGER HOLE

HOLE NO. **HA216A**			
PROJECT **NH2**	CO-ORD.	R.L. **Approx. -0.7 m**	SHEET **1 of 1**
LOCATION **See site plan, CH 530:10L (from edge of seawall)**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **0.6 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Marine Sediment	Silty fine SAND; greyish brown mottled reddish brown, very loose, moist, poorly graded. Groundwater level at 0.0m (surface). Becomes orange brown, saturated at 0.25m.						Contamination sample at 0.1m	
Waitemata Group	Clayey SILT; with some fine sand, grey, stiff, wet, low plasticity. Becomes hard at 0.5m.					UTP		
	End of Hand Auger at 0.6m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.5m.							

SKETCH OF EXPOSURE

NOTES

Shear vane 1559
Correction factor = 1.563
Contamination samples taken at 0.0m (x2)

LOGGED S Farquhar	DATE EXCAVATED 29-05-2014		
CHECKED BY:	EXCAVATOR		
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA216A**

LOG OF AUGER HOLE

OPUS			HOLE NO. **HA217**
PROJECT: **NH2**	CO-ORD.	R.L.: **Approx. -1.1 m**	SHEET: **1 of 1**
LOCATION: **See site plan, CH 580:6 (from edge of sea wall)**	REF. GRID	DATUM: **MSL**	TOTAL DEPTH: **0.05 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
MS	Silty CLAY; very soft, saturated, grey, low plasticity, some shells. Groundwater level at 0.0m (surface).							
	No hand auger attempted due to scala refusal. Scala-penetrometer test undertaken from 0.0 m to 0.25 m.						Contamination sample at 0.1m	

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
MS = Marine Sediment

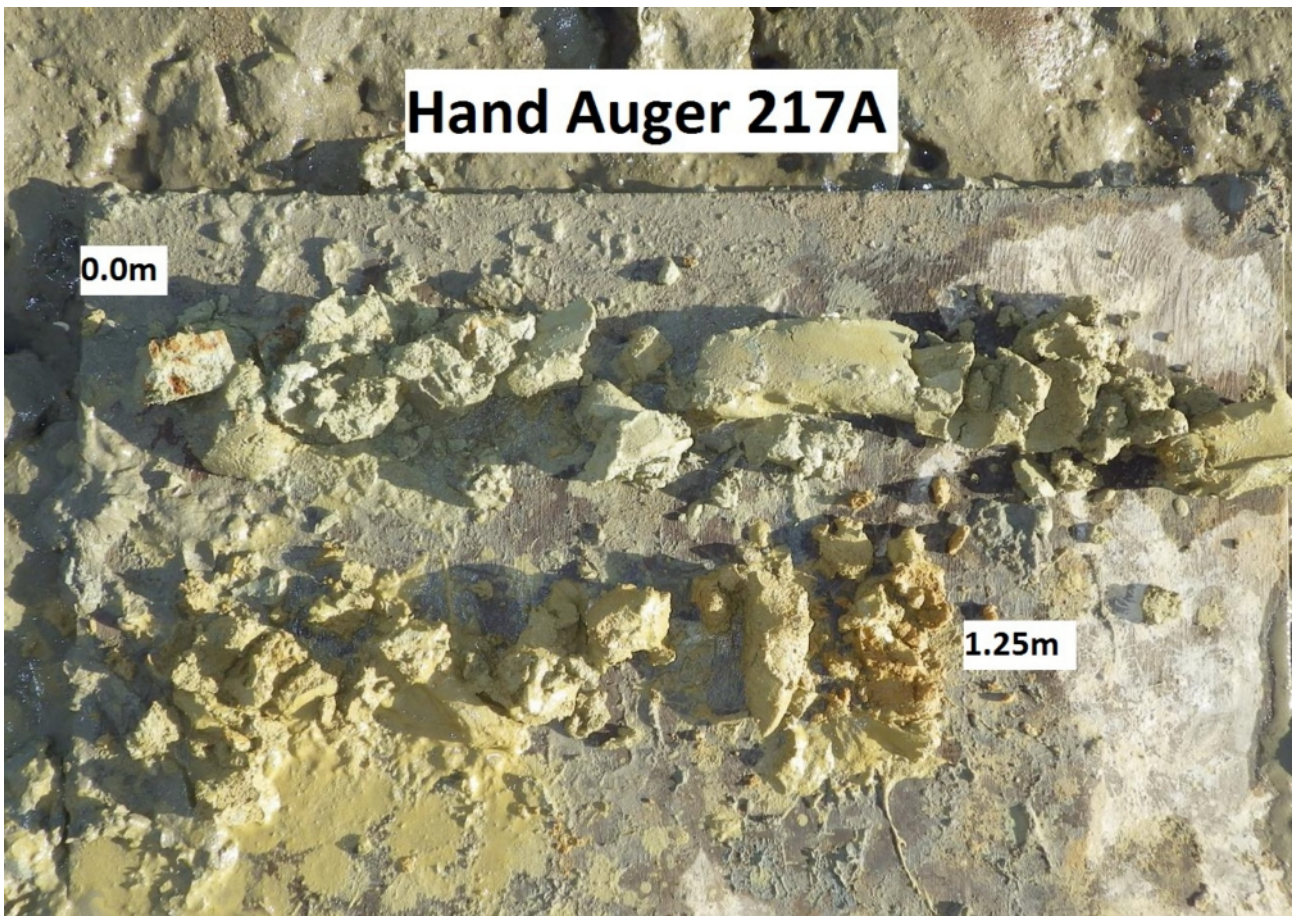
	LOGGED: T Van Deelen	DATE EXCAVATED: 24-06-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	**HA217**

LOG OF AUGER HOLE

PROJECT: NH2	CO-ORD.	R.L.: Approx. -0.6 m	HOLE NO.: HA217A
LOCATION: See site plan, CH 580:11L (from edge of sea wall)	REF. GRID	DATUM: MSL	SHEET: 1 of 1
			TOTAL DEPTH: 1.25 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
M	Silty CLAY; grey, very soft, saturated, low plasticity, some shells. Groundwater level at 0.0m (surface).							
Waitemata Group	Silty fine SAND; with minor clay, grey mottled orange, loose, saturated, low plasticity.							
	Fine SAND; with some silt, minor clay and trace siltstone fragments, loose, saturated, low plasticity.					104/17		
	Fine SAND; with some silt, grey, medium dense, saturated, poorly graded.	1				UTP		
	End of Hand Auger at 1.0m. Too hard to auger. Scala-penetrometer test undertaken from 0.0m to 0.6m and 1.0m to 1.2m.							
		-2						

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m (x2)
Bulk sample taken at 0.5m
M = Marine Sediment

LOGGED: B Mason		DATE EXCAVATED: 24-06-2014	
CHECKED BY:		EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT: Watercare Services Limited	JOB NO.: 1-C0935.46	HA217A

LOG OF AUGER HOLE

HOLE NO. **HA218**

PROJECT	CO-ORD.	R.L.	SHEET
NH2	1747913 E 5927168 N	12.12 m	1 of 1
LOCATION	**REF. GRID**	**DATUM**	**TOTAL DEPTH**
See site plan, SH16, Hobsonville		MSL	3.5 m

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Fill	Silty CLAY; with some coarse sand, brown, firm, moist, moderate plasticity, some rootlets.	12					Contamination sample at 0.1m	
	Silty CLAY; with minor fine sand, light brownish grey, stiff, moist, moderate plasticity, and trace pumice. Becomes sensitive at 0.5m.					70/13		
		1				100/25	Contamination sample at 1.0m	
	Silty CLAY; with some fine to coarse sub-angular gravel (scoria and basalt), brown, stiff, moist, moderately plastic.					67/29		Bulk sample at 1.5m
	Trace fine subangular gravel and minor organics at 1.9m.	2				120/59	Contamination sample at 2.0m	
		10						
	Becomes dark brown at 2.4m.					151/59		
		3				116/72		Bulk sample at 3.0m
	End of Hand Auger at 3.5m. Too hard to auger. Multiple attempts. No scala-penetrometer test undertaken.							

SKETCH OF EXPOSURE

NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.1m, 1.0m, 2.0m
Bulk samples taken at 1.5m, 3.0m

LOGGED	DATE EXCAVATED	
S Farquhar	28-05-2014	
CHECKED BY:	EXCAVATOR	
CLIENT	JOB NO.	HA218
Watercare Services Limited	1-C0935.46	

Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005)
Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2
Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)

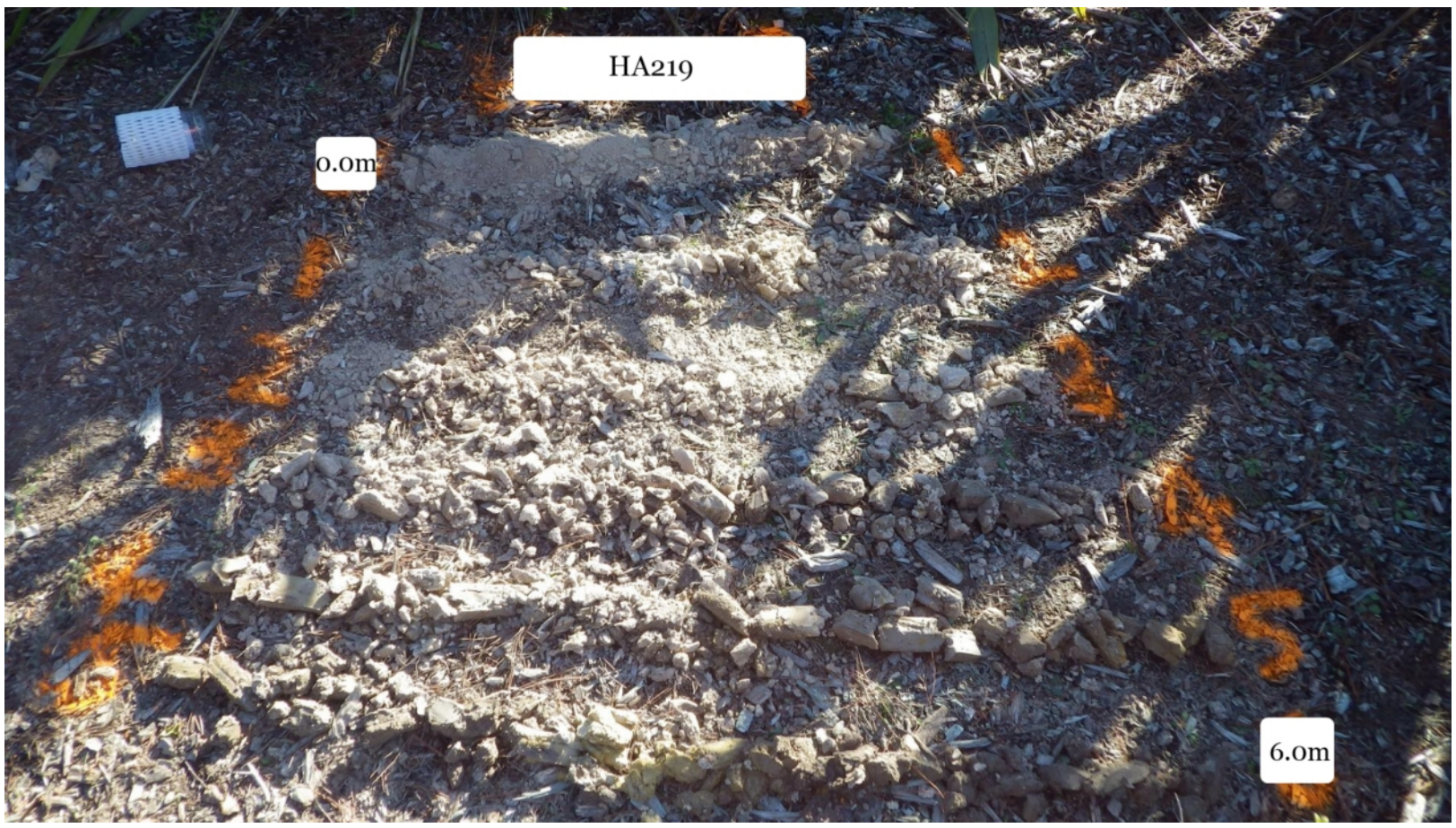
LOG OF AUGER HOLE

OPUS

HOLE NO. **HA219**			
PROJECT **NH2**	CO-ORD. **1747913 E 5927190 N**	R.L. **9.09 m**	SHEET **1 of 1**
LOCATION **See site plan, SH16, Hobsonville**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **6 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SHEAR STRENGTH kPa	OTHER TESTS	SAMPLES
Fill	Clayey SILT; with trace fine sand, light brown, hard, dry, low plasticity.						203+	Contamination sample at 0.1m	
	Clayey SILT; with minor fine sand, light brown mottled orange and dark brown, hard, dry, low plasticity.	8	1				203+	Contamination sample at 1.0m	Bulk sample at 1.5m
	Silty CLAY; with trace fine sand, light brown mottled orange and dark brown, hard, dry, brittle but moderate plasticity on remould.						UTP		
	Clayey SILT; with trace fine sand, white mottled orange and dark brown, hard, dry, low plasticity.								
	SILT; with some fine sand, minor clay, light brown with white flecks, hard, low plasticity, trace rootlets.								
	Silty CLAY; with minor fine sand, light greyish brown mottled orange, hard, dry, brittle but moderate plasticity on remould.		2				203+	Contamination sample at 2.0m	
	Clayey SILT; with minor fine sand, light grey mottled brownish orange, hard, dry, low plasticity.						203+		
	Silty CLAY; with minor fine sand, light greyish brown mottled orange, hard, dry, moderate plasticity. Trace manganese staining at 3.0m.	6	3				203+		Bulk sample at 3.0m
	Silty CLAY; greyish brown, hard, moist, moderate plasticity. High plasticity from 3.7m. Becomes brownish grey mottled brownish orange and dark brown, and very stiff from 4.0m. Trace fine sand and moderate plasticity from 4.3m. Becomes hard from 4.5m.		4				203+ 122/59 203+		Bulk sample at 4.0m
	CLAY; with some silt, grey streaked brownish orange, hard, moist, high plasticity.								
	Silty CLAY; greyish brown, hard, moist, moderate plasticity. Becomes very stiff, moderately sensitive from 5.0m. Becomes yellowish brown mottled grey from 5.3m. Becomes brownish grey, moist from 5.6m.	4	5				119/36 158/58		
	End of Hand Auger at 6.0m. Target depth achieved. No scala-penetrometer test undertaken.		6				116/72		

SKETCH OF EXPOSURE



NOTES

Shear vane 1558
Correction factor = 1.449
Contamination samples taken at 0.0m, 1.0m, 2.0m
Bulk samples at 1.5m, 3.0m, 4.0m

	LOGGED S Farquhar	DATE EXCAVATED 28-05-2014	
	CHECKED BY:	EXCAVATOR	
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HA219**

LOG OF AUGER HOLE

HOLE NO. **HABH201**			
PROJECT **NH2**	CO-ORD. **1747947 E 5927231 N**	R.L. **4.37 m**	SHEET **1 of 1**
LOCATION **See site plan, SH16, Hobsonville**	REF. GRID	DATUM **MSL**	TOTAL DEPTH **2.5 m**

GEOLOGY/UNIT	DESCRIPTION	R.L. (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	SOIL TESTS: SCALA PENETROMETER Blows per 100 mm (0 2 4 6 8 10 12 14 16 18 20)	SOIL TESTS: SHEAR STRENGTH kPa	SOIL TESTS: OTHER TESTS	SAMPLES
Fill	Silty TOPSOIL; with trace fine sand, dark brown, firm, moist, some organics (fresh wood and rootlets).							
	Silty CLAY; with some fine sand, grey, moist, firm, high plasticity, trace rootlets and organics.							
	Silty CLAY; with some sand and trace fine gravel, grey mottled light brown, firm, moist, moderate plasticity, trace organics.	4						
	Becomes stiff, sensitive at 0.5m.					84/23		
	Becomes very stiff at 1.0m.	1				128/53		
	Silty CLAY; with some fine sand and pumice fragments, brownish orange, very stiff, moist, moderate plasticity.							
	Silty CLAY; with trace fine to medium angular gravel, brownish orange, very stiff, moist, moderate plasticity.					UTP		
	Medium angular basalt GRAVEL; loose, poorly graded.							
	Silty CLAY; with trace gravel, brownish orange mottled white, hard, moist, moderate plasticity.							
	Becomes very stiff at 2.0m.	2				175/88		
	End of Hand Auger at 2.5 m. Too hard to auger. Multiple attempts. No scala-penetrometer test undertaken due to underground services uncertainty.	2				166/100		

SKETCH OF EXPOSURE

NOTES

Shear vane 1559
Correction factor = 1.563

LOGGED J Burton	DATE EXCAVATED 28-05-2014		
CHECKED BY:	EXCAVATOR		
Guideline for the field classification of soil and rock for engineering purposes: NZ Geotechnical Society (2005) Determination of penetration resistance of a soil, NZS 4402 : 1988, Test 6.5.2 Shear strength using a hand held shear vane: NZ Geotechnical Society (8/2001)	CLIENT Watercare Services Limited	JOB NO. 1-C0935.46	**HABH201**

APPENDIX G SOIL CONTAMINATION ASSESSMENT

Project: North Harbour No. 2 Watermain - GREENHITHE SECTION ONLY

Soil Test Results (i.e. sediment test results reported seperately)

	Sample Details and Analytical Results							Adopted Acceptance Criteria		Other Criteria	
Sample Location	BH201	BH201	BH201	BH202	BH202	BH204	BH204	SGV (5)		TP153 (8)	
Field Sample Ref	BH201-0.1m	BH201-1.0m	BH201-1.0m (10)	BH202-0.1m	BH202-1.0m	BH204-0.1m	BH204-1.0m		ALW Plan PA Limits (6)	non volcanic	volcanic
Lab Sample Ref.	1289075.4	1289075.5	1289075.7	1283722.1	1283722.2	1289075.1	1289075.2				
Date sampled (5)	9/06/2014	9/06/2014	9/06/2014	28/05/2014	28/05/2014	5/06/2014	5/06/2014	Comm/Ind Land Use			
Sample depth	0.1	1.0	1.0	0.1	1.0	0.1	1.0		Schedule 10		
Material Type	soil	soil	soil	soil	soil	soil	soil				
Heavy Metals (1)											
Arsenic	3	3	3	<2	<2	3	3	70	100	12	12
Cadmium	0.11	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	1300	7.5	0.65	0.65
Chromium	7	14	9	6	7	17	14	6300	400	55	125
Copper	10	15	15	24	7	15	10	>10,000	325	45	90
Lead	14.2	8.3	16.1	7.2	16.5	40	7	3300	250	65	65
Mercury	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	4200	0.75	0.45	0.45
Nickel	6	9	11	5	4	17	8	1500 (7)	105	35	320
Zinc	31	17	33	71	16	25	16	23,000 (7)	400	180	1160
Total Petroleum Hydrocarbons											
C7 - C9	< 9	< 9	< 9	< 8	< 10	< 9	< 9	-	710-2700(12)	-	-
C10 - C14	< 20	< 20	< 20	< 20	< 20	< 20	< 20	-	560-1500(12)	-	-
C15 - C36	< 40	< 40	< 40	< 40	< 40	< 40	< 40	-	>20,000(12)	-	-
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Acenaphthylene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Anthracene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Benzo[a]anthrac	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	35	2.15	-	-
Benzo[b]fluorant + Benzo[j]fluorant	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Benzo[g,h,i]peryl	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Benzo[k]fluorant	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Chrysene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Dibenzo[a,h]anth	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Fluoranthene	0.03	< 0.03	<0.03	< 0.03	< 0.04	0.03	< 0.03	-	-	-	-
Fluorene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Indeno(1,2,3-c,d)pyrene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Naphthalene	< 0.14	< 0.15	< 0.14	< 0.14	< 0.16	< 0.14	< 0.14	-	69(12)	-	-
Phenanthrene	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	< 0.03	-	-	-	-
Pyrene	0.04	< 0.03	0.04	< 0.03	< 0.04	0.04	< 0.03	-	1.3-1600(12)	-	-
Note: other parameters such as Organochlorine Pesticides continued on the next page											

Organochlorine Pesticides											
Aldrin	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
alpha-BHC	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
beta-BHC	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
delta-BHC	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
gamma-BHC (Lindane)	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	14,000(13)	-	-
cis-Chlordane	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
trans-Chlordane	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Total Chlordane [(cis+trans)*100/42]	< 0.04	-	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-	-	-
2,4'-DDD	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
4,4'-DDD	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
2,4'-DDE	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
4,4'-DDE	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
2,4'-DDT	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	1000	12 or 0.7(11)		
4,4'-DDT	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-			-	-
Dieldrin	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	160	190(13)	-	-
Endosulfan I	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Endosulfan II	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Endosulfan sulphate	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Endrin	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Endrin aldehyde	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Endrin ketone	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Heptachlor	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Heptachlor epoxide	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Hexachlorobenzene	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-
Methoxychlor	< 0.010	-	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-

Notes:

1) All heavy metals total recoverable.
2) All test results in mg/kg dry weight.
3) National Environmental Standard- Soil Contaminant Standard or Soil Guideline Value for Commercial/Industrial Land Use, see also note 5 below
4) Sample depth in metres below ground level
5) MfE, 2011, Tables 54 & 55, Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health, for commercial/industrial, outdoor worker and maintenance
6) ARP:ALW (Operative in Part, 21 October 2010). It may be inferred from Note 3 of Schedule 10 that where the heavy metal limit for human health is not shown then the limit is equal or higher than the discharge limit.
7) United States Environmental Protection Agency (USEPA), Human Health Medium – Regional Screening Levels (RSL, May 2013) – International risk – based SGVs for residential land use, non-cancer endpoint, all pathways.
8) Auckland Regional Council- Technical Publication TP153- for non-volcanic and volcanic soils- used as cleanfill values, i.e. if the site sediment is disposed off-site to a licensed cleanfill site located in a non-volcanic soil type area the non-volcanic TP153 values apply, note, maximum values stated, e.g. for arsenic the range is 0.4-12 mg/kg.
9) **BOLD** values: exceed the T153- non volcanic soils concentrations
10) Duplicate sample
11) The criteria 12 mg/kg applies to land that is not developed. The criteria 0.7 mg/kg applies to land that is being redeveloped (redevelopment does not include cultivation and the formation and maintenance of tracks) during the redevelopment phase only. Once redevelopment has been completed, the higher criteria applies.
12) MfE, Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011) Module 4 – Tier 1 Soil Screening Criteria Residential land use, all pathways, for silty clay soil with surface (<1m) depth of contamination (Table 4.10) and for the protection of groundwater quality for potable use (Table 4.20) with surface contamination (<1 m) and depth to groundwater as 4 m.
13) MfE, Identifying, Investigating and Managing Risks Associated with Former Sheep-dipSites, November 2006 – SGVs for human health for commercial/industrial (unpaved) land use- (Table 4).

APPENDIX H SEDIMENT CONTAMINATION ASSESSMENT

Project: North Harbour No. 2 Watermain - GREENHITHE SECTION ONLY

Sediment Test Results (i.e. soil test results reported seperately)

	Sample Details and Analytical Results														Adopted Acceptance Criteria	Other Criteria			
Sample Location	HA206	HA208	HA209	HA210a	HA210a	HA211	HA212a	HAS213	HA214a	HA215	HA217	Tab 1	Tab 2	Tab 3		TP153 (6)		ANZECC Sed. Quality (7)	
Field Sample Ref	HA206-0.0m	HA208-0.0m	HA209-0.0m	HA210a-0.0m	HA210a-0.5m	HA211-0.0m	HA212a-0.0m	HAS213-0.0m	HA214a-0.0m	HA215-0.0m	HA217-0.0m	Tab1, 0-0.2m	Tab2, 0-0.2m	Tab3, 0-0.2m	ARP:ALW PA Limits (5)	non volcanic	volcanic	ISQG-low	ISQG-high
Lab Sample Ref.	1289075.23	1297663.1	1297663.5	1293375.13	1293375.14	1289075.17	1289075.23	1293375.5	1293375.20	1293375.16	1293375.11	1355272.1	1355272.2	1355272.3					
Date sampled (4)	12/06/2014	1/07/2014	26/06/2014	24/06/2014	24/06/2014	11/09/2014	13/06/2014	13/06/2014	25/06/2014	25/06/2014	24/06/2014	21/11/2014	21/11/2014	21/11/2014					
Sample depth	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0-0.2	0.0-0.2	0.0-0.2	Schedule 10				
Soil Type	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment	sediment					
Heavy Metals (1)																			
Arsenic	7.3	8	8	8	<2	**15.8**	**18**	11	**23**	**16**	**19**	**35**	**30**	**17.6**	100	12	12	20	70
Cadmium	0.089	<0.10	<0.10	<0.10	<0.10	0.031	<0.10	<0.10	<0.10	<0.10	<0.10	0.04	0.046	0.039	7.5	0.65	0.65	1.5	10
Chromium	14.5	25	28	18	8	11.4	22	16	21	17	20	15.1	12.1	14.1	400	55	125	80	370
Copper	19.6	26	27	19	7	11.7	18	17	19	17	19	12.2	10.2	11	325	45	90	65	270
Lead	22	31	34	24	4.6	15.9	29	27	32	29	30	24	25	18.7	250	65	65	50	220
Mercury	0.117	<0.10	0.20	0.11	<0.10	0.081	0.1	0.1	0.13	0.11	0.11	0.093	0.103	0.095	0.75	0.45	0.45	0.15	1
Nickel	8.7	10	10	7	2	4.9	7	7	8	8	7	6.6	6.5	6.6	105	35	320	21	52
Zinc	97	117	125	91	14	58	95	98	119	101	106	89	91	78	400	180	1160	200	410
Total Petroleum Hydrocarbons																			
C7 - C9	< 40	< 30	< 30	<18	< 10	< 13	< 13	< 14	< 14	< 13	< 16	< 12	< 11	< 11	710-2700(10)	-	-	-	-
C10 - C14	< 70	< 50	< 50	< 40	< 20	< 30	< 30	< 30	< 30	< 30	< 40	< 30	< 30	< 30	560-1500(10)	-	-	-	-
C15 - C36	< 140	<100	<90	< 80	< 40	< 50	< 50	< 60	< 60	< 50	< 70	< 50	< 50	< 50	>20,000(10)	-	-	-	-
Polycyclic Aromatic Hydrocarbons																			
Acenaphthene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	0.017	0.003	0.008	-	-	-	0.016	0.5
Acenaphthylene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	0.008	0.003	0.005	-	-	-	0.044	0.64
Anthracene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.06	< 0.05	< 0.06	0.039	0.007	0.015	-	-	-	0.085	1.1
Benzo[a]anthrac	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.13	< 0.05	< 0.06	0.121	0.025	0.062	-	-	-	0.261	1.6
Benzo[a]pyrene (BAP)	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.19	0.04	< 0.06	0.147	0.032	0.078	2.15	-	-	0.43	1.6
BaP (equiv)									0.27			0.21							
Benzo[b]fluorant + Benzo[j]fluorant	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.21	0.05	< 0.06	0.169	0.04	0.091	-	-	-		
Benzo[g,h,i]peryl	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.15	0.05	< 0.06	0.093	0.024	0.052	-	-	-		
Benzo[k]fluorant	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.1	< 0.05	< 0.06	0.064	0.015	0.035	-	-	-		
Chrysene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.19	< 0.05	< 0.06	0.123	0.027	0.065	-	-	-	0.384	2.8
Dibenzo[a,h]anth	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	0.018	0.005	0.01	-	-	-	0.063	0.26
Fluoranthene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	0.05	0.43	0.09	< 0.06	0.34	0.064	0.168	-	-	-	0.6	5.1
Fluorene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	0.015	0.003	0.007	-	-	-	0.019	0.54
Indeno(1,2,3-c,d)pyrene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.08	< 0.05	< 0.06	0.093	0.022	0.051	-	-	-		
Naphthalene	<0.6	< 0.4	< 0.4	<0.3	< 0.16	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	< 0.012	< 0.011	< 0.011	69(10)	-	-	0.16	2.1
Phenanthrene	< 0.11	< 0.08	< 0.08	< 0.06	< 0.04	< 0.05	< 0.05	< 0.05	0.33	0.06	< 0.06	0.25	0.042	0.095	-	-	-	0.24	1.5

Pyrene	< 0.11	< 0.08	< 0.08	0.07	< 0.04	< 0.05	< 0.05	0.06	0.5	0.12	0.07	0.3	0.059	0.152	1.3-1600(10)	-	-	0.665	2.6
Note: other parameters such as Organochlorine Pesticides, Tributyl Tin and Total Organic Carbon continued on the next page																			
Organochlorine Pesticides																			
Aldrin	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
alpha-BHC	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
beta-BHC	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
delta-BHC	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
gamma-BHC (Lindane)	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	14,000(11)	-	-	0.00032	0.001
cis-Chlordane	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-		
trans-Chlordane	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-		
Total Chlordane [(cis+trans)*100/42]	< 0.04	< 0.04	< 0.04	< 0.04	-	-	< 0.04	-	< 0.04	-	-	< 0.0020	< 0.0020	< 0.0020	-	-	-	0.0005	0.006
2,4'-DDD	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-		
4,4'-DDD	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	0.002	0.02
2,4'-DDE	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-		
4,4'-DDE	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	0.0022	0.027
2,4'-DDT	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	12 or 0.7(12)				
4,4'-DDT	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010		-	-	0.0016	0.046
Dieldrin	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	190(11)	-	-	0.00002	0.008
Endosulfan I	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Endosulfan II	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Endosulfan sulphate	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Endrin	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-		
Endrin aldehyde	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	0.00002	0.008
Endrin ketone	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-		
Heptachlor	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Heptachlor epoxide	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Hexachlorobenzene	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Methoxychlor	< 0.010	< 0.010	< 0.010	< 0.010	-	-	< 0.010	-	< 0.010	-	-	< 0.0010	< 0.0010	< 0.0010	-	-	-	-	-
Tributyl Tin																			
Dibutyltin	<0.005	<0.005	<0.005	<0.005	-	-	<0.005	-	<0.005	-	-	<0.005	-	-	-	-	-	-	-
Monobutyltin	<0.007	<0.007	<0.007	<0.007	-	-	<0.007	-	<0.007	-	-	<0.007	-	-	-	-	-	-	-
Tributyltin	<0.004	<0.004	<0.004	<0.004	-	-	<0.004	-	<0.004	-	-	<0.004	-	-	-	-	-	0.005	0.07
Triphenyltin	<0.003	<0.003	<0.003	<0.003	-	-	<0.003	-	<0.003	-	-	<0.003	-	-	-	-	-	-	-
Total Organic Carbo	0.99	4.2	-	2.2	-	4.0	1.56	1.26	1.54	1.31	1.41	0.94	0.84	0.87	-	-	-	-	-

Notes:

1) All heavy metals total recoverable.

2) All test results in mg/kg dry weight.

3) All TPH, PaH, OCP and TBT test results less that the detection limit of the laboratory analytical equipment

4) Sample depth in metres below ground level

5) ALW Plan (Operative in Part, 21 October 2010). It may be inferred from Note 3 of Schedule 10 that where the heavy metal limit for human health is not shown then the limit is equal or higher than the discharge limit.
6) Auckland Regional Council- Technical Publication TP153- for non-volcanic and volcanic soils- used as cleanfill values, i.e. if the site sediment is disposed off-site to a licensed cleanfill site located in a non-volcanic soil type area the non-volcanic TP153 values apply, note, maximum values stated, e.g. for arsenic the range is 0.4-12 mg/kg.
7) Austarlian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) Guidelines, October 2000, Sediment Quality Guidelines, Table 3.5.1- Interim Sediment Quality Guideline (ISQG) Low (trigger value) and ISQG high
8) **BOLD** values: exceed the T153- non volcanic soils concentrations
9) Underline value: exceeds the ISQG-low value.
10) MfE, Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011) Module 4 – Tier 1 Soil Screening Criteria Residential land use, all pathways, for silty clay soil with surface (<1m) depth of contamination (Table 4.10) and for the protection of groundwater quality for potable use (Table 4.20) with surface contamination (<1 m) and depth to groundwater as 4 m.
11) MfE, Identifying, Investigating and Managing Risks Associated with Former Sheep-dipSites, November 2006 – SGVs for human health for commercial/industrial (unpaved) land use- (Table 4).
12) The criteria 12 mg/kg applies to land that is not developed. The criteria 0.7 mg/kg applies to land that is being redeveloped (redevelopment does not include cultivation and the formation and maintenance of tracks) during the redevelopment phase only. Once redevelopment has been completed, the higher criteria applies.

APPENDIX I UPPER CONFIDENCE LIMIT- HEAVY METALS

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	15/12/2014 9:30:46 a.m.
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	14	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	1	Mean	15.55
Maximum	35	Median	15.9
SD	9.35	Std. Error of Mean	2.499
Coefficient of Variation	0.601	Skewness	0.64

Normal GOF Test

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.98	95% Adjusted-CLT UCL (Chen-1995)	20.12
		95% Modified-t UCL (Johnson-1978)	20.05

Gamma GOF Test

A-D Test Statistic	0.418	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.231	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.172	k star (bias corrected MLE)	1.754
Theta hat (MLE)	7.159	Theta star (bias corrected MLE)	8.865
nu hat (MLE)	60.81	nu star (bias corrected)	49.12
MLE Mean (bias corrected)	15.55	MLE Sd (bias corrected)	11.74
		Approximate Chi Square Value (0.05)	34.03
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	32.37

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	22.45	95% Adjusted Gamma UCL (use when n<50)	23.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.832	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors Lognormal GOF Test**

55	5% Lilliefors Critical Value				0.237	Data appear Lognormal at 5% Significance Level						
56	**Data appear Approximate Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59	Minimum of Logged Data				0	Mean of logged Data						2.497
60	Maximum of Logged Data				3.555	SD of logged Data						0.878
61												
62	**Assuming Lognormal Distribution**											
63	95% H-UCL				33.56	90% Chebyshev (MVUE) UCL						30.2
64	95% Chebyshev (MVUE) UCL				36.08	97.5% Chebyshev (MVUE) UCL						44.24
65	99% Chebyshev (MVUE) UCL				60.27							
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71	95% CLT UCL				19.66	95% Jackknife UCL						19.98
72	95% Standard Bootstrap UCL				19.53	95% Bootstrap-t UCL						20.94
73	95% Hall's Bootstrap UCL				21.07	95% Percentile Bootstrap UCL						19.64
74	95% BCA Bootstrap UCL				19.84							
75	90% Chebyshev(Mean, Sd) UCL				23.05	95% Chebyshev(Mean, Sd) UCL						26.44
76	97.5% Chebyshev(Mean, Sd) UCL				31.16	99% Chebyshev(Mean, Sd) UCL						40.41
77												
78	**Suggested UCL to Use**											
79	95% Student's-t UCL				19.98							
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
84	For additional insight the user may want to consult a statistician.											
85												
86												
87	**Cadmium**											
88												
89	**General Statistics**											
90	Total Number of Observations				14	Number of Distinct Observations						6
91						Number of Missing Observations						0
92	Minimum				0.031	Mean						0.0496
93	Maximum				0.089	Median						0.05
94	SD				0.0128	Std. Error of Mean						0.00341
95	Coefficient of Variation				0.257	Skewness						2.26
96												
97	**Normal GOF Test**											
98	Shapiro Wilk Test Statistic				0.657	**Shapiro Wilk GOF Test**						
99	5% Shapiro Wilk Critical Value				0.874	Data Not Normal at 5% Significance Level						
100	Lilliefors Test Statistic				0.417	**Lilliefors GOF Test**						
101	5% Lilliefors Critical Value				0.237	Data Not Normal at 5% Significance Level						
102	**Data Not Normal at 5% Significance Level**											
103												
104	**Assuming Normal Distribution**											
105	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
106	95% Student's-t UCL				0.0557	95% Adjusted-CLT UCL (Chen-1995)						0.0575
107						95% Modified-t UCL (Johnson-1978)						0.056
108												

109	**Gamma GOF Test**											
110	A-D Test Statistic				1.859	**Anderson-Darling Gamma GOF Test**						
111	5% A-D Critical Value				0.734	Data Not Gamma Distributed at 5% Significance Level						
112	K-S Test Statistic				0.386	**Kolmogrov-Smirnoff Gamma GOF Test**						
113	5% K-S Critical Value				0.228	Data Not Gamma Distributed at 5% Significance Level						
114	**Data Not Gamma Distributed at 5% Significance Level**											
115												
116	**Gamma Statistics**											
117	k hat (MLE)				19.83	k star (bias corrected MLE)						15.62
118	Theta hat (MLE)				0.0025	Theta star (bias corrected MLE)						0.00318
119	nu hat (MLE)				555.1	nu star (bias corrected)						437.5
120	MLE Mean (bias corrected)				0.0496	MLE Sd (bias corrected)						0.0126
121						Approximate Chi Square Value (0.05)						390
122	Adjusted Level of Significance				0.0312	Adjusted Chi Square Value						384.1
123												
124	**Assuming Gamma Distribution**											
125	95% Approximate Gamma UCL (use when n>=50))				0.0557	95% Adjusted Gamma UCL (use when n<50)						0.0566
126												
127	**Lognormal GOF Test**											
128	Shapiro Wilk Test Statistic				0.75	**Shapiro Wilk Lognormal GOF Test**						
129	5% Shapiro Wilk Critical Value				0.874	Data Not Lognormal at 5% Significance Level						
130	Lilliefors Test Statistic				0.371	**Lilliefors Lognormal GOF Test**						
131	5% Lilliefors Critical Value				0.237	Data Not Lognormal at 5% Significance Level						
132	**Data Not Lognormal at 5% Significance Level**											
133												
134	**Lognormal Statistics**											
135	Minimum of Logged Data				-3.474	Mean of logged Data						-3.028
136	Maximum of Logged Data				-2.419	SD of logged Data						0.226
137												
138	**Assuming Lognormal Distribution**											
139	95% H-UCL				0.0557	90% Chebyshev (MVUE) UCL						0.0586
140	95% Chebyshev (MVUE) UCL				0.0627	97.5% Chebyshev (MVUE) UCL						0.0684
141	99% Chebyshev (MVUE) UCL				0.0795							
142												
143	**Nonparametric Distribution Free UCL Statistics**											
144	**Data do not follow a Discernible Distribution (0.05)**											
145												
146	**Nonparametric Distribution Free UCLs**											
147	95% CLT UCL				0.0553	95% Jackknife UCL						0.0557
148	95% Standard Bootstrap UCL				0.055	95% Bootstrap-t UCL						0.0584
149	95% Hall's Bootstrap UCL				0.0838	95% Percentile Bootstrap UCL						0.0556
150	95% BCA Bootstrap UCL				0.057							
151	90% Chebyshev(Mean, Sd) UCL				0.0599	95% Chebyshev(Mean, Sd) UCL						0.0645
152	97.5% Chebyshev(Mean, Sd) UCL				0.0709	99% Chebyshev(Mean, Sd) UCL						0.0836
153												
154	**Suggested UCL to Use**											
155	95% Student's-t UCL				0.0557	or 95% Modified-t UCL						0.056
156												
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
159	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
160	For additional insight the user may want to consult a statistician.											
161												
162												

163	**Chromium**											
164												
165	**General Statistics**											
166					Total Number of Observations	14			Number of Distinct Observations	14		
167									Number of Missing Observations	0		
168					Minimum	8			Mean	17.3		
169					Maximum	28			Median	16.5		
170					SD	5.48			Std. Error of Mean	1.465		
171					Coefficient of Variation	0.317			Skewness	0.348		
172												
173	**Normal GOF Test**											
174					Shapiro Wilk Test Statistic	0.985			**Shapiro Wilk GOF Test**			
175					5% Shapiro Wilk Critical Value	0.874			Data appear Normal at 5% Significance Level			
176					Lilliefors Test Statistic	0.0938			**Lilliefors GOF Test**			
177					5% Lilliefors Critical Value	0.237			Data appear Normal at 5% Significance Level			
178	**Data appear Normal at 5% Significance Level**											
179												
180	**Assuming Normal Distribution**											
181					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
182					95% Student's-t UCL	19.89			95% Adjusted-CLT UCL (Chen-1995)	19.85		
183									95% Modified-t UCL (Johnson-1978)	19.92		
184												
185	**Gamma GOF Test**											
186					A-D Test Statistic	0.109			**Anderson-Darling Gamma GOF Test**			
187					5% A-D Critical Value	0.735			Detected data appear Gamma Distributed at 5% Significance Level			
188					K-S Test Statistic	0.084			**Kolmogrov-Smirnoff Gamma GOF Test**			
189					5% K-S Critical Value	0.229			Detected data appear Gamma Distributed at 5% Significance Level			
190	**Detected data appear Gamma Distributed at 5% Significance Level**											
191												
192	**Gamma Statistics**											
193					k hat (MLE)	10.31			k star (bias corrected MLE)	8.147		
194					Theta hat (MLE)	1.678			Theta star (bias corrected MLE)	2.124		
195					nu hat (MLE)	288.6			nu star (bias corrected)	228.1		
196					MLE Mean (bias corrected)	17.3			MLE Sd (bias corrected)	6.061		
197									Approximate Chi Square Value (0.05)	194.1		
198					Adjusted Level of Significance	0.0312			Adjusted Chi Square Value	190		
199												
200	**Assuming Gamma Distribution**											
201					95% Approximate Gamma UCL (use when n>=50))	20.33			95% Adjusted Gamma UCL (use when n<50)	20.77		
202												
203	**Lognormal GOF Test**											
204					Shapiro Wilk Test Statistic	0.982			**Shapiro Wilk Lognormal GOF Test**			
205					5% Shapiro Wilk Critical Value	0.874			Data appear Lognormal at 5% Significance Level			
206					Lilliefors Test Statistic	0.107			**Lilliefors Lognormal GOF Test**			
207					5% Lilliefors Critical Value	0.237			Data appear Lognormal at 5% Significance Level			
208	**Data appear Lognormal at 5% Significance Level**											
209												
210	**Lognormal Statistics**											
211					Minimum of Logged Data	2.079			Mean of logged Data	2.801		
212					Maximum of Logged Data	3.332			SD of logged Data	0.333		
213												
214	**Assuming Lognormal Distribution**											
215					95% H-UCL	20.8			90% Chebyshev (MVUE) UCL	22.03		
216					95% Chebyshev (MVUE) UCL	24.16			97.5% Chebyshev (MVUE) UCL	27.12		

217				99% Chebyshev (MVUE) UCL	32.92							
218												
219					**Nonparametric Distribution Free UCL Statistics**							
220					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
221												
222					**Nonparametric Distribution Free UCLs**							
223				95% CLT UCL	19.71					95% Jackknife UCL	19.89	
224				95% Standard Bootstrap UCL	19.62					95% Bootstrap-t UCL	19.91	
225				95% Hall's Bootstrap UCL	19.8					95% Percentile Bootstrap UCL	19.57	
226				95% BCA Bootstrap UCL	19.76							
227				90% Chebyshev(Mean, Sd) UCL	21.69					95% Chebyshev(Mean, Sd) UCL	23.68	
228				97.5% Chebyshev(Mean, Sd) UCL	26.45					99% Chebyshev(Mean, Sd) UCL	31.87	
229												
230					**Suggested UCL to Use**							
231				95% Student's-t UCL	19.89							
232												
233					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
234					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
235					and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.							
236					For additional insight the user may want to consult a statistician.							
237												
238												
239	**Copper**											
240												
241					**General Statistics**							
242				Total Number of Observations	14					Number of Distinct Observations	11	
243										Number of Missing Observations	0	
244				Minimum	7					Mean	16.69	
245				Maximum	27					Median	17.5	
246				SD	5.77					Std. Error of Mean	1.542	
247				Coefficient of Variation	0.346					Skewness	0.178	
248												
249					**Normal GOF Test**							
250				Shapiro Wilk Test Statistic	0.942					**Shapiro Wilk GOF Test**		
251				5% Shapiro Wilk Critical Value	0.874					Data appear Normal at 5% Significance Level		
252				Lilliefors Test Statistic	0.164					**Lilliefors GOF Test**		
253				5% Lilliefors Critical Value	0.237					Data appear Normal at 5% Significance Level		
254					**Data appear Normal at 5% Significance Level**							
255												
256					**Assuming Normal Distribution**							
257					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
258				95% Student's-t UCL	19.42					95% Adjusted-CLT UCL (Chen-1995)	19.31	
259										95% Modified-t UCL (Johnson-1978)	19.44	
260												
261					**Gamma GOF Test**							
262				A-D Test Statistic	0.465					**Anderson-Darling Gamma GOF Test**		
263				5% A-D Critical Value	0.736					Detected data appear Gamma Distributed at 5% Significance Level		
264				K-S Test Statistic	0.21					**Kolmogrov-Smirnoff Gamma GOF Test**		
265				5% K-S Critical Value	0.229					Detected data appear Gamma Distributed at 5% Significance Level		
266					**Detected data appear Gamma Distributed at 5% Significance Level**							
267												
268					**Gamma Statistics**							
269				k hat (MLE)	8.275					k star (bias corrected MLE)	6.549	
270				Theta hat (MLE)	2.017					Theta star (bias corrected MLE)	2.549	

271					nu hat (MLE)	231.7					nu star (bias corrected)	183.4
272					MLE Mean (bias corrected)	16.69					MLE Sd (bias corrected)	6.523
273											Approximate Chi Square Value (0.05)	153.1
274					Adjusted Level of Significance	0.0312					Adjusted Chi Square Value	149.4
275												
276					**Assuming Gamma Distribution**							
277					95% Approximate Gamma UCL (use when n>=50))	20					95% Adjusted Gamma UCL (use when n<50)	20.49
278												
279					**Lognormal GOF Test**							
280					Shapiro Wilk Test Statistic	0.93					**Shapiro Wilk Lognormal GOF Test**	
281					5% Shapiro Wilk Critical Value	0.874					Data appear Lognormal at 5% Significance Level	
282					Lilliefors Test Statistic	0.227					**Lilliefors Lognormal GOF Test**	
283					5% Lilliefors Critical Value	0.237					Data appear Lognormal at 5% Significance Level	
284					**Data appear Lognormal at 5% Significance Level**							
285												
286					**Lognormal Statistics**							
287					Minimum of Logged Data	1.946					Mean of logged Data	2.753
288					Maximum of Logged Data	3.296					SD of logged Data	0.378
289												
290					**Assuming Lognormal Distribution**							
291					95% H-UCL	20.7					90% Chebyshev (MVUE) UCL	21.92
292					95% Chebyshev (MVUE) UCL	24.26					97.5% Chebyshev (MVUE) UCL	27.51
293					99% Chebyshev (MVUE) UCL	33.88						
294												
295					**Nonparametric Distribution Free UCL Statistics**							
296					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
297												
298					**Nonparametric Distribution Free UCLs**							
299					95% CLT UCL	19.23					95% Jackknife UCL	19.42
300					95% Standard Bootstrap UCL	19.15					95% Bootstrap-t UCL	19.47
301					95% Hall's Bootstrap UCL	19.62					95% Percentile Bootstrap UCL	19.14
302					95% BCA Bootstrap UCL	19.21						
303					90% Chebyshev(Mean, Sd) UCL	21.32					95% Chebyshev(Mean, Sd) UCL	23.41
304					97.5% Chebyshev(Mean, Sd) UCL	26.32					99% Chebyshev(Mean, Sd) UCL	32.04
305												
306					**Suggested UCL to Use**							
307					95% Student's-t UCL	19.42						
308												
309					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
310					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
311					and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.							
312					For additional insight the user may want to consult a statistician.							
313												
314												
315	**Lead**											
316												
317					**General Statistics**							
318					Total Number of Observations	14					Number of Distinct Observations	12
319											Number of Missing Observations	0
320					Minimum	4.6					Mean	24.73
321					Maximum	34					Median	26
322					SD	7.724					Std. Error of Mean	2.064
323					Coefficient of Variation	0.312					Skewness	-1.43
324												

325	**Normal GOF Test**											
326					Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk GOF Test**					
327					5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level					
328					Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**					
329					5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level					
330	**Data appear Normal at 5% Significance Level**											
331												
332	**Assuming Normal Distribution**											
333	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
334					95% Student's-t UCL	28.38	95% Adjusted-CLT UCL (Chen-1995)	27.28				
335							95% Modified-t UCL (Johnson-1978)	28.25				
336												
337	**Gamma GOF Test**											
338					A-D Test Statistic	1.177	**Anderson-Darling Gamma GOF Test**					
339					5% A-D Critical Value	0.737	Data Not Gamma Distributed at 5% Significance Level					
340					K-S Test Statistic	0.239	**Kolmogrov-Smirnoff Gamma GOF Test**					
341					5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level					
342	**Data Not Gamma Distributed at 5% Significance Level**											
343												
344	**Gamma Statistics**											
345					k hat (MLE)	6.161	k star (bias corrected MLE)	4.889				
346					Theta hat (MLE)	4.014	Theta star (bias corrected MLE)	5.058				
347					nu hat (MLE)	172.5	nu star (bias corrected)	136.9				
348					MLE Mean (bias corrected)	24.73	MLE Sd (bias corrected)	11.18				
349							Approximate Chi Square Value (0.05)	110.8				
350					Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	107.7				
351												
352	**Assuming Gamma Distribution**											
353					95% Approximate Gamma UCL (use when n>=50))	30.54	95% Adjusted Gamma UCL (use when n<50)	31.42				
354												
355	**Lognormal GOF Test**											
356					Shapiro Wilk Test Statistic	0.676	**Shapiro Wilk Lognormal GOF Test**					
357					5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level					
358					Lilliefors Test Statistic	0.259	**Lilliefors Lognormal GOF Test**					
359					5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level					
360	**Data Not Lognormal at 5% Significance Level**											
361												
362	**Lognormal Statistics**											
363					Minimum of Logged Data	1.526	Mean of logged Data	3.125				
364					Maximum of Logged Data	3.526	SD of logged Data	0.506				
365												
366	**Assuming Lognormal Distribution**											
367					95% H-UCL	34.33	90% Chebyshev (MVUE) UCL	36.3				
368					95% Chebyshev (MVUE) UCL	41.15	97.5% Chebyshev (MVUE) UCL	47.87				
369					99% Chebyshev (MVUE) UCL	61.08						
370												
371	**Nonparametric Distribution Free UCL Statistics**											
372	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
373												
374	**Nonparametric Distribution Free UCLs**											
375					95% CLT UCL	28.12	95% Jackknife UCL	28.38				
376					95% Standard Bootstrap UCL	28.12	95% Bootstrap-t UCL	27.77				
377					95% Hall's Bootstrap UCL	27.44	95% Percentile Bootstrap UCL	27.79				
378					95% BCA Bootstrap UCL	27.41						

379				90% Chebyshev(Mean, Sd) UCL		30.92				95% Chebyshev(Mean, Sd) UCL		33.73
380				97.5% Chebyshev(Mean, Sd) UCL		37.62				99% Chebyshev(Mean, Sd) UCL		45.27
381												
382						**Suggested UCL to Use**							
383				95% Student's-t UCL		28.38						
384												
385						Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.						
386						These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)						
387						and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.						
388						For additional insight the user may want to consult a statistician.						
389												
390						**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**						
391						**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**						
392												
393												
394	**Mercury**											
395												
396						**General Statistics**						
397				Total Number of Observations		14				Number of Distinct Observations		10
398										Number of Missing Observations		0
399				Minimum		0.05				Mean		0.104
400				Maximum		0.2				Median		0.102
401				SD		0.0359				Std. Error of Mean		0.0096
402				Coefficient of Variation		0.347				Skewness		1.165
403												
404						**Normal GOF Test**						
405				Shapiro Wilk Test Statistic		0.858				**Shapiro Wilk GOF Test**		
406				5% Shapiro Wilk Critical Value		0.874				Data Not Normal at 5% Significance Level		
407				Lilliefors Test Statistic		0.214				**Lilliefors GOF Test**		
408				5% Lilliefors Critical Value		0.237				Data appear Normal at 5% Significance Level		
409						**Data appear Approximate Normal at 5% Significance Level**						
410												
411						**Assuming Normal Distribution**						
412				**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**		
413				95% Student's-t UCL		0.12				95% Adjusted-CLT UCL (Chen-1995)		0.122
414										95% Modified-t UCL (Johnson-1978)		0.121
415												
416						**Gamma GOF Test**						
417				A-D Test Statistic		0.762				**Anderson-Darling Gamma GOF Test**		
418				5% A-D Critical Value		0.735				Data Not Gamma Distributed at 5% Significance Level		
419				K-S Test Statistic		0.203				**Kolmogrov-Smirnoff Gamma GOF Test**		
420				5% K-S Critical Value		0.229				Detected data appear Gamma Distributed at 5% Significance Level		
421						**Detected data follow Appr. Gamma Distribution at 5% Significance Level**						
422												
423						**Gamma Statistics**						
424				k hat (MLE)		9.202				k star (bias corrected MLE)		7.277
425				Theta hat (MLE)		0.0112				Theta star (bias corrected MLE)		0.0142
426				nu hat (MLE)		257.6				nu star (bias corrected)		203.8
427				MLE Mean (bias corrected)		0.104				MLE Sd (bias corrected)		0.0384
428										Approximate Chi Square Value (0.05)		171.7
429				Adjusted Level of Significance		0.0312				Adjusted Chi Square Value		167.8
430												
431						**Assuming Gamma Distribution**							
432				95% Approximate Gamma UCL (use when n>=50))		0.123				95% Adjusted Gamma UCL (use when n<50)		0.126

433												
434	**Lognormal GOF Test**											
435				Shapiro Wilk Test Statistic		0.882	**Shapiro Wilk Lognormal GOF Test**					
436				5% Shapiro Wilk Critical Value		0.874	Data appear Lognormal at 5% Significance Level					
437				Lilliefors Test Statistic		0.227	**Lilliefors Lognormal GOF Test**					
438				5% Lilliefors Critical Value		0.237	Data appear Lognormal at 5% Significance Level					
439	**Data appear Lognormal at 5% Significance Level**											
440												
441	**Lognormal Statistics**											
442				Minimum of Logged Data		-2.996	Mean of logged Data					-2.324
443				Maximum of Logged Data		-1.609	SD of logged Data					0.352
444												
445	**Assuming Lognormal Distribution**											
446				95% H-UCL		0.126	90% Chebyshev (MVUE) UCL					0.133
447				95% Chebyshev (MVUE) UCL		0.147	97.5% Chebyshev (MVUE) UCL					0.165
448				99% Chebyshev (MVUE) UCL		0.202						
449												
450	**Nonparametric Distribution Free UCL Statistics**											
451	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
452												
453	**Nonparametric Distribution Free UCLs**											
454				95% CLT UCL		0.119	95% Jackknife UCL					0.12
455				95% Standard Bootstrap UCL		0.119	95% Bootstrap-t UCL					0.124
456				95% Hall's Bootstrap UCL		0.14	95% Percentile Bootstrap UCL					0.12
457				95% BCA Bootstrap UCL		0.123						
458				90% Chebyshev(Mean, Sd) UCL		0.132	95% Chebyshev(Mean, Sd) UCL					0.145
459				97.5% Chebyshev(Mean, Sd) UCL		0.163	99% Chebyshev(Mean, Sd) UCL					0.199
460												
461	**Suggested UCL to Use**											
462				95% Student's-t UCL		0.12						
463												
464	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
465	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
466	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
467	For additional insight the user may want to consult a statistician.											
468												
469												
470	**Nickel**											
471												
472	**General Statistics**											
473				Total Number of Observations		14	Number of Distinct Observations					8
474							Number of Missing Observations					0
475				Minimum		2	Mean					7.093
476				Maximum		10	Median					7
477				SD		2.014	Std. Error of Mean					0.538
478				Coefficient of Variation		0.284	Skewness					-0.97
479												
480	**Normal GOF Test**											
481				Shapiro Wilk Test Statistic		0.892	**Shapiro Wilk GOF Test**					
482				5% Shapiro Wilk Critical Value		0.874	Data appear Normal at 5% Significance Level					
483				Lilliefors Test Statistic		0.241	**Lilliefors GOF Test**					
484				5% Lilliefors Critical Value		0.237	Data Not Normal at 5% Significance Level					
485	**Data appear Approximate Normal at 5% Significance Level**											
486												

487	**Assuming Normal Distribution**											
488	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
489	95% Student's-t UCL				8.046		95% Adjusted-CLT UCL (Chen-1995)					7.829
490							95% Modified-t UCL (Johnson-1978)					8.023
491												
492	**Gamma GOF Test**											
493	A-D Test Statistic				1.077		**Anderson-Darling Gamma GOF Test**					
494	5% A-D Critical Value				0.735		Data Not Gamma Distributed at 5% Significance Level					
495	K-S Test Statistic				0.299		**Kolmogrov-Smirnoff Gamma GOF Test**					
496	5% K-S Critical Value				0.229		Data Not Gamma Distributed at 5% Significance Level					
497	**Data Not Gamma Distributed at 5% Significance Level**											
498												
499	**Gamma Statistics**											
500	k hat (MLE)				9.048		k star (bias corrected MLE)					7.157
501	Theta hat (MLE)				0.784		Theta star (bias corrected MLE)					0.991
502	nu hat (MLE)				253.3		nu star (bias corrected)					200.4
503	MLE Mean (bias corrected)				7.093		MLE Sd (bias corrected)					2.651
504							Approximate Chi Square Value (0.05)					168.6
505	Adjusted Level of Significance				0.0312		Adjusted Chi Square Value					164.8
506												
507	**Assuming Gamma Distribution**											
508	95% Approximate Gamma UCL (use when n>=50))				8.428		95% Adjusted Gamma UCL (use when n<50)					8.626
509												
510	**Lognormal GOF Test**											
511	Shapiro Wilk Test Statistic				0.727		**Shapiro Wilk Lognormal GOF Test**					
512	5% Shapiro Wilk Critical Value				0.874		Data Not Lognormal at 5% Significance Level					
513	Lilliefors Test Statistic				0.326		**Lilliefors Lognormal GOF Test**					
514	5% Lilliefors Critical Value				0.237		Data Not Lognormal at 5% Significance Level					
515	**Data Not Lognormal at 5% Significance Level**											
516												
517	**Lognormal Statistics**											
518	Minimum of Logged Data				0.693		Mean of logged Data					1.903
519	Maximum of Logged Data				2.303		SD of logged Data					0.394
520												
521	**Assuming Lognormal Distribution**											
522	95% H-UCL				8.997		90% Chebyshev (MVUE) UCL					9.522
523	95% Chebyshev (MVUE) UCL				10.57		97.5% Chebyshev (MVUE) UCL					12.03
524	99% Chebyshev (MVUE) UCL				14.89							
525												
526	**Nonparametric Distribution Free UCL Statistics**											
527	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
528												
529	**Nonparametric Distribution Free UCLs**											
530	95% CLT UCL				7.978		95% Jackknife UCL					8.046
531	95% Standard Bootstrap UCL				7.951		95% Bootstrap-t UCL					7.946
532	95% Hall's Bootstrap UCL				7.894		95% Percentile Bootstrap UCL					7.893
533	95% BCA Bootstrap UCL				7.829							
534	90% Chebyshev(Mean, Sd) UCL				8.708		95% Chebyshev(Mean, Sd) UCL					9.44
535	97.5% Chebyshev(Mean, Sd) UCL				10.45		99% Chebyshev(Mean, Sd) UCL					12.45
536												
537	**Suggested UCL to Use**											
538	95% Student's-t UCL				8.046							
539												
540	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

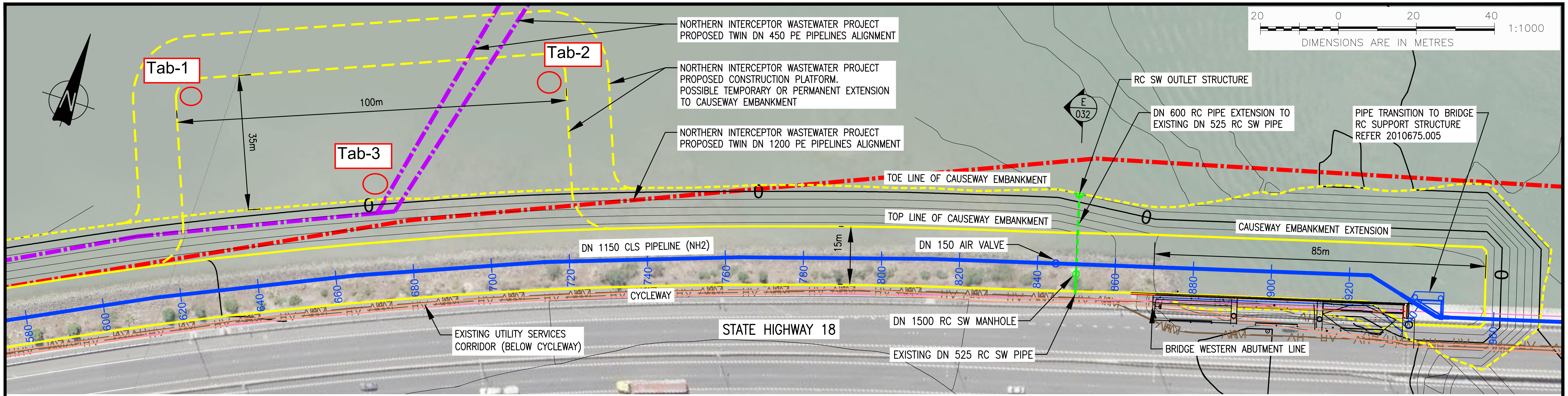
	A	B	C	D	E	F	G	H	I	J	K	L
541	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
542	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
543	For additional insight the user may want to consult a statistician.											
544												
545	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
546	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
547												
548												
549	**Zinc**											
550												
551	**General Statistics**											
552					Total Number of Observations	14			Number of Distinct Observations	13		
553									Number of Missing Observations	0		
554					Minimum	14			Mean	91.36		
555					Maximum	125			Median	96		
556					SD	28.05			Std. Error of Mean	7.498		
557					Coefficient of Variation	0.307			Skewness	-1.715		
558												
559	**Normal GOF Test**											
560					Shapiro Wilk Test Statistic	0.845			**Shapiro Wilk GOF Test**			
561					5% Shapiro Wilk Critical Value	0.874			Data Not Normal at 5% Significance Level			
562					Lilliefors Test Statistic	0.252			**Lilliefors GOF Test**			
563					5% Lilliefors Critical Value	0.237			Data Not Normal at 5% Significance Level			
564	**Data Not Normal at 5% Significance Level**											
565												
566	**Assuming Normal Distribution**											
567	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
568					95% Student's-t UCL	104.6			95% Adjusted-CLT UCL (Chen-1995)	100		
569									95% Modified-t UCL (Johnson-1978)	104.1		
570												
571	**Gamma GOF Test**											
572					A-D Test Statistic	1.638			**Anderson-Darling Gamma GOF Test**			
573					5% A-D Critical Value	0.738			Data Not Gamma Distributed at 5% Significance Level			
574					K-S Test Statistic	0.317			**Kolmogrov-Smirnoff Gamma GOF Test**			
575					5% K-S Critical Value	0.229			Data Not Gamma Distributed at 5% Significance Level			
576	**Data Not Gamma Distributed at 5% Significance Level**											
577												
578	**Gamma Statistics**											
579					k hat (MLE)	5.636			k star (bias corrected MLE)	4.476		
580					Theta hat (MLE)	16.21			Theta star (bias corrected MLE)	20.41		
581					nu hat (MLE)	157.8			nu star (bias corrected)	125.3		
582					MLE Mean (bias corrected)	91.36			MLE Sd (bias corrected)	43.18		
583									Approximate Chi Square Value (0.05)	100.5		
584					Adjusted Level of Significance	0.0312			Adjusted Chi Square Value	97.52		
585												
586	**Assuming Gamma Distribution**											
587					95% Approximate Gamma UCL (use when n>=50))	114			95% Adjusted Gamma UCL (use when n<50)	117.4		
588												
589	**Lognormal GOF Test**											
590					Shapiro Wilk Test Statistic	0.606			**Shapiro Wilk Lognormal GOF Test**			
591					5% Shapiro Wilk Critical Value	0.874			Data Not Lognormal at 5% Significance Level			
592					Lilliefors Test Statistic	0.333			**Lilliefors Lognormal GOF Test**			
593					5% Lilliefors Critical Value	0.237			Data Not Lognormal at 5% Significance Level			
594	**Data Not Lognormal at 5% Significance Level**											

	Lognormal Statistics	
Minimum of Logged Data	2.639	Mean of logged Data 4.423
Maximum of Logged Data	4.828	SD of logged Data 0.548
	Assuming Lognormal Distribution	
95% H-UCL	133	90% Chebyshev (MVUE) UCL 139.2
95% Chebyshev (MVUE) UCL	158.9	97.5% Chebyshev (MVUE) UCL 186.2
99% Chebyshev (MVUE) UCL	239.9	
	Nonparametric Distribution Free UCL Statistics	
	Data do not follow a Discernible Distribution (0.05)	
	Nonparametric Distribution Free UCLs	
95% CLT UCL	103.7	95% Jackknife UCL 104.6
95% Standard Bootstrap UCL	103.5	95% Bootstrap-t UCL 102.4
95% Hall's Bootstrap UCL	101	95% Percentile Bootstrap UCL 102.2
95% BCA Bootstrap UCL	100.8	
90% Chebyshev(Mean, Sd) UCL	113.9	95% Chebyshev(Mean, Sd) UCL 124
97.5% Chebyshev(Mean, Sd) UCL	138.2	99% Chebyshev(Mean, Sd) UCL 166
	Suggested UCL to Use	
95% Chebyshev (Mean, Sd) UCL	124	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

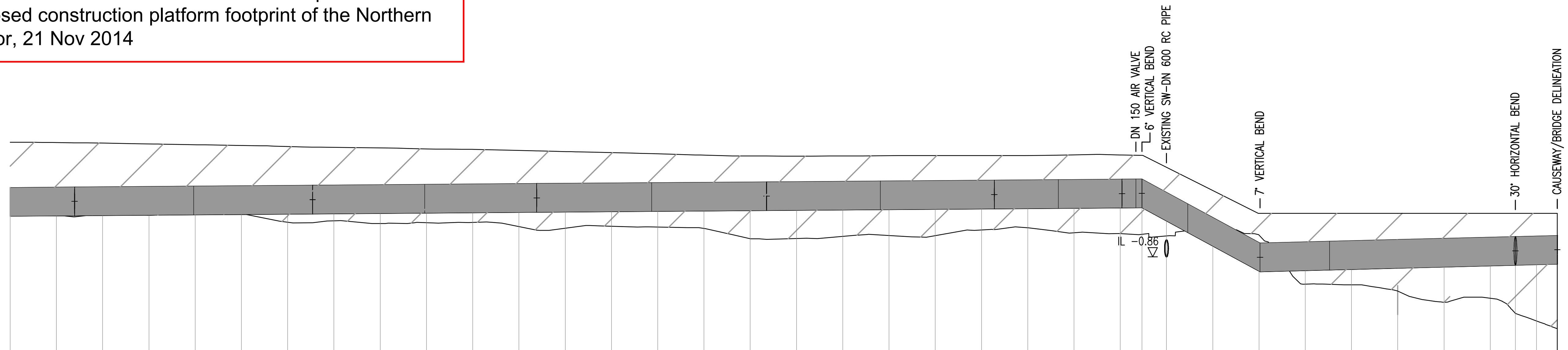
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

APPENDIX J ADDITIONAL SEDIMENT TESTING- PROPOSED CONSTRUCTION PLATFORM-NORTHERN INTERCEPTOR PROJECT



PLAN: NH2 PIPELINE DISTANCE 600.00 – 940.00m

Tab-1, Tab-2 and Tab-3: Three sediment samples taken within the proposed construction platform footprint of the Northern Interceptor, 21 Nov 2014



DATUM RL: −4.00

PIPE DIAMETER AND MATERIAL: DN 1150mm CLS

PIPE GRADE: 0.15% 502.06m; −10.82% 25.55m; 0.5% 64.28m

DISTANCE (m)	EXISTING SURFACE LEVEL (m)	FINISHED SURFACE LEVEL (m)	DEPTH TO INVERT (m)	INVERT LEVEL (m)
600.00	2.00	5.07	3.20	1.87
610.00	1.89	5.06	3.17	1.88
620.00	1.96	5.04	3.14	1.90
630.00	1.91	5.00	3.09	1.91
640.00	2.04	4.97	3.04	1.93
650.00	1.95	4.94	2.99	1.94
660.00	1.61	4.89	2.93	1.96
670.00	1.68	4.85	2.88	1.97
680.00	1.56	4.83	2.84	1.99
690.00	1.59	4.78	2.78	2.00
700.00	1.60	4.76	2.74	2.02
710.00	1.43	4.71	2.68	2.03
720.00	1.35	4.67	2.62	2.05
730.00	1.44	4.63	2.56	2.06
740.00	1.41	4.57	2.49	2.08
750.00	1.35	4.51	2.42	2.09
760.00	0.90	4.48	2.37	2.11
770.00	0.91	4.47	2.35	2.12
780.00	1.00	4.48	2.34	2.14
790.00	1.04	4.49	2.33	2.15
800.00	1.04	4.50	2.33	2.17
810.00	1.28	4.50	2.31	2.18
820.00	1.38	4.50	2.30	2.20
830.00	1.16	4.52	2.31	2.21
840.00	1.12	4.52	2.29	2.23
844.68	1.09	4.50	2.26	2.24
850.00	1.02	3.99	2.33	1.66
860.00	1.22	2.99	2.41	0.58
870.00	1.06	2.00	2.50	−0.50
880.00	−1.06	2.00	2.48	−0.48
890.00	−1.09	2.00	2.43	−0.43
900.00		2.00	2.38	−0.38
910.00	−1.84	2.00	2.33	−0.33
920.00		2.00	2.28	−0.28
925.44	−2.33	2.00	2.25	−0.25
930.00	−2.65	2.00	2.22	−0.22
934.50	−2.95	2.00	2.20	−0.20

LONGITUDINAL SECTION: NH2 PIPELINE DISTANCE 600.00 – 940.00m

SCALES: HORIZ 1:1000, VERT 1:200

PRELIMINARY DESIGN

ISSUE	DATE	AMENDMENT	BY	APPD.
1	17.10.14	PRELIMINARY DESIGN	M.N.V.	A.T.S.

DESIGNED	N.H.	10.14
DES. CHECKED	A.T.S.	10.14
DRAWN	M.N.V.	10.14
DWG. CHECKED	A.T.S.	10.14
PROJECT LEADER	M.A.E.	10.14
INFRAST'R APP'D		

OPERATIONS

INFRASTRUCTURE

Watercare

GREENHITHE BRIDGE WATERMAIN DUPLICATION

CIVIL DESIGN

NH2 PIPELINE LAYOUT PLAN AND LONGITUDINAL SECTION – SHEET 1 OF 3

CAD FILE 2010674.002-005 DATE 17.10.14

ORIGINAL SCALE A3 1:1,000 CONTRACT No. 5663

REF No. WMNH2-91-C-004 ISSUE –

DWG No. 2010674.004 1

Plot Date: Oct 20, 2014 – 3:20pm U:\Jobs\42073300\01_DWG_Current\02 Civil_2010674.002–005.dwg

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Jacobs New Zealand Limited	**Lab No:**	1355272	SPv1
Contact:	W Starke	**Date Registered:**	25-Nov-2014	
	C/- Jacobs New Zealand Limited	**Date Reported:**	09-Dec-2014	
	PO Box 9806	**Quote No:**	65091	
	Newmarket	**Order No:**		
	AUCKLAND 1149	**Client Reference:**	AE04521	
		Submitted By:	C Sjardin	

Sample Type: Sediment

Sample Name:		Tab 1 0-0.2 21-Nov-2014 2:30 pm	Tab 2 0-0.2 21-Nov-2014 2:15 pm	Tab 3 0-0.2 21-Nov-2014 3:05 pm	Tab 1 0-0.2 [<63um Fraction]	Tab 2 0-0.2 [<63um Fraction]
Lab Number:		1355272.1	1355272.2	1355272.3	1355272.4	1355272.5
Individual Tests						
Dry Matter	g/100g as rcvd	60	67	62	-	-
Extractable Copper*	mg/kg dry wt	-	-	-	21	22
Extractable Lead*	mg/kg dry wt	-	-	-	30	30
Extractable Zinc*	mg/kg dry wt	-	-	-	124	121
Total Organic Carbon*	g/100g dry wt	0.94	0.84	0.87	-	-
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	35	30	17.6	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.040	0.046	0.039	-	-
Total Recoverable Chromium	mg/kg dry wt	15.1	12.1	14.1	-	-
Total Recoverable Copper	mg/kg dry wt	12.2	10.2	11.0	-	-
Total Recoverable Lead	mg/kg dry wt	24	25	18.7	-	-
Total Recoverable Mercury	mg/kg dry wt	0.093	0.103	0.095	-	-
Total Recoverable Nickel	mg/kg dry wt	6.6	6.5	6.6	-	-
Total Recoverable Zinc	mg/kg dry wt	89	91	78	-	-
Organochlorine Pesticides Trace in Soil						
Aldrin	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
alpha-BHC	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
beta-BHC	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
delta-BHC	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
cis-Chlordane	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
trans-Chlordane	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
2,4'-DDD	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
4,4'-DDD	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
2,4'-DDE	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
4,4'-DDE	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
2,4'-DDT	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
4,4'-DDT	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Dieldrin	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endosulfan I	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endosulfan II	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endrin	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endrin aldehyde	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endrin ketone	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Heptachlor	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-

Sample Type: Sediment						
Sample Name:		Tab 1 0-0.2 21-Nov-2014 2:30 pm	Tab 2 0-0.2 21-Nov-2014 2:15 pm	Tab 3 0-0.2 21-Nov-2014 3:05 pm	Tab 1 0-0.2 [<63um Fraction]	Tab 2 0-0.2 [<63um Fraction]
Lab Number:		1355272.1	1355272.2	1355272.3	1355272.4	1355272.5
Organochlorine Pesticides Trace in Soil						
Hexachlorobenzene	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Methoxychlor	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.002	< 0.002	< 0.002	-	-
Polycyclic Aromatic Hydrocarbons Trace in Soil						
Acenaphthene	mg/kg dry wt	0.017	0.003	0.008	-	-
Acenaphthylene	mg/kg dry wt	0.008	0.003	0.005	-	-
Anthracene	mg/kg dry wt	0.039	0.007	0.015	-	-
Benzo[a]anthracene	mg/kg dry wt	0.121	0.025	0.062	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.147	0.032	0.078	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.169	0.040	0.091	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.093	0.024	0.052	-	-
Benzo[k]fluoranthene	mg/kg dry wt	0.064	0.015	0.035	-	-
Chrysene	mg/kg dry wt	0.123	0.027	0.065	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	0.018	0.005	0.010	-	-
Fluoranthene	mg/kg dry wt	0.34	0.064	0.168	-	-
Fluorene	mg/kg dry wt	0.015	0.003	0.007	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.093	0.022	0.051	-	-
Naphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	-	-
Phenanthrene	mg/kg dry wt	0.25	0.042	0.095	-	-
Pyrene	mg/kg dry wt	0.30	0.059	0.152	-	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	< 0.005	-	-	-	-
Monobutyltin (as Sn)	mg/kg dry wt	< 0.007	-	-	-	-
Tributyltin (as Sn)	mg/kg dry wt	< 0.004	-	-	-	-
Triphenyltin (as Sn)	mg/kg dry wt	< 0.003	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 12	< 11	< 11	-	-
C10 - C14	mg/kg dry wt	< 30	< 30	< 30	-	-
C15 - C36	mg/kg dry wt	< 50	< 50	< 50	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	< 80	-	-

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: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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%.	-	1-3
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	1-3
Organochlorine Pesticides Trace in Soil	Sonication extraction, SPE cleanup, GPC cleanup (if required), dual column GC-ECD analysis. Tested on dried sample	0.0010 - 0.002 mg/kg dry wt	1-3
Polycyclic Aromatic Hydrocarbons Trace in Soil	Sonication extraction, SPE cleanup, GC-MS SIM analysis US EPA 8270C. Tested on as received sample [KBIs:5784,4273,2695]	0.002 - 0.010 mg/kg dry wt	1-3
Tributyl Tin Trace in Soil samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis. Tested on dried sample	0.003 - 0.007 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1-3
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	1-3

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
ARC 2M HCl Extraction*	<63µm Sieved Fraction, extracted with 2M HCl. Solid:Liquid 1:50 w/v. ARC Tech Publication No. 47, 1994.	-	4-5
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-3
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	1-2
Extractable Copper*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	1.0 mg/kg dry wt	4-5
Extractable Lead*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	0.2 mg/kg dry wt	4-5
Extractable Zinc*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	2 mg/kg dry wt	4-5
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

ANALYSIS REQUEST

R J Hill Laboratories Limited
1 Clyde Street,
Private Bag 3205
Hamilton, New Zealand

Phone: +64 7 858 2000
Fax: +64 7 858 2001
Email: mail@hill-labs.co.nz
Web: www.hill-laboratories.com

Office use Job No:

Client
Name: Jacobs New Zealand Limited 31906
Address: PO Box 9806, Newmarket
AUCKLAND 1149
Phone: 09 928 5500 Fax: 09 928 5501
Client Reference:
Quote No: 65091 Order No:
Primary Contact W Starke 13741
Submitted By W Starke 13741
Charge To Jacobs New Zealand Limited 31906

Results To ☒ Mail Primary Contact ☒ Mail Submitter
☐ Fax Results
☒ Email Results Walter.Starke@jacobs.com

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories
☒ Please tick if you require COC to be emailed back
Date & Time: 24/11/14 12:15pm
Name: Caleb Sjardin
Signature: Caleb Sjardin

Received at Hill Laboratories
Date & Time:
Name:
Signature:

Condition ☐ Room Temp ☐ Chilled ☐ Frozen
Temp:

☐ Sample & Analysis details checked
Signature:

ADDITIONAL INFORMATION

also email copy of C.o.C to csjardin@tonkin.co.nz

Priority ☐ Low ☐ Normal ☑ High
☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

NOTE: The estimated turnaround time for the types and number of samples and analyses specified on this quote is by 4:30 pm, 10 working days following the day of receipt of the samples at the laboratory.

Quoted Sample Types
Sediment (Sed)

Requested Reporting Date:

No.	Sample Name	Sample Date/Time	Sample Type	Tests Required
1	Tab 1	21/11/14 2:30pm	Sediment	Please test as per Quote
2	Tab 2	21/11/14 2:15pm	Sediment	# 65091, there is no
3	Tab 3	21/11/14 3:05pm	Sediment	PSOIL container for Site
4				Tab 3.
5				
6				
7				
8				
9				
10				