Eastern Busway

EB2 and EB3 Residential

Contaminated Land Effects Assessment

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Eastern Busway

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Effects on the Environment
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
BPO	Best Practicable Option
CEMP	Construction Environmental Management Plan
CLMP	Contaminated Land Management Plan
CMA	Coastal Marine Area
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3 Commercial/ EB3C	Eastern Busway 3 (Pakuranga Creek to Botany)
EB3 Residential/ EB3R	Eastern Busway 3 (SEART to Pakuranga Creek)
EB4	Eastern Busway 4 (link between Ti Rakau Drive and Te Irirangi Drive, Botany Town Centre Station)
EBA	Eastern Busway Alliance
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
MCA	Multi Criteria Analysis
NES-CS	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NES-FW	Resource Management (National Environmental Standards for Freshwater) Regulations 2020
NPS - FM	National Policy Statement for Freshwater Management 2020
NPS - UD	National Policy Statement for Urban Development 2020
NZCPS	New Zealand Coastal Policy Statement 2010
NoR	Notice of Requirement
AUP(OP)	Auckland Unitary Plan (Operative in Part) 2016
PWA	Public Works Act 1981
RTN	Rapid Transit Network
RRF	Reeves Road Flyover
RMA	Resource Management Act 1991
SEART	South-Eastern Highway

Executive Summary

This technical report describes the assessment of contaminated land effects associated with the operation and construction of EB2 and EB3R. An Assessment of Environmental Effects (AEE) is required to supports the resource consent application for EB2 and EB3R. This report assesses land within EB2 and EB3R and identifies if resources consent is required under the NES-CS and AUP (OP). Based on the information reviewed as part of this assessment, two sites were identified within EB2 and EB3R where contamination may be encountered during construction activities as part of the EBA project, which are the following:

- Land and carriageway adjacent to 3 Reeves Road (EB2)
- Carriageway adjacent 11 Cortina Place (EB3R)

EB2

3 Reeves Road is currently occupied by an operating service station and therefore has been identified as having ongoing HAIL activities occurring on site. No previous environmental investigations detailing the state of groundwater and soil at 3 Reeves Road have been undertaken; therefore, as a conservative assumption it is reasonably likely for contamination to exist at 3 Reeves Road and migrating to adjacent land. The SSESCP indicated that approximately 250 m^3 of soil disturbance is required in the carriageway directly adjacent to the site for piling activities associated with the Reeves Road Flyover. Soil disturbance will likely exceed the permitted activity criteria for the NES – CS and AUP(OP) Chapter E30, therefore it is recommended discretionary consent should be sought for excavation activities occurring within the carriageway adjacent to 3 Reeves Road. Sampling within the carriageway and any potential effects to human health will be managed via a CLMP.

All remaining sites within EB2 identified as part of this assessment comply with the AUP(OP) permitted activity rules outlined in chapter E30 and the NES-CS.

EB3R

Residual hydrocarbons are reasonably likely to be found within the carriageway adjacent to the former service station at 11 Cortina Place, due to migration via groundwater from an identified HAIL site, therefore the NES – CS and AUP(OP) will apply to the carriageway. As soil disturbance volumes are unlikely to meet permitted activity criteria for both the NES – CS and the AUP(OP) Chapter E30, consent is sought for a discretionary activity for works. Sampling within the carriageway and any potential effects to human health will be managed via a CLMP.

All remaining sites within EB3R identified as part of this assessment comply with AUP(OP) permitted activity rules outlined in chapter E30 and the NES-CS.

1 Introduction

1.1 Overview of the Eastern Busway Project

The Eastern Busway Project (the Project) is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in southeast Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments. The Project includes:

- 5km of two-lane busway
- New bridge for buses across Pakuranga Creek
- Improved active mode infrastructure (walking and cycling) along the length of the busway
- Three intermediate bus stations
- Two major interchange bus stations.

The Project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the programme) which includes a dedicated busway and bus stations between Panmure, Pakuranga and Botany town centres. The dedicated busway will provide an efficient rapid transit network (RTN) service between the town centres, while local bus networks will continue to provide more direct local connections within the town centre areas. The Project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The programme includes the following works which are not part of the Eastern Busway Project:

- Panmure Bus and Rail Station and construction of Te Horeta Road (completed)
- Eastern Busway 1 (EB1) – Panmure to Pakuranga (completed)

The Eastern Busway project consists of the following packages:

- Early Works Consents – William Roberts Road (WRR) extension from Reeves Road to Ti Rakau Drive (LUC60401706); and Project Construction Yard at 169 – 173 Pakuranga Road (LUC60403744).
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station **(this Assessment)**
- Eastern Busway 3 Residential (EB3R) – Ti Rakau Drive from the South-Eastern Arterial (SEART) to Pakuranga Creek, including Edgewater and Gossamer Intermediate Bus Stations **(this Assessment)**
- Eastern Busway 3 Commercial (EB3 Commercial) – Gossamer Drive to Guys Reserve, including two new bridges, and an offline bus route through Burswood
- Eastern Busway 4 – Guys Reserve to a new bus station in the Botany Town Centre, including a link road through Guys Reserve.

The overall Project is shown in **Figure 1** below.

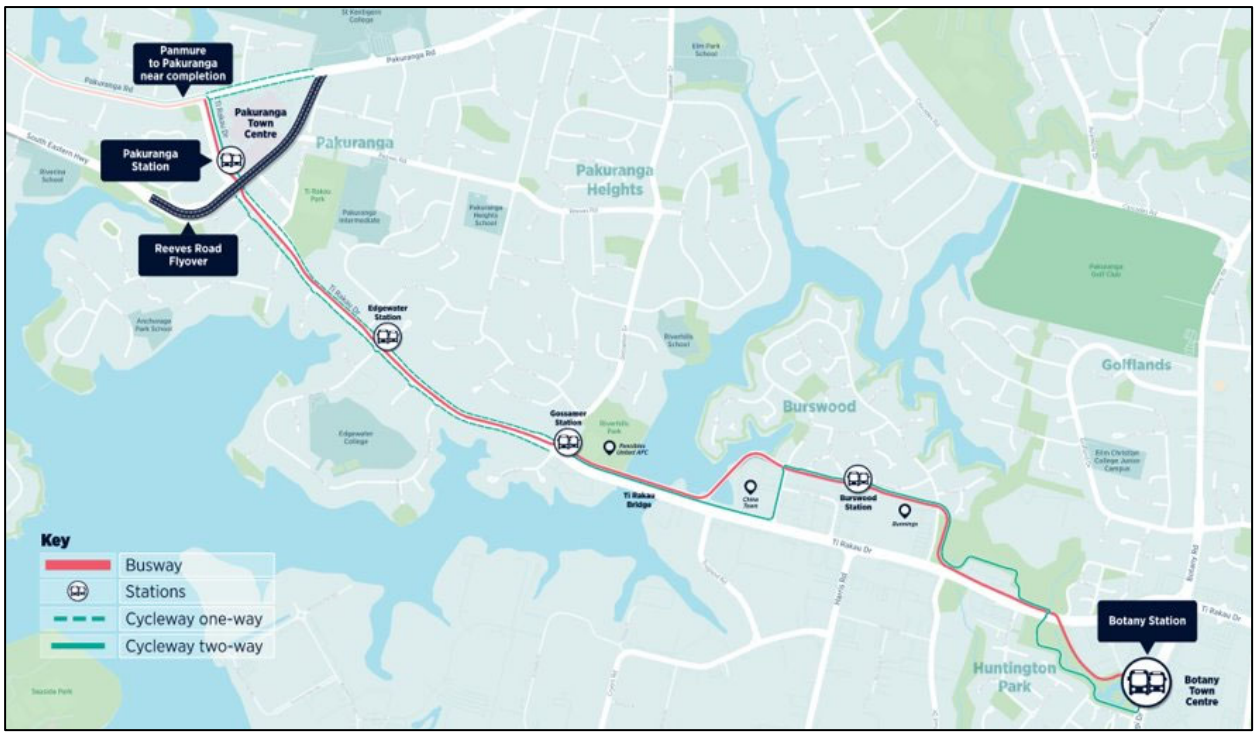

Figure 1. Project alignment

1.2 Project Objectives

The Project Objectives are:

1. Provide a multi modal transport corridor that connects Pakuranga and Botany to the wider network and increases access to a choice of transport options
2. Provide transport infrastructure that integrates with existing land use and supports a quality, compact urban form
3. Provide transport infrastructure that improves linkages, journey time and reliability of the public transport network
4. Contribute to accessibility and place shaping by providing better transport connections between, within and to the town centre
5. Provide transport infrastructure that is safe for everyone
6. Safeguard future transport infrastructure required at (or in vicinity of) Botany Town Centre to support the development of a strategic public transport connection to Auckland Airport.

The Project Objectives have been considered in relation to this assessment, with those particularly relevant to the assessment being Objective 2, given the potential for the disturbance of contaminated material to adversely affect existing land uses.

2 Proposal Description

The below is a summary of the works proposed within the EB2 and EB3R packages. Refer to the AEE for additional detail on the works proposed.

2.1 Eastern Busway 2

The EB2 section of the Project commences from the intersection of Ti Rakau Drive and Pakuranga Road, connecting with EB1, and traverses east along Ti Rakau Drive to the intersection of SEART. The north-south extent of EB2 is between SEART and Pakuranga Road along Reeves Road and William Roberts Road. The main components of EB2 are described below.

2.1.1 Busway and Pakuranga Town Centre Bus Station

A segregated dedicated two-way busway is proposed along Ti Rakau Drive to provide prioritised access for bus services between Pakuranga Town Centre and Botany. From Pakuranga Road to SEART, the busway will run on the northern side of Ti Rakau Drive.

The proposed Pakuranga bus station is a key facility for services running to and from the Panmure Station Interchange, Howick, Highland Park, Eastern Beach, Bucklands Beach and Sunnyhills. The bus station will be located along the northern side of Ti Rakau Drive, on land currently occupied for Pakuranga Plaza and 26 Ti Rakau Drive. The bus station will feature two platforms and will contain a mixture of street furniture and structures, including bus shelters, electronic messaging signage and seating. New proposed pedestrian crossings will provide connections to the bus station and Pakuranga Plaza. Modifications to the Ti Rakau Drive median strip, landscaping, and general traffic lane reconfiguration will enable safe and efficient bus movement for the busway once it becomes operative.

2.1.2 Reeves Road Flyover (RRF)

The RRF will provide two general traffic lanes in each direction connecting SEART to Pakuranga Road, to reduce local traffic congestion along Pakuranga Road and Ti Rakau Drive. The RRF will start opposite Paul Place Reserve, pass over Ti Rakau Drive and Reeves Road, before finishing at a new intersection with Pakuranga Road. Traffic lanes for the RRF will be elevated and run through the centre of SEART, requiring the relocation of the SEART off-ramp to the north of the existing off-ramp.

2.1.3 Walking and Cycling Facilities

EB2 includes improvements to active transport infrastructure and connections. This includes a new cycleway, improved footpaths, and new pedestrian crossings. These works will improve the safety and connectivity of walking and cycling links across Pakuranga Town Centre.

2.1.4 Supporting Works

A range of works will be undertaken in support of the EB2 package. This includes the relocation of network utility services, new street lighting, earthworks, removal of vegetation, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

2.2 Eastern Busway 3 Residential

The EB3R section of the busway is a continuation of EB2 from the intersection of SEART and Ti Rakau Drive, with the proposed dedicated busway proceeding centrally along Ti Rakau Drive towards Gossamer Drive and Riverhills Park in the east. EB3R will largely occur within land vested as road or land currently owned by Auckland Transport. The construction of EB3R will take a staged approach to minimize disruption to the existing road network and its users. The main components of EB3R have been described below.

2.2.1 Edgewater and Gossamer Intermediate Bus Stations

EB3R includes two intermediate bus stations on Ti Rakau Drive, located within the vicinity of Edgewater Drive and Gossamer Drive. Both stations will have separate platforms for eastbound and westbound bus movements. A range of street furniture and structures will also be constructed, such as modular bus shelters pedestrian linkages, electronic messaging signage, seating and cycling storage facilities.

2.2.2 Western Bridge Abutment

EB3R includes construction of the western bridge abutment for a new future bridge across Pakuranga Creek. The abutment will be located within the area that is currently the south-eastern section of Riverhills Park. Only the bridge abutment is included in the EB3R package of works. The remaining parts of the bridge will form part of the EB3C approval package.

2.2.3 Walking and Cycling Facilities

Provision has been made for walking and cycling along the route of EB3R. This includes footpaths and uni-directional cycleways located on either side of Ti Rakau Drive from SEART to Gossamer Drive. Signalised pedestrian crossings will be provided at key intersections along Ti Rakau Drive, including adjacent to the proposed Edgewater bus station.

2.2.4 Associated changes the road network

The proposed changes to the road network include lane arrangement and intersection reconfigurations and changes to the parking arrangement and access to Edgewater Drive Shops. Changes are also proposed to the access arrangements for residential properties along the EB3R alignment. New westbound lanes for general traffic will be established within the land which has been acquired by Auckland Transport and will be vested as road once it becomes operative, as the busway alignment replaces the existing westbound lanes.

2.2.5 Supporting Works

A range of works will be undertaken in support of the EB3R package. This includes the relocation of network utility services, new street lighting, removal of vegetation, earthworks, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

3 Specialist Assessment

Chapter Summary
• *The purpose of this report is to inform the AEE relating to the Notice of Requirement (NoR), required regional consents and consents required under National Environment Standards for EB2; the AEE and district and regional consents applications for EB3R, including the identification of the ways in which any adverse effects will be mitigated.* • *The excavation volumes for the project are detailed in the Erosion and Sediment Control Effects Assessment.* • *Both the NES-CS and AUP(OP) are relevant to EB2 and EB3R due to soil disturbance activities occurring.*

3.1 Assessment Content

This report is a review and assessment of contaminated land effects associated with the operation and construction of EB2 and EB3R packages of the Eastern Busway project.

Its purpose is to inform the AEE relating to the Notice of Requirement (NoR), required regional consents and consents required under National Environment Standards for EB2; the AEE and district and regional consents applications for EB3R, including the identification of the ways in which any adverse effects will be mitigated.

This contaminated land assessment:

- Assesses whether sites within EB2 and EB3R have been subject to contaminating activities (if applicable) including the location(s) and type(s) of these activities
- Assesses the potential significance of the identified sources and the potential implications in relation to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)[1]
- Provides general commentary on AUP (OP) rules in relation to contamination
- Provides a general assessment of the potential effects of works within EB2 and EB3R on human health and the environment, and the potential mitigation measures to avoid, remedy or mitigate those effects (in relation to contamination effects)

This contaminated land assessment involves the:

- Review and assessment of previous environmental investigations in the vicinity of EB2 and EB3R
- Review of publicly available historical aerial photographs
- Review of Auckland Council (AC) contaminated land enquiry
- Assessment of the potential extent of contamination present/not present, specifically in relation to EB2 and EB3R
- Identification of suitable disposal locations for the removed soil, if required, as part of a Contaminated Land Management Plan (CLMP).

[1] MfE, 2011 – National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health.

This report has been completed in general accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guidelines No. 1, 'Reporting on Contaminated Sites in New Zealand', Revised 2021[2].

3.2 Specific Project Elements

The Erosion and Sediment Control Effects Assessment[3] (ESCEA) details areas within the proposed EBA packages where excavation during works is required.

3.2.1 EB2 Package

It is understood that the approximate total volume of excavation in the EB2 package is 52,000 m^3, which comprises of 30,000 m^3 of cut and 22,000 m^3 of fill.

As part of the EB2 package, a Flyover (RRF) along Reeves Road is proposed, which runs from the South-Eastern Arterial (SEART) to Pakuranga Road. Excavation for piling will be required along Reeves Road for which approximately 250 m^3 of soil disturbance will be required for each pile.

3.2.2 EB3R Package

It is understood that the approximate total volume of excavation in the EB3R package is 52,000 m^3, which comprises of 20,000 m^3 of cut and 32,000 m^3 of fill.

Approximately 1150 m^3 of proposed excavation is required for removal and replacement of pavement surfaces within the site directly south of 11 Cortina Place. The area comprises of 1,350 m^2 in the carriageway and 2,050 m^2 in the residential area south of Ti Rakau Drive (an area of approximately 3,400 m^2 in total). Further, approximately 150 m^3 of material will be required to be disturbed for stormwater service trenches and approximately 100 m^3 for the common services trench on the southern side of Ti Rakau Drive. In total for the works south of Cortina Place approximately 1,400 m^3 of material will be disturbed as part of the proposed works over a total area of 3,400 m^2.

It should be noted that these are approximate volumes given at the time of reporting.

3.3 Regulatory Requirements

As part of this assessment, consent may be required under the NES-CS and AUP(OP) if a piece of land disturbed as part of works within EB2 and EB3R has been subject to HAIL activities.

3.3.1 NES-CS

The NES-CS is designed to ensure that the land affected by contaminants in soil is appropriately identified and assessed when particular activities are undertaken, such as soil disturbance (Regulation 5(4)), and that the effects of activities occurring on a piece of land that may cause risk(s) to human health are managed (Regulation 5(7)).

Regulation 5 (7) of the NES-CS describes land subject to the Regulations as:

> *(7) the piece of land is a piece of land that is described by 1 of the following:*

[2] MfE, 2011 – Contaminated land management guidelines No 1, Reporting on contaminated sites in New Zealand. Revised 2021.
[3] Site Specific Erosion and Sediment Control Plan, Eastern Busway Alliance

(a) an activity or industry described in the Activities and Industries List (HAIL) is being undertaken on it
(b) an activity or industry described in the HAIL has been undertaken on it
(c) it is more likely than not that an activity or industry described in the HAIL is being or has been undertaken on it.

The Ministry of Environment (MfE) has developed the HAIL[4], which is a compilation of activities and industries that are considered likely to cause land contamination resulting from hazardous substance use, storage, or disposal, both currently and historically. The HAIL is intended to identify activities or industries where hazardous substances have the potential to cause soil and groundwater contamination. The HAIL groups similar industries together, which typically use or store hazardous substances that could cause contamination if these substances escaped from safe storage, were disposed of on the site, or were lost to the environment through use. If the proposed activity is on, or intersects with, a piece of land that currently has, or has had, a HAIL activity on it, then the NES-CS applies. Regulation 3 categorises certain land uses within the HAIL. Pertinent to this assessment is HAIL category H for adjacent sites. Category H is defined as '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'.

3.3.2 Auckland Unitary Plan – E30 Contaminated Land

This section of the AUP(OP) addresses the effects of the discharge from contaminated land or land containing elevated levels of contaminants into air, or into water, or into land under section 15 of the Resource management Act 1991. Chapter E30 of the AUP(OP) is relevant to EB2 and EB3R due to the potential discharges associated with soil disturbance that may liberate contaminants.

This assessment supports the resource consent applications and obligations under the NES-CS and Chapter E30 (of the AUP(OP)) for any HAIL sites identified within the EB2 and EB3R work areas.

[4] *Hazardous Activities and Industries List (HAIL).* Ministry for the Environment, October 2011

4 Methodology

Chapter Summary
• *To meet the contaminated land assessment objectives, previous environmental investigation reports, historical aerial photographs, and an Auckland Council (AC) site contamination enquiry report were reviewed.*

As part of this report previous environmental investigation reports, historical aerial photographs, and an Auckland Council (AC) site contamination enquiry report were reviewed. Impact from previous and/or current HAIL activities identified and recommendations in previous investigations were then taken into consideration to provide a general assessment of the potential effects of the work, and the potential mitigation measures to avoid, remedy or mitigate those effects (in relation to contamination effects).

4.1 Previous Environmental Investigations

Environmental investigation reports available for sites with HAIL activities within EB2 and EB3R have been reviewed as part of this assessment to determine if they have been subject to contaminating activities. The available previous environmental investigation reports are included in **Appendix A.**

4.2 Aerial Photographs

A review of publicly available historical aerial photographs has been conducted in the vicinity of EB2 and EB3R, to identify historical or current HAIL sites not identified in previous environmental investigations. Historical aerial photographs were reviewed from the Retrolens Historical Image Resource[5], Auckland Council's GeoMaps online portal[6] and Google Earth Pro online services[7] in conjunction with Google Maps[8].

Copies of available historical aerial photographs are included in **Appendix B.**

4.3 AC Contamination Enquiry

Information received from an AC site contamination enquiry report, based on records and information currently held by AC's Natural Resources and Specialist Input Unit Records was reviewed. This includes data on landfill bores, air discharge, industrial and trade process consents and environmental assessments within the boundaries of EB2 and EB3R. A copy of the AC contamination enquiry and relevant environmental reports are included in **Appendix C** and **Appendix D**.

[5] https://retrolens.co.nz accessed 11 November 2021
[6] https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html accessed 11 November 2021
[7] Goggle Earth Pro accessed 11 November 2021
[8] https://www.google.com/maps accessed 11 November 2021

5 Existing Environment – Eastern Busway 2

Chapter Summary
• *Based on the information reviewed, there are eight sites within EB2 where HAIL activities were identified, and asbestos was confirmed to be present in the Seven Oaks Drive residential area.*

5.1 Previous Environmental Investigations

To assess the features and values potentially impacted by the proposal, a review of previous environmental investigations in the vicinity of EB2 has been undertaken. The following reports were reviewed and are summarised below:

- Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), June 2000
- Phase 1 PSI for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment, prepared by GHD Limited (GHD), 7 December 2012
- Previous Investigation at 3 Kentigern Close:
    - Tank Removal TR07/774, Site No 002021, Pattle Delamore Partners Limited (PDP) – August 2008
    - Environmental Site Assessment (ESA) (Stages 1 & 2), Fraser Thomas Limited – August 2009.
- Data Gap Analysis, Environmental Sampling (AECOM) – 2018
- Asbestos sampling (AECOM) – 2021.

5.1.1 Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.

During GHD ‘s 2000 Landfill Assessment Report, the closed landfills throughout the Manukau City region were reviewed to ensure the necessary resource consents were in place. From information provided by the Manukau City Council (MCC), historical records revealed that 39 closed landfill sites existed within the MCC owned property. GHD evaluated each site to determine the potential for adverse environmental effects to clarify which sites may require resource consents from Auckland Council (previously known as Auckland Regional Council (ARC)).

The assessment was carried out based on the following key criteria:

- Age of the landfill
- Type of fill
- Leachate discharge
- Proximity to water courses
- Hydraulics, water level and rainfall
- Leachate toxicity risk factor (LRF).

During the assessment, GHD used the LRF as one of the key indicators for identifying sites that may pose significant risk to the environment and may require resource consent for discharge of leachate. The LRF is the measured concentrations of contaminants in the leachate expressed as a ratio of relevant standards or guidelines to assess the relative risks to the environment from the landfill discharges. In the case of this report, GHD used the following five parameters for the ratio: cadmium, chromium, lead, ammonia-nitrogen, and total nitrate levels.

The investigation and monitoring were carried out in accordance with the Australia and New Zealand Environmental and Conservation Council (ANZECC) guidelines for contaminated sites, leading to more targeted and detailed investigations on those sites that required further work. Preliminary investigations involved a screening process in which surface water and groundwater samples were collected from selected sites between August 1994 and November 1996.

Following the screening process, GHD selected high priority landfills based on the key indicators, with subsequent groundwater bores installed on sites between December 1995 and February 1996. GHD monitored landfill gases during drilling to ensure the concentrations were lower than the lower explosive limit (LEL), the concentration of gas required to support combustion. At no times did the gas levels recorded in any bore exceed the LEL.

Further details on the investigation methodology are included in the report included in full in **Appendix A.**

From the sites evaluated in the report, Dale Crescent Reserve was identified as a closed landfill within EB2.

The key findings and conclusions of the assessment relevant to EB2 are as follows:

- There was no record of any landfills having a specifically engineered clay cap, liner and or base. Anecdotal evidence suggests that the landfills were established on top of existing ground, which was confirmed during the drilling of the groundwater bores
- All landfills were generally underlain to a variable depth and with variable quality of silt or clay type medium of unknown permeability
- None of the landfills within EB2 had a leachate collection system installed during infilling
- The fill type at Dale Crescent was listed as cleanfill and gravel[9]
- The site is approximately 100 m from the nearest watercourse (Tāmaki River)
- Four bores were advanced at Dale Crescent. During bore drilling, soil materials consisted of gravel, silt and clay to depths between 1 and 1.25 m bgl. Groundwater was intercepted at depth greater than 2 m bgl
- Dale Crescent was given an LRF of 7.5[10], above the maximum acceptable value (MAV) of 5. It was noted the ammonia levels and landfill gases at this site were higher than most of the others evaluated. This was surprising given no refuse was found during drilling, although bore logs indicated there may have been organic material beneath the fill during earthworks operations, which may have influenced leachate concentrations and gas emissions. GHD concluded that considering Dale Crescent was filled with cleanfill and gravel only and is not in close proximity to any watercourses, any environmental risk from the site is considered to be not significant and should be excluded from any need for resource consent.

5.1.2 Phase 1 PSI for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment, prepared by GHD Limited (GHD), dated 7 December 2012.

During their 2012 assessment, GHD reviewed packages EB2, EB3R, EB3C and EB4, areas previously referred to as Packages 3 & 4 by the assessment. The purpose of the PSI was to support AT in meeting the requirements of the NES-CS as it applies to 'a piece of land'. As such, the objective of the PSI was to

[9] Table 8, Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.
[10] Table 9, Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.

assess the likelihood of the presence of soil contamination resulting from historical and/or current land use activity within or adjacent to the EBA packages.

The PSI comprised of a review of information from the following sources:

- Draft alignment plans as of October 2012 developed by GHD/Aurecon
- Selected publicly available historical aerial photographs from 1940 to 2010
- Collection of photographs as part of a walkover conducted on 26 September 2012
- AC contaminated sites register
- AC groundwater borehole register
- Readily available site investigation reports resulting from site register search
- Readily available geology and hydrogeology information
- Publicly available information on the environmental fate of contaminants
- Identification of sensitive human and/or environmental receptors.

GHD presented the following key findings and conclusions relevant to EB2:

- Along the length of the EBA packages there are a number of geological units present with the most prominent being rhyolitic pumiceous deposits of the Tauranga Group Engineered construction fill (likely comprising re-compacted clay/gravel and may include construction and demolition wastes) is noted in a large complex between Ti Rakau Drive and Pakuranga Road
- A site contamination enquiry was completed, seeking records from AC. Numerous items were identified including pollution incidents, records of discharge consents, submittal of an environmental site assessment (ESA) reports for a service station facility, and borehole installation records for environmental monitoring or investigation purposes at two sites (one service station and one chemical supplier facility)
- A walkover identified no sensitive receptors in close proximity to the EBA packages
- GHD identified seven HAIL sites along EB2. The report stated that, given significant soil will be disturbed along the EBA packages the regulations of the NES-CS apply on the basis of HAIL category H adjacent sites. Category H is defined as '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'. The identified HAIL sites are detailed in **Table 1** below.

Table 1- Summary of HAIL Sites within EB2 (GHD 2012)

Site Name	Landuse Activity	HAIL Category
3 Kentigern Close / 102 Pakuranga Road	Former service station, now a commercial complex	F7 – Service stations including retail or commercial refuelling activities
141 Pakuranga Road	Service station	F7 – Service stations including retail or commercial refuelling activities
Pakuranga Plaza, Aylesbury Street, Pakuranga Town Centre	New Zealand Dry Cleaners	A5 – Dry-cleaning plants including dry-cleaning premises or the bulk storage of dry-cleaning solvents
12 Cortina Place*	Pakuranga Panel Beaters	F4 – Motor vehicle workshops
16 Cortina Place*	Pakuranga Automotive	F4 – Motor vehicle workshops
16D Cortina Place*	Pakuranga Auto Transport	F4 – Motor vehicle workshops
3 Reeves Road	Service station	F7 – Service stations including retail or commercial refuelling activities

*Note: Indicates sites detailed in the William Roberts Road Extension Contaminated Land Technical Report.

5.1.3 Previous Investigation at 3 Kentigern Close

A timeline of investigations at the former service station located at 3 Kentigern Close is presented below. The reports are attached in full in **Appendix A**.

Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland – Tank Removal TR07/774, Site No 002021, Pattle Delamore Partners Limited (PDP) – August 2008.

The scope of work included the removal of 4 x Underground Storage Tanks (USTs), which comprised of 1 x 40,00 L diesel UST, 3 x 40,000 L petrol USTs, associated pipework, dispensers and vents removed from the former Mobil Pakuranga. A total of nineteen test pits were also excavated in order to assess soil quality in the vicinity of the Underground Petroleum Storage System (UPSS) components, in locations where historic USTs were thought to be located and in areas where a mechanics workshop may have historically been located.

In their report, PDP noted no obvious petroleum hydrocarbon staining was observed in the bedding material during the removal of the UPSS. Visual and olfactory evidence of hydrocarbon contamination was noted within soils excavated during test pitting activities. PDP reported that a total of 143 tonnes of petroleum hydrocarbon impacted material was removed from site and disposed of at a licensed facility for contaminated waste.

All soil samples collected from the site returned concentrations of total petroleum hydrocarbon (TPH) and benzene, toluene, ethylbenzene and xylenes (BTEX) below the Oil Industry Guidelines Tier 1 Soil Acceptance Criteria via All Pathways for commercial/industrial land use.

Three soil samples taken from the tank pits were analysed for Heavy Metals. The reported concentrations were all below the AC Permitted Activity Criteria and the Auckland Background Concentrations (Volcanic).

PDP concluded that no resource consent was required for the residual soil concentrations at the site.

102 Pakuranga Road, Manukau City, Environmental Site Assessment (ESA) (Stages 1 & 2), Fraser Thomas Limited (Fraser Thomas) – August 2009.

In their 2009 ESA, Fraser Thomas assessed and investigated any actual or potential site contamination issues as a result of previous uses of the site at 102 Pakuranga Road.

During their ESA, Fraser Thomas noted that the 2008 tank removal report from PDP had been reviewed by ARC and that a Certificate of Compliance (CoC) had been issued. However, Fraser Thomas highlighted that the site had been refurbished in 1989, with works including the demolition and removal of existing buildings, USTs and fuel pumps. It was understood that a tank removal report was not prepared for these activities and a site investigation with soil sampling was not conducted. The ESA indicated that no test pit investigation, soil sampling or groundwater sampling had occurred in the location of two large historical USTs shown in the 1989 Mobil Demolition Plan. In order for the site owners to obtain a CoC, Fraser Thomas completed a test pitting programme and installed groundwater sampling piezometers in the vicinity of the historical USTs. Soil and groundwater samples were collected to determine heavy metal, TPH and BTEX concentrations and the presence of separate phase hydrocarbons was checked in the piezometers.

Fraser Thomas presented the following results from their soil and groundwater ESA:

- Petroleum hydrocarbon concentrations from soil samples collected did not exceed the Proposed Auckland Regional Plan for Air, Land and Water (PARP: ALW 2008) Tier 1 guidelines
- All Heavy Metal concentrations in soil samples collected met the permitted activity criteria listed in schedule 10 of the PARP: ALW (2008)
- Groundwater sampling indicated that contamination of groundwater at the site was not occurring. The groundwater sampling results confirmed that the environmental effect of the hydrocarbons noted in excavations to the south and east of the forecourt are less than minor and have not impacted groundwater.

In conclusion, Fraser Thomas determined that based on the evidence presented in both the PDP 2008 tank removal report and their 2009 ESA, the site was deemed to meet permitted activity criteria as detailed in the PARP: ALW (2008).

5.1.4 Environmental Sampling (AECOM) – 2019

In 2019, following recommendations of the 2012 PSI completed by GHD (section 5.1.2), AECOM undertook a Gap Analysis in support of the application for resource consents associated with soil disturbances for the proposed alignment. The Gap Analysis identified areas where further investigation was required. Between February 2019 and April and August 2019, six boreholes (advanced for geotechnical purposes) and thirty-three environmental hand augers were completed within the wider EBA works, of which fourteen soil samples were collected from eight hand augers and one borehole within EB2 at depths between 0.1 and 1.3 m bgl.

Samples were analysed for the following contaminants:

- Heavy metals
- Total petroleum hydrocarbons (TPH)
- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)
- Polycyclic aromatic hydrocarbons (PAHs)

The environmental assessment focussed on the collection of soil samples for laboratory analysis from materials within anticipated areas of soil disturbance. The analytical results from samples collected from locations within the EB2 package are presented in **Table A1** in **Appendix A**. Soil samples were analysed for contaminants associated with the HAIL activities at or in the vicinity of the EB2 package (listed in **Table 2** below). The investigation locations relevant to the EB2 package are presented in **Figure 2** below.

The Data Gap Assessment is included in section 3.0 of the Draft Environmental Assessment in **Appendix F.**

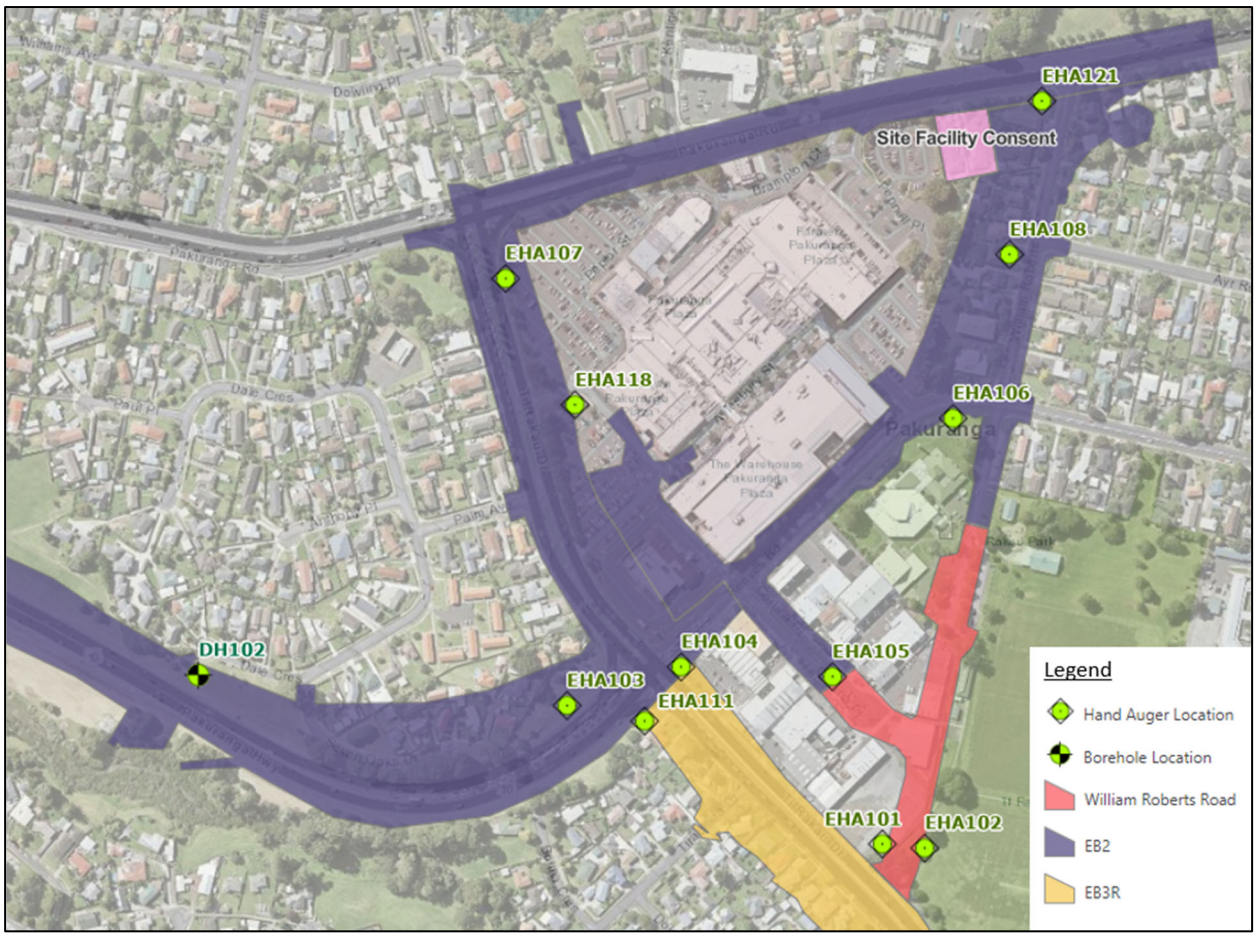

Figure 2: 2018 Environmental Investigation Locations within EB2.

Table 2 - Summary of sample locations from 2018 Environmental Investigation

Sampling Location	Rationale	Sampling Location	Rationale
EHA103	Area of proposed soil disturbance	EHA107	Area of proposed soil disturbance
EHA104	Area of proposed soil disturbance	EHA108	Area of proposed soil disturbance
EHA105	Pakuranga Panel Beaters (12 Cortina Place)	EHA118	Near Former New Zealand Dry Cleaners (Pakuranga Plaza)
EHA106	Area of proposed soil disturbance	EHA121	Area of proposed soil disturbance

A summary of the soil analytical results in EB2 is as follows:

- All analytical results were below criteria for NES-CS, Oil Industry Guidelines and Permitted Activity Criteria
- All TPH, BTEX and SVOC concentrations were below the laboratory limit of reporting (LOR
- Minor concentrations of PAHs were recorded at EHA106 at a depth of 0.5 m below ground level (bgl), however concentrations were below all of the relevant benchmarking criteria. All other samples analysed for PAHs were below the laboratory LOR
- Heavy Metal concentrations from all sample analytical results were below the Auckland Background Concentrations (non-volcanic), with the exception of a surface sample collected at EHA107, which was above the Auckland Background Concentrations for lead.

5.1.5 Asbestos sampling (AECOM) - 2021

During geotechnical works associated with EB2 in October 2021, an AECOM staff member discovered possible fragments of Asbestos Containing Materials (ACM). The material was collected at a depth of 1 m bgl by a public walkway at the end of Seven Oaks Drive (a residential area in Pakuranga). The fragments were double bagged and sent to Hill Laboratories for analysis, which confirmed the presence of ACM. Following the discovery of ACM, AECOM abandoned the geotechnical works in the area of Seven Oaks Drive. The lab report and photographs of the sample location are included in **Appendix E**.

5.1.6 1R Dale Crescent, Soil Quality Assessment, EBA, March 2022.

The Soil Quality Assessment was completed as part of a land transfer from Waka Kotahi to Auckland Council to better understand soil quality at 1R Dale Crescent. The Site is understood to contain fill material deposited during the construction of the Pakuranga Highway and therefore identified as a closed landfill site. Works included the advancement of five test pits to 2.0 m bgl from which twelve soil samples were submitted to Hill laboratories for analysis of the following:

- Two shallow soil samples considered to be representative of shallow fill materials were analysed for asbestos (using the BRANZ Guidelines for Semi Quantitative Asbestos in Soil analysis methodology)
- Five soil samples taken from between 0.2 m bgl and 1.8 m bgl were analysed for heavy metals
- Five soil samples were analysed for TPH from between 0.5 m bgl and 2.0 m bgl
- Two soil samples were analysed for SVOCs from between 0.4 m bgl and 0.75 m bgl.

The following field observations were noted during excavation of the test pits:

- Soil primarily comprised of clays, silts and sand
- A metal fragment was observed in TP4 however, no other refuse was discovered during the remaining excavation
- Soil headspace VOC concentrations in bagged samples ranged between 0.0 ppm and 2.0 ppm
- No visual or olfactory evidence of impact was noted in soil samples collected from the test pits
- No fragments of potentially asbestos containing material (ACM) were noted in any of the fill material within the test pits
- Groundwater was not encountered during excavation at TP1-TP4. Groundwater was encountered at 1.6 m bgl at TP5.

Analytical results from the samples collected from TP1-5 are summarised below:

- Analytical results from samples collected from TP1 (at a depth of 1.8 m bgl) returned copper and chromium concentrations above the Auckland Background Concentrations (non-volcanic), however results were below criteria for the NES–CS and AC Permitted Activity Criteria
- Samples collected from TP2-5 returned heavy metals concentrations consistent with Auckland Background Concentrations, with the exception of samples EBA_TP3_0.4 and EBA_TP4_0.0-0.15 returning nickel concentrations above Auckland Background Concentrations
- Minor hydrocarbons were detected in samples EBA_TP1_2.0 and EBA_TP5_1.5, however concentrations were below Oil industry Guidelines
- All samples returned results below the NES–CS and AC Permitted Activity Criteria
- Samples collected from TP2 and TP4 returned concentrations of SVOCs below the laboratory LOR.

A copy of the report is included in full in **Appendix H.**

5.2 Aerial Photographs

Historical and current aerial photographs were obtained through the AC GeoMaps online portal, the Retrolens online portal and Google Maps. A review of aerial photographs was undertaken for the period 1939 through to the present day. This allowed for the determination of land use changes and the identification of any pertinent items that have become apparent since the PSI in December 2012, but also to allow for the identification of any pertinent land uses that may have been omitted during the development of previous environmental investigations. The aerial photographs are included in **Appendix B**.

The review of aerial photographs highlighted the following key items:

- Much of the land is undeveloped farmland in the 1939 aerial photograph, with the exception of multiple residential dwellings and ancillary farm buildings
- Development of Pakuranga Plaza and surrounding commercial/residential buildings occurred sometime between 1939 and 1968
- A building has been constructed at 141 Pakuranga Road between 1939 and 1968, however the landuse isn't clear. Google Street View indicates the site was developed into a service station sometime prior to 2008
- There is a building located at or within the vicinity of 3 Kentigern Close in the 1968 aerial photograph. The 1996 aerial photograph indicates the site was redeveloped sometime between 1988 and 1996. The 2010 aerial photograph indicates that some of the structures seen in the 1996 aerial are still present, however exposed soils in the northwest corner of the site indicate excavation has occurred in the site and a structure has been removed in the northern portion of the site. The 2015 aerial photograph indicates the site was redeveloped sometime between 2010 and 2015
- Infilling for Highway 10 southwest of Ti Rakau Drive begun between 1968 and 1972, with a number of residential buildings removed around the Dale Crescent / Paul Place Reserve for the development. Land has been reclaimed south of Highway 10 on an inlet of the Tāmaki River. Dale Crescent / Paul Place reserve have been filled during the works
- A building located at 12 Cortina Place is present in the 1968 aerial photograph
- On the 1972 aerial photograph buildings are present at 16 and 16D Cortina Place. The buildings have been constructed sometime between 1968 and 1972
- A large, grassed area visible northwest of Dale Crescent / Paul Place Reserve, in the 1972 aerial photograph, has been replaced with residential housing in the 1980 aerial photograph
- Highway 10 appears to be complete in the 1980 aerial photograph
- The building located at 13 Cortina Place is no longer present in the 2017 aerial image. The site is currently a carpark.

5.3 Auckland Council Contamination Enquiry

The following details the information received from the AC contamination enquiry in relation to EB2:

- There is one closed landfill site within EB2, located at Dale Crescent (1R Dale Crescent, Pakuranga. The site is detailed as previously being used for cleanfill disposal
- A 2008 tank removal report and 2009 ESA pertaining to the former service station located at 3 Kentigern Close

A copy of the AC contamination enquiry is included in **Appendix C.**

5.4 EB2 Package Summary

Based on the information reviewed, there are eight sites within EB2 where HAIL activities were identified, and asbestos was confirmed to be present in the Seven Oaks Drive residential area. These sites are summarised in **Table 3** and the potential for contamination to be encountered is detailed in the following sub-sections. It should be noted sites identified within the William Roberts Road extension have not been detailed in the following subsections. For further details on those sites, refer to the William Roberts Road Extension Contaminated Land Technical Report in **Appendix D**.

Table 3 - Summary of findings within EB2.

Site Name/Location	Landuse Activity	HAIL Category	Comments
3 Kentigern Close / 102 Pakuranga Road	Former service stations, now a commercial complex	F7 – Service stations including retail or commercial refuelling activities	Site investigated. No contamination encountered.
Pakuranga Plaza, Former New Zealand Dry Cleaners	Former dry cleaner	A5 – Dry-cleaning plants including dry-cleaning premises or the bulk storage of dry-cleaning solvents	No soil disturbance planned at or adjacent to this location.
Dale Crescent/Paul Place Reserve	Closed landfill site	G3 – Landfill sites	Site investigated. No contamination encountered.
141 Pakuranga Road	Service station	F7 – Service stations including retail or commercial refuelling activities	No soil disturbance planned at or adjacent to this location.
3 Reeves Road	Service station	F7 – Service stations including retail or commercial refuelling activities	No site investigation. Potential for migration of contaminants into area of soil disturbance within EB2.
12 Cortina Place*	Pakuranga Panel Beaters	F4 – Motor vehicle workshops	Addressed in William Roberts Road Extension Contaminated Land Technical Report.
16 Cortina Place*	Pakuranga Automotive	F4 – Motor vehicle workshops	
16D Cortina Place*	Pakuranga Auto Transport	F4 – Motor vehicle workshops	

*Note: Indicates sites detailed in the William Roberts Road Extension Technical Report

5.4.1 3 Kentigern Close

As detailed in **Section 5.1.3** this site is the location of a former service station. Investigations in 2008 and 2009 identified there was no impact to soil or groundwater from contaminants and the site met the permitted activity criteria under the former PARP: ALW (2008). Therefore, this site is considered unlikely to be a significant source of contamination during the EB2 works.

5.4.2 Former New Zealand Dry Cleaners

The 2012 PSI[11] identified New Zealand Dry Cleaners as a site with HAIL activities within EB2. The New Zealand Dry Cleaners is no longer present at the site. Planned soil disturbance works for EB2 are considered to be a sufficient distance from the Former New Zealand Dry Cleaners site and therefore impact to soil to be disturbed is considered unlikely.

[11] GHD Limited, 2012, Phase 1 PSI for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment, dated 7 December 2012.

5.4.3 Dale Crescent

The 2000 Landfill Assessment Report identified this site as a closed landfill. The investigation indicated no refuse was discovered during intrusive activities and the site was recorded as filled with cleanfill materials. From onsite monitoring, elevated leachate and landfill gas levels were noted, however, bore logs indicated this may have been caused by naturally occurring organic material beneath the cleanfill. GHD concluded that any environmental risk from the site is considered to be not significant and should be excluded from any need for resource consent.

In 2018, AECOM collected soil samples from Dale Crescent (DH102) and analysed for Heavy Metals and pesticides. All concentrations of Heavy Metals returned results in accordance with Auckland Background Concentration (non-volcanic range). All concentrations of SVOCs returned results below the laboratory LOR.

Twelve soil samples were collected from five test pits across Dale Crescent as part of a 2022 Soil Quality Assessment. Minor concentrations of copper, chromium and nickel were detected in soil samples above Auckland Background Concentration (non-volcanic), however all samples collected returned results below the NES – CS, AC Permitted Activity Criteria and the Oil Industry Guidelines.

As per the ESCEA, Dale Crescent is an area of potential cut and fill. From the information reviewed above, this site is unlikely to be a significant source of contamination.

5.4.4 141 Pakuranga Road

This site was identified in the 2012 PSI as a service station. Planned soil disturbance works for EB2 are considered to be a sufficient distance from the service station and therefore impact to soil to be disturbed is considered unlikely.

5.4.5 3 Reeves Road

GHD identified the service station as a site with HAIL activities in their 2012 PSI. A request to the AC contaminated land team returned no environmental investigation pertaining to 3 Reeves Road. As soil and groundwater quality are unknown, a conservative assumption is to consider 3 Reeves Road reasonably likely for contamination to be present and migrating offsite.

The service station is located directly adjacent to the proposed RRF where piling is proposed. As per HAIL Category H (described in **Section 3.3**), the area of soil disturbance associated with piling for the RRF is directly adjacent and down-gradient from the service station and therefore is considered a 'piece of land' under the NES-CS and consent is required. A proposed piling plan is attached in **Appendix G**, which details the proximity of the soil disturbance area to the service station.

Section 3.2.1 indicates approximately 250 m^3 of soil disturbance will be required for the piling works adjacent to 3 Reeves Road (within the Reeves Road carriageway). Therefore, this portion of the works will exceed the permitted activity criteria for soil disturbance volume as allowed under the Regulation 8(3) of the NES-CS (25 m^3 per 500 m^2 of soil disturbance and 5 m^3 per 500 m^2 of removal). Due to limited access under the carriageway (meaning adequate sampling cannot be undertaken until intrusive work begins), the controlled activity standards under the NES – CS cannot be met. Therefore, discretionary activity status should be sought for works in this area and any potential effects to human health managed through a CLMP.

Soil disturbance volumes for the piling works adjacent to 3 Reeves Road does not comply with the permitted activity criteria of Chapter E30 of the AUP(OP), as volumes will exceed 200m^3. However, to comply with the controlled activity criteria under section E30.6.2.1, a detailed site investigation must be prepared and submitted to AC for consideration. As there is limited access under the carriageway (meaning adequate sampling cannot be undertaken until intrusive work begins), discretionary land use consent is required, with any environmental effects managed through a CLMP.

6 Existing Environment – Eastern Busway 3 Residential

Chapter Summary
• *Based on the information reviewed, there were three sites identified within EB3 where HAIL activities were identified.*

6.1 Previous Environmental Investigations

To assess the features and values potentially impacted by the proposal a review of previous environmental investigations in EB3R has been undertaken. The following reports detailed below are included in full in **Appendix A**.

The AC contamination enquiry (**Section 6.3**) revealed that 11 Cortina Place was a former service station. Multiple environmental investigations have occurred at 11 Cortina Place, which are summarised in the William Roberts Road Extension Contaminated Land Technical Report included in **Appendix D**.

6.1.1 Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.

The 2000 Landfill Assessment Report reviewed the closed landfills throughout the Manukau City region to ensure the necessary resource consents were in place. The further information pertaining to the report background can be found above in **section 5.1**.

From the sites evaluated in the report, the following two sites were identified as a former landfill site within EB3R:

- Ti Rakau Park, and
- Riverhills Park.

The report detailed the following in relation to the sites:

- There was no record of any landfills having a specifically engineered clay cap, liner or base. Anecdotal evidence suggests that the landfills were established on top of existing ground, which was confirmed during the drilling of the groundwater bores
- All landfills were generally underlain to a variable depth and with variable quality of silt or clay type medium of unknown permeability
- None of the landfills within EB2 had a leachate collection system installed during infilling.

Ti Rakau Park

- The fill type at Ti Rakau Park was listed as cleanfill[12]
- Seven bores were advanced at Ti Rakau Park. During the bore installation soils materials consisted of silt and clay between 0.5 and 2.5m
- No abnormal landfill gas readings were recorded during the advancement of boreholes in Ti Rakau Park
- No refuse or organic matter was encountered during drilling in Ti Rakau Park.

Riverhills Park

[12] Table 8, Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.

- The site is located adjacent to a tributary of the Tāmaki River
- Three bores were advanced at Riverhills Park. The bore logs indicate that soil materials generally consist of sand, silt and clay to a depth of 1.5 m bgl
- Groundwater was discovered in one of the three bores at a depth of 2 m bgl
- No refuse or abnormal gas readings were encountered during drilling
- Table 7 of the report noted there was considerable herbicide spraying along the edge to the estuary, which may have posed an ecological risk
- Riverhills Park was given an LRF of 0.78, well below the MAV of 5. This indicates it wasn't a site of interest and did not require a resource consent.

6.1.2 Phase 1 PSI for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment, prepared by GHD Limited (GHD), dated 7 December 2012.

GHD presented the following key findings and conclusions relevant to EB3R:

- A site contamination enquiry was completed seeking records from AC which identified pollution incidents, no records of discharge consents, and no borehole installation records
- A walkover identified no sensitive receptors in close proximity to the EBA packages
- A discharge consent was identified at 11 Cortina Place, which was the result of the removal of a Underground Petroleum Storage System (UPSS) in May 2010. The report identified 11 Cortina Place as a former service station which had HAIL activities previously occurring on site.

6.1.3 Previous Investigations at 11 Cortina Place

As noted in the William Roberts Road Technical Report (attached in **Appendix D**) the site is a former service station. A 2010 UPSS decommissioning report indicated that following the removal of the fuel storage tanks on site, soil samples collected from within the site returned concentrations of hydrocarbons exceeding the Oil Industry Guidelines Tier 1 Acceptance criteria for industrial/commercial land use. Following remedial excavation in 2016, the soil validation report (2016) indicated the remedial objective was achieved within the site and that soil conditions meet the adopted industrial/commercial land use criteria.

The conceptual site model (2015) indicated hydrocarbon impacts were present along the Ti Rakau Drive frontage, associated with the former stormwater interceptor and ancillary connections. It was initially thought the stormwater interceptor would effectively act as 'cut-off' for migration of hydrocarbon down the natural groundwater hydraulic gradient. Following completion of the remedial works, the residual hydrocarbon impacts within the carriageway (Ti Rakau Drive) were recommended to be managed through a contaminated land management plan.

6.1.4 Environmental Sampling (AECOM) - 2019

In 2019 following recommendations of the 2012 PSI completed by GHD (section 5.1.2), AECOM undertook a Gap Analysis in support of the application for resource consents associated with soil disturbances for the proposed alignment. The Gap Analysis identified areas where further investigation was required. Between April and February 2019, six boreholes (advanced for geotechnical purposes) and thirty-three environmental hand augers were completed within the wider EBA works; of which twenty-six soil samples were collected from eighteen hand augers and two boreholes within EB3R at depths between 0.1 and 2.0 m bgl. Samples were analysed for the following contaminants:

- Heavy metals
- TPH

- BTEX
- PAHs
- Semi Volatile Organic Compounds (SVOCs; includes pesticides and herbicides)
- Volatile Organic Compounds (VOCs)
- Asbestos.

The environmental assessment focused on the collection of soil samples for laboratory analysis from materials within anticipated areas of soil disturbance and Riverhills Park. The analytical results from samples collected from locations within EB3R are presented in **Table A2** in **Appendix A**. The investigation locations relevant to EB3R are presented in **Figure 3** below.

Figure 3 - 2019 Environmental Investigation Locations within EB3R, and HAIL sites in or adjacent to EB3R

A summary of the analytical results are as follows:

EB3R

- All analytical results were below all environmental guideline criteria
- All TPH, PAH and SVOC concentrations were below the laboratory LOR
- No asbestos was detected in samples analysed
- Heavy Metal concentrations from all samples analysed were below the Auckland Background Concentrations.

Riverhills Park

- All analytical results were below all environmental guideline criteria
- All TPH, PAH and SVOC concentrations were below the laboratory LOR, with the exception of minor detections of hydrocarbons at HA9, but still well below the relevant criteria

- No asbestos was detected in samples analysed
- Heavy Metal concentrations from all samples analysed were below the Auckland Background Concentrations (non-volcanic).

6.2 Historical Aerials

Historical and current aerial photographs were obtained through the AC GeoMaps online portal, the Retrolens online portal and Google Maps. A review of aerial photographs was undertaken for the period 1939 through to the present day for EB3R. This allowed for the determination of landuse changes and the identification of any pertinent items that have become apparent since the PSI in December 2012 but also to allow for the identification of any pertinent land uses that may have been omitted during the development of previous environmental investigations. The aerial photographs are included in **Appendix B**.

The review of aerial photographs highlighted the following key items:

- Much of the land is undeveloped farmland in the 1939 aerial photograph, with the exception of multiple residential dwellings and ancillary farm buildings
- Ti Rakau Drive is yet to be constructed in the 1939 aerial photograph
- Ti Rakau Park appears to have been developed into a sports field from either unused land or farm pastures sometime before the 1968 aerial photograph. Sports field outlines are visible in the 1972 aerial photograph
- Either side of Ti Rakau Drive has been developed with residential properties in the 1968 aerial photograph. Ti Rakau Bridge has not been constructed, with Ti Rakau Drive ending approximately 25 m west of the Tāmaki River
- Riverhills Park has not yet been developed, in its place there is an excavated area in the 1968 aerial photograph
- Housing has been further developed in the 1972 aerial photograph. Residential properties have been constructed south of Ti Rakau Drive at the eastern end
- The Ti Rakau Drive is yet to connect Pakuranga with Botany in the 1972 aerial photograph; however, the construction of the Ti Rakau Bridge appears to be underway, with what appears to be structural piles visible
- Riverhills Park appears to have been partially backfilled in the 1972 aerial photograph
- In the 1980 aerial photograph, Ti Rakau Bridge has been constructed, connecting Pakuranga with Botany. Riverhills Park has been backfilled, levelled and appears to have been converted into a sportsground
- In the 1996 aerial photograph, Freemantle Place has been constructed just south of Ti Rakau Drive, near Ti Rakau Bridge
- The site at 11 Cortina Place has been developed between 1980 and 1996, into what appears to be the former service station. The site at 11 Cortina Place is vacant in the 2015-2016 aerial photograph. Google Earth confirms the site was cleared in 2012. The site began redevelopment in 2017 and is now occupied by the 'Pakuranga Medical Centre' which comprises of a two-storey building and associated carpark

6.3 Auckland Council Contamination Enquiry

The following details the information received from the AC contamination enquiry pertaining to identified HAIL sites within EB3R:

- There are two closed landfill sites within EB3R located at Riverhills Park (168R Gossamer Drive, Pakuranga Heights) and Ti Rakau Park (27R William Roberts Road, Pakuranga)
- A consent for the discharge of contaminants at 11 Cortina Place for a former service station. The consent relates to closure of the site and discharge to land and water from remediation of contaminated land and is dated March 2016

A copy of the AC contamination enquiry report is included in Appendix C. The previous investigations of these sites that have been undertaken are described above.

6.4 EB3R Summary

Based on the information reviewed, there were three sites identified within EB2 where HAIL activities were identified. These sites are noted in Figure 3 summarised in Table 4 - Summary of findings within EB3RTable 4 and the potential for contamination to be encountered is detailed in the following sub sections. It should be noted sites identified within the William Roberts Road extension have not been detailed in the following subsections. For further details on those sites, refer to the William Roberts Road Extension Contaminated Land Technical Report in Appendix D.

Table 4 - Summary of findings within EB3R

Site Name/Location	Landuse Activity	HAIL Category	Comments
Riverhills Park	Closed landfill site	G3 – Landfill sites	Site investigated. No contamination encountered.
Ti Rakau Park	Closed landfill site	G3 – Landfill sites	No soil disturbance planned at or adjacent to this location.
11 Cortina Place / 64B Ti Rakau Drive*	Former service station, Pakuranga Medical Centre	F7 – Service stations including retail or commercial refuelling activities	The site has been addressed in the William Roberts Road Extension Contaminated and Technical Report, however residual hydrocarbon impacts potentially remain in the carriageway adjacent to the site (Ti Rakau Drive).

*Note: Indicates sites detailed in the William Roberts Road Extension Technical Report

6.4.1 Riverhills Park

Based on the AC contamination enquiry for EB3R, Riverhills Park was identified as a closed landfill where HAIL activities may have occurred. The site is located adjacent to proposed works which run through the southern edge of the park. The 2000 Landfill Assessment Report detailed that the site had previously been filled with cleanfill. This was confirmed during drilling when no refuse or abnormal landfill gases were noted.

The 2000 Landfill Assessment Report noted considerable herbicide spraying along the eastern edge of the park. Further sampling by AECOM in 2018 and 2019 at Riverhills Park returned herbicide concentrations below the laboratory LOR for all samples collected. Minor detections of hydrocarbons were noted at HA9: however, results were below the Oil Industry Guidelines.

Based on the information reviewed in the 2000 Landfill Assessment Report and analytical results from samples collected from Riverhills Park in 2018, it is unlikely to be a significant source of contamination.

6.4.2 Ti Rakau Park

As detailed in the SSESCP, there will be no significant excavation activities occurring within Ti Rakau Park as part of the EB3R package, therefore the site will not be evaluated as part of this assessment.

For further information on Ti Rakau park refer to the William Roberts Technical Report included in full in **Appendix D**.

6.4.3 11 Cortina Place

This site was identified as a former service station in the 2012 PSI. Previous environmental investigations indicate that potential residual hydrocarbon impacts remain within the carriageway (Ti Rakau Drive) adjacent to the site. As part of works within the proposed alignment, approximately 1,400 m^3 of soil disturbance within an area of 3,400 m^2 is required in the carriageway adjacent to the former service station. Due to the potential for encountering residual hydrocarbon impacted soils within the carriageway (Ti Rakau Drive) and adopting a conservative approach, the NES – CS and AUP(OP) Chapter E30 will apply to the carriageway adjacent to 11 Cortina Place. The current estimated soil disturbance volume indicates the works in the carriageway (Ti Rakau Drive) adjacent to the site will not meet the permitted activity criteria of both the NES – CS (25 m^3 per 500 m^2 of soil disturbance and 5 m^3 per 500 m^2 of removal) and AUP(OP) Chapter E30 (200m^3). As there is limited access under the carriageway (meaning adequate sampling cannot be undertaken until site establishment), the controlled activity criteria under both the NES – CS and the AUP(OP) cannot be met. Therefore, discretionary consent should be sought for works in this area, with any potential effects to human health and the environment encountered to be managed through a CLMP.

7 Assessment of Contaminated Land Effects

Chapter Summary
Based on the findings within this assessment, the following two sites were identified within EB2 and EB3R with potential effects during construction: • *The land and carriageway adjacent to 3 Reeves Road* • *The carriageway adjacent to 11 Cortina Place* *The potential effects from the site includes:* • *Exposure to contaminated soil and/or groundwater to construction workers (direct contact, ingestion or inhalation)* • *Discharge of soil contaminants to land or air during construction* *All remaining HAIL sites identified in **Sections 5** and **6** will not trigger consent requirements because:* • *The site is not located within or adjacent to any area of significant excavation* • *The site has been evaluated and contamination is unlikely to be present.*

Based on the findings within **Sections 5** and **6** of this assessment, the potential effects of construction within EB2 and EB3R are presented in Table 4 below.

Table 4 - Assessment of Effects within EB2 and EB3R.

Site Name	Landuse Activity	Potential Effects
Land and carriageway adjacent to 3 Reeves Road	Service Station	- Exposure to contaminated soil and/or groundwater to construction workers (direct contact, ingestion or inhalation) - Discharge of soil contaminant to land or air during construction
The carriageway adjacent to 11 Cortina Place	Service Station	- Exposure to contaminated soil and/or groundwater to construction workers (direct contact, ingestion or inhalation) - Discharge of soil contaminant to land or air during construction.

All remaining HAIL sites identified in **Sections 5** and **6** will not trigger the need for consent due to the following:

- The site is not located within or adjacent to any area of significant excavation
- The site has been evaluated and contamination is unlikely to be present.

8 Mitigation

Chapter Summary
• *A CLMP will be provided as part of this assessment in order to manage potential contamination within EB2 and EB3R and provide guidance for the impact to works, health of the public and surrounding environment.* • *Hazardous building materials have been encountered during investigations within EB2 and may be present during works within EB2 and EB3. If further unexpected discoveries are encountered the CLMP should be consulted for guidance during works.*

8.1 Residential Properties

As part of the proposed works within EB2 and EB3R, numerous residential buildings are planned for deconstruction/demolition. Owing to the ages of the housing stock in the vicinity of EB2 and EB3R, it is possible that some buildings may contain hazardous building material like asbestos or lead based paint. Such contaminants have the potential to generate localised effects when soil disturbance occurs. As highlighted in **Section 5.1.5**, asbestos was discovered within Seven Oaks Drive during geotechnical works. During removal of structures within the proposed alignment, the CLMP should be consulted for guidance.

8.2 Unexpected Discoveries

It is more likely than not that during the course of the works, unexpected discoveries of impact in soils will be encountered. This could include hazardous building materials from demolition work/fly tipping, visual observations of staining or the presence of odours etc. The effects from unexpected discoveries can be appropriately mitigated via the measures detailed in the CLMP.

8.3 Contaminated Land Management Plan (CLMP)

Based on the information reviewed as part of this technical report, there is the potential for contaminated soils and groundwater or hazardous building materials to be encountered during the construction of EB2 and EB3R, which may have the potential to impact the health of workers, the health of the public and surrounding environment. However, it is considered that any effects can be appropriately managed via the CLMP used in conjunction with the Construction Environmental Management Plan (CEMP) and the ESCEA.

The CLMP has been prepared by a SQEP and will require updating as the Project progresses, as further information becomes available and includes:

- Summary of information and overview of the proposed alignment construction methodology
- Summary of any soil sampling works undertaken
- Roles and responsibilities and contact details for the parties involved in the land disturbance activities, including the SQEP
- Identify potential and known hazards arising from contamination (if present)
- Identify specific management procedures developed for construction earthworks including:
    - On Site soil management practices
    - Off Site soil transport and disposal
    - Erosion and sediment control
    - Management of dust and odour

- Contingency measures in the event of accidental/unexpected discovery (asbestos, unknown fill, odours, staining etc.)
- Post development controls (if required).

The contractor will need to manage its health and safety obligations with respect to risks relating to contaminated land. Measures to protect the health of workers, the public and the surrounding environment will need to be incorporated into any health and safety plan that relates to work on sites where potential or known hazards have been identified in the AEE.

9 Recommendations and Conclusions

Hazardous Building Materials

As highlighted above in Section 8.1 and 8.2, hazardous materials such as asbestos and leaded paints may be encountered during structure removal and soil excavation activities. Unexpected discoveries of hazardous materials during site works will be managed through a CLMP and a SQEP should be consulted.

EB2

As part of previous investigations, 3 Reeves Road has been identified as a service station with current HAIL activities occurring on site and no environmental investigations detailing the state of groundwater and soil at present exist for the site. As a conservative assumption it is reasonably likely for contamination to exist on 3 Reeves Road and migrating via groundwater to adjacent land. Therefore, consent will be required for the carriageway adjacent to 3 Reeves Road. The ESCEA indicated that approximately 250 m^3 of soil disturbance is required in land directly adjacent to the site for piling activities associated with the Reeves Road Flyover. Soil disturbance will likely exceed the permitted activity standards for the NES – CS and AUP(OP) Chapter E30, therefore discretionary consent is being sought for excavation activities occurring at this site. Any potential effects should be managed by the CLMP.

All remaining sites within EB2 identified as part of this assessment comply with AUP(OP) permitted activity rules outlined in Section E30 and the NES-CS.

EB3R

Based on the information review as part of this assessment, Riverhills Park is unlikely to be a significant source of contamination, and therefore the NES – CS and AUP(OP) Chapter E30 do not apply. The SSESCP identified that no soil disturbance is required within Ti Rakau Park as part of the proposed alignment, therefore consideration for this site as part of this assessment is not required.

Residual hydrocarbons are reasonably likely to be found within the carriageway adjacent to the former service station at 11 Cortina Place. As soil disturbance volumes are unlikely to meet permitted activity criteria for both the NES – CS and the AUP(OP) Chapter E30, consent is sought for a discretionary activity for works. Any potential effects should be managed by the CLMP.

Appendix A: Previous Environmental Investigations

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MANUKAU CITY COUNCIL

ASSESSMENTS OF OLD LANDFILLS SITES REPORTS (copies)

Manukau City Council

MANUKAU
City Council

Assessment of Old Landfills

Contract No. 15951

June 2000

GHD
MANAGEMENT
ENGINEERING
ENVIRONMENT

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Contents

Appendices

1. Background

Auckland Regional Council (ARC) has undertaken a review of the sanitary landfill operations throughout the region to ensure that all the necessary resource consents are in place. As part of this and with the assistance of territorial local authorities (TLA) throughout the region, closed landfills have also been evaluated. In this context Manukau City Council (MCC) produced an inventory of the historical landfill sites for its area.

Historical records revealed that 39 closed landfill sites existed within MCC owned property. Each site was evaluated to determine the potential for adverse environmental effects. A priority list of sites requiring further evaluation was generated for the MCC area.

In 1994 MCC began a programme of investigations to identify discharges of leachate and landfill gas from the old landfill sites that may be having an adverse effect on the environment, and where necessary and practicable to carry out remedial site works. In this regard, Manukau City is committed to finding longer term solutions to the closed landfills, and as far as possible eliminate associated risks to the general public in relation to health & safety and risks to the environment.

The programme includes carrying out assessments for each of the closed landfill sites; to elucidate which of the sites may require resource consents from the ARC. In the above context, and based on the agreed assessment criteria given below, this report has been prepared to identify Old Landfills that may require resource consents.

2. Assessment Criteria

In this report assessments of the Old Landfills have been carried out, based on agreed criteria between Manukau City Council and Auckland Regional Council. The key criteria are:

- Age of the landfill
- Type of fill
- Leachate discharge
- Proximity to water courses
- Hydraulics, water levels & rainfall
- Leachate toxicity risk factor

It was also agreed that assessments to evaluate the need for resource consents for the Old Landfills should be weighted towards assessment of environmental effects. This includes the assumption that the Landfill sites are public open spaces.

In meeting the above objectives, the following key issues were also considered to be part of the assessment process:

- Health and Safety of the General Public
- Structural Integrity
- Ecological Impacts
- Water Quality
- Sediment & Erosion Control
- Air Quality

The issue of land use and management were considered to be separate from the resource consent application process and as a consequence have not been included within this report.

3. Landfill Locations

The old landfill sites are located on MCC owned properties (with the exception of Miro Road site, which is owned by Te Puea Marae) and their names and road locations are listed below in Table 1. A map of each site is given in Appendix A of this document.

Table 1: Landfill Names and General Locations

No.	Landfill Site Name	Road Location & Suburb
1	Hills Rd	Hills Rd, Mayfield Park, Otara
2	Whitford Bridge	Whitford Road, Whitford Bridge Reserve, Whitford
3	Pah Rd	Papatoetoe Cemetery, Papatoetoe
4	Ngati Otara Park	Alexander Crescent, Ngati Otara Park, Otara
5	Riverina Ave	Riverina Ave, Pakuranga
6	Riverhills Park	Cnr Ti Rakau Dr and Gossamer Drive, Pakuranga
7	Leabank Park	Claymore Street, Manurewa
8	Miro Rd	Cnr Miro Road and Mahunga Road, Mangere Bridge
9	Dale Crescent	Dale Crescent, Pakuranga
10	Kingfisher Pl.	Kingfisher Place, Mangere
11	Coxhead Rd	Cnr Coxhead Road and Kohiwi Road, Manurewa
12	Oruarangi Rd	Oruarangi Road, Ihumatao
13	Gt. South Rd	Great South Road, South Bank, Otahuhu
14	Robert Allan Rd	Robert Allan Way, Pakuranga
15	Roscommon Rd	Cnr Roscommon & McGlaughlin Roads, Puhinui
16	Tiraumea Reserve	Tiraumea Ave, Pakuranga
17	Old Quarry Rd	Cnr Walmsely and Coronation Roads, Mangere
18	Udys Rd	Cnr Udys and Reeves Roads, Pakuranga
19	Norana Rd	Norana Ave, Favona
20	Ennis Ave	Ennis Ave, Pakuranga

21	Kiwi Esplanade	Kiwi Esplanade, Mangere Bridge
22	Riverhills School	Between Gossamer Dr & La Trobe St, Pakuranga
23	Millen Ave	Millen Ave, Pakuranga
24	Ti Rakau Park	Between Cortina Place & Ti Rakau Dr, Pakuranga
25	Harania Ave	Harania Ave, Favona
26	Botany Rd	Cnr Botany and Andrew Roads, Pakuranga
27	Tanners Rd	Tanners Road, Mangere
28	Clifton Rd	Clifton Road, Beachlands
29	Bairds Rd	Bairds Road, Otara
30	Riverlea Rd	Tamaki Bay Drive, Pakuranga
31	Harania Inlet	John Fletcher Drive, Favona
32	Beach Rd	Beach Road, Favona
33	Bells Rd	Bells Road, Pakuranga
34	Elm Park	Gossamer Dr, Pakuranga
35	Hilltop Rd	Cnr Hilltop and Redoubt Roads, Manukau Heights
36	Allenby Rd	Cnr Allenby and Great South Roads, Papatoetoe
37	Manukau Yacht Club	Kiwi Esplanade, Mangere Bridge
38	Mangemangeroa Bridge	Whitford Road, Whitford
39	Omana Park	Omana Road, Papatoetoe

4. History

The history of waste disposal in Manukau City, goes back to the period when the landfills were managed by former Manukau County Councils. Some of the former local authorities, which make up the present Manukau City Council, such as the Papatoetoe Borough Council, operated their own landfills. Papatoetoe Borough Council operated the Kohuora Crater landfill, but not for an extensive period of time. The Kohuora Crater landfill has been investigated and remediated separately.

Some sites have been considered and listed in previous reports but have since been found to be outside the scope of this investigation as they are in private ownership. These are Allens Rd, Point View Drive, Ruaiti Rd and Lukes Bridge.

The information available on the history of some sites is unclear. Further monitoring has been carried out on these sites to ascertain the extent of contamination and their effects on the environment. Furthermore, there are some sites, which have no recorded history of contaminated material or domestic refuse being dumped at them.

The relevant histories of individual sites are given with other respective information in Appendix E of this document.

5. Methodology

5.1 Preliminary Investigations & Screening

The investigations and monitoring carried out for this project were generally undertaken along the ANZECC (Australia and New Zealand Environment and Conservation Council) guidelines for contaminated sites. The methodology allowed for general screening investigations on all landfill sites, leading to more targeted and detailed investigations on those sites that required further work.

The order of investigations had been adjusted in some instances to suit resources, local conditions and assess potential environmental risks associated with individual landfills. For example, initial sampling was undertaken in waterways adjacent to many of the landfills. However this was largely discontinued after results showed that there were low concentrations of contaminants in these waterways.

As part of the preliminary investigations and screening process, the methodology also included Leachate Strength Assessment as described in the ESR report "The Assessment of Ground and Surface Water Contamination at Former Landfills, Manukau City" on the Manukau landfills (July 1996). Details of the ESR report has already been described in previous MCC reports to the ARC. Nevertheless, the monitoring data for bore (B) and surface (S) water samples are given for reference in Appendix B.

In brief, the leachate strength is based on the average concentration of a set of key indicators relative to their concentrations in a typical landfill leachate. The set of indicators chosen consists of iron, manganese, zinc and ammonia. The other analytes consistently measured throughout the monitoring process have been cadmium, chromium, lead and zinc.

For each landfill site the most representative sampling locations were selected by considering the nature of the sampling location, the concentrations at that location and the consistency of results. Results from tidal pools, estuaries and streams were found to be too diluted and variable. For this reason, the decision was made to consider only springs directly out of the landfill and groundwater bores, to evaluate the leachate strength.

For each landfill site, the concentrations of each of the key indicators were averaged between the sampling locations at that site and over samples taken at different times at any one sampling location. The result is a representative average concentration of each of the key indicators at that site.

These average values were then divided by the concentration of those analytes in a typical landfill leachate. This gives for the site, the relative strength of each of the indicators.

These percentages for the individual indicators were then averaged to arrive at an overall percentage. This overall percentage gives an indication of the strength of

the leachate from the site relative to the strength of leachate from an operating landfill.

The reason that the strength of the individual indicators are considered separately is that it allows easier identification of possible outlier results and other possible anomalies in the results.

Table 2 below illustrates the methodology for deriving the Average Leachate Strength Values for individual Landfill bore (B) and surface (S) water samples.

Using the concentration of indicators in an operating landfill does not necessarily give a good indication of the potential for effects. The potential for adverse effects of each of the individual indicators may vary considerably. It is recognised that the above methodology does not take into account, the varying potential for effects from each of the individual indicators.

Table 2: Examples of Leachate Strength Assessment

Site	Site Type	Fe %	Mn %	Zn %	NH4+ %	Leachate Strength	Average Strength
Oruarangi 1	B	10.84	6.69	0.24	0	4.44	
Oruarangi 1	B	7.53	0	0.08	0.1	2.57	3.51
Coxhead Rd	B	33.13	4.46	4.65	1.4	10.91	
Coxhead Rd	B	26.2	0	3.38	1.24	10.28	10.59
Elm Park 1	S	1.3	3.5	0.08	0.06	1.24	
Elm Park 1	S	231.93	0.51	0	0.93	77.79	15.91
Gt Sth 3	B	30.12	0	0.18	0.15	10.15	
Gt Sth 4	B	11.14	0	1.03	5.11	5.76	7.96
Coronation Rd 3	S	12.65	7.64	0.28	0.2	5.19	
Coronation Rd 4	S	8.13	5.73	0.01	0.29	3.54	
Coronation Rd 3	S	10.54	7.01	0.14	0.16	4.46	
Coronation Rd 4	S	9.04	5.1	0.01	0.27	3.6	
Old Quarry 3	S	13.86	5.1	0.12	0.12	4.8	
Old Quarry 3	S	0.63	2.23	0.06	0.04	0.74	
Old Quarry 7	B	15.96	0	1.83	0.02	5.94	
Old Quarry 3	S	25	0	0.06	0.1	8.39	4.58
Harania 4	S	0.54	0.48	0.2	0.02	0.31	
Harania 2	B	0.11	0.25	0.1	0.03	0.12	
Harania 3	B	1.45	8.28	0.06	1.58	2.84	
Harania 5	B	1.99	0.57	0.07	0	0.66	
Harania 2	S	0.25	1.27	0.17	0.36	0.51	
Harania 2	B	3.92	0	0.05	0.11	1.36	
Harania 3	B	37.65	0	0.15	1.22	13.01	
Harania 5	B	6.93	0	0.21	0.05	2.4	2.39

The method assumes that the potential for effects for each of the indicators is equal at the concentrations in the typical landfill and varies exactly in proportion to the concentration of the indicator in the typical landfill. This is known not to be the case. For example, iron does not have a significant adverse effect on the environment relative to its concentration.

Nevertheless, the leachate strength values are useful as one of the screening tools for determining which of the old landfills could be considered as not likely to have any significant adverse effect on the environment, public health and safety.

In general, the methodology for assessing the old landfills also included, site descriptions, which take into account the physical setting and history of development, landfill operations and closures. Wherever possible, attempts have been made to measure the discharges of the landfills to streams adjacent or passing through the sites, by sampling at monitoring points immediately upstream and downstream of the sites, and at springs that migrate from the best known location of the filled areas.

Some of the old landfills, which have no recorded history of contaminated material or domestic refuse being dumped at them (i.e. have primarily clean-fill), were considered to pose no significant risk to the environment. Hence, no leachate monitoring was considered to be necessary for these sites.

The preliminary prioritisation was based on data such as the landfill size, age, the type of fill and the sensitivity of the surrounding environment. Detailed information on individual landfills is given in Appendix E of this report. The methodology for evaluation included other key factors such as:

- landfill capping & ground cover
- landfill stability
- public health & safety issues
- landfill status - closed or operational
- landfill maintenance
- proximity to water courses
- landfill gas
- landfill odour levels

Table 3 below provides a list of landfills, which are considered to be of no significant risk to the environment or to public health and safety. This was established at an early stage of the investigations and hence as a consequence no detailed monitoring was carried out for these landfills.

Table 3: Landfills considered not to be of significant risk to the environment after preliminary assessments

No.	Landfill Site Name	Road Location & Suburb
15	Roscommon Rd	Cnr Roscommon & McGlaughlin Roads, Puhinui
16	Tiraumea Reserve	Tiraumea Ave, Pakuranga
18	Udys Rd	Cnr Udys and Reeves Roads, Pakuranga
19	Norana Rd	Norana Ave, Favona
23	Millen Ave	Millen Ave, Pakuranga
25	Harania Ave	Harania Ave, Favona
26	Botany Rd	Cnr Botany and Andrew Roads, Pakuranga
27	Tanners Rd	Tanners Road, Mangere
28	Clifton Rd	Clifton Road, Beachlands
29	Bairds Rd	Bairds Road, Otara
30	Riverlea Rd	Tamaki Bay drive, Pakuranga
31	Harania Inlet	John Fletcher Drive, Favona
32	Beach Rd	Beach Road, Favona
33	Bells Rd	Bells Road, Pakuranga
34	Elm Park	Gossamer Dr, Pakuranga
35	Hilltop Rd	Cnr Hilltop and Redoubt Roads, Manukau Heights
36	Allenby Rd	Cnr Allenby and Great South Roads, Papatoetoe
37	Manukau Yacht Club	Kiwi Esplanade, Mangere Bridge
38	Mangemangeroa Bridge	Whitford Road, Whitford
39	Omana Park	Omana Road, Papatoetoe

Following this initial prioritisation exercise undertaken in July 1995, boreholes were drilled on the higher priority landfill sites and groundwater quality assessments undertaken. Where relevant, surface water quality assessments were also carried out.

For these landfills the leachate monitoring was carried out to ascertain the levels of contaminants and their potential adverse impact on the environment. Table 4 below provides list of landfills where boreholes were drilled.

Table 4: Landfills where more detailed investigations were carried out including leachate monitoring

No.	Landfill Site Name	Road Location & Suburb
1	Hills Rd	Hills Rd, Mayfield Park, Otara
2	Whitford Bridge	Whitford Road, Whitford Bridge Reserve, Whitford
3	Pah Rd	Papatoetoe Cemetery, Papatoetoe
4	Ngati Otara Park	Alexander Crescent, Ngati Otara Park, Otara
5	Riverina Ave	Riverina Ave, Pakuranga
6	Riverhills Park	Cnr Ti Rakau Dr and Gossamer Drive, Pakuranga
7	Leabank Park	Claymore Street, Manurewa
8	Miro Rd	Cnr Miro Road and Mahunga Road, Mangere Bridge
9	Dale Crescent	Dale Crescent, Pakuranga
10	Kingfisher Pl.	Kingfisher Place, Mangere
11	Coxhead Rd	Cnr Coxhead Road and Kohiwi Road, Manurewa
12	Oruarangi Rd	Oruarangi Road, Ihumatao
13	Gt. South Rd	Great South Road, South Bank, Otahuhu
14	Robert Allan Rd	Robert Allan Way, Pakuranga
17	Old Quarry Rd	Cnr Walmsely and Coronation Roads, Mangere
20	Ennis Ave	Ennis Ave, Pakuranga
21	Kiwi Esplanade	Kiwi Esplanade, Mangere Bridge
22	Riverhills School	Between Gossamer Dr & La Trobe St, Pakuranga
24	Ti Rakau Park	Between Cortina Place & Ti Rakau Dr, Pakuranga

5.2 Standards & Guidelines

To assess the relative risks to the environment from landfill discharges, the leachate and water quality data obtained, are expressed as a ratio of the relevant standard or guideline.

Some of the contaminant guideline values used are those from the U.S. Environmental Protection Agency for the Toxic Characteristic Leaching Procedure (TCLP) Tests. Other guideline values, which are not given for the TCLP Test, are from the Australia and New Zealand Environment and Conservation Council (ANZECC) Guidelines for Fresh & Marine Water Quality. These ANZECC standards / guidelines have been developed as part of the national water quality management strategy for New Zealand and Australia.

Hence the standards / guidelines are considered to be relevant for use in the assessment of relative risks to the environment from discharges of the leachate.

5.3 Leachate Risk Factor (LRF)

To assess the level of risk to the environment from contaminants in landfill leachates, the basic principles used is similar to that used in the assessment of contaminants in drinking water for monitoring & grading of water quality. The methodology is simple and yet effective in comparing the level of contaminant in the leachate to the respective environmental standard or guideline.

For example, the drinking water standard (Drinking Water Standard of New Zealand 1995) for Boron is 0.3 mg /L. If the levels of Boron in drinking water supply is below 50% of the guideline value (i.e. less than 0.15 mg / L), then the **risk of contamination** is considered to be **not significant** and no regular monitoring is required for Boron.

On the other hand, if the level of Boron is measured at levels between 0.15 and 0.3 mg / L, then even though the contaminant level is below the guideline, the **potential risk** of contamination is considered to be significant and the monitoring must be carried out on a regular basis.

Of course if the contaminant level is above the guideline value then the water supply is in non-compliance and the risk to consumers from the contaminant is considered to be significant.

Similarly, as an example, the TCLP regulatory threshold level for Cadmium in landfill leachate is 1.0 mg / L. Hence concentration of Cadmium in the leachate at levels above 1.0 mg / L, would be considered to be of significant risk to the receiving environment. This would require regulatory consent for discharge of the leachate into the environment under specific conditions.

On the other hand, if the level of Cadmium is measured at levels between 0.5 and 1.0 mg / L, then even though the contaminant level is below the guideline, the potential risk of contamination is considered to be significant and the monitoring must be carried out on a regular basis. In such cases, a regulatory consent for discharge of the leachate into the environment may be required depending on other factors such as the sensitivity of the receiving waters and toxicity characteristics of the contaminant.

However, if the level of Cadmium in the leachate is below 50% of the guideline value (i.e. less than 0.5 mg / L), then the risk of any actual or potential adverse environmental effects is considered to be not significant and no regular monitoring is required. In this case there would be no requirement for discharge consent.

Hence the measured concentrations of contaminants in the leachate, are expressed as a ratio of relevant standard or guideline, to assess the relative risks to the environment from the landfill discharges. These ratios have been used as

part of the methodology in determining which of the MCC Old Landfills may require resource consent from the ARC.

It should be noted that the leachate risk factors (LRF) derived are only one of the key issues for consideration in deciding whether there is a need for resource consent. Other factors, such as relative significance of individual contaminants and sensitivity of the receiving environment may also be a key indicator as to whether resource consent for the specific landfill is required.

5.4 LRF Parameters for MCC Old Landfills

In case of MCC Old Landfills, five contaminant parameters have been used for calculation of the LRF. These parameters are Cadmium, Chromium, Lead, Ammonia-Nitrogen, and Total Nitrate levels. The criteria for selection of these parameters are based on the fact that:

- they are indicators of leachate toxicity to the environment and public health
- reliable standards or guidelines are available for these contaminants
- the borehole leachate data for these parameters were available for the assessments in this report

The LRF values obtained for the five individual contaminants are combined and expressed as a sum in Table 5 below. In terms of LRF, those landfill sites with relatively high values are highlighted and more detailed review carried out.

Note:

For ANZECC Guidelines (mg/L), allowance has been made for dilution factor of 100 times. This is necessary as these Guidelines are for levels in the receiving waters and need to be adjusted for comparable concentrations in the landfill leachate itself.

It should also be noted that the dilution factor in the receiving water is likely to be significantly greater with tidal influences at many sites.

The US EPA Guidelines are for levels in the landfill leachate in mg/L.

Combined LRF >5 - Significant.

Table 5: Calculation of Leachate Risk Factors for MCC Old Landfills

	Leachate Toxicity Risk Factors					
Landfill	Cd	Cr	Pb	NH_4 - N	Nitrate	Totals
Hills Rd	0.07	0.118	0.24	60	0.95	61.38
Whitford Bridge	0.01	0.058	0.236	0.64	0.49	1.43
Pah Rd	0.086	0.48	1.86	26	0.18	28.61
Ngati Otara	0.029	0.028	0.104	4.6	0.52	5.28
Riverina Ave	0.01	0.44	0.184	0.028	0.03	0.69
Riverhills	0.01	0.004	0.0086	0.72	0.04	0.78
Leabank		0.0138	0.0104	0.002	0.24	0.27
Miro Rd	0.027	0.6	0.74	6.4	0.14	7.91
Dale Cres	0.038	0.02	0.0172	7.4	0.02	7.50
Kingfisher Place	0.01	0.024	0.034	0.158	0.05	0.28
Coxhead Rd	0.01	0.014	0.11	1.26	0.03	1.42
Oruarangi Rd		0.007	0.0094	0.086	0.085	0.19
Great South Road	0.06	0.014	0.09	5.8	0.0017	5.97
Robert Allan Rd	0.01	0.0062	0.017	18.8	0.11	18.94
Old Quarry Rd	0.01	0.032	0.22	0.26		0.52
Ennis Ave	0.01	0.002	0.004	0.094	0.037	0.15
Kiwi Esplanade	0.01	0.14	0.4	0.138		0.69
Riverhills School	0.01	0.002	0.02	0.0036	0.0003	0.04
Ti Rakau Dr	0.01	0.0016	0.0148	0.058	0.042	0.13
Harania Rd	0.01	2.8	0.6	1.42	0.0061	4.84
Bairds Rd	0.01	0.006	0.04	0.054		0.11
US EPA Guideline	1.0	5.0	5.0			
ANZECC Guideline				5.0	10	

The concentration values used for calculation of LRF for each of the chosen parameters are based on worst case scenario. That is, using the highest measured concentration of the contaminant in any of the leachate sample obtained from the respective landfill.

5.5 Criteria for Application of LRF

For an individual contaminant, a LRF value of over 0.5 is considered to be significant in relation to **potential** adverse effect on the environment. Hence,

the combined LRF value for five contaminants would need to be over 2.5 to be considered as being significant.

Similarly, for an individual contaminant, a LRF value of over 1.0 is considered to be significant in relation to actual adverse effect on the environment. Hence, the combined LRF value for five contaminants would need to be over 5.0 to be considered as being significant. Clearly in these cases there is a key indicator that shows that resource consent may be required for discharge of leachate to the receiving environment.

Hence, the Maximum Acceptable Value (MAV) for combined effects of five contaminants is considered to be 5.0 (i.e. combined LRF values of the five contaminants).

In relation to landfills with LRF values between 2.5 to 5.0, they may or may not have any significant adverse effect on the environment. In these cases other factors, such as landfill size, type of fill, receiving environment, etc., have also been taken into consideration in assessing whether these landfills require any resource consent.

5.6 Consideration of Other Factors

The methodology for evaluation includes other key factors such as:

- landfill capping & ground cover
- landfill stability
- public health & safety issues
- landfill status - closed or operational
- landfill maintenance
- proximity to water courses
- landfill gas
- landfill odour levels

The process involved site visits and assessments based on above factors, of all MCC Old Landfills (39 in total). Other details of individual landfills are given in Appendix E of this report. A summary of the information obtained is tabulated in Section 8.2.

6. Sources of Information

Information for this report has been drawn from a variety of sources. This includes information on the history, location and extent of the sites, which has been largely obtained from the recollections of long serving council staff. Furthermore, such information has been supplemented in places by the memories of the public who either worked on some of the sites, or lived near them at the time of filling.

Another source of information has been through an article in local papers (Manukau Courier and Eastern Courier), that asked former employees and residents to contact a nominated staff member. This drew a number of responses and provided historical information about some of the old landfills.

Information about the catchments of various streams flowing through or close proximity to the landfills, has been drawn from MCC Stormwater Catchment Management Plans.

The underlying geological information for Coxhead Rd and Pah Rd has been drawn from the Geological Map of New Zealand for the Auckland urban area (Kermode L.0. 1992). The remainder of the information has been drawn from the Geological Map of New Zealand, 1:25000 (Industrial Series). The sheets used were Sheet N42/5 (Eden) L.O.Kermode & E..J.Searle 1966 DSIR, Sheet N42/6 (Howick) L.O.Kermode 1975, Sheet N42/8 (Mangere) L.O.Kermode 1966, Sheet N42/9 (Whitford)) L.O.Kermode 1986.

Background information for the Pah Rd site was supplemented by information from the "Preliminary Site Investigation for the South Auckland Cemetery", January 1995 by Pattle Delamore Partners Ltd.

Chemical analysis results, interpretation and some background information regarding leachates, have been obtained from the MCC "Old Landfill Leachates" report and subsequent reports prepared by Environmental Science and Research Ltd.

Information from Bore logs, with the exception of Miro Rd, have been obtained from the MCC "Landfill Drilling Logs" report prepared by Groundsearch EES. The bore hole logs for the three groundwater monitoring bores installed at Miro Rd have been prepared by Manukau City Council staff.

Information relating to visual assessments and descriptions of the existing site surface, observable contamination, site stability, risk to public health and safety, and maintenance of the Old Landfill sites, are based on site visits by relevant GHD consultant and Manukau City Council staff. These are discussed in Section 8 of this report.

7. Monitoring Data

7.1 Initial Investigations & Monitoring

The initial investigations involved surface water sampling only. Samples were taken at drains running through the sites, springs coming out of the sites and the adjacent surface water bodies.

Surface water samples were taken in two rounds between August and October 1994. Further surface water samples were taken in February, April and September 1995.

Both surface and groundwater samples were taken from selected sites in December 1995. A full round of surface and groundwater sampling was undertaken in March to May 1996, and October / November 1996.

Some of the old landfill sites may have an impact on nearby streams. These sites include:

- Riverina Ave
- Kingfisher Place
- Pah Road
- Robert Allan Park
- Hills Road-Mayfield Park
- Oruarangi Road
- Harania Ave
- Elm Park
- Bairds Road
- Coxhead Park
- Old Quarry Road

At each of these sites, upstream and downstream water samples were taken and analysed. The detailed analytical data is shown in Appendix C.

Review of the surface water sampling results indicated that generally the landfills had no significant impact on the contaminant levels in surface waters flowing over the landfills or those adjacent to the sites. A discussion of the individual analytical data is given in Appendix E.

7.2 Data for Priority Landfills

After the preliminary investigations and screening process, the high priority landfills were selected for the drilling investigation programme. Bores were drilled on the sites in December 1995 and February 1996. The testing programme was progressively refined as more knowledge was gained of the sites and the concentrations of substances being found at or around the sites.

Following the installation of groundwater bores, sampling was largely discontinued in all of the surface water sampling locations except the springs coming out of some sites. The environmental parameters that have consistently been monitored are listed below:

- Cadmium
- Chromium
- Copper
- Manganese
- Iron
- Lead
- Zinc
- Ammonia Nitrogen
- Total Nitrate
- dissolved oxygen
- pH
- electrical conductivity
- salinity
- temperature

Assessment on-site:

- odour
- clarity
- colour

Boron has been monitored for most of the programme. Nitrite, nitrate, nitrite + nitrate nitrogen and total nitrogen have all been measured at varying times.

The analytes initially monitored but discontinued following the first review were aluminium, arsenic, cobalt, mercury, molybdenum, nickel, phosphorus, sulphur, selenium and strontium. Potassium, magnesium, sodium and calcium were also measured but subsequently excluded.

The detailed analytical data is shown in Appendix B.

7.3 Groundwater Bore Location

The placement of the groundwater bores on the sites varied from site to site depending on the topography of the site, the location of surface water, the type of material found in the bores and whether they contained groundwater.

On many sites drilling was undertaken at many locations throughout the sites. Piezometers were installed only in those bores thought likely to provide good samples of the site groundwater and / or where it was thought likely leachate was being produced.

For those sites where groundwater was encountered above the bottom of the fill the piezometers were installed at the location(s) where it was thought most likely to intercept groundwater that has passed through the body of the fill. This is usually at the downhill end of the original profile prior to the placement of fill, through or close to the bed of former streams (prior to the placement of fill) and / or where the groundwater level is lowest. If the available information was inconclusive, piezometers were placed where the fill was deepest and at the downhill end of the current surface.

7.4 Sampling Procedures

Normal procedures have been followed regarding the cleaning of equipment to prevent cross-contamination of samples.

To ensure comparability of results, samples at any one site have been taken at the same time in the tidal cycle, at all marine and estuarine sites for different sampling rounds. (e.g. samples at Harania Ave would be taken within the time range of 1 to 2 hours before low tide). In most cases, the level of groundwater in the bores has been largely independent of the level of the tide.

At sampling locations other than in the sea, or in a flowing estuary or stream, the sampling site was prepared to ensure that the sample taken was as free from sediment as possible.

Where springs were sampled, the sampling procedure ensured that the water gathered was fresh spring water rather than water that had potentially been pooled at the site for some time. To achieve this all vegetation was cleared away from immediately around the sampling area and where necessary, the sampling location was dug out to remove any stagnant water and mud to allow flow of fresh spring water into the sampling location. The site was left to stand for a minimum period of one hour to allow settling of sediment before taking the water samples.

For bores which do not dry, the purging was continued until at least three well volumes had been removed before sampling. For bores that did dry, pumping was continued until the well was dry. The bore would then be re-sampled when the water level had recovered sufficiently.

For each sampling run, one field blank for both ground and surface water was taken per day.

For each sampling run, extra samples or replicates were taken for quality control purposes. This required that at least one sample was replicated, or 5% of the total number of samples, whichever was the greater, for both groundwater and surface water. Furthermore, one trip blank was taken per sampling round.

7.5 Subsurface Investigations

The drilling investigations commenced in August 1995 with three boreholes being dug on the Miro Rd (Te Puea Marae) site. Drilling was undertaken on Hills Rd, Ngati Otara, Whitford Bridge, Old Quarry Rd and Elm Park in December 1995. Bores were drilled on more of the sites in January 1996. A brief summary of the borehole results is presented in Table 6. A more detailed discussion of the local site conditions and the results is presented in the individual site reports in Appendix E of this document.

The landfill drilling logs have been presented to the ARC as part of previous report to the ARC. The site maps are presented as Appendix A of this report.

Out of the 'original' set of sites, bores were drilled on the greater priority sites. The priority for these sites was based on the preliminary prioritisation exercise undertaken in July 1995 and described above in Section 7.4 of this document.

The method of drilling used was by rotary auger on most sites. A hammer drill was used on Miro Rd and for part of the Oruarangi Rd site.

It is also noted that borehole and surface water samples were generally turbid and were not filtered prior to laboratory analysis. This is likely to provide higher contaminant values than that actually present in the soluble form. The contaminants bound to the suspended solids generally have low bio-availability. Hence the contaminant concentrations obtained are total levels in the sample and not just the soluble fraction. This issues adds to the worst case scenario methodology used for calculation of the LRF values in Section 5.4 of this report.

Table 6: Drilling Investigations Summary

No.	Site Name	No. of Bores	Refuse in #Bores	Gas (> 10% LEL) in #Bores	Ground water in #Bores	Ground -water Depth (m)	# Piezo's
1	Hills Rd	4	4	4	4	1.5	4
2	Whitford Br.	11	2	2	9	1.2	6
3	Pah Rd	3	3	0	3	2	3
4	Ngati Otara	3	3	1	3	1.2	3
5	Riverina Ave.	5	0	0	2	2	1
6	Riverhills Pk.	3	0	0	1	2	1
7	Leabank Pk	9	0	0	1	2	1
8	Miro Rd	3					3
8	Udys Rd	2	0	0	2	2.5	1
9	Dale Crescent	4	0	4	3	2	1
11	Coxhead Rd	4	3	1	2	2	1
12	Oruarangi	7	1	0	1	2.5 - 12.0	3
13	Gt. Sth Rd	4	4	1	2	5	4
14	Robert Allan	4	1	2	3	1.5	2
16	Tiraumea Ave.	3	0	0	1	1.7	0
17	Old Quarry	7	2	5	1	2.3	1
20	Ennis Ave.	3	1	0	0	-	1
23	Millen Rd	2	0	1	2	1.5	0
24	Ti Rakau Pk	7	0	0	3	2-3	1
25	Harania Ave.	5	1	0	5	1.2-2	3
34	Elm Park	6	0	0	1	1.6	0

8. Environmental Effects

The MCC old landfill sites have been investigated and indicative parameters monitored for a considerable period of time since 1994. This has also included physical observations, monitoring of contaminant levels in surface water samples and landfill leachates, particularly for signs of any significant effect on the environment and / or risk to the health of respective neighbouring communities. In this context a large collection of scientific data has been considered, assessed and presented as part of this report.

8.1 General Characteristics of the Landfills

The landfill sites are relatively young (< 40 years) and a large proportion of them are relatively small in size in terms of either volume of waste and/or ground area covered. The largest site under consideration, Hills Rd (Mayfield Park), is less than three hectares. Most sites are less than 0.5 hectare.

Many of the larger old landfill sites in Manukau have been covered over and are now used as open space recreational areas. Some of these open spaces are also used for contact sports. Many of the smaller sites are drainage or esplanade reserves. The main use of these sites is therefore for recreation or to provide a buffer area.

The history of the old landfill sites is varied. For example, Hills Rd, Ngati Otara and Pah Rd were operated as municipal refuse dumps. Whereas Miro Rd and Whitford Bridge, largely took materials from inorganic collections. But it is likely that household refuse would have been diverted to each of these sites on occasions. Many of the remaining sites reportedly took a mixture of materials ranging from clean-fill to illegal household refuse. For some sites it is thought that they took clean-fill only.

A majority of landfills were reclamations, such as in-fill of small stream gullies and banks or estuarine inlets. They are generally very low lying with nearly all of them being close to the coast. These sites themselves are mostly flat or gently rolling. Only the Mangemangeroa Bridge, Pah Rd, Kingfisher Place, Riverhills Park and Riverina Ave sites have steep side slopes.

8.2 Site Inspections & Assessments

There is no record of any of the landfills having a specifically engineered clay liner or base. Anecdotal evidence suggests that the landfills were established on top of existing ground. This has largely been confirmed by the drilling investigations. The landfills are generally underlain to a variable depth and with variable quality of silt or clay type medium and unknown permeability.

The integrity and value of this material as a seal is likely to be low. None of the landfills have a leachate collection system.

The sites, which are now recreational parks, have had cover but this was more to provide a physical barrier and contoured surface rather than designed to limit water ingress. The cover on the sites generally consist of reasonably permeable materials such as topsoil. There is no evidence that a specifically engineered clay cap has been placed over any of the sites.

All of the sites are covered with some form of grass with sporadic native and exotic trees. The majority of sites are well maintained by MCC Parks. A summary of site inspection report is given in Table 7.

Stormwater drains cross many of the old landfill sites in urban areas. Sewers also cross a few sites. Searches of records have shown that there are other utility services around the fringes of many sites, but they do not actually cross the sites.

There are residential or commercial buildings just beyond the edge of the filled area at the following sites:

- Riverhills School - houses
- Hills Rd - houses
- Ngati Otara - marae buildings and houses
- Great South Rd - commercial buildings
- Miro Rd - marae buildings
- Harania Rd - houses
- Kingfisher Pl. - houses
- Dale Crescent - houses
- Riverina Ave. - houses
- Riverhills Park – clubhouse

The sites, which are major recreational parks, have a positive visual impact on the environment in their present form. The rest of the sites are largely not visible to the public.

Table 7: Site Information Summary

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
1	Hills Rd	Grass cover	Recent clay capping. No visual signs of instability or soil erosion. Well developed as a Park and sports ground.	No significant risk identified	closed	Well maintained. Some further work in progress
2	Whitford Bridge (Park)	Grass cover	Good ground cover in grass over all areas including at interface with Turanga Creek. There are signs of herbicide spraying and soil erosion along one part of the site close to swampy area	No significant risk identified	Closed	Part of the site is well developed as a Park. Another part is used as horse paddock for Pony Club. The site is well maintained.
3	Pah Rd	Grass cover	Significant vegetation at interface with estuary. No signs of erosion or slips	No significant risk identified	closed	Well maintained
4	Ngati Otara Park	Grass cover	No visual signs of instability or soil erosion. Well developed as a Park	No significant risk identified	closed	Well maintained
5	Riverina Ave	Grass cover	Vegetation along the foreshore. But herbicide spraying leading to signs of erosion and instability along the edges of the Estuary	Herbicide spraying along the edges of the Estuary may pose ecological risk. No other significant risk identified	Closed	Generally well maintained as a Park
6	Riverhills Park	Grass cover	No visual signs of instability or soil erosion. Well developed as a Park and sports ground.	No significant risk identified	Closed	Considerable herbicide spraying along the edge to the estuary. This may pose some ecological risk. Otherwise well maintained
7	Leabank Park	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve and sports field

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
8	Miro Rd	Grass cover	Recent clay capping. No visual signs of instability or soil erosion. Well developed as a Park	No significant risk identified	Closed	Well maintained as a reserve. Some further work in progress
9	Dale Crescent	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve
10	Kingfisher Pl.	Grass cover	Herbicide spraying along interface with estuary. There is very little vegetation. Evidence of soil erosion and slumping along the interface with estuary.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
11	Coxhead Rd	Grass cover	Good ground cover in grass over all areas including at interface with Stream. No signs of erosion or slips	No significant risk identified	Closed	Well developed and maintained as a Park with mature trees. Stormwater drainage runs through the site and is discharged into the Stream
12	Oruarangi Rd	Grass cover	Good ground cover in vegetation over all areas including at interface with Oruarangi Stream. No signs of erosion or slips	There is poor fencing to the site. Hence a significant amount of rubbish is still being dumped at the site, including household waste. The site is close to residential area and may pose a significant risk to public health, particularly to children.	Closed	Undeveloped, overgrown with grass and shrubs. Site maintenance work is currently being carried out by MCC.
13	Gt. South Rd	Grass cover	No signs of instability. Significant dumping of commercial & industrial rubbish, including discharge of oil & grease, along the interface with the estuary.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained, but maintenance work is currently being carried out by MCC

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
14	Robert Allan Rd	Grass cover	No visible signs of instability or soil erosion. Reclaimed estuary area still very swampy in parts. Underground stormwater drain discharges at the interface with the estuary.	No significant risk identified	Closed	No signs of rubbish and well Maintained
15	Roscommon Rd	Grass cover	Good ground cover in grass over all areas including at interface with Puhinui Stream. No signs of erosion or slips	No significant risk identified	Closed	Undeveloped, overgrown with grass and shrubs. Stormwater discharge into the Puhinui Stream
16	Tiraumea Reserve	Grass cover	Vegetation along the foreshore. Generally no visual signs of instability or soil erosion.	Some herbicide spraying along the edges of the Estuary that may pose ecological risk. No other significant risk identified	Closed	Well maintained as a reserve
17	Old Quarry Rd	Grass cover	Herbicide spraying along interface with Stream. In some places spraying is right down to the edge of Stream. Has potential for erosion in this context.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
18	Udys Rd	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	Well maintained as a reserve
19	Norana Rd	Grass cover	No signs of instability. Significant dumping of domestic rubbish along the foreshore, the interface with the Manukau Harbour.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained
20	Ennis Ave	Grass cover	No visual signs of instability or soil erosion. Adjacent to a tributary of Pakuranga Stream.	No significant risk identified. Some herbicide spraying to get rid of noxious weeds	Closed	Well Maintained
21	Kiwi Esplanade	Grass cover	Some vegetation at interface with Manukau Harbour shoreline. No signs of erosion or slips	No significant risk identified	closed	Well maintained

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
22	Riverhills School	Grass cover	No visual signs of instability or soil erosion. Adjacent to Stream and Estuary.	No significant risk identified	Closed	Well maintained as a reserve
23	Millen Ave	Grass cover	No visual signs of instability or soil erosion. Adjacent to Tamaki Estuary	No significant risk identified	Closed	Well maintained as a reserve with some mature trees
24	Ti Rakau Park	Grass cover	No visual signs of instability or soil erosion.	No significant risk identified	Closed	Well maintained as a reserve and sports ground
25	Harania Ave	Grass cover	Mostly open space with vegetation at interface with the Stream. No signs of erosion or instability.	No significant risk identified	Closed	Well maintained
26	Botany Rd	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
27	Tanners Rd	Grass cover	Top fill cap is about 2 metres and well grassed	No significant risk identified	Closed	Well maintained
28	Clifton Rd	Grass cover	This is a small reclaimed area developed as a boat ramp. The landfill is surrounded by Turanga Estuary on three sides and is subject to natural forces from tidal flows. There is good ground cover in grass. There are also some rocks along the edges with the Estuary. This provides some protection from erosion. No visual signs of erosion or slips were identified.	No significant risk identified	Closed	This site could be enhanced with planting of trees and removing some of the exposed solid waste. This includes items such as steel wire / rods left exposed in the sandy beach area at the boundary with the Estuary.
29	Bairds Rd	Grass cover	No signs of instability. Significant dumping of domestic rubbish along the interface with the road and Stream.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained, but maintenance work is currently being carried out by MCC
30	Riverlea Rd	Grass cover	No visual signs of instability or soil erosion. Good vegetation cover along the foreshore	No significant risk identified	Closed	Well maintained as a reserve
31	Harania Inlet	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
32	Beach Rd	Grass cover	Herbicide spraying along interface with Manukau Harbour. There is evidence of soil erosion along the shoreline.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
33	Bells Rd	Grass cover	Generally no visual signs of instability or soil erosion. Adjacent to stream	No significant risk identified	Closed	A small Park, well maintained as a reserve
34	Elm Park	Grass cover	No visual signs of instability but weed spraying along the steep slopes are prone to erosion. The Park itself is not a landfill. It is only the strip of land along the edge of a tributary of Pakuranga Stream, that was used as a landfill.	No significant risk to people identified, but the herbicide spraying may pose ecological risk.	Closed	Well Maintained
35	Hilltop Rd	Grass cover	Good ground cover in grass over all areas. Deep topsoil layer and no signs of landfill rubbish. A small Stream starts at the bottom end of the landfill. No signs of erosion or slips	No significant risk identified	Closed	Undeveloped, overgrown with grass and shrubs.
36	Allenby Rd	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
37	Manukau Yacht Club	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
38	Mangemangeroa Bridge	Grass & shrub cover	Good ground cover in dense bush over all areas including the steep slopes. Without the vegetation this site would be highly prone to erosion & slips. No signs of erosion or slips were identified. At down-slope boundary the landfill adjoins the Mangemangeroa River.	No significant risk identified	Closed	This site has significant natural vegetation that is essential for protection from soil erosion & slips. The steep slopes and deep valleys limit the options for any further development of the site.
39	Omana Park	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified arising from the old landfill.	Closed	Generally well maintained as a reserve and sports field

8.3 Type of Fills and Landfill Area

The old landfills have a range of fill material including clean-fill, non-household refuse, inorganic refuse, etc., and the details are shown in Table 8. A large number of the landfills mainly contain clean-fill and many are less than 0.5 hectare in size.

Table 8: Old Landfills – Use, Type of Fill & Area

No	Site	Current Use	Fill Type	Area
1	Hills Rd	Park	Sewage Treatment Plant, Municipal Tip	2 (ha)
2	Whitford Bridge	Reserve ,Pasture	Municipal Tip, Demolition material	3
3	Pah Rd	Park	Municipal Tip	0.5
4	Ngati Otara Park	Park	Municipal Tip	0.6
5	Riverina Ave	Park	Cleanfill	0.3
6	Riverhills Park	Sports Field	Cleanfill,	1.5
7	Leabank Park	Sports Field	Cleanfill	2
8	Miro Rd	Waste Land	Inorganic Refuse, Cleanfill, Domestic Waste	2
9	Dale Crescent	Open Space	Cleanfill and Gravel	1
10	Kingfisher Pl.	Reserve	Inorganic Fill	0.05
11	Coxhead Rd	Reserve	Municipal Tip	0.4
12	Oruarangi Rd	Refuse Collection Area	Inorganic Refuse, Sewage Sludge, Green Waste	0.2
13	Gt. South Rd	Reserve	Cleanfill, Domestic Waste	0.3
14	Robert Allan Rd	Open Space	Cleanfill	0.2
15	Roscommon Rd	Road Reserve	Non Household Refuse	0.2
16	Tiraumea Reserve	Reserve Access	Unknown	0.2
17	Old Quarry Rd	Reserve	Municipal Tip, Cleanfill, Green Waste	0.1
18	Udys Rd	Reserve	Cleanfill, Non-Household Refuse	0.2
19	Norana Rd	Reserve	Inorganic Refuse, Green Waste	0.2
20	Ennis Ave	Reserve	Cleanfill, Demolition Material	0.05
21	Kiwi Esplanade	Reserve	Cleanfill, Demolition Material, Inorganic Refuse	0.1
22	Riverhills School	Road Reserve	Unknown	-
23	Millen Ave	Reserve	Cleanfill	0.05
24	Ti Rakau Park	Reserve	Cleanfill	4
25	Harania Ave	Park	Non-Household Refuse	0.3
26	Botany Rd	Reserve	Non-Household Refuse	0.1
27	Tanners Rd	Marae	Bin Disposal, Cleanfill	0.05
28	Clifton Rd	Reserve	Demolition Material, Inorganic Refuse	0.05
29	Bairds Rd	Reserve	Non-Household Refuse	0.05
30	Riverlea Rd	Reserve	Non-Household Refuse	0.05
31	Harania Inlet	Reserve	Non-Household Refuse	0.05

No	Site	Current Use	Fill Type	Area
32	Beach Rd	Reserve	Non-Household Refuse	0.05
33	Bells Rd	Reserve	Non-Household Refuse	0.05
34	Elm Park	Park	Cleanfill,	-
35	Hilltop Rd	Road Reserve	Inorganic Refuse	0.05
36	Allenby Rd	Playground	Cleanfill, Car Bodies	-
37	Manukau Yacht Club	Road Reserve	Cleanfill, Demolition Material, Green Waste	0.8
38	Mangemangeroa Bridge	Road Reserve	Illegal Dumping, Non-Household Refuse	0.3
39	Omana Park	Park	Cleanfill, Demolition Material	0.2

The landfill fill-type and size are some of the factors that have been used in assessing the environmental risk associated with specific landfills in this report. But it should also be noted that these were not the sole reasons for determining whether the landfill should be exempt from resource consent process.

8.4 Leachate Discharge & Risk Factor

Generally, the levels of environmental contaminants were found to be below or close to the detection limits of the various parameters. Furthermore, they were found to be well below levels of concern in terms of any significant adverse environmental effect.

The results from the organic tips show leachate being produced in some cases thirty years after closure though not in strong concentrations. The oldest site shows no measurable leachate. The leachate producing lives of landfills are affected by a number of factors including temperature, composition of fill and the rate of water ingress into refuse. The volume of leachate produced will depend on these factors and the size of the fill. These factors vary from site to site and generally take forty to seventy years to stabilise.

As many of the old landfill sites are getting to ages of thirty years or so, it is reasonable to suggest that the effects of the landfills will not persist for too long into the future.

The water quality results also show variations in baseline water quality, both between different sites and at the same site at different times. These variations may well be due to climatic, seasonal or tidal factors, or from variable contaminant loading from other sources. Furthermore, the water quality results also confirm that seawater intrusion is influencing leachate at many of the sites.

The concentrations of contaminants, volume of leachate produced and the sensitivity of the receiving environment are some of the critical factors in assessing the environmental risk level from a landfill.

In this context the Leachate Risk Factors (LRF) derived for the MCC Old Landfills listed in Table 9, are used as one of the key indicators for identifying

sites that may pose significant risk to the environment and may require resource consent for discharge of leachate.

The details of the methodology used to derive the LRF values are described in Section 5 of this report. It should be emphasized again however, that the derived LRF values are based on worst case scenario, in that the highest contaminant levels measured in the leachate from respective landfills were used for the calculations.

For example, the Lead levels in leachates from Hills Road landfill ranged from <0.02 to 1.20 mg/L. The Lead concentration level used for calculation of LRF value was 1.20 mg/L. Similarly, the LRF values for Cadmium, Chromium, Ammonia and Nitrate in Hills Road landfill leachates were calculated.

The LRF values shown in Table 9, is a composite of all LRF values of individual contaminants for each of the landfills. As described in Section 5 of this report the maximum acceptable value (MAV) of LRF for any landfill is

Table 9: Aggregated Leachate Risk Factors for MCC Old Landfills

LANDFILL	LEACHATE RISK FACTORS
Hills Rd	61.4
Whitford Bridge	1.4
Pah Rd	28.6
Ngati Otara	5.3
Riverina Ave	0.7
Riverhills	0.8
Leabank	0.3
Miro Rd	7.9
Dale Cres	7.5
Kingfisher Ave	0.3
Coxhead Rd	1.4
Oruarangi Rd	0.2
Grt South Road	6.0
Robert Allan Rd	18.9
Old Quarry Rd	0.5
Ennis Ave	0.1
Kiwi Esplanade	0.7
Riverhills School	0.0
Ti Rakau Dr	0.1
Harania Rd	4.8
Bairds Rd	0.1
MAV for combined effects of five contaminants	5.0
MAV - Maximum Acceptable Value	

less than 5. This means that, if the contaminant concentrations in the leachate are less than the environmental guideline values, then the risk to the environment from the leachate may be considered to be not significant.

On the above basis, seven of the landfills listed above are identified as those that may pose a significant risk to the environment and hence require resource consents for discharge of leachate to the receiving environment. In terms of leachate toxicity the other landfills listed above, do not pose a risk to the environment.

It should be noted that the LRF values are one of a number of key factors in assessing the risk to the environment from the MCC Old Landfills. Other issues discussed in this section of the report must also be taken into account in the final assessment of which landfills may require resource consents from the ARC.

8.5 Proximity to Watercourses

Eight of the 39 landfills are a significant distance away from any watercourses. Twenty six landfills are however close to streams or creeks, and 5 landfills interface with Manukau Harbour.

From the landfill bore water data, surface water and stream monitoring data, it is noted that even for the sites in close proximity to watercourses, there is no significant, in fact barely detectable, levels of landfill leachate impacting on the respective adjacent watercourse.

Hence any risk from adverse environmental effects, from discharge of leachate to adjacent watercourses, are not considered to be significant for most of the MCC Old Landfills. However, a small number of the old landfills identified in Section 8.4 of this report (highlighted in Table 9) require further considerations in this regard.

In this context, other factors such as size of the landfill, type of fill and age may eliminate any significant risk from the respective landfill regarding adverse effect from discharge of leachate to watercourses. For example, "Robert Allen Road Landfill", has clean-fill only and is only about 0.25 ha in area. Any risk from relatively low volumes of leachate discharge from this landfill to the adjacent watercourse, are likely to be not significant.

Another key factor is the existing condition of the watercourses adjacent to the landfill. In practically all cases, the levels of contaminants in the receiving watercourses are significantly higher then those in the respective landfill leachate itself. The ANZECC Committee in developing the "Australia and New Zealand Guidelines for Fresh & Marine Water Quality" has recognised this issue.

Hence, in situations where the receiving water has significantly higher levels of contaminants entering the watercourse from other sources, then a higher

priority should be given to those sources, and the resources directed to that and not on the respective landfill. In this context the significance of adverse environmental effect from the landfill is very low compared to the major cause of contaminants in the respective watercourse. Therefore in terms of environmental risk assessment, the risk from the leachate discharge from the MCC Old Landfills to the respective watercourses may be considered to be not significant relative to other risks to that environment.

Specific issues related to individual landfills are discussed in Appendix E of this report.

8.6 Hydraulics, Water Levels & Rainfall

None of the MCC Old Landfills are close to any aquifer of significance to any water resource. A large number of the landfills are subject to coastal influences, such as salt-water intrusion in the groundwater. It is possible therefore that over the years, the salt water may have acted as a flush and have already removed any contaminants that were present in the respective landfills.

The relatively high rainfall levels in the Manukau Catchment act as a carrier of contaminants from the landfills to the receiving waters. But the high volumes of ground and surface waters resulting from rainfalls, also result in significant dilution of contaminants in the landfill leachate. This is reflected in the low levels of leachate contaminants measured in the respective landfills and downstream waters.

Again, in the above context, the risk from MCC Old Landfills, to the respective surrounding environments are likely to be not significant.

Specific issues related to individual landfills are discussed in Appendix E of this report.

8.7 Assessment of Gas Emissions

Drilling showed a range of filled materials, from substantial concentrations of refuse to clean-fill. The results are summarised in the individual site reports in Appendix E of this document.

Gas was principally monitored during drilling to ensure that gas concentrations in the boreholes were lower than the lower explosive limit (LEL), the concentration of gas required to support combustion. At no times did the gas levels recorded in any bore exceed the LEL.

8.8 Assessment of the Surrounding Environments

Most sites are in residential areas. Miro Rd is in the Mangere light industrial area along Mahunga Drive and is adjacent to a marae with elderly housing and a school. The Whitford Bridge and Mangemangeroa Bridge sites are in semi-rural settings.

The Mangemangeroa Bridge and Whitford Bridge sites are surrounded by steep country. All other sites are surrounded by flat to slightly rolling land.

Sites that are now recreational parks have high public visibility and their visual impacts are generally positive. The landfill sites that are in esplanade and drainage reserves, though usually in sensitive residential areas, generally are not that visible and their impact is assessed to be not significant. The Roscommon Rd site has a negative visual impact. However, it is not easily recognisable as an old landfill site, even though the whole area has a generally unkempt appearance.

8.8.1 Use of Condition Index

For the purposes of preliminary investigation and prioritisation of the landfills by MCC, a condition index was developed for each site. The condition index, involves assigning a score to each site in a number of key result areas, including:

- groundwater resources
- freshwater ecology
- recreational uses of water
- shellfish
- settlement
- tapu & mana
- physical contact
- terrestrial ecology
- marine ecology
- fishing
- gas exposure
- slope stability
- mauri
- miscellaneous public health

Generally, the MCC Old Landfills are well maintained as a Public Park or Reserve with good ground cover in grass and a variety of plants. The Condition Index values were used as one of the indicators together with other factors such as Leachate Strength (see Section 5), landfill size, fill-type, Leachate Risk Factor, etc., to assess actual or potential risk to the environment and/or to public health and safety.

Assessments of potential effects of specific landfills on their neighbouring environment are discussed in Appendix E in terms of these key indicators.

8.8.2 Ecosystems

The aquatic and terrestrial ecology of streams and rivers at all of the landfill sites has been degraded over time by urban and industrial development. Verbal

reports of long term residents and MCC staff indicate that fish life, water quality and riverbed conditions have been severely altered over the years. In this context the relatively small discharges, if any, from the old landfills, are insignificant compared to other contributors to the neighbouring aquatic systems.

Nevertheless, both, the Manukau Harbour, and the Tamaki River including the Tamaki Estuary (whose catchment includes the remaining sites), supports significant shellfish banks and fisheries. Moreover, inlets into these mangrove communities in the estuaries, remain significant fish breeding grounds and reservoirs of local ecosystem diversity. Hence any risk to the aquatic environment must be minimised.

Nearly all the landfill sites considered in this study either border on or discharge into streams that flow into either the Manukau Harbour or the Tamaki River, both of which are significantly polluted (Snelder and Trueman, 1995). Most of the likely effects of landfills considered in this report relate to the release of leachate from the landfills into surrounding surface water and groundwater.

There are two very important qualifications of the Leachate Strength results. Firstly, the methodology used takes no account of dilution prior to measurement. The greater the groundwater flow through a site, the more the leachate will be diluted and the less the measured concentration of the contaminants will be. By not taking account of the potential for dilution it is effectively assumed that the dilution factor is the same at each site.

Secondly, no control groundwater readings were taken upstream of the landfill sites to determine whether the presence of leachate indicators is actually due to the landfill itself or due to some other source.

Hence a greater significance is given to the Leachate Risk Factors in assessment of potential environmental effects of the landfills on the ecosystems compared to the Leachate Strength values.

8.8.3 Activities

Freshwater streams, which are close to the old landfill sites, are generally too small for water recreation. Furthermore, most of these streams are estuarine and have significant pollution levels due to other environmental factors such as urban surface water run-offs. Hence these streams are not used extensively for water recreation. It is noted that the Otara Lake, downstream of Hills Road is being considered for upgrading for water sports.

8.9 Risk to Public Health & Safety

A number of the sites are located adjacent to or very near schools and kindergartens. Generally, these sites do not pose a significant public health

risk, but some sites may have increased potential for such problems where the soil is exposed due to surface erosion.

For example, there are schools or kindergartens very close to the landfill at Elm Park, Ti Rakau Park, Ngati Otara and Udys Rd. Furthermore, a number of landfill sites have now become public reserves, which increases the risk of public health and safety problems through physical contact with refuse. It is therefore important that the landfill sites continue to be maintained and any surface erosion or exposures are covered and grassed.

Extensive site visits carried out indicate that the MCC Old Landfills are generally well maintained and no public health problems arising from the sites have been reported prior to or during the period of close monitoring since 1994. This indicates that, public health risk from these old landfills, are not significant.

8.10 Maori Values

The Maori values of tapu and mana may be offended at the Miro Rd and Ngati Otara sites where marae buildings border the landfill. There is potential for the Maori value of mauri to be offended at nearly all the sites where there is a waterway adjacent to the landfill.

8.11 Assessment of Surface Water

Notwithstanding the limitations of the physico-chemical criteria for surface water quality assessment, it has been used as a broadbrush tool in the early phase in conjunction with qualitative assessments. It was based on the assumption that leachate discharges from landfills enter the nearest watercourse and that the impact of the landfill may be assessed by comparing concentrations of contaminants upstream and downstream of the landfill.

Internationally recognised ambient standards have been used as an absolute measure of the effect of the landfills on surface water quality.

The results of surface water sampling and analysis have shown that the effects of the landfills on adjacent waterways are negligible. For surface water, elevated levels of contaminants (as compared against expected background levels) have only been measured at 'on-site' sampling locations, such as springs and in settled pools. However, these levels are still well below the guideline values for surface waters and are not likely to have any significant adverse effect on the impacted waterways.

To take into account any adverse impact of leachate on receiving streams, for relevant landfill sites, upstream and downstream water samples were taken and concentrations of leachate indicators analyzed. Generally the data available indicate no significant contamination of the streams from the landfill leachates. However, where there are marked increases in conductivity between the

upstream and downstream water samples, this may be due to impact of leachate from the respective landfill site. The leachate concentration levels are generally low and are not considered to have any significant adverse effect on the environment.

Given the relatively small size of the leachate discharges into the receiving waters, it is not surprising that in most cases even the limits of detection were not exceeded.

8.12 Safeguard & Mitigation

All necessary precautions and mitigation measures will be taken as per conditions of discharge permit.

Where risks have been identified, mitigation measures have been initiated. For example the landfills at Hill Rd (Mayfield Park) and Miro Road have recently been clay capped.

As practically all MCC Old Landfills are Parks or Reserves, any landfill surface erosion and exposure is also managed to ensure grass and /or plant cover of the area.

Generally the maintenance of the old landfills is of high quality and where issues of environmental significance arise, environmental risk management mechanism are already in place to take the necessary mitigation action.

8.13 Consultation

The assessment of MCC Old Landfills has been carried out in close consultation with the ARC and as part of that process, this report is based on the agreed criteria for the "Assessment of Environmental Effects" and identification of the landfills that may require resource consents from the ARC.

In terms of public consultation the approach has been to consult with those that have some relevant knowledge of the old landfill, such as longer-term residents and various Council employees. The investigations to date have not yet uncovered any serious problems.

An informal report was made to the Otara Community Board in 1996.

Where it was necessary to carry out investigations on adjacent properties, the owners /residents were informed and the issues explained. This involved initial letters followed by discussions with property owners. For example, it was necessary to consult with affected parties in order to carry out physical works at Hills Road and Miro Road Landfills.

Other consultations undertaken so far in this project are:

- All known current and retired long-service staff were consulted about the existence and location of sites and knowledge of the known sites.
- An article was placed in local papers (Manukau Courier and Eastern Courier) asking former employees and residents to contact a nominated staff member.
- There has been consultation undertaken with the parties affected (principally neighboring businesses and interested environmental groups) for the Miro Rd land use consent application.

Extensive consultation was also entered with the Te Puea Marae committee with regards to the Miro Road. This also included consultation with the Huakina Development Trust over the entire project. The expectations outlined by the Huakina in consultation regarding the former landfill sites coincide with the general approach adopted by the MCC.

Further consultations will be undertaken with the neighbouring community, as part of any discharge permit application process.

8.14 Future Monitoring

The extensive period of monitoring already carried out between 1994 to 1999, show that the levels of environmental contaminants at the old landfill sites, generally to be below or close to the detection limit values for the parameters measured. For most of the sites, any potential adverse impact on neighbouring areas or water bodies are likely to be insignificant and hence may not require any further monitoring of the sites.

8.15 Conclusions

Manukau City Council has carried out extensive monitoring over a long period of time (since 1994) to identify environmental risks associated with the Old Landfill Sites in the MCC Catchment. The evaluations used a number of methodologies, to ascertain actual and/or potential environmental effects from the landfills. These included;

- use of Condition Index (see Section 8.8.1)
- calculation of Leachate Strength (see Section 5.1)
- site inspections & assessments (see Section 8.2)
- calculation of Leachate Risk Factor (see Sections 5.3 & 8.4)

Some of the methodologies such as Condition Index and Leachate Strength, have been described in detail in previous reports to the ARC. The key criteria for assessment of environmental effects in this report are more focused on the LRF values and site inspections and assessments.

Taking into consideration all factors addressed in this report, the key conclusions are that:

- No significant adverse effects from discharge of landfill leachates, were identified on the water quality of receiving waters adjacent to the respective landfills.
- Many of the old landfills have clean fill with minimal organic matter and do not produce or are not likely to produce any significant volumes of leachate in the future.
- The environmental risk for actual or potential adverse effects, from very low levels of contaminants present in a small number of the landfill leachates, are generally considered to be not significant.

However, seven landfills were identified as having contaminant levels in the leachates that may pose some risk to the environment. These landfills are:

- Hills Road (Mayfield Park)
- Pah Road
- Ngati Otara
- Miro Road
- Dale Crescent
- Great South Road
- Robert Allen Road

It is noted that the worst case scenarios were considered in calculation of the LRF values (see Sections 5.3 & 5.4). The highest contaminant levels measured in the respective bore hole leachates were used in the calculations of the LRF values. Furthermore, the contaminant concentrations used are total levels in the sample and not just the soluble fraction. This further adds to the worst case scenario methodology used for calculation of the LRF values.

Considering the fact that Dale Crescent has clean-fill and gravel only, and is not in close proximity to any watercourses, any environmental risk from this site is considered to be not significant. Hence, the Dale Crescent site should be excluded from any need for resource consents.

Similarly, the Robert Allan Road landfill has clean-fill only, and is a relatively small site (0.25 ha), which is well maintained by MCC. Although this site is in close proximity to a watercourse, no adverse environmental effects were identified. Hence, it is considered that this site should also be excluded from any need for resource consents.

In our assessments, only five of the MCC Old Landfill sites may require further consideration by ARC as to whether there is any justification for any resource consents for the sites. These sites are:

- Hills Road (Mayfield Park)
- Pah Road
- Ngati Otara
- Miro Road
- Great South Road

It is noted again that a number of environmental issues have been identified in relation to the above five landfills and these issues, are currently being addressed by the Manukau City Council. These issues have resulted in clay capping of landfills, cleaning localised rubbish dumping within landfill sites and re-vegetation of landfill surfaces subject to localised soil erosion or susceptible to slips.

Public health and safety issues such as the potential for landfill gas effects, has been measured to some degree by measuring the gas levels relative to the lower explosion level (LEL) values. While gas is being produced, the low concentration of organic matter in the refuse and the reduced organic decomposition due to the ageing of the landfill sites significantly limit gas production. There are no visible signs of landfill gas production, such as cracks in the ground or grass discoloration, at any of the sites.

Site visits and assessments generally showed no indication of any potential risks to public health and safety associated with the MCC Old Landfills. The site visits included assessments of odour, ground cover and the risk posed by direct physical contact with landfill surface, dust levels, and indicators of soil erosion and slips. Where signs of any soil erosion and rubbish dumping was identified, MCC has taken immediate action to mitigate the situation as part of the daily management of the landfills. Hence any potential for adverse environmental effects is avoided.

Although no detailed assessment of the potential for slope stability at the old landfill sites has been carried out, the length, grade and width of the slope have been examined to get a measure of the potential for slope stability. Generally, any risk to public health and safety from the old landfill sites, are considered to be not significant.

9. Scope and Limits of Investigations

This report is based on Manukau City Council investigations and information prepared for the purpose of this commission. Previous reports in relation to the Old Landfills prepared for Manukau City Council by ESR Environmental Limited and Groundsearch EES Limited, were made available to GHD Limited and they have also been used as sources of information. The assessments made and the conclusions drawn are based on the data and information provided from the above sources. Gutteridge Haskins and Davey Pty Ltd (GHD) accepts no responsibility for other use of the data.

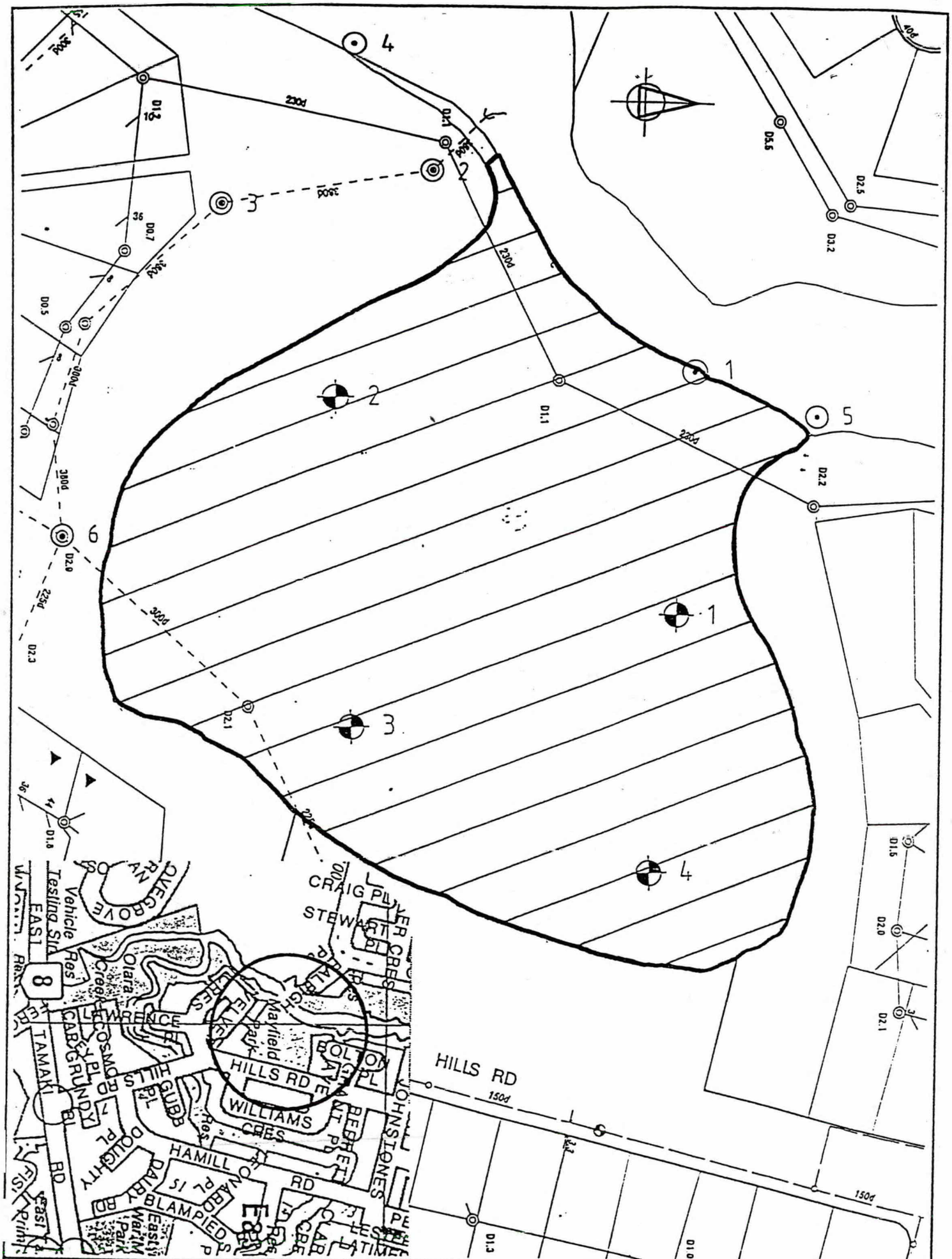
Where drill hole or test pit logs, laboratory tests, geophysical tests and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the investigation locations tests points and sample points and is not warranted in respect to the conditions that may be encountered across the site at other than these locations. It is emphasized that the actual characteristics of the subsurface materials may vary significantly between adjacent test points and sample intervals and at locations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

An understanding of the subsurface site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part or issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which has been modified in any way as outlined above.

Appendix A

Site Maps of MCC Old Landfills



MANUKAU CONSULTANTS

Consulting Civil & Structural Engineers, Geotechnical Lab, Project Management, Contract Documentation & Supervision, Surveying.

Telephone (09) 262 8099
Fax (09) 262 3131

TITLE

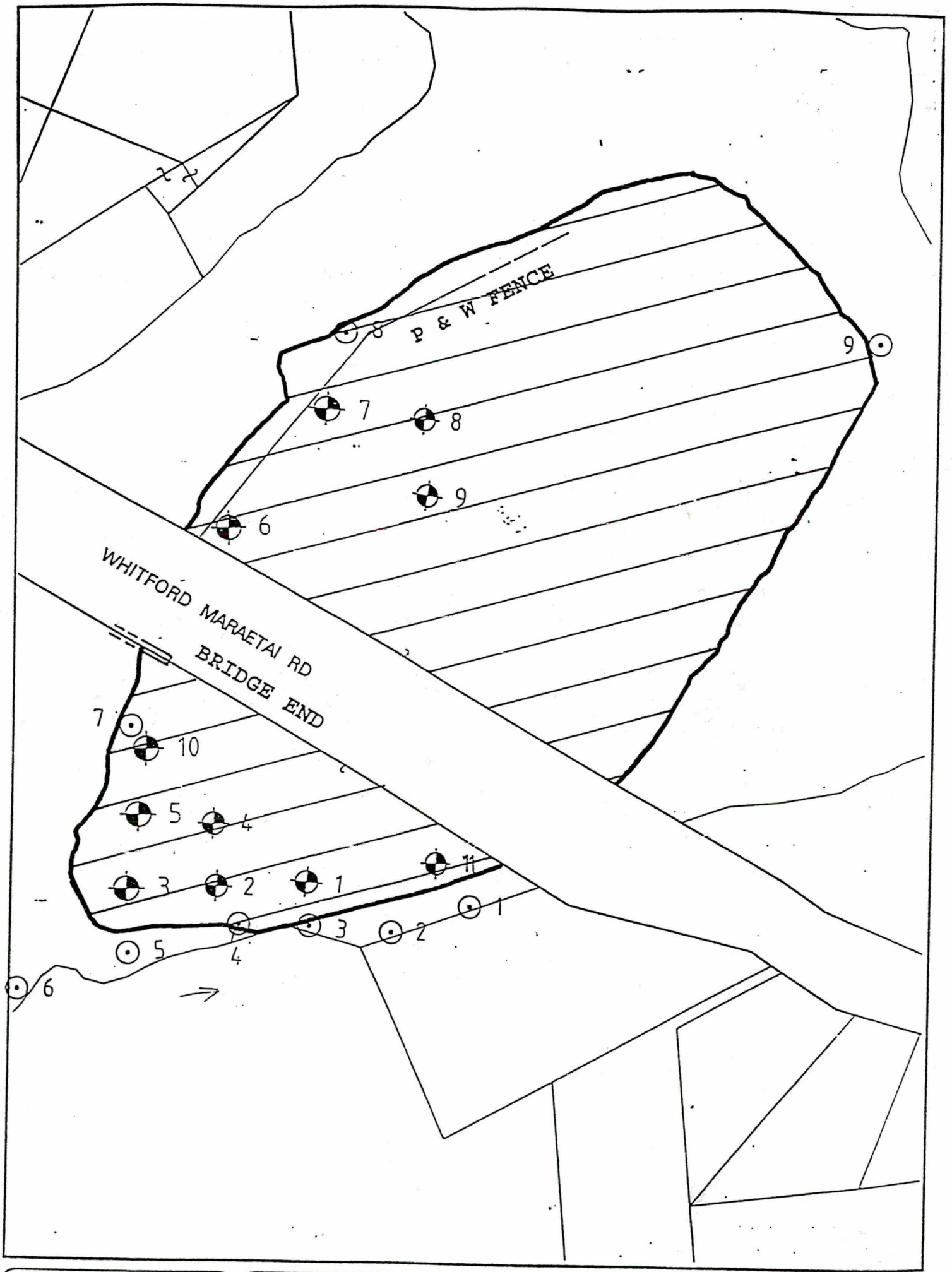
HILLS ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SCALE	DATE
DRAWN	G. Lander	07/99
CHECKED	A. Robinson	07/99
M.C. APPROVED		

PLAN NO 1



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Fax (09) 262 3131

TITLE

WHITFORD BRIDGE
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	07/98
CHECKED	A. Robinson	07/98
M.E. APPROVED		

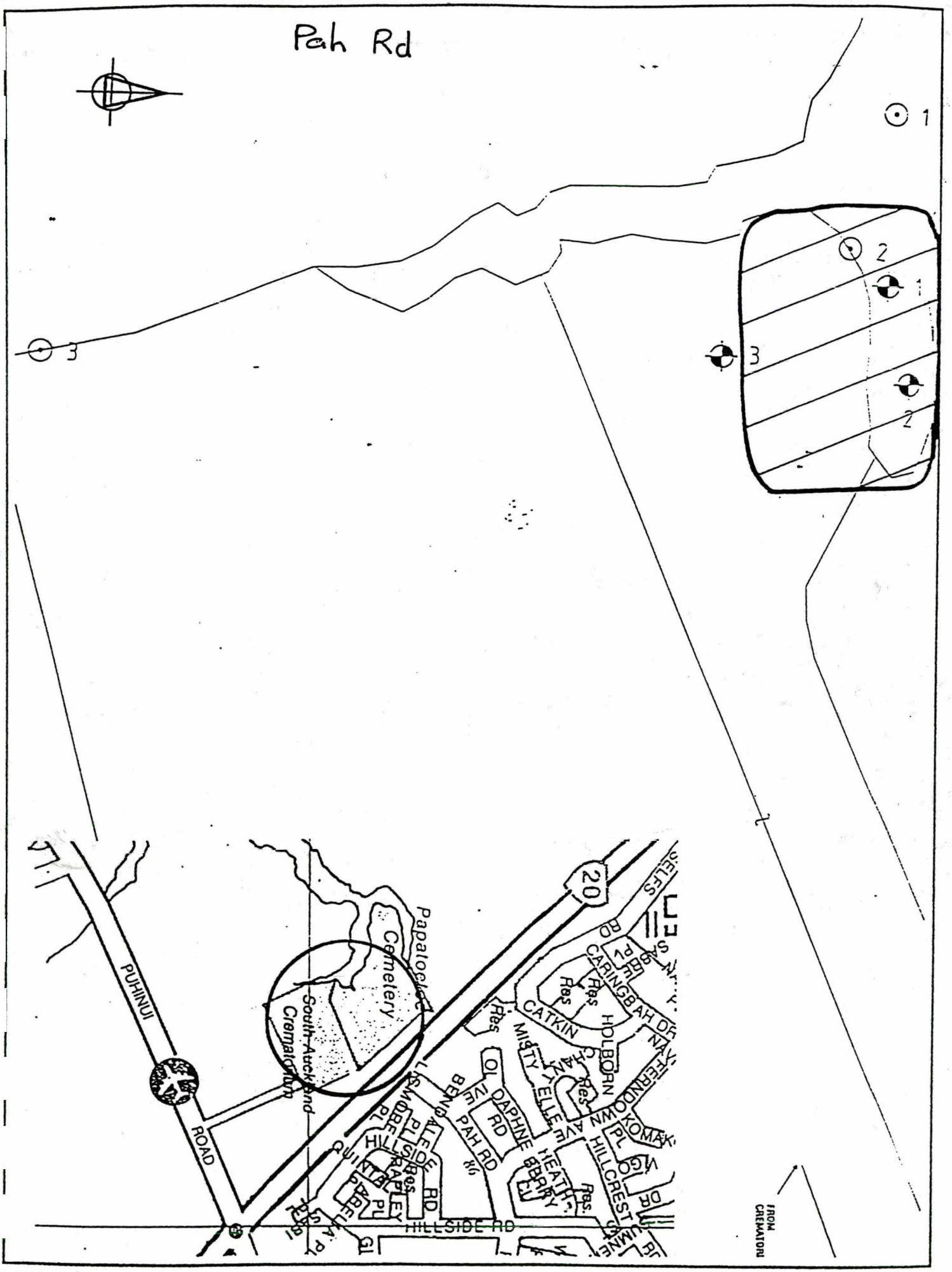
Blk 4 Sheet 54,55 TP 18a, 18b.

Lot 1, DP 41610 1.1609 ha.

Lot 2 DP 11565 6.5748 ha

Pt Lot 1 DP 20852 5.8850 ha.

X



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Telephone (09) 262 0000
Fax (09) 262 0131

TITLE

PAPATOETOE CEMETERY
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.E. APPROVED		

REV CHK

REV.

Blk 3 Sheet ~~46~~ 94 TP 26a, 26b, 26c, 26d.

15 R

Pt Allot 520 + 133 m²

SO 53719 SO 56819

Parish of Maroochy.

1.0317 ha.

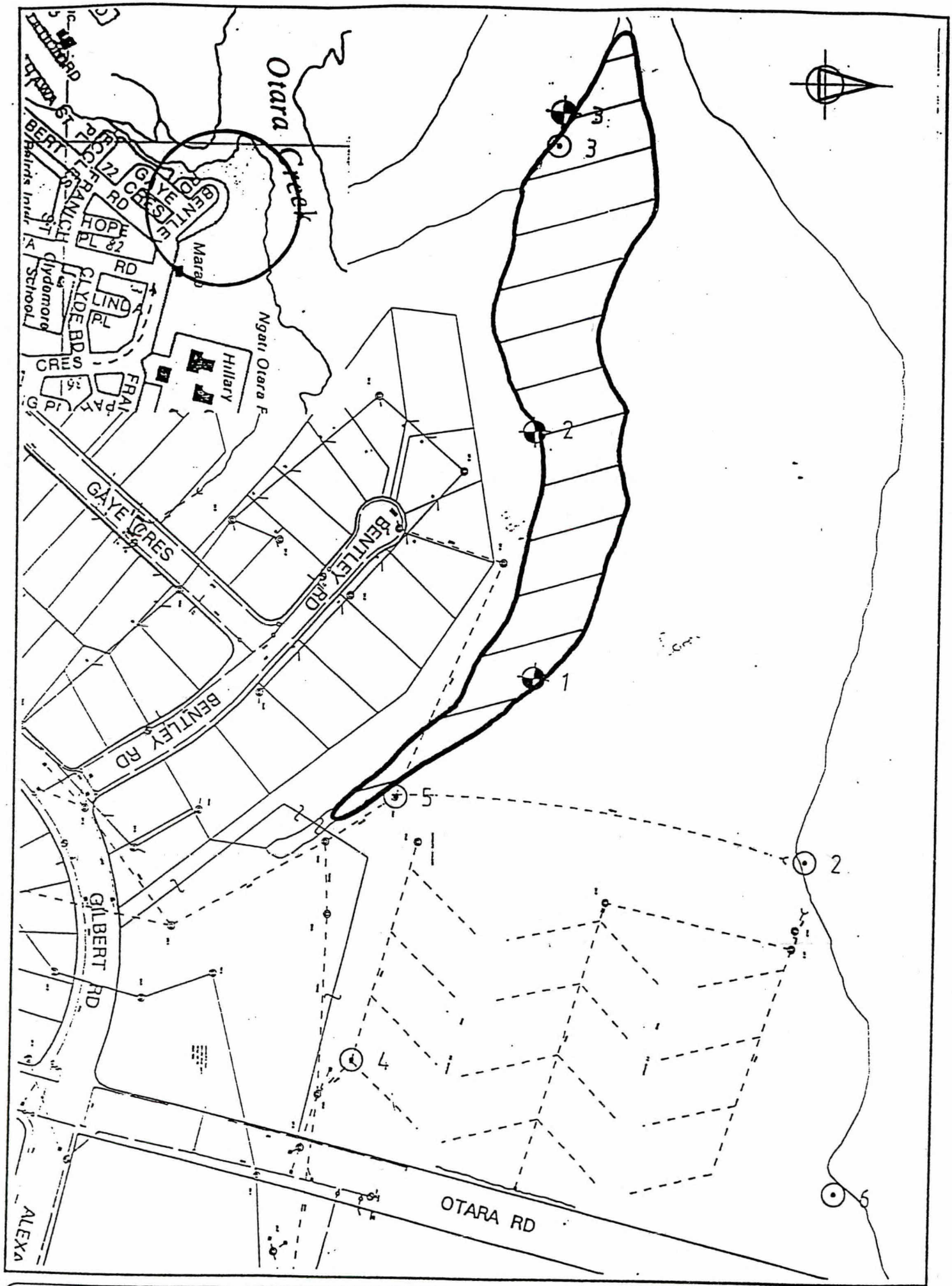
✓ △

10398 Info Detail C.1484

LIR

Shirley Treneary 8828.

Report on all properties (Street Address LD) relating to Info Detail 10398.



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Fax (09) 262 3131

TITLE

NGATI OTARA
WATER SAMPLING LOCATIONS

REV CHK

	SIGNED	DATE
DRAWN	D. Lander	02/99
CHECKED	A. Robinson	02/99
M.E. APPROVED		

REV.

PLANNING

Blk	Sheet	TP
3	88, 89	24c
7	04	

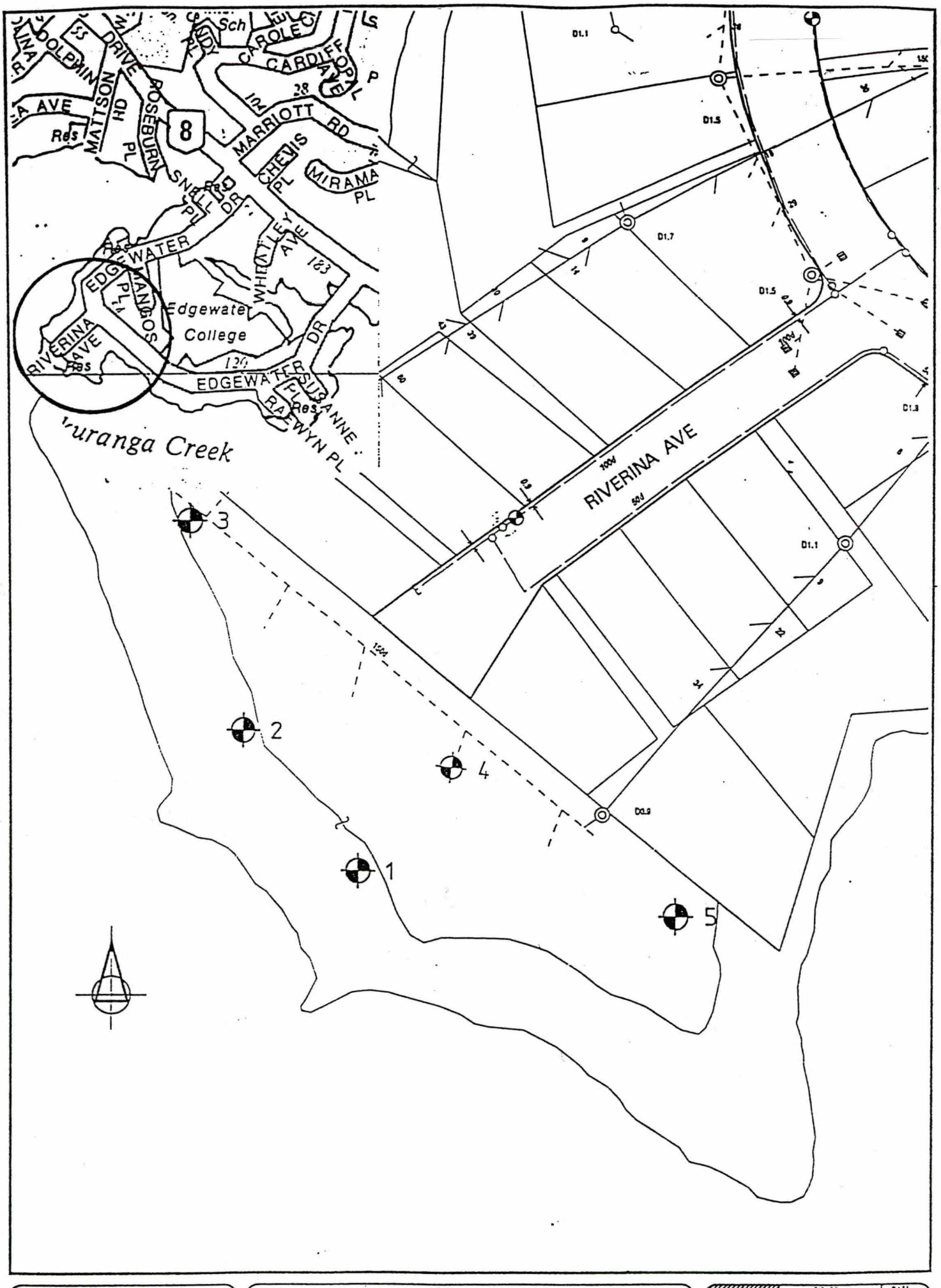
33R Edgewater Drive

Lot 267
DP 54562
4325 m²

✓ Δ

Lot 256
DP 54562
7411 m²

✓ Δ



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Telephone (09) 262 0911
Fax (09) 262 0913

TITLE

RIVERINA AVENUE
WATER SAMPLING LOCATIONS

REV CHK

REV

	SCHED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

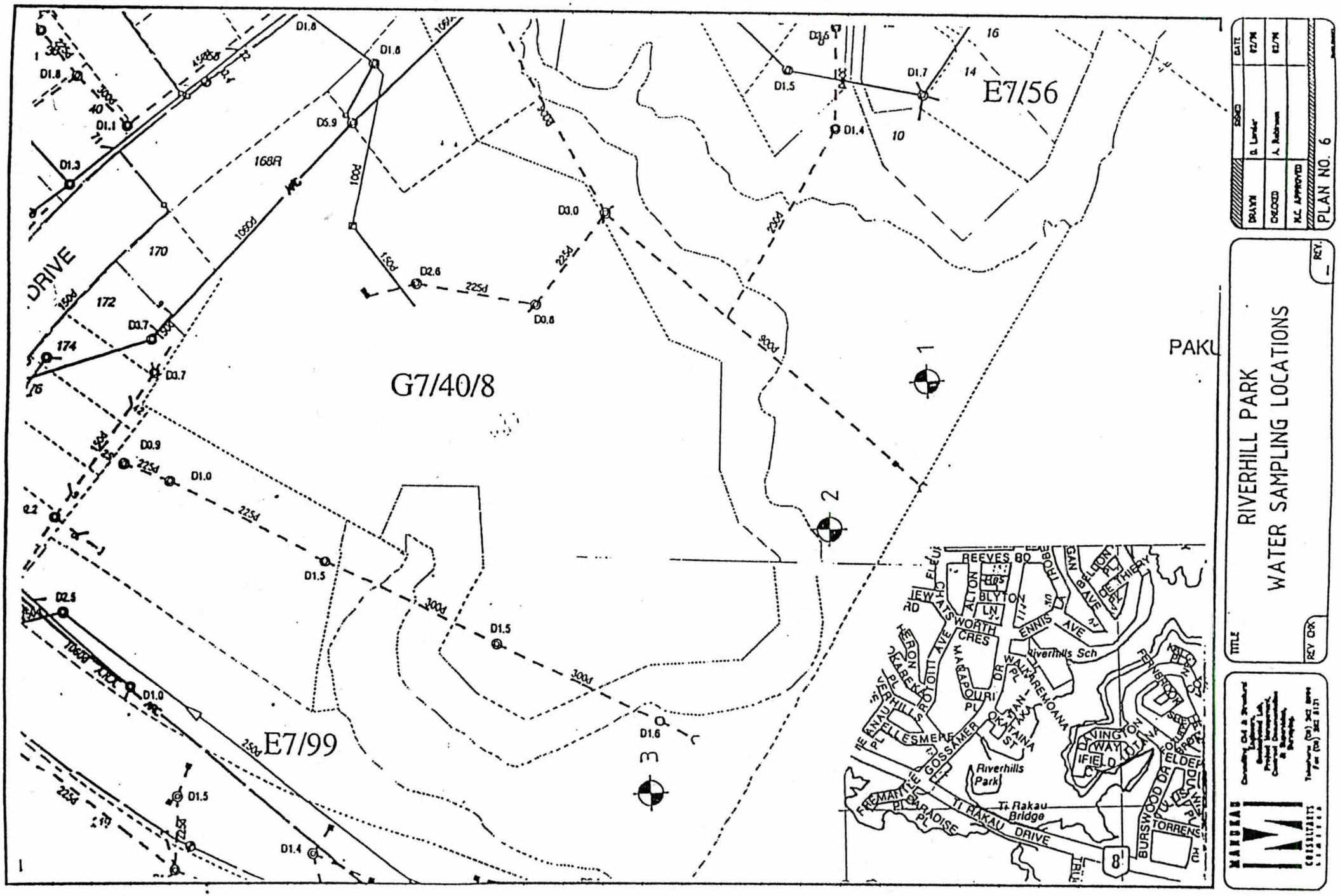
PLAN NO 5

Blk 7 Shed ⊗ TP
13, 14, 15, 16 23d, 24b, 24d

SO 51501 1.4282 ha. ◁ ✓

Lot 109 D.P 52077 6528 m² ×

Lot 108 DP 52077 2.0520 ha. ×

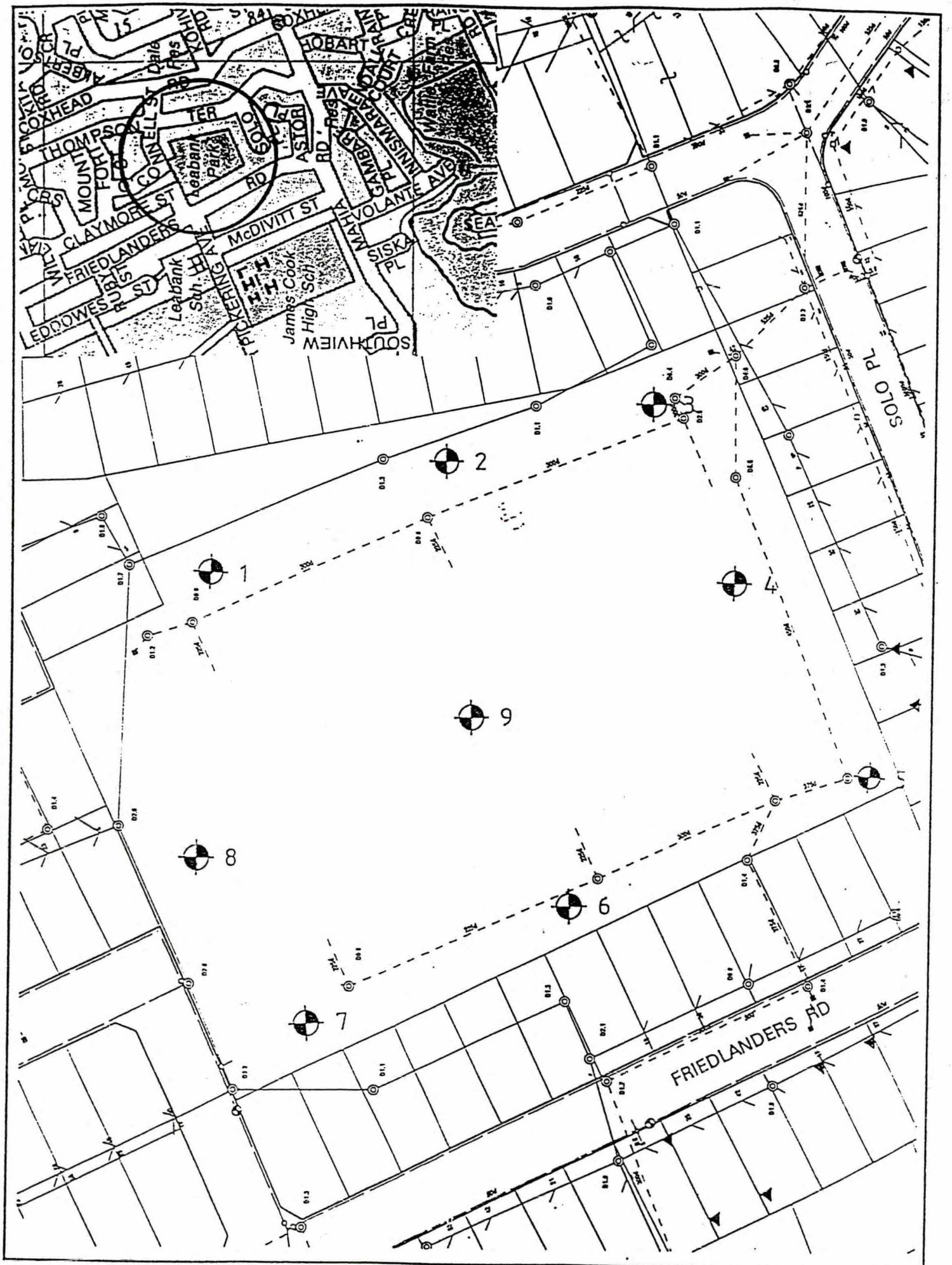


BLK	Sh.	TP
9	16, 17	30d

30R

Lot 1 DP 51364

3.6949 ha.



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Fax (09) 262 3131

TITLE

LEABANK PARK
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

REV CHK

REV

Blk. Sh. TP

01 ~~91~~, 92, ~~93~~. 10a 10c 5d.

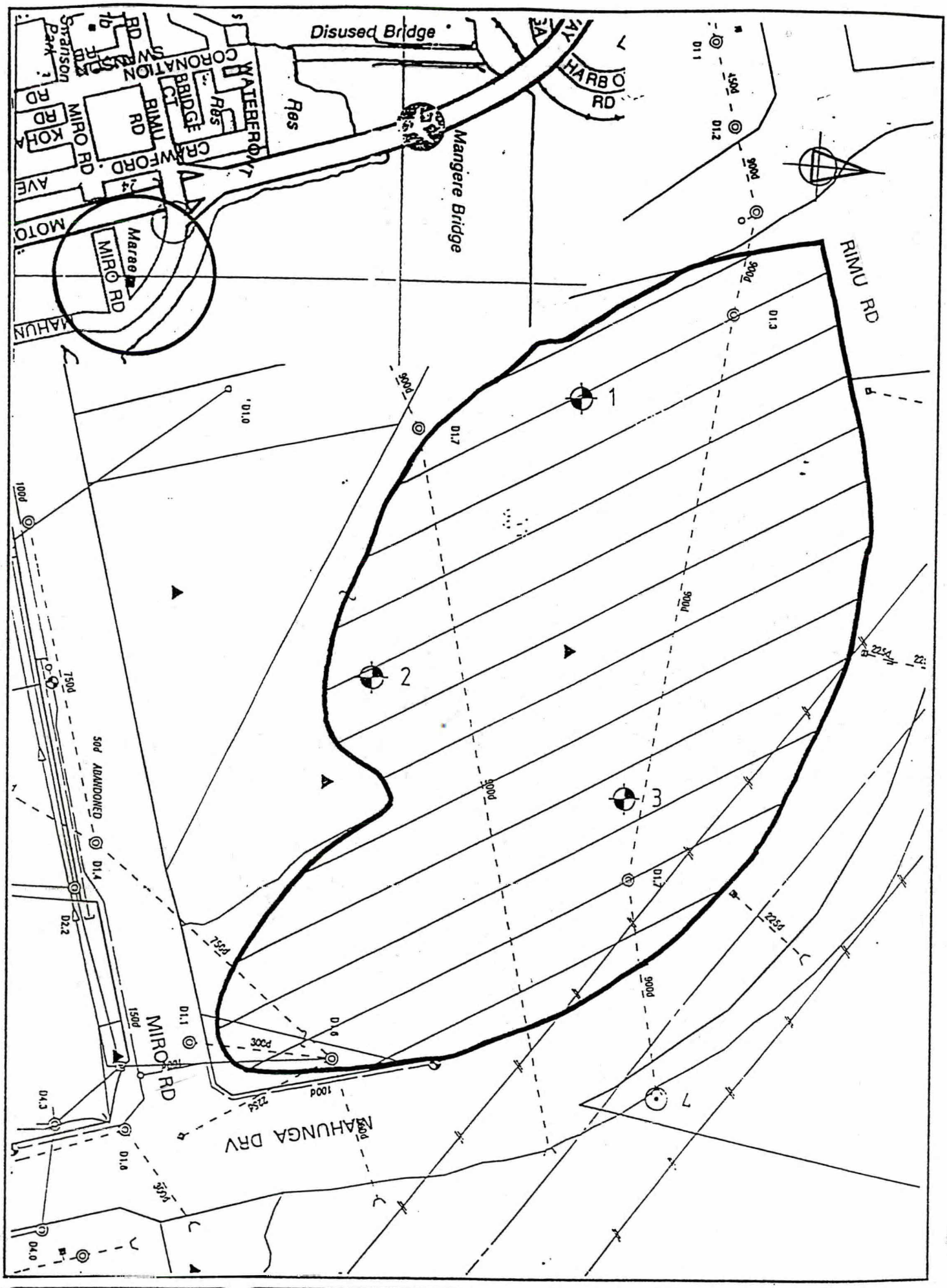
Pt Sec 1 Blk V Otahuhu SD.

SO 56622 2.0670 ha ✓

0.3213 ✓

Sec 14 SO 56538

610 m²



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Fax (09) 262 5131

TITLE

MIRO ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV --

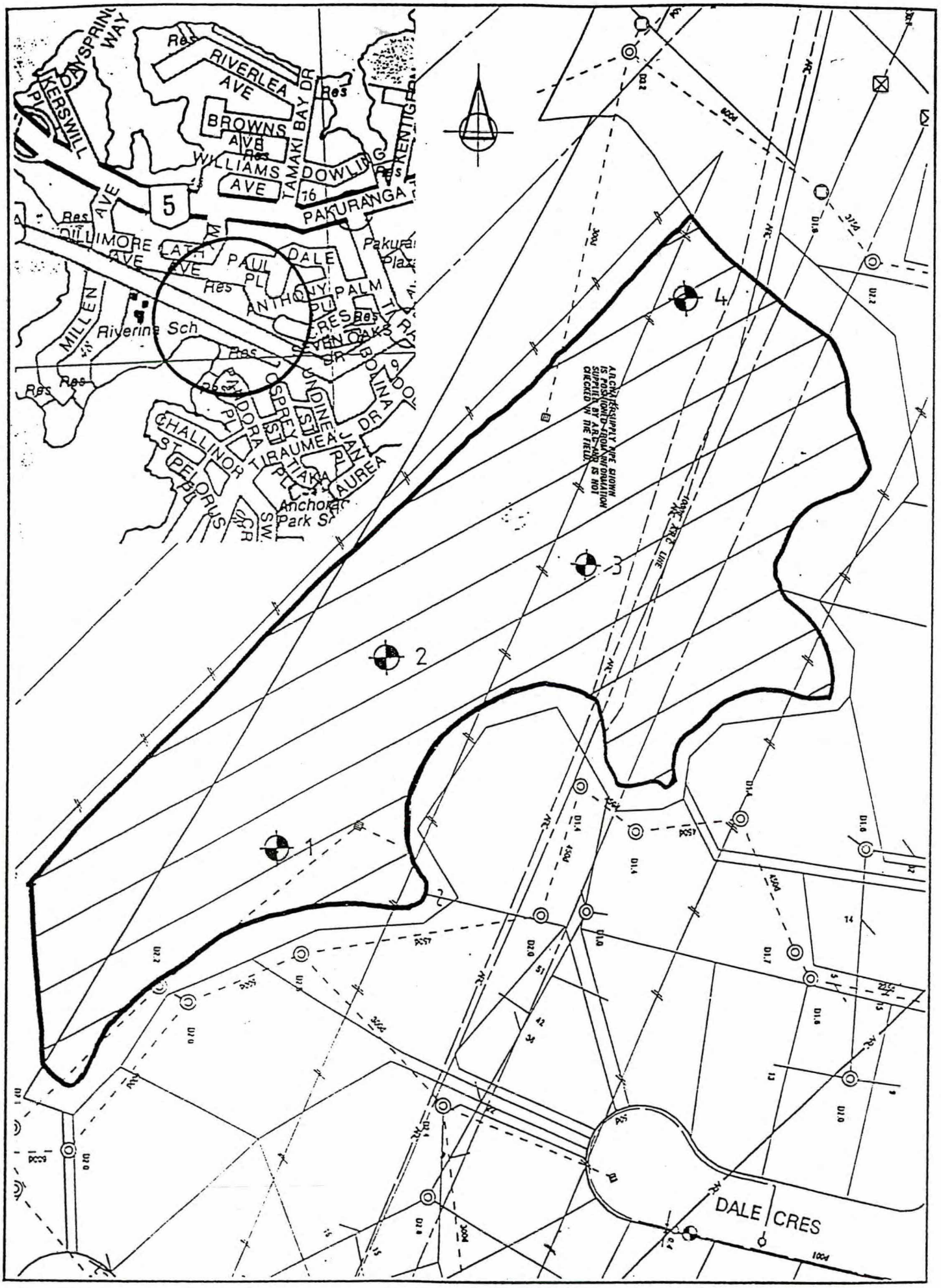
	SIGNED	DATE
DRAWN	D. Lawlor	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO 8

Blk.	Sh.	TP
03	~~86,87~~	23C

Sec 1 SD 52269

9740m²



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Telephone (09) 262 8111
Fax (09) 262 313

DALE CRESENT
WATER SAMPLING LOCATIONS

REV

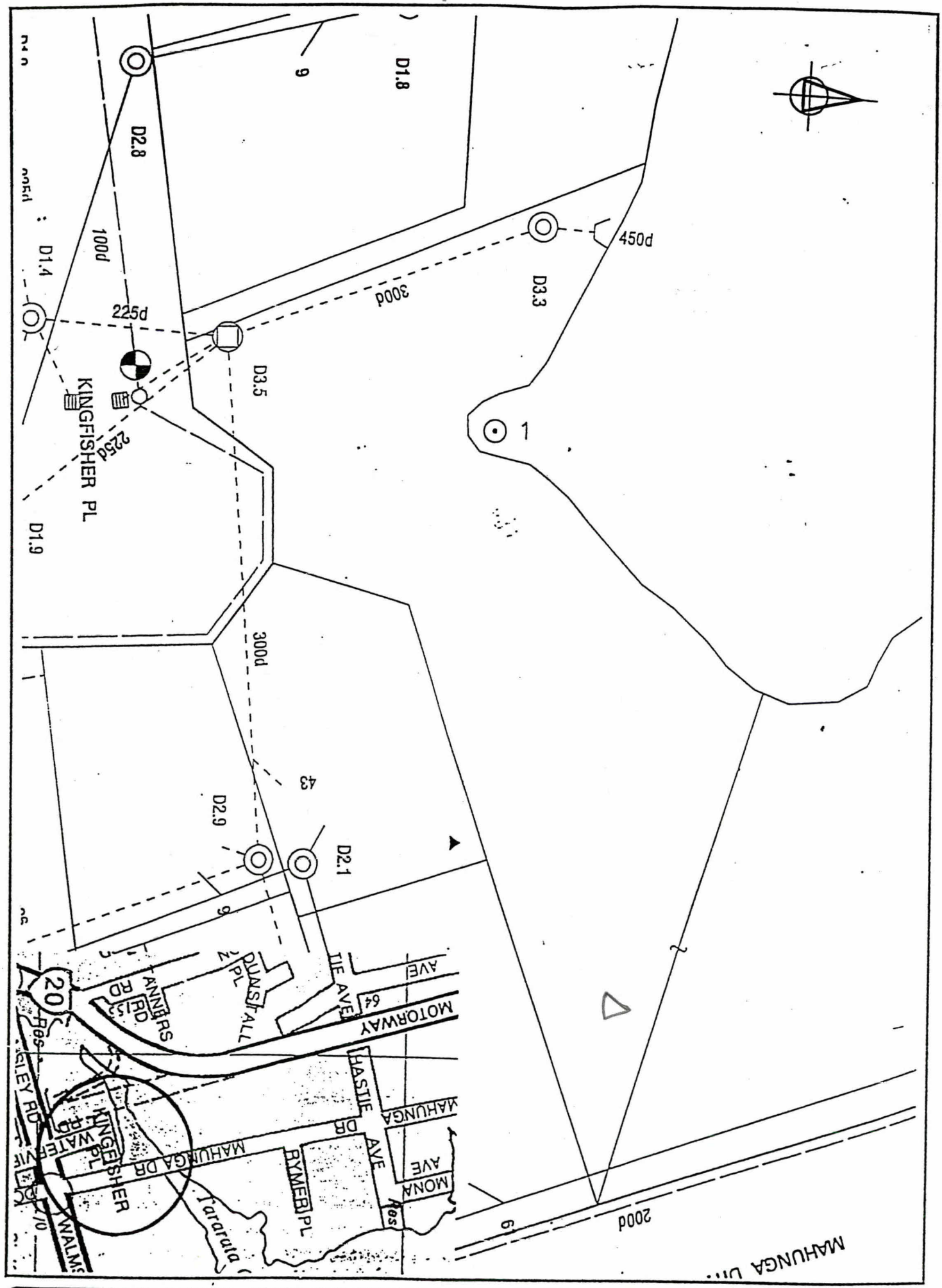
	SIGNED	DATE
DRAWN	D. Lander	07/11
CHECKED	A. Rahman	07/11
M.C. APPROVED		

PLAN NO 9

Blk.	Sl.	TP
~~03~~	~~83~~	~~26a~~
01	95	

Lot 34
DP 99764
2330 m²
Δ ✓

Lot 37
DP 99763
5130m²
x



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Telephone (09) 262 8000
Fax (09) 262 8131

TITLE

KINGFISHER PLACE
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO.

Blk. Sh. TP

~~15, 4, 28~~, 29, ~~30, 31~~ 30d 31b

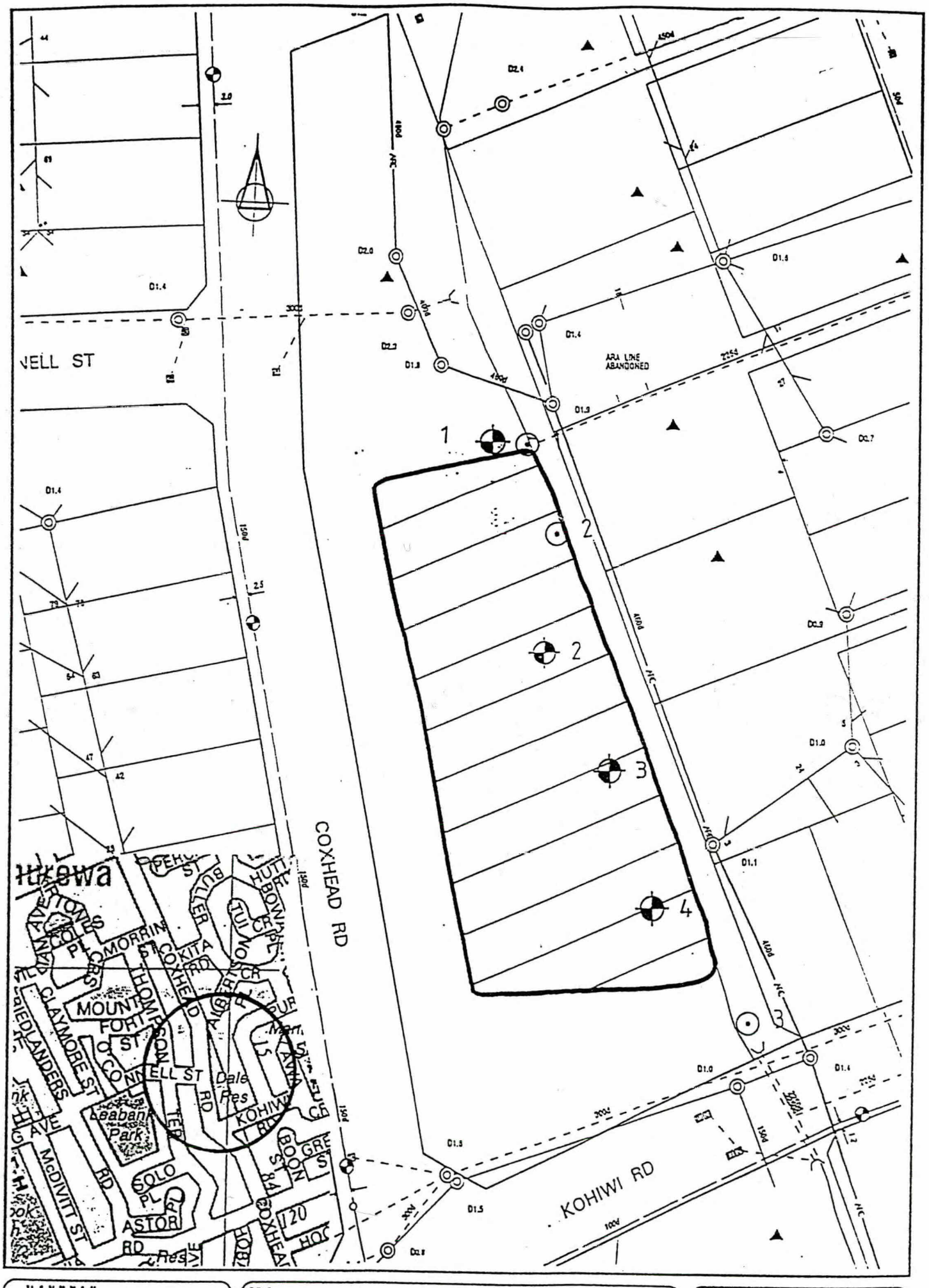
44a

68R

Allot 101

SO 42279 Parish Papakura.

1.2788ha.



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Telephone (09) 262 8999
Fax (09) 262 5131

TITLE

COXHEAD ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Rahman	02/98
M.C. APPROVED		

PLAN NO 11

Blk.	Sl.	To
02	41, ~~42, 43~~	7a, 7b, 7c
	~~47, 52, 53, 63~~	8a

490

Lot 1 DP 156506

20.9500ha.

X

(Δ next section)

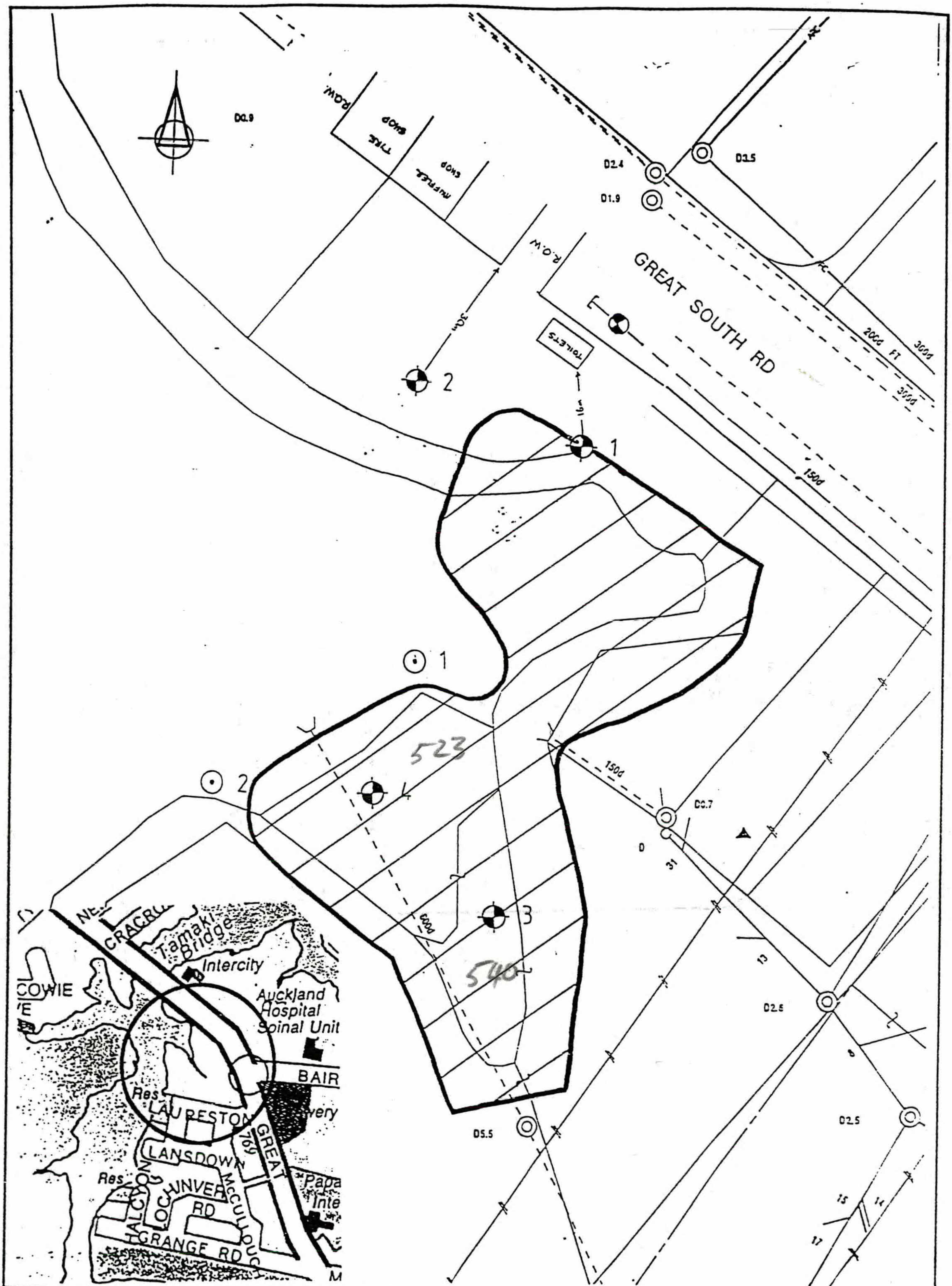
Pt. Allot 78A

9422m². ?

Blk.	Sh.	
03	72	16d.
04	61 72	

Allot 523
SO 55438 Parish of Manurewa.
813 m² Δ ✓

Allot 540
SO 55438
450 m² Δ ✓



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TITLE

GREAT SOUTH ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/91
CHECKED	A. Robinson	02/91
M.C. APPROVED		

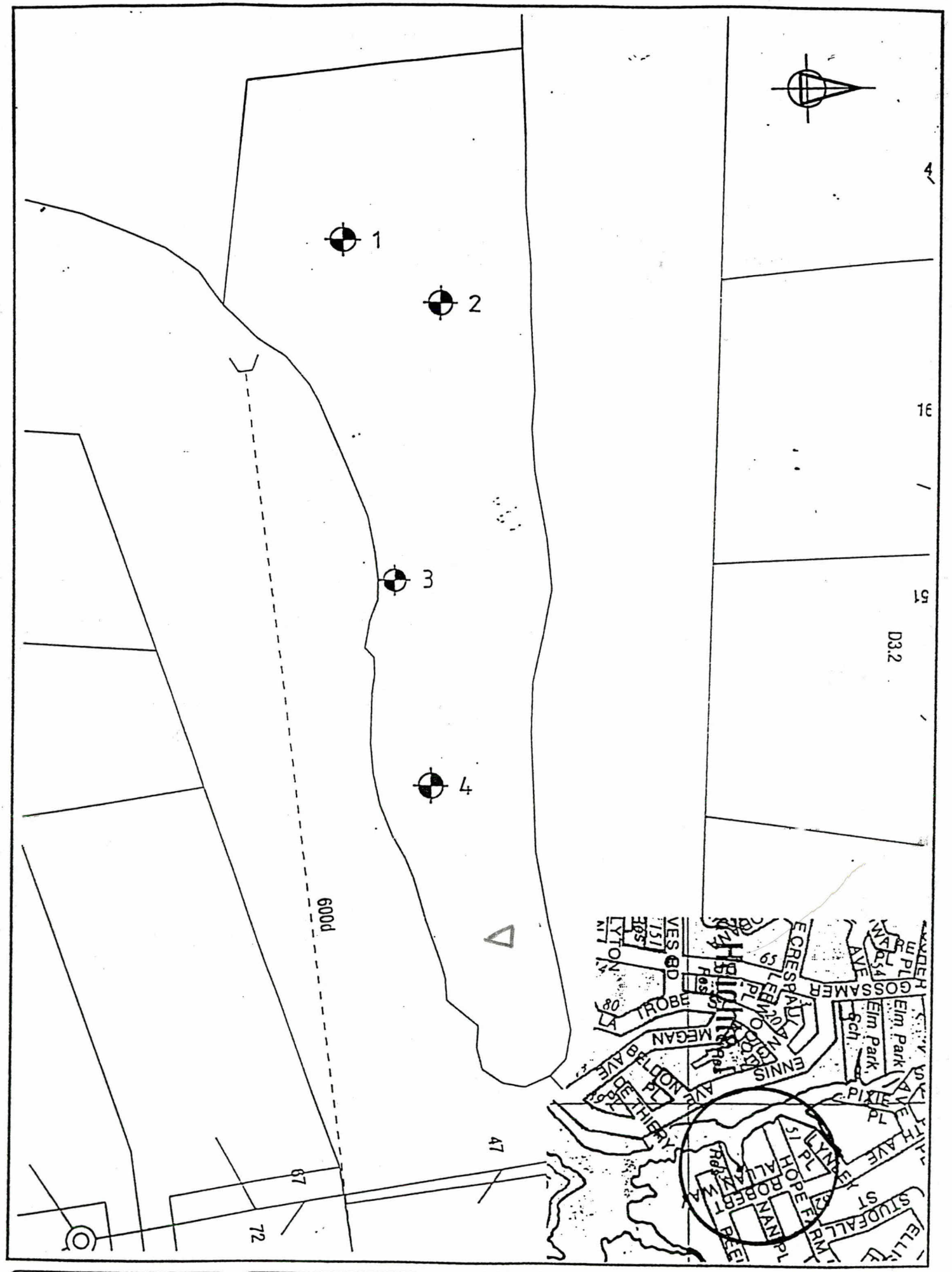
Blk.	Sh.	TP
07	26	36c, 37a

Allot 386

SO 49436 Parish of Pa Kuranga.

2011 m²

Δ ✓



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Telephone (09) 262 8099

TITLE

ROBERT ALLAN ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	07/11
CHECKED	A. Robinson	07/11
M.C. APPROVED		

REV CHK

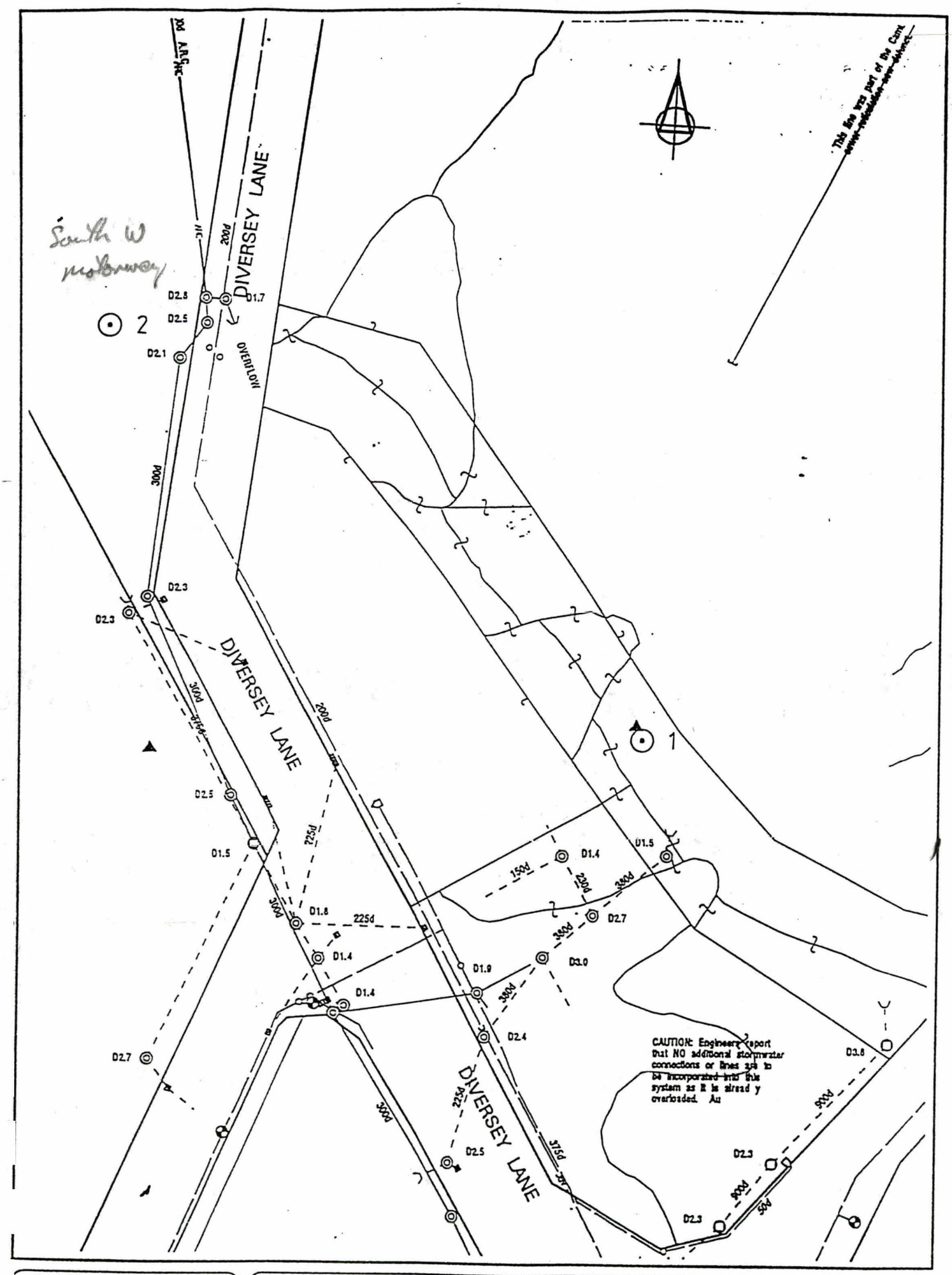
Blk.	Sh.	TP
04	~~68~~, 69	18d.

(1)

Pt Lot 1
DP 28051
2033 m²

△ ✓

(2) SW motorway. ×



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Fax (09) 262 5131

TITLE

ROSCOMMON ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

REV CHK

REV.

PLAN NO. 45

TIRAUMEA RESERVE
WATER SAMPLING LOCATIONS

TITLE

DRAWN	D. Lawler	07/11
CHECKED	A. Robinson	07/11
RLE APPROVED		
	SCALE	DATE

MAXDRAU CONSULTANTS

TIRAUMEA DRV

~~BLK~~ Sh. TP

01 ~~80, 81, 82, 85~~ 10c, 11a, 5b, 5d

~~94, 95~~

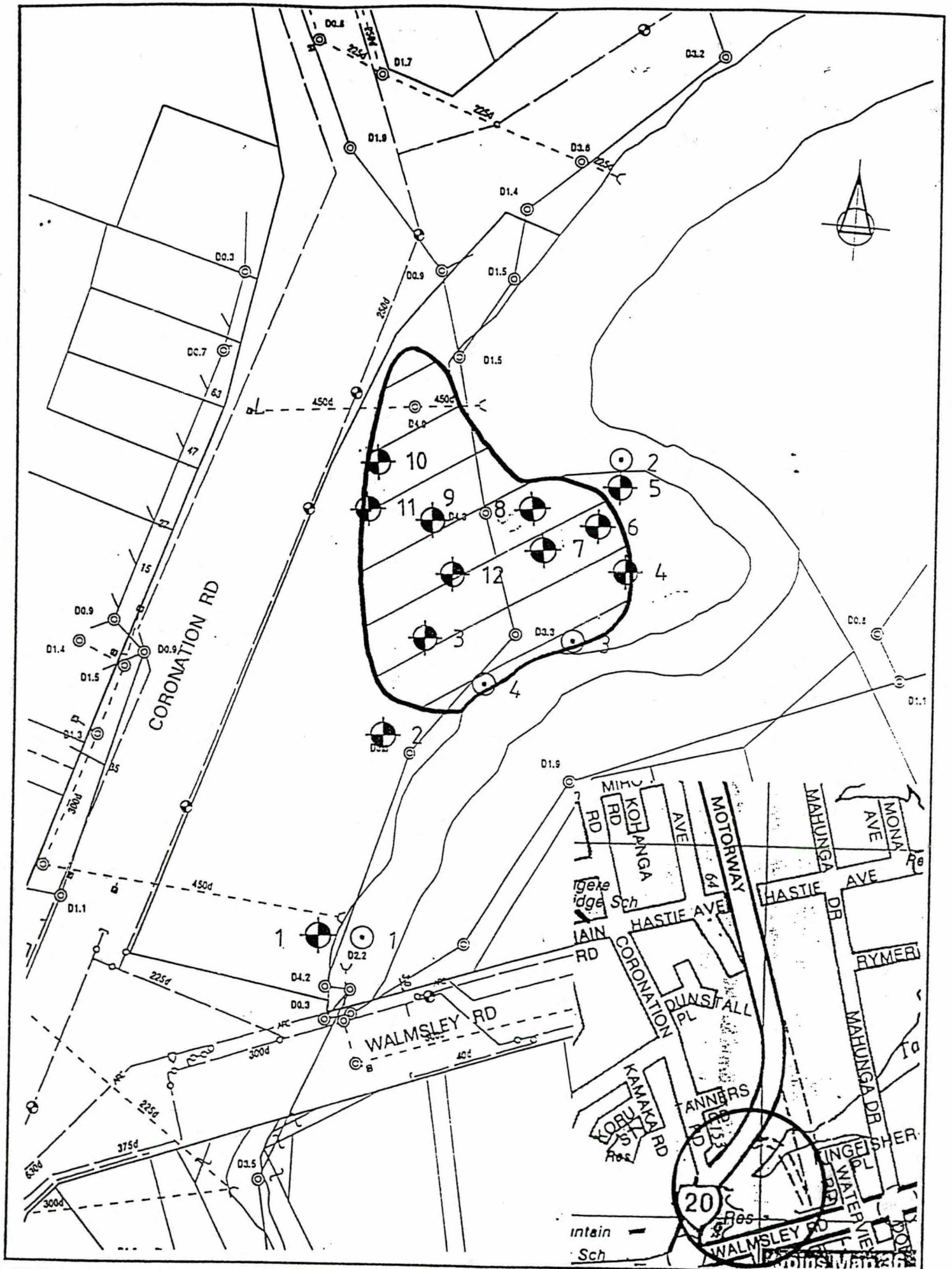
All of 218

SO 59109

Suburbs of Mangere.

1.1600 ha.

Δ ✓



Blk. 07 Sh. Pt

~~5~~, 14, ~~15, 16~~ 23d, 24b

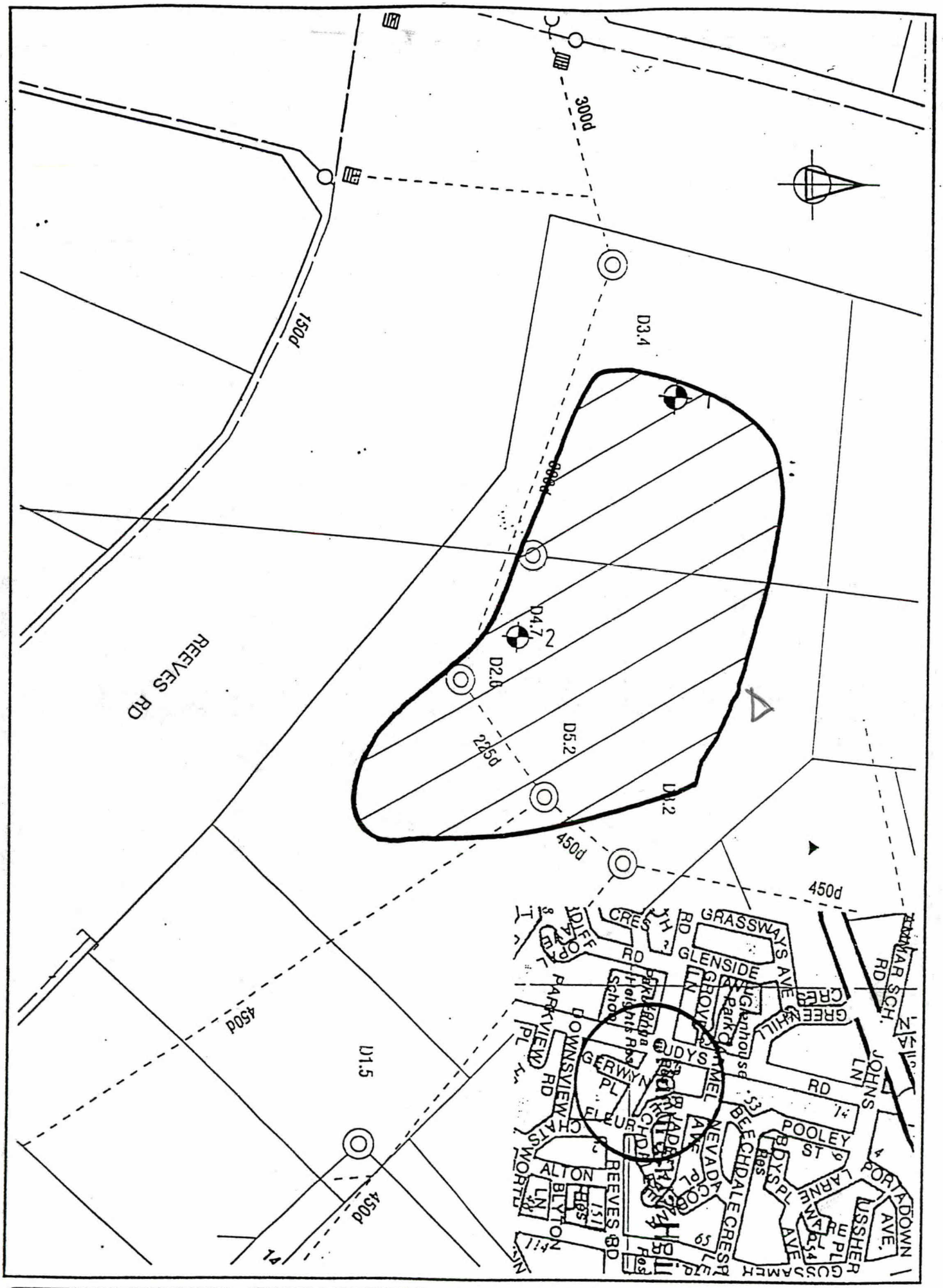
74R

Lot 279

DP 57254

3546 m²

Δ ✓



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Fax (09) 262 8131

TITLE

UDYS ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGN:	DATE:
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO. 18

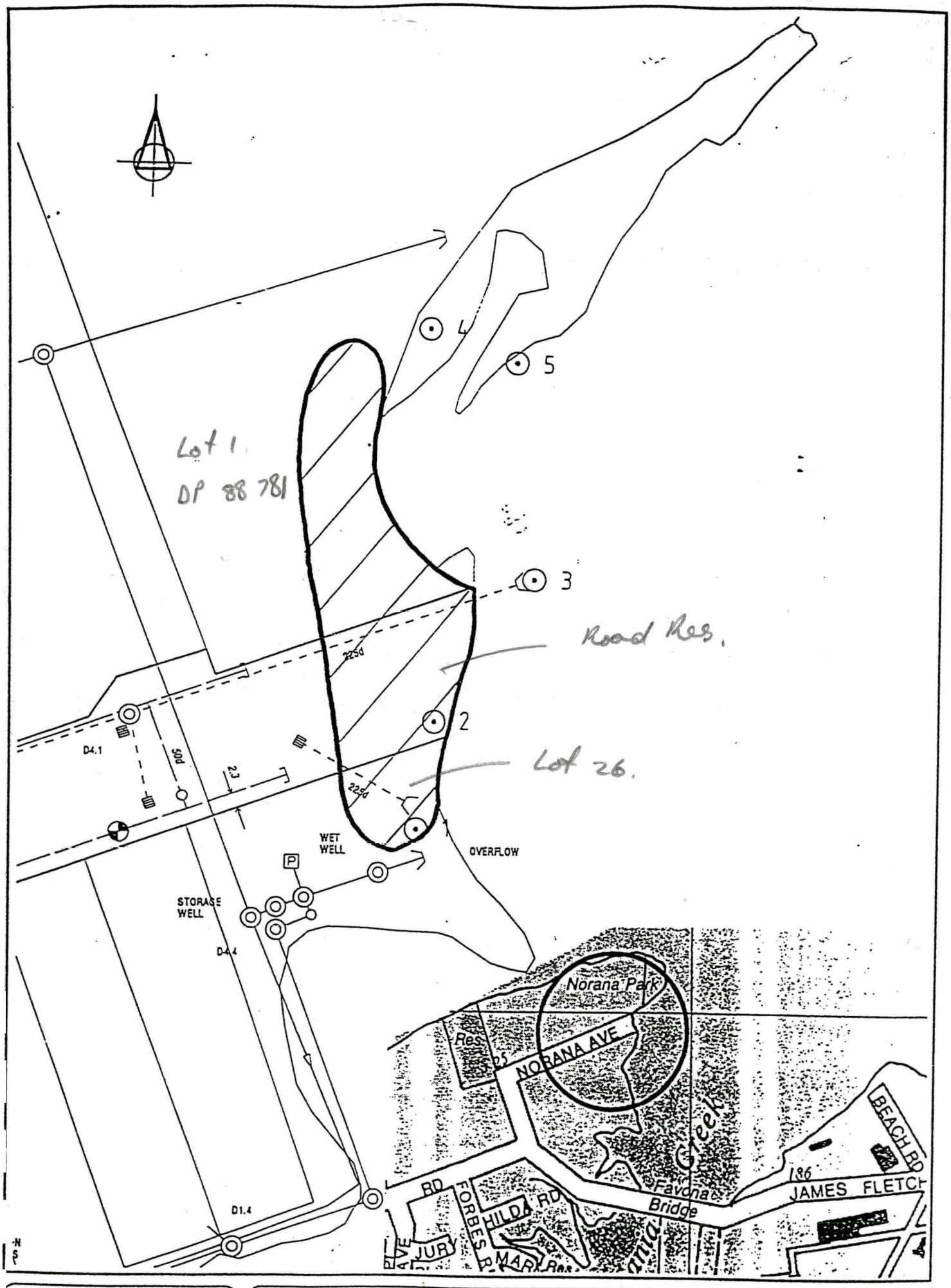
Blk. Sh. TP

03 21, ~~22~~ 10 Q

Lot 26
DP 22801
1290 m²

Lot 1
DP 88781
2.1865 ha

Road Reserve Wairarapa Rd



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TITLE

NORANA ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robertson	02/11
M.C. APPROVED		

Blk.	Sh.	TP
07	~~44, 5~~ 26, ~~27~~	23d, 24b, 36c, 37a

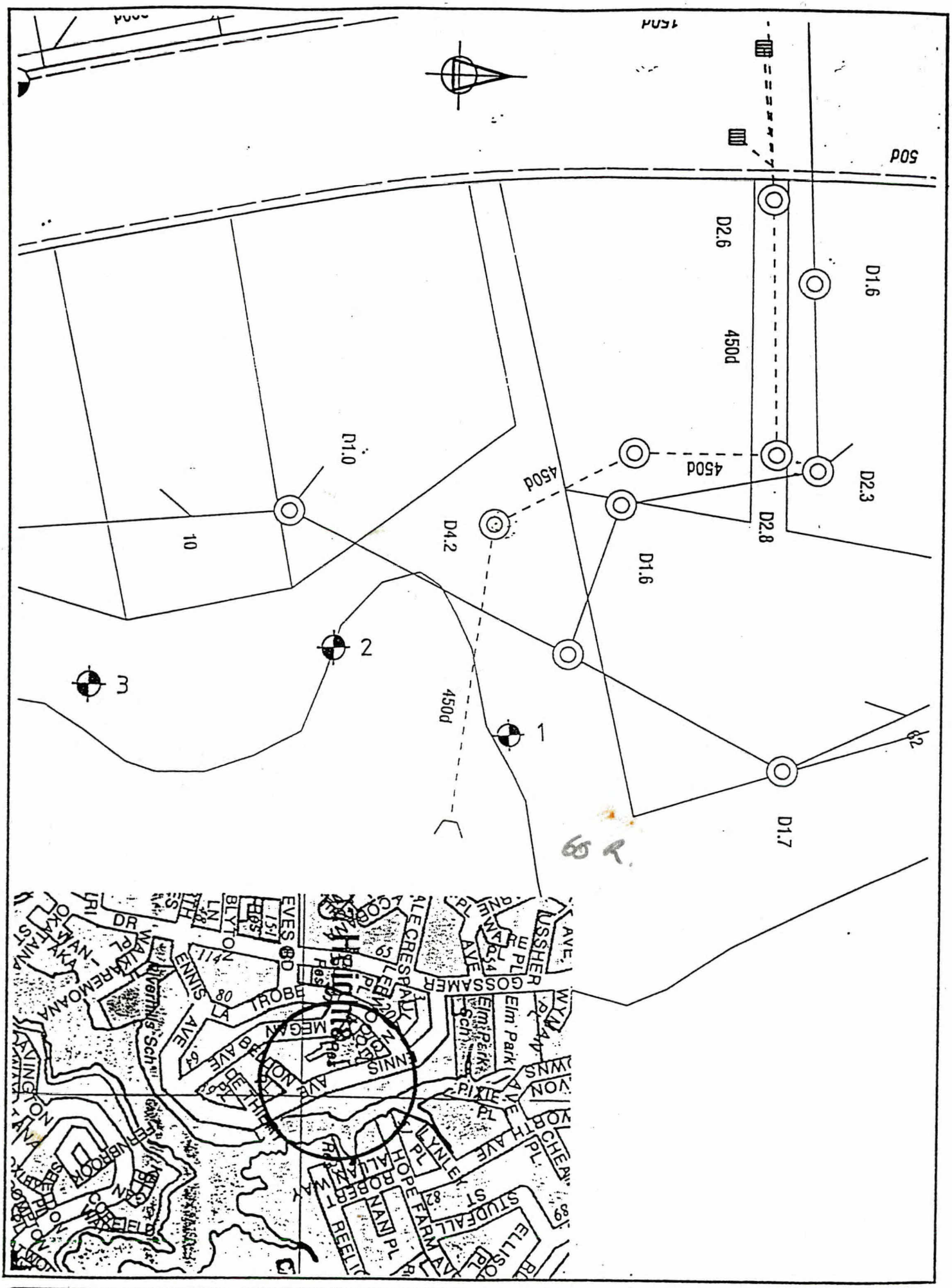
60R

Lot 118

DP 55287

6083 m²

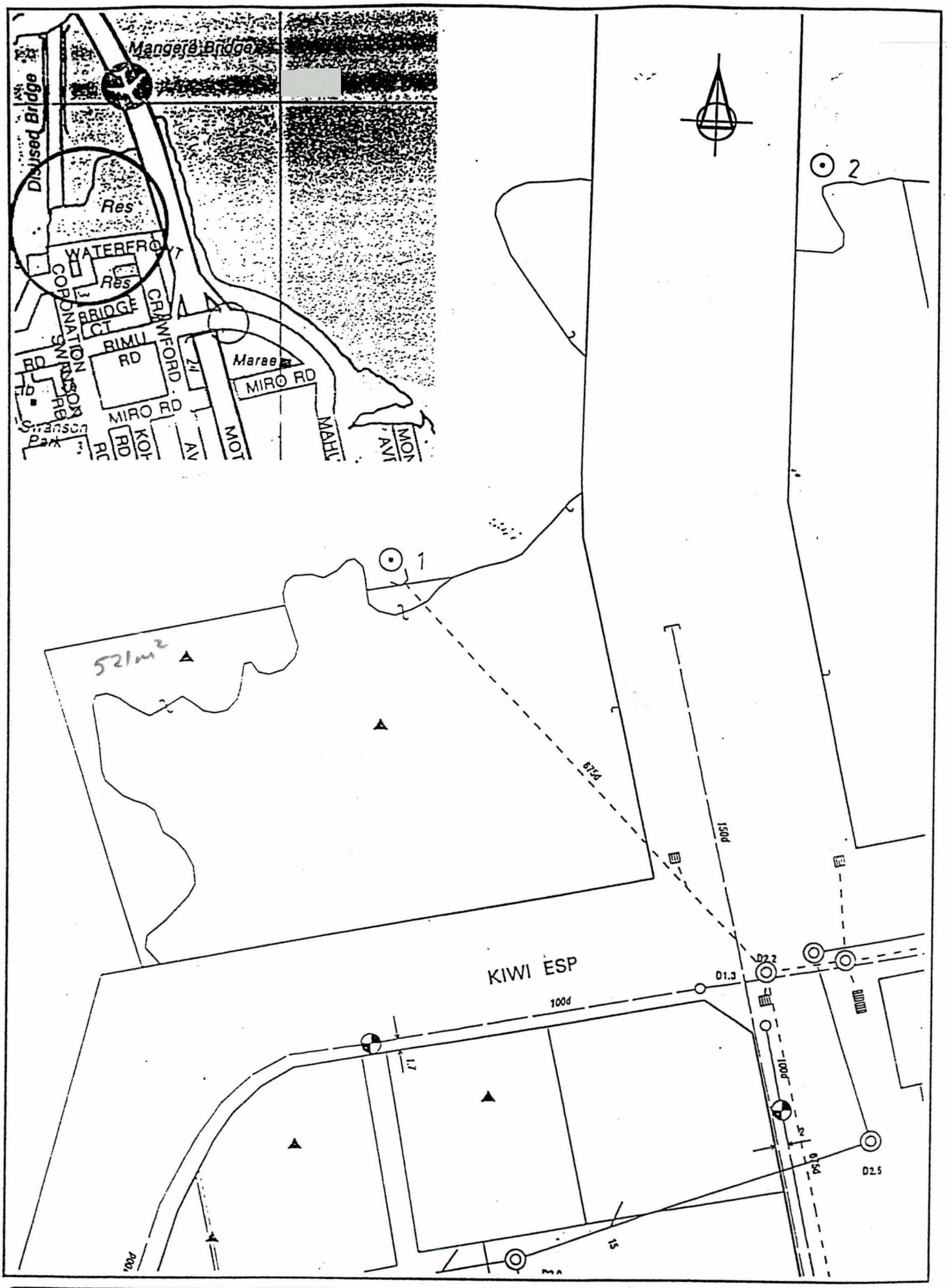
X



Blk.	Pt.	TP
01	~~44, 57, 67,~~ ~~68,~~ 80	5a, 5b.

Pt Allot 68
SO 25129 ×
Village of Mangere

Pt
SO 42353
521m² Δ J



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Fax (09) 262 8137

TITLE

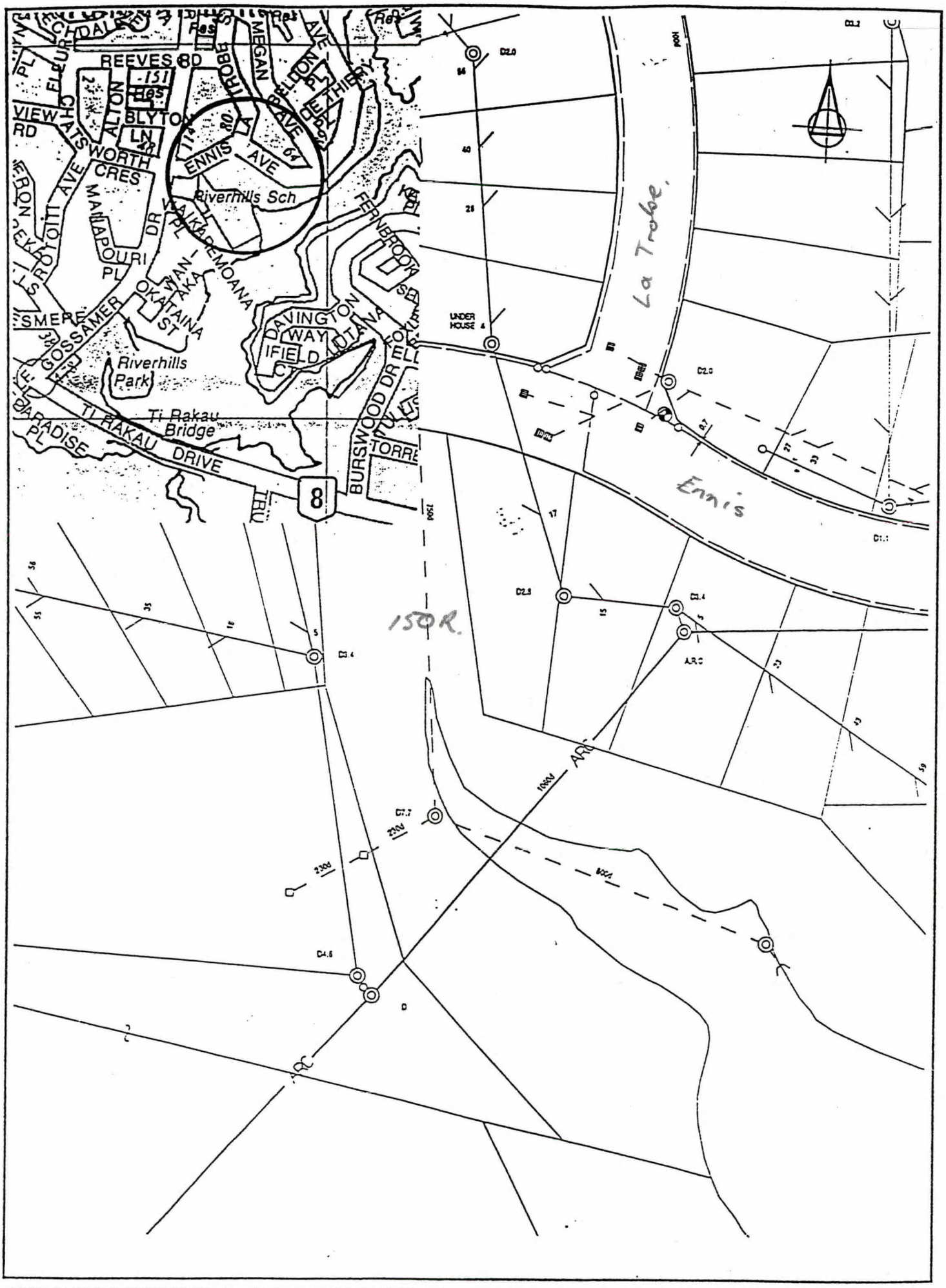
KIWI ESPLANADE
WATER SAMPLING LOCATIONS

REV CHK

REV. --

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

PLAN NO. 21



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TITLE

RIVERHILLS SCHOOL
WATER SAMPLING LOCATIONS

	SCALE	DATE
DRAWN	G. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

REV CHK

REV.

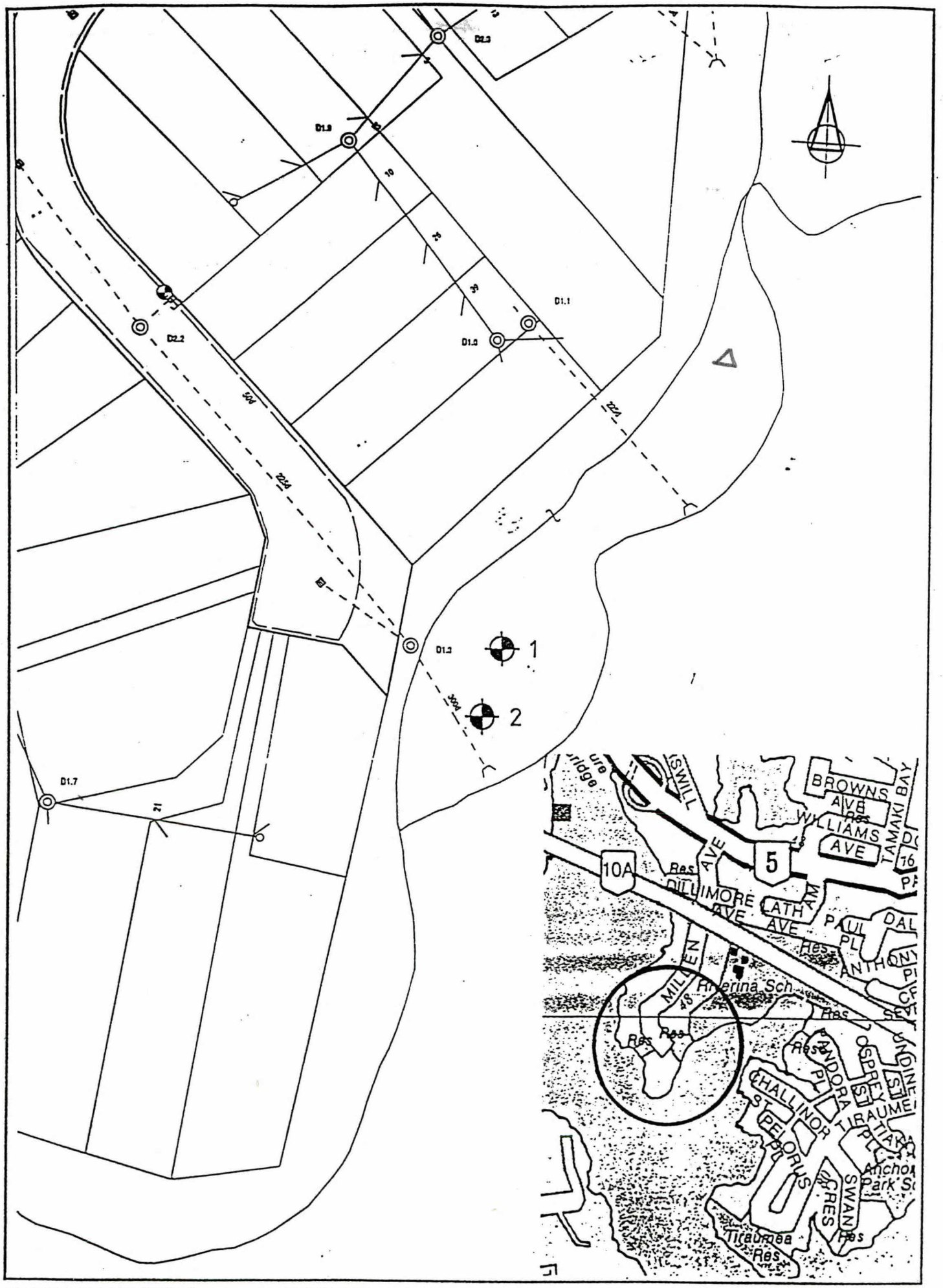
PLAN NO. 22

Blk.	Sh.	TP
03	~~24~~, 75	23c 24a

SO 49492

2760 m²

Δ ✓



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TITLE

MILLEN AVENUE
WATER SAMPLING LOCATIONS

REV CHK

REV.

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
MCC APPROVED		

PLAN NO. 22

Blk.	Sh.	TP
~~03~~	~~86~~	23C 24Q
07	~~02~~ 03	

Pt Lot 1

DP 5?777

5.9273ha

△ ✓

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TITLE

TI RAKAU PARK
WATER SAMPLING LOCATIONS

REV	CHK	DATE

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

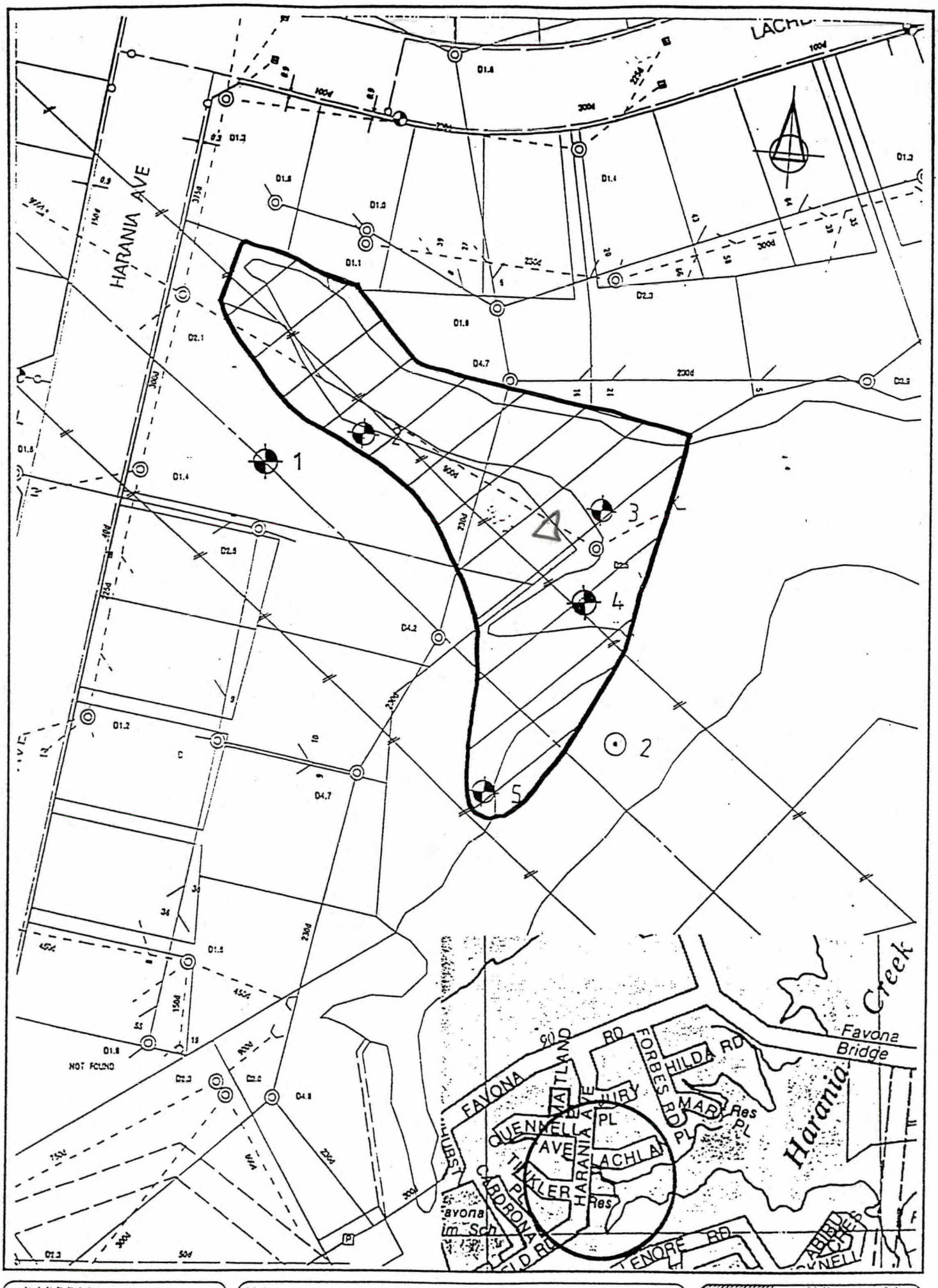
Blk. 03

Sh. ~~10, 11, 22~~, 23

TP 10d, 11b.

Lot 61
DP 61809
2914 m²

Δ ✓



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Telephone (09) 262 8999

TITLE

HARANIA AVENUE
WATER SAMPLING LOCATIONS

REV CHK

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

Blk. Pr.

06 72 36b, 36d, 46c

Lot 19

DP 48346

1252 m²

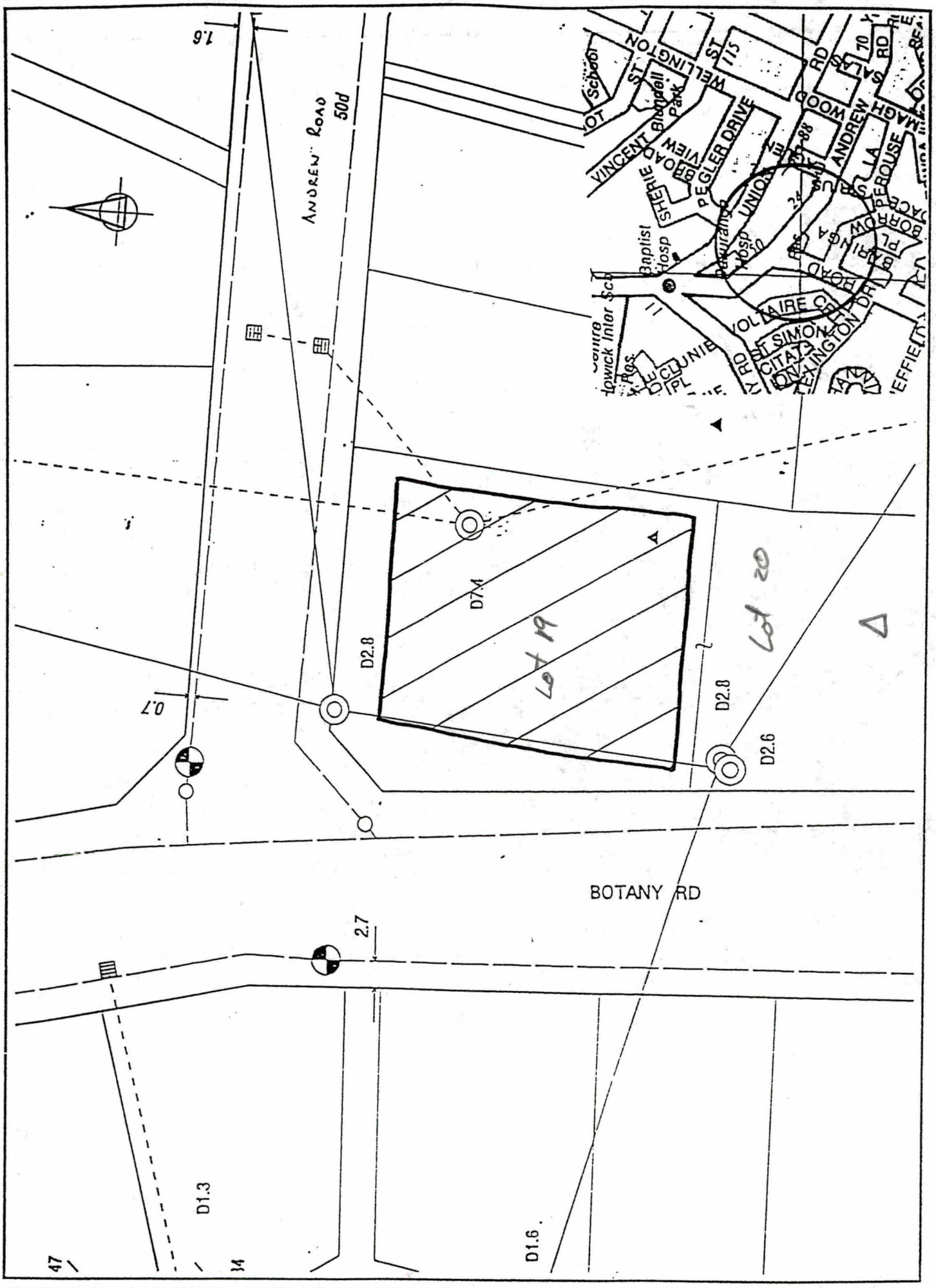
×

Lot 20

DP 48346

1189 m²

△ ✓



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TITLE

BOTANY ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
PLC APPROVED		

REV CHK

REV

PLAN NO. 21

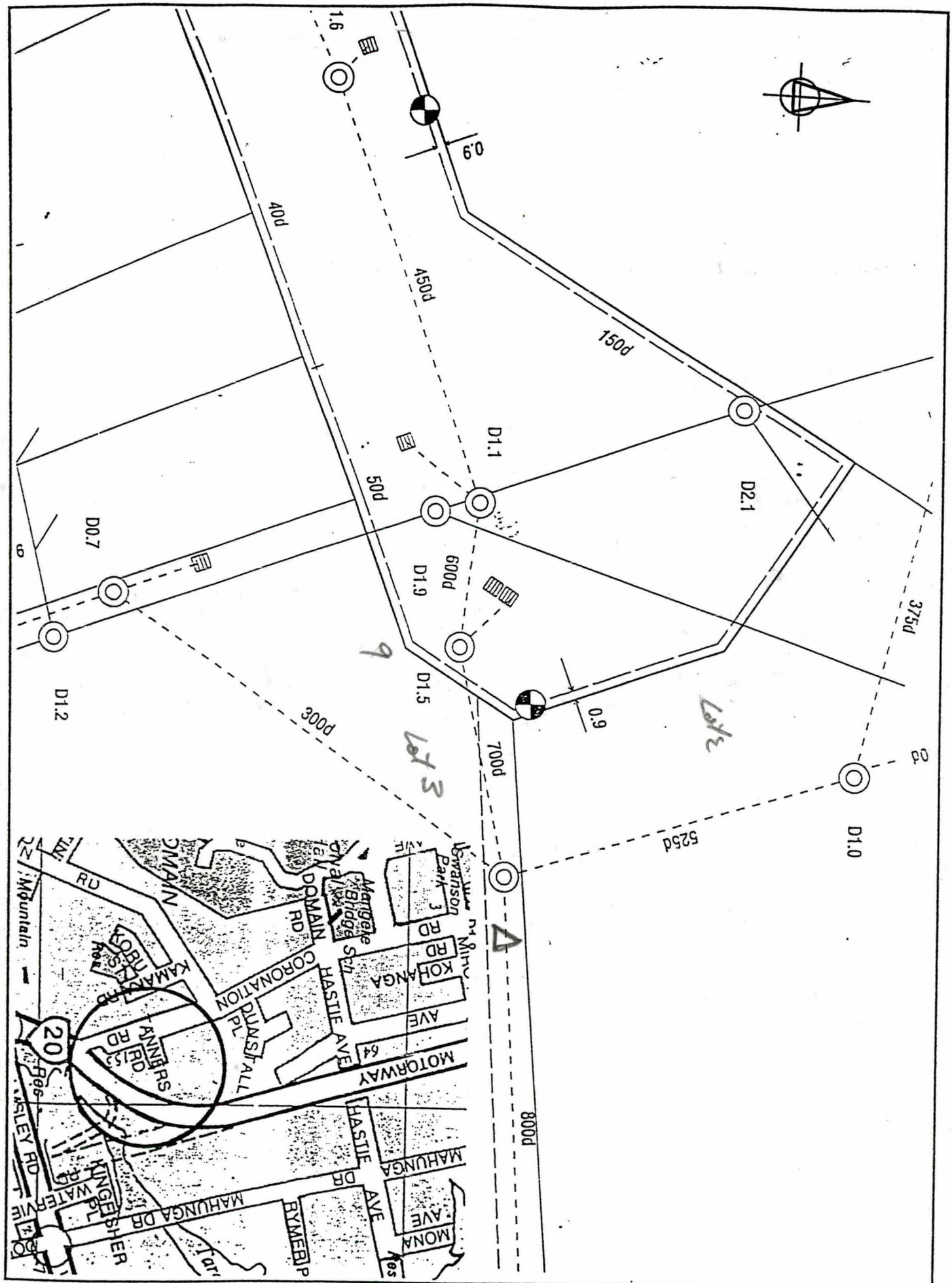
Blk. Sh. TP

01 ~~92~~, 94, ~~95~~ 10c, 11a

not defined.

Lot 3
DP 114450

Lot 2
DP 114450
4.3939 ha



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TITLE

TANNERS ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

REV CHK

REV

BK. SK. TP

01 V 01,02,04 55, 57

~~05~~ 1

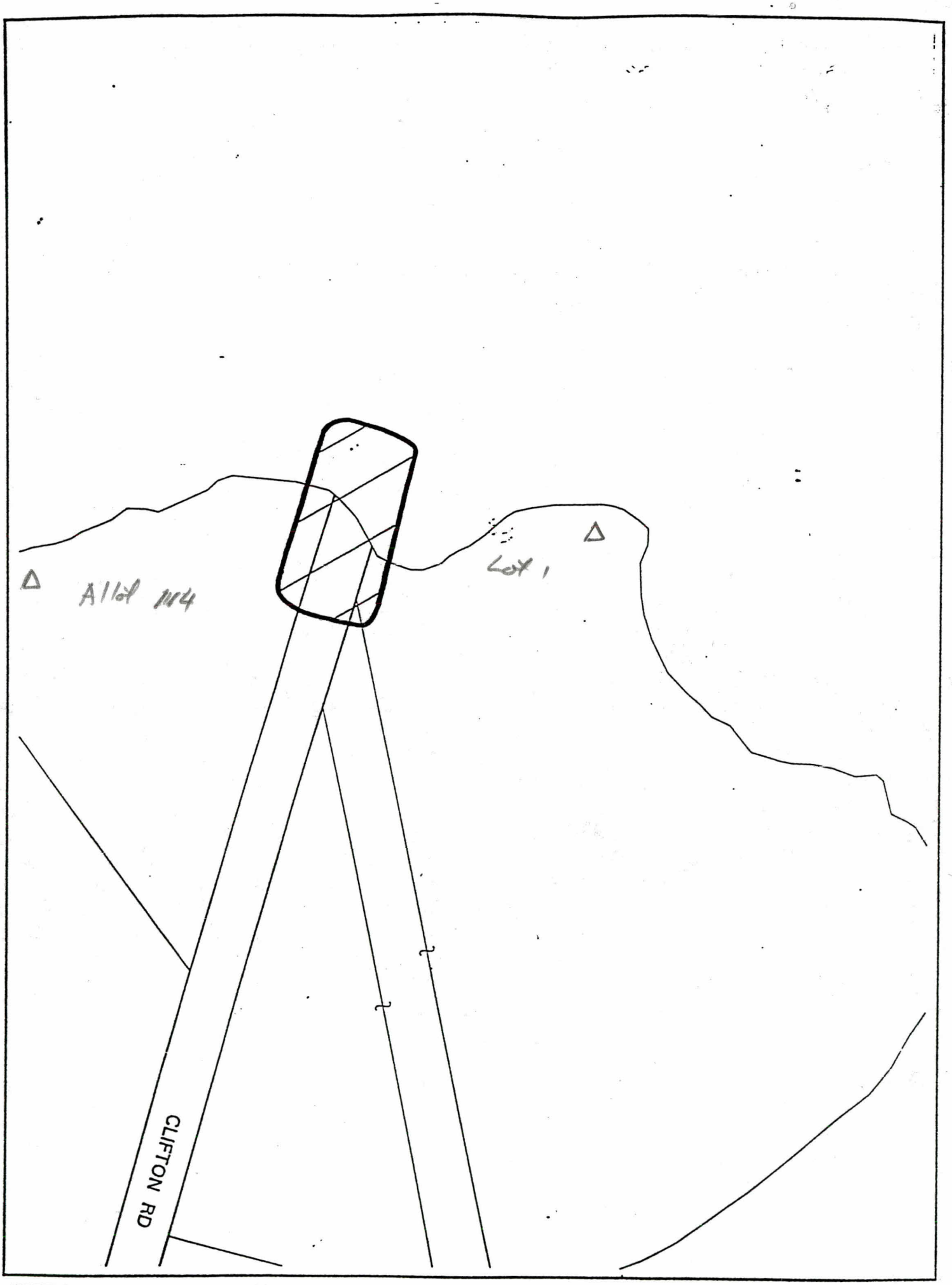
II I

End Rd. – Road Reserve

528 R

Allot 114
SO 45515 Parish of Pakuranga.
1.6946 ha. Δ ✓

Lot 1
DP 16612 Δ ✓
4.5932 ha.



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TITLE

CLIFTON ROAD
WATER SAMPLING LOCATIONS

REV CHK

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

Blk.	Sh.	TP
03	84	166 26a

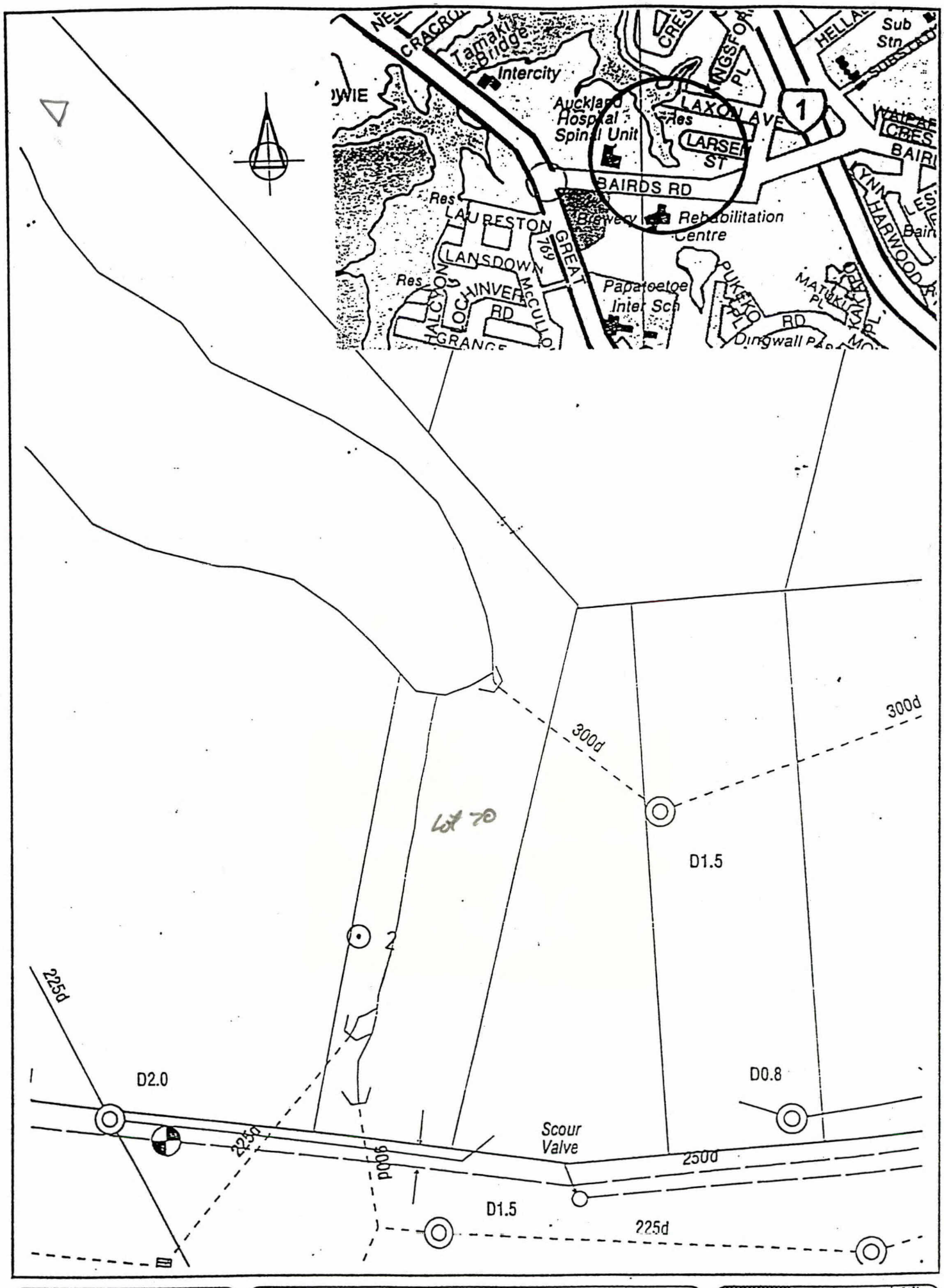
28 R

Lot 70

DP 43950

9384 m²

Δ ✓



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TITLE

BAIRDS ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

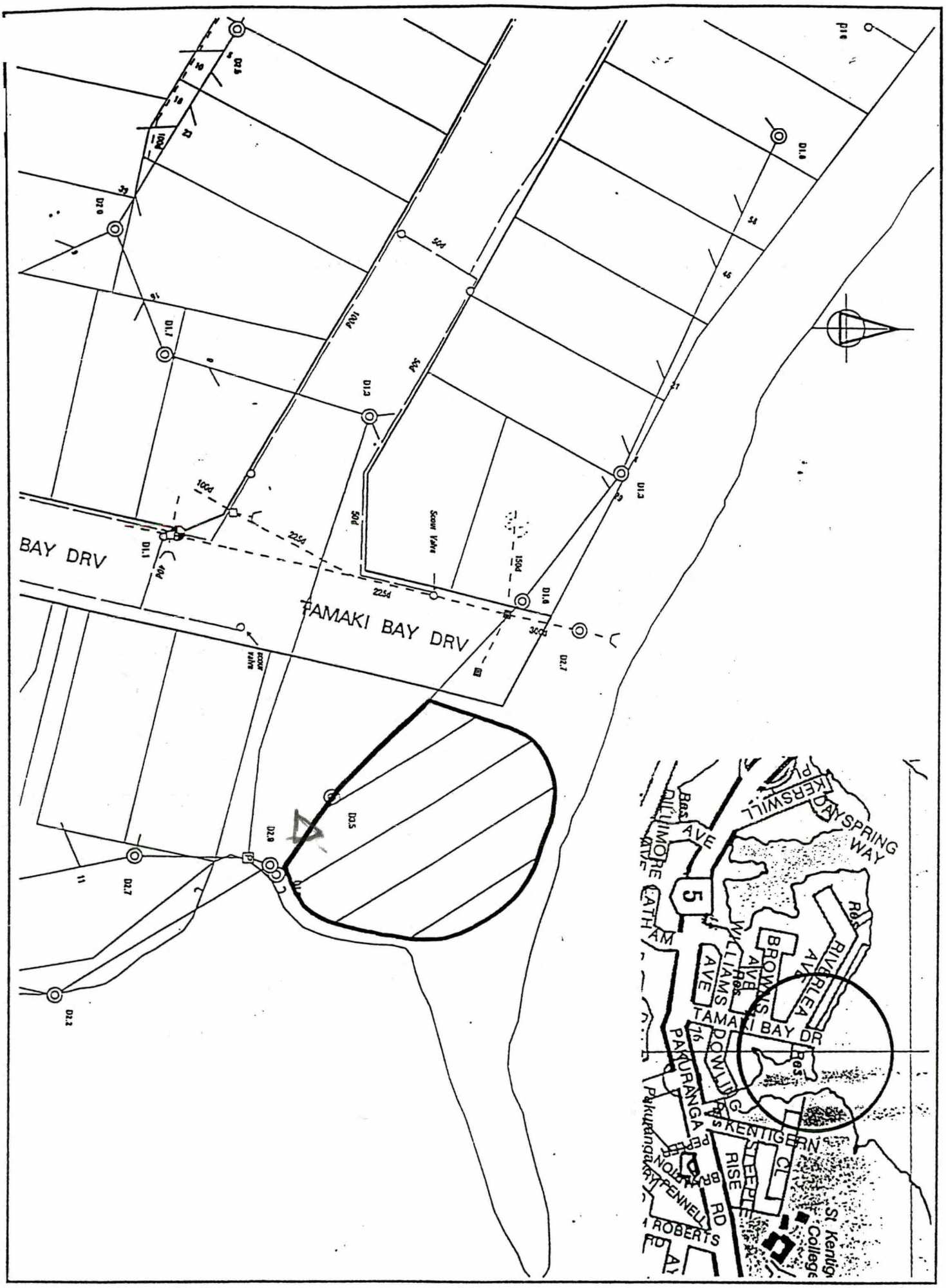
	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Rooney	02/98
M.E. APPROVED		

PLAN NO 25

Blk. Sh. TP
03 85 23C

Lot 84
DP 39000
1.1458 ha.
A ✓

Leigh
3 copies of
Te Kuiti Carpark
Contract for signing.
Thanks
Stuart.



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TITLE

RIVERLEA ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/08
CHECKED	A. Robinson	02/08
M.C. APPROVED		

REV CHK

Blk. 03 Sh. 22 10 d

145 R

On

Lot 9

DP 49029 Δ ✓

961 m² ?

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Fax (09) 262 5131

TITLE

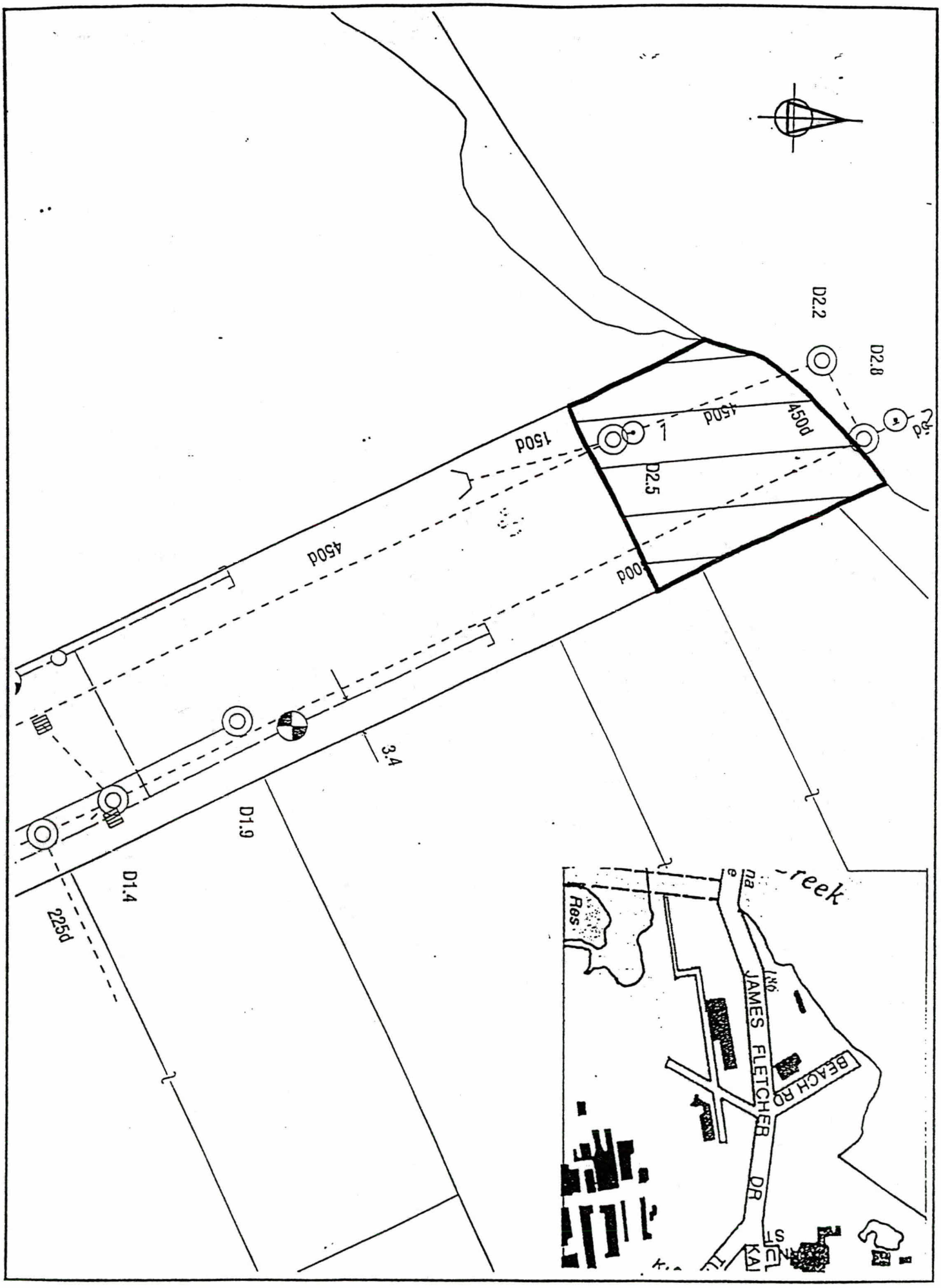
HARANIA INLET
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
MLC APPROVED		

REV CHK

REV

PLAN NO. 24



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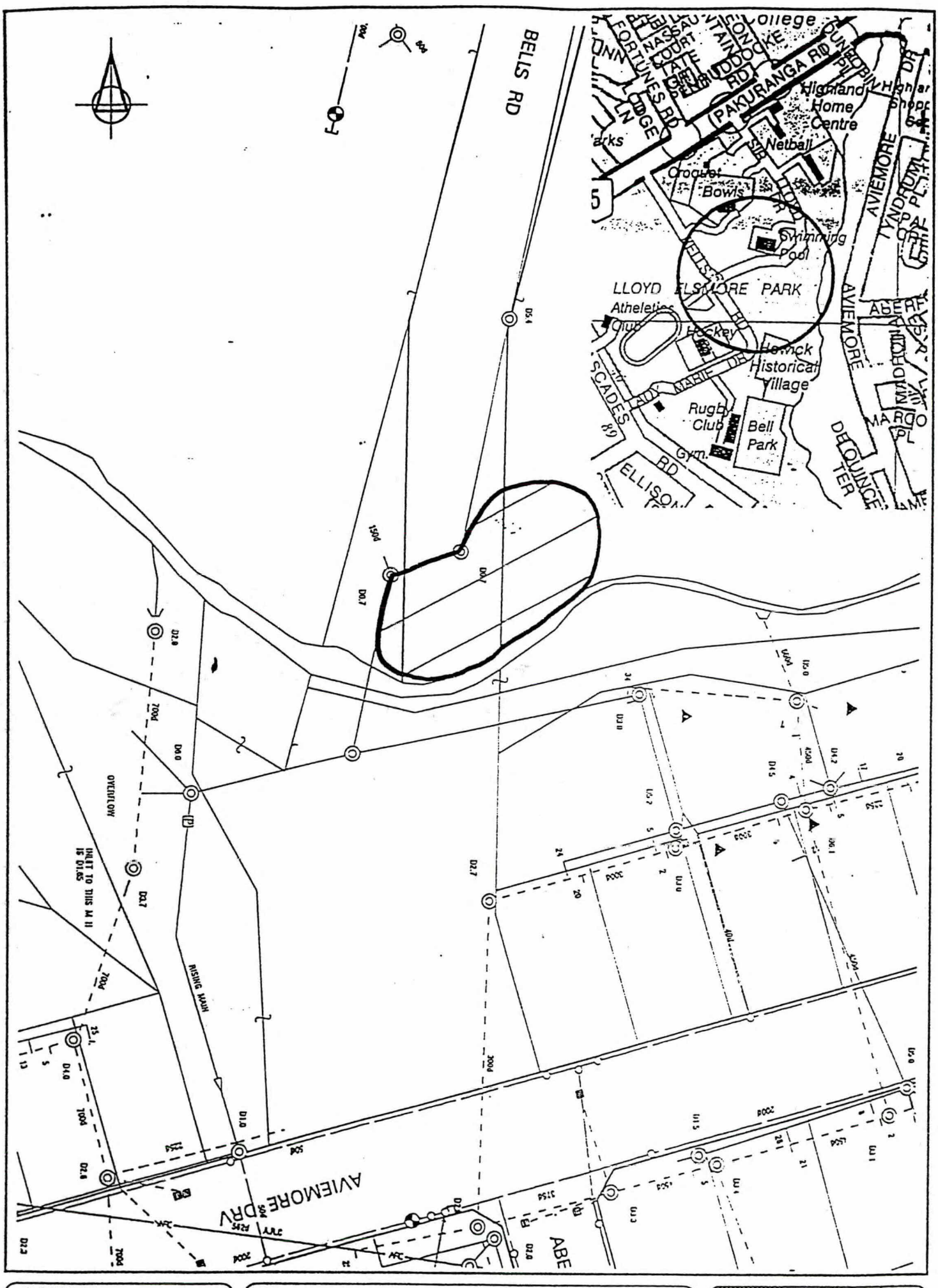
TITLE

BEACH ROAD
WATER SAMPLING LOCATIONS

	SCALE:	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Rahman	02/98
PLC APPROVED		

REV CHK

REV



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TITLE

BELLS ROAD
WATER SAMPLING LOCATIONS

REV CHG

	SCALE	DATE
DRAWN	D Lander	02/98
CHECKED	A Robinson	02/98
M.I. APPROVED		

Blk. Sh. TP

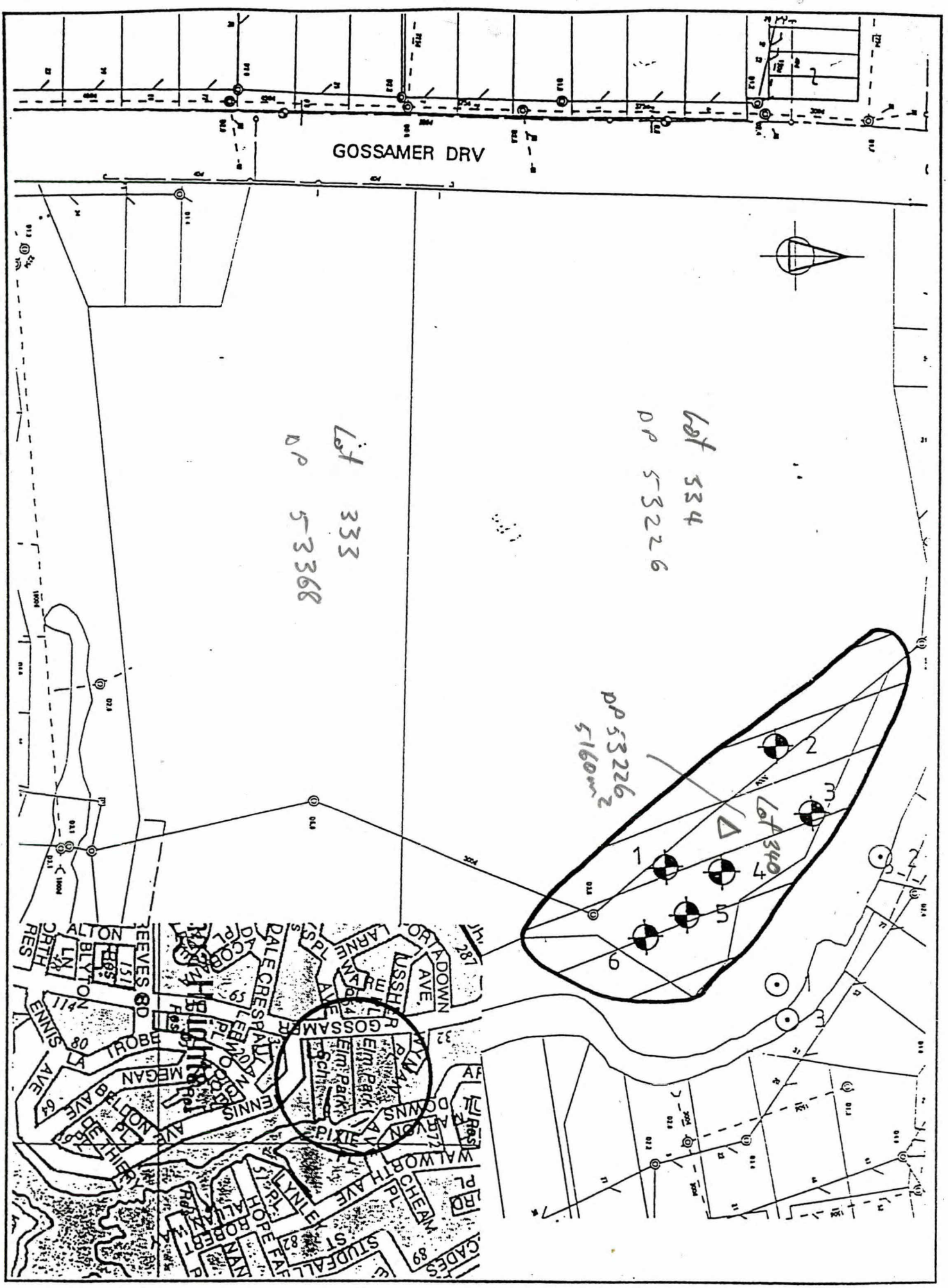
07 ~~13, 14, 15, 16~~ 25 23d, 24b 24d

Lot 340

DP 53 226

5160 m²

Δ ✓



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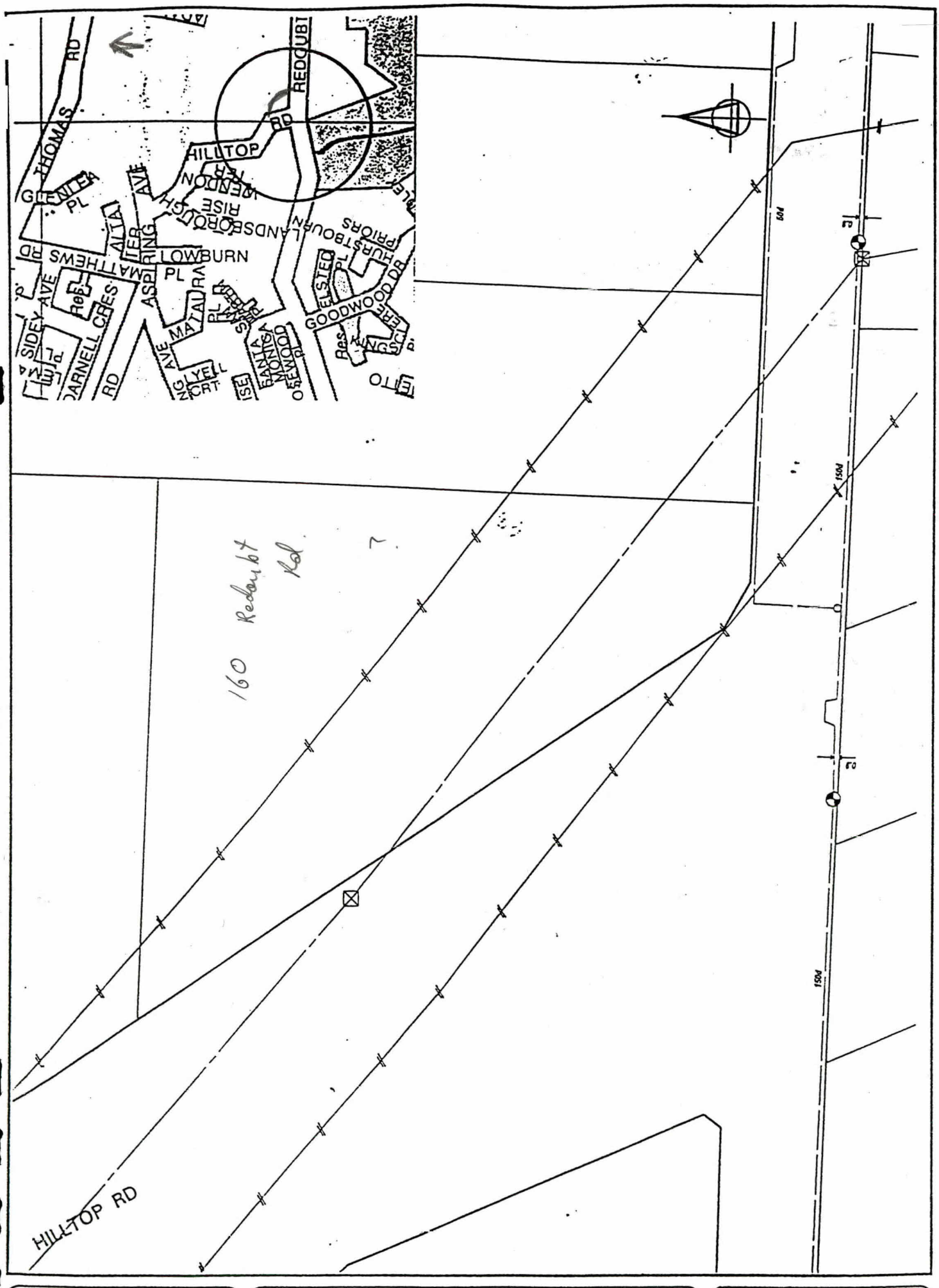
TITLE

ELM PARK
WATER SAMPLING LOCATIONS

	SCALE	DATE
DRAWN	Q. Lander	02/12
CHECKED	A. Robinson	02/12
M.C. APPROVED		

Blk.	Sh.	TP
08	~~41~~, 43	41a

Road Reserve Intersection	?	X
Lot 2 DP 41071 8094 m²		X



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TITLE

HILLTOP ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

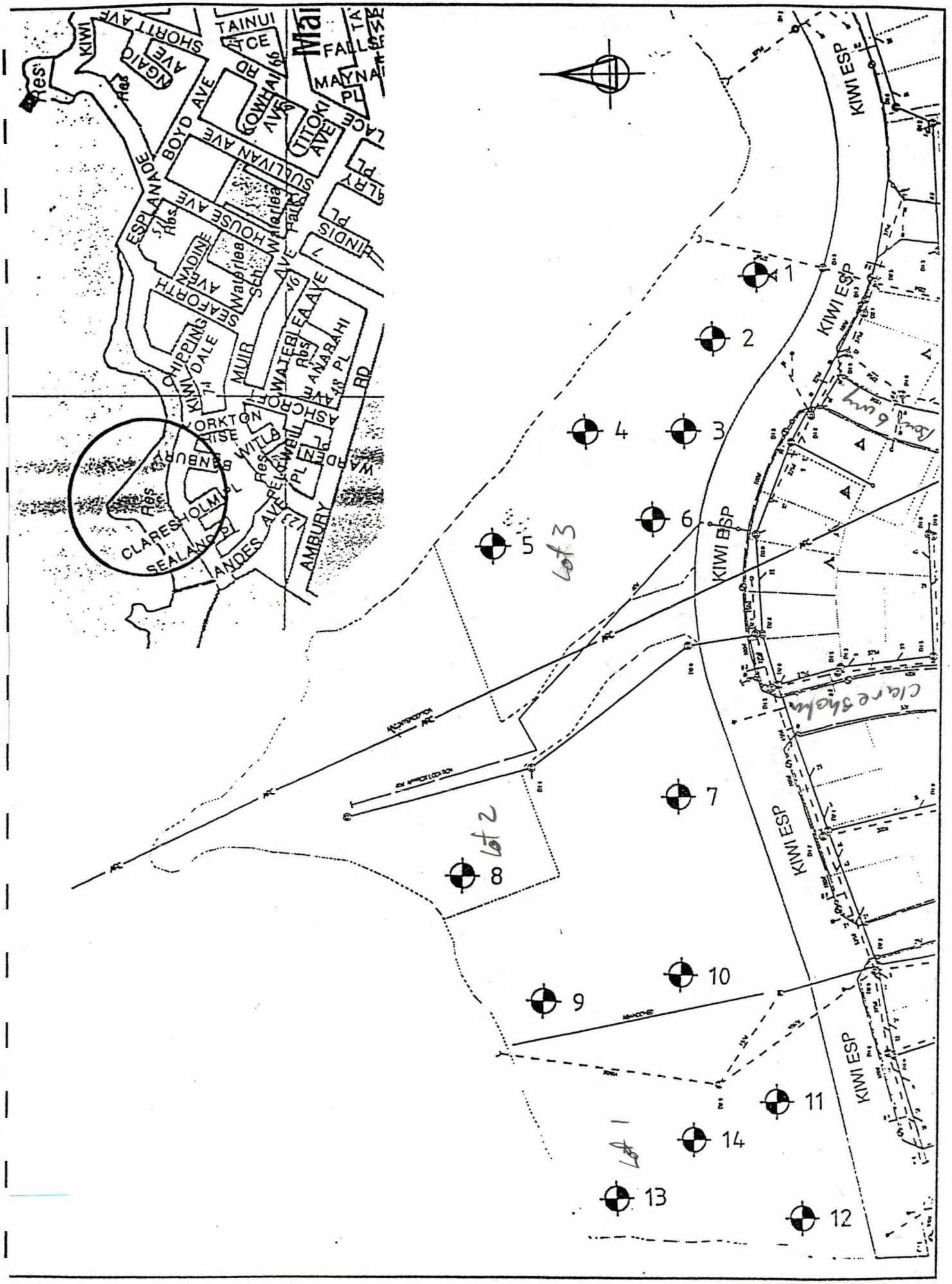
Blk.	Sh.	TP
01	44, ~~56, 57,~~ ~~68, 80~~	59, 56

TOR

Lot 3 DP 77585
2.1112 ha Δ ✓

Lot 2 DP 77585
1.2552 ha. Δ ✓

Lot 1 DP 77585
2.5144 ha. Δ ✓



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TITLE

MANUKAU YACHT CLUB
WATER SAMPLING LOCATIONS

	SCALE	DATE
DRAWN	D. Lander	02/08
CHECKED	A. Roonsar	02/08
M.C. APPROVED		

? Blk Sh.

~~11~~ ~~33~~ 49a

7 89

828

Allot 306

SO 38747

Parish of Pakuranga. ?

435 m² Δ ✓

or is on road reserve.?

38 Omana Pk. PT Lot 2 Δ ✓

04 62 176. DP 34852

39. Allenby Rd.

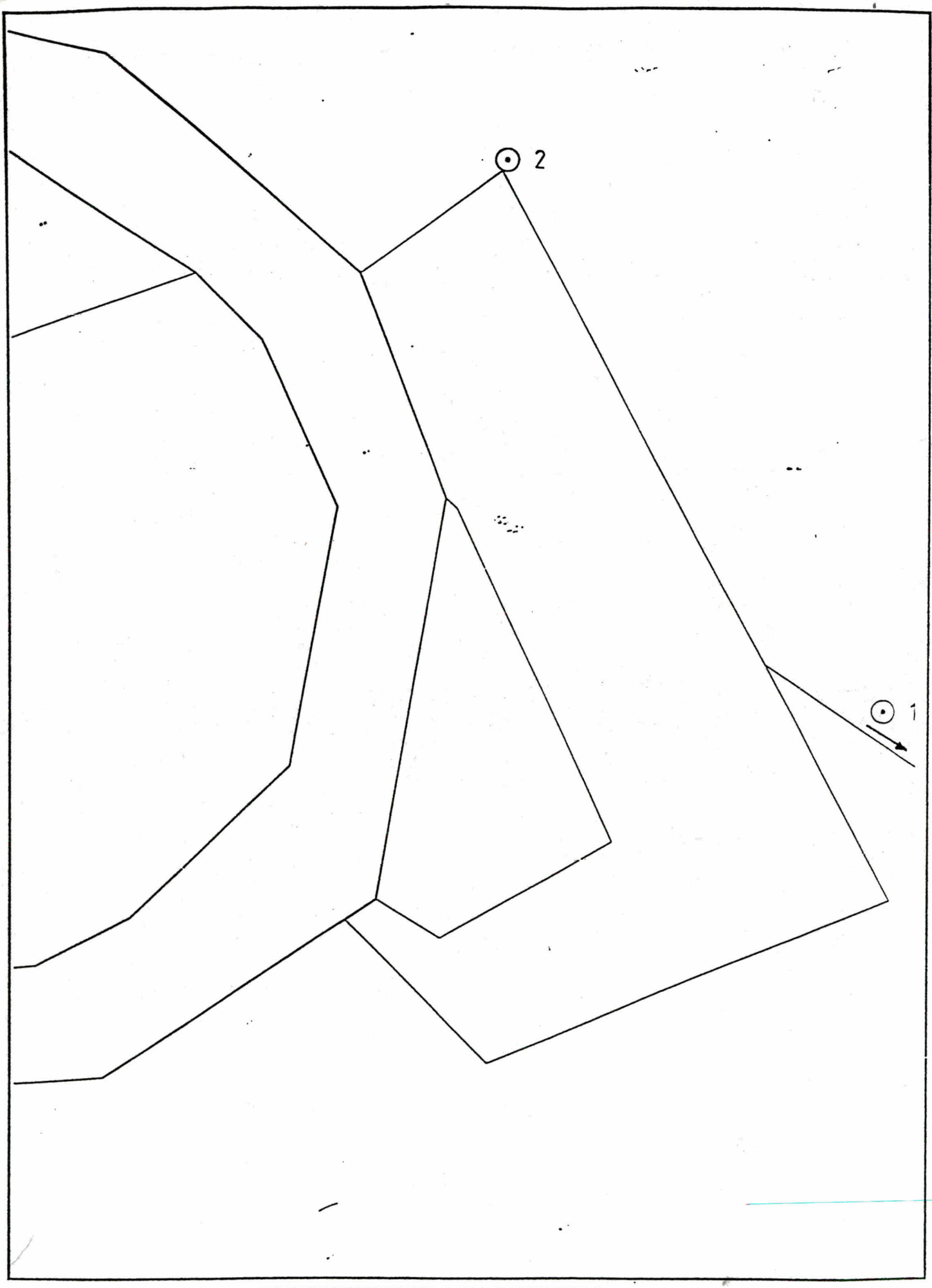
04 89, ~~90~~, 27C

Allot 377

SO 46043 Parish of Manurewa

1.3130 ha Δ ✓

(66)



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TITLE

MOUNGAMOUNGAROA BRIDGE
WATER SAMPLING LOCATIONS

REV CHK

REV. --

	SCALE	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO. 38

GHD

Appendix B

Chemical Analysis Data for Bore & Surface Water

HILLS RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_3-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N	TOC/ NPOC ppm	DO	pH	EC	salinity	temp	odour	clarity	colour
17-Oct-94	Hills Rd 1		0.33	73	<0.01	<0.02	<0.03	40	9.7	30.3	1.6	62	<0.2	0.02		628	13				14		2.1	6.2	850	500	15	nil	clear	clear
06-Sep-95	Hills Rd 1		0.4	77	<0.01	<0.02	<0.03	3.4	10.3	32.5	1.6	67	<0.2	0.3		74	10				11		2.3	6.81	800	0	16	none	clear	none
19-Dec-95	Hills Rd 1	B	0.66	120	0.007	0.59	0.72	470	72	110	5.9	820	1.2	2.7	250		<0.04	0.095	<0.1		98	450	0.9	6.54	380	2.5	16.5	methane	murky	dk. gry
19-Jan-96	Hills Rd 1	B	0.53	58	0.0003	0.003	0.007	1	51	130	0.24	1000	0.005	0.19	2000		190	0.026	<0.1		1.4	4.3								
01-Apr-96	Hills Rd 1	B			<0.001	0.033	0.027	51			0.38		0.22	0.14			210		0.61			110	0.6	6.71	450	3	20	strong	cloudy	gr. black
25-Oct-96	Hills Rd 1	B	0.9			0.013	0.014	64					0.034	0.061	450		59	0.02	0.033			58	1.3	7.73	280	2	22	strong	cloudy	gr. / blk
12-Feb-98	Hills Rd 1	B	0.75	-	<0.00005	0.004	0.003	-	-	-	0.95	-	0.014	0.035	250	-		0.006	0.02	-	42	56	1.25	6.37	-	1	20.5	slight	s. cloudy	
10-Jun-98	Hills Rd 1	B	0.5	-	<0.0005	0.005	0.006	32	-	-	1.2	-	0.21	0.033	87	-	-	0.002	0.09	-	49	31	1.6	6.15	-	10	17	slight	sl cloudy	lt brown
21-Jul-98	Hills Rd 1	B	0.69	-	<0.0005	0.003	0.005	32	-	-	1.1	-	0.015	0.019	120	-	-	0.02	<0.01	-	50	31	8.1	6.58	-	-	17	slight	clear	clear
13-Sep-95	Hills Rd 1	S	0.42	460	0.063	2.6	2.6	6.3	71	1900	32	1000	4.3	19	-	140	21	-	-		390		0.5							
22-Apr-96	Hills Rd 1	S			<0.001	0.002	0.015	2.9			0.51		0.005	0.016			3.2			3		17								
22-Apr-96	Hills Rd 1	S			<0.001	0.002	0.015	2.9			0.51		0.005	0.016			3.2		3			1.7	1.6	7.13	330	2	16	slight	clear	clear
27-Nov-96	Hills Rd 1	S	0.7			0.004	0.008	31					0.001	0.031	990		19	0.024	0.1				4	6.76	360	2.3	19	none	opaque	brown
25-May-98	Hills Rd 1	S	1.3	-	<0.0005	0.005	0.016	8	-	-	0.6	-	<0.003	0.12	4500	-	-	0.018	0.68	-	0.092	12	3.6	6.5	-	8	17	nil	sl cloudy	silty
22-Jul-98	Hills Rd 1	S	0.59	-	<0.0005	<0.002	0.006	1.1	-	-	0.02	-	<0.003	0.042	310	-	-	0.03	0.04	-	0.04	10	6	6.27	-	11	16	weak	clear	lt gry
19-Oct-98	Hills Rd 1	S	0.665	-	0.00025	0.002	0.0075	2.71	-	-	1.06	-	0.0047	0.06	1900	-	-	0.02	1	-	-	24.3	5.2	6.43	600	55	26	Nil	Opaque	lt orange
17-Oct-94	Hills Rd 2		0.23	18	<0.01	<0.02	<0.03	2.7	<1.3	14	0.5	38	<0.2	<0.01		<2	2.9				10		6.9	6.32	370	0	15.5	ammonia	clear	clear
06-Sep-95	Hills Rd 2		0.2	17	<0.01	<0.02	<0.03	2.2	3.5	12.5	0.3	31	<0.2	<0.01		56	2.1				7.7		8	6.73	300	0	15	pungent	clear	none
19-Dec-95	Hills Rd 2	B	0.32	59	0.003	0.005	0.021	11	13	29	1.7	52	0.016	0.072	45		0.81	0.012	9.5		9.7	36	1.5	6.31	85	0.5	15	methane	clear	lt. gry
19-Jan-96	Hills Rd 2	B	0.46	49	0.0003	0.003	0.011	0.74	42	110	0.24	800	0.007	0.15	1800		<0.04	<0.005	0.6		1.2	5								
01-Apr-96	Hills Rd 2	B			<0.001	0.012	0.009	70			0.62		0.03	0.15			29		<0.003			14	0.9	6.18	130	<1	18	strong	cloudy	gr. black
12-Feb-98	Hills Rd 2	B	0.24	-	0.00519	0.084	0.091	-	-	-	2	-	0.14	0.92	110	-		0.036	<0.01	-	8.4	20	2.1	6.21	-	0.5	19	slight	s. cloudy	silty res.
26-May-98	Hills Rd 2	B	0.23	-	<0.0005	0.003	0.006	55	-	-	2.6	-	0.008	0.075	44	-	-	0.012	<0.01	-	15	20	1.9	6.9	-	0.6	18	nil	sl cloudy	sl silty
21-Jul-98	Hills Rd 2	B	0.23	-	0.0011	0.12	0.16	110	-	-	4.7	-	0.12	0.56	18	-	-	0.04	0.05	-	2	23	4.5	6.09	-	-	17	slight	sl cloudy	lt gry
16-Oct-98	Hills Rd 2	B	0.12	-	0.00074	0.0087	0.0134	52.6	-	-	2.82	-	0.0376	0.163	45	-	-	0.01	0.2	-	-	28.8	3.8	6.15	55	3	21	Nil	Opaque	Opaque
17-Oct-94	Hills Rd 3		0.36	23	<0.01	<0.02	<0.03	6.7	5	17.5	0.5	48	<0.2	<0.01		63	6.5				14		6.7	6.15	450	100	15	nil	clear	clear
19-Dec-95	Hills Rd 3	B	1.1	66	0.002	0.18	0.15	150	54	86	3.7	210	0.21	0.8	320		<0.04	7.7	<0.1		130	180	1.3	6.35	180	1.5	18	nil	v.cloudy	dk. gry
19-Jan-96	Hills Rd 3	B	0.46	49	0.0003	0.004	0.035	1.4	43	100	0.25	780	0.006	0.17	1700		200	0.01	0.2		1	4.7								
01-Apr-96	Hills Rd 3	B			0.004	0.17	0.17	160			2.9		0.21	0.69			300		0.039			180	0.5	6.69	475	3	18	strong	cloudy	gr. black
26-Jun-98	Hills Rd 3	B	0.55	-	<0.0005	0.04	0.038	53	-	-	3.1	-	0.03	0.21	96	-	-	<0.001	<0.01	-	50	33	2.5	6.2	-	10	18	slight	sl cloudy	blackish
21-Jul-98	Hills Rd 3	B	0.07	-	0.0006	0.007	0.003	44	-	-	2.7	-	0.014	0.076	45	-	-	<0.01	0.02	-	3.6	12	2.26	6.26	-	-	17	slight	opaque	blkish
16-Oct-98	Hills Rd 3	B	0.238	-	0.00272	0.0944	0.161	130	-	-	4.17	-	0.173	0.545	65 ; 65	-	-	<0.01	0.5	-	-	81.1	1.8	5.96	60	3	20	slight	Opaque	Dk grey
17-Oct-94	Hills Rd 4		<0.07	8.9	<0.01	<0.02	<0.03	1.8	<1.3	5.7	0.1	22	<0.2	<0.01		20	<0.04				2.3		10.8	6.59	198	0	17	nil	clear	clear
17-Feb-95	Hills Rd 4		1.5	125	<0.01	0.04	<0.03	0.73	117	377	0.33	3557	<0.2	0.03		56	0.31				1.2		15	8.13	58	0	23.5	fishy	fair	v lt grey
19-Dec-95	Hills Rd 4	B	2.7	86	0.001	0.11	0.11	110	16	75	1.2	200	0.13	1	140		<0.04	4.2	<0.1		28	130	1.3	6.57	160	1	17.5	methane	v.cloudy	dk. grn. gry
01-Apr-96	Hills Rd 4	B			<0.001	0.017	0.015	49			0.72		0.024	0.13			64		0.018			56	0.6	6.4	200	1	18	slight	cloudy	gr. black
12-Feb-98	Hills Rd 4	B	2.4	-	<0.00005	0.044	0.044	-	-	-	0.84	-	0.0032	0.16	210	-		0.03	0.01	-	17	59	1	6.42	-	1	19	slight	cloudy	dk gry
22-Jul-98	Hills Rd 4	B	1.7	-	0.0008	0.022	0.022	48	-	-	2.7	-	0.02	0.13	3	-	-	0.01	0.01	-	4.8	38	4.6	6.4	-	9	16	slight	sl cloudy	lt gry
17-Oct-98	Hills Rd 4	B	0.477	-	0.00008	0.0028	0.004	33	-	-	1.28	-	0.011	0.018	60	-	-	<0.01 ; <	1	-	-	78	2.8	6.34	130	5	19	organic	Opaque	Lt grey
17-Oct-94	Hills Rd 5		<0.07	11	<0.01	<0.02	<0.03	2.8	<1.3	6.3	0.2	22	<0.2	0.1		219	<0.04				2.6		10.8	6.82	190	0	16	nil	clear	clear
17-Feb-95	Hills Rd 5		1.4	111	<0.01	0.03	<0.03	1.1	102	329	0.32	2992	<0.2	0.05		174	0.54				1.6		16	8.39	660	0	25	fishy	fair	v lt grey
17-Feb-98	Hills Rd 5	S	1.3	-	0.00081	0.014	0.023	-	-	-	0.72	-	0.014	0.11	3700	-	-	0.002	0.03	-	<0.02	23	0.85	7.04	-	8	24	strong	cloudy	gry/blk
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
													0.005	*0.05*																

WHITFORD PARK

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
10-Feb-98	Whitford	S	1.8	-	0.0003	0.002	0.004	-	-	-	1.5	-	<0.001	0.01	8100 ; 81	-	-	0.003	0.02	-	0.20 , 0.1	-	2.9	6.95	2500	12.5	24	mod stg.	sl cldy	sl oil shn
17-Oct-94	Whitford 1		0	o.9	<0.01	<0.01	<0.03	0.6	<1.3	2.5	0.07	11.2	<0.2	0.01		76	<0.04				0.93		8.6	6.07	100	0	13	nil	clear	clear
17-Feb-95	Whitford 1		0.1	7.8	<0.01	<0.01	<0.03	2.1	3.2	4.5	0.03	20.5	<0.2	0.06		86	0.16				38		8	7.11	610	0	19	nil	clear	clear
29-Mar-96	Whitford 1	B			<0.001	0.043	0.049	36			6.4		0.12	0.75			0.008		1.3			8	0.7	6.51	300	2	20	slight	opaque	gr. / blk.
28-Jul-96	Whitford 1	B	0.23	-	<0.0005	<0.0005	0.021	7.7	-	-	0.62	-	0.006	0.18	77	-	-	<0.01	0.35	-	0.15	5	3.5	6.21	60	4	17	Nil	Opaque	lgt gry
11-Oct-96	Whitford 1	B	0.5			0.042	0.067	48					0.11	0.83	710		3.6	<0.005	0.03				1.6	6.78	199		17	mod.	cloudy	grey
10-Feb-98	Whitford 1	B	0.76	-	0.00216	0.02	0.064	-	-	-	2.3	-	0.066	0.79	940	-	-	0.003 ; 0.	0.02	-	4.9	-	6.2	6.79	330	2	23.5	sl. Leach	cldy, gry	-
14-May-98	Whitford 1	B	0.86	-	0.0005	0.011	0.041	32	-	-	3.1	-	0.029	0.39	810	-	-	<0.001	<0.01	-	4.4	11	-	6.44	329	2	-	slight	sl cloudy	silty
20-Oct-98	Whitford 1	B	0.288	-	0.00053	0.0051	0.027	13.3	-	-	1.69	-	0.0189	0.196	270	-	-	0.05	0.2	-	-	22.1	3.8	6.63	110	5	21	organic	Opaque	Lt grey
17-Oct-94	Whitford 2		<0.01	1.9	<0.01	<0.01	<0.03	1.6	<1.3	3	0.1	14.5	<0.2	0.01		342	<0.04				1.1		9	6.3	103	0	13	nil	clear	clear
17-Oct-94	Whitford 3		0.12	22.2	<0.01	<0.01	<0.03	0.8	4.2	13.5	0.5	46.2	<0.2	0.01		132	< 0.04				0.74		4.5	6.41	350	0	13	nil	clear	clear
19-Dec-95	Whitford 3	B	0.85	140	0.001	0.019	0.059	30	40	78	6.6	560	0.19	0.77	1000		<0.04	<0.005	9.6		5.2	31	1.85	6.95	590	3.9	16.5	nil	cloudy	grn .gry
29-Mar-96	Whitford 3	B			<0.001	0.011	0.027	31			5.1		0.089	0.25			0.017		4.9			9.4	1.75	6.62	380	2	20	slight	opaque	gr. / blk.
11-Oct-96	Whitford 3	B	0.5			0.026	0.031	62					0.13	0.17	790		5	0.014	0.13				1.5	6.77	323		16	mod.	cloudy	gr. brown
05-Feb-98	Whitford 3	B	0.7	-	0.00038	0.027	0.076	-	-	-	3	-	1.18	0.64	590	-	-	0.008	0.02	-	5.5	-	5	6.8 ; 6.7	185	1	23	slight	cldy, silty	-
14-May-98	Whitford 3	B	0.495	-	<0.0005	0.0105	0.03	52.5	-	-	3.4	-	0.0825	0.34	580	-	-	0.017	0.02	-	3.9	9	-	6.5	257	1	-	nil	sl cloudy	silty
28-Jul-98	Whitford 3	B	0.32	-	0.0005	0.0005	0.037	31	-	-	2.1	-	0.013	0.073	210	-	-	<0.01	0.03	-	1.8	7	2.9	6.41	100	5	18	Weak	sl cldy	lgt gry
20-Oct-98	Whitford 3	B	0.297	-	0.00017	0.0012	0.0076	34.5	-	-	2.37	-	0.0124	0.051	305	-	-	0.04	0.3	-	-	29.2	3.2	6.48	118	6	22	organic	Opaque	Lt orange
17-Oct-94	Whitford 4		0.06	13.1	<0.01	<0.01	<0.03	1.4	3.2	10	0.17	43.2	< 0.2	0.01		48	< 0.04				0.76		9.7	6.75	290	0	13	nil	clear	clear
17-Oct-94	Whitford 5		0.07	11.6	<0.01	<0.01	<0.03	3	3.7	11.1	0.12	61.2	< 0.2	0.01		260	< 0.04				0.76		9.7	6.75	390	0	14	nil	clear	clear
17-Feb-95	Whitford 5		3.1	318	<0.1	0.14	<0.3	4.3	280	950	2.4	7790	< 2	< 0.1		126	0.23				0.8		6.6	6.73	420	0	23	nil	clear	clear
19-Dec-95	Whitford 5	B	0.56	87	0.011	0.17	0.3	380	34	77	15	290	0.28	20	380		< 0.04	< 0.005	< 0.1		24	160	0.35	6.63	191	1	18 8	nil	cloudy	blk. gry
29-Mar-96	Whitford 5	B			<0.001	0.013	0.024	29			6.3		0.034	1.4			1.1		0.03			6.4	1.4	6.43	115	<1	20	slight	opaque	gr. / blk.
11-Oct-96	Whitford 5	B	0.3			0.013	0.021	64					0.043	1.1	97		3.2	0.011	0.22				1.6	6.72	93		17	mod.	cloudy	grey
05-Feb-98	Whitford 5	B	0.38	-	0.00062	0.004	0.009	-	-	-	2.1	-	0.018	0.49	140	-	-	0.002	0.01	-	2.5	-	4.1	6.7	95	0.5	24	sl. Leach	cloudy	-
14-May-98	Whitford 5	B	0.25	-	0.0013	0.005	0.023	57	-	-	2.9	-	0.053	1.2	130	-	-	0.03	< 0.01	-	1.2	8	-	6.4	84	0.4	-	nil	sl cloudy	silty
20-Oct-98	Whitford 5	B	0.197	-	0.00066	0.0024	0.0112	40.6	-	-	3.44	-	0.0152	0.353	280	-	-	<0.01	0.1	-	-	32	4.2	6.39	70	4	23	organic	Opaque	Lt orange
28-Jul-00	Whitford 5	B	0.16	-	0.0006	0.007	0.007	24	-	-	2.4	-	0.006	0.27	77	-	-	<0.01	<0.01	-	0.58	6	2.7	6.15	50	4	16.5	Weak	sl cldy	lgt gry
17-Oct-94	Whitford 6		0.02	6.6	<0.01	<0.01	<0.03	1.6	<1.3	5.5	0.04	29.7	< 0.2	0.01		199	< 0.04				0.83		10.4	6.88	220	0	14.5	nil	clear	clear
17-Feb-95	Whitford 6		3.9	367	<0.1	0.23	<0.3	1.2	346	1164	0.38	9661	< 2	0.12		62	0.35				0.7		12	7.4	500	1000	25	nil	clear	clear
19-Dec-95	Whitford 6	B	0.27	32	0.003	0.087	0.25	180	24	31	8.2	30	0.23	1.5	20		0.84	0.011	<0.1		2.4	30	2.3	6.77	240	1.5	20.7	slight	cloudy	grn. gry
01-Apr-96	Whitford 6	B			<0.001	0.03	0.044	48			3		0.085	0.25			0.059		0.15			3.5	5.4	5.87	45	<1	18	slight	opaque	or. / br.
11-Oct-96	Whitford 6	B	<0.1			0.018	0.025	25					0.066	0.15	20		< 0.01	< 0.005	0.6				4.4	6.4	19		18	slight	cloudy	lt. brown
11-Feb-98	Whitford 6	B	0.26	-	0.00045	0.044	0.04	-	-	-	2.1	-	0.015	0.26	89	-	-	0.002	0.01	-	0.36	-	4.2	6.32	60	0	23.5	Nil	cloudy	-
21-May-98	Whitford 6	B	0.1	-	<0.0005	0.008	0.022	65	-	-	3.4	-	0.041	0.46	160	-	-	<0.001	<0.01	-	0.22	9	3.5	6.05	90	0.5	19	nil	sl cloudy	orange
21-Oct-98	Whitford 6	B	0.059	-	0.00069	0.0086	0.0318	26.4	-	-	0.847	-	0.031	0.277	30	-	-	<0.01	0.3	-	-	10.4	4.2	5.89	25	3	20	Nil	Opaque	Lt orange
29-Jul-00	Whitford 6	B	0.05	-	0.005	0.005	0.029	25	-	-	0.8	-	0.04	0.26	20	-	-	<0.01	<0.01	-	<0.01	4	2.9	6.29	25	4	17	Nil	sl cldy	lgt orge
17-Oct-94	Whitford 7		0.14	25.7	<0.01	<0.01	<0.03	19.2	4.8	15.7	0.9	76.2	< 0.2	0.01		165	< 0.04				0.28		2.5	6.33	530	100	15	nil	light rust	light rust
19-Dec-95	Whitford 7	B	0.61	110	0.006	0.29	0.26	200	24	57	12	190	0.87	6.7	250		<0.04	<0.005	<0.1		4.9	69	5.1	7.13	24	0	17.5	nil	cloudy	brown
11-Oct-96	Whitford 7	B	0.7			0.24	0.22	260					0.79	6	120		2	0.016	0.019				0.2	6.76	89		18	mod.	cloudy	gr. / blck
10-Feb-98	Whitford 7	B	0.48	-	0.00164	0.042	0.061	-	-	-	1.1	-	0.18	1.9	300	-	-	0.005	0.03	-	3.5	-	4.5	6.71	135	0.5	22	sl. Sulphs	cl, silty re	-
21-May-98	Whitford 7	B	0.34	-	0.0031	0.1	0.14	106	-	-	2.7	-	0.43	3.3	190	-	-	0.003	0.02	-	2.5	10	2.05	6.57	110	0.6	17	oily	sl cloudy	blackish
29-Jul-98	Whitford 7	B	0.11	-	0.0008	0.007	0.016	14	-	-	0.95	-	0.024	0.33	42	-	-	<0.01	<0.01	-	0.15	6	2.35	6.25	40	3	16	Nil	clear	clear
21-Oct-98	Whitford 7	B	0.164	-	0.00099	0.0119	0.0232	39.2	-	-	2.16	-	0.0555	0.608	85	-	-	0.01	0.4	-	-	14.1	3.8	6.56	60	4	20	slight	Opaque	Lt orange
13-Sep-95	Whitford 7	S	0.33	56	0.0035	0.11	0.11	330	16	35	2.4	110	0.13	1.6	-	30	0.25	-	-		5			0.5						
18-Apr-96	Whitford 7	S			<0.001	<0.001	0.018	0.5			0.27		0.005	0.04			0.12			0.015			3.7							
18-Apr-96	Whitford 7	S			<0.001	<0.001	0.018	0.5			0.27		0.005	0.04			0.12		0.015			3.7	1.7	6.8	2450	16	19	strong	clear	or. / br
18-Apr-96	Whitford 7	S	0.2			0.003	0.002	27					<0.001	0.01	320		0.35	<0.005	0.027				1.9	6.67	132.3		17.5	mod.	sl. cloudy	lt. brown
21-May-98	Whitford 7	S	0.52	-	<0.0005	<0.002	0.004	22	-	-	1.9	-	<0.003	0.024	1100	-	-	<0.001	<.001	-	<0.02	10	1.8	6.62	420	2	16	nil	sl.cloudy	sl or/br
29-Jul-98	Whitford 7	S	0.19	-	<0.005	0.002	<0.002	17	-	-	1.1	-	<0.003	<0.005	280	-	-	<0.01	<0.01	-	0.02	11	1.5	6.48	90	5	16	Weak	sl cldy	lgt orge s
20-Oct-98	Whitford 7	S	0.212	-	0.00012	0.0012	0.0018	32.8	-	-	1.65	-	0.002	0.012	265	-	-	<0.01	0.1	-	-	23.6	1.1	6.18	110	60	21	Nil	Opaque	Lt orange

17-Oct-94	Whitford 8		0.23	113.7	<0.01	<0.01	<0.03	0.7	9.7	38.3	0.22	100	<0.2	0.01		43	<0.04				1.5		4.2	6.38	800	500	15	nil	clear	clear
17-Oct-94	Whitford 9		<0.1	8.9	<0.01	<0.01	<0.03	2.4	1.7	9.8	0.05	68	<0.2	0.01		84	<0.04				0.97		10.8	6.8	400	0	15	nil	clear	clear
17-Feb-95	Whitford 9		4	375	<0.1	0.27	<0.3	1.8	352	1187	0.44	9891	<2	<0.1		202	0.41				0.8		9.8	7.32	600	1000	25	nil	clear	clear
29-Mar-96	Whitford 10	B			<0.001	0.019	0.047	78			3.7		0.19	0.33			0.023		1.1			19	2.1	6.29	190	1	22	slight	opaque	gr. / br.
10-Oct-96	Whitford 10	B	0.1			0.018	0.041	150					0.069	0.2	440		2	0.005	0.033									mod.	cloudy	grey
13-Feb-98	Whitford 10	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-May-98	Whitford 10	B	0.27	-	0.001	0.01	0.046	86		-	3.3	-	0.12	0.18	870	-	-	0.004	0.11	-	4.1	55	-	5.89	290	2	-	nil	sl cloudy	silty
28-Jul-98	Whitford 10	B	0.16	-	0.0006	0.005	0.02	30	-	-	1.6	-	0.012	0.046	220	-	-	<0.01	<0.01	-	0.24	13	N/A	5.97	90	5	18	Weak	sl cldy	orange
21-Oct-98	Whitford 10	B	0.18	-	0.00022	0.0029	0.0179	51.8	-	-	2.01	-	0.0242	0.046	420	-	-	0.02	0.5	-	-	40.3	unable to	6.37	118	6	21	slight	Opaque	Lt orange
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

PAH RD

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_3-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
13-May-96	Pah Rd				<0.001	<0.002	0.01	4.1			1.1		0.006	0.15			46		<0.003			26	2.65	7.09	140	<1	18	slight	clear	lt. br.
11-Oct-96	Pah Rd	S	1.1			0.004	0.003	6.4					<0.001	0.019	74		25	<0.005	0.42			19	2.8	7.17	112.3	-	20.8	slight	clear	lt. / or.
17-Feb-98	Pah Rd	S	2.4	-	<.00005	0.003	<0.002	-	-	-	0.35	-	<0.001	0.014	630	-	-	0.52	0.92	-	12	34	1.4	7.15	-	1.5	22	nil	clear, oil	black sed.
25-May-98	Pah Rd	S	2.9	-	<0.0005	<0.002	0.0055	12	-	-	0.55	-	<0.003	0.385	7900	-	-	0.025	0.26	-	19	15	3.2	7.1	-	15	16.5	nil	sl cloudy	sl orange
18-Oct-94	Pah Rd 1		<0.02	19	<0.01	<0.01	<0.03	0.4	<1.3	18	0.04	35	<0.2	<0.01		1420	<0.04				3.7		10.6	6.69	380	100	17	nil	clear	clear
24-Feb-95	Pah Rd 1		0.35	25.5	<0.01	<0.01	<0.03	2.3	14	35.5	0.36	251	<0.2	0.02		1400	0.21				0.8		6.8	7	1700	0	22	nil	clear	clear
12-Mar-96	Pah Rd 1	B			0.009	0.97	0.85	370			8.5		1.8	3.6			77	<0.005	<0.1			39	1.45	6.38	150	<1	18	mod.	cloudy	lt. br.
10-Oct-96	Pah Rd 1	B	0.2			0.01	0.011	31					0.025	0.048	28		24	0.023	<0.005			13	1.2	6.61	73	-	20	slight	sl. cloudy	lt. grey
13-Feb-98	Pah Rd 1	B	0.38	-	0.0002	0.086	0.053	-	-	-	0.7	-	0.003	0.08	46	-	-	0.018	<0.01	-	22	22	1.4	6.51	-	0.5	18.5	nil	sl cloudy	-
19-May-98	Pah Rd 1	B	1.3	-	0.0013	0.12	0.012	93	-	-	1.1	-	0.45	0.69	39.5	-	-	0.04	<0.05	-	190	30	2.9	-	-	0.9	19	nil	sl cloudy	blackish
22-Jul-98	Pah Rd 1	B	0.2	-	<0.0005	<0.002	0.004	24	-	-	0.56	-	<0.003	0.009	57	-	-	<0.01	<0.01	-	21	10	-	6.28	-	3	16	weak	clear	clear
19-Oct-98	Pah Rd 1	B	0.596	-	0.00019	0.0017	0.0057	24.2	-	-	0.337	-	0.0142	0.052	110	-	-	<0.01	0.6	-	-	30.2	2	6.61	75	6	19	organic	opaque	Lt grey
18-Oct-94	Pah Rd 2		0.26	100	<0.01	<0.01	<0.03	0.7	10	38	0.2	36	< 0.2	0.27		35	< 0.04				7.1		4.3	6.47	800	700	16	nil	clear	clear
12-Mar-96	Pah Rd 2	B			0.042	2.4	2.4	530			9.7		9.3	14			130	<0.005	<0.1			27	1.8	6.58	170	1	18	strong	cloudy	lt. br.
10-Oct-96	Pah Rd 2	B	1.9			1.2	1	540					4.5	7	27		62	<0.005	0.11			35	0.1	6.62	118	-	18	slight	cloudy	gr. / blk
13-Feb-98	Pah Rd 2	B	1.1	-	0.00019	0.018	0.017	-	-	-	0.52	-	0.087	0.15	50	-	-	0.007	<0.01	-	51	30	1.3	6.7	-	1	19	medium	cloudy	-
19-May-98	Pah Rd 2	B	1.5	-	<0.0005	0.055	0.0065	67	-	-	1	-	0.16	0.21	90	-	-	0.046	<0.05	-	260	53	2.4	-	-	1	19	nil	sl cloudy	blackish
22-Jul-98	Pah Rd 2	B	0.09	-	0.0007	0.035	0.033	50	-	-	1.1	-	0.13	0.2	21	-	-	<0.01	0.02	-	4.2	23	-	6.56	-	3	16	weak	sl cloudy	lt gry
19-Oct-98	Pah Rd 2	B	0.235	-	0.00241	0.122	0.358	87.4	-	-	1.42	-	0.488	0.743	55	-	-	0.02	0.5	-	-	36	2.2	6.47	100	6	20	organic	opaque	Dk grey
23-Jul-98	Pah Rd 2	S	1.7	-	<0.0005	0.003	0.01	12	-	-	0.49	-	<0.003	0.009	310	-	-	0.1	1.7	-	21	20	-	7.27	-	15	18	weak	opaque	lt orange
23-Oct-98	Pah Rd 2	S	1.63	-	0.0007	0.038	0.09	126	-	-	1.44	-	0.037	0.32	1815	-	-	0.02	0.7	-	-	29.6	2.2	7.43	300	38	18	slight	sl cloudy	grey
18-Oct-94	Pah Rd 3		<0.02	15	<0.01	<0.01	<0.03	0.3	<1.3	15	0.06	26	<0.2	<0.01		60	<0.04				4.6		8.4	6.86	300	0	15	nil	clear	clear
24-Feb-95	Pah Rd 3		0.39	17	<0.01	<0.01	<0.03	5	3.1	11.2	0.76	32	<0.2	0.03		75	0.08				1		3.5	7.53	280	N/T	18	nil	clear	clear
12-Mar-96	Pah Rd 3	B			0.008	0.33	0.43	160			4.1		1.2	4.8			66	<0.005	<0.1			27	0.8	6.72	175	1	19	mod.	cloudy	lt. br.
10-Oct-96	Pah Rd 3	B	0.9			0.2	0.21	170					0.69	2.3	38		54	<0.005	0.02			25	0.3	6.85	141	-	20	mod.	cloudy	gr. / blk
13-Feb-98	Pah Rd 3	B	0.72	-	0.000185	0.011	0.013	-	-	-	0.335	-	0.0355	0.12	52	-	-	0.007	<0.01	-	23	23	1.6	6.87	-	1	19.5	slight	clear	-
11-Jun-98	Pah Rd 3	B	1.2	-	<0.0005	0.005	<0.002	23	-	-	0.3	-	0.012	0.084	57	-	-	0.004	0.01	-	65	33	1.7	6.7	-	1	17	slight	sl cloudy	sl silty
23-Jul-98	Pah Rd 3	B	0.69	-	<0.0005	<0.002	0.013	11	-	-	0.34	-	0.011	0.14	67	-	-	0.05	1.8	-	31	19	-	6.85	-	10	17	nil	opaque	lt orange
19-Oct-98	Pah Rd 3	B	0.152	-	0.00012	0.0027	0.241	22.2	-	-	0.769	-	0.0084	0.13	50 ; 50	-	-	<0.01	0.7	-	-	31.7	2.6	6.17	52	3	19	organic	opaque	Lt grey
24-Feb-95	Pah Rd A		0.74	37.5	<0.01	<0.01	<0.03	2.7	32	77	0.24	658	<0.2	0.03		25	0.061				1.1									
13-Sep-95	Pah Rd 13	S	0.98	380	0.086	0.8	4.7	1500	32	110	28	68	5.8	30	-	4600	0.44	-	-		72		0.5							
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

NGATI OTARA

date collect	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_4-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
02-Sep-95	Ngati Otara		<0.2	5.1	<0.01	<0.01	<0.03	8.4	19	4.3	0.4	6.7	<0.2	0.03		53								6.17	230	0	14	none	clear	none
25-May-98	Ngati Otara	S	2	-	<0.0005	0.003	0.007	19	-	-	0.45	-	<0.003	0.048		-	-	0.024	0.2	-	24	19	2.2	-	-	-	17	nil	sl cloudy	sl silty
06-Sep-94	Ngati Otara 1		<0.2	20	<0.01	<0.01	<0.03	1.2	3	7.9	0.07	18	<0.2	<0.01		89	0.06				4.4		9.2	6.37	270	0	15	none	clear	none
17-Oct-94	Ngati Otara 1		0.03	19	<0.01	<0.01	<0.03	1.4	<1.3	11	0.2	24	<0.2	<0.01		759	0.09				2		4.8	6.44	307	0	15.8	petrol	fair	clear
19-Dec-95	Ngati Otara 1	B	0.39	53	0.001	0.017	0.026	37	18	23	0.83	50	0.027	0.24	21		0.9	9.5	4.1		38	380	1.3	6.54	100	0.5	18.5	nil	cloudy	grey
27-Jul-98	Ngati Otara 1	B	0.32	-	<0.0005	<0.002	<0.002	27	-	-	1.1	-	<0.003	<0.005	23	-	-	0.02	<0.01	-	26	16	-	6.25	-	4	17	weak	opaque	lt orange
17-Oct-98	Ngati Otara 1	B	0.294	-	0.00085	0.0048	0.0131	41.6	-	-	1.21	-	0.0308	0.196	55	-	-	0.09	0.4	-	-	67.6	2	6.45	80	4	22	oily	Opaque	Dk grey
06-Sep-94	Ngati Otara 2		<0.2	19	<0.01	<0.01	<0.03	1.8	2.1	8.4	0.16	25	<0.2	0.09		77	2.3				6.9		9.5	6.51	1020	0.5	14	pungent	clear	none
17-Oct-94	Ngati Otara 2		0.15	19	<0.01	<0.01	<0.03	3.2	1.6	9	0.2	24	<0.2	<0.01		1125	<0.04				9.7		8.3	6.35	1000	600	15.8	nil	clear	clear
24-Feb-95	Ngati Otara 2		0.3	17.1	<0.01	<0.01	<0.03	1.6	9.9	15.4	0.16	125	<0.2	0.07		48	12				14		2	7.44	500	0	20	mildew	fair-opaqu	v lt grey
02-Apr-96	Ngati Otara 2	B			0.029	0.11	0.46	250			3		0.3	14			10		0.011			12	0.6	6.69	100	<1	21	moderate	opaque	gr. / br.
29-Oct-96	Ngati Otara 2	B	0.5			0.009	0.076	59					0.041	0.75	13		0.64	0.016	0.013			9.1	1.8	6.62	65	<1	18	strong	v.dark	gr. brown
11-Feb-98	Ngati Otara 2	B	0.69	-	0.00448	0.016	0.21	-	-	-	0.88	-	0.089	1	19	-	-	0.0001	<0.01	-	8.2	14	3.2	6.66	-	0.5	19.5	sl sulphour	sl cloudy	silty res.
22-May-98	Ngati Otara 2	B	0.48	-	0.0088	0.021	0.31	105	-	-	0.68	-	0.14	1.7	-	-	-	0.031	<0.01	-	13	17	1.92	6.8	-	0.5	19	nil	sl silty	blackish
24-Jul-98	Ngati Otara 2	B	0.53	-	0.0006	<0.002	0.029	2.7	-	-	0.46	-	<0.003	0.099	21	-	-	<0.01	0.8	-	0.43	10	-	6.2	-	4	16.5	weak	opaque	lt orange
17-Oct-98	Ngati Otara 2	B	0.437	-	0.00126	0.0018	0.0629	25.5	-	-	0.994	-	0.0233	0.169	30	-	-	0.03	0.6	-	-	29.1	2.9	6.37	60	2	19	nil	Opaque	Lt orange
26-Sep-94	Ngati Otara 3		0.95	84	<0.01	<0.01	<0.03	12	14	31	0.5	120	<0.2	<0.01		237	9.9				10		4.2	5.87	273	0	15	nil	clear	clear
17-Oct-94	Ngati Otara 3		0.8	77	<0.01	0.02	<0.03	12	14	29	0.6	103	<0.2	<0.01		76	8.1				9.8		3.9	6.26	184	0	16	nil	clear	clear
19-Dec-95	Ngati Otara 3	B	1.1	75	0.01	0.14	0.54	150	14	25	3	30	0.52	1.9	19		<0.04	<0.005	5.2		9.7	89	1.5	6.67	100	0.5	19	nil	cloudy	gry/grn
29-Oct-96	Ngati Otara 3	B	0.9			0.029	0.11	85					0.1	0.8	28		23	0.1	0.052			21	2.4	6.56	55	<1	18	strong	v.dark	black
11-Feb-98	Ngati Otara 3	B	1.1	-	0.00873	0.08	0.046	-	-	-	1.3	-	0.27	1.06	51	-	-	0.007	0.02	-	5.7	26	1.3	6.31	-	0.5	24.5	slight	v cloudy	dk gry
22-May-98	Ngati Otara 3	B	1.4	-	0.01	0.075	0.48	140	-	-	2.4	-	0.36	1.1	-	-	-	0.036	0.08	-	19	35	1.86	7.1	-	0.4	19	nil	sl silty	blackish
24-Jul-98	Ngati Otara 3	B	1.3	-	0.0014	0.021	0.091	76	-	-	0.94	-	0.073	0.22	23	-	-	0.02	0.07		9.1	18	-	6.43	-	3	16	weak	opaque	orange
17-Oct-98	Ngati Otara 3	B	0.903	-	0.00305	0.0215	0.0894	99.8	-	-	0.751	-	0.0755	0.263	25	-	-	0.03	0.3	-	-	36.8	2	6.54	48	2	20	organic	Opaque	Dk grey
13-Sep-95	Ngati Otara 3	S	1.1	110	0.0024	0.067	0.093	480	21	42	0.78	190	0.1	0.58	-	310	13	-	-		17		2							
22-Apr-96	Ngati Otara 3	S			<0.001	0.002	0.025	2.4			0.29		0.004	0.07			7.7		9.5			13	1.9	6.52	270	1.5	18	slight	clear	clear
27-Nov-96	Ngati Otara 3	S	1.8			0.003	0.017	36					<0.001	0.059	2600		25	0.04	0.36			10	3	6.53	1100	7.5	19	nil	opaque	brown
16-Feb-98	Ngati Otara 3	S	2.4	-	<0.00005	0.001	0.006	-	-	-	0.31	-	<0.001	0.044	4000	-	-	0.032	2.1	-	7.1	11	1.25	6.58	-	7.5	23	nil	clear	-
27-Jul-98	Ngati Otara 3	S	2.8	-	<0.0005	0.002	0.041	16	-	-	0.39	-	0.009	0.12	8600	-	-	<0.01	0.55	-	<0.01	5	-	7.2	-	190	18	weak	sl cloudy	grey
17-Oct-94	Ngati Otara 4		0.04	10	<0.01	<0.01	<0.03	0.6	<1.3	6	0.1	16	<0.2	<0.01		685	<0.04				6		10.4	6.26	458	0	16	?	clear	clear
24-Feb-95	Ngati Otara 4		0.4	16.1	<0.01	<0.01	<0.03	1.1	10.6	3.9	0.19	40.5	<0.2	0.1		15	34				36		3.5							
17-Oct-94	Ngati Otara 5		0.06	42	<0.01	<0.01	<0.03	15	3.7	13	0.8	29	<0.2	<0.01		206	<0.04				10		8.5	6	470	0	16	nil	clear	clear
24-Feb-95	Ngati Otara 5		2	14	<0.1	<0.1	<0.3	2	13	4	0.14	27	<2	<0.1		78	25				29			7.32	25000	15000	20	salt	clear	clear
13-Sep-95	Ngati Otara 5	S	0.31	63	0.0004	0.002	0.011	21	8.9	14	0.51	42	0.006	0.047	-	40	7.5	-	-		10		0							
22-Apr-96	Ngati Otara 5	S			<0.001	0.002	0.02	1.2			0.11		0.007	0.16			0.032		3			2.7	8.1	6.44	20	0	17	nil	clear	clear
29-Oct-96	Ngati Otara 5	S	<0.1			0.003	0.018	30					0.01	0.16	28		0.87	0.069	3.7			4.2	7.1	6.23	21.4	-	15.9	nil	clear	clear
17-Oct-94	Ngati Otara 6		<0.02	19	<0.01	<0.01	<0.03	4.9	1.6	21	2.6	62	<0.2	0.03		20	0.09				0.44		8	6.78	12,500	9000	19	faint org	fair	clear
17-Oct-94	Ngati Otara 7		1.2	109	<0.01	<0.01	<0.03	2.2	113	322	0.2	3080	0.2	0.06		420	0.24				1.5		10.8	7.44	1100	200	20	wstwatr	clear	v lt grey
24-Feb-95	Ngati Otara 7		2.5	192	<0.1	<0.1	<0.3	1.6	180	603	0.26	4966	<2	<0.1		496	0.16				0.8		7.4							
19-Oct-98	Ngati Otara 12	S	2.49	-	0.0001	0.0108	0.0072	4.27	-	-	0.295	-	0.0036	0.024	11760	-	-	<0.01	0.5	-	-	8.4	8.2	7.25	2900	265	24	nil	Opaque	Lt grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

RIVERINA AVE

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_3-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Mar-96	Riverina 4				0.002	2.2	0.74	920			11		0.92	2.1			0.14	<0.005	0.011			27	1.25	5.63	120	<1	22			yellow / br.
06-Nov-96	Riverina 4		0.2			0.094	0.072	54					0.052	0.11	280		0.02	< 0.005	0.028			4.8	5.3	5.6	100	<1	17	slight	cloudy	or. / brown
04-Jun-98	Riverina 4		<0.05	-	<0.0005	0.027	0.49	34	-	-	0.72	-	0.047	0.58	84	-	-	0.005	0.01	-	0.13	17	5.8	5.49	-	0	17	sl odour	sl cloudy	blackish
22-Oct-98	Riverina 4	B	0.05	-	0.00046	0.0148	0.195	11.7	-	-	0.409	-	0.0214	0.194	55	-	-	0.02	0.3	-	-	28.1	3.5	5.58	22	1	19	mod	sl cloudy	grey
Comparison Data																													
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

RIVERHILLS PARK

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC* NPOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
07-Apr-96	Riverhills 2	B			<0.001	0.002	0.01	140			5		0.005	0.11			1.3		0.1			5.2	3.55	5.25	240	1.5	19	slight	cloudy	lt. br.
20-Oct-96	Riverhills 2	B	0.1			0.02	0.024	410					0.022	0.1	1900		3.6	0.077	0.048			21	2.5	5.62	485		19	strong	cloudy	gr. br.
27-May-98	Riverhills 2	B	<0.05	-	<0.0005	0.021	0.036	130	-	-	4.8	-	0.043	0.11	880	-	-	0.022	0.09	-	2.05	19	4.9	5.9	-	2	16	nil	sl silty	blackish
23-Oct-98	Riverhills 2	B	0.023	-	0.0003	0.0149	0.0213	88.2	-	-	0.0006	-	0.0287	0.071	500	-	-	<0.01	0.4	-	-	15.9	3.4	5.77	102	4	19	slight	sl cloudy	Lt grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

LEABANK PARK

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
2-Apr-96	Leabank 5	B																											
29-Oct-96	Leabank 5	B	<0.1			0.069	0.033	60					0.052	0.21	27		<0.01	0.02	2.4			1.6	4.2	8.75	13	<1	19	nil	or. / br.	low
Comparsion Data																													
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

MIRO RD

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
28-Oct-94	Miro Rd 1		<0.1	13	<0.01	<0.01	0.04	3.1	1.7	1.7	0.09	7.6	<0.2	0.18		45	0.29				1.8		7.3	7.68	910	600	16	salt	Clear	Clear
19-Dec-95	Miro Rd 1	B	1.2	96	0.001	0.009	0.022	17	40	88	0.38	250	0.022	0.21	220		26	<0.005	<0.1		34	64		6.84	230	1.5	19.5	nil	clear	lt. ylow
25-Mar-96	Miro Rd 1	B			0.001	0.002	0.025	5				1.9	0.012	0.052			32	<0.005	0.004			68	1.15	6.98	230	1	18	mod.	cloudy	gry / br.
05-Nov-96	Miro Rd 1	B	0.8			0.028	0.028	28					0.026	0.035	2600		12	< 0.005	0.021			30	2.9	7.16	900	6	17	mod.	cloudy	dk gry
12-Feb-98	Miro Rd 1	B	0.9	-	0.00019	0.1	0.19	-	-	-	0.4	-	0.13	0.34	210	-	-	0.002	<0.01	-	13	40	0.8	7.02	-	1	20.5	sl. leach	sl. cloud	-
20-May-98	Miro Rd 1	B	0.93	-	<0.0005	0.0065	0.009	17	-	-	0.24	-	0.0041	0.28	200	-	-	0.15	0.35	-	0.65	11	3.05	17	-	1	17	nil	sl cloud	sl silty
23-Jul-98	Miro Rd 1	B	1.5	-	<0.005	0.003	0.015	28	-	-	0.6	-	0.004	0.15	95	-	-	0.08	<0.01	-	21	34	1.5	7.01	-	13	18	weak	clear	clear
20-Oct-98	Miro Rd 1	B	1.01	-	0.00002	0.0036	0.0059	23	-	-	0.534	-	0.0196	0.147	145	-	-	0.01	1.4	-	-	82.8	1.8	7.11	160	7	25	slight	opaque	lt orange
19-Dec-95	Miro Rd 2	B	0.98	110	0	0.008	0.021	27	67	180	2.2	1400	0.012	0.13	3000		<0.04	<0.005	<0.1		16	160		6.66	750	5	16	nil	clear	lt.gry
12-Feb-98	Miro Rd 2	B	1.15	-	<0.0005	0.003	0.005	-	-	-	1.4	-	0.02	0.022	3700	-	-	<0.001	<0.01	-	4.8	21	1.3	7.42	-	4	18.5	Nil	clear	-
26-Aug-94	Miro Rd 3		1.8	220	<0.1	0.4	<0.3	1.2	167	574	1.3	4388	< 2	< 0.1		177	-				-		2	7.02	15500	11	16	Nil	Fair	Gr./Brown
28-Oct-94	Miro Rd 3		<0.1	40	<0.01	<0.01	<0.03	5.9	17.4	41	0.6	175	<0.2	<0.01		380	4.7				6.2		7.4	6.7	500	0	16	Nil	Clear	Clear
15-Sep-95	Miro Rd 3	S	0.7	160	0.0015	0.15	0.22	120	47	140	2.3	400	0.69	0.71	-	360	14	-	-		18		3							
19-Dec-95	Miro Rd 3	B	1.1	110	0.002	0.014	0.035	24	75	160	2	1200	0.034	0.17	2600		<0.04	<0.005	<0.1		15	72		6.6	1000	6.5	20	nil	clear	br. gry
25-Mar-96	Miro Rd 3	B			0.001	0.002	0.023	4.9				2.1	0.012	0.048			4.3	<0.005	0.048			31	4.3	6.83	900	5	22	mod.	cloudy	gry / br.
26-Mar-96	Miro Rd 3	B			0.001	0.038	0.077	33				1.4	0.08	0.19			12	0.008	0.011	*		54	2	6.97	1400	9	18	mod.	cloudy	gry / br.
05-Nov-96	Miro Rd 3	B	1			0.086	0.12	110					0.11	0.19	2200		10	0.007	0.037			53	3.3	7.2	600	4	20	strong	dark	black
05-Nov-96	Miro Rd 3	B	1.2			0.011	0.013	28					0.056	0.24	180		27	0.005	0.029			39	2.2	7.13	190	1	20	strong	mod.	grey
17-Feb-98	Miro Rd 3	B	0.64	-	<0.00005	0.003	0.007	-	-	-	1.3	-	0.003	0.025	1600	-	-	0.007	0.007	-	6.9	51	1.55	7.33	-	4	19	Nil	clear	sl. brown
26-Aug-94	Miro Rd 4		1.3	194	<0.1	0.27	<0.3	1.1	134	458	1.5	3373	<2	<0.1		458	-				-		2.5	7.18	15000	1	14	Nil	Slight O	Gr./Brown
28-Oct-94	Miro Rd 4		<0.1	26	<0.01	<0.01	<0.03	3.6	14.1	25	0.38	163	< 0.2	< 0.01		340	2.6				3.9		8	7.65	265	0	17	Nil	Clear	Clear
15-Sep-95	Miro Rd 4	S	0.83	1600	0.001	0.07	0.12	100	56	150	2.3	780	0.3	0.34	-	390	13	-	-		15		3							
14-May-96	Miro Rd 4	S			<0.001	<0.002	0.02	0.08			0.03		0.39	0.03			0.16		5.8			0.8	707	6.65	105	<1	17	nil	clear	clear
05-Nov-96	Miro Rd 4	S	<0.1			<0.001	0.001	0.078					<0.001	<0.002	49		0.053	<0.005	6.3			1	5.4	6.72	37.1	-	17.7	slight	clear	clear
26-Aug-94	Miro Rd 5		<0.1	24	<0.01	<0.01	<0.03	<0.01	10.1	35	<0.01	212	<0.2	<0.01		50	-				-		7	7	1300	0.5	16	Nil	Crystal	Crystal
28-Oct-94	Miro Rd 5		<0.1	14	<0.01	<0.01	<0.03	0.2	4.1	15	<0.01	68	<0.2	<0.01		245	<0.04				4.1		9.4	6.89	720	300	16.5	Nil	Clear	Clear
26-Aug-94	Miro Rd 6		<0.1	24	<0.01	<0.01	<0.03	0.04	10.5	37	0.03	237	<0.2	<0.01		2143	-				-		6.7	7.18	1500	1	16	Nil	Crystal	Crystal
28-Oct-94	Miro Rd 6		<0.1	19	<0.01	<0.01	<0.03	0.1	6.6	25	<0.01	122	<0.2	<0.01		220	<0.04				5.5		4.5	6.86	6000	3500	19	Nil	Clear	Clear
24-Feb-95	Miro Rd 6		0.56	50	<0.01	<0.01	<0.03	0.4	32.5	103	0.06	758	<0.2	0.05		220	0.25				4.4		-	6.95	350	3	16	rusty/car	cloudy	Greenish brown
26-Aug-94	Miro Rd 8		<0.1	63	<0.01	<0.01	<0.03	0.1	10.5	36	0.03	170	<0.2	<0.01		2500	-				-		8.4	7.3	950	0	14	Nil	Clear	Clear
28-Oct-94	Miro Rd 8		<0.1	18	<0.01	<0.01	<0.03	1.3	3.8	7.3	0.18	35	<0.2	0.03		495	0.16				0.88		2.3	7.09	2000	1000	20	Nil	Clear	Clear
26-Aug-94	Miro Rd 9		0.23	44	<0.01	0.04	<0.03	0.4	26.7	90	0.18	725	<0.2	0.05		3223	-				-		9.5	7.33	3400	2	13.5	Nil	Clear	Clear
24-Feb-95	Miro Rd 9		0.4	21.5	<0.01	<0.01	<0.03	1.8	20.5	29	0.13	347	<0.2	0.08		270	0.76				1.6		-	7.17	430	3	15.5	Nil	cloudy	Lt. greenish brow
26-Aug-94	Miro Rd 10		3.2	321	<0.1	0.62	<0.3	0.4	311	1025	0.08	8720	<2	<0.1		8728	-				-		9.4	7.23	110	0	18	Nil	fair-opa	dark grey
26-Aug-94	Miro Rd 11		3.3	337	<0.1	0.59	<0.3	<0.3	331	1077	0.07	9283	<2	<0.1		9723	-				-		5.8	7.12	131	900	16	compost	Clear	Clear
15-Sep-95	Miro Rd B1 Borehol	B	1.1	97	0.0013	0.097	0.11	36	40	84	0.73	210	0.1	0.47	220	220	30	0.004	<0.005		26		1.5							
15-Sep-95	Miro Rd B2 Borehol	B	1.1	160	0.0013	0.11	0.15	61	71	190	2.4	1600	0.073	0.29	3000	300	15	0.005	<0.005		15		6.5							
15-Sep-95	Miro Rd B3 Borehol	B	0.75	400	0.027	3	4.4	2900	150	440	52	1200	3.7	6.9	2100	300	13	0.005	<0.005		33		5							
15-Sep-95	Miro Rd B3#		-	-	0.00049	0.0072	0.066	1.7	-	-	0.3	-	0.013	0.07		-	-				-		-							
27-Apr-95	Miro Rd F		0.38	84	<0.01	<0.01	<0.03	5.7	16.6	70.8	1.8	358	<0.2	<0.01		86	1.2				1.6		-	7.18	190	1.5	17	Nil	cloudy	Grey
27-Apr-95	Miro Rd GH		0.7	144	<0.01	<0.01	<0.03	15.8	67.7	139.8	0.9	968	<0.2	0.03		735	36				38		-	7.11	850	6.5	15.5	Nil	cloudy	Greenish grey
27-Apr-95	Miro Rd ON		0.3	108	<0.01	<0.01	<0.03	2.1	5	50.8	0.16	85	<0.2	<0.01		330	0.13				0.45		-	7.27	650	5	19	Nil	cloudy	Greenish grey

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
Comparison Data																													
	blank																												
	sea water																												
	river water		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*		-	-				-		-							
	Greenmount		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*		-	-				-		-							
	ARC Trade Waste		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*		-	-				-		-							
			22	-	*<0.01*	*0.19*	*0.07*	*128*	-	-	*13*	-	*0.18*	*25*		*10500*	-				-		-							
			25	-	*1*	*30*	*10*	-	-	-	*20*	-	*10*	*25*		-	-				-		-							
USEPA Fresh Acute			-	-	*0.0039*	*0.016*	*0.18*	-	-	-	-	-	*0.083*	*0.12*		-	-				-		-							
USEPA Marine Acute			-	-	*0.043*	*1.1*	*0.0029*	-	-	-	-	-	*0.22*	*0.095*		-	-				-		-							
ANZECC Freshwater			-	-	**0.0002*	*0.01*	**0.002*	*1*	-	-	-	-	**0.001*	**0.005*		-	-				-		-							
ANZECC Marine			-	-	*0.002*	*0.05*	*0.005*	-	-	-	-	-	*0.005*	*0.05*		-	-				-		-							

# denotes results from reanalysis of sample following filtration

DALE CRES

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_4-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Mar-96	Dale Cres 1	B			0.001	0.1	0.054	150			8.1		0.086	0.3			37	<0.005	0.003			130	1	6.41	2700	18	19	strong	cloudy	grey
06-Nov-96	Dale Cres 1	B	2.2		0.038		0.051	130					0.05	0.13	6500		28	0.008	0.017			54	3.1	6.64	1700	11	19	v.strong	black	black
04-Jun-98	Dale Cres 3	B	0.66	-	<0.0005	0.032	0.089	75	-	-	1.8	-	0.055	0.37	2000	-	-	0.006	<0.01	-	11	56	2.6	6.46	-	<0.1	16	organic	cloudy	black
23-Oct-98	Dale Cres 3	B	0.88	-	<0.0005	<0.005	0.023	77.7	-	-	3.62	-	0.015	0.07	3455	-	-	0.03	0.2	-	-	139	2.2	6.81	790	70	19	strong	sl cldy	blackish
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

KINGFISHER PL.

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_4-N	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Kingfisher 1		0.19	79	<0.01	<0.01	<0.03	10	5.5	9.6	2.3	41	<0.2	0.15		73	0.79				1.6		4.7	6.26	500	0.1	17	clear	none	none
19-Oct-94	Kingfisher 1		0.17	72	<0.01	<0.01	<0.03	11	7.8	20.8	2.3	82	<0.2	<0.01		854	<0.04				1.7		6	6.46	670	100	16	nil	clear	clear
23-Oct-98	Kingfisher 1		1.41	-	0.0017	0.017	0.036	146	-	-	2.15	-	0.038	0.83	6770	-	-	0.06	0.5	-	-	12.3	3.8	7.46	1150	103	17	mod	sl cldy	lt orange
12-Sep-95	Kingfisher 1	S	0.5	100	0.0051	0.076	0.092	740	16	34	3.7	92	0.12	3.2	-	480	0.23	-	-		8.7		0.5							
13-May-96	Kingfisher 1	S			0.002	0.12	0.16	1200			4.7		0.17	6.4			2.5		0.004			7	0.35	6.97	90	<1	17	slight	cloudy	or. br.
25-May-98	Kingfisher 1	S	4	-	0.0005	0.008	0.0018	9.3	-	-	0.8	-	<0.003	0.095	14000	-	-	0.15	0.35	-	0.65	11	4.7	7.2	-	25	17	nil	sl cloudy	sl silty
19-Oct-94	Kingfisher 2		<0.01	7.6	<0.01	<0.01	<0.03	0.25	<1.3	27.3	0.02	17	<0.2	<0.01		237	<0.04				2.9		9.5	6.19	160	0	15	nil	clear	clear
24-Feb-95	Kingfisher 2		0.23	11.1	<0.01	<0.01	<0.03	0.68	4.6	11.1	0.07	92	<0.2	0.27		245	0.15				0.9		7.2	6.72	700	0	21	nil	clear	clear
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

COXHEAD RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD	NH_4-N	Nitrite mg/l	Nitrate mg/l	NNN	Total N	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
23-Sep-94	Coxhead Rd 1		0.1	12.3	<0.01	<0.01	<0.03	0.2	<1.3	4.4	0.03	19	<0.2	0.1		424	<0.04				3.2		10.8	6.81	150	0	14	none	clear	none
18-Oct-94	Coxhead Rd 1		<0.02	9.2	<0.01	<0.01	<0.03	0.2	<1.3	4.7	0.04	16	<0.2	<0.01		930	<0.04				3.4		10.2	6.86	170	0	16	none	clear	none
23-Sep-94	Coxhead Rd 2		0.1	10.4	<0.01	<0.01	<0.03	0.5	<1.3	3.3	0.07	18	<0.2	0.02		114	0.09				4		10.6	6.58	150	0	15	none	clear	none
18-Oct-94	Coxhead Rd 2		<0.02	6.5	<0.01	<0.01	<0.03	0.3	<1.3	3.5	0.1	18	<0.2	<0.01		685	0.07				4.2		9.3	6.58	160	0	17	none	clear	none
17-Feb-95	Coxhead Rd 2		0.19	12.9	<0.01	<0.01	<0.03	0.35	3.7	5.9	0.02	47.5	<0.2	0.04		92	0.05				2.9		9.6	7.24	300	0	19	none	clear	none
13-Sep-95	Coxhead Rd 2	S	0.19	8.6	0.0002	0.002	0.02	0.86	1.7	3.7	0.09	18	0.006	0.027	-	15	0.08	-	-		4.3		0							
27-Mar-96	Coxhead Rd 2	B			0.003	0.07	0.31	110			1.4		0.55	3.3			6.3	0.009	0.14			14*	0.75	6.43	90	<1	18	slight	cloudy	grey
29-Oct-96	Coxhead Rd 2	B	0.4			0.025	0.15	87					0.29	2.4	36		5.6		0.025	0.005		15	2.65	7.79	80	<1	20	nil	cloudy	grey
7-Aug-98	Coxhead Rd 2	B	0.28	-	<0.0005	0.003	0.035	73	-	-	0.42	-	0.068	0.31	10	-	-	0.043	0.01	-	6.2	17.5	3.6	6.57	-	0.4	18	sl silty	cloudy	sl silty
23-Oct-98	Coxhead Rd 2	B	0.224	-	0.00062	0.0026	0.0357	58.4	-	-	0.802	-	0.0818	0.331	30	-	-	0.2	0.3	-	-	27.9	1.8	6.81	60	2	19	strong	opaque	blackish
23-Sep-94	Coxhead Rd 3		0.1	12	<0.01	<0.01	<0.03	0.3	<1.3	4.2	0.04	18	<0.2	0.06		316	<0.04				3		10.8	6.57	150	0	14	none	clear	none
18-Oct-94	Coxhead Rd 3		<0.02	9.2	<0.01	<0.01	<0.03	0.1	<1.3	4.7	0.04	16	<0.2	<0.01		780	<0.04				3.5		9.6	6.56	175	0	17	none	clear	none
17-Feb-95	Coxhead Rd 3		0.13	13.1	<0.01	0.02	<0.03	0.4	3.1	4.8	0.02	47.5	<0.2	0.05		202	0.07				2.8		11	7.02	296	0	19	none	clear	none
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*																	
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*																	
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*																	
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*																	
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*																	
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*																	
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*																	
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*																	
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*																	

ORUARANGI RD

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
5-Nov-96	Oruarangi 1	B	<0.1			0.035	0.018	25					0.047	0.059	140		0.43	0.026	0.85			3.9	2.9	6.36	80	<1	23	smelly	cloudy	grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

GREAT SOUTH RD

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Gt Sth Rd 1		0.25	55	<0.01	<0.01	<0.03	2.4	5.8	15	0.3	56	<0.2	0.26		163	0.12				0.59		4.1	6.56	510	0	16	swamp	clear	none
24-Feb-95	Gt Sth Rd 1		0.5	75	0.06	<0.01	0.52	373	9.4	17.4	0.98	66	0.45	15.3		122	2.5				57		0.5	6.88	700	100	22	org	opaque	dark grey
12-Sep-95	Gt Sth Rd 1	S	0.4	59	0.0009	0.002	0.015	11	8.3	13	0.8	47	0.013	0.49	-	35	0.35	-	-		0.75		0							
13-Nov-96	Gt Sth Rd 1	S	0.3			0.016	0.074	33					0.11	0.26			0.32	<0.005	0.044			16	2.4	6.9	83	-	19.1	strong	sl. cldy	gr.black
26-Sep-94	Gt Sth Rd 2		0.38	75	<0.01	<0.01	<0.03	5.7	13	29	0.6	112	<0.2	0.13		265	0.34				0.97		5.4	6.62	680	0.3	15	swamp	clear	none
24-Feb-95	Gt Sth Rd 2		0.31	13.8	<0.01	<0.01	<0.03	2.8	2.5	2.6	0.06	13.9	<0.2	0.26		246	0.18				0.7		4	6.86	150	0	22	nil	clear	v lt yellow
13-Nov-96	Gt Sth Rd 2	S	<0.1			0.018	0.068	9.4					0.073	0.96			0.031	<0.005	0.052			14	5.1	5.82	3	-	18.5	mod.	sl. cldy	grey
12-Sep-95	Gt Sth Rd 3	S	0.35	32	0.0003	0.002	0.009	3.1	4.7	6.6	0.13	29	0.008	0.19	-	25	0.29	-	-		1.6		0							
30-Oct-96	Gt Sth Rd 3	B	0.2			0.026	0.019	100					0.089	0.13			0.67	<0.005	0.017			7.3	2.95	5.62	31	<1	19	slight	cloudy	or. br.
30-Oct-96	Gt Sth Rd 4	B	1.5			0.07	0.11	37					0.11	0.73			23	0.005	0.016			22	2.7	6.76	800	5	20	strong	opaque	black
14-May-96					0.002	0.01	0.08	46			1.2		0.05	1.7			2.9		0.007			10	0.95	6.98	100	<1	18	strong	opaque	black
14-May-96					<0.001	<0.002	0.02	3.3			0.3		0.007	0.07			1.1		0.006			6	2	6.59	27	0	20	nil	clear	or. br.
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

ROBERT ALLAN WAY

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
4-Apr-96	Robert Allan 2	B			<0.001	0.004	0.014	36			3.5		0.004	0.053			94		0.007			140	1.3	6.59	950	6	18	slight	cloudy	lt.grey
30-Oct-96	Robert Allan 2	B	1.4			0.031	0.028	89					0.064	0.069	5400		6.3	<0.005	0.016			19	4	6.72	1300	8	16	strong	cloudy	gry. blk
27-May-98	Robert Allan 2	B	0.55	-	0.01	0.031	0.042	52	-	-	3.4	-	0.085	0.12	1100	-	-	0.016	0.05	-	1.9	28	3.8	7.1	-	2	15	nil	sl cloudy	blackish
22-Oct-98	Robert Allan 2	B	0.59	-	<0.0005	0.007	0.01	37	-	-	4.89	-	0.014	0.02	2315	-	-	<0.01	0.7	-	-	26.8	3.2	7.01	550	50	20	mod	opaque	sk grey
4-Apr-96	Robert Allan 3	B			<0.001	0.002	0.008	3.2			4		0.003	0.04			6.6		0.007			27	1.6	6.3	1550	10	17	moderate	cloudy	lt.grey
30-Oct-96	Robert Allan 3	B	0.5			0.011	0.025	120					0.005	0.032	2600		89	0.079	0.011			175	1	6.76	750	5	17	metallic	opaque	gry. blk
27-May-98	Robert Allan 3	B	0.014	-	<0.0005	0.025	0.031	94	-	-	2.7	-	0.03	0.12	2300	-	-	0.002	<0.01	-	80	125	2.8	6.9	-	5	15	nil	sl cloudy	blackish
22-Oct-98	Robert Allan 3	B	0.24	-	0.0006	0.008	0.044	133	-	-	3.45	-	0.059	0.16	2280	-	-	0.01	1.1	-	-	183	3.5	7.34	700	60	20	mod	sl cloudy	grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

ENNIS AVE

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
2-Apr-96	Ennis Ave				<0.001	0.003	0.02	0.84			0.048		0.007	0.09			0.067		0.37			4.8	7.4	6.44	22	0	15	nil	clear	clear
5-Nov-96	Ennis Ave		<0.1			0.001	0.005	4.7					<0.001	0.093	67		0.47	<0.005	0.11			4.9	6.4	6.5	40.2	-	13.3	odour	clear	lt. br.
Comparison Data																													
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

KIWI ESPLANADE

date collected	location	B (mg/ml)	Ca (mg/ml)	Cd (mg/ml)	Cr (mg/ml)	Cu (mg/ml)	Fe (mg/ml)	K (mg/ml)	Mg (mg/ml)	Mn (mg/ml)	Na (mg/ml)	Pb (mg/ml)	Zn (mg/ml)	Cl (mg/ml)	COD (mg/ml)	NH_3-N (mg/ml)	Nitrite (mg/ml)	Nitrate (mg/ml)	NNN (mg/ml)	Total N (mg/ml)	DO	TOC	pH	EC	salinity	temp	odour	clarity	colour
28-Sep-94	Esplanade 1	0.28	32	<0.01	0.1	<0.03	1	21	56	0.06	446	<0.02	0.04		590	0.05				0.67	9.3		7.07	2550	1.8	14	none	clear	light greysh brown
28-Oct-94	Esplanade 1	1.3	132	<0.01	0.14	<0.03	1.5	116	319	0.5	2836	<0.02	0.03		185	0.55				1.5	4.3		7.39	10000	7000	14	nil	clear	clear
15-Feb-95	Esplanade 1	3.8	368	<0.1	0.44	2.1	0.31	343	1147	0.22	9610	>2	0.28		188	0.4				1.6	5.5		6.28	490	0	22	nil	clear	clear
28-Sep-94	Esplanade 2	2.9	282	<0.1	0.33	<0.3	38	272	866	0.6	7020	<0.2	<0.1		95	0.69				5	9.7			29000	22	15	none	opaque	light greysh brown
28-Oct-94	Esplanade 2	4.1	379	<0.1	0.7	<0.3	24	388	1195	0.5	10250	<0.2	0.08		70	0.09				4.2									
15-Feb-95	Esplanade 2	4	370	<0.1	0.47	0.3	2.4	368	1213	0.21	10302	<2	<0.1		52	0.62				1.3	12		N/T	15000	32000	22	nil	clear	clear
Comparison Data																													
	blank	*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water	*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water	*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount	*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste	*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute				*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute				*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater				**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine				*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

RIVERHILLS SCHOOL

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
07-Apr-96	Riverhills School	S			<0.001	<0.001	0.015	4.6			0.57		0.1	0.09			0.018		<0.003			3.2	5.6	6.37	32	0	17	nil	clear	clear
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

TI RAKAU DR

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC* NPOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
07-Apr-96	Ti Rakau 1	B			<0.001	0.008	0.018	3.9			0.25		0.074	0.064			0.022		0.42			17	2.1	6.4	35	0	18	slight	opaque	gr brown
06-Nov-96	Ti Rakau 1	B	0.1			0.008	0.008	8					0.014	0.016	54		0.29	0.007	0.059			13	3.7	6.62	70	<1	18	mod.	cloudy	gr. black
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

HARANIA RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Harania Rd 1		0.08	12	<0.01	<0.02	<0.03	0.4	3	7	0.04	18	<0.2	0.07		137	<0.04				8.2		9	6.28	190	0	15	nil	clear	clear
17-Oct-94	Harania Rd 1		<0.02	10	<0.01	<0.02	<0.03	0.2	4.3	7	<0.02	16	<0.2	0.1		20	0.07				6.8		5.8	6.55	165	0	17	nil	clear	clear
17-Feb-95	Harania Rd 1		0.12	32	<0.01	<0.02	<0.03	0.65	11.1	24.5	0.71	45	<0.2	0.17		112	0.13				31		8	6.67	92	0	19	nil	clear	nil
26-Sep-94	Harania Rd 2		0.07	9	<0.01	<0.02	<0.03	0.3	0.7	5	<0.02	16	<0.2	0.04		84	<0.04				4.2		6.1	6.35	140	0	15	nil	clear	clear
17-Feb-95	Harania Rd 2		0.13	36.5	<0.01	<0.02	<0.03	6.8	17.3	33.5	2.5	118	<0.2	0.29		70	0.24				28		1.6	6.46	93	0	18	nil	fair	nil
07-Apr-96	Harania Rd 2	B			<0.001	0.002	0.008	0.38			0.031		0.079	0.068			0.13		0.004			3.2*	2.3	4.97	20	0	20	slight	sl. cloudy	or. / br.
25-Oct-96	Harania Rd 2	B	0.1			14	0.014	13					0.019	0.033	19		0.5	<0.005	0.028			7.4	2.95	8.37	23	<1	20	slight	sl. cloudy	gr. / br.
13-Sep-95	Harania Rd 2	S	0.28	76	0.0072	0.4	0.99	340	25	38	25	37	3	7.2	-	20	0.92	-	-		27		0							
14-May-96	Harania Rd 2	S			<0.001	<0.002	0.03	0.82			0.4		0.01	0.12			1.6		8.7			3.6*	2.45	6.65	32	0	18	nil	clear	clear
26-Nov-96	Harania Rd 2	S	0.1			<0.001	0.01	0.16					<0.001	0.089	97		<0.01	0.04	13			3.3	3.6	6.04	49	0	17	none	clear	clear
26-Sep-94	Harania Rd 3		0.19	9	<0.01	<0.02	<0.03	0.5	1.6	7	0.03	34	<0.2	0.05		35	<0.04				4		8	6.35	242	0	15	nil	clear	clear
17-Oct-94	Harania Rd 3		<0.02	12	<0.01	<0.02	<0.03	0.2	4.3	10	<0.02	30	<0.2	0.04		195	<0.04				7		6.7	6.82	261	0	17	nil	clear	clear
17-Feb-95	Harania Rd 3		0.84	90	<0.01	0.03	<0.03	1.5	75	233	1	2019	<0.2	0.09		46	0.27				9		6.2	6.38	540	0	19	nil	clear	nil
07-Apr-96	Harania Rd 3	B			<0.001	0.002	0.008	4.8			0.003		2.6	0.04			7.1		<0.003			23*	0.35	6.29	130	<1	22	slight	cloudy	gr. / br.
25-Oct-96	Harania Rd 3	B	0.5			0.039	0.039	120					0.049	0.1	520		5.5	0.032	0.039			33	1.75	8.08	195	1	18	strong	opaque	gr. / blck
26-Sep-94	Harania Rd 4		0.43	17	<0.01	<0.02	<0.03	0.5	2.7	10	0.15	26	<0.2	0.06		181	0.5				11		8.2	5.97	240	0	15	nil	clear	clear
17-Oct-94	Harania Rd 4		<0.02	12	<0.01	<0.02	<0.03	0.9	2.9	7	0.16	19	<0.2	0.26		335	0.24				6.7		6	6.62	102	0	16	nil	clear	clear
17-Feb-95	Harania Rd 4		0.4	123	<0.01	<0.02	<0.03	3	131	62	0.39	139	<0.2	0.58		110	0.22				83		8.2	6.38	540	0	18	nil	clear	nil
13-Sep-95	Harania Rd 4	S	0.41	18	0.0003	0.003	0.014	1.8	8.5	13	0.15	59	0.013	0.14	-	40	0.11	-	-		12		0							
17-Feb-95	Harania Rd 5		0.3	85	<0.01	<0.02	<0.03	2.7	89	39	0.29	57	<0.2	0.36		98	0.19				44		9	6.41	19	0	19	nil	clear	nil
07-Apr-96	Harania Rd 5	B			<0.001	0.03	0.045	6.6			0.023		0.18	0.052			<0.006		<0.003			0.2*	3	5.52	90	<1	21	slight	sl. cloudy	or. / br.
25-Oct-96	Harania Rd 5	B	0.4			0.09	0.091	23					0.076	0.15	170		0.22	0.005	0.061			32	3.2	5.15	80	0	19	strong	opaque	brown
17-Feb-95	Harania Rd 6		0.14	9.5	<0.01	<0.02	<0.03	1.9	3.7	2.6	0.2	25.5	<0.2	0.05		185	0.91				2.1		2	6.81	21	0	21	nil	clear	nil
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

BAIRDS RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC	DO
23-Sep-94	Bairds Rd 1		0.13	9.5	<0.01	<0.02	<0.03	0.6	<1.3	4.5	0.12	19	<0.2	0.1		1730	0.05				1.9		8.4
15-Feb-95	Bairds Rd 1		0.19	11.3	<0.01	0.03	0.16	1.7	3.4	5	0.06	32.5	<0.2	<0.1		1300	0.27				0.7		3
23-Sep-94	Bairds Rd 2		0.23	16.2	<0.01	<0.02	<0.03	4	<1.3	6	0.35	25	<0.2	0.08		247	0.09				1.5		6
12-Sep-95	Bairds Rd 2	S	0.62	50	0.0002	0.003	0.009	30	2.1	9.7	2.9	33	0.023	0.05	-	30	0.11	-	-		0.57		0
23-Sep-94	Bairds Rd 3		0.3	9.7	<0.01	<0.02	<0.03	0.7	<1.3	4.5	0.12	20	<0.2	0.12		549	<0.04				1.8		8.6
15-Feb-95	Bairds Rd 3		0.12	11	<0.01	0.03	0.08	1.4	2.6	4	0.11	25.5	<0.2	0.06		256	0.17				0.5		3.5
Comparison Data																							
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*									
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*									
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*									
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*							
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*									
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*									
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*									
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*									
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*									

OLD QUARRY RD

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Coronation Rd 1	S	0.03	10	<0.01	<0.01	<0.03	2.5	<1.3	5.1	0.08	17	<0.2	0.05		145	0.07				2.5		9.8	6.49	135	0	17	none	opaque	light greysh brown
17-Oct-94	Coronation Rd 1	S	<0.02	16	<0.01	<0.01	<0.03	0.5	2.3	9	0.02	30	<0.2	0.1		65	0.07				3.3		8.3	6.85	230	0	16	none	clear	clear
26-Sep-94	Coronation Rd 2	S	0.04	9	<0.01	<0.01	<0.03	2.4	<1.3	5.9	0.06	16	<0.2	0.04		<2	<0.04				2.5		10.2	6.53	140	0	15	none	clear	light greysh brown
17-Oct-94	Coronation Rd 2	S	<0.02	16	<0.01	<0.01	<0.03	0.7	2.1	9	0.04	33	<0.2	0.02		210	0.07				3.3		7.8	6.73	248	0	15	none	clear	clear
26-Sep-94	Coronation Rd 3	S	0.2	75	<0.01	<0.01	<0.03	42	5.9	47	2.4	70	<0.2	0.2		38	0.88				1.8		2.2	6.03	800	0.5	14	none	clear	light greysh brown
17-Oct-94	Coronation Rd 3	S	<0.02	80	<0.01	<0.01	<0.03	35	7.7	47	2.2	63	<0.2	0.1		355	0.74				1.5		4.3	6.37	1800	500	15	dull org	susp rust	clear
26-Sep-94	Coronation Rd 4	S	0.24	83	<0.01	0.02	<0.03	27	5.1	50	1.8	55	<0.2	<0.01		102	1.3				1.7		2.5	6.22	800	0.5	17	none	clear	light greysh brown
17-Oct-94	Coronation Rd 4	S	0.2	85	<0.01	<0.01	<0.03	30	8	49	1.6	58	<0.2	<0.01		170	1.2				1.7		2.8	6.47	8000	500	17	dull org	susp rust	clear
14-May-96	Old Quarry Rd	S			<0.001	<0.002	0.02	2.1			0.7		0.008	0.04			0.18		1.1			5.8	2.65	6.95	750	<1	20	slight	clear	lt. orange
24-Feb-96	Old Quarry Rd 1	S	0.27	9.2	<0.01	<0.01	<0.03	3	2.7	4.9	0.08	27.5	<0.2	0.08		80	0.2				1.3		4	7.01	nt	0	22	none	opaque	light grey brown
24-Feb-96	Old Quarry Rd 2	S	0.26	9.6	<0.01	<0.01	<0.03	3	4	6	0.07	41	<0.2	0.12		54	0.16				1.4		4.2	6.96	nt	0	22	none	opaque	light grey brown
12-Sep-95	Old Quarry Rd 3	S	0.39	75	0.0005	0.005	0.011	46	8.1	41	1.6	64	0.024	0.088	-	50	0.54	-	-		1.3		0.5							
12-Sep-95	Old Quarry Rd 4	S	0.46	170	0.0028	0.16	0.24	1800	17	82	5.5	79	1.1	2	-	440	0.49	-	-		2.9		0.5							
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

Appendix C

Data for Stream Water Samples

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Manukau City - OLD LANDFILL TESTING

Location: RIVERINA AVE

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		30.10.99	30.10.99
Time - sampling		8.07am	8.30am
Low tide		6.03am	6.03am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	7.35	7.66
Dissolved Oxygen	mg/l	11.99	11.33
Conductivity	mS/m	Exceeds limits of the portable machine	
Clarity		Opaque	Opaque
Visual Inspection		Tidal	Tidal
SAMPLE Number			
Lab sample No		121AN	122AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 30.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **RIVERINA AVE**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		121AM	122AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L		
Chromium	mg/L		
Copper	mg/L		
Lead	mg/L		
Manganese	mg/L		
Zinc	mg/L		
Iron	mg/L		
Cadmium	mg/L		
TOC	ppm	10.6	11.8
Nitrate - N	mgNO_3-N/L	0.6	0.4
Nitrite - N	mgNO_2-N/L	0.01	0.02
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.8	0.3
Chloride	mg/L	13 450	14 975

Tested by: SPJ Date: 30.10.99
Checked by: Date:

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Manukau City - OLD LANDFILL TESTING

Location: **KINGFISHER PLACE**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		29.10.99	29.10.99
Time - sampling		8.50am	9.15am
Low tide		8.17am	8.17am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.54	6.75
Dissolved Oxygen	mg/l	9.82	9.28
Conductivity	mS/m	260.00	378.00
Clarity		Clear	Clear
Visual Inspection		Flow steady	Flow steady
SAMPLE Number			
Lab sample No		113AN	114AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ & DH Date: 29.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **KINGFISHER PLACE**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		113AN	114AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L		
Chromium	mg/L		
Copper	mg/L		
Lead	mg/L		
Manganese	mg/L		
Zinc	mg/L		
Iron	mg/L		
Cadmium	mg/L		
TOC	ppm	7.2	9
Nitrate - N	$mgNO_3$-N/L	1.5	1.5
Nitrite - N	$mgNO_2$-N/L	0.04	0.04
Total Ammoniacal Nitrogen	$mgNH_3$-N/L	0.3	0.8
Chloride	mg/L	730	1170

Tested by: SPJ & DH Date: 29.10.99
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Manukau City - OLD LANDFILL TESTING

Location: **PAH ROAD**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		28.10.99	28.10.99
Time - sampling		10.30am	11.00am
Low tide		7.55am	7.55am
Weather		Overcast	Overcast
MEASUREMENTS			
pH	-	7.21	7.25
Dissolved Oxygen	mg/l	14.06	13.99
Conductivity	mS/m	24.5	95.6
Clarity		Clear	Clear
Visual Inspection		Flow steady	Flow steady
SAMPLE Number			
Lab sample No		965AM	966AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 28.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **PAH ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		965AN	966AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.024	0.099
Chromium	mg/L	0.0011	0.0015
Copper	mg/L	0.0034	0.0033
Lead	mg/L	0.0011	0.0012
Manganese	mg/L	0.118	0.32
Zinc	mg/L	0.011	0.017
Iron	mg/L	0.88	1.55
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	10.8	12.2
Nitrate - N	mgNO_3-N/L	0.9	1
Nitrite - N	mgNO_2-N/L	0.03	0.24
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	35	295

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Manukau City - OLD LANDFILL TESTING

Location: **ROBERT ALLAN PARK**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		26.10.999	26.10.99
Time - sampling		3.50pm	4.05pm
Low tide		3.28pm	3.28pm
Weather		Overcast	Overcast
MEASUREMENTS			
pH	-	7.03	7.21
Dissolved Oxygen	mg/l	7.94	8.24
Conductivity	mS/m	1883	Out of range
Clarity		Clear	Clear
Visual Inspection		Odourless	Odourless
SAMPLE Number			
Lab sample No		086AN	087AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 26.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **ROBERT ALLAN PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		088AN	087AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	1.67	1.94
Chromium	mg/L	<0.005	<0.005
Copper	mg/L	0.006	0.007
p	mg/L	0.002	0.002
Manganese	mg/L	0.443	0.340
Zinc	mg/L	0.080	0.07
Iron	mg/L	0.9	0.7
Cadmium	mg/L	<0.0005	<0.0005
TOC	ppm	14.0	12.5
Nitrate - N	$mgNO_3$-N/L	0.7	0.8
Nitrite - N	$mgNO_2$-N/L	0.04	0.02
Total Ammoniacal Nitrogen	$mgNH_3$-N/L	<0.2	<0.2
Chloride	mg/L	665	720

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Manukau City - OLD LANDFILL TESTING

Location: **HILLS ROAD - MAYFIELD PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		987AM	988AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.058	0.093
Chromium	mg/L	0.0023	0.0019
Copper	mg/L	0.0039	0.0039
Lead	mg/L	0.0014	0.0017
Manganese	mg/L	0.0613	0.0712
Zinc	mg/L	0.024	0.028
Iron	mg/L	1.15	1.19
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	3.6	3.9
Nitrate - N	mgNO_3-N/L	1.5	2.2
Nitrite - N	mgNO_2-N/L	0.03	0.04
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.8	0.3
Chloride	mg/L	95	185
Salinity	mg/L	172	334

Tested by: SPJ Date: 26.10.99
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Manukau City - OLD LANDFILL TESTING

Location: ORUARANGI ROAD

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		20.10.99	20.10.99
Time - sampling		2.00pm	2.15pm
Low tide		1.09pm	1.09pm
Weather		Fine	Fine
MEASUREMENTS			
pH	-	7.34	7.40
Dissolved Oxygen	mg/l	10.24	8.62
Conductivity	mS/m	34.5	35.0
Clarity		Clear	Clear
Visual Inspection		No flow	flow
SAMPLE Number			
Lab sample No		064AN	065AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: TB & RT Date: 20.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **ORUARANGI ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		064AN	065AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.055	0.057
Chromium	mg/L	<0.0005	<0.0005
Copper	mg/L	0.0031	0.0032
Lead	mg/L	0.0004	0.0003
Manganese	mg/L	0.0735	0.0759
Zinc	mg/L	0.016	0.016
Iron	mg/L	0.37	0.36
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	13.6	13.6
Nitrate - N	mgNO_3-N/L	0.2	0.2
Nitrite - N	mgNO_2-N/L	<0.01	<0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	0.6
Chloride	mg/L	53	46

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Manukau City - OLD LANDFILL TESTING

Location: **HARANIA AVE**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		19.10.99	19.10.99
Time - sampling		11.15am	11.45am
Low tide		11.58am	11.58am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.32	6.91
Dissolved Oxygen	mg/l	7.52	8.03
Conductivity	mS/m	25.90	44.30
Clarity		Clear	Clear
Visual Inspection		No flow	Slight flow
SAMPLE Number			
Lab sample No		044AN	045AN
Lab Used		SGS	SGS
Method of collection		Baller	Bailer

Tested by: TB Date: 19.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **HARANIA PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		044AN	045AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.041	0.076
Chromium	mg/L	0.0006	<0.0005
Copper	mg/L	0.0094	0.0058
Lead	mg/L	0.0007	0.0007
Manganese	mg/L	0.0742	0.0313
Zinc	mg/L	0.041	0.060
Iron	mg/L	0.26	0.15
Cadmium	mg/L	0.00008	<0.00005
TOC	ppm	4.6	7.6
Nitrate - N	mgNO_3-N/L	10.1	4.4
Nitrite - N	mgNO_2-N/L	0.02	0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	28	64

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Manukau City - OLD LANDFILL TESTING

Location: **OLD QUARRY ROAD**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		19.10.99	19.10.99
Time - sampling		12.00pm	12.30pm
Low tide		11.58am	11.58am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	7.07	7.00
Dissolved Oxygen	mg/l	9.70	9.24
Conductivity	mS/m	26.30	27.90
Clarity		Clear	Clear
Visual Inspection		Flow	Slight flow
SAMPLE Number			
Lab sample No		046AN	047AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: TB Date: 19.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **OLD QUARRY ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		046AN	047AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.037	0.038
Chromium	mg/L	<0.005	<0.0005
Copper	mg/L	0.0019	0.0020
Lead	mg/L	0.0007	0.0005
Manganese	mg/L	0.0169	0.0176
Zinc	mg/L	0.025	0.026
Iron	mg/L	0.2	0.22
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	6.7	72
Nitrate - N	mgNO_3-N/L	0.3	0.2
Nitrite - N	mgNO_2-N/L	<0.01	<0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	28	25

Tested by: TB Date: 19.10.99
Checked by: Date:

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Manukau City - OLD LANDFILL TESTING

Location: **ELM PARK**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		12.10.99	12.10.99
Time - sampling		2.35pm	2.55pm
Low tide		4.16pm	4.16pm
Weather		Overcast	Overcast
MEASUREMENTS			
pH	-	7.08	7.12
Dissolved Oxygen	mg/l	8.50	8.40
Conductivity	mS/m	39.50	72.10
Clarity		Clear	Clear
Visual Inspection		Flow steady	Flow steady
SAMPLE Number			
Lab sample No		992AM	993AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 12.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **ELM PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		992AM	993AM
Method of collection		Baller	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.33	0.060
Chromium	mg/L	0.0006	0.0013
Copper	mg/L	0.0027	0.0047
Lead	mg/L	0.0007	0.0019
Manganese	mg/L	0.0897	0.102
Zinc	mg/L	0.048	0.059
Iron	mg/L	0.72	1.01
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	7.2	4.7
Nitrate - N	mgNO_3-N/L	4.6	4.8
Nitrite - N	mgNO_2-N/L	0.02	0.02
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	25	100
Salinity	mg/L	45	181

Tested by: SPJ Date: 12.10.99
Checked by: TB Date: 8.11.99

Report Number : 21 2212 00
Page

Manukau City - OLD LANDFILL TESTING

Location: **BAIRDS ROAD**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		11.10.99	11.10.99
Time - sampling		1.20pm	2.05pm
Low tide		3.35pm	3.35pm
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.15	6.42
Dissolved Oxygen	mg/l	6.20	6.10
Conductivity	mS/m	19.71	14.41
Clarity		Clear	Clear
Visual Inspection		Flowing	Flowing
SAMPLE Number			
Lab sample No		989AM	990AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 11.10.99
Checked by: TB Date: 8.11.99

Report Number
Page

Manukau City - OLD LANDFILL TESTING

Location: **BAIRDS ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		989AM	990AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.056	0.056
Chromium	mg/L	0.0009	0.0008
Copper	mg/L	0.0048	0.0037
Lead	mg/L	0.002	0.0014
Manganese	mg/L	0.107	0.104
Zinc	mg/L	0.074	0.074
Iron	mg/L	0.86	0.79
Cadmium	mg/L	0.00006	0.00005
TOC	ppm	6.2	6.4
Nitrate - N	mgNO_3-N/L	2.5	2.6
Nitrite - N	mgNO_2-N/L	0.01	0.02
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.6	0.3
Chloride	mg/L	15	15
Salinity	mg/L	27	27

Tested by: SPJ Date: 11.10.99
Checked by: TB Date: 8.11.99

Report Number : 21 2212 00
Page

Manukau City - OLD LANDFILL TESTING

Location: **COXHEAD PARK**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		11.10.99	11.10.99
Time - sampling		3.00PM	3.20PM
Low tide		N/A	N/A
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.78	6.80
Dissolved Oxygen	mg/l	8.40	8.60
Conductivity	mS/m	17.25	17.76
Clarity		Clear	Clear
Visual Inspection		Flowing	Flowing
SAMPLE Number			
Lab sample No		967AM	968AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 11.10.99
Checked by: TB Date: 8.11.99

Report Number
Page

Manukau City - OLD LANDFILL TESTING

Location: **COXHEAD PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		967AM	968AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.045	0.046
Chromium	mg/L	0.0008	0.0007
Copper	mg/L	0.0014	0.0012
Lead	mg/L	0.0005	0.0003
Manganese	mg/L	0.0378	0.0384
Zinc	mg/L	0.032	0.032
Iron	mg/L	0.26	0.22
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	1.6	2.2
Nitrate - N	mgNO_3-N/L	3.1	3.6
Nitrite - N	mgNO_2-N/L	0.01	0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.3	0.8
Chloride	mg/L	15	15
Salinity	mg/L	27	27

Tested by: SPJ Date: 11.10.99
Checked by: TB Date: 8.11.99

Appendix D

Data for Great South Road Borehole Samples

GREAT SOUTH ROAD OLD LANDFILL
BOREHOLE MONITORING RECORD

SGS LAB NUMBER: 0834/00
GHD REPORT NUMBER: 21 2530 00

PARAMETER	UNIT	Borehole 1	Borehole 2
Depth of Borehole	m	6.23	6.07
Depth to water level	m	3.09	3.11
Date sampled	-	24.3.00	24.3.00
Time sampled		12.00pm	11.25am
pH	-	5.93	6.64
Conductivity	mS/m	28.4	485
Temperature	Deg C	17.8	18.9
Observations	-	Rusty smell, cloudy and orange	Sulphurous odour, cloudy and yellow grey
Organochlorine Pesticides			
Alpha – BHC	mg/kg	<0.01	<0.01
Beta – BHC	mg/kg	<0.01	<0.01
Lindane	mg/kg	<0.01	<0.01
Heptachlor	mg/kg	<0.01	<0.01
Aldrin	mg/kg	<0.01	<0.01
Heptachlorepoxide	mg/kg	<0.01	<0.01
Endosulfan I	mg/kg	<0.01	<0.01
DDE	mg/kg	<0.01	<0.01
Dieldrin	mg/kg	<0.01	<0.01
Endrin	mg/kg	<0.01	<0.01
Sample Numbers		427AR	428AR

Sampled by ; TB & RC Date ; 24 3.00

Transpositions Checked By ; TB Date ; 17.04.00

SGS LAB NUMBER: 0834/00

PARAMETER	UNIT	Borehole 1	Borehole 2
O, P' – DDT	mg/kg	<0.01	<0.01
Endosulfan II	mg/kg	<0.01	<0.01
P, P' – DDD	mg/kg	<0.01	<0.01
P, P' – DDT	mg/kg	<0.01	<0.01
Methoxychlor	mg/kg	<0.01	<0.01
BTEX			
Benzene	mg/lt	<0.01	<0.01
Toluene	mg/lt	<0.01	<0.01
Ethyl benzene	mg/lt	<0.01	<0.01
Xylenes	mg/lt	<0.01	<0.01
Polyaromatic Hydrocarbons			
Naphthalene	mg/lt	<0.01	<0.01
Acenaphthalene	mg/lt	<0.01	<0.01
Acenaphthene	mg/lt	<0.01	<0.01
Flourene	mg/lt	<0.01	<0.01
Phenanthrene	mg/lt	<0.01	<0.01
Anthracene	mg/lt	<0.01	<0.01
Fluoranthene	mg/lt	<0.01	<0.01
Pyrene	mg/lt	<0.01	<0.01
Benz(a)anthracene	mg/lt	<0.01	<0.01
Chrysene	mg/lt	<0.01	<0.01
Benzo(b)fluoranthene	mg/lt	<0.01	<0.01
Benzo(k)fluoranthene	mg/lt	<0.01	<0.01
Benzo(a)pyrene	mg/lt	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/lt	<0.01	<0.01
Dibenz(a,h)anthracene	mg/lt	<0.01	<0.01
Benzo(ghi)perylene	mg/lt	<0.01	<0.01
Sample Numbers		427AR	428AR

Sampled by ; TB & RC Date ; 24.3.00

Transpositions Checked By ; TB Date ; 17.04.00

SGS LAB NUMBER: 0834/00

PARAMETER	UNIT	Borehole 1	Borehole 2
Phthalates			
Dimethylphthalate	mg/lt	<0.01	<0.01
Diethylphthalate	mg/lt	<0.01	<0.01
Dibutylphthalate	mg/lt	<0.01	<0.01
Benzylbutylphthalate	mg/lt	<0.01	<0.01
Bis(2-ethylhexyl)phthalate	mg/lt	<0.01	<0.01
Di-n-octylphthalate	mg/lt	<0.01	<0.01
PCB's			
PCB	mg/lt	<0.004	<0.004
Phenols			
Phenol	mg/lt	<0.01	<0.01
2-Chlorophenol	mg/lt	<0.01	<0.01
2-Methylphenol	mg/lt	<0.01	<0.01
3 & 4-Methylphenol	mg/lt	<0.01	<0.01
2-Nitrophenol	mg/lt	<0.01	<0.01
2,4-Dimethylphenol	mg/lt	<0.01	<0.01
2,4-Dichlorophenol	mg/lt	<0.01	<0.01
2,6-Dichlorophenol	mg/lt	<0.01	<0.01
4-Cholro-3-methylphenol	mg/lt	<0.01	<0.01
2,4,6-Trichlorophenol	mg/lt	<0.01	<0.01
2,4,5-Trichlorophenol	mg/lt	<0.01	<0.01
4-Nitrophenol	mg/lt	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	mg/lt	<0.01	<0.01
2-Methyl-4,6-dinitrophenol	mg/lt	<0.01	<0.01
Pentachlorophenol	mg/lt	<0.01	<0.01
2-sec-Butyl-4,6-Dinitrophenol	mg/lt	<0.01	<0.01
Sample Numbers	-	427AR	428AR

Methodology : GC/MS after solvent extraction
GC/ECD after solvent extraction

Sampled By : TB & RC Date : 24.3.00

Transpositions Checked By : TB Date : 17.04.00

Analytes Measured

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)
26-Sep-94	Gt Sth Rd 1		0.25	55	<0.01	<0.01	<0.03	2.4	5.8	15	0.3	56	<0.2	0.26		163
26-Sep-94	Gt Sth Rd 2		0.38	75	<0.01	<0.01	<0.03	5.7	13	29	0.6	112	<0.2	0.13		265
24-Feb-95	Gt Sth Rd 1		0.5	75	0.06	<0.01	0.52	373	9.4	17.4	0.98	66	0.45	15.3		122
24-Feb-95	Gt Sth Rd 2		0.31	13.8	<0.01	<0.01	<0.03	2.8	2.5	2.6	0.06	13.9	<0.2	0.26		246
12-Sep-95	Gt South Rd 1	S	0.4	59	0.0009	0.002	0.015	11	8.3	13	0.8	47	0.013	0.49	-	35
12-Sep-95	Gt South Rd 3	S	0.35	32	0.0003	0.002	0.009	3.1	4.7	6.6	0.13	29	0.008	0.19	-	25
14-May-96					0.002	0.01	0.08	46			1.2		0.05	1.7		
14-May-96					<0.001	<0.002	0.02	3.3			0.3		0.007	0.07		
	blank		0.21	1.4	<0.01	<0.01	<0.03	0.14	1.3	0.2	0.006	3.1	<0.2	0.02		
	sea water		3.3	337	<0.1	<0.1	<0.3	0.3	331	1077	0.07	9283	<2	0.4		
	river water		<0.1	4.2	<0.01	<0.01	<0.03	5.9	6.1	7.5	0.13	24.4	<0.2	0.01		
	Greenmount		22		<0.01	0.19	0.07	128			13		0.18	25		10500
	ARC Trade Waste		25		1	30	10				20		10	25		
USEPA Fresh Acute					0.0039	0.016	0.18						0.083	0.12		
USEPA Marine Acute					0.043	1.1	0.0029						0.22	0.095		
ANZECC Freshwater					*0.0002	0.01	*0.002	1					*0.001	*0.005		
ANZECC Marine					0.002	0.05	0.005						0.005	0.05		

Analytes Measured

date collected	location		NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Gt Sth Rd 1		0.12				0.59		4.1	6.56	510	0	16	swamp	clear	none
26-Sep-94	Gt Sth Rd 2		0.34				0.97		5.4	6.62	680	0.3	15	swamp	clear	none
24-Feb-95	Gt Sth Rd 1		2.5				57		0.5	6.88	700	100	22	org	opaque	dark grey
24-Feb-95	Gt Sth Rd 2		0.18				0.7		4	6.86	150	0	22	nil	clear	v lt yellow
12-Sep-95	Gt South Rd 1	S	0.35	-	-		0.75		0							
12-Sep-95	Gt South Rd 3	S	0.29	-	-		1.6		0							
14-May-96			2.9		0.007			10	0.95	6.98	100	<1	18	strong	opaque	black
14-May-96			1.1		0.006			6	2	6.59	27	0	20	nil	clear	or. br.
	blank															
	sea water															
	river water															
	Greenmount															
	ARC Trade Waste															
USEPA Fresh Acute																
USEPA Marine Acute																
ANZECC Freshwater																
ANZECC Marine																

Appendix E

Site Specific Data

Site Specific Data

This section contains the individual site reports of the seven MCC Old Landfills that may require additional review by the ARC. Each site report contains:

- basic data on the site and the condition index value
- description of the site itself, and the history
- a narrative of the main investigation and results
- a descriptive assessment of the importance of the site
- site map
- chemical analysis results

The basic data on the site includes such information as the estimated area, average depth and fill volume. The area and depth have been fairly well defined in most sites as a result of the borehole investigations. Where there is uncertainty, because the bore investigation data did not sufficiently define these quantities, an estimate of the quantities has been made.

Where no bores were dug and no other information was available, a conservative overestimate of the fill depth or area has been made. It is inferred that the fill areas are within the boundaries of the properties within which the old landfills are contained. The fill depth is taken to be the difference in height between the top surface of the fill and the natural ground at the base of the fill beyond the landfill footprint. The volume of fill has in all cases been taken as the product of these parameters.

The site maps (Appendix A) show the site location and the sampling points. The locations of the investigation bores are also shown in the maps.

1.1 Hills Road (Mayfield Park)

Site Name	Hills Rd
Filltype	Household
Estimated Fill Volume (m^3)	100000
Estimated Fill Area (ha)	2
Estimated Average Depth (m)	5
Road Location	Hills Rd, Mayfield Park
Suburb	Otara

Adjacent Watercourse	Otara Creek
Open	1963
Close	1967
Underlying Geology	Sedimentary materials of the Tauranga group
Legal Description	Allot 356 (SO 45686)
Leachate Strength (%)	11.01
Condition Index Value	6041

Note: The area of the main body Mayfield Park that contains the landfill is about 3 ha. However the depth of fill will vary over the site. The greatest depth of fill will be found in the former riverbed (where the bores installed on the site have been dug). The area located within the former bend of the river, was excavated for cover material being placed in the creek bed. This area was later filled also with refuse but the depth of refuse would be much less. To allow for this change in depth we have only allowed for a 'representative' fill area of 2 ha.

1.1.1 ***Location and Description***

The site is in the area bordered by Hills Rd, the Otara Creek and Velvet Crescent in Otara. The area is now part of Mayfield Park.

The fill area is roughly oval in shape. The surface is moderately uneven and does not drain properly making it inadequate for contact sports particularly during winter. The filled areas show signs of settlement. This is consistent with fill consolidation as refuse decomposes.

The edge of the site along the Otara Creek drops steeply down to the mudflats. The eastern boundary slopes up at approximately 25 degrees bank to Hills Rd. A low stone wall has been built along the full length of the site above the Otara Creek bank.

The bulk of the site is mown grass with exotic trees around the perimeter. None exhibit any sign of stress that might be associated with landfill gas or leachate influence. The eastern bank of the Otara Creek has reeds, flax, weeds and young mangroves.

There are several springs on the banks of the Otara Creek. The strongest springs come out of the landfill at about the location of the route of the former creek.

1.1.2 History

Information about the site is from the recollections of long serving staff, past and present residents and some sketchy council records.

The site was originally used as the sewerage treatment plant for the original Housing Corporation subdivision of Otara. Following its acquisition by the then Manukau County the almost circular bend in the Otara River was straightened. The County filled the resulting ox bow lake. It was the major municipal dump for Manukau County at the time and received all types of household and commercial rubbish. There is no record of filling or earthworks on the western side of the present channel.

Written records and verbal reports from present and past residents show that local residents complained of many operational problems which resulted in such nuisances as rats, mosquitoes, flies, dust and odour etc.

1.1.3 Surface Water and Ecology

The catchment for the Otara creek contains many industrial, commercial, urban and rural areas. A breakdown of the zoning for the Otara Lake catchment is given in the report for the Ngati Otara site. Stormwater runoff and possible sewerage overflows affect water quality.

The Otara Creek flows south to north on the western edge of the site and is tidal at this point. The creek is very unsightly. The water appears dark, dead and polluted. However this is most likely due to industry and other pollutant sources in the catchment. Water quality results indicate high levels of biological pollutants (most probably as a result of sewer overflows).

Former residents reported that Otara Creek by the landfill was a very popular swimming spot with firm riverbeds and provided rich fishing grounds. The river is now heavily silted and is not safe for swimming or fishing.

Only a few small finned fish have been observed in the stream. A proper biological evaluation of the stream has not been done yet.

The Otara Lake, which is just downstream, is the subject of water quality initiatives by the MCC, ARC and ECNZ with intention of making the lake suitable for contact recreation. These initiatives may have to address problems in the catchment and thus there may be a positive effect on the water quality of the Otara Creek at Hills Rd.

1.1.4 Drains

Stormwater lines (225 diameter falling into 380 diameter) cross and fringe on the southern edge of the site. A 230 diameter sewer runs inside the stone wall on the western edge.

1.1.5 Surrounds

The Otara area is predominantly flat and low lying with some gentle rolling hills. There is residential housing on the southern and northern edges of the site and across Hills Rd on the western side. The site is part of Mayfield Park reserve, which runs to the north and south on the western side of the creek. In addition the drainage reserve to the creek runs further north and south. Mayfield school is within a couple of blocks of the site.

1.1.6 Water Sampling

Six monitoring stations were established. Site 4 just upstream and Site 5 just downstream of the landfill in the stream provide samples indicative of the impacts of landfill discharges on the stream water quality. There is the possibility that tidal effects will propagate contaminants and saline water upstream reducing the value of the control.

Site 1 sampled a spring, which according to the records is about the location of a piped outlet from one end of the filled former oxbow riverbed. The spring should allow direct measurement of the leachate. It is distinctly rusty possibly with iron oxide from the landfill.

Site 2 is located on the last manhole of a stormwater culvert before it discharges into the creek. The culvert skirts the southern boundary of the landfill. The joints in the manhole walls at Site 2 are noticeably encrusted with rusty oxide deposits. During wet weather they act as entry points for water into the manhole chamber. This suggests that groundwater from the surrounding filled area may be entering the manhole during wet weather and is possibly carrying leachate into the manhole. Sites 3 and 6 are stormwater manholes further up the grade on the same culvert.

In general sampling from culverts does have limitations namely that leachate will only be present in the culvert if it can get into the culvert. If the flow is not continuous then sampling on any particular day may not detect leachate. However the increased length of culvert through the fill area should increase the chance that leachate will enter the culvert.

1.1.7 Pooled Water Sampling

It is common for water to pool on this site during winter. MCC became concerned that water pooling on the site could contain leachate, which may pose a public health risk.

A special set of tests was carried out on the pooled water. The results are shown in table 10.

Table 10 : Parameters in Pond Water at Hills Rd

Parameter	Unit	Result
Cadmium	mg / l	<0.003
Copper	mg / l	0.02
Chromium	mg / l	0.03
Iron	mg / l	35
Lead	mg / l	0.03
Manganese	mg / l	1.8
Zinc	mg / l	0.1
Nitrate	mgNO_3 - M/L	0.027
Nitrite	mgNO_2 - M/L	<0.005
Total Ammonia Nitrogen	mgNH_3 - M/L	1.9
Non-purgable organic carbon	mg / l	27

1.1.8 ***Subsurface Investigations***

Four bores were drilled on site. They were located in areas that appeared to be settling and were likely to pick up the location of previous bend in the river that was filled.

The fill was 4 to 4.5m deep in the two bores closest to the present creek. It was 5 to 5.5m deep in the bores closest to the road. All four bores showed that Waitemata group materials underlay the fill. The water table was intercepted in all bores at a depth of around 1.5m. Piezometers were installed in all bores.

A mixture of clay fill and assorted refuse was found in all of the bores. Gas levels between 60% and 75% LEL were recorded in all of the bores.

The topsoil depth was approximately 0.2m.

1.1.9 ***Consultation***

A letter drop to neighbouring residents took place in December 1994 to inform them what the investigation is for and to request information. No responses were received.

A report to the Otara Ward community board March 1995 meeting and a subsequent article in the Manukau Courier resulted in several callers providing historical information about this site.

1.1.10 ***Results and Conclusions***

The water quality results taken for this investigation have shown a low level of contamination. While there are low concentrations of leachate indicators in the

spring at site 1, there is no detectable change in water quality between sampling stations 4 and 5.

In November 1998, Manukau City Council started a project to lay a clay cap on this landfill. The intention is to improve the year round usability of the park surface and reduce infiltration into the landfill below.

Overall, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.2 Pah Road (Papatoetoe Cemetery)

Site Name	Pah Rd
Filltype	Household
Estimated Fill Volume (m^3)	30000
Estimated Fill Area (ha)	0.5
Estimated Average Depth (M)	6
Road Location	Papatoetoe Cemetery
Suburb	Papatoetoe
Adjacent Watercourse	Waokauri Creek
Open	unknown
Close	1965
Underlying Geology	Pumiceous deposits of the Tauranga group
Legal Description	PT LOT 2 DP 11565
Leachate Strength (%)	20.94
Condition Index Value	2927

1.2.1 Location and Description

The site is located within the South Auckland cemetery. The cemetery is on the north side of Puhinui Rd several hundred metres from its intersection with Roscommon Rd. The cemetery is bound by the Waokauri creek to the west and the southwestern motorway to the east.

The landfill is now an open space park area within the cemetery. It is adjacent to the carparks outside the cemetery administration office. It falls gently westwards to the Waokauri creek. The surface is well maintained surrounded by scattered trees. There is no sign of settlement on the surface but it is possible that this is due to maintenance and continued local filling by cemetery staff. The grass and surrounding trees show no sign of distress.

The front face of the filled area is quite steep and is covered in weeds and scrubs. Underneath this vegetation there is rubble, metals and concrete etc. and other obstructions typical of old dumps. The fill area fringes onto the creek.

1.2.2 *History*

The fill was formed in part by filling a branch of the Waokauri Creek. Filled area also extended along the bank of the main tributary. The site was operated as the municipal rubbish dump by the Papatoetoe City Council and received all types of household and commercial refuse.

1.2.3 *Surrounds*

The Waokauri creek runs north to south on the western edge of the cemetery. The stream is relatively free flowing, relatively clear and flowing on both sides with an assortment of waterweeds. No aquatic life such as fish and eels were observed. There are mangroves starting on the Waokauri creek just to the south of the landfill area.

The land within the cemetery extends for several hundred metres to the north, east and south of the landfill site. The crematorium is about 100m to the southeast of the landfill area. The land in the cemetery all fall gently to the Waokauri Creek. Beyond the motorway approximately half a kilometre from the cemetery, there is residential housing. The land immediately on the other side of the creek from the landfill is being used for horticulture. Beyond that the surrounding land to the north, south and west is rural being used for agriculture and horticulture. In general the surrounding land beyond the cemetery is flat.

1.2.4 *Water Sampling*

Three sampling sites are located on the Waokauri Creek for surface water quality testing. Site 2 is the rusty spring just above the toe of the filled slope. Site 1 is just downstream of the spring at the base of the filled tributary. Site A is in the mangroves. Site 3 is upstream from the filled area taken as a control. On the last two occasions samples have been taken at or immediately below the spring at site 2.

1.2.5 *Subsurface Investigations - Landfill Investigation*

Three boreholes were dug within the bounds of the landfill in January 1996. All three bores showed a depth of fill ranging between 7.5m (at the top of the bank) to 6.0m depth (at the other two bores). They all contained a mix of refuse and clay, with quite a high content of rubbish in places. No abnormal gas readings were measured.

Each bore showed that Waitemata group underlay the fill.

The groundwater table was intercepted in each bore at 1.5 to 2m depths. Piezometers were installed in each bore.

Topsoil of depths 0.6m and 1.3m was found in two of the bores. Topsoil was not recorded as being found in the last bore.

Groundwater samples were taken from all three bores in March 1996.

1.2.6 ***Previous Groundwater Investigations***

There is some specific background information for this site. To investigate problems with the shallow depth of the groundwater table and possible groundwater contamination arising from the graves a groundwater contamination investigation was undertaken in November 1994 by Pattle Delamore Partners. Some of the findings of their investigation are summarised here with the kind permission of the Manager of Manukau Memorial Gardens. We should note that Pattle Delamore did not seem to be aware that the site contained a landfill and their investigations did not include the landfill area.

During that investigation seven bores were dug on the site - one to the north, two to the east and four to the south of the landfill. Pattle Delamore acknowledges that insufficient bores were dug to clearly establish groundwater contours and its flow directions on the site. The pattern of groundwater is not simple and the results could be interpreted as being the result of perched groundwater or being due to groundwater flowing to former and still existing stream tributaries. It could be expected though that the general direction of groundwater would be to the east towards the stream.

The samples taken at the Pattle Delamore bores 2 and 3 are reasonably representative of the background groundwater quality.

The analytes tested both in our investigation and in the previous investigation were ammonia, nitrate and conductivity.

Ammonia in the landfill was in the range 70 - 130 mg/l, whereas the background groundwater showed levels of approximately 0.05 mg/l.

Nitrate measured in the landfill was less than 0.1 mg/l, whereas it was measured as 15 g/l in the background water. This disparity could possibly be due to the fact that the landfill groundwater was not analysed soon enough.

The overall picture is that the background groundwater, upstream of the influence of the landfill (and/or the graves - which Pattle Delamore separately

conclude are not having a significant impact) does not contain high concentrations of contaminants.

1.2.7 ***Results and Conclusions***

The surface water quality results showed no measurable contamination above background levels.

The groundwater analyses from the bores in the landfill area show that the average concentration of selected leachate indicators is 20.94% of the concentration of those indicators in a typical landfill leachate.

Again, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.3 Ngati Otara (Otara Park)

Site Name	Ngati Otara
Filltype	Household
Estimated Fill Volume (m^3)	24000
Estimated Fill Area (ha)	0.6
Estimated Average Depth (m)	4
Road Location	Alexander Crescent, Ngati Otara Park
Suburb	Otara
Adjacent Watercourse	Otara Lake
Open	1967
Close	1969
Underlying Geology	Inter-tidal mud and thick, fine and bedded ash
Legal Description	Pt Allot 520 Manurewa PSH (S0 53719)
Leachate Strength (%)	14.80
Condition Index Value	2162

1.3.1 ***Location and Description***

This site consists of a filled former inlet of the Otara Lake located inside the Otara Park in the area bordered by the Otara Lake, Otara Rd and Alexander Crescent. The site is now a recreational park consisting of passive recreation areas surrounding and to the west of a number of playing fields.

The confirmed filled area is a reclaimed tributary of the Otara Creek at the western end of the park. The tributary originated from around the location of the present marae. The front face of the fill falls onto a still existing tributary of the lake near the power station.

The site is largely flat and slightly lower than the surrounding ground. The land is generally flat. There are reasonably steep banks falling down to the Otara Lake to the north and the small tributary / inlet to the west.

The surface is a well-maintained grass surface with scattered trees over those areas not on the playing fields. None of the vegetation shows any signs of distress except for one tree at

the western edge of the fill area that is dying. There are signs of surface settlement causing poor drainage and probable ponding on a portion of the reclaimed area.

There are rusty springs at the edge of the tidal mudflats on the front face of the fill which are most likely carrying discharges from the buried refuse (they are dry during summer). Due to the presence of these springs the site is classified as discharging to water rather than discharging to ground.

Access onto the site can be gained through Otara Road, which extends on to the park to the east of the landfill area.

1.3.2 ***History***

No written records of fill quantities or compositions were kept. Verbal reports from council staff and members of the public confirm the location of the site, which was operated by council as a municipal refuse dump. The landfill reclaimed a former branch of an inlet of the Otara Lake inlet on the western side of the park. Aerial photographs taken prior to the reclamation confirm the extent of filling. The remainder of the inlet has not been filled. All household and commercial refuse types were accepted for filling.

Apart from the reclaimed inlet it is not certain whether other sites in the park area were filled. It has been reported that the various original hills and gullies all over the present Ngati Otara Park were filled with cleanfill, rubbish, hardfill etc. However the verbal reports on the existence and location of these sites are conflicting. If other sites have been filled with refuse they are probably minor compared to the volume of fill contained in the main fill area.

1.3.3 ***Surface Water and Ecology***

The Otara Lake is manmade and was formed by damming the Otara Creek close to where it joined the Tamaki River. The water in the lake is saline and tidal.

The 'Otara Lake Water Quality Study' by Manukau Consultants gives the following breakdown of zoning in the Otara Lake catchment.

Table 11: Land Uses in Catchment of Otara Lake

Land Use Zones	Area (ha)	%
Residential	812	23.0
Business	436	12.0
Future Development	546	16.0
Rural	992	28.0
Roads	286	8.0
Public Open Spaces	200	6.0
Miscellaneous	246	7.0

The urban areas are predominantly residential with significant commercial and industrial development. Urban stormwater runoff, sewerage overflows and/or illegal links to stormwater pipes have further influence on the lake water quality characteristics. General water quality results indicate that the lake is substantially polluted regardless of any influence of the landfill. The lake edge is heavily silted and muddy. The lake carries high levels of suspended particles, micro-organisms and metal pollutants.

The degraded water quality in the Otara Lake makes swimming and fishing for food unsafe. However the area is the subject of water quality initiatives by the MCC, ARC and ECNZ with intention of making the area suitable for contact water sports.

Some finned fish are still observable but the diversity and population of aquatic life is far less than that which long term residents reported to have existed prior to the development of the catchment. Long term residents reported the waterway to have contained plentiful fish such as mullet and was a popular swimming location. Riverbanks and bottoms were firmer and lack the silt and mud, which now cover the tidal flats. Fish from the Otara Creek are unlikely to be safe for consumption.

There are no freshwater streams crossing the park.

1.3.4 ***Drains***

Flows in the extensive network of stormwater drains underneath the northern playing field have been sampled due to the possibility that they may be collecting seepage from the various filled sites.

The top or eastern end of the known fill area is cut by a stormwater culvert, which joins two other culverts running out from beneath the marae grounds.

Sampling from the manhole where these three culverts meet has shown evidence of sewerage connections into the stormwater system.

A network of subsoil drains underlies the sports grounds between the known fill area and the extension of Otara Rd going into the park.

1.3.5 ***Surrounds***

There are single storey marae buildings within the marae grounds just to the southeast of the known fill area. There is residential housing within fifty metres of the southern edge of the known fill area.

The surrounding area is generally flat and used for a mix of residential housing, commercial and industrial uses. Hillary College is within the bounds of Otara Park and Clydemore School and Bairds Intermediate are within a couple of hundred metres of the site. The Otara shopping centre and Manukau Polytechnic are beyond that. To the west is ECNZ's Otahuhu gas turbine power station, which operates during peak load periods. The purpose of the dam, which forms the Otara Lake, is to impound cooling water for the power station. The southern motorway is just beyond the power station. The Hills Rd site is just upstream to the southeast.

1.3.6 ***Water Sampling***

The main filling area was in the former gully running between sites 3 and 5 whose extents are shown on the sampling map. Sites 3 & 5 would be expected to have the greatest probability of showing any contamination. Site 3 is a spring on the front face of this filled area and should provide direct information on the leachate. However as site 3 is in the tidal mudflat, the saline influence on samples taken from that location may confuse the characterisation of water quality / leachate strength.

Site 5 is a manhole to a stormwater culvert built within or very close to the filled area. There is a distinct vile smell in the manhole at site 5 whose chamber walls are heavily encrusted with rusty deposits at the joints. The joints constantly drip with inflowing seepage. This possibly suggests that water is entering the chamber loaded with dissolved metals, which become deposited as oxides on the manhole walls. This may mean that leachate is entering into the culvert here. Site 5 is unlikely to have been influenced by seawater.

Sampling locations 2 and 4 also sample stormwater culverts. Site 2 is shown in the map in the stormwater outfall to the Otara Creek. This outfall is in a tidal area. Though none of the culverts which feed these sites pass through or underneath the known filled area they have been sampled due to the uncertain location of fill on the site.

Site 6 samples a rivulet close to the tidal area in the Otara creek bank. The rivulet starts from a spring on the side of the slope away from the sports ground. it was sampled in case it contained any leachate discharges. Station 7 is in the Otara Creek at the end of Alexander Rd.

1.3.7 ***Subsurface Investigations***

Three bores were dug on the site along the former inlet. The deepest fill (6.5m) was found at the higher end of the old inlet where the ground is higher. 1.5m of fill was found in the middle bore and 2.5m was found in the bore closest to the existing inlet. The results

suggest that the second bore be probably placed in the side rather than the middle of the former gully.

A mixture of refuse, organic materials and clay was found in all of the bores. Gas levels in 37% LEL were measured in the second bore but no abnormal readings were measured in the other bores.

The groundwater table was intercepted in all of the bores between 1 and 2m depth. Piezometers were installed in all of the bores. In the second borehole the groundwater was found to be below the fill interface.

The topsoil depth was around 0.6m in the top two bores, but there was none at all in the lower bore.

The bore furthermost from the estuary was found to be underlain by estuarine clay. The other two bores were found to be underlain by Waitemata group materials. This suggests that Waitemata group underlies the whole area. It may be that only the first bore was actually placed in the centre of the old stream channel.

1.3.8 ***Consultations***

A letter drop to neighbouring residents took place in December 1994 to inform them what the investigation is for and to request information. No responses were received.

A report to the Otara Ward community board March meeting and a subsequent article in the Manukau Courier resulted in several callers providing historical information about this site. There have been several responses but none indicated any environmental problems.

1.3.9 ***Results and Conclusions***

The surface water quality monitoring results indicated a low level of contamination at the site. Combined results of groundwater samples and

sample from the spring at the front face of the fill showed that the average concentration of selected leachate indicators is 14.80% of the concentration of those indicators in a typical landfill leachate.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.4 Miro Road (Te Puea Marae)

Site Name	Miro Rd
Filltype	Mixed
Estimated Fill Volume (m^3)	30000
Estimated Fill Area (ha)	2
Estimated Average Depth (m)	1.5 ha
Road Location	NW Cnr Miro And Mahunga, within Te Puea Marae
Suburb	Mangere Bridge
Adjacent Watercourse	Manukau harbour
Open	1982
Close	1987
Underlying Geology	Inter-tidal mud containing some sand, silt and shell
Legal Description	Pt Sec 1 Blk V Otahuhu SD (SO 56622)
Leachate Strength (%)	4.46 (extreme result excluded)
Condition Index Value	916

1.4.1 Location and Description

Miro Rd, Mahunga Drive and the Mt Roskill - Mangere motorway, enclose the site.

The site falls from the motorway overbridge in the northwestern corner to the intersection of Mahunga Drive and Miro Rd at the southeast. There is a sharp bank on the western side of the site falls towards the motorway and there are mild slopes in all other directions.

The fill surface was never adequately sealed and contoured. Irregularities on the surface impede surface water runoff. The presence of obstacles on the ground such as concrete blocks, stones and metal make mowing and general

maintenance difficult. The exposure of the obstacles is due to inadequate surface cover. The site is at present unusable for even passive recreation.

The vegetation on the site consists of thick grass and weeds. A number of trees have been planted around the fringes of the site adjacent to Mahunga Drive.

The Marae trustees are considering plans to build a major complex for health and community purposes. Foundation conditions will probably restrict potentially suitable areas for building development to the southeastern half of the site.

The site is almost directly adjacent to the Mangere interchange off the motorway and is highly visible from the motorway, Mahunga Drive off-ramp and Mahunga Drive itself.

1.4.2 ***Reported History***

The original foreshore ran in a jagged line from halfway along the western boundary to cross approximately halfway along the southern boundary. All other areas are reclaimed lands and fill probably overlies original ground near the marae buildings. This site was filled in as a reclamation of the former impounded marine enclosure created by the construction of Mahunga Drive.

The site was owned by the MCC when it was operated as a fill. Since the completion of filling the site has been vested in the marae trustees. Council undertook to hand over the site in a suitable state.

No written records of fill types or quantities were kept but verbal reports from council staff and members of the public suggest that the materials received at the site were cleanfill, inorganic refuse, street sweepings and cesspits. There was some illegal dumping of household refuse.

1.4.3 ***Surface Water and Ecology***

There are no surface creeks or well-defined drainage lines on the site.

Mahunga Drive borders the Manukau harbour. Tidal water comes up stormwater culverts on site and permeates the filled areas. The water quality of the Manukau Harbour is impaired but the ARC has initiatives to improve this.

The present state of water quality in the near Manukau Harbour limits recreational uses of the harbour. Swimming, fishing, food harvesting and other recreational activities may be safer in the long term if the Arc efforts are successful. Any improvements in water quality though, are likely to occur after or towards the end of this sites potential leachate production period.

The near by Manukau Harbour accepts waste discharges from a multitude of other industrial and waste disposal sites.

There is a small mangrove community along the seawall where the stormwater pipe which run underneath the site discharge.

1.4.4 *Drains*

Two 900 diameter stormwater underground culverts traverse the site falling towards Mahunga Drive from the motorway. A 750 diameter third culvert crosses the south-east corner of the site east of the marae buildings from Miro Rd and exiting onto Mahunga Drive. There are understood to be a number of private drainage connections in this same area. Two stormwater cut-off trenches have recently been installed adjacent to the Marae fence and drain into one of the culverts.

1.4.5 *Surrounds*

The site backs onto the Mangere-Mt Roskill Motorway to the west. On the eastern side of the motorway the land use is predominantly industrial and this area extends to the south along Mahunga Drive. On the other side land use is residential but the motorway forms a barrier.

The marae operates a community centre presently on the other side of Miro Rd from the landfill site. The centre includes old people's homes and a youth training centre. A kohanga recreational centre is presently being established. The marae trustees also have plans to develop a health centre. The health centre will possibly be established on or directly adjacent to the fill area.

There are single storey marae buildings at the Southwest corner of the block on which the marae sits. As discussed above there are further marae buildings on the other side of Miro Rd. Next door to the marae buildings on the opposite corner of Miro and Mahunga Rds is a large factory warehouse.

A description of the other pollutant sources around the Manukau Harbour is given in the site report for Harania Ave.

1.4.6 *Water Sampling*

The manholes in stormwater culverts and tidal pools at the culvert outlets have been used as sampling sites. These would show contamination if waters contaminated with leachate seeped into the stormwater culvert. There was evidence of seepage occurring at two of the manhole chambers. Apart from the downstream locations at the outlets and the control samples in the sea all the samples were taken from the manhole chambers.

Sites 1 and 4 are the upstream control and downstream sites respectively on the northernmost culvert on the site. Sites 2 and 3 are between them. During high tides the seawater level came up at least as far as site 3 but was never observed at site 2.

In the middle culvert there are two sites, denoted 5 and 6. Site 6 is the culvert outlet. A soakage trench constructed parallel to the marae fence, to prevent surface water flooding the marae grounds, has been connected to the manhole at site 5. This should increase the possibility of leachate entering this culvert though only if it gets to the subsoil drain which is not guaranteed as it is quite shallow and set back from the known fill area.

The southernmost culvert line is sampled at site 7 within the filled area and site 8 downstream at the outlet. Site 9 samples a culvert line running over non-landfill site but through the factory site adjacent to the marae. Sites downstream of the filled area e. g. 4,6,8,9 are below tide levels and so will have marine influence. Two sites just offshore, sites 10 and 11, are intended to provide background analyte levels.

1.4.7 ***Subsurface Investigations***

A preliminary soils investigation was undertaken in April 1995 to confirm our understanding of the fill materials present at the site. Though this investigation provided some useful background information it was considered too limited in scope to provide sufficient information for background assessment.

Three boreholes were drilled in August 1995 for the purpose of installing piezometers for groundwater monitoring.

In May / June 1996 an extensive geotechnical investigation was undertaken. The investigation showed that refuse is concentrated mostly in the top north-western half of the site and along the Mahunga Drive boundary.

1.4.8 ***Results and Conclusions***

Only the bore samples have been used in the calculation of the leachate strength. The average concentration of selected leachate indicators is 4.46% of the concentration of those indicators in a typical landfill leachate. This however does exclude some of the extreme results, which were thought to have been affected by the presence of sediment in the samples. If the extreme results are included then the leachate strength is 20.17%.

Recently the site has been capped and grassed.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.5 Dale Crescent

Site Name	Dale Crescent

Filltype	Inorganic
Estimated Fill Volume (m^3)	15000
Estimated Fill Area (ha)	1
Estimated Average Depth (m)	1.5
Road Location	Between Waipuna Motorway and Dale Crescent
Suburb	Pakuranga
Adjacent Watercourse	stormwater discharges to tributary of Tamaki River other side of motorway
Open	unknown
Close	unknown
Legal Description	Sec 1 SO 52269
Leachate Strength (%)	17.56
Condition Index Value	635

1.5.1 ***Location and Description***

The site is located just at the western end of the Waipuna Bridge in the flat open space area bound by the residential properties on Dale Crescent and the embankment of the Pakuranga - Panmure motorway. The site was apparently created at the time of the motorway construction by filling in the previous swampy area.

1.5.2 ***Surface Water and Ecology***

The site is approximately 100m from the Tamaki River at its closest point. This is just downstream of the confluence of the Pakuranga and Otahuhu Creeks. The catchment to the Tamaki River contains principally residential and commercial / industrial areas. Most of the few remaining rural areas are currently being subdivided and developed. The estuary is completely tidal at this point.

Aquatic fauna is scarce and does not display species diversity. This is characteristic of the ecosystems in degraded urban waterways.

1.5.3 ***Drains***

Stormwater lines run to the east and west, draining cesspits in the middle of the site adjacent to the footpath. The drains are at the east and west ends running away from the middle of the site. A major 1060 diameter Watercare water

supply pipe crosses the northern part of the site. Bulk power transmission lines also run overhead.

1.5.4 *Surrounds*

The properties sharing the northern boundary of the site, and those to the south of the site beyond the motorway are residential. The Pakuranga shopping centre is located to the east. Pakuranga Intermediate is within five hundred metres to the east. The Riverina School is several hundred metres to the west and Anchorage Park School is several hundred metres further to the south.

1.5.5 *Subsurface Investigations*

Four bores were drilled in a rough line along the site. All bores showed a mix of gravel, silt and clay fill of depths between 1 and 2.5m. It appears likely that organic materials were not imported onto the site.

The water table was intercepted at 2 to 2.5m depths in all but the easternmost bore where it was not found by 3m depth. The southernmost bore, closest to the motorway showed that Waitemata group materials underlay the fill. In the other bores marine / estuarine deposits were found.

In two bores where marine sediments were found, the fill also contained plant fragments. It is likely that the plant fragments are the remnants of vegetation on the site prior to the placement of the fill. The groundwater table was also intercepted in these two bores and the measured gas levels were 75% and 90% LEL. In the latter there was also a bubbling noise. A piezometer was installed in this bore.

In the other two bores the measured gas levels were around 35% LEL. Groundwater was found in one of these bores. It may be that the gas levels occur as a result of decomposition of the plant fragments.

In the three bores where the groundwater table was found it was between 2 and 2.5m deep. Topsoil was found in one bore to a depth of 0.1m, but was not found elsewhere.

1.5.6 *Results and Conclusions*

The average concentration of selected leachate indicators is 17.56% of the concentration of those indicators in a typical landfill leachate. The level of ammonia at this site is also higher than the level at most of the other sites.

This level of contamination is quite surprising as no refuse was found during drilling and the bores on the site covered the site reasonably well. However the bore logs do indicate that the fill was not entirely clean clay. This indicates in

itself that the fill was not entirely taken from the surplus of earthworks operations.

Another possibility is that the level of contamination is due to rotting plant fragments. These were shown to be present during drilling. The fill may have been placed over the site without first removing the organic material beneath it.

Overall, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.6 Great South Road

Site Name	Great South Rd
Filltype	Hazardous
Estimated Fill Volume (m3)	15000
Estimated Fill Area (ha)	0.3
Estimated Average Depth (m)	5
Road Location	Great South Rd, South Bank/West Side on River
Suburb	Otahuhu
Adjacent Watercourse	Tamaki River
Open	1977
Close	1982
Underlying Geology	Inter-tidal mud and sedimentary materials of the Tauranga Group
Legal Description	Allot 523 & 540 Manurewa PSH (SO 55438) T.B.A.
Leachate Strength (%)	7.96
Condition Index Value	545

1.6.1 Location, Description and History

The site is on the southern bank of the Tamaki River on the western side of Great South Rd. The reserve, which includes the site, extends to the Manukau end of the Tamaki River Bridge. The filled area is less than 50m from Great South Rd.

Filling took place in a former inlet / tributary of the river in two separate areas. The back end of the inlet has been filled and a small bay has been formed on the riverbank. Filling has also taken place on one side of this bay. The two

filled areas do not join up completely except possibly for a small layer. Illegal rubbish dumping and littering is still going on between and behind the two filled areas.

All of the filled area is owned by MCC. The filled area to the side of the bay and the front of the first filled area is all within the drainage reserve. However the back end of the former filled area, though owned by MCC is enclosed within a fence which also contains land currently owned by Glaxo Wellcome. Glaxo Wellcome currently has an agreement to sell their land. The area enclosed within the Glaxo Wellcome fence is a well maintained garden area. The MCC owned part of the same area of fill has a sloping uneven surface, which rolls downhill to the inlet. The other filled area has a steep and roughly maintained surface.

Low lying parts of the site within the drainage reserve have become very boggy because not all parts of the site drain well. The ground is littered with hard rubbish dumping including old car parts. The surface vegetation is grass, shrubs, flaxes and weeds with a few exotic trees. None show any signs of distress. The maintenance of the surface is made difficult due to the surface obstructions.

As noted above the inlet has at present been only partially filled. The filled area now fringes onto an area of tidal mudflat, which is sheltered from the direct river flow by the arms of the former inlet. There are mangroves established on the inter-tidal area and upstream and downstream of the site.

There is a dirty tidal pool at the base of the filled area, which has been sampled from time to time. No fluid has actually been observed to discharge into this pool, or in fact anywhere else on the site. For this reason the site is classified as discharging to ground rather than discharging to water. The tidal pool sometimes shows a faint oily sheen.

The Tamaki River at this location is predominantly tidal and there is significant sea water influence. The adverse water quality of the Tamaki River and the presence of deep mud make swimming and fishing for food unsafe.

The site has two stormwater culverts discharging into the inter-tidal area on the edge of the reclamation. A 600 diameter culvert was installed at the same time as the reclamation of the valley on the western edge of the site. A 150 diameter culvert was installed further to the west.

Manukau City Council has no legal vehicular access onto the site. Access for site inspections and water samples has been gained through a driveway on private property. It is not possible to drive fully onto the reclamation area proper. Foot access is possible around the reserve area from the Great South Rd Bridge.

1.6.2 ***History***

Most of the history of this site has been derived from ARC records. It appears that the area on which the fill was sited was previously designated as tidal land.

Permission was gained to fill the land with the proviso that the completed reclamation would be vested in Manukau City Council.

We have found very little direct correspondence between Manukau City Council and the then Wellcome NZ Ltd. However we have been able to establish that Manukau City Council was contracted by Wellcome NZ Ltd to fill in the land however it is not clear whether this agreement was reached after the original decision to vest the land in Manukau City Council.

It was found when the fill was surveyed that the amount of filling that had been undertaken exceeded the amount set down in the reclamation permit. A second permit was issued to regularise the situation. Anecdotal reports from MCC staff indicated that the arrangement between Wellcome and the MCC involved a cost sharing exercise for the installation of culverts and both parties would have access to the site to dispose of hardfill.

The site was supposed to have been a hardfill site. However there has been some illegal household and commercial dumping. A few adjoining garages have been observed to allow wash-down effluents to run onto the site and this practice is thought to still continue. Several car wrecks have been dumped on the fringes of the site.

1.6.3 ***Surrounds***

The site is in the middle of the Otahuhu / Papatoetoe industrial area. Low areas predominantly surround the site with very slight fall towards the Tamaki River.

The site is part of the esplanade reserve for the Tamaki River. To the north and east the property boundaries extend around to the Great South Road Bridge crossing the Tamaki River. The property continues upstream. To the south and east the site is bounded by privately owned industrial properties.

The surrounding land on the southern bank is used for light industry such as workshops and warehouses. It is possible that yard effluents from these adjacent businesses are occasionally discharged onto the site by either stormwater drains or overland flow. Any industry in the catchment of the stormwater culverts could contribute to contaminant discharge onto the site near the stormwater outlets. Urban and industrial land uses in the catchment no doubt contribute to the degradation of water quality in the Tamaki River at the site.

1.6.4 ***Water Sampling***

Sampling site 1 is in a spring in the inter-tidal zone and site 2 is located under the mangrove stands. They are both close to the toe of the filled area. As site 1 is located above the tide level at low tide it is only intermittently flushed. Site 2 is lower and will receive continuous tidal flushing. Flushing at both sites is due to tidal action rather than direct river flow. As both sites are at the bottom of a bank it is possible that contaminants from off the property could reach the

location where the samples are taken from. These could affect the levels of contaminants found in samples taken from the site.

1.6.5 ***Subsurface Investigations***

The two halves of the site have been designated independently in the bore logs as 'Great South Rd' and 'Glaxo Wellcome', the latter being that part of the site within the bounds of the Glaxo Wellcome site. Gas levels of 10% LEL were recorded in the bore above marine mud.

In the 'Great South Rd' half two bores were dug. The depth of fill was 4.5m and 5m for the two bores. The groundwater table was intercepted just above the fill / natural ground interface. The fill contained an assortment of refuse. Marine mud was found beneath the fill in one bore, while Waitemata group materials underlay the fill at the other bore. The water level was intercepted at or just above the fill / natural ground interface. One bore showed a depth of 0.8m topsoil whereas the other showed none.

In the 'Glaxo Wellcome' half two further bores were drilled. Each bore showed an assortment of clay fills and rubbish. The groundwater table was not installed at either bore however it was high tide at the time of drilling. The fact that the groundwater table was not intercepted and that marine mud was not found suggests that these bores were not installed in the centre of the old estuary. There was an average of 0.6m topsoil in this half of the site.

Piezometers were installed in all four bores. However two of the bores have subsequently been buried under tyres. It is necessary to contact neighbouring landowners to have the tyres removed.

More recently further investigations have been carried out to ascertain whether there were any significant levels of organic pollutants of environmental concern at the site. Two borehole water samples were taken and analysed for a wide range of known environmental contaminants. The results of the analysis are attached to this report as Appendix D.

No significant levels of any of the organic pollutants were detected in the samples.

1.6.6 ***Results and Conclusions***

The surface water monitoring results indicated a high degree of contamination on one occasion. The concentrations (of analytes) found are not necessarily in a pattern characteristic of landfill leachates (high levels of zinc have been found but little else). It is possible that this contamination was due to wash-downs from surrounding properties. Otherwise the results have shown low levels of contamination.

The average concentration of selected leachate indicators is 7.96% of the concentration of those indicators in a typical landfill leachate. No significant levels of any of the organic pollutants were detected in the leachate samples.

1.7 Robert Allan Road

Site Name	Robert Allan
Filltype	Mixed
Estimated Fill Volume (m3)	5600
Estimated Fill Area (ha)	0.25
Estimated Average Depth (m)	2.25
Road Location	off Robert Allan Way, almost opposite Nan Pl.
Suburb	Pakuranga
Adjacent Watercourse	unnamed (to Pakuranga Creek)
Open	unknown
Close	unknown
Underlying Geology	Soft mud and silt. Moderately weathered Tauranga group silt and clay close by
Legal Description	Allot 386 Pakuranga PSH (SO 49436)
Leachate Strength (%)	8.55
Condition Index Value	199

1.7.1 Location and Description

The site is an empty lot between residential properties in suburban Pakuranga. It borders onto a tributary of the Pakuranga Creek. The site is several hundred metres downstream of the Elm

The Park site, several hundred metres upstream of the Riverhills School site and is almost immediately opposite the Ennis Ave site.

MCC maps suggest that the site consist of the reclamation of a former inlet of the creek running down the northern half of the site. No other record of the site is documented and the fill type was not known prior to drilling.

The site surface is uneven and has a boggy, unkempt appearance even in summer suggesting that it does not drain well. There is a row of tall pine trees running down the northern boundary of the site.

The site borders onto a tributary of the Pakuranga Creek, which is itself, a tributary of the Tamaki River. The catchment to the creek at this side contains almost entirely residential areas.

The estuary is tidal at this point.

The aquatic ecology appears barren on observation, as is characteristic of most urban rivers.

There is a 600 diameter stormwater drain running parallel to the filled area along the length of the site before discharging into the creek.

1.7.2 ***Surrounds***

The Pakuranga Creek tributary flows south past the site. The area around the site is all residential. The Elm Park and Riverhills Schools are within several hundred metres north and south respectively but are on the other side of the creek.

The topography of the surrounding land is moderately hilly.

1.7.3 ***Subsurface Investigations***

Four bores were dug in a rough line along the site, up to three metres deep. The depth of fill encountered was around three metres, with greater depths being found at the back of the site away from the creek where the ground is slightly higher.

The water table was encountered at about 1.5m depth in every bore except the bore closest to the creek, which was drilled at low tide. Piezometers were installed in the two bores in the middle of the site.

Some organic debris and plant fragments were found in one of the bores. Otherwise the fill was all clay. Gas levels ranging from 15% to 35% LEL were found in the bores.

Topsoil depth was found to a depth of 0.3m in one of the bores. It was not found elsewhere. The bores show that Waitemata group materials underlie the site though marine sand was found in one of the bores.

1.7.4 ***Results and Conclusions***

The average concentration of selected leachate indicators is 8.55% of the concentration of those indicators in a typical landfill leachate.

The amount of gas measured could be due to the decomposition of plant matter that was not removed prior to the placement of the fill.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.8 Harania Ave

Site Name	Harania Ave
Filltype	Mixed
Estimated Fill Volume (M3)	6000
Estimated Fill Area (ha)	0.3
Estimated Average Depth (M)	2
Road Location	Harania Ave Reserve Opposite Tinkler Ave
Suburb	Favona
Adjacent Watercourse	Manukau Harbour
Open	unknown
Close	unknown
Underlying Geology	
Legal Description	Lot 61 DP 61809
Leachate Strength (%)	2.39
Condition Index Value	58

1.8.1 Location and Description

The site is in Harania Park. The park is around an estuarine tributary of the Harania Inlet. A tributary of the creek appears on many maps to cut westward through Harania Ave but is actually piped through a 900 diameter culvert that runs through the filled area before discharging into the estuary. The main body of the creek goes south past the site. The site is now a recreational reserve off Harania Ave opposite Tinkler Ave. It has a well maintained grass surface.

No record of the site is documented and information is from the memories of long serving council staff. The extent of filling on this site was uncertain, but has largely being confirmed by exploratory drilling.

Filling took place in the former extension of the inlet which ran towards Harania Rd and Tinkler Ave. As described above, the water course which ran through the former inlet is now piped, and the culvert discharges into the inlet. It may also have taken place along the existing stream edge. It is thought to have taken all non-household types of refuse.

Fill also took place along the front of the site on the edge of the creek.

The creek itself is freshwater at the top, southern end of the site. It becomes saline at the bottom end of the site. The creek is choked by plantlife along the length of the site - with water weeds upstream and mangrove stands downstream. The water in the creek is slow moving - the water in it is dark from silt and a high density of plant material.

The site is flat with a slight fall towards the estuary. It is prone to water logging along the depression where the old creek used to be.

The water quality of the Harania Inlet appears polluted and heavily silted.

Aside from the 900 diameter stormwater culvert the site is crossed by 230 diameter sewer lines running north to south just to the western edge of the estuary. There are two further stormwater outlets probably beyond the extent of filling at the northern end of the site.

The surrounding land to the north, east and south is predominantly residential. The Favona Primary school is a couple of blocks from the site along Wakefield Rd which runs onto Harania Ave. The Mangere hospital and training centre grounds are on the other side of the stream.

The Manukau Harbour is fairly polluted and there is some heavy industry in the catchment area of the Harania Inlet including the Pacific steel plant and its adjacent private landfill. This landfill takes waste processing materials from the plant. The cover at this site appears to consist of a dusty silty material. The near Manukau Harbour is also bordered by several large Auckland City Council and Auckland Regional Services Trust former landfills, the former Westfield freezing works and the now largely abandoned Station Rd railway workshops among other possible major impact sources. The harbour is noted to suffer adversely from poor (at least historically) silt control practices and from the effects of urban stormwater runoff.

The heavy industry along the shorelines of the inlet, other landfilling and reclamation activities both ongoing and historical along the shoreline of the inlet are all possible other pollutant sources. The adverse water quality of the inlet and the Manukau harbour in general restricts recreational uses of the water in the area. While the thick mangroves will form a barrier preventing silt from the inlet from travelling upstream, other contaminants could be expected to flush back up the creek.

The site is underlain, most probably , by intertidal mud containing some sand, silt and shell. The site could be underlain by sedimentary materials of the Tauranga group.

1.8.2 ***Water Sampling***

Sites 1 to 4 are all in the estuary. As mentioned above it is not certain at present whether filling took place along the creek past where it turns south (moving upstream) at the northern end of the site. Even if it did take place the tidal action which extends at least up to between sites 2 and 3 where the

mangroves begin may result in flushing and mixing of the area and thus may blur any possible difference between sites 2 , 3 and 4 by either dilution or by propagating contamination upstream. This possibility has been mitigated to some extent by taking samples at or near low tide. Site 1 is beyond the mangroves upstream and should be clear of any saline influence. However because it is not saline site 1 is not necessarily a good control of the downstream sites. Thus the detection of contamination at sites 1, 2 and 3 would not necessarily be due to the landfill. The non- detection of contamination downstream would however show that the landfill is not affecting the marine environment.

Sites 5 and 6 are in the stormwater culvert running west to east from near Tinkler Ave. These sampling sites would only detect leachate if it can enter the culvert i. e. non contamination of leachate in the culvert does not mean it does not exist, only that it cannot be detected in the culvert.

1.8.3 *Subsurface Investigations*

Five bores were dug on the site.

Four boreholes were dug along or next to the old stream bed which used to flow from near the present Tinkler Ave. Up to 2m of clay fill was found in these four bores.

The fifth bore was located on the existing stream, bank. This bore showed 1.5m of clay fill with some wood fragments at the bottom of this layer. Below this there was another 1.3m of clay with wood fragments.

The groundwater table was intercepted at 1.5 to 2m in all bores. Three piezometers were installed. No abnormal gas readings were measured in any of the bores.

1.8.4 *Results and Conclusions*

The water quality results indicated a moderate level of contamination, though this cannot necessarily be attribute to the landfill. The groundwater tests however showed that the average concentration of selected leachate indicators is 2.39% of the concentration of those indicators in a typical landfill leachate. This indicates that the contaminant levels from the landfill itself are very low.

Furthermore, the overall indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured

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MOBIL PAKURANGA, 102 PAKURANGA ROAD, MANUKAU CITY, AUCKLAND – TANK REMOVAL TR07/774, SITE NO. 002021

1.0 Introduction

Mobil Oil New Zealand Limited (Mobil) has engaged Pattle Delamore Partners Limited (PDP) to carry out a site assessment during the removal of an underground petroleum storage system (UPSS) at Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland (the site). The assessment has been conducted to determine the environmental conditions at the site, and to provide a preliminary assessment of the possible environmental effects of any petroleum hydrocarbon residues associated with the UPSS.

The assessment is for the existing building layout and assumes continued commercial/industrial land use at the site. It is based on comparison of reported petroleum hydrocarbon concentrations in the soil with the Tier 1 Soil Acceptance Criteria from the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, 1999).

The assessment was completed during multiple site visits by PDP occurring between 8 February and 19 February 2008 during the removal of the UPSS.

This letter report describes the methods and results of the assessment.

2.0 Site Description

2.1 The Site

The site is located at 102 Pakuranga Road, on the corner of Pakuranga Road and Kentigern Close. The site (Figure 1) is currently vacant. The topography of the site gently slopes to the north-west. The legal description of the site is Lot 1 DP 149241, Lot 51 DP 69912, and Lot 52 DP 69912 and is zoned Business Zone 1 as per the Manukau City Council District Plan.

The UPSS consisted of four 40,000L underground storage tanks (USTs). One of the tanks was used for the storage of 96 petrol, two for 91 petrol products and one for diesel and associated pipework and dispensers. The USTs were located towards the north-west corner of the site. For the locations of individual UPSS components, please refer to Figure 1.

At the time of the PDP site visits, site infrastructure included a small, centrally located service station sales room and a 40m long forecourt canopy located immediately to the south of the sales room, parallel to Pakuranga Road. A carwash facility located to the north of the sales room and adjacent to the tank pit had been removed prior to the PDP site visit.

Stormwater disposal within the vicinity of the UPSS is via two surface stormwater drainage sumps located in the north-western corner of the site.

An underground public stormwater pipe runs across the site in an east to west direction. During the tank removal, the stormwater pipe was exposed in the southern wall of the tank pit (Photograph 5).

2.2 Site Environs

Bounding the site to the north and east are residential properties, to the south, beyond Pakuranga Road, commercial retail units including a BP Oil New Zealand (BP) service station, and to the west, beyond Kentigern Close, residential properties.

The nearest surface waterway is the Tamaki River Estuary, located approximately 70m to the north-west of the site.

2.3 Future Site Use

The future use of the site is unknown, though it is expected to continue to be used for commercial purposes (i.e. continued commercial/industrial land use).

3.0 Site Investigation Activities – Tank Removal

On 7 February 2008, three 40,000L petrol USTs and one 40,000L diesel UST were removed from the site by Petroleum Solutions Ltd (PSL). The dispensers had been removed prior to the present site works. All fuel and vent lines were removed in the days following the tank removal. Details of the tank, tank pit, bedding material and fuel lines are given below along with any field observations of petroleum hydrocarbon impacts.

3.1 Tank and Pit Details

Tank Pit 1 The four 40,000L USTs were removed from an unlined pit excavated to a depth of approximately 4.5m below ground level (bgl). The tanks were overlain by a 0.2m thick concrete pad. According to PSL, the tanks were installed in 1989. The natural geology observed in the walls of the tank pit consisted of light grey mottled orange silty clay from 0.2m to 3.5m bgl underlain by orangey grey sandy clay to a depth of 4.3m bgl. The soils encountered at the base of the tank pit (4.3m - 4.5m bgl) were dark brown clays. Groundwater was not encountered within the excavation. A detailed geological log (TP1) and photograph of the tank pit are appended.

Tank 1 40,000L, diesel, direct and remote fill, single-walled fibreglass tank. The tank was in good condition and there was no indication of any holes within the tank.

Tank 2 40,000L, 96 petrol, direct and remote fill, single-walled fibreglass tank. The tank was in good condition and there was no indication of any holes within the tank.

Tank 3 40,000L, 91 petrol, direct and remote fill, single-walled fibreglass tank. The tank was in good condition at the time of exposure, but was split during removal (Photographs 2 and 3). The tank was empty and no spillage was noted.

Tank 4 40,000L, 91 petrol, direct and remote fill, single-walled fibreglass tank. The tank was in good condition and there was no indication of any holes within the tank.

3.2 Fuel Dispenser and Pipework

The fuel dispensers had been removed previous to these site works, and on 14 February 2008 associated fibreglass pipework was removed from the site. The dispensers were all located under the canopy (Photograph 6) to the south of the store and had been removed prior to these site operations (for the purpose of this assessment, the dispenser

islands have been numbered 1-4 from west to east). The vent lines ran from the south-west corner of the tank pit to the western property boundary, and were removed from the site.

3.3 Soil Sampling

To provide a preliminary assessment of the environmental effects of any petroleum hydrocarbon residues remaining in soils, soil samples were collected for laboratory analysis from the site following the removal of the UPSS. The samples were collected into glass jars provided by the analytical laboratory and kept in chilled storage prior to submission to RJ Hill Laboratories Ltd, Hamilton, New Zealand for analysis, under PDP chain-of-custody procedures.

The samples were analysed for total petroleum hydrocarbon (TPH), and benzene, toluene, ethylbenzene and xylene (BTEX) compounds. Duplicate soil samples were held in cold storage at the laboratory in case follow-up polycyclic aromatic hydrocarbon (PAH) analysis was required.

In addition to duplicate samples collected for laboratory analyses, soil samples were collected from each sample location for the sole purpose of field screening [photo-ionising compound readings, including petroleum hydrocarbon vapour using a photo-ionisation detector (PID[1])]. These soil samples were placed into laboratory supplied glass jars which were half filled and sealed with aluminium foil. The samples were allowed to stand for several minutes prior to the foil being pierced and measuring the headspace vapour readings with the PID.

Details of the soil samples collected from each area and analysed are as follows (details for individual sample depth, soil type, PID reading, and location are provided in Tables 1 and 2; locations are also shown on Figures 2 and 3):

- Twelve samples were collected from the walls of the excavation at less than 1 m below ground level (samples TP1/1, TP1/5, TP1/10, TP1/14, TP1/17, TP1/20, TP1/23, TP1/26, TP1/29, TP1/32, TP1/35, and TP1/38);
- Twelve samples were collected from natural soils from the walls of the excavation between 1 – 4m bgl (samples TP1/2, TP1/6, TP1/11, TP1/15, TP1/18, TP1/21, TP1/24, TP1/27, TP1/30, TP1/33, TP1/36, and TP1/39);
- Twelve samples were collected from natural soils from the walls of the excavation at depths below 4 m bgl (samples TP1/4, TP1/7, TP1/12, TP1/16, TP1/19, TP1/22, TP1/25, TP1/28, TP1/31, TP1/34, TP1/37, and TP1/40);
- Five samples were collected from natural soils at the base of the excavation (samples TP1/3, TP1/8, TP1/9, TP1/13, and TP1/41);
- Five samples were taken from the backfill material, which was returned to the tank pit (samples BF1, BF2, BF3, BF4, and BF5);
- Four samples were collected from natural soils immediately beneath the base of the former fuel dispensers (samples FL10, FL14, FL15, and FL16);
- Four samples were collected from natural soils immediately beneath the vents and vent lines (sample FL1, FL2, FL22, and FL23);
- One sample was collected from natural soils immediately beneath the base of the remote fill points (sample FL25);

[1] A PID measures most volatile photo-ionisable compounds providing they have an ionisation potential below 10.6 eV. This includes most petroleum hydrocarbon compounds with a carbon range of between 1 and 10.

- Seventeen samples were collected from natural soils immediately beneath the fuel lines running across the site (FL3 – FL6, FL13, FL18 – FL20, FL26 – FL30, FL31 – FL34). Test pits were also excavated at a number of locations along the fuel lines. For further information please refer to Section 4.0;

The soil samples that were collected from the site following the removal of the UPSS are expected to provide a suitable assessment of any remaining petroleum hydrocarbon residues.

3.4 Petroleum Hydrocarbon Observations

During the removal of the USTs, petroleum hydrocarbon staining of natural soils was observed in the south-western corner of the tank pit. Photo-ionising compound readings were measured up to 66.3 parts per million (ppm) (sample TP1/41) within the remaining natural soils within the base of the tank pit.

Petroleum hydrocarbon staining was observed in the natural soils below the former dispensers. Photo-ionising compound readings were measured up to 19.8 ppm (sample FL15) within the soil samples collected from natural soils immediately beneath the dispensers. Petroleum hydrocarbon staining was also evident to the soils located immediately beneath the fuel lines at the positions where the fuel lines turn 90 degrees (to the south of the forecourt canopy). These impacted soils were noted to have a green colour and a strong petroleum odour. Photo-ionising compound readings were measured at 1893 ppm within the soil samples (TST8/1, 1.1m bgl) collected from the natural soils in these locations.

3.5 Tank Pit Bedding Material

The bedding material removed from the tank pit comprised 'pea' gravel (5-8mm diameter). No obvious petroleum hydrocarbon staining was observed within the bedding material removed from around the tanks. Photo-ionising compound readings were measured up to 24.7 ppm within the bedding material (sample BF1). All of the bedding material was returned to the tank pit following the removal of the tanks.

4.0 Site Investigation Activities – Test Pitting

A total of nineteen test-pits were excavated on site by PSL. Nine of these test pits were excavated in locations identified as areas where historical site plans show that USTs had been located. Three of the test pits were excavated to the east of the store where there had potentially been a mechanics workshop in the past. Three test pits were excavated to a shallow depth under the previous position of the on-site drainage sumps located around the remote fill and carwash areas. The final four test pits were excavated to remove contaminated natural soils based on field PID readings and visual observations.

4.1 Test Pit Details

Test Pit 1 Test Pit 1 (TST1) was located approximately 6 m south of Dispenser Island 2 and was excavated to a depth of 4.3m bgl through 0.2m of asphalt underlain by sandy gravel fill (0.2 – 1.4m bgl), brown clay fill from 1.4 – 4.1m bgl and brown black clay from 4.1 -4.3m bgl. Broken pipework and concrete fragments were identified within TST1. Groundwater seepage at 2.6m bgl was noted to have a sheen and a strong petroleum odour. Test Pit 1 was excavated in the approximate location of an historic UST.

Test Pit 2 Test Pit 2 (TST2) was located approximately 5m east of Test Pit 1. TST2 was excavated to a depth of 3.8m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 1.4m bgl), grey mottled orange clay fill from 1.4 – 3.4m bgl and grey brown clay from 3.4 – 3.8m bgl. Broken pipework and concrete fragments were identified within TST2. No groundwater was noted in this test pit. Test Pit 2 was excavated in the location of an historic UST.

Test Pit 3 Test Pit 3 (TST3) was located approximately 1.5m west of the store and 1.5m north of the canopy. TST3 was excavated to a depth of 2.2m bgl through 0.2m of asphalt underlain by gravel fill to 2.2m bgl.

Groundwater seepage was noted at 1.4m bgl. Test Pit 3 was excavated in the approximate location of an historic UST.

Test Pit 4 Test Pit 4 (TST4) was located immediately to the east of Dispenser Island 2. TST4 was excavated to a depth of 2.8m bgl through 0.2m of asphalt underlain by sandy gravel fill (0.2 – 0.4m bgl) and green with orange mottle clay from 0.4 – 1.3m bgl, and green clay from 1.3 – 2.3m bgl, and grey green clay from 2.3 – 2.8m bgl. No groundwater was noted in this test pit. Test Pit 4 was excavated in the approximate location of an historic UST.

Test Pit 5 Test Pit 5 (TST5) was located approximately 10m southwest of the store directly beneath the removed fuel line. TST5 was excavated to a depth of 3.8m bgl through 0.2m of asphalt underlain by sandy gravel fill (0.2 – 1.1m bgl), dark grey clay (1.1 – 2.9m bgl), and sandy clay from 2.9 – 3.8m bgl. No groundwater was noted in this test pit. Test Pit 5 was excavated in the approximate location of an historic UST.

Test Pit 6 Test Pit 6 (TST6) was located on the south-east corner of the fuel line that ran parallel to the canopy. TST6 was excavated to a depth of 4.4m bgl through 0.2m of asphalt underlain by sandy gravel fill (0.2 – 1.0m bgl), green clay fill from 1.0 – 2.9m bgl, and grey clay from 2.9 – 3.2m bgl, light grey sandy clay fill from 3.2 – 3.8m bgl, and brown clay from 3.8 – 4.4m bgl. Concrete fragments (< 500mm) were identified in TST6. Groundwater seepage at 1.2m bgl was noted to have a sheen and a strong petroleum odour. Test Pit 6 was excavated in the approximate location of an historic UST. Due to site observations, the soils encountered within TST6 were subsequently excavated and removed from site. Please refer to Test Pit 14 for further details.

Test Pit 7 Test Pit 7 (TST7) was located approximately 6m southeast of the eastern corner of the fuel line that ran parallel to the canopy. TST7 was excavated to a depth of 3.7m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 1.1m bgl) and variable colour clay from 1.1 – 3.2m bgl. The test pit was finished in light grey sandy clay from 3.2 – 3.7m bgl. Test Pit 7 was excavated in the location of an historic UST. No groundwater was noted in this test pit.

Test Pit 8 Test Pit 8 (TST8) was located on the western corner of the fuel line that ran parallel to the canopy. TST8 was excavated to a depth of 4.2m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 1.0m bgl), green clay from 1.0 – 1.9m bgl, and grey with orange mottle clay from 1.9 – 3.0m bgl, light grey sandy clay from 3.0 – 4.1m bgl, and brown clay from 4.1m bgl. Groundwater seepage at 1.2m bgl was noted to have a sheen and a strong petroleum odour. Due to site observations, the soils encountered within TST8 were subsequently excavated and removed from site. Please refer to Test Pit 11 for further details.

Test Pit 9 Test Pit 9 (TST9) was located approximately 10m southeast of the eastern corner of the fuel line that ran parallel to the canopy. TST9 was excavated to a depth of 4.2m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 1.0m bgl), green mottled orange clay from 1.0 – 2.8m bgl, light grey sandy clay from 2.8 – 4.0m bgl and brown clay from 4.0 – 4.2m bgl. No groundwater was noted in this test pit. Test Pit 9 was excavated as an extension of Test Pit 7.

Test Pit 10 Test Pit 10 (TST10) was located approximately 14m south of the store. TST10 was excavated to a depth of 4.2m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 1.3m bgl), grey mottled orange clay from 1.3 – 2.8m bgl, light grey sandy clay from 2.8 – 3.9m bgl, and brown clay from 3.9 – 4.2m bgl. Groundwater seepage was noted at 3.6m bgl.

Test Pit 11 Test Pit 11 (TST11) located on the south-east corner of the fuel line that ran parallel to the canopy. Test Pit 11 was an extension of test pit 8, excavated to 2.5m bgl and designed to remove the petroleum hydrocarbon impacted soils in this area. The removal of these impacted soils was based on field observations and PID readings. The excavated soil was removed from site and disposed of at Envirowaste

Services Ltd, Hampton Downs Landfill. The geological log of this test pit is appended as TST8. The soil disposal dockets are appended.

Test Pit 12 Test Pit 12 (TST12) was located approximately 3m to the east of the store and 4m north of the canopy. TST12 was excavated to a depth of 4.2m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 0.8m bgl), light grey clay from 0.8 – 2.4m bgl, light grey silty clay from 2.4 – 3.4m bgl, and light grey sandy clay from 3.4 – 4.2m bgl. Groundwater seepage was noted at 3.6m bgl. Test Pit 12 was located in an area where a former mechanics workshop was likely to be located.

Test Pit 13 Test Pit 13 (TST13) was located approximately 1.5m to the east of the store and 1.5m north of the canopy. TST13 was excavated to a depth of 4.2m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 0.9m bgl), grey clay from 0.9 – 2.9m bgl, and variable colour silty clay from 2.9 – 4.0m bgl, and brown clay from 4.0 – 4.2m bgl. No groundwater was noted in this test pit. Test Pit 13 was located in an area where a former mechanics workshop was likely to be located.

Test Pit 14 Test Pit 14 (TST14) was located at the south-east corner of the fuel line that ran parallel to the canopy. Test Pit 14 was an extension of test pit 6, excavated to 3.0m bgl and designed to remove the petroleum hydrocarbon impacted soils in this area. The removal of these impacted soils was based on field observations and PID readings. The excavated soil was removed from site and disposed of at Envirowaste Services Ltd, Hampton Downs Landfill. The geological log of this test pit is appended as TST6. The soil disposal dockets are appended.

Test Pit 15 Test Pit 15 (TST15) was located approximately 3.0m east of the store and 10m north of the canopy. TST15 was excavated to a depth of 4.2m bgl through 0.2m of asphalt underlain by gravel fill (0.2 – 1.0m bgl), grey mottled orange clay from 1.0 – 3.4m bgl and light grey sandy clay from 3.4 – 4.2m bgl. Groundwater seepage was noted at 3.6m bgl. Test Pit 15 was located in an area where a former mechanics workshop was likely to be located.

Test Pit 16 Test Pit 16 (TST16) was located approximately 11m north of the store. TST16 was excavated to a depth of 1.6m bgl through gravel fill from 0.0 – 0.6m bgl and orange brown clay from 0.6 – 1.6m bgl. No groundwater was noted in this test pit. Test Pit 16 was excavated to assess soils under a removed drainage sump associated with the former carwash.

Test Pit 17 Test Pit 17 (TST17) was located approximately 13m north of the north-eastern corner of the store. TST17 was excavated to a depth of 1.6m bgl through gravel fill from 0.0 – 0.6m bgl and light orange/grey clay from 0.6 – 1.6m bgl. No groundwater was noted in this test pit. Test Pit 17 was excavated to assess soils under a removed drainage sump associated with the former carwash.

Test Pit 18 Test Pit 18 (TST18) was located approximately 17m north-east of the north-eastern corner of the store. TST18 was excavated to a depth of 1.6m bgl through gravel fill of various sizes from 0.0 – 1.2m bgl and orange clay from 1.2 – 1.6 m bgl. No groundwater was noted in this test pit. Test Pit 18 was excavated to assess soils under a removed drainage sump associated with the former carwash.

Test Pit 19 Test Pit 19 (TST19) was located immediately to the west of Dispenser Island 1. Test Pit 19 was excavated in order to remove soils for which an elevated PID reading of 10.6 ppm (TST19/2) was recorded and to further assess the potential for hydrocarbon residues to exist within soil in this area. TST19 was excavated to a depth of 2.0m bgl through 0.2m of concrete, sandy gravel fill from 0.2 – 1.1m bgl, grey, with occasional orange and green mottling, clay from 1.1 – 1.5m bgl and grey clay from 1.5 – 2.0m bgl. No groundwater was noted in this test pit.

Detailed geological logs of these test pits are appended.

4.2 Soil Sampling

A total of sixty-one soil samples were collected during the test pitting activities for laboratory analysis to provide a preliminary assessment of the environmental effects of any petroleum hydrocarbon residues remaining in soils. Sample collection for analysis and field screening is as described in Section 3.3.

The samples were analysed for total petroleum hydrocarbon (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX) compounds. Test pits TST12 and TST13 were located in an area that may have housed a mechanics workshop in the past. As such, and in order to assess the risk posed to human health, the soil samples collected from within the top metre from these test pit locations were also analysed for the heavy metals; arsenic, cadmium, chromium, copper, lead, nickel, and zinc. Sample TST14/1, collected from the top metre of soil, was also analysed for the heavy metals in order to assess the background concentrations away from the area where the mechanics workshop was suspected to have been located.

Duplicate soil samples were held in cold storage at the laboratory in case follow-up polycyclic aromatic hydrocarbon (PAH) analysis was required.

Details of the soil samples collected from each area and analysed are as follows (details for individual sample depth, soil type, PID reading, and location are provided in Tables 3, 4 and 5; locations are also shown on Figure 3):

- Three samples were collected from test pit 1 (samples TST1/1, TST1/4 and TST1/8). Sample TST1/1 was collected from soils at a depth of 0.5m bgl, TST1/4 from 2m bgl, and TST1/8 from 4.3m bgl.
- Two samples were collected from test pit 2 (samples TST2/1 and TST2/4). Sample TST2/1 was collected from soils at 0.5m bgl, TST2/4 from 2m bgl.
- Two samples were collected from test pit 3 (samples TST3/1 and TST3/3). Sample TST3/1 was collected from soils at a depth of 0.5m bgl, TST3/3 from 1.5m bgl.
- Two samples were collected from test pit 4 (samples TST4/1 and TST4/4). Sample TST4/1 was collected from soils at a depth of 0.5m bgl, TST4/4 from 2m bgl.
- Two samples were collected from test pit 5 (samples TST5/1 and TST5/7). Sample TST5/1 was collected from soils at a depth of 0.5m bgl, TST5/7 from 3.5m bgl.
- Four samples were collected from test pit 6 (samples TST6/1, TST6/2, TST6/6 and TST6/8). Sample TST6/1 was collected from soils at a depth of 0.5m bgl, TST6/2 and TST6/6 from 1.1m bgl and 3m bgl respectively, and TST6/8 from 4.1m bgl.
- Three samples were collected from test pit 7 (samples TST7/1, TST7/4 and TST7/7). Sample TST7/1 was collected from soils at a depth of 0.5m bgl, TST7/4 and TST7/7 from 2m bgl and 3m bgl respectively.
- Three samples were collected from test pit 8 (samples TST8/1, TST8/2 and TST8/7). Sample TST8/1 and TST8/2 were collected from soils from 1.1m bgl and 1.5m bgl respectively, and TST8/7 from 4.1m bgl. No sample was collected from the top 1m due to this soil being removed from site during the removal of the fuel line.
- Three samples were collected from test pit 9 (samples TST9/1, TST9/2 and TST9/8). Sample TST9/1 was collected from soils at a depth of 0.5m bgl, TST9/2 from 1.1m bgl and TST9/8 from 4.1m bgl.
- Three samples were collected from test pit 10 (samples TST10/8, TST10/3 and TST10/7). Sample TST10/8 was collected from soils at a depth of 0.5m bgl, TST10/3 from 2m bgl and TST10/7 from 4.1m bgl.

- Eight soil samples were collected from test pit 11 in order to validate the removal of petroleum hydrocarbon impacted soils in this area. Samples TST11/1, TST11/3, TST11/4 and TST11/11 were collected at a depth of 0.5m bgl, from each side of the pit. Sample TST11/7 was collected at 2.0m bgl, and TST11/8, TST11/9, TST11/10 were collected from 2.5m bgl, from each side of the pit.

- Three samples were collected from test pit 12 (samples TST12/1, TST12/2 and TST12/8). Sample TST12/1 was collected from soils at a depth of 0.5m bgl, TST12/2 from between 1.1m bgl and TST12/8 from 4.1m bgl.

- Three samples were collected from test pit 13 (samples TST13/1, TST13/4 and TST13/8). Sample TST13/1 was collected from soils at a depth of 0.5m bgl, TST13/4 from 2m bgl and TST13/8 from 4.1m bgl.

- Eight samples were collected from test pit 14 based on field observations and field PID measurements. Samples TST14/1, TST14/2, TST14/3 and TST14/4 were collected from soils at a depth of 0.5m bgl, from each side of the pit. Sample TST14/5 was collected from 2.8m bgl and samples TST14/6, TST14/7 and TST14/8 were collected from soils at 3m bgl, from each side of the pit.

- Two samples were collected from test pit 15 (samples TST15/2 and TST15/8). Sample TST15/2 was collected from soils at 1.1m bgl and TST15/8 from 4.1m bgl. No sample was collected from the top 1m due to this soil being removed from site during the removal of the fuel line.

- Two samples were collected from test pit 16 (samples TST16/1 and TST16/2). Sample TST16/1 was collected at a depth of 0.5m bgl and TST16/2 at 1.5m bgl.

- Two samples were collected from test pit 17 (samples TST17/1 and TST17/2). Sample TST17/1 was collected at a depth of 0.5m bgl, TST17/2 at 1.1m bgl.

- Two samples were collected from test pit 18 (samples TST18/1 and TST18/3). Sample TST18/1 was at a depth of 0.5m bgl and TST18/3 from 1.5m bgl.

- Four samples were collected from test pit 19 (samples TST19/1, TST19/2, TST 19/3 and TST19/4). Sample TST19/1 was collected from soils at a depth of 0.5m bgl, TST19/2 from 1.1m bgl, TST19/3 at 1.5m bgl and TST19/4 at 2m bgl.

The soil samples that were collected from the site following the test pitting activities are expected to provide a suitable assessment of any remaining petroleum hydrocarbon residues in these areas.

4.3 Petroleum Hydrocarbon Observations

During the test pitting activities, petroleum hydrocarbon staining to soils and strong petroleum hydrocarbon odours were noted in TST6 and TST8. Photo-ionising compound readings for samples collected from these test pits were measured up to 1738 ppm (sample TST6/1) and 1893 ppm (TST8/1). Another elevated PID reading of 2024 ppm was also recorded for sample TST2/4.

4.4 Soil Removal

Based upon visual observations and PID readings, a total of 143 tonnes of petroleum hydrocarbon impacted material within test pits TST11 and TST14 was removed from site and disposed of at Envirowaste Services Ltd, Hampton Downs Landfill, North Waikato.

5.0 Stratigraphy and Hydrogeology

The geological map of the area (Kermode, 1992) indicates that the site and surrounding area is underlain by pumiceous deposits of the Tauranga Group (Rhyolite Pumice) which are described as 'light grey, massive to finely laminated, mud to sand sized pumice'.

A search of the Auckland Regional Council (ARC) borehole database in November 2007 identified 7 groundwater bores within a 1km radius of the site. Six of the bores are listed as proposed groundwater monitoring/testing wells. The remaining bore, located approximately 550m east of the site, is used for irrigation purposes and is described as being 265m in depth with casing to approximately 157m bgl. According to the ARC records the consents for all 7 bores have expired.

No groundwater bores for potable water supply are listed within 1km of the site.

Groundwater was not encountered within the tank pit excavated to approximately 4.3m bgl. However, groundwater seepage was noted in a number of test pits excavated across the site at depths ranging from 1.2m bgl to 3.6m bgl likely to be a perched water table. Given the distance from the site to the Tamaki River Estuary (70m north-west) and the topographic gradient in the immediate area, the shallow water table is expected to be less than 10m bgl. Groundwater is expected to flow in a general north-westerly direction towards the Tamaki River Estuary.

5.1 Sensitivity of the Underlying Aquifer

Section 5.2.3 of the MfE (1999) guidelines has been used to assess the sensitivity of the underlying aquifer based on the information that has been obtained and reviewed for the site.

- The shallow aquifer (water table) beneath the site is not expected to be artesian;
- Given the distance from the site to the Tamaki River Estuary and the topographic gradient in the immediate area, the shallow water table is expected to be less than 10m bgl; and
- Shallow groundwater within the area surrounding the site is not expected to be of a quality suitable for use.

Therefore, the underlying aquifer is not considered to be sensitive with respect to groundwater use, in accordance with Section 5.2.3 of the MfE (1999) guidelines.

- The nearest surface waterway is the Tamaki River Estuary located approximately 70m to the northwest of the site. Groundwater beneath the site is expected to flow in a north-westerly direction towards the Tamaki River Estuary.

Therefore, the underlying aquifer is considered to be sensitive with respect to the possible impact of contaminated groundwater on surface water and its associated ecosystems, in accordance with Section 5.2.3 of the MfE guidelines (1999).

For the purposes of this assessment, the aquifer has been considered as not sensitive for groundwater use; and sensitive with respect to possible impact of contaminated groundwater on the nearby surface water body and its associated ecosystems.

6.0 Laboratory Results and Comparison to Applicable Criteria - Petroleum Hydrocarbons

One hundred and thirty-three soil samples were analysed by the laboratory for TPH and BTEX compounds. Results of the laboratory analyses are presented in Tables 1, 2, and 3. Copies of the laboratory reports are appended.

6.1 Applicable Tier 1 Soil Acceptance Criteria

The MfE (1999) Tier 1 soil acceptance criteria have been developed on a risk based approach with the primary consideration being the protection of human health for a range of land uses including commercial/industrial, residential and agricultural. The criteria have also been developed to account for the protection of maintenance/excavation workers and for the protection of groundwater. In addition to site usage the Tier 1 acceptance criteria take into consideration the environmental settings including soil type (permeability), depth to contamination, depth to groundwater, groundwater quality and yield and proximity to surface water and ecological receptors.

As such, the Tier 1 soil acceptance criteria via All Pathways are a reflection of the most stringent criteria associated with the protection of human health via several exposure routes. Comparison of analytical results to these criteria reveals whether a more in-depth review of the potential exposure pathways is required at the site. Where a detailed review is required, route specific criteria are determined based on a site-specific assessment of both potential receptors and exposure pathways.

The MfE Tier 1 guidelines are not applicable to sites that continue to store and dispense petroleum fuels, as may be the case for this site. However, in the absence of MfE acceptance criteria for continued petroleum use, the Tier 1 soil acceptance criteria (All Pathways) for commercial/industrial land use (MfE, 1999) have been applied as conservative screening criteria and are presented in Tables 1, 2, and 3. "Sand", "sandy silt", and "silty clay" soil types have been applied for comparison with the relevant criteria for the soil samples. These soil types are considered to be the most suitable based on the materials observed at the site.

Although the underlying groundwater aquifer has been defined as sensitive with respect to the possible impact of contaminated groundwater on surface water (Section 5.1), the soil acceptance criteria for Protection of Groundwater Quality are not applicable in this instance because they have been derived to be protective of groundwater immediately beneath the site for potable use and are therefore over-protective of potential surface water receptors.

6.2 Soil Sampling Results – Initial Assessment

6.2.1 Tank Pit

All twelve samples collected from natural soils from depths of less than 1m bgl, from Tank Pit 1 (samples TP1/1, TP1/5, TP1/10, TP1/14, TP1/17, TP1/20, TP1/23, TP1/26, TP1/29, TP1/32, TP1/35, and TP1/38) returned TPH and BTEX concentrations below the corresponding laboratory detection levels, 60mg/kg and up to 0.225mg/kg respectively.

Eleven samples collected from natural soils at depths between 1 and 4m from Tank Pit 1 (samples TP1/2, TP1/6, TP1/11, TP1/15, TP1/18, TP1/21, TP1/24, TP1/27, TP1/30, TP1/33, TP1/36, and TP1/39) returned TPH and BTEX concentrations below the corresponding laboratory level of detection, 60mg/kg and up to 0.191mg/kg respectively, with the exception of sample TP1/11, which recorded a total xylenes concentration of 0.34mg/kg.

Eleven of the seventeen samples collected from natural soils at the base of Tank Pit 1, below 4m bgl (samples TP1/4, TP1/7, TP1/13, TP1/16, TP1/19, TP1/22, TP1/25, TP1/31, TP1/34, TP1/37, and TP1/40) returned TPH and BTEX concentrations below the corresponding laboratory level of detection (60mg/kg). One sample (TP1/41) recorded a TPH concentration of 370mg/kg, 60 % of which was found within the C_{15}-C_{36} carbon range. The gas chromatogram for sample TP1/41 was similar to that of petrol and lubricating oil. Six samples recorded BTEX concentrations above the laboratory levels of detection, up to 23.6mg/kg (total xylenes, TP1/41).

6.2.2 Bedding Material

The five samples collected from the bedding material returned to Tank Pit 1 (samples BF1, BF2, BF3, BF4, and BF5) returned TPH and BTEX concentrations below the corresponding laboratory detection levels, 60mg/kg and up to 0.150mg/kg respectively.

6.2.3 Fuel Dispenser and Pipework

Of the four soil samples collected from beneath the dispenser islands (FL10, FL14, FL15, and FL16), samples FL14, FL15 and FL16 returned TPH concentrations below the corresponding laboratory detection levels (60mg/kg). Sample FL10 recorded a TPH concentration of 940mg/kg, 95 % of which was reported within the C_{15}-C_{36} carbon band. The gas chromatogram for sample FL10 was similar to that of diesel.

Only sample FL15 recorded BTEX concentrations above the laboratory detection levels, with benzene, ethylbenzene, and total xylene concentrations reported as 0.33mg/kg, 0.19kg/kg, and 0.3275mg/kg respectively.

All of the soil samples collected from the soils beneath the fuel lines returned TPH and BTEX concentrations below the laboratory levels of detection with the exception of sample FL13, which recorded concentrations of benzene, ethylbenzene, and total xylenes above the laboratory levels of detection at concentrations of 0.18mg/kg, 0.21mg/kg, and 0.2765mg/kg respectively.

6.2.4 Test Pitting

All twenty-two soil samples collected from soils within the top metre of the test pits returned BTEX concentrations of less than the corresponding laboratory detection limits (up to 0.150mg/kg). Eighteen of the twenty-two samples collected returned TPH concentrations below the laboratory levels of detection (60mg/kg). Of the remaining soil samples, a maximum TPH concentration of 390mg/kg was reported for sample TST7/1, 95 % of which was found within the C_{15} – C_{36} carbon range.

Fourteen of the twenty-six samples collected from natural soils between 1 and 4m bgl returned TPH and BTEX concentrations below the laboratory levels of detection. For the remaining soil samples, maximum TPH and BTEX concentrations were reported as follows; TPH at 1000mg/kg (TST7/7), benzene at 0.56mg/kg (TST19/4), toluene at 0.2mg/kg (TST19/4), ethylbenzene at 0.62mg/kg (TST11/7) and total xylenes at 2.83mg/kg (TST11/7).

Five of the six samples collected from below 4m bgl within the test pits returned TPH concentrations below the laboratory levels of detection (60mg/kg). Sample TST1/8 recorded a TPH concentration of 180mg/kg, approximately 100 % of which was found within the C_{15}-C_{36} carbon range. The gas chromatogram for TST1/8 is similar to that of lubricating oil. All six samples returned BTEX concentrations below the laboratory levels of detection (up to 0.255mg/kg).

6.3 Comparison of Soil Sample Results with Tier 1 Soil Acceptance Criteria – All Pathways and Protection of Groundwater Quality

6.3.1 All Pathways Criteria

All samples collected from the site following the removal of the UPSS returned TPH and BTEX concentrations below the applicable Tier 1 soil acceptance criteria via All Pathways in the context of commercial/industrial land use.

7.0 Laboratory Results and Comparison to Applicable Criteria - Heavy Metals

Three soil samples (see Section 4.2) were analysed by the laboratory for heavy metals. Results of the laboratory analyses are presented in Table 4. A copy of the laboratory report is appended.

7.1 Applicable Tier 1 Soil Acceptance Criteria – Heavy Metals

National soil quality standards for heavy metals are currently under development by the MfE. In the absence of a National Environmental Standard, there are a range of New Zealand and international guidelines that could be applied to the site.

Under permitted activity Rule 5.5.41 of the proposed ARC Regional Plan: Air Land and Water (ALWP, 2008), the ARC have published a series of permitted activity soil criteria. Under Rule 5.5.41, the discharge of heavy metal contaminants to land or water is a permitted activity subject to the concentrations of contaminants (or the 95% upper confidence limit (UCL) of the mean) not exceeding the greater of either; the criteria specified in Schedule 9 of the ALWP or, the Auckland Regional Council (ARC, 2001) 'Background Concentrations of Inorganic Elements in Soils from the Auckland Region'.

The heavy metals for which the soil samples have been analysed are all listed within Schedule 9.

The three samples analysed for heavy metals (samples TST12/1, TST13/1 and TST14/1) were all collected from the gravel fill material encountered and at a depth of 0.5m bgl. It is likely that the fill material encountered on site was of a volcanic origin (given the presence of volcanic cones within the Auckland area as the predominant source of construction fill materials) and as such the background concentrations for a volcanic soil (ARC, 2001) are considered to be the appropriate Permitted Activity threshold.

7.2 Soil Sampling Results – Initial Assessment

For the three soil samples collected from depths of less than 1m bgl, the reported concentrations for the seven heavy metals are summarised as follows:

- Concentrations of arsenic were all below the laboratory level of detection of 2.0mg/kg.
- Concentrations of cadmium ranged from below the laboratory level of detection (0.10mg/kg) to a maximum of 0.11mg/kg (TST14/1).
- Concentrations of chromium ranged from a minimum of 41mg/kg (TST13/1) to a maximum of 44mg/kg (TST14/1).
- Concentrations of copper ranged from a minimum of 54mg/kg (TST13/1) to a maximum of 60mg/kg (TST14/1).
- Concentrations of nickel ranged from a minimum of 170mg/kg (TST14/1) to a maximum of 190mg/kg (TST12/1).
- Concentrations of lead ranged from a minimum of 1.5mg/kg (TST13/1 and TST14/1) to a maximum of 2.1mg/kg (TST12/1).
- Concentrations of zinc ranged from a minimum of 48mg/kg (TST13/1) to a maximum of 53mg/kg (TST12/1).

7.3 Comparison of Soil Sample Results with Applicable Guidelines – Heavy Metals

For the three samples collected from site and analysed for heavy metals, the reported concentrations of arsenic, cadmium, chromium, copper, lead, nickel and zinc are all below the ARC Permitted Activity Threshold. As such, the residual heavy metal concentrations in soil do not trigger a discharge consent.

8.0 Environmental Assessment

8.1 Health Risk Assessment

None of the soil samples contained petroleum hydrocarbon concentrations above the MfE Tier 1 soil acceptance criteria via All Pathways in the context of commercial/industrial land use.

As such, a more detailed human health risk assessment is not required.

8.2 Ecological Risk Assessment

A Tier 1 ecological risk assessment has been conducted in accordance with the MfE (1999) guidelines. It was found that the nearest ecological receptor is the Tamaki River Estuary located approximately 70m north-west of the former UPSS.

During the Phase 1 ESA the following source-pathway-receptor linkages were identified:

- migration of petroleum hydrocarbon residues (separate phase and dissolved phase) via the stormwater system to the nearby Tamaki River Estuary; and
- migration of petroleum hydrocarbon residues (separate phase and dissolved phase) via groundwater flow to the nearby Tamaki River Estuary.

Given that the Mobil UPSS has been removed from site and that no storage of petroleum hydrocarbons is currently being undertaken on site, the risk to the Tamaki River Estuary via the migration of petroleum hydrocarbon residues via the stormwater system is considered to be not applicable.

The underlying aquifer has been identified as not sensitive for groundwater use; but sensitive with respect to possible impact of contaminated groundwater on the nearby surface water body and its associated ecosystems. Section 5.2.3 of the MfE guidelines states that 'where the receiving water body facilitates significant dilution of the groundwater discharged into it, sites within 100m of a surface water are unlikely to affect the surface water quality significantly, unless free phase hydrocarbon is present and migrating off-site'. Based on the dilution available from the Tamaki River Estuary, and given that the natural soils on site (silty clay) have a low permeability and a the separation distance between the site and the Tamaki River Estuary is 70m, the risk to the surface waterway via the migration of any petroleum hydrocarbon residues via groundwater flow is expected to be low.

No other significant ecological receptors have been identified within the immediate vicinity of the site. A copy of the completed ecological checklist is appended.

8.2.1 Fate and Transport Ecological Risk Assessment

In order to confirm that the risk to the nearby Tamaki River Estuary via the migration of petroleum hydrocarbon residues in groundwater is low, a Tier 2 computer fate and transport model (BP RISC) was used to predict the concentration of dissolved phase petroleum residues (benzene) that could be present in the estuary, related to the residue concentrations that have been found at the site.

The model was developed in the ecological risk assessment function and was based on a simple site conceptual model of the site conditions which simulates source zone soil residues (assumed to be at the tank pit at the site) leaching to groundwater and migrating via groundwater to the estuary 70m down gradient of the site. The model allows the site specific parameters such as soil type, source concentrations, aquifer and receptor properties to be entered to determine the concentration of dissolved petroleum compounds in the surface water receptor (Tamaki River Estuary). In this case, the model was run to check whether the assumed highest concentration of benzene in soil (2.4mg/kg) at the site (at the base of the tank pit) could impact the nearby Tamaki River Estuary.

The model was developed based on a number of key assumptions to allow input parameters to be matched as closely as possible to the site conditions while maintaining a conservative approach to obtain a 'reasonable maximum estimate' of the surface water concentration in the estuary.

A summary of selected key input parameters assumed for the model (with descriptions of conservative assumptions) are as follows;

- Source zone soil concentration of benzene; 2.4mg/kg (assumed to be uniform over source volume)

- Source zone volume; 392m^3 (assumes 1m thick layer of source benzene at 2.4mg/kg beneath entire tank pit footprint)
- Soil type; Silty loam (approx. hydraulic conductivity 1 x 10^{-6} m/s)
- Distance to surface water; 70m
- Hydraulic Gradient; 0.2m/m (conservatively assumes groundwater table elevation beneath the site to be level with the base of the tank pit – perched groundwater observed at shallow depth in test pits not considered to be representative of wider site hydrogeology)
- Volume of surface water; 20,000m^3 (conservatively assumes a small arm (area) of the Tamaki River Estuary approximately 20,000m^2 is the receiving water body – i.e. not the entire Tamaki River).
- Fraction of surface water volume available for mixing; 10% (10% of the above water volume is available for mixing).

Based on the above, the BP RISC model determined a maximum surface water concentration of benzene in the closest section of the Tamaki River Estuary to be in the order of 0.0001mg/L. This concentration is approximately two to three orders of magnitude less than the ANZECC 2000, Marine Water Trigger Value, 95% level of protection (0.7mg/L) from the ANZECC 2000, Australia and New Zealand Environment and Conservation Council Guidelines. In summary, the results of the Tier 2 risk model confirms that the expected risk to the closest ecological receptor (Tamaki River Estuary) is low.

9.0 Conclusions

A Mobil UPSS comprising one 40,000L diesel UST, three 40,000L petrol USTs, associated pipework, dispensers and vents has been removed from Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland. A total of nineteen test pits were also excavated in order to assess soils in the vicinity of the UPSS components, in locations where historic USTs were thought to be located and in areas where a mechanics workshop may have historically been located.

No obvious petroleum hydrocarbon staining was observed in the bedding material during the removal of the UPSS. Visual and olfactory evidence of hydrocarbon contamination was noted within soils excavated during test pitting activities. This impacted soil was removed off-site and disposed of at Envirowaste Services Ltd, Hampton Downs Landfill, Auckland.

The underlying aquifer has been identified as not sensitive for groundwater use; but sensitive with respect to possible impact of contaminated groundwater on the nearby surface water body and its associated ecosystems.

All soil samples collected from the site returned concentrations of TPH and BTEX below the MfE Tier 1 soil acceptance criteria via All Pathways in the context of commercial/industrial land use.

Given that the natural soils on site (silty clay) are expected to have a low permeability and the separation distance between the site and the Tamaki River Estuary is 70m, the risk to the surface waterway via the migration of petroleum hydrocarbon residues via groundwater flow is expected to be low. MfE Guidelines (MfE, 1999) state that for a large river system, or coastal water (such as the Tamaki River Estuary), sites with petroleum residues within 100m of the surface water are unlikely to significantly affect the water quality unless free phase hydrocarbon is present and migrating off-site. A computer based fate and transport model was used to confirm that the risk of benzene residues remaining beneath the tank pit impacting the nearby Tamaki River estuary was low.

Three soil samples were also analysed for heavy metals. The reported concentrations are all below the ARC Permitted Activity Thresholds under Rule 5.5.41 of the Draft ARC Plan. Therefore, this information suggests that no Resource Consent is required for the residual soil concentrations at this site.

10.0 Limitations

This report has been prepared on the basis of visual observations of the excavation of a tank pit containing four 40,000L USTs, the excavation of 19 test pits, observations made during the inspection of the site, and the testing of 133 soil samples for petroleum hydrocarbon residues. The information has been used to describe the ground conditions in the vicinity of the soil sample locations. The hydrogeological and petroleum residue conditions away from these locations are unknown and should not be extrapolated from the results of this study without further investigation.

The information contained within this report applies to the date of the site inspection (8 - 19 February 2008). With time, the site conditions could change so that the reported assessment and conclusions are no longer valid. Thus, in the future, the report should not be used without confirming the validity of the report's information at that time.

The report has been prepared for Mobil Oil New Zealand Limited, according to their instructions, for the particular objectives described in the report. The information contained in the report should not be used by anyone else or for any other purposes.

11.0 References

ANZECC, 2000. Australian and New Zealand Guidelines for the fresh and marine water quality Volume 1. The Guidelines. A report prepared by the Australian and New Zealand Environment and Conservation Council.

Auckland Regional Council. *ARC Technical Publication No. 153, 2001: Background Concentrations of Inorganic Elements in Soils from the Auckland Region*.

Auckland Regional Council, 2001. *Proposed Auckland Regional Plan: Air, Land and Water*. Updated 14 December 2007.

Kermode L. O. 1992. *Geology of the Auckland Urban Area*. Geological Map of New Zealand 1:50,000, Sheet R11. Map (1 sheet) and text (63p.), Lower Hutt, Institute of Geological and Nuclear Sciences.

MfE, August 1999. *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, Ministry for the Environment, Wellington, New Zealand.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by:	Checked by:	Directed, reviewed and approved by:
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Analytical Tables

Table 1: Soil Sample Results - Tank Pit & Bedding Material - ALL PATHWAYS

Soil Samples Collected at a Depth of <1 m Below Ground Level																			
Sample Name	TP1/1	TP1/5	TP1/10	TP1/14	TP1/17	TP1/20	TP1/23	TP1/26	TP1/29	TP1/32	TP1/35	TP1/38	BF1	BF2	BF3	BF4	BF5	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	629497.1	629497.5	629497.10	629497.14	629497.17	629497.20	629497.23	629497.26	629497.29	629497.32	629497.35	629497.38	629497.83	629497.84	629497.85	629497.86	627497.87			
Sample Location	E wall	E wall	W wall	N wall	N wall	N wall	N wall	S wall	W wall	S wall	S wall	S wall	Backfill	Backfill	Backfill	Backfill	Backfill			
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Soil Type - Field	silt	silt	clay silt	silt	clay	clay silt	silty clay	clay	clay	silty clay	clay	silt	gravel	gravel	gravel	gravel	gravel	Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Silty Clay	Sandy Silt	Sandy Silt	Silty Clay	Silty Clay	Sandy Silt	Silty Clay	Sandy Silt	Sand	Sand	Sand	Sand	Sand			
Sample Depth (m bgl)	0.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	<1 m	<1 m	<1 m
PID Reading (ppm)	0.2	0.8	0.5	0.3	0.6	0.3	0.1	0.3	1.0	0.5	0.1	0.5	24.7	22.1	10.3	15.6	14.7			
C_7-C_9 hydrocarbons	< 11	< 8.4	< 11	< 8.5	< 10	< 9.9	< 11	< 9.1	< 9.9	< 8.8	< 9.2	< 9.6	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	120 (m)	(500) (6,m)	(8,800) (6,v)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	(1,500) (6,x)	(1,700) (6,x)	(1,900) (6,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	-	-	-
Benzene	< 0.075	< 0.055	< 0.069	< 0.054	< 0.070	< 0.058	< 0.059	< 0.050	< 0.068	< 0.058	< 0.059	< 0.053	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	3.0 (m)	3.6 (v)	7.2 (v)
Toluene	< 0.075	< 0.055	< 0.069	< 0.054	< 0.070	< 0.058	< 0.059	< 0.050	< 0.068	< 0.058	< 0.059	< 0.053	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	(94) (6,m)	(270) (6,v)	(670) (6,v)
Ethylbenzene	< 0.075	< 0.055	< 0.069	< 0.054	< 0.070	< 0.058	< 0.059	< 0.050	< 0.068	< 0.058	< 0.059	< 0.053	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	(180) (6,v)	(200) (6,v)	(350) (6,v)
Total xylenes [7]	< 0.225	< 0.165	< 0.209	< 0.164	< 0.210	< 0.178	< 0.179	< 0.150	< 0.208	< 0.178	< 0.179	< 0.163	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	(150) (6,m)	(200) (6,v)	(510) (6,v)
Soil Samples Collected at a Depth of 1 - 4 m Below Ground Level																				
Sample Name	TP1/2	TP1/6	TP1/11	TP1/15	TP1/18	TP1/21	TP1/24	TP1/27	TP1/30	TP1/33	TP1/36	TP1/39						Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	629497.2	629497.6	629497.11	629497.15	629497.18	629497.21	629497.24	629497.27	629497.3	629497.33	629497.36	629497.39								
Sample Location	E wall	E wall	W wall	N wall	N wall	N wall	N wall	S wall	W wall	S wall	S wall	W wall								
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining								
Soil Type - Field	silt	silty clay	silt	silt	silty clay	clay silt	clay silt	clay	silt	sandy silt	silt	silt						Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Silty Clay	Sandy Silt	Sand	Sandy Silt	Sandy Silt								
Sample Depth (m bgl)	3	3	3	3.1	3	3	3	3	3	2.9	3	3						1 - 4 m	1 - 4 m	1 - 4 m
PID Reading (ppm)	0.3	1	24.4	0.3	0.4	0.6	21.3	0.5	7.4	0.1	0.3	0.2								
C_7-C_9 hydrocarbons	< 9.3	< 9.5	< 8.7	< 8.8	< 9.5	< 9.6	< 9.1	< 11	< 8.9	< 8.8	< 8.7	< 9.0						120 (m)	(500) (6,m)	(20,000) (6,m)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20						(1,900) (6,x)	(2,200) (6,x)	(8,900) (6,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30						NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60						-	-	-
Benzene	< 0.061	< 0.060	< 0.057	< 0.053	< 0.053	< 0.056	< 0.054	< 0.076	< 0.054	< 0.050	< 0.057	< 0.061						3.0 (m)	7.2 (v)	(20) (6,v)
Toluene	< 0.061	< 0.060	< 0.057	< 0.053	< 0.053	< 0.056	< 0.054	< 0.076	< 0.054	< 0.050	< 0.057	< 0.061						(94) (6,m)	(480) (6,m)	(3,100) (6,v)
Ethylbenzene	< 0.061	< 0.060	< 0.057	< 0.053	< 0.053	< 0.056	< 0.054	< 0.076	< 0.054	< 0.050	< 0.057	< 0.061						(300) (6,8,v)	(300) (6,v)	(2,600) (6,v)
Total xylenes [7]	< 0.191	< 0.180	0.34	<0.163	< 0.163	< 0.176	< 0.164	< 0.236	< 0.164	< 0.150	< 0.177	< 0.191						(150) (6,m)	(420) (6,v)	(2,300) (6,v)
Soil Samples Collected at a Depth of >4 m Below Ground Level																				
Sample Name	TP1/3	TP1/4	TP1/7	TP1/8	TP1/9	TP1/12	TP1/13	TP1/16	TP1/19	TP1/22	TP1/25	TP1/28	TP1/31	TP1/34	TP1/37	TP1/40	TP1/41	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	629497.3	629497.4	629497.7	629497.8	629497.9	629497.12	629497.13	629497.16	629497.19	629497.22	629497.25	629497.28	629497.31	629497.34	629497.37	629497.4	629497.41			
Sample Location	centre base	E wall	E wall	NW base	NE base	W wall	SE base	N wall	N wall	N wall	N wall	S wall	E wall	S wall	S wall	S wall	SW base			
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Soil Type - Field	silty sand	silt	silty clay	sand	silt	silt	silty clay	silt	clay	silty sand	silt	sandy clay	clay	silt	silt	silt	clay	Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Sand	Sandy Silt	Sandy Silt	Sand	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Silty Clay	Sand	Sandy Silt	Sandy Silt	Silty Clay	Sandy Silt	Sandy Silt	Sandy Silt	Silty Clay			
Sample Depth (m bgl)	4.5	4.3	4.3	4.3	4.3	4.2	4.3	4.3	4.3	4.2	4.2	4.1	4.3	4.2	4.3	4.3	4.4	>4 m	>4 m	>4 m
PID Reading (ppm)	11.6	0.1	1.8	53.8	10.3	50	13.9	2.2	5.3	1.7	1.5	6.8	0.8	0.1	0.9	3.9	66.3			
C_7-C_9 hydrocarbons	< 9.2	< 8.5	< 9.9	< 8.8	< 11	< 8.8	< 9.5	< 11	< 11	< 8.2	< 9.6	< 8.8	< 9.2	< 9.9	< 9.0	< 11	39	(12,000) (6,8,v)	(12,000) (6,v)	NA (4)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	110	(2,100) (6,x)	(3,400) (6,x)	NA (4)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	220	NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	370	-	-	-
Benzene	< 0.055	< 0.054	< 0.070	0.14	0.15	0.12	< 0.056	< 0.062	< 0.069	< 0.050	< 0.054	< 0.052	< 0.056	< 0.063	< 0.050	< 0.060	2.4	9.3 (8,v)	9.3 (v)	(54) (6,v)
Toluene	< 0.055	< 0.054	< 0.070	0.11	0.26	1.5	< 0.056	< 0.062	< 0.069	< 0.050	< 0.054	< 0.052	< 0.056	< 0.063	< 0.050	< 0.060	4	(770) (6,v)	(790) (6,v)	(10,000) (6,v)
Ethylbenzene	0.74	< 0.054	< 0.070	0.18	0.13	0.45	< 0.056	< 0.062	< 0.069	< 0.050	< 0.054	< 0.052	< 0.056	< 0.063	< 0.050	< 0.060	5.8	(390) (6,v)	(450) (6,v)	(9,100) (6,v)
Total xylenes [7]	< 0.165	< 0.164	< 0.210	0.85	0.81	3.19	< 0.176	< 0.192	< 0.209	<0.150	< 0.164	0.956	< 0.176	< 0.193	< 0.150	< 0.180	23.6	(580) (6,v)	(590) (6,v)	(7,300) (6,v)

Note:

1. All results in mg/kg.
2. Criteria from Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, August 1999).
3. Criteria assume commercial/industrial land use, 'sand', 'sandy silt' and 'silty clay' soil types and contamination depths of <1 m, 1 - 4 m and, >4m below ground level
4. NA indicates contaminant is not limiting as health based criterion is significantly higher than may be encountered on site (i.e. 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants)
5. The following notes indicate the limiting pathway for each criterion: m - maintenance/excavation, v - volatilisation, x - PAH surrogate
6. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.
7. Total xylenes was calculated by adding the laboratory results of the individual xylene isomers. Where one of the xylene isomers was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
8. Due to the boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for the sandy silt soil type. Therefore, the criteria for sand are set equal to the criteria for sandy silt
9. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on the benzo(a)pyrene equivalent concentration and is calculated by multiplying each of the seven PAH concentrations by toxic equivalence factors and summing the result. Where a laboratory result for an individual PAH compound is below the laboratory detection limit the concentration is taken to be half the detection limit.
10. ND - none of the individual PAH compounds were recorded above the laboratory limit of detection.

a. Contaminated soil layer is in direct contact with groundwater and hence no attenuation associated with vertical migration through the soil column occurs

Table 2: Soil Sample Results - Dispensers, Remote Fill Points, Fuel Lines, Vents - ALL PATHWAYS

Soil Samples Collected at a Depth of <1 m Below Ground Level

Sample Name	FL1	FL2	FL3	FL4	FL5	FL6	FL10	FL16	FL18	FL19			Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	630362.1	630362.2	630362.3	630362.4	630362.5	630362.6	630362.13	630362.18	630639.41	630362.35					
Sample Location	Vents	Vent Lines	Fuel Line	Fuel Line	Fuel Line	Fuel Line	Dispenser Island 3	Dispenser Island 1	Fuel Line	Fuel Line					
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining					
Soil Type - Field	gravel	silty clay	sandy gravel	sandy gravel	sandy gravel	sandy gravel	sand	clay	clay	clay			Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Sand	Sandy Silt	Sand	Sand	Sand	Sand	Sand	Silty Clay	Silty Clay	Silty Clay					
Sample Depth (m bgl)	0.5	0.5	0.5	0.9	0.9	0.9	0.6	0.9	0.7	0.7			<1 m	<1 m	<1 m
PID Reading (ppm)	17.6	0.2	0.5	0.1	0.5	65.7	10	2.8	2.6	4.7					
C_7-C_9 hydrocarbons	< 8.0	< 9.3	< 8.0	< 8.0	< 8.0	< 8.0	21	< 9.0	< 9.6	< 9.7			120 (m)	(500) (6,m)	(8,800) (6,v)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	26	< 20	< 20	< 20			(1,500) (6,x)	(1,700) (6,x)	(1,900) (6,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	< 30	900	< 30	< 30	< 30			NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60	< 60	< 60	940	< 60	< 60	< 60			-	-	-
Benzene	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.056	< 0.059	< 0.062			3.0 (m)	3.6 (v)	7.2 (v)
Toluene	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.056	< 0.059	< 0.062			(94) (6,m)	(270) (6,v)	(670) (6,v)
Ethylbenzene	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.056	< 0.059	< 0.062			(180) (6,v)	(200) (6,v)	(350) (6,v)
Total xylenes [7]	< 0.150	< 0.192	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.176	< 0.179	< 0.192			(150) (6,m)	(200) (6,v)	(510) (6,v)

Soil Samples Collected at a Depth of <1 m Below Ground Level

Sample Name	FL20	FL22	FL23	FL26	FL27	FL28	FL29	FL30	FL31	FL32	FL33	FL34	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	630362.36	630639.42	630639.43	630362.24	630362.25	630362.26	630362.27	630362.28	630639.44	630639.45	630639.46	630639.47			
Sample Location	Fuel Line	Vents	Vent Lines	Fuel Line	Fuel Line	Fuel Line	Fuel Line	Fuel Line	Fuel Line	Fuel Line	Fuel Line	Fuel Line			
Soil Fate	Remaining	Removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Soil Type - Field	clay	clay	clay	clay	clay	clay	clay	clay	clay	clay	clay	clay	Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay			
Sample Depth (m bgl)	0.6	0.7	0.6	0.8	0.7	0.6	0.6	0.5	0.5	0.6	0.5	0.7	<1 m	<1 m	<1 m
PID Reading (ppm)	23.8	1.2	0.5	0.8	0.5	0.1	0.1	7.4	3.4	0.9	1.8	0.3			
C_7-C_9 hydrocarbons	< 8.9	< 8.2	< 11	< 8.5	< 9.3	< 8.5	< 8.6	< 9.6	< 8.4	< 8.4	< 9.3	< 9.4	120 (m)	(500) (6,m)	(8,800) (6,v)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	(1,500) (6,x)	(1,700) (6,x)	(1,900) (6,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	-	-	-
Benzene	< 0.062	< 0.052	< 0.065	< 0.051	< 0.063	< 0.056	< 0.057	< 0.066	< 0.050	< 0.050	< 0.050	< 0.057	3.0 (m)	3.6 (v)	7.2 (v)
Toluene	< 0.062	< 0.052	< 0.065	< 0.051	< 0.063	< 0.056	< 0.057	< 0.066	< 0.050	< 0.050	< 0.050	< 0.057	(94) (6,m)	(270) (6,v)	(670) (6,v)
Ethylbenzene	< 0.062	< 0.052	< 0.065	< 0.051	< 0.063	< 0.056	< 0.057	< 0.066	< 0.050	< 0.050	< 0.050	< 0.057	(180) (6,v)	(200) (6,v)	(350) (6,v)
Total xylenes [7]	< 0.192	< 0.162	< 0.195	< 0.161	< 0.193	< 0.176	< 0.177	< 0.206	< 0.150	< 0.150	< 0.150	< 0.177	(150) (6,m)	(200) (6,v)	(510) (6,v)

Soil Samples Collected at a Depth of 1 - 4 m Below Ground Level

Sample Name	FL13	FL14	FL15	FL25									Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	630362.15	630362.16	360362.17	630362.23											
Sample Location	Fuel Line	Dispenser Island 4	Dispenser Island 2	Remote Fill											
Soil Fate	Remaining	Remaining	Remaining	Remaining											
Soil Type - Field	clay	clay	clay	clay									Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Silty Clay	Silty Clay	Silty Clay	Silty Clay											
Sample Depth (m bgl)	1.9	2	1.2	1.1									1 - 4 m	1 - 4 m	1 - 4 m
PID Reading (ppm)	17.5	9.1	19.8	0.4											
C_7-C_9 hydrocarbons	< 8.5	< 9.9	< 8.5	< 9.2									120 (m)	(500) (6,m)	(20,000) (6,m)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20									(1,900) (6,x)	(2,200) (6,x)	(8,900) (6,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30									NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60									-	-	-
Benzene	0.18	< 0.060	0.33	< 0.060									3.0 (m)	7.2 (v)	(20) (6,v)
Toluene	< 0.053	< 0.060	< 0.055	< 0.060									(94) (6,m)	(480) (6,m)	(3,100) (6,v)
Ethylbenzene	0.21	< 0.060	0.19	< 0.060									(300) (6,8,v)	(300) (6,v)	(2,600) (6,v)
Total xylenes [7]	0.2765	< 0.180	0.3275	< 0.180									(150) (6,m)	(420) (6,v)	(2,300) (6,v)

Note:

1. All results in mg/kg.
2. Criteria from Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, August 1999).
3. Criteria assume commercial/industrial land use, 'sand', 'sandy silt' and 'silty clay' soil types and contamination depths of <1 m and 1 - 4 m below ground level.
4. NA indicates contaminant is not limiting as health based criterion is significantly higher than may be encountered on site (i.e. 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants).
5. The following notes indicate the limiting pathway for each criterion: m - maintenance/excavation, v - volatilisation, x - PAH surrogate.
6. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.
7. Total xylenes was calculated by adding the laboratory results of the individual xylene isomers. Where one of the xylene isomers was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
8. Due to the boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for the sandy silt soil type. Therefore, the criteria for sand are set equal to the criteria for sandy silt.
9. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on the benzo(a)pyrene equivalent concentration and is calculated by multiplying each of the seven PAH concentrations by toxic equivalence factors and summing the result. Where a laboratory result for an individual PAH compound is below the laboratory detection limit the concentration is taken to be half the detection limit.
10. ND - none of the individual PAH compounds were recorded above the laboratory limit of detection.

a. Contaminated soil layer is in direct contact with groundwater and hence no attenuation associated with vertical migration through the soil column occurs.

Table 3: Soil Sample Results - Tank Pit & Bedding Material - ALL PATHWAYS

Soil Samples Collected at a Depth of <1 m Below Ground Level

Sample Name	TST1/1	TST2/1	TST3/1	TST4/1	TST5/1	TST7/1	TST9/1	TST10/8	TST11/1	TST11/3	TST11/4	TST11/11	TST12/1	TST13/1	TST14/1	TST14/2	TST14/3	TST14/4	TST16/1	TST17/1	TST18/1	TST19/1	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	630639.1	630639.3	630639.71	630639.81	630639.5	630639.105	630639.119	630639.122	631051.1	631051.2	631051.3	631051.8	631051.23	631051.77	631051.93	631051.94	631051.95	631051.96	631051.53	631051.55	631051.57	631051.59			
Sample Location	Test Pit 1	Test Pit 2	Test Pit 3	Test Pit 4	Test Pit 5	Test Pit 7	Test Pit 9	Test Pit 10	Test Pit 11 S	Test Pit 11 N	Test Pit 11 W	Test Pit 11 E	Test Pit 12	Test Pit 13	Test Pit 14 W	Test Pit 14 S	Test Pit 14 E	Test Pit 14 N	Test Pit 16	Test Pit 17	Test Pit 18	Test Pit 19			
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Soil Type - Field	gravel	gravel	gravel	clay	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	gravel	Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Sand	Sand	Sand	Silty Clay	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand			
Sample Depth (m bgl)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			
PID Reading (ppm)	8.6	17	0.4	10.5	3.7	4.2	63.2	37.1	6.4	10.8	8.8	10.2	0.3	5.3	1.1	5.2	0.4	1.7	0.7	0.5	0.5	1.1	<1 m	<1 m	<1 m
C_7-C_9 hydrocarbons	< 8.0	< 8.0	< 8.0	12	< 8.0	11	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0	120 (m)	(500) (6,m)	(8,800) (6,v)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	110	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	41	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	(1,500) (8,x)	(1,700) (8,x)	(1,900) (6,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	370	< 30	< 30	< 30	< 30	< 30	< 30	210	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	140	< 60	390	< 60	< 60	< 50	< 60	< 60	< 60	210	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	-	-	-
Benzene	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	3.0 (m)	3.6 (v)	7.2 (v)
Toluene	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	(94) (6,m)	(270) (6,v)	(670) (6,v)
Ethylbenzene	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	(180) (6,v)	(200) (6,v)	(350) (6,v)
Total xylenes [7]	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	(150) (6,m)	(200) (6,v)	(510) (6,v)

Soil Samples Collected at a Depth of 1 - 4 m Below Ground Level

Sample Name	TST1/4	TST2/4	TST3/3	TST4/4	TST5/7	TST7/4	TST7/7	TST9/2	TST10/3	TST11/7	TST11/8	TST11/9	TST11/10	TST12/2	TST13/4	TST14/5	TST14/6	TST14/7	TST14/8	TST15/2	TST16/2	TST17/2	TST18/3	TST19/2	TST19/3	TST19/4	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	630639.2	630639.4	630639.72	630639.82	630639.6	630639.11	630639.11	630639.12	630639.12	631051.4	631051.5	631051.6	631051.7	631031.24	631051.8	631051.97	631051.98	631051.99	631051.1	631051.39	631051.54	631051.56	631051.58	631051.6	631051.61	631051.62			
Sample Location	Test Pit 1	Test Pit 2	Test Pit 3	Test Pit 4	Test Pit 5	Test Pit 7	Test Pit 7	Test Pit 9	Test Pit 10	Test Pit 11 E	Test Pit 11 W	Test Pit 11 S	Test Pit 11 N	Test Pit 12	Test Pit 13	Test Pit 14 W	Test Pit 14 N	Test Pit 14 E	Test Pit 14 S	Test Pit 15	Test Pit 16	Test Pit 17	Test Pit 18	Test Pit 19	Test Pit 19	Test Pit 19			
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Soil Type - Field	clay	clay	gravel	clay	silty clay	clay	clay	clay	clay	clay	clay	clay	clay	clay	clay	clay	sandy clay	clay	sandy clay	clay	clay	clay	clay	clay	clay	clay	Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Silty Clay	Silty Clay	Sand	Silty Clay	Sandy Silt	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Sandy Silt	Silty Clay	Sandy Silt	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay			
Sample Depth (m bgl)	2	2	1.5	2	3.5	2	3	1.1	2	2	2.5	2.5	2.5	1.1	2	2.8	3	3	3	1.1	1.5	1.1	1.5	1.1	1.5	2	1 - 4 m	1 - 4 m	1 - 4 m
PID Reading (ppm)	597	2024	0.2	113	0.8	84.9	85.1	21.9	356	92.3	10.3	50.5	39.7	10.5	82.1	5.5	0.5	1.3	0.6	300	0.6	0.6	0.7	10.6	5.4	0.3			
C_7-C_9 hydrocarbons	< 8.6	< 9.3	19	< 10	< 8.5	< 9.7	18	< 8.0	< 11	14	14	< 9.0	< 8.5	< 9.7	< 9.8	< 9.9	< 8.7	< 8.2	< 9.7	< 8.6	11	< 9.4	< 9.0	< 8.0	< 8.7	< 11	120 (m)	(500) (6,m)	(20,000) (6,m)
C_{10}-C_{14} hydrocarbons	33	< 20	< 20	< 20	< 20	91	360	25	< 20	< 20	< 20	< 20	< 20	47	< 20	< 20	< 20	< 20	< 20	71	< 20	< 20	< 20	< 20	< 20	< 20	(1,900) (8,x)	(2,200) (8,x)	(8,900) (8,x)
C_{15}-C_{36} hydrocarbons	< 30	< 30	< 30	< 30	< 30	150	630	58	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	250	< 30	< 30	< 30	< 30	< 30	< 30	NA (4)	NA (4)	NA (4)
TPH	< 60	< 60	< 60	< 60	< 60	250	1000	88	< 50	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	< 60	320	< 60	< 60	< 60	< 60	< 60	< 60	-	-	-
Benzene	< 0.055	< 0.065	< 0.050	< 0.065	< 0.051	< 0.058	< 0.061	< 0.050	< 0.065	< 0.079	< 0.057	< 0.058	< 0.056	< 0.055	< 0.057	< 0.056	< 0.053	< 0.052	< 0.056	< 0.051	< 0.064	< 0.065	< 0.055	< 0.050	< 0.057	0.56	3.0 (m)	7.2 (v)	(20) (6,v)
Toluene	< 0.055	< 0.065	< 0.050	< 0.065	< 0.051	< 0.058	< 0.061	< 0.050	< 0.065	< 0.079	< 0.057	< 0.058	< 0.056	< 0.055	< 0.057	< 0.056	< 0.053	< 0.052	< 0.056	< 0.051	< 0.064	< 0.065	< 0.055	< 0.050	< 0.057	0.2	(94) (6,m)	(480) (6,m)	(3,100) (6,v)
Ethylbenzene	< 0.055	< 0.065	< 0.050	< 0.065	< 0.051	< 0.058	< 0.061	< 0.050	< 0.065	0.62	< 0.057	< 0.058	< 0.056	< 0.055	< 0.057	< 0.056	< 0.053	< 0.052	< 0.056	< 0.051	< 0.064	< 0.065	< 0.055	< 0.050	0.067	0.51	(300) (6,8,v)	(300) (6,v)	(2,600) (6,v)
Total xylenes [7]	< 0.165	< 0.195	< 0.150	< 0.195	< 0.151	< 0.178	< 0.191	< 0.150	< 0.195	2.83	< 0.177	< 0.178	< 0.176	< 0.165	< 0.177	< 0.176	< 0.163	< 0.162	< 0.176	< 0.161	< 0.194	< 0.195	< 0.165	< 0.150	0.179	2.76	(150) (6,m)	(420) (6,v)	(2,300) (6,v)

Soil Samples Collected at a Depth of >4 m Below Ground Level

Sample Name	TST1/8	TST6/8	TST8/7	TST9/8	TST10/7	TST12/8	TST13/8	TST15/8	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3] Commercial/ Industrial Land Use ALL PATHWAYS
Laboratory Reference	630639.56	630639.55	630639.59	630639.12	630639.12	631031.25	631051.84	631051.4			
Sample Location	Test Pit 1	Test Pit 6	Test Pit 8	Test Pit 9	Test Pit 10	Test Pit 12	Test Pit 13	Test Pit 15			
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Soil Type - Field	clay	clay	clay	clay	clay	sandy clay	clay	sandy clay	Sand	Sandy Silt	Silty Clay
Soil Type - MfE (1999)	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Sandy Silt	Silty Clay	Sandy Silt			
Sample Depth (m bgl)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	>4 m	>4 m	>4 m
PID Reading (ppm)	7.4	24.3	15.3	40.1	1.5	1.5	0.6	0.6			
C_7-C_9 hydrocarbons	< 13	< 8.6	< 8.9	< 9.9	< 9.5	< 8.0	< 11	< 9.2	(12,000) (6,8,v)	(12,000) (6,v)	NA (4)
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	(2,100) (6,x)	(3,400) (6,x)	NA (4)
C_{15}-C_{36} hydrocarbons	190	< 30	< 30	< 30	< 30	< 30	< 30	< 30	NA (4)	NA (4)	NA (4)
TPH	180	< 60	< 60	< 60	< 60	< 60	< 60	< 60	-	-	-
Benzene	< 0.085	< 0.053	< 0.052	< 0.066	< 0.058	< 0.053	< 0.081	< 0.060	9.3 (8,v)	9.3 (v)	(54) (6,v)
Toluene	< 0.085	0.19	< 0.052	< 0.066	< 0.058	< 0.053	< 0.081	< 0.060	(770) (6,v)	(790) (6,v)	(10,000) (6,v)
Ethylbenzene	< 0.085	0.058	< 0.052	< 0.066	< 0.058	< 0.053	< 0.081	< 0.060	(390) (6,v)	(450) (6,v)	(9,100) (6,v)
Total xylenes [7]	< 0.255	0.27	0.166	< 0.206	< 0.178	< 0.163	< 0.251	< 0.180	(580) (6,v)	(590) (6,v)	(7,300) (6,v)

Note:
1. All results in mg/kg.
2. Criteria from Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, August 1999).
3. Criteria assume commercial/industrial land use, 'sand', 'sandy silt' and 'silty clay' soil types and contamination depths of <1 m, 1 - 4 m, and >4m below ground level
4. NA indicates contaminant is not limiting as health based criterion is significantly higher than may be encountered on site (i.e. 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants)
5. The following notes indicate the limiting pathway for each criterion: m - maintenance/excavation, v - volatilisation, x - PAH surrogate
6. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
7. Total xylenes was calculated by adding the laboratory results of the individual xylene isomers. Where one of the xylene isomers was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits
8. Due to the boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for the sandy silt soil type. Therefore, the criteria for sand are set equal to the criteria for sandy silt
9. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on the benzo(a)pyrene equivalent concentration and is calculated by multiplying each of the seven PAH concentrations by toxic equivalence factors and summing the result. Where a laboratory result for an individual PAH compound is below the laboratory detection limit the concentration is taken to be half the detection limit.
10. ND - none of the individual PAH compounds were recorded above the laboratory limit of detection.
a. Contaminated soil layer is in direct contact with groundwater and hence no attenuation associated with vertical migration through the soil column occurs

Table 4: Soil Sample Results - Heavy Metals

Sample Name	TST12/1	TST13/1	TST14/1	Backgrond Ranges of Trace Elements in Auckland Soils [2]	ARC Permitted Activity Thresholds [4]
Laboratory Reference	631051.23	631051.77	631051.93		
Sample Location	Test Pit 12	Test Pit 13	Test Pit 14		
Soil Fate	Remaining	Remaining	Remaining		
Soil Type - Field	Gravel	Gravel	Gravel		
Soil Type - MfE (1999)	Sand	Sand	Sand		
Sample Depth (m bgl)	0.5	0.5	0.5	Volcanic	
PID Reading (ppm)	0.3	5.3	1.1		
Arsenic	< 2.0	< 2.0	< 2.0	0.4 - 12	30 [3a]
Cadmium	< 0.10	< 0.10	0.11	<0.1 - 0.65	1 [3a]
Chromium	43	41	44	3 - 125	400 [3b]
Copper	58	54	60	20 - 90	325 [3b]
Nickel	190	180	170	4 - 320	105 [3b]
Lead	2.1	1.5	1.5	<1.5 - 65	250 [3b]
Zinc	53	48	51	54 - 1,160	400 [3b]

Note:
1. All results in mg/kg.
2. Background Concentrations of Inorganic Elements in Soils from the Auckland Region, ARC Technical Publication No. 153, October 2001.
3a. ARC Schedule 9 Permitted Activity Soil Criteria (Human Health)
3b. ARC Schedule 9 Permitted Activity Soil Criteria (Discharge)
4. Auckland Regional Council permitted activity guideline criteria in accordance with the ARC proposed Air Land Water Plan, Rule 5.5.41.

Table 5: Soil Sample Results - Soil Removed Offsite

Sample Name	TST6/1	TST6/2	TST6/6	TST8/1	TST8/2
Laboratory Reference	630639.91	630639.92	630639.93	630639.57	630639.58
Sample Location	Test Pit	Test Pit	Test Pit	Test Pit	Test Pit
Soil Fate	Removed	Removed	Removed	Removed	Removed
Soil Type - Field	gravel	clay	clay	clay	clay
Sample Depth (m bgl)	0.5	1.1	3	1.1	1.5
PID Reading (ppm)	1738	1539	1300	1893	1781
C_7-C_9 hydrocarbons	9.9	39	32	160	170
C_{10}-C_{14} hydrocarbons	< 20	340	< 20	96	150
C_{15}-C_{36} hydrocarbons	< 30	600	< 30	< 30	< 30
TPH	< 60	980	< 60	260	330
Benzene	< 0.050	< 0.051	< 0.050	3.1	3.8
Toluene	0.079	4.6	< 0.050	23	30
Ethylbenzene	0.1	1.4	< 0.050	11	15
Total xylenes [2]	2.78	9.7	< 0.150	70	98

Note:

1. All results in mg/kg.

2. Total xylenes was calculated by adding the laboratory results of the individual xylene isomers. Where one of the xylene isomers was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits

Figures

MOBIL PAKURANGA (002021), 102 PAKURANGA ROAD, MANUKAU CITY, AUCKLAND, TANK REMOVAL – MOBIL OIL NEW ZEALAND LTD

SITE LOCATION

Legend

UPSS
- Tank Pit
- UST (removed Feb 08)
- UST, historical
- Test Pit
- D — Dispenser (removed)
- Fill Point (removed Feb 08)
- Observation well (removed Feb 08)
- Vent pipe (removed Feb 08)

Underground Services
- Fuel Line (removed Feb 08)
- Vent Line (removed Feb 08)
- S — Sewer
- SV — Stormwater

Drainage
- Manhole, current
- Sump, current
- Sump, removed
- Drainage Duct
- Interceptor, current
- Interceptor (removed Feb 08)

Boundary Material
- Wooden fence
- Concrete block wall
- Investigation Area

Notes:
1. Aerial photography courtesy of NZ Aerial Mapping (date of photography 13 July 2003).
2. Cadastral information derived from LINZ data.
3. Base drawing derived from Mobil Engineering PDF of Existing Plan drawing number 002021/23/16 dated 2/2/95.

Figure 1 : SITE PLAN, UPSS AND TEST PIT LOCATIONS

Scale 1:400 (A3)

A02093101D001.dwg [A02093001.jpg] Aug-08 Final

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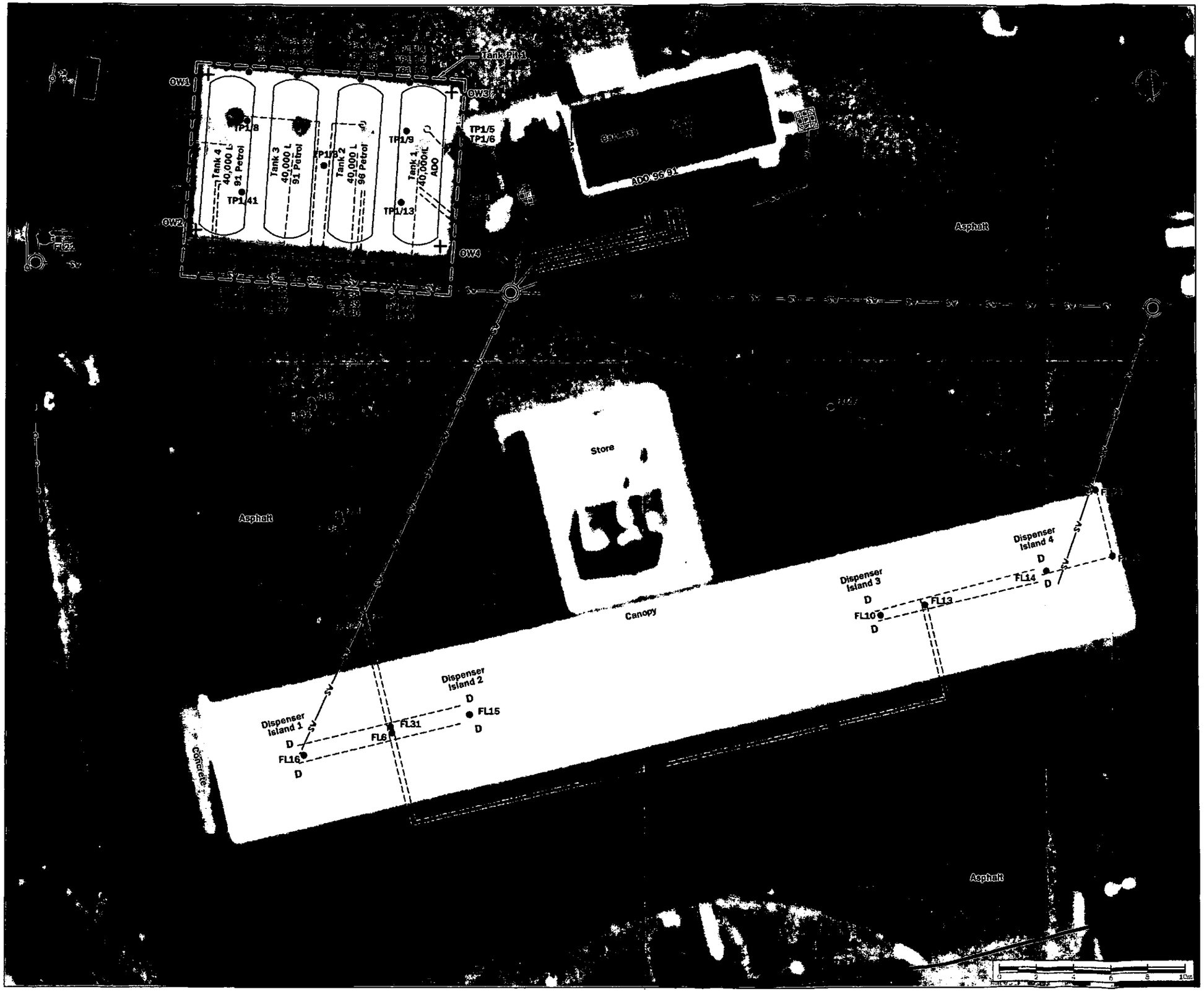


Figure 2 : UPSS SAMPLING LOCATIONS

Legend

- TP1/1 — Soil Sample Location

UPSS

- Tank Pit
- UST (removed Feb 08)
- D — Dispenser (removed)
- Fill Point (removed Feb 08)
- Observation well (removed Feb 08)
- Vent pipe (removed Feb 08)

Underground Services

- Fuel Line (removed Feb 08)
- Vent Line (removed Feb 08)
- SW — Stormwater

Drainage

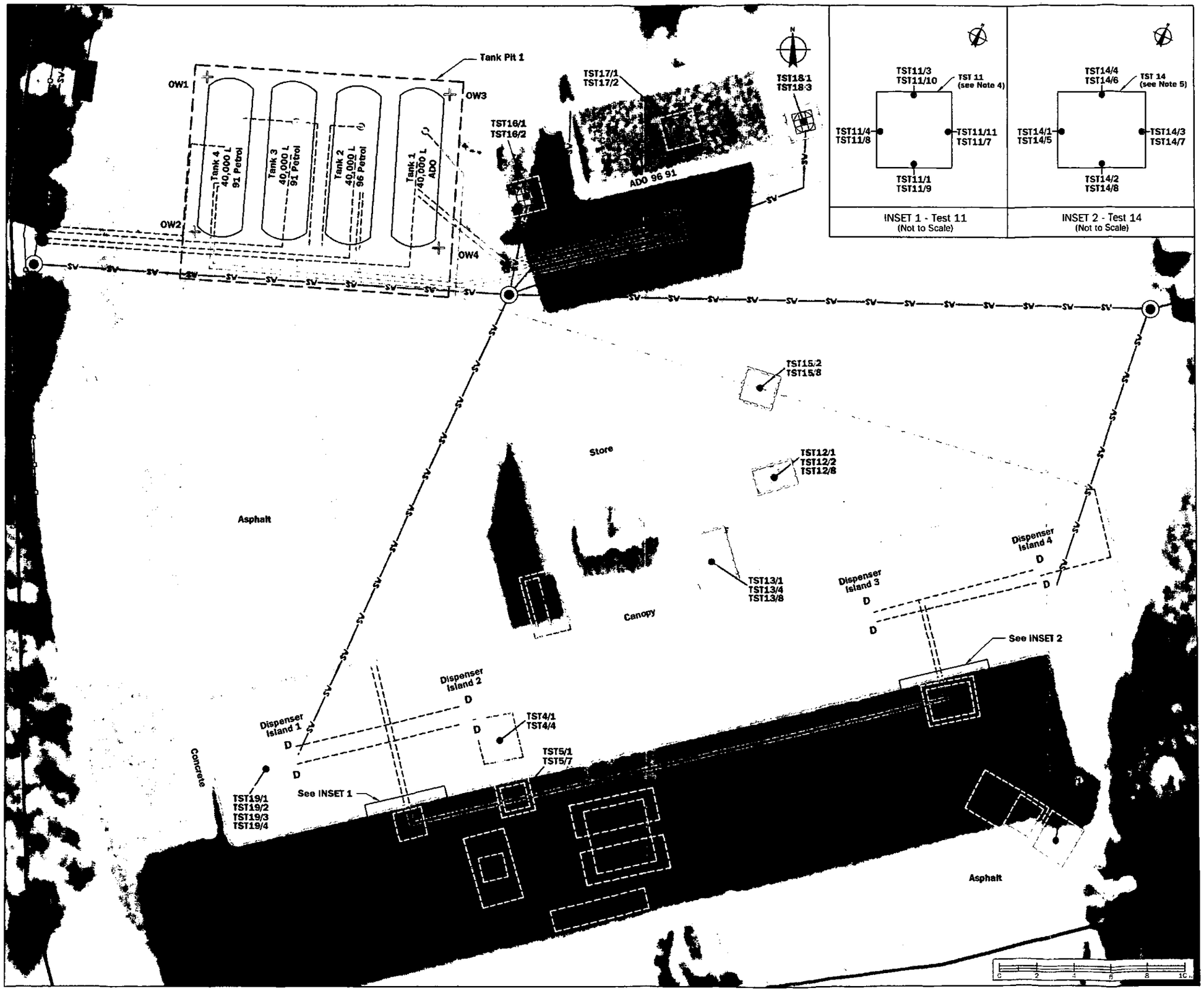
- Manhole, current
- Sump, current
- Sump, removed
- Interceptor (removed Feb 08)

Boundary Material

- Wooden fence
- Concrete block wall
- Investigation Area

Notes:
1. Aerial photography courtesy of NZ Aerial Mapping (date of photography 13 July 2003).
2. Cadastral information derived from LINZ data.
3. Base drawing derived from Mobil Engineering PDF of Existing Plan drawing number 002021/23/16 dated 2/2/95.

Scale 1:200 (A3)



Legend

- TST1/1 — Soil Sample Location

UPSS

- Tank Pit
- UST (removed Feb 08)
- UST, historical
- Test Pit
- D — Dispenser (removed)
- Fill Point (removed Feb 08)
- Observation well (removed Feb 08)
- Vent pipe (removed Feb 08)

Underground Services

- Fuel Line (removed Feb 08)
- Vent Line (removed Feb 08)
- SV — Stormwater

Drainage

- Manhole, current
- Sump, current
- Sump, removed
- Interceptor (removed Feb 08)

Boundary Material

- Wooden fence
- Concrete block wall
- Investigation Area

Notes:
1. Aerial photography courtesy of NZ Aerial Mapping (date of photography 13 July 2003).
2. Cadastral information derived from LINZ data.
3. Base drawing derived from Mobil Engineering PDF of Existing Plan drawing number 002021/23/16 dated 2/2/95.
4. TST 8 was removed through the excavation of TST 11.
5. TST 6 was removed through the excavation of TST 14.

Figure 3 : TEST PIT SAMPLING LOCATIONS

Scale 1:200 (A3)

Logs

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST2**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road
DATE: 13/02/2008
DATE BACKFILLED: 13/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular to subangular, loosely packed, poorly graded (5-10mm) coarsening down		0.5	TST2/1	17	
		1.0		1937	
FILL. CLAY with concrete boulders (< 500mm), grey, homogeneous, soft, moist, moderately plastic with occassional pipework and steel fragments. Colour change at 1.9m from grey to grey with orange mottling Colour change at 2.3m to grey		1.5		1655	
		2.0	TST2/4	2024	
		2.5		1603	
		3.0		679	
CLAY, grey/brown, homogeneous, soft, moist, moderately plastic		3.5		45.9	
END OF TEST PIT AT 3.8m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST02

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST3**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd		LOCATION: Mobil Pakuranga, 102 Pakuranga Road	
DATE: 14/02/2008	DATE BACKFILLED: 14/02/2008	LOGGED BY: RWL	SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular to subangular, loosely packed, poorly graded (1-10mm) coarsening down to gap graded at the base with gravels (25-50mm) and gravelly rubble (<500mm)		0.5	TST3/1	× 0.4	
		1.0		× 0.3	
		1.5	TST3/3	× 0.2	
		2.0		× 0.6	

END OF TEST PIT AT 2.2m

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST03

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST4**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road
DATE: 14/02/2008
DATE BACKFILLED: 14/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. Sandy GRAVEL, subangular to subrounded, loosely packed, well graded (5-25mm)					
CLAY, green with orange mottling, soft, moist, moderately plastic Colour change at 1.3m to green Colour change at 2.3m from green to grey/green		0.5	TST4/1	× 10.5	
		1.0		× 51	
		1.5		× 89.6	
		2.0	TST4/4	× 113	
		2.5		× 28.4	

END OF TEST PIT AT 2.8m

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST04

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST5**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road

DATE: 13/02/2008
DATE BACKFILLED: 13/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. Sandy GRAVEL, angular to subangular, loosely packed, poorly graded (3-5mm) coarsening down to poorly graded (8-20mm)		0.5	TST5/1	× 3.7	
		1.0		× 8.3	
CLAY, dark grey with orange mottling, soft, moist, moderately plastic Colour change at 1.5m to orange with light grey mottling Colour change at 2.0m to grey with orange mottling		1.5		× 2.0	
		2.0		× 1.2	
		2.5		× 1.0	
Sandy CLAY, light grey, firm, moist to dry, slightly plastic		3.0		× 1.0	
		3.5	TST5/7	× 0.8	
END OF TEST PIT AT 3.8m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST05

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST6/TST14**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road
DATE: 13/02/2008
DATE BACKFILLED: 13/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. Sandy GRAVEL, angular to subangular, loosely packed, poorly graded (1-5mm)		0.5	various	various	
FILL. CLAY with concrete boulders (< 500mm), green, soft, wet, moderately plastic (hydrocarbon odour) Colour change at 2.9m from green to grey		1.0	TST6/2	1539	
		1.5		548	
		2.0		893	
		2.5		478	
			TST14/3	5.5	
		3.0	various	various	
FILL. Sandy CLAY, light grey, moderately stiff to firm, moist to dry, slightly plastic with occassional pipework and steel fragments		3.5		433	
CLAY, brown, soft, moist, slightly plastic		4.0	TST6/8	24.3	
END OF TEST PIT AT 4.4m					

Notes: Excavated by Petroleum Solutions Limited
*various - refer to Table 3 for samples collected and PID readings

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level:--
Coordinates:

Filename: A02093101_TST06

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST7**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd		LOCATION: Mobil Pakuranga, 102 Pakuranga Road	
DATE: 13/02/2008	DATE BACKFILLED: 13/02/2008	LOGGED BY: RWL	SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular, loosely packed, well-graded (5-20mm)		0.5	TST7/1	4.2	
		1.0		9.6	
CLAY, light grey, soft, moist, moderately plastic Colour change at 1.5m from light grey to green/grey with orange mottling Colour change at 2.4m to green with orange mottling Colour change at 2.8m to green/grey		1.5		6.7	
		2.0	TST7/4	84.9	
		2.5		9.5	
		3.0	TST7/7	85.1	
Sandy CLAY, light grey, firm, moist to dry, slightly plastic		3.5		3.4	

END OF TEST PIT AT 3.7m

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST07

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST8/TST11**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd

LOCATION: Mobil Pakuranga, 102 Pakuranga Road

DATE: 14/02/2008

DATE BACKFILLED: 14/02/2008

LOGGED BY: RWL

SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular to subangular, loose, well graded (5-20mm)		0.5	various	various	
CLAY, green with orange mottling, soft, moist, moderately plastic Colour change at 1.9m to grey with orange mottling		1.0	TST8/1	1893	sheen, strong odour
		1.5	TST8/2	1781	
		2.0		69.1	
		2.5	various	various	
Sandy CLAY, light grey, moist to dry, soft to firm, slightly plastic		3.0		10.1	
		3.5		12.3	
CLAY, brown, soft, moist, plastic		4.0	TST8/7	15.3	
END OF TEST PIT AT 4.2m					

Notes: Excavated by Petroleum Solutions Limited
*various - refer to Table 3 for samples collected and PID readings

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST08

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST9**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd		LOCATION: Mobil Pakuranga, 102 Pakuranga Road	
DATE: 14/02/2008	DATE BACKFILLED: 14/02/2008	LOGGED BY: RWL	SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular to subangular, loosely packed, gap graded 5-15mm gravels and >150mm gravelly rubble		0.5	TST9/1	63.2	
CLAY, grey with orange mottling, soft, moist, moderately plastic		1.0	TST9/2	219	
		1.5		109	
		2.0		63.3	
		2.5		60.2	
Sandy CLAY, light grey, moderately stiff to firm, moist to dry, slightly plastic		3.0		15.1	
		3.5		43.7	
CLAY, brown, soft, moist, plastic		4.0	TST9/8	40.1	

END OF TEST PIT AT 4.2m

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST09

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST10**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd		LOCATION: Mobil Pakuranga, 102 Pakuranga Road	
DATE: 14/02/2008	DATE BACKFILLED: 14/02/2008	LOGGED BY: RWL	SHEET 1 OF 1

DESCRIPTION OF SOIL	DEPTH (m)	SAMPLE DETAILS	TESTS
ASPHALT.	0.0		
FILL. GRAVEL, angular to subangular, loosely packed, poorly graded (1-10mm)	0.5	TST10/8	37.1
	1.0		1.2
CLAY, grey with orange mottling, soft, moist (slight hydrocarbon odour) Colour change at 2.4m to orange with grey mottling, along with a moisture change to dry	1.5		343
	2.0	TST10/3	356
	2.5		5.6
Sandy CLAY, light grey, moist to dry, moderately stiff to firm, slightly plastic	3.0		2.7
	3.5		2.6
CLAY, brown, soft, moist, plastic	4.0	TST10/7	1.5
END OF TEST PIT AT 4.2m			

WATER OBSERVATIONS: ▼ (seepage inflow at 3.5m)

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST10

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST12**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd

LOCATION: Mobil Pakuranga, 102 Pakuranga Road

DATE: 18/02/2008

DATE BACKFILLED: 18/02/2008

LOGGED BY: RWL

SHEET 1 OF 1

DESCRIPTION OF SOIL	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.	0.0			
FILL. GRAVEL, angular to subangular, loosely packed, poorly graded (only 1-10mm represented)	0.5	TST12/1	0.38	
CLAY, light grey, soft, moist, moderately plastic	1.0	TST12/2	10.5	
	1.5		7.9	
	2.0		4.0	
Silty CLAY, light grey, soft to very soft, moist to wet, moderately plastic	2.5		2.3	
	3.0		3.7	
Sandy CLAY, light grey, very soft, moist to wet, moderately to highly plastic	3.5		1.4	
	4.0	TST12/8	1.5	
END OF TEST PIT AT 4.2m				

Notes: Excavated by Petroleum Solutions Limited

KEY

- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST12

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST13**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road
DATE: 19/02/2008
DATE BACKFILLED: 19/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular to subangular, loosely packed, poorly graded (1-20mm)		0.5	TST13/1	5.3	
CLAY, green/grey with orange mottling, homogeneous, soft, moist Colour change at 1.9m to grey Colour change at 2.4m from grey to orange		1.0 1.5 2.0 2.5	TST13/4	5.8 39.6 82.1 5.4	
Silty CLAY, light grey, very soft, moist to wet, slightly plastic Colour change at 3.3m from light grey to dark grey/brown along with a moisture change to moist to dry, and a hardness change to firm		3.0 3.5		1.0 0.7	
CLAY, brown, soft, moist, moderately plastic, homogeneous		4.0	TST13/8	0.6	
END OF TEST PIT AT 4.2m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST13

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST15**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd		LOCATION: Mobil Pakuranga, 102 Pakuranga Road	
DATE: 18/02/2008	DATE BACKFILLED: 18/02/2008	LOGGED BY: RWL	SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.		0.0			
FILL. GRAVEL, angular to subangular, loosely packed, gap graded with 1-10mm gravels and larger >100mm gravelly rubble		0.5			
CLAY, green with orange mottling, soft, wet, plastic, homogeneous Colour change at 1.4m to grey with orange mottling		1.0	TST15/2	× 300	
		1.5		× 3.0	
		2.0		× 1.6	
		2.5		× 1.4	
		3.0		× 0.8	
Sandy CLAY, light grey, soft to moderately firm, dry to moist, moderately plastic		3.5		× 0.5	
		4.0	TST15/8	× 0.5	
END OF TEST PIT AT 4.2m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level:--
Coordinates:

Filename: A02093101_TST15

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST16**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road

DATE: 18/02/2008
DATE BACKFILLED: 18/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
FILL. GRAVEL, angular to subangular, tightly packed, poorly graded (1-20mm)		0.0			
		0.5	TST16/1	× 0.7	
CLAY, orange/brown, soft, wet, moderately plastic, homogeneous		1.0			
		1.5	TST16/2	× 0.6	
END OF TEST PIT AT 1.6m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST16

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST17**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd		LOCATION: Mobil Pakuranga, 102 Pakuranga Road	
DATE: 18/02/2008	DATE BACKFILLED: 18/02/2008	LOGGED BY: RWL	SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
FILL. GRAVEL, angular - subangular, tightly packed, poorly graded (5-10mm)		0.0			
		0.5	TST17/1	0.5	
CLAY, light grey/orange, soft, moist, moderately plastic, homogeneous Colour change at 1.3m from light grey/orange to orange		1.0	TST17/2	0.6	
		1.5		0.3	
END OF TEST PIT AT 1.6m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST17

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST18**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road

DATE: 18/02/2008
DATE BACKFILLED: 18/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
FILL. GRAVEL, angular to subangular, loosely packed, poorly graded (10-25mm)		0.0			
FILL. GRAVEL, subangular, loosely packed, poorly graded (representing 5mm gravels only)		0.5	● TST18/1	× 0.5	
		1.0		× 0.4	
CLAY, orange, soft, moist to wet, moderately plastic, homogeneous		1.5	● TST18/3	× 0.7	
END OF TEST PIT AT 1.6m					

Notes: Excavated by Petroleum Solutions Limited

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST18

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST19**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road
DATE: 14/02/2008
DATE BACKFILLED: 14/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
CONCRETE.		0.0			
FILL. Sandy GRAVEL, subangular to subrounded, loosely packed, well graded (5-25mm)		0.5	TST19/1	1.1	
		1.0	TST19/2	10.6	
CLAY, grey with occasional orange and green mottling, soft, moist, moderately plastic Colour change at 1.5m to grey		1.5	TST19/3	5.4	
		2.0	TST19/4	0.3	

END OF TEST PIT AT 2.0m

Notes: Excavated by Petroleum Solutions Limited

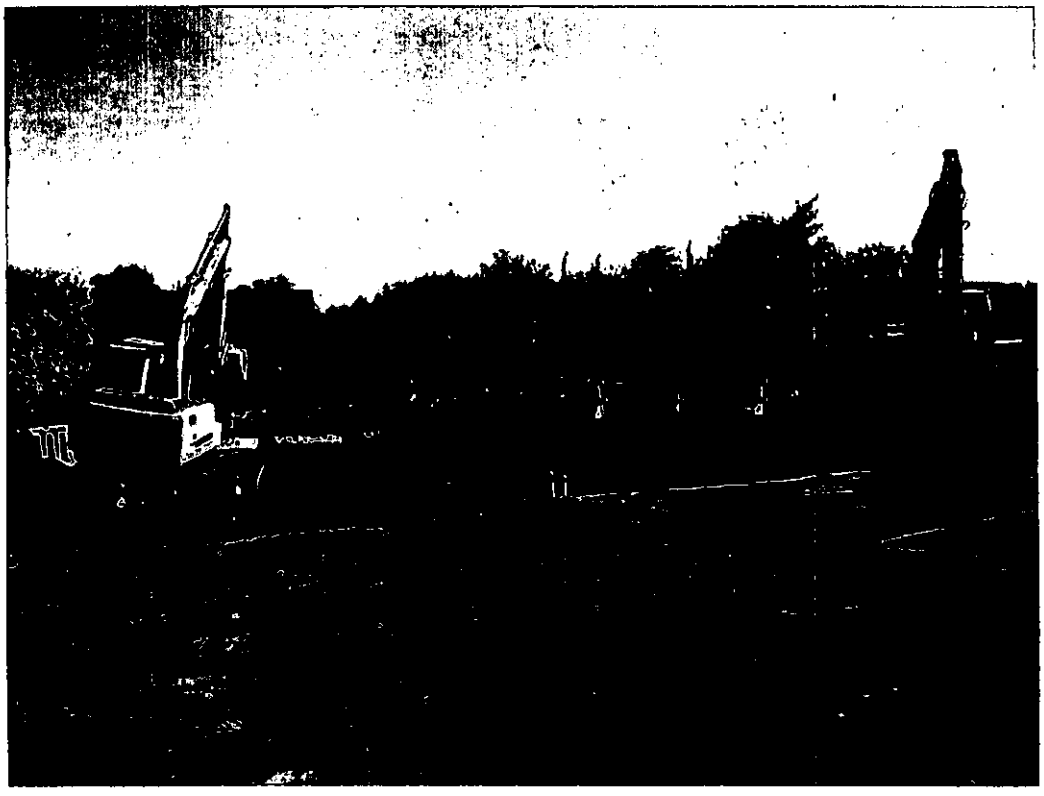
KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

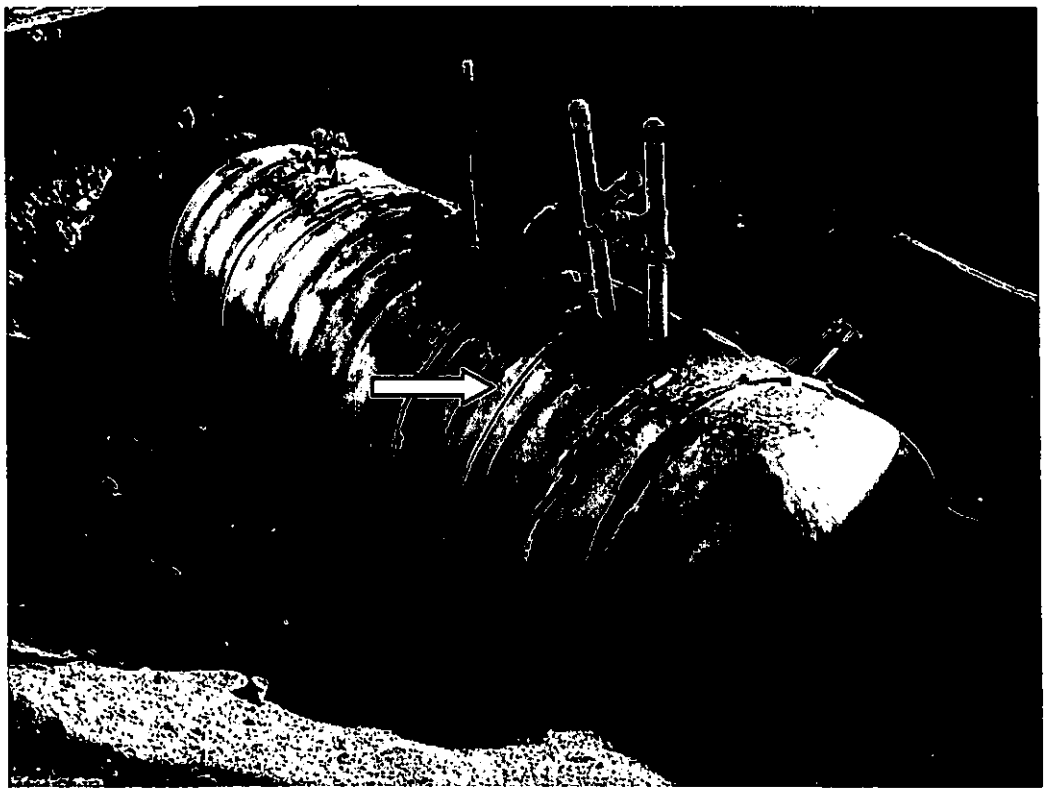
Filename: A02093101_TST04

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

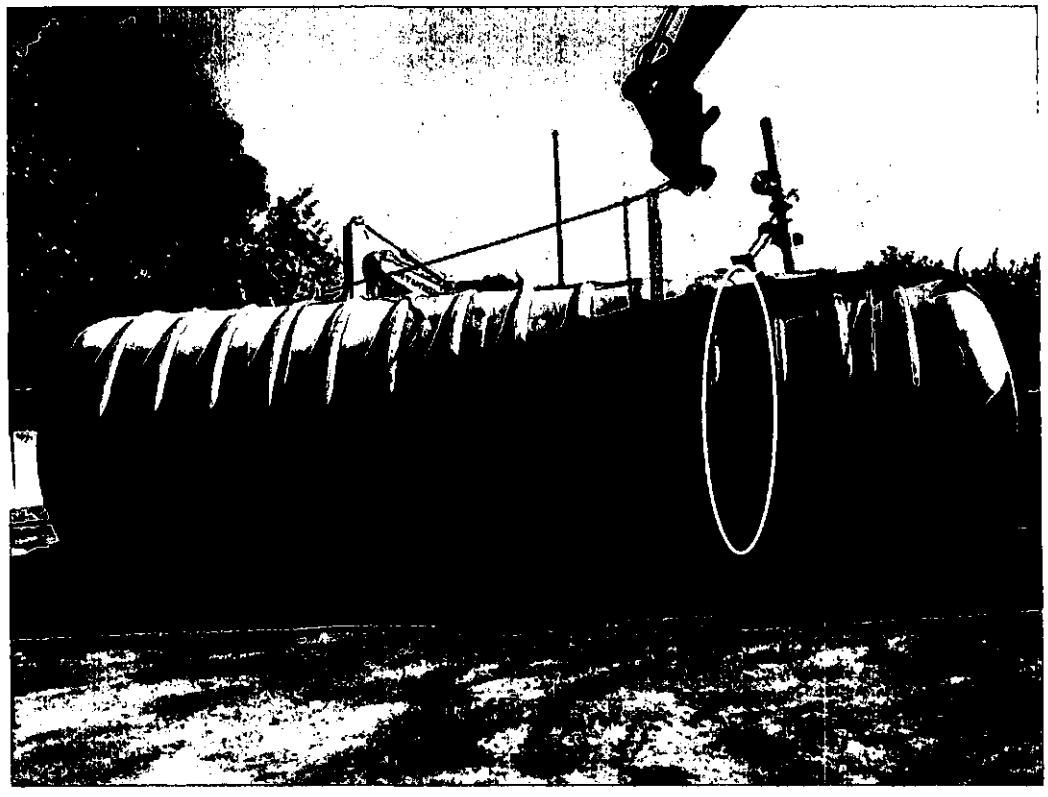
Site Photographs



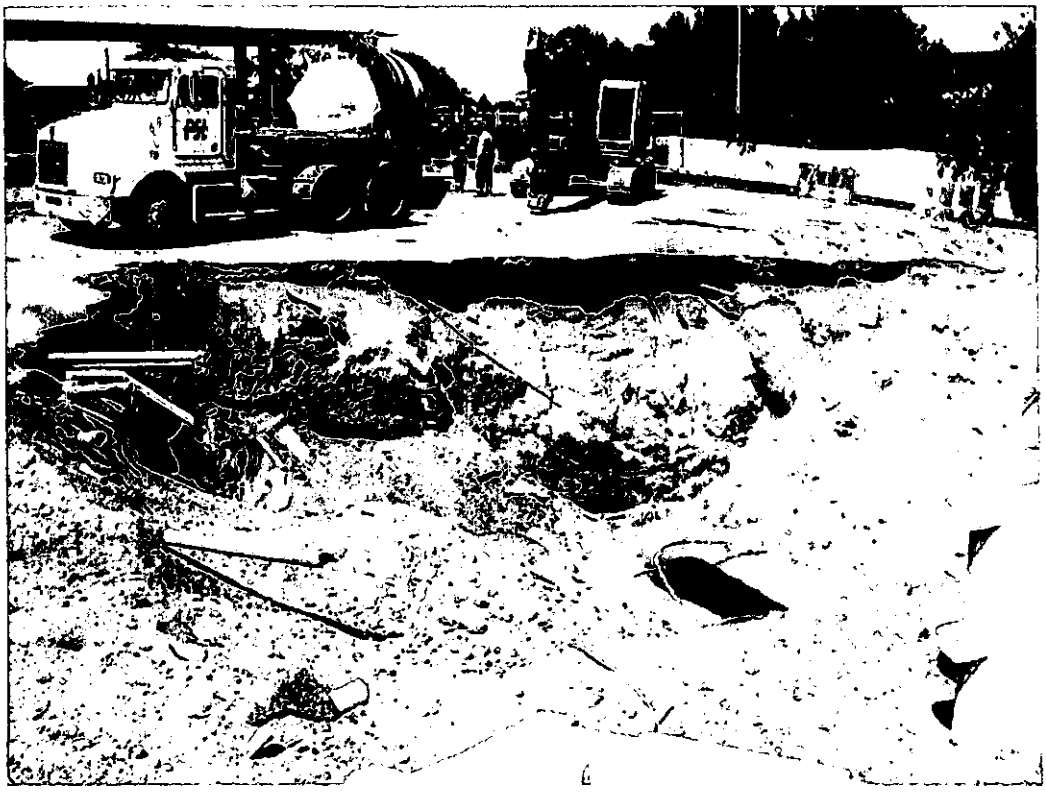
Photograph 1: Looking north. Excavating the tank pit.



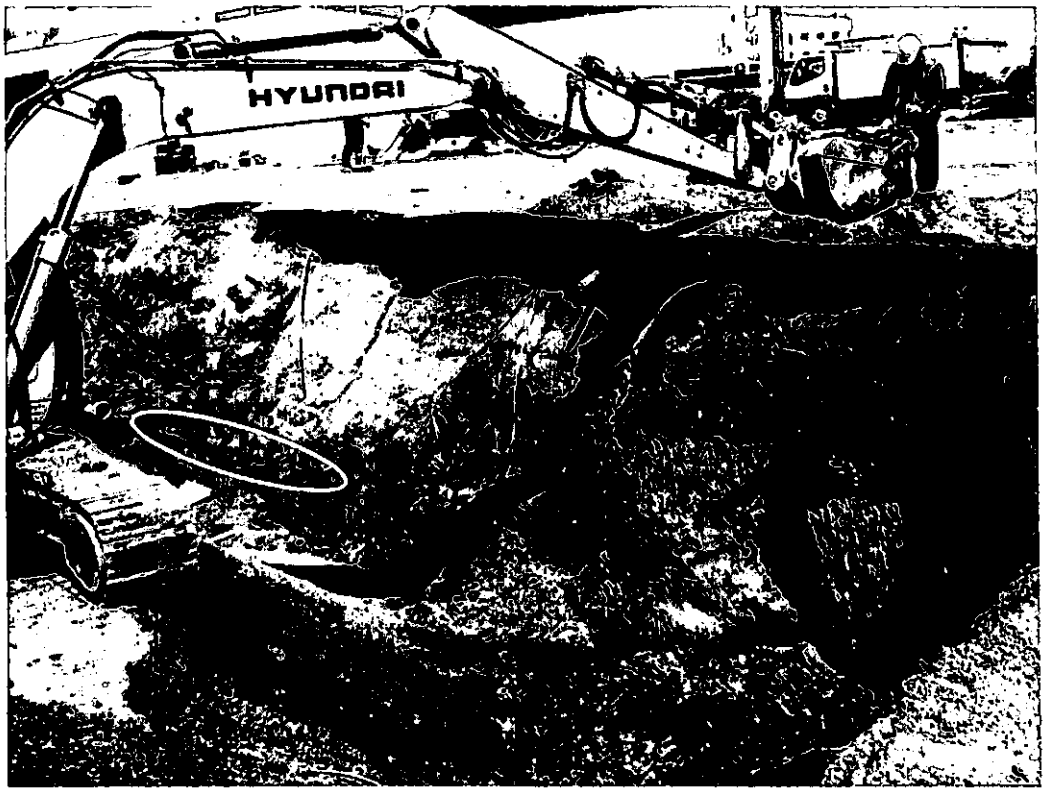
Photograph 2: Tank 3 prior to removal. Note the split in the tank. The water observed to the right of the photograph was standing water within the tank pit.



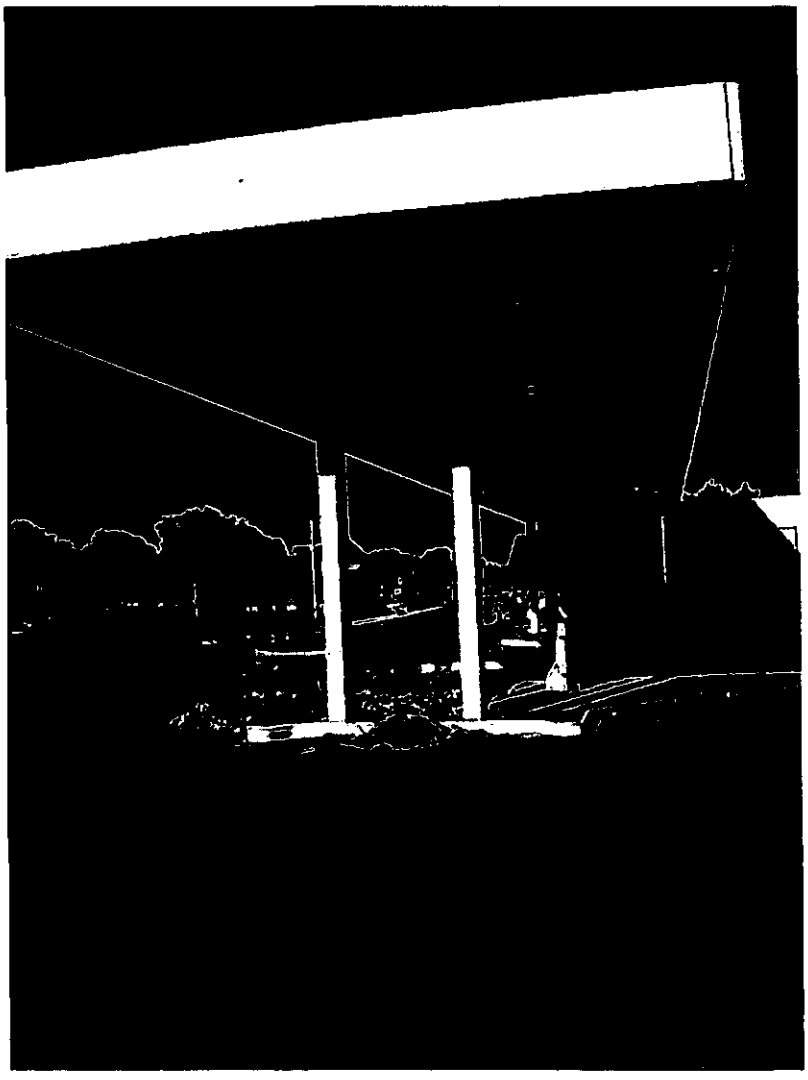
Photograph 3: Tank 3 following removal. The split in the tank is circled.



Photograph 4: The tank pit following the removal of Tank 3. The water within the base of the pit was standing water.



Photograph 5: Collecting soil samples from the southern wall of the tank pit via the excavator bucket. Note the exposed natural geology and the exposed stormwater pipe (circled).



Photograph 6: Looking east during the removal of the fuel lines between dispenser islands 3 and 4.

Ecological Assessment Checklist

Ecological assessment checklist

Tier 1 Ecological Assessment Checklist

Receptor (Non-Human) and Exposure Pathway Identification (adapted from Idaho RBCA Guidance, 1996 and ASTM draft RBCA guidance for Chemical Release Sites, 1997) Site Identification

Site Name: FORMER PAKURANGA S/S	Location 102 PAKURANGA ROAD
Date: 7/02/08	Assessor: RWL.

Background

Product released:	N/A	Approximate date of release:	N/A
Approximate volume of release:	N/A	Geology:	clays + silts
Depth to groundwater:	> 4m	Distance to nearest surface water:	~ 70m.

Identification of receptors

1. Are marshes, swamps, tidal flats or other ecologically sensitive wetlands near[1] the site?	✓
2. Are other aquatic habitats such as rivers, lakes or streams near the site?	✓
3. Are ecologically important marine or estuarine environments near the site?	✓
4. Are ecologically important or sensitive environments such as national parks or nature reserves located near the site?	×
5. Are habitats for rare, threatened or endangered species near the site?	×
6. Are culturally important ecological receptors located the site?	×
7. Are commercially or recreationally important ecological receptors near the site?	✓
8. Are forested, grassland or other habitats of significance located near the site?	×

If a potentially significant ecological receptor has been identified proceed to the exposure pathway analysis.

N/A

[1] "Near" should be judged on a site-specific basis given the likely contaminant's transport by wind, surface run-off or groundwater transport

Exposure pathway analysis

	Receptors		
	1	2	3
1. **Could contaminants reach receptor via groundwater?**	✓		
- Can contaminants leach or dissolve into groundwater?	✓		
- Are contaminants mobile in groundwater?	?		
- Does groundwater discharge into receiving environments such that it can impact on the receptor?	✓		
2. **Could contaminants reach the receptor via the migration of separate phase hydrocarbons?**	?		
- Are separate phase hydrocarbons present at the site?	✗		
- Is the separate phase migrating toward the receptor?	✗		
- Could discharge of separate phase hydrocarbons to a receiving environment occur such that an impact on the receptor may occur?	✓		
3. **Could contaminants reach the receptors via runoff?**	?		
- Are the contaminants present in the surface soil?	?		
- Is the surface soil exposed?	✗		
- Can the contaminants be leached from or eroded with the surface soils?	?		
- Is the receptor downhill from the source?	✓		
4. **Could the receptors come in direct contact with contaminated soil at the site?**	✗		
- Is the receptor located within a contaminated area?	✗		
- Is the contamination present at the surface or otherwise located so that receptors may come in contact with it?	✗		
5. **Are there visible indications of stressed receptors or habitats for ecologically significant receptors at or near the site?**	✗		

If a potentially complete exposure pathway is identified for an ecologically significant receptor, **proceed with more detailed, site-specific assessment (Tier 2).**

Receptor/habitat description

Receptor /habitat	Description
1	Tidal flats, Estuary, Stream : Tamaki Estuary
2	
3	

Observed impacts on ecological receptors or habitats associated with the site

Receptor	Assessment of Impact		
	None	Limited	Significant
On-site vegetation	✓ nothing noted		
Off-site vegetation	✓ nothing noted		
On-site animal life (eg. invertebrates, birds, fish)	✓ birds only		
Off-site animal life (eg. invertebrates, birds, fish)	✓ nothing noted		
Other impacts	✓ no other impacts		

Laboratory Reports

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Pattle Delamore Partners Ltd	**Lab No:**	629497 SPv1
Contact:	Sheridan, Grant	**Date Registered:**	12-Feb-2008
	c/o Pattle Delamore Partners Ltd	**Date Reported:**	15-Feb-2008
	P O Box 9528	**Quote No:**	31582
	Newmarket	**Order No:**	A02093101
	AUCKLAND	**Client Reference:**	A02093101
		Submitted By:	Sheridan, Grant

RECEIVED
19 FEB 2008
BY:

Sample Type: Soil

Sample Name:		TP1/1 08-Feb-2008	TP1/2 08-Feb-2008	TP1/3 08-Feb-2008	TP1/4 08-Feb-2008	TP1/5 08-Feb-2008
Lab Number:		629497.1	629497.2	629497.3	629497.4	629497.5
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	62	72	76	78	77
Benzene	mg/kg dry wt	< 0.075	< 0.061	< 0.055	< 0.054	< 0.055
Toluene	mg/kg dry wt	< 0.075	< 0.061	< 0.055	< 0.054	< 0.055
Ethylbenzene	mg/kg dry wt	< 0.075	< 0.061	0.74	< 0.054	< 0.055
m&p-Xylene	mg/kg dry wt	< 0.15	< 0.13	< 0.11	< 0.11	< 0.11
o-Xylene	mg/kg dry wt	< 0.075	< 0.061	< 0.055	< 0.054	< 0.055
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	62	72	76	78	77
C7 - C9	mg/kg dry wt	< 11	< 9.3	< 9.2	< 8.5	< 8.4
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TP1/6 08-Feb-2008	TP1/7 08-Feb-2008	TP1/8 08-Feb-2008	TP1/9 08-Feb-2008	TP1/10 08-Feb-2008
Lab Number:		629497.6	629497.7	629497.8	629497.9	629497.10
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	72	66	81	73	67
Benzene	mg/kg dry wt	< 0.060	< 0.070	0.14	0.15	< 0.069
Toluene	mg/kg dry wt	< 0.060	< 0.070	0.11	0.26	< 0.069
Ethylbenzene	mg/kg dry wt	< 0.060	< 0.070	0.18	0.13	< 0.069
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.14	0.57	0.59	< 0.14
o-Xylene	mg/kg dry wt	< 0.060	< 0.070	0.28	0.22	< 0.069
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	72	66	81	73	67
C7 - C9	mg/kg dry wt	< 9.5	< 9.9	< 8.8	< 11	< 11
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TP1/11 08-Feb-2008	TP1/12 08-Feb-2008	TP1/13 08-Feb-2008	TP1/14 08-Feb-2008	TP1/15 08-Feb-2008
Lab Number:		629497.11	629497.12	629497.13	629497.14	629497.15
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	75	78	76	78	78
Benzene	mg/kg dry wt	< 0.057	0.12	< 0.056	< 0.054	< 0.053
Toluene	mg/kg dry wt	< 0.057	1.5	< 0.056	< 0.054	< 0.053

Sample Type: Soil						
	Sample Name:	TP1/11 08-Feb-2008	TP1/12 08-Feb-2008	TP1/13 08-Feb-2008	TP1/14 08-Feb-2008	TP1/15 08-Feb-2008
	Lab Number:	629497.11	629497.12	629497.13	629497.14	629497.15
BTEX in Soil by Headspace GC-MS						
Ethylbenzene	mg/kg dry wt	< 0.057	0.45	< 0.056	< 0.054	< 0.053
m&p-Xylene	mg/kg dry wt	0.21	2.2	< 0.12	< 0.11	< 0.11
o-Xylene	mg/kg dry wt	0.13	0.99	< 0.056	< 0.054	< 0.053
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	75	78	76	78	78
C7 - C9	mg/kg dry wt	< 8.7	< 8.8	< 9.5	< 8.5	< 8.8
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	TP1/16 08-Feb-2008	TP1/17 08-Feb-2008	TP1/18 08-Feb-2008	TP1/19 08-Feb-2008	TP1/20 08-Feb-2008
	Lab Number:	629497.16	629497.17	629497.18	629497.19	629497.20
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	71	66	77	65	74
Benzene	mg/kg dry wt	< 0.062	< 0.070	< 0.053	< 0.069	< 0.058
Toluene	mg/kg dry wt	< 0.062	< 0.070	< 0.053	< 0.069	< 0.058
Ethylbenzene	mg/kg dry wt	< 0.062	< 0.070	< 0.053	< 0.069	< 0.058
m&p-Xylene	mg/kg dry wt	< 0.13	< 0.14	< 0.11	< 0.14	< 0.12
o-Xylene	mg/kg dry wt	< 0.062	< 0.070	< 0.053	< 0.069	< 0.058
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	71	66	77	65	74
C7 - C9	mg/kg dry wt	< 11	< 10	< 9.5	< 11	< 9.9
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	TP1/21 08-Feb-2008	TP1/22 08-Feb-2008	TP1/23 08-Feb-2008	TP1/24 08-Feb-2008	TP1/25 08-Feb-2008
	Lab Number:	629497.21	629497.22	629497.23	629497.24	629497.25
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	76	84	72	77	78
Benzene	mg/kg dry wt	< 0.056	< 0.050	< 0.059	< 0.054	< 0.054
Toluene	mg/kg dry wt	< 0.056	< 0.050	< 0.059	< 0.054	< 0.054
Ethylbenzene	mg/kg dry wt	< 0.056	< 0.050	< 0.059	< 0.054	< 0.054
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.10	< 0.12	< 0.11	< 0.11
o-Xylene	mg/kg dry wt	< 0.056	< 0.050	< 0.059	< 0.054	< 0.054
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	76	84	72	77	78
C7 - C9	mg/kg dry wt	< 9.6	< 8.2	< 11	< 9.1	< 9.6
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	TP1/26 08-Feb-2008	TP1/27 08-Feb-2008	TP1/28 08-Feb-2008	TP1/29 08-Feb-2008	TP1/30 08-Feb-2008
	Lab Number:	629497.26	629497.27	629497.28	629497.29	629497.30
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	81	61	80	66	77
Benzene	mg/kg dry wt	< 0.050	< 0.076	< 0.052	< 0.068	< 0.054
Toluene	mg/kg dry wt	< 0.050	< 0.076	< 0.052	< 0.068	< 0.054
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.076	< 0.052	< 0.068	< 0.054
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.16	0.93	< 0.14	< 0.11
o-Xylene	mg/kg dry wt	< 0.050	< 0.076	< 0.052	< 0.068	< 0.054

Sample Type: Soil

Sample Name:		TP1/26 08-Feb-2008	TP1/27 08-Feb-2008	TP1/28 08-Feb-2008	TP1/29 08-Feb-2008	TP1/30 08-Feb-2008
Lab Number:		629497.26	629497.27	629497.28	629497.29	629497.30
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	81	61	80	66	77
C7 - C9	mg/kg dry wt	< 9.1	< 11	< 8.8	< 9.9	< 8.9
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TP1/31 08-Feb-2008	TP1/32 08-Feb-2008	TP1/33 08-Feb-2008	TP1/34 08-Feb-2008	TP1/35 08-Feb-2008
Lab Number:		629497.31	629497.32	629497.33	629497.34	629497.35
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	75	74	84	70	73
Benzene	mg/kg dry wt	< 0.056	< 0.058	< 0.050	< 0.063	< 0.059
Toluene	mg/kg dry wt	< 0.056	< 0.058	< 0.050	< 0.063	< 0.059
Ethylbenzene	mg/kg dry wt	< 0.056	< 0.058	< 0.050	< 0.063	< 0.059
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.12	< 0.10	< 0.13	< 0.12
o-Xylene	mg/kg dry wt	< 0.056	< 0.058	< 0.050	< 0.063	< 0.059
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	75	74	84	70	73
C7 - C9	mg/kg dry wt	< 9.2	< 8.8	< 8.8	< 9.9	< 9.2
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TP1/36 08-Feb-2008	TP1/37 08-Feb-2008	TP1/38 08-Feb-2008	TP1/39 08-Feb-2008	TP1/40 08-Feb-2008
Lab Number:		629497.36	629497.37	629497.38	629497.39	629497.40
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	73	81	78	72	71
Benzene	mg/kg dry wt	< 0.057	< 0.050	< 0.053	< 0.061	< 0.060
Toluene	mg/kg dry wt	< 0.057	< 0.050	< 0.053	< 0.061	< 0.060
Ethylbenzene	mg/kg dry wt	< 0.057	< 0.050	< 0.053	< 0.061	< 0.060
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.10	< 0.11	< 0.13	< 0.12
o-Xylene	mg/kg dry wt	< 0.057	< 0.050	< 0.053	< 0.061	< 0.060
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	73	81	78	72	71
C7 - C9	mg/kg dry wt	< 8.7	< 9.0	< 9.6	< 9.0	< 11
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TP1/41 08-Feb-2008	TP1 BF1 08-Feb-2008	TP1 BF2 08-Feb-2008	TP1 BF3 08-Feb-2008	TP1 BF4 08-Feb-2008
Lab Number:		629497.41	629497.83	629497.84	629497.85	629497.86
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	60	92	96	97	97
Benzene	mg/kg dry wt	2.4	< 0.050	< 0.050	< 0.050	< 0.050
Toluene	mg/kg dry wt	4.0	< 0.050	< 0.050	< 0.050	< 0.050
Ethylbenzene	mg/kg dry wt	5.8	< 0.050	< 0.050	< 0.050	< 0.050
m&p-Xylene	mg/kg dry wt	19	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	4.6	< 0.050	< 0.050	< 0.050	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	60	92	96	97	97
C7 - C9	mg/kg dry wt	39	< 8.0	< 8.0	< 8.0	< 8.0
C10 - C14	mg/kg dry wt	110	< 20	< 20	< 20	< 20

Sample Type: Soil						
Sample Name:		TP1/41	TP1 BF1	TP1 BF2	TP1 BF3	TP1 BF4
		08-Feb-2008	08-Feb-2008	08-Feb-2008	08-Feb-2008	08-Feb-2008
Lab Number:		629497.41	629497.83	629497.84	629497.85	629497.86
Total Petroleum Hydrocarbons in Soil						
C15 - C36	mg/kg dry wt	220	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	370	< 60	< 60	< 60	< 60

Sample Name:		TP1 BF5				
		08-Feb-2008				
Lab Number:		629497.87				
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	96	-	-	-	-
Benzene	mg/kg dry wt	< 0.050	-	-	-	-
Toluene	mg/kg dry wt	< 0.050	-	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.050	-	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	-	-	-	-
o-Xylene	mg/kg dry wt	< 0.050	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	96	-	-	-	-
C7 - C9	mg/kg dry wt	< 8.0	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 30	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	-	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

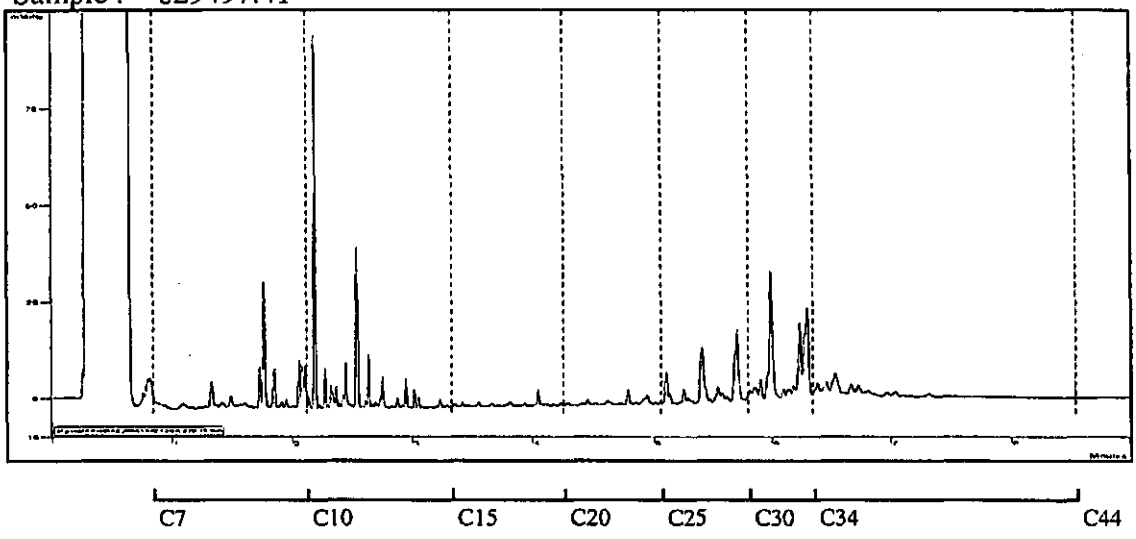
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
BTEX in Soil by Headspace GC-MS*	Solvent extraction, Headspace GC-MS analysis	-	1-41, 83-87
Total Petroleum Hydrocarbons in Soil*	Sonication extraction, Silica cleanup, GC-FID analysis	-	1-41, 83-87
Dry Matter (Org)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1-41, 83-87

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.

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

Sample : 629497.41



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ANALYSIS REPORT

Client:	Pattle Delamore Partners Ltd	**Lab No:**	630362 SPv1
Contact:	Lidgard, Rod	**Date Registered:**	14-Feb-2008
	Pattle Delamore Partners Limited	**Date Reported:**	19-Feb-2008
	PO Box 9528	**Quote No:**	31582
	Newmarket, Auckland	**Order No:**	
		Client Reference:	A02093101
		Submitted By:	Lidgard, Rod

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Sample Type: Soil

Sample Name:		FL1 12-Feb-2008	FL2 12-Feb-2008	FL3 12-Feb-2008	FL4 12-Feb-2008	FL5 12-Feb-2008
Lab Number:		630362.1	630362.2	630362.3	630362.4	630362.5
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	99	71	94	93	95
Benzene	mg/kg dry wt	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050
Toluene	mg/kg dry wt	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.13	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.050	< 0.062	< 0.050	< 0.050	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	99	71	94	93	95
C7 - C9	mg/kg dry wt	< 8.0	< 9.3	< 8.0	< 8.0	< 8.0
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		FL6 12-Feb-2008	FL10 12-Feb-2008	FL13 12-Feb-2008	FL14 12-Feb-2008	FL15 12-Feb-2008
Lab Number:		630362.6	630362.13	630362.15	630362.16	630362.17
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	94	96	78	73	76
Benzene	mg/kg dry wt	< 0.050	< 0.050	0.18	< 0.060	0.33
Toluene	mg/kg dry wt	< 0.050	< 0.050	< 0.053	< 0.060	< 0.055
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.050	0.21	< 0.060	0.19
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	0.25	< 0.12	0.30
o-Xylene	mg/kg dry wt	< 0.050	< 0.050	< 0.053	< 0.060	< 0.055
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	94	96	78	73	76
C7 - C9	mg/kg dry wt	< 8.0	21	< 8.5	< 9.9	< 8.5
C10 - C14	mg/kg dry wt	< 20	26	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	900	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	940	< 60	< 60	< 60

Sample Name:		FL16 12-Feb-2008	FL25 12-Feb-2008	FL26 12-Feb-2008	FL27 12-Feb-2008	FL28 12-Feb-2008
Lab Number:		630362.18	630362.23	630362.24	630362.25	630362.26
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	76	72	80	70	75
Benzene	mg/kg dry wt	< 0.056	< 0.060	< 0.051	< 0.063	< 0.056
Toluene	mg/kg dry wt	< 0.056	< 0.060	< 0.051	< 0.063	< 0.056

Sample Type: Soil						
	Sample Name:	FL16 12-Feb-2008	FL25 12-Feb-2008	FL26 12-Feb-2008	FL27 12-Feb-2008	FL28 12-Feb-2008
	Lab Number:	630362.18	630362.23	630362.24	630362.25	630362.26
BTEX in Soil by Headspace GC-MS						
Ethylbenzene	mg/kg dry wt	< 0.056	< 0.060	< 0.051	< 0.063	< 0.056
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.12	< 0.11	< 0.13	< 0.12
o-Xylene	mg/kg dry wt	< 0.056	< 0.060	< 0.051	< 0.063	< 0.056
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	76	72	80	70	75
C7 - C9	mg/kg dry wt	< 9.0	< 9.2	< 8.5	< 9.3	< 8.5
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	FL29 12-Feb-2008	FL30 12-Feb-2008	FL19 12-Feb-2008	FL20 12-Feb-2008	
	Lab Number:	630362.27	630362.28	630362.35	630362.36	
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	75	68	70	72	-
Benzene	mg/kg dry wt	< 0.057	< 0.066	< 0.062	< 0.062	-
Toluene	mg/kg dry wt	< 0.057	< 0.066	< 0.062	< 0.062	-
Ethylbenzene	mg/kg dry wt	< 0.057	< 0.066	< 0.062	< 0.062	-
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.14	< 0.13	< 0.13	-
o-Xylene	mg/kg dry wt	< 0.057	< 0.066	< 0.062	< 0.062	-
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	75	68	70	72	-
C7 - C9	mg/kg dry wt	< 8.6	< 9.6	< 9.7	< 8.9	-
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
BTEX in Soil by Headspace GC-MS*	Solvent extraction, Headspace GC-MS analysis	-	1-6, 13, 15-18, 23-28, 35-36
Total Petroleum Hydrocarbons in Soil*	Sonication extraction, Silica cleanup, GC-FID analysis	-	1-6, 13, 15-18, 23-28, 35-36
Dry Matter (Org)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1-6, 13, 15-18, 23-28, 35-36

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

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

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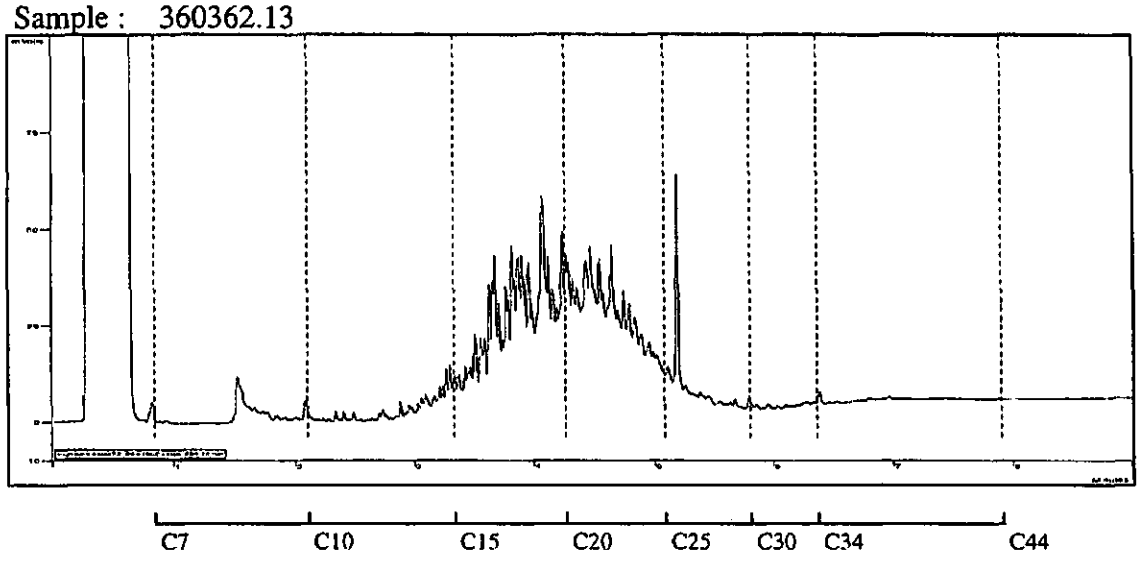
Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

Sample : 360362.13



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ANALYSIS REPORT

Client:	Pattle Delamore Partners Ltd	**Lab No:**	630639	SPv1
Contact:	Lidgard, Rod	**Date Registered:**	16-Feb-2008	
	Pattle Delamore Partners Limited	**Date Reported:**	22-Feb-2008	
	PO Box 9528	**Quote No:**		
	Newmarket, Auckland	**Order No:**		
		Client Reference:	A02093101	
		Submitted By:	Lidgard, Rod	

RECEIVED 26 FEB 2008 BY:

Sample Type: Soil

Sample Name:		TST1/1 13-Feb-2008	TST1/4 13-Feb-2008	TST2/1 13-Feb-2008	TST2/4 13-Feb-2008	TST5/1 13-Feb-2008
Lab Number:		630639.1	630639.2	630639.3	630639.4	630639.5
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	95	76	96	68	96
Benzene	mg/kg dry wt	< 0.050	< 0.055	< 0.050	< 0.065	< 0.050
Toluene	mg/kg dry wt	< 0.050	< 0.055	< 0.050	< 0.065	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.055	< 0.050	< 0.065	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.11	< 0.10	< 0.13	< 0.10
o-Xylene	mg/kg dry wt	< 0.050	< 0.055	< 0.050	< 0.065	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	95	76	96	68	96
C7 - C9	mg/kg dry wt	< 8.0	< 8.6	< 8.0	< 9.3	< 8.0
C10 - C14	mg/kg dry wt	< 20	33	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TST5/7 13-Feb-2008	FL18 13-Feb-2008	FL22 13-Feb-2008	FL23 13-Feb-2008	FL31 13-Feb-2008
Lab Number:		630639.6	630639.41	630639.42	630639.43	630639.44
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	81	74	80	67	81
Benzene	mg/kg dry wt	< 0.051	< 0.059	< 0.052	< 0.065	< 0.050
Toluene	mg/kg dry wt	< 0.051	< 0.059	< 0.052	< 0.065	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.051	< 0.059	< 0.052	< 0.065	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.11	< 0.12	< 0.11	< 0.13	< 0.10
o-Xylene	mg/kg dry wt	< 0.051	< 0.059	< 0.052	< 0.065	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	81	74	80	67	81
C7 - C9	mg/kg dry wt	< 8.5	< 9.6	< 8.2	< 11	< 8.4
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		FL32 13-Feb-2008	FL33 13-Feb-2008	FL34 13-Feb-2008	TST6/8 13-Feb-2008	TST1/8 13-Feb-2008
Lab Number:		630639.45	630639.46	630639.47	630639.55	630639.56
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	79	80	75	77	56
Benzene	mg/kg dry wt	< 0.050	< 0.050	< 0.057	< 0.053	< 0.085
Toluene	mg/kg dry wt	< 0.050	< 0.050	< 0.057	0.19	< 0.085

Sample Type: Soil						
	Sample Name:	FL32 13-Feb-2008	FL33 13-Feb-2008	FL34 13-Feb-2008	TST6/8 13-Feb-2008	TST1/8 13-Feb-2008
	Lab Number:	630639.45	630639.46	630639.47	630639.55	630639.56
BTEX in Soil by Headspace GC-MS						
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.050	< 0.057	0.058	< 0.085
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.12	0.17	< 0.17
o-Xylene	mg/kg dry wt	< 0.050	< 0.050	< 0.057	0.10	< 0.085
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	79	80	75	77	56
C7 - C9	mg/kg dry wt	< 8.4	< 9.3	< 9.4	< 8.6	< 13
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	190
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	180

	Sample Name:	TST8/1 13-Feb-2008	TST8/2 13-Feb-2008	TST8/7 13-Feb-2008	TST3/1 13-Feb-2008	TST3/3 13-Feb-2008
	Lab Number:	630639.57	630639.58	630639.59	630639.71	630639.72
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	74	71	79	95	94
Benzene	mg/kg dry wt	3.1	3.8	< 0.052	< 0.050	< 0.050
Toluene	mg/kg dry wt	23	30	< 0.052	< 0.050	< 0.050
Ethylbenzene	mg/kg dry wt	11	15	< 0.052	< 0.050	< 0.050
m&p-Xylene	mg/kg dry wt	53	75	0.14	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	17	23	< 0.052	< 0.050	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	74	71	79	95	94
C7 - C9	mg/kg dry wt	160	170	< 8.9	< 8.0	19
C10 - C14	mg/kg dry wt	96	150	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	260	330	< 60	< 60	< 60

	Sample Name:	TST4/1 13-Feb-2008	TST4/4 13-Feb-2008	TST6/1 13-Feb-2008	TST6/2 13-Feb-2008	TST6/6 13-Feb-2008
	Lab Number:	630639.81	630639.82	630639.91	630639.92	630639.93
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	80	69	96	80	79
Benzene	mg/kg dry wt	< 0.050	< 0.065	< 0.050	< 0.051	< 0.050
Toluene	mg/kg dry wt	< 0.050	< 0.065	0.079	4.6	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.065	0.10	1.4	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.13	0.58	7.0	< 0.10
o-Xylene	mg/kg dry wt	< 0.050	< 0.065	2.2	2.7	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	80	69	96	80	79
C7 - C9	mg/kg dry wt	12	< 10	9.9	39	32
C10 - C14	mg/kg dry wt	110	< 20	< 20	340	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	600	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	140	< 60	< 60	980	< 60

	Sample Name:	TST7/1 13-Feb-2008	TST7/4 13-Feb-2008	TST7/7 13-Feb-2008	TST9/1 14-Feb-2008	TST9/2 14-Feb-2008
	Lab Number:	630639.105	630639.106	630639.107	630639.119	630639.120
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	95	73	71	95	85
Benzene	mg/kg dry wt	< 0.050	< 0.058	< 0.061	< 0.050	< 0.050
Toluene	mg/kg dry wt	< 0.050	< 0.058	< 0.061	< 0.050	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.058	< 0.061	< 0.050	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.12	< 0.13	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.050	< 0.058	< 0.061	< 0.050	< 0.050

Sample Type: Soil						
	Sample Name:	TST7/1 13-Feb-2008	TST7/4 13-Feb-2008	TST7/7 13-Feb-2008	TST9/1 14-Feb-2008	TST9/2 14-Feb-2008
	Lab Number:	630639.105	630639.106	630639.107	630639.119	630639.120
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	95	73	71	95	85
C7 - C9	mg/kg dry wt	11	< 9.7	18	< 8.0	< 8.0
C10 - C14	mg/kg dry wt	< 20	91	360	< 20	25
C15 - C36	mg/kg dry wt	370	150	630	< 30	58
Total hydrocarbons (C7 - C36)	mg/kg dry wt	390	250	1000	< 60	88

	Sample Name:	TST9/8 14-Feb-2008	TST10/8 14-Feb-2008	TST10/3 14-Feb-2008	TST10/7 14-Feb-2008	
	Lab Number:	630639.121	630639.122	630639.123	630639.124	
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	68	94	68	72	-
Benzene	mg/kg dry wt	< 0.066	< 0.050	< 0.065	< 0.058	-
Toluene	mg/kg dry wt	< 0.066	< 0.050	< 0.065	< 0.058	-
Ethylbenzene	mg/kg dry wt	< 0.066	< 0.050	< 0.065	< 0.058	-
m&p-Xylene	mg/kg dry wt	< 0.14	< 0.10	< 0.13	< 0.12	-
o-Xylene	mg/kg dry wt	< 0.066	< 0.050	< 0.065	< 0.058	-
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	68	94	68	72	-
C7 - C9	mg/kg dry wt	< 9.9	< 8.0	< 11	< 9.5	-
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.3 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.4 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
BTEX in Soil by Headspace GC-MS*	Solvent extraction, Headspace GC-MS analysis	-	1-6, 41-47, 55-59, 71-72, 81-82, 91-93, 105-107, 119-124
Total Petroleum Hydrocarbons in Soil*	Sonication extraction, Silica cleanup, GC-FID analysis	-	1-6, 41-47, 55-59, 71-72, 81-82, 91-93, 105-107, 119-124
Dry Matter (Org)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1-6, 41-47, 55-59, 71-72, 81-82, 91-93, 105-107, 119-124

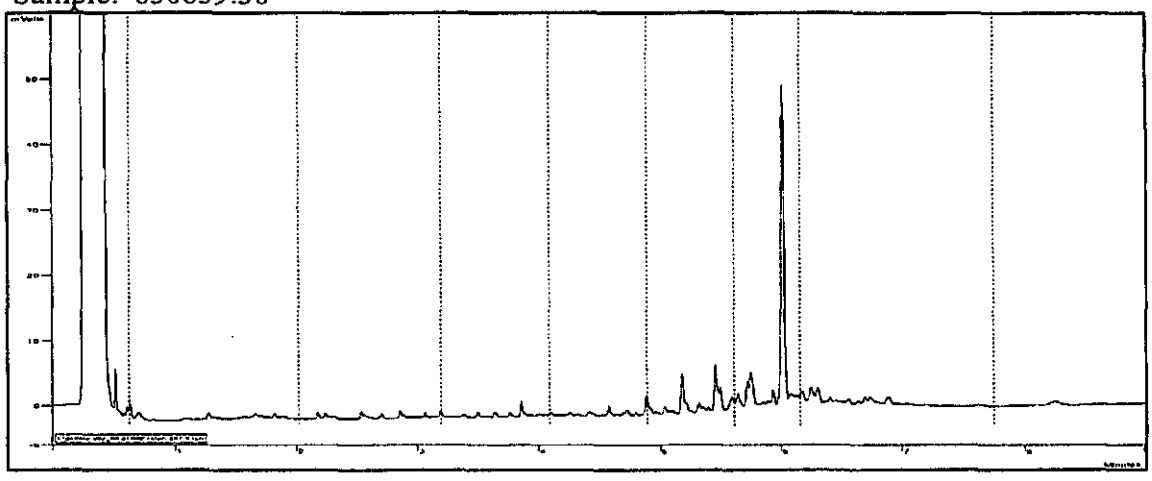
These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

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.

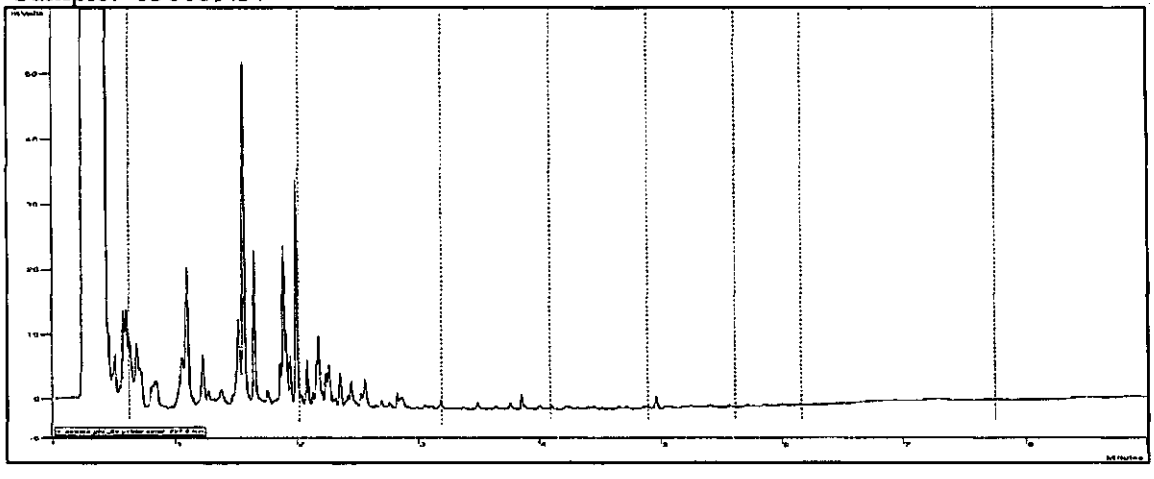
This report must not be reproduced, except in full, without the written consent of the signatory.

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

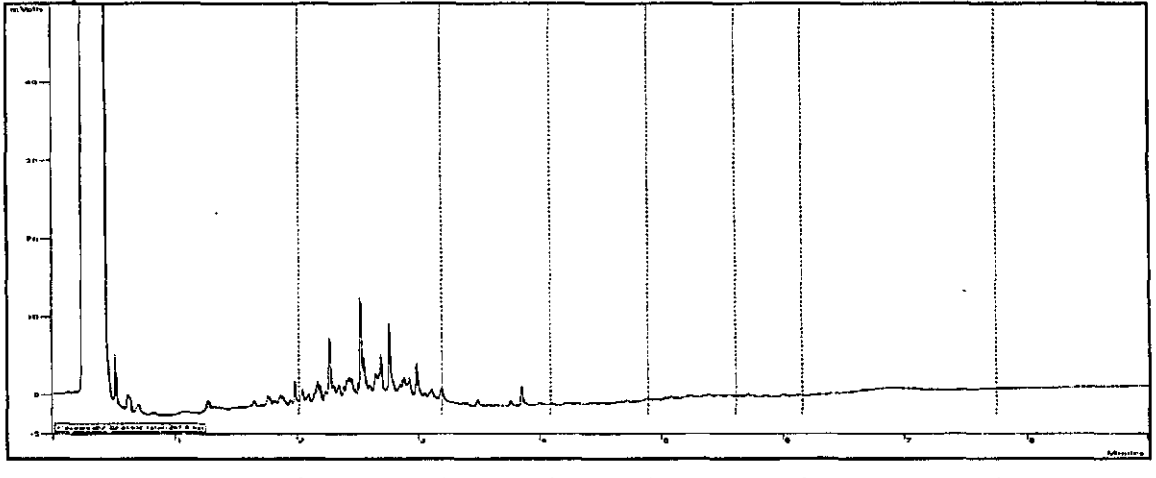
Sample: 630639.56



Sample: 630639.57

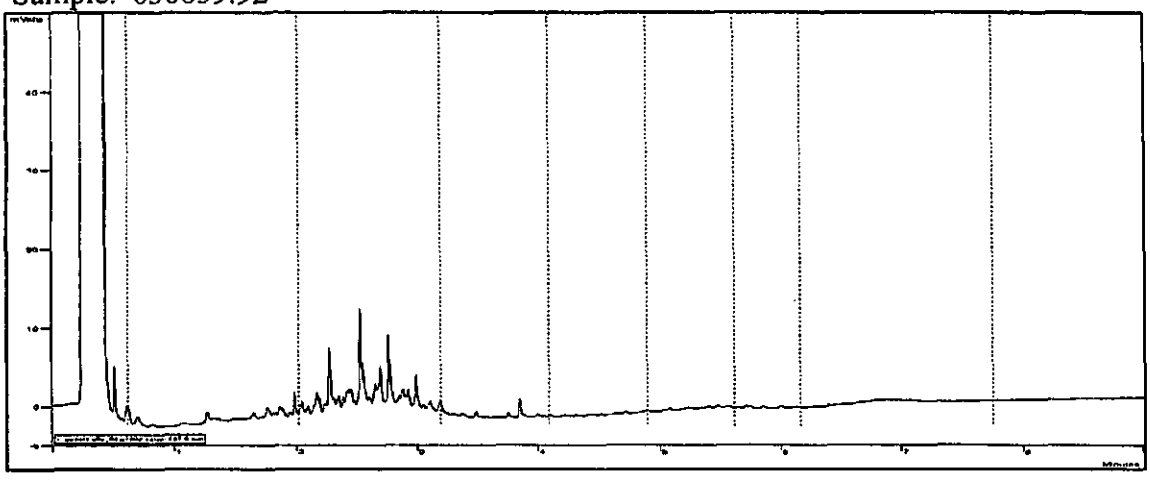


Sample: 630639.81

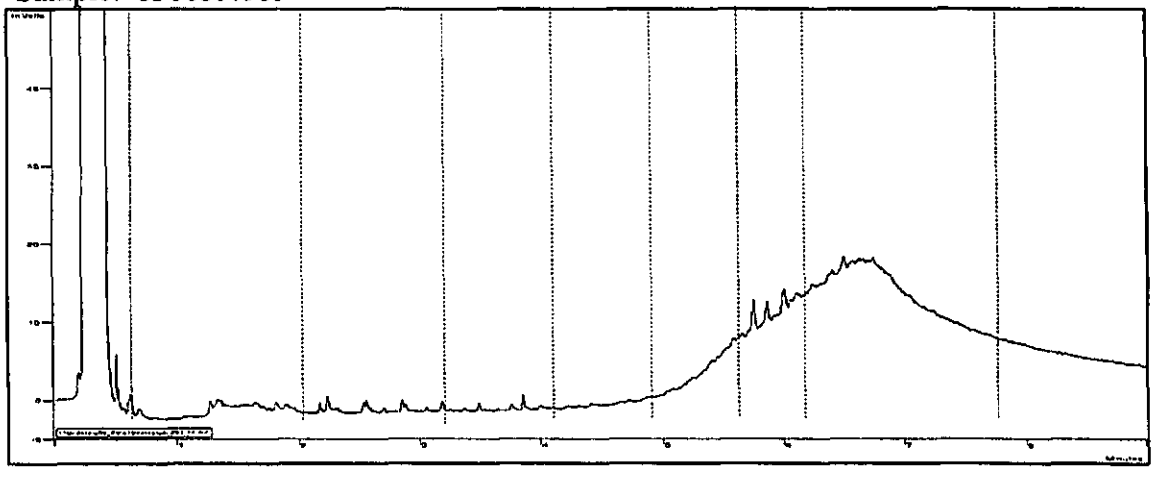


C7 C10 C15 C20 C25 C30 C34 C44

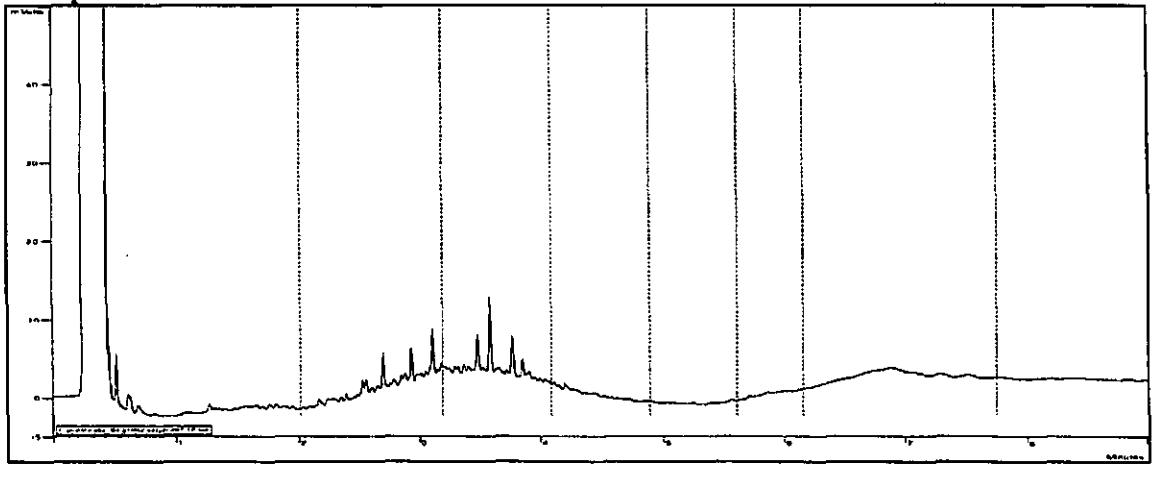
Sample: 630639.92



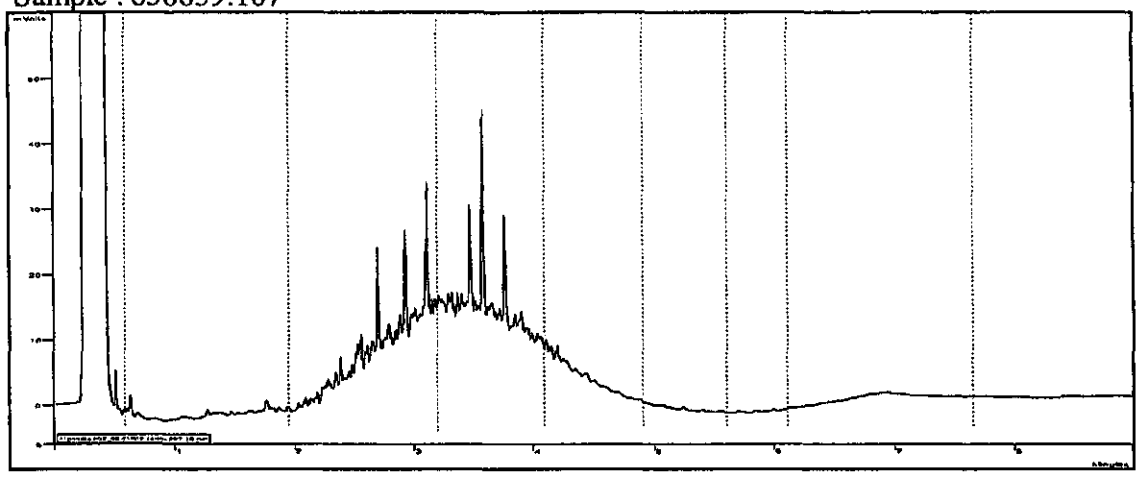
Sample: 630639.103

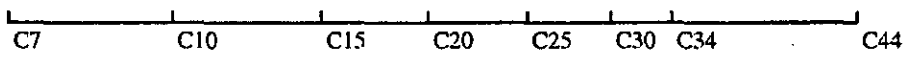


Sample: 630639.106



Sample : 630639.107





PATTLE DELAMORE PARTNERS LTD

LOG OF TANK PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TP1**

JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd

LOCATION: Mobil Pakuranga, 102 Pakuranga Road

DATE: 8/02/2008

DATE BACKFILLED: 8/02/2008

LOGGED BY: RWL

SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
CONCRETE		0.0			
Silty CLAY; light grey with orange mottling. Moist; stiff to firm		0.5	*various	*various	
			TP1/1	0.2	
		1.0			
		1.5			
		2.0			
		2.5			
			TP1/33	0.1	
		3.0	*various	*various	
			TP1/15	0.3	
Sandy CLAY; orange/grey. Moist; soft		3.5			
		4.0			
			TP1/28	6.8	
			*various	*various	
			*various	*various	
CLAY; dark brown. Moist; firm to stiff			TP1/41	66.3	
		4.5	TP1/3	11.6	
END OF TANK PIT AT 4.5m					

Notes: Excavated by Petroleum Solutions Limited

The geological log is taken from the northern wall of the tank pit.

* Refer to Table 1 for samples collected and PID readings.

KEY

- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST01

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

PATTLE DELAMORE PARTNERS LTD

LOG OF TEST PIT
Mobil Pakuranga - Tank Removal

PIT NO. **TST1**
JOB NO: A02093101

CLIENT: Mobil Oil NZ Ltd
LOCATION: Mobil Pakuranga, 102 Pakuranga Road
DATE: 13/02/2008
DATE BACKFILLED: 13/02/2008
LOGGED BY: RWL
SHEET 1 OF 1

DESCRIPTION OF SOIL	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
ASPHALT.	0.0			
FILL. Sandy GRAVEL; angular - subangular, loosely packed, poorly graded (5-10mm) coarsening down to poorly graded (<300mm) gravelly rubble	0.5	TST1/1	8.6	
	1.0		76.2	
FILL. CLAY with occassional concrete boulders (< 500mm), brown/grey, homogeneous, soft, moist, moderately plastic with occassional broken pipe-work, and steel fragments. Colour change at 2.9m from brown/grey to green	1.5		141	
	2.0	TST1/4	597	
	2.5		404	
	3.0		401	
	3.5		60	
	4.0			
CLAY, black/brown, homogeneous, soft, moist, moderately plastic		TST1/8	7.4	
END OF TEST PIT AT 4.3m				

Notes: Excavated by Petroleum Solutions Limited

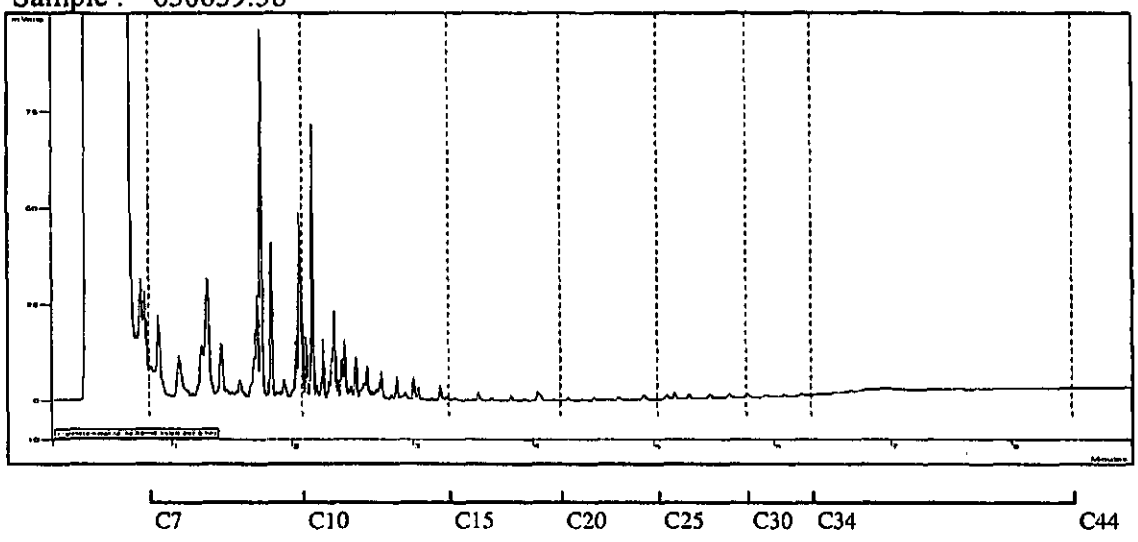
KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Excavator
Datum:
Ground Level: --
Coordinates:

Filename: A02093101_TST01

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

Sample : 630639.58



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ANALYSIS REPORT

Client:	Pattle Delamore Partners Ltd	**Lab No:**	631051 SPv1
Contact:	Meakin, Chris	**Date Registered:**	20-Feb-2008
	c/o Pattle Delamore Partners Ltd	**Date Reported:**	28-Feb-2008
	P O Box 9528	**Quote No:**	
	Newmarket	**Order No:**	
	AUCKLAND	**Client Reference:**	A02093101
		Submitted By:	Lidgard, Rod

RECEIVED
3 MAR 2008
BY:

Sample Type: Soil

Sample Name:		TST11/1 ✓ 18-Feb-2008	TST11/3 ✓ 18-Feb-2008	TST11/4 ✓ 18-Feb-2008	TST11/7 ✓ 18-Feb-2008	TST11/8 ✓ 18-Feb-2008
Lab Number:		631051.1	631051.2	631051.3	631051.4	631051.5
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	96	94	95	60	75
Benzene	mg/kg dry wt	< 0.050	< 0.050	< 0.050	< 0.079	< 0.057
Toluene	mg/kg dry wt	< 0.050	< 0.050	< 0.050	< 0.079	< 0.057
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.050	< 0.050	0.62	< 0.057
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	2.5	< 0.12
o-Xylene	mg/kg dry wt	< 0.050	< 0.050	< 0.050	0.33	< 0.057
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	96	94	95	60	75
C7 - C9	mg/kg dry wt	< 8.0	< 8.0	< 8.0	14	14
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

Sample Name:		TST11/9 ✓ 18-Feb-2008	TST11/10 ✓ 18-Feb-2008	TST11/11 ✓ 18-Feb-2008	TST12/1 ✓ 18-Feb-2008	TST12/2 ✓ 18-Feb-2008
Lab Number:		631051.6	631051.7	631051.8	631051.23	631051.24
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	-	-	< 2.0	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	-	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	-	-	-	43	-
Total Recoverable Copper	mg/kg dry wt	-	-	-	58	-
Total Recoverable Lead	mg/kg dry wt	-	-	-	2.1	-
Total Recoverable Nickel	mg/kg dry wt	-	-	-	190	-
Total Recoverable Zinc	mg/kg dry wt	-	-	-	53	-
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	73	76	93	96	76
Benzene	mg/kg dry wt	< 0.058	< 0.056	< 0.050	< 0.050	< 0.055
Toluene	mg/kg dry wt	< 0.058	< 0.056	< 0.050	< 0.050	< 0.055
Ethylbenzene	mg/kg dry wt	< 0.058	< 0.056	< 0.050	< 0.050	< 0.055
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.12	< 0.10	< 0.10	< 0.11
o-Xylene	mg/kg dry wt	< 0.058	< 0.056	< 0.050	< 0.050	< 0.055
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	73	76	93	96	76
C7 - C9	mg/kg dry wt	< 9.0	< 8.5	< 8.0	< 8.0	< 9.7
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	47
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	210	< 30

Sample Type: Soil						
	Sample Name:	TST11/9 18-Feb-2008	TST11/10 18-Feb-2008	TST11/11 18-Feb-2008	TST12/1 18-Feb-2008	TST12/2 18-Feb-2008
	Lab Number:	631051.6	631051.7	631051.8	631051.23	631051.24
Total Petroleum Hydrocarbons in Soil						
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	210	< 60

	Sample Name:	TST12/8 18-Feb-2008	TST15/2 18-Feb-2008	TST15/8 18-Feb-2008	TST16/1 18-Feb-2008	TST16/2 18-Feb-2008
	Lab Number:	631051.25	631051.39	631051.40	631051.53	631051.54
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	78	79	71	95	68
Benzene	mg/kg dry wt	< 0.053	< 0.051	< 0.060	< 0.050	< 0.064
Toluene	mg/kg dry wt	< 0.053	< 0.051	< 0.060	< 0.050	< 0.064
Ethylbenzene	mg/kg dry wt	< 0.053	< 0.051	< 0.060	< 0.050	< 0.064
m&p-Xylene	mg/kg dry wt	< 0.11	< 0.11	< 0.12	< 0.10	< 0.13
o-Xylene	mg/kg dry wt	< 0.053	< 0.051	< 0.060	< 0.050	< 0.064
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	78	79	71	95	68
C7 - C9	mg/kg dry wt	< 8.0	< 8.6	< 9.2	< 8.0	11
C10 - C14	mg/kg dry wt	< 20	71	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	250	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	320	< 60	< 60	< 60

	Sample Name:	TST17/1 18-Feb-2008	TST17/2 18-Feb-2008	TST18/1 18-Feb-2008	TST18/3 18-Feb-2008	TST19/1 18-Feb-2008
	Lab Number:	631051.55	631051.56	631051.57	631051.58	631051.59
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	93	69	93	76	96
Benzene	mg/kg dry wt	< 0.050	< 0.065	< 0.050	< 0.055	< 0.050
Toluene	mg/kg dry wt	< 0.050	< 0.065	< 0.050	< 0.055	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.050	< 0.065	< 0.050	< 0.055	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.13	< 0.10	< 0.11	< 0.10
o-Xylene	mg/kg dry wt	< 0.050	< 0.065	< 0.050	< 0.055	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	93	69	93	76	96
C7 - C9	mg/kg dry wt	< 8.0	< 9.4	< 8.0	< 9.0	< 8.0
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	TST19/2 18-Feb-2008	TST19/3 18-Feb-2008	TST19/4 18-Feb-2008	TST13/1 19-Feb-2008	TST13/4 19-Feb-2008
	Lab Number:	631051.60	631051.61	631051.62	631051.77	631051.80
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	-	-	< 2.0	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	-	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	-	-	-	41	-
Total Recoverable Copper	mg/kg dry wt	-	-	-	54	-
Total Recoverable Lead	mg/kg dry wt	-	-	-	1.5	-
Total Recoverable Nickel	mg/kg dry wt	-	-	-	180	-
Total Recoverable Zinc	mg/kg dry wt	-	-	-	48	-
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	95	74	68	93	73
Benzene	mg/kg dry wt	< 0.050	< 0.057	0.56	< 0.050	< 0.057
Toluene	mg/kg dry wt	< 0.050	< 0.057	0.20	< 0.050	< 0.057
Ethylbenzene	mg/kg dry wt	< 0.050	0.067	0.51	< 0.050	< 0.057
m&p-Xylene	mg/kg dry wt	< 0.10	0.15	2.1	< 0.10	< 0.12
o-Xylene	mg/kg dry wt	< 0.050	< 0.057	0.66	< 0.050	< 0.057

Sample Type: Soil						
	Sample Name:	TST19/2 18-Feb-2008	TST19/3 18-Feb-2008	TST19/4 18-Feb-2008	TST13/1 19-Feb-2008	TST13/4 19-Feb-2008
	Lab Number:	631051.60	631051.61	631051.62	631051.77	631051.80
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	95	74	68	93	73
C7 - C9	mg/kg dry wt	< 8.0	< 8.7	< 11	< 8.0	< 9.8
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	41	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	TST13/8 ✓ 19-Feb-2008	TST14/1 ✓ 19-Feb-2008	TST14/2 ✓ 19-Feb-2008	TST14/3 ✓ 19-Feb-2008	TST14/4 ✓ 19-Feb-2008
	Lab Number:	631051.84	631051.93	631051.94	631051.95	631051.96
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	< 2.0	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	-	0.11	-	-	-
Total Recoverable Chromium	mg/kg dry wt	-	44	-	-	-
Total Recoverable Copper	mg/kg dry wt	-	60	-	-	-
Total Recoverable Lead	mg/kg dry wt	-	1.5	-	-	-
Total Recoverable Nickel	mg/kg dry wt	-	170	-	-	-
Total Recoverable Zinc	mg/kg dry wt	-	51	-	-	-
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	60	96	95	97	96
Benzene	mg/kg dry wt	< 0.081	< 0.050	< 0.050	< 0.050	< 0.050
Toluene	mg/kg dry wt	< 0.081	< 0.050	< 0.050	< 0.050	< 0.050
Ethylbenzene	mg/kg dry wt	< 0.081	< 0.050	< 0.050	< 0.050	< 0.050
m&p-Xylene	mg/kg dry wt	< 0.17	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.081	< 0.050	< 0.050	< 0.050	< 0.050
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	60	96	95	97	96
C7 - C9	mg/kg dry wt	< 11	< 8.0	< 8.0	< 8.0	< 8.0
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

	Sample Name:	TST14/5 ✓ 19-Feb-2008	TST14/6 ✓ 19-Feb-2008	TST14/7 ✓ 19-Feb-2008	TST14/8 ✓ 19-Feb-2008	
	Lab Number:	631051.97	631051.98	631051.99	631051.100	
BTEX in Soil by Headspace GC-MS						
Dry Matter	g/100g as rcvd	75	79	79	74	-
Benzene	mg/kg dry wt	< 0.056	< 0.053	< 0.052	< 0.056	-
Toluene	mg/kg dry wt	< 0.056	< 0.053	< 0.052	< 0.056	-
Ethylbenzene	mg/kg dry wt	< 0.056	< 0.053	< 0.052	< 0.056	-
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.11	< 0.11	< 0.12	-
o-Xylene	mg/kg dry wt	< 0.056	< 0.053	< 0.052	< 0.056	-
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	75	79	79	74	-
C7 - C9	mg/kg dry wt	< 9.9	< 8.7	< 8.2	< 9.7	-
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	-
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Soil

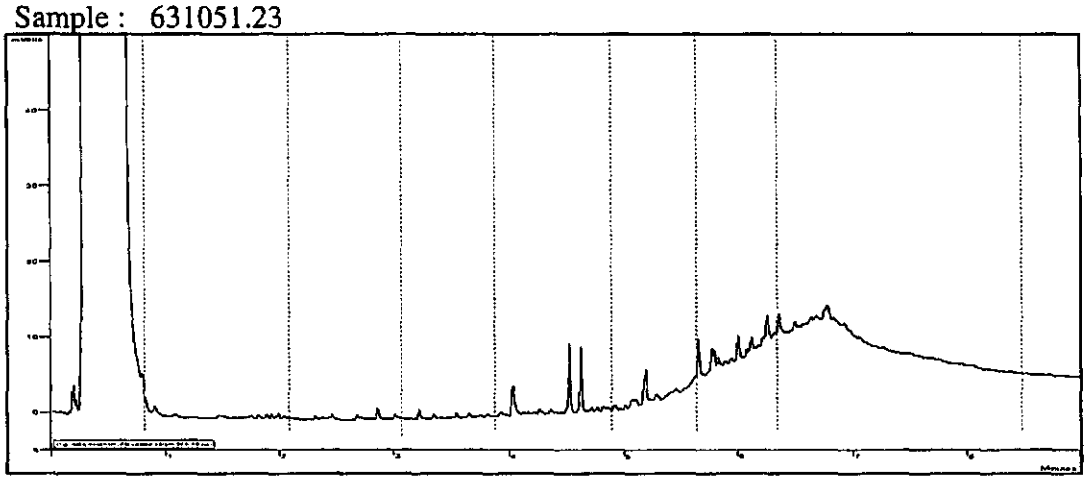
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation*	Air dried at 35°C and sieved, <2mm fraction.	-	23, 77, 93
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn*	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	23, 77, 93
BTEX in Soil by Headspace GC-MS*	Solvent extraction, Headspace GC-MS analysis	-	1-8, 23-25, 39-40, 53-62, 77, 80, 84, 93-100
Total Petroleum Hydrocarbons in Soil*	Sonication extraction, Silica cleanup, GC-FID analysis	-	1-8, 23-25, 39-40, 53-62, 77, 80, 84, 93-100
Dry Matter (Org)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1-8, 23-25, 39-40, 53-62, 77, 80, 84, 93-100
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2	-	23, 77, 93

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

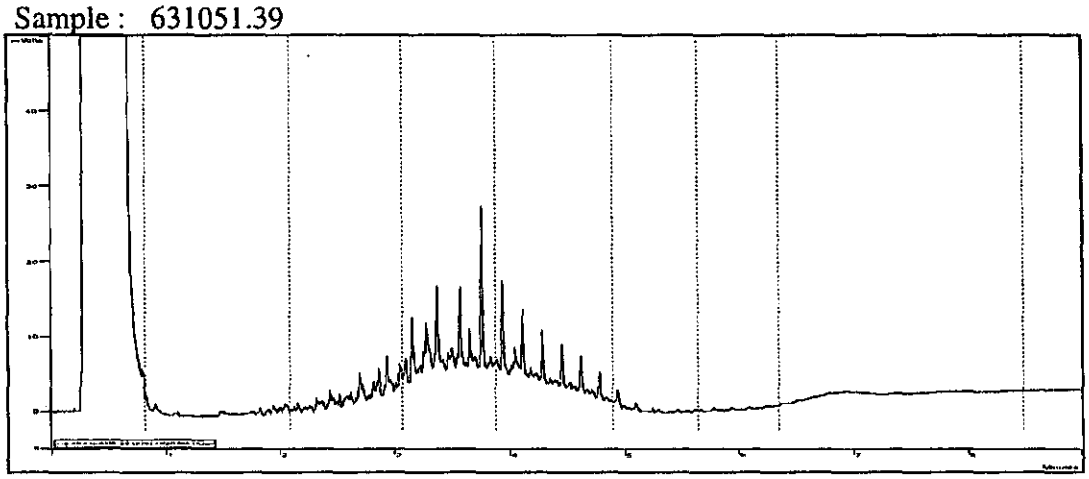
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

Sample : 631051.23



Sample : 631051.39



Sea Horse Investments Limited

CERTIFICATE OF COMPLIANCE APPLICATION FOR 102 PAKURANGA ROAD PAKURANGA

ENVIRONMENTAL SITE ASSESSMENT (STAGES 1 & 2)

Project No.	31863	Approved for Issue	
Version No.	2	Name	Ray Hedgland
Status	Final	Signature	
Authors	Tristan Bellingham		
Reviewer	Ray Hedgland	Date	5 August 2009

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SEA HORSE INVESTMENTS LTD.

102 PAKURANGA ROAD, MANUKAU CITY
ENVIRONMENTAL SITE ASSESSMENT (STAGES 1 & 2)

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APPENDICES

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B	Site Walkover Photos
C	Laboratory Results
D	Laboratory Transcripts
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SEA HORSE INVESTMENTS LTD.

102 PAKURANGA ROAD, MANUKAU CITY
ENVIRONMENTAL SITE ASSESSMENT (STAGES 1 & 2)

SUMMARY CONTAMINATED SITES REPORT CHECKLIST

Report sections and information to be presented	PSI	SIR	RAP	SVR	MMP	Notes
Executive summary	R ☑	R ☑	R ☐	R ☐	R ☐	
Scope of work	R ☑	R ☑	R ☐	R ☐	R ☐	
Site identification	R ☑	R ☑	R ☐	R ☐	R ☐	
Site history	R ☑	S ☑	S ☐	S ☐	S ☐	
Site condition and surrounding environment	R ☑	S ☑	S ☐	S ☐	S ☐	
Geology and hydrology	A ☑	R ☑	S ☐	S ☐	S ☐	
Sampling and analysis plan and sampling methodology	A ☑	R ☑	X	R ☐	R ☐	
Field quality assurance and quality control (QA/QC)	N ☑	R ☑	X	R ☐	S ☐	
Laboratory QA/QC	N ☑	R ☑	X	R ☐	X	
QA/QC data evaluation	N ☐	R ☐	X	R ☐	X	3
Basis for guideline values	R ☑	R ☑	R ☐	R ☐	R ☐	
Results	A ☑	R ☑	R ☐	R ☐	S ☐	
Site Characterisation	R ☑	R ☑	R ☐	R ☐	R ☐	
Remedial actions	X	X	R ☐	S ☐	S ☐	
Validation	X	X	X	R ☐	S ☐	
Site management plan	X	X	R ☐	S ☐	S ☐	
Ongoing monitoring	X	X	X	N ☐	R ☐	
Conclusions and recommendations	R ☑	R ☑	R ☐	R ☐	R ☐	

KEY:

1. PSI = preliminary site inspection report
   SIR = detailed site investigation report
   RAP = site remedial action plan
   SVR = site validation report
   MMP = ongoing monitoring and management plan
2. R = corresponding details required
   A = readily available information should be included;
   S = summary of this section's details is adequate if detailed information has been included in an available referenced report;
   N = include only if no further site investigation is to be undertaken;
   X = not applicable and may be omitted.
3. Not included here due to small scale of this investigation.

SEA HORSE INVESTMENTS LTD.

102 PAKURANGA ROAD, MANUKAU CITY ENVIRONMENTAL SITE ASSESSMENT (STAGES 1 & 2)

EXECUTIVE SUMMARY

In response to instructions from James Chan of Bayleys Real Estate Ltd, on behalf of Sea Horse Investments Ltd, Fraser Thomas undertook an environmental site assessment (Stage 1 & 2) for 102 Pakuranga Rd (Lot 1 DP149241, Lots 51 & 52 DP69912), Manukau City. The proposed redevelopment of the site is unknown at this stage but is likely to be in keeping with the current Business 1 zoning. The site has been used primarily as a service station with underground storage tanks (USTs) since the early 1960s. Prior to that the site was farmland and did not contain any buildings or structures.

The original service station and mechanics workshop were located on the southeast part of the subject site with the remainder of the land in pasture. The site was refurbished in 1989 by Mobil Oil NZ (Mobil), with works including demolition and removal of existing buildings, USTs and fuel pumps. It is our understanding that a tank removal report was not prepared for these activities and a site investigation with soil sampling was not conducted (pre Resource Management Act). This was confirmed by Mobil.

In 2008 the site was decommissioned by Mobil and a report titled *Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland – Tank Removal TR07/774 Site No O02021* was prepared by Pattle Delamore Partners (PDP). This report was based on an extensive investigation of the site which included soil sampling and test pitting at various locations across the site corresponding to historic and recent USTs, pipe work, fuel dispensing pumps and drainage sumps. Some hydrocarbon contaminated soil (143 tonne) was removed from test pits 11 and 14 to Hampton Downs landfill. The PDP report concluded that all issues relating to use of the site as a petrol service station had been addressed and no contamination issues remained due to this land use. This conclusion was verified by Auckland Regional Council (ARC) and a Certificate of Compliance (CoC) was issued under Rule 5.5.42 of the Proposed Auckland Regional Plan: Air, Land & Water (PARP:ALW 2008).

Our investigation into the site history highlighted the fact that no test pit investigation or soil sampling had occurred in the location of the two large historic USTs shown in the 1989 Mobil Demolition Plan (dwg no O02021/06/08). In addition, in order to obtain a CoC from ARC under Rule 5.5.41 of the PARP:ALW (2008) further soil and groundwater sampling was required to determine heavy metal, total petroleum hydrocarbon (TPHs) and benzene, toluene, ethylbenzene and xylene (BTEX) concentrations and to check for the presence of separate phase hydrocarbons.

Test pit and soil sampling results from across the site confirm that while there is some evidence of the presence of hydrocarbons to the south and east of the concrete forecourt, this is minor and Tier 1 guidelines as detailed under Rule 5.5.41 of the PARP:ALW (2008) are met for all soil samples. Likewise heavy metal concentrations

meet permitted activity criteria listed in Schedule 10 of the PARP:ALW (2008). Groundwater sampling indicates that contamination of groundwater at the site is not occurring. These groundwater sampling results confirm that the environmental effects of the hydrocarbons noted in excavations to the south and east of the forecourt are less than minor and have not impacted on groundwater.

In conclusion, based on the evidence presented in the PDP tank removal report and this report, the subject site is deemed to meet permitted activity criteria as detailed in the PARP:ALW (2008). Hence we request that a CoC based on Rule 5.5.41 of the PARP:ALW (2008) be issued.

SEA HORSE INVESTMENTS LTD

102 PAKURANGA ROAD, MANUKAU CITY
ENVIRONMENTAL SITE ASSESSMENT (STAGES 1 & 2)

1.0 INTRODUCTION

In response to instructions from James Chan of Bayleys Real Estate Ltd, on behalf of Seahorse Investments Ltd, Fraser Thomas undertook an environmental site assessment (Stage 1 & 2) for 102 Pakuranga Rd (Lots 51 and 52 DP69912 and Lot 1 DP149241), Manukau City.

The scope of the assessment and investigation was limited to an environmental site assessment related to any actual or potential site contamination issues as a result of previous uses of the site. Hence, environmental issues with respect to noise, trees, stormwater and planning aspects are not covered by this investigation.

The format of this report is as follows:

- Rationale, objectives and scope of work.
- Site details.
- Investigation methodology.
- Desktop study, site walkover results and intrusive investigation results and discussion.
- Conclusions and recommendations.
- Site plans, drawings, certificates of title, relevant documentation, representative photographs, borelogs and laboratory results in appendix form.

2.0 RATIONALE, OBJECTIVES AND SCOPE OF WORK

The main rationale and objectives for this investigation are:

- To assess the nature and extent of any soil and groundwater contamination present at the site due to historical land use.
- To demonstrate to Council that the site is suitable or can be rehabilitated to be suitable for future development.
- To support an application for a Certificate of Compliance (CoC) for the site based on Rule 5.5.41 of the PARP:ALW (2008).

The scope of the environmental site assessment is limited to addressing the above issues.

3.0 SITE DETAILS

3.1 AERIAL PHOTOGRAPHS

Aerial photographs from 1959, 1978, 1980, 1987, 1996, 2001 and 2007/8 are included in drawings 31863/2 to 31863/5. The aerials from 1978, 1980, 1987 and 1996 were obtained from MCC archives, the aerials from 1959 and 2001 were obtained from the ARC GIS website while the 2007/8 aerial was obtained from the Manukau City

Council (MCC) Geographic Information System (GIS) website. Descriptions of the aerials are given in section 5.6.

3.2 LOCATION AND ZONING

The general and specific location of the site is shown in drawing 31863/1. This site (Lots 51 and 52, DP69912 and Lot 1 DP149241) covers an area of 4,242m^2. The site is located at 102 Pakuranga Road, on the corner of Pakuranga Road and Kentigern Close. Bounding the site to the north and east are residential properties, to the south beyond Pakuranga Road are commercial retail units including a BP Oil New Zealand (BP) service station. To the west, beyond Kentigern Close are residential properties. The property is zoned "Business Zone 1" under the MCC Operative District Plan (2002).

3.3 TOPOGRAPHY, GEOLOGY, GROUNDWATER AND SOILS

The topography at 102 Pakuranga Road is generally flat and gently slopes down to the north-west. The New Zealand Geological Map (scale 1:50,000, Auckland, Sheet R11) indicates that the site is underlain by pumiceous deposits of the Tauranga Group (Rhyolite Pumice) which are described as 'light grey, massive to finely laminated, mud to sand sized pumice'. This is in agreement with a geotechnical investigation of the site undertaken by Pattle Delamore Partners Ltd (PDP) during the removal of the underground storage tanks (USTs) at the site. More detail can be found in the PDP report titled *Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland – Tank Removal TR07/774 Site No O02021* and dated 8 August 2008. The results of the PDP soil investigation and relevant hydrogeology information are summarised as follows:

- The natural geology observed in the walls of the main tank pit consisted of light grey mottled orange silty clay to 3.5m below ground level (bgl) with orangey grey sandy clay to a depth of 4.3m bgl and dark brown clays below.
- The test pit log details indicate that the site is underlain by sandy gravel fill layer with depth varying from 0.2 to 2.0m thick below the asphalt layer. Typical fill depths are in the 0.8 to 1.2m range. Material comprising moderately plastic clay was generally encountered below 1.1m.
- Subsoil colouring exhibited grey and orange mottling commencing at depths varying from 0.4 to 3.4m, indicating the seasonally high groundwater level may be as high as 0.4m to 3.4m deep.
- Groundwater seepage from a perched water table was noted in several test pits to the south of the forecourt.
- The results of the test pit investigation at the site generally confirm the stratigraphy as indicated on the geological map.

The Tamaki River Estuary is located approximately 70m north-west of the site. Groundwater flow is anticipated to flow in a generally north-westerly direction towards the Tamaki River Estuary.

The installation of the groundwater sampling boreholes included logging of the soils by a Fraser Thomas geotechnical engineer. Borelogs are included in Appendix F. The site is underlain by clayey silt and silty clay alluvial sediments, with paved areas of the site containing approximately 0.7m of granular fill. Test pitting across the site for soil sampling confirmed that granular fill ranged from 0.4 to 1.0m deep across paved areas of the site. Granular fill in the location of historic USTs extended to approximately 4m

below ground level in some cases. Groundwater is present at 1.7m, 1.8m and 1.3m in BH1, BH2 and BH3 respectively.

The assumed direction of groundwater travel is to the northwest towards the Tamaki River Estuary approximately 100m away. This is supported by ground surface and groundwater levels at the three boreholes based on LIDAR contour information (ALGGi website), field observations and groundwater depth measurements. Groundwater RLs in BH1, BH2 and BH3 are approximately 8.3m, 8.2m and 7.7m respectively. Hence BH1 is the upgradient borehole, with BH2 and BH3 both downgradient.

3.4 PROPOSED DEVELOPMENT

The proposed development of the site is currently unknown. It is likely to continue to be used for commercial purposes (i.e. continued commercial/industrial land use) in accordance with the current Business 1 zoning.

4.0 INVESTIGATION METHODOLOGY

The methodology used for this site assessment is summarised below:

1. Desktop study involving review of existing historical information for the site, historical photographs, aerial maps, certificates of title, Council's property files, Auckland Regional Council (ARC) files and interviews with persons familiar with the site such as previous and current owners and tenants. Relevant certificates of title are set out in Appendix A.

2. Preliminary site investigation: site walkover, visual appraisal of the property and the general vicinity in order to identify any disturbed and potentially contaminated areas. Areas requiring particular attention include places such as any former underground storage tank and pipe work locations. Relevant photographs are set out in Appendix B.

3. Preparation of a soil and groundwater sampling investigation plan, based on the desktop study and site walkover results (see Drawing 31863/1 and Section 6.1). The sampling investigation is described in more detail in section 6.3.

4. The soil samples were collected using various soil sampling equipment, including stainless steel trowels, foot soil corers (diameter = 2.5cm, length = 150mm) and borehole augers. Grid soil samples (S1-S12) and fill samples (Fill1-Fill12) were screened using a photo-ionisation detector (PID) monitor where sample jars containing the soil were covered with aluminium foil which was pierced with the PID probe to sample the headspace within the sample jar. PID readings were taken approximately 2 hours after sampling. Sampling equipment was cleaned at the beginning and end of sampling. Disposable gloves were worn by field staff.

5. Groundwater samples were collected using a Waterra foot valve and Teflon tubing after purging the groundwater sampling piezometers (3 well volumes). Piezometers were installed with the slotted section extending approximately 0.5m above and 1.0m below the groundwater level to allow detection of any separate

phase hydrocarbons floating on top of the groundwater. Sampling equipment was cleaned at the beginning and end of sampling. Disposable gloves were worn by field staff.

6. All samples were placed in individual containers provided by Hill Laboratories and then stored and transported in chilly bins with freezer pads to keep them cool, as per standard chain of custody procedures. Laboratory testing was undertaken by Hill Laboratories Ltd, an IANZ accredited laboratory, using their routine commercial methods. The soil and fill samples were tested for heavy metals (HMs), with some only tested for lead. Total petroleum hydrocarbon (TPHs) and benzene, toluene, ethylbenzene and xylene (BTEX) analysis was only conducted where visual or olfactory evidence and/or PID readings indicated that hydrocarbons may have been present. All analyses were to screening level. Groundwater samples were analysed for dissolved HMs, TPHs and BTEX to trace level. The full laboratory results are set out in Appendix C. Original laboratory transcripts are included in Appendix D. All results are presented on a dry weight basis.

7. Laboratory results were assessed for acceptability based on accepted standards and guidelines, including:
   - "Contaminated Land Management Guidelines", No 1 (Reporting on Contaminated Sites in New Zealand, November 2003), No 2 (Hierarchy and Application in New Zealand of Environmental Guideline Values, November 2003) and No 5 (Site Investigation and Analysis of Soils, February 2004), Ministry for the Environment (MfE).
   - "Proposed Auckland Regional Plan: Air, Land and Water", Auckland Regional Council (May 2008).
   - "Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand", MfE, (June 1999), herein referred to as the MfE hydrocarbon guideline document.
   - "Background Concentrations of Inorganic Elements in Soils from the Auckland Region", ARC, TP153 (2001).
   - Australian and New Zealand Guidelines for Fresh and Marine Water Quality, (2001).

   The focus of the soil investigation was on compliance of the HMs, TPHs and BTEX with permitted activity criteria detailed in the PARP:ALW (2008).

8. Preparation of an environmental site assessment report, including the results of the desktop study, site walkover survey, intrusive investigation and laboratory testing, analysis and discussion of results, and conclusions and recommendations.

9. Provision of site plans, drawings, certificates of title, relevant documentation, representative photographs, borelogs and laboratory results as appendices to this report.

10. Fraser Thomas Health and Safety Management Plan procedures were followed throughout the duration of the investigation.

5.0 DESKTOP STUDY AND WALKOVER SURVEY RESULTS

5.1 INTRODUCTION

The results of the desktop study and site walkover survey are summarised in this section and illustrated in drawing 31863/1. Associated photos are shown in Appendix B.

Throughout the site walkover survey, a visual assessment was used to classify any foreign materials as particular contaminants, without any formal identification. Hence, reference to a specific contaminant in the survey results should essentially be read as "suspected contaminant", unless stated otherwise.

5.2 SITE IDENTIFICATION AND OWNERSHIP

The site details and ownership history are summarised below.

Table 2: Site Details and Ownership History

Registered Owners		Seahorse Investments Ltd
Street Address		102 Pakuranga Road, Pakuranga
Legal Description		Lot 51 and 52 DP69912, Lot 1 DP199241
Title		NA25D/184, NA25D/185, NA88D/782
Area (ha)		1363, 985 and 2278 square metres more or less
Zoning		Business 1 Zone
Ownership History		
CTs	**From**	**Registered Owner**
454/255	Mar 1927	Frances Mary Simcox & the Public Trustee
	May 1927	Transfer to Edwin James Berry of Panmure farmer
456/128	May 1927	Edwin James Berry of Panmure farmer
	Sep 1929	Transfer to John Arthur Cunliffe, labourer
	Apr 1939	Transfer to Garnet Lidball Herd of Howick, retired draper
	Aug 1940	Transfer to Harold Sydney Edwards, farmer
	Feb 1945	Transfer to Leslie Roy Davis, mechanic
	Apr 1951	Transfer to Dudley Kingston Dowling, teacher
	Feb 1963	Transfer of Lot 1 plan 51368 to Pakuranga Motors Limited
	Sep 1963	C46205 Cancelled as to Lots 1,2, 3 and 4 plan 52174 and new CT issued 214/1499
	Dec 1963	Transfer of the residue to Cosy Homes Limited
1A/1329	Feb 1963	Pakuranga Motors Limited (area 1394m^2)
	Mar 1965	Transfer to Pakuranga Holdings Ltd.
	Oct 1969	Transfer to Jolce Holdings Ltd.
	Oct 1987	Transfer to Kilroy Investments Ltd.
	Aug 1990	Transfer to Breadeaze Corporation Ltd.
	Jul 1993	C.501688.2 O.N.C.T Cancelled as to Part Lot 1 Plan 149241 and new CT issued 88D/782
3A/231	Dec 1963	Cosy Homes Ltd (area 4.5117Ha)
	May 1969	Transfer to Leon Robert Idoine of Auckland, Company Director and Mary Alice Idoine his wife
25D/186	Nov 1973	Leon Robert Idoine of Auckland, Company Director and Mary

		Alice Idoine his wife
	Jan 1981	Transfer to L.R. Idoine Limited
	Aug 1983	Transfer to Machron Nominees
	Jan 1986	Transfer to Pakuranga Motels Ltd.
	Mar 1990	Transfer to Kilroy Investments Ltd.
	Aug 1990	Transfer to Breadeaze Corporation Ltd
	Jul 1993	C.501688.2 O.N.C.T Cancelled as to Part Lot 1 plan 149241 and new CT issued: 88D/782
25D/184	Nov 1973	Sea Horse Investment Ltd. (area 1363m^2)
25D/185	Nov 1973	Sea Horse Investment Ltd (area 601m^2)
88D/782	Jul 1993	Sea Horse Investment Ltd (area 2278m^2)

The title certificates for 102 Pakuranga Road indicate that the land constituting the site (Lot 51 and 52 DP69912, Lot 1 DP199241) was originally on a single title from 1927-1963 that was first owned by Frances Mary Simcox and the Public Trustee. The other main owners prior to 1963 consist of farmers, labourer, retired draper, mechanic and teacher. Part of the subject site was sold to Pakuranga Motors Ltd and the rest to Cosy Homes Ltd in 1963. Between 1963 and 2008 the properties each had several owners, typically owned by commercial/industrial companies. From this information it is inferred that these sites were used for commercial/industrial purposes (including the use as a garage and petrol service station from 1963 onwards through to 2008) from as early as 1963 until 2008. Sea Horse Investment Ltd acquired ownership of Lot 51 and 52 DP69912 in 1973 and Lot 1 DP149241 in 1993. The main land use for these properties throughout their history appears to be for farming between 1927 and 1963 and more recently for commercial/industrial purposes from 1963 onwards.

5.3 INTERVIEWS

Mobil Oil NZ Ltd (service station operator 1989-2008)

Ms Catherine Harris (021 815 682) of Mobil Oil NZ Ltd was interviewed about the history of the site. Ms Harris confirmed that Mobil renovated and operated the site from 1989 onwards. Ms Harris does not know who owned or operated the garage and service station on the site prior to 1989. The renovation of the site that occurred in 1989 at the start of Mobil's tenure involved the removal of the old USTs which were located in the forecourt area. Being pre-1991 (Resource Management Act), Ms Harris did not know of any tank removal reports or soil sampling being done during removal of the old USTs. Ms Harris confirmed that Mobil has two Pattle Delamore reports on the site, namely a phase 1 report on the site history, and the 2008 tank removal report. Ms Harris indicated that the information contained in the phase 1 report is based on council records, aerial photographs and other readily available information. Ms Harris confirmed that this phase 1 report is confidential and will not be released by Mobil.

Leon Robert Idoine (former owner; (09) 521-1995)

Mr Leon Robert Idoine owned a 4 acre lot and an 11 acre lot in the vicinity of, and including part of, the subject site. The lots extended from the foreshore to the main road which was called the Ellerslie–Howick Road in the 1960s and abutted the Pakuranga Motors site where the old service station was located (part of the subject site). Mr Idoine confirmed that the service station was present in the 1960s when he

purchased the adjacent land. He thought it unlikely that the service station had a full mechanical workshop but may have had a small workshop typical of that period which would have fixed punctures and changed batteries. The service station would have contained USTs for fuel.

The land owned by Mr Idoine was bare farmland used for grazing cattle prior to being subdivided, primarily for residential lots. There were no buildings on the land at the time of purchase by Mr Idoine and he thought it unlikely that there would have been any sheep dips or similar contamination hotspots. Mr Idoine did not know what was on the service station site prior to that being built. The only filling that would have occurred would have been 'cut and fill' from roads during development of the subdivision in the 1970s. Most of the topsoil from roads was placed on residential lots according to Mr Idoine.

Other Owners
Considerable efforts on behalf of the client to contact previous owners and others with knowledge of the site were unsuccessful. Hence there are gaps in the historical usage profile of the subject site.

5.4 MCC RECORDS

MCC records on the 102 Pakuranga Road property file do not contain any information regarding actual or suspected contamination issues. The following building consent information related to commercial buildings, plumbing, drainage and sign works was on file:

- 1962: Garage & service station 2100sqft
- 1982: Canopy
- 1989: New service station & workshop 80m^2
- 1991: New Carwash Facility 55m^2
- 1992: Relocate existing Mobil sign

Drainage plans from 1963 when the site was operated by Pakuranga Motors Ltd indicate that there were three 20ft long scoria irrigation trenches onsite. One of these was for wastewater and was connected to a septic tank.

Drainage plans from 1971 indicate that a new addition to the existing building was constructed at this time. Stormwater (SW) and wastewater (WW) were connected to reticulated systems with SW discharging to an existing SW line to the north and WW discharging to a sanitary sewer manhole to the southeast. A building plan from 1971 indicates that a warrant of fitness testing facility and a workshop, both with vehicle servicing pits, were located onsite.

A drawing from 1975 indicates the location of fuel pumps and confirms that a lube bay and workshop were present inside the buildings on site.

Renovation of the site in 1989 is detailed in various Mobil plans and shows the location of USTs, fuel dispensing pumps and sales room. A workshop and offices building along the northern boundary of the site shown on early plans are deleted on construction plans. Hence it is assumed that this building was not constructed. The

petroleum services plan shows the location of USTs, dispenser pumps and associated pipework. SW and WW services are shown on the drainage plan and indicate that both SW and WW discharge to the north through separate piped systems. SW from the forecourt area is shown as draining to an oil interceptor on the western boundary of the site prior to release to the main SW line. A demolition plan from 1989 shows the location of the old USTs, dispenser pumps and building. Notes on this drawing confirm that all tanks, pumps, dispensers and pipework were to be removed and holes backfilled in an appropriate manner. Concrete slabs and buildings were to be demolished and services were to be disconnected and abandoned, and removed if practical.

The proposed car wash construction plan from 1992 shows an existing oil interceptor located in the northwest corner of the site and a storage area in the northeast corner. The new car wash is located slightly north of the centre of the site and immediately east of the existing USTs. Notes indicate that the USTs were to remain, but that the concrete slab over the USTs was to be replaced. The 1992 petroleum services plan indicates that new pipework was to be installed in the vicinity of the USTs to reflect the change in product in some USTs (conversion from regular to diesel and super to regular). The 1992 car wash drainage plan shows a Type E oil interceptor to the south of the car wash connecting to an existing sanitary sewer line.

A copy of the Mobil Demolition Plan from 1989 is attached in the Figures & Drawing section.

5.5 ARC RECORDS

An ARC contaminated site inquiry returned references to two files (6-03-0143 and 6-03-1288) relating to a major petrol spill in May 1996. ARC was contacted regarding viewing of the files and it was confirmed that a contaminated site report was also present for this site. The majority of the information was not publically available however due to confidentiality issues. ARC confirmed that a Local Government Official Information Act (LGOIMA) request would be required to access this information which may or may not be released. Hence these ARC files were not viewed.

The consents database for contaminated site, landfill, air, borehole or industrial waste found within approximately 200m of the site was searched. No consents were identified.

A search of the ARC borehole database by PDP in November 2007 identified 7 groundwater bores within 1km radius of the site. Six of the bores are listed as proposed groundwater monitoring/testing wells. The remaining bore, located approximately 550m east of the site is used for irrigation purposes and is reported as being 265m in depth with a casing to approximately 157m bgl and was used for irrigation purposes. All seven borehole consents have expired.

5.6 AERIAL PHOTOGRAPHS

1959 (Drawing No: 31863/2, Black and white)

- The site and the surrounding area appear to be in pasture. The site does not contain any buildings.
- Pakuranga Road has been formed but does not appear to be as wide as it is now. Kentigern Close has not been formed.
- There are buildings on the other side of Pakuranga Road, opposite the subject site.

1978 (Drawing No: 31863/2, Black and white)

- There appear to be three connected buildings onsite surrounded by a hardstand yard area. Several vehicles, tanks or containers are present, mainly to the east of the buildings. The northern and western part of the site is not developed and appears to be grassed.
- Kentigern Close and connecting roads have been formed and Pakuranga Road is now significantly wider with 2 or 3 lanes in each direction.
- The site to the east has been developed with several buildings present. The site immediately north appears to have a residential type building at the front and a larger 'U' shaped building behind.

1980 (Drawing No: 31863/3, Black and white)

- The site appears to be unchanged from the 1978 aerial described above.
- The Pakuranga Mall opposite the site across Pakuranga Road appears to be fully developed with large buildings and extensive parking areas.
- The other surrounding sites to the east and north are as described for the 1978 aerial above.

1987 (Drawing No: 31863/3, Color)

- The site appears to be relatively unchanged from the 1978 and 1980 aerials with the three main buildings and hardstand area still present on the eastern side of the site and the northern and western parts still in grass.
- The surrounding area to the east and north appears to be residential with numerous additional houses erected between 1980 and 1987.
- The lot to the north is still in grass and the lot opposite across Kentigern Close could be a motel based on the size and shape of the building.

1996 (Drawing No: 31863/4, Color)

- The site has changed significantly since 1987 with the three old buildings either demolished or changed. There is now a long building located on the southern part of the site parallel to Pakuranga Road. This is likely to be the covered forecourt area. A small square building is attached to the long building on the northern side. One or two additional buildings are present on the northern part of the site (possibly a car wash).
- The site is now fully developed and entirely impervious except for some narrow landscaped strips around the boundary.
- Surrounding properties are as per the 1987 aerial described above.

2001 (Drawing No: 31863/4, Color)

- The site is generally as per the 1996 aerial.
- The location of the USTs is marked by the concrete pad and filling point covers visible in the northwest part of the site.
- There appears to be a small shed, or a parked vehicle, in the northeast corner of the site.
- On the western boundary is what appears to be a truck and trailer unit.

2007/8 (Drawing No: 31863/5, Color)

- The site is generally as per the 2001 aerial.
- The location of the USTs is marked by the concrete pad and filling point covers visible in the northwest part of the site.
- A truck is parked near the northwest corner of the site along the western boundary.
- There is a small shed in the northeast corner of the site along with some other items (drum/container).

5.7 PREVIOUS ENVIRONMENTAL SITE ASSESSMENTS

Pattle Delamore Partners Ltd Tank Removal Report 2008

The existing PDP tank removal report titled *Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland – Tank Removal TR07/774, Site No. 002021* has been reviewed by ARC and a CoC under rule 5.5.42 of the PARP:ALW (May 2008) issued (No. 52100).

In our opinion, the above report comprehensively covers most of the issues on site relating to petroleum storage and dispensing. The main tank pit, fuel pipe work, sumps, historic workshop and most of the historic USTs have been investigated. There is however one significant omission that should have been covered, namely the lack of investigation in the area of the two large historic USTs shown in the Mobil Demolition Plan from 1989 (dwg no. O02021/06/08). This drawing was on the MCC property file so should have been readily accessible to PDP at the time of their investigation.

The PDP report did not cover any of the site history, the only heavy metal analysis was for samples taken in the location of the old automotive garage workshop, and no groundwater sampling was undertaken.

Stage 1 Desktop Report

Mobil Oil NZ Ltd has a 'phase 1' desktop report on the history of the site also written by PDP. According to Catherine Harris of Mobil this report is confidential and will not be released. It is however on file at ARC and is available for viewing and consideration by ARC officers only.

5.8 SITE WALKOVER (20 APRIL 2009)

The main site walkover was undertaken at 102 Pakuranga Road by Dr Tristan Bellingham (Environmental Engineer, Fraser Thomas Ltd) on 20 April 2009 in changeable weather. Site features are shown in drawing 31863/1 and summarised below.

The site was accessed from Pakuranga Road and is presently fully fenced with either permanent or temporary fencing. The main forecourt, canopy and retail shop are still present. The shop is however boarded up and all the fuel pumps have been removed from the forecourt area. The footprint of the former car wash is identifiable as a large rectangle break in the pavement. Similarly the location of test pits and the main tank pit are identifiable, as are the areas where fuel pipe work has been removed. The location of the large historic USTs not investigated by PDP is to the northeast of the existing forecourt.

The majority of the site is impervious asphalt pavement. There are narrow strips of garden areas around the perimeter of the site. The majority of the site is flat but there is a reasonable grade down to the low point in the northwest corner of the site. There is an oil and grit interceptor (OGI) in the northwest corner of the site.

6.0 LABORATORY RESULT ANALYSIS

6.1 RATIONALE

The following investigation and sampling was undertaken to provide the additional information needed for issue of a Certificate of Compliance for the site.

A test pit was excavated and four soil samples were taken in the location of historic USTs that were not investigated by PDP in their 2008 tank removal report. The Mobil Demolition Plan (dwg no. O02021/06/08), stamped and signed by MCC in late 1989, shows the former location of these large historic USTs.

Twelve soil samples were taken from native soils below the hardfill from across the site based on a 19.4m grid according to MfE guidelines for a 4,500m^2 site. These samples were tested for heavy metals.

Twelve samples of fill material were taken from the locations of historic USTs and other areas of fill. These samples were analysed for heavy metals.

Eleven soil samples were taken from native silt/clay soils below the fill material at the locations of historic USTs. These samples were analysed for lead.

Soil and fill samples were also analysed for TPHs and BTEX where visual and olfactory evidence, and/or PID readings, indicated the possible presence of hydrocarbons.

Two soil samples were taken from either side of the OGI in the northwest corner of the site. These samples were analysed for heavy metals and TPHs due to possible contamination of surrounding soil from leaks from the OGI.

Three groundwater samples were taken from around the perimeter of the site from sampling piezometers installed for that purpose. Piezometer installation for hand auger boreholes BH1 and BH3 was generally in accordance with Figures 3.2 and 3.3 of the MfE hydrocarbon contamination guideline document (1999). These piezometers were capped and sealed with bentonite to prevent surface water entering the well. The slotted screen section extended at least 0.5m above and 1.0m below the groundwater level. Machine borehole BH2 was drilled to a depth of 10m. The slotted section of this piezometer was installed between 7 and 10m bgl. All three piezometers were purged of three well volumes prior to groundwater sampling, and all three piezometers were checked for separate phase hydrocarbons.

The sampling programme detailed above was discussed with ARC who indicated that it was comprehensive and adequately addressed the outstanding issues not covered by the PDP report. Subject to the sample results, it is expected that this investigation should be sufficient for ARC to issue a CoC for the site based on Rule 5.5.41 of the PARP:ALW (2008).

6.2 EVALUATION BASIS

Results were evaluated against Rules 5.5.41 and 5.5.42 of the PARP:ALW (2008) to determine whether the site meets permitted activity criteria. In particular, Rule 5.5.41 of the states that hydrocarbon contaminant concentrations shall not exceed the Tier 1 soil acceptance for the current/proposed land use as specified in the *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, MfE 1999. Rule 5.5.42 contains further conditions relating specifically to sites used for petroleum USTs. Condition c) of this rule states that discharges of contaminants to land or water shall not contain separate phase hydrocarbons. Permitted activity criteria for common contaminants are listed in Schedule 10 of the PARP:ALW (2008) and background concentrations[1] were used to evaluate some heavy metal results in soil samples.

ANZECC[2] trigger values for freshwater for the protection of 80% of species as detailed in PARP:ALW (2008) were used to evaluate groundwater sampling results.

The laboratory results from the soils sampled are compared against guidelines for residential sites, as the most stringent criteria. The site is however zoned Business 1 and it is assumed that this land use will continue following any future development of the site.

6.3 METHODOLOGY

The site at 102 Pakuranga Road has been the subject of a tank removal report and associated investigation and remediation activities undertaken by PDP on behalf of Mobil as detailed in Section 5.7 above. The shortcomings of the PDP report are discussed above and this investigation was designed to complement the PDP report by

[1] *Background Concentrations of Inorganic Elements in Soils from the Auckland Region*, ARC, Technical Publication 153, Oct 2001.
[2] Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2001.

addressing the main outstanding issues and enable a CoC under Rule 5.5.41 of the PARP:ALW (2008) to be issued for the site.

Hence grid and targeted test pitting, augering and sampling were carried out across the site as described in section 6.1. The test pitting and sampling was supervised and/or undertaken by Dr Tristan Bellingham (Environmental Engineer, Fraser Thomas). Fraser Thomas geotechnical engineers put down groundwater sampling bores, logged soils, and installed groundwater sampling piezometers. Refer to section 4 for further details regarding sampling methodology.

Soil samples were analysed for HMs or lead. Analysis for TPHs and BTEX was undertaken where visual or olfactory evidence, or PID readings, indicated the possible presence of hydrocarbons. Groundwater samples were analysed for HMs, TPHs and BTEX.

6.4 RESULTS SUMMARY

A summary of the laboratory results and sample locations are provided in drawing 31863/1, together with relevant PARP:ALW (2008) and Tier 1 guideline values for different land uses as detailed in the MfE hydrocarbon guideline document.

Key results are summarized below:

Visual and Olfactory Evidence

- Field visit on 20th April 2009
  - There was a hydrocarbon sheen on the groundwater accumulating in the base of the test pit excavated at the location of the large historic USTs not investigated by PDP (sample points SH01-SH04 and Fill7).
  - The hydrocarbon odour was first noticed when the test pit excavation reached 1.5m depth, the depth at which groundwater seepage into the test pit was first observed.
- Field visit on 9th July 2009
  - Test pits excavated at sample points Fill 3, Fill 4, Fill 5 and Fill 6 along the southern side of the concrete forecourt had groundwater seepage at approximately 1.5m.
  - The hydrocarbon odour was relatively strong but the sheen on the water in the base of the test pits was less obvious than in the test pit excavated on 20th April.
  - No such visual or olfactory hydrocarbon evidence was observed in test pits at Fill10, Fill11 and Fill12 located between Fill3/Fill4 and Fill5/Fill6.

Soil Sampling

A complete list of sampling results is included in Appendix C. A summary of the results is included below.

- Grid Soil Samples S1-S12

  - Heavy metal results were well within permitted activity criteria listed in Schedule 10 of the PARP:ALW (2008) and generally at or slightly above background level.
  - PID readings were zero for all samples except for S2 (82ppm) and S8 (240ppm). Hence only S2 and S8 were analysed for TPHs, with both recording <60mg/kg.
  - No visual or olfactory evidence of hydrocarbons was observed in any of the test pits excavated at sample points S1-S12.
- Lead Soil Samples Pb1-Pb12
  - All lead soil samples, taken from silt/clay soils below hardfill at the locations of historic USTs and pipelines, were around background levels.
  - No visual or olfactory evidence of hydrocarbons was observed in any of the test pits excavated at sample points Pb1-Pb12.
- Fill Samples Fill1-Fill12
  - Heavy metal results were generally near background levels and were all well within permitted activity criteria, except for nickel. Elevated nickel concentrations up to 240mg/kg were recorded.
  - PID readings were taken for samples Fill3 to Fill6 which had visual and olfactory evidence of hydrocarbon contamination. Results ranged from 25ppm to 880ppm. These samples were analysed for TPHs with Fill3 recording <60mg/kg, Fill6 recording 370mg/kg and Fill4 and Fill5 recording the highest results at 1,100 and 1,200mg/kg respectively.
  - No visual or olfactory evidence of hydrocarbons was observed in any of the test pits excavated at sample points Fill1-Fill2 and Fill7-Fill12.
- Oil and Grit Interceptor Soil Samples OGI1 and OGI2
  - Heavy metal concentrations were at or near background level and no TPHs were detected.
  - No visual or olfactory evidence of hydrocarbons was observed in any of the test pits excavated at sample points OGI1-OGI2.
- Large historic USTs
  - TPH concentration in the two clay samples (SH01 and SH02) was <60mg/kg.
  - Lead concentration in SH01 and SH02 composite was 17mg/kg.
  - TPH concentration in the sand sample (SH03) was 130mg/kg.
  - TPH concentration in the hardfill sample (SH04) was 73mg/kg.
  - Visual and olfactory evidence of hydrocarbons was observed in groundwater accumulating in the excavation cavity at depths >1.5m.

Groundwater Sampling

Separate phase hydrocarbons were not detected in any of the groundwater sampling bores. TPHs were not detected in the groundwater at a detection limit of 0.7mg/L and BTEX levels were either below detection limits (<1.0µg/L for benzene, toluene and ethylbenzene, and <3.0µg/L for xylene), or only present at very low levels (µg/L range). Dissolved heavy metal concentrations in all three samples were below ANZECC guidelines for the protection of 80% of species in freshwater as specified in the PARP:ALW (2008). The only exception was dissolved copper in the sample from BH3 which had a copper level of 3.1µg/L compared to the guideline of 2.5µg/L. A complete table of groundwater sampling results is included in Appendix C.

6.5 DISCUSSION

Section 5.7 above summarised the PDP tank removal report completed in 2008. This report is reasonably comprehensive and addresses the majority of the issues related to the historic use of the site as a service station. As noted above there are some omissions from this report and these have been addressed by this investigation. This report should be seen as being complementary to the PDP report as there has been no attempt to repeat the work already done by PDP.

The visual and olfactory evidence detailed above indicates that there was a potential issue with residual hydrocarbon contamination in the vicinity of the concrete forecourt. Evidence of this was found by PDP during their investigation and some material was excavated and removed from site. Similar evidence was found during the FTL investigation in some, but not all, of the test pits excavated to the south and east of the forecourt.

However, the soil sampling results indicate that concentrations of TPHs are relatively low, even when PID readings indicate that hydrocarbons may be present. All TPH and BTEX results are well below Tier 1 guidelines for residential and commercial/industrial land uses for sandy soils. The highest results were clustered around the south and east of the concrete forecourt, and there is no evidence of hydrocarbon contamination across the remainder of the site. Similarly, TPH and BTEX concentrations in groundwater are also very low and separate phase hydrocarbons are not present in the groundwater sampling boreholes.

Based on this evidence, we conclude that the hydrocarbon contamination observed in the vicinity of the forecourt is very minor and relevant permitted activity criteria, as detailed under Rule 5.5.41, are met.

Heavy metal concentrations across the site are generally at or near background levels and well within permitted activity criteria. Some fill samples taken from historic UST locations have elevated nickel concentrations but these are understood to be due to background levels for hardfill sourced from volcanic areas. Likewise, lead concentrations in silt/clay soil below fill material in the location of historic USTs, are well below permitted activity criteria. Heavy metal concentrations in all groundwater samples were below the ANZECC guideline for the protection of 80% of species in freshwater, as specified by the PARP:ALW (2008), except for dissolved copper in BH3. The copper concentration in this sample (3.1µg/L) is only slightly higher that the freshwater guideline (2.5µg/L). However, given the proximity of the site to the Tamaki River estuary (approximately 100m to the northwest), and the direct discharge of groundwater into the estuarine environment, the marine water guideline of 8.0µg/L for the protection of 80% of species should apply. Hence all guidelines for heavy metals are met.

Based on this evidence, we conclude that the heavy metal, TPH and BTEX concentrations across the site meet the relevant permitted activity criteria as detailed under Rule 5.5.41.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The original service station and mechanics workshop were located on the southeast part of the subject site with the remainder of the land in pasture. The site was refurbished in 1989 by Mobil Oil NZ (Mobil), with works including demolition and removal of existing buildings, USTs and fuel pumps. It is our understanding that a tank removal report was not prepared for these activities and a site investigation with soil sampling was not conducted (pre Resource Management Act). This was confirmed by Mobil.

In 2008 the site was decommissioned by Mobil and a report titled *Mobil Pakuranga, 102 Pakuranga Road, Manukau City, Auckland – Tank Removal TR07/774 Site No O02021* was prepared by Pattle Delamore Partners (PDP). This report was based on an extensive investigation of the site which included soil sampling and test pitting at various locations across the site corresponding to historic and recent USTs, pipe work, fuel dispensing pumps and drainage sumps. Some hydrocarbon contaminated soil (143 tonne) was removed from test pits 11 and 14 to Hampton Downs landfill. The PDP report concluded that all issues relating to use of the site as a petrol service station had been addressed and no contamination issues remained due to this land use. This conclusion was verified by Auckland Regional Council (ARC) and a Certificate of Compliance (CoC) was issued under Rule 5.5.42 of the Proposed Auckland Regional Plan: Air, Land & Water (PARP:ALW 2008).

Our investigation into the site history highlighted the fact that no test pit investigation or soil sampling had occurred in the location of the two large historic USTs shown in the 1989 Mobil Demolition Plan (dwg no O02021/06/08). In addition, in order to obtain a CoC from ARC under Rule 5.5.41 of the PARP:ALW (2008) further soil and groundwater sampling was required to determine heavy metal, total petroleum hydrocarbon (TPHs) and benzene, toluene, ethylbenzene and xylene (BTEX) concentrations and to check for the presence of separate phase hydrocarbons.

Test pit and soil sampling results from across the site confirm that while there is some evidence of the presence of hydrocarbons to the south and east of the concrete forecourt, this is minor and Tier 1 guidelines as detailed under Rule 5.5.41 of the PARP:ALW (2008) are met. Likewise heavy metal concentrations meet permitted activity criteria listed in Schedule 10 of the PARP:ALW (2008). Groundwater sampling indicates that contamination of groundwater at the site is not occurring. These groundwater sampling results confirm that the environmental effects of the hydrocarbons noted in excavations to the south and east of the forecourt are less than minor and have not impacted on groundwater.

In conclusion, based on the evidence presented in the PDP tank removal report and this report, the subject site is deemed to meet permitted activity criteria as detailed in the PARP:ALW (2008). Hence we request that a CoC based on Rule 5.5.41 of the PARP:ALW (2008) be issued.

8.0 LIMITATIONS

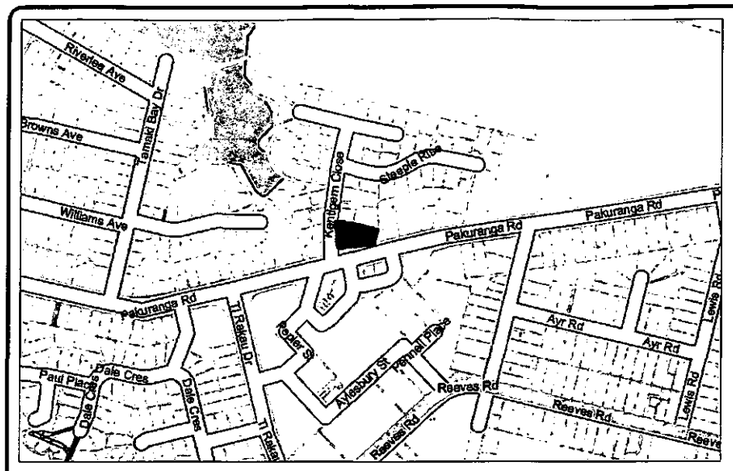
We have performed our services for this project in accordance with current professional standards for an assessment of the nature and extent of any soil contamination on-site, based upon preliminary site assessment investigations and current regulatory standards for site contamination. The scope of the site assessment activities was generally in accordance with the Ministry for Environment Contaminated Land Management Guideline's (Parts 1, 2 and 5) and the PARP:ALW. Conclusions on actual or potential contamination cannot be applied to areas outside of the site investigation.

Limited sampling was undertaken as part of this investigation. We do not assume any liability for misrepresentation or items not visible, accessible or present at the subject site during the time of the site inspection.

 The professional opinion expressed herein has been prepared solely for, and is furnished to Auckland Regional Council, Manukau City Council and our client, Sea Horse Investments Ltd, on the express condition that it will only be used for the works and the purpose for which it is intended.

No liability is accepted by this firm or by any principal, or director, or any servant or agent of this firm, in respect of its use by any other person, and any other person who relies upon any matter contained in this report does so entirely at its own risk. This disclaimer shall apply notwithstanding that this report may be made available to any person by any person in connection with any application for permission or approval, or pursuant to any requirement of law.

Figures and Drawings



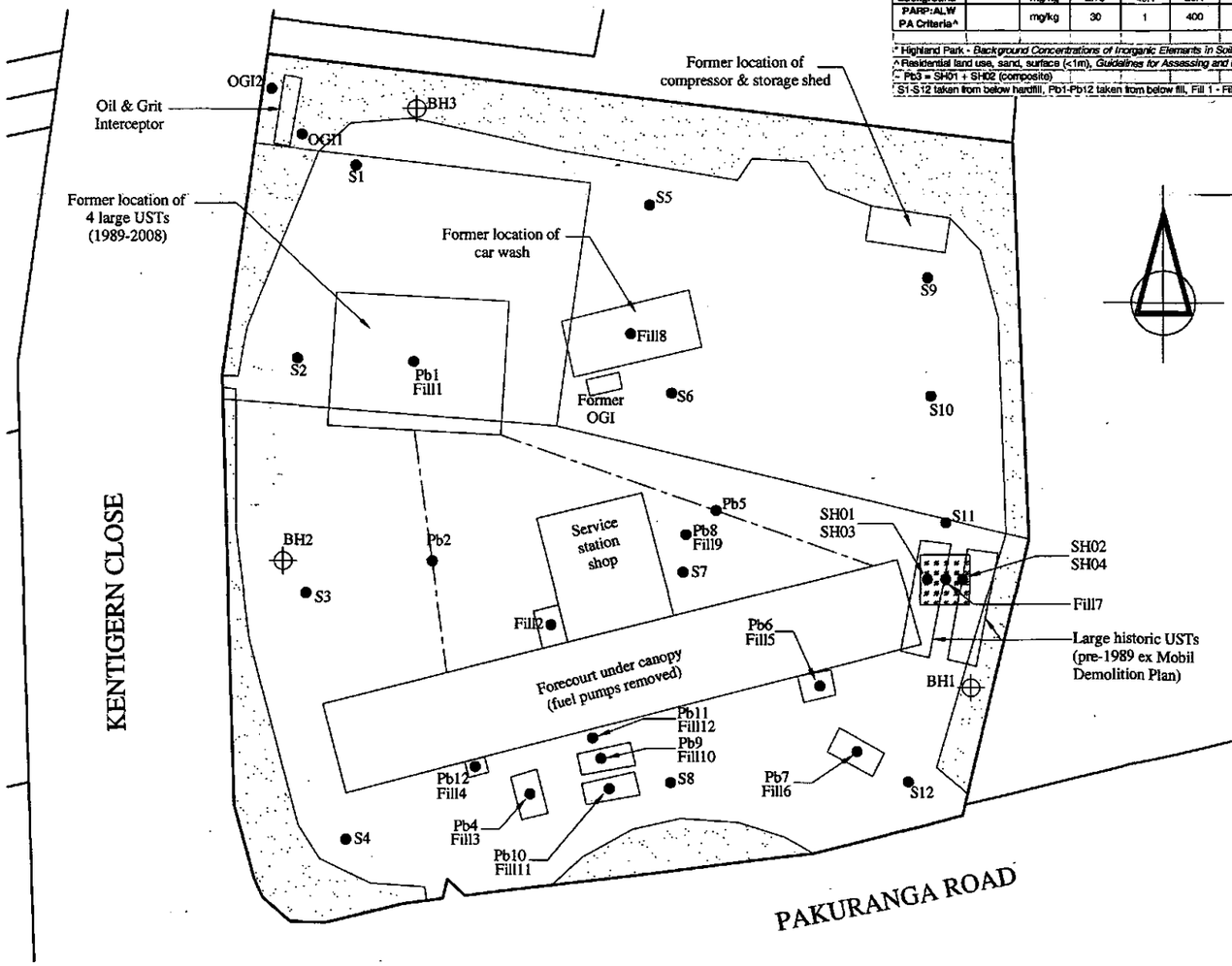
SITE LOCATION
SCALE NTS

Sample No.	Depth * (m)	Units	As	Cd	Cr	Cu	Pb	Ni	Zn	PID Reading	TPHs C7-C9	TPHs C10-C14	TPHs C15-C36	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
S1	0-0.2	mg/kg	<2.0	<0.1	34	11	11	22	50	0	-	-	-	-	-	-	-	-
S2	0-0.2	mg/kg	<2.0	<0.1	32	11	7.6	23	46	0	-	-	-	-	-	-	-	-
S3	0-0.2	mg/kg	<2.0	<0.1	27	13	8	22	42	82	<10	<20	<30	-	-	-	-	-
S4	0-0.2	mg/kg	3.7	<0.1	43	16	7.6	26	64	0	-	-	-	-	-	-	-	-
S5	0-0.2	mg/kg	3.8	<0.1	45	16	7.7	34	58	0	-	-	-	-	-	-	-	-
S6	0-0.2	mg/kg	6.5	<0.1	45	17	10	26	56	0	-	-	-	-	-	-	-	-
S7	0-0.2	mg/kg	2.2	<0.1	38	21	8.1	31	74	0	-	-	-	-	-	-	-	-
S8	0-0.2	mg/kg	<2.0	<0.1	35	16	9.1	30	52	240	23	26	<30	-	-	-	-	-
S9	0-0.2	mg/kg	<2.0	<0.1	39	25	12	31	72	0	-	-	-	-	-	-	-	-
S10	0-0.2	mg/kg	3.7	<0.1	40	10	6.4	22	48	0	-	-	-	-	-	-	-	-
S11	0-0.2	mg/kg	3.2	<0.1	47	24	11	38	74	0	-	-	-	-	-	-	-	-
S12	0-0.2	mg/kg	<2.0	<0.1	34	8.9	4.9	18	40	0	-	-	-	-	-	-	-	-
Pb1	0-0.2	mg/kg	-	-	-	-	9.3	-	-	-	-	-	-	-	-	-	-	-
Pb2	0-0.2	mg/kg	-	-	-	-	8.4	-	-	-	-	-	-	-	-	-	-	-
Pb4	0-0.2	mg/kg	-	-	-	-	9.3	-	-	-	-	-	-	-	-	-	-	-
Pb5	0-0.2	mg/kg	-	-	-	-	8.9	-	-	-	-	-	-	-	-	-	-	-
Pb6	0-0.2	mg/kg	-	-	-	-	8.5	-	-	-	-	-	-	-	-	-	-	-
Pb7	0-0.2	mg/kg	-	-	-	-	8.6	-	-	-	-	-	-	-	-	-	-	-
Pb8	0-0.2	mg/kg	-	-	-	-	9.2	-	-	-	-	-	-	-	-	-	-	-
Pb9	0-0.2	mg/kg	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-
Pb10	0-0.2	mg/kg	-	-	-	-	8.8	-	-	-	-	-	-	-	-	-	-	-
Pb11	0-0.2	mg/kg	-	-	-	-	7.1	-	-	-	-	-	-	-	-	-	-	-
Pb12	0-0.2	mg/kg	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-
Fill 1	0.5-1.0	mg/kg	3.8	<0.1	29	39	8.6	67	64	-	-	-	-	-	-	-	-	-
Fill 2	0.5-1.0	mg/kg	<2.0	<0.1	40	50	2.4	190	50	-	-	-	-	-	-	-	-	-
Fill 3	0.5-1.0	mg/kg	<2.0	<0.1	46	51	7.1	160	82	25	<9.5	<20	<30	<0.062	<0.062	<0.062	<0.13	<0.062
Fill 4	0.5-1.0	mg/kg	4.8	<0.1	27	21	11	31	61	880	39	240	810	<0.05	<0.05	0.23	<0.1	0.097
Fill 5	0.5-1.0	mg/kg	3.4	<0.1	20	18	8.1	19	56	426	18	280	850	<0.05	<0.05	0.7	1.7	0.053
Fill 6	0.5-1.0	mg/kg	<2.0	<0.1	42	52	4.5	160	70	739	46	160	160	<0.05	<0.05	<0.05	<0.1	<0.05
Fill 7	0.5-1.0	mg/kg	<2.0	<0.1	55	63	2.2	240	65	-	-	-	-	-	-	-	-	-
Fill 8	0.5-1.0	mg/kg	4.6	<0.1	34	33	19	75	68	-	-	-	-	-	-	-	-	-
Fill 9	0.5-1.0	mg/kg	<2.0	<0.1	40	51	2.9	140	61	-	-	-	-	-	-	-	-	-
Fill 10	0.5-1.0	mg/kg	<2.0	<0.1	50	53	3.6	190	65	-	-	-	-	-	-	-	-	-
Fill 11	0.5-1.0	mg/kg	<2.0	<0.1	39	43	3.5	140	55	-	-	-	-	-	-	-	-	-
Fill 12	0.5-1.0	mg/kg	2.3	<0.1	43	53	3.9	160	64	-	-	-	-	-	-	-	-	-
SH01	2.5	mg/kg	-	-	-	-	-	-	-	-	<9.8	32	<30	-	-	-	-	-
SH02	2.5	mg/kg	-	-	-	-	-	-	-	-	<9.1	<20	<30	-	-	-	-	-
SH01 + SH02	2.5	mg/kg	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-
SH03	1.5	mg/kg	-	-	-	-	-	-	-	-	16	91	<30	-	-	-	-	-
SH04	1.5	mg/kg	-	-	-	-	-	-	-	-	17	43	<30	-	-	-	-	-
OGI 1 & 2	1.0	mg/kg	2.8	<0.1	34	40	17	110	63	-	<8.5	<20	<30	-	-	-	-	-
Background*		mg/kg	2.75	<0.1	28.1	11.5	12.9	23.2	55.9	-	-	-	-	-	-	-	-	-
PARP:ALW PA Criteria^		mg/kg	30	1	400	325	250	105	400	-	120	470	NA	1.1	68	53	48	

* Highland Park - *Background Concentrations of Inorganic Elements in Soils from the Auckland Region*, ARC TP153, 2001.
^ Residential land use, sand, surface (<1m), *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, MfE, 1999.
- Pb3 = SH01 + SH02 (composite)
S1-S12 taken from below hardfill, Pb1-Pb12 taken from below fill, Fill 1 - Fill 12 taken from various depths in fill material, SH01-SH02 taken from below fill.

Sample No.	Depth to GW (m)	Units	As	Cd	Cr	Cu	Pb	Ni	Zn	TPHs	Benzene	Toluene	Ethylbenzene	Xylene
BH1	1.7	µg/L	1.3	<0.05	<0.05	0.9	3.0	5.5	22	<700	<1.0	14	<1.0	<3.0
BH2	1.8	µg/L	<1.0	<0.05	<0.05	<0.5	<0.1	1.0	10	<700	<1.0	4.6	5.9	46
BH3	1.3	µg/L	<1.0	<0.05	<0.5	3.1	<0.1	3.0	17	<700	<1.0	<1.0	<1.0	<3.0
ANZECC Guideline - 80% protection, freshwater		µg/L	140	0.6	40	2.5 ^	9.4	17	31	ID	2000	ID	ID	340 *

Notes
^ Guideline for protection of 80% of species in marine water is 8.0 µ/L
p-Xylene
ANZECC guideline - Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2001



LEGEND

- Landscaped garden areas
- FTL test pit
- Soil sample points •S1 & •Pb1
- Groundwater sampling boreholes ⊕ BH1
- Location of old fuel lines

0 2 5 10 25
Scale 1:500

SURVEYED			APPROVED DATE
DESIGNED	TB	APR 09	
DRAWN	TB	APR 09	
CAD	TB	APR 09	
CHECKED	SF	MAY 09	

REVISION	CHANGES	CHECKED	DATE

NOTES

1. Site features in approximate location only. Not surveyed.
2. Cadastral site boundary information imported from Quickmap.
3. A hydrocarbon odour and sheen were observed in in groundwater seeping into test pits at sample points Fill3, Fill4, Fill5, Fill6 and Fill 7.
4. Location of historic USTs taken from the PDP plan (2008) and the Mobil Demolition Plan (1989).

CLIENT
SEA HORSE INVESTMENTS LTD

PROJECT
102 PAKURANGA ROAD
PAKURANGA

TITLE
SITE LOCATION,
SITE FEATURES &
SAMPLING RESULTS PLAN

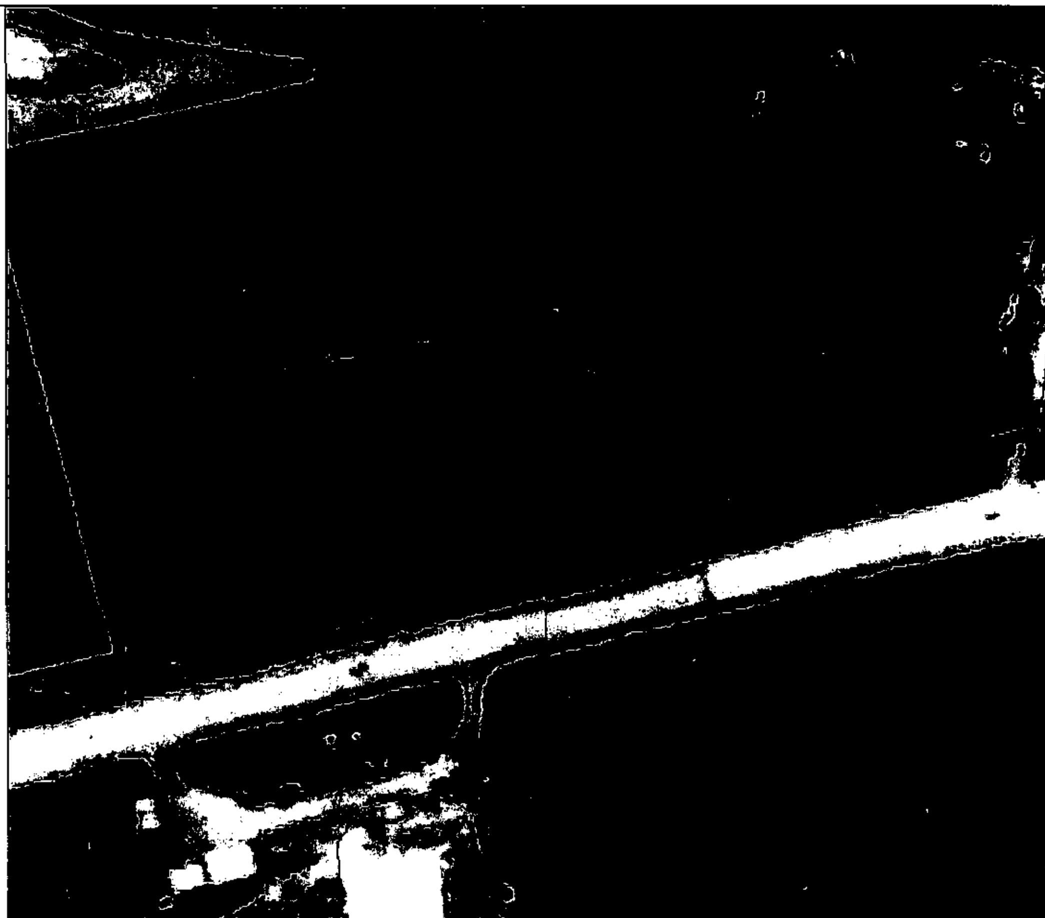
Fraser Thomas
- CONSULTING ENGINEERS
- RESOURCE MANAGERS
- ENVIRONMENTAL CONSULTANTS
- SURVEYORS & PLANNERS

152 KOLMAR ROAD, PAPATOETOE
PO BOX 23-273
TEL:+64-9-278 7078
FAX: PAPATOETOE +64-9-278 3697

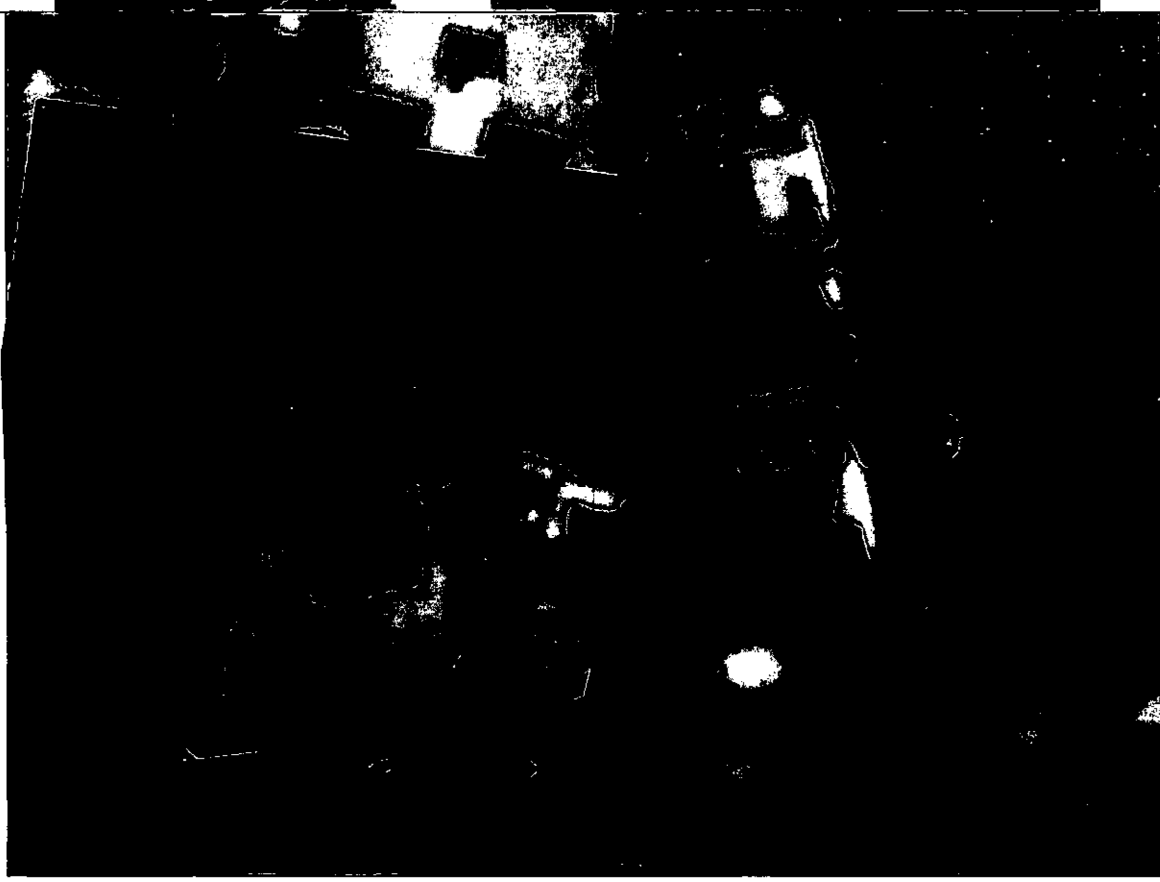
WILLIAMS ROAD, PAIHIA
PO BOX 154
TEL:+64-9-402-7838
FAX: PAIHIA +64-9-402 7838

SCALE 1:500 (A3)
DRAWING No 31863/1 REVISION
SHEET 1 of 1

P:\31 series\31863\31863-1 to 5.dwg, 5/08/2009 1:57:58 p.m., TOSHIBA Upstairs New.pc3



1959

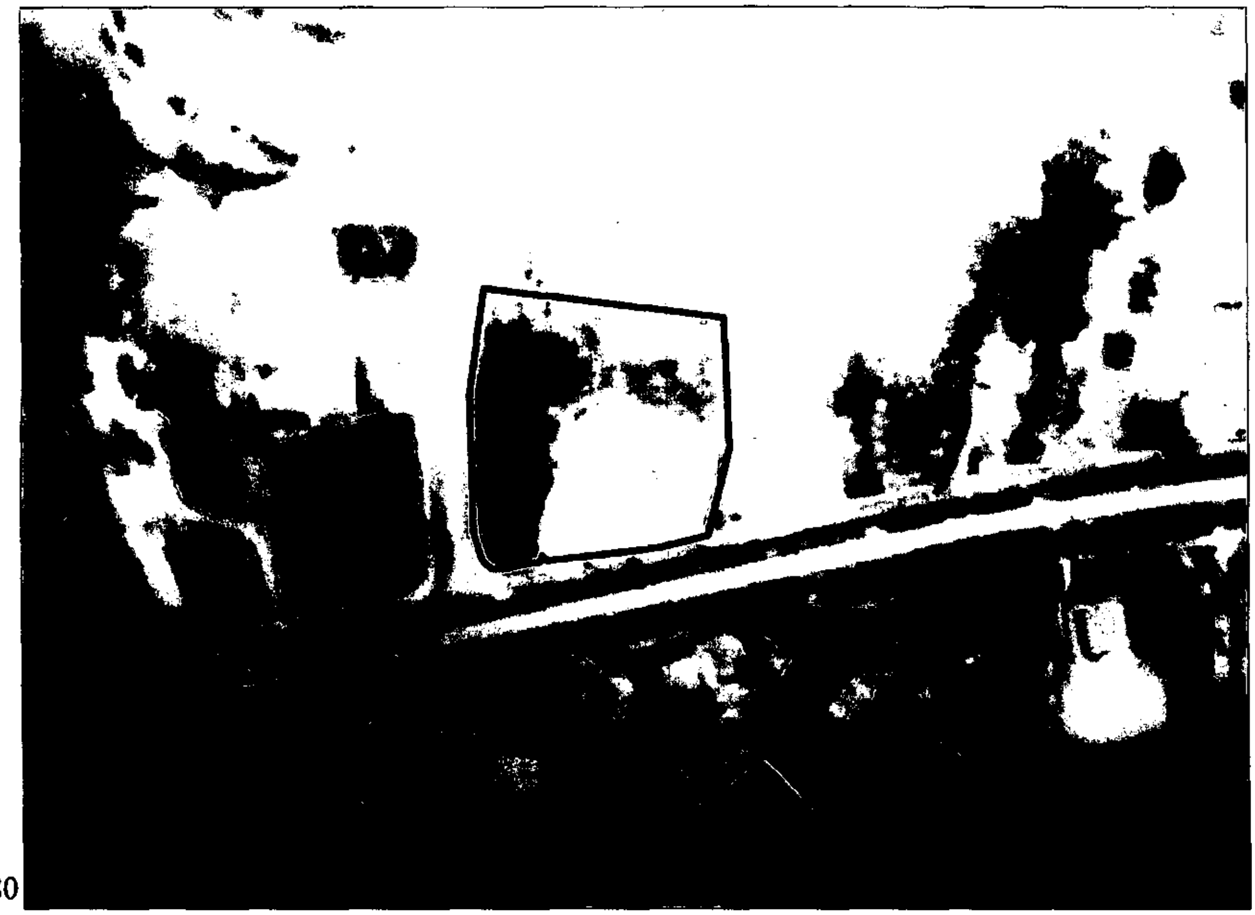


1978

P104 series\31863\31863 1 to 5.dwg, 1959 1978, 30/04/2009 4:49:52 p.m.

Fraser Thomas

CLIENT	PROJECT	TITLE		DRAWING NUMBER
SEA HORSE INVESTMENTS LTD	SITE INVESTIGATION REPORT 102 PAKURANGA ROAD PAKURANGA	AERIAL PHOTOGRAPHS 1959 & 1978	DESIGNED: TB; DRAWN: TB; CAD: TB; CHECKED: SF	31863/2
				SCALE: NTS (A4)



1980

1987

Fraser Thomas	CLIENT SEA HORSE INVESTMENTS LTD	PROJECT SITE INVESTIGATION REPORT 102 PAKURANGA ROAD PAKURANGA	TITLE AERIAL PHOTOGRAPHS 1980 & 1987	SURVEYED		ISSUE	DATE	AMENDMENT	BY
				DESIGNED	TB				
				DRAWN	TB				
				CAD	TB				
				CHECKED	SF				
				REVISION					

DRAWING NUMBER 31863/3

SCALE: NTS (A4)

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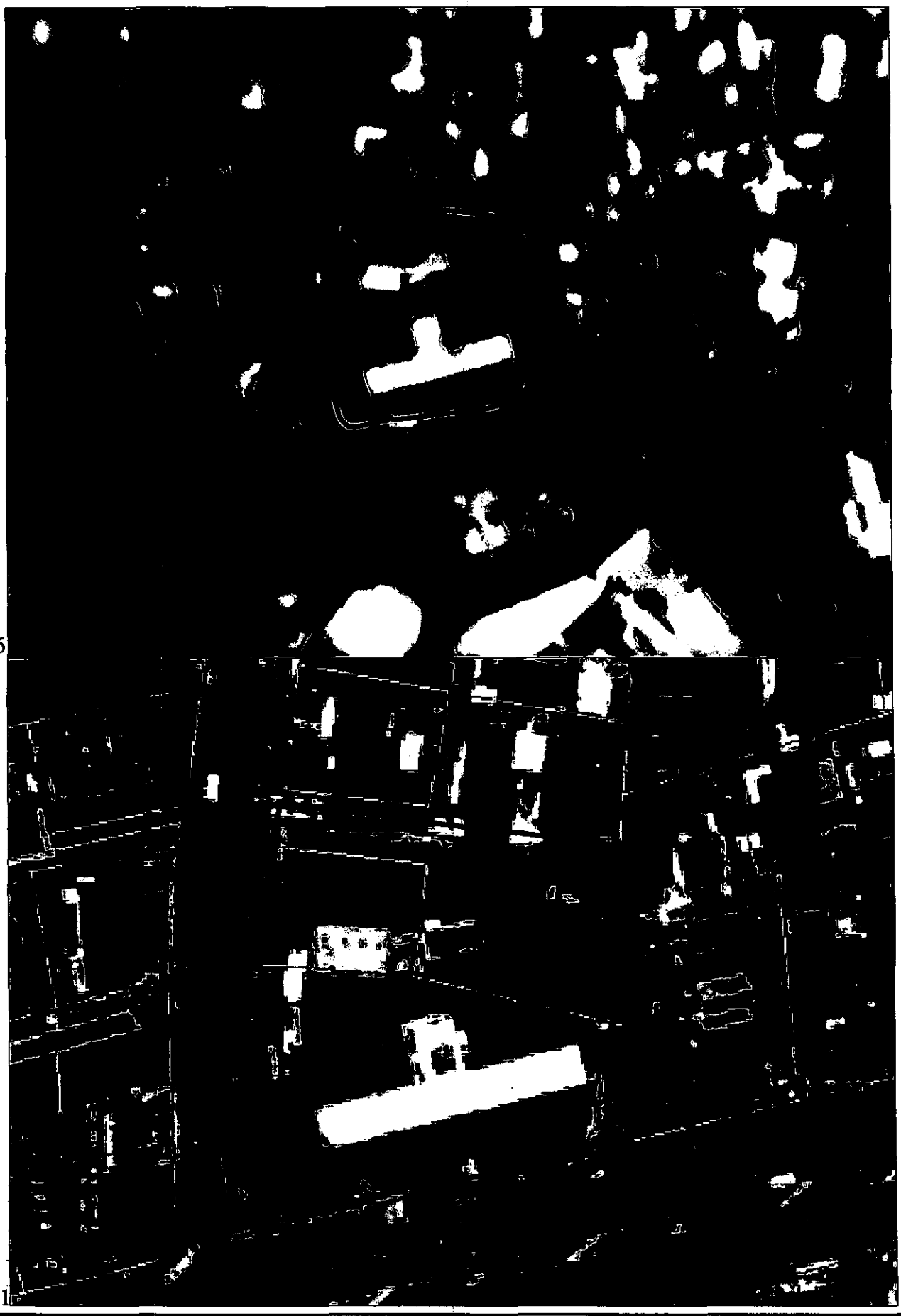


1996

2001

P:\31 series\31863\31863-1 to 5.dwg, 1996-2001, 30/04/2009 4:51:16 p.m.

Fraser Thomas

151 KOLMAR ROAD, PAPATOETOE PO BOX 73-272 TEL: 09-278 7072
WILLIAMS ROAD, PUKEKOHE PO BOX 154 TEL: 09-238-7838
FAX: PAPATOETOE 09-278 3097 | PUKEKOHE 09-238-7839

CLIENT: SEA HORSE INVESTMENTS LTD

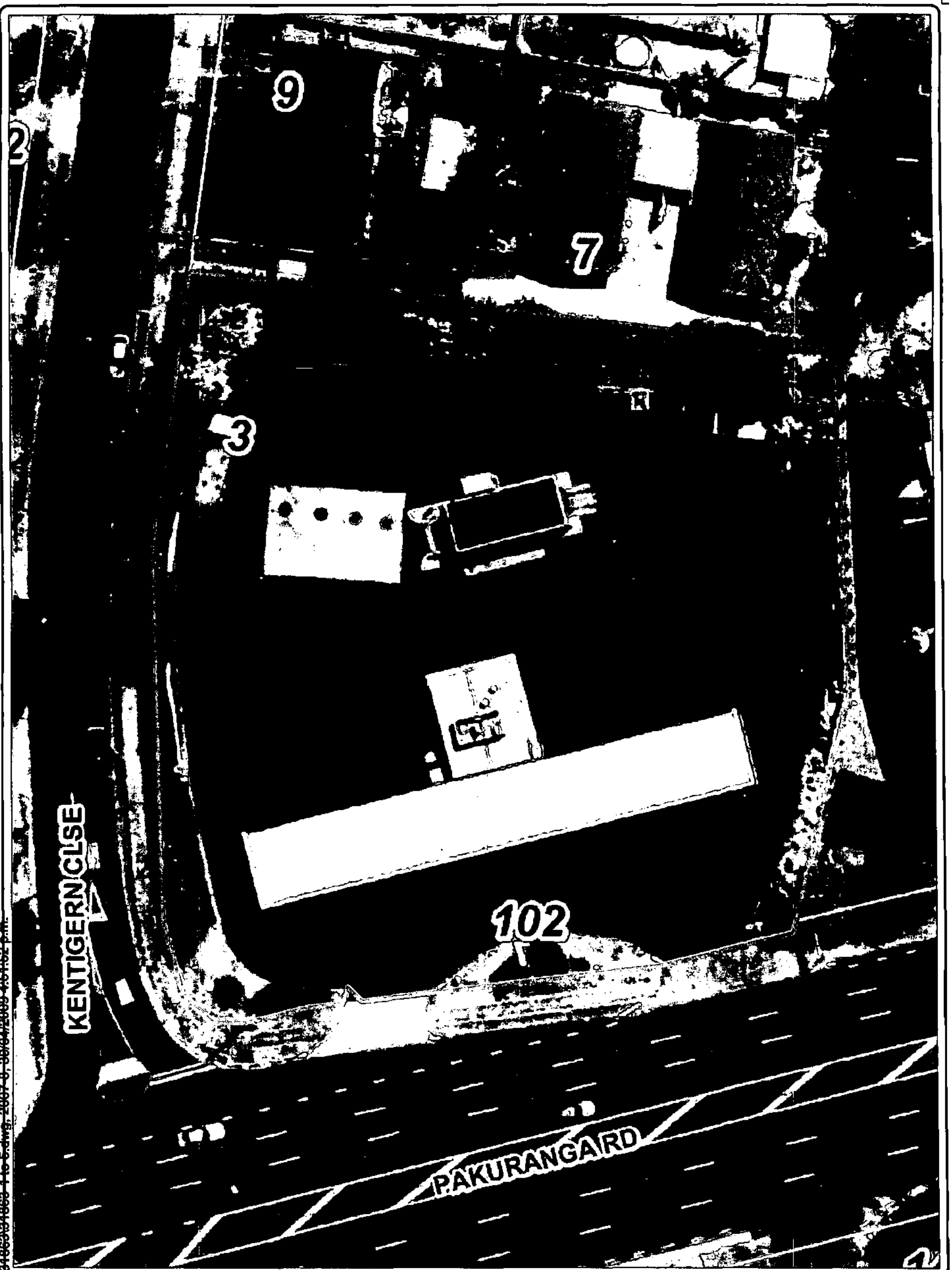
PROJECT: SITE INVESTIGATION REPORT 102 PAKURANGA ROAD PAKURANGA

TITLE: AERIAL PHOTOGRAPHS 1996 & 2001

		ISSUE	DATE	AMENDMENT	BY
SURVEYED					
DESIGNED	TB				
DRAWN	TB				
CAD	TB				
CHECKED	SF				
REVISION					

DRAWING NUMBER: 31863/4

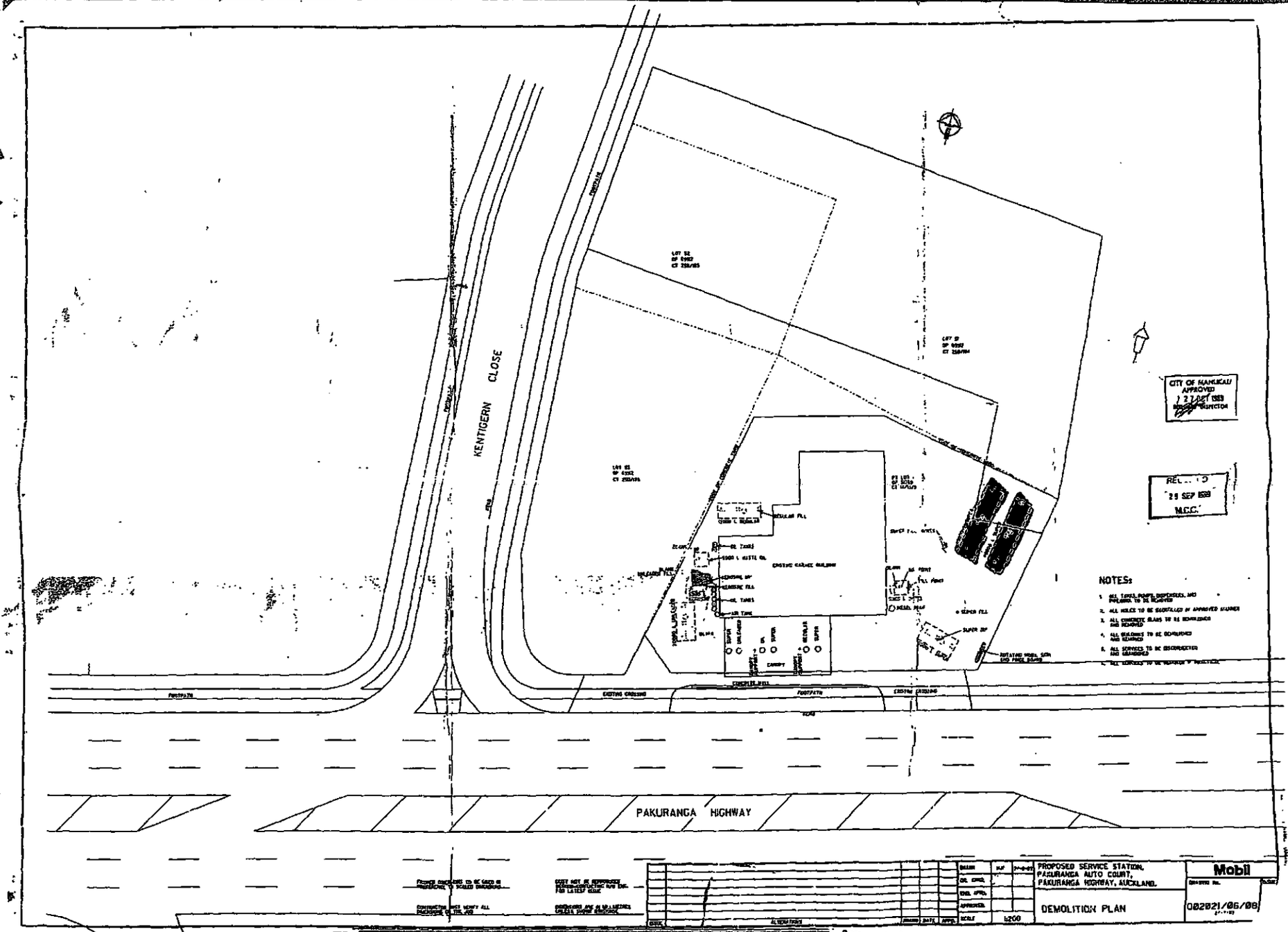
SCALE: NTS (A4)



Fraser Thomas	CLIENT SEA HORSE INVESTMENTS LTD	PROJECT SITE INVESTIGATION REPORT 102 PAKURANGA ROAD PAKURANGA	TITLE AERIAL PHOTOGRAPH 2007/8	SURVEYED		ISSUE	DATE	AMENDMENT	BY
				DESIGNED	TB				
				DRAWN	TB				
				CAD	TB				
				CHECKED	SF				
				REVISION					

DRAWING NUMBER 31863/5

SCALE: NTS (A4)



Appendix A

Certificates of Title

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA25D/185**
Land Registration District	**North Auckland**
Date Issued	02 November 1973

Prior References
NA3A/231

Estate	Fee Simple
Area	601 square metres more or less
Legal Description	Lot 52 Deposited Plan 69912

Proprietors
Sea Horse Investments Limited

Interests
C116116.10 Memorandum of Encumbrance to the Manukau City Council - 13.3.1990 at 2.40 pm
C116116.14 CAVEAT BY MOBIL OIL NEW ZEALAND LIMITED - 13.3.1990 AT 2.40 PM
C530159.3 Mortgage to BNZ Finance Limited - 22.10.1993 at 2.27 pm

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA25D/184**
Land Registration District	**North Auckland**
Date Issued	02 November 1973

Prior References
NA3A/231

Estate	Fee Simple
Area	1363 square metres more or less
Legal Description	Lot 51 Deposited Plan 69912

Proprietors
Sea Horse Investments Limited

Interests
C116116.10 Memorandum of Encumbrance to the Manukau City Council - 13.3.1990 at 2.40 pm
C116116.14 CAVEAT BY MOBIL OIL NEW ZEALAND LIMITED - 13.3.1990 AT 2.40 PM
C530159.3 Mortgage to BNZ Finance Limited - 22.10.1993 at 2.27 pm

CANCELLED

(Land and Deeds—6.
[Form B.

NEW ZEALAND.

Reference: Vol. 454, Folio 225
Transfer No. 211794
Application No.
Order for N/O No.

Register-book, Vol. 456, folio 120

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT.

This Certificate, dated the third day of May, one thousand nine hundred and twenty-seven under the hand and seal of the District Land Registrar of the Land Registration District of AUCKLAND Witnesseth that

EDWIN JAMES BERRY of Panmure farmer

is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial under written or endorsed hereon, subject also to any existing right of the Crown to take and lay off roads under the provisions of any Act of the General Assembly of New Zealand) in the land hereinafter described, as the same is delineated by the plan hereon bordered green, be the several admeasurements a little more or less, that is to say: All that parcel of land containing fifteen acres two roods and thirty-six perches more or less being lots eight (8) nine (9) and ten (10) on a plan deposited in the Land Registry Office at Auckland as No.14882 and being portion of Fairburn's Old Land Claim No. 269A situated in Block II of the Otahuhu Survey District.

K107208

AUCKLAND DISTRICT LAND REGISTRAR NEW ZEALAND

Assistant District Land Registrar.

Agreement as to fencing contained in Transfer No.211794.

Asst. L.R.

Mortgage No. 146852 Edwin James Berry to The State Advances Superintendent produced 14-5-27 at 12.0 [illegible] Asst. L.R.

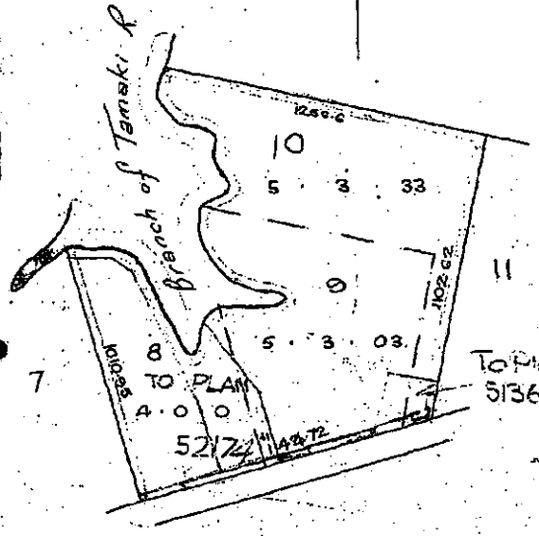
Mortgage No. 146905 Edwin James Berry to William [illegible] produced 18/5/27 at 12.35 [illegible] Asst. L.R.

Transfer No. 231469 Edwin James Berry to John Arthur Sunliffe of Auckland, labourer produced 17.9.29 at 11.10 a.m. [illegible] A.L.R.

Mortgage No. 199806 John Arthur Sunliffe to Walter Hughes Engineer of Auckland [illegible] produced 17.9.29 at 11.12 a.m. [illegible] A.L.R.

Variation of terms of mortgage No. 199806 produced 21.9.1934 at 9.45 a.m. [illegible] A.L.R.

over



Total Area 15 . 2 . 36

Scale 4 chns to an inch

CANCELLED

CANCELLED.

Transfer 307724 of mortgage 199806 Walter Hughes Raymer to John Arthur Cunliffe of Auckland, labourer produced 4/4/1939 at 12.20 p.m.

A.L.R.

Transfer No. 307896 John Arthur Cunliffe to James Tidball Herd of Howick retired draper produced 6/4/1939 at 11.55 a.m.

A.L.R.

Transfer 325104 Garnet Tidball Herd to Harold Sydney Edwards of Mairaki Farmer produced 26.8.1940 at 2.30 p.m.

A.L.R.

Mortgage 266478 Harold Sydney Edwards to Garnet Tidball Herd produced 26.8.1940 at 2.30 p.m.

DISCHARGED

A.L.R.

Transfer 383206 Harold Sydney Edwards to Leslie Roy Davis of Ponsonby, mechanic produced 13.2.45 at 10.15 a.m.

A.L.R.

Transfer 489949 Leslie Roy Davis to Dudley Kingston Dowling of Ponsonby, teacher produced 19/4/1951 at 11.33 a.m.

A.L.R.

Mortgage 355818 Dudley Kingston Dowling to The Guardian Trust and Executors Company of New Zealand Limited ~ produced 19/4/1951 at 11.34 a.m.

DISCHARGED

A.L.R.

Mortgage 445846 to The Guardian Trust and Executors Company of New Zealand Limited produced 7.10.1957 at 12.16 p.m.

DISCHARGED

A.L.R.

Mortgage 530284 to The Commercial Bank of Australia Limited produced 29.10.1959 at 11.15 a.m.

DISCHARGED

A.L.R.

K. 107206 imposing a building restriction affecting Lot 1 Plan 51368. Entered 31.12.1962

A.L.R.

Discharge of mortgage 445846 as to Lot 2 Plan 51368 Produced 21.12.1962 at 9.00 a.m.

A.L.R.

Discharge of mortgage 530284 as to Lot 2 Plan 51368 Produced 21.12.1962 at 9.01 a.m.

A.L.R.

Pursuant to section 35 (3) of the Counties Amendment Act 1961, Lot 2 plan 51368 is vested in Her Majesty the Queen as road

A.L.R.

Variation of Terms of Mortgage 445846 Produced 22/2/1963 at 12.0 o'clock

A.L.R.

Transfer 695265 of Lot 1 plan 51368 to Pakuranga Motors Limited Produced 27.2.1963 at 2.11 p.m.

1A/1229

A.L.R.

Discharge of Mortgage 445846 as to Lot 1 Plan 51368. Produced 27.2.1963 at 2.9 p.m.

A.L.R.

Mortgage 544832 to the residue to The Commercial Bank of Australia Limited Produced 8.8.1963 at 11.51 a.m.

DISCHARGED

A.L.R.

Discharge of Mortgage 445846 as to Lots 5, 6 and 7 Plan 52174 Produced 12.9.1963 at 12.2 p.m.

A.L.R.

Discharge of Mortgage 544832 as to Lots 1, 2, 3, 4, 5, 6 and 7 plan 52174 Produced 12.9.1963 at 12.2 p.m.

A.L.R.

Pursuant to section 35 (3) of the Counties Amendment Act 1961, Lot(s) 6 plan 52174 is/are vested in Her Majesty the Queen as Road

A.L.R.

Pursuant to section 35 (4) of the Counties Amendment Act 1961, Lots 5 & 7 plan 52174 are vested in the Chairman, Councillors, and Inhabitants of the County of Manukau respectively as a reserve for Recreation, Esplanade subject to the Reserves and Domains Act 1953.

A.L.R.

C.46205 Cancelled as to 12.9.1963 Lots 1 and 2, 3 and 4 plan 52174 and new C.T. issued Vol 2A Fol 1499

A.L.R.

Transfer 713333 of the residue to Gray Homes Limited Produced 12.12.1963 at 10.12 a.m.

3A/231

A.L.R.

Cancelled except as to road and reserves.

[Land and Deeds—4.

[Form B.

NEW ZEALAND.

Reference: *Vol.* 127 , *Folio* s 11 and 12
Transfer No. 209535
Application No.
Order for N/C No.

Register-book,
Vol. 454 , *folio* 225

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT.

This Certificate, dated the eighteenth day of March one thousand nine hundred and twenty seven under the hand and seal of the District Land Registrar of the Land Registration District of AUCKLAND Witnesseth that

FRANCES MARY SIMCOX wife of William Henry Simcox of Otaki and THE PUBLIC TRUSTEE are seised of an estate in fee simple as tenants in common in equal shares

~~is seised of an estate in fee simple~~ (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial under written or endorsed hereon, subject also to any existing right of the Crown to take and lay off roads under the provisions of any Act of the General Assembly of New Zealand) in the land hereinafter described, as the same is delineated by the plan hereon bordered green, be the several admeasurements a little more or less, that is to say: All ~~that~~ those parcels of land containing together three hundred and three acres three roods thirty four perches and four tenths of a perch more or less being Lots 1, 2, 3, ~~4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42~~ (43, 44 and 45) on a plan deposited in the Land Registry Office at Auckland as No. 14882 and being portions of Fairburn's Old Land Claim No. 269 situated in Block II of the Otahuhu Survey District.

AUCKLAND DISTRICT LAND REGISTRY

Assistant ~~District~~ Land Registrar.

X 7450 Caveat by James Valentine Lawes against Lot 28 on plan 14882 Entered 15th September 1921 at 11.54 a.m.

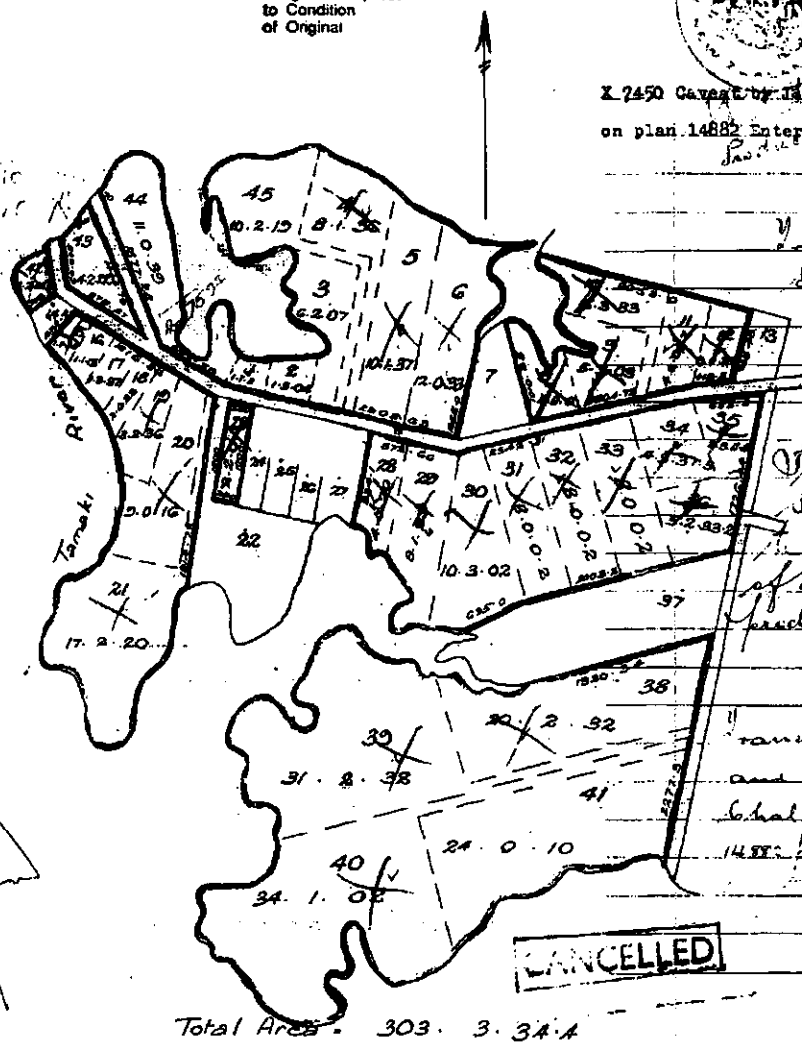
Assst. Land Regr.

Transfer of Frances Mary Simcox and The Public Trustee to Edwin James Berry of Lot 2 and 10 plan 14882 produced 3/4/27 at 2.45

Transfer No 214771 Frances Mary Simcox and The Public Trustee to George Edward Simcox of Lots 5 and 6 plan 14882 produced 11/5/27 at 3 pm

Transfer No 215350 Frances Mary Simcox and The Public Trustee to Thomas Challinor Purchaser of Lot 38 plan 14882 produced 1-9-27

CANCELLED



with ... 30, 31, 32 33 36 plan 14882 [illegible] appurtenant [illegible] [illegible] [illegible] [illegible] [illegible] Transfer No 21(?)92 produced 29/9/24 at 11.5 [illegible]

Transfer No 216242 Frances Mary Simcox and The Public Trustee to Robert Millen of Lots 29 31 and 32 plan 14882 produced 4/10/27 at 11.5 am

Asst L Regr

Transfer No 214105 Frances Mary Simcox and the Public Trustee to James Valentine Lawes of Lot 28 plan 14882 produced 21-7-27 at 10.25 am and Entered 19-10-27 at 12.50 pm

Asst L Regr

Transfer No 21(?)433 Frances Mary Simcox and the Public Trustee to James Nelson [illegible] of lot 40 plan 14882 produced [illegible] at 11.40 [illegible]

Transfer No 218297 Frances Mary Simcox and The Public Trustee to Alfred Glenny Laurie of lots 33 34 35 and 36 plan 14882 produced 18/12/27 at 2.20 pm

Transfer No 218795 Frances Mary Simcox and The Public Trustee to Ronald Wallace Riley of Lot 12 plan 14882 produced 13/1/28 at 11.45 am

Asst L Regr

Transfer No 22(?)126 Frances Mary Simcox and the Public Trustee to Robert Millen of lot 30 plan 14882 produced 26 4 28 at [illegible]

Transmission No 24154 of the interest of Frances Mary Simcox deceased of the balance to William Martin Simcox of Forest Lakes Otaki sheep farmer Francis Selwyn Simcox of Otaki and Edwin Percivale Simcox of Manakau both sheepfarmers as Executors ~~as tenants in common with the Public Trustee~~ Entered 6.2.29 at 10.5 am

Transfer No 230129 William Martin Simcox Francis Selwyn Simcox and Edwin Percivale Simcox to the said William Martin Simcox Francis Selwyn Simcox and Edwin Percivale Simcox of their undivided moiety in Lots 1 2 3 42 43 44 and 45 on plan 14882 as tenants in common in equal shares produced 18/3/29 at 10.40 am

Asst L Regr

Transfer No 238216 The Registered Proprietors to Clarissa Amelia Bennett and Madge Irene Bennett of Lot 11 plan 14882 produced [illegible]/30 at 10.4 am

K No. 11366 Certificate of Charge under Land & Income Tax Amendment Act 1924 produced 30-3-30 [illegible]

DISCHARGE

Assist. Land Regr.

Transfer No 240136 The Registered Proprietors to Robert Millen of lot 21 plan 14882 produced 13-5-30 at 10.50 am

Transfer No 240743 The Registered Proprietors to Maude Amelia Murray and Lucy Kate Skeet of Lot 4 plan 14882 as tenants in common in equal shares produced [illegible] 30 at 12.40 pm

No 7594 Proclamation taking part of lot 46 plan 14882 for a road. Entered [illegible]

Transfer No 273656 The Registered Proprietors to Thomas Jordan Fleming of Lots 19 20 and 23 plan 14882 produced 13 10 3[illegible] at [illegible]

Transfer No 273230 of Lot 42 plan 14882 The Public Trustee to Henry Joseph Reilly produced 13-11-1935 at 10.10 a.m.

[illegible] No [illegible] of lot 13 plan 14882 Registered proprietors to Ethel Blanch [illegible] produced 19.12.1935 at 2.25 pm

K. No. [illegible] Notice of Statutory Land Charge by [illegible]

Entered / /19 at

Assist. Land Regr.

Notice of Order of the Court of Review under The Mortgagors and Lessees Rehabilitation Act, 1936. Entered [illegible] at [illegible]

Asst. Land Regr.

Transfer 310634 of residue of Lot 44 plan 14882 The Public Trustee to Wilson Rothery Limited produced 17-8-1939 at 10.40 am

717/94

Transfer 313830 of Lots 1, 2, 3 and 45 plan 14882 The Public Trustee to Joseph Roberts produced 15-9-1939 at 2.7 pm

716/118

Transfer [illegible] of lot 41 plan 14882 the registered proprietors to Edward [illegible] [illegible] produced [illegible] at [illegible]

785/139

Manakau [illegible]

A-54/273 cont'd

Transfer 363750 of Lots 16, 17 and 18 plan 14853
to registered proprietors to Henry Gregory
produced 6-9-1943 at 10-10 a.m.

Transfer 373787 of Miscellaneous excepting road
to registered proprietors to Ethel Rowena Barber
produced 26-8-1944 at 2:25 p.m.

CANCELLED

Land and Deeds 69

No. 25D/186

Prior C.T. 3A/231

Transfer No.

N/C. Order No. 050396.1.

REGISTER

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 2nd day of November one thousand nine hundred and seventy-three under the seal of the District Land Registrar of the Land Registration District of North Auckland

WITNESSETH that LEON ROBERT IDOINE of Auckland company director and MARY ALICE IDOINE his wife are

seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 985 square metres more or less being Lot 53 on Deposited Plan 69912 and being part Fairburn's Old Land Claim 269A.

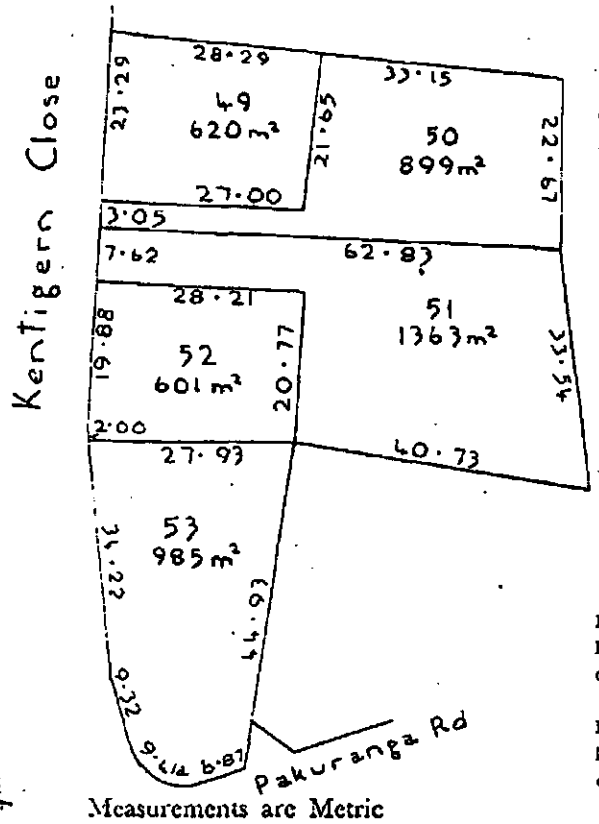
DISTRICT LAND REGISTRAR NORTH AUCKLAND, N.Z.

Assistant Land Registrar

Manukau City

A478867 Compensation Certificate by Manukau City Council 7.7.1970 at 2.18 o'c

A.L.R. TFG



Measurements are Metric

DP 69912

967048.6 Transfer to L.R. Idoine Limited at Papatoetoe - 23.1.1981 at 2.35 o'c

A.L.R.

B.209252.1 Transfer to Machron Nominees Limited at Auckland - 26.8.1983 at 11.25 o'c

A.L.R

B.209252.2 Mortgage to L.R. Idoine Limited - 26.8.1983 at 11.25 o'c

DISCHARGED

A.L.R

B.229972.1 Transfer of Mortgage B.209252.2 to Leon Robert Idoine and Mary Alice Idoine - 31.10.1983 at 1.41 o'c

A.L.R.

B.496575.2 Transfer to Pakuranga Motels Limited at Auckland - 14.1.1986 at 11.11 o'c

REJECTED

A.L.R.

B.496575.3 Mortgage to Bramwell and Grossman Nominees Limited - 14.1.1986 at 11.11 o'c

REJECTED

A.L.R.

A.L.R.

25D/186

Register copy for L. & D. 69, 71, 72

B.499126.2 Transfer to Pakuranga Motels Limited at Auckland - 22.1.1986 at 11.14 o'c

A.L.R

B.499126.3 Mortgage to Bramwell and Grossman Nominees Limited - 22.1.1986 at 11.14 o'c

A.L.R

B.741285.6 Mortgage to Westpac Merchant Finance Limited, Westpac Finance Limited and Westpac Securities Limited - 16.10.1987 at 9.46 o'c

A.L.R.

B.824199.1 CAVEAT BY MOBIL OIL NEW ZEALAND LIMITED - 9.5.1988 at 9.52 o'c

A.L.R.

C.116116.6 Transfer to Kilroy Investments Limited at Papakura - 13.3.1990 at 2.40 oc

A.L.R.

C.116116.10 Memorandum of Encumbrance to the Manukau City Council - 13.3.1990 at 2.40 oc

Discharged 11/3/1999

A.L.R.

C.116116.11 Mortgage to Westpac Merchant Finance Limited, Westpac Finance Limited and Westpac Securities Limited - 13.3.1990 at 2.40 oc

Discharged 22/3/1990

A.L.R.

C.116116.12 Mortgage to ASB Bank Limited - 13.3.1990 at 2.40 oc

A.L.R.

A.L.R.

C.116116.14 CAVEAT BY MOBIL OIL NEW ZEALAND LIMITED - 13.3.1990 at 2.40 oc

A.L.R.

C.179289.5 Transfer to Breadeaze Corporation Limited at Auckland - 24.8.1990 at 2.43 o'c (with Caveator's consent under Caveat C.116116.14)

A.L.R.

C.179289.6 Mortgage to ASB Bank Limited - 24.8.1990 at 2.43 o'c (with Caveator's consent under Caveat C.116116.14)

Plan 149241 Lodged 11-11-1991

A.L.R.

C.337232.1 CAVEAT BY COUNTRYWIDE BANKING CORPORATION LIMITED - 12.12.1991 at 1.31 o'c

A.L.R.

C.365623.3 Mortgage to Countrywide Banking Corporation - 15.4.1992 at 2.12 o'c (with consent of Caveator under Caveat C.116116.14)

A.L.R.

C.501688.1 Withdrawal of Caveat C.116116.4 as to Lot 3 Plan 149241 - 27.7.1993 at 2.00 oc

A.L.R.

Pursuant to Section 306(3) Local Government Act 1974 Lot 3 Plan 149241 is vested in the Manukau City Council as road

A.L.R.

C.501688.2) Cancelled as to Part Lot
O.N.C.T) 1 Plan 149241 and new CT
27.7.1993) issued: **88D/782**

A.L.R.

CANCELLED
DUPLICATE DESTROYED

Reference:
Prior C/T. 456/128

Transfer No. 713363
N/C. Order No.

CANCELLED

Land and Deeds 69

No. 3A/231

REGISTER

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 12th day of December one thousand nine hundred and sixty-three under the seal of the District Land Registrar of the Land Registration District of North Auckland

WITNESSETH that COSY HOMES LIMITED at Papatoetoe

is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 11 acres 23.8 perches more or less being part Lots 8, 9, and 10 Deposited Plan 14882 and being part of Fairburns Old Land Claim 269A.

DISTRICT LAND REGISTRAR NORTH AUCKLAND, N.Z.

DCWragge
Assistant Land Registrar.

11-0-23.8
2.3 - 218631
11-0-21.5

METRIC AREA IS 4.5117 ha
4.5117 ha

Conversion Factors:
1 = 4046m²
1 = m²
1 Link = .2012 metres

Agreement as to fencing contained in Transfer 211794.

DCWragge A.L.R.

A.72944 Mortgage to The National Bank of New Zealand Limited. Produced 30.4.1965 at 9.16 o'c.

Discharged Produced

A.L.R.

A390364 Transfer to Leon Robert Idoine of Auckland, Company Director and Mary Alice Idoine his wife. 20.5.1969 at 9.30 oc

A.L.R

A478867 Compensation Certificate pursuant to Section 17 of the Public Works Amendment Act 1948 - 7.7.1970 at 2.18 o'c. (by Manukau City Council)

J. McHenry A.L.R. 5811

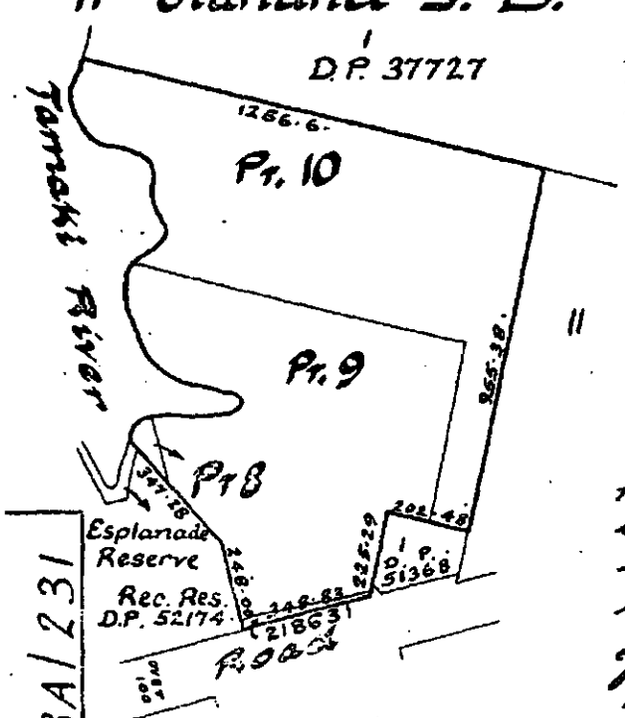
218631 Gazette Notice taking part (2.3 P) for street and vesting same in the Mayor Councillors and Citizens of the City of Manukau from and after the 20th day of November 1972 at 12.19.72 at 1.52 p.m.

Caveat 141642 17/7/73 Rejected

Register copy for L. & D. 69, 71

11 Otahuhu S.D.

D.P. 37727



No. 3A/231

Total area: 11. 0. 23.8

Scale: 1 inch = 4 chains

244319 - rejected

Pursuant to Section 352 (3) Municipal Corporations Act 1954, Lot 63 is/are vested in the Mayor, Councillors and Citizens of the City of MANUKAU as street.

D.P. 69912

050396.1 O.N.C.T. 2.11.1973 Cancelled as to part lots 54, 55 and lots 56-61 inclusive on plan 69912 and new CT's issued

lots 54, 55. 25D/187-188
" 56-61. 25D/189-~~191~~ 193 A.L.R.

Lot 61 - 26D/16.

Pursuant to Section 352 (3) Municipal Corporations Act 1954, Lot 64 is/are vested in the Mayor, Councillors and Citizens of the City of Manukau as street.

D.P. 69913

050396.2 ONCT 2.11.1973 Cancelled as to lots 24-28, part lot 29, part lot 32 lots 33-36, part lot 37, part lot 46, lots 47-48 on plan 69913 and new CT's issued

lots 24-28. 25D/194-198
" 29 - 25D/199 A.L.R.
" 32-37. 25D/202-207
" 46-48. 25D/216-218

Pursuant to Section 352 (3) Municipal Corporations Act 1954, Lot 65 is/are vested in the Mayor, Councillors and Citizens of the City of Manukau as street.

DP 69914

Pursuant to Section 352 (4) Municipal Corporations Act 1954, Lot 62 is/are vested in the Mayor, Councillors and Citizens of the City as ~~a street~~ of Manukau recreation reserve

DP. 69914

L.R.

26C/1111

050396.3 ONCT 2.11.1973 Cancelled as to lots 6-23 inclusive on plan 69914 and new CT's issued

lots 6-23. 25D/219-236 DLR

Cancelled

Lein 152719 17/12

153388 24-12-73.

Reference:
Prior C/T. 456/128

Transfer No. 695265

N/C. Order No.

Land and Deeds 69

REGISTER

No. 1A/1329

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 27th day of February one thousand nine hundred and sixty-three under the seal of the District Land Registrar of the Land Registration District of NORTH AUCKLAND

WITNESSETH that PAKURANGA MOTORS LIMITED at Pakuranga

is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 1 ROOD 15.1 PERCHES more or less being Lot 1 Deposited Plan 51368 and being part Fairburns Old Land Claim 269A.

DISTRICT LAND REGISTRAR NORTH AUCKLAND, N.Z.

D.C. Wragge
Assistant Land Registrar

METRIC AREA IS 1394m2
1394m2

Conversion Factors:
1 Acre = 4046m²
1 Perch = 25.29m²
1 Link = .2012 metres

Fencing covenants in Transfers 211794 and 695265.

D.C. Wragge A.L.R.

Building Line Restriction contained in K.107206.

D.C. Wragge A.L.R.

Mortgage 535893 to Irene Thelma ... Produced 27.2.1963 at 2.13 o'c.

DISCHARGED ... A.L.R.

A.L.R.

Mortgage 535894 to Neale Lovelace Wagstaff. Produced 27.2.1963 at 2.13 o'c.

DISCHARGED 27/8/... A.L.R.

D.C. Wragge A.L.R.

Transfer 704995 of Mortgage 535894 to Eric A. Harnish Limited. Produced 6.8.1963 at 1.42o'c

D.C. Wragge A.L.R.

A.67730 Transfer to Pakuranga Holdings Limited. Produced 31.3.1965 at 11.12o'c.

A.L.R.

A.420633 Transfer to Jolce Holdings Limited at Auckland - 6.10.1969 at 12.10.o'c.

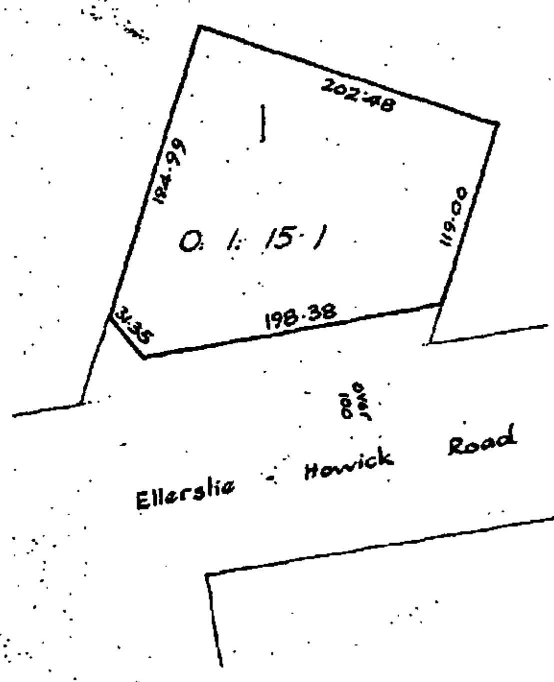
J. ... A.L.R.

A.420634 Mortgage to The Bank of New Zealand Officers Provident Association - 6.10.1969 at ... o'c.

DISCHARGED ...

J. ... A.L.R.

II Otahuhu S.D.



Scale: 1 inch = 1 chain.

DELT. ...

No. 1A/1329

Register copy for L. & D. 69, 71, 72

1A/1329

A.420635 Mortgage to NZ Finance Company Limited - 10.[illegible] 12.10 o'c

A.L.R.

275783.1 Variation of terms of Mortgage A420634 - 4.2.1974 at 10.05 o'c

for A.L.R.

436743.2 Mortgage to Bank of New Zealand - 23.9.1976 at 10.04 o'c

for A.L.R.

436743.3 Memorandum of priority making Mortgage 436743.2 a first mortgage and Mortgage A420635 a second mortgage - 23.9.1976 at 10.14 o'c

for A.L.R.

442557.2 Mortgage to Bank of New Zealand - 24.11.1976 at 10.55 oc.

for A.L.R.

442557.3 Memorandum of Priority making Mortgage 442557.2 a first mortgage and Mortgage A420635 a second mortgage - 24.11.1976 at 10.55 oc

for A.L.R.

B.145926.2 Mortgage to ANZ Banking Group (New Zealand) Limited - 2.2.1983 at 9.58 o'c

A.L.R.

B.741285.3 Transfer to Kilroy Investments Limited at Papakura - 16.10.1987 at 9.46 o'c

A.L.R.

B.741285.4 Mortgage to Westpac Merchant Finance Limited, Westpac Finance Limited and Westpac Securities Limited - 16.10.1987 at 9.46 o'c

A.L.R.

B.741285.7 Mortgage to Jolce Holdings Limited - 16.10.1987 at 9.46 o'c

A.L.R.

Discharged 24/8/1990

C.116116.11 Mortgage to Westpac Merchant Finance Limited, Westpac Finance Limited and Westpac Securities Limited - 13.3.1990 at 2.40 oc

Discharged A.L.R.

C.116116.12 Mortgage to ASB Bank Limited - 13.3.1990 at 2.40 oc

A.L.R.

29/8/91

C.116116.10 Memorandum of Encumbrance to the Manukau City Council - 13.3.1990 at 2.40 o'c

A.L.R.

C.179289.5 Transfer to Breadeaze Corporation Limited at Auckland - 24.8.1990 at 2.43 o'c

A.L.R.

C.179289.6 Mortgage to [illegible] Bank Limited - 24.8.1990 at 2.[illegible] o'c

C365623.2

Plan 149241 Lodged 11-11-1991

A.L.R.

C.337232.1 CAVEAT BY COUNTRYWIDE BANKING CORPORATION LIMITED 4.12.1991 at 1.31 o'c

C365623.1

A.L.R.

C 365623.3 Mortgage to Countrywide Banking Corporation - 15.4.1992 at 2.12 o'c

A.L.R.

Pursuant to Section 306(3)Local Government Act 1974 Lot 2 Plan 149241 is vested in the Manukau City Council as road

A.L.R.

C.501688.2) Cancelled as to Part Lot
O.N.C.T) 1 Plan 149241 and new CT
27.7.1993) issued: 88D/782

A.L.R.

CANCELLED
DUPLICATE DESTROYED

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA88D/782**
Land Registration District	**North Auckland**
Date Issued	27 July 1993

Prior References
NA1A/1329 NA25D/186

Estate	Fee Simple
Area	2278 square metres more or less
Legal Description	Lot 1 Deposited Plan 149241

Proprietors
Sea Horse Investments Limited

Interests
K107206 Building Line Restriction (Affects part formerly CT NA1A/1329)
C116116.10 Encumbrance to The Manukau City Council - 13.3.1990 at 2.40 pm
C116116.14 CAVEAT BY MOBIL OIL NEW ZEALAND LIMITED - 13.3.1990 AT 2.50 PM (AFFECTS PART FORMERLY CT NA25D/186)
C530159.3 Mortgage to BNZ Finance Limited - 22.10.1993 at 2.27 pm

Appendix B

Site Walkover Photographs

Site Photos: 20 April 2009 – Site Features and SH01 to SH04

Photo 1. View of site from Pakuranga Road showing forecourt, canopy and boarded up shop.

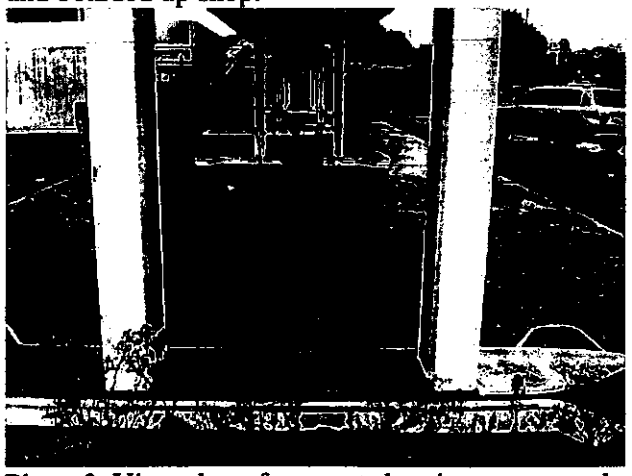


Photo 2. View along forecourt showing pumps and pipe work removed.

Photo 3. View from the northeast corner of the site.

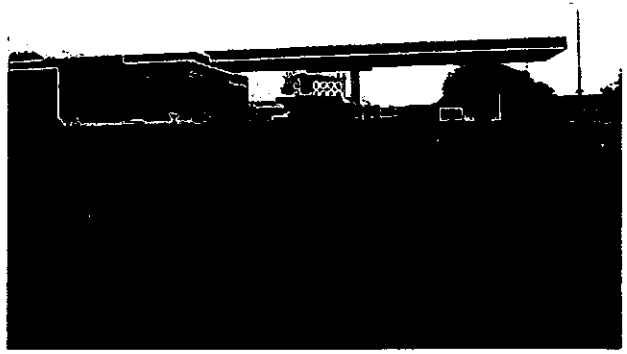


Photo 4. View from the northwest corner of the site. Unsealed area is the former location of the Mobil USTs removed in 2008.

Photo 5. View west from the northeast corner of the site. The unsealed area in the middle of the photo is the former location of the car wash.

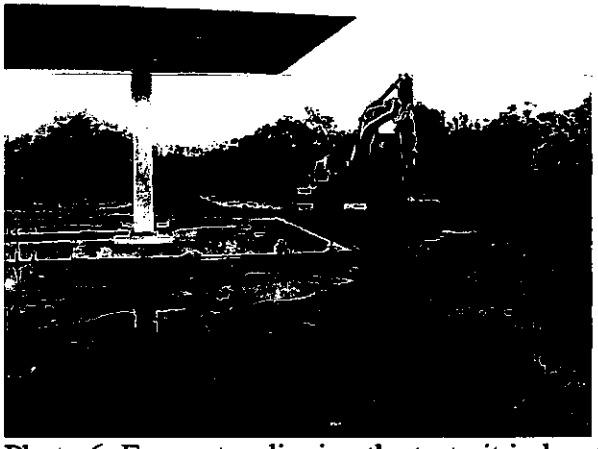


Photo 6. Excavator digging the test pit in location of historic USTs to the east of the existing forecourt area. Samples locations SH01 to SH02.

Photo 7. Test pit showing ponded groundwater that seeped in from east and west sides of the pit at ~1.5m bgl. A hydrocarbon sheen is visible on the wall of the test pit immediately in front of the digger.

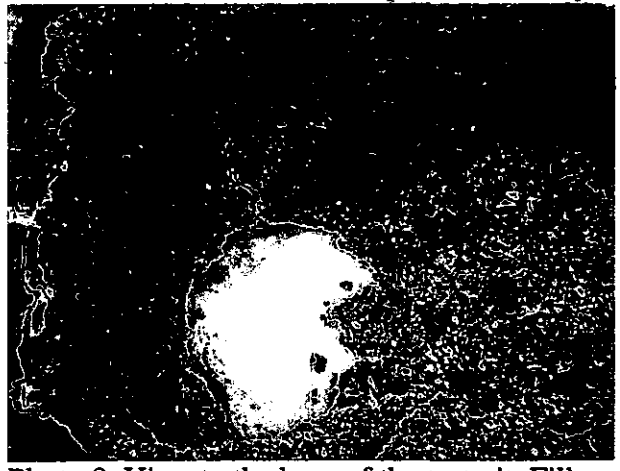


Photo 8. View to the base of the test pit. Fill material is mainly sand and hardfill, with clay in the base of the pit.

Site Photos: 9 July 2009 – S1 to S12

Photo 1: Hole S1 (Approx. 0.5m deep)

Photo 2: Hole S2 (Approx. 0.5m deep)

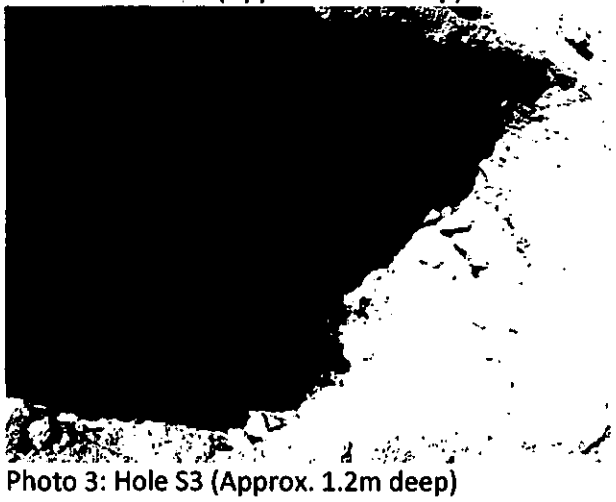


Photo 3: Hole S3 (Approx. 1.2m deep)

Photo 4: Hole S4 (Approx. 1.2m deep)

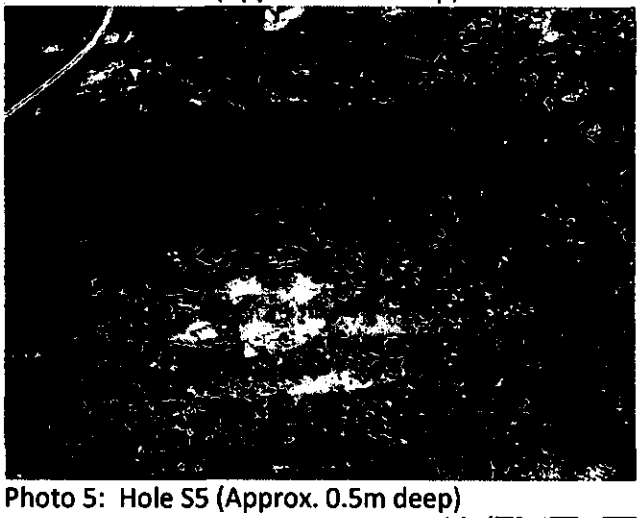


Photo 5: Hole S5 (Approx. 0.5m deep)

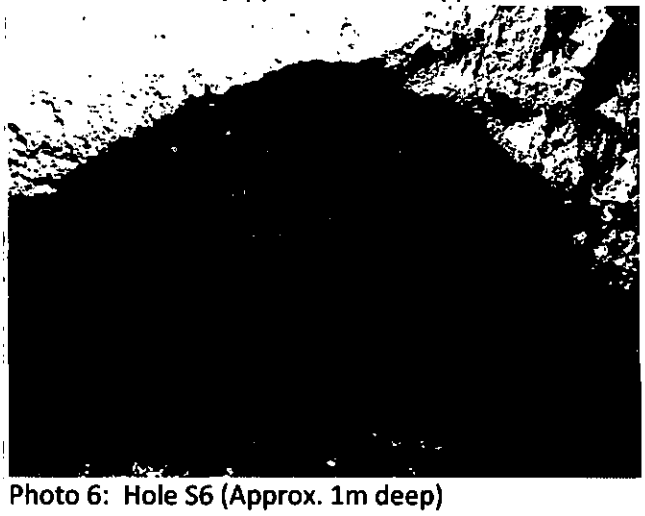


Photo 6: Hole S6 (Approx. 1m deep)

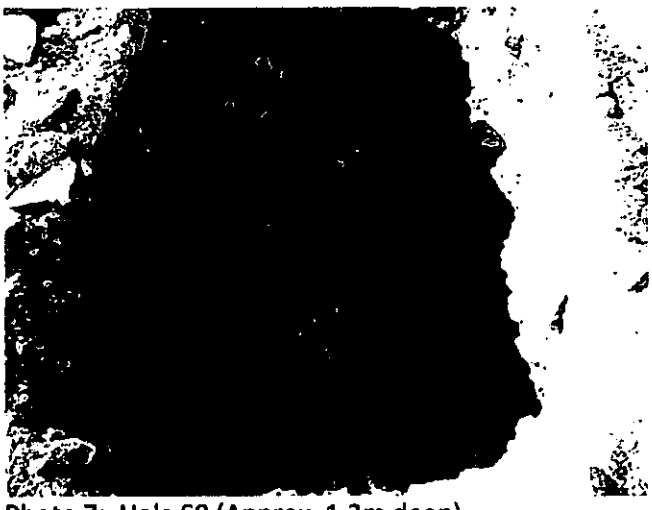


Photo 7: Hole S8 (Approx. 1.3m deep)

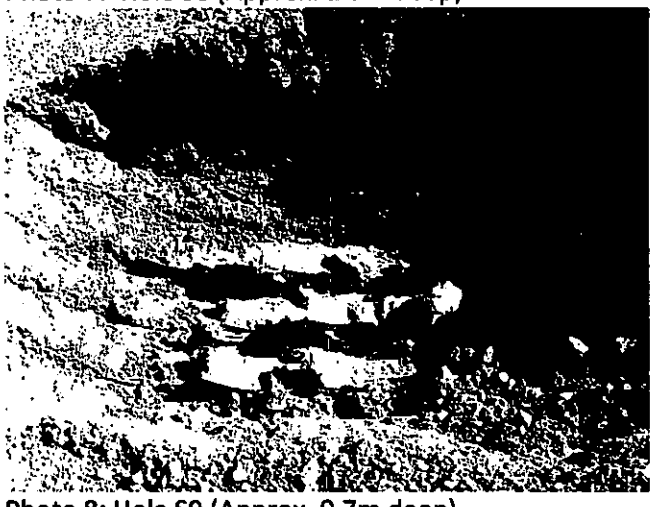


Photo 8: Hole S9 (Approx. 0.7m deep)

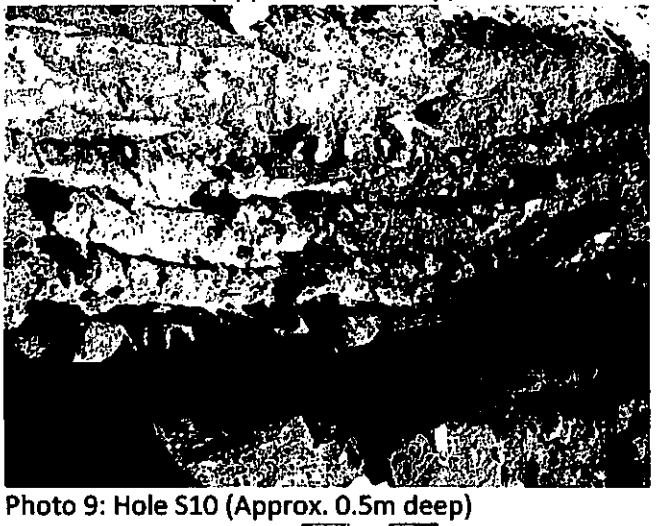


Photo 9: Hole S10 (Approx. 0.5m deep)

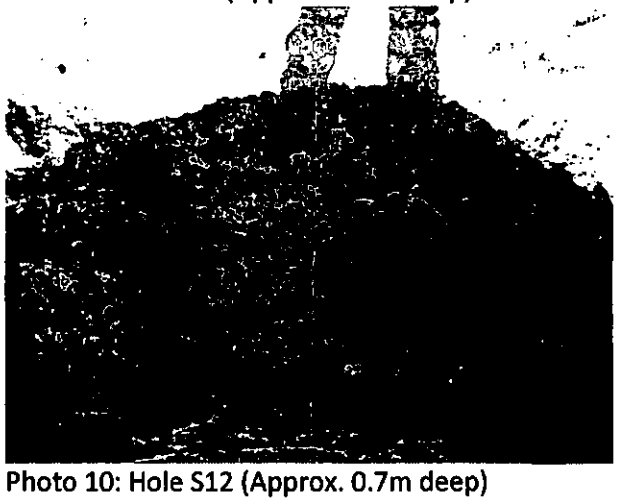


Photo 10: Hole S12 (Approx. 0.7m deep)

Site Photos: 9 July 2009 – Fill/Pb1 to Fill/Pb12

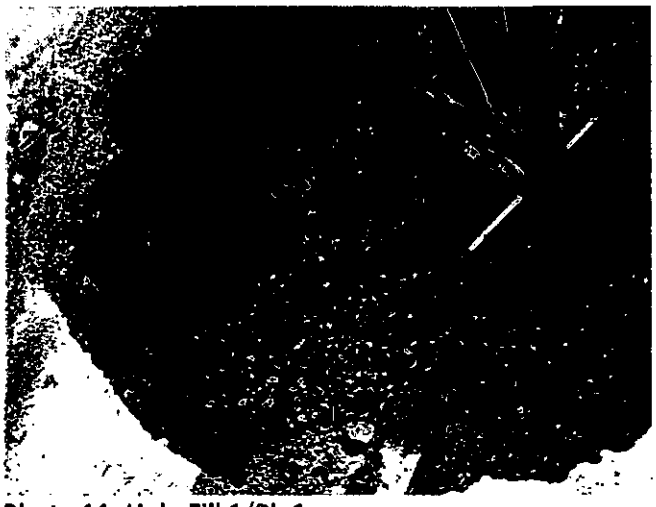


Photo 11: Hole Fill 1/Pb 1

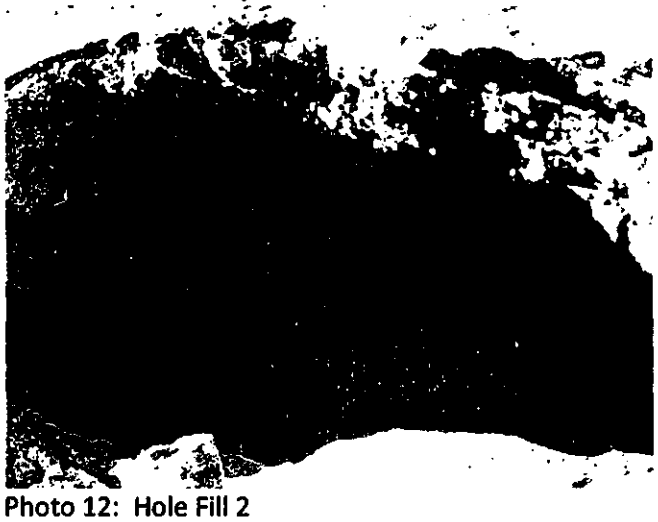


Photo 12: Hole Fill 2

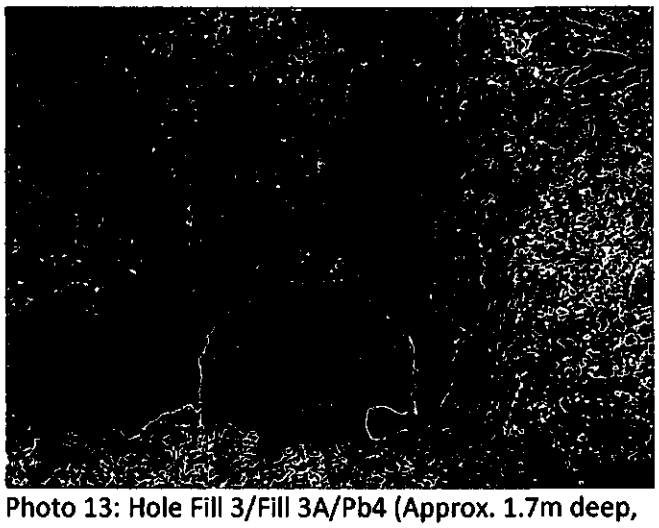


Photo 13: Hole Fill 3/Fill 3A/Pb4 (Approx. 1.7m deep, hydrocarbon smell/sheen)

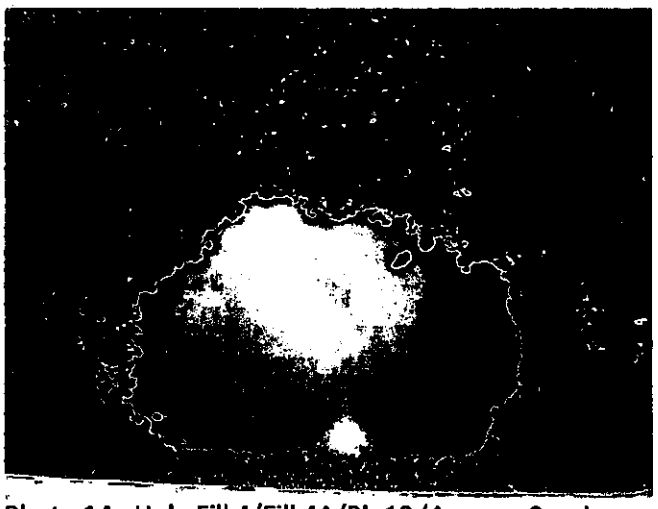


Photo 14: Hole Fill 4/Fill 4A/Pb 12 (Approx. 2m deep, hydrocarbon smell/sheen)

Photo 15: Hole Pb 5 (Approx. 1m deep)

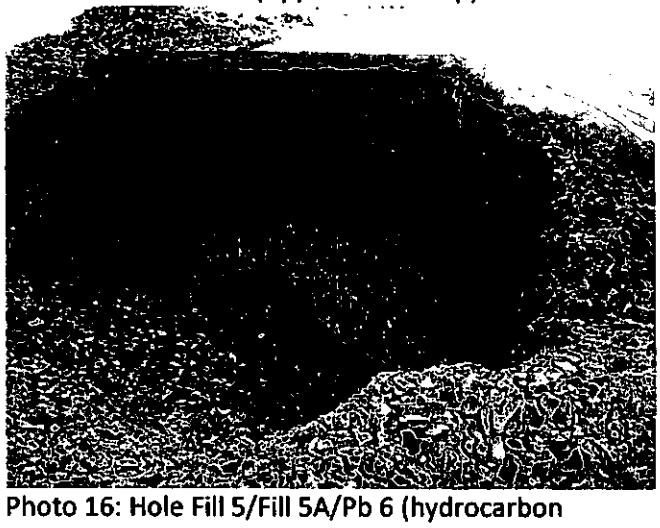


Photo 16: Hole Fill 5/Fill 5A/Pb 6 (hydrocarbon smell/sheen)

Photo 17: Hole Fill 6/Fill 6A/Pb 7 (hydrocarbon smell/sheen)

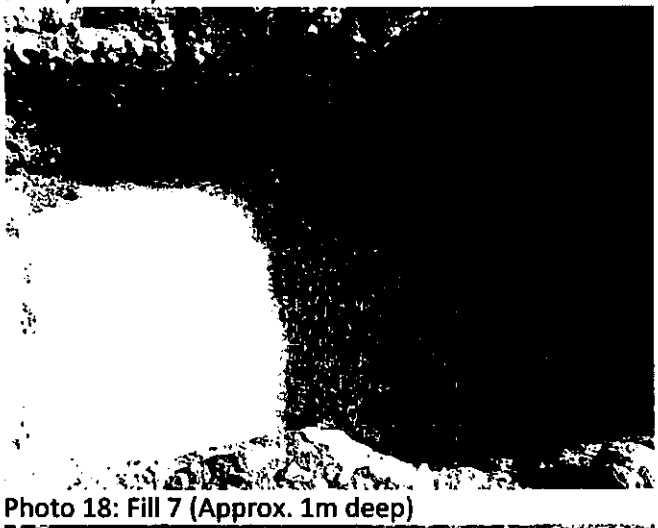


Photo 18: Fill 7 (Approx. 1m deep)

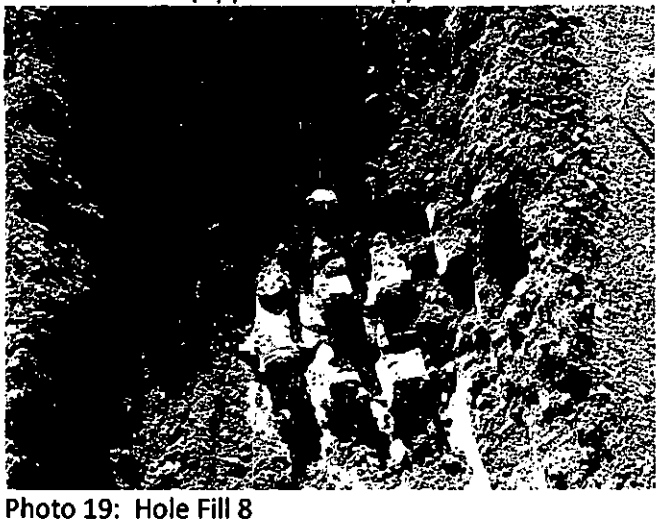


Photo 19: Hole Fill 8

Photo 20: Hole Fill 9/Pb 8 (Approx. 1.2m deep)

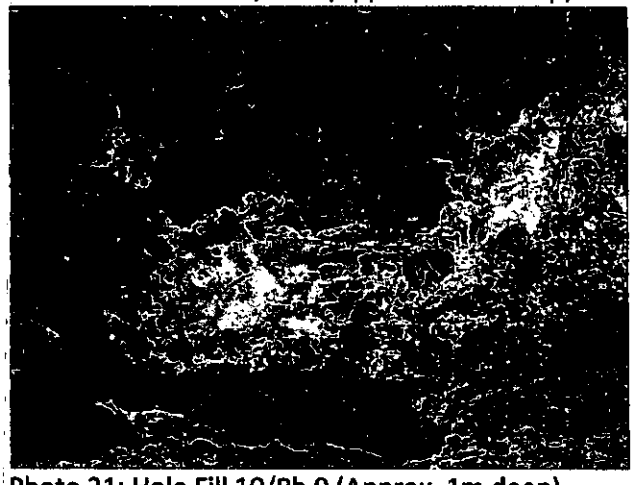


Photo 21: Hole Fill 10/Pb 9 (Approx. 1m deep)

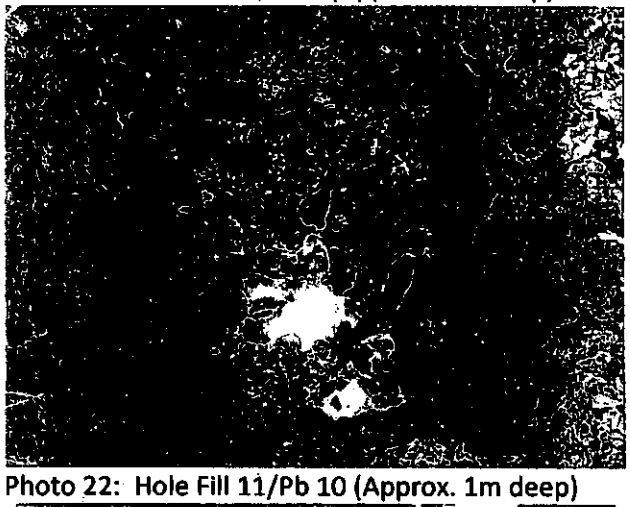


Photo 22: Hole Fill 11/Pb 10 (Approx. 1m deep)

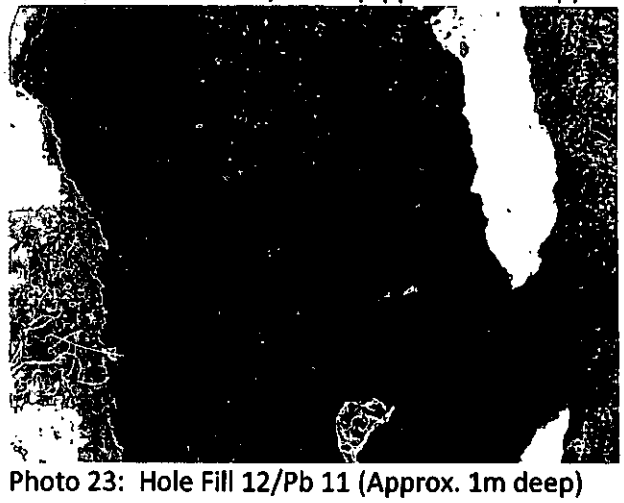


Photo 23: Hole Fill 12/Pb 11 (Approx. 1m deep)

Appendix C

Laboratory Results

31863 - Sea Horse Investments Ltd
102 Pakuranga Road, Pakuranga

Sample No.	Depth to GW (m)	Units	As	Cd	Cr	Cu	Pb	Ni	Zn	TPHs	Benzene	Toluene	Ethylbenzene	Xylene
BH1	1.7	µg/L	1.3	<0.05	<0.05	0.9	3.0	8.6	22	<700	<1.0	14	<1.0	<3.0
BH2	1.8	µg/L	<1.0	<0.05	<0.05	<0.5	<0.1	1.0	10	<700	<1.0	4.6	5.9	48
BH3	1.3	µg/L	<1.0	<0.05	<0.5	3.1	<0.1	3.0	17	<700	<1.0	<1.0	<1.0	<3.0
ANZECC Guideline - 80% protection, freshwater		µg/L	140	0.8	40	2.5 ^	9.4	17	31	ID	2000	ID	ID	340 *

Notes
^ Guideline for protection of 80% of species in marine water is 8.0µg/L
* p-Xylene
ANZECC guideline - Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2001

31863 - Sea Horse Investments Ltd
102 Pakuranga Road, Pakuranga

Sample No.	Depth ' (m)	Units	As	Cd	Cr	Cu	Pb	Ni	Zn	PID Reading	TPHs C7-C9	TPHs C10-C14	TPHs C15-C36	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
S1	0-0.2	mg/kg	<2.0	<0.1	34	11	11	22	50	0	-	-	-	-	-	-	-	-
S2	0-0.2	mg/kg	<2.0	<0.1	32	11	7.6	23	46	0	-	-	-	-	-	-	-	-
S3	0-0.2	mg/kg	<2.0	<0.1	27	13	8	22	42	82	<10	<20	<30	-	-	-	-	-
S4	0-0.2	mg/kg	3.7	<0.1	43	16	7.6	26	64	0	-	-	-	-	-	-	-	-
S5	0-0.2	mg/kg	3.8	<0.1	45	16	7.7	34	58	0	-	-	-	-	-	-	-	-
S6	0-0.2	mg/kg	6.5	<0.1	45	17	10	26	56	0	-	-	-	-	-	-	-	-
S7	0-0.2	mg/kg	2.2	<0.1	38	21	8.1	31	74	0	-	-	-	-	-	-	-	-
S8	0-0.2	mg/kg	<2.0	<0.1	35	16	9.1	30	52	240	23	26	<30	-	-	-	-	-
S9	0-0.2	mg/kg	<2.0	<0.1	39	25	12	31	72	0	-	-	-	-	-	-	-	-
S10	0-0.2	mg/kg	3.7	<0.1	40	10	6.4	22	48	0	-	-	-	-	-	-	-	-
S11	0-0.2	mg/kg	3.2	<0.1	47	24	11	38	74	0	-	-	-	-	-	-	-	-
S12	0-0.2	mg/kg	<2.0	<0.1	34	8.9	4.9	18	40	0	-	-	-	-	-	-	-	-
Pb1	0-0.2	mg/kg	-	-	-	-	9.3	-	-	-	-	-	-	-	-	-	-	-
Pb2	0-0.2	mg/kg	-	-	-	-	8.4	-	-	-	-	-	-	-	-	-	-	-
Pb4	0-0.2	mg/kg	-	-	-	-	9.3	-	-	-	-	-	-	-	-	-	-	-
Pb5	0-0.2	mg/kg	-	-	-	-	6.9	-	-	-	-	-	-	-	-	-	-	-
Pb6	0-0.2	mg/kg	-	-	-	-	8.5	-	-	-	-	-	-	-	-	-	-	-
Pb7	0-0.2	mg/kg	-	-	-	-	8.6	-	-	-	-	-	-	-	-	-	-	-
Pb8	0-0.2	mg/kg	-	-	-	-	9.2	-	-	-	-	-	-	-	-	-	-	-
Pb9	0-0.2	mg/kg	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-
Pb10	0-0.2	mg/kg	-	-	-	-	8.8	-	-	-	-	-	-	-	-	-	-	-
Pb11	0-0.2	mg/kg	-	-	-	-	7.1	-	-	-	-	-	-	-	-	-	-	-
Pb12	0-0.2	mg/kg	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-
Fill 1	0.5-1.0	mg/kg	3.8	<0.1	29	39	8.5	67	64	-	-	-	-	-	-	-	-	-
Fill 2	0.5-1.0	mg/kg	<2.0	<0.1	40	50	2.4	190	50	-	-	-	-	-	-	-	-	-
Fill 3	0.5-1.0	mg/kg	<2.0	<0.1	46	51	7.1	160	82	25	<9.5	<20	<30	<0.062	<0.062	<0.062	<0.13	<0.062
Fill 4	0.5-1.0	mg/kg	4.8	<0.1	27	21	11	31	61	880	39	240	810	<0.05	<0.05	0.23	<0.1	0.097
Fill 5	0.5-1.0	mg/kg	3.4	<0.1	20	18	8.1	19	56	426	18	280	850	<0.05	<0.05	0.7	1.7	0.053
Fill 6	0.5-1.0	mg/kg	<2.0	<0.1	42	52	4.5	160	70	739	46	160	160	<0.05	<0.05	<0.05	<0.1	<0.05
Fill 7	0.5-1.0	mg/kg	<2.0	<0.1	55	63	2.2	240	65	-	-	-	-	-	-	-	-	-
Fill 8	0.5-1.0	mg/kg	4.6	<0.1	34	33	19	75	68	-	-	-	-	-	-	-	-	-
Fill 9	0.5-1.0	mg/kg	<2.0	<0.1	40	51	2.9	140	61	-	-	-	-	-	-	-	-	-
Fill 10	0.5-1.0	mg/kg	<2.0	<0.1	50	53	3.6	190	65	-	-	-	-	-	-	-	-	-
Fill 11	0.5-1.0	mg/kg	<2.0	<0.1	39	43	3.5	140	55	-	-	-	-	-	-	-	-	-
Fill 12	0.5-1.0	mg/kg	2.3	<0.1	43	53	3.9	160	64	-	-	-	-	-	-	-	-	-
SH01	2.5	mg/kg	-	-	-	-	-	-	-	-	<9.8	32	<30	-	-	-	-	-
SH02	2.5	mg/kg	-	-	-	-	-	-	-	-	<9.1	<20	<30	-	-	-	-	-
SH01 + SH02	2.5	mg/kg	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-
SH03	1.5	mg/kg	-	-	-	-	-	-	-	-	16	91	<30	-	-	-	-	-
SH04	1.5	mg/kg	-	-	-	-	-	-	-	-	17	43	<30	-	-	-	-	-
OGI 1 & 2	1.0	mg/kg	2.8	<0.1	34	40	17	110	63	-	<8.5	<20	<30	-	-	-	-	-
Background*		mg/kg	2.75	<0.1	28.1	11.5	12.9	23.2	55.9	-	-	-	-	-	-	-	-	-
PARP:ALW PA Criteria^		mg/kg	30	1	400	325	250	105	400	-	120	470	NA	1.1	68	53	48	

* Highland Park - *Background Concentrations of Inorganic Elements in Soils from the Auckland Region,* ARC TP153, 2001.
^ Residential land use, sand, surface (<1m), *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, MfE, 1999.
- Pb3 = SH01 + SH02 (composite)
S1-S12 taken from below hardfill, Pb1-Pb12 taken from below fill, Fill 1 - Fill 12 taken from various depths in fill material, SH01-SH02 taken from below fill.

Appendix D

Laboratory Transcripts

Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Fraser Thomas Ltd.	**Lab No:**	689704 SPv2
Contact:	Tristan Bellingham	**Date Registered:**	21-Apr-2009
	C/- Fraser Thomas Ltd.	**Date Reported:**	03-Jul-2009
	P O Box 23 273	**Quote No:**	
	Papatoetoe	**Order No:**	
	Auckland 2155	**Client Reference:**	31863
		Submitted By:	Tristan Bellingham

Amended Report

This report replaces an earlier report issued on the 27 Apr 2009 at 1:36 pm
As requested by the client, Total Recoverable Lead has now been analysed on sample 689704.5 (SH01 + SH02 (Composite)).

Sample Type: Soil

Sample Name:	SH01 20-Apr-2009 10:00 am	SH02 20-Apr-2009 10:00 am	SH03 20-Apr-2009 10:00 am	SH04 20-Apr-2009 10:00 am	SH01 + SH02 (Composite)
Lab Number:	689704.1	689704.2	689704.3	689704.4	689704.5
Individual Tests					
Dry Matter g/100g as rcvd	73	74	81	82	-
Total Recoverable Lead mg/kg dry wt	-	-	-	-	17
Total Petroleum Hydrocarbons in Soil					
C7 - C9 mg/kg dry wt	< 9.8	< 9.1	16	17	-
C10 - C14 mg/kg dry wt	32	< 20	91	43	-
C15 - C36 mg/kg dry wt	< 30	< 30	< 30	< 30	-
Total hydrocarbons (C7 - C36) mg/kg dry wt	< 60	< 60	130	73	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Soil

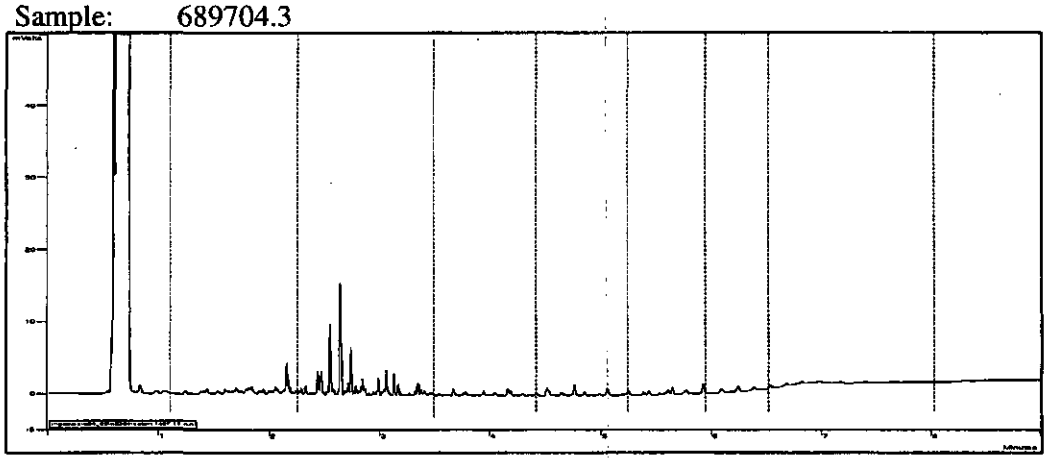
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction.	-	5
Total Petroleum Hydrocarbons in Soil	Sonication extraction, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-4
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry.	0.10 g/100g as rcvd	1-4
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	5
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	1-2
Total Recoverable Lead	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.40 mg/kg dry wt	5

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

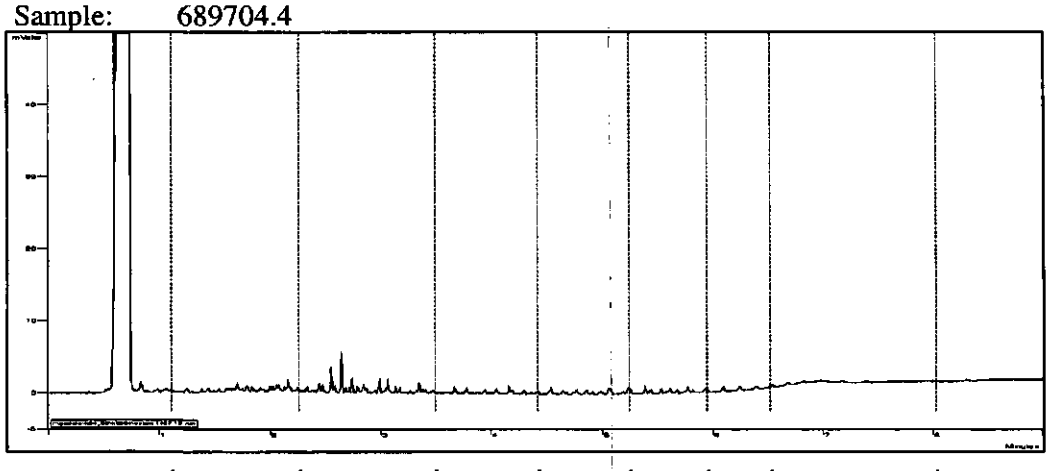
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Karen Nichol BSc
Client Services Manager - Environmental Division

Sample: 689704.3



Sample: 689704.4



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Hamilton 3240, New Zealand

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Fraser Thomas Ltd.	**Lab No:**	707986	SPv2
Contact:	Tristan Bellingham	**Date Registered:**	10-Jul-2009	
	C/- Fraser Thomas Ltd.	**Date Reported:**	22-Jul-2009	
	P O Box 23 273	**Quote No:**	36818	
	Papatoetoe	**Order No:**		
	Auckland 2155	**Client Reference:**		
		Submitted By:	Tristan Bellingham	

Sample Type: Soil

Sample Name:		S1 09-Jul-2009	S2 09-Jul-2009	S3 09-Jul-2009	S4 09-Jul-2009	S5 09-Jul-2009
Lab Number:		707986.4	707986.5	707986.6	707986.7	707986.8
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	70	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2.0	< 2.0	< 2.0	3.7	3.8
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	34	32	27	43	45
Total Recoverable Copper	mg/kg dry wt	11	11	13	16	16
Total Recoverable Lead	mg/kg dry wt	11	7.6	8.0	7.6	7.7
Total Recoverable Nickel	mg/kg dry wt	22	23	22	26	34
Total Recoverable Zinc	mg/kg dry wt	50	46	42	64	58
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 10	-	-
C10 - C14	mg/kg dry wt	-	-	< 20	-	-
C15 - C36	mg/kg dry wt	-	-	< 30	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	< 60	-	-

Sample Name:		S6 09-Jul-2009	S7 09-Jul-2009	S8 09-Jul-2009	S9 09-Jul-2009	S10 09-Jul-2009
Lab Number:		707986.9	707986.10	707986.11	707986.12	707986.13
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	69	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	6.5	2.2	< 2.0	< 2.0	3.7
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	45	38	35	39	40
Total Recoverable Copper	mg/kg dry wt	17	21	16	25	10
Total Recoverable Lead	mg/kg dry wt	10	8.1	9.1	12	6.4
Total Recoverable Nickel	mg/kg dry wt	26	31	30	31	22
Total Recoverable Zinc	mg/kg dry wt	56	74	52	72	48
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	23	-	-
C10 - C14	mg/kg dry wt	-	-	26	-	-
C15 - C36	mg/kg dry wt	-	-	< 30	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	< 60	-	-

Sample Name:		S11 09-Jul-2009	S12 09-Jul-2009	Pb1 09-Jul-2009	Pb2 09-Jul-2009	Pb4 09-Jul-2009
Lab Number:		707986.14	707986.15	707986.16	707986.17	707986.18
Individual Tests						
Total Recoverable Lead	mg/kg dry wt	-	-	9.3	8.4	9.3
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						

Sample Type: Soil						
	Sample Name:	S11 09-Jul-2009	S12 09-Jul-2009	Pb1 09-Jul-2009	Pb2 09-Jul-2009	Pb4 09-Jul-2009
	Lab Number:	707986.14	707986.15	707986.16	707986.17	707986.18
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	3.2	< 2.0	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	47	34	-	-	-
Total Recoverable Copper	mg/kg dry wt	24	8.9	-	-	-
Total Recoverable Lead	mg/kg dry wt	11	4.9	-	-	-
Total Recoverable Nickel	mg/kg dry wt	38	18	-	-	-
Total Recoverable Zinc	mg/kg dry wt	74	40	-	-	-

	Sample Name:	Pb5 09-Jul-2009	Pb6 09-Jul-2009	Pb7 09-Jul-2009	Pb8 09-Jul-2009	Pb9 09-Jul-2009
	Lab Number:	707986.19	707986.20	707986.21	707986.22	707986.23
Individual Tests						
Total Recoverable Lead	mg/kg dry wt	6.9	8.5	8.6	9.2	11

	Sample Name:	Pb10 09-Jul-2009	Pb11 09-Jul-2009	Pb12 09-Jul-2009	Fill 1 09-Jul-2009	Fill 2 09-Jul-2009
	Lab Number:	707986.24	707986.25	707986.26	707986.27	707986.28
Individual Tests						
Total Recoverable Lead	mg/kg dry wt	8.8	7.1	16	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	-	-	3.8	< 2.0
Total Recoverable Cadmium	mg/kg dry wt	-	-	-	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	-	-	-	29	40
Total Recoverable Copper	mg/kg dry wt	-	-	-	39	50
Total Recoverable Lead	mg/kg dry wt	-	-	-	8.5	2.4
Total Recoverable Nickel	mg/kg dry wt	-	-	-	67	190
Total Recoverable Zinc	mg/kg dry wt	-	-	-	64	50

	Sample Name:	Fill 3 09-Jul-2009	Fill 3A 09-Jul-2009	Fill 4A 09-Jul-2009	Fill 5A 09-Jul-2009	Fill 6A 09-Jul-2009
	Lab Number:	707986.29	707986.30	707986.31	707986.32	707986.33
Individual Tests						
Dry Matter	g/100g as rcvd	-	71	80	80	89
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2.0	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	46	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	51	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	7.1	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	160	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	82	-	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	-	< 0.062	< 0.050	< 0.050	< 0.050
Toluene	mg/kg dry wt	-	< 0.062	< 0.050	< 0.050	< 0.050
Ethylbenzene	mg/kg dry wt	-	< 0.062	0.23	0.70	< 0.050
m&p-Xylene	mg/kg dry wt	-	< 0.13	< 0.10	1.7	< 0.10
o-Xylene	mg/kg dry wt	-	< 0.062	0.097	0.053	< 0.050
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	< 9.5	39	18	46
C10 - C14	mg/kg dry wt	-	< 20	240	280	160
C15 - C36	mg/kg dry wt	-	< 30	810	850	160
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	< 60	1,100	1,200	370

	Sample Name:	Fill 4 09-Jul-2009	Fill 5 09-Jul-2009	Fill 6 09-Jul-2009	Fill 7 09-Jul-2009	Fill 8 09-Jul-2009
	Lab Number:	707986.34	707986.35	707986.36	707986.37	707986.38
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	4.8	3.4	< 2.0	< 2.0	4.6
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	27	20	42	55	34

Sample Type: Soil						
	Sample Name:	Fill 4 09-Jul-2009	Fill 5 09-Jul-2009	Fill 6 09-Jul-2009	Fill 7 09-Jul-2009	Fill 8 09-Jul-2009
	Lab Number:	707986.34	707986.35	707986.36	707986.37	707986.38
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Copper	mg/kg dry wt	21	18	52	63	33
Total Recoverable Lead	mg/kg dry wt	11	8.1	4.5	2.2	19
Total Recoverable Nickel	mg/kg dry wt	31	19	160	240	75
Total Recoverable Zinc	mg/kg dry wt	61	56	70	65	68

	Sample Name:	Fill 9 09-Jul-2009	Fill 10 09-Jul-2009	Fill 11 09-Jul-2009	Fill 12 09-Jul-2009	OG1 - OG2 Composite 09-Jul-2009
	Lab Number:	707986.39	707986.40	707986.41	707986.42	707986.45
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	-	81
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	< 2.0	< 2.0	< 2.0	2.3	2.8
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	40	50	39	43	34
Total Recoverable Copper	mg/kg dry wt	51	53	43	53	40
Total Recoverable Lead	mg/kg dry wt	2.9	3.6	3.5	3.9	17
Total Recoverable Nickel	mg/kg dry wt	140	190	140	160	110
Total Recoverable Zinc	mg/kg dry wt	61	65	55	64	63
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	-	-	< 8.5
C10 - C14	mg/kg dry wt	-	-	-	-	< 20
C15 - C36	mg/kg dry wt	-	-	-	-	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	-	-	< 60

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

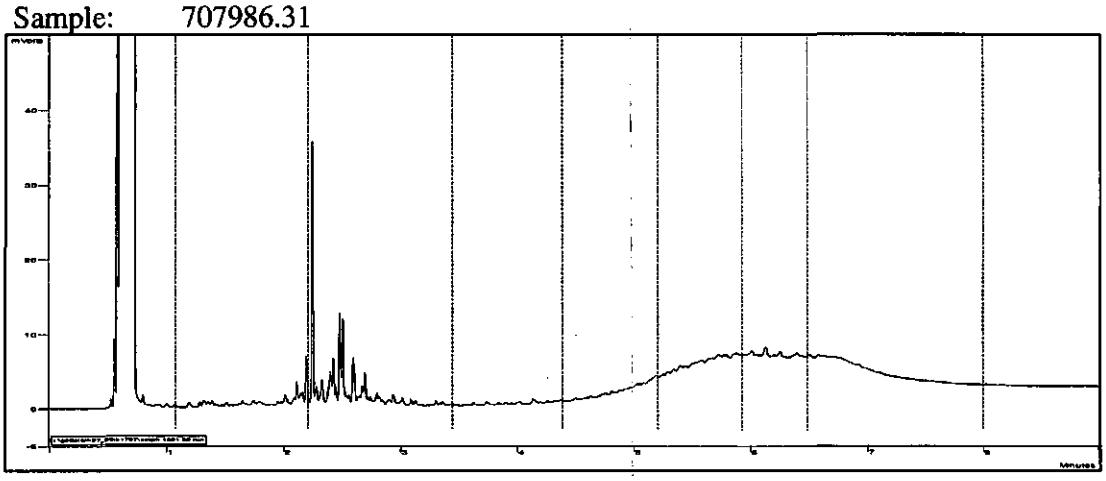
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction.	-	4-29, 34-42, 45
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	4-15, 27-29, 34-42, 45
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B	-	30-33
Total Petroleum Hydrocarbons in Soil	Sonication extraction, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	6, 11, 30-33, 45
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry.	0.10 g/100g as rcvd	6, 11, 30-33, 45
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	4-29, 34-42, 45
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	43-44
Total Recoverable Lead	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.40 mg/kg dry wt	16-26

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

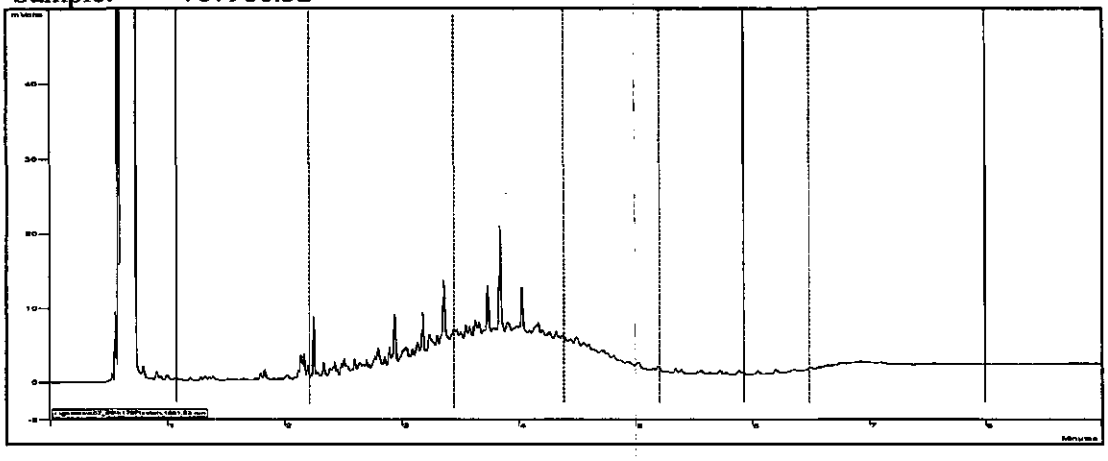
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

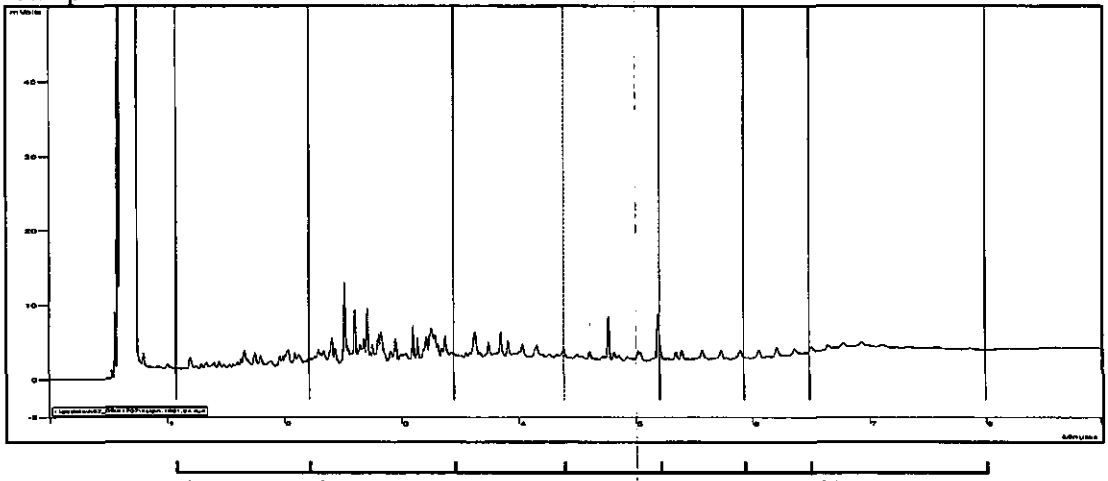
Sample: 707986.31



Sample: 707986.32



Sample: 707986.33



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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Fraser Thomas Ltd.	**Lab No:**	711131	SPv3
Contact:	Tristan Bellingham	**Date Registered:**	24-Jul-2009	
	C/- Fraser Thomas Ltd.	**Date Reported:**	05-Aug-2009	
	P O Box 23 273	**Quote No:**		
	Papatoetoe	**Order No:**		
	Auckland 2155	**Client Reference:**		
		Submitted By:	Tristan Bellingham	

Sample Type: Aqueous

Sample Name:		BH1 23-Jul-2009 10:45 am	BH2 23-Jul-2009 11:00 am	BH3 23-Jul-2009 11:10 am		
Lab Number:		711131.1	711131.2	711131.3		
Heavy metals, dissolvd, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	0.0013	< 0.0010	< 0.0010	-	-
Dissolved Cadmium	g/m³	< 0.000050	< 0.000050	< 0.000050	-	-
Dissolved Chromium	g/m³	< 0.00050	< 0.00050	< 0.00050	-	-
Dissolved Copper	g/m³	0.00088	< 0.00050	0.0031	-	-
Dissolved Lead	g/m³	0.0030	< 0.00010	< 0.00010	-	-
Dissolved Nickel	g/m³	0.0086	0.0010	0.0030	-	-
Dissolved Zinc	g/m³	0.022	0.010	0.017	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
Toluene	g/m³	0.014	0.0046	< 0.0010	-	-
Ethylbenzene	g/m³	< 0.0010	0.0059	< 0.0010	-	-
m&p-Xylene	g/m³	< 0.0020	0.034	< 0.0020	-	-
o-Xylene	g/m³	< 0.0010	0.014	< 0.0010	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	< 0.10	< 0.10	-	-
C10 - C14	g/m³	< 0.20	< 0.20	< 0.20	-	-
C15 - C36	g/m³	< 0.40	< 0.40	< 0.40	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 0.70	< 0.70	< 0.70	-	-

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: Aqueous

Test	Method Description	Default Detection Limit	Samples
Heavy metals, dissolvd, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level	-	1-3
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1-3
Total Petroleum Hydrocarbons in Water	Solvent extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005.	-	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.

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

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

Appendix E

QA/QC

Appendix E: QA/QC

Item	Description
Field Quality Assurance	
Sampling Team Details	Tristan Bellingham, Environmental Engineer, FTL
Intended duplicate/blank frequency	None – due to small scale and nature of investigation.
Sample Records	• FTL chain of custody forms. • Sample locations shown in drawing 31863/1. • Site observations and weather conditions stated in main report.
Chain of Custody	• FTL/Hill Laboratories standard forms. • Dispatch courier: NZ Courier
Other	• Cleaning of sampling equipment described in main report.
Laboratory QA/QC	
Chain of custody	• See attached forms.
Analytical methods and detection limits	• See Appendix D (Hill Laboratories letterhead), following lab results.
QA/QC Data evaluation	
General	Not done, due to the small scale of this investigation.

Appendix F

Borelogs

HAND AUGER BOREHOLE LOG

SHEET 1 OF 1

BOREHOLE NO. BH 1

PROJECT: SEA HORSE INVESTMENTS LTD
102 PAKURANGA ROAD
PAKURANGA

PROJECT NO. 61211

CO-ORDINATES E N

GROUND LEVEL DATUM

Date Drilled 20.07.09 Logged by J. McLaren Checked

DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC LOG	% CORE RECOVERY	UNDRAINED SHEAR STRENGTH (kPa) Vane readings corrected as per BS 1377 X Shear Vane ○ Residual Shear Vane	WATER CONTENT (%) W_p W_f W_l	WATER CONTENT (%)	SPT results & (p) pocket penetrometer (kPa)
0.0	[TOPSOIL]						
0.5	SILT, clayey, whitish grey, mottled brown, moist to wet, moderately plastic, very stiff. [ALLUVIAL SEDIMENTS]						
1.0							
1.5							
2.0	SILT, clayey, lightish grey, moist, non-plastic, very stiff.						
2.5	band of sand band of sand						
3.0	EOB @ 3.0m						
3.5							
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							

REMARKS:

1. Hand auger borehole to a depth of approximately 3.0 m below existing ground surface.
2. Standpipe piezometer (32mm uPVC) installed on 20.07.09. Slotted pipe installed between depths of approximately 1.0 m and 2.5 m below the existing ground surface. Annulus around slotted pipe backfilled with pea gravel. Bentonite plug installed to approximately 1.0 m below existing ground surface.
3. Groundwater not encountered during augering but at 1.7m below existing ground surface after 24hrs.

Fraser Thomas
• CONSULTING ENGINEERS
• RESOURCE MANAGERS
• ENVIRONMENTAL CONSULTANTS
• SURVEYORS & PLANNERS

MACHINE BOREHOLE LOG

SHEET 1 OF 2

BOREHOLE NO. BH 2

PROJECT. SEA HORSE INVESTMENTS LTD
102 PAKURANGA ROAD
PAKURANGA

PROJECT NO. 61211

CO-ORDINATES E N

GROUND LEVEL DATUM

Date Drilled 29.06.09 Logged by J. McLaren Checked

DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC LOG	% CORE RECOVERY
0.0	[TARMAC]		
	Hardfill [GAP40]		
0.5	GRAVEL, sandy, with some cobbles, poorly graded, subrounded to angular, dark brown/black basalt. [FILL]		100
1.0	SILT, clayey, whitish grey, intermixed dark blueish grey, mottled dark brown, moist to wet, slightly plastic, very stiff, Frequent organic inclusions (peat). [ALLUVIAL SEDIMENTS]		100
2.0			
2.5	SILT, some clay, minor sand, light brownish grey, locally mottled yellow and black, moist, non plastic, very stiff.		
3.0			
3.5	CLAY, dark grey, intermixed black, moist to wet, highly plastic, very stiff.		100
4.0	SILT, minor clay, trace sand, dark grey, mottled light grey and black, moist, slightly to moderately plastic, very stiff.		
4.5	CLAY, silty, dark greyish brown, mottled black, moist, slight to moderately plastic, very stiff, frequent organic inclusions of peat		100
5.0			
5.5			
6.0			100
6.5	CLAY, some silt, blueish grey, mottled dark brown, moist to wet, moderately plastic, very stiff, frequent organic inclusions (peat).		
7.0	continue on sheet 2.		

UNDRAINED SHEAR STRENGTH (kPa)
Vane readings corrected as per BS 1377
X Shear Vane
○ Residual Shear Vane
50 100 150 200

WATER CONTENT (%)
W_p W_f W_l
X — ● — I
20 40 60 80

WATER CONTENT (%)

SPT results & (p) pocket penetrometer (kPa)

REMARKS:
1. Drilling method: open barrel to a depth of approximately 10.0 m below existing ground surface.
2. Standpipe piezometer (50mm uPVC) installed on 30.06.09. Slotted pipe installed between depths of approximately 07.00 m and 10.0 m below the existing ground surface. Annulus around slotted pipe backfilled with pea gravel. Bentonite seals installed between approximately 4.5 m and 6.5 m below existing ground surface. Bentonite plug installed between 0.5 m and approximately 1.5 m below existing ground surface.
3. Groundwater not encountered due to drilling disturbance on 30.06.09. Groundwater at 1.8m below existing ground surface on 20.07.09..

Fraser Thomas
• CONSULTING ENGINEERS
• RESOURCE MANAGERS
• ENVIRONMENTAL CONSULTANTS
• SURVEYORS & PLANNERS

MACHINE BOREHOLE LOG

SHEET 2 OF 2

BOREHOLE NO. BH 2

PROJECT. SEA HORSE INVESTMENTS LTD
102 PAKURANGA ROAD
PAKURANGA

PROJECT NO. 61211

CO-ORDINATES E N

GROUND LEVEL DATUM

Date Drilled 29-30.06.09 Logged by J. McLaren Checked

DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC LOG	% CORE RECOVERY	UNDRAINED SHEAR STRENGTH (kPa) Vane readings corrected as per BS 1377 X Shear Vane ○ Residual Shear Vane	WATER CONTENT (%) W_p W_f W_l	WATER CONTENT (%)	SPT results & (p) pocket penetrometer (kPa)
7.0	continue from sheet 1.			50 100 150 200	20 40 60 80		
	CLAY, some silt, blueish grey, mottled dark brown, moist to wet, moderately plastic, very stiff, frequent organic inclusions (peat)						
7.5							
	CLAY, minor to some silt, blueish grey, mottled dark grey, moist, highly plastic, very stiff.		100				
8.0							
8.5							
9.0	band of peat, dark brown, fibrous.		100				
9.5							
10.0	EOB @ 10.0 m TARGET DEPTH						
10.5							
11.0							
11.5							
12.0							
12.5							
13.0							
13.5							
14.0							

REMARKS:

Fraser Thomas

- CONSULTING ENGINEERS
- RESOURCE MANAGERS
- ENVIRONMENTAL CONSULTANTS
- SURVEYORS & PLANNERS

HAND AUGER BOREHOLE LOG

SHEET 1 OF 1

BOREHOLE NO. BH 3

PROJECT. SEA HORSE INVESTMENTS LTD
102 PAKURANGA ROAD
PAKURANGA

PROJECT NO. 61211

CO-ORDINATES E N

GROUND LEVEL DATUM

Date Drilled 20.07.09 Logged by J. McLaren Checked

DEPTH (m)	DESCRIPTION OF STRATA
0.0	[TOPSOIL]
0.5	SILT, clayey, light brownish grey, intermixed grey, mottled light yellow & dark brown, moist to wet, slightly to moderately plastic, stiff. [ALLUVIAL SEDIMENTS]
1.0	
1.5	
2.0	SILT, clayey, brownish grey, mottled brownish orange, moist to wet, moderately plastic, very stiff.
2.5	
3.0	SILT, minor to some clay, minor sand, brownish light grey, mottled yellowish brown, moist, slightly plastic, very stiff.
3.5	SILT, clayey, dark brown, intermixed brown, mottled orange, moist, non plastic, very stiff, occasional organic inclusions (peat).
4.0	CLAY, silty, minor sand, brownish grey, intermixed dark brown, mottled black, moist, slight to moderately plastic, very stiff, frequent organic inclusions of peat
4.5	CLAY, minor to some silt, blueish grey, moist, moderately to highly plastic, very stiff.
5.0	EOB @ 5.0m
5.5	
6.0	
6.5	
7.0	

GRAPHIC LOG | % CORE RECOVERY

UNDRAINED SHEAR STRENGTH (kPa)
Vane readings corrected as per BS 1377
X Shear Vane
○ Residual Shear Vane
50 100 150 200

WATER CONTENT (%)
W_p W_f W_l
20 40 60 80

WATER CONTENT (%)

SPT results & (p) pocket penetrometer (kPa)

REMARKS:
1. Drilling method: hand auger to a depth of approximately 5.0 m below existing ground surface.
2. Standpipe piezometer (32mm uPVC) installed on 20.07.09. Slotted pipe installed between depths of approximately 1.0 m and 4.5 m below the existing ground surface. Annulus around slotted pipe backfilled with pea gravel. Bentonite plug installed to approximately 1.0 m below existing ground surface.
3. Groundwater not encountered during augering but present at 1.3m below ground level after 24hrs.

Fraser Thomas
• CONSULTING ENGINEERS
• RESOURCE MANAGERS
• ENVIRONMENTAL CONSULTANTS
• SURVEYORS & PLANNERS

07 December 2012

Renata Smit
Auckland Transport
31-33 Manukau Station Road
Manukau

Our ref: 51/28564/16//AMETI PSI

Dear Renata,

Phase 1 Preliminary Site Investigation for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment

1 Introduction

GHD Limited (GHD) was engaged by Auckland Transport to undertake a Phase 1 Preliminary Site Investigation (PSI) for the proposed Package 4 Scheme Assessment which is part of the Auckland Manukau Eastern Transport Initiative (AMETI) Project which runs between Pakuranga and Botany, Auckland. The following route comprises the Package 4 Scheme Assessment which is the subject of this assessment;

Segment 1 – Pakuranga Road between the eastern abutment of the Panmure Bridge and Ti Rakau Drive.

Segment 2 – Pakuranga Town Centre and its immediately surrounding corridors i.e. Pakuranga Road, between Ti Rakau Drive (including the Pakuranga Road intersection) and St Kentigerns signalised entrance; Ti Rakau Drive, between Pakuranga Road and Reeves Road (including the Reeves Road intersection); and Reeves Road, between William Roberts Road and Ti Rakau Drive.

Segment 3 – Ti Rakau Drive between Reeves Road and Gossamer Drive.

Segment 4 – Ti Rakau Drive between Gossamer Drive and Greenmount Drive.

Segment 5 – Ti Rakau Drive between Greenmount Drive and Botany Road.

It is understood that this Preliminary Site Investigation will support resource consent applications for the project, and feed into design considerations where necessary.

2 NES Requirements

The intention of this assessment is to support Auckland Transport in meeting the requirements of the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES) which took effect on January 1st 2012. As such, some land uses are classified as a HAIL activity (Hazardous Activities and Industries List) and there is potential that these land uses have occurred or are occurring along the alignment and will need to be investigated before construction begins. Disturbance of soil (at a scale above a prescribed threshold volume) at a HAIL site is a controlled activity, and as such requires consent. The NES covers a range of land use activities.

The NES also requires investigation of soil contaminants to assess potential risks to human health, and this requirement is triggered if the land is to be subdivided, developed or disturbed.

The intention of the Soil NES is to enable safe use of contaminated land to ensure that contaminated land is appropriately assessed prior to development, and if necessary, the land is made safe for human activity. The NES does not include criteria for environmental risk assessment. However, environmental risks should be considered in accordance with New Zealand guidelines.

The NES addresses land that is located adjacent to a HAIL site that may be impacted by contaminants from the HAIL site (HAIL category H).

It is understood that this PSI will support the Auckland Transport resource consent applications for the project and help meet their obligations under the NES for any HAIL sites that may be encountered along the Pakuranga Scheme Assessment of the AMETI alignment.

3 Hazardous Activities and Industries List

The HAIL is incorporated by reference into the NES. Under the NES, land is considered to be contaminated or potentially contaminated if an activity or industry on the HAIL 'is being undertaken, has been undertaken or is ***more likely than not*** to have been undertaken'[1]. If current, and/or historic land uses are included on the HAIL and are identified on the land under investigation then the NES is triggered. Proposed activities also trigger the NES and include removal of underground fuel storage systems and associated soil, soil sampling, soil disturbance, subdivision of land and changing land use.

4 Objectives

The objective of this report was to:

- assess the likelihood[2] of the presence of soil and/or groundwater contamination resulting from historic and/or current land use[3] along the route and/or adjacent to the route.

5 Scope of work

This assessment was undertaken in accordance with the Ministry for Environment *Contaminated Land Management Guidelines: Reporting on Contaminated Sites in New Zealand (No. 1) 2011*. This guideline is referenced in the *National Environmental Standards (NES) for Assessing and Managing Contaminants in Soil to Protect Human Health*.

A review of information available from the following sources was completed as part of this assessment:

- draft alignment plans as at October 2012 developed by GHD/Aurecon
- a review of publicly available historical aerial photos from 1940 to 2010
- a review of site photos
- Auckland Council contaminated sites and borehole register search
- review of readily available site investigation reports resulting from the site register search

[1] Ministry for the Environment. (2011). *Draft user's guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.* Wellington, New Zealand: Ministry for the Environment.

[2] Defined in the NES as: Likely is greater than 50% chance, and unlikely is less than 50% chance of contaminants being present.

[3] Land that may be impacted by the migration of contaminants from adjacent sites is addressed in the NES (refer category H in the Hazardous Activities & Industries; HAIL List).

- an alignment walkover inspection conducted on the 26th September 2012
- review of readily available geology and hydrogeology information
- review of surrounding land uses to assess potential off site environmental impacts to the property or properties of interest
- identification of potential contaminants of concern
- publically available information on the environmental fate of contaminants
- identification of sensitive human and/or environmental receptors.

6 Project Description

The AMETI project aims to develop an integrated multi-modal transport system that supports population and economic growth in East Auckland around the areas of Glen Innes, Howick and Botany.

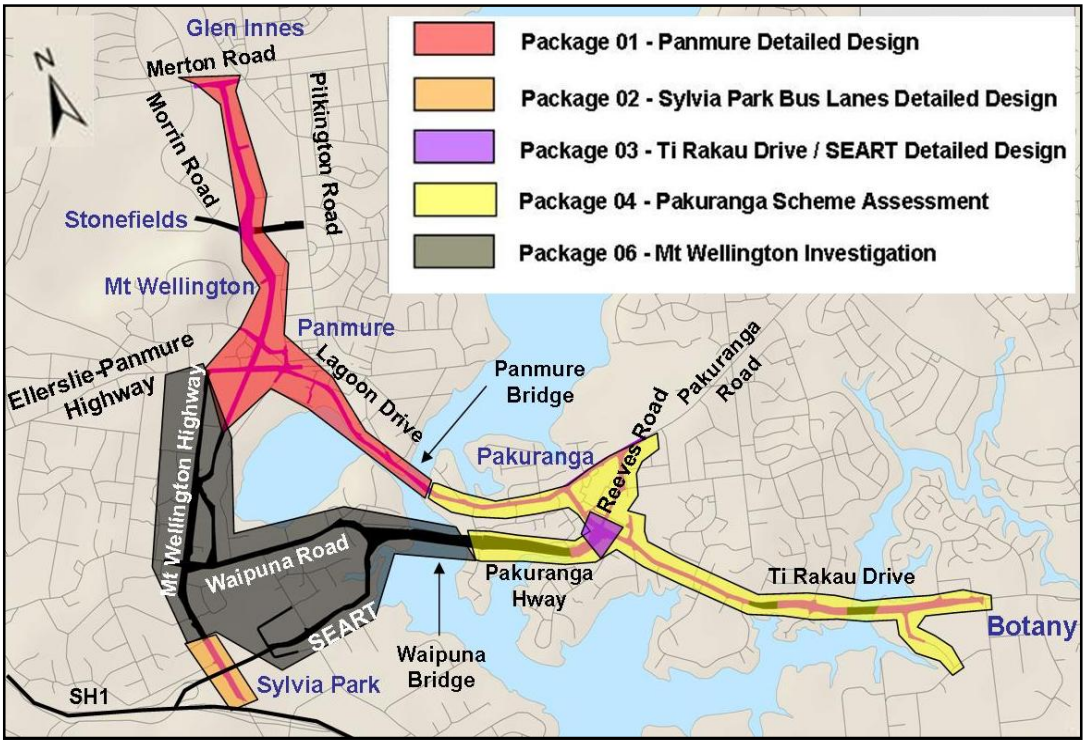
The project aims to provide more and improved transport choices to significantly enhance the safety, quality and attractiveness of passenger transport, walking and cycling while recognising that not all transport demand can be accommodated by these modes alone. The project includes providing Rapid Transport Network infrastructure or the ability to further develop this site at a future date. This will enable frequent and reliable bus services to improve access between the Eastern suburbs of Howick, Pakuranga and Botany and the Auckland City area, particularly the Auckland CBD.

GHD, in partnership with Aurecon, was commissioned by the then Manukau City Council (MCC) in February 2010 to undertake Package 04 (Pakuranga Scheme Assessment) of the AMETI project, which involves the preparation of a Scoping Report followed by a Scheme Assessment Report (SAR) for improvement works on Pakuranga Road, Ti Rakau Drive and Reeves Road including incorporation of the Rapid Transit Network (RTN)[4].

The packages of work included in the AMETI programme are illustrated in Figure 1. The geographic extent of the current PSI is illustrated as Package 04; the Pakuranga Scheme Assessment.

[4] Auckland Transport website http://www.aucklandtransport.govt.nz/improving-transport/ameti/phase-2-panmure-to-pakuranga/Pages/default.aspx

Figure 1: Package 04 Pakuranga Scheme Assessment shows the extent of the assessment



6.1 Alignment Setting

In general, from Panmure Bridge and Waipuna Bridge on the western end of the alignment to Ti Rakau Bridge the land use is predominantly residential. From Ti Rakau Bridge to Botany Town Centre the land use is mixed commercial/industrial. The area was formerly utilised as pastoral grazing land and urban development occurred from the mid-1950s. Appendix 2 shows the alignment in more detail.

7 Site Description

The following site description is based on readily available information on geology and hydrogeology, a review of aerial photos and the results of a contaminated site search via Auckland Council's Natural Resources and Specialist Input Unit.

7.1 Geology

Along the length of the project there are a number of geological units present[5], the most prominent being rhyolitic pumiceous deposits of the Tauranga Group. This unit consist of light grey to orange-brown undifferentiated pumiceous mud, sand and gravel with black muddy peat and lignite. Near the Tamaki River is a lithic tuff deposit which consists of thin graded beds of grey mud-sand sized lithic fragments of comminuted country rock. The lithic fragments include basalt and basanite fragments, mudstone, sandstone, alluvium and micaceous sand. To the north of Ti Rikau Drive (near Udys Road) the near

[5] Kermode, L.O. 1992: Geology of the Auckland Urban Area, Scale 1:50 000. Institute of Geological & Nuclear Sciences Geological Map 2. 1 sheet + 63p. Institute of Geological & Nuclear Sciences Ltd, Lower Hutt, New Zealand.

surface unit is Flysch of the East Coast Bays Formation which consists of well bedded, variably graded, grey to greenish grey muddy sandstone.

The large complex between Ti Rakau Drive and Pakuranga Road consists of engineered construction fill. The construction fill likely consists of re-compacted clay to gravel sized material and may include construction and demolition wastes. The industrial zone between Trugood Drive and Burswood Drive is a mottled patchwork of construction fill and basalt and basanite lavas derived from the Auckland Volcanic Field. The lavas are grey to dark grey, dense fine grained basalt or basanite. To the west of the intersection between Botany Road and Ti Rakau Drive, near Bard Place Reserve, there is a rhyolitic pumice deposit which consists of light grey massive to finely laminated pumice deposit. The fragments in this unit are mud to sand sized and include non-welded ignimbrite, tephra (ash fall volcanic deposits), and alluvial pumice deposits.

7.2 Hydrogeology

Given the proximity to coastal areas, regional groundwater flow is anticipated to be in a generally North, North East and North West direction towards the inner Waitemata Harbour. Localised groundwater flows will also be expected towards the Tamaki Basin, Tamaki River and the Pakuranga Creek. Shallow unconfined groundwater will tend to be influenced by local topography and proximate surface water bodies.

7.3 Review of aerial photos

Historical aerial photos were obtained from the Auckland Council GIS Viewer[6]. The aerial photo dates available and selected for the purposes of this assessment included:

- 1940, 1959, 1996, 2006, 2008 and 2010

These photos were selected to identify previous and current land uses that may indicate potential contamination of the area within which the road works will take place. The following tables provide a summary of observations from the historical aerial photos.

Because of the significant extent of the proposed alignment, a limited set of photographs has been summarised here initially as a general overview, with subsequent focus on specific sites.

[6] http://maps.aucklandcouncil.govt.nz/AucklandCouncilViewer/

7.3.1 Alignment overview

Date	Observations
1940	There is limited aerial photography available for this date. The photograph available depicts the land use in Pakuranga to be predominantly farmland dedicated to what appears to be pastoral farming. The road bridge crosses the Tamaki Estuary at Kerswill Road. The Waipuna and the Panmure bridges are yet to be constructed. The blacked out area on the image indicates that aerial photography is not available for this area. Historically, land use in the Pakuranga area consisted of horticultural market gardening activities and as such it is considered likely that trace concentrations of pesticides such as DDT remain in the topsoil and therefore residual risk remains with regard soil disturbance in the area regarding these contaminants.
	

Date	Observations
1959	The aerial image shows that land use has intensified with residential developments in the Pakuranga area as well as along the Tamaki river closest to the bridge. The land use is still predominantly what appears to be pastoral farming. A racing track is located south of what is present day Pakuranga Town Centre. Panmure Bridge has now been constructed over the Tamaki Estuary. The blacked out area on the image indicates that aerial photography is not available for this area.
	

Date	Observations
1996	By 1996 farmland has given way to mainly mixed urban residential in the Pakuranga Area and to the early stages of Botany Industrial area and town centre. The area was not fully developed yet as evidenced by extensive land development in the Botany area although the industrial area appears well developed at this stage. An orchard appears to be located on what is modern day Greenmount Park. Greenmount landfill is also active as well. Close to Panmure bridge a greenhouse is in operation. Pakuranga substation occupies land off Ti Rakau Drive. The Bridge at Kerswill Road has now been removed and the Waipuna Bridge has been constructed south of Panmure Bridge.
	

Date	Observations
2006	The large area of exposed soil related to land development activities apparent in the Botany area in 1996 is now occupied by high density residential and industrial developments. Land use has intensified and there is less green open space apparent. Greenmount parks land use has changed since 1996 from apparent orchard to parkland.
	

Date	Observations
2010	Urban development continues but there are no major changes apparent compared to 2006 and land use overall remains relatively static.
	

7.3.2 Site specific overview

Date	Observations
2008	Glasshouses can be seen on the aerial photo at 24 Pakuranga Road (oval) and a potential small scale orchard in 39 Pakuranga Road (circle) which may present pesticide contamination issues, although both sites are separate from the alignment and therefore not considered likely to affect the project.
	

Date	Observations
2008	3 Kentigern Close is the site of a former Mobil branded service station (large circle). This site is currently vacant. A contaminated site investigation was undertaken in 2008 and the report was issued to the former Auckland Regional Council. A copy of the report was requested from Mobil but is yet to be received at the time of writing. A copy was also requested from Auckland Council under the Local Government Official Information and Meetings Act 1987 but the report was not available to read. Directly across the road a BP branded service station is currently in operation (small circle). These sites may present issues relating to hydrocarbon contamination during construction of the alignment.
	

Date	Observations
2010	New Zealand Dry Cleaners are located at Aylesbury Street, Pakuranga Town Centre. This business may present contamination issues to the proposed alignment with regards chlorinated solvents and potentially other volatile organic compounds (VOCs).
	

Date	Observations
2008	Pakuranga Automotive (large oval) and Pakuranga Panelbeaters (circle) are located at 16 and 12 Cortina Place respectively. Pakuranga Auto Transport are located at 16D Cortina Place (small circle). These businesses may present issues to the proposed alignment with regards hydrocarbon, solvents and trace element contamination as a result of activities relating to vehicle servicing and repair.
	

Date	Observations
2008	3 Reeves Road is currently occupied by a Gull branded service station and may present issues relating to hydrocarbon contamination to the construction phase of the alignment as a result of fuel storage facilities here.
	

Date	Observations
2010	64B Ti Rakau Drive /11 Cortina Place is the site of a former Caltex branded service station. It is currently a vacant site. A site investigation[7] concluded that 7 soil samples exceeded the Oil Industry Guideline Tier 1 Criteria for Commercial / Industrial Land Use. These samples exceeded the criteria for subsurface maintenance/excavation worker human health pathways for selected hydrocarbon contaminants and could present a health risk to construction workers on the alignment.
	

[7] URS, O'Donohue, K., 2010, Caltex Pakuranga Service Station – Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment.

Date	Observations
2010	242 Ti Rakau Drive is currently occupied by a Mobil branded service station and may present issues relating to hydrocarbon contamination to the construction phase of the alignment as a result of fuel storage facilities there. Enquiries with the Auckland Council have not identified any environmental investigation reports available for this site. The Pakuranga Creek flows close to the site.
	

Date	Observations
2008	Best Automotive Clinic is located at 245 Burswood Drive. This business may present issues to the proposed alignment with regards hydrocarbon, solvents and trace element contamination as a result of activities relating to vehicle servicing and repair.
	

Date	Observations
2008	Sandvik Materials Technology is located at 269 Ti Rakau Drive. This business may present issues to the proposed alignment with regards hydrocarbon and trace element contamination as a result of materials processing.
	

Date	Observations
2006	279 Ti Rakau Drive is the site of a former timber storage yard (rectangular outline). It is currently a buy and sell yard and may host residual contamination relating to timber treatments. Across the road at 284 Ti Rakau Drive a Z branded service station is currently in operation (oval outline) and may also present issues during construction of the alignment relating to hydrocarbon contamination.
	

Date	Observations
2008	Forging Ahead is located at 293 Ti Rakau Drive. This business may present issues to the proposed alignment with regards hydrocarbon and trace element contamination resulting from foundry operations.
	

Date	Observations
2008	333 Ti Rakau Drive is occupied by the Blue n Green Dry Cleaners (large oval) whilst next door on the corner of Harris Road and Ti Rakau Drive is a BP branded service station (circle). Behind BP is Jireh Auto Tyres at 179 Harris Road (small oval) dealing in automotive repairs. The service station may present issues to the construction of the alignment relating to hydrocarbon contamination and the dry cleaners may present issues related to chlorinated solvent and VOC contamination. The auto workshop may also have some issues with solvents, hydrocarbons as well as trace elements.
	

Date	Observations
2010	380 Ti Rakau Drive is occupied by the Howick and Eastern Bus Company whilst next door at 384 is a Gull branded service station. Both of these sites may present issues to the construction of the alignment relating to hydrocarbon contamination as a result of fuel storage facilities at both sites. A tributary of the Pakuranga Creek flows at the back of both properties and could be considered a sensitive receptor. According to council borehole records Chevron have installed a borehole at 380 Ti Rakau Drive for monitoring purposes. A site investigation report was not available from Auckland Council. It is understood that Chevron previously operated a Caltex branded service station at 384 Ti Rakau Drive.
	

Date	Observations
2010	550 Te Iriringi Drive is currently occupied by a Z branded service station and may present issues relating to hydrocarbon contamination during the construction phase of the alignment along Te Koha Road as a result of fuel storage facilities here.
	

8 Council Records

A site contamination enquiry was completed for the road alignment by seeking records from Auckland Council. The complete results of this search are included as Appendix A of this report. A contaminated site discharge was identified at 11 Cortina Place / 64B Ti Rakau Drive (Caltex branded service station). The Council's register indicates that a tank pull report was received by the then Auckland Regional Council when the Underground Petroleum Storage System (UPSS) was removed from the site in May 2010. As a result, a discharge consent was required for the site. Another contaminated site discharge was identified at 3 Kentigern Close (Mobil branded service station) and the register indicates that an Environmental Site Assessment report was received by the council for that site.

The site reports for these properties have been requested from Auckland Council. The site investigation report was received for the Caltex branded service station but not the Mobil branded service station. The report[8] for 11 Cortina Place / 64B Ti Rakau Drive detailed 9 soil samples that exceeded the Oil Industry Guideline Tier 1 Criteria for Commercial / Industrial Land Use. Seven soil samples exceeded the criteria for subsurface maintenance/excavation worker human health pathways for selected contaminants. This will need to be taken into account during the alignment works regarding the health and safety of construction workers.

Auckland Council recommended that Mobil should be contacted to gain access to the site report for the Mobil branded service station. Mobil was contacted by phone[9] and they recommended an email request be submitted but the site report is yet to be received. Following that a request for more information was submitted to the Auckland Council Local Government Official Information and Meeting Act (LGOIMA) process. Auckland Council responded that they were withholding the Environmental Site Assessment Report provided by Mobil under section 7(2)(c)(i) of the LGOMIA as the report was supplied under an obligation of confidence and making it available would "be likely to prejudice the supply of similar information, or information from the same source, and it is in the public interest that such information should continue to be supplied". Given that both Mobil and Auckland Council have been contacted for more information on the site and that this information is not forthcoming any construction activities on site should proceed on the assumption of contamination existing onsite.

The Environmental Site Assessment report for the Mobil site should be read in conjunction with this assessment to better understand the risks associated with the former service station at 3 Kentigern Close regarding the health and safety of construction workers.

A borehole register search conducted by the Auckland Council Natural Resources and Specialist Input Unit revealed 3 cases of borehole installation for the following contaminated and potentially contaminated sites.

[8] URS, O'Donohue, K., 2010, Caltex Pakuranga Service Station – Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment.

[9] Personal Communication with Erin Richards of Exxon Mobil on 16th October 2012

Site Name	Address	Purpose
Chevron	380 Ti Rakau Drive, Pakuranga	The construction of a bore for monitoring purposes.
Chevron	11 Cortina Place / 64B Ti Rakau Drive, Pakuranga.	The construction of 4 bores for contaminated site investigations.
T.M.K Packers Ltd.	257 Ti Rakau Drive, Pakuranga	The construction of 4 bores for environmental monitoring.

9 Potential Locations of Interest

To summarise the site specific review the following sites were noted as potential contaminated sites that may present contamination issues once work commences on the alignment.

Site Name	Activity	HAIL Activity	Potential Contaminant of Concern based upon identified HAIL activity
3 Kentigern Close	BP branded service station	Vehicle refuelling, service and repair	Total petroleum hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
Aylesbury Street, Pakuranga Town Centre	New Zealand Dry Cleaners	Chemical manufacture, application and bulk storage	Chlorinated Solvents, VOCs
12 Cortina Place	Pakuranga Panelbeaters	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
16 Cortina Place	Pakuranga Automotive	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
16D Cortina Place	Pakuranga Auto Transport	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
3 Reeves Road	Gull branded service station	Vehicle refuelling, service and repair	TPH, BTEX
242 Ti Rakau Drive	Mobil branded service station	Vehicle refuelling, service and repair	TPH, BTEX

245 Burswood Drive	Best Automotive Clinic	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
269 Ti Rakau Drive	Sandvik Materials Technology	Metal extraction, refining and reprocessing, storage and use	TPH, BTEX, Trace Elements
279 Ti Rakau Drive	Former Timber Storage yard.	Chemical manufacture, application and bulk storage	Trace Elements, PCP, PAH, Pesticides
Corner Ti Rakau Drive and Burswood Drive	Z branded service station	Vehicle refuelling, service and repair	TPH, BTEX
179D Harris Road	Jireh Auto Tyres	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
Corner Ti Rakau Drive and Harris Road	BP branded service station	Vehicle refuelling, service and repair	TPH, BTEX
293 Ti Rakau Drive	Forging Ahead (Foundry)	Metal extraction, refining and reprocessing, storage and use	TPH, BTEX, Trace Elements
333 Ti Rakau Drive	Blue n Green Dry Cleaners	Chemical manufacture, application and bulk storage	Chlorinated Solvents, VOCs
380 Ti Rakau Drive	Howick and Eastern Bus Depot	Vehicle refuelling, service and repair	TPH, BTEX
386 Ti Rakau Drive	Gull branded service station	Vehicle refuelling, service and repair	TPH, BTEX
550 Te Irirangi Drive	Z branded service station	Vehicle refuelling, service and repair	TPH, BTEX

10 Potential Contaminants of Concern

The table below outlines the potential contaminants of concern that may be present in the area surrounding the proposed road upgrade. The identified contaminants are based on past and current land use.

Soil Contaminants	Potential Source
Inorganic elements	Arsenic, copper and chromium are commonly used timber treatment chemicals used for fence posts, and other timbers used in the outdoor environment. Trace elements relating to foundry operations.
Total petroleum hydrocarbons (TPH), Benzene, toluene, ethylbenzene, xylenes (BTEX)	Petrol stations and associated underground storage tanks and fuel system.
VOCs and Chlorinated Solvents	Dry Cleaning Services, automotive workshops.
Pentachlorophenol (PCP)	Wood preservative (anti sap stain) used in the treatment of timber.

11 Sensitive Receptors

A site walkover and aerial photo review identified no sensitive receptors in close proximity to the potentially contaminated sites along the AMETI alignment with the exception of the tributary of the Pakuranga Creek flowing at the back of the Gull Service Station at 386 Ti Rakau Drive. The alignment is located in an urban landscape and as such there is limited access to exposed soil, although once the alignment construction begins the amount of exposed soil will increase. The land use is a mix of commercial, residential and industrial. There are nursing homes, schools, gardens, streams and parks in the vicinity of the alignment but none of these are in close proximity to the potential contaminated sites listed.

12 Qualitative Assessment of Risk

The following assessment of potential risk is qualitative only and does not represent a detailed quantitative assessment of risk to human health or the environment. Rather, it presents a selection of the primary contaminants of concern that may be encountered along the alignment.

12.1 Organochlorines

Pentachlorophenol (PCP) is an organochlorine preservative used in the treatment of timber and as such may be present at the former timber storage yard and as such may pose a risk during the construction of the alignment. Exposure to PCP can cause harmful effects on the liver and kidneys and may cause cancer[10].

[10] http://water.epa.gov/drink/contaminants/basicinformation/pentachlorophenol.cfm

Chlorinated solvents are used in a range of commercial and industrial purposes to include mixing and thinning solutions. Their chlorine chemical structure allows them to dissolve organic material and some compounds are used as a raw material in the production of other chemicals. There is a range of short term and long term exposure effects including skin problems, and damage to the nervous system, kidneys and liver. Some chlorinated solvents are known to cause cancer[11].

12.2 Trace Elements

Generally, trace elements are immobile under normal soil (non-acidic or alkaline) conditions. These trace elements tend to sorb strongly to the (inorganic) soil particles; hence the propensity for leaching is very limited for most soil conditions and impacted topsoil can be mobilised as dust or sediment if the soil is exposed.

Copper chrome arsenate (CCA) contamination (if any) of near surface soil from the storage of treated timber is likely to be limited to that of the storage yard. The highly localised nature of the contamination restricts the risk posed to either human health or the environment.

Copper adsorbs strongly to most soil types. Along with other trace elements, the mobility of copper represents a low human health risk. Copper can pose a threat to sediment and surface water quality under certain conditions if sediment control measures are not sufficient to contain impacted soil that is exposed.

12.3 Petroleum Hydrocarbons

Petroleum hydrocarbons can exist in the soil environment as a separate phase liquid; dissolved in groundwater or the soil solution; and/or vapour[12]. Physical (including groundwater processes), chemical and biological processes affect the fate and migratory rates of these contaminants. The key influences include sorption (adsorption and absorption), diffusion (dilution and dispersion), volatilisation, chemical and biological degradation which are ultimately determined by the characteristics of the soil.

The low molecular weight fraction of petrol volatilises rapidly when exposed to the atmosphere. These compounds have a reported biodegradable half-life of five years in groundwater[12]. In the soil environment the half-life can be as short as 1-4 weeks[13].

Petroleum hydrocarbons can be toxic to the environment and human health. The volatile compounds have an adverse effect on the central nervous system of animals and benzene has been identified as a human carcinogen[12]. Some higher molecular weight compounds present in diesel and fuel oils (PAHs) are also carcinogenic.

Also associated with the accumulation of petroleum hydrocarbon vapour and liquid is a fire and/or explosion risk. This requires oxygen and the introduction of an ignition source[12].

[11] http://www.worker-health.org/chlorinatedsolvents.html

[12] Ministry for the Environment. (1999). Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011).

[13] Ahrens, M. (2008). *Literature review of organic chemicals of emerging environmental concern in use in Auckland* (Prepared by NIWA for Auckland Regional Council. Auckland Regional Council Technical Report 2008/028).

13 Conclusions

Based upon the review of available information, the alignment walk over inspection and qualitative risk assessments undertaken as part of this Preliminary Site Investigation, the following conclusions can been drawn:

- Adjacent to the road alignment up to 20 sites with land uses included on the HAIL were identified. Given that the surface soil will be disturbed along the alignment corridor through significant soil disturbance activity the regulations of the NES apply on the basis of HAIL category H adjacent sites. Category H is defined as "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."
- The likelihood that the HAIL activities identified adjacent to the proposed alignment the proposed alignment may impact the alignment varies for each site depending on the nature of the contaminants and therefore the likely migration mechanisms. The relative likelihood of contaminant migration to the alignment from each site is summarised in the table below;

Site Name	**Activity**	**Contamination Risk Rating**	**Potential Contaminant of Concern based upon identified HAIL activity**
11 Cortina Place / 64B Ti Rakau Drive	Former Caltex branded service station, now a vacant site	High Risk	Total petroleum hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
24 Pakuranga Road	Market Gardening	Low Risk	Pesticides, Inorganic Elements
39 Pakuranga Road	Possible Orchard	Low Risk	Pesticides, Inorganic Elements
3 Kentigern Close	BP branded service station	Medium to High Risk (review risk after review of Mobil environmental site assessment report.)	TPH, BTEX
Aylesbury Street, Pakuranga Town Centre	New Zealand Dry Cleaners	Medium Risk	Chlorinated Solvents, VOCs
12 Cortina Place	Pakuranga Panelbeaters	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
16 Cortina Place	Pakuranga Automotive	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements

16D Cortina Place	Pakuranga Auto Transport	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
3 Reeves Road	Gull branded service station	Medium Risk	TPH, BTEX
242 Ti Rakau Drive	Mobil branded service station	Medium Risk	TPH, BTEX
245 Burswood Drive	Best Automotive Clinic	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
269 Ti Rakau Drive	Sandvik Materials Technology	Medium Risk	TPH, BTEX, Trace Elements
279 Ti Rakau Drive	Former Timber Storage yard.	Low to Medium Risk	Trace Elements, PCP, PAH, Pesticides
Corner Ti Rakau Drive and Burswood Drive	Z branded service station	Medium Risk	TPH, BTEX
179D Harris Road	Jireh Auto Tyres	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
Corner Ti Rakau Drive and Harris Road	BP branded service station	Medium Risk	TPH, BTEX
293 Ti Rakau Drive	Forging Ahead (Foundry)	Medium Risk	TPH, BTEX, Trace Elements
333 Ti Rakau Drive	Blue n Green Dry Cleaners	Medium Risk	Chlorinated Solvents, VOCs
380 Ti Rakau Drive	Howick and Eastern Bus Depot	Medium Risk	TPH, BTEX
386 Ti Rakau Drive	Gull branded service station	Medium Risk	TPH, BTEX
550 Te Irirangi Drive	Z branded service station	Medium Risk	TPH, BTEX

14 Recommendations

We recommend that Auckland Transport considers the following in order to minimise risks associated with contaminated land along the alignment of the proposed road works;

- Obtain environmental site investigations reports from Auckland Council

- Engage with the Auckland Council contaminated site officers to present this report and the planned strategy to assess potential contamination from adjacent sites along the alignment.
- Undertake intrusive soil investigations to assess potential contaminants along the alignment, at locations where the adjacent land use has been identified as having current or historic HAIL activities and where the likelihood of contamination has been assessed as medium to high.

15 Limitations

This Preliminary Site Investigation refers to the proposed AMETI Project as described in Section 4 of this report and:

1. has been prepared by GHD Limited ("GHD") for Auckland Transport;

2. may only be used and relied on by Auckland Transport;

3. must not be copied to, used by, or relied on by any person other than Auckland Transport without the prior written consent of GHD and subject always to the next paragraph; and

4. GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Auckland Transport arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- were limited to those specifically detailed in section 3;
- were undertaken in accordance with current professional practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report; and
- did not include the collection of samples for the purpose of laboratory analysis or verification of information obtained from the site history review.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report ("Assumptions"), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions and/or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

GHD has prepared this Report on the basis of information provided by Auckland Transport (and others who provided information to GHD including Government authorities, which GHD has not independently verified or checked ("Unverified Information") beyond the agreed scope of work).

GHD expressly disclaims responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

Inspections undertaken in respect of this Report were limited to visual inspections only and were constrained by the particular site conditions, such as locations of buildings, services or vegetation.

The opinions, conclusions and any recommendations in this Report are based on information obtained from readily available information sources.

Except as otherwise expressly stated in this Report, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.

16 Third Party Reliance

The work created in this document is the property of GHD Ltd and any unauthorised use of it in any form whatsoever is prohibited. The document is intended for the use of Auckland Transport. It has been prepared in accordance with the Terms of Engagement for the commission and on the basis of specific instructions and information provided by the client for exclusive use by the client for its particular purpose. The contents and conclusions of this document may therefore be inappropriate for any third party in the context of that third party's particular purposes and circumstances. Any third party should obtain its own independent information or advice and no responsibility is accepted and no duty of care is assumed by GHD Ltd to any third party who may use or rely on the whole or any part of the content of this document.

Yours sincerely
GHD Limited

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09 3708204

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09 3708206

Appendix A

Auckland Council Site Contamination Search

Auckland Council
Te Kaunihera o Tāmaki Makaurau

25 September 2012

GHD
Level 16
ASB Bank Centre
135 Albert Street
Auckland

Attention: Sean Toland

Dear Sean

Site Contamination Enquiry – Various properties along AMETI route.

This letter is in response to your enquiry requesting available site contamination information for the sites as indicated in your email of 25 September 2012. 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 below outline the reference for the site files and pollution incident files available for the subject site:

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**2C Amera Place**		
Pollution Date	22/05/08	Comment	Incident no. 08/2053. Vomit smell.
Pollution Date	09/05/11	Comment	Incident no. 11/0598. Waste being tipped into stormwater drain continuously.
Pollution Date	03/11/03		Incident no. 03/1344. Restaurant tipping fat to stormwater.

File Reference	6-03-2874		
File Name	**2G Amera Place**		
Site Occupier Name	Dynamo Group Ltd		
Pollution Date	14/01/03	Comment	Concrete in drain.
Pollution Date	02/09/02	Comment	Concrete in drain.

File Reference	P270-04-03		
File Name	Catchment file		
Site address	**12 Amera Place**		
Pollution Date	06/06/03	Comment	Incident no. 03/0628. Discharge from small building site
Pollution Date	03/11/03	Comment	Incident no. 03/1344. Restaurant tipping fat to stormwater.

File Reference	P270-04-01-03		
File Name	Catchment file		
Site address	**183 Harris Rd - BP Express Ti Rakau**		
Pollution Date	12/04/04	Comment	Incident no. 04/0627. Petrol spill on forecourt.
Site Visit Date	15/01/01	Comment	Site audit.

File Reference	T096-03		
File Name	Catchment File		
Site Occupier Name	**166B Harris Road**		
Pollution Date	21/03/11	Comment	Incident no. 11/0689. Carwashing soapy liquid to stormwater.
Site Visit Date		Comment	

File Reference	T096-03		
File Name	Catchment File		
Site Occupier Name	**Corner Harris Road & TiRakau Drive**		
Pollution Date	01/09/09	Comment	Incident no. 09/2608. Fire page fertilizers to road and stormwater from crash.
Site Visit Date		Comment	

File Reference	T096-03		
File Name	Catchment file		
Site Address	**13 Millen Ave**		
Pollution Date	23/03/12	Comment	Incident no. 12/1671. Sewage overflow.

File Reference	T096-03		
File Name	**Catchment file**		
Site Address	**Pakuranga Shopping Centre**		
Pollution Date	23/03/11	Comment	Incident no. 11/0958. Strong sewage smell coming from carpark.
Site Address	**34 Pakuranga Road**		
Pollution Date	11/11/08	Comment	Burning.
Site Address	**130 Pakuranga Road**		
Pollution Date	19/06/12	Comment	Incident no. 12/2449. Dye in stormwater.
Pollution Date	20/04/12	Comment	Incident no. 12/1768. Oil slick coming down the Tamaki river behind St Kentigern College, Pakuranga
Site Address	**140 Pakuranga Road**		
Pollution Date	27/12/10	Comment	Incident no. 11/0011. Brown slick in the Tamaki River
Site Address	**165 Pakuranga Highway (BP Town Centre)**		
Pollution Date	23/07/05	Comment	Incident no. 05/1898. Hydrocarbon spill – 10-200 litres.
Pollution Date	04/10/03	Comment	Incident no. 03/1327. Hydrocarbon spill – less than 10 litres.
Site Address	**172 Pakuranga Road**		
Pollution Date	28/11/10	Comment	Incident no. 11/0330. Burning
Site Address	**Pakuranga Road**		
Pollution Date	14/11/03	Comment	Incident no. 03/1088. Vehicle washing to stormwater.

File Reference	6-03-1340		
File Name	**2 Pakuranga Rd, Pakuranga**		
Site Occupier Name	Panmure Bridge Marina Ltd		
Pollution Date	22/06/01	Comment	Washing to stormwater.
Pollution Date	07/08/97	Comment	Spill when spray painting.
Pollution Date	31/07/97	Comment	Boat sanded on slipway.

File Reference	P270-04-17		
File Name	**22 Pakuranga Road**		
Site Occupier Name	Foley Concrete Ltd		
Pollution Date	12/10/05	Comment	Concrete waste to stormwater.
Pollution Date	18/02/03	Comment	Concrete waste to stormwater.

File Reference	6-03-0143		
File Name	**102 Pakuranga Road**		
Site Address	Mobil Service Station		
Pollution Date	29/07/94	Comment	Engines cleaned to yard and waste to stormwater.

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**Corrner Pakuranga Highway and Ti Rakau Drive**		
Pollution Date	01/08/06	Comment	Possible battery acid on petrol station forecourt
File Reference	P270-04-03		
File Name	Catchment file		
Site Address	**3 Reeves Road**		
Site Visit Date	31/07/94	Comment	Site audit.

File Reference	6-03-1754		
File Name	**3 Reeves Road**		
Site Occupier Name	Gull Petroleum		
Pollution Date	17/01/01	Comment	Petrol on forecourt washed off with water.

File Reference	6-03-2954		
File Name	**7 Reeves Road**		
Site Occupier Name	Great City Restaurant		
Pollution Date	03/10/02	Comment	Leakage from waste bin.
Pollution Date	10/09/02	Comment	Leakage from waste bin (leaking blood).

File Reference	T096-03		
File Name	Catchment file		
Site Address	**7 Reeves Road**		
Pollution Date	14/02/12	Comment	Incident no. 12/0816. White / grey smoke coming from restaurant.

File Reference	T096-03		
File Name	Catchment file		
Site Address	**Corner Reeves Road, and TiRakau Road intersection.**		
Pollution Date	23/03/11	Comment	Incident no. 11/1035. Major sewage spill.

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**Corrner Ti Rakau Drive and Te Irirangi**		
Pollution Date	07/07/05	Comment	Incident no 05/1795. Hydraulic oil spill to stormwater cesspit.

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**Corrner Ti Rakau Drive and Waipuna Highway**		
Pollution Date	31/01/92	Comment	Incident no. 91/0127. Drum of hydrochloric acid spilled on road.

File Reference	T096-03		
File Name	Catchment file		
Site Address	**550 Te Irirangi Drive**		
Pollution Date	13/05/07	Comment	Incident no. 07/1916. Petrol spill.
Pollution Date	21/07/05	Comment	Incident no. 05/1890. Diesel spill – approx 180 litres.

Pollution Date	03/03/05	Comment	Incident no. 05/0795. Mixed fuel being drained to forecourt. 10-200 litres.
Site visit Date	20/01/01	Comment	Site audit.
Pollution Date	17/06/08	Comment	Incident no. 08/2296. Oil spill to stormwater.

File Reference	A224-06		
File Name	Catchment file (Air Quality)		
Site Address	**164 TiRakau Drive**		
Pollution Date	18/11/08	Comment	Incident no. 08/3750. Burning.
Pollution Date	21/01/08	Comment	Incident no. 08/0328. Burning.
Site Address	**214 TiRakau Drive**		
Pollution Date	09/04/07	Comment	Incident no. 07/2040. Burning.
Site Address	**451 TiRakau Drive**		
Pollution Date	18/06/08	Comment	Incident no. 08/2331. Odour from Pizza Hutt.
Site Address	**TiRakau Drive**		
Pollution Date	22/12/09	Comment	Incident no. 10/0043. Burning.

File Reference	A256-03		
File Name	Catchment file		
Site Address	**Ti Rakau Dr (TJ's Carwash)**		
Pollution Date	14/01/08	Comment	Incident no. 07/0582. Overspray from car wash.
Site Visit Date		Comment	

File Reference	T096-03		
File Name	Catchment file (Air Quality)		
Site Address	**53 TiRakau Drive**		
Pollution Date	07/12/11	Comment	Incident no. 11/4523. Sediment to stormwater.
Site Address	**81 TiRakau Drive**		
Pollution Date	6/4/2008	Comment	Incident no. 08/2170. Concrete cutting.
Site Address	**97 TiRakau Drive**		
Pollution Date	20/11/09	Comment	Incident no. 09/3355. Milky coloured stream.
Site Address	**128 TiRakau Drive**		
Pollution Date	01/08/05	Comment	Incident no. 05/1980. Concrete washing to stormwater.
Site Address	**130 TiRakau Drive**		
Pollution Date	10/08/10	Comment	Paint to stormwater. .
Site Address	**164 TiRakau Drive**		
Pollution Date	13/01/08	Comment	Burning incident.
Site Address	**176 TiRakau Drive**		
Pollution Date	04/05/10	Comment	Incident no. 10/1678. Oil washing to stormwater.
Pollution Date	29/03/10	Comment	Incident no. 10/1282. Oil spill on driveway.
Site Address	**242 TiRakau Drive**		
Site visit Date	27/09/02	Comment	Site audit.
Site visit Date	15/01/01	Comment	Site audit.
Site Address	**249 TiRakau Drive**		
Pollution Date	25/11/09	Comment	Incident no. 09/3469. Rotten egg odour.
Pollution Date	13/09/10	Comment	Sewage odour.
Pollution Date	30/06/10	Comment	Incident no. 10/2214. Sewage odour.
Pollution Date	16/04/10	Comment	Incident no. 10/1456. Strong odour.
Site Address	**263 TiRakau Drive**		
Pollution Date	16/10/01	Comment	Wasterblasting to stormwater.

Site Address	**290 TiRakau Drive**		
Pollution Date	27/05/09	Comment	Incident no. 09/1878. Odour from a fish shop.
Site Address	**298 TiRakau Drive**		
Pollution Date	13/03/06	Comment	Incident no.06/0794. Oil spill from restaurant.
Site Address	**320 TiRakau Drive**		
Pollution Date	21/07/12	Comment	Incident no. 12/2755. Concrete dust in channel and gutter.
Pollution Date	28/05/09	Comment	Incident no. Clay washed to creek (from Urban Worx Limited).
Site Address	**380 TiRakau Drive**		
Site visit Date	13/01/02	Comment	Site audit.
Site Address	**396 TiRakau Drive (Soda Blast Auckland)**		
Pollution Date	14/02/08	Comment	Incident no. 08/0275. Waterblasting of soda to stormwater.
Site Address	**451 TiRakau Drive**		
Pollution Date	22/06/11	Comment	Incident no. 11/2871. Paint discharged to stormwater.
Pollution Date	28/01/10	Comment	Incident no. 10/0597. Waste cooking spill.
Pollution Date	04/04/08	Comment	Incident no. 08/1463. Waste cooking spill.
Pollution Date	10/10/11	Comment	Incident no. 11/2871. Paint discharge to stormwater.
Site Address	**500 TiRakau Drive**		
Pollution Date	15/06/12	Comment	Incident no. 12/2451. Fire at bowling alley.
Site Address	**TiRakau Drive**		
Pollution Date	14/11/09	Comment	Incident no. 09/3542. Odour complaint.
Pollution Date	2/1/2007	Comment	Incident no. 07/3676. Petrol to stormwater.
Pollution Date	23/02/07	Comment	Incident no. 07/0877. Car washing to stormwater.
Pollution Date	13/07/04	Comment	Incident no. 04/0935. TJ's carwash discharge to stormwater.
Pollution Date	27/11/01	Comment	Incident no. 01/0683. Washing paint brushes to stormwater.
Pollution Date	30/11/93	Comment	Incident no. 93/0754. Hydrocarbon spill from BP.
Site Address	**Ti Rakau Bridge-Mangrove Swamp**		
Pollution Date	23/01/96	Comment	Incident no. 96/0144. 2 X 44 Gallon Drums Going Down Stream, Planks Of Wood & Oil Slick, Ending Up In Swamp Area

File Reference	7-45-3322		
File Name	**53 TiRakau Drive**		
Pollution Date	07/12/11	Comment	Sediment to stormwater.

File Reference	6-03-1527		
File Name	**249 TiRakau Drive**		
Site Occupier Name	Cascade Hire Centre Ltd		
Site visit Date	04/08/94	Comment	Site audit.

File Reference	P240-04-04		
Site Address	**279 TiRakau Drive - Total Hire Limited**		
Pollution Date	19/01/02	Comment	Incident no. 02/1104. Waste oil overflowing out of drums.
Site Address	**TiRakau Drive**		
Pollution Date		Comment	Incident no.

File Reference	6-03-2465		
File Name	**298 TiRakau Drive**		
Site Occupier Name	Lucky House Restaurant		
Pollution Date	18/05/01	Comment	Washing dishes to stormwater.

File Reference	6-03-2724		
File Name	**318D TiRakau Drive**		
Site Occupier Name	Redox Chemicals NZ		
Pollution Date	18/01/02	Comment	Chemical spill to road.

File Reference	6-03-2157		
File Name	**330 TiRakau Drive**		
Site Occupier Name	Howick & Eastern Buses Ltd		
Pollution Date	14/10/99	Comment	Site visit.

File Reference	6-03-2928		
File Name	**347 TiRakau Drive**		
Site Occupier Name	TJ's Carwash		
Pollution Date	12/02/07	Comment	Carwash to stormwater.
Pollution Date	04/07/04	Comment	Carwash to stormwater.
Pollution Date	15/09/02	Comment	Carwash to stormwater.

File Reference	6-03-2157		
File Name	**380 TiRakau Drive**		
Site Occupier Name	Howick & Eastern Buses		
Pollution Date	26/08/12	Comment	Small oil spill.
Site Visit Date	14/10/99	Comment	Site audit.

File Reference	6-03-2294		
File Name	**TiRakau Drive**		
Site Occupier Name	**Plumbing World**		
Pollution Date	19/10/07	Comment	Black chemical substance seeping from ground.

File Reference	6-03-0141		
File Name	**92-98 Harris Road (but incident was on TiRakau Road)**		
Pollution Date	01/10/95	Comment	Incident no. 95/0014. Chemical Spill At Aspac. Watertech Trucks by Ponds on Ti Rakau Drive

The general catchment file and site visit file for the catchment (6-03 and 6-03-SV respectively) 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 within sites which are approximately 50 metres of either side of the road reserve. Relevant details of the identified consents are appended to this letter (Attachment A).

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 site being investigated: Ground Floor, Kotuku House, 4 Osterley Way, Manukau Central 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).

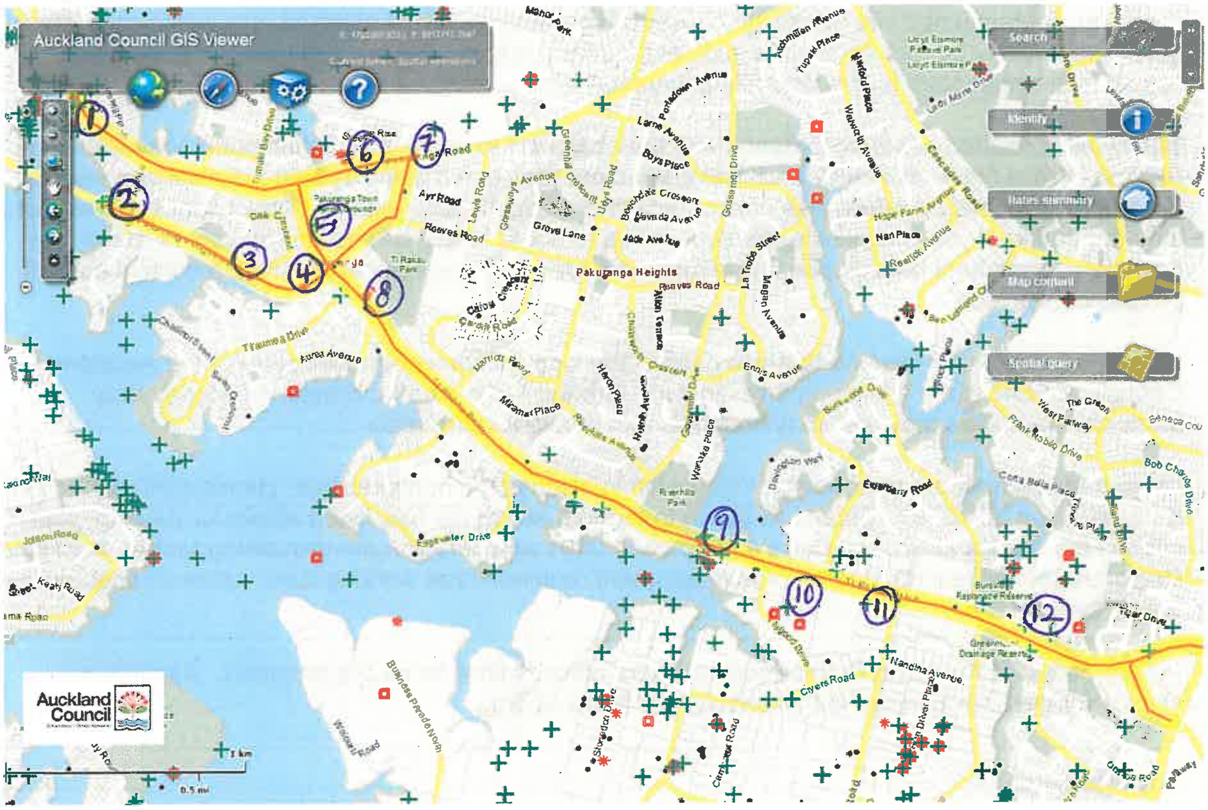
Please note: the Auckland Council cost recovers officer's time for all site enquiries. As such an invoice for the time involved in this enquiry will follow shortly.

Yours sincerely

pp

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

Attachment A



1 ACTIVITY DESCRIPTION:	To authorise the construction of up to 16 bores for investigation purposes.
ACTIVITY ID:	21951
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Opus International Consultants Ltd
CONSENT NUMBER:	28231
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20040824
FILE REFERENCE:	C512-12-3153*
GRANTED DATE:	20030820
LOC TYPE:	Point
PROCESSING OFFICER:	_Sarah Pinkerton
PROPERTY ADDRESS:	Eastern Corridor Auckland City & Manukau City
PURPOSE:	To authorise the construction of up to 16 bores for investigation purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	St Johns
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of up to 16 100mm diameter bores, to a depth of approximately 40m. Installation of PVC casing.

2. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	20039
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited

CONSENT NUMBER:	24690
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20010531
FILE REFERENCE:	15256
GRANTED DATE:	20010223
LOC TYPE:	Point
PROCESSING OFFICER:	_Wes Smith
PROPERTY ADDRESS:	Parts of the four power transmission towers as described in the application, being towers on the Otahuhu-Penrose A Line Numbered 20, 22 and 37 and tower Number 9 on the Penrose-Roskill A Line.
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Manukau & Auckland City
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	The discharge of blast media and wastewater to ground as a result of power transmission tower refurbishment trials.

2. ACTIVITY DESCRIPTION:	Clean & paint tower previously coated wit lead-based paint
ACTIVITY ID:	20066
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited
CONSENT NUMBER:	25577
CONSENT STATUS:	Superseded
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20041231
FILE REFERENCE:	15256
GRANTED DATE:	20011025
LOC TYPE:	Point
PROCESSING OFFICER:	_Belinda Gillespie
PROPERTY ADDRESS:	All transmission towers Otahuhu-Penrose B Line Manukau City
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	Null

2. ACTIVITY DESCRIPTION:	Clean & paint tower previously coated wit lead-based paint
ACTIVITY ID:	20066
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited

CONSENT NUMBER:	26761
CONSENT STATUS:	Expired (Not Replace
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20041231
FILE REFERENCE:	15256
GRANTED DATE:	20020913
LOC TYPE:	Point
PROCESSING OFFICER:	_Clive Couldwell
PROPERTY ADDRESS:	All transmission towers Otahuhu-Penrose B Line Manukau City
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(a) and (b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	Null

2. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	20111
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited
CONSENT NUMBER:	26789
CONSENT STATUS:	Expired (Not Replace
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20041231
FILE REFERENCE:	15256
GRANTED DATE:	20020913
LOC TYPE:	Point
PROCESSING OFFICER:	_Clive Couldwell
PROPERTY ADDRESS:	Parts of the transmission towers as described in the application, being tower Number 25 on the PEN - ROS A Line Auckland City
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	Null

3. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of nineteen bores for Geotechnical investigation.
ACTIVITY ID:	28689
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1766322
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4948*
GRANTED DATE:	Null

LOC TYPE:	Point
NORTHING:	5912882
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52773
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of nineteen bores for Geotechnical investigation.
REVIEW DATE:	Null
SITE DESCR:	Multiple sites across Reeves Rd Flyover, Pakuranga. Sites ranging between coordinates: 1) E 1766322 N 5912882 2) E 1766548 N 5912835 3) E 1767011 N 5913381
SITE NAME:	Reeves Rd Flyover
WORKS DESCRIPTION:	Null

4. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of nineteen bores for Geotechnical investigation.
ACTIVITY ID:	28689
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1766548
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4948*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5912835
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52773
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of nineteen bores for Geotechnical investigation.
REVIEW DATE:	Null
SITE DESCR:	Multiple sites across Reeves Rd Flyover, Pakuranga. Sites ranging between coordinates: 1) E 1766322 N 5912882 2) E 1766548 N 5912835 3) E 1767011 N 5913381
SITE NAME:	Reeves Rd Flyover
WORKS DESCRIPTION:	Null

5. ACTIVITY DESCRIPTION:	5/12/09 ext appeal date to due to submitteres not getting their copy of decision WBS 30355 master C 8 Pakuranga - network discharges wetweather and emergency discharges
ACTIVITY ID:	20592
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Wastewater Discharge
CONSENT HOLDER:	Watercare Services Limited
CONSENT NUMBER:	30355
CONSENT STATUS:	Issued
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20431231
FILE REFERENCE:	18036
GRANTED DATE:	20091030
LOC TYPE:	Point

PROCESSING OFFICER:	Lisa Doran
PROPERTY ADDRESS:	Wastewater Network within the Catchment 8 Pakuranga Manukau City
PURPOSE:	To authorise the discharge of wastewater to land or water as a result of wet weather wastewater overflows, and/or overflows resulting solely from network blockages or breakages, and/or exfiltration, and/or power failure or mechanical failure at pump stat
REVIEW DATE:	20151231
SITE DESCRIPTION:	PS 9, 10, 11, 12, 13, 17, 18, 33 and 65
SITE NAME:	C 8 Pakuranga
WORKS DESCRIPTION:	As indicated in the Catchment 8 WNMP prepared by Manukau Water Limited.

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Tank removal
ACTIVITY ID:	21038
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Under Assessment
EASTING:	1766716.5
EXPIRY DATE:	Null
FILE REFERENCE:	Null
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5913366.2
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52127
PROCESSING OFFICER:	Null
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	file T096-03-1288
REVIEW DATE:	Null
SITE DESCR:	Lot 1 DP 149241, Lot 51 & 52 DP 69912
SITE NAME:	Mobil Pakuranga
WORKS DESCRIPTION:	Environmental Site Assessment report received 12/09/08

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Ex Mobil service station. Remediation undertaken by Mobil. The CoC granted 21/9/2009.
ACTIVITY ID:	21076
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1766716
EXPIRY DATE:	Null
FILE REFERENCE:	21158
GRANTED DATE:	20090921
LOC TYPE:	Point
NORTHING:	5913382
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52257
PROCESSING OFFICER:	John O'Grady
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	An application for a Certificate of Compliance to certify that the soil contaminant levels at the site.meet the PA criteria, based on PARP:ALW

	Rule 5.5.41
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Sea Horse Investments Ltd
WORKS DESCRIPTION:	Rule 5.5.41

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Removal of underground storage tanks and pipework
ACTIVITY ID:	21021
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1766716
EXPIRY DATE:	Null
FILE REFERENCE:	21158
GRANTED DATE:	20090209
LOC TYPE:	Point
NORTHING:	5913382
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52100
PROCESSING OFFICER:	John O'Grady
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	Certifying that the petroleum hydrocarbon residues left in the soils tested after the removal of the UPSS meet the ARC PA Criteria under rule 5.5.42(2) for the site being used for petroleum storage
REVIEW DATE:	Null
SITE DESCR:	Certifying that the petroleum hydrocarbon residues left in the soils tested after the removal of the UPSS meet the ARC PA Criteria under rule 5.5.42(2) for the site being used for petroleum storage
SITE NAME:	Sea Horse Investments Ltd
WORKS DESCRIPTION:	PO Dave Robotham Rule 55 42 (2)

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Tank removal
ACTIVITY ID:	21038
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Under Assessment
EASTING:	1766716.5
EXPIRY DATE:	Null
FILE REFERENCE:	Null
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5913366.2
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52127
PROCESSING OFFICER:	Null
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	file T096-03-1288
REVIEW DATE:	Null
SITE DESCR:	Lot 1 DP 149241, Lot 51 & 52 DP 69912
SITE NAME:	Mobil Pakuranga
WORKS DESCRIPTION:	Environmental Site Assessment report received 12/09/08

7. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of nineteen bores for Geotechnical investigation.
ACTIVITY ID:	28689
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1767011
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4948*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5913381
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52773
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of nineteen bores for Geotechnical investigation.
REVIEW DATE:	Null
SITE DESCR:	Multiple sites across Reeves Rd Flyover, Pakuranga. Sites ranging between coordinates: 1) E 1766322 N 5912882 2) E 1766548 N 5912835 3) E 1767011 N 5913381
SITE NAME:	Reeves Rd Flyover
WORKS DESCRIPTION:	Null

8. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Tank removal validation report provided to AC on the 28 June 2010.
ACTIVITY ID:	21228
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Null
EASTING:	1766830
EXPIRY DATE:	Null
FILE REFERENCE:	6-03-4522
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5912819
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52616
PROCESSING OFFICER:	Andrew Kalbarczyk
PROPERTY ADDRESS:	11 Cortina Place Pakuranga Manukau City
PURPOSE:	Tanks were pulled in 2010, site no longer a petrol station. 9 samples exceeded the applicable soil acceptance criteria. Those exceedances relate to protection of maintenance/excavation workers, and indoor inhalation human health exposure pathways. Full
REVIEW DATE:	Null
SITE DESCR:	Tank removal validation report provided to AC on the 28 June 2010.
SITE NAME:	11 Cortina Place, Pakuranga
WORKS DESCRIPTION:	CONSENT IS REQUIRED FOR THIS SITE!

8. ACTIVITY:	Bore

ACTIVITY DESCRIPTION:	The construction of four bores for contaminated site investigation.
ACTIVITY ID:	28063
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1766810
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4841
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5912797
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52654
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	11 Cortina Place Pakuranga Manukau City
PURPOSE:	The construction of four bores for contaminated site investigation.
REVIEW DATE:	Null
SITE DESCR:	56 Ti Rakau Drive, Pakuranga
SITE NAME:	Chevron
WORKS DESCRIPTION:	The construction of four 100mm diameter bores to a maximum depth of 6m. Installation of Grade D PVC casing material to an approximate depth of 6m. Proposed grouting to 0.5m.

9. ACTIVITY DESCRIPTION:	To authorise the construction of up to 16 bores for investigation purposes.
ACTIVITY ID:	21951
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Opus International Consultants Ltd
CONSENT NUMBER:	28231
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20040824
FILE REFERENCE:	C512-12-3153*
GRANTED DATE:	20030820
LOC TYPE:	Point
PROCESSING OFFICER:	Sarah Pinkerton
PROPERTY ADDRESS:	Eastern Corridor Auckland City & Manukau City
PURPOSE:	To authorise the construction of up to 16 bores for investigation purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	St Johns
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of up to 16 100mm diameter bores, to a depth of approximately 40m. Installation of PVC casing.

9. ACTIVITY DESCRIPTION:	Largely domestic use for toilets and showers etc.
ACTIVITY ID:	1397
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	TRU-TEST LIMITED
CONSENT NUMBER:	12889
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.

EXPIRY DATE:	19950711
FILE REFERENCE:	C512-12-1309
GRANTED DATE:	19940711
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for the extraction of groundwater for supply to industrial showers & toilets.
REVIEW DATE:	Null
SITE DESCRIPTION:	241 TI RAKAU DRIVE, EAST TAMAKI
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx 120m depth and installation of steel casing to approx. 90m.

9. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	5225
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Pattle Delamore Partners Limited
CONSENT NUMBER:	14985
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	19970311
FILE REFERENCE:	C512-12-1701*
GRANTED DATE:	19960311
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	242 Ti Rakau Drive East Tamaki Manukau City
PURPOSE:	Authorize the construction of three (3) piezometers for groundwater level and/or Chemistry investigations 3 bores drilled under bore code 5225. Details of S1 bore entered.
REVIEW DATE:	Null
SITE DESCRIPTION:	242 Ti Rakau Drive, Pakuranga
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of three (3) 50mm dia. piezometers to approx 5m depth. Installation of PVC casing to approx 5m and PVC screen from approx. 1m to 5m if required.

10. ACTIVITY DESCRIPTION:	To authorise the construction of four bores for environmental monitoring.
ACTIVITY ID:	23194
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	T.M.K. Packers Limited
CONSENT NUMBER:	36060
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20090807
FILE REFERENCE:	C512-12-4267*
GRANTED DATE:	20080808
LOC TYPE:	Point
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	257 Ti Rakau Drive East Tamaki Manukau City

PURPOSE:	To authorise the construction of four bores for environmental monitoring.
REVIEW DATE:	Null
SITE DESCRIPTION:	known as 2/20 Trugood Drive - Rates data as shown in property data 257 Ti Rakau Drive
SITE NAME:	T.M.K Packers Limited
WORKS DESCRIPTION:	The construction of four 50mm diameter bores to an approximate depth of 5m. Installation of PVC casing to an approximate depth of 5m. Proposed grouting to 0.5m. Screen material PVC, depth to top of screen 1m and bottom of screen 5m.

11. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	20209
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Discharge To Air
CONSENT HOLDER:	The Spa & Pool Factory Ltd *In Liq*
CONSENT NUMBER:	29732
CONSENT STATUS:	Issued
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20130428
FILE REFERENCE:	17693
GRANTED DATE:	20030428
LOC TYPE:	Point
PROCESSING OFFICER:	_Manukau City Council
PROPERTY ADDRESS:	295 Ti Rakau Drive East Tamaki Manukau City
PURPOSE:	To control the discharge of atmospheric contaminants to air.
REVIEW DATE:	Null
SITE DESCRIPTION:	C-93
SITE NAME:	Spa and Pool Factory
WORKS DESCRIPTION:	Null

12. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	21814
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Chevron New Zealand ***USE 751***
CONSENT NUMBER:	27499
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20031201
FILE REFERENCE:	C512-12-3033
GRANTED DATE:	20021202
LOC TYPE:	Point
PROCESSING OFFICER:	__Michelle Ip
PROPERTY ADDRESS:	380 Ti Rakau Drive East Tamaki Manukau City
PURPOSE:	Authorise the construction of a bore for monitoring purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 50mm diameter bore to a depth of approximately 10m. Installation of PVC casing to a depth of approximately 10m.

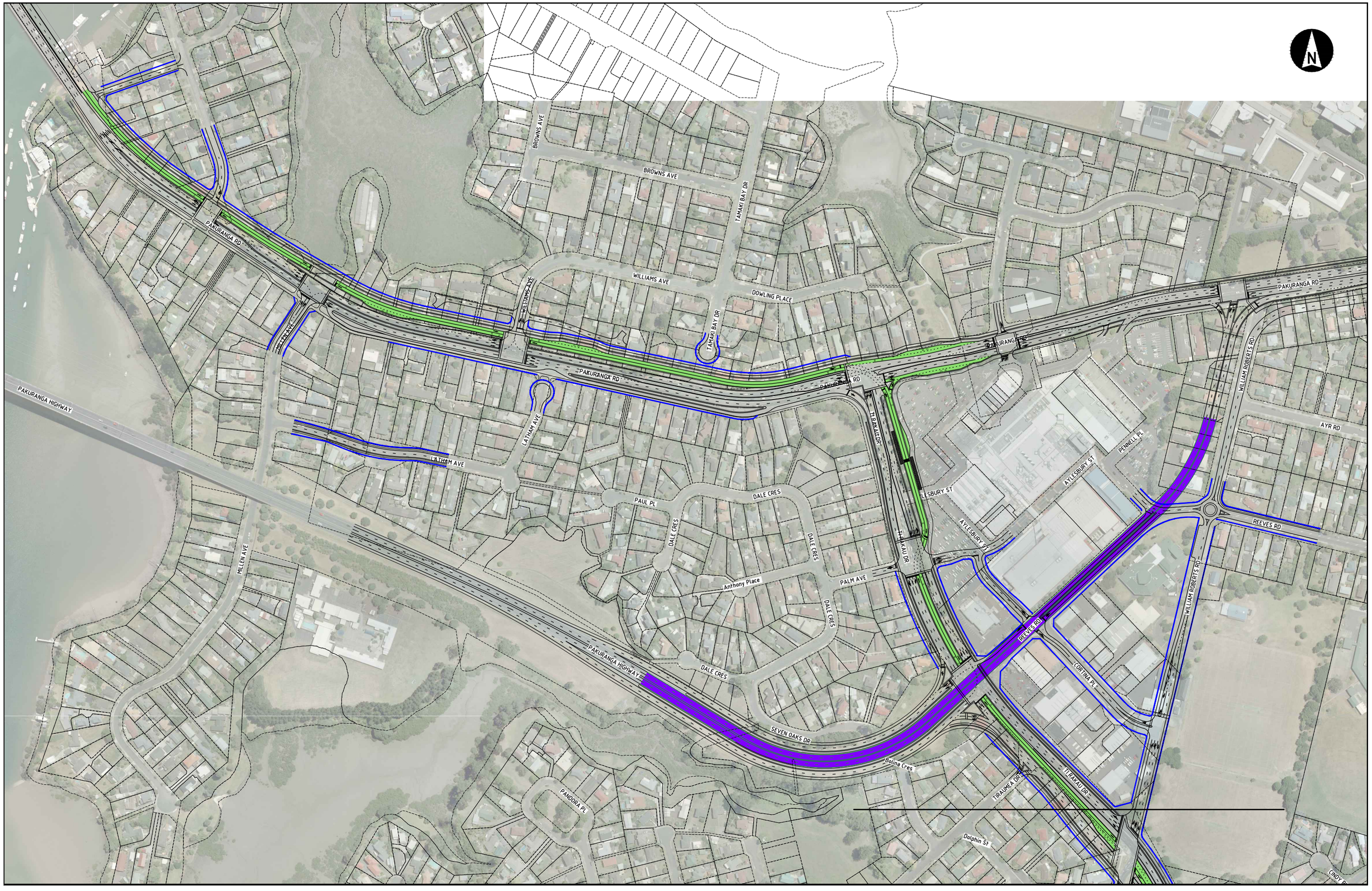
Appendix B

Pakuranga Scheme Assessment Alignment Sheets

A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

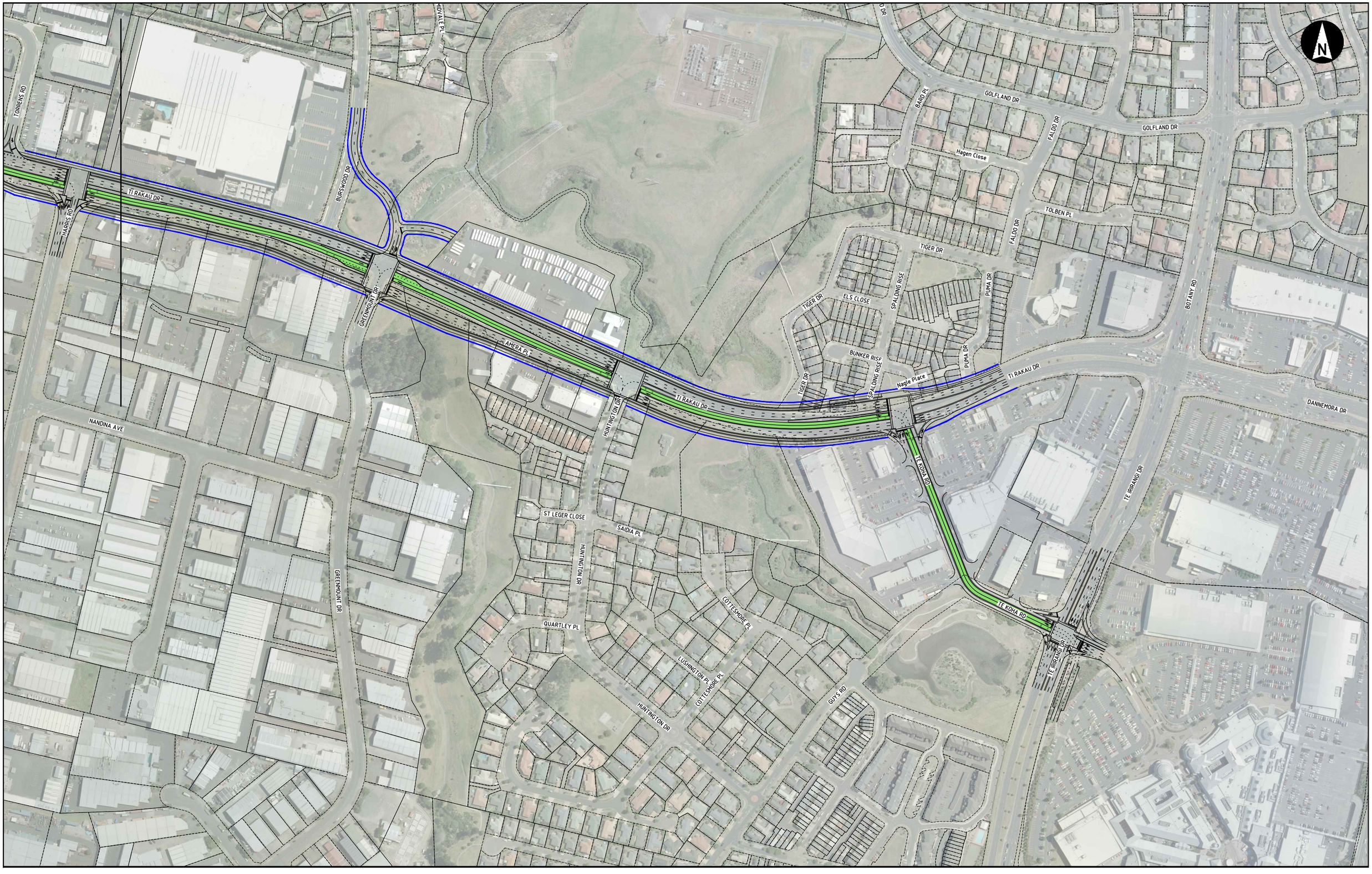
AMETI PACKAGE 4
- SHEET 2



A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

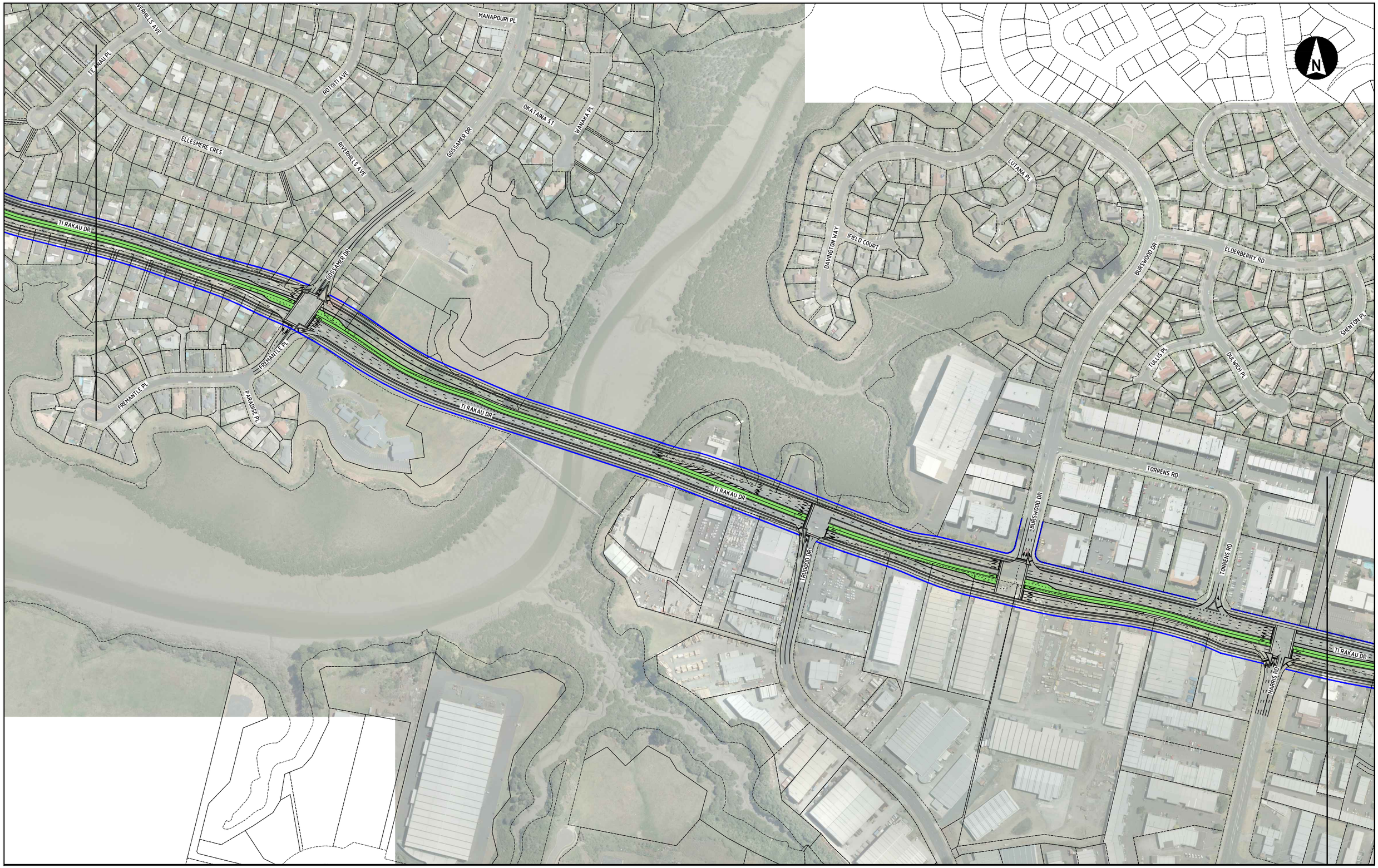
AMETI PACKAGE 4
- SHEET 1



A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

AMETI PACKAGE 4 - SHEET 4



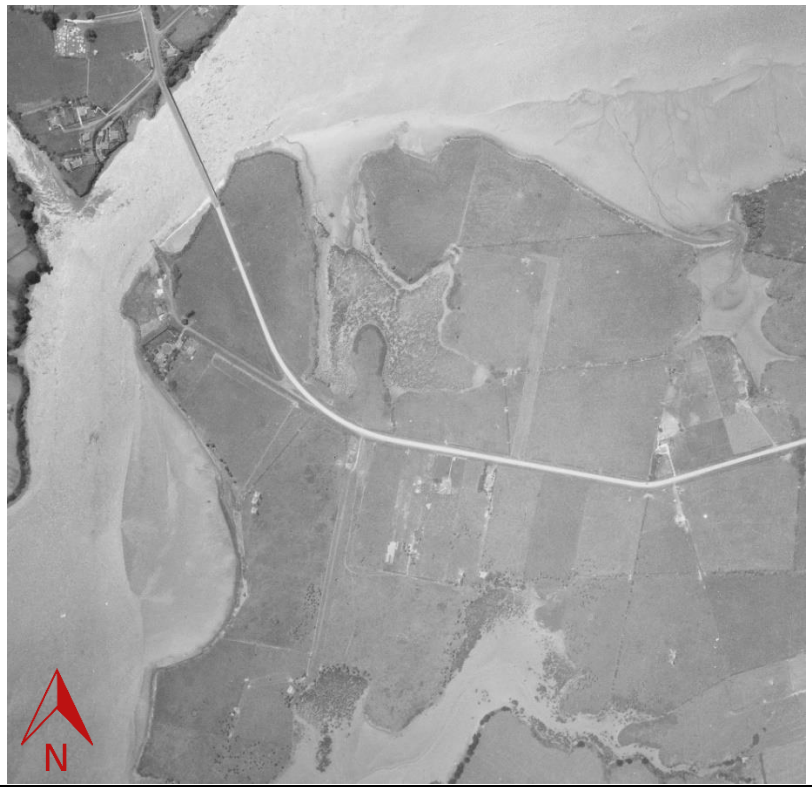
A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

AMETI PACKAGE 4 - SHEET 3

Appendix B: Historical Aerials

Historical Aerials - Eastern Busways – EB2 Package

Reference	Photographs
Date: 1939 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB2	
Date: 1968 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB2	

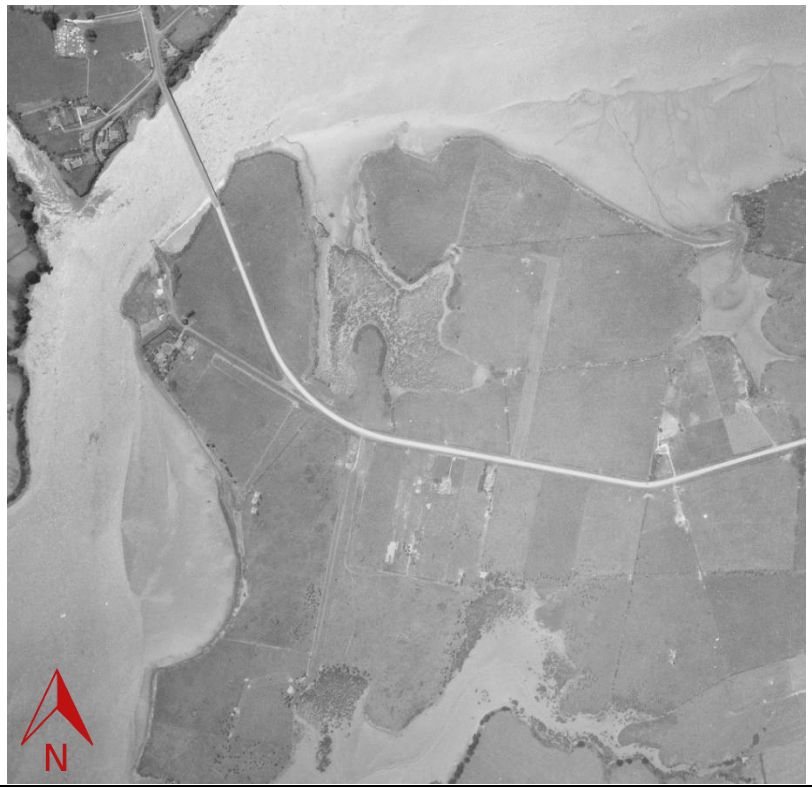
Reference	Photographs
Date: 1972 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB2	
Date: 1980 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB2	

Reference	Photographs
Date: 1988 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB2	
Date: 1996 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB2	

Reference	Photographs
Date: 2010 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB2	
Date: 2015 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB2	

Reference	Photographs
Date: 2017 Source: Google Earth Pro online services Area: EB2	

Historical Aerials - Eastern Busways – EB3R Package

Reference	Photographs
Date: 1939 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB3R	
Date: 1968 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB3R	

Reference	Photographs
Date: 1972 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB3R	
Date: 1980 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB3R	

Reference	Photographs
Date: 1988 Source: Retrolens Historical Image Resource https://www.retrolens.nz Area: EB3R	
Date: 1996 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB3R	

Reference	Photographs
Date: 2010 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB3R	
Date: 2015 Source: Auckland Council Geomaps https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html Area: EB3R	

Reference	Photographs
Date: 2017 Source: Google Earth Pro online services Area: EB3R	

Appendix C: Auckland Council Contamination Enquiries

18 May 2021

AECOM
PO Box 434
HAMILTON 3240

Attention: Kerryn Mclellan

Dear Kerryn

Site Contamination Enquiry – *Ameti Eastern Busway Route*

This letter is in response to your enquiry requesting available site contamination information within Auckland Council records for the above site. Please note this report does not constitute a site investigation report; such reports are required to be prepared by a (third-party) Suitably Qualified and Experienced Practitioner.

The following details are based on information available to the Contamination, Air & Noise Team in the Resource Consent Department. The details provided may be from former regional council information, as well as property information held by the former district/city councils. For completeness the relevant property file should also be requested to obtain all historical records and reports via 09 3010101 or online at:

https://www.aucklandcouncil.govt.nz/buying-property/order-property-report/Pages/order-property-file.aspx.

1. Hazardous Activities and Industries List (HAIL) Information

This list published by the Ministry for the Environment (MfE) comprises activities and industries that are considered likely to cause land contamination as a result of hazardous substance use, storage, and/or disposal.

Council's records indicate the following sites have possibly been subject to activities that fall within the HAIL:

- 27R William Roberts Road, Pakuranga

For more information on these sites, please the tab 'Property Notes From SAP' within Attachment A.

Please note:

- *If you are demolishing any building that may have asbestos containing materials (ACM) in it, you have obligations under the Health and Safety at Work (Asbestos) Regulations 2016 for the management and removal of asbestos, including the need to engage a Competent Asbestos Surveyor to confirm the presence or absence of any ACM.*
- *Paints used on external parts of properties up until the mid-1970's routinely contained lead, a poison and a persistent environmental pollutant. You are advised to ensure that soils affected by old, peeling or flaking paint are assessed in relation to the proposed use of the property, including high risk use by young children.*

2. Consents and Incidents Information (200m radius of the selected site)

The Council database was searched for records of the following activities within approximately 200 metres of the site:

- Pollution Incidents (including air discharges, oil or diesel spills)
- Bores
- Contaminated site and air discharges, and industrial trade process consents
- Closed Landfills
- Air quality permitted activities

A map of the search area is included within Attachment B.

Relevant details of any pollution incidents and consents are appended to this letter (Attachment A). Please refer to the column titled 'Property Address' on the spreadsheet to aid in identifying corresponding data on the map.

While the Auckland Council has carried out the above 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.

If you wish to clarify anything in this letter that relates to this site, please contact contaminatedsites@aucklandcouncil.govt.nz. Any follow up requests for information on other sites must go through the online order process.

Should you wish to request any of the files referenced above and/or listed in the attached spreadsheet 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 the files will be available).

Please note Auckland Council cost recovers officer's time for all site enquiries. As such an invoice for $128 for the time involved in this enquiry will follow shortly.

Yours Sincerely,

Contamination, Air and Noise Team
Specialist Unit | Resource Consents
Auckland Council


Williams Avenue
Dowling Place
Tamaki Bay Drive
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
William Roberts Road
Bennett Road
Lewis Road
Ayr Road
Ayr Road
Lewis Road
Paul Place
Dale Crescent
Dale Crescent
Dale Crescent
Anthony Place
Palm Avenue
Ti Rakau Drive
Ti Rakau Drive
Ti Rakau Drive
Ti Rakau Drive
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Pakuranga Highway
Dale Crescent
Dale Crescent
Seven Oaks Drive
Pakuranga Highway
Cortina Place
Rosina Place
Ti Rakau Drive
Ti Rakau Drive
Ti Rakau Drive
Tiraumea Drive
Bolina Crescent
Dolphin Street
Pandora Place
Pandora Place
Osprey Street
Undine Street
Tiraumea Drive
Tiraumea Drive
Mattson Road
Cindy Place
Legend
Buffered
ClosedLandfill
ContaminatedSubTypes
PossibleContamRecords
PropertyNotesFromSAP
LegacyApplicationsAll
LegacyBores
LegacyConsentsAll
LegacyPermittedActivities
OAS_CONS_D_CONTAMINATED_SITE
Land Outside
Sea Outside
Water
Sea Outside

14 June 2021

Aecom NZ Limited
OI Box 4241
AUCKLAND 1140

Attention: Kerryn Mclellan

Dear Kerryn

Site Contamination Enquiry – *Ti Rakau Drive*

This letter is in response to your enquiry requesting available site contamination information within Auckland Council records for the above site. Please note this report does not constitute a site investigation report; such reports are required to be prepared by a (third-party) Suitably Qualified and Experienced Practitioner.

The following details are based on information available to the Contamination, Air & Noise Team in the Resource Consent Department. The details provided may be from former regional council information, as well as property information held by the former district/city councils. For completeness the relevant property file should also be requested to obtain all historical records and reports via 09 3010101 or online at:

https://www.aucklandcouncil.govt.nz/buying-property/order-property-report/Pages/order-property-file.aspx.

1. Hazardous Activities and Industries List (HAIL) Information

This list published by the Ministry for the Environment (MfE) comprises activities and industries that are considered likely to cause land contamination as a result of hazardous substance use, storage, and/or disposal.

Council's records indicate the following sites have possibly been subject to activities that fall within the HAIL:

- 168R Gossamer Drive, Pakuranga Heights
- 33R Edgewater Drive, Pakuranga
- 27R William Roberts Road, Pakuranga

Please see the tab 'Property Notes From SAP' within Attachment A for more information.

Please note:

- *If you are demolishing any building that may have asbestos containing materials (ACM) in it, you have obligations under the Health and Safety at Work (Asbestos) Regulations 2016 for the management and removal of asbestos, including the need to engage a Competent Asbestos Surveyor to confirm the presence or absence of any ACM.*
- *Paints used on external parts of properties up until the mid-1970's routinely contained lead, a poison and a persistent environmental pollutant. You are advised to ensure that soils affected by old, peeling or flaking paint are assessed in relation to the proposed use of the property, including high risk use by young children.*

2. Consents and Incidents Information (200m radius of the selected site)

The Council database was searched for records of the following activities within approximately 200 metres of the site:

- Pollution Incidents (including air discharges, oil or diesel spills)
- Bores
- Contaminated site and air discharges, and industrial trade process consents
- Closed Landfills
- Air quality permitted activities

A map of relevant records can be found appended to this letter (Attachment B).

Relevant details of any pollution incidents and consents are appended to this letter (Attachment A). Please refer to the column titled 'Property Address' on the spreadsheet to aid in identifying corresponding data on the map.

While the Auckland Council has carried out the above 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.

If you wish to clarify anything in this letter that relates to this site, please contact contaminatedsites@aucklandcouncil.govt.nz. Any follow up requests for information on other sites must go through the online order process.

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Please note Auckland Council cost recovers officer's time for all site enquiries. As such an invoice for $128 for the time involved in this enquiry will follow shortly.

Yours Sincerely,

Contamination, Air and Noise Team
Specialist Unit | Resource Consents
Auckland Council


Legend
Buffered
ClosedLandfill
ContaminatedSubTypes
PossibleContamRecords
PropertyNotesFromSAP
LegacyApplicationsAll
LegacyBores
LegacyConsentsAll
LegacyPermittedActivities
OAS_CONS_D_CONTAMINATED_SITE
SIIEDPollution
Ti Rakau Drive
Dolphin Street
Mattson Road
Aurea Avenue
Roseburn Place
Carole Crescent
Cardiff Road
Marriott Road
Udys Road
Reeves Road
Downsview Road
Blyton Lane
Parkview Place
Chatsworth Crescent
Ennis Avenue
Heron Place
Miramar Place
Okareka Place
Te Anau Place
Riverhills Avenue
Rotoiti Avenue
Gossamer Drive
Ellesmere Crescent
Edgewater Drive
Mangos Place
Riverina Avenue
Raewyn Place
Fremantle Place
Trugood Drive

Appendix D: William Roberts Road Extension - Technical Report

Eastern Busway

William Roberts Road Extension

Contaminated Land Effects Assessment

Eastern Busway

William Roberts Road Extension

Document Reference: EB234-1-PL-RP-Z0-000004

Document History and Status			
Rev	**Date**	**Author**	**Status**
A	16/03/21	Harry Jones	Final

Document Approval					
Rev	**Action**	**Name**	**Position**	**Date**	**Signature**
A	Reviewed by	Shannon Holroyd	SQEP	18/01/22	On file
B	Reviewed by	Emilie Eddington	SQEP	3/02/22	On file
C	Reviewed by	Shannon Holroyd	SQEP	17/03/22	On file
C	Reviewed by	Roger McDonald	Planning Lead	23/03/22	On file
1	Approved by	Emilie Eddington	SQEP	23/03/22	On file
1	Approved by	Karyn Sinclair	RMA Planning and Property Manager		

Table of Contents

Figures

Tables

List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Environmental Effects
AC	Auckland Council
AT	Auckland Transport
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
BPO	Best practicable option
CEMP	Construction Environmental Management Plan
CMA	Coastal Marine Area
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3 - Commercial	Eastern Busway 3 (Ti Rakau Bridge to Botany)
EB3 - Residential	Eastern Busway 3 (Pakuranga to Ti Rakau Bridge)
EB4	Eastern Busway 4 (Botany Town Centre Station)
EBA	Eastern Busway Alliance
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
MCA	Multi Criteria Analysis
NES - CS	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NES - FW	Resource Management (National Environmental Standards for Freshwater) Regulations 2020
NPS - FM	National Policy Statement for Freshwater Management 2020
NPS - UD	National Policy Statement for Urban Development 2020
NZCPS	New Zealand Coastal Policy Statement 2010
NoR	Notice of Requirement
PWA	Public Works Act 1981
RTN	Rapid Transit Network
RRF	Reeves Road Flyover
RMA	Resource Management Act 1991

Executive Summary

This technical report describes the assessment of contaminated land effects associated with the operation and construction of the William Roberts Road extension (the proposed alignment). The purpose is to inform the Assessment of Environmental Effects (AEE) of contaminants within the areas of proposed soil disturbance associated with the works, which supports the resource consent application for the proposal.

Based on the findings of a 2012 Preliminary Site Investigation (PSI) by GHD within the proposed Alignment, three sites were identified adjacent or within the proposed alignment where HAIL activities were identified, which are the following:

- 16 Cortina Place
- 16D Cortina Place
- 64B Ti Rakau / 11 Cortina Place.

Following an Auckland Council (AC) Contaminated Site Enquiry an additional site was identified at Ti Rakau Park, which was noted as a historical landfill site.

As outlined in Section 3.2, buildings located at 16 and 16D Cortina Place are proposed for demolition, with excavation also proposed for the instalment of stormwater and cut and cover excavation of surface soils. Collectively soil disturbance from these activities is likely to exceed 200 m^3. As approximately 750 m^3 of soil is proposed for disturbance at 16 and 16D Cortina Place, it is considered likely the volume of soil disturbance will exceed the permitted activity volume under Regulation 8(3) of the NES - CS. This soil disturbance also does not comply with the Auckland Unitary Plan (Operative in Part) (AUP(OP)) permitted activity standards outlined in Chapter E30 (Contaminated Land). As such, discretionary activity land use consents are required for works at these sites under both the NES - CS and AUP(OP), with any potential effects to human health and the wider environment mitigated through a Contaminated Land Management Plan (CLMP).

Previous environmental investigations indicate the former Caltex branded service station at 64B Ti Rakau Drive contained impacted material from historical activities on site. Following remedial activities, the site was deemed to have meet the remediation objectives, indicating encountering impacted material during excavation in the proposed alignment was unlikely. Although the onsite remedial objectives of the Caltex site exit were met, a 2015 conceptual site model indicated minor residual hydrocarbon impacts could be present within the carriageway adjacent (Ti Rakau Drive). As this carriageway is in a separate package (EB2 and EB3R) to the proposed alignment, management of the effects of the residual hydrocarbon impact will be addressed as part of the CLMP for EB2 and EB3R.

Information reviewed from the AC contamination enquiry identified a closed landfill site within the vicinity of Ti Rakau Park (27R William Roberts Road, Pakuranga) that was used for cleanfill disposal. Works within the proposed alignment require the relocation of utilities via a service trench located in the footpath of William Roberts Road, with a small portion of the trench located in the southern portion of Ti Rakau Park (approximately 144 m^3). The site was deemed low risk by the 2000 Old Landfills Assessment and recent soil samples returned results below adopted criteria, indicating it is unlikely impacted materials will be present within excavations in the southern portion of Ti Rakau Park. However, older cleanfills in the Auckland Region were known to accept organic waste that has the potential to produce landfill gases, the effects of which should be managed by the CLMP for excavation activities in Ti Rakau Park.

1 Introduction

1.1 Overview of the Project

The Eastern Busway Project (the project) is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in south east Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments.

The project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the programme) which includes a dedicated busway and bus stations between Panmure, Pakuranga and Botany town centres. The dedicated busway will provide an efficient rapid transit network (RTN) service between the town centres, while local bus networks will continue to provide more direct local connections within the town centre areas. The project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The programme includes the following works which do not form part of the Eastern Busway Project:

- Panmure Bus and Rail Station and construction of Te Horeta Road (completed)
- Eastern Busway 1 (EB1) – Panmure to Pakuranga (completed)

The Eastern Busway project consists of the following packages:

- William Roberts Road Extension (this application)
- Early Works Consents
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station
- Eastern Busway 3 – Residential (EB3 Residential) – Pakuranga (SEART) intersection along Ti Rakau Drive to Ti Rakau Bridge
- Eastern Busway 3 Commercial (EB3 Commercial) – Ti Rakau Bridge to Botany
- Eastern Busway 4 (EB4) - Botany.

The overall Project alignment is shown in Figure 1 below.

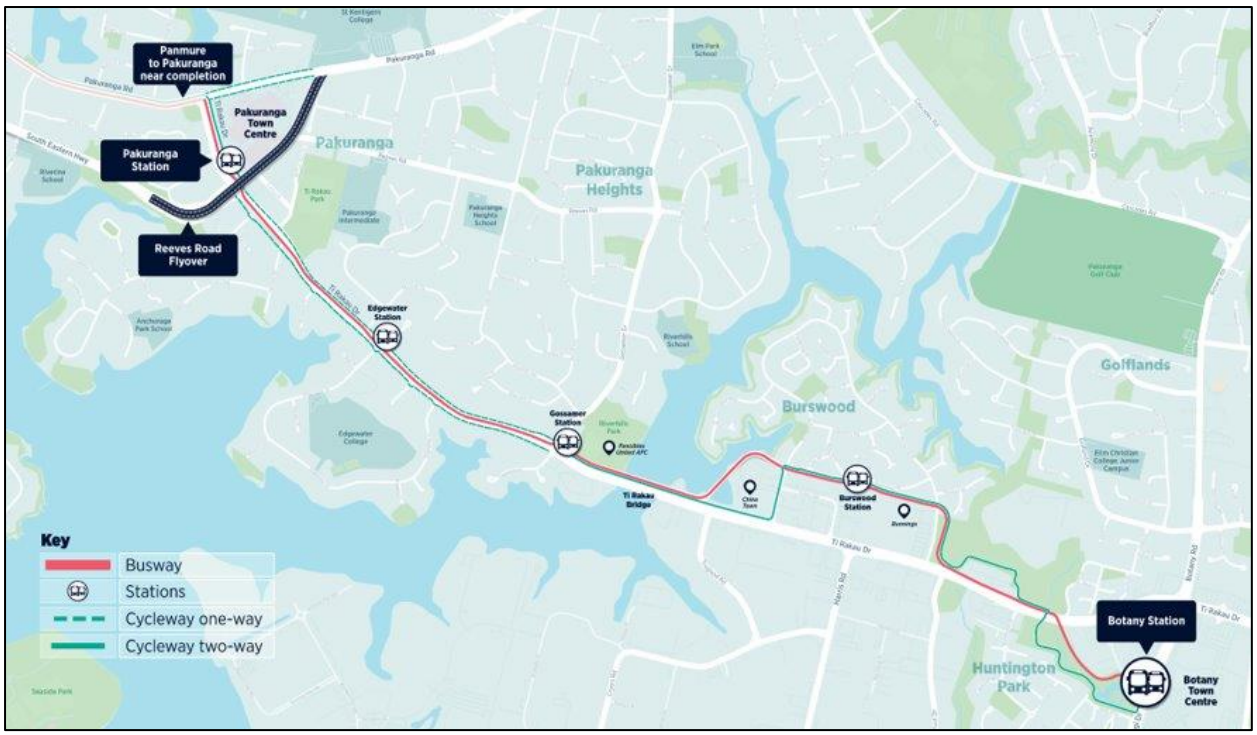

Figure 1. Project alignment

1.2 Project Objectives

The project objectives are:

1. Provide a multi modal transport corridor that connects Pakuranga and Botany to the wider network and increases access to a choice of transport options
2. Provide transport infrastructure that integrates with existing land use and supports a quality, compact urban form
3. Provide transport infrastructure that improves linkages, journey time and reliability of the public transport network
4. Contribute to accessibility and place shaping by providing better transport connections between, within and to the town centre
5. Provide transport infrastructure that is safe for everyone
6. Safeguard future transport infrastructure required at (or in vicinity of) Botany Town Centre to support the development of a strategic public transport connection to Auckland Airport.

2 Proposal Description

2.1 William Roberts Road Extension

William Roberts Road is located to the west of the Pakuranga Town Centre and intersects with Pakuranga Road to the north. It is proposed to extend William Roberts Road south, intersecting with Ti Rakau Drive. This extension is the subject of this assessment of effects and comprises of the following elements:

- Demolition and clearing of the work area
- Excavation of combined services trenches (CST) under proposed footpaths, and relocation of existing utilities to the trenches
- Removal and reconstruction of existing pavement
- Minor earthworks, being removal of topsoil
- Tree removal
- Removal and replacement of on-street car parks
- A new raised pedestrian crossing to Ti Rakau Park
- A new raised priority-controlled intersection within William Roberts Road at the eastern end of Cortina Place
- Stormwater overland flow swale.

The proposed alignment is shown in Figure 2 below.

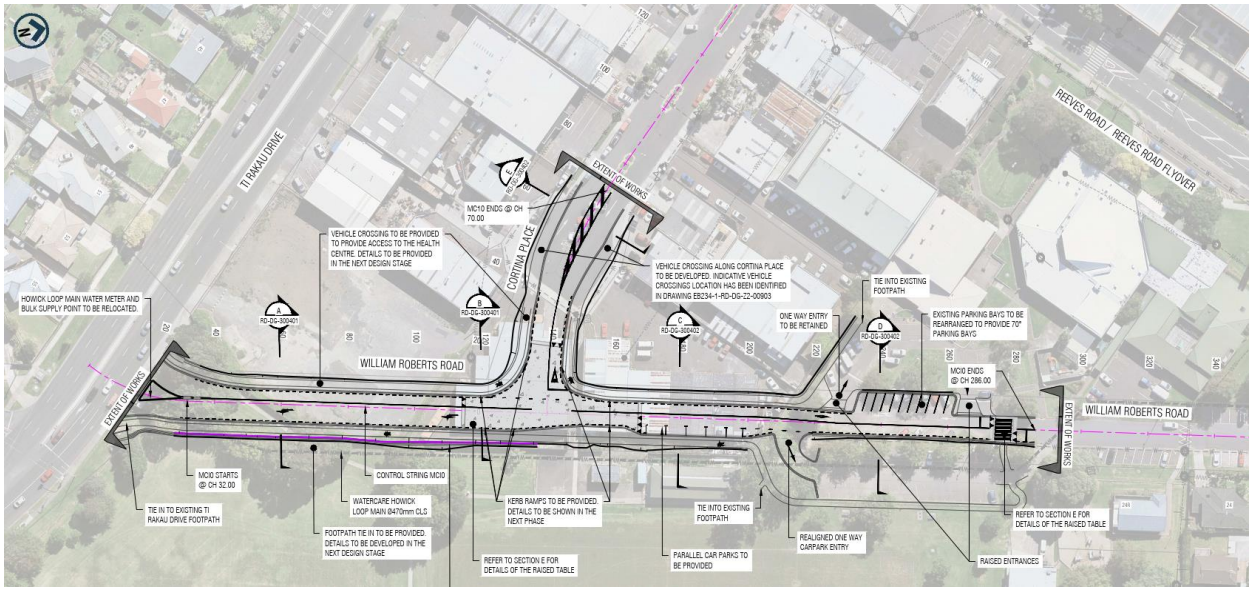

Figure 2. Proposed William Roberts Road extension.

A detailed description of the proposal is provided in Section 4 of the Assessment of Environmental Effects (AEE) that this report is appended to.

3 Specialist Assessment

3.1 Assessment Content

This technical report describes the assessment of contaminated land effects associated with the operation and construction of the William Roberts Road extension (the proposed alignment). The purpose is to inform the AEE of contaminants within the areas of proposed soil disturbance associated with the works.

Purpose:

- Assess whether sites along the proposed alignment have been subject to contaminating (or potentially contaminating) activities, and location(s) and type(s) of these activities
- Advise Auckland Council on the significance of the identified sources and the potential implications in regard to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES - CS)[1]
- Provide general commentary on regional and district authority rules in relation to contamination (if present)
- Provide a general assessment of the potential effects of the work, and the potential mitigation measures to avoid, remedy or mitigate those effects (in relation to contamination effects).

This contaminated land assessment involves:

- Review and assess previous environmental investigations in the vicinity of the Site
- Review publicly available historical aerial photographs
- Review Auckland Council (AC) contaminated land enquiry
- Provide some data to assess the extent of contamination present/not present, specifically in relation to the proposed alignment to be constructed
- Provide information in support of the resource consent application, if required
- Provision of this report completed in general accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guidelines No. 1, 'Reporting on Contaminated Sites in New Zealand', Revised 2011[2]
- Identification of suitable disposal locations for the removed soil, if required, as part of a Contaminated Land Management Plan (CLMP)

3.2 Specific Project Elements

The construction methodology (as detailed in section 4.0 of the AEE) outlines areas within the proposed alignment where excavation during works is required. The overall footprint of the works is approximately 8,350m^2, within which approximately 2,250m^3 of material is to be disturbed for the whole proposed alignment. Approximately 700m^3 of excavation is associated with the stormwater drainage relocation and multiple combined service trenches. The remaining excavation of approximately 1,500m^3 is associated with minor cut to waste and backfill in addition to excavations

[1] MfE, 2011 – National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health.
[2] MfE, 2011 – Contaminated land management guidelines No 1, Reporting on contaminated sites in New Zealand. Revised 2021.

associated with the milling, undercutting and reworking of existing developed land. These areas of excavation will be assessed in conjunction with any contamination activities historical and/or current.

Approximately 450 m^3 is to be disturbed for a services relocation trench in the eastern footpath of William Roberts Road, with a small portion of the trench (approximately 144 m^3) located in the southern portion of Ti Rakau Park.

Buildings located at 16 and 16D Cortina Place are proposed for demolition during works within the proposed alignment. Plans indicate stormwater services will intersect the northern boundary of 16D Cortina Place, then run south to the proposed intersection with Cortina Place and William Roberts Road. The stormwater instalment will require excavation for a services trench, with the proposed excavation volume being approximately 150 m^3 within 16 and 16D Cortina (collectively).

The construction team indicated that following the installation of utilities in the proposed alignment, excavation will be required at 16 and 16D Cortina Place using a cut and cover methodology. The methodology involves the excavation of surface soils to a depth of 0.75 m below ground level (bgl), following which geo-cloth is laid for dust suppression. The excavation will cover an area of approximately 800 m^2, with an excavation volume of approximately 600 m^3 within the proposed alignment. Collectively soil disturbance from these activities is approximately 750 m^3.

Structures identified for demolition within the proposed alignment with potential asbestos containing material will also be reviewed as part of this technical report.

4 Methodology

The following section details methodologies used to assess features and values potentially impacted by the proposed alignment as outlined in section 3.1 and provide rationale for determining the likely level of effects.

4.1 Previous Environmental Investigations

To assess the potential impact of the proposed alignment, a review of previous environmental investigations in the vicinity of the proposed alignment has been undertaken. The Ministry of Environment (MfE) has developed a Hazardous Activities and Industries List (HAIL)[3] which is a compilation of activities and industries that are considered likely to cause land contamination resulting from hazardous substance use, storage, or disposal, both currently and historically. The HAIL is intended to identify activities and industries where hazardous substances are more likely than not to have been used or stored on site and therefore have a greater probability of soil and groundwater contamination. The HAIL groups similar industries together, which typically use or store hazardous substances that could cause contamination if these substances escaped from safe storage, were disposed of on the site, or were lost to the environment through use. Impact from previous and/or current HAIL activities identified and recommendations in previous investigations have been take into consideration to mitigate any environmental effects during works in the proposed alignment.

4.2 Aerial Photographs

A review of publicly available historical aerial photographs has been conducted in the vicinity of the proposed alignment, to identify historical or current HAIL sites not identified in previous environmental investigations. Historical aerial images were reviewed from the Retrolens Historical Image Resource[4], AC Geomaps online portal[5] and Google Earth pro online services[6] in conjunction with Google Maps street view[7].

4.3 AC Contamination Enquiry

Information was requested and received from AC contaminated site enquiry records and information currently held by the AC's Natural Resources and Specialist Input Unit. Records include landfills bores, air discharge, industrial and trade process consents and environmental assessments within the proposed alignment.

[3] *Hazardous Activities and Industries List (HAIL).* Ministry for the Environment, October 2011
[4] https://retrolens.co.nz accessed 11 November 2021
[5] https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html accessed 11 November 2021
[6] Goggle Earth Pro. accessed 11 November 2021
[7] https://www.google.com/maps accessed 11 November 2021

5 Existing Environment

5.1 Previous Environmental Investigations

To assess the features and values potentially impacted by the proposal, a review of previous environmental investigations in the vicinity of the proposed alignment has been undertaken. The following reports were reviewed and are summarised below:

- Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), June 2000
- Phase 1 PSI for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment, prepared by GHD Limited (GHD), 7 December 2012
- Environmental Sampling (AECOM) - 2019
- Previous investigations at 64B Ti Rakau Drive:
    - Caltex Pakuranga Service Station - Underground Petroleum Storage System (UPSS) Decommissioning, Residual Petroleum Hydrocarbon Assessment (URS) – May 2010
    - Environmental Site Assessment (URS) - November 2011
    - Environmental Site Assessment, Site Delineation Report (URS) - May 2014
    - Conceptual Site Model (URS) - November 2015
    - Resource Consent Application and Assessment of Environmental Effects (AEE), Former Caltex Pakuranga Service Station (URS) – February 2016
    - Soil Validation Report (SVR), Former Caltex Pakuranga (URS) – June 2016

5.1.1 **Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.**

The 2000 Old Landfills Assessment reviewed the closed landfills throughout the Manukau City region to ensure the necessary resource consents were in place. From information provided by the Manukau City Council (MCC), historical records revealed that 39 closed landfill sites existed within the MCC owned property. Each site was evaluated to determine the potential for adverse environmental effects in order to clarify which sites may require resource consents from the Auckland Regional Council (ARC).

The assessment was carried out based on the following key criteria:

- Age of the landfill
- Type of fill
- Leachate discharge
- Proximity to water courses
- Hydraulics, water level and rainfall
- Leachate toxicity risk factor (LRF)

During the assessment LRF was one of the key indicators for identifying sites that may pose significant risk to the environment and may require resource consent for discharge of leachate.

Investigation and monitoring carried out with regard to the Australia and New Zealand Environmental and Conservation Council (ANZECC) guidelines for contaminated sites, lead to more targeted and detailed investigations on those sites that required further work. Preliminary investigations involved a screening process in which surface water and groundwater samples were collected from selected sites between August 1994 and November 1996.

Following the screening process, high priority landfills were selected based on the key criteria, with subsequent groundwater bores installed on sites between December 1995 and February 1996. Gas was monitored during drilling to ensure that gas concentrations were lower than the lower explosive limit (LEL), the concentration of gas required to support combustion. At no times did the gas levels recorded in any bore exceed the LEL.

Further details on the investigation methodology are included in the report included in full in **Annexure A.**

From the sites evaluated in the report, Ti Rakau Park is located within the proposed alignment and was not identified as a site that may pose a significant risk to the environment.

The key findings and conclusions of the assessment relevant to the proposed alignment:

- The fill type at Ti Rakau Park was list as cleanfill[8]
- Seven bores were advanced at Ti Rakau Park. During the bore installation soils materials consisted of silt and clay between 0.5 and 2.5m
- No abnormal landfill gas readings were recorded during the advancement of boreholes in Ti Rakau Park
- No refuse or organic matter was encountered during drilling in Ti Rakau Park. There was no record of any landfills having a specifically engineered clay cap, liner, or base. Anecdotal evidence suggests that the landfills were established on top of existing ground, which was confirmed during the drilling of the groundwater bores
- All landfills were generally underlain to a variable depth and with variable quality of silt or clay type medium and unknown permeability
- None of the landfills have a leachate collection system
- GHD determined that Ti Rakau Park wasn't a site of interest and did not require resource consent

5.1.2 Phase 1 PSI for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment, prepared by GHD Limited (GHD), dated 7 December 2012.

The 2012 assessment reviewed packages EB2, EB3 Residential (EB3R), EB3 Commercial (EB3C) and EB4, areas previously referred to as Packages 3 & 4. The purpose of the PSI was to support AT in meeting the requirements of the NES - CS. The NES - CS applies to 'a piece of land' where a hazardous activity or industry (historically or current) has been identified. As such, the objective of the PSI was to assess the likelihood of the presence of soil contamination resulting from historical and/or current land use activity within or adjacent to the proposed alignment.

The PSI comprised of a review of information from the following sources:

- Draft alignment plans as of October 2012 developed by GHD/Aurecon
- Selected publicly available historical aerial photographs from 1940 to 2010
- Collection of photographs as part of a walkover conducted on 26 September 2012
- AC contaminated sites register
- AC groundwater borehole register
- Readily available site investigation reports resulting from site register search
- Readily available geology and hydrogeology information
- Publicly available information on the environmental fate of contaminants

[8] Table 8, Assessment of Old Landfills for Manukau City Council, prepared by GHD Limited (GHD), dated June 2000.

- Identification of sensitive human and/or environmental receptor

In their PSI report, GHD presented the following key findings and conclusions relevant to William Roberts Road are as follows:

- Along the lengths of the proposed alignment there are numerous geological units present with the most prominent being rhyolitic pumiceous deposits of the Tauranga Group
- Engineered construction fill is noted to a large extent, in the GHD report, between Ti Rakau Drive and Pakuranga Road (GHD also reported that it was likely re-compacted clay/gravel and included construction and demolition wastes)
- A site contamination enquiry was completed seeking records from AC. A number of items were identified including pollution incidents, records of discharge consents, submittal of a tank pull report, submittal of an environmental site assessment (ESA) report for service station facility, and borehole installation records for environmental monitoring or investigation purposes at two sites (one service stations and one chemical supplier facility)
- A walkover identified no sensitive receptors in close proximity to the proposed transport improvement works area

Based on the key findings and conclusions presented in the GHD PSI, there are three sites adjacent or within the proposed alignment where HAIL activities were identified. GHD stated that, given surface soils will be disturbed along the alignment corridor through significant soil disturbance, the regulations of the NES - CS apply on the basis of HAIL category H adjacent sites. Category H is defined as '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'. The identified HAIL sites adjacent or within the proposed alignment are detailed in **Table 1.**

Table 1 Summary of Identified HAIL Sites adjacent or within the proposed alignment (modified from GHD, 2012)

Site Name	Land use Activity	HAIL Category	Adjacent or Within
11 Cortina Place / 64B Ti Rakau Drive	Former service station, now Pakuranga Medical Centre	F7 – Service stations including retail or commercial refuelling activities	Adjacent (historically the eastern portion of the site is within the proposed alignment)
16 Cortina Place	Pakuranga Automotive	F4 – Motor vehicle workshops	Within
16D Cortina Place	Pakuranga Auto Transport	F4 – Motor vehicle workshops	Within

5.1.3 Previous Investigations at 64B Ti Rakau Drive

A timeline of environmental investigations by URS (presently AECOM) at the former service station located at 64B Ti Rakau Drive (the Site) is detailed in the 2016 Resource Consent Application and AEE report included in **Annexure A** and presented below:

Caltex Pakuranga Service Station - Underground Petroleum Storage System (UPSS) Decommissioning, Residual Petroleum Hydrocarbon Assessment – May 2010

The scope of works included the removal of 4 x USTs comprising 2 x 40,000 L 91 octane petrol, 1 x 40,000 L 96 octane petrol, 1x 20,000 L diesel and associated pipe work and dispensers.

A soil validation and sampling exercise was completed at the time of decommissioning and indicated concentrations of hydrocarbons compounds within the soil exceeded Oil Industry Guidelines, Tier 1 acceptance criteria for industrial/commercial land use. Exceedances were detected in shallow soil samples collect within the footprint of the former forecourt, general vicinity of the former dispenser islands, remote fills, and interceptor. No exceedances were detected within soil samples collected from the UPSS tank pit excavation in the location of the former fuel storage tanks.

Environmental Site Assessment (ESA) - November 2011

URS completed an ESA to assess shallow soil and groundwater conditions at the Site. These works involved the advancement of four boreholes and installation of and sampling from four on-site groundwater monitoring wells (MW1 to MW4).

Elevated concentrations of hydrocarbons compounds were detected within MW2, located at the southeast site boundary in both soil and groundwater samples analysed.

Environmental Site Assessment, Site Delineation Report - May 2014

In May 2014, URS undertook further environmental assessment involving the completion of sixteen test pits (TP1 To TP16). Concentrations of petroleum hydrocarbons above the Oil Industry Guidelines for commercial/industrial land use was localised in the vicinity of the former stormwater interceptor and ancillary pipework.

Conceptual Site Model - November 2015

In May 2015, AECOM undertook an exercise to appraise the likely extent of hydrocarbon impact in soil and groundwater beyond the boundary of this site with Ti Rakau Drive from the former service station.

Following a review of onsite services and existing soil and groundwater data in conjunction with the less permeable nature of the underlying natural geology, it was determined that the remaining hydrocarbon impacts likely resided predominantly around the on-site stormwater management system. This infrastructure is located parallel to the Ti Rakau Drive frontage and it is likely that residual impact remains in this area following the decommissioning of the UPSS. Soil hydrocarbon impacts were considered to be largely restricted to within the site boundary. Any impacts beyond the site (in the carriageway) were expected to be minor and could be managed with a CLMP.

Resource Consent Application and Assessment of Environmental Effects (AEE), Former Caltex Pakuranga Service Station – February 2016

The AEE provided support for a short-term resource consent to apply during proposed soil remediation works at the former service station. The site was sold to AT who has provided permission for Chevron to undertake the works applied for under this consent application. To meet future Commercial/Industrial land use, Chevron volunteered to remediate the site. It was anticipated in the AEE that approximately 1,600 m^3 of soil will be excavated, of this approximately 1300 m^3 (2,400 tonnes) of material will be removed from the Site. Approximately 600 m^3 of excavated overburden (excavated to gain access to the impacted soils at depth) is expected to meet Commercial/Industrial land use criteria to allow re-use as fill material on-Site.

Soil Validation Report (SVR), Former Caltex Pakuranga – June 2016

In April and May 2016, Chevron commissioned Fuel Installations Auckland Limited to undertake a remedial excavation for the removal of hydrocarbon impacted soil with subsequent backfilling of the excavation. Over the course of the remedial works, approximately 2,563 tonnes of hydrocarbon impacted soil was removed from the Site and disposed of at appropriate facilities. AECOM was engaged to undertake an environmental oversight role of the works and complete a subsequent SVR. A total of 59 soil validation samples were collected, representative of Site conditions post remedial works. All soil validation results complied with MfE Guidelines for Commercial/Industrial land use.

Overall, it was considered that the remedial objective was achieved and that soil conditions at the Site meet the adopted Commercial/Industrial land use criteria.

5.1.4 Environmental Sampling 2019

In 2019, following recommendations of the 2012 PSI completed by GHD (section 5.1.2), AECOM undertook a Gap Analysis in support of the application for resources consents associated with soil disturbances for the proposed alignment. The Gap Analysis identified areas where further investigation was required. Between April and August 2019 and February 2019, six boreholes (advanced for geotechnical purposes) and thirty-three environmental hand augers were completed within the wider EBA works, of which five soil samples were collect from three hand augers within the proposed alignment (hand augers EHA101, EHA102 and EHA105; Figure 3 below). Samples were analysed for the following contaminants:

- Heavy metals
- Total petroleum hydrocarbons (TPH)
- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)
- Polycyclic aromatic hydrocarbons (PAHs).

The environmental assessment focussed on the collection of soil samples for laboratory analysis from materials within anticipated areas of soil disturbance. The analytical results from samples collected from hand augers EHA101, EHA102 and EHA105 are presented on **Table A1** in **Annexure A**. Soil samples were analysed for contaminants associated with the HAIL activities at or in the vicinity of the proposed alignment (listed in **Table 1** above and shown on **Figure 3** below). The investigation locations relevant to the proposed alignment (EHA101, EHA102 and EHA105) are presented in **Figure 3** below.

The Data Gap Assessment is included in section 3.0 of the Draft Environmental Assessment in **Annexure D.**

Figure 3 Relevant 2019 Environmental Investigation Locations

A summary of the analytical and laboratory results presented on Table A1 in Annexure A is as follows:

- Hand Auger EHA101 was sampled at a depth of 0.2 m below ground level (bgl) for Heavy Metal concentrations and 0.8-0.9 m bgl for TPH and BTEX concentrations
- Hand Auger EHA102 was sampled at a depth of 0.3 m bgl for Heavy Metal concentrations.
- Hand Auger EHA 105 was sampled at a depth of 0.2-0.3 m bgl for Heavy Metals and 0.8-0.9 m bgl for Heavy Metals and PAH concentrations
- All analytical results were below criteria for NES - CS, Oil Industry Guidelines and AUP(OP) Permitted Activity Criteria
- All TPH, BTEX and PAH concentrations were below the laboratory limit of reporting (LOR)
- All Heavy Metals concentrations in samples collected from EHA101, EHA102 and EHA105 were consistent with the Auckland Background Concentrations.

5.2 Aerial photographs

Historical and current aerial photographs were obtained through the AC Geomaps online portal, the Retrolens online portal and Google Maps/Streetview 2019 imagery. A review of aerial photographs was undertaken for the period 1939 through to the present day. This allowed for the determination of land use changes and the identification of any pertinent items that have become apparent since the PSI in December 2012 but also to allow for the identification of any pertinent land uses that may have been omitted during the development of previous environmental investigations. The aerial photographs are included in **Annexure B**.

The review of aerial photographs highlighted the following key items as they pertain to the proposed alignment:

- On the 1968 aerial photograph there are buildings present to the southwest of present day Ti Rakau Drive at the junction of the current Highway 10. A number of these buildings are no longer present on the 1972 aerial photograph as infilling of the current Highway 10 location to the southwest of Ti Rakau Drive is evident
- Ti Rakau Park appears to have been developed into a sports field from either unused land or farm pastures sometime before the 1968 aerial photograph. Sports field outlines are visible in the 1972 aerial photograph
- On the 1972 aerial photograph buildings are present at 16 and 16D Cortina Place (HAIL sites listed in Table 1). The buildings have been constructed sometime between 1968 and 1972
- The 1980 aerial photograph records Highway 10 having been constructed
- The site at 64B Ti Rakau Drive (HAIL site listed in Table 1) has been developed between 1980 and 1996, into what appears to be the beforementioned service station
- The site at 64B Ti Rakau Drive is vacant in the 2015-2016 aerial photograph. Google Earth confirms the site was cleared in 2012. The site began redevelopment in 2017 and is now occupied by the 'Pakuranga Medical Centre' which comprises of a two-storey building and associated carpark
- The building located at 13 Cortina Place is no longer present in the 2017 aerial image. The site is currently a carpark.

5.3 Auckland Council Contamination Enquiry

The following details the information received from the AC contamination enquiry. The report identified the following:

- There is one closed landfill site within the vicinity of Ti Rakau Park (27R William Roberts Road, Pakuranga).
- A consent for the discharge of contaminants at 64B Ti Rakau Drive for a former service station. The consent relates to closure of the site and discharge to land and water from remediation of contaminated land and is dated March 2016.

A copy of the AC contamination enquiry report is included in **Annexure C.**

6 Assessment of Contaminated Land Effects

6.1 Construction

The following details the potential effects of construction in conjunction with a review of the existing environment in section 5 above. The key areas of concern where mitigation has been considered are as follows:

- Removal of buildings at 16 and 16D Cortina Place and stormwater instalment
- Services Trench in Ti Rakau Park (closed landfill site)
- Former service station at 64B Ti Rakau Drive.

6.1.1 **16 and 16D Cortina Place**

As outlined in Section 3.2, buildings located at 16 and 16D Cortina Place are proposed for demolition, with excavation also proposed for the instalment of stormwater and cut and cover excavation of surface soils. Collectively, conservative soil disturbance from these activities is approximately 750 m^3.

GHD identified 16 and 16D Cortina Place as sites with HAIL activities in the 2012 PSI. Both locations are motor vehicle workshops, which the NES - CS associates the following hazardous substances with their activities: petroleum hydrocarbons, solvents and heavy metals contained in waste oil. A request to the AC contaminated land team returned no environmental investigations pertaining to 16 or 16D Cortina Place. Buildings are still present at the site and therefore sampling cannot be undertaken until site establishment. As soil and groundwater quality are unknown, a conservative assumption is to consider the potential for contamination to be likely. The sites are therefore identified as a 'piece of land' under the NES - CS.

6.1.2 **Ti Rakau Park**

Information reviewed from the AC contamination enquiry identified a closed landfill site within the vicinity of Ti Rakau Park (27R William Roberts Road, Pakuranga) that was used for cleanfill disposal. Aerial photographs indicate that the site was developed into a sportsground sometime before 1968. No signs of land disturbance are evident in aerial photographs at the site since the 1968 aerial. No other information pertaining to the date of filling at the site has been encountered during this assessment.

As detailed in Section 5.1, the 2000 Assessment of Old Landfills indicated no refuse or abnormal landfill gases were encountered during the intrusive works and the site was identified as low risk. Works within the proposed alignment require the relocation of utilities via a service trench located in the footpath of William Roberts Road, with a small portion of the trench located in the southern portion of Ti Rakau Park (approximately 144 m^3). Section 5.1.4 indicates a soil sample was collected from the southern portion of Ti Rakau Park where the services trench is proposed to intersect the park. The Sample collected from EHA102 returned heavy metals concentration consistent with the Auckland Background Concentrations. The sample also returned analytical results below criteria for NES - CS, Oil Industry Guidelines and AUP(OP) Permitted Activity Criteria.

As the site was deemed low risk by the 2000 Assessment and with recent soil samples returning results below adopted criteria, it is unlikely impacted materials will be present within excavations in the southern portion of Ti Rakau Park.

Following a review of information as part of this report it is likely the site was only used for cleanfill disposal however older cleanfills in the Auckland Region were known to accept organic waste that has

the potential to breakdown over time and produce landfill gases. As the 2019 sampling did not investigate landfill gases, a recommendation should be made as part of the CLMP to manage potential effects from landfill gases.

6.1.3 Former Service Station at 64B Ti Rakau Drive

The information reviewed from the multiple environmental investigation prior to the remedial works at 64B Ti Rakau Drive highlights the following:

- In 2010, during decommissioning, hydrocarbon concentrations in soil samples collected from the former forecourt area, the general vicinity of the former dispenser islands, the remote fills and interceptor exceeded Oil industry Guidelines Tier 1 soil acceptance criteria for commercial/industrial land use. No exceedances were detected in soil samples collected from the former fuel storage tanks
- 2011 and 2014 environmental assessments reported elevated concentrations of hydrocarbon compounds on the southeast site boundary in both soil and groundwater and concentrations of petroleum hydrocarbons above the Oil Industry Guidelines for commercial/industrial land use in the vicinity of the former stormwater interceptor and ancillary pipework
- The 2015 conceptual site model deemed that the hydrocarbon impacts were considered to be largely restricted to within the Site boundary and impacts beyond the site, in the carriageway, were expected to be minor and should be managed via a CLMP
- In 2016, a total of 2,563 tonnes of hydrocarbon impacted soil was removed from the Site and all soil validation results complied with MfE Guidelines for Commercial/Industrial land-use. It was considered that the remedial objective was achieved
- Soil samples collected in 2019 from the southeast boundary of the former service station returned hydrocarbon concentrations below the laboratory LOR.

The historical aerial images indicate the northeast portion of the former service station was located within the proposed alignment and therefore is within the ‘piece of land’. However, since the site was deemed to have met the remedial objectives outlined in the 2016 SVR, and only minor excavation is proposed in the proposed alignment, adjacent to 64B Ti Rakau Drive, encountering impacted soil during construction works is considered to be unlikely.

The 2015 conceptual site model indicated minor residual hydrocarbon impacts were expected to be present within the carriageway (Ti Rakau Drive). As this carriageway is located within a separate package (EB2 and EB3R) to the proposed alignment detailed in this report, management of the effects of the residual hydrocarbon impact will be addressed as part of the CLMP for EB2 and EB3R.

7 Mitigation

7.1 Regulatory Context

7.1.1 NES - CS

The NES - CS is designed to ensure that the land affected by contaminants in soil is appropriately identified and assessed when particular activities, such as soil disturbance take place (Regulation 5(4)). Regulation 5 (7) of the NES - CS describes land subject to the Regulations as:

> *(7) the piece of land is a piece of land that is described by 1 of the following:*
> *(a) an activity or industry described in the HAIL is being undertaken on it*
> *(b) an activity or industry described in the HAIL has been undertaken on it*
> *(c) it is more likely than not that an activity or industry described in the HAIL is being or has been undertaken on it.*

Section 3.2 indicates approximately 750 m^3 of soil is proposed for disturbance at 16 and 16D Cortina Place. The volume of soil disturbance will exceed the permitted activity volume under Regulation 8(3) of the NES - CS (25 m^3 per 500 m^2 of soil disturbance and 5 m^3 per 500 m^2 of removal) therefore consent will be required. As detailed sampling has not been completed for the 'piece of land', it should be considered that soil disturbance cannot meet the requirements of a controlled activity under Regulation 9 and restricted discretionary activity under Regulation 10.

As sampling cannot be undertaken until site establishment for 16 and 16D Cortina Place, discretionary activity land use consent is required, with any potential effects to human health mitigated through a CLMP.

Ti Rakau Park and 64B Ti Rakau Drive are both considered unlikely to be significant sources of contaminants within the proposed alignment, therefore are not considered to be identified as a 'piece of land' under the NES - CS and do not require consent for activities undertaken on site under the NES - CS.

7.1.2 Auckland Unitary Plan (Operative in Part)

Chapter E30 of the AUP(OP) addresses the effects of the discharge or contaminants from contaminated land or land containing elevated levels of contaminants into air, or into water, or into land pursuant to section 15 of the Resource Management Act 1991. As both Ti Rakau Park and 64B Ti Rakau are considered unlikely to be significant sources of contaminants, within the proposed alignment, consent is not required for activities undertaken on these sites.

The soil disturbance at 16 and 16D Cortina Place does not comply with the permitted activity standards of Chapter E30, as soil disturbance volumes will exceed 200m^3. Therefore, to meet controlled activity rules under section E30.6.2.1 of the AC Unitary Plan, a detailed site investigation must be prepared and submitted to Council for consideration. As sampling cannot be undertaken until site establishment for 16 and 16D Cortina Place, discretionary land use consent is required, and related environmental effects can be managed through a CLMP.

7.2 Asbestos Containing Material and Leaded Paint

Owing to the age of the housing stock in the vicinity of the proposed alignment, it is possible that buildings may contain hazardous building materials such as asbestos and lead based paint which have the potential to provide for localised impact to soil if in disrepair. Of the structures located within the areas of proposed works, two were identified with potential hazardous building materials at 16 Cortina Place and 16D Cortina Place. As demolition of these structures is proposed, an asbestos containing material survey should be undertaken prior to demolition. Impact by asbestos in soil should be assessed at this time.

7.3 Unexpected Discoveries

It is possible that during the course of the works unexpected discoveries of impact in soil will be discovered, for example hazardous building materials from fly tipping, visual observations of staining or the presence of odours etc. If unexpected discoveries such as these are made during site works, a suitably qualified environmental practitioner (SQEP) should be consulted.

7.4 Management of Effects

Based on the information reviewed as part of the AEE, it is likely for contaminated soils and groundwater to be encountered during excavation within the proposed alignment. There is also potential for asbestos containing material, leaded paint, and unexpected contaminants to be encountered during works within the proposed alignment. It is considered that any effects could be appropriately managed via the development of a CLMP.

The CLMP should be prepared by a SQEP and will require updating as the Project progresses, as further information becomes available and will include but not be limited to:

- Summary of information and overview of the proposed alignment construction methodology
- Summary of any soil sampling works undertaken
- Roles and responsibilities and contact details for the parties involved in the land disturbance activities, including the SQEP
- Identify hazards arising from contamination (if present)
- Identify potential effects from landfill gases at Ti Rakau Park and manage the effects accordingly
- Identify a sampling regime for 16 and 16D Cortina Place
- Identify specific management procedures developed for construction earthworks including:
    - On Site soil management practices
    - Off Site soil transport and disposal
    - Erosion and sediment control
    - Management of dust and odour
- Contingency measures in the event of accidental/unexpected discovery (asbestos, unknown fill, odours, staining etc.)
- Post development controls (if required).

If the land use along the proposed alignment was to change to a more sensitive land use than that proposed as part of the Project, the risk from contamination (if present) should be assessed by a SQEP.

The contractor will also need to manage its health and safety obligations with respect to risks relating to contaminated land. Measures to protect the health of workers, the public and the surrounding environment will need to be incorporated into any health and safety plan that relates to work on sites where potential or known hazards have been identified in the AEE.

8 Conclusions

Based on the information reviewed as part of this assessment:

- Soil disturbance activities are planned at 16 and 16D Cortina Place, sites identified as historically or currently having HAIL activities undertaken on them. It is considered likely that there will be a risk to human health or the environment for contaminants in soil to be disturbed at 16 and 16D Cortina Place. A such, resource consent is required under both the AUP(OP) and NES - CS), with any risks to human health and the environment managed by a CLMP
- Resource consent is not required under the remaining sites
- It is possible during works that unexpected discoveries of impact in soil may be encountered. If unexpected discoveries such as these are made during site works, a SQEP should be consulted
- All remaining sites identified within the proposed alignment are deemed unlikely to be a risk to human health

Annexure A – Previous Environmental Investigations

Annexure B – Historical Aerials

Annexure C – AC Reports

Annexure D – 2019 DRAFT Environmental Assessment

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MANUKAU CITY COUNCIL

ASSESSMENTS OF OLD LANDFILLS SITES REPORTS (copies)

Manukau City Council

MANUKAU
City Council

Assessment of Old Landfills

Contract No. 15951

June 2000

GHD
MANAGEMENT
ENGINEERING
ENVIRONMENT

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Contents

Appendices

1. Background

Auckland Regional Council (ARC) has undertaken a review of the sanitary landfill operations throughout the region to ensure that all the necessary resource consents are in place. As part of this and with the assistance of territorial local authorities (TLA) throughout the region, closed landfills have also been evaluated. In this context Manukau City Council (MCC) produced an inventory of the historical landfill sites for its area.

Historical records revealed that 39 closed landfill sites existed within MCC owned property. Each site was evaluated to determine the potential for adverse environmental effects. A priority list of sites requiring further evaluation was generated for the MCC area.

In 1994 MCC began a programme of investigations to identify discharges of leachate and landfill gas from the old landfill sites that may be having an adverse effect on the environment, and where necessary and practicable to carry out remedial site works. In this regard, Manukau City is committed to finding longer term solutions to the closed landfills, and as far as possible eliminate associated risks to the general public in relation to health & safety and risks to the environment.

The programme includes carrying out assessments for each of the closed landfill sites; to elucidate which of the sites may require resource consents from the ARC. In the above context, and based on the agreed assessment criteria given below, this report has been prepared to identify Old Landfills that may require resource consents.

2. Assessment Criteria

In this report assessments of the Old Landfills have been carried out, based on agreed criteria between Manukau City Council and Auckland Regional Council. The key criteria are:

- Age of the landfill
- Type of fill
- Leachate discharge
- Proximity to water courses
- Hydraulics, water levels & rainfall
- Leachate toxicity risk factor

It was also agreed that assessments to evaluate the need for resource consents for the Old Landfills should be weighted towards assessment of environmental effects. This includes the assumption that the Landfill sites are public open spaces.

In meeting the above objectives, the following key issues were also considered to be part of the assessment process:

- Health and Safety of the General Public
- Structural Integrity
- Ecological Impacts
- Water Quality
- Sediment & Erosion Control
- Air Quality

The issue of land use and management were considered to be separate from the resource consent application process and as a consequence have not been included within this report.

3. Landfill Locations

The old landfill sites are located on MCC owned properties (with the exception of Miro Road site, which is owned by Te Puea Marae) and their names and road locations are listed below in Table 1. A map of each site is given in Appendix A of this document.

Table 1: Landfill Names and General Locations

No.	Landfill Site Name	Road Location & Suburb
1	Hills Rd	Hills Rd, Mayfield Park, Otara
2	Whitford Bridge	Whitford Road, Whitford Bridge Reserve, Whitford
3	Pah Rd	Papatoetoe Cemetery, Papatoetoe
4	Ngati Otara Park	Alexander Crescent, Ngati Otara Park, Otara
5	Riverina Ave	Riverina Ave, Pakuranga
6	Riverhills Park	Cnr Ti Rakau Dr and Gossamer Drive, Pakuranga
7	Leabank Park	Claymore Street, Manurewa
8	Miro Rd	Cnr Miro Road and Mahunga Road, Mangere Bridge
9	Dale Crescent	Dale Crescent, Pakuranga
10	Kingfisher Pl.	Kingfisher Place, Mangere
11	Coxhead Rd	Cnr Coxhead Road and Kohiwi Road, Manurewa
12	Oruarangi Rd	Oruarangi Road, Ihumatao
13	Gt. South Rd	Great South Road, South Bank, Otahuhu
14	Robert Allan Rd	Robert Allan Way, Pakuranga
15	Roscommon Rd	Cnr Roscommon & McGlaughlin Roads, Puhinui
16	Tiraumea Reserve	Tiraumea Ave, Pakuranga
17	Old Quarry Rd	Cnr Walmsely and Coronation Roads, Mangere
18	Udys Rd	Cnr Udys and Reeves Roads, Pakuranga
19	Norana Rd	Norana Ave, Favona
20	Ennis Ave	Ennis Ave, Pakuranga

21	Kiwi Esplanade	Kiwi Esplanade, Mangere Bridge
22	Riverhills School	Between Gossamer Dr & La Trobe St, Pakuranga
23	Millen Ave	Millen Ave, Pakuranga
24	Ti Rakau Park	Between Cortina Place & Ti Rakau Dr, Pakuranga
25	Harania Ave	Harania Ave, Favona
26	Botany Rd	Cnr Botany and Andrew Roads, Pakuranga
27	Tanners Rd	Tanners Road, Mangere
28	Clifton Rd	Clifton Road, Beachlands
29	Bairds Rd	Bairds Road, Otara
30	Riverlea Rd	Tamaki Bay Drive, Pakuranga
31	Harania Inlet	John Fletcher Drive, Favona
32	Beach Rd	Beach Road, Favona
33	Bells Rd	Bells Road, Pakuranga
34	Elm Park	Gossamer Dr, Pakuranga
35	Hilltop Rd	Cnr Hilltop and Redoubt Roads, Manukau Heights
36	Allenby Rd	Cnr Allenby and Great South Roads, Papatoetoe
37	Manukau Yacht Club	Kiwi Esplanade, Mangere Bridge
38	Mangemangeroa Bridge	Whitford Road, Whitford
39	Omana Park	Omana Road, Papatoetoe

4. History

The history of waste disposal in Manukau City, goes back to the period when the landfills were managed by former Manukau County Councils. Some of the former local authorities, which make up the present Manukau City Council, such as the Papatoetoe Borough Council, operated their own landfills. Papatoetoe Borough Council operated the Kohuora Crater landfill, but not for an extensive period of time. The Kohuora Crater landfill has been investigated and remediated separately.

Some sites have been considered and listed in previous reports but have since been found to be outside the scope of this investigation as they are in private ownership. These are Allens Rd, Point View Drive, Ruaiti Rd and Lukes Bridge.

The information available on the history of some sites is unclear. Further monitoring has been carried out on these sites to ascertain the extent of contamination and their effects on the environment. Furthermore, there are some sites, which have no recorded history of contaminated material or domestic refuse being dumped at them.

The relevant histories of individual sites are given with other respective information in Appendix E of this document.

5. Methodology

5.1 Preliminary Investigations & Screening

The investigations and monitoring carried out for this project were generally undertaken along the ANZECC (Australia and New Zealand Environment and Conservation Council) guidelines for contaminated sites. The methodology allowed for general screening investigations on all landfill sites, leading to more targeted and detailed investigations on those sites that required further work.

The order of investigations had been adjusted in some instances to suit resources, local conditions and assess potential environmental risks associated with individual landfills. For example, initial sampling was undertaken in waterways adjacent to many of the landfills. However this was largely discontinued after results showed that there were low concentrations of contaminants in these waterways.

As part of the preliminary investigations and screening process, the methodology also included Leachate Strength Assessment as described in the ESR report "The Assessment of Ground and Surface Water Contamination at Former Landfills, Manukau City" on the Manukau landfills (July 1996). Details of the ESR report has already been described in previous MCC reports to the ARC. Nevertheless, the monitoring data for bore (B) and surface (S) water samples are given for reference in Appendix B.

In brief, the leachate strength is based on the average concentration of a set of key indicators relative to their concentrations in a typical landfill leachate. The set of indicators chosen consists of iron, manganese, zinc and ammonia. The other analytes consistently measured throughout the monitoring process have been cadmium, chromium, lead and zinc.

For each landfill site the most representative sampling locations were selected by considering the nature of the sampling location, the concentrations at that location and the consistency of results. Results from tidal pools, estuaries and streams were found to be too diluted and variable. For this reason, the decision was made to consider only springs directly out of the landfill and groundwater bores, to evaluate the leachate strength.

For each landfill site, the concentrations of each of the key indicators were averaged between the sampling locations at that site and over samples taken at different times at any one sampling location. The result is a representative average concentration of each of the key indicators at that site.

These average values were then divided by the concentration of those analytes in a typical landfill leachate. This gives for the site, the relative strength of each of the indicators.

These percentages for the individual indicators were then averaged to arrive at an overall percentage. This overall percentage gives an indication of the strength of

the leachate from the site relative to the strength of leachate from an operating landfill.

The reason that the strength of the individual indicators are considered separately is that it allows easier identification of possible outlier results and other possible anomalies in the results.

Table 2 below illustrates the methodology for deriving the Average Leachate Strength Values for individual Landfill bore (B) and surface (S) water samples.

Using the concentration of indicators in an operating landfill does not necessarily give a good indication of the potential for effects. The potential for adverse effects of each of the individual indicators may vary considerably. It is recognised that the above methodology does not take into account, the varying potential for effects from each of the individual indicators.

Table 2: Examples of Leachate Strength Assessment

Site	Site Type	Fe %	Mn %	Zn %	NH4+ %	Leachate Strength	Average Strength
Oruarangi 1	B	10.84	6.69	0.24	0	4.44	
Oruarangi 1	B	7.53	0	0.08	0.1	2.57	3.51
Coxhead Rd	B	33.13	4.46	4.65	1.4	10.91	
Coxhead Rd	B	26.2	0	3.38	1.24	10.28	10.59
Elm Park 1	S	1.3	3.5	0.08	0.06	1.24	
Elm Park 1	S	231.93	0.51	0	0.93	77.79	15.91
Gt Sth 3	B	30.12	0	0.18	0.15	10.15	
Gt Sth 4	B	11.14	0	1.03	5.11	5.76	7.96
Coronation Rd 3	S	12.65	7.64	0.28	0.2	5.19	
Coronation Rd 4	S	8.13	5.73	0.01	0.29	3.54	
Coronation Rd 3	S	10.54	7.01	0.14	0.16	4.46	
Coronation Rd 4	S	9.04	5.1	0.01	0.27	3.6	
Old Quarry 3	S	13.86	5.1	0.12	0.12	4.8	
Old Quarry 3	S	0.63	2.23	0.06	0.04	0.74	
Old Quarry 7	B	15.96	0	1.83	0.02	5.94	
Old Quarry 3	S	25	0	0.06	0.1	8.39	4.58
Harania 4	S	0.54	0.48	0.2	0.02	0.31	
Harania 2	B	0.11	0.25	0.1	0.03	0.12	
Harania 3	B	1.45	8.28	0.06	1.58	2.84	
Harania 5	B	1.99	0.57	0.07	0	0.66	
Harania 2	S	0.25	1.27	0.17	0.36	0.51	
Harania 2	B	3.92	0	0.05	0.11	1.36	
Harania 3	B	37.65	0	0.15	1.22	13.01	
Harania 5	B	6.93	0	0.21	0.05	2.4	2.39

The method assumes that the potential for effects for each of the indicators is equal at the concentrations in the typical landfill and varies exactly in proportion to the concentration of the indicator in the typical landfill. This is known not to be the case. For example, iron does not have a significant adverse effect on the environment relative to its concentration.

Nevertheless, the leachate strength values are useful as one of the screening tools for determining which of the old landfills could be considered as not likely to have any significant adverse effect on the environment, public health and safety.

In general, the methodology for assessing the old landfills also included, site descriptions, which take into account the physical setting and history of development, landfill operations and closures. Wherever possible, attempts have been made to measure the discharges of the landfills to streams adjacent or passing through the sites, by sampling at monitoring points immediately upstream and downstream of the sites, and at springs that migrate from the best known location of the filled areas.

Some of the old landfills, which have no recorded history of contaminated material or domestic refuse being dumped at them (i.e. have primarily clean-fill), were considered to pose no significant risk to the environment. Hence, no leachate monitoring was considered to be necessary for these sites.

The preliminary prioritisation was based on data such as the landfill size, age, the type of fill and the sensitivity of the surrounding environment. Detailed information on individual landfills is given in Appendix E of this report. The methodology for evaluation included other key factors such as:

- landfill capping & ground cover
- landfill stability
- public health & safety issues
- landfill status - closed or operational
- landfill maintenance
- proximity to water courses
- landfill gas
- landfill odour levels

Table 3 below provides a list of landfills, which are considered to be of no significant risk to the environment or to public health and safety. This was established at an early stage of the investigations and hence as a consequence no detailed monitoring was carried out for these landfills.

Table 3: Landfills considered not to be of significant risk to the environment after preliminary assessments

No.	Landfill Site Name	Road Location & Suburb
15	Roscommon Rd	Cnr Roscommon & McGlaughlin Roads, Puhinui
16	Tiraumea Reserve	Tiraumea Ave, Pakuranga
18	Udys Rd	Cnr Udys and Reeves Roads, Pakuranga
19	Norana Rd	Norana Ave, Favona
23	Millen Ave	Millen Ave, Pakuranga
25	Harania Ave	Harania Ave, Favona
26	Botany Rd	Cnr Botany and Andrew Roads, Pakuranga
27	Tanners Rd	Tanners Road, Mangere
28	Clifton Rd	Clifton Road, Beachlands
29	Bairds Rd	Bairds Road, Otara
30	Riverlea Rd	Tamaki Bay drive, Pakuranga
31	Harania Inlet	John Fletcher Drive, Favona
32	Beach Rd	Beach Road, Favona
33	Bells Rd	Bells Road, Pakuranga
34	Elm Park	Gossamer Dr, Pakuranga
35	Hilltop Rd	Cnr Hilltop and Redoubt Roads, Manukau Heights
36	Allenby Rd	Cnr Allenby and Great South Roads, Papatoetoe
37	Manukau Yacht Club	Kiwi Esplanade, Mangere Bridge
38	Mangemangeroa Bridge	Whitford Road, Whitford
39	Omana Park	Omana Road, Papatoetoe

Following this initial prioritisation exercise undertaken in July 1995, boreholes were drilled on the higher priority landfill sites and groundwater quality assessments undertaken. Where relevant, surface water quality assessments were also carried out.

For these landfills the leachate monitoring was carried out to ascertain the levels of contaminants and their potential adverse impact on the environment. Table 4 below provides list of landfills where boreholes were drilled.

Table 4: Landfills where more detailed investigations were carried out including leachate monitoring

No.	Landfill Site Name	Road Location & Suburb
1	Hills Rd	Hills Rd, Mayfield Park, Otara
2	Whitford Bridge	Whitford Road, Whitford Bridge Reserve, Whitford
3	Pah Rd	Papatoetoe Cemetery, Papatoetoe
4	Ngati Otara Park	Alexander Crescent, Ngati Otara Park, Otara
5	Riverina Ave	Riverina Ave, Pakuranga
6	Riverhills Park	Cnr Ti Rakau Dr and Gossamer Drive, Pakuranga
7	Leabank Park	Claymore Street, Manurewa
8	Miro Rd	Cnr Miro Road and Mahunga Road, Mangere Bridge
9	Dale Crescent	Dale Crescent, Pakuranga
10	Kingfisher Pl.	Kingfisher Place, Mangere
11	Coxhead Rd	Cnr Coxhead Road and Kohiwi Road, Manurewa
12	Oruarangi Rd	Oruarangi Road, Ihumatao
13	Gt. South Rd	Great South Road, South Bank, Otahuhu
14	Robert Allan Rd	Robert Allan Way, Pakuranga
17	Old Quarry Rd	Cnr Walmsely and Coronation Roads, Mangere
20	Ennis Ave	Ennis Ave, Pakuranga
21	Kiwi Esplanade	Kiwi Esplanade, Mangere Bridge
22	Riverhills School	Between Gossamer Dr & La Trobe St, Pakuranga
24	Ti Rakau Park	Between Cortina Place & Ti Rakau Dr, Pakuranga

5.2 Standards & Guidelines

To assess the relative risks to the environment from landfill discharges, the leachate and water quality data obtained, are expressed as a ratio of the relevant standard or guideline.

Some of the contaminant guideline values used are those from the U.S. Environmental Protection Agency for the Toxic Characteristic Leaching Procedure (TCLP) Tests. Other guideline values, which are not given for the TCLP Test, are from the Australia and New Zealand Environment and Conservation Council (ANZECC) Guidelines for Fresh & Marine Water Quality. These ANZECC standards / guidelines have been developed as part of the national water quality management strategy for New Zealand and Australia.

Hence the standards / guidelines are considered to be relevant for use in the assessment of relative risks to the environment from discharges of the leachate.

5.3 Leachate Risk Factor (LRF)

To assess the level of risk to the environment from contaminants in landfill leachates, the basic principles used is similar to that used in the assessment of contaminants in drinking water for monitoring & grading of water quality. The methodology is simple and yet effective in comparing the level of contaminant in the leachate to the respective environmental standard or guideline.

For example, the drinking water standard (Drinking Water Standard of New Zealand 1995) for Boron is 0.3 mg /L. If the levels of Boron in drinking water supply is below 50% of the guideline value (i.e. less than 0.15 mg / L), then the **risk of contamination** is considered to be **not significant** and no regular monitoring is required for Boron.

On the other hand, if the level of Boron is measured at levels between 0.15 and 0.3 mg / L, then even though the contaminant level is below the guideline, the **potential risk** of contamination is considered to be significant and the monitoring must be carried out on a regular basis.

Of course if the contaminant level is above the guideline value then the water supply is in non-compliance and the risk to consumers from the contaminant is considered to be significant.

Similarly, as an example, the TCLP regulatory threshold level for Cadmium in landfill leachate is 1.0 mg / L. Hence concentration of Cadmium in the leachate at levels above 1.0 mg / L, would be considered to be of significant risk to the receiving environment. This would require regulatory consent for discharge of the leachate into the environment under specific conditions.

On the other hand, if the level of Cadmium is measured at levels between 0.5 and 1.0 mg / L, then even though the contaminant level is below the guideline, the potential risk of contamination is considered to be significant and the monitoring must be carried out on a regular basis. In such cases, a regulatory consent for discharge of the leachate into the environment may be required depending on other factors such as the sensitivity of the receiving waters and toxicity characteristics of the contaminant.

However, if the level of Cadmium in the leachate is below 50% of the guideline value (i.e. less than 0.5 mg / L), then the risk of any actual or potential adverse environmental effects is considered to be not significant and no regular monitoring is required. In this case there would be no requirement for discharge consent.

Hence the measured concentrations of contaminants in the leachate, are expressed as a ratio of relevant standard or guideline, to assess the relative risks to the environment from the landfill discharges. These ratios have been used as

part of the methodology in determining which of the MCC Old Landfills may require resource consent from the ARC.

It should be noted that the leachate risk factors (LRF) derived are only one of the key issues for consideration in deciding whether there is a need for resource consent. Other factors, such as relative significance of individual contaminants and sensitivity of the receiving environment may also be a key indicator as to whether resource consent for the specific landfill is required.

5.4 LRF Parameters for MCC Old Landfills

In case of MCC Old Landfills, five contaminant parameters have been used for calculation of the LRF. These parameters are Cadmium, Chromium, Lead, Ammonia-Nitrogen, and Total Nitrate levels. The criteria for selection of these parameters are based on the fact that:

- they are indicators of leachate toxicity to the environment and public health
- reliable standards or guidelines are available for these contaminants
- the borehole leachate data for these parameters were available for the assessments in this report

The LRF values obtained for the five individual contaminants are combined and expressed as a sum in Table 5 below. In terms of LRF, those landfill sites with relatively high values are highlighted and more detailed review carried out.

Note:

For ANZECC Guidelines (mg/L), allowance has been made for dilution factor of 100 times. This is necessary as these Guidelines are for levels in the receiving waters and need to be adjusted for comparable concentrations in the landfill leachate itself.

It should also be noted that the dilution factor in the receiving water is likely to be significantly greater with tidal influences at many sites.

The US EPA Guidelines are for levels in the landfill leachate in mg/L.

Combined LRF >5 - Significant.

Table 5: Calculation of Leachate Risk Factors for MCC Old Landfills

	Leachate Toxicity Risk Factors					
Landfill	Cd	Cr	Pb	NH_4 - N	Nitrate	Totals
Hills Rd	0.07	0.118	0.24	60	0.95	61.38
Whitford Bridge	0.01	0.058	0.236	0.64	0.49	1.43
Pah Rd	0.086	0.48	1.86	26	0.18	28.61
Ngati Otara	0.029	0.028	0.104	4.6	0.52	5.28
Riverina Ave	0.01	0.44	0.184	0.028	0.03	0.69
Riverhills	0.01	0.004	0.0086	0.72	0.04	0.78
Leabank		0.0138	0.0104	0.002	0.24	0.27
Miro Rd	0.027	0.6	0.74	6.4	0.14	7.91
Dale Cres	0.038	0.02	0.0172	7.4	0.02	7.50
Kingfisher Place	0.01	0.024	0.034	0.158	0.05	0.28
Coxhead Rd	0.01	0.014	0.11	1.26	0.03	1.42
Oruarangi Rd		0.007	0.0094	0.086	0.085	0.19
Great South Road	0.06	0.014	0.09	5.8	0.0017	5.97
Robert Allan Rd	0.01	0.0062	0.017	18.8	0.11	18.94
Old Quarry Rd	0.01	0.032	0.22	0.26		0.52
Ennis Ave	0.01	0.002	0.004	0.094	0.037	0.15
Kiwi Esplanade	0.01	0.14	0.4	0.138		0.69
Riverhills School	0.01	0.002	0.02	0.0036	0.0003	0.04
Ti Rakau Dr	0.01	0.0016	0.0148	0.058	0.042	0.13
Harania Rd	0.01	2.8	0.6	1.42	0.0061	4.84
Bairds Rd	0.01	0.006	0.04	0.054		0.11
US EPA Guideline	1.0	5.0	5.0			
ANZECC Guideline				5.0	10	

The concentration values used for calculation of LRF for each of the chosen parameters are based on worst case scenario. That is, using the highest measured concentration of the contaminant in any of the leachate sample obtained from the respective landfill.

5.5 Criteria for Application of LRF

For an individual contaminant, a LRF value of over 0.5 is considered to be significant in relation to **potential** adverse effect on the environment. Hence,

the combined LRF value for five contaminants would need to be over 2.5 to be considered as being significant.

Similarly, for an individual contaminant, a LRF value of over 1.0 is considered to be significant in relation to actual adverse effect on the environment. Hence, the combined LRF value for five contaminants would need to be over 5.0 to be considered as being significant. Clearly in these cases there is a key indicator that shows that resource consent may be required for discharge of leachate to the receiving environment.

Hence, the Maximum Acceptable Value (MAV) for combined effects of five contaminants is considered to be 5.0 (i.e. combined LRF values of the five contaminants).

In relation to landfills with LRF values between 2.5 to 5.0, they may or may not have any significant adverse effect on the environment. In these cases other factors, such as landfill size, type of fill, receiving environment, etc., have also been taken into consideration in assessing whether these landfills require any resource consent.

5.6 Consideration of Other Factors

The methodology for evaluation includes other key factors such as:

- landfill capping & ground cover
- landfill stability
- public health & safety issues
- landfill status - closed or operational
- landfill maintenance
- proximity to water courses
- landfill gas
- landfill odour levels

The process involved site visits and assessments based on above factors, of all MCC Old Landfills (39 in total). Other details of individual landfills are given in Appendix E of this report. A summary of the information obtained is tabulated in Section 8.2.

6. Sources of Information

Information for this report has been drawn from a variety of sources. This includes information on the history, location and extent of the sites, which has been largely obtained from the recollections of long serving council staff. Furthermore, such information has been supplemented in places by the memories of the public who either worked on some of the sites, or lived near them at the time of filling.

Another source of information has been through an article in local papers (Manukau Courier and Eastern Courier), that asked former employees and residents to contact a nominated staff member. This drew a number of responses and provided historical information about some of the old landfills.

Information about the catchments of various streams flowing through or close proximity to the landfills, has been drawn from MCC Stormwater Catchment Management Plans.

The underlying geological information for Coxhead Rd and Pah Rd has been drawn from the Geological Map of New Zealand for the Auckland urban area (Kermode L.0. 1992). The remainder of the information has been drawn from the Geological Map of New Zealand, 1:25000 (Industrial Series). The sheets used were Sheet N42/5 (Eden) L.O.Kermode & E..J.Searle 1966 DSIR, Sheet N42/6 (Howick) L.O.Kermode 1975, Sheet N42/8 (Mangere) L.O.Kermode 1966, Sheet N42/9 (Whitford)) L.O.Kermode 1986.

Background information for the Pah Rd site was supplemented by information from the "Preliminary Site Investigation for the South Auckland Cemetery", January 1995 by Pattle Delamore Partners Ltd.

Chemical analysis results, interpretation and some background information regarding leachates, have been obtained from the MCC "Old Landfill Leachates" report and subsequent reports prepared by Environmental Science and Research Ltd.

Information from Bore logs, with the exception of Miro Rd, have been obtained from the MCC "Landfill Drilling Logs" report prepared by Groundsearch EES. The bore hole logs for the three groundwater monitoring bores installed at Miro Rd have been prepared by Manukau City Council staff.

Information relating to visual assessments and descriptions of the existing site surface, observable contamination, site stability, risk to public health and safety, and maintenance of the Old Landfill sites, are based on site visits by relevant GHD consultant and Manukau City Council staff. These are discussed in Section 8 of this report.

7. Monitoring Data

7.1 Initial Investigations & Monitoring

The initial investigations involved surface water sampling only. Samples were taken at drains running through the sites, springs coming out of the sites and the adjacent surface water bodies.

Surface water samples were taken in two rounds between August and October 1994. Further surface water samples were taken in February, April and September 1995.

Both surface and groundwater samples were taken from selected sites in December 1995. A full round of surface and groundwater sampling was undertaken in March to May 1996, and October / November 1996.

Some of the old landfill sites may have an impact on nearby streams. These sites include:

- Riverina Ave
- Kingfisher Place
- Pah Road
- Robert Allan Park
- Hills Road-Mayfield Park
- Oruarangi Road
- Harania Ave
- Elm Park
- Bairds Road
- Coxhead Park
- Old Quarry Road

At each of these sites, upstream and downstream water samples were taken and analysed. The detailed analytical data is shown in Appendix C.

Review of the surface water sampling results indicated that generally the landfills had no significant impact on the contaminant levels in surface waters flowing over the landfills or those adjacent to the sites. A discussion of the individual analytical data is given in Appendix E.

7.2 Data for Priority Landfills

After the preliminary investigations and screening process, the high priority landfills were selected for the drilling investigation programme. Bores were drilled on the sites in December 1995 and February 1996. The testing programme was progressively refined as more knowledge was gained of the sites and the concentrations of substances being found at or around the sites.

Following the installation of groundwater bores, sampling was largely discontinued in all of the surface water sampling locations except the springs coming out of some sites. The environmental parameters that have consistently been monitored are listed below:

- Cadmium
- Chromium
- Copper
- Manganese
- Iron
- Lead
- Zinc
- Ammonia Nitrogen
- Total Nitrate
- dissolved oxygen
- pH
- electrical conductivity
- salinity
- temperature

Assessment on-site:

- odour
- clarity
- colour

Boron has been monitored for most of the programme. Nitrite, nitrate, nitrite + nitrate nitrogen and total nitrogen have all been measured at varying times.

The analytes initially monitored but discontinued following the first review were aluminium, arsenic, cobalt, mercury, molybdenum, nickel, phosphorus, sulphur, selenium and strontium. Potassium, magnesium, sodium and calcium were also measured but subsequently excluded.

The detailed analytical data is shown in Appendix B.

7.3 Groundwater Bore Location

The placement of the groundwater bores on the sites varied from site to site depending on the topography of the site, the location of surface water, the type of material found in the bores and whether they contained groundwater.

On many sites drilling was undertaken at many locations throughout the sites. Piezometers were installed only in those bores thought likely to provide good samples of the site groundwater and / or where it was thought likely leachate was being produced.

For those sites where groundwater was encountered above the bottom of the fill the piezometers were installed at the location(s) where it was thought most likely to intercept groundwater that has passed through the body of the fill. This is usually at the downhill end of the original profile prior to the placement of fill, through or close to the bed of former streams (prior to the placement of fill) and / or where the groundwater level is lowest. If the available information was inconclusive, piezometers were placed where the fill was deepest and at the downhill end of the current surface.

7.4 Sampling Procedures

Normal procedures have been followed regarding the cleaning of equipment to prevent cross-contamination of samples.

To ensure comparability of results, samples at any one site have been taken at the same time in the tidal cycle, at all marine and estuarine sites for different sampling rounds. (e.g. samples at Harania Ave would be taken within the time range of 1 to 2 hours before low tide). In most cases, the level of groundwater in the bores has been largely independent of the level of the tide.

At sampling locations other than in the sea, or in a flowing estuary or stream, the sampling site was prepared to ensure that the sample taken was as free from sediment as possible.

Where springs were sampled, the sampling procedure ensured that the water gathered was fresh spring water rather than water that had potentially been pooled at the site for some time. To achieve this all vegetation was cleared away from immediately around the sampling area and where necessary, the sampling location was dug out to remove any stagnant water and mud to allow flow of fresh spring water into the sampling location. The site was left to stand for a minimum period of one hour to allow settling of sediment before taking the water samples.

For bores which do not dry, the purging was continued until at least three well volumes had been removed before sampling. For bores that did dry, pumping was continued until the well was dry. The bore would then be re-sampled when the water level had recovered sufficiently.

For each sampling run, one field blank for both ground and surface water was taken per day.

For each sampling run, extra samples or replicates were taken for quality control purposes. This required that at least one sample was replicated, or 5% of the total number of samples, whichever was the greater, for both groundwater and surface water. Furthermore, one trip blank was taken per sampling round.

7.5 Subsurface Investigations

The drilling investigations commenced in August 1995 with three boreholes being dug on the Miro Rd (Te Puea Marae) site. Drilling was undertaken on Hills Rd, Ngati Otara, Whitford Bridge, Old Quarry Rd and Elm Park in December 1995. Bores were drilled on more of the sites in January 1996. A brief summary of the borehole results is presented in Table 6. A more detailed discussion of the local site conditions and the results is presented in the individual site reports in Appendix E of this document.

The landfill drilling logs have been presented to the ARC as part of previous report to the ARC. The site maps are presented as Appendix A of this report.

Out of the 'original' set of sites, bores were drilled on the greater priority sites. The priority for these sites was based on the preliminary prioritisation exercise undertaken in July 1995 and described above in Section 7.4 of this document.

The method of drilling used was by rotary auger on most sites. A hammer drill was used on Miro Rd and for part of the Oruarangi Rd site.

It is also noted that borehole and surface water samples were generally turbid and were not filtered prior to laboratory analysis. This is likely to provide higher contaminant values than that actually present in the soluble form. The contaminants bound to the suspended solids generally have low bio-availability. Hence the contaminant concentrations obtained are total levels in the sample and not just the soluble fraction. This issues adds to the worst case scenario methodology used for calculation of the LRF values in Section 5.4 of this report.

Table 6: Drilling Investigations Summary

No.	Site Name	No. of Bores	Refuse in #Bores	Gas (> 10% LEL) in #Bores	Ground water in #Bores	Ground -water Depth (m)	# Piezo's
1	Hills Rd	4	4	4	4	1.5	4
2	Whitford Br.	11	2	2	9	1.2	6
3	Pah Rd	3	3	0	3	2	3
4	Ngati Otara	3	3	1	3	1.2	3
5	Riverina Ave.	5	0	0	2	2	1
6	Riverhills Pk.	3	0	0	1	2	1
7	Leabank Pk	9	0	0	1	2	1
8	Miro Rd	3					3
8	Udys Rd	2	0	0	2	2.5	1
9	Dale Crescent	4	0	4	3	2	1
11	Coxhead Rd	4	3	1	2	2	1
12	Oruarangi	7	1	0	1	2.5 - 12.0	3
13	Gt. Sth Rd	4	4	1	2	5	4
14	Robert Allan	4	1	2	3	1.5	2
16	Tiraumea Ave.	3	0	0	1	1.7	0
17	Old Quarry	7	2	5	1	2.3	1
20	Ennis Ave.	3	1	0	0	-	1
23	Millen Rd	2	0	1	2	1.5	0
24	Ti Rakau Pk	7	0	0	3	2-3	1
25	Harania Ave.	5	1	0	5	1.2-2	3
34	Elm Park	6	0	0	1	1.6	0

8. Environmental Effects

The MCC old landfill sites have been investigated and indicative parameters monitored for a considerable period of time since 1994. This has also included physical observations, monitoring of contaminant levels in surface water samples and landfill leachates, particularly for signs of any significant effect on the environment and / or risk to the health of respective neighbouring communities. In this context a large collection of scientific data has been considered, assessed and presented as part of this report.

8.1 General Characteristics of the Landfills

The landfill sites are relatively young (< 40 years) and a large proportion of them are relatively small in size in terms of either volume of waste and/or ground area covered. The largest site under consideration, Hills Rd (Mayfield Park), is less than three hectares. Most sites are less than 0.5 hectare.

Many of the larger old landfill sites in Manukau have been covered over and are now used as open space recreational areas. Some of these open spaces are also used for contact sports. Many of the smaller sites are drainage or esplanade reserves. The main use of these sites is therefore for recreation or to provide a buffer area.

The history of the old landfill sites is varied. For example, Hills Rd, Ngati Otara and Pah Rd were operated as municipal refuse dumps. Whereas Miro Rd and Whitford Bridge, largely took materials from inorganic collections. But it is likely that household refuse would have been diverted to each of these sites on occasions. Many of the remaining sites reportedly took a mixture of materials ranging from clean-fill to illegal household refuse. For some sites it is thought that they took clean-fill only.

A majority of landfills were reclamations, such as in-fill of small stream gullies and banks or estuarine inlets. They are generally very low lying with nearly all of them being close to the coast. These sites themselves are mostly flat or gently rolling. Only the Mangemangeroa Bridge, Pah Rd, Kingfisher Place, Riverhills Park and Riverina Ave sites have steep side slopes.

8.2 Site Inspections & Assessments

There is no record of any of the landfills having a specifically engineered clay liner or base. Anecdotal evidence suggests that the landfills were established on top of existing ground. This has largely been confirmed by the drilling investigations. The landfills are generally underlain to a variable depth and with variable quality of silt or clay type medium and unknown permeability.

The integrity and value of this material as a seal is likely to be low. None of the landfills have a leachate collection system.

The sites, which are now recreational parks, have had cover but this was more to provide a physical barrier and contoured surface rather than designed to limit water ingress. The cover on the sites generally consist of reasonably permeable materials such as topsoil. There is no evidence that a specifically engineered clay cap has been placed over any of the sites.

All of the sites are covered with some form of grass with sporadic native and exotic trees. The majority of sites are well maintained by MCC Parks. A summary of site inspection report is given in Table 7.

Stormwater drains cross many of the old landfill sites in urban areas. Sewers also cross a few sites. Searches of records have shown that there are other utility services around the fringes of many sites, but they do not actually cross the sites.

There are residential or commercial buildings just beyond the edge of the filled area at the following sites:

- Riverhills School - houses
- Hills Rd - houses
- Ngati Otara - marae buildings and houses
- Great South Rd - commercial buildings
- Miro Rd - marae buildings
- Harania Rd - houses
- Kingfisher Pl. - houses
- Dale Crescent - houses
- Riverina Ave. - houses
- Riverhills Park – clubhouse

The sites, which are major recreational parks, have a positive visual impact on the environment in their present form. The rest of the sites are largely not visible to the public.

Table 7: Site Information Summary

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
1	Hills Rd	Grass cover	Recent clay capping. No visual signs of instability or soil erosion. Well developed as a Park and sports ground.	No significant risk identified	closed	Well maintained. Some further work in progress
2	Whitford Bridge (Park)	Grass cover	Good ground cover in grass over all areas including at interface with Turanga Creek. There are signs of herbicide spraying and soil erosion along one part of the site close to swampy area	No significant risk identified	Closed	Part of the site is well developed as a Park. Another part is used as horse paddock for Pony Club. The site is well maintained.
3	Pah Rd	Grass cover	Significant vegetation at interface with estuary. No signs of erosion or slips	No significant risk identified	closed	Well maintained
4	Ngati Otara Park	Grass cover	No visual signs of instability or soil erosion. Well developed as a Park	No significant risk identified	closed	Well maintained
5	Riverina Ave	Grass cover	Vegetation along the foreshore. But herbicide spraying leading to signs of erosion and instability along the edges of the Estuary	Herbicide spraying along the edges of the Estuary may pose ecological risk. No other significant risk identified	Closed	Generally well maintained as a Park
6	Riverhills Park	Grass cover	No visual signs of instability or soil erosion. Well developed as a Park and sports ground.	No significant risk identified	Closed	Considerable herbicide spraying along the edge to the estuary. This may pose some ecological risk. Otherwise well maintained
7	Leabank Park	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve and sports field

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
8	Miro Rd	Grass cover	Recent clay capping. No visual signs of instability or soil erosion. Well developed as a Park	No significant risk identified	Closed	Well maintained as a reserve. Some further work in progress
9	Dale Crescent	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve
10	Kingfisher Pl.	Grass cover	Herbicide spraying along interface with estuary. There is very little vegetation. Evidence of soil erosion and slumping along the interface with estuary.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
11	Coxhead Rd	Grass cover	Good ground cover in grass over all areas including at interface with Stream. No signs of erosion or slips	No significant risk identified	Closed	Well developed and maintained as a Park with mature trees. Stormwater drainage runs through the site and is discharged into the Stream
12	Oruarangi Rd	Grass cover	Good ground cover in vegetation over all areas including at interface with Oruarangi Stream. No signs of erosion or slips	There is poor fencing to the site. Hence a significant amount of rubbish is still being dumped at the site, including household waste. The site is close to residential area and may pose a significant risk to public health, particularly to children.	Closed	Undeveloped, overgrown with grass and shrubs. Site maintenance work is currently being carried out by MCC.
13	Gt. South Rd	Grass cover	No signs of instability. Significant dumping of commercial & industrial rubbish, including discharge of oil & grease, along the interface with the estuary.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained, but maintenance work is currently being carried out by MCC

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
14	Robert Allan Rd	Grass cover	No visible signs of instability or soil erosion. Reclaimed estuary area still very swampy in parts. Underground stormwater drain discharges at the interface with the estuary.	No significant risk identified	Closed	No signs of rubbish and well Maintained
15	Roscommon Rd	Grass cover	Good ground cover in grass over all areas including at interface with Puhinui Stream. No signs of erosion or slips	No significant risk identified	Closed	Undeveloped, overgrown with grass and shrubs. Stormwater discharge into the Puhinui Stream
16	Tiraumea Reserve	Grass cover	Vegetation along the foreshore. Generally no visual signs of instability or soil erosion.	Some herbicide spraying along the edges of the Estuary that may pose ecological risk. No other significant risk identified	Closed	Well maintained as a reserve
17	Old Quarry Rd	Grass cover	Herbicide spraying along interface with Stream. In some places spraying is right down to the edge of Stream. Has potential for erosion in this context.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
18	Udys Rd	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	Well maintained as a reserve
19	Norana Rd	Grass cover	No signs of instability. Significant dumping of domestic rubbish along the foreshore, the interface with the Manukau Harbour.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained
20	Ennis Ave	Grass cover	No visual signs of instability or soil erosion. Adjacent to a tributary of Pakuranga Stream.	No significant risk identified. Some herbicide spraying to get rid of noxious weeds	Closed	Well Maintained
21	Kiwi Esplanade	Grass cover	Some vegetation at interface with Manukau Harbour shoreline. No signs of erosion or slips	No significant risk identified	closed	Well maintained

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
22	Riverhills School	Grass cover	No visual signs of instability or soil erosion. Adjacent to Stream and Estuary.	No significant risk identified	Closed	Well maintained as a reserve
23	Millen Ave	Grass cover	No visual signs of instability or soil erosion. Adjacent to Tamaki Estuary	No significant risk identified	Closed	Well maintained as a reserve with some mature trees
24	Ti Rakau Park	Grass cover	No visual signs of instability or soil erosion.	No significant risk identified	Closed	Well maintained as a reserve and sports ground
25	Harania Ave	Grass cover	Mostly open space with vegetation at interface with the Stream. No signs of erosion or instability.	No significant risk identified	Closed	Well maintained
26	Botany Rd	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
27	Tanners Rd	Grass cover	Top fill cap is about 2 metres and well grassed	No significant risk identified	Closed	Well maintained
28	Clifton Rd	Grass cover	This is a small reclaimed area developed as a boat ramp. The landfill is surrounded by Turanga Estuary on three sides and is subject to natural forces from tidal flows. There is good ground cover in grass. There are also some rocks along the edges with the Estuary. This provides some protection from erosion. No visual signs of erosion or slips were identified.	No significant risk identified	Closed	This site could be enhanced with planting of trees and removing some of the exposed solid waste. This includes items such as steel wire / rods left exposed in the sandy beach area at the boundary with the Estuary.
29	Bairds Rd	Grass cover	No signs of instability. Significant dumping of domestic rubbish along the interface with the road and Stream.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained, but maintenance work is currently being carried out by MCC
30	Riverlea Rd	Grass cover	No visual signs of instability or soil erosion. Good vegetation cover along the foreshore	No significant risk identified	Closed	Well maintained as a reserve
31	Harania Inlet	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
32	Beach Rd	Grass cover	Herbicide spraying along interface with Manukau Harbour. There is evidence of soil erosion along the shoreline.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
33	Bells Rd	Grass cover	Generally no visual signs of instability or soil erosion. Adjacent to stream	No significant risk identified	Closed	A small Park, well maintained as a reserve
34	Elm Park	Grass cover	No visual signs of instability but weed spraying along the steep slopes are prone to erosion. The Park itself is not a landfill. It is only the strip of land along the edge of a tributary of Pakuranga Stream, that was used as a landfill.	No significant risk to people identified, but the herbicide spraying may pose ecological risk.	Closed	Well Maintained
35	Hilltop Rd	Grass cover	Good ground cover in grass over all areas. Deep topsoil layer and no signs of landfill rubbish. A small Stream starts at the bottom end of the landfill. No signs of erosion or slips	No significant risk identified	Closed	Undeveloped, overgrown with grass and shrubs.
36	Allenby Rd	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
37	Manukau Yacht Club	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
38	Mangemangeroa Bridge	Grass & shrub cover	Good ground cover in dense bush over all areas including the steep slopes. Without the vegetation this site would be highly prone to erosion & slips. No signs of erosion or slips were identified. At down-slope boundary the landfill adjoins the Mangemangeroa River.	No significant risk identified	Closed	This site has significant natural vegetation that is essential for protection from soil erosion & slips. The steep slopes and deep valleys limit the options for any further development of the site.
39	Omana Park	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified arising from the old landfill.	Closed	Generally well maintained as a reserve and sports field

8.3 Type of Fills and Landfill Area

The old landfills have a range of fill material including clean-fill, non-household refuse, inorganic refuse, etc., and the details are shown in Table 8. A large number of the landfills mainly contain clean-fill and many are less than 0.5 hectare in size.

Table 8: Old Landfills – Use, Type of Fill & Area

No	Site	Current Use	Fill Type	Area
1	Hills Rd	Park	Sewage Treatment Plant, Municipal Tip	2 (ha)
2	Whitford Bridge	Reserve ,Pasture	Municipal Tip, Demolition material	3
3	Pah Rd	Park	Municipal Tip	0.5
4	Ngati Otara Park	Park	Municipal Tip	0.6
5	Riverina Ave	Park	Cleanfill	0.3
6	Riverhills Park	Sports Field	Cleanfill,	1.5
7	Leabank Park	Sports Field	Cleanfill	2
8	Miro Rd	Waste Land	Inorganic Refuse, Cleanfill, Domestic Waste	2
9	Dale Crescent	Open Space	Cleanfill and Gravel	1
10	Kingfisher Pl.	Reserve	Inorganic Fill	0.05
11	Coxhead Rd	Reserve	Municipal Tip	0.4
12	Oruarangi Rd	Refuse Collection Area	Inorganic Refuse, Sewage Sludge, Green Waste	0.2
13	Gt. South Rd	Reserve	Cleanfill, Domestic Waste	0.3
14	Robert Allan Rd	Open Space	Cleanfill	0.2
15	Roscommon Rd	Road Reserve	Non Household Refuse	0.2
16	Tiraumea Reserve	Reserve Access	Unknown	0.2
17	Old Quarry Rd	Reserve	Municipal Tip, Cleanfill, Green Waste	0.1
18	Udys Rd	Reserve	Cleanfill, Non-Household Refuse	0.2
19	Norana Rd	Reserve	Inorganic Refuse, Green Waste	0.2
20	Ennis Ave	Reserve	Cleanfill, Demolition Material	0.05
21	Kiwi Esplanade	Reserve	Cleanfill, Demolition Material, Inorganic Refuse	0.1
22	Riverhills School	Road Reserve	Unknown	-
23	Millen Ave	Reserve	Cleanfill	0.05
24	Ti Rakau Park	Reserve	Cleanfill	4
25	Harania Ave	Park	Non-Household Refuse	0.3
26	Botany Rd	Reserve	Non-Household Refuse	0.1
27	Tanners Rd	Marae	Bin Disposal, Cleanfill	0.05
28	Clifton Rd	Reserve	Demolition Material, Inorganic Refuse	0.05
29	Bairds Rd	Reserve	Non-Household Refuse	0.05
30	Riverlea Rd	Reserve	Non-Household Refuse	0.05
31	Harania Inlet	Reserve	Non-Household Refuse	0.05

No	Site	Current Use	Fill Type	Area
32	Beach Rd	Reserve	Non-Household Refuse	0.05
33	Bells Rd	Reserve	Non-Household Refuse	0.05
34	Elm Park	Park	Cleanfill,	-
35	Hilltop Rd	Road Reserve	Inorganic Refuse	0.05
36	Allenby Rd	Playground	Cleanfill, Car Bodies	-
37	Manukau Yacht Club	Road Reserve	Cleanfill, Demolition Material, Green Waste	0.8
38	Mangemangeroa Bridge	Road Reserve	Illegal Dumping, Non-Household Refuse	0.3
39	Omana Park	Park	Cleanfill, Demolition Material	0.2

The landfill fill-type and size are some of the factors that have been used in assessing the environmental risk associated with specific landfills in this report. But it should also be noted that these were not the sole reasons for determining whether the landfill should be exempt from resource consent process.

8.4 Leachate Discharge & Risk Factor

Generally, the levels of environmental contaminants were found to be below or close to the detection limits of the various parameters. Furthermore, they were found to be well below levels of concern in terms of any significant adverse environmental effect.

The results from the organic tips show leachate being produced in some cases thirty years after closure though not in strong concentrations. The oldest site shows no measurable leachate. The leachate producing lives of landfills are affected by a number of factors including temperature, composition of fill and the rate of water ingress into refuse. The volume of leachate produced will depend on these factors and the size of the fill. These factors vary from site to site and generally take forty to seventy years to stabilise.

As many of the old landfill sites are getting to ages of thirty years or so, it is reasonable to suggest that the effects of the landfills will not persist for too long into the future.

The water quality results also show variations in baseline water quality, both between different sites and at the same site at different times. These variations may well be due to climatic, seasonal or tidal factors, or from variable contaminant loading from other sources. Furthermore, the water quality results also confirm that seawater intrusion is influencing leachate at many of the sites.

The concentrations of contaminants, volume of leachate produced and the sensitivity of the receiving environment are some of the critical factors in assessing the environmental risk level from a landfill.

In this context the Leachate Risk Factors (LRF) derived for the MCC Old Landfills listed in Table 9, are used as one of the key indicators for identifying

sites that may pose significant risk to the environment and may require resource consent for discharge of leachate.

The details of the methodology used to derive the LRF values are described in Section 5 of this report. It should be emphasized again however, that the derived LRF values are based on worst case scenario, in that the highest contaminant levels measured in the leachate from respective landfills were used for the calculations.

For example, the Lead levels in leachates from Hills Road landfill ranged from <0.02 to 1.20 mg/L. The Lead concentration level used for calculation of LRF value was 1.20 mg/L. Similarly, the LRF values for Cadmium, Chromium, Ammonia and Nitrate in Hills Road landfill leachates were calculated.

The LRF values shown in Table 9, is a composite of all LRF values of individual contaminants for each of the landfills. As described in Section 5 of this report the maximum acceptable value (MAV) of LRF for any landfill is

Table 9: Aggregated Leachate Risk Factors for MCC Old Landfills

LANDFILL	LEACHATE RISK FACTORS
Hills Rd	61.4
Whitford Bridge	1.4
Pah Rd	28.6
Ngati Otara	5.3
Riverina Ave	0.7
Riverhills	0.8
Leabank	0.3
Miro Rd	7.9
Dale Cres	7.5
Kingfisher Ave	0.3
Coxhead Rd	1.4
Oruarangi Rd	0.2
Grt South Road	6.0
Robert Allan Rd	18.9
Old Quarry Rd	0.5
Ennis Ave	0.1
Kiwi Esplanade	0.7
Riverhills School	0.0
Ti Rakau Dr	0.1
Harania Rd	4.8
Bairds Rd	0.1
MAV for combined effects of five contaminants	5.0
MAV - Maximum Acceptable Value	

less than 5. This means that, if the contaminant concentrations in the leachate are less than the environmental guideline values, then the risk to the environment from the leachate may be considered to be not significant.

On the above basis, seven of the landfills listed above are identified as those that may pose a significant risk to the environment and hence require resource consents for discharge of leachate to the receiving environment. In terms of leachate toxicity the other landfills listed above, do not pose a risk to the environment.

It should be noted that the LRF values are one of a number of key factors in assessing the risk to the environment from the MCC Old Landfills. Other issues discussed in this section of the report must also be taken into account in the final assessment of which landfills may require resource consents from the ARC.

8.5 Proximity to Watercourses

Eight of the 39 landfills are a significant distance away from any watercourses. Twenty six landfills are however close to streams or creeks, and 5 landfills interface with Manukau Harbour.

From the landfill bore water data, surface water and stream monitoring data, it is noted that even for the sites in close proximity to watercourses, there is no significant, in fact barely detectable, levels of landfill leachate impacting on the respective adjacent watercourse.

Hence any risk from adverse environmental effects, from discharge of leachate to adjacent watercourses, are not considered to be significant for most of the MCC Old Landfills. However, a small number of the old landfills identified in Section 8.4 of this report (highlighted in Table 9) require further considerations in this regard.

In this context, other factors such as size of the landfill, type of fill and age may eliminate any significant risk from the respective landfill regarding adverse effect from discharge of leachate to watercourses. For example, "Robert Allen Road Landfill", has clean-fill only and is only about 0.25 ha in area. Any risk from relatively low volumes of leachate discharge from this landfill to the adjacent watercourse, are likely to be not significant.

Another key factor is the existing condition of the watercourses adjacent to the landfill. In practically all cases, the levels of contaminants in the receiving watercourses are significantly higher then those in the respective landfill leachate itself. The ANZECC Committee in developing the "Australia and New Zealand Guidelines for Fresh & Marine Water Quality" has recognised this issue.

Hence, in situations where the receiving water has significantly higher levels of contaminants entering the watercourse from other sources, then a higher

priority should be given to those sources, and the resources directed to that and not on the respective landfill. In this context the significance of adverse environmental effect from the landfill is very low compared to the major cause of contaminants in the respective watercourse. Therefore in terms of environmental risk assessment, the risk from the leachate discharge from the MCC Old Landfills to the respective watercourses may be considered to be not significant relative to other risks to that environment.

Specific issues related to individual landfills are discussed in Appendix E of this report.

8.6 Hydraulics, Water Levels & Rainfall

None of the MCC Old Landfills are close to any aquifer of significance to any water resource. A large number of the landfills are subject to coastal influences, such as salt-water intrusion in the groundwater. It is possible therefore that over the years, the salt water may have acted as a flush and have already removed any contaminants that were present in the respective landfills.

The relatively high rainfall levels in the Manukau Catchment act as a carrier of contaminants from the landfills to the receiving waters. But the high volumes of ground and surface waters resulting from rainfalls, also result in significant dilution of contaminants in the landfill leachate. This is reflected in the low levels of leachate contaminants measured in the respective landfills and downstream waters.

Again, in the above context, the risk from MCC Old Landfills, to the respective surrounding environments are likely to be not significant.

Specific issues related to individual landfills are discussed in Appendix E of this report.

8.7 Assessment of Gas Emissions

Drilling showed a range of filled materials, from substantial concentrations of refuse to clean-fill. The results are summarised in the individual site reports in Appendix E of this document.

Gas was principally monitored during drilling to ensure that gas concentrations in the boreholes were lower than the lower explosive limit (LEL), the concentration of gas required to support combustion. At no times did the gas levels recorded in any bore exceed the LEL.

8.8 Assessment of the Surrounding Environments

Most sites are in residential areas. Miro Rd is in the Mangere light industrial area along Mahunga Drive and is adjacent to a marae with elderly housing and a school. The Whitford Bridge and Mangemangeroa Bridge sites are in semi-rural settings.

The Mangemangeroa Bridge and Whitford Bridge sites are surrounded by steep country. All other sites are surrounded by flat to slightly rolling land.

Sites that are now recreational parks have high public visibility and their visual impacts are generally positive. The landfill sites that are in esplanade and drainage reserves, though usually in sensitive residential areas, generally are not that visible and their impact is assessed to be not significant. The Roscommon Rd site has a negative visual impact. However, it is not easily recognisable as an old landfill site, even though the whole area has a generally unkempt appearance.

8.8.1 Use of Condition Index

For the purposes of preliminary investigation and prioritisation of the landfills by MCC, a condition index was developed for each site. The condition index, involves assigning a score to each site in a number of key result areas, including:

- groundwater resources
- freshwater ecology
- recreational uses of water
- shellfish
- settlement
- tapu & mana
- physical contact
- terrestrial ecology
- marine ecology
- fishing
- gas exposure
- slope stability
- mauri
- miscellaneous public health

Generally, the MCC Old Landfills are well maintained as a Public Park or Reserve with good ground cover in grass and a variety of plants. The Condition Index values were used as one of the indicators together with other factors such as Leachate Strength (see Section 5), landfill size, fill-type, Leachate Risk Factor, etc., to assess actual or potential risk to the environment and/or to public health and safety.

Assessments of potential effects of specific landfills on their neighbouring environment are discussed in Appendix E in terms of these key indicators.

8.8.2 Ecosystems

The aquatic and terrestrial ecology of streams and rivers at all of the landfill sites has been degraded over time by urban and industrial development. Verbal

reports of long term residents and MCC staff indicate that fish life, water quality and riverbed conditions have been severely altered over the years. In this context the relatively small discharges, if any, from the old landfills, are insignificant compared to other contributors to the neighbouring aquatic systems.

Nevertheless, both, the Manukau Harbour, and the Tamaki River including the Tamaki Estuary (whose catchment includes the remaining sites), supports significant shellfish banks and fisheries. Moreover, inlets into these mangrove communities in the estuaries, remain significant fish breeding grounds and reservoirs of local ecosystem diversity. Hence any risk to the aquatic environment must be minimised.

Nearly all the landfill sites considered in this study either border on or discharge into streams that flow into either the Manukau Harbour or the Tamaki River, both of which are significantly polluted (Snelder and Trueman, 1995). Most of the likely effects of landfills considered in this report relate to the release of leachate from the landfills into surrounding surface water and groundwater.

There are two very important qualifications of the Leachate Strength results. Firstly, the methodology used takes no account of dilution prior to measurement. The greater the groundwater flow through a site, the more the leachate will be diluted and the less the measured concentration of the contaminants will be. By not taking account of the potential for dilution it is effectively assumed that the dilution factor is the same at each site.

Secondly, no control groundwater readings were taken upstream of the landfill sites to determine whether the presence of leachate indicators is actually due to the landfill itself or due to some other source.

Hence a greater significance is given to the Leachate Risk Factors in assessment of potential environmental effects of the landfills on the ecosystems compared to the Leachate Strength values.

8.8.3 Activities

Freshwater streams, which are close to the old landfill sites, are generally too small for water recreation. Furthermore, most of these streams are estuarine and have significant pollution levels due to other environmental factors such as urban surface water run-offs. Hence these streams are not used extensively for water recreation. It is noted that the Otara Lake, downstream of Hills Road is being considered for upgrading for water sports.

8.9 Risk to Public Health & Safety

A number of the sites are located adjacent to or very near schools and kindergartens. Generally, these sites do not pose a significant public health

risk, but some sites may have increased potential for such problems where the soil is exposed due to surface erosion.

For example, there are schools or kindergartens very close to the landfill at Elm Park, Ti Rakau Park, Ngati Otara and Udys Rd. Furthermore, a number of landfill sites have now become public reserves, which increases the risk of public health and safety problems through physical contact with refuse. It is therefore important that the landfill sites continue to be maintained and any surface erosion or exposures are covered and grassed.

Extensive site visits carried out indicate that the MCC Old Landfills are generally well maintained and no public health problems arising from the sites have been reported prior to or during the period of close monitoring since 1994. This indicates that, public health risk from these old landfills, are not significant.

8.10 Maori Values

The Maori values of tapu and mana may be offended at the Miro Rd and Ngati Otara sites where marae buildings border the landfill. There is potential for the Maori value of mauri to be offended at nearly all the sites where there is a waterway adjacent to the landfill.

8.11 Assessment of Surface Water

Notwithstanding the limitations of the physico-chemical criteria for surface water quality assessment, it has been used as a broadbrush tool in the early phase in conjunction with qualitative assessments. It was based on the assumption that leachate discharges from landfills enter the nearest watercourse and that the impact of the landfill may be assessed by comparing concentrations of contaminants upstream and downstream of the landfill.

Internationally recognised ambient standards have been used as an absolute measure of the effect of the landfills on surface water quality.

The results of surface water sampling and analysis have shown that the effects of the landfills on adjacent waterways are negligible. For surface water, elevated levels of contaminants (as compared against expected background levels) have only been measured at 'on-site' sampling locations, such as springs and in settled pools. However, these levels are still well below the guideline values for surface waters and are not likely to have any significant adverse effect on the impacted waterways.

To take into account any adverse impact of leachate on receiving streams, for relevant landfill sites, upstream and downstream water samples were taken and concentrations of leachate indicators analyzed. Generally the data available indicate no significant contamination of the streams from the landfill leachates. However, where there are marked increases in conductivity between the

upstream and downstream water samples, this may be due to impact of leachate from the respective landfill site. The leachate concentration levels are generally low and are not considered to have any significant adverse effect on the environment.

Given the relatively small size of the leachate discharges into the receiving waters, it is not surprising that in most cases even the limits of detection were not exceeded.

8.12 Safeguard & Mitigation

All necessary precautions and mitigation measures will be taken as per conditions of discharge permit.

Where risks have been identified, mitigation measures have been initiated. For example the landfills at Hill Rd (Mayfield Park) and Miro Road have recently been clay capped.

As practically all MCC Old Landfills are Parks or Reserves, any landfill surface erosion and exposure is also managed to ensure grass and /or plant cover of the area.

Generally the maintenance of the old landfills is of high quality and where issues of environmental significance arise, environmental risk management mechanism are already in place to take the necessary mitigation action.

8.13 Consultation

The assessment of MCC Old Landfills has been carried out in close consultation with the ARC and as part of that process, this report is based on the agreed criteria for the "Assessment of Environmental Effects" and identification of the landfills that may require resource consents from the ARC.

In terms of public consultation the approach has been to consult with those that have some relevant knowledge of the old landfill, such as longer-term residents and various Council employees. The investigations to date have not yet uncovered any serious problems.

An informal report was made to the Otara Community Board in 1996.

Where it was necessary to carry out investigations on adjacent properties, the owners /residents were informed and the issues explained. This involved initial letters followed by discussions with property owners. For example, it was necessary to consult with affected parties in order to carry out physical works at Hills Road and Miro Road Landfills.

Other consultations undertaken so far in this project are:

- All known current and retired long-service staff were consulted about the existence and location of sites and knowledge of the known sites.
- An article was placed in local papers (Manukau Courier and Eastern Courier) asking former employees and residents to contact a nominated staff member.
- There has been consultation undertaken with the parties affected (principally neighboring businesses and interested environmental groups) for the Miro Rd land use consent application.

Extensive consultation was also entered with the Te Puea Marae committee with regards to the Miro Road. This also included consultation with the Huakina Development Trust over the entire project. The expectations outlined by the Huakina in consultation regarding the former landfill sites coincide with the general approach adopted by the MCC.

Further consultations will be undertaken with the neighbouring community, as part of any discharge permit application process.

8.14 Future Monitoring

The extensive period of monitoring already carried out between 1994 to 1999, show that the levels of environmental contaminants at the old landfill sites, generally to be below or close to the detection limit values for the parameters measured. For most of the sites, any potential adverse impact on neighbouring areas or water bodies are likely to be insignificant and hence may not require any further monitoring of the sites.

8.15 Conclusions

Manukau City Council has carried out extensive monitoring over a long period of time (since 1994) to identify environmental risks associated with the Old Landfill Sites in the MCC Catchment. The evaluations used a number of methodologies, to ascertain actual and/or potential environmental effects from the landfills. These included;

- use of Condition Index (see Section 8.8.1)
- calculation of Leachate Strength (see Section 5.1)
- site inspections & assessments (see Section 8.2)
- calculation of Leachate Risk Factor (see Sections 5.3 & 8.4)

Some of the methodologies such as Condition Index and Leachate Strength, have been described in detail in previous reports to the ARC. The key criteria for assessment of environmental effects in this report are more focused on the LRF values and site inspections and assessments.

Taking into consideration all factors addressed in this report, the key conclusions are that:

- No significant adverse effects from discharge of landfill leachates, were identified on the water quality of receiving waters adjacent to the respective landfills.
- Many of the old landfills have clean fill with minimal organic matter and do not produce or are not likely to produce any significant volumes of leachate in the future.
- The environmental risk for actual or potential adverse effects, from very low levels of contaminants present in a small number of the landfill leachates, are generally considered to be not significant.

However, seven landfills were identified as having contaminant levels in the leachates that may pose some risk to the environment. These landfills are:

- Hills Road (Mayfield Park)
- Pah Road
- Ngati Otara
- Miro Road
- Dale Crescent
- Great South Road
- Robert Allen Road

It is noted that the worst case scenarios were considered in calculation of the LRF values (see Sections 5.3 & 5.4). The highest contaminant levels measured in the respective bore hole leachates were used in the calculations of the LRF values. Furthermore, the contaminant concentrations used are total levels in the sample and not just the soluble fraction. This further adds to the worst case scenario methodology used for calculation of the LRF values.

Considering the fact that Dale Crescent has clean-fill and gravel only, and is not in close proximity to any watercourses, any environmental risk from this site is considered to be not significant. Hence, the Dale Crescent site should be excluded from any need for resource consents.

Similarly, the Robert Allan Road landfill has clean-fill only, and is a relatively small site (0.25 ha), which is well maintained by MCC. Although this site is in close proximity to a watercourse, no adverse environmental effects were identified. Hence, it is considered that this site should also be excluded from any need for resource consents.

In our assessments, only five of the MCC Old Landfill sites may require further consideration by ARC as to whether there is any justification for any resource consents for the sites. These sites are:

- Hills Road (Mayfield Park)
- Pah Road
- Ngati Otara
- Miro Road
- Great South Road

It is noted again that a number of environmental issues have been identified in relation to the above five landfills and these issues, are currently being addressed by the Manukau City Council. These issues have resulted in clay capping of landfills, cleaning localised rubbish dumping within landfill sites and re-vegetation of landfill surfaces subject to localised soil erosion or susceptible to slips.

Public health and safety issues such as the potential for landfill gas effects, has been measured to some degree by measuring the gas levels relative to the lower explosion level (LEL) values. While gas is being produced, the low concentration of organic matter in the refuse and the reduced organic decomposition due to the ageing of the landfill sites significantly limit gas production. There are no visible signs of landfill gas production, such as cracks in the ground or grass discoloration, at any of the sites.

Site visits and assessments generally showed no indication of any potential risks to public health and safety associated with the MCC Old Landfills. The site visits included assessments of odour, ground cover and the risk posed by direct physical contact with landfill surface, dust levels, and indicators of soil erosion and slips. Where signs of any soil erosion and rubbish dumping was identified, MCC has taken immediate action to mitigate the situation as part of the daily management of the landfills. Hence any potential for adverse environmental effects is avoided.

Although no detailed assessment of the potential for slope stability at the old landfill sites has been carried out, the length, grade and width of the slope have been examined to get a measure of the potential for slope stability. Generally, any risk to public health and safety from the old landfill sites, are considered to be not significant.

9. Scope and Limits of Investigations

This report is based on Manukau City Council investigations and information prepared for the purpose of this commission. Previous reports in relation to the Old Landfills prepared for Manukau City Council by ESR Environmental Limited and Groundsearch EES Limited, were made available to GHD Limited and they have also been used as sources of information. The assessments made and the conclusions drawn are based on the data and information provided from the above sources. Gutteridge Haskins and Davey Pty Ltd (GHD) accepts no responsibility for other use of the data.

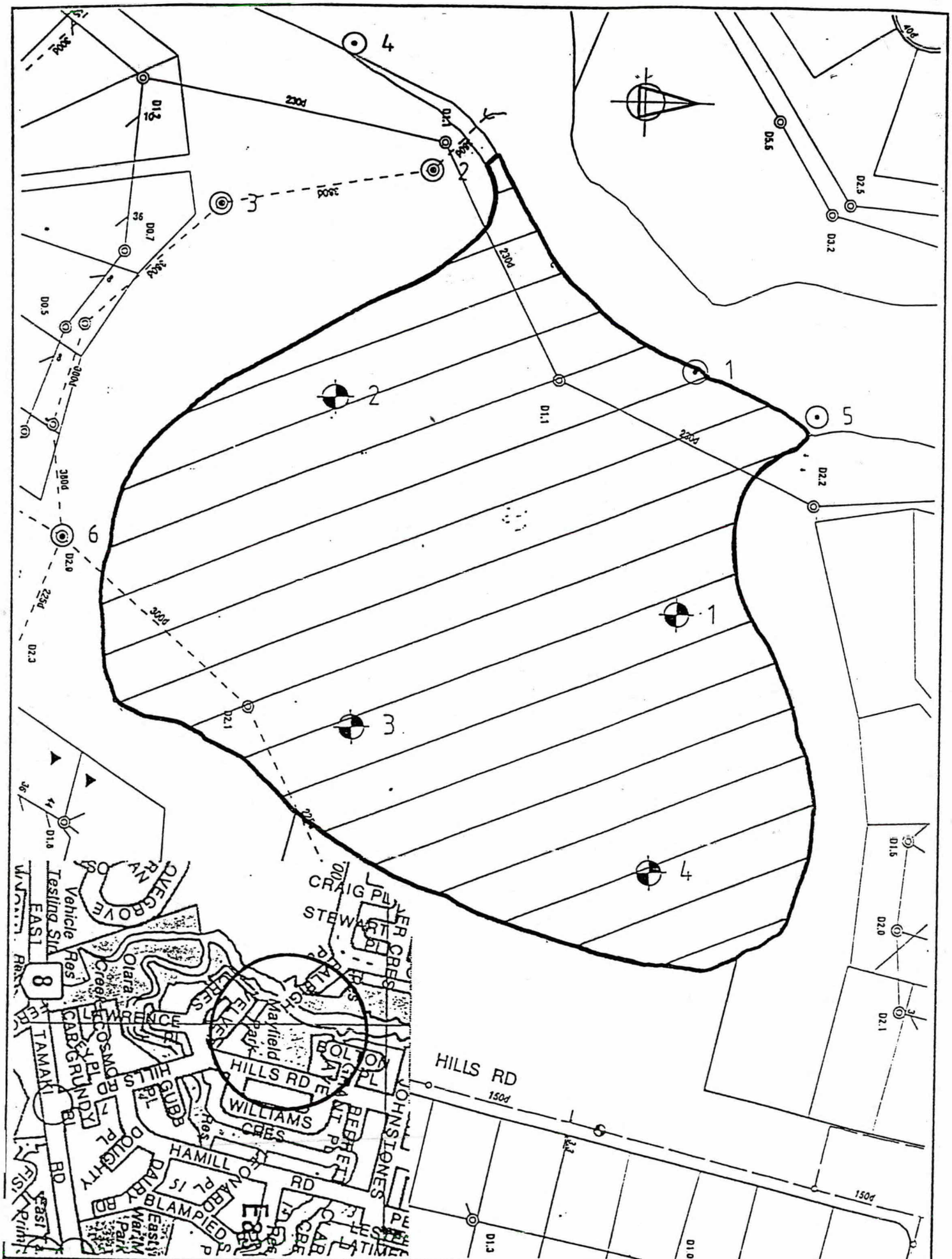
Where drill hole or test pit logs, laboratory tests, geophysical tests and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the investigation locations tests points and sample points and is not warranted in respect to the conditions that may be encountered across the site at other than these locations. It is emphasized that the actual characteristics of the subsurface materials may vary significantly between adjacent test points and sample intervals and at locations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

An understanding of the subsurface site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part or issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which has been modified in any way as outlined above.

Appendix A

Site Maps of MCC Old Landfills



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Fax (09) 262 3131

TITLE

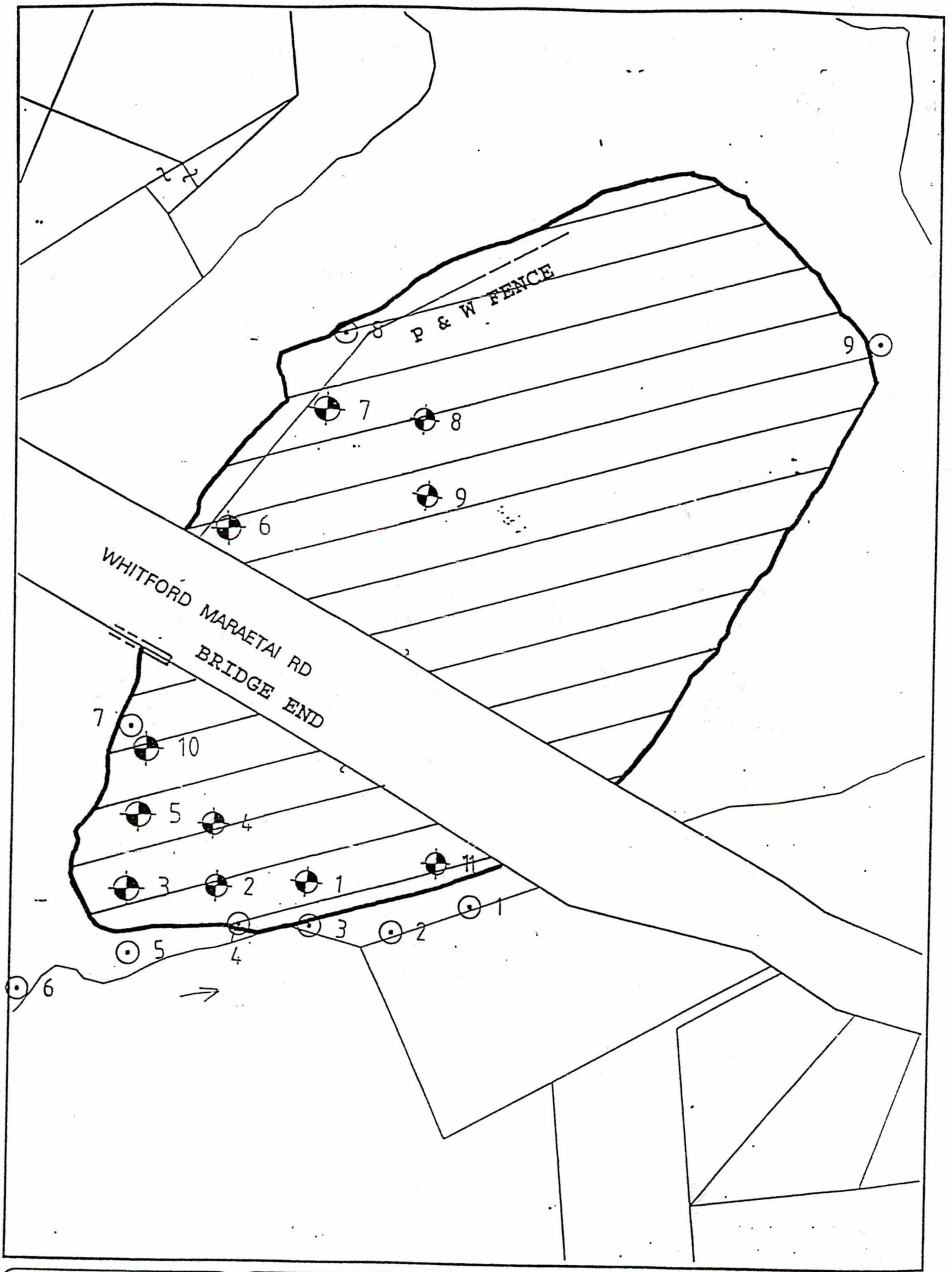
HILLS ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SCALE	DATE
DRAWN	G. Lander	07/99
CHECKED	A. Robinson	07/99
M.C. APPROVED		

PLAN NO 1



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TITLE

WHITFORD BRIDGE
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	07/98
CHECKED	A. Robinson	07/98
M.E. APPROVED		

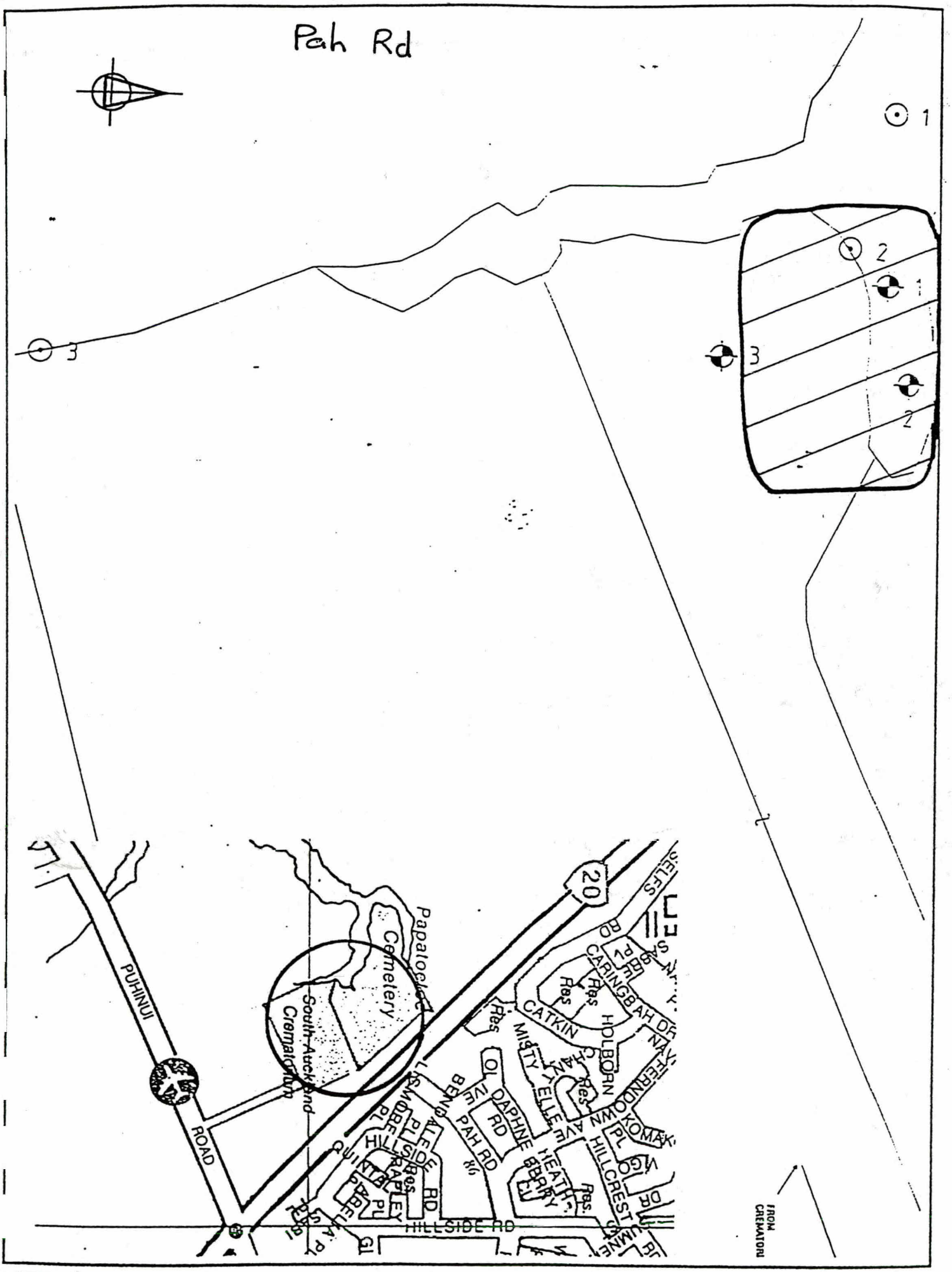
Blk 4 Sheet 54,55 TP 18a, 18b.

Lot 1, DP 41610 1.1609 ha.

Lot 2 DP 11565 6.5748 ha

Pt Lot 1 DP 20852 5.8850 ha.

X



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Fax (09) 262 0131

TITLE

PAPATOETOE CEMETERY
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.E. APPROVED		

REV CHK

REV.

Blk 3 Sheet ~~46~~ 94 TP 26a, 26b, 26c, 26d.

15 R

Pt Allot 520 + 133 m²

SO 53719 SO 56819

Parish of Maroochy.

1.0317 ha.

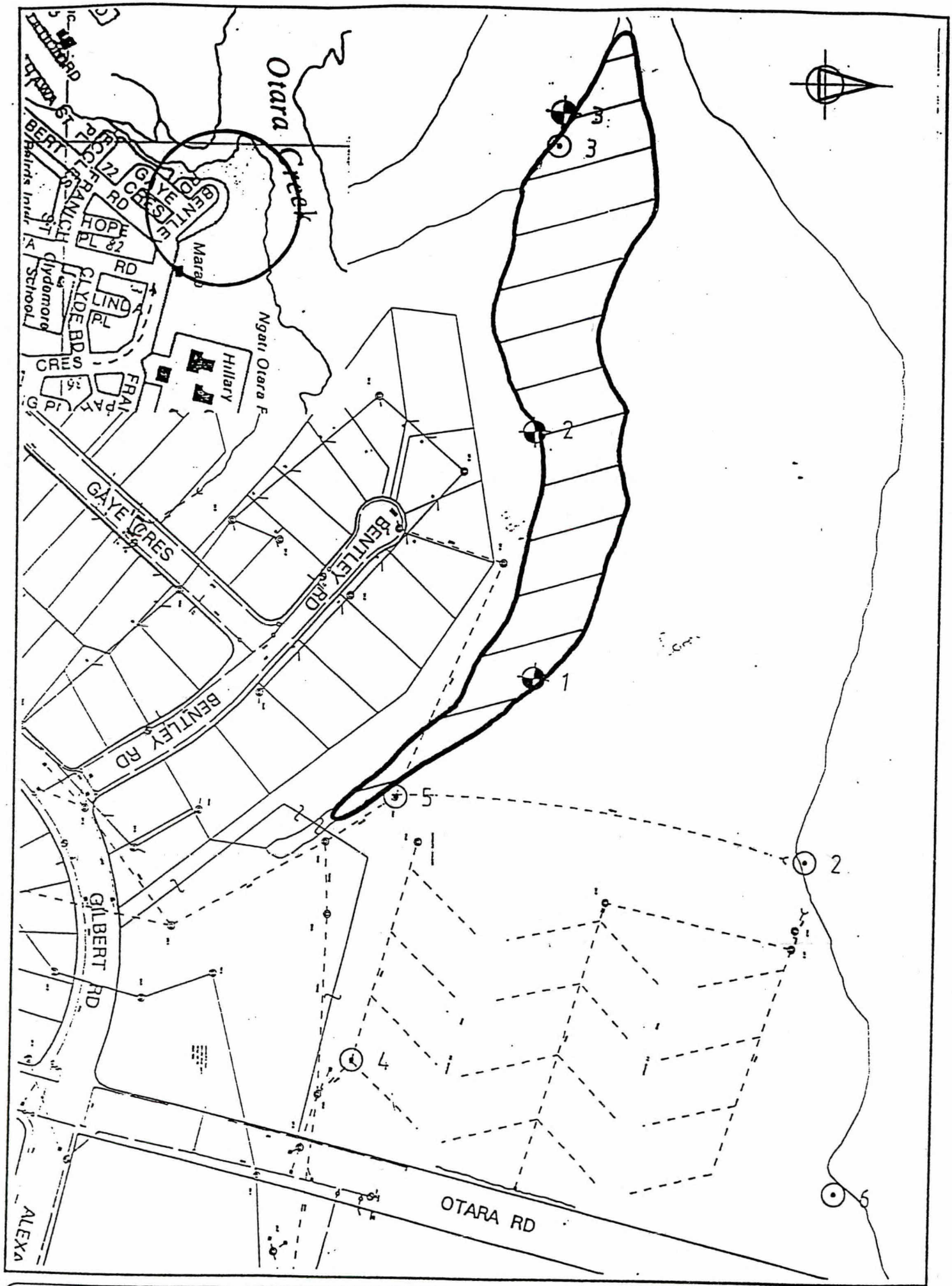
✓ △

10398 Info Detail C.1484

LIR

Shirley Treneary 8828.

Report on all properties (Street Address LD) relating to Info Detail 10398.



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Fax (09) 262 3131

TITLE

NGATI OTARA
WATER SAMPLING LOCATIONS

REV CHK

	SIGNED	DATE
DRAWN	D. Lander	02/99
CHECKED	A. Robinson	02/99
M.E. APPROVED		

REV.

PLANNING

Blk	Sheet	TP
3	88, 89	24c
7	04	

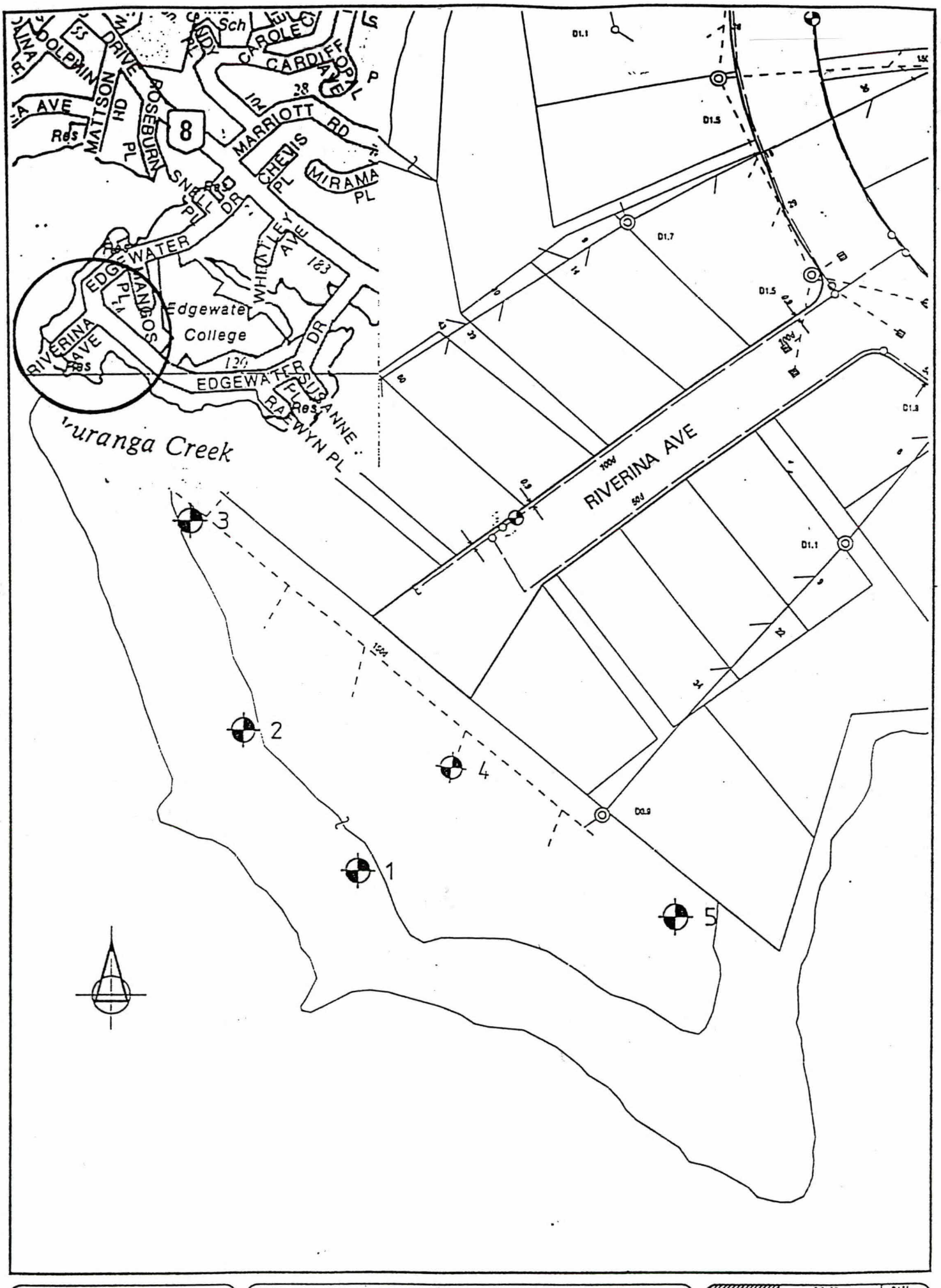
33R Edgewater Drive

Lot 267
DP 54562
4325 m²

✓ Δ

Lot 256
DP 54562
7411 m²

✓ Δ



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Fax (09) 262 0913

TITLE

RIVERINA AVENUE
WATER SAMPLING LOCATIONS

REV CHK

REV

	SCHED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

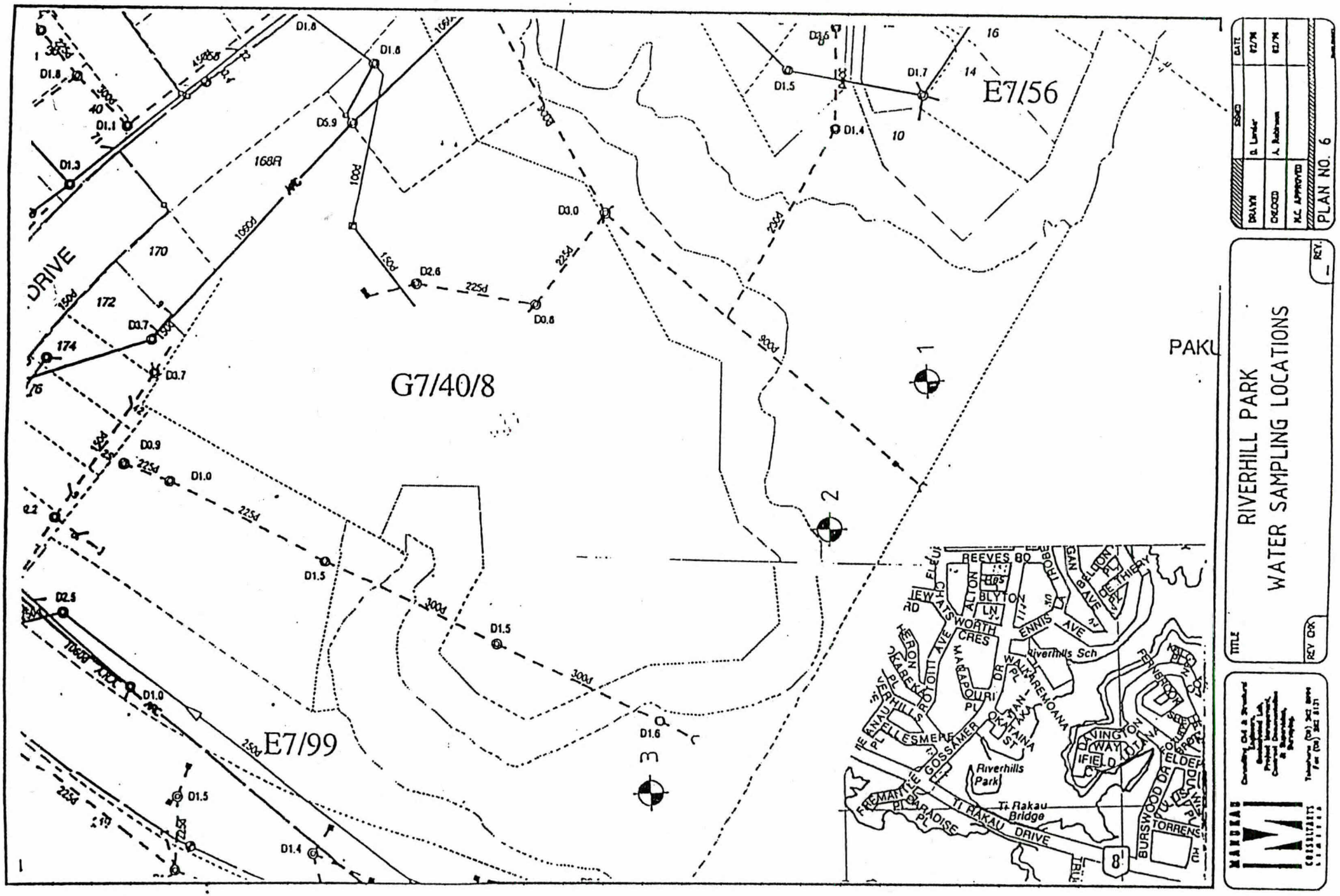
PLAN NO 5

Blk 7 Shed ⊗ TP
13, 14, 15, 16 23d, 24b, 24d

SO 51501 1.4282 ha. ◁ ✓

Lot 109 D.P 52077 6528 m² ×

Lot 108 DP 52077 2.0520 ha. ×

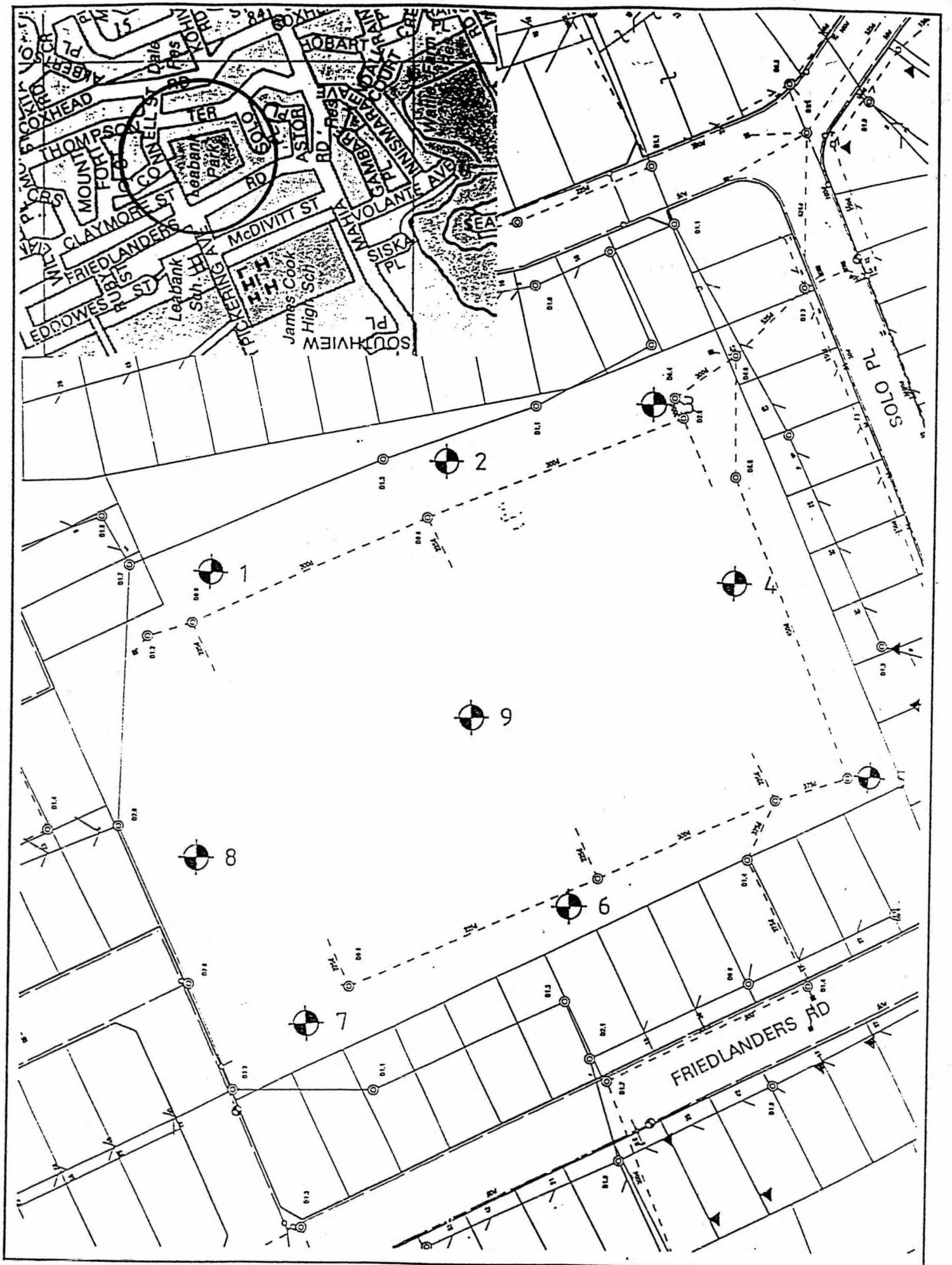


BLK	Sh.	TP
9	16, 17	30d

30R

Lot 1 DP 51364

3.6949 ha.



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TITLE

LEABANK PARK
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

REV CHK

REV

Blk. Sh. TP

01 ~~91~~, 92, ~~93~~. 10a 10c 5d.

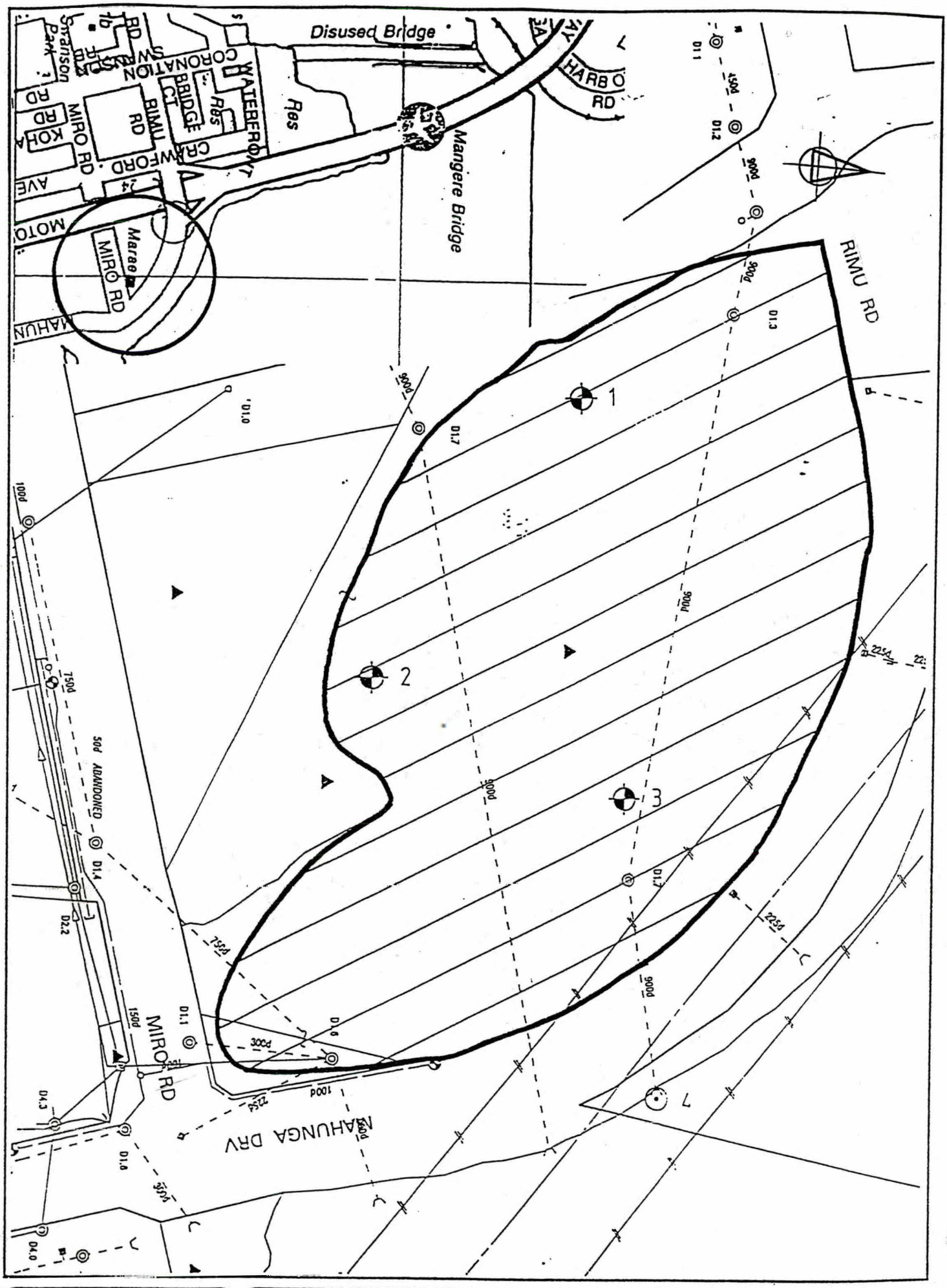
Pt Sec 1 Blk V Otahuhu SD.

SO 56622 2.0670 ha ✓

0.3213 ✓

Sec 14 SO 56538

610 m²



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TITLE

MIRO ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV --

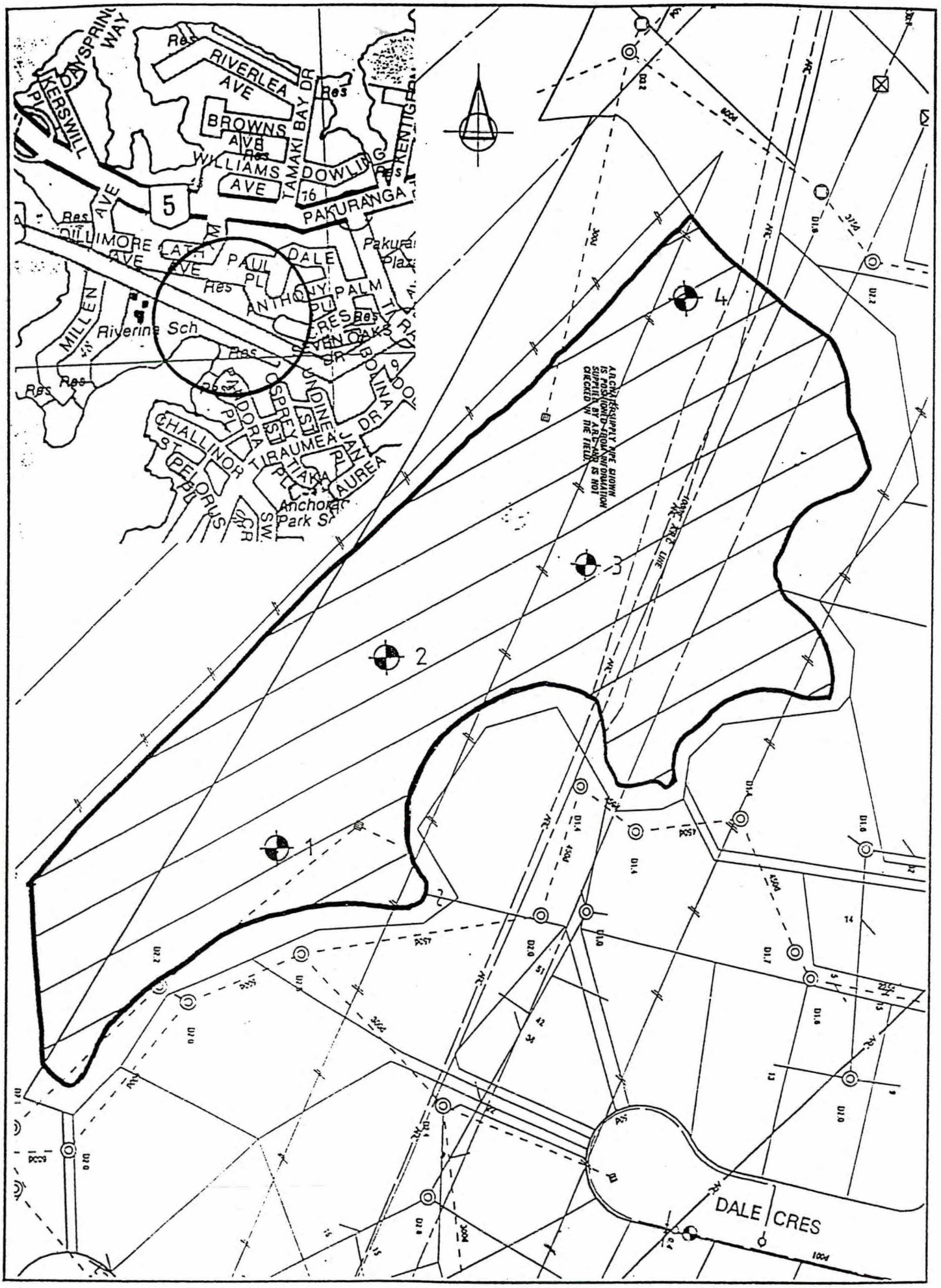
	SIGNED	DATE
DRAWN	D. Lawlor	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO 8

Blk.	Sh.	TP
03	~~86,87~~	23C

Sec 1 SD 52269

9740m²



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Fax (09) 262 313

DALE CRESENT
WATER SAMPLING LOCATIONS

REV

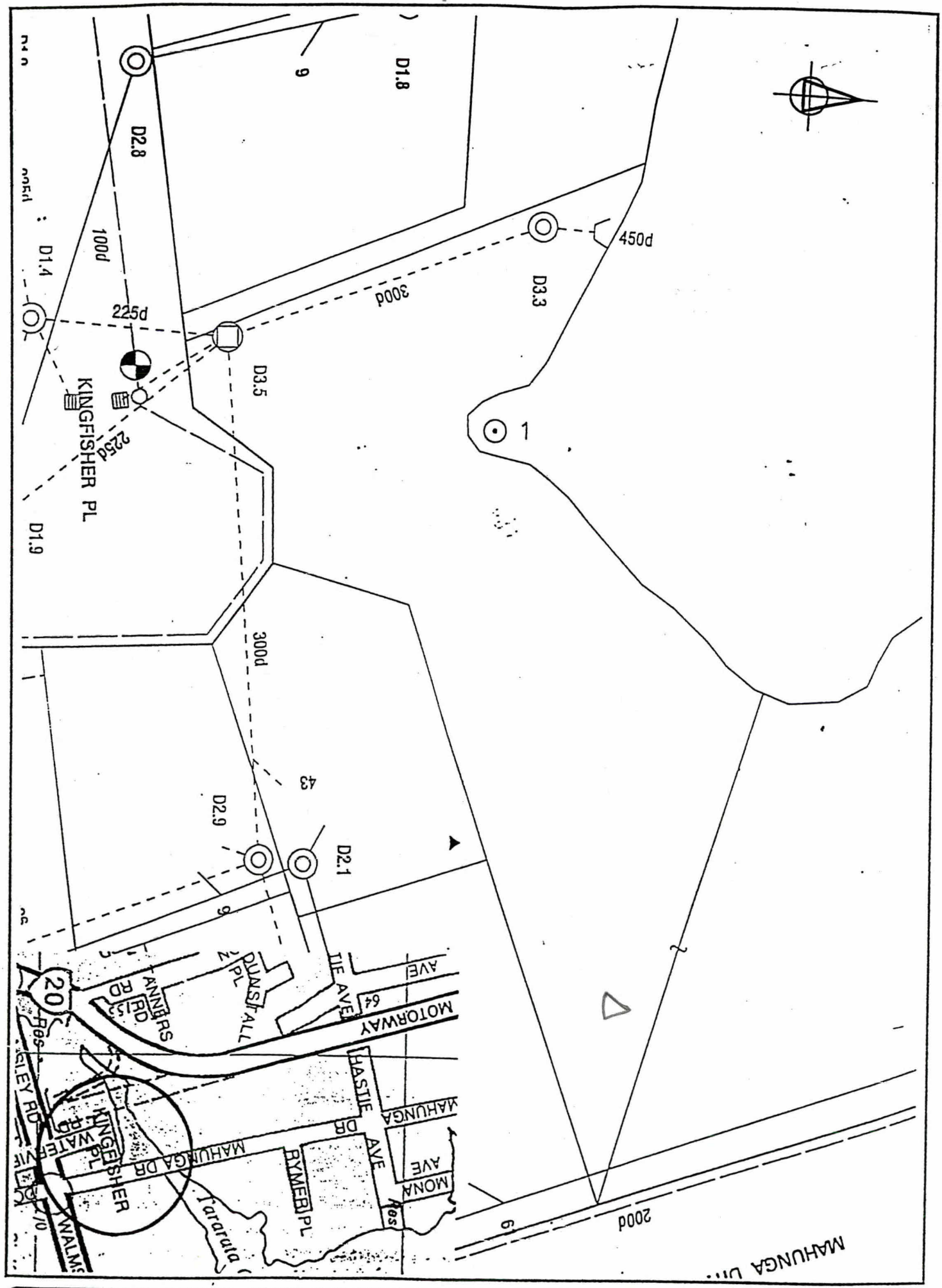
	SIGNED	DATE
DRAWN	D. Lander	07/11
CHECKED	A. Rahman	07/11
M.C. APPROVED		

PLAN NO 9

Blk.	Sl.	TP
~~03~~	~~83~~	~~26a~~
01	95	

Lot 34
DP 99764
2330 m²
Δ ✓

Lot 37
DP 99763
5130m²
x



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Fax (09) 262 8131

TITLE

KINGFISHER PLACE
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO.

Blk. Sh. TP

~~15, 4, 28~~, 29, ~~30, 31~~ 30d 31b

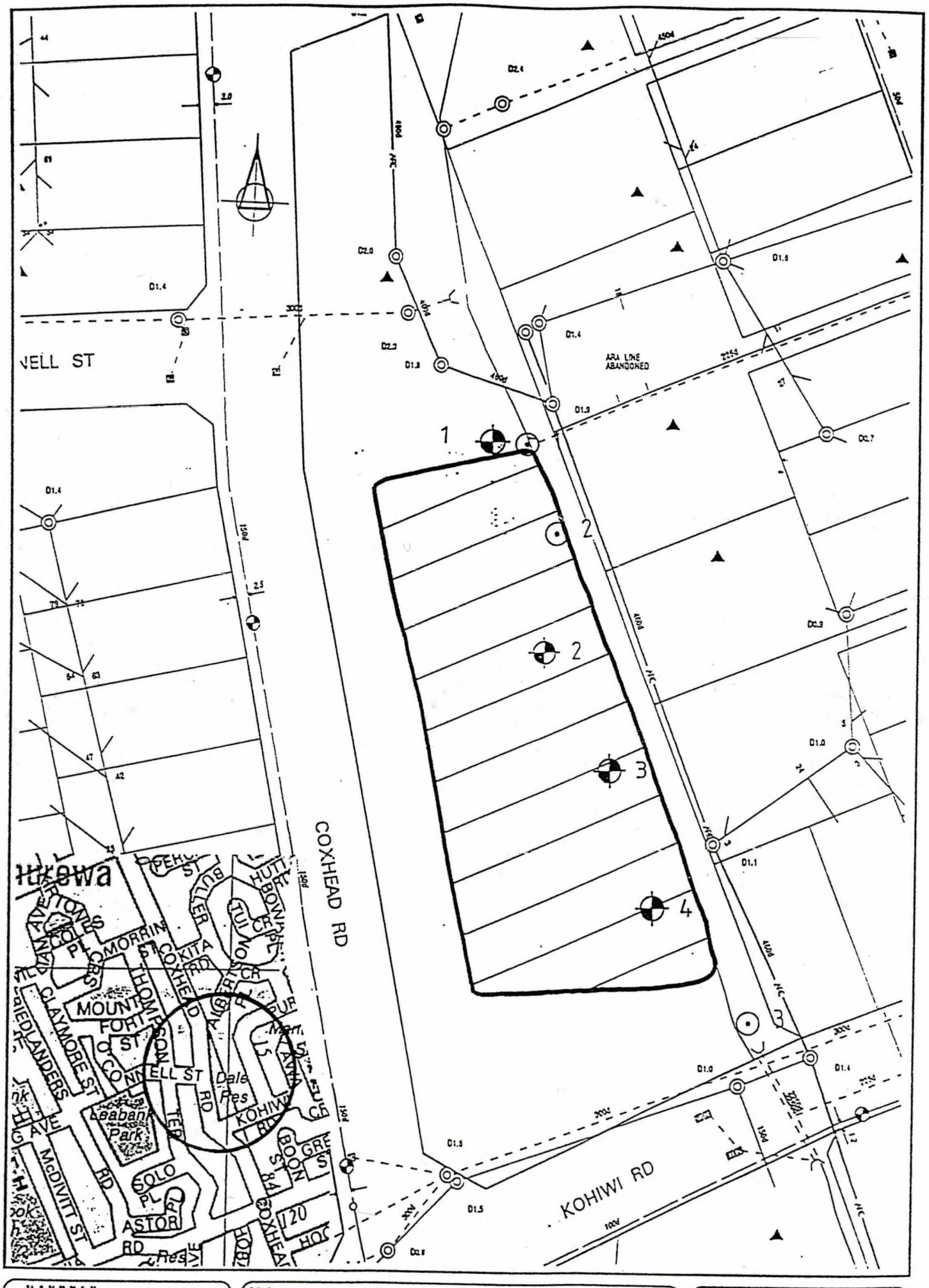
44a

68R

Allot 101

SO 42279 Parish Papakura.

1.2788ha.



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Fax (09) 262 5131

TITLE

COXHEAD ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Rahman	02/98
M.C. APPROVED		

PLAN NO 11

Blk.	Sl.	To
02	41, ~~42, 43~~	7a, 7b, 7c
	~~47, 52, 53, 63~~	8a

490

Lot 1 DP 156506

20.9500ha.

X

(Δ next section)

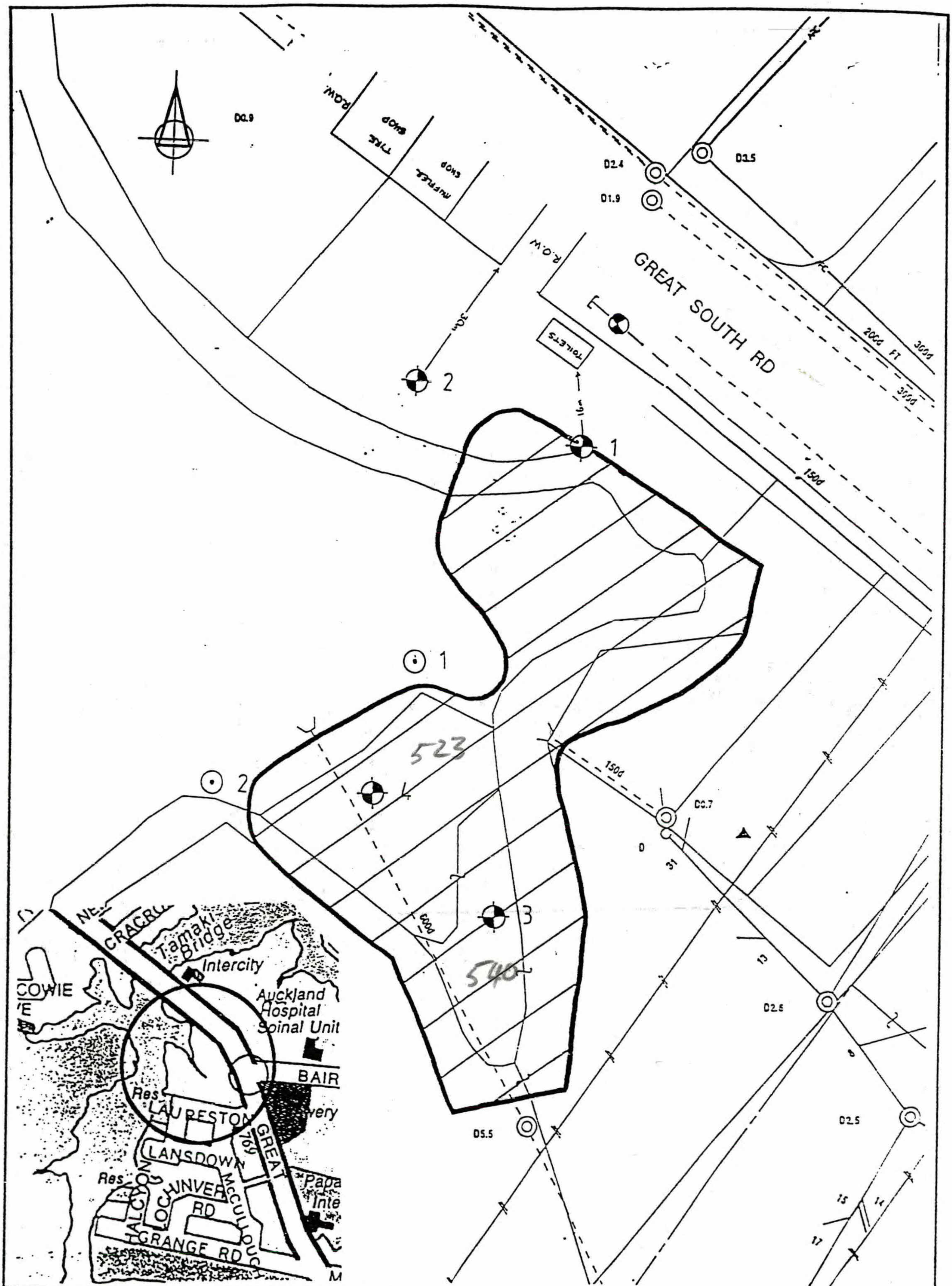
Pt. Allot 78A

9422m². ?

Blk.	Sh.	
03	72	16d.
04	61 72	

Allot 523
SO 55438 Parish of Manurewa.
813m² Δ ✓

Allot 540
SO 55438
450m² Δ ✓



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TITLE

GREAT SOUTH ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	07/91
CHECKED	A. Robinson	07/91
M.C. APPROVED		

REV CHK

REV

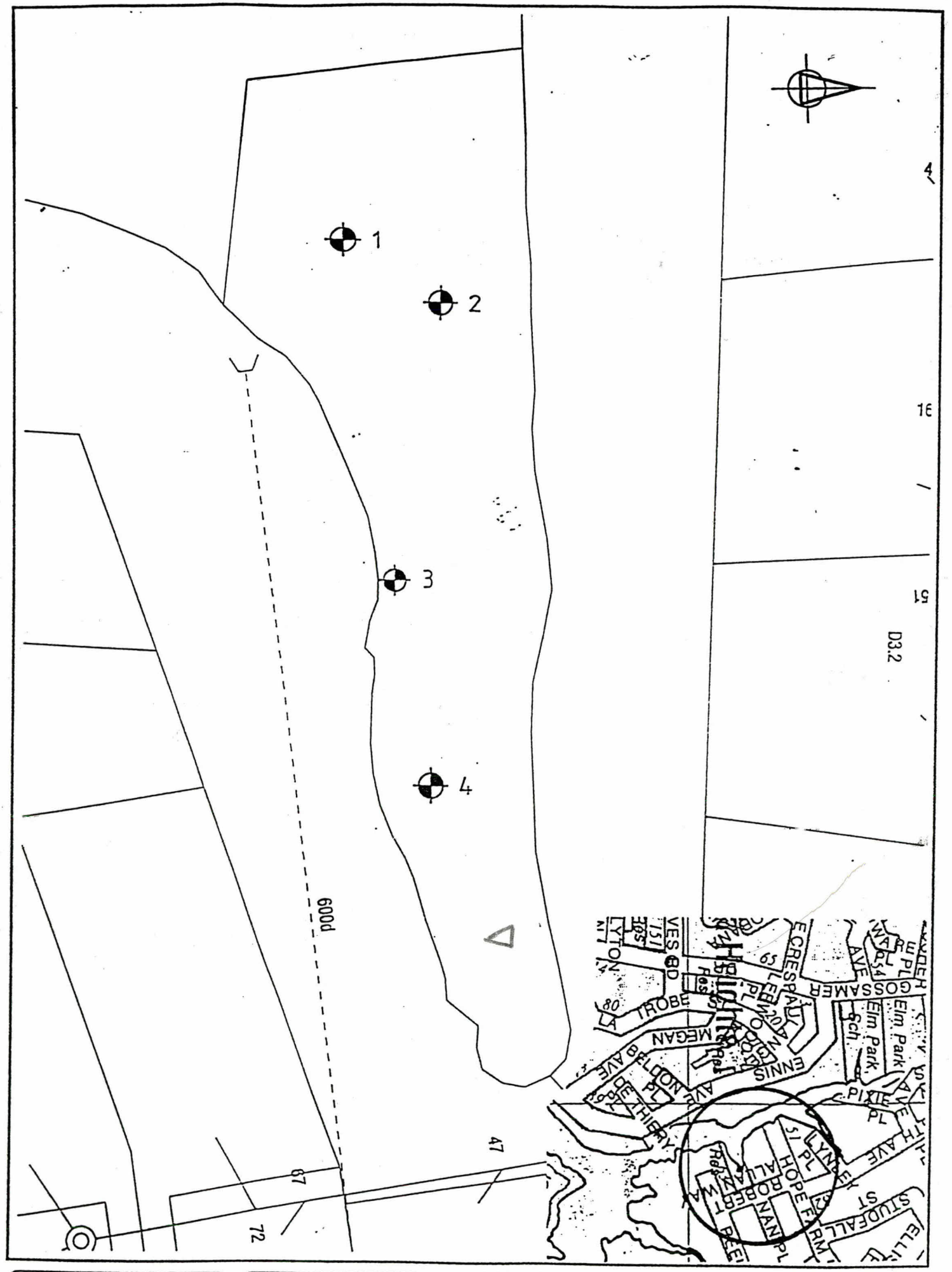
Blk.	Sh.	TP
07	26	36c, 37a

Allot 386

SO 49436 Parish of Pa Kuranga.

2011 m²

Δ ✓



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TITLE

ROBERT ALLAN ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	07/11
CHECKED	A. Robinson	07/11
M.C. APPROVED		

REV CHK

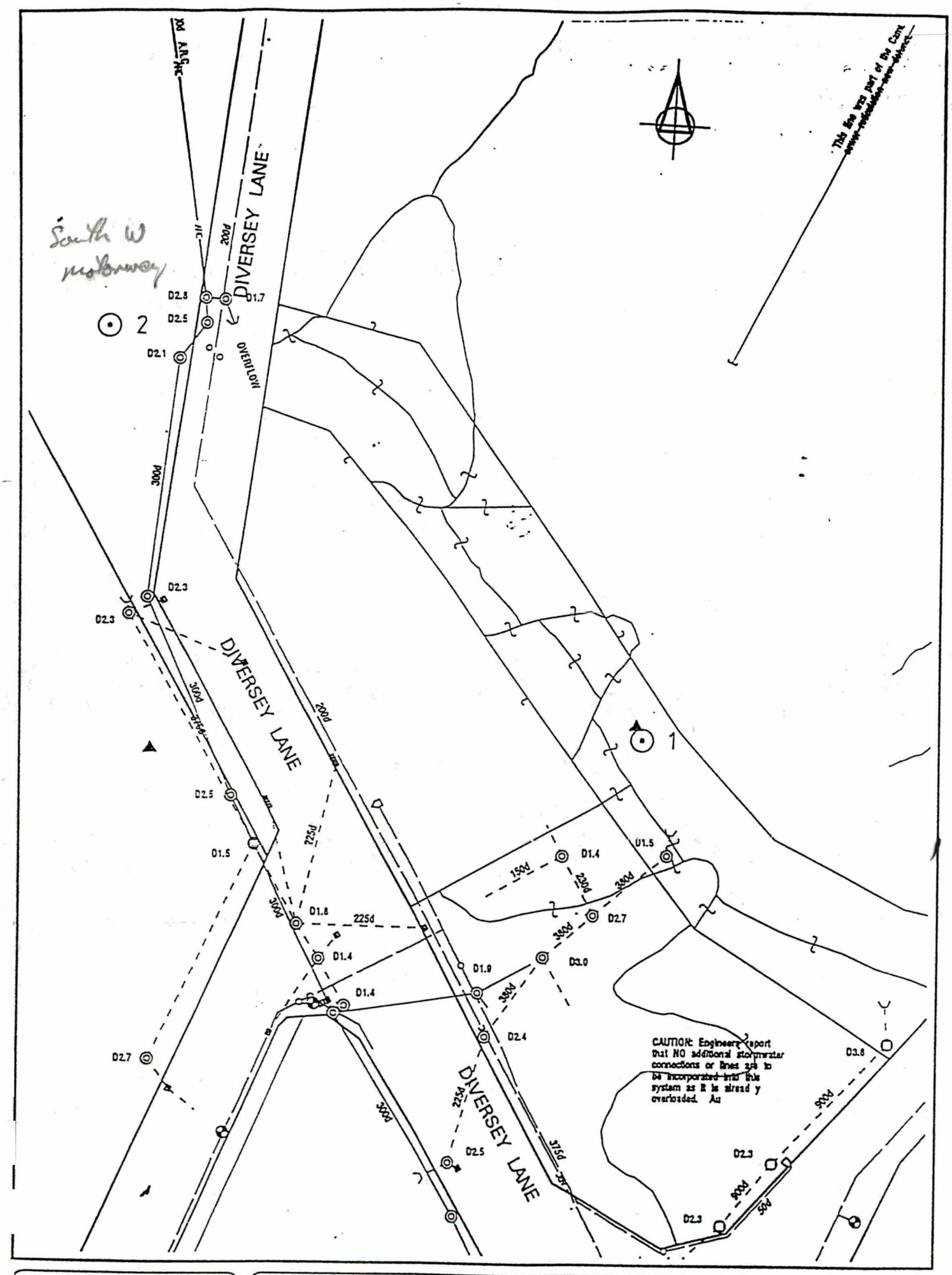
Blk.	Sh.	TP
04	~~68~~, 69	18d.

(1)

Pt Lot 1
DP 28051
2033 m²

△ ✓

(2) SW motorway. ×



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Fax (09) 262 5131

TITLE

ROSCOMMON ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

REV CHK

REV.

PLAN NO. 45

TIRAUMEA RESERVE
WATER SAMPLING LOCATIONS

TITLE

DRAWN	D. Lawler	07/11
CHECKED	A. Robinson	07/11
RLE APPROVED		
	SCALE	DATE

MAXDRAU CONSULTANTS

TIRAUMEA DRV

~~BLK~~ Sh. TP

01 ~~80, 81, 82, 85~~ 10c, 11a, 5b, 5d

~~94, 95~~

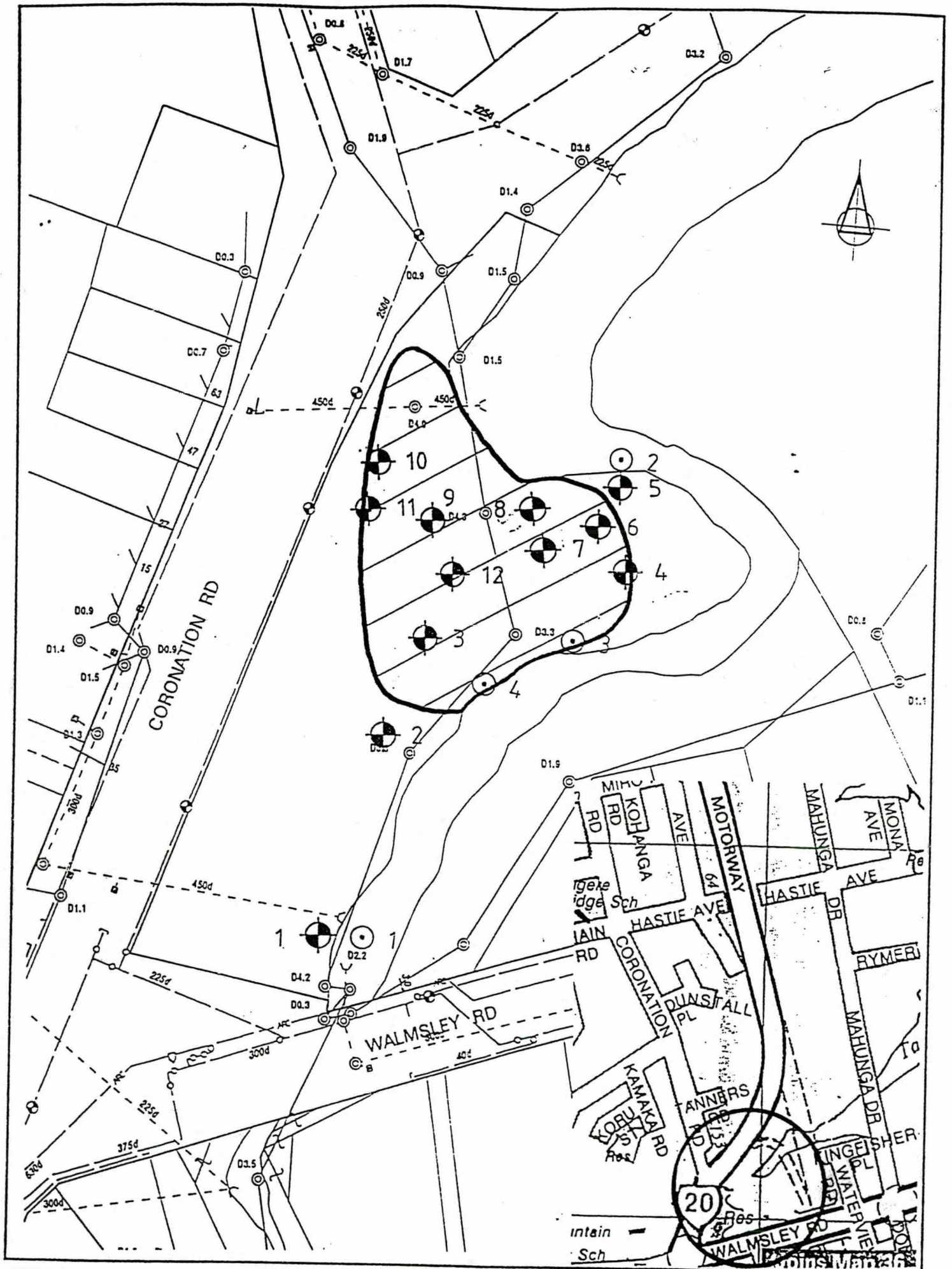
All of 218

SO 59109

Suburbs of Mangere.

1.1600 ha.

Δ ✓



Blk. 07 Sh. Pt

~~5~~, 14, ~~15, 16~~ 23d, 24b

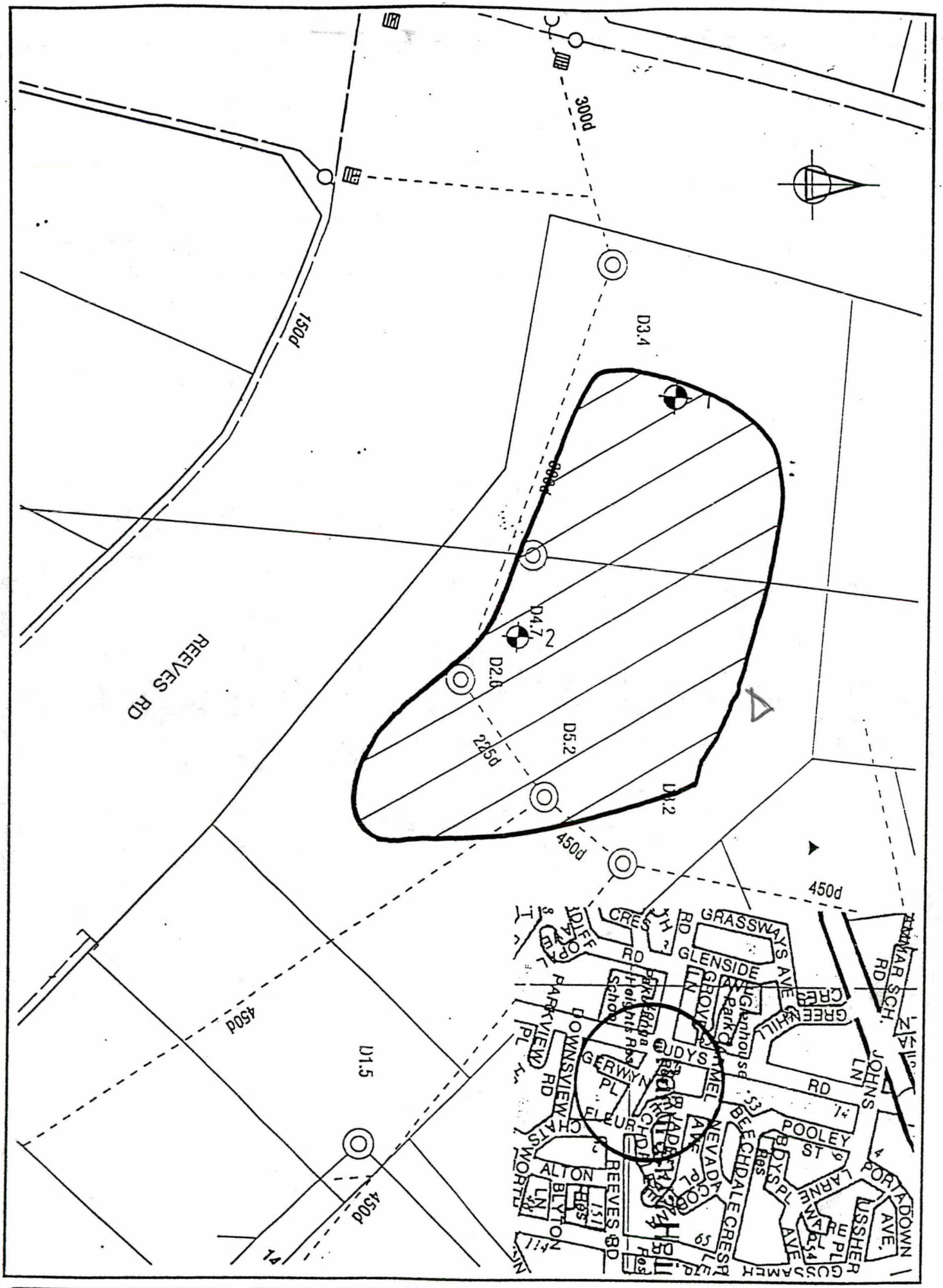
74R

Lot 279

DP 57254

3546 m²

Δ ✓



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Fax (09) 262 8131

TITLE

UDYS ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGN:	DATE:
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO. 18

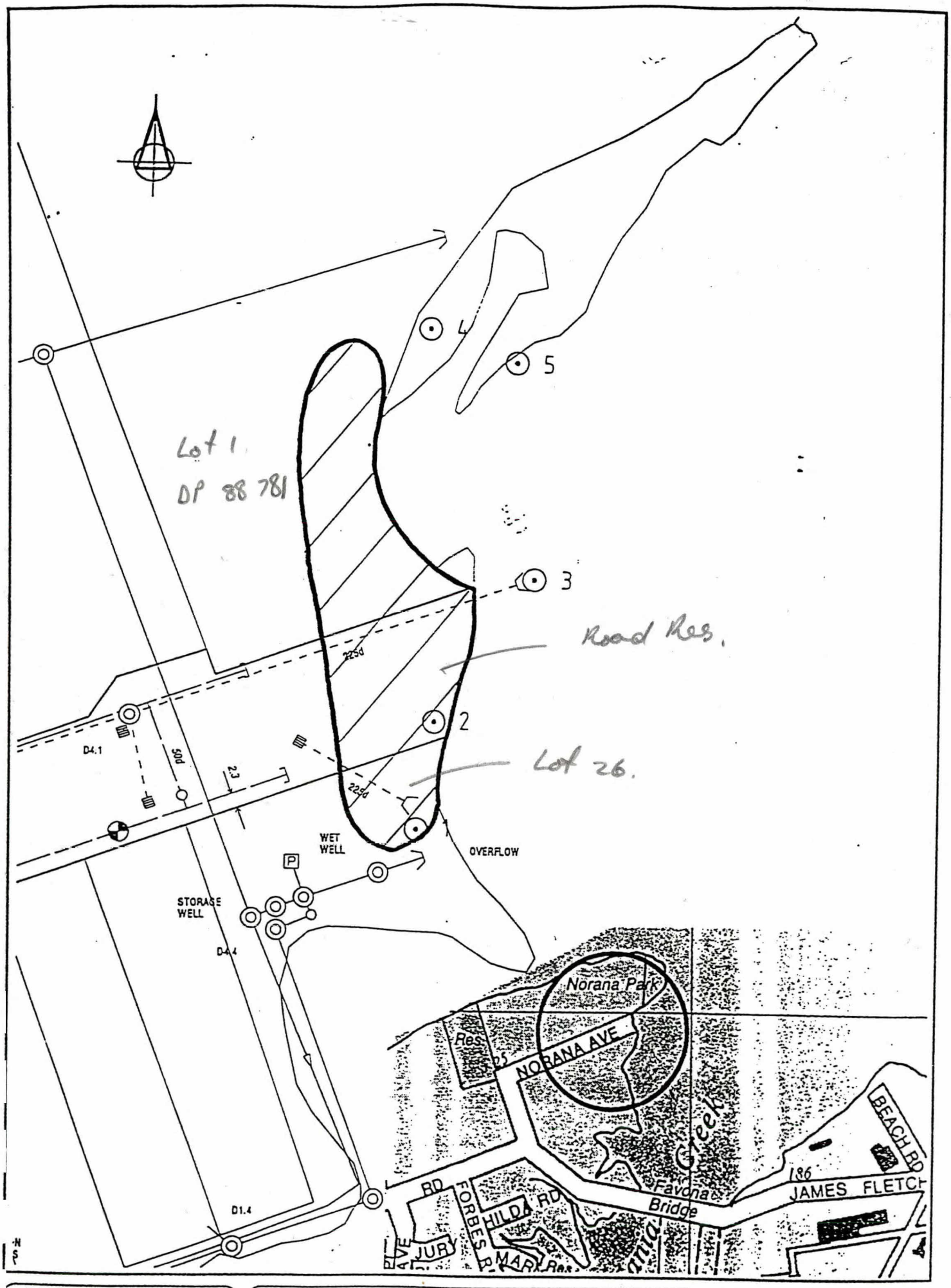
Blk. Sh. TP

03 21, ~~22~~ 10 Q

Lot 26
DP 22801
1290 m²

Lot 1
DP 88781
2.1865 ha

Road Reserve Wairarapa Rd



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TITLE

NORANA ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robertson	02/11
M.C. APPROVED		

Blk.	Sh.	TP
07	~~44, 5~~ 26, ~~27~~	23d, 24b, 36c, 37a

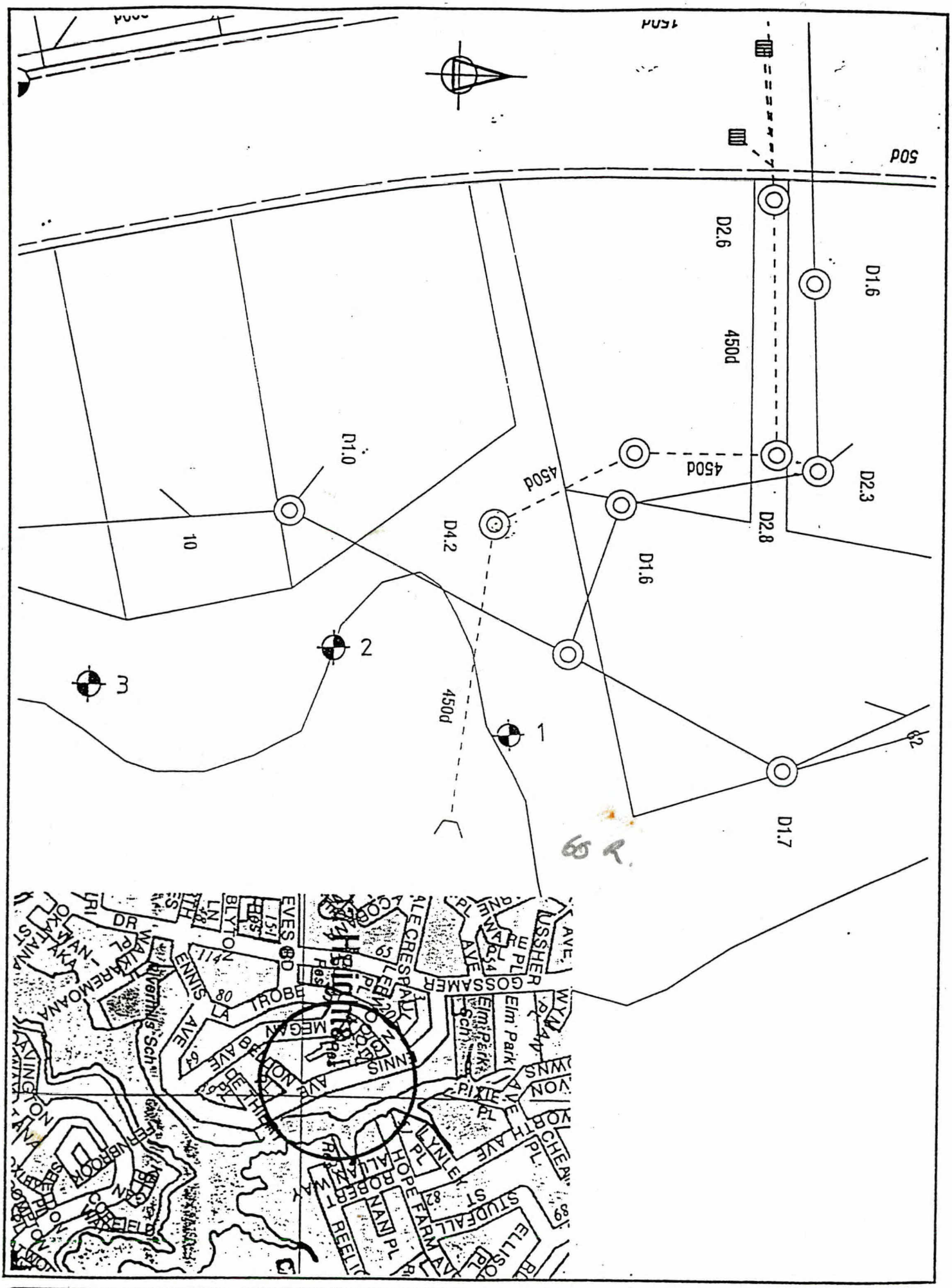
60R

Lot 118

DP 55287

6083 m²

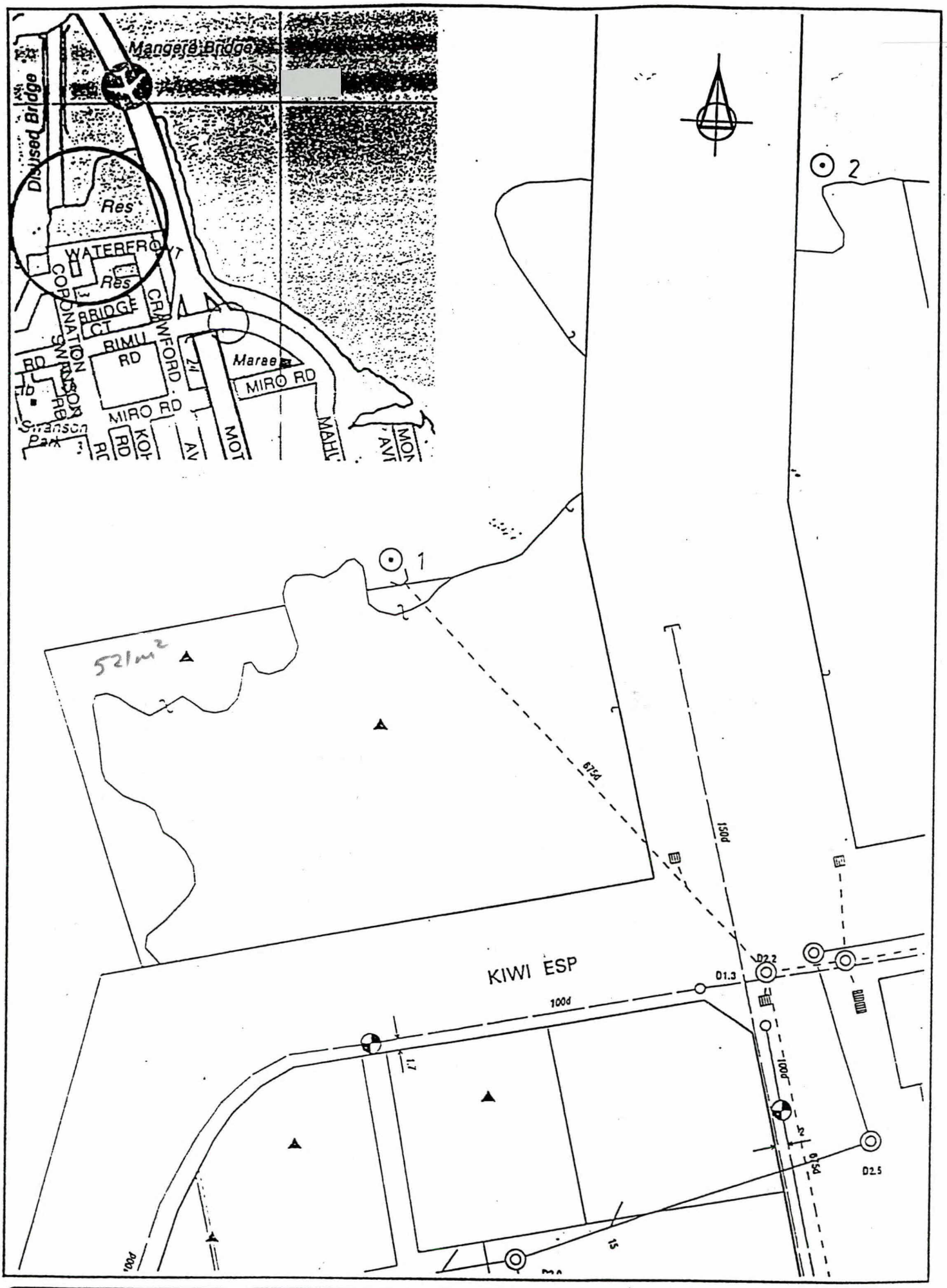
X



Blk.	Pt.	TP
01	~~44, 57, 67,~~ ~~68,~~ 80	5a, 5b.

Pt Allot 68
SO 25129 ×
Village of Mangere

Pt
SO 42353
521m² Δ J



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Fax (09) 262 8137

TITLE

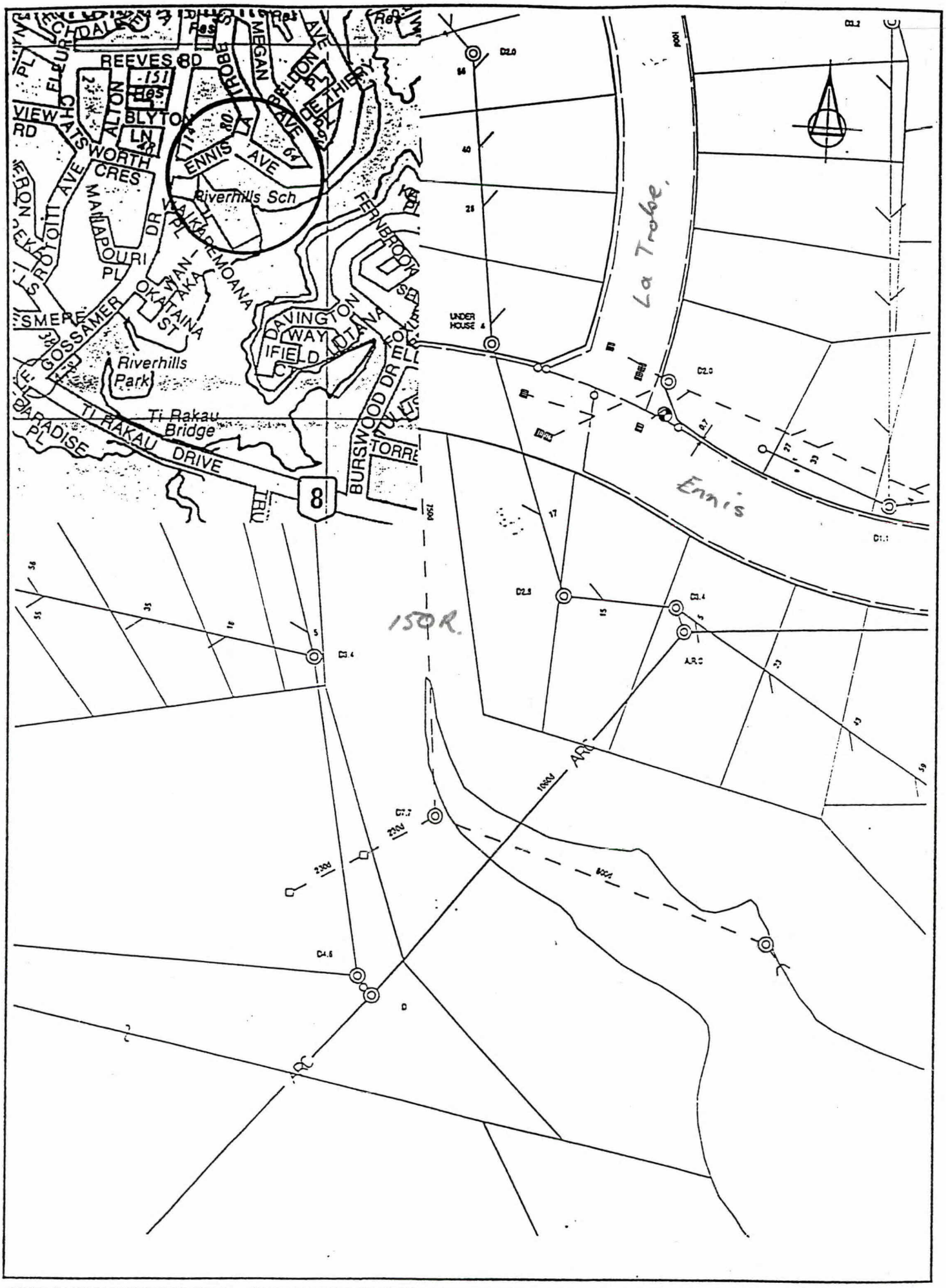
KIWI ESPLANADE
WATER SAMPLING LOCATIONS

REV CHK

REV. --

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

PLAN NO. 21



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TITLE

RIVERHILLS SCHOOL
WATER SAMPLING LOCATIONS

	SCALE	DATE
DRAWN	G. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

REV CHK

REV.

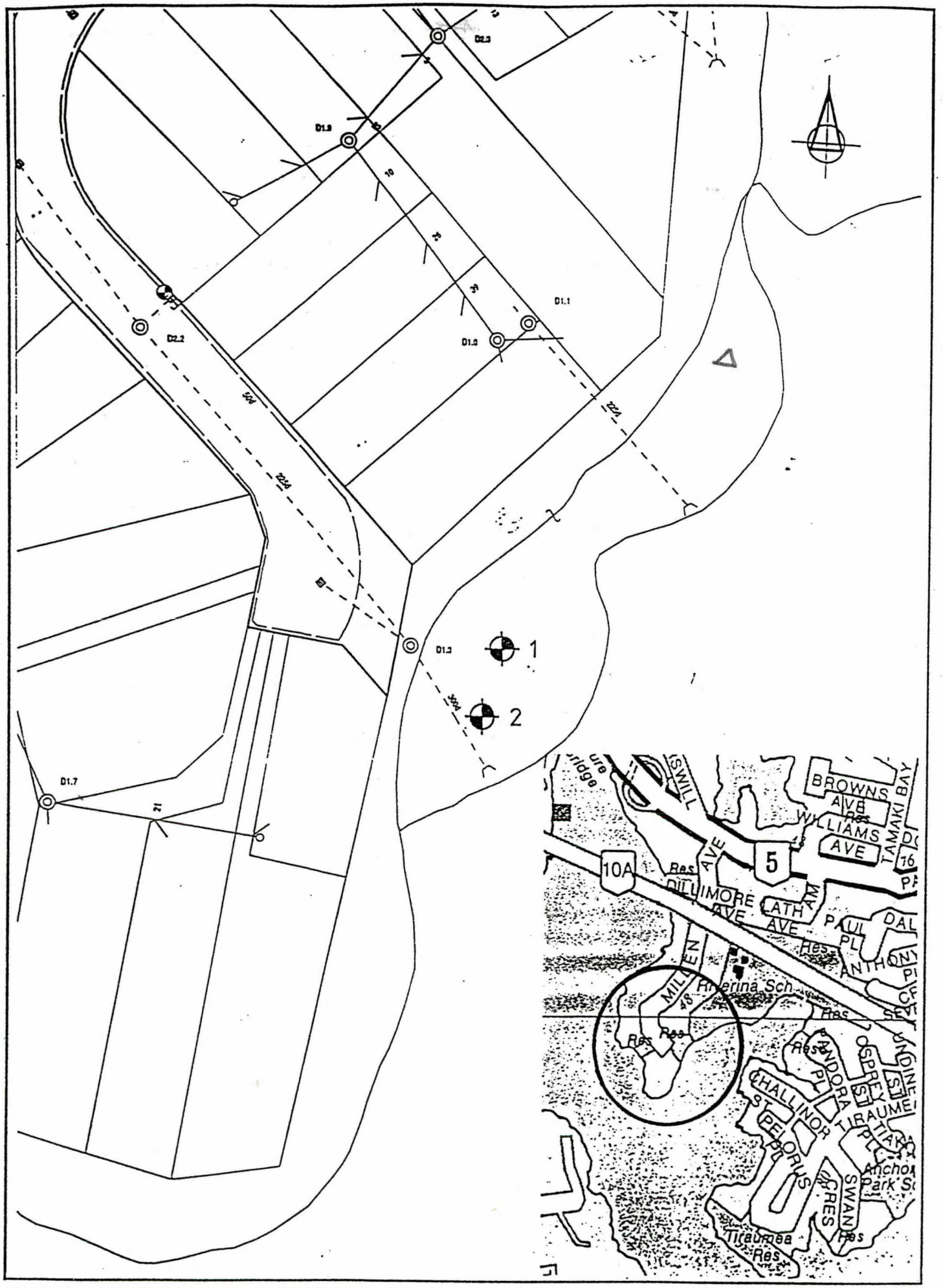
PLAN NO. 22

Blk.	Sh.	TP
03	~~24~~, 75	23c 24a

SO 49492

2760 m²

Δ ✓



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TITLE

MILLEN AVENUE
WATER SAMPLING LOCATIONS

REV CHK

REV.

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
MCC APPROVED		

PLAN NO. 22

Blk.	Sh.	TP
~~03~~	~~86~~	23C 24Q
07	~~02~~ 03	

Pt Lot 1

DP 5?777

5.9273ha

△ ✓

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TITLE

TI RAKAU PARK
WATER SAMPLING LOCATIONS

REV	CHK	DATE

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

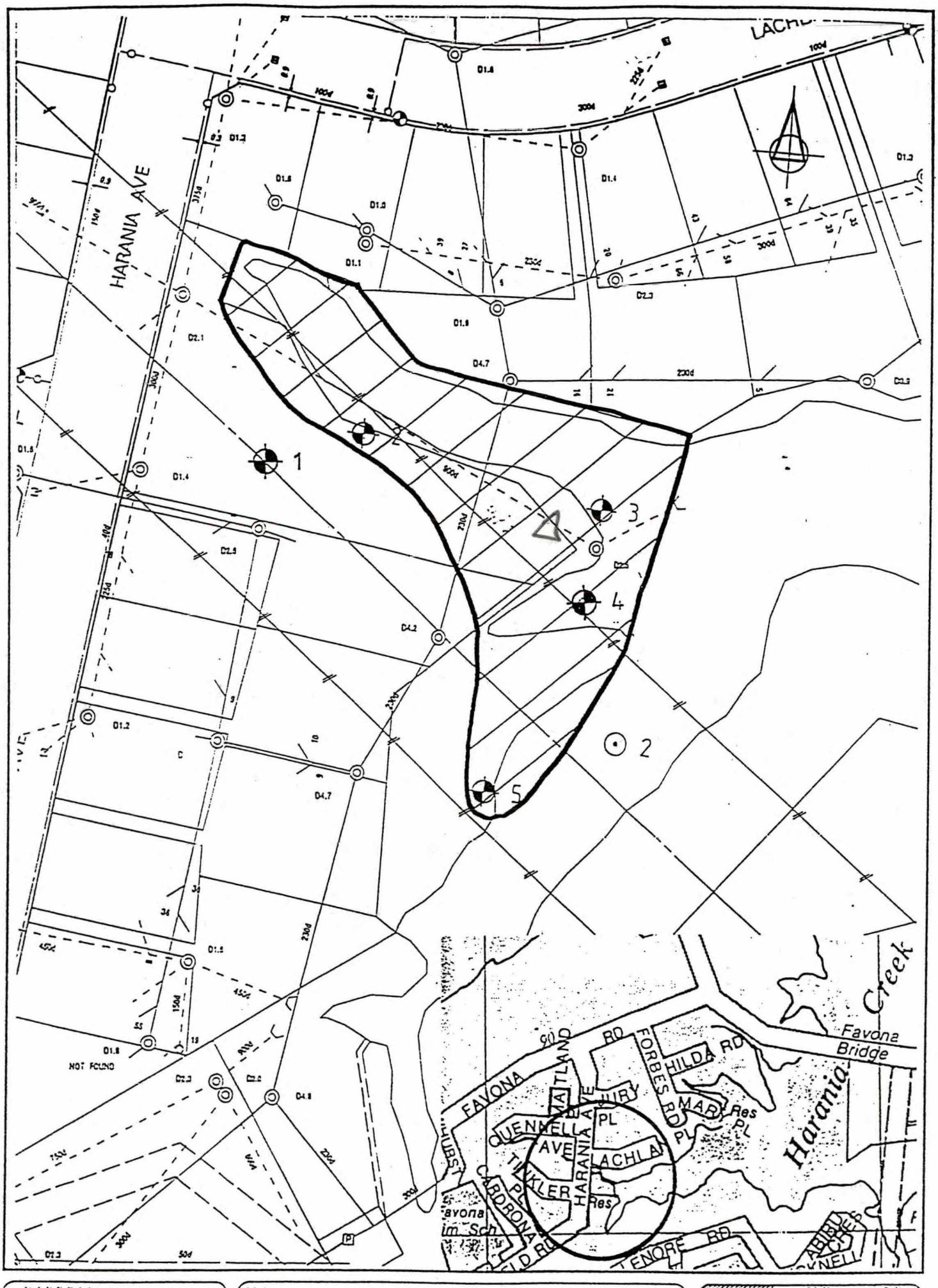
Blk. 03

Sh. ~~10, 11, 22~~, 23

TP 10d, 11b.

Lot 61
DP 61809
2914 m²

Δ ✓



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TITLE

HARANIA AVENUE
WATER SAMPLING LOCATIONS

REV CHK

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

Blk. Pr.

06 72 36b, 36d, 46c

Lot 19

DP 48346

1252 m²

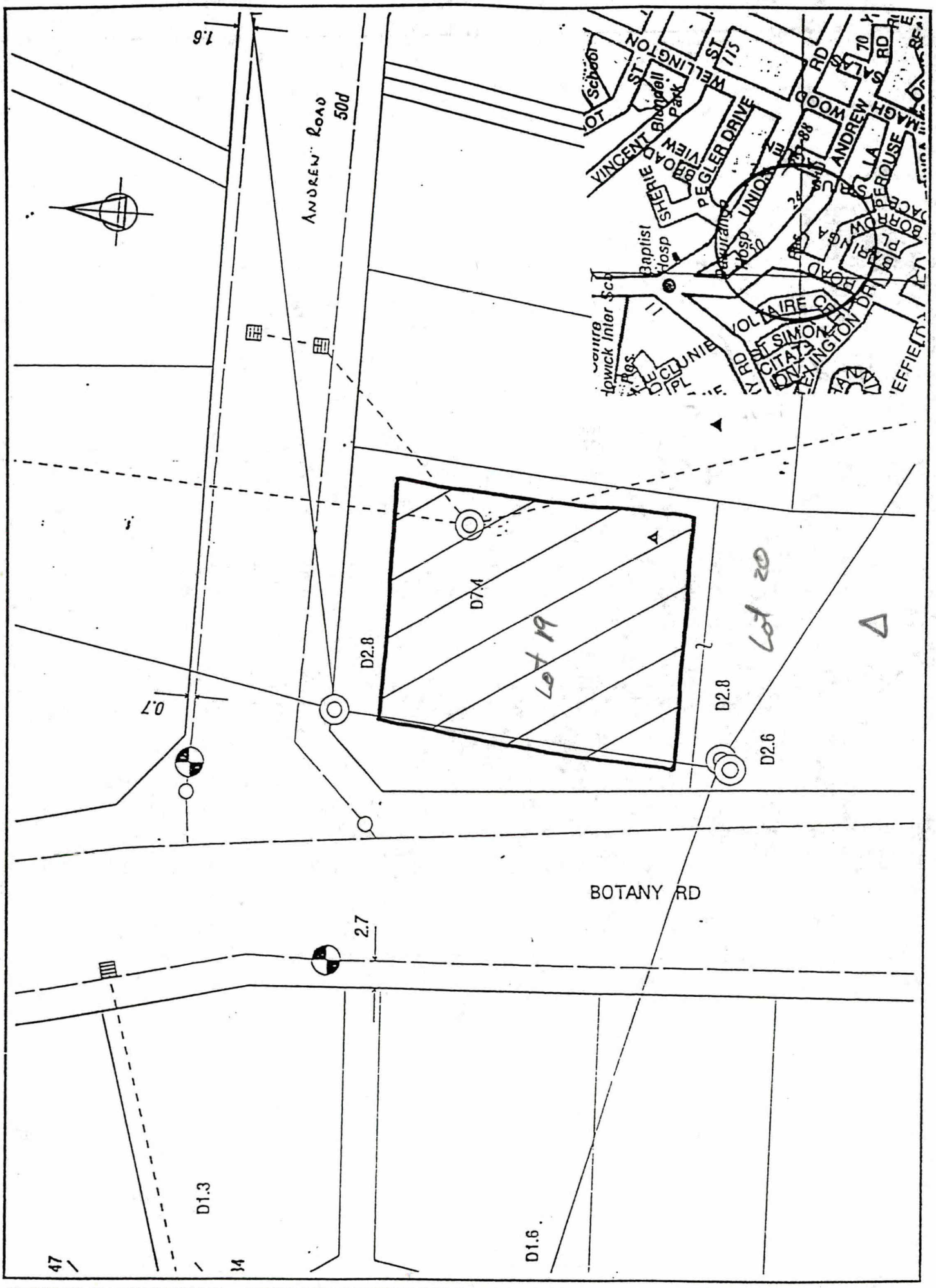
×

Lot 20

DP 48346

1189 m²

△ ✓



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TITLE

BOTANY ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
PLC APPROVED		

REV CHK

REV

PLAN NO. 21

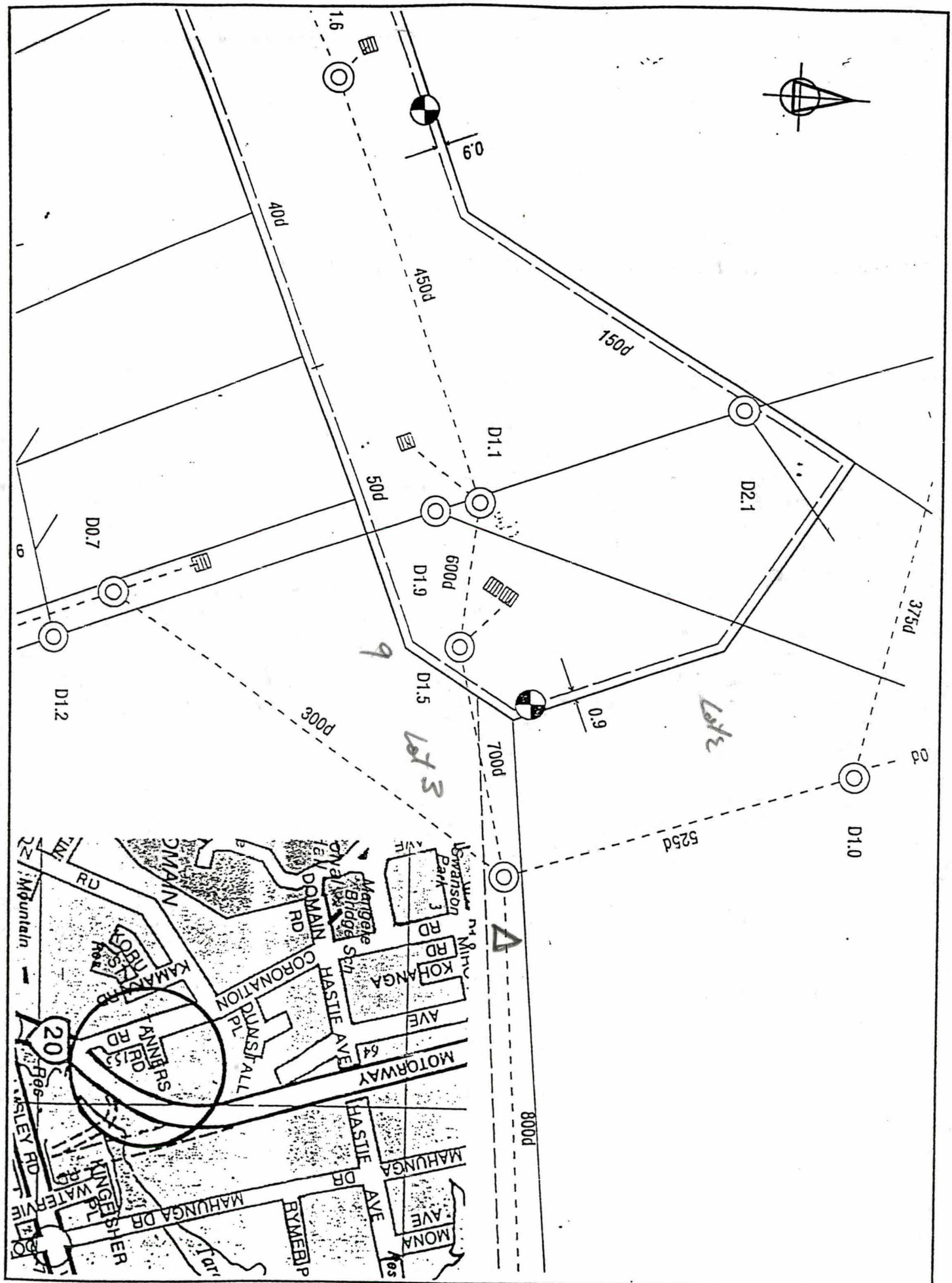
Blk. Sh. TP

01 ~~92~~, 94, ~~95~~ 10c, 11a

not defined.

Lot 3
DP 114450

Lot 2
DP 114450
4.3939 ha



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TITLE

TANNERS ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/11
CHECKED	A. Robinson	02/11
M.C. APPROVED		

REV CHK

REV

BK. SK. TP

01 V 01,02,04 55, 57

~~05~~ 1

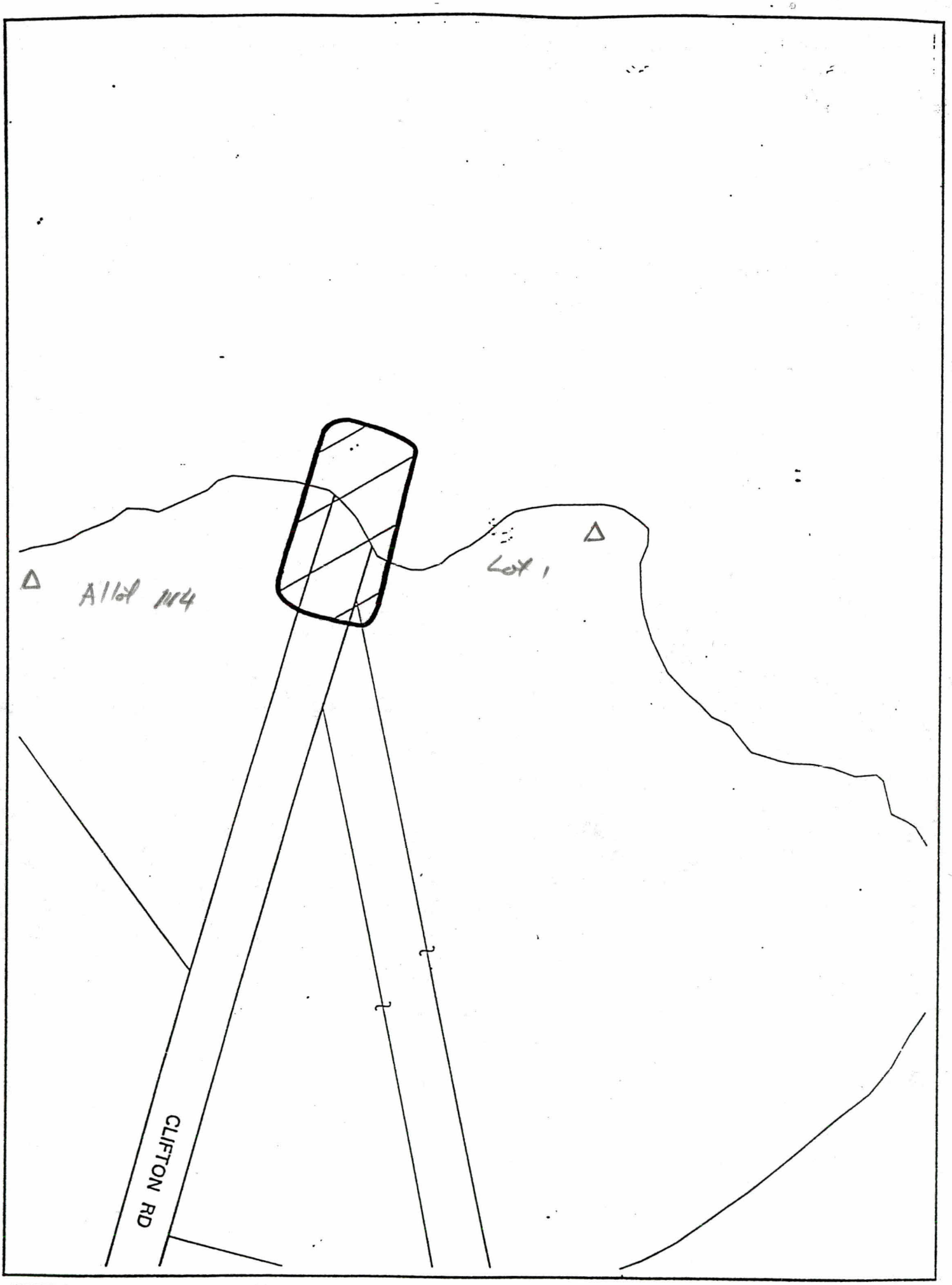
II I

End Rd. – Road Reserve

528 R

Allot 114
SO 45515 Parish of Pakuranga.
1.6946 ha. Δ ✓

Lot 1
DP 16612 Δ ✓
4.5932 ha.



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TITLE

CLIFTON ROAD
WATER SAMPLING LOCATIONS

REV CHK

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

Blk.	Sh.	TP
03	84	166 26a

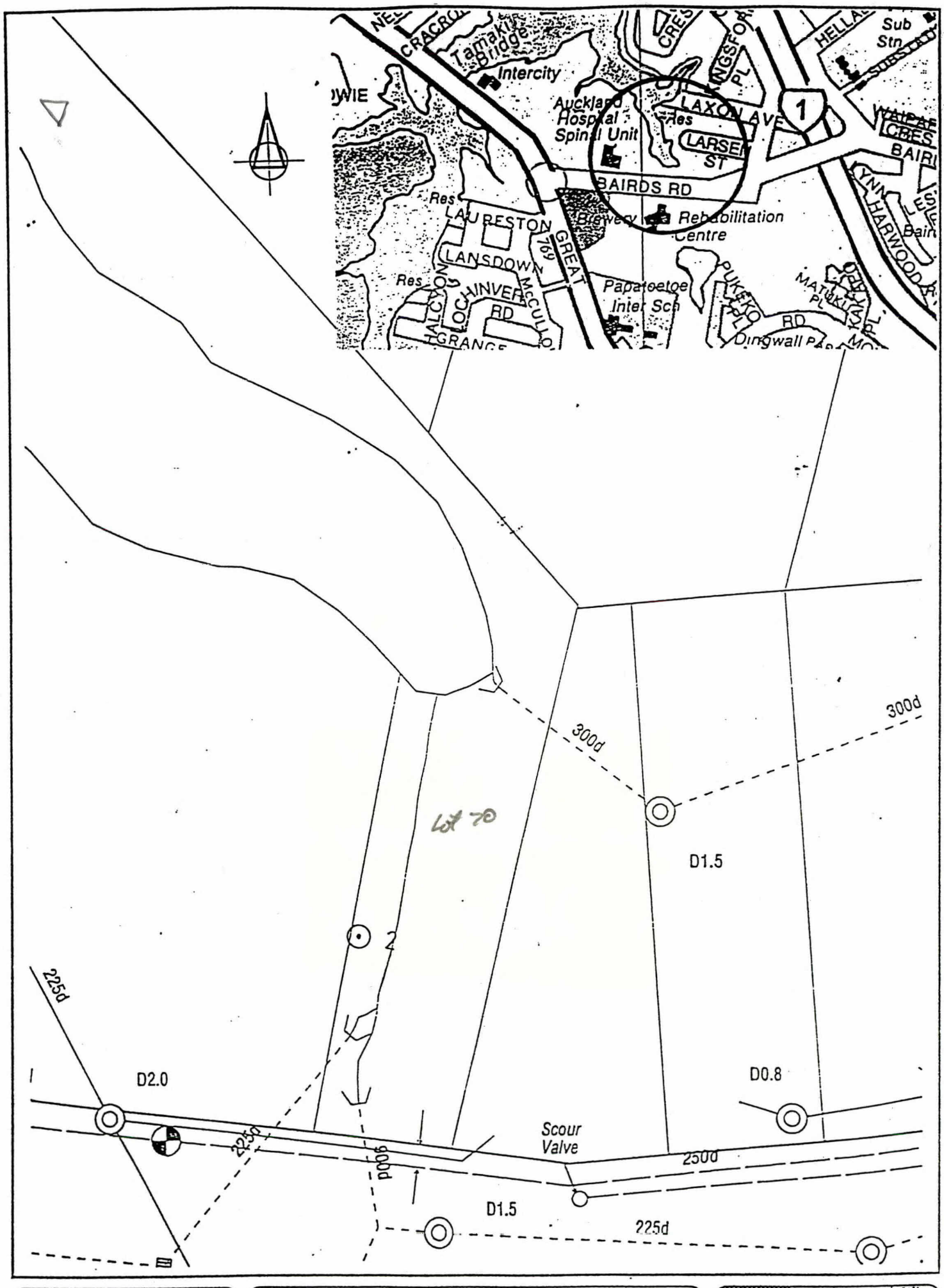
28 R

Lot 70

DP 43950

9384 m²

Δ ✓



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TITLE

BAIRDS ROAD
WATER SAMPLING LOCATIONS

REV CHK

REV

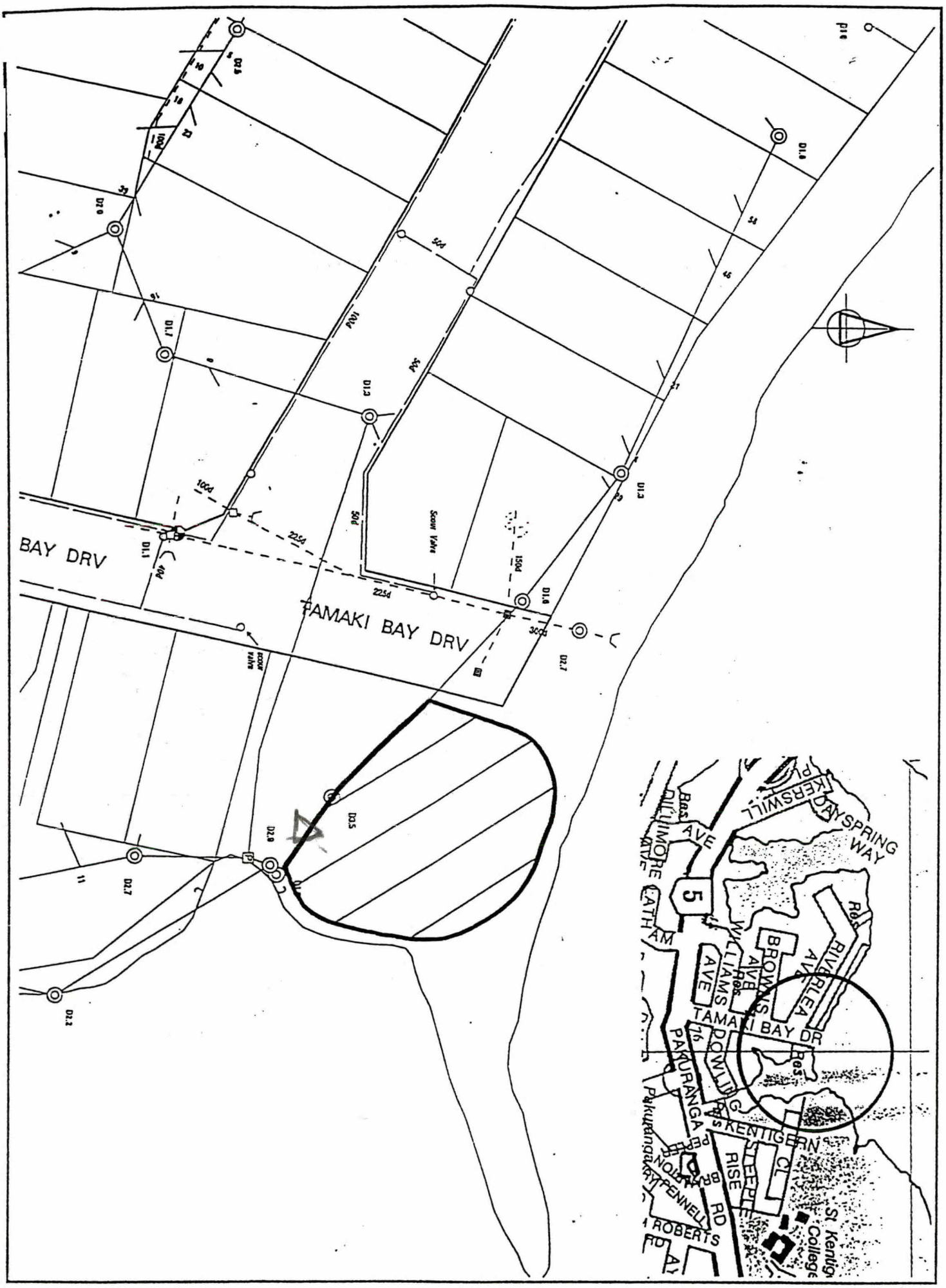
	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Rooney	02/98
M.E. APPROVED		

PLAN NO 25

Blk. Sh. TP
03 85 23C

Lot 84
DP 39000
1.1458 ha.
A ✓

Leigh
3 copies of
Te Kuiti Carpark
Contract for signing.
Thanks
Stuart.



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TITLE

RIVERLEA ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/08
CHECKED	A. Robinson	02/08
M.C. APPROVED		

REV CHK

Blk. 03 Sh. 22 10 d

145 R

On

Lot 9

DP 49029 Δ ✓

961 m² ?

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TITLE

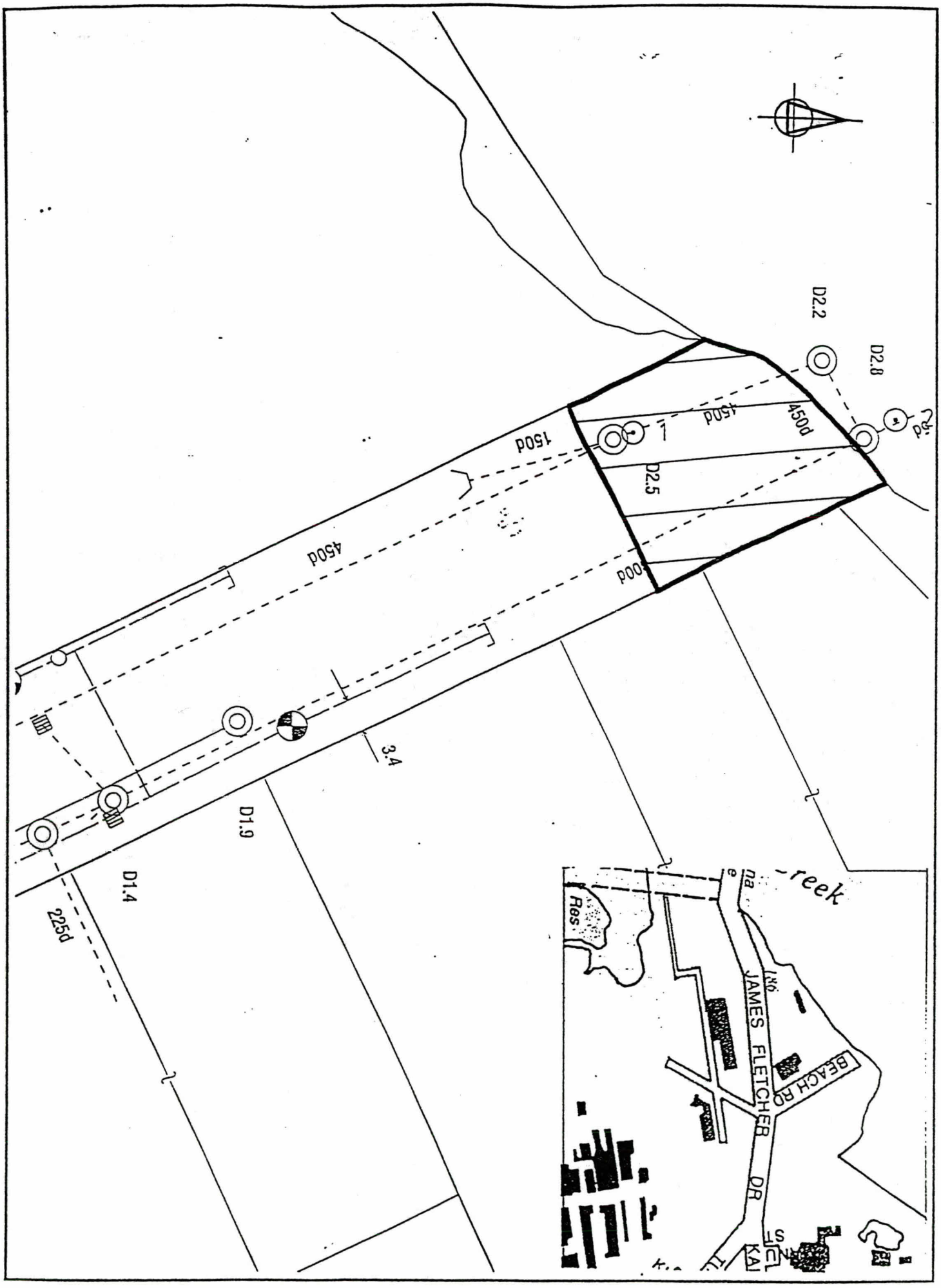
HARANIA INLET
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
MLC APPROVED		

REV CHK

REV

PLAN NO. 24



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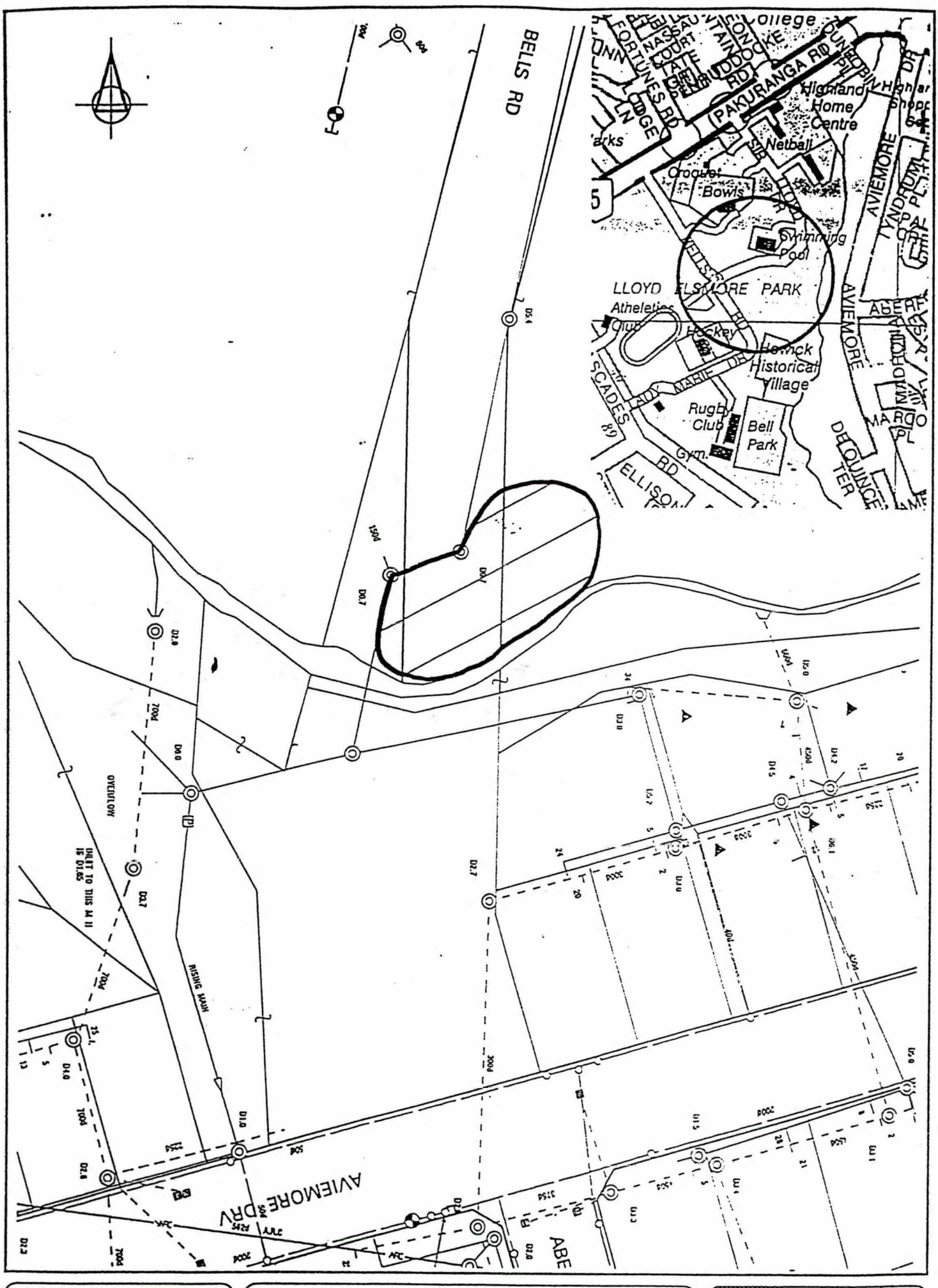
TITLE

BEACH ROAD
WATER SAMPLING LOCATIONS

	SCALE:	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Rahman	02/98
PLC APPROVED		

REV CHK

REV



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TITLE

BELLS ROAD
WATER SAMPLING LOCATIONS

REV CHG

	SCALE	DATE
DRAWN	D Lander	02/98
CHECKED	A Robinson	02/98
M.I. APPROVED		

Blk. Sh. TP

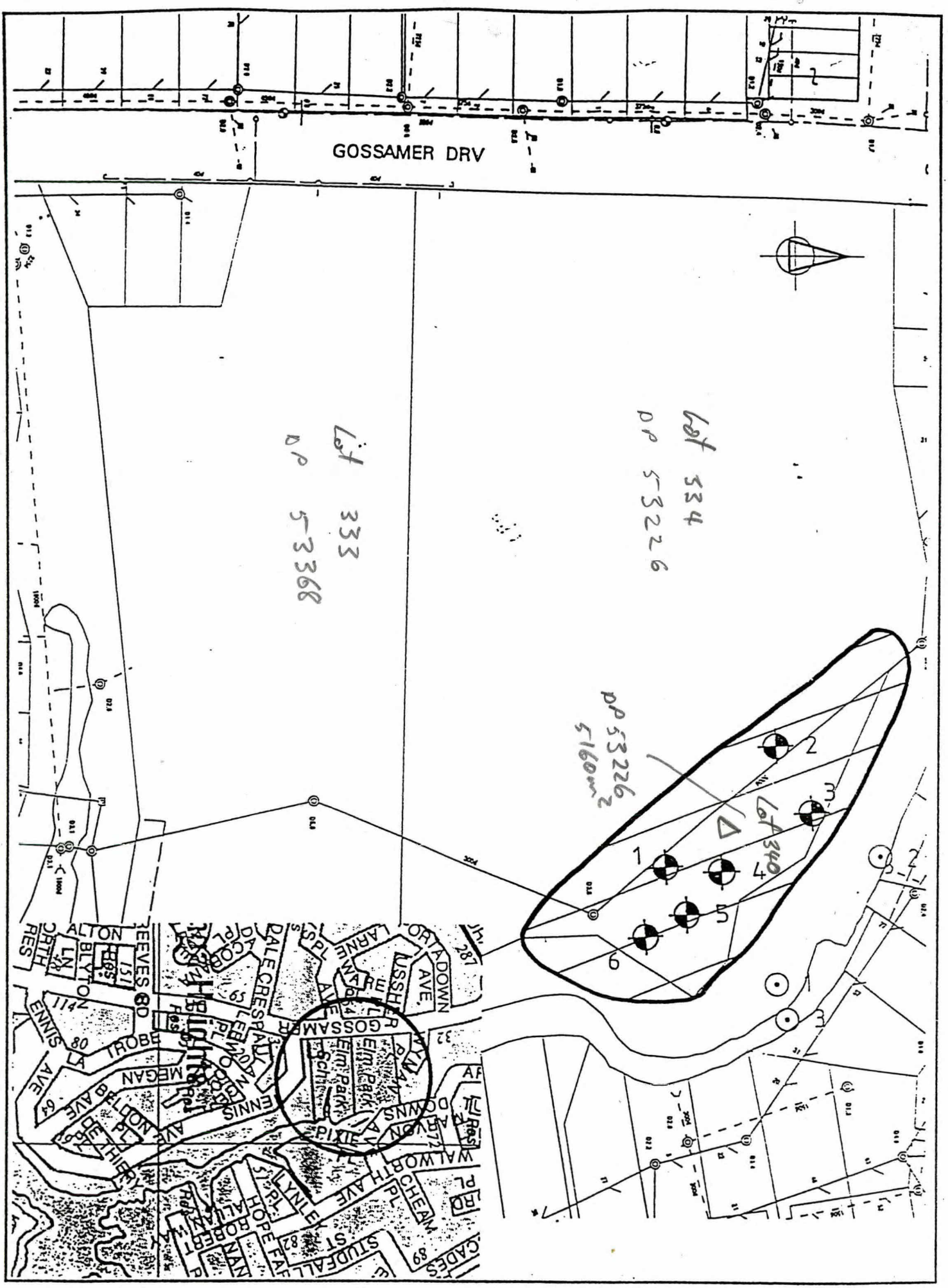
07 ~~13, 14, 15, 16~~ 25 23d, 24b 24d

Lot 340

DP 53 226

5160 m²

Δ ✓



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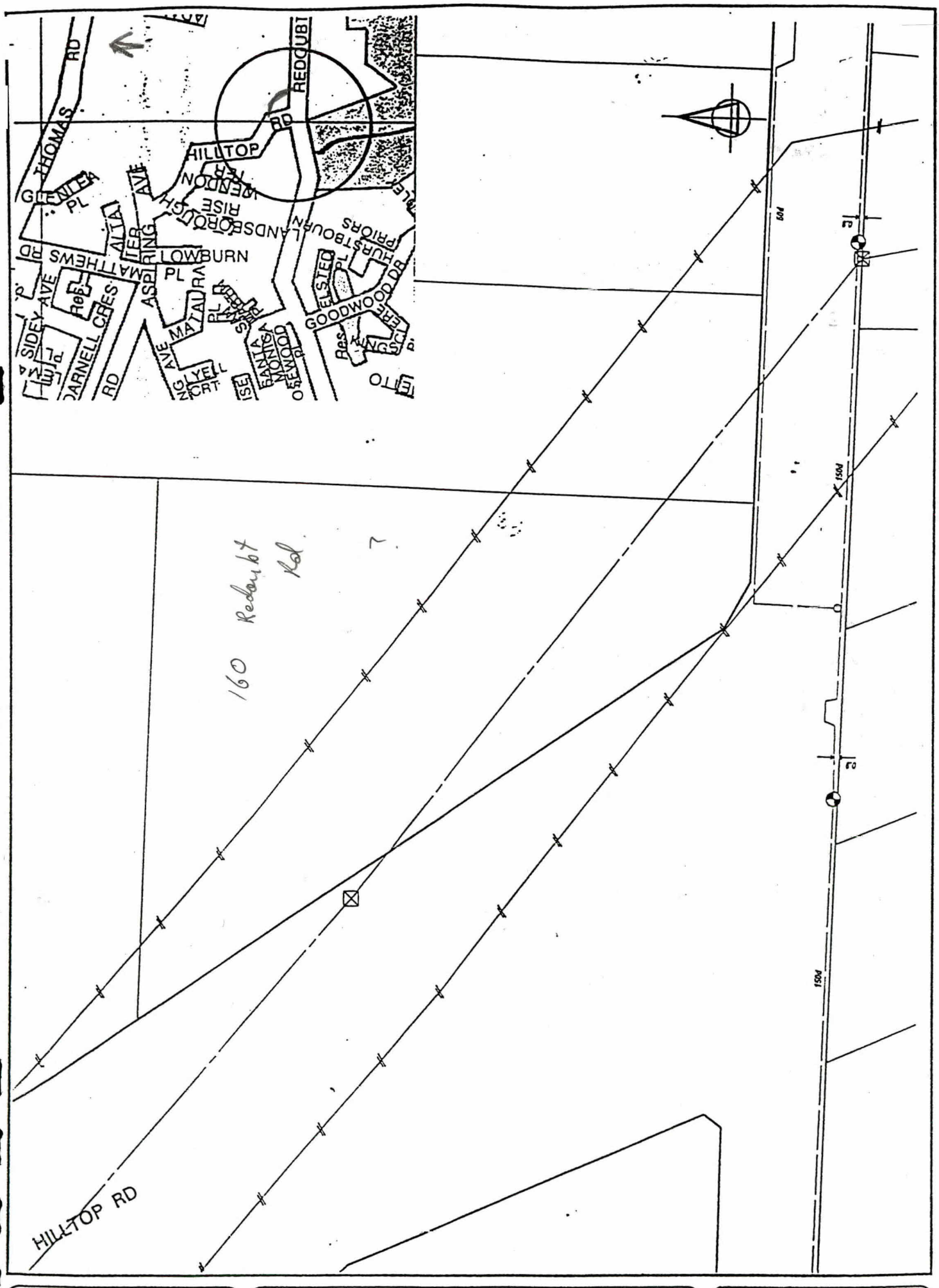
TITLE

ELM PARK
WATER SAMPLING LOCATIONS

	SCALE	DATE
DRAWN	Q. Lander	02/12
CHECKED	A. Robinson	02/12
M.C. APPROVED		

Blk.	Sh.	TP
08	~~41~~, 43	41a

Road Reserve Intersection	?	X
Lot 2 DP 41071 8094 m²		X



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TITLE

HILLTOP ROAD
WATER SAMPLING LOCATIONS

	SIGNED	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

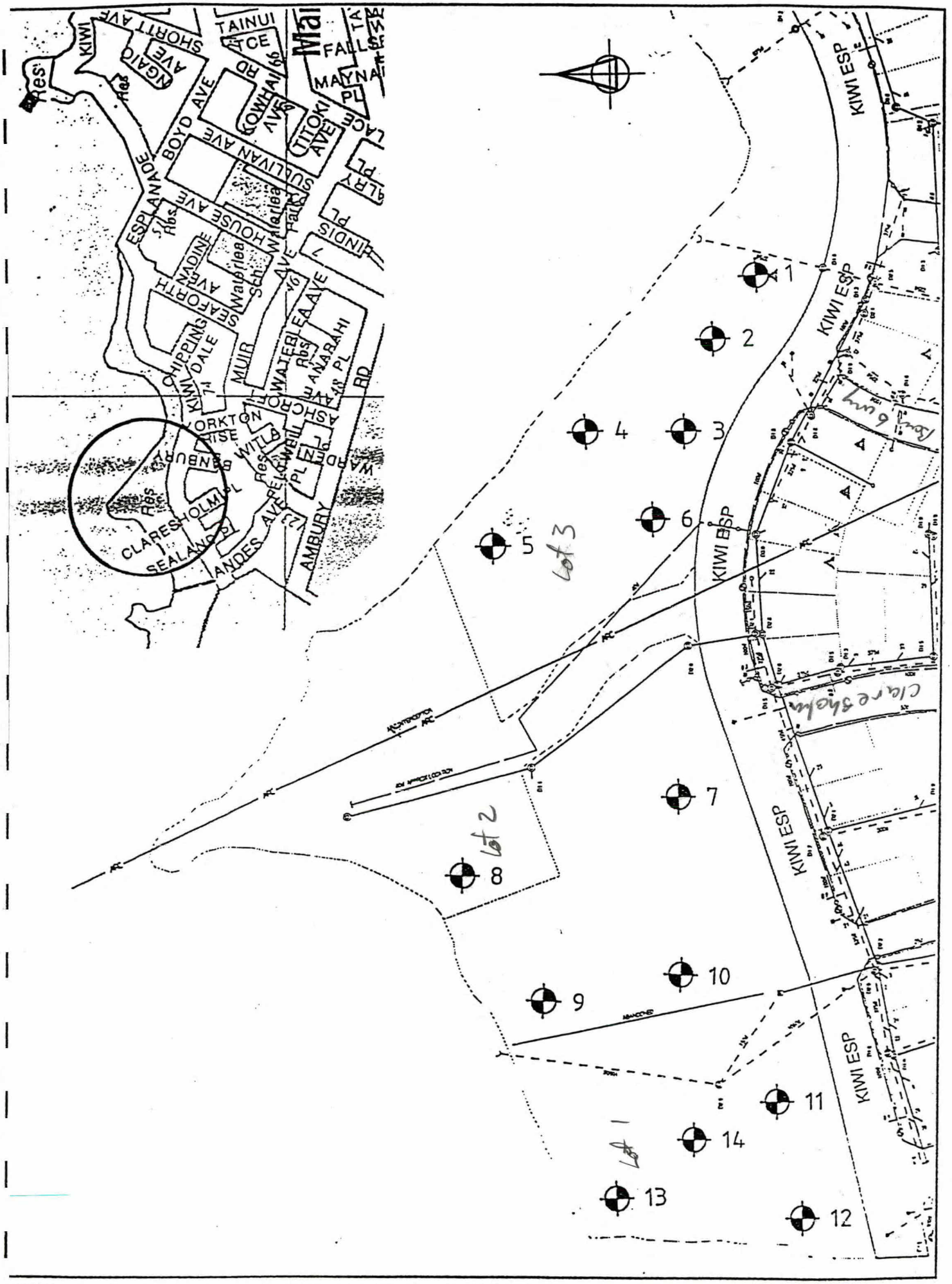
Blk.	Sh.	TP
01	44, ~~56, 57,~~ ~~68, 80~~	59, 56

TOR

Lot 3 DP 77585
2.1112 ha Δ ✓

Lot 2 DP 77585
1.2552 ha. Δ ✓

Lot 1 DP 77585
2.5144 ha. Δ ✓



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TITLE

MANUKAU YACHT CLUB
WATER SAMPLING LOCATIONS

	SCALE	DATE
DRAWN	D. Lander	02/08
CHECKED	A. Roonsar	02/08
M.C. APPROVED		

? Blk Sh.

~~11~~ ~~33~~ 49a

7 89

828

Allot 306

SO 38747

Parish of Pakuranga. ?

435 m² Δ ✓

or is on road reserve.?

38 Omana Pk. PT Lot 2 Δ ✓

04 62 176. DP 34852

39. Allenby Rd.

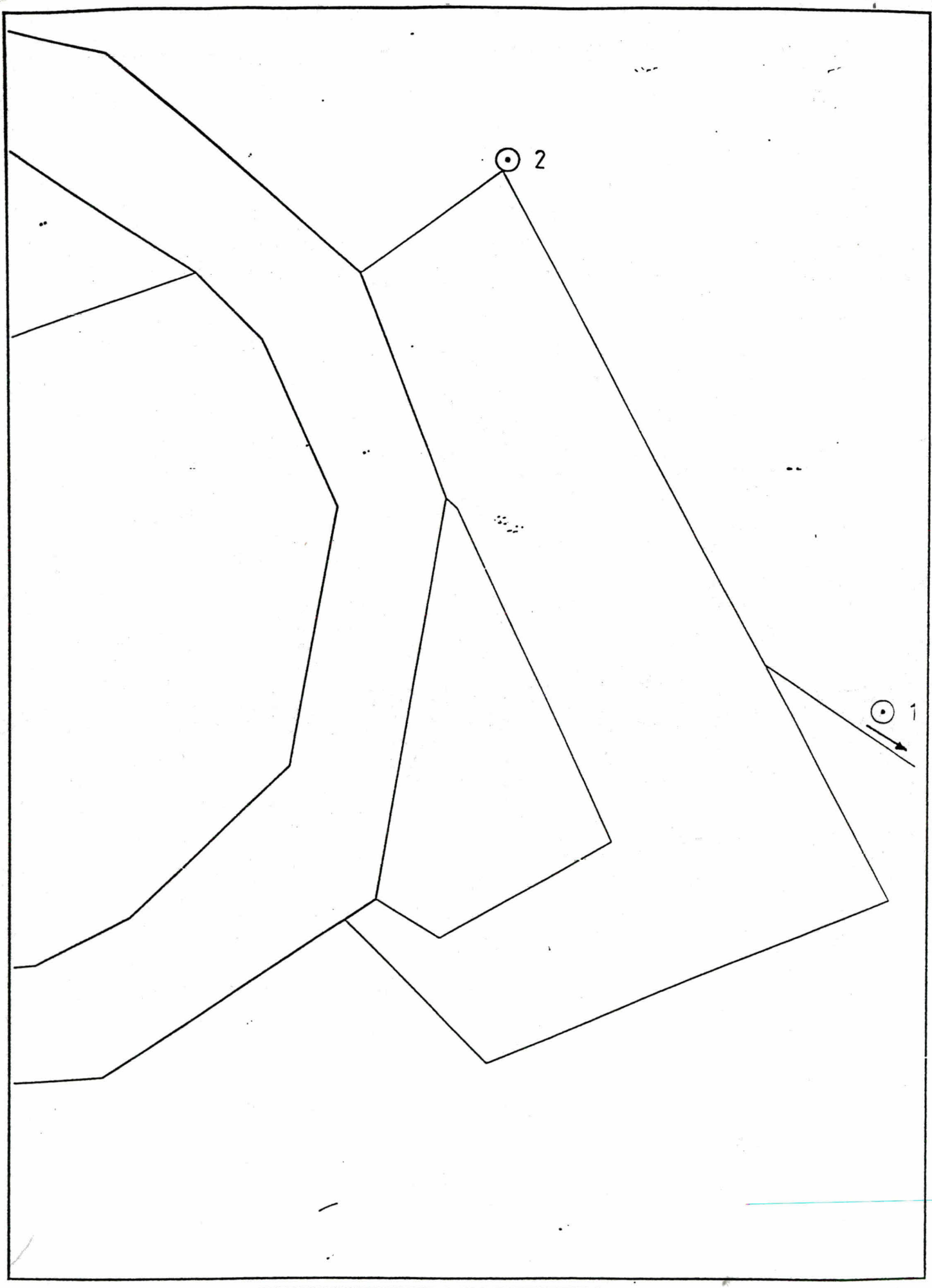
04 89, ~~90~~, 27C

Allot 377

SO 46043 Parish of Manurewa

1.3130 ha Δ ✓

(66)



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TITLE

MOUNGAMOUNGAROA BRIDGE
WATER SAMPLING LOCATIONS

REV CHK

REV. --

	SCALE	DATE
DRAWN	D. Lander	02/98
CHECKED	A. Robinson	02/98
M.C. APPROVED		

PLAN NO. 38

GHD

Appendix B

Chemical Analysis Data for Bore & Surface Water

HILLS RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_3-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N	TOC/ NPOC ppm	DO	pH	EC	salinity	temp	odour	clarity	colour
17-Oct-94	Hills Rd 1		0.33	73	<0.01	<0.02	<0.03	40	9.7	30.3	1.6	62	<0.2	0.02		628	13				14		2.1	6.2	850	500	15	nil	clear	clear
06-Sep-95	Hills Rd 1		0.4	77	<0.01	<0.02	<0.03	3.4	10.3	32.5	1.6	67	<0.2	0.3		74	10				11		2.3	6.81	800	0	16	none	clear	none
19-Dec-95	Hills Rd 1	B	0.66	120	0.007	0.59	0.72	470	72	110	5.9	820	1.2	2.7	250		<0.04	0.095	<0.1		98	450	0.9	6.54	380	2.5	16.5	methane	murky	dk. gry
19-Jan-96	Hills Rd 1	B	0.53	58	0.0003	0.003	0.007	1	51	130	0.24	1000	0.005	0.19	2000		190	0.026	<0.1		1.4	4.3								
01-Apr-96	Hills Rd 1	B			<0.001	0.033	0.027	51			0.38		0.22	0.14			210		0.61			110	0.6	6.71	450	3	20	strong	cloudy	gr. black
25-Oct-96	Hills Rd 1	B	0.9			0.013	0.014	64					0.034	0.061	450		59	0.02	0.033			58	1.3	7.73	280	2	22	strong	cloudy	gr. / blk
12-Feb-98	Hills Rd 1	B	0.75	-	<0.00005	0.004	0.003	-	-	-	0.95	-	0.014	0.035	250	-		0.006	0.02	-	42	56	1.25	6.37	-	1	20.5	slight	s. cloudy	
10-Jun-98	Hills Rd 1	B	0.5	-	<0.0005	0.005	0.006	32	-	-	1.2	-	0.21	0.033	87	-	-	0.002	0.09	-	49	31	1.6	6.15	-	10	17	slight	sl cloudy	lt brown
21-Jul-98	Hills Rd 1	B	0.69	-	<0.0005	0.003	0.005	32	-	-	1.1	-	0.015	0.019	120	-	-	0.02	<0.01	-	50	31	8.1	6.58	-	-	17	slight	clear	clear
13-Sep-95	Hills Rd 1	S	0.42	460	0.063	2.6	2.6	6.3	71	1900	32	1000	4.3	19	-	140	21	-	-		390		0.5							
22-Apr-96	Hills Rd 1	S			<0.001	0.002	0.015	2.9			0.51		0.005	0.016			3.2			3		17								
22-Apr-96	Hills Rd 1	S			<0.001	0.002	0.015	2.9			0.51		0.005	0.016			3.2		3			1.7	1.6	7.13	330	2	16	slight	clear	clear
27-Nov-96	Hills Rd 1	S	0.7			0.004	0.008	31					0.001	0.031	990		19	0.024	0.1				4	6.76	360	2.3	19	none	opaque	brown
25-May-98	Hills Rd 1	S	1.3	-	<0.0005	0.005	0.016	8	-	-	0.6	-	<0.003	0.12	4500	-	-	0.018	0.68	-	0.092	12	3.6	6.5	-	8	17	nil	sl cloudy	silty
22-Jul-98	Hills Rd 1	S	0.59	-	<0.0005	<0.002	0.006	1.1	-	-	0.02	-	<0.003	0.042	310	-	-	0.03	0.04	-	0.04	10	6	6.27	-	11	16	weak	clear	lt gry
19-Oct-98	Hills Rd 1	S	0.665	-	0.00025	0.002	0.0075	2.71	-	-	1.06	-	0.0047	0.06	1900	-	-	0.02	1	-	-	24.3	5.2	6.43	600	55	26	Nil	Opaque	lt orange
17-Oct-94	Hills Rd 2		0.23	18	<0.01	<0.02	<0.03	2.7	<1.3	14	0.5	38	<0.2	<0.01		<2	2.9				10		6.9	6.32	370	0	15.5	ammonia	clear	clear
06-Sep-95	Hills Rd 2		0.2	17	<0.01	<0.02	<0.03	2.2	3.5	12.5	0.3	31	<0.2	<0.01		56	2.1				7.7		8	6.73	300	0	15	pungent	clear	none
19-Dec-95	Hills Rd 2	B	0.32	59	0.003	0.005	0.021	11	13	29	1.7	52	0.016	0.072	45		0.81	0.012	9.5		9.7	36	1.5	6.31	85	0.5	15	methane	clear	lt. gry
19-Jan-96	Hills Rd 2	B	0.46	49	0.0003	0.003	0.011	0.74	42	110	0.24	800	0.007	0.15	1800		<0.04	<0.005	0.6		1.2	5								
01-Apr-96	Hills Rd 2	B			<0.001	0.012	0.009	70			0.62		0.03	0.15			29		<0.003			14	0.9	6.18	130	<1	18	strong	cloudy	gr. black
12-Feb-98	Hills Rd 2	B	0.24	-	0.00519	0.084	0.091	-	-	-	2	-	0.14	0.92	110	-		0.036	<0.01	-	8.4	20	2.1	6.21	-	0.5	19	slight	s. cloudy	silty res.
26-May-98	Hills Rd 2	B	0.23	-	<0.0005	0.003	0.006	55	-	-	2.6	-	0.008	0.075	44	-	-	0.012	<0.01	-	15	20	1.9	6.9	-	0.6	18	nil	sl cloudy	sl silty
21-Jul-98	Hills Rd 2	B	0.23	-	0.0011	0.12	0.16	110	-	-	4.7	-	0.12	0.56	18	-	-	0.04	0.05	-	2	23	4.5	6.09	-	-	17	slight	sl cloudy	lt gry
16-Oct-98	Hills Rd 2	B	0.12	-	0.00074	0.0087	0.0134	52.6	-	-	2.82	-	0.0376	0.163	45	-	-	0.01	0.2	-	-	28.8	3.8	6.15	55	3	21	Nil	Opaque	Opaque
17-Oct-94	Hills Rd 3		0.36	23	<0.01	<0.02	<0.03	6.7	5	17.5	0.5	48	<0.2	<0.01		63	6.5				14		6.7	6.15	450	100	15	nil	clear	clear
19-Dec-95	Hills Rd 3	B	1.1	66	0.002	0.18	0.15	150	54	86	3.7	210	0.21	0.8	320		<0.04	7.7	<0.1		130	180	1.3	6.35	180	1.5	18	nil	v.cloudy	dk. gry
19-Jan-96	Hills Rd 3	B	0.46	49	0.0003	0.004	0.035	1.4	43	100	0.25	780	0.006	0.17	1700		200	0.01	0.2		1	4.7								
01-Apr-96	Hills Rd 3	B			0.004	0.17	0.17	160			2.9		0.21	0.69			300		0.039			180	0.5	6.69	475	3	18	strong	cloudy	gr. black
26-Jun-98	Hills Rd 3	B	0.55	-	<0.0005	0.04	0.038	53	-	-	3.1	-	0.03	0.21	96	-	-	<0.001	<0.01	-	50	33	2.5	6.2	-	10	18	slight	sl cloudy	blackish
21-Jul-98	Hills Rd 3	B	0.07	-	0.0006	0.007	0.003	44	-	-	2.7	-	0.014	0.076	45	-	-	<0.01	0.02	-	3.6	12	2.26	6.26	-	-	17	slight	opaque	blkish
16-Oct-98	Hills Rd 3	B	0.238	-	0.00272	0.0944	0.161	130	-	-	4.17	-	0.173	0.545	65 ; 65	-	-	<0.01	0.5	-	-	81.1	1.8	5.96	60	3	20	slight	Opaque	Dk grey
17-Oct-94	Hills Rd 4		<0.07	8.9	<0.01	<0.02	<0.03	1.8	<1.3	5.7	0.1	22	<0.2	<0.01		20	<0.04				2.3		10.8	6.59	198	0	17	nil	clear	clear
17-Feb-95	Hills Rd 4		1.5	125	<0.01	0.04	<0.03	0.73	117	377	0.33	3557	<0.2	0.03		56	0.31				1.2		15	8.13	58	0	23.5	fishy	fair	v lt grey
19-Dec-95	Hills Rd 4	B	2.7	86	0.001	0.11	0.11	110	16	75	1.2	200	0.13	1	140		<0.04	4.2	<0.1		28	130	1.3	6.57	160	1	17.5	methane	v.cloudy	dk. grn. gry
01-Apr-96	Hills Rd 4	B			<0.001	0.017	0.015	49			0.72		0.024	0.13			64		0.018			56	0.6	6.4	200	1	18	slight	cloudy	gr. black
12-Feb-98	Hills Rd 4	B	2.4	-	<0.00005	0.044	0.044	-	-	-	0.84	-	0.0032	0.16	210	-		0.03	0.01	-	17	59	1	6.42	-	1	19	slight	cloudy	dk gry
22-Jul-98	Hills Rd 4	B	1.7	-	0.0008	0.022	0.022	48	-	-	2.7	-	0.02	0.13	3	-	-	0.01	0.01	-	4.8	38	4.6	6.4	-	9	16	slight	sl cloudy	lt gry
17-Oct-98	Hills Rd 4	B	0.477	-	0.00008	0.0028	0.004	33	-	-	1.28	-	0.011	0.018	60	-	-	<0.01 ; <	1	-	-	78	2.8	6.34	130	5	19	organic	Opaque	Lt grey
17-Oct-94	Hills Rd 5		<0.07	11	<0.01	<0.02	<0.03	2.8	<1.3	6.3	0.2	22	<0.2	0.1		219	<0.04				2.6		10.8	6.82	190	0	16	nil	clear	clear
17-Feb-95	Hills Rd 5		1.4	111	<0.01	0.03	<0.03	1.1	102	329	0.32	2992	<0.2	0.05		174	0.54				1.6		16	8.39	660	0	25	fishy	fair	v lt grey
17-Feb-98	Hills Rd 5	S	1.3	-	0.00081	0.014	0.023	-	-	-	0.72	-	0.014	0.11	3700	-	-	0.002	0.03	-	<0.02	23	0.85	7.04	-	8	24	strong	cloudy	gry/blk
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
													0.005	*0.05*																

WHITFORD PARK

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
10-Feb-98	Whitford	S	1.8	-	0.0003	0.002	0.004	-	-	-	1.5	-	<0.001	0.01	8100 ; 81	-	-	0.003	0.02	-	0.20 , 0.1	-	2.9	6.95	2500	12.5	24	mod stg.	sl cldy	sl oil shn
17-Oct-94	Whitford 1		0	o.9	<0.01	<0.01	<0.03	0.6	<1.3	2.5	0.07	11.2	<0.2	0.01		76	<0.04				0.93		8.6	6.07	100	0	13	nil	clear	clear
17-Feb-95	Whitford 1		0.1	7.8	<0.01	<0.01	<0.03	2.1	3.2	4.5	0.03	20.5	<0.2	0.06		86	0.16				38		8	7.11	610	0	19	nil	clear	clear
29-Mar-96	Whitford 1	B			<0.001	0.043	0.049	36			6.4		0.12	0.75			0.008		1.3			8	0.7	6.51	300	2	20	slight	opaque	gr. / blk.
28-Jul-96	Whitford 1	B	0.23	-	<0.0005	<0.0005	0.021	7.7	-	-	0.62	-	0.006	0.18	77	-	-	<0.01	0.35	-	0.15	5	3.5	6.21	60	4	17	Nil	Opaque	lgt gry
11-Oct-96	Whitford 1	B	0.5			0.042	0.067	48					0.11	0.83	710		3.6	<0.005	0.03				1.6	6.78	199		17	mod.	cloudy	grey
10-Feb-98	Whitford 1	B	0.76	-	0.00216	0.02	0.064	-	-	-	2.3	-	0.066	0.79	940	-	-	0.003 ; 0.	0.02	-	4.9	-	6.2	6.79	330	2	23.5	sl. Leach	cldy, gry	-
14-May-98	Whitford 1	B	0.86	-	0.0005	0.011	0.041	32	-	-	3.1	-	0.029	0.39	810	-	-	<0.001	<0.01	-	4.4	11	-	6.44	329	2	-	slight	sl cloudy	silty
20-Oct-98	Whitford 1	B	0.288	-	0.00053	0.0051	0.027	13.3	-	-	1.69	-	0.0189	0.196	270	-	-	0.05	0.2	-	-	22.1	3.8	6.63	110	5	21	organic	Opaque	Lt grey
17-Oct-94	Whitford 2		<0.01	1.9	<0.01	<0.01	<0.03	1.6	<1.3	3	0.1	14.5	<0.2	0.01		342	<0.04				1.1		9	6.3	103	0	13	nil	clear	clear
17-Oct-94	Whitford 3		0.12	22.2	<0.01	<0.01	<0.03	0.8	4.2	13.5	0.5	46.2	<0.2	0.01		132	< 0.04				0.74		4.5	6.41	350	0	13	nil	clear	clear
19-Dec-95	Whitford 3	B	0.85	140	0.001	0.019	0.059	30	40	78	6.6	560	0.19	0.77	1000		<0.04	<0.005	9.6		5.2	31	1.85	6.95	590	3.9	16.5	nil	cloudy	grn .gry
29-Mar-96	Whitford 3	B			<0.001	0.011	0.027	31			5.1		0.089	0.25			0.017		4.9			9.4	1.75	6.62	380	2	20	slight	opaque	gr. / blk.
11-Oct-96	Whitford 3	B	0.5			0.026	0.031	62					0.13	0.17	790		5	0.014	0.13				1.5	6.77	323		16	mod.	cloudy	gr. brown
05-Feb-98	Whitford 3	B	0.7	-	0.00038	0.027	0.076	-	-	-	3	-	1.18	0.64	590	-	-	0.008	0.02	-	5.5	-	5	6.8 ; 6.7	185	1	23	slight	cldy, silty	-
14-May-98	Whitford 3	B	0.495	-	<0.0005	0.0105	0.03	52.5	-	-	3.4	-	0.0825	0.34	580	-	-	0.017	0.02	-	3.9	9	-	6.5	257	1	-	nil	sl cloudy	silty
28-Jul-98	Whitford 3	B	0.32	-	0.0005	0.0005	0.037	31	-	-	2.1	-	0.013	0.073	210	-	-	<0.01	0.03	-	1.8	7	2.9	6.41	100	5	18	Weak	sl cldy	lgt gry
20-Oct-98	Whitford 3	B	0.297	-	0.00017	0.0012	0.0076	34.5	-	-	2.37	-	0.0124	0.051	305	-	-	0.04	0.3	-	-	29.2	3.2	6.48	118	6	22	organic	Opaque	Lt orange
17-Oct-94	Whitford 4		0.06	13.1	<0.01	<0.01	<0.03	1.4	3.2	10	0.17	43.2	< 0.2	0.01		48	< 0.04				0.76		9.7	6.75	290	0	13	nil	clear	clear
17-Oct-94	Whitford 5		0.07	11.6	<0.01	<0.01	<0.03	3	3.7	11.1	0.12	61.2	< 0.2	0.01		260	< 0.04				0.76		9.7	6.75	390	0	14	nil	clear	clear
17-Feb-95	Whitford 5		3.1	318	<0.1	0.14	<0.3	4.3	280	950	2.4	7790	< 2	< 0.1		126	0.23				0.8		6.6	6.73	420	0	23	nil	clear	clear
19-Dec-95	Whitford 5	B	0.56	87	0.011	0.17	0.3	380	34	77	15	290	0.28	20	380		< 0.04	< 0.005	< 0.1		24	160	0.35	6.63	191	1	18 8	nil	cloudy	blk. gry
29-Mar-96	Whitford 5	B			<0.001	0.013	0.024	29			6.3		0.034	1.4			1.1		0.03			6.4	1.4	6.43	115	<1	20	slight	opaque	gr. / blk.
11-Oct-96	Whitford 5	B	0.3			0.013	0.021	64					0.043	1.1	97		3.2	0.011	0.22				1.6	6.72	93		17	mod.	cloudy	grey
05-Feb-98	Whitford 5	B	0.38	-	0.00062	0.004	0.009	-	-	-	2.1	-	0.018	0.49	140	-	-	0.002	0.01	-	2.5	-	4.1	6.7	95	0.5	24	sl. Leach	cloudy	-
14-May-98	Whitford 5	B	0.25	-	0.0013	0.005	0.023	57	-	-	2.9	-	0.053	1.2	130	-	-	0.03	< 0.01	-	1.2	8	-	6.4	84	0.4	-	nil	sl cloudy	silty
20-Oct-98	Whitford 5	B	0.197	-	0.00066	0.0024	0.0112	40.6	-	-	3.44	-	0.0152	0.353	280	-	-	<0.01	0.1	-	-	32	4.2	6.39	70	4	23	organic	Opaque	Lt orange
28-Jul-00	Whitford 5	B	0.16	-	0.0006	0.007	0.007	24	-	-	2.4	-	0.006	0.27	77	-	-	<0.01	<0.01	-	0.58	6	2.7	6.15	50	4	16.5	Weak	sl cldy	lgt gry
17-Oct-94	Whitford 6		0.02	6.6	<0.01	<0.01	<0.03	1.6	<1.3	5.5	0.04	29.7	< 0.2	0.01		199	< 0.04				0.83		10.4	6.88	220	0	14.5	nil	clear	clear
17-Feb-95	Whitford 6		3.9	367	<0.1	0.23	<0.3	1.2	346	1164	0.38	9661	< 2	0.12		62	0.35				0.7		12	7.4	500	1000	25	nil	clear	clear
19-Dec-95	Whitford 6	B	0.27	32	0.003	0.087	0.25	180	24	31	8.2	30	0.23	1.5	20		0.84	0.011	<0.1		2.4	30	2.3	6.77	240	1.5	20.7	slight	cloudy	grn. gry
01-Apr-96	Whitford 6	B			<0.001	0.03	0.044	48			3		0.085	0.25			0.059		0.15			3.5	5.4	5.87	45	<1	18	slight	opaque	or. / br.
11-Oct-96	Whitford 6	B	<0.1			0.018	0.025	25					0.066	0.15	20		< 0.01	< 0.005	0.6				4.4	6.4	19		18	slight	cloudy	lt. brown
11-Feb-98	Whitford 6	B	0.26	-	0.00045	0.044	0.04	-	-	-	2.1	-	0.015	0.26	89	-	-	0.002	0.01	-	0.36	-	4.2	6.32	60	0	23.5	Nil	cloudy	-
21-May-98	Whitford 6	B	0.1	-	<0.0005	0.008	0.022	65	-	-	3.4	-	0.041	0.46	160	-	-	<0.001	<0.01	-	0.22	9	3.5	6.05	90	0.5	19	nil	sl cloudy	orange
21-Oct-98	Whitford 6	B	0.059	-	0.00069	0.0086	0.0318	26.4	-	-	0.847	-	0.031	0.277	30	-	-	<0.01	0.3	-	-	10.4	4.2	5.89	25	3	20	Nil	Opaque	Lt orange
29-Jul-00	Whitford 6	B	0.05	-	0.005	0.005	0.029	25	-	-	0.8	-	0.04	0.26	20	-	-	<0.01	<0.01	-	<0.01	4	2.9	6.29	25	4	17	Nil	sl cldy	lgt orge
17-Oct-94	Whitford 7		0.14	25.7	<0.01	<0.01	<0.03	19.2	4.8	15.7	0.9	76.2	< 0.2	0.01		165	< 0.04				0.28		2.5	6.33	530	100	15	nil	light rust	light rust
19-Dec-95	Whitford 7	B	0.61	110	0.006	0.29	0.26	200	24	57	12	190	0.87	6.7	250		<0.04	<0.005	<0.1		4.9	69	5.1	7.13	24	0	17.5	nil	cloudy	brown
11-Oct-96	Whitford 7	B	0.7			0.24	0.22	260					0.79	6	120		2	0.016	0.019				0.2	6.76	89		18	mod.	cloudy	gr. / blck
10-Feb-98	Whitford 7	B	0.48	-	0.00164	0.042	0.061	-	-	-	1.1	-	0.18	1.9	300	-	-	0.005	0.03	-	3.5	-	4.5	6.71	135	0.5	22	sl. Sulphs	cl, silty re	-
21-May-98	Whitford 7	B	0.34	-	0.0031	0.1	0.14	106	-	-	2.7	-	0.43	3.3	190	-	-	0.003	0.02	-	2.5	10	2.05	6.57	110	0.6	17	oily	sl cloudy	blackish
29-Jul-98	Whitford 7	B	0.11	-	0.0008	0.007	0.016	14	-	-	0.95	-	0.024	0.33	42	-	-	<0.01	<0.01	-	0.15	6	2.35	6.25	40	3	16	Nil	clear	clear
21-Oct-98	Whitford 7	B	0.164	-	0.00099	0.0119	0.0232	39.2	-	-	2.16	-	0.0555	0.608	85	-	-	0.01	0.4	-	-	14.1	3.8	6.56	60	4	20	slight	Opaque	Lt orange
13-Sep-95	Whitford 7	S	0.33	56	0.0035	0.11	0.11	330	16	35	2.4	110	0.13	1.6	-	30	0.25	-	-		5			0.5						
18-Apr-96	Whitford 7	S			<0.001	<0.001	0.018	0.5			0.27		0.005	0.04			0.12			0.015			3.7							
18-Apr-96	Whitford 7	S			<0.001	<0.001	0.018	0.5			0.27		0.005	0.04			0.12		0.015			3.7	1.7	6.8	2450	16	19	strong	clear	or. / br
18-Apr-96	Whitford 7	S	0.2			0.003	0.002	27					<0.001	0.01	320		0.35	<0.005	0.027				1.9	6.67	132.3		17.5	mod.	sl. cloudy	lt. brown
21-May-98	Whitford 7	S	0.52	-	<0.0005	<0.002	0.004	22	-	-	1.9	-	<0.003	0.024	1100	-	-	<0.001	<.001	-	<0.02	10	1.8	6.62	420	2	16	nil	sl.cloudy	sl or/br
29-Jul-98	Whitford 7	S	0.19	-	<0.005	0.002	<0.002	17	-	-	1.1	-	<0.003	<0.005	280	-	-	<0.01	<0.01	-	0.02	11	1.5	6.48	90	5	16	Weak	sl cldy	lgt orge s
20-Oct-98	Whitford 7	S	0.212	-	0.00012	0.0012	0.0018	32.8	-	-	1.65	-	0.002	0.012	265	-	-	<0.01	0.1	-	-	23.6	1.1	6.18	110	60	21	Nil	Opaque	Lt orange

17-Oct-94	Whitford 8		0.23	113.7	<0.01	<0.01	<0.03	0.7	9.7	38.3	0.22	100	<0.2	0.01		43	<0.04				1.5		4.2	6.38	800	500	15	nil	clear	clear
17-Oct-94	Whitford 9		<0.1	8.9	<0.01	<0.01	<0.03	2.4	1.7	9.8	0.05	68	<0.2	0.01		84	<0.04				0.97		10.8	6.8	400	0	15	nil	clear	clear
17-Feb-95	Whitford 9		4	375	<0.1	0.27	<0.3	1.8	352	1187	0.44	9891	<2	<0.1		202	0.41				0.8		9.8	7.32	600	1000	25	nil	clear	clear
29-Mar-96	Whitford 10	B			<0.001	0.019	0.047	78			3.7		0.19	0.33			0.023		1.1			19	2.1	6.29	190	1	22	slight	opaque	gr. / br.
10-Oct-96	Whitford 10	B	0.1			0.018	0.041	150					0.069	0.2	440		2	0.005	0.033									mod.	cloudy	grey
13-Feb-98	Whitford 10	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-May-98	Whitford 10	B	0.27	-	0.001	0.01	0.046	86		-	3.3	-	0.12	0.18	870	-	-	0.004	0.11	-	4.1	55	-	5.89	290	2	-	nil	sl cloudy	silty
28-Jul-98	Whitford 10	B	0.16	-	0.0006	0.005	0.02	30	-	-	1.6	-	0.012	0.046	220	-	-	<0.01	<0.01	-	0.24	13	N/A	5.97	90	5	18	Weak	sl cldy	orange
21-Oct-98	Whitford 10	B	0.18	-	0.00022	0.0029	0.0179	51.8	-	-	2.01	-	0.0242	0.046	420	-	-	0.02	0.5	-	-	40.3	unable to	6.37	118	6	21	slight	Opaque	Lt orange
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

PAH RD

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_3-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
13-May-96	Pah Rd				<0.001	<0.002	0.01	4.1			1.1		0.006	0.15			46		<0.003			26	2.65	7.09	140	<1	18	slight	clear	lt. br.
11-Oct-96	Pah Rd	S	1.1			0.004	0.003	6.4					<0.001	0.019	74		25	<0.005	0.42			19	2.8	7.17	112.3	-	20.8	slight	clear	lt. / or.
17-Feb-98	Pah Rd	S	2.4	-	<.00005	0.003	<0.002	-	-	-	0.35	-	<0.001	0.014	630	-	-	0.52	0.92	-	12	34	1.4	7.15	-	1.5	22	nil	clear, oil	black sed.
25-May-98	Pah Rd	S	2.9	-	<0.0005	<0.002	0.0055	12	-	-	0.55	-	<0.003	0.385	7900	-	-	0.025	0.26	-	19	15	3.2	7.1	-	15	16.5	nil	sl cloudy	sl orange
18-Oct-94	Pah Rd 1		<0.02	19	<0.01	<0.01	<0.03	0.4	<1.3	18	0.04	35	<0.2	<0.01		1420	<0.04				3.7		10.6	6.69	380	100	17	nil	clear	clear
24-Feb-95	Pah Rd 1		0.35	25.5	<0.01	<0.01	<0.03	2.3	14	35.5	0.36	251	<0.2	0.02		1400	0.21				0.8		6.8	7	1700	0	22	nil	clear	clear
12-Mar-96	Pah Rd 1	B			0.009	0.97	0.85	370			8.5		1.8	3.6			77	<0.005	<0.1			39	1.45	6.38	150	<1	18	mod.	cloudy	lt. br.
10-Oct-96	Pah Rd 1	B	0.2			0.01	0.011	31					0.025	0.048	28		24	0.023	<0.005			13	1.2	6.61	73	-	20	slight	sl. cloudy	lt. grey
13-Feb-98	Pah Rd 1	B	0.38	-	0.0002	0.086	0.053	-	-	-	0.7	-	0.003	0.08	46	-	-	0.018	<0.01	-	22	22	1.4	6.51	-	0.5	18.5	nil	sl cloudy	-
19-May-98	Pah Rd 1	B	1.3	-	0.0013	0.12	0.012	93	-	-	1.1	-	0.45	0.69	39.5	-	-	0.04	<0.05	-	190	30	2.9	-	-	0.9	19	nil	sl cloudy	blackish
22-Jul-98	Pah Rd 1	B	0.2	-	<0.0005	<0.002	0.004	24	-	-	0.56	-	<0.003	0.009	57	-	-	<0.01	<0.01	-	21	10	-	6.28	-	3	16	weak	clear	clear
19-Oct-98	Pah Rd 1	B	0.596	-	0.00019	0.0017	0.0057	24.2	-	-	0.337	-	0.0142	0.052	110	-	-	<0.01	0.6	-	-	30.2	2	6.61	75	6	19	organic	opaque	Lt grey
18-Oct-94	Pah Rd 2		0.26	100	<0.01	<0.01	<0.03	0.7	10	38	0.2	36	< 0.2	0.27		35	< 0.04				7.1		4.3	6.47	800	700	16	nil	clear	clear
12-Mar-96	Pah Rd 2	B			0.042	2.4	2.4	530			9.7		9.3	14			130	<0.005	<0.1			27	1.8	6.58	170	1	18	strong	cloudy	lt. br.
10-Oct-96	Pah Rd 2	B	1.9			1.2	1	540					4.5	7	27		62	<0.005	0.11			35	0.1	6.62	118	-	18	slight	cloudy	gr. / blk
13-Feb-98	Pah Rd 2	B	1.1	-	0.00019	0.018	0.017	-	-	-	0.52	-	0.087	0.15	50	-	-	0.007	<0.01	-	51	30	1.3	6.7	-	1	19	medium	cloudy	-
19-May-98	Pah Rd 2	B	1.5	-	<0.0005	0.055	0.0065	67	-	-	1	-	0.16	0.21	90	-	-	0.046	<0.05	-	260	53	2.4	-	-	1	19	nil	sl cloudy	blackish
22-Jul-98	Pah Rd 2	B	0.09	-	0.0007	0.035	0.033	50	-	-	1.1	-	0.13	0.2	21	-	-	<0.01	0.02	-	4.2	23	-	6.56	-	3	16	weak	sl cloudy	lt gry
19-Oct-98	Pah Rd 2	B	0.235	-	0.00241	0.122	0.358	87.4	-	-	1.42	-	0.488	0.743	55	-	-	0.02	0.5	-	-	36	2.2	6.47	100	6	20	organic	opaque	Dk grey
23-Jul-98	Pah Rd 2	S	1.7	-	<0.0005	0.003	0.01	12	-	-	0.49	-	<0.003	0.009	310	-	-	0.1	1.7	-	21	20	-	7.27	-	15	18	weak	opaque	lt orange
23-Oct-98	Pah Rd 2	S	1.63	-	0.0007	0.038	0.09	126	-	-	1.44	-	0.037	0.32	1815	-	-	0.02	0.7	-	-	29.6	2.2	7.43	300	38	18	slight	sl cloudy	grey
18-Oct-94	Pah Rd 3		<0.02	15	<0.01	<0.01	<0.03	0.3	<1.3	15	0.06	26	<0.2	<0.01		60	<0.04				4.6		8.4	6.86	300	0	15	nil	clear	clear
24-Feb-95	Pah Rd 3		0.39	17	<0.01	<0.01	<0.03	5	3.1	11.2	0.76	32	<0.2	0.03		75	0.08				1		3.5	7.53	280	N/T	18	nil	clear	clear
12-Mar-96	Pah Rd 3	B			0.008	0.33	0.43	160			4.1		1.2	4.8			66	<0.005	<0.1			27	0.8	6.72	175	1	19	mod.	cloudy	lt. br.
10-Oct-96	Pah Rd 3	B	0.9			0.2	0.21	170					0.69	2.3	38		54	<0.005	0.02			25	0.3	6.85	141	-	20	mod.	cloudy	gr. / blk
13-Feb-98	Pah Rd 3	B	0.72	-	0.000185	0.011	0.013	-	-	-	0.335	-	0.0355	0.12	52	-	-	0.007	<0.01	-	23	23	1.6	6.87	-	1	19.5	slight	clear	-
11-Jun-98	Pah Rd 3	B	1.2	-	<0.0005	0.005	<0.002	23	-	-	0.3	-	0.012	0.084	57	-	-	0.004	0.01	-	65	33	1.7	6.7	-	1	17	slight	sl cloudy	sl silty
23-Jul-98	Pah Rd 3	B	0.69	-	<0.0005	<0.002	0.013	11	-	-	0.34	-	0.011	0.14	67	-	-	0.05	1.8	-	31	19	-	6.85	-	10	17	nil	opaque	lt orange
19-Oct-98	Pah Rd 3	B	0.152	-	0.00012	0.0027	0.241	22.2	-	-	0.769	-	0.0084	0.13	50 ; 50	-	-	<0.01	0.7	-	-	31.7	2.6	6.17	52	3	19	organic	opaque	Lt grey
24-Feb-95	Pah Rd A		0.74	37.5	<0.01	<0.01	<0.03	2.7	32	77	0.24	658	<0.2	0.03		25	0.061				1.1									
13-Sep-95	Pah Rd 13	S	0.98	380	0.086	0.8	4.7	1500	32	110	28	68	5.8	30	-	4600	0.44	-	-		72		0.5							
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

NGATI OTARA

date collect	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_4-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
02-Sep-95	Ngati Otara		<0.2	5.1	<0.01	<0.01	<0.03	8.4	19	4.3	0.4	6.7	<0.2	0.03		53								6.17	230	0	14	none	clear	none
25-May-98	Ngati Otara	S	2	-	<0.0005	0.003	0.007	19	-	-	0.45	-	<0.003	0.048		-	-	0.024	0.2	-	24	19	2.2	-	-	-	17	nil	sl cloudy	sl silty
06-Sep-94	Ngati Otara 1		<0.2	20	<0.01	<0.01	<0.03	1.2	3	7.9	0.07	18	<0.2	<0.01		89	0.06				4.4		9.2	6.37	270	0	15	none	clear	none
17-Oct-94	Ngati Otara 1		0.03	19	<0.01	<0.01	<0.03	1.4	<1.3	11	0.2	24	<0.2	<0.01		759	0.09				2		4.8	6.44	307	0	15.8	petrol	fair	clear
19-Dec-95	Ngati Otara 1	B	0.39	53	0.001	0.017	0.026	37	18	23	0.83	50	0.027	0.24	21		0.9	9.5	4.1		38	380	1.3	6.54	100	0.5	18.5	nil	cloudy	grey
27-Jul-98	Ngati Otara 1	B	0.32	-	<0.0005	<0.002	<0.002	27	-	-	1.1	-	<0.003	<0.005	23	-	-	0.02	<0.01	-	26	16	-	6.25	-	4	17	weak	opaque	lt orange
17-Oct-98	Ngati Otara 1	B	0.294	-	0.00085	0.0048	0.0131	41.6	-	-	1.21	-	0.0308	0.196	55	-	-	0.09	0.4	-	-	67.6	2	6.45	80	4	22	oily	Opaque	Dk grey
06-Sep-94	Ngati Otara 2		<0.2	19	<0.01	<0.01	<0.03	1.8	2.1	8.4	0.16	25	<0.2	0.09		77	2.3				6.9		9.5	6.51	1020	0.5	14	pungent	clear	none
17-Oct-94	Ngati Otara 2		0.15	19	<0.01	<0.01	<0.03	3.2	1.6	9	0.2	24	<0.2	<0.01		1125	<0.04				9.7		8.3	6.35	1000	600	15.8	nil	clear	clear
24-Feb-95	Ngati Otara 2		0.3	17.1	<0.01	<0.01	<0.03	1.6	9.9	15.4	0.16	125	<0.2	0.07		48	12				14		2	7.44	500	0	20	mildew	fair-opaqu	v lt grey
02-Apr-96	Ngati Otara 2	B			0.029	0.11	0.46	250			3		0.3	14			10		0.011			12	0.6	6.69	100	<1	21	moderate	opaque	gr. / br.
29-Oct-96	Ngati Otara 2	B	0.5			0.009	0.076	59					0.041	0.75	13		0.64	0.016	0.013			9.1	1.8	6.62	65	<1	18	strong	v.dark	gr. brown
11-Feb-98	Ngati Otara 2	B	0.69	-	0.00448	0.016	0.21	-	-	-	0.88	-	0.089	1	19	-	-	0.0001	<0.01	-	8.2	14	3.2	6.66	-	0.5	19.5	sl sulphour	sl cloudy	silty res.
22-May-98	Ngati Otara 2	B	0.48	-	0.0088	0.021	0.31	105	-	-	0.68	-	0.14	1.7	-	-	-	0.031	<0.01	-	13	17	1.92	6.8	-	0.5	19	nil	sl silty	blackish
24-Jul-98	Ngati Otara 2	B	0.53	-	0.0006	<0.002	0.029	2.7	-	-	0.46	-	<0.003	0.099	21	-	-	<0.01	0.8	-	0.43	10	-	6.2	-	4	16.5	weak	opaque	lt orange
17-Oct-98	Ngati Otara 2	B	0.437	-	0.00126	0.0018	0.0629	25.5	-	-	0.994	-	0.0233	0.169	30	-	-	0.03	0.6	-	-	29.1	2.9	6.37	60	2	19	nil	Opaque	Lt orange
26-Sep-94	Ngati Otara 3		0.95	84	<0.01	<0.01	<0.03	12	14	31	0.5	120	<0.2	<0.01		237	9.9				10		4.2	5.87	273	0	15	nil	clear	clear
17-Oct-94	Ngati Otara 3		0.8	77	<0.01	0.02	<0.03	12	14	29	0.6	103	<0.2	<0.01		76	8.1				9.8		3.9	6.26	184	0	16	nil	clear	clear
19-Dec-95	Ngati Otara 3	B	1.1	75	0.01	0.14	0.54	150	14	25	3	30	0.52	1.9	19		<0.04	<0.005	5.2		9.7	89	1.5	6.67	100	0.5	19	nil	cloudy	gry/grn
29-Oct-96	Ngati Otara 3	B	0.9			0.029	0.11	85					0.1	0.8	28		23	0.1	0.052			21	2.4	6.56	55	<1	18	strong	v.dark	black
11-Feb-98	Ngati Otara 3	B	1.1	-	0.00873	0.08	0.046	-	-	-	1.3	-	0.27	1.06	51	-	-	0.007	0.02	-	5.7	26	1.3	6.31	-	0.5	24.5	slight	v cloudy	dk gry
22-May-98	Ngati Otara 3	B	1.4	-	0.01	0.075	0.48	140	-	-	2.4	-	0.36	1.1	-	-	-	0.036	0.08	-	19	35	1.86	7.1	-	0.4	19	nil	sl silty	blackish
24-Jul-98	Ngati Otara 3	B	1.3	-	0.0014	0.021	0.091	76	-	-	0.94	-	0.073	0.22	23	-	-	0.02	0.07		9.1	18	-	6.43	-	3	16	weak	opaque	orange
17-Oct-98	Ngati Otara 3	B	0.903	-	0.00305	0.0215	0.0894	99.8	-	-	0.751	-	0.0755	0.263	25	-	-	0.03	0.3	-	-	36.8	2	6.54	48	2	20	organic	Opaque	Dk grey
13-Sep-95	Ngati Otara 3	S	1.1	110	0.0024	0.067	0.093	480	21	42	0.78	190	0.1	0.58	-	310	13	-	-		17		2							
22-Apr-96	Ngati Otara 3	S			<0.001	0.002	0.025	2.4			0.29		0.004	0.07			7.7		9.5			13	1.9	6.52	270	1.5	18	slight	clear	clear
27-Nov-96	Ngati Otara 3	S	1.8			0.003	0.017	36					<0.001	0.059	2600		25	0.04	0.36			10	3	6.53	1100	7.5	19	nil	opaque	brown
16-Feb-98	Ngati Otara 3	S	2.4	-	<0.00005	0.001	0.006	-	-	-	0.31	-	<0.001	0.044	4000	-	-	0.032	2.1	-	7.1	11	1.25	6.58	-	7.5	23	nil	clear	-
27-Jul-98	Ngati Otara 3	S	2.8	-	<0.0005	0.002	0.041	16	-	-	0.39	-	0.009	0.12	8600	-	-	<0.01	0.55	-	<0.01	5	-	7.2	-	190	18	weak	sl cloudy	grey
17-Oct-94	Ngati Otara 4		0.04	10	<0.01	<0.01	<0.03	0.6	<1.3	6	0.1	16	<0.2	<0.01		685	<0.04				6		10.4	6.26	458	0	16	?	clear	clear
24-Feb-95	Ngati Otara 4		0.4	16.1	<0.01	<0.01	<0.03	1.1	10.6	3.9	0.19	40.5	<0.2	0.1		15	34				36		3.5							
17-Oct-94	Ngati Otara 5		0.06	42	<0.01	<0.01	<0.03	15	3.7	13	0.8	29	<0.2	<0.01		206	<0.04				10		8.5	6	470	0	16	nil	clear	clear
24-Feb-95	Ngati Otara 5		2	14	<0.1	<0.1	<0.3	2	13	4	0.14	27	<2	<0.1		78	25				29			7.32	25000	15000	20	salt	clear	clear
13-Sep-95	Ngati Otara 5	S	0.31	63	0.0004	0.002	0.011	21	8.9	14	0.51	42	0.006	0.047	-	40	7.5	-	-		10		0							
22-Apr-96	Ngati Otara 5	S			<0.001	0.002	0.02	1.2			0.11		0.007	0.16			0.032		3			2.7	8.1	6.44	20	0	17	nil	clear	clear
29-Oct-96	Ngati Otara 5	S	<0.1			0.003	0.018	30					0.01	0.16	28		0.87	0.069	3.7			4.2	7.1	6.23	21.4	-	15.9	nil	clear	clear
17-Oct-94	Ngati Otara 6		<0.02	19	<0.01	<0.01	<0.03	4.9	1.6	21	2.6	62	<0.2	0.03		20	0.09				0.44		8	6.78	12,500	9000	19	faint org	fair	clear
17-Oct-94	Ngati Otara 7		1.2	109	<0.01	<0.01	<0.03	2.2	113	322	0.2	3080	0.2	0.06		420	0.24				1.5		10.8	7.44	1100	200	20	wstwatr	clear	v lt grey
24-Feb-95	Ngati Otara 7		2.5	192	<0.1	<0.1	<0.3	1.6	180	603	0.26	4966	<2	<0.1		496	0.16				0.8		7.4							
19-Oct-98	Ngati Otara 12	S	2.49	-	0.0001	0.0108	0.0072	4.27	-	-	0.295	-	0.0036	0.024	11760	-	-	<0.01	0.5	-	-	8.4	8.2	7.25	2900	265	24	nil	Opaque	Lt grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

RIVERINA AVE

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_3-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Mar-96	Riverina 4				0.002	2.2	0.74	920			11		0.92	2.1			0.14	<0.005	0.011			27	1.25	5.63	120	<1	22			yellow / br.
06-Nov-96	Riverina 4		0.2			0.094	0.072	54					0.052	0.11	280		0.02	< 0.005	0.028			4.8	5.3	5.6	100	<1	17	slight	cloudy	or. / brown
04-Jun-98	Riverina 4		<0.05	-	<0.0005	0.027	0.49	34	-	-	0.72	-	0.047	0.58	84	-	-	0.005	0.01	-	0.13	17	5.8	5.49	-	0	17	sl odour	sl cloudy	blackish
22-Oct-98	Riverina 4	B	0.05	-	0.00046	0.0148	0.195	11.7	-	-	0.409	-	0.0214	0.194	55	-	-	0.02	0.3	-	-	28.1	3.5	5.58	22	1	19	mod	sl cloudy	grey
Comparison Data																													
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

RIVERHILLS PARK

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC* NPOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
07-Apr-96	Riverhills 2	B			<0.001	0.002	0.01	140			5		0.005	0.11			1.3		0.1			5.2	3.55	5.25	240	1.5	19	slight	cloudy	lt. br.
20-Oct-96	Riverhills 2	B	0.1			0.02	0.024	410					0.022	0.1	1900		3.6	0.077	0.048			21	2.5	5.62	485		19	strong	cloudy	gr. br.
27-May-98	Riverhills 2	B	<0.05	-	<0.0005	0.021	0.036	130	-	-	4.8	-	0.043	0.11	880	-	-	0.022	0.09	-	2.05	19	4.9	5.9	-	2	16	nil	sl silty	blackish
23-Oct-98	Riverhills 2	B	0.023	-	0.0003	0.0149	0.0213	88.2	-	-	0.0006	-	0.0287	0.071	500	-	-	<0.01	0.4	-	-	15.9	3.4	5.77	102	4	19	slight	sl cloudy	Lt grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

LEABANK PARK

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
2-Apr-96	Leabank 5	B																											
29-Oct-96	Leabank 5	B	<0.1			0.069	0.033	60					0.052	0.21	27		<0.01	0.02	2.4			1.6	4.2	8.75	13	<1	19	nil	or. / br.	low
Comparsion Data																													
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

MIRO RD

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
28-Oct-94	Miro Rd 1		<0.1	13	<0.01	<0.01	0.04	3.1	1.7	1.7	0.09	7.6	<0.2	0.18		45	0.29				1.8		7.3	7.68	910	600	16	salt	Clear	Clear
19-Dec-95	Miro Rd 1	B	1.2	96	0.001	0.009	0.022	17	40	88	0.38	250	0.022	0.21	220		26	<0.005	<0.1		34	64		6.84	230	1.5	19.5	nil	clear	lt. ylow
25-Mar-96	Miro Rd 1	B			0.001	0.002	0.025	5				1.9	0.012	0.052			32	<0.005	0.004			68	1.15	6.98	230	1	18	mod.	cloudy	gry / br.
05-Nov-96	Miro Rd 1	B	0.8			0.028	0.028	28					0.026	0.035	2600		12	< 0.005	0.021			30	2.9	7.16	900	6	17	mod.	cloudy	dk gry
12-Feb-98	Miro Rd 1	B	0.9	-	0.00019	0.1	0.19	-	-	-	0.4	-	0.13	0.34	210	-	-	0.002	<0.01	-	13	40	0.8	7.02	-	1	20.5	sl. leach	sl. cloud	-
20-May-98	Miro Rd 1	B	0.93	-	<0.0005	0.0065	0.009	17	-	-	0.24	-	0.0041	0.28	200	-	-	0.15	0.35	-	0.65	11	3.05	17	-	1	17	nil	sl cloud	sl silty
23-Jul-98	Miro Rd 1	B	1.5	-	<0.005	0.003	0.015	28	-	-	0.6	-	0.004	0.15	95	-	-	0.08	<0.01	-	21	34	1.5	7.01	-	13	18	weak	clear	clear
20-Oct-98	Miro Rd 1	B	1.01	-	0.00002	0.0036	0.0059	23	-	-	0.534	-	0.0196	0.147	145	-	-	0.01	1.4	-	-	82.8	1.8	7.11	160	7	25	slight	opaque	lt orange
19-Dec-95	Miro Rd 2	B	0.98	110	0	0.008	0.021	27	67	180	2.2	1400	0.012	0.13	3000		<0.04	<0.005	<0.1		16	160		6.66	750	5	16	nil	clear	lt.gry
12-Feb-98	Miro Rd 2	B	1.15	-	<0.0005	0.003	0.005	-	-	-	1.4	-	0.02	0.022	3700	-	-	<0.001	<0.01	-	4.8	21	1.3	7.42	-	4	18.5	Nil	clear	-
26-Aug-94	Miro Rd 3		1.8	220	<0.1	0.4	<0.3	1.2	167	574	1.3	4388	< 2	< 0.1		177	-				-		2	7.02	15500	11	16	Nil	Fair	Gr./Brown
28-Oct-94	Miro Rd 3		<0.1	40	<0.01	<0.01	<0.03	5.9	17.4	41	0.6	175	<0.2	<0.01		380	4.7				6.2		7.4	6.7	500	0	16	Nil	Clear	Clear
15-Sep-95	Miro Rd 3	S	0.7	160	0.0015	0.15	0.22	120	47	140	2.3	400	0.69	0.71	-	360	14	-	-		18		3							
19-Dec-95	Miro Rd 3	B	1.1	110	0.002	0.014	0.035	24	75	160	2	1200	0.034	0.17	2600		<0.04	<0.005	<0.1		15	72		6.6	1000	6.5	20	nil	clear	br. gry
25-Mar-96	Miro Rd 3	B			0.001	0.002	0.023	4.9				2.1	0.012	0.048			4.3	<0.005	0.048			31	4.3	6.83	900	5	22	mod.	cloudy	gry / br.
26-Mar-96	Miro Rd 3	B			0.001	0.038	0.077	33				1.4	0.08	0.19			12	0.008	0.011	*		54	2	6.97	1400	9	18	mod.	cloudy	gry / br.
05-Nov-96	Miro Rd 3	B	1			0.086	0.12	110					0.11	0.19	2200		10	0.007	0.037			53	3.3	7.2	600	4	20	strong	dark	black
05-Nov-96	Miro Rd 3	B	1.2			0.011	0.013	28					0.056	0.24	180		27	0.005	0.029			39	2.2	7.13	190	1	20	strong	mod.	grey
17-Feb-98	Miro Rd 3	B	0.64	-	<0.00005	0.003	0.007	-	-	-	1.3	-	0.003	0.025	1600	-	-	0.007	0.007	-	6.9	51	1.55	7.33	-	4	19	Nil	clear	sl. brown
26-Aug-94	Miro Rd 4		1.3	194	<0.1	0.27	<0.3	1.1	134	458	1.5	3373	<2	<0.1		458	-				-		2.5	7.18	15000	1	14	Nil	Slight O	Gr./Brown
28-Oct-94	Miro Rd 4		<0.1	26	<0.01	<0.01	<0.03	3.6	14.1	25	0.38	163	< 0.2	< 0.01		340	2.6				3.9		8	7.65	265	0	17	Nil	Clear	Clear
15-Sep-95	Miro Rd 4	S	0.83	1600	0.001	0.07	0.12	100	56	150	2.3	780	0.3	0.34	-	390	13	-	-		15		3							
14-May-96	Miro Rd 4	S			<0.001	<0.002	0.02	0.08			0.03		0.39	0.03			0.16		5.8			0.8	707	6.65	105	<1	17	nil	clear	clear
05-Nov-96	Miro Rd 4	S	<0.1			<0.001	0.001	0.078					<0.001	<0.002	49		0.053	<0.005	6.3			1	5.4	6.72	37.1	-	17.7	slight	clear	clear
26-Aug-94	Miro Rd 5		<0.1	24	<0.01	<0.01	<0.03	<0.01	10.1	35	<0.01	212	<0.2	<0.01		50	-				-		7	7	1300	0.5	16	Nil	Crystal	Crystal
28-Oct-94	Miro Rd 5		<0.1	14	<0.01	<0.01	<0.03	0.2	4.1	15	<0.01	68	<0.2	<0.01		245	<0.04				4.1		9.4	6.89	720	300	16.5	Nil	Clear	Clear
26-Aug-94	Miro Rd 6		<0.1	24	<0.01	<0.01	<0.03	0.04	10.5	37	0.03	237	<0.2	<0.01		2143	-				-		6.7	7.18	1500	1	16	Nil	Crystal	Crystal
28-Oct-94	Miro Rd 6		<0.1	19	<0.01	<0.01	<0.03	0.1	6.6	25	<0.01	122	<0.2	<0.01		220	<0.04				5.5		4.5	6.86	6000	3500	19	Nil	Clear	Clear
24-Feb-95	Miro Rd 6		0.56	50	<0.01	<0.01	<0.03	0.4	32.5	103	0.06	758	<0.2	0.05		220	0.25				4.4		-	6.95	350	3	16	rusty/car	cloudy	Greenish brown
26-Aug-94	Miro Rd 8		<0.1	63	<0.01	<0.01	<0.03	0.1	10.5	36	0.03	170	<0.2	<0.01		2500	-				-		8.4	7.3	950	0	14	Nil	Clear	Clear
28-Oct-94	Miro Rd 8		<0.1	18	<0.01	<0.01	<0.03	1.3	3.8	7.3	0.18	35	<0.2	0.03		495	0.16				0.88		2.3	7.09	2000	1000	20	Nil	Clear	Clear
26-Aug-94	Miro Rd 9		0.23	44	<0.01	0.04	<0.03	0.4	26.7	90	0.18	725	<0.2	0.05		3223	-				-		9.5	7.33	3400	2	13.5	Nil	Clear	Clear
24-Feb-95	Miro Rd 9		0.4	21.5	<0.01	<0.01	<0.03	1.8	20.5	29	0.13	347	<0.2	0.08		270	0.76				1.6		-	7.17	430	3	15.5	Nil	cloudy	Lt. greenish brow
26-Aug-94	Miro Rd 10		3.2	321	<0.1	0.62	<0.3	0.4	311	1025	0.08	8720	<2	<0.1		8728	-				-		9.4	7.23	110	0	18	Nil	fair-opa	dark grey
26-Aug-94	Miro Rd 11		3.3	337	<0.1	0.59	<0.3	<0.3	331	1077	0.07	9283	<2	<0.1		9723	-				-		5.8	7.12	131	900	16	compost	Clear	Clear
15-Sep-95	Miro Rd B1 Borehol	B	1.1	97	0.0013	0.097	0.11	36	40	84	0.73	210	0.1	0.47	220	220	30	0.004	<0.005		26		1.5							
15-Sep-95	Miro Rd B2 Borehol	B	1.1	160	0.0013	0.11	0.15	61	71	190	2.4	1600	0.073	0.29	3000	300	15	0.005	<0.005		15		6.5							
15-Sep-95	Miro Rd B3 Borehol	B	0.75	400	0.027	3	4.4	2900	150	440	52	1200	3.7	6.9	2100	300	13	0.005	<0.005		33		5							
15-Sep-95	Miro Rd B3#		-	-	0.00049	0.0072	0.066	1.7	-	-	0.3	-	0.013	0.07		-	-				-		-							
27-Apr-95	Miro Rd F		0.38	84	<0.01	<0.01	<0.03	5.7	16.6	70.8	1.8	358	<0.2	<0.01		86	1.2				1.6		-	7.18	190	1.5	17	Nil	cloudy	Grey
27-Apr-95	Miro Rd GH		0.7	144	<0.01	<0.01	<0.03	15.8	67.7	139.8	0.9	968	<0.2	0.03		735	36				38		-	7.11	850	6.5	15.5	Nil	cloudy	Greenish grey
27-Apr-95	Miro Rd ON		0.3	108	<0.01	<0.01	<0.03	2.1	5	50.8	0.16	85	<0.2	<0.01		330	0.13				0.45		-	7.27	650	5	19	Nil	cloudy	Greenish grey

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
Comparison Data																													
	blank																												
	sea water																												
	river water		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*		-	-				-		-							
	Greenmount		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*		-	-				-		-							
	ARC Trade Waste		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*		-	-				-		-							
			22	-	*<0.01*	*0.19*	*0.07*	*128*	-	-	*13*	-	*0.18*	*25*		*10500*	-				-		-							
			25	-	*1*	*30*	*10*	-	-	-	*20*	-	*10*	*25*		-	-				-		-							
USEPA Fresh Acute			-	-	*0.0039*	*0.016*	*0.18*	-	-	-	-	-	*0.083*	*0.12*		-	-				-		-							
USEPA Marine Acute			-	-	*0.043*	*1.1*	*0.0029*	-	-	-	-	-	*0.22*	*0.095*		-	-				-		-							
ANZECC Freshwater			-	-	**0.0002*	*0.01*	**0.002*	*1*	-	-	-	-	**0.001*	**0.005*		-	-				-		-							
ANZECC Marine			-	-	*0.002*	*0.05*	*0.005*	-	-	-	-	-	*0.005*	*0.05*		-	-				-		-							

# denotes results from reanalysis of sample following filtration

DALE CRES

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_4-N (mg/l)	Nitrite	Nitrate	NNN	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Mar-96	Dale Cres 1	B			0.001	0.1	0.054	150			8.1		0.086	0.3			37	<0.005	0.003			130	1	6.41	2700	18	19	strong	cloudy	grey
06-Nov-96	Dale Cres 1	B	2.2		0.038		0.051	130					0.05	0.13	6500		28	0.008	0.017			54	3.1	6.64	1700	11	19	v.strong	black	black
04-Jun-98	Dale Cres 3	B	0.66	-	<0.0005	0.032	0.089	75	-	-	1.8	-	0.055	0.37	2000	-	-	0.006	<0.01	-	11	56	2.6	6.46	-	<0.1	16	organic	cloudy	black
23-Oct-98	Dale Cres 3	B	0.88	-	<0.0005	<0.005	0.023	77.7	-	-	3.62	-	0.015	0.07	3455	-	-	0.03	0.2	-	-	139	2.2	6.81	790	70	19	strong	sl cldy	blackish
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

KINGFISHER PL.

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH_4-N	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Kingfisher 1		0.19	79	<0.01	<0.01	<0.03	10	5.5	9.6	2.3	41	<0.2	0.15		73	0.79				1.6		4.7	6.26	500	0.1	17	clear	none	none
19-Oct-94	Kingfisher 1		0.17	72	<0.01	<0.01	<0.03	11	7.8	20.8	2.3	82	<0.2	<0.01		854	<0.04				1.7		6	6.46	670	100	16	nil	clear	clear
23-Oct-98	Kingfisher 1		1.41	-	0.0017	0.017	0.036	146	-	-	2.15	-	0.038	0.83	6770	-	-	0.06	0.5	-	-	12.3	3.8	7.46	1150	103	17	mod	sl cldy	lt orange
12-Sep-95	Kingfisher 1	S	0.5	100	0.0051	0.076	0.092	740	16	34	3.7	92	0.12	3.2	-	480	0.23	-	-		8.7		0.5							
13-May-96	Kingfisher 1	S			0.002	0.12	0.16	1200			4.7		0.17	6.4			2.5		0.004			7	0.35	6.97	90	<1	17	slight	cloudy	or. br.
25-May-98	Kingfisher 1	S	4	-	0.0005	0.008	0.0018	9.3	-	-	0.8	-	<0.003	0.095	14000	-	-	0.15	0.35	-	0.65	11	4.7	7.2	-	25	17	nil	sl cloudy	sl silty
19-Oct-94	Kingfisher 2		<0.01	7.6	<0.01	<0.01	<0.03	0.25	<1.3	27.3	0.02	17	<0.2	<0.01		237	<0.04				2.9		9.5	6.19	160	0	15	nil	clear	clear
24-Feb-95	Kingfisher 2		0.23	11.1	<0.01	<0.01	<0.03	0.68	4.6	11.1	0.07	92	<0.2	0.27		245	0.15				0.9		7.2	6.72	700	0	21	nil	clear	clear
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

COXHEAD RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD	NH_4-N	Nitrite mg/l	Nitrate mg/l	NNN	Total N	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
23-Sep-94	Coxhead Rd 1		0.1	12.3	<0.01	<0.01	<0.03	0.2	<1.3	4.4	0.03	19	<0.2	0.1		424	<0.04				3.2		10.8	6.81	150	0	14	none	clear	none
18-Oct-94	Coxhead Rd 1		<0.02	9.2	<0.01	<0.01	<0.03	0.2	<1.3	4.7	0.04	16	<0.2	<0.01		930	<0.04				3.4		10.2	6.86	170	0	16	none	clear	none
23-Sep-94	Coxhead Rd 2		0.1	10.4	<0.01	<0.01	<0.03	0.5	<1.3	3.3	0.07	18	<0.2	0.02		114	0.09				4		10.6	6.58	150	0	15	none	clear	none
18-Oct-94	Coxhead Rd 2		<0.02	6.5	<0.01	<0.01	<0.03	0.3	<1.3	3.5	0.1	18	<0.2	<0.01		685	0.07				4.2		9.3	6.58	160	0	17	none	clear	none
17-Feb-95	Coxhead Rd 2		0.19	12.9	<0.01	<0.01	<0.03	0.35	3.7	5.9	0.02	47.5	<0.2	0.04		92	0.05				2.9		9.6	7.24	300	0	19	none	clear	none
13-Sep-95	Coxhead Rd 2	S	0.19	8.6	0.0002	0.002	0.02	0.86	1.7	3.7	0.09	18	0.006	0.027	-	15	0.08	-	-		4.3		0							
27-Mar-96	Coxhead Rd 2	B			0.003	0.07	0.31	110			1.4		0.55	3.3			6.3	0.009	0.14			14*	0.75	6.43	90	<1	18	slight	cloudy	grey
29-Oct-96	Coxhead Rd 2	B	0.4			0.025	0.15	87					0.29	2.4	36		5.6		0.025	0.005		15	2.65	7.79	80	<1	20	nil	cloudy	grey
7-Aug-98	Coxhead Rd 2	B	0.28	-	<0.0005	0.003	0.035	73	-	-	0.42	-	0.068	0.31	10	-	-	0.043	0.01	-	6.2	17.5	3.6	6.57	-	0.4	18	sl silty	cloudy	sl silty
23-Oct-98	Coxhead Rd 2	B	0.224	-	0.00062	0.0026	0.0357	58.4	-	-	0.802	-	0.0818	0.331	30	-	-	0.2	0.3	-	-	27.9	1.8	6.81	60	2	19	strong	opaque	blackish
23-Sep-94	Coxhead Rd 3		0.1	12	<0.01	<0.01	<0.03	0.3	<1.3	4.2	0.04	18	<0.2	0.06		316	<0.04				3		10.8	6.57	150	0	14	none	clear	none
18-Oct-94	Coxhead Rd 3		<0.02	9.2	<0.01	<0.01	<0.03	0.1	<1.3	4.7	0.04	16	<0.2	<0.01		780	<0.04				3.5		9.6	6.56	175	0	17	none	clear	none
17-Feb-95	Coxhead Rd 3		0.13	13.1	<0.01	0.02	<0.03	0.4	3.1	4.8	0.02	47.5	<0.2	0.05		202	0.07				2.8		11	7.02	296	0	19	none	clear	none
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*																	
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*																	
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*																	
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*																	
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*																	
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*																	
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*																	
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*																	
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*																	

ORUARANGI RD

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
5-Nov-96	Oruarangi 1	B	<0.1			0.035	0.018	25					0.047	0.059	140		0.43	0.026	0.85			3.9	2.9	6.36	80	<1	23	smelly	cloudy	grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

GREAT SOUTH RD

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Gt Sth Rd 1		0.25	55	<0.01	<0.01	<0.03	2.4	5.8	15	0.3	56	<0.2	0.26		163	0.12				0.59		4.1	6.56	510	0	16	swamp	clear	none
24-Feb-95	Gt Sth Rd 1		0.5	75	0.06	<0.01	0.52	373	9.4	17.4	0.98	66	0.45	15.3		122	2.5				57		0.5	6.88	700	100	22	org	opaque	dark grey
12-Sep-95	Gt Sth Rd 1	S	0.4	59	0.0009	0.002	0.015	11	8.3	13	0.8	47	0.013	0.49	-	35	0.35	-	-		0.75		0							
13-Nov-96	Gt Sth Rd 1	S	0.3			0.016	0.074	33					0.11	0.26			0.32	<0.005	0.044			16	2.4	6.9	83	-	19.1	strong	sl. cldy	gr.black
26-Sep-94	Gt Sth Rd 2		0.38	75	<0.01	<0.01	<0.03	5.7	13	29	0.6	112	<0.2	0.13		265	0.34				0.97		5.4	6.62	680	0.3	15	swamp	clear	none
24-Feb-95	Gt Sth Rd 2		0.31	13.8	<0.01	<0.01	<0.03	2.8	2.5	2.6	0.06	13.9	<0.2	0.26		246	0.18				0.7		4	6.86	150	0	22	nil	clear	v lt yellow
13-Nov-96	Gt Sth Rd 2	S	<0.1			0.018	0.068	9.4					0.073	0.96			0.031	<0.005	0.052			14	5.1	5.82	3	-	18.5	mod.	sl. cldy	grey
12-Sep-95	Gt Sth Rd 3	S	0.35	32	0.0003	0.002	0.009	3.1	4.7	6.6	0.13	29	0.008	0.19	-	25	0.29	-	-		1.6		0							
30-Oct-96	Gt Sth Rd 3	B	0.2			0.026	0.019	100					0.089	0.13			0.67	<0.005	0.017			7.3	2.95	5.62	31	<1	19	slight	cloudy	or. br.
30-Oct-96	Gt Sth Rd 4	B	1.5			0.07	0.11	37					0.11	0.73			23	0.005	0.016			22	2.7	6.76	800	5	20	strong	opaque	black
14-May-96					0.002	0.01	0.08	46			1.2		0.05	1.7			2.9		0.007			10	0.95	6.98	100	<1	18	strong	opaque	black
14-May-96					<0.001	<0.002	0.02	3.3			0.3		0.007	0.07			1.1		0.006			6	2	6.59	27	0	20	nil	clear	or. br.
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

ROBERT ALLAN WAY

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
4-Apr-96	Robert Allan 2	B			<0.001	0.004	0.014	36			3.5		0.004	0.053			94		0.007			140	1.3	6.59	950	6	18	slight	cloudy	lt.grey
30-Oct-96	Robert Allan 2	B	1.4			0.031	0.028	89					0.064	0.069	5400		6.3	<0.005	0.016			19	4	6.72	1300	8	16	strong	cloudy	gry. blk
27-May-98	Robert Allan 2	B	0.55	-	0.01	0.031	0.042	52	-	-	3.4	-	0.085	0.12	1100	-	-	0.016	0.05	-	1.9	28	3.8	7.1	-	2	15	nil	sl cloudy	blackish
22-Oct-98	Robert Allan 2	B	0.59	-	<0.0005	0.007	0.01	37	-	-	4.89	-	0.014	0.02	2315	-	-	<0.01	0.7	-	-	26.8	3.2	7.01	550	50	20	mod	opaque	sk grey
4-Apr-96	Robert Allan 3	B			<0.001	0.002	0.008	3.2			4		0.003	0.04			6.6		0.007			27	1.6	6.3	1550	10	17	moderate	cloudy	lt.grey
30-Oct-96	Robert Allan 3	B	0.5			0.011	0.025	120					0.005	0.032	2600		89	0.079	0.011			175	1	6.76	750	5	17	metallic	opaque	gry. blk
27-May-98	Robert Allan 3	B	0.014	-	<0.0005	0.025	0.031	94	-	-	2.7	-	0.03	0.12	2300	-	-	0.002	<0.01	-	80	125	2.8	6.9	-	5	15	nil	sl cloudy	blackish
22-Oct-98	Robert Allan 3	B	0.24	-	0.0006	0.008	0.044	133	-	-	3.45	-	0.059	0.16	2280	-	-	0.01	1.1	-	-	183	3.5	7.34	700	60	20	mod	sl cloudy	grey
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

ENNIS AVE

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
2-Apr-96	Ennis Ave				<0.001	0.003	0.02	0.84			0.048		0.007	0.09			0.067		0.37			4.8	7.4	6.44	22	0	15	nil	clear	clear
5-Nov-96	Ennis Ave		<0.1			0.001	0.005	4.7					<0.001	0.093	67		0.47	<0.005	0.11			4.9	6.4	6.5	40.2	-	13.3	odour	clear	lt. br.
Comparison Data																													
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

KIWI ESPLANADE

date collected	location	B (mg/ml)	Ca (mg/ml)	Cd (mg/ml)	Cr (mg/ml)	Cu (mg/ml)	Fe (mg/ml)	K (mg/ml)	Mg (mg/ml)	Mn (mg/ml)	Na (mg/ml)	Pb (mg/ml)	Zn (mg/ml)	Cl (mg/ml)	COD (mg/ml)	NH_3-N (mg/ml)	Nitrite (mg/ml)	Nitrate (mg/ml)	NNN (mg/ml)	Total N (mg/ml)	DO	TOC	pH	EC	salinity	temp	odour	clarity	colour
28-Sep-94	Esplanade 1	0.28	32	<0.01	0.1	<0.03	1	21	56	0.06	446	<0.02	0.04		590	0.05				0.67	9.3		7.07	2550	1.8	14	none	clear	light greysh brown
28-Oct-94	Esplanade 1	1.3	132	<0.01	0.14	<0.03	1.5	116	319	0.5	2836	<0.02	0.03		185	0.55				1.5	4.3		7.39	10000	7000	14	nil	clear	clear
15-Feb-95	Esplanade 1	3.8	368	<0.1	0.44	2.1	0.31	343	1147	0.22	9610	>2	0.28		188	0.4				1.6	5.5		6.28	490	0	22	nil	clear	clear
28-Sep-94	Esplanade 2	2.9	282	<0.1	0.33	<0.3	38	272	866	0.6	7020	<0.2	<0.1		95	0.69				5	9.7			29000	22	15	none	opaque	light greysh brown
28-Oct-94	Esplanade 2	4.1	379	<0.1	0.7	<0.3	24	388	1195	0.5	10250	<0.2	0.08		70	0.09				4.2									
15-Feb-95	Esplanade 2	4	370	<0.1	0.47	0.3	2.4	368	1213	0.21	10302	<2	<0.1		52	0.62				1.3	12		N/T	15000	32000	22	nil	clear	clear
Comparison Data																													
	blank	*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water	*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water	*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount	*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste	*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute				*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute				*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater				**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine				*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

RIVERHILLS SCHOOL

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
07-Apr-96	Riverhills School	S			<0.001	<0.001	0.015	4.6			0.57		0.1	0.09			0.018		<0.003			3.2	5.6	6.37	32	0	17	nil	clear	clear
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

TI RAKAU DR

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC* NPOC mg/l	DO	pH	EC	salinity	temp	odour	clarity	colour
07-Apr-96	Ti Rakau 1	B			<0.001	0.008	0.018	3.9			0.25		0.074	0.064			0.022		0.42			17	2.1	6.4	35	0	18	slight	opaque	gr brown
06-Nov-96	Ti Rakau 1	B	0.1			0.008	0.008	8					0.014	0.016	54		0.29	0.007	0.059			13	3.7	6.62	70	<1	18	mod.	cloudy	gr. black
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

HARANIA RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC* NPOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Harania Rd 1		0.08	12	<0.01	<0.02	<0.03	0.4	3	7	0.04	18	<0.2	0.07		137	<0.04				8.2		9	6.28	190	0	15	nil	clear	clear
17-Oct-94	Harania Rd 1		<0.02	10	<0.01	<0.02	<0.03	0.2	4.3	7	<0.02	16	<0.2	0.1		20	0.07				6.8		5.8	6.55	165	0	17	nil	clear	clear
17-Feb-95	Harania Rd 1		0.12	32	<0.01	<0.02	<0.03	0.65	11.1	24.5	0.71	45	<0.2	0.17		112	0.13				31		8	6.67	92	0	19	nil	clear	nil
26-Sep-94	Harania Rd 2		0.07	9	<0.01	<0.02	<0.03	0.3	0.7	5	<0.02	16	<0.2	0.04		84	<0.04				4.2		6.1	6.35	140	0	15	nil	clear	clear
17-Feb-95	Harania Rd 2		0.13	36.5	<0.01	<0.02	<0.03	6.8	17.3	33.5	2.5	118	<0.2	0.29		70	0.24				28		1.6	6.46	93	0	18	nil	fair	nil
07-Apr-96	Harania Rd 2	B			<0.001	0.002	0.008	0.38			0.031		0.079	0.068			0.13		0.004			3.2*	2.3	4.97	20	0	20	slight	sl. cloudy	or. / br.
25-Oct-96	Harania Rd 2	B	0.1			14	0.014	13					0.019	0.033	19		0.5	<0.005	0.028			7.4	2.95	8.37	23	<1	20	slight	sl. cloudy	gr. / br.
13-Sep-95	Harania Rd 2	S	0.28	76	0.0072	0.4	0.99	340	25	38	25	37	3	7.2	-	20	0.92	-	-		27		0							
14-May-96	Harania Rd 2	S			<0.001	<0.002	0.03	0.82			0.4		0.01	0.12			1.6		8.7			3.6*	2.45	6.65	32	0	18	nil	clear	clear
26-Nov-96	Harania Rd 2	S	0.1			<0.001	0.01	0.16					<0.001	0.089	97		<0.01	0.04	13			3.3	3.6	6.04	49	0	17	none	clear	clear
26-Sep-94	Harania Rd 3		0.19	9	<0.01	<0.02	<0.03	0.5	1.6	7	0.03	34	<0.2	0.05		35	<0.04				4		8	6.35	242	0	15	nil	clear	clear
17-Oct-94	Harania Rd 3		<0.02	12	<0.01	<0.02	<0.03	0.2	4.3	10	<0.02	30	<0.2	0.04		195	<0.04				7		6.7	6.82	261	0	17	nil	clear	clear
17-Feb-95	Harania Rd 3		0.84	90	<0.01	0.03	<0.03	1.5	75	233	1	2019	<0.2	0.09		46	0.27				9		6.2	6.38	540	0	19	nil	clear	nil
07-Apr-96	Harania Rd 3	B			<0.001	0.002	0.008	4.8			0.003		2.6	0.04			7.1		<0.003			23*	0.35	6.29	130	<1	22	slight	cloudy	gr. / br.
25-Oct-96	Harania Rd 3	B	0.5			0.039	0.039	120					0.049	0.1	520		5.5	0.032	0.039			33	1.75	8.08	195	1	18	strong	opaque	gr. / blck
26-Sep-94	Harania Rd 4		0.43	17	<0.01	<0.02	<0.03	0.5	2.7	10	0.15	26	<0.2	0.06		181	0.5				11		8.2	5.97	240	0	15	nil	clear	clear
17-Oct-94	Harania Rd 4		<0.02	12	<0.01	<0.02	<0.03	0.9	2.9	7	0.16	19	<0.2	0.26		335	0.24				6.7		6	6.62	102	0	16	nil	clear	clear
17-Feb-95	Harania Rd 4		0.4	123	<0.01	<0.02	<0.03	3	131	62	0.39	139	<0.2	0.58		110	0.22				83		8.2	6.38	540	0	18	nil	clear	nil
13-Sep-95	Harania Rd 4	S	0.41	18	0.0003	0.003	0.014	1.8	8.5	13	0.15	59	0.013	0.14	-	40	0.11	-	-		12		0							
17-Feb-95	Harania Rd 5		0.3	85	<0.01	<0.02	<0.03	2.7	89	39	0.29	57	<0.2	0.36		98	0.19				44		9	6.41	19	0	19	nil	clear	nil
07-Apr-96	Harania Rd 5	B			<0.001	0.03	0.045	6.6			0.023		0.18	0.052			<0.006		<0.003			0.2*	3	5.52	90	<1	21	slight	sl. cloudy	or. / br.
25-Oct-96	Harania Rd 5	B	0.4			0.09	0.091	23					0.076	0.15	170		0.22	0.005	0.061			32	3.2	5.15	80	0	19	strong	opaque	brown
17-Feb-95	Harania Rd 6		0.14	9.5	<0.01	<0.02	<0.03	1.9	3.7	2.6	0.2	25.5	<0.2	0.05		185	0.91				2.1		2	6.81	21	0	21	nil	clear	nil
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*																
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*														
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*																
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*																

BAIRDS RD

date collected	location		B mg/l	Ca mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Fe mg/l	K mg/l	Mg mg/l	Mn mg/l	Na mg/l	Pb mg/l	Zn mg/l	Cl mg/l	COD mg/l	NH_4-N mg/l	Nitrite mg/l	Nitrate mg/l	NNN mg/l	Total N mg/l	TOC	DO
23-Sep-94	Bairds Rd 1		0.13	9.5	<0.01	<0.02	<0.03	0.6	<1.3	4.5	0.12	19	<0.2	0.1		1730	0.05				1.9		8.4
15-Feb-95	Bairds Rd 1		0.19	11.3	<0.01	0.03	0.16	1.7	3.4	5	0.06	32.5	<0.2	<0.1		1300	0.27				0.7		3
23-Sep-94	Bairds Rd 2		0.23	16.2	<0.01	<0.02	<0.03	4	<1.3	6	0.35	25	<0.2	0.08		247	0.09				1.5		6
12-Sep-95	Bairds Rd 2	S	0.62	50	0.0002	0.003	0.009	30	2.1	9.7	2.9	33	0.023	0.05	-	30	0.11	-	-		0.57		0
23-Sep-94	Bairds Rd 3		0.3	9.7	<0.01	<0.02	<0.03	0.7	<1.3	4.5	0.12	20	<0.2	0.12		549	<0.04				1.8		8.6
15-Feb-95	Bairds Rd 3		0.12	11	<0.01	0.03	0.08	1.4	2.6	4	0.11	25.5	<0.2	0.06		256	0.17				0.5		3.5
Comparison Data																							
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.02*									
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.4*									
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.01*									
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*25*		*10500*							
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*									
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*0.12*									
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.095*									
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	**0.005*									
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	*0.05*									

OLD QUARRY RD

date collecte	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)	NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Coronation Rd 1	S	0.03	10	<0.01	<0.01	<0.03	2.5	<1.3	5.1	0.08	17	<0.2	0.05		145	0.07				2.5		9.8	6.49	135	0	17	none	opaque	light greysh brown
17-Oct-94	Coronation Rd 1	S	<0.02	16	<0.01	<0.01	<0.03	0.5	2.3	9	0.02	30	<0.2	0.1		65	0.07				3.3		8.3	6.85	230	0	16	none	clear	clear
26-Sep-94	Coronation Rd 2	S	0.04	9	<0.01	<0.01	<0.03	2.4	<1.3	5.9	0.06	16	<0.2	0.04		<2	<0.04				2.5		10.2	6.53	140	0	15	none	clear	light greysh brown
17-Oct-94	Coronation Rd 2	S	<0.02	16	<0.01	<0.01	<0.03	0.7	2.1	9	0.04	33	<0.2	0.02		210	0.07				3.3		7.8	6.73	248	0	15	none	clear	clear
26-Sep-94	Coronation Rd 3	S	0.2	75	<0.01	<0.01	<0.03	42	5.9	47	2.4	70	<0.2	0.2		38	0.88				1.8		2.2	6.03	800	0.5	14	none	clear	light greysh brown
17-Oct-94	Coronation Rd 3	S	<0.02	80	<0.01	<0.01	<0.03	35	7.7	47	2.2	63	<0.2	0.1		355	0.74				1.5		4.3	6.37	1800	500	15	dull org	susp rust	clear
26-Sep-94	Coronation Rd 4	S	0.24	83	<0.01	0.02	<0.03	27	5.1	50	1.8	55	<0.2	<0.01		102	1.3				1.7		2.5	6.22	800	0.5	17	none	clear	light greysh brown
17-Oct-94	Coronation Rd 4	S	0.2	85	<0.01	<0.01	<0.03	30	8	49	1.6	58	<0.2	<0.01		170	1.2				1.7		2.8	6.47	8000	500	17	dull org	susp rust	clear
14-May-96	Old Quarry Rd	S			<0.001	<0.002	0.02	2.1			0.7		0.008	0.04			0.18		1.1			5.8	2.65	6.95	750	<1	20	slight	clear	lt. orange
24-Feb-96	Old Quarry Rd 1	S	0.27	9.2	<0.01	<0.01	<0.03	3	2.7	4.9	0.08	27.5	<0.2	0.08		80	0.2				1.3		4	7.01	nt	0	22	none	opaque	light grey brown
24-Feb-96	Old Quarry Rd 2	S	0.26	9.6	<0.01	<0.01	<0.03	3	4	6	0.07	41	<0.2	0.12		54	0.16				1.4		4.2	6.96	nt	0	22	none	opaque	light grey brown
12-Sep-95	Old Quarry Rd 3	S	0.39	75	0.0005	0.005	0.011	46	8.1	41	1.6	64	0.024	0.088	-	50	0.54	-	-		1.3		0.5							
12-Sep-95	Old Quarry Rd 4	S	0.46	170	0.0028	0.16	0.24	1800	17	82	5.5	79	1.1	2	-	440	0.49	-	-		2.9		0.5							
Comparison Data																														
	blank		*0.21*	*1.4*	*<0.01*	*<0.01*	*<0.03*	*0.14*	*1.3*	*0.2*	*0.006*	*3.1*	*<0.2*	*0.12*		*54*	*0.16*				*1.4*		*4.2*	*6.96*	*nt*	*0*	*22*	*none*	*opaque*	*light grey brown*
	sea water		*3.3*	*337*	*<0.1*	*<0.1*	*<0.3*	*0.3*	*331*	*1077*	*0.07*	*9283*	*<2*	*0.02*																
	river water		*<0.1*	*4.2*	*<0.01*	*<0.01*	*<0.03*	*5.9*	*6.1*	*7.5*	*0.13*	*24.4*	*<0.2*	*0.4*																
	Greenmount		*22*		*<0.01*	*0.19*	*0.07*	*128*			*13*		*0.18*	*0.01*																
	ARC Trade Waste		*25*		*1*	*30*	*10*				*20*		*10*	*25*		*10500*														
USEPA Fresh Acute					*0.0039*	*0.016*	*0.18*						*0.083*	*25*																
USEPA Marine Acute					*0.043*	*1.1*	*0.0029*						*0.22*	*0.12*																
ANZECC Freshwater					**0.0002*	*0.01*	**0.002*	*1*					**0.001*	*0.095*																
ANZECC Marine					*0.002*	*0.05*	*0.005*						*0.005*	**0.005*																

Appendix C

Data for Stream Water Samples

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Manukau City - OLD LANDFILL TESTING

Location: RIVERINA AVE

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		30.10.99	30.10.99
Time - sampling		8.07am	8.30am
Low tide		6.03am	6.03am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	7.35	7.66
Dissolved Oxygen	mg/l	11.99	11.33
Conductivity	mS/m	Exceeds limits of the portable machine	
Clarity		Opaque	Opaque
Visual Inspection		Tidal	Tidal
SAMPLE Number			
Lab sample No		121AN	122AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 30.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **RIVERINA AVE**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		121AM	122AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L		
Chromium	mg/L		
Copper	mg/L		
Lead	mg/L		
Manganese	mg/L		
Zinc	mg/L		
Iron	mg/L		
Cadmium	mg/L		
TOC	ppm	10.6	11.8
Nitrate - N	mgNO_3-N/L	0.6	0.4
Nitrite - N	mgNO_2-N/L	0.01	0.02
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.8	0.3
Chloride	mg/L	13 450	14 975

Tested by: SPJ Date: 30.10.99
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Manukau City - OLD LANDFILL TESTING

Location: **KINGFISHER PLACE**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		29.10.99	29.10.99
Time - sampling		8.50am	9.15am
Low tide		8.17am	8.17am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.54	6.75
Dissolved Oxygen	mg/l	9.82	9.28
Conductivity	mS/m	260.00	378.00
Clarity		Clear	Clear
Visual Inspection		Flow steady	Flow steady
SAMPLE Number			
Lab sample No		113AN	114AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ & DH Date: 29.10.99
Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **KINGFISHER PLACE**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		113AN	114AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L		
Chromium	mg/L		
Copper	mg/L		
Lead	mg/L		
Manganese	mg/L		
Zinc	mg/L		
Iron	mg/L		
Cadmium	mg/L		
TOC	ppm	7.2	9
Nitrate - N	$mgNO_3$-N/L	1.5	1.5
Nitrite - N	$mgNO_2$-N/L	0.04	0.04
Total Ammoniacal Nitrogen	$mgNH_3$-N/L	0.3	0.8
Chloride	mg/L	730	1170

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Manukau City - OLD LANDFILL TESTING

Location: **PAH ROAD**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		28.10.99	28.10.99
Time - sampling		10.30am	11.00am
Low tide		7.55am	7.55am
Weather		Overcast	Overcast
MEASUREMENTS			
pH	-	7.21	7.25
Dissolved Oxygen	mg/l	14.06	13.99
Conductivity	mS/m	24.5	95.6
Clarity		Clear	Clear
Visual Inspection		Flow steady	Flow steady
SAMPLE Number			
Lab sample No		965AM	966AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

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Manukau City - OLD LANDFILL TESTING

Location: **PAH ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		965AN	966AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.024	0.099
Chromium	mg/L	0.0011	0.0015
Copper	mg/L	0.0034	0.0033
Lead	mg/L	0.0011	0.0012
Manganese	mg/L	0.118	0.32
Zinc	mg/L	0.011	0.017
Iron	mg/L	0.88	1.55
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	10.8	12.2
Nitrate - N	mgNO_3-N/L	0.9	1
Nitrite - N	mgNO_2-N/L	0.03	0.24
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	35	295

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Manukau City - OLD LANDFILL TESTING

Location: **ROBERT ALLAN PARK**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		26.10.999	26.10.99
Time - sampling		3.50pm	4.05pm
Low tide		3.28pm	3.28pm
Weather		Overcast	Overcast
MEASUREMENTS			
pH	-	7.03	7.21
Dissolved Oxygen	mg/l	7.94	8.24
Conductivity	mS/m	1883	Out of range
Clarity		Clear	Clear
Visual Inspection		Odourless	Odourless
SAMPLE Number			
Lab sample No		086AN	087AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

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Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **ROBERT ALLAN PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		088AN	087AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	1.67	1.94
Chromium	mg/L	<0.005	<0.005
Copper	mg/L	0.006	0.007
p	mg/L	0.002	0.002
Manganese	mg/L	0.443	0.340
Zinc	mg/L	0.080	0.07
Iron	mg/L	0.9	0.7
Cadmium	mg/L	<0.0005	<0.0005
TOC	ppm	14.0	12.5
Nitrate - N	$mgNO_3$-N/L	0.7	0.8
Nitrite - N	$mgNO_2$-N/L	0.04	0.02
Total Ammoniacal Nitrogen	$mgNH_3$-N/L	<0.2	<0.2
Chloride	mg/L	665	720

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Manukau City - OLD LANDFILL TESTING

Location: **HILLS ROAD - MAYFIELD PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		987AM	988AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.058	0.093
Chromium	mg/L	0.0023	0.0019
Copper	mg/L	0.0039	0.0039
Lead	mg/L	0.0014	0.0017
Manganese	mg/L	0.0613	0.0712
Zinc	mg/L	0.024	0.028
Iron	mg/L	1.15	1.19
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	3.6	3.9
Nitrate - N	mgNO_3-N/L	1.5	2.2
Nitrite - N	mgNO_2-N/L	0.03	0.04
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.8	0.3
Chloride	mg/L	95	185
Salinity	mg/L	172	334

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Manukau City - OLD LANDFILL TESTING

Location: ORUARANGI ROAD

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		20.10.99	20.10.99
Time - sampling		2.00pm	2.15pm
Low tide		1.09pm	1.09pm
Weather		Fine	Fine
MEASUREMENTS			
pH	-	7.34	7.40
Dissolved Oxygen	mg/l	10.24	8.62
Conductivity	mS/m	34.5	35.0
Clarity		Clear	Clear
Visual Inspection		No flow	flow
SAMPLE Number			
Lab sample No		064AN	065AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

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Checked by: TB Date: 8.11.99

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Manukau City - OLD LANDFILL TESTING

Location: **ORUARANGI ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		064AN	065AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.055	0.057
Chromium	mg/L	<0.0005	<0.0005
Copper	mg/L	0.0031	0.0032
Lead	mg/L	0.0004	0.0003
Manganese	mg/L	0.0735	0.0759
Zinc	mg/L	0.016	0.016
Iron	mg/L	0.37	0.36
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	13.6	13.6
Nitrate - N	mgNO_3-N/L	0.2	0.2
Nitrite - N	mgNO_2-N/L	<0.01	<0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	0.6
Chloride	mg/L	53	46

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Manukau City - OLD LANDFILL TESTING

Location: **HARANIA AVE**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		19.10.99	19.10.99
Time - sampling		11.15am	11.45am
Low tide		11.58am	11.58am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.32	6.91
Dissolved Oxygen	mg/l	7.52	8.03
Conductivity	mS/m	25.90	44.30
Clarity		Clear	Clear
Visual Inspection		No flow	Slight flow
SAMPLE Number			
Lab sample No		044AN	045AN
Lab Used		SGS	SGS
Method of collection		Baller	Bailer

Tested by: TB Date: 19.10.99
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Manukau City - OLD LANDFILL TESTING

Location: **HARANIA PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		044AN	045AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.041	0.076
Chromium	mg/L	0.0006	<0.0005
Copper	mg/L	0.0094	0.0058
Lead	mg/L	0.0007	0.0007
Manganese	mg/L	0.0742	0.0313
Zinc	mg/L	0.041	0.060
Iron	mg/L	0.26	0.15
Cadmium	mg/L	0.00008	<0.00005
TOC	ppm	4.6	7.6
Nitrate - N	mgNO_3-N/L	10.1	4.4
Nitrite - N	mgNO_2-N/L	0.02	0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	28	64

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Manukau City - OLD LANDFILL TESTING

Location: **OLD QUARRY ROAD**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		19.10.99	19.10.99
Time - sampling		12.00pm	12.30pm
Low tide		11.58am	11.58am
Weather		Fine	Fine
MEASUREMENTS			
pH	-	7.07	7.00
Dissolved Oxygen	mg/l	9.70	9.24
Conductivity	mS/m	26.30	27.90
Clarity		Clear	Clear
Visual Inspection		Flow	Slight flow
SAMPLE Number			
Lab sample No		046AN	047AN
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

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Manukau City - OLD LANDFILL TESTING

Location: **OLD QUARRY ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		046AN	047AN
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.037	0.038
Chromium	mg/L	<0.005	<0.0005
Copper	mg/L	0.0019	0.0020
Lead	mg/L	0.0007	0.0005
Manganese	mg/L	0.0169	0.0176
Zinc	mg/L	0.025	0.026
Iron	mg/L	0.2	0.22
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	6.7	72
Nitrate - N	mgNO_3-N/L	0.3	0.2
Nitrite - N	mgNO_2-N/L	<0.01	<0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	28	25

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Manukau City - OLD LANDFILL TESTING

Location: **ELM PARK**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		12.10.99	12.10.99
Time - sampling		2.35pm	2.55pm
Low tide		4.16pm	4.16pm
Weather		Overcast	Overcast
MEASUREMENTS			
pH	-	7.08	7.12
Dissolved Oxygen	mg/l	8.50	8.40
Conductivity	mS/m	39.50	72.10
Clarity		Clear	Clear
Visual Inspection		Flow steady	Flow steady
SAMPLE Number			
Lab sample No		992AM	993AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

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Manukau City - OLD LANDFILL TESTING

Location: **ELM PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		992AM	993AM
Method of collection		Baller	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.33	0.060
Chromium	mg/L	0.0006	0.0013
Copper	mg/L	0.0027	0.0047
Lead	mg/L	0.0007	0.0019
Manganese	mg/L	0.0897	0.102
Zinc	mg/L	0.048	0.059
Iron	mg/L	0.72	1.01
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	7.2	4.7
Nitrate - N	mgNO_3-N/L	4.6	4.8
Nitrite - N	mgNO_2-N/L	0.02	0.02
Total Ammoniacal Nitrogen	mgNH_3-N/L	<0.2	<0.2
Chloride	mg/L	25	100
Salinity	mg/L	45	181

Tested by: SPJ Date: 12.10.99
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Manukau City - OLD LANDFILL TESTING

Location: **BAIRDS ROAD**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		11.10.99	11.10.99
Time - sampling		1.20pm	2.05pm
Low tide		3.35pm	3.35pm
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.15	6.42
Dissolved Oxygen	mg/l	6.20	6.10
Conductivity	mS/m	19.71	14.41
Clarity		Clear	Clear
Visual Inspection		Flowing	Flowing
SAMPLE Number			
Lab sample No		989AM	990AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

Tested by: SPJ Date: 11.10.99
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Manukau City - OLD LANDFILL TESTING

Location: **BAIRDS ROAD**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		989AM	990AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.056	0.056
Chromium	mg/L	0.0009	0.0008
Copper	mg/L	0.0048	0.0037
Lead	mg/L	0.002	0.0014
Manganese	mg/L	0.107	0.104
Zinc	mg/L	0.074	0.074
Iron	mg/L	0.86	0.79
Cadmium	mg/L	0.00006	0.00005
TOC	ppm	6.2	6.4
Nitrate - N	mgNO_3-N/L	2.5	2.6
Nitrite - N	mgNO_2-N/L	0.01	0.02
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.6	0.3
Chloride	mg/L	15	15
Salinity	mg/L	27	27

Tested by: SPJ Date: 11.10.99
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Manukau City - OLD LANDFILL TESTING

Location: **COXHEAD PARK**

STREAM SAMPLING

Parameter	Units	Results	
Site			
Type of Site		Up stream	Down Stream
Date - of sampling		11.10.99	11.10.99
Time - sampling		3.00PM	3.20PM
Low tide		N/A	N/A
Weather		Fine	Fine
MEASUREMENTS			
pH	-	6.78	6.80
Dissolved Oxygen	mg/l	8.40	8.60
Conductivity	mS/m	17.25	17.76
Clarity		Clear	Clear
Visual Inspection		Flowing	Flowing
SAMPLE Number			
Lab sample No		967AM	968AM
Lab Used		SGS	SGS
Method of collection		Bailer	Bailer

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Manukau City - OLD LANDFILL TESTING

Location: **COXHEAD PARK**

LABORATORY RESULTS

Parameter	Units	Results	
Site			
Type of Site		Up Stream	Down Stream
SAMPLE			
Lab sample No		967AM	968AM
Method of collection		Bailer	Bailer
Lab Used		SGS	SGS
ANALYSIS			
Boron	mg/L	0.045	0.046
Chromium	mg/L	0.0008	0.0007
Copper	mg/L	0.0014	0.0012
Lead	mg/L	0.0005	0.0003
Manganese	mg/L	0.0378	0.0384
Zinc	mg/L	0.032	0.032
Iron	mg/L	0.26	0.22
Cadmium	mg/L	<0.00005	<0.00005
TOC	ppm	1.6	2.2
Nitrate - N	mgNO_3-N/L	3.1	3.6
Nitrite - N	mgNO_2-N/L	0.01	0.01
Total Ammoniacal Nitrogen	mgNH_3-N/L	0.3	0.8
Chloride	mg/L	15	15
Salinity	mg/L	27	27

Tested by: SPJ Date: 11.10.99
Checked by: TB Date: 8.11.99

Appendix D

Data for Great South Road Borehole Samples

GREAT SOUTH ROAD OLD LANDFILL
BOREHOLE MONITORING RECORD

SGS LAB NUMBER: 0834/00
GHD REPORT NUMBER: 21 2530 00

PARAMETER	UNIT	Borehole 1	Borehole 2
Depth of Borehole	m	6.23	6.07
Depth to water level	m	3.09	3.11
Date sampled	-	24.3.00	24.3.00
Time sampled		12.00pm	11.25am
pH	-	5.93	6.64
Conductivity	mS/m	28.4	485
Temperature	Deg C	17.8	18.9
Observations	-	Rusty smell, cloudy and orange	Sulphurous odour, cloudy and yellow grey
Organochlorine Pesticides			
Alpha – BHC	mg/kg	<0.01	<0.01
Beta – BHC	mg/kg	<0.01	<0.01
Lindane	mg/kg	<0.01	<0.01
Heptachlor	mg/kg	<0.01	<0.01
Aldrin	mg/kg	<0.01	<0.01
Heptachlorepoxide	mg/kg	<0.01	<0.01
Endosulfan I	mg/kg	<0.01	<0.01
DDE	mg/kg	<0.01	<0.01
Dieldrin	mg/kg	<0.01	<0.01
Endrin	mg/kg	<0.01	<0.01
Sample Numbers		427AR	428AR

Sampled by ; TB & RC Date ; 24 3.00

Transpositions Checked By ; TB Date ; 17.04.00

SGS LAB NUMBER: 0834/00

PARAMETER	UNIT	Borehole 1	Borehole 2
O, P' – DDT	mg/kg	<0.01	<0.01
Endosulfan II	mg/kg	<0.01	<0.01
P, P' – DDD	mg/kg	<0.01	<0.01
P, P' – DDT	mg/kg	<0.01	<0.01
Methoxychlor	mg/kg	<0.01	<0.01
BTEX			
Benzene	mg/lt	<0.01	<0.01
Toluene	mg/lt	<0.01	<0.01
Ethyl benzene	mg/lt	<0.01	<0.01
Xylenes	mg/lt	<0.01	<0.01
Polyaromatic Hydrocarbons			
Naphthalene	mg/lt	<0.01	<0.01
Acenaphthalene	mg/lt	<0.01	<0.01
Acenaphthene	mg/lt	<0.01	<0.01
Flourene	mg/lt	<0.01	<0.01
Phenanthrene	mg/lt	<0.01	<0.01
Anthracene	mg/lt	<0.01	<0.01
Fluoranthene	mg/lt	<0.01	<0.01
Pyrene	mg/lt	<0.01	<0.01
Benz(a)anthracene	mg/lt	<0.01	<0.01
Chrysene	mg/lt	<0.01	<0.01
Benzo(b)fluoranthene	mg/lt	<0.01	<0.01
Benzo(k)fluoranthene	mg/lt	<0.01	<0.01
Benzo(a)pyrene	mg/lt	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	mg/lt	<0.01	<0.01
Dibenz(a,h)anthracene	mg/lt	<0.01	<0.01
Benzo(ghi)perylene	mg/lt	<0.01	<0.01
Sample Numbers		427AR	428AR

Sampled by ; TB & RC Date ; 24.3.00

Transpositions Checked By ; TB Date ; 17.04.00

SGS LAB NUMBER: 0834/00

PARAMETER	UNIT	Borehole 1	Borehole 2
Phthalates			
Dimethylphthalate	mg/lt	<0.01	<0.01
Diethylphthalate	mg/lt	<0.01	<0.01
Dibutylphthalate	mg/lt	<0.01	<0.01
Benzylbutylphthalate	mg/lt	<0.01	<0.01
Bis(2-ethylhexyl)phthalate	mg/lt	<0.01	<0.01
Di-n-octylphthalate	mg/lt	<0.01	<0.01
PCB's			
PCB	mg/lt	<0.004	<0.004
Phenols			
Phenol	mg/lt	<0.01	<0.01
2-Chlorophenol	mg/lt	<0.01	<0.01
2-Methylphenol	mg/lt	<0.01	<0.01
3 & 4-Methylphenol	mg/lt	<0.01	<0.01
2-Nitrophenol	mg/lt	<0.01	<0.01
2,4-Dimethylphenol	mg/lt	<0.01	<0.01
2,4-Dichlorophenol	mg/lt	<0.01	<0.01
2,6-Dichlorophenol	mg/lt	<0.01	<0.01
4-Cholro-3-methylphenol	mg/lt	<0.01	<0.01
2,4,6-Trichlorophenol	mg/lt	<0.01	<0.01
2,4,5-Trichlorophenol	mg/lt	<0.01	<0.01
4-Nitrophenol	mg/lt	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	mg/lt	<0.01	<0.01
2-Methyl-4,6-dinitrophenol	mg/lt	<0.01	<0.01
Pentachlorophenol	mg/lt	<0.01	<0.01
2-sec-Butyl-4,6-Dinitrophenol	mg/lt	<0.01	<0.01
Sample Numbers	-	427AR	428AR

Methodology : GC/MS after solvent extraction
GC/ECD after solvent extraction

Sampled By : TB & RC Date : 24.3.00

Transpositions Checked By : TB Date : 17.04.00

Analytes Measured

date collected	location		B (mg/l)	Ca (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	K (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Pb (mg/l)	Zn (mg/l)	Cl (mg/l)	COD (mg/l)
26-Sep-94	Gt Sth Rd 1		0.25	55	<0.01	<0.01	<0.03	2.4	5.8	15	0.3	56	<0.2	0.26		163
26-Sep-94	Gt Sth Rd 2		0.38	75	<0.01	<0.01	<0.03	5.7	13	29	0.6	112	<0.2	0.13		265
24-Feb-95	Gt Sth Rd 1		0.5	75	0.06	<0.01	0.52	373	9.4	17.4	0.98	66	0.45	15.3		122
24-Feb-95	Gt Sth Rd 2		0.31	13.8	<0.01	<0.01	<0.03	2.8	2.5	2.6	0.06	13.9	<0.2	0.26		246
12-Sep-95	Gt South Rd 1	S	0.4	59	0.0009	0.002	0.015	11	8.3	13	0.8	47	0.013	0.49	-	35
12-Sep-95	Gt South Rd 3	S	0.35	32	0.0003	0.002	0.009	3.1	4.7	6.6	0.13	29	0.008	0.19	-	25
14-May-96					0.002	0.01	0.08	46			1.2		0.05	1.7		
14-May-96					<0.001	<0.002	0.02	3.3			0.3		0.007	0.07		
	blank		0.21	1.4	<0.01	<0.01	<0.03	0.14	1.3	0.2	0.006	3.1	<0.2	0.02		
	sea water		3.3	337	<0.1	<0.1	<0.3	0.3	331	1077	0.07	9283	<2	0.4		
	river water		<0.1	4.2	<0.01	<0.01	<0.03	5.9	6.1	7.5	0.13	24.4	<0.2	0.01		
	Greenmount		22		<0.01	0.19	0.07	128			13		0.18	25		10500
	ARC Trade Waste		25		1	30	10				20		10	25		
USEPA Fresh Acute					0.0039	0.016	0.18						0.083	0.12		
USEPA Marine Acute					0.043	1.1	0.0029						0.22	0.095		
ANZECC Freshwater					*0.0002	0.01	*0.002	1					*0.001	*0.005		
ANZECC Marine					0.002	0.05	0.005						0.005	0.05		

Analytes Measured

date collected	location		NH4-N (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	NNN (mg/l)	Total N (mg/l)	TOC	DO	pH	EC	salinity	temp	odour	clarity	colour
26-Sep-94	Gt Sth Rd 1		0.12				0.59		4.1	6.56	510	0	16	swamp	clear	none
26-Sep-94	Gt Sth Rd 2		0.34				0.97		5.4	6.62	680	0.3	15	swamp	clear	none
24-Feb-95	Gt Sth Rd 1		2.5				57		0.5	6.88	700	100	22	org	opaque	dark grey
24-Feb-95	Gt Sth Rd 2		0.18				0.7		4	6.86	150	0	22	nil	clear	v lt yellow
12-Sep-95	Gt South Rd 1	S	0.35	-	-		0.75		0							
12-Sep-95	Gt South Rd 3	S	0.29	-	-		1.6		0							
14-May-96			2.9		0.007			10	0.95	6.98	100	<1	18	strong	opaque	black
14-May-96			1.1		0.006			6	2	6.59	27	0	20	nil	clear	or. br.
	blank															
	sea water															
	river water															
	Greenmount															
	ARC Trade Waste															
USEPA Fresh Acute																
USEPA Marine Acute																
ANZECC Freshwater																
ANZECC Marine																

Appendix E

Site Specific Data

Site Specific Data

This section contains the individual site reports of the seven MCC Old Landfills that may require additional review by the ARC. Each site report contains:

- basic data on the site and the condition index value
- description of the site itself, and the history
- a narrative of the main investigation and results
- a descriptive assessment of the importance of the site
- site map
- chemical analysis results

The basic data on the site includes such information as the estimated area, average depth and fill volume. The area and depth have been fairly well defined in most sites as a result of the borehole investigations. Where there is uncertainty, because the bore investigation data did not sufficiently define these quantities, an estimate of the quantities has been made.

Where no bores were dug and no other information was available, a conservative overestimate of the fill depth or area has been made. It is inferred that the fill areas are within the boundaries of the properties within which the old landfills are contained. The fill depth is taken to be the difference in height between the top surface of the fill and the natural ground at the base of the fill beyond the landfill footprint. The volume of fill has in all cases been taken as the product of these parameters.

The site maps (Appendix A) show the site location and the sampling points. The locations of the investigation bores are also shown in the maps.

1.1 Hills Road (Mayfield Park)

Site Name	Hills Rd
Filltype	Household
Estimated Fill Volume (m^3)	100000
Estimated Fill Area (ha)	2
Estimated Average Depth (m)	5
Road Location	Hills Rd, Mayfield Park
Suburb	Otara

Adjacent Watercourse	Otara Creek
Open	1963
Close	1967
Underlying Geology	Sedimentary materials of the Tauranga group
Legal Description	Allot 356 (SO 45686)
Leachate Strength (%)	11.01
Condition Index Value	6041

Note: The area of the main body Mayfield Park that contains the landfill is about 3 ha. However the depth of fill will vary over the site. The greatest depth of fill will be found in the former riverbed (where the bores installed on the site have been dug). The area located within the former bend of the river, was excavated for cover material being placed in the creek bed. This area was later filled also with refuse but the depth of refuse would be much less. To allow for this change in depth we have only allowed for a 'representative' fill area of 2 ha.

1.1.1 ***Location and Description***

The site is in the area bordered by Hills Rd, the Otara Creek and Velvet Crescent in Otara. The area is now part of Mayfield Park.

The fill area is roughly oval in shape. The surface is moderately uneven and does not drain properly making it inadequate for contact sports particularly during winter. The filled areas show signs of settlement. This is consistent with fill consolidation as refuse decomposes.

The edge of the site along the Otara Creek drops steeply down to the mudflats. The eastern boundary slopes up at approximately 25 degrees bank to Hills Rd. A low stone wall has been built along the full length of the site above the Otara Creek bank.

The bulk of the site is mown grass with exotic trees around the perimeter. None exhibit any sign of stress that might be associated with landfill gas or leachate influence. The eastern bank of the Otara Creek has reeds, flax, weeds and young mangroves.

There are several springs on the banks of the Otara Creek. The strongest springs come out of the landfill at about the location of the route of the former creek.

1.1.2 History

Information about the site is from the recollections of long serving staff, past and present residents and some sketchy council records.

The site was originally used as the sewerage treatment plant for the original Housing Corporation subdivision of Otara. Following its acquisition by the then Manukau County the almost circular bend in the Otara River was straightened. The County filled the resulting ox bow lake. It was the major municipal dump for Manukau County at the time and received all types of household and commercial rubbish. There is no record of filling or earthworks on the western side of the present channel.

Written records and verbal reports from present and past residents show that local residents complained of many operational problems which resulted in such nuisances as rats, mosquitoes, flies, dust and odour etc.

1.1.3 Surface Water and Ecology

The catchment for the Otara creek contains many industrial, commercial, urban and rural areas. A breakdown of the zoning for the Otara Lake catchment is given in the report for the Ngati Otara site. Stormwater runoff and possible sewerage overflows affect water quality.

The Otara Creek flows south to north on the western edge of the site and is tidal at this point. The creek is very unsightly. The water appears dark, dead and polluted. However this is most likely due to industry and other pollutant sources in the catchment. Water quality results indicate high levels of biological pollutants (most probably as a result of sewer overflows).

Former residents reported that Otara Creek by the landfill was a very popular swimming spot with firm riverbeds and provided rich fishing grounds. The river is now heavily silted and is not safe for swimming or fishing.

Only a few small finned fish have been observed in the stream. A proper biological evaluation of the stream has not been done yet.

The Otara Lake, which is just downstream, is the subject of water quality initiatives by the MCC, ARC and ECNZ with intention of making the lake suitable for contact recreation. These initiatives may have to address problems in the catchment and thus there may be a positive effect on the water quality of the Otara Creek at Hills Rd.

1.1.4 Drains

Stormwater lines (225 diameter falling into 380 diameter) cross and fringe on the southern edge of the site. A 230 diameter sewer runs inside the stone wall on the western edge.

1.1.5 Surrounds

The Otara area is predominantly flat and low lying with some gentle rolling hills. There is residential housing on the southern and northern edges of the site and across Hills Rd on the western side. The site is part of Mayfield Park reserve, which runs to the north and south on the western side of the creek. In addition the drainage reserve to the creek runs further north and south. Mayfield school is within a couple of blocks of the site.

1.1.6 Water Sampling

Six monitoring stations were established. Site 4 just upstream and Site 5 just downstream of the landfill in the stream provide samples indicative of the impacts of landfill discharges on the stream water quality. There is the possibility that tidal effects will propagate contaminants and saline water upstream reducing the value of the control.

Site 1 sampled a spring, which according to the records is about the location of a piped outlet from one end of the filled former oxbow riverbed. The spring should allow direct measurement of the leachate. It is distinctly rusty possibly with iron oxide from the landfill.

Site 2 is located on the last manhole of a stormwater culvert before it discharges into the creek. The culvert skirts the southern boundary of the landfill. The joints in the manhole walls at Site 2 are noticeably encrusted with rusty oxide deposits. During wet weather they act as entry points for water into the manhole chamber. This suggests that groundwater from the surrounding filled area may be entering the manhole during wet weather and is possibly carrying leachate into the manhole. Sites 3 and 6 are stormwater manholes further up the grade on the same culvert.

In general sampling from culverts does have limitations namely that leachate will only be present in the culvert if it can get into the culvert. If the flow is not continuous then sampling on any particular day may not detect leachate. However the increased length of culvert through the fill area should increase the chance that leachate will enter the culvert.

1.1.7 Pooled Water Sampling

It is common for water to pool on this site during winter. MCC became concerned that water pooling on the site could contain leachate, which may pose a public health risk.

A special set of tests was carried out on the pooled water. The results are shown in table 10.

Table 10 : Parameters in Pond Water at Hills Rd

Parameter	Unit	Result
Cadmium	mg / l	<0.003
Copper	mg / l	0.02
Chromium	mg / l	0.03
Iron	mg / l	35
Lead	mg / l	0.03
Manganese	mg / l	1.8
Zinc	mg / l	0.1
Nitrate	mgNO_3 - M/L	0.027
Nitrite	mgNO_2 - M/L	<0.005
Total Ammonia Nitrogen	mgNH_3 - M/L	1.9
Non-purgable organic carbon	mg / l	27

1.1.8 ***Subsurface Investigations***

Four bores were drilled on site. They were located in areas that appeared to be settling and were likely to pick up the location of previous bend in the river that was filled.

The fill was 4 to 4.5m deep in the two bores closest to the present creek. It was 5 to 5.5m deep in the bores closest to the road. All four bores showed that Waitemata group materials underlay the fill. The water table was intercepted in all bores at a depth of around 1.5m. Piezometers were installed in all bores.

A mixture of clay fill and assorted refuse was found in all of the bores. Gas levels between 60% and 75% LEL were recorded in all of the bores.

The topsoil depth was approximately 0.2m.

1.1.9 ***Consultation***

A letter drop to neighbouring residents took place in December 1994 to inform them what the investigation is for and to request information. No responses were received.

A report to the Otara Ward community board March 1995 meeting and a subsequent article in the Manukau Courier resulted in several callers providing historical information about this site.

1.1.10 ***Results and Conclusions***

The water quality results taken for this investigation have shown a low level of contamination. While there are low concentrations of leachate indicators in the

spring at site 1, there is no detectable change in water quality between sampling stations 4 and 5.

In November 1998, Manukau City Council started a project to lay a clay cap on this landfill. The intention is to improve the year round usability of the park surface and reduce infiltration into the landfill below.

Overall, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.2 Pah Road (Papatoetoe Cemetery)

Site Name	Pah Rd
Filltype	Household
Estimated Fill Volume (m^3)	30000
Estimated Fill Area (ha)	0.5
Estimated Average Depth (M)	6
Road Location	Papatoetoe Cemetery
Suburb	Papatoetoe
Adjacent Watercourse	Waokauri Creek
Open	unknown
Close	1965
Underlying Geology	Pumiceous deposits of the Tauranga group
Legal Description	PT LOT 2 DP 11565
Leachate Strength (%)	20.94
Condition Index Value	2927

1.2.1 Location and Description

The site is located within the South Auckland cemetery. The cemetery is on the north side of Puhinui Rd several hundred metres from its intersection with Roscommon Rd. The cemetery is bound by the Waokauri creek to the west and the southwestern motorway to the east.

The landfill is now an open space park area within the cemetery. It is adjacent to the carparks outside the cemetery administration office. It falls gently westwards to the Waokauri creek. The surface is well maintained surrounded by scattered trees. There is no sign of settlement on the surface but it is possible that this is due to maintenance and continued local filling by cemetery staff. The grass and surrounding trees show no sign of distress.

The front face of the filled area is quite steep and is covered in weeds and scrubs. Underneath this vegetation there is rubble, metals and concrete etc. and other obstructions typical of old dumps. The fill area fringes onto the creek.

1.2.2 *History*

The fill was formed in part by filling a branch of the Waokauri Creek. Filled area also extended along the bank of the main tributary. The site was operated as the municipal rubbish dump by the Papatoetoe City Council and received all types of household and commercial refuse.

1.2.3 *Surrounds*

The Waokauri creek runs north to south on the western edge of the cemetery. The stream is relatively free flowing, relatively clear and flowing on both sides with an assortment of waterweeds. No aquatic life such as fish and eels were observed. There are mangroves starting on the Waokauri creek just to the south of the landfill area.

The land within the cemetery extends for several hundred metres to the north, east and south of the landfill site. The crematorium is about 100m to the southeast of the landfill area. The land in the cemetery all fall gently to the Waokauri Creek. Beyond the motorway approximately half a kilometre from the cemetery, there is residential housing. The land immediately on the other side of the creek from the landfill is being used for horticulture. Beyond that the surrounding land to the north, south and west is rural being used for agriculture and horticulture. In general the surrounding land beyond the cemetery is flat.

1.2.4 *Water Sampling*

Three sampling sites are located on the Waokauri Creek for surface water quality testing. Site 2 is the rusty spring just above the toe of the filled slope. Site 1 is just downstream of the spring at the base of the filled tributary. Site A is in the mangroves. Site 3 is upstream from the filled area taken as a control. On the last two occasions samples have been taken at or immediately below the spring at site 2.

1.2.5 *Subsurface Investigations - Landfill Investigation*

Three boreholes were dug within the bounds of the landfill in January 1996. All three bores showed a depth of fill ranging between 7.5m (at the top of the bank) to 6.0m depth (at the other two bores). They all contained a mix of refuse and clay, with quite a high content of rubbish in places. No abnormal gas readings were measured.

Each bore showed that Waitemata group underlay the fill.

The groundwater table was intercepted in each bore at 1.5 to 2m depths. Piezometers were installed in each bore.

Topsoil of depths 0.6m and 1.3m was found in two of the bores. Topsoil was not recorded as being found in the last bore.

Groundwater samples were taken from all three bores in March 1996.

1.2.6 ***Previous Groundwater Investigations***

There is some specific background information for this site. To investigate problems with the shallow depth of the groundwater table and possible groundwater contamination arising from the graves a groundwater contamination investigation was undertaken in November 1994 by Pattle Delamore Partners. Some of the findings of their investigation are summarised here with the kind permission of the Manager of Manukau Memorial Gardens. We should note that Pattle Delamore did not seem to be aware that the site contained a landfill and their investigations did not include the landfill area.

During that investigation seven bores were dug on the site - one to the north, two to the east and four to the south of the landfill. Pattle Delamore acknowledges that insufficient bores were dug to clearly establish groundwater contours and its flow directions on the site. The pattern of groundwater is not simple and the results could be interpreted as being the result of perched groundwater or being due to groundwater flowing to former and still existing stream tributaries. It could be expected though that the general direction of groundwater would be to the east towards the stream.

The samples taken at the Pattle Delamore bores 2 and 3 are reasonably representative of the background groundwater quality.

The analytes tested both in our investigation and in the previous investigation were ammonia, nitrate and conductivity.

Ammonia in the landfill was in the range 70 - 130 mg/l, whereas the background groundwater showed levels of approximately 0.05 mg/l.

Nitrate measured in the landfill was less than 0.1 mg/l, whereas it was measured as 15 g/l in the background water. This disparity could possibly be due to the fact that the landfill groundwater was not analysed soon enough.

The overall picture is that the background groundwater, upstream of the influence of the landfill (and/or the graves - which Pattle Delamore separately

conclude are not having a significant impact) does not contain high concentrations of contaminants.

1.2.7 ***Results and Conclusions***

The surface water quality results showed no measurable contamination above background levels.

The groundwater analyses from the bores in the landfill area show that the average concentration of selected leachate indicators is 20.94% of the concentration of those indicators in a typical landfill leachate.

Again, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.3 Ngati Otara (Otara Park)

Site Name	Ngati Otara
Filltype	Household
Estimated Fill Volume (m^3)	24000
Estimated Fill Area (ha)	0.6
Estimated Average Depth (m)	4
Road Location	Alexander Crescent, Ngati Otara Park
Suburb	Otara
Adjacent Watercourse	Otara Lake
Open	1967
Close	1969
Underlying Geology	Inter-tidal mud and thick, fine and bedded ash
Legal Description	Pt Allot 520 Manurewa PSH (S0 53719)
Leachate Strength (%)	14.80
Condition Index Value	2162

1.3.1 ***Location and Description***

This site consists of a filled former inlet of the Otara Lake located inside the Otara Park in the area bordered by the Otara Lake, Otara Rd and Alexander Crescent. The site is now a recreational park consisting of passive recreation areas surrounding and to the west of a number of playing fields.

The confirmed filled area is a reclaimed tributary of the Otara Creek at the western end of the park. The tributary originated from around the location of the present marae. The front face of the fill falls onto a still existing tributary of the lake near the power station.

The site is largely flat and slightly lower than the surrounding ground. The land is generally flat. There are reasonably steep banks falling down to the Otara Lake to the north and the small tributary / inlet to the west.

The surface is a well-maintained grass surface with scattered trees over those areas not on the playing fields. None of the vegetation shows any signs of distress except for one tree at

the western edge of the fill area that is dying. There are signs of surface settlement causing poor drainage and probable ponding on a portion of the reclaimed area.

There are rusty springs at the edge of the tidal mudflats on the front face of the fill which are most likely carrying discharges from the buried refuse (they are dry during summer). Due to the presence of these springs the site is classified as discharging to water rather than discharging to ground.

Access onto the site can be gained through Otara Road, which extends on to the park to the east of the landfill area.

1.3.2 ***History***

No written records of fill quantities or compositions were kept. Verbal reports from council staff and members of the public confirm the location of the site, which was operated by council as a municipal refuse dump. The landfill reclaimed a former branch of an inlet of the Otara Lake inlet on the western side of the park. Aerial photographs taken prior to the reclamation confirm the extent of filling. The remainder of the inlet has not been filled. All household and commercial refuse types were accepted for filling.

Apart from the reclaimed inlet it is not certain whether other sites in the park area were filled. It has been reported that the various original hills and gullies all over the present Ngati Otara Park were filled with cleanfill, rubbish, hardfill etc. However the verbal reports on the existence and location of these sites are conflicting. If other sites have been filled with refuse they are probably minor compared to the volume of fill contained in the main fill area.

1.3.3 ***Surface Water and Ecology***

The Otara Lake is manmade and was formed by damming the Otara Creek close to where it joined the Tamaki River. The water in the lake is saline and tidal.

The 'Otara Lake Water Quality Study' by Manukau Consultants gives the following breakdown of zoning in the Otara Lake catchment.

Table 11: Land Uses in Catchment of Otara Lake

Land Use Zones	Area (ha)	%
Residential	812	23.0
Business	436	12.0
Future Development	546	16.0
Rural	992	28.0
Roads	286	8.0
Public Open Spaces	200	6.0
Miscellaneous	246	7.0

The urban areas are predominantly residential with significant commercial and industrial development. Urban stormwater runoff, sewerage overflows and/or illegal links to stormwater pipes have further influence on the lake water quality characteristics. General water quality results indicate that the lake is substantially polluted regardless of any influence of the landfill. The lake edge is heavily silted and muddy. The lake carries high levels of suspended particles, micro-organisms and metal pollutants.

The degraded water quality in the Otara Lake makes swimming and fishing for food unsafe. However the area is the subject of water quality initiatives by the MCC, ARC and ECNZ with intention of making the area suitable for contact water sports.

Some finned fish are still observable but the diversity and population of aquatic life is far less than that which long term residents reported to have existed prior to the development of the catchment. Long term residents reported the waterway to have contained plentiful fish such as mullet and was a popular swimming location. Riverbanks and bottoms were firmer and lack the silt and mud, which now cover the tidal flats. Fish from the Otara Creek are unlikely to be safe for consumption.

There are no freshwater streams crossing the park.

1.3.4 ***Drains***

Flows in the extensive network of stormwater drains underneath the northern playing field have been sampled due to the possibility that they may be collecting seepage from the various filled sites.

The top or eastern end of the known fill area is cut by a stormwater culvert, which joins two other culverts running out from beneath the marae grounds.

Sampling from the manhole where these three culverts meet has shown evidence of sewerage connections into the stormwater system.

A network of subsoil drains underlies the sports grounds between the known fill area and the extension of Otara Rd going into the park.

1.3.5 ***Surrounds***

There are single storey marae buildings within the marae grounds just to the southeast of the known fill area. There is residential housing within fifty metres of the southern edge of the known fill area.

The surrounding area is generally flat and used for a mix of residential housing, commercial and industrial uses. Hillary College is within the bounds of Otara Park and Clydemore School and Bairds Intermediate are within a couple of hundred metres of the site. The Otara shopping centre and Manukau Polytechnic are beyond that. To the west is ECNZ's Otahuhu gas turbine power station, which operates during peak load periods. The purpose of the dam, which forms the Otara Lake, is to impound cooling water for the power station. The southern motorway is just beyond the power station. The Hills Rd site is just upstream to the southeast.

1.3.6 ***Water Sampling***

The main filling area was in the former gully running between sites 3 and 5 whose extents are shown on the sampling map. Sites 3 & 5 would be expected to have the greatest probability of showing any contamination. Site 3 is a spring on the front face of this filled area and should provide direct information on the leachate. However as site 3 is in the tidal mudflat, the saline influence on samples taken from that location may confuse the characterisation of water quality / leachate strength.

Site 5 is a manhole to a stormwater culvert built within or very close to the filled area. There is a distinct vile smell in the manhole at site 5 whose chamber walls are heavily encrusted with rusty deposits at the joints. The joints constantly drip with inflowing seepage. This possibly suggests that water is entering the chamber loaded with dissolved metals, which become deposited as oxides on the manhole walls. This may mean that leachate is entering into the culvert here. Site 5 is unlikely to have been influenced by seawater.

Sampling locations 2 and 4 also sample stormwater culverts. Site 2 is shown in the map in the stormwater outfall to the Otara Creek. This outfall is in a tidal area. Though none of the culverts which feed these sites pass through or underneath the known filled area they have been sampled due to the uncertain location of fill on the site.

Site 6 samples a rivulet close to the tidal area in the Otara creek bank. The rivulet starts from a spring on the side of the slope away from the sports ground. it was sampled in case it contained any leachate discharges. Station 7 is in the Otara Creek at the end of Alexander Rd.

1.3.7 ***Subsurface Investigations***

Three bores were dug on the site along the former inlet. The deepest fill (6.5m) was found at the higher end of the old inlet where the ground is higher. 1.5m of fill was found in the middle bore and 2.5m was found in the bore closest to the existing inlet. The results

suggest that the second bore be probably placed in the side rather than the middle of the former gully.

A mixture of refuse, organic materials and clay was found in all of the bores. Gas levels in 37% LEL were measured in the second bore but no abnormal readings were measured in the other bores.

The groundwater table was intercepted in all of the bores between 1 and 2m depth. Piezometers were installed in all of the bores. In the second borehole the groundwater was found to be below the fill interface.

The topsoil depth was around 0.6m in the top two bores, but there was none at all in the lower bore.

The bore furthermost from the estuary was found to be underlain by estuarine clay. The other two bores were found to be underlain by Waitemata group materials. This suggests that Waitemata group underlies the whole area. It may be that only the first bore was actually placed in the centre of the old stream channel.

1.3.8 ***Consultations***

A letter drop to neighbouring residents took place in December 1994 to inform them what the investigation is for and to request information. No responses were received.

A report to the Otara Ward community board March meeting and a subsequent article in the Manukau Courier resulted in several callers providing historical information about this site. There have been several responses but none indicated any environmental problems.

1.3.9 ***Results and Conclusions***

The surface water quality monitoring results indicated a low level of contamination at the site. Combined results of groundwater samples and

sample from the spring at the front face of the fill showed that the average concentration of selected leachate indicators is 14.80% of the concentration of those indicators in a typical landfill leachate.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.4 Miro Road (Te Puea Marae)

Site Name	Miro Rd
Filltype	Mixed
Estimated Fill Volume (m^3)	30000
Estimated Fill Area (ha)	2
Estimated Average Depth (m)	1.5 ha
Road Location	NW Cnr Miro And Mahunga, within Te Puea Marae
Suburb	Mangere Bridge
Adjacent Watercourse	Manukau harbour
Open	1982
Close	1987
Underlying Geology	Inter-tidal mud containing some sand, silt and shell
Legal Description	Pt Sec 1 Blk V Otahuhu SD (SO 56622)
Leachate Strength (%)	4.46 (extreme result excluded)
Condition Index Value	916

1.4.1 Location and Description

Miro Rd, Mahunga Drive and the Mt Roskill - Mangere motorway, enclose the site.

The site falls from the motorway overbridge in the northwestern corner to the intersection of Mahunga Drive and Miro Rd at the southeast. There is a sharp bank on the western side of the site falls towards the motorway and there are mild slopes in all other directions.

The fill surface was never adequately sealed and contoured. Irregularities on the surface impede surface water runoff. The presence of obstacles on the ground such as concrete blocks, stones and metal make mowing and general

maintenance difficult. The exposure of the obstacles is due to inadequate surface cover. The site is at present unusable for even passive recreation.

The vegetation on the site consists of thick grass and weeds. A number of trees have been planted around the fringes of the site adjacent to Mahunga Drive.

The Marae trustees are considering plans to build a major complex for health and community purposes. Foundation conditions will probably restrict potentially suitable areas for building development to the southeastern half of the site.

The site is almost directly adjacent to the Mangere interchange off the motorway and is highly visible from the motorway, Mahunga Drive off-ramp and Mahunga Drive itself.

1.4.2 ***Reported History***

The original foreshore ran in a jagged line from halfway along the western boundary to cross approximately halfway along the southern boundary. All other areas are reclaimed lands and fill probably overlies original ground near the marae buildings. This site was filled in as a reclamation of the former impounded marine enclosure created by the construction of Mahunga Drive.

The site was owned by the MCC when it was operated as a fill. Since the completion of filling the site has been vested in the marae trustees. Council undertook to hand over the site in a suitable state.

No written records of fill types or quantities were kept but verbal reports from council staff and members of the public suggest that the materials received at the site were cleanfill, inorganic refuse, street sweepings and cesspits. There was some illegal dumping of household refuse.

1.4.3 ***Surface Water and Ecology***

There are no surface creeks or well-defined drainage lines on the site.

Mahunga Drive borders the Manukau harbour. Tidal water comes up stormwater culverts on site and permeates the filled areas. The water quality of the Manukau Harbour is impaired but the ARC has initiatives to improve this.

The present state of water quality in the near Manukau Harbour limits recreational uses of the harbour. Swimming, fishing, food harvesting and other recreational activities may be safer in the long term if the Arc efforts are successful. Any improvements in water quality though, are likely to occur after or towards the end of this sites potential leachate production period.

The near by Manukau Harbour accepts waste discharges from a multitude of other industrial and waste disposal sites.

There is a small mangrove community along the seawall where the stormwater pipe which run underneath the site discharge.

1.4.4 *Drains*

Two 900 diameter stormwater underground culverts traverse the site falling towards Mahunga Drive from the motorway. A 750 diameter third culvert crosses the south-east corner of the site east of the marae buildings from Miro Rd and exiting onto Mahunga Drive. There are understood to be a number of private drainage connections in this same area. Two stormwater cut-off trenches have recently been installed adjacent to the Marae fence and drain into one of the culverts.

1.4.5 *Surrounds*

The site backs onto the Mangere-Mt Roskill Motorway to the west. On the eastern side of the motorway the land use is predominantly industrial and this area extends to the south along Mahunga Drive. On the other side land use is residential but the motorway forms a barrier.

The marae operates a community centre presently on the other side of Miro Rd from the landfill site. The centre includes old people's homes and a youth training centre. A kohanga recreational centre is presently being established. The marae trustees also have plans to develop a health centre. The health centre will possibly be established on or directly adjacent to the fill area.

There are single storey marae buildings at the Southwest corner of the block on which the marae sits. As discussed above there are further marae buildings on the other side of Miro Rd. Next door to the marae buildings on the opposite corner of Miro and Mahunga Rds is a large factory warehouse.

A description of the other pollutant sources around the Manukau Harbour is given in the site report for Harania Ave.

1.4.6 *Water Sampling*

The manholes in stormwater culverts and tidal pools at the culvert outlets have been used as sampling sites. These would show contamination if waters contaminated with leachate seeped into the stormwater culvert. There was evidence of seepage occurring at two of the manhole chambers. Apart from the downstream locations at the outlets and the control samples in the sea all the samples were taken from the manhole chambers.

Sites 1 and 4 are the upstream control and downstream sites respectively on the northernmost culvert on the site. Sites 2 and 3 are between them. During high tides the seawater level came up at least as far as site 3 but was never observed at site 2.

In the middle culvert there are two sites, denoted 5 and 6. Site 6 is the culvert outlet. A soakage trench constructed parallel to the marae fence, to prevent surface water flooding the marae grounds, has been connected to the manhole at site 5. This should increase the possibility of leachate entering this culvert though only if it gets to the subsoil drain which is not guaranteed as it is quite shallow and set back from the known fill area.

The southernmost culvert line is sampled at site 7 within the filled area and site 8 downstream at the outlet. Site 9 samples a culvert line running over non-landfill site but through the factory site adjacent to the marae. Sites downstream of the filled area e. g. 4,6,8,9 are below tide levels and so will have marine influence. Two sites just offshore, sites 10 and 11, are intended to provide background analyte levels.

1.4.7 ***Subsurface Investigations***

A preliminary soils investigation was undertaken in April 1995 to confirm our understanding of the fill materials present at the site. Though this investigation provided some useful background information it was considered too limited in scope to provide sufficient information for background assessment.

Three boreholes were drilled in August 1995 for the purpose of installing piezometers for groundwater monitoring.

In May / June 1996 an extensive geotechnical investigation was undertaken. The investigation showed that refuse is concentrated mostly in the top north-western half of the site and along the Mahunga Drive boundary.

1.4.8 ***Results and Conclusions***

Only the bore samples have been used in the calculation of the leachate strength. The average concentration of selected leachate indicators is 4.46% of the concentration of those indicators in a typical landfill leachate. This however does exclude some of the extreme results, which were thought to have been affected by the presence of sediment in the samples. If the extreme results are included then the leachate strength is 20.17%.

Recently the site has been capped and grassed.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.5 Dale Crescent

Site Name	Dale Crescent

Filltype	Inorganic
Estimated Fill Volume (m^3)	15000
Estimated Fill Area (ha)	1
Estimated Average Depth (m)	1.5
Road Location	Between Waipuna Motorway and Dale Crescent
Suburb	Pakuranga
Adjacent Watercourse	stormwater discharges to tributary of Tamaki River other side of motorway
Open	unknown
Close	unknown
Legal Description	Sec 1 SO 52269
Leachate Strength (%)	17.56
Condition Index Value	635

1.5.1 ***Location and Description***

The site is located just at the western end of the Waipuna Bridge in the flat open space area bound by the residential properties on Dale Crescent and the embankment of the Pakuranga - Panmure motorway. The site was apparently created at the time of the motorway construction by filling in the previous swampy area.

1.5.2 ***Surface Water and Ecology***

The site is approximately 100m from the Tamaki River at its closest point. This is just downstream of the confluence of the Pakuranga and Otahuhu Creeks. The catchment to the Tamaki River contains principally residential and commercial / industrial areas. Most of the few remaining rural areas are currently being subdivided and developed. The estuary is completely tidal at this point.

Aquatic fauna is scarce and does not display species diversity. This is characteristic of the ecosystems in degraded urban waterways.

1.5.3 ***Drains***

Stormwater lines run to the east and west, draining cesspits in the middle of the site adjacent to the footpath. The drains are at the east and west ends running away from the middle of the site. A major 1060 diameter Watercare water

supply pipe crosses the northern part of the site. Bulk power transmission lines also run overhead.

1.5.4 *Surrounds*

The properties sharing the northern boundary of the site, and those to the south of the site beyond the motorway are residential. The Pakuranga shopping centre is located to the east. Pakuranga Intermediate is within five hundred metres to the east. The Riverina School is several hundred metres to the west and Anchorage Park School is several hundred metres further to the south.

1.5.5 *Subsurface Investigations*

Four bores were drilled in a rough line along the site. All bores showed a mix of gravel, silt and clay fill of depths between 1 and 2.5m. It appears likely that organic materials were not imported onto the site.

The water table was intercepted at 2 to 2.5m depths in all but the easternmost bore where it was not found by 3m depth. The southernmost bore, closest to the motorway showed that Waitemata group materials underlay the fill. In the other bores marine / estuarine deposits were found.

In two bores where marine sediments were found, the fill also contained plant fragments. It is likely that the plant fragments are the remnants of vegetation on the site prior to the placement of the fill. The groundwater table was also intercepted in these two bores and the measured gas levels were 75% and 90% LEL. In the latter there was also a bubbling noise. A piezometer was installed in this bore.

In the other two bores the measured gas levels were around 35% LEL. Groundwater was found in one of these bores. It may be that the gas levels occur as a result of decomposition of the plant fragments.

In the three bores where the groundwater table was found it was between 2 and 2.5m deep. Topsoil was found in one bore to a depth of 0.1m, but was not found elsewhere.

1.5.6 *Results and Conclusions*

The average concentration of selected leachate indicators is 17.56% of the concentration of those indicators in a typical landfill leachate. The level of ammonia at this site is also higher than the level at most of the other sites.

This level of contamination is quite surprising as no refuse was found during drilling and the bores on the site covered the site reasonably well. However the bore logs do indicate that the fill was not entirely clean clay. This indicates in

itself that the fill was not entirely taken from the surplus of earthworks operations.

Another possibility is that the level of contamination is due to rotting plant fragments. These were shown to be present during drilling. The fill may have been placed over the site without first removing the organic material beneath it.

Overall, the indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.6 Great South Road

Site Name	Great South Rd
Filltype	Hazardous
Estimated Fill Volume (m3)	15000
Estimated Fill Area (ha)	0.3
Estimated Average Depth (m)	5
Road Location	Great South Rd, South Bank/West Side on River
Suburb	Otahuhu
Adjacent Watercourse	Tamaki River
Open	1977
Close	1982
Underlying Geology	Inter-tidal mud and sedimentary materials of the Tauranga Group
Legal Description	Allot 523 & 540 Manurewa PSH (SO 55438) T.B.A.
Leachate Strength (%)	7.96
Condition Index Value	545

1.6.1 Location, Description and History

The site is on the southern bank of the Tamaki River on the western side of Great South Rd. The reserve, which includes the site, extends to the Manukau end of the Tamaki River Bridge. The filled area is less than 50m from Great South Rd.

Filling took place in a former inlet / tributary of the river in two separate areas. The back end of the inlet has been filled and a small bay has been formed on the riverbank. Filling has also taken place on one side of this bay. The two

filled areas do not join up completely except possibly for a small layer. Illegal rubbish dumping and littering is still going on between and behind the two filled areas.

All of the filled area is owned by MCC. The filled area to the side of the bay and the front of the first filled area is all within the drainage reserve. However the back end of the former filled area, though owned by MCC is enclosed within a fence which also contains land currently owned by Glaxo Wellcome. Glaxo Wellcome currently has an agreement to sell their land. The area enclosed within the Glaxo Wellcome fence is a well maintained garden area. The MCC owned part of the same area of fill has a sloping uneven surface, which rolls downhill to the inlet. The other filled area has a steep and roughly maintained surface.

Low lying parts of the site within the drainage reserve have become very boggy because not all parts of the site drain well. The ground is littered with hard rubbish dumping including old car parts. The surface vegetation is grass, shrubs, flaxes and weeds with a few exotic trees. None show any signs of distress. The maintenance of the surface is made difficult due to the surface obstructions.

As noted above the inlet has at present been only partially filled. The filled area now fringes onto an area of tidal mudflat, which is sheltered from the direct river flow by the arms of the former inlet. There are mangroves established on the inter-tidal area and upstream and downstream of the site.

There is a dirty tidal pool at the base of the filled area, which has been sampled from time to time. No fluid has actually been observed to discharge into this pool, or in fact anywhere else on the site. For this reason the site is classified as discharging to ground rather than discharging to water. The tidal pool sometimes shows a faint oily sheen.

The Tamaki River at this location is predominantly tidal and there is significant sea water influence. The adverse water quality of the Tamaki River and the presence of deep mud make swimming and fishing for food unsafe.

The site has two stormwater culverts discharging into the inter-tidal area on the edge of the reclamation. A 600 diameter culvert was installed at the same time as the reclamation of the valley on the western edge of the site. A 150 diameter culvert was installed further to the west.

Manukau City Council has no legal vehicular access onto the site. Access for site inspections and water samples has been gained through a driveway on private property. It is not possible to drive fully onto the reclamation area proper. Foot access is possible around the reserve area from the Great South Rd Bridge.

1.6.2 ***History***

Most of the history of this site has been derived from ARC records. It appears that the area on which the fill was sited was previously designated as tidal land.

Permission was gained to fill the land with the proviso that the completed reclamation would be vested in Manukau City Council.

We have found very little direct correspondence between Manukau City Council and the then Wellcome NZ Ltd. However we have been able to establish that Manukau City Council was contracted by Wellcome NZ Ltd to fill in the land however it is not clear whether this agreement was reached after the original decision to vest the land in Manukau City Council.

It was found when the fill was surveyed that the amount of filling that had been undertaken exceeded the amount set down in the reclamation permit. A second permit was issued to regularise the situation. Anecdotal reports from MCC staff indicated that the arrangement between Wellcome and the MCC involved a cost sharing exercise for the installation of culverts and both parties would have access to the site to dispose of hardfill.

The site was supposed to have been a hardfill site. However there has been some illegal household and commercial dumping. A few adjoining garages have been observed to allow wash-down effluents to run onto the site and this practice is thought to still continue. Several car wrecks have been dumped on the fringes of the site.

1.6.3 ***Surrounds***

The site is in the middle of the Otahuhu / Papatoetoe industrial area. Low areas predominantly surround the site with very slight fall towards the Tamaki River.

The site is part of the esplanade reserve for the Tamaki River. To the north and east the property boundaries extend around to the Great South Road Bridge crossing the Tamaki River. The property continues upstream. To the south and east the site is bounded by privately owned industrial properties.

The surrounding land on the southern bank is used for light industry such as workshops and warehouses. It is possible that yard effluents from these adjacent businesses are occasionally discharged onto the site by either stormwater drains or overland flow. Any industry in the catchment of the stormwater culverts could contribute to contaminant discharge onto the site near the stormwater outlets. Urban and industrial land uses in the catchment no doubt contribute to the degradation of water quality in the Tamaki River at the site.

1.6.4 ***Water Sampling***

Sampling site 1 is in a spring in the inter-tidal zone and site 2 is located under the mangrove stands. They are both close to the toe of the filled area. As site 1 is located above the tide level at low tide it is only intermittently flushed. Site 2 is lower and will receive continuous tidal flushing. Flushing at both sites is due to tidal action rather than direct river flow. As both sites are at the bottom of a bank it is possible that contaminants from off the property could reach the

location where the samples are taken from. These could affect the levels of contaminants found in samples taken from the site.

1.6.5 ***Subsurface Investigations***

The two halves of the site have been designated independently in the bore logs as 'Great South Rd' and 'Glaxo Wellcome', the latter being that part of the site within the bounds of the Glaxo Wellcome site. Gas levels of 10% LEL were recorded in the bore above marine mud.

In the 'Great South Rd' half two bores were dug. The depth of fill was 4.5m and 5m for the two bores. The groundwater table was intercepted just above the fill / natural ground interface. The fill contained an assortment of refuse. Marine mud was found beneath the fill in one bore, while Waitemata group materials underlay the fill at the other bore. The water level was intercepted at or just above the fill / natural ground interface. One bore showed a depth of 0.8m topsoil whereas the other showed none.

In the 'Glaxo Wellcome' half two further bores were drilled. Each bore showed an assortment of clay fills and rubbish. The groundwater table was not installed at either bore however it was high tide at the time of drilling. The fact that the groundwater table was not intercepted and that marine mud was not found suggests that these bores were not installed in the centre of the old estuary. There was an average of 0.6m topsoil in this half of the site.

Piezometers were installed in all four bores. However two of the bores have subsequently been buried under tyres. It is necessary to contact neighbouring landowners to have the tyres removed.

More recently further investigations have been carried out to ascertain whether there were any significant levels of organic pollutants of environmental concern at the site. Two borehole water samples were taken and analysed for a wide range of known environmental contaminants. The results of the analysis are attached to this report as Appendix D.

No significant levels of any of the organic pollutants were detected in the samples.

1.6.6 ***Results and Conclusions***

The surface water monitoring results indicated a high degree of contamination on one occasion. The concentrations (of analytes) found are not necessarily in a pattern characteristic of landfill leachates (high levels of zinc have been found but little else). It is possible that this contamination was due to wash-downs from surrounding properties. Otherwise the results have shown low levels of contamination.

The average concentration of selected leachate indicators is 7.96% of the concentration of those indicators in a typical landfill leachate. No significant levels of any of the organic pollutants were detected in the leachate samples.

1.7 Robert Allan Road

Site Name	Robert Allan
Filltype	Mixed
Estimated Fill Volume (m3)	5600
Estimated Fill Area (ha)	0.25
Estimated Average Depth (m)	2.25
Road Location	off Robert Allan Way, almost opposite Nan Pl.
Suburb	Pakuranga
Adjacent Watercourse	unnamed (to Pakuranga Creek)
Open	unknown
Close	unknown
Underlying Geology	Soft mud and silt. Moderately weathered Tauranga group silt and clay close by
Legal Description	Allot 386 Pakuranga PSH (SO 49436)
Leachate Strength (%)	8.55
Condition Index Value	199

1.7.1 Location and Description

The site is an empty lot between residential properties in suburban Pakuranga. It borders onto a tributary of the Pakuranga Creek. The site is several hundred metres downstream of the Elm

The Park site, several hundred metres upstream of the Riverhills School site and is almost immediately opposite the Ennis Ave site.

MCC maps suggest that the site consist of the reclamation of a former inlet of the creek running down the northern half of the site. No other record of the site is documented and the fill type was not known prior to drilling.

The site surface is uneven and has a boggy, unkempt appearance even in summer suggesting that it does not drain well. There is a row of tall pine trees running down the northern boundary of the site.

The site borders onto a tributary of the Pakuranga Creek, which is itself, a tributary of the Tamaki River. The catchment to the creek at this side contains almost entirely residential areas.

The estuary is tidal at this point.

The aquatic ecology appears barren on observation, as is characteristic of most urban rivers.

There is a 600 diameter stormwater drain running parallel to the filled area along the length of the site before discharging into the creek.

1.7.2 ***Surrounds***

The Pakuranga Creek tributary flows south past the site. The area around the site is all residential. The Elm Park and Riverhills Schools are within several hundred metres north and south respectively but are on the other side of the creek.

The topography of the surrounding land is moderately hilly.

1.7.3 ***Subsurface Investigations***

Four bores were dug in a rough line along the site, up to three metres deep. The depth of fill encountered was around three metres, with greater depths being found at the back of the site away from the creek where the ground is slightly higher.

The water table was encountered at about 1.5m depth in every bore except the bore closest to the creek, which was drilled at low tide. Piezometers were installed in the two bores in the middle of the site.

Some organic debris and plant fragments were found in one of the bores. Otherwise the fill was all clay. Gas levels ranging from 15% to 35% LEL were found in the bores.

Topsoil depth was found to a depth of 0.3m in one of the bores. It was not found elsewhere. The bores show that Waitemata group materials underlie the site though marine sand was found in one of the bores.

1.7.4 ***Results and Conclusions***

The average concentration of selected leachate indicators is 8.55% of the concentration of those indicators in a typical landfill leachate.

The amount of gas measured could be due to the decomposition of plant matter that was not removed prior to the placement of the fill.

The indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured.

1.8 Harania Ave

Site Name	Harania Ave
Filltype	Mixed
Estimated Fill Volume (M3)	6000
Estimated Fill Area (ha)	0.3
Estimated Average Depth (M)	2
Road Location	Harania Ave Reserve Opposite Tinkler Ave
Suburb	Favona
Adjacent Watercourse	Manukau Harbour
Open	unknown
Close	unknown
Underlying Geology	
Legal Description	Lot 61 DP 61809
Leachate Strength (%)	2.39
Condition Index Value	58

1.8.1 Location and Description

The site is in Harania Park. The park is around an estuarine tributary of the Harania Inlet. A tributary of the creek appears on many maps to cut westward through Harania Ave but is actually piped through a 900 diameter culvert that runs through the filled area before discharging into the estuary. The main body of the creek goes south past the site. The site is now a recreational reserve off Harania Ave opposite Tinkler Ave. It has a well maintained grass surface.

No record of the site is documented and information is from the memories of long serving council staff. The extent of filling on this site was uncertain, but has largely being confirmed by exploratory drilling.

Filling took place in the former extension of the inlet which ran towards Harania Rd and Tinkler Ave. As described above, the water course which ran through the former inlet is now piped, and the culvert discharges into the inlet. It may also have taken place along the existing stream edge. It is thought to have taken all non-household types of refuse.

Fill also took place along the front of the site on the edge of the creek.

The creek itself is freshwater at the top, southern end of the site. It becomes saline at the bottom end of the site. The creek is choked by plantlife along the length of the site - with water weeds upstream and mangrove stands downstream. The water in the creek is slow moving - the water in it is dark from silt and a high density of plant material.

The site is flat with a slight fall towards the estuary. It is prone to water logging along the depression where the old creek used to be.

The water quality of the Harania Inlet appears polluted and heavily silted.

Aside from the 900 diameter stormwater culvert the site is crossed by 230 diameter sewer lines running north to south just to the western edge of the estuary. There are two further stormwater outlets probably beyond the extent of filling at the northern end of the site.

The surrounding land to the north, east and south is predominantly residential. The Favona Primary school is a couple of blocks from the site along Wakefield Rd which runs onto Harania Ave. The Mangere hospital and training centre grounds are on the other side of the stream.

The Manukau Harbour is fairly polluted and there is some heavy industry in the catchment area of the Harania Inlet including the Pacific steel plant and its adjacent private landfill. This landfill takes waste processing materials from the plant. The cover at this site appears to consist of a dusty silty material. The near Manukau Harbour is also bordered by several large Auckland City Council and Auckland Regional Services Trust former landfills, the former Westfield freezing works and the now largely abandoned Station Rd railway workshops among other possible major impact sources. The harbour is noted to suffer adversely from poor (at least historically) silt control practices and from the effects of urban stormwater runoff.

The heavy industry along the shorelines of the inlet, other landfilling and reclamation activities both ongoing and historical along the shoreline of the inlet are all possible other pollutant sources. The adverse water quality of the inlet and the Manukau harbour in general restricts recreational uses of the water in the area. While the thick mangroves will form a barrier preventing silt from the inlet from travelling upstream, other contaminants could be expected to flush back up the creek.

The site is underlain, most probably , by intertidal mud containing some sand, silt and shell. The site could be underlain by sedimentary materials of the Tauranga group.

1.8.2 ***Water Sampling***

Sites 1 to 4 are all in the estuary. As mentioned above it is not certain at present whether filling took place along the creek past where it turns south (moving upstream) at the northern end of the site. Even if it did take place the tidal action which extends at least up to between sites 2 and 3 where the

mangroves begin may result in flushing and mixing of the area and thus may blur any possible difference between sites 2 , 3 and 4 by either dilution or by propagating contamination upstream. This possibility has been mitigated to some extent by taking samples at or near low tide. Site 1 is beyond the mangroves upstream and should be clear of any saline influence. However because it is not saline site 1 is not necessarily a good control of the downstream sites. Thus the detection of contamination at sites 1, 2 and 3 would not necessarily be due to the landfill. The non- detection of contamination downstream would however show that the landfill is not affecting the marine environment.

Sites 5 and 6 are in the stormwater culvert running west to east from near Tinkler Ave. These sampling sites would only detect leachate if it can enter the culvert i. e. non contamination of leachate in the culvert does not mean it does not exist, only that it cannot be detected in the culvert.

1.8.3 *Subsurface Investigations*

Five bores were dug on the site.

Four boreholes were dug along or next to the old stream bed which used to flow from near the present Tinkler Ave. Up to 2m of clay fill was found in these four bores.

The fifth bore was located on the existing stream, bank. This bore showed 1.5m of clay fill with some wood fragments at the bottom of this layer. Below this there was another 1.3m of clay with wood fragments.

The groundwater table was intercepted at 1.5 to 2m in all bores. Three piezometers were installed. No abnormal gas readings were measured in any of the bores.

1.8.4 *Results and Conclusions*

The water quality results indicated a moderate level of contamination, though this cannot necessarily be attribute to the landfill. The groundwater tests however showed that the average concentration of selected leachate indicators is 2.39% of the concentration of those indicators in a typical landfill leachate. This indicates that the contaminant levels from the landfill itself are very low.

Furthermore, the overall indicative data obtained for the site in relation to the levels of environmental contaminants, were found to be below or close to the detection limits of the various parameters measured

GROUND*SEARCH* EES Ltd.

LANDFILL DRILLING LOGS
AND SITE MAPS
for Manukau City Council.
February 1996

GROUND*SEARCH* EES Ltd
3067 Great North Rd
New Lynn
Auckland

Ph 64-9-826-0700 Fax 64-9-826-0900

soil is the foundation of life

4.0. RIVERHILLS PARK, PAKURANGA.

Drilling was completed at Riverhills Park, Pakuranga on the 16th of January 1996. All drilling was done by Prodrill with GSEES supervising and logging the holes.

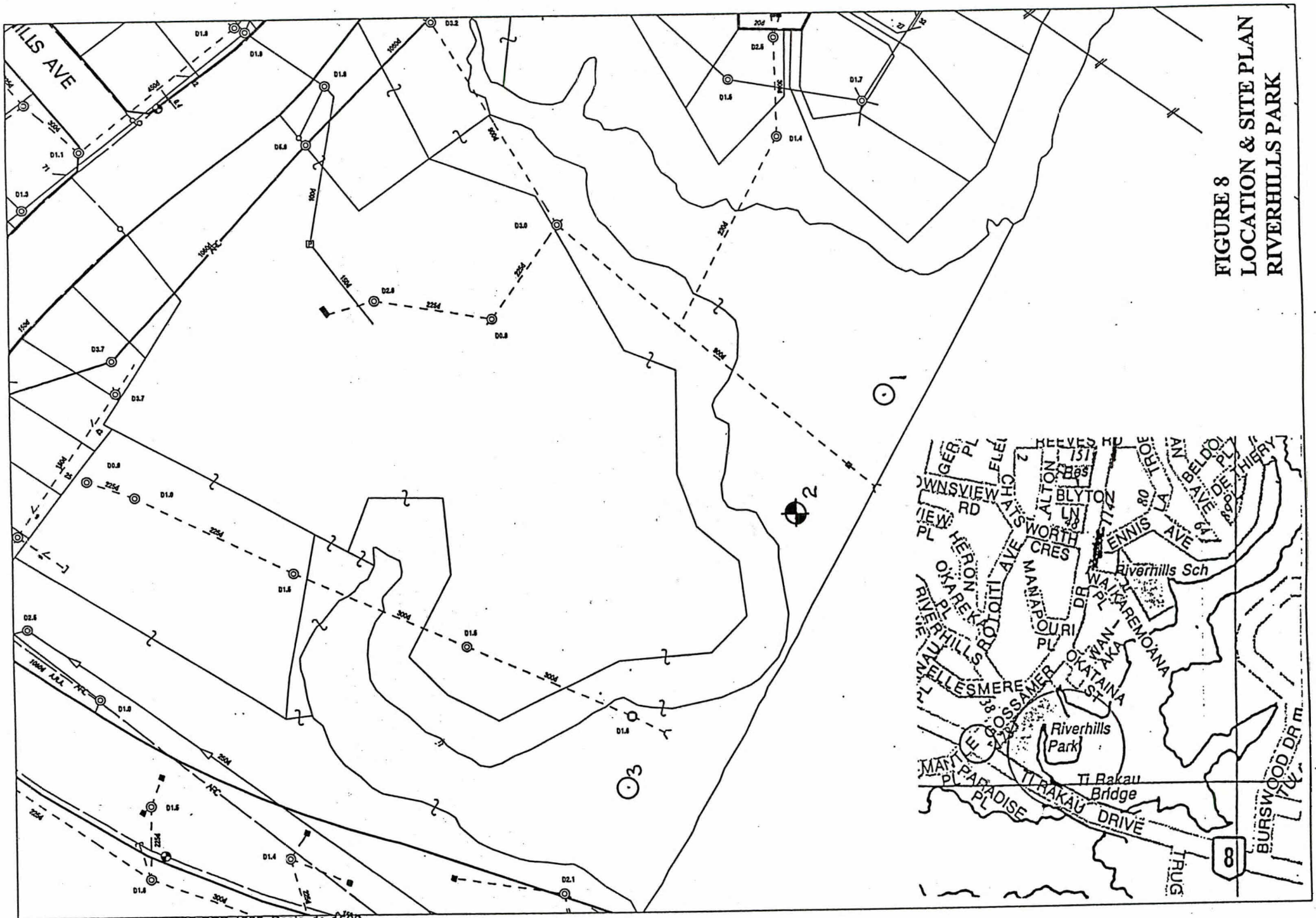
Drill logs including descriptions and depths, water table depth, and piezometer installation information are included. The borehole locations are given on the appended map.

Explosive gas levels.

No abnormal gas readings were recorded.

4.1. Riverhills Park Site Summary Table.

DRILL SITE	*DEPTH (m)*	*PIEZO INSTALLED*	*COMMENTS*
BH1	3.0	no	Clay fill.
BH2	3.0	yes	Clay fill.
BH3	2.5	no	Clay fill.



Screen plot for aprocter 19-SEP-1995 Scale 1: 1500

SITE : Riverhills Park, Gossamer Drive, Pakuranga. Project number: FE 373	BOREHOLE NO: 1 Sheet 1 of 1

Drill Type:	100mm auger	Weather Conditions: Fine	Project No: FE 373
Drill Fluid:	Dry	Datum:	Logged: AJS
Date Drilled:	Jan 16 1996	Ground Elevation (m):	Checked: WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0		0-1.1m : Firm, moist,cream-brown, moderately plastic, silty clay fill.				
			0.5						
			1.0		1.1-3.0m : Soft, moist, moderately plastic, blue-grey-brown, fine sandy silty clay, completely weathered Waitemata Group.				
			1.5						
			2.0						
			2.5						No abnormal gas readings on gas meter. No piezometer installed. No water table intercepted, (low tide at time of drilling).
			3.0		EOH 3.0m				
			3.5						
			4.0						

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SITE : Riverhills Park, Gossamer Drive, Pakuranga. Project number: FE 373	BOREHOLE NO: 2 Sheet 1 of 1

Drill Type:	100mm auger	Weather Conditions:	Fine	Project No:	FE 373
Drill Fluid:	Dry	Datum:		Logged:	AJS
Date Drilled:	Jan 16 1996	Ground Elevation (m):		Checked:	WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0.5		0-1.1m : Firm, dry, orange-cream-brown, slightly plastic, silty clay fill.				
			1.0		1.1-1.5m : Soft, dry, moderately plastic, grey-blue silty clay fill.				
			1.5		1.5-2.2m : Soft, moist, moderately plastic, grey-blue-green, silty clay, completely weathered Waitemata Group.				
	V		2.0		2.2-2.7m : Soft, wet, moderately plastic, silty clay, completely weathered Waitemata Group.				
			2.5		2.7-3.0m : Stiff, moist, very slightly plastic, grey-green-blue-brown-orange, medium gravelly silty clay, completely weathered Waitemata Group. EOH 3.0m				No abnormal gas readings on gas meter. Installed 3.0m long 50mm pvc piezometer with 2.5m screen.
			3.0						
			3.5						
			4.0						

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SITE : Riverhills Park, Gossamer Drive, Pakuranga, Project number: FE 373	BOREHOLE NO: 3 Sheet 1 of 1

Drill Type: 100mm auger | Weather Conditions: Fine | Project No: FE 373
Drill Fluid: Dry | Datum: | Logged: AJS
Date Drilled: Jan 16 1996 | Ground Elevation (m): | Checked: WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0		0-1.0.2m : Soft-firm, dry, orange-grey-brown, very slightly plastic, silty clay fill. 0.2-1.0m : Loose, dry, yellow-orange, fine sandy silty clay fill.				
			0.5						
			1.0		1.0-1.2m : Firm, moist, moderately plastic, cream-yellow-brown, fine sandy silty clay fill. 1.2-2.5m : Firm, moist, moderately plastic, blue-grey, fine sandy silty clay, completely weathered Waitemata Group.				
			1.5						
			2.0						No abnormal gas readings on gas meter.
			2.5		EOH 2.5m				No piezometer installed. No water table intercepted (low tide at time of drilling).
			3.0						
			3.5						
			4.0						

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5.0. DALE CRESCENT, PAKURANGA.

Drilling was completed at Dale Crescent, Pakuranga on the 16th of January 1996. All drilling was done by Prodrill with GSEES supervising and logging the holes.

Drill logs including descriptions and depths, water table depth, and piezometer installation information are included. The borehole locations are given on the appended map.

Explosive gas levels.

High levels of explosive gases were measured in all the boreholes, from 34% to 90% LEL.

5.1. Dale Crescent Site Summary Table.

DRILL SITE	*DEPTH (m)*	*PIEZO INSTALLED*	*COMMENTS*
BH1	3.0	no	Clay fill, gas levels 75% LEL.
BH2	2.5	no	Clay fill, gas levels 35% LEL.
BH3	3.0	yes	Clay fill, gas levels 90% LEL.
BH4	3.0	no	Clay fill, gas levels 34% LEL.

[redacted]

Screen plot for abrocter 19-SEP-1995 Scale 1: 1000

SITE : Dale Crescent, Pakuranga.	BOREHOLE NO: 1
Project number: FE 373	Sheet 1 of 1

Drill Type: 100mm auger Weather Conditions: Fine Project No: FE 373
Drill Fluid: Dry Datum: Logged: AJS
Date Drilled: Jan 16 1996 Ground Elevation (m): Checked: WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0		0-1.0 : Firm, dry, moderately plastic, brown-white-orange-grey, silty clay fill.				
			0.5						
			1.0		1.0-1.5m : Firm-soft, moist, moderately plastic, grey, silty clay fill.				
			1.5		1.5-2.0m : Soft, moist, moderately plastic, grey, fine sandy silty clay estuarine deposits with decayed plant fragments.				
	V		2.0		2.0-3.0m : Firm, moist, moderately plastic, blue-grey, fine sandy silty clay micaceous completely weathered Waitemata Group.				
			2.5						
			3.0		EOH 3.0m				Gas meter recorded 75% explosive gases in borehole 1 (probably rotting plant fragments) No piezometer installed.
			3.5						
			4.0						

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SITE : Dale Crescent, Pakuranga.	BOREHOLE NO: 2
Project number: FE 373	Sheet 1 of 1

Drill Type:	100mm auger	Weather Conditions:	Fine	Project No:	FE 373
Drill Fluid:	Dry	Datum:		Logged:	AJS
Date Drilled:	Jan 16 1996	Ground Elevation (m):		Checked:	WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0		0-0.1m : Topsoil 0.1-1.1m : Firm, moist, moderately plastic, grey-orange-purple-brown, medium gravelly silty clay fill.				
			0.5						
			1.0		1.1-2.2m: Firm, moist, moderately plastic, blotchy green-blue-grey-orange-brown silty clay fill.				
			1.5						
	V		2.0						Gas meter recorded 35% explosive gases in borehole.
					2.2-2.5m : Soft, moderately plastic, moist, blue-green silty clay completely weathered Waitemata Group. EOH 2.5m				No piezometer installed.
			2.5						
			3.0						
			3.5						
			4.0						

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SITE : Dale Crescent, Pakuranga.	BOREHOLE NO: 3
Project number: FE 373	Sheet 1 of 1

Drill Type:	100mm auger	Weather Conditions: Fine	Project No: FE 373
Drill Fluid:	Dry	Datum:	Logged: AJS
Date Drilled:	Jan 16 1996	Ground Elevation (m):	Checked: WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0.5		0-1.0m : Firm, moist, moderately plastic, yellow-orange-purple-brown, medium gravelly silty clay fill.				
			1.0		1.0-3.0m : Soft, moist, moderately plastic, grey, medium-fine gravelly silty clay + plant fragments.				
			1.5						
			2.0						
	V		2.5						Gas meter recorded 90% explosive gases in borehole (probably rotting plant fragments), and a strong smell and bubbling noisecame from the hole. Installed 3.0m long 50mm pvc piezometer with 2.0m screen.
			3.0						
			3.5						
			4.0						

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SITE : Dale Crescent, Pakuranga.	BOREHOLE NO: 4
Project number: FE 373	Sheet 1 of 1

Drill Type:	100mm auger	Weather Conditions:	Fine	Project No:	FE 373
Drill Fluid:	Dry	Datum:		Logged:	AJS
Date Drilled:	Jan 16 1996	Ground Elevation (m):		Checked:	WT

DRILLING METHOD	WATER TABLE	SAMPLE NUMBERS	DEPTH (m)	LEGEND	SOIL DESCRIPTION: strength, plasticity, colour, moisture, type ROCK DESCRIPTION colour, weathering, fabric, strength rock name, discontinuities	STRENGTH / DENSITY	DRY DENSITY (Mg/m3)	OTHER TESTS	REMARKS:
			0.5		0-0.8m : Firm, dry, moderately plastic, cream-orange-brown, coarse sandy silty clay fill.				
			1.0		0.8-1.8m : Firm, dry, moderately plastic, fine gravelly silty clay fill.				
			1.5						
			2.0		1.8-3.0m : Soft, moist, moderately plastic, black silty clay marine mud.				
			2.5						Gas meter recorded 34% explosive gases in borehole (probably rotting plant fragments). No piezometer installed.
			3.0		EOH 3.0m				No water table intercepted.
			3.5						
			4.0						

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GRC GROUNDSEARCH

07 December 2012

Renata Smit
Auckland Transport
31-33 Manukau Station Road
Manukau

Our ref: 51/28564/16//AMETI PSI

Dear Renata,

Phase 1 Preliminary Site Investigation for the Pakuranga Scheme Assessment of the Auckland Manukau Eastern Transport Initiative (AMETI) Alignment

1 Introduction

GHD Limited (GHD) was engaged by Auckland Transport to undertake a Phase 1 Preliminary Site Investigation (PSI) for the proposed Package 4 Scheme Assessment which is part of the Auckland Manukau Eastern Transport Initiative (AMETI) Project which runs between Pakuranga and Botany, Auckland. The following route comprises the Package 4 Scheme Assessment which is the subject of this assessment;

Segment 1 – Pakuranga Road between the eastern abutment of the Panmure Bridge and Ti Rakau Drive.

Segment 2 – Pakuranga Town Centre and its immediately surrounding corridors i.e. Pakuranga Road, between Ti Rakau Drive (including the Pakuranga Road intersection) and St Kentigerns signalised entrance; Ti Rakau Drive, between Pakuranga Road and Reeves Road (including the Reeves Road intersection); and Reeves Road, between William Roberts Road and Ti Rakau Drive.

Segment 3 – Ti Rakau Drive between Reeves Road and Gossamer Drive.

Segment 4 – Ti Rakau Drive between Gossamer Drive and Greenmount Drive.

Segment 5 – Ti Rakau Drive between Greenmount Drive and Botany Road.

It is understood that this Preliminary Site Investigation will support resource consent applications for the project, and feed into design considerations where necessary.

2 NES Requirements

The intention of this assessment is to support Auckland Transport in meeting the requirements of the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES) which took effect on January 1st 2012. As such, some land uses are classified as a HAIL activity (Hazardous Activities and Industries List) and there is potential that these land uses have occurred or are occurring along the alignment and will need to be investigated before construction begins. Disturbance of soil (at a scale above a prescribed threshold volume) at a HAIL site is a controlled activity, and as such requires consent. The NES covers a range of land use activities.

The NES also requires investigation of soil contaminants to assess potential risks to human health, and this requirement is triggered if the land is to be subdivided, developed or disturbed.

The intention of the Soil NES is to enable safe use of contaminated land to ensure that contaminated land is appropriately assessed prior to development, and if necessary, the land is made safe for human activity. The NES does not include criteria for environmental risk assessment. However, environmental risks should be considered in accordance with New Zealand guidelines.

The NES addresses land that is located adjacent to a HAIL site that may be impacted by contaminants from the HAIL site (HAIL category H).

It is understood that this PSI will support the Auckland Transport resource consent applications for the project and help meet their obligations under the NES for any HAIL sites that may be encountered along the Pakuranga Scheme Assessment of the AMETI alignment.

3 Hazardous Activities and Industries List

The HAIL is incorporated by reference into the NES. Under the NES, land is considered to be contaminated or potentially contaminated if an activity or industry on the HAIL 'is being undertaken, has been undertaken or is ***more likely than not*** to have been undertaken'[1]. If current, and/or historic land uses are included on the HAIL and are identified on the land under investigation then the NES is triggered. Proposed activities also trigger the NES and include removal of underground fuel storage systems and associated soil, soil sampling, soil disturbance, subdivision of land and changing land use.

4 Objectives

The objective of this report was to:

- assess the likelihood[2] of the presence of soil and/or groundwater contamination resulting from historic and/or current land use[3] along the route and/or adjacent to the route.

5 Scope of work

This assessment was undertaken in accordance with the Ministry for Environment *Contaminated Land Management Guidelines: Reporting on Contaminated Sites in New Zealand (No. 1) 2011*. This guideline is referenced in the *National Environmental Standards (NES) for Assessing and Managing Contaminants in Soil to Protect Human Health*.

A review of information available from the following sources was completed as part of this assessment:

- draft alignment plans as at October 2012 developed by GHD/Aurecon
- a review of publicly available historical aerial photos from 1940 to 2010
- a review of site photos
- Auckland Council contaminated sites and borehole register search
- review of readily available site investigation reports resulting from the site register search

[1] Ministry for the Environment. (2011). *Draft user's guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.* Wellington, New Zealand: Ministry for the Environment.

[2] Defined in the NES as: Likely is greater than 50% chance, and unlikely is less than 50% chance of contaminants being present.

[3] Land that may be impacted by the migration of contaminants from adjacent sites is addressed in the NES (refer category H in the Hazardous Activities & Industries; HAIL List).

- an alignment walkover inspection conducted on the 26th September 2012
- review of readily available geology and hydrogeology information
- review of surrounding land uses to assess potential off site environmental impacts to the property or properties of interest
- identification of potential contaminants of concern
- publically available information on the environmental fate of contaminants
- identification of sensitive human and/or environmental receptors.

6 Project Description

The AMETI project aims to develop an integrated multi-modal transport system that supports population and economic growth in East Auckland around the areas of Glen Innes, Howick and Botany.

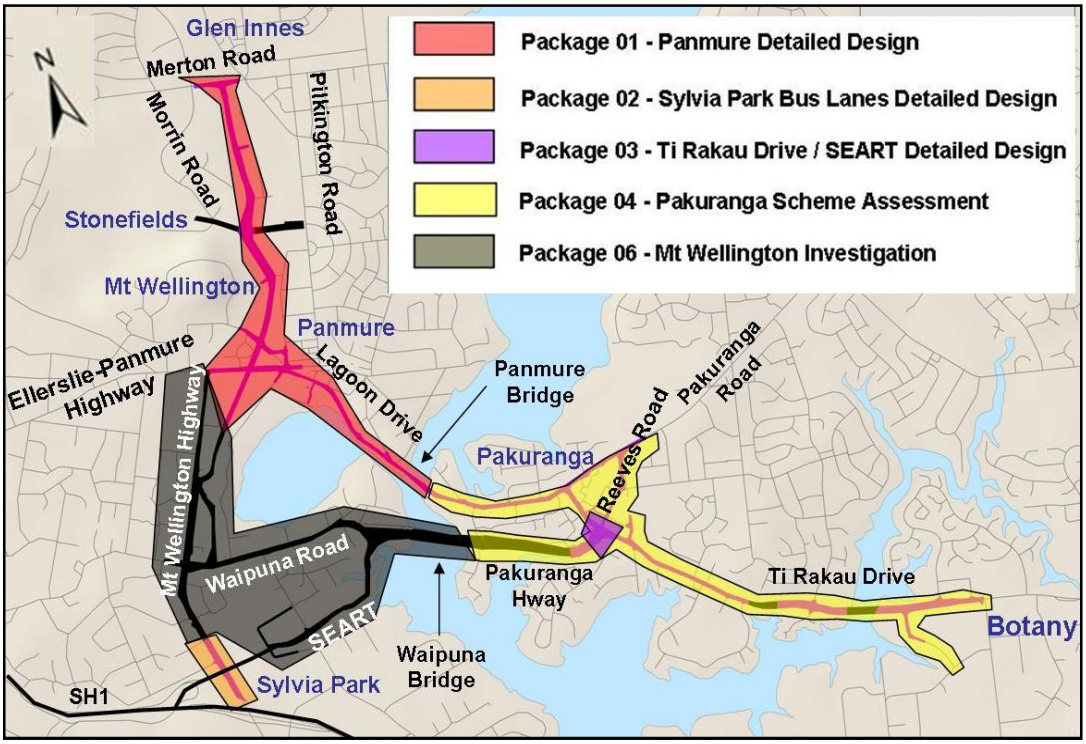
The project aims to provide more and improved transport choices to significantly enhance the safety, quality and attractiveness of passenger transport, walking and cycling while recognising that not all transport demand can be accommodated by these modes alone. The project includes providing Rapid Transport Network infrastructure or the ability to further develop this site at a future date. This will enable frequent and reliable bus services to improve access between the Eastern suburbs of Howick, Pakuranga and Botany and the Auckland City area, particularly the Auckland CBD.

GHD, in partnership with Aurecon, was commissioned by the then Manukau City Council (MCC) in February 2010 to undertake Package 04 (Pakuranga Scheme Assessment) of the AMETI project, which involves the preparation of a Scoping Report followed by a Scheme Assessment Report (SAR) for improvement works on Pakuranga Road, Ti Rakau Drive and Reeves Road including incorporation of the Rapid Transit Network (RTN)[4].

The packages of work included in the AMETI programme are illustrated in Figure 1. The geographic extent of the current PSI is illustrated as Package 04; the Pakuranga Scheme Assessment.

[4] Auckland Transport website http://www.aucklandtransport.govt.nz/improving-transport/ameti/phase-2-panmure-to-pakuranga/Pages/default.aspx

Figure 1: Package 04 Pakuranga Scheme Assessment shows the extent of the assessment



6.1 Alignment Setting

In general, from Panmure Bridge and Waipuna Bridge on the western end of the alignment to Ti Rakau Bridge the land use is predominantly residential. From Ti Rakau Bridge to Botany Town Centre the land use is mixed commercial/industrial. The area was formerly utilised as pastoral grazing land and urban development occurred from the mid-1950s. Appendix 2 shows the alignment in more detail.

7 Site Description

The following site description is based on readily available information on geology and hydrogeology, a review of aerial photos and the results of a contaminated site search via Auckland Council's Natural Resources and Specialist Input Unit.

7.1 Geology

Along the length of the project there are a number of geological units present[5], the most prominent being rhyolitic pumiceous deposits of the Tauranga Group. This unit consist of light grey to orange-brown undifferentiated pumiceous mud, sand and gravel with black muddy peat and lignite. Near the Tamaki River is a lithic tuff deposit which consists of thin graded beds of grey mud-sand sized lithic fragments of comminuted country rock. The lithic fragments include basalt and basanite fragments, mudstone, sandstone, alluvium and micaceous sand. To the north of Ti Rikau Drive (near Udys Road) the near

[5] Kermode, L.O. 1992: Geology of the Auckland Urban Area, Scale 1:50 000. Institute of Geological & Nuclear Sciences Geological Map 2. 1 sheet + 63p. Institute of Geological & Nuclear Sciences Ltd, Lower Hutt, New Zealand.

surface unit is Flysch of the East Coast Bays Formation which consists of well bedded, variably graded, grey to greenish grey muddy sandstone.

The large complex between Ti Rakau Drive and Pakuranga Road consists of engineered construction fill. The construction fill likely consists of re-compacted clay to gravel sized material and may include construction and demolition wastes. The industrial zone between Trugood Drive and Burswood Drive is a mottled patchwork of construction fill and basalt and basanite lavas derived from the Auckland Volcanic Field. The lavas are grey to dark grey, dense fine grained basalt or basanite. To the west of the intersection between Botany Road and Ti Rakau Drive, near Bard Place Reserve, there is a rhyolitic pumice deposit which consists of light grey massive to finely laminated pumice deposit. The fragments in this unit are mud to sand sized and include non-welded ignimbrite, tephra (ash fall volcanic deposits), and alluvial pumice deposits.

7.2 Hydrogeology

Given the proximity to coastal areas, regional groundwater flow is anticipated to be in a generally North, North East and North West direction towards the inner Waitemata Harbour. Localised groundwater flows will also be expected towards the Tamaki Basin, Tamaki River and the Pakuranga Creek. Shallow unconfined groundwater will tend to be influenced by local topography and proximate surface water bodies.

7.3 Review of aerial photos

Historical aerial photos were obtained from the Auckland Council GIS Viewer[6]. The aerial photo dates available and selected for the purposes of this assessment included:

- 1940, 1959, 1996, 2006, 2008 and 2010

These photos were selected to identify previous and current land uses that may indicate potential contamination of the area within which the road works will take place. The following tables provide a summary of observations from the historical aerial photos.

Because of the significant extent of the proposed alignment, a limited set of photographs has been summarised here initially as a general overview, with subsequent focus on specific sites.

[6] http://maps.aucklandcouncil.govt.nz/AucklandCouncilViewer/

7.3.1 Alignment overview

Date	Observations
1940	There is limited aerial photography available for this date. The photograph available depicts the land use in Pakuranga to be predominantly farmland dedicated to what appears to be pastoral farming. The road bridge crosses the Tamaki Estuary at Kerswill Road. The Waipuna and the Panmure bridges are yet to be constructed. The blacked out area on the image indicates that aerial photography is not available for this area. Historically, land use in the Pakuranga area consisted of horticultural market gardening activities and as such it is considered likely that trace concentrations of pesticides such as DDT remain in the topsoil and therefore residual risk remains with regard soil disturbance in the area regarding these contaminants.
	

Date	Observations
1959	The aerial image shows that land use has intensified with residential developments in the Pakuranga area as well as along the Tamaki river closest to the bridge. The land use is still predominantly what appears to be pastoral farming. A racing track is located south of what is present day Pakuranga Town Centre. Panmure Bridge has now been constructed over the Tamaki Estuary. The blacked out area on the image indicates that aerial photography is not available for this area.
	

Date	Observations
1996	By 1996 farmland has given way to mainly mixed urban residential in the Pakuranga Area and to the early stages of Botany Industrial area and town centre. The area was not fully developed yet as evidenced by extensive land development in the Botany area although the industrial area appears well developed at this stage. An orchard appears to be located on what is modern day Greenmount Park. Greenmount landfill is also active as well. Close to Panmure bridge a greenhouse is in operation. Pakuranga substation occupies land off Ti Rakau Drive. The Bridge at Kerswill Road has now been removed and the Waipuna Bridge has been constructed south of Panmure Bridge.
	

Date	Observations
2006	The large area of exposed soil related to land development activities apparent in the Botany area in 1996 is now occupied by high density residential and industrial developments. Land use has intensified and there is less green open space apparent. Greenmount parks land use has changed since 1996 from apparent orchard to parkland.
	

Date	Observations
2010	Urban development continues but there are no major changes apparent compared to 2006 and land use overall remains relatively static.
	

7.3.2 Site specific overview

Date	Observations
2008	Glasshouses can be seen on the aerial photo at 24 Pakuranga Road (oval) and a potential small scale orchard in 39 Pakuranga Road (circle) which may present pesticide contamination issues, although both sites are separate from the alignment and therefore not considered likely to affect the project.
	

Date	Observations
2008	3 Kentigern Close is the site of a former Mobil branded service station (large circle). This site is currently vacant. A contaminated site investigation was undertaken in 2008 and the report was issued to the former Auckland Regional Council. A copy of the report was requested from Mobil but is yet to be received at the time of writing. A copy was also requested from Auckland Council under the Local Government Official Information and Meetings Act 1987 but the report was not available to read. Directly across the road a BP branded service station is currently in operation (small circle). These sites may present issues relating to hydrocarbon contamination during construction of the alignment.
	

Date	Observations
2010	New Zealand Dry Cleaners are located at Aylesbury Street, Pakuranga Town Centre. This business may present contamination issues to the proposed alignment with regards chlorinated solvents and potentially other volatile organic compounds (VOCs).
	

Date	Observations
2008	Pakuranga Automotive (large oval) and Pakuranga Panelbeaters (circle) are located at 16 and 12 Cortina Place respectively. Pakuranga Auto Transport are located at 16D Cortina Place (small circle). These businesses may present issues to the proposed alignment with regards hydrocarbon, solvents and trace element contamination as a result of activities relating to vehicle servicing and repair.
	

Date	Observations
2008	3 Reeves Road is currently occupied by a Gull branded service station and may present issues relating to hydrocarbon contamination to the construction phase of the alignment as a result of fuel storage facilities here.
	

Date	Observations
2010	64B Ti Rakau Drive /11 Cortina Place is the site of a former Caltex branded service station. It is currently a vacant site. A site investigation[7] concluded that 7 soil samples exceeded the Oil Industry Guideline Tier 1 Criteria for Commercial / Industrial Land Use. These samples exceeded the criteria for subsurface maintenance/excavation worker human health pathways for selected hydrocarbon contaminants and could present a health risk to construction workers on the alignment.
	

[7] URS, O'Donohue, K., 2010, Caltex Pakuranga Service Station – Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment.

Date	Observations
2010	242 Ti Rakau Drive is currently occupied by a Mobil branded service station and may present issues relating to hydrocarbon contamination to the construction phase of the alignment as a result of fuel storage facilities there. Enquiries with the Auckland Council have not identified any environmental investigation reports available for this site. The Pakuranga Creek flows close to the site.
	

Date	Observations
2008	Best Automotive Clinic is located at 245 Burswood Drive. This business may present issues to the proposed alignment with regards hydrocarbon, solvents and trace element contamination as a result of activities relating to vehicle servicing and repair.
	

Date	Observations
2008	Sandvik Materials Technology is located at 269 Ti Rakau Drive. This business may present issues to the proposed alignment with regards hydrocarbon and trace element contamination as a result of materials processing.
	

Date	Observations
2006	279 Ti Rakau Drive is the site of a former timber storage yard (rectangular outline). It is currently a buy and sell yard and may host residual contamination relating to timber treatments. Across the road at 284 Ti Rakau Drive a Z branded service station is currently in operation (oval outline) and may also present issues during construction of the alignment relating to hydrocarbon contamination.
	

Date	Observations
2008	Forging Ahead is located at 293 Ti Rakau Drive. This business may present issues to the proposed alignment with regards hydrocarbon and trace element contamination resulting from foundry operations.
	

Date	Observations
2008	333 Ti Rakau Drive is occupied by the Blue n Green Dry Cleaners (large oval) whilst next door on the corner of Harris Road and Ti Rakau Drive is a BP branded service station (circle). Behind BP is Jireh Auto Tyres at 179 Harris Road (small oval) dealing in automotive repairs. The service station may present issues to the construction of the alignment relating to hydrocarbon contamination and the dry cleaners may present issues related to chlorinated solvent and VOC contamination. The auto workshop may also have some issues with solvents, hydrocarbons as well as trace elements.
	

Date	Observations
2010	380 Ti Rakau Drive is occupied by the Howick and Eastern Bus Company whilst next door at 384 is a Gull branded service station. Both of these sites may present issues to the construction of the alignment relating to hydrocarbon contamination as a result of fuel storage facilities at both sites. A tributary of the Pakuranga Creek flows at the back of both properties and could be considered a sensitive receptor. According to council borehole records Chevron have installed a borehole at 380 Ti Rakau Drive for monitoring purposes. A site investigation report was not available from Auckland Council. It is understood that Chevron previously operated a Caltex branded service station at 384 Ti Rakau Drive.
	

Date	Observations
2010	550 Te Iriringi Drive is currently occupied by a Z branded service station and may present issues relating to hydrocarbon contamination during the construction phase of the alignment along Te Koha Road as a result of fuel storage facilities here.
	

8 Council Records

A site contamination enquiry was completed for the road alignment by seeking records from Auckland Council. The complete results of this search are included as Appendix A of this report. A contaminated site discharge was identified at 11 Cortina Place / 64B Ti Rakau Drive (Caltex branded service station). The Council's register indicates that a tank pull report was received by the then Auckland Regional Council when the Underground Petroleum Storage System (UPSS) was removed from the site in May 2010. As a result, a discharge consent was required for the site. Another contaminated site discharge was identified at 3 Kentigern Close (Mobil branded service station) and the register indicates that an Environmental Site Assessment report was received by the council for that site.

The site reports for these properties have been requested from Auckland Council. The site investigation report was received for the Caltex branded service station but not the Mobil branded service station. The report[8] for 11 Cortina Place / 64B Ti Rakau Drive detailed 9 soil samples that exceeded the Oil Industry Guideline Tier 1 Criteria for Commercial / Industrial Land Use. Seven soil samples exceeded the criteria for subsurface maintenance/excavation worker human health pathways for selected contaminants. This will need to be taken into account during the alignment works regarding the health and safety of construction workers.

Auckland Council recommended that Mobil should be contacted to gain access to the site report for the Mobil branded service station. Mobil was contacted by phone[9] and they recommended an email request be submitted but the site report is yet to be received. Following that a request for more information was submitted to the Auckland Council Local Government Official Information and Meeting Act (LGOIMA) process. Auckland Council responded that they were withholding the Environmental Site Assessment Report provided by Mobil under section 7(2)(c)(i) of the LGOMIA as the report was supplied under an obligation of confidence and making it available would "be likely to prejudice the supply of similar information, or information from the same source, and it is in the public interest that such information should continue to be supplied". Given that both Mobil and Auckland Council have been contacted for more information on the site and that this information is not forthcoming any construction activities on site should proceed on the assumption of contamination existing onsite.

The Environmental Site Assessment report for the Mobil site should be read in conjunction with this assessment to better understand the risks associated with the former service station at 3 Kentigern Close regarding the health and safety of construction workers.

A borehole register search conducted by the Auckland Council Natural Resources and Specialist Input Unit revealed 3 cases of borehole installation for the following contaminated and potentially contaminated sites.

[8] URS, O'Donohue, K., 2010, Caltex Pakuranga Service Station – Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment.

[9] Personal Communication with Erin Richards of Exxon Mobil on 16th October 2012

Site Name	Address	Purpose
Chevron	380 Ti Rakau Drive, Pakuranga	The construction of a bore for monitoring purposes.
Chevron	11 Cortina Place / 64B Ti Rakau Drive, Pakuranga.	The construction of 4 bores for contaminated site investigations.
T.M.K Packers Ltd.	257 Ti Rakau Drive, Pakuranga	The construction of 4 bores for environmental monitoring.

9 Potential Locations of Interest

To summarise the site specific review the following sites were noted as potential contaminated sites that may present contamination issues once work commences on the alignment.

Site Name	Activity	HAIL Activity	Potential Contaminant of Concern based upon identified HAIL activity
3 Kentigern Close	BP branded service station	Vehicle refuelling, service and repair	Total petroleum hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
Aylesbury Street, Pakuranga Town Centre	New Zealand Dry Cleaners	Chemical manufacture, application and bulk storage	Chlorinated Solvents, VOCs
12 Cortina Place	Pakuranga Panelbeaters	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
16 Cortina Place	Pakuranga Automotive	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
16D Cortina Place	Pakuranga Auto Transport	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
3 Reeves Road	Gull branded service station	Vehicle refuelling, service and repair	TPH, BTEX
242 Ti Rakau Drive	Mobil branded service station	Vehicle refuelling, service and repair	TPH, BTEX

245 Burswood Drive	Best Automotive Clinic	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
269 Ti Rakau Drive	Sandvik Materials Technology	Metal extraction, refining and reprocessing, storage and use	TPH, BTEX, Trace Elements
279 Ti Rakau Drive	Former Timber Storage yard.	Chemical manufacture, application and bulk storage	Trace Elements, PCP, PAH, Pesticides
Corner Ti Rakau Drive and Burswood Drive	Z branded service station	Vehicle refuelling, service and repair	TPH, BTEX
179D Harris Road	Jireh Auto Tyres	Vehicle refuelling, service and repair	Chlorinated solvents, TPH, BTEX, Trace Elements
Corner Ti Rakau Drive and Harris Road	BP branded service station	Vehicle refuelling, service and repair	TPH, BTEX
293 Ti Rakau Drive	Forging Ahead (Foundry)	Metal extraction, refining and reprocessing, storage and use	TPH, BTEX, Trace Elements
333 Ti Rakau Drive	Blue n Green Dry Cleaners	Chemical manufacture, application and bulk storage	Chlorinated Solvents, VOCs
380 Ti Rakau Drive	Howick and Eastern Bus Depot	Vehicle refuelling, service and repair	TPH, BTEX
386 Ti Rakau Drive	Gull branded service station	Vehicle refuelling, service and repair	TPH, BTEX
550 Te Irirangi Drive	Z branded service station	Vehicle refuelling, service and repair	TPH, BTEX

10 Potential Contaminants of Concern

The table below outlines the potential contaminants of concern that may be present in the area surrounding the proposed road upgrade. The identified contaminants are based on past and current land use.

Soil Contaminants	Potential Source
Inorganic elements	Arsenic, copper and chromium are commonly used timber treatment chemicals used for fence posts, and other timbers used in the outdoor environment. Trace elements relating to foundry operations.
Total petroleum hydrocarbons (TPH), Benzene, toluene, ethylbenzene, xylenes (BTEX)	Petrol stations and associated underground storage tanks and fuel system.
VOCs and Chlorinated Solvents	Dry Cleaning Services, automotive workshops.
Pentachlorophenol (PCP)	Wood preservative (anti sap stain) used in the treatment of timber.

11 Sensitive Receptors

A site walkover and aerial photo review identified no sensitive receptors in close proximity to the potentially contaminated sites along the AMETI alignment with the exception of the tributary of the Pakuranga Creek flowing at the back of the Gull Service Station at 386 Ti Rakau Drive. The alignment is located in an urban landscape and as such there is limited access to exposed soil, although once the alignment construction begins the amount of exposed soil will increase. The land use is a mix of commercial, residential and industrial. There are nursing homes, schools, gardens, streams and parks in the vicinity of the alignment but none of these are in close proximity to the potential contaminated sites listed.

12 Qualitative Assessment of Risk

The following assessment of potential risk is qualitative only and does not represent a detailed quantitative assessment of risk to human health or the environment. Rather, it presents a selection of the primary contaminants of concern that may be encountered along the alignment.

12.1 Organochlorines

Pentachlorophenol (PCP) is an organochlorine preservative used in the treatment of timber and as such may be present at the former timber storage yard and as such may pose a risk during the construction of the alignment. Exposure to PCP can cause harmful effects on the liver and kidneys and may cause cancer[10].

[10] http://water.epa.gov/drink/contaminants/basicinformation/pentachlorophenol.cfm

Chlorinated solvents are used in a range of commercial and industrial purposes to include mixing and thinning solutions. Their chlorine chemical structure allows them to dissolve organic material and some compounds are used as a raw material in the production of other chemicals. There is a range of short term and long term exposure effects including skin problems, and damage to the nervous system, kidneys and liver. Some chlorinated solvents are known to cause cancer[11].

12.2 Trace Elements

Generally, trace elements are immobile under normal soil (non-acidic or alkaline) conditions. These trace elements tend to sorb strongly to the (inorganic) soil particles; hence the propensity for leaching is very limited for most soil conditions and impacted topsoil can be mobilised as dust or sediment if the soil is exposed.

Copper chrome arsenate (CCA) contamination (if any) of near surface soil from the storage of treated timber is likely to be limited to that of the storage yard. The highly localised nature of the contamination restricts the risk posed to either human health or the environment.

Copper adsorbs strongly to most soil types. Along with other trace elements, the mobility of copper represents a low human health risk. Copper can pose a threat to sediment and surface water quality under certain conditions if sediment control measures are not sufficient to contain impacted soil that is exposed.

12.3 Petroleum Hydrocarbons

Petroleum hydrocarbons can exist in the soil environment as a separate phase liquid; dissolved in groundwater or the soil solution; and/or vapour[12]. Physical (including groundwater processes), chemical and biological processes affect the fate and migratory rates of these contaminants. The key influences include sorption (adsorption and absorption), diffusion (dilution and dispersion), volatilisation, chemical and biological degradation which are ultimately determined by the characteristics of the soil.

The low molecular weight fraction of petrol volatilises rapidly when exposed to the atmosphere. These compounds have a reported biodegradable half-life of five years in groundwater[12]. In the soil environment the half-life can be as short as 1-4 weeks[13].

Petroleum hydrocarbons can be toxic to the environment and human health. The volatile compounds have an adverse effect on the central nervous system of animals and benzene has been identified as a human carcinogen[12]. Some higher molecular weight compounds present in diesel and fuel oils (PAHs) are also carcinogenic.

Also associated with the accumulation of petroleum hydrocarbon vapour and liquid is a fire and/or explosion risk. This requires oxygen and the introduction of an ignition source[12].

[11] http://www.worker-health.org/chlorinatedsolvents.html

[12] Ministry for the Environment. (1999). Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011).

[13] Ahrens, M. (2008). *Literature review of organic chemicals of emerging environmental concern in use in Auckland* (Prepared by NIWA for Auckland Regional Council. Auckland Regional Council Technical Report 2008/028).

13 Conclusions

Based upon the review of available information, the alignment walk over inspection and qualitative risk assessments undertaken as part of this Preliminary Site Investigation, the following conclusions can been drawn:

- Adjacent to the road alignment up to 20 sites with land uses included on the HAIL were identified. Given that the surface soil will be disturbed along the alignment corridor through significant soil disturbance activity the regulations of the NES apply on the basis of HAIL category H adjacent sites. Category H is defined as "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."
- The likelihood that the HAIL activities identified adjacent to the proposed alignment the proposed alignment may impact the alignment varies for each site depending on the nature of the contaminants and therefore the likely migration mechanisms. The relative likelihood of contaminant migration to the alignment from each site is summarised in the table below;

Site Name	**Activity**	**Contamination Risk Rating**	**Potential Contaminant of Concern based upon identified HAIL activity**
11 Cortina Place / 64B Ti Rakau Drive	Former Caltex branded service station, now a vacant site	High Risk	Total petroleum hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
24 Pakuranga Road	Market Gardening	Low Risk	Pesticides, Inorganic Elements
39 Pakuranga Road	Possible Orchard	Low Risk	Pesticides, Inorganic Elements
3 Kentigern Close	BP branded service station	Medium to High Risk (review risk after review of Mobil environmental site assessment report.)	TPH, BTEX
Aylesbury Street, Pakuranga Town Centre	New Zealand Dry Cleaners	Medium Risk	Chlorinated Solvents, VOCs
12 Cortina Place	Pakuranga Panelbeaters	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
16 Cortina Place	Pakuranga Automotive	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements

16D Cortina Place	Pakuranga Auto Transport	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
3 Reeves Road	Gull branded service station	Medium Risk	TPH, BTEX
242 Ti Rakau Drive	Mobil branded service station	Medium Risk	TPH, BTEX
245 Burswood Drive	Best Automotive Clinic	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
269 Ti Rakau Drive	Sandvik Materials Technology	Medium Risk	TPH, BTEX, Trace Elements
279 Ti Rakau Drive	Former Timber Storage yard.	Low to Medium Risk	Trace Elements, PCP, PAH, Pesticides
Corner Ti Rakau Drive and Burswood Drive	Z branded service station	Medium Risk	TPH, BTEX
179D Harris Road	Jireh Auto Tyres	Medium Risk	Chlorinated solvents, TPH, BTEX, Trace Elements
Corner Ti Rakau Drive and Harris Road	BP branded service station	Medium Risk	TPH, BTEX
293 Ti Rakau Drive	Forging Ahead (Foundry)	Medium Risk	TPH, BTEX, Trace Elements
333 Ti Rakau Drive	Blue n Green Dry Cleaners	Medium Risk	Chlorinated Solvents, VOCs
380 Ti Rakau Drive	Howick and Eastern Bus Depot	Medium Risk	TPH, BTEX
386 Ti Rakau Drive	Gull branded service station	Medium Risk	TPH, BTEX
550 Te Irirangi Drive	Z branded service station	Medium Risk	TPH, BTEX

14 Recommendations

We recommend that Auckland Transport considers the following in order to minimise risks associated with contaminated land along the alignment of the proposed road works;

- Obtain environmental site investigations reports from Auckland Council

- Engage with the Auckland Council contaminated site officers to present this report and the planned strategy to assess potential contamination from adjacent sites along the alignment.
- Undertake intrusive soil investigations to assess potential contaminants along the alignment, at locations where the adjacent land use has been identified as having current or historic HAIL activities and where the likelihood of contamination has been assessed as medium to high.

15 Limitations

This Preliminary Site Investigation refers to the proposed AMETI Project as described in Section 4 of this report and:

1. has been prepared by GHD Limited ("GHD") for Auckland Transport;

2. may only be used and relied on by Auckland Transport;

3. must not be copied to, used by, or relied on by any person other than Auckland Transport without the prior written consent of GHD and subject always to the next paragraph; and

4. GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Auckland Transport arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- were limited to those specifically detailed in section 3;
- were undertaken in accordance with current professional practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report; and
- did not include the collection of samples for the purpose of laboratory analysis or verification of information obtained from the site history review.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report ("Assumptions"), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions and/or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

GHD has prepared this Report on the basis of information provided by Auckland Transport (and others who provided information to GHD including Government authorities, which GHD has not independently verified or checked ("Unverified Information") beyond the agreed scope of work).

GHD expressly disclaims responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

Inspections undertaken in respect of this Report were limited to visual inspections only and were constrained by the particular site conditions, such as locations of buildings, services or vegetation.

The opinions, conclusions and any recommendations in this Report are based on information obtained from readily available information sources.

Except as otherwise expressly stated in this Report, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.

16 Third Party Reliance

The work created in this document is the property of GHD Ltd and any unauthorised use of it in any form whatsoever is prohibited. The document is intended for the use of Auckland Transport. It has been prepared in accordance with the Terms of Engagement for the commission and on the basis of specific instructions and information provided by the client for exclusive use by the client for its particular purpose. The contents and conclusions of this document may therefore be inappropriate for any third party in the context of that third party's particular purposes and circumstances. Any third party should obtain its own independent information or advice and no responsibility is accepted and no duty of care is assumed by GHD Ltd to any third party who may use or rely on the whole or any part of the content of this document.

Yours sincerely
GHD Limited

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09 3708204

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09 3708206

Appendix A

Auckland Council Site Contamination Search

Auckland Council
Te Kaunihera o Tāmaki Makaurau

25 September 2012

GHD
Level 16
ASB Bank Centre
135 Albert Street
Auckland

Attention: Sean Toland

Dear Sean

Site Contamination Enquiry – Various properties along AMETI route.

This letter is in response to your enquiry requesting available site contamination information for the sites as indicated in your email of 25 September 2012. 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 below outline the reference for the site files and pollution incident files available for the subject site:

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**2C Amera Place**		
Pollution Date	22/05/08	Comment	Incident no. 08/2053. Vomit smell.
Pollution Date	09/05/11	Comment	Incident no. 11/0598. Waste being tipped into stormwater drain continuously.
Pollution Date	03/11/03		Incident no. 03/1344. Restaurant tipping fat to stormwater.

File Reference	6-03-2874		
File Name	**2G Amera Place**		
Site Occupier Name	Dynamo Group Ltd		
Pollution Date	14/01/03	Comment	Concrete in drain.
Pollution Date	02/09/02	Comment	Concrete in drain.

File Reference	P270-04-03		
File Name	Catchment file		
Site address	**12 Amera Place**		
Pollution Date	06/06/03	Comment	Incident no. 03/0628. Discharge from small building site
Pollution Date	03/11/03	Comment	Incident no. 03/1344. Restaurant tipping fat to stormwater.

File Reference	P270-04-01-03		
File Name	Catchment file		
Site address	**183 Harris Rd - BP Express Ti Rakau**		
Pollution Date	12/04/04	Comment	Incident no. 04/0627. Petrol spill on forecourt.
Site Visit Date	15/01/01	Comment	Site audit.

File Reference	T096-03		
File Name	Catchment File		
Site Occupier Name	**166B Harris Road**		
Pollution Date	21/03/11	Comment	Incident no. 11/0689. Carwashing soapy liquid to stormwater.
Site Visit Date		Comment	

File Reference	T096-03		
File Name	Catchment File		
Site Occupier Name	**Corner Harris Road & TiRakau Drive**		
Pollution Date	01/09/09	Comment	Incident no. 09/2608. Fire page fertilizers to road and stormwater from crash.
Site Visit Date		Comment	

File Reference	T096-03		
File Name	Catchment file		
Site Address	**13 Millen Ave**		
Pollution Date	23/03/12	Comment	Incident no. 12/1671. Sewage overflow.

File Reference	T096-03		
File Name	**Catchment file**		
Site Address	**Pakuranga Shopping Centre**		
Pollution Date	23/03/11	Comment	Incident no. 11/0958. Strong sewage smell coming from carpark.
Site Address	**34 Pakuranga Road**		
Pollution Date	11/11/08	Comment	Burning.
Site Address	**130 Pakuranga Road**		
Pollution Date	19/06/12	Comment	Incident no. 12/2449. Dye in stormwater.
Pollution Date	20/04/12	Comment	Incident no. 12/1768. Oil slick coming down the Tamaki river behind St Kentigern College, Pakuranga
Site Address	**140 Pakuranga Road**		
Pollution Date	27/12/10	Comment	Incident no. 11/0011. Brown slick in the Tamaki River
Site Address	**165 Pakuranga Highway (BP Town Centre)**		
Pollution Date	23/07/05	Comment	Incident no. 05/1898. Hydrocarbon spill – 10-200 litres.
Pollution Date	04/10/03	Comment	Incident no. 03/1327. Hydrocarbon spill – less than 10 litres.
Site Address	**172 Pakuranga Road**		
Pollution Date	28/11/10	Comment	Incident no. 11/0330. Burning
Site Address	**Pakuranga Road**		
Pollution Date	14/11/03	Comment	Incident no. 03/1088. Vehicle washing to stormwater.

File Reference	6-03-1340		
File Name	**2 Pakuranga Rd, Pakuranga**		
Site Occupier Name	Panmure Bridge Marina Ltd		
Pollution Date	22/06/01	Comment	Washing to stormwater.
Pollution Date	07/08/97	Comment	Spill when spray painting.
Pollution Date	31/07/97	Comment	Boat sanded on slipway.

File Reference	P270-04-17		
File Name	**22 Pakuranga Road**		
Site Occupier Name	Foley Concrete Ltd		
Pollution Date	12/10/05	Comment	Concrete waste to stormwater.
Pollution Date	18/02/03	Comment	Concrete waste to stormwater.

File Reference	6-03-0143		
File Name	**102 Pakuranga Road**		
Site Address	Mobil Service Station		
Pollution Date	29/07/94	Comment	Engines cleaned to yard and waste to stormwater.

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**Corrner Pakuranga Highway and Ti Rakau Drive**		
Pollution Date	01/08/06	Comment	Possible battery acid on petrol station forecourt
File Reference	P270-04-03		
File Name	Catchment file		
Site Address	**3 Reeves Road**		
Site Visit Date	31/07/94	Comment	Site audit.

File Reference	6-03-1754		
File Name	**3 Reeves Road**		
Site Occupier Name	Gull Petroleum		
Pollution Date	17/01/01	Comment	Petrol on forecourt washed off with water.

File Reference	6-03-2954		
File Name	**7 Reeves Road**		
Site Occupier Name	Great City Restaurant		
Pollution Date	03/10/02	Comment	Leakage from waste bin.
Pollution Date	10/09/02	Comment	Leakage from waste bin (leaking blood).

File Reference	T096-03		
File Name	Catchment file		
Site Address	**7 Reeves Road**		
Pollution Date	14/02/12	Comment	Incident no. 12/0816. White / grey smoke coming from restaurant.

File Reference	T096-03		
File Name	Catchment file		
Site Address	**Corner Reeves Road, and TiRakau Road intersection.**		
Pollution Date	23/03/11	Comment	Incident no. 11/1035. Major sewage spill.

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**Corrner Ti Rakau Drive and Te Irirangi**		
Pollution Date	07/07/05	Comment	Incident no 05/1795. Hydraulic oil spill to stormwater cesspit.

File Reference	T096-03		
File Name	Catchment file		
Site Occupier Name	**Corrner Ti Rakau Drive and Waipuna Highway**		
Pollution Date	31/01/92	Comment	Incident no. 91/0127. Drum of hydrochloric acid spilled on road.

File Reference	T096-03		
File Name	Catchment file		
Site Address	**550 Te Irirangi Drive**		
Pollution Date	13/05/07	Comment	Incident no. 07/1916. Petrol spill.
Pollution Date	21/07/05	Comment	Incident no. 05/1890. Diesel spill – approx 180 litres.

Pollution Date	03/03/05	Comment	Incident no. 05/0795. Mixed fuel being drained to forecourt. 10-200 litres.
Site visit Date	20/01/01	Comment	Site audit.
Pollution Date	17/06/08	Comment	Incident no. 08/2296. Oil spill to stormwater.

File Reference	A224-06		
File Name	Catchment file (Air Quality)		
Site Address	**164 TiRakau Drive**		
Pollution Date	18/11/08	Comment	Incident no. 08/3750. Burning.
Pollution Date	21/01/08	Comment	Incident no. 08/0328. Burning.
Site Address	**214 TiRakau Drive**		
Pollution Date	09/04/07	Comment	Incident no. 07/2040. Burning.
Site Address	**451 TiRakau Drive**		
Pollution Date	18/06/08	Comment	Incident no. 08/2331. Odour from Pizza Hutt.
Site Address	**TiRakau Drive**		
Pollution Date	22/12/09	Comment	Incident no. 10/0043. Burning.

File Reference	A256-03		
File Name	Catchment file		
Site Address	**Ti Rakau Dr (TJ's Carwash)**		
Pollution Date	14/01/08	Comment	Incident no. 07/0582. Overspray from car wash.
Site Visit Date		Comment	

File Reference	T096-03		
File Name	Catchment file (Air Quality)		
Site Address	**53 TiRakau Drive**		
Pollution Date	07/12/11	Comment	Incident no. 11/4523. Sediment to stormwater.
Site Address	**81 TiRakau Drive**		
Pollution Date	6/4/2008	Comment	Incident no. 08/2170. Concrete cutting.
Site Address	**97 TiRakau Drive**		
Pollution Date	20/11/09	Comment	Incident no. 09/3355. Milky coloured stream.
Site Address	**128 TiRakau Drive**		
Pollution Date	01/08/05	Comment	Incident no. 05/1980. Concrete washing to stormwater.
Site Address	**130 TiRakau Drive**		
Pollution Date	10/08/10	Comment	Paint to stormwater. .
Site Address	**164 TiRakau Drive**		
Pollution Date	13/01/08	Comment	Burning incident.
Site Address	**176 TiRakau Drive**		
Pollution Date	04/05/10	Comment	Incident no. 10/1678. Oil washing to stormwater.
Pollution Date	29/03/10	Comment	Incident no. 10/1282. Oil spill on driveway.
Site Address	**242 TiRakau Drive**		
Site visit Date	27/09/02	Comment	Site audit.
Site visit Date	15/01/01	Comment	Site audit.
Site Address	**249 TiRakau Drive**		
Pollution Date	25/11/09	Comment	Incident no. 09/3469. Rotten egg odour.
Pollution Date	13/09/10	Comment	Sewage odour.
Pollution Date	30/06/10	Comment	Incident no. 10/2214. Sewage odour.
Pollution Date	16/04/10	Comment	Incident no. 10/1456. Strong odour.
Site Address	**263 TiRakau Drive**		
Pollution Date	16/10/01	Comment	Wasterblasting to stormwater.

Site Address	**290 TiRakau Drive**		
Pollution Date	27/05/09	Comment	Incident no. 09/1878. Odour from a fish shop.
Site Address	**298 TiRakau Drive**		
Pollution Date	13/03/06	Comment	Incident no.06/0794. Oil spill from restaurant.
Site Address	**320 TiRakau Drive**		
Pollution Date	21/07/12	Comment	Incident no. 12/2755. Concrete dust in channel and gutter.
Pollution Date	28/05/09	Comment	Incident no. Clay washed to creek (from Urban Worx Limited).
Site Address	**380 TiRakau Drive**		
Site visit Date	13/01/02	Comment	Site audit.
Site Address	**396 TiRakau Drive (Soda Blast Auckland)**		
Pollution Date	14/02/08	Comment	Incident no. 08/0275. Waterblasting of soda to stormwater.
Site Address	**451 TiRakau Drive**		
Pollution Date	22/06/11	Comment	Incident no. 11/2871. Paint discharged to stormwater.
Pollution Date	28/01/10	Comment	Incident no. 10/0597. Waste cooking spill.
Pollution Date	04/04/08	Comment	Incident no. 08/1463. Waste cooking spill.
Pollution Date	10/10/11	Comment	Incident no. 11/2871. Paint discharge to stormwater.
Site Address	**500 TiRakau Drive**		
Pollution Date	15/06/12	Comment	Incident no. 12/2451. Fire at bowling alley.
Site Address	**TiRakau Drive**		
Pollution Date	14/11/09	Comment	Incident no. 09/3542. Odour complaint.
Pollution Date	2/1/2007	Comment	Incident no. 07/3676. Petrol to stormwater.
Pollution Date	23/02/07	Comment	Incident no. 07/0877. Car washing to stormwater.
Pollution Date	13/07/04	Comment	Incident no. 04/0935. TJ's carwash discharge to stormwater.
Pollution Date	27/11/01	Comment	Incident no. 01/0683. Washing paint brushes to stormwater.
Pollution Date	30/11/93	Comment	Incident no. 93/0754. Hydrocarbon spill from BP.
Site Address	**Ti Rakau Bridge-Mangrove Swamp**		
Pollution Date	23/01/96	Comment	Incident no. 96/0144. 2 X 44 Gallon Drums Going Down Stream, Planks Of Wood & Oil Slick, Ending Up In Swamp Area

File Reference	7-45-3322		
File Name	**53 TiRakau Drive**		
Pollution Date	07/12/11	Comment	Sediment to stormwater.

File Reference	6-03-1527		
File Name	**249 TiRakau Drive**		
Site Occupier Name	Cascade Hire Centre Ltd		
Site visit Date	04/08/94	Comment	Site audit.

File Reference	P240-04-04		
Site Address	**279 TiRakau Drive - Total Hire Limited**		
Pollution Date	19/01/02	Comment	Incident no. 02/1104. Waste oil overflowing out of drums.
Site Address	**TiRakau Drive**		
Pollution Date		Comment	Incident no.

File Reference	6-03-2465		
File Name	**298 TiRakau Drive**		
Site Occupier Name	Lucky House Restaurant		
Pollution Date	18/05/01	Comment	Washing dishes to stormwater.

File Reference	6-03-2724		
File Name	**318D TiRakau Drive**		
Site Occupier Name	Redox Chemicals NZ		
Pollution Date	18/01/02	Comment	Chemical spill to road.

File Reference	6-03-2157		
File Name	**330 TiRakau Drive**		
Site Occupier Name	Howick & Eastern Buses Ltd		
Pollution Date	14/10/99	Comment	Site visit.

File Reference	6-03-2928		
File Name	**347 TiRakau Drive**		
Site Occupier Name	TJ's Carwash		
Pollution Date	12/02/07	Comment	Carwash to stormwater.
Pollution Date	04/07/04	Comment	Carwash to stormwater.
Pollution Date	15/09/02	Comment	Carwash to stormwater.

File Reference	6-03-2157		
File Name	**380 TiRakau Drive**		
Site Occupier Name	Howick & Eastern Buses		
Pollution Date	26/08/12	Comment	Small oil spill.
Site Visit Date	14/10/99	Comment	Site audit.

File Reference	6-03-2294		
File Name	**TiRakau Drive**		
Site Occupier Name	**Plumbing World**		
Pollution Date	19/10/07	Comment	Black chemical substance seeping from ground.

File Reference	6-03-0141		
File Name	**92-98 Harris Road (but incident was on TiRakau Road)**		
Pollution Date	01/10/95	Comment	Incident no. 95/0014. Chemical Spill At Aspac. Watertech Trucks by Ponds on Ti Rakau Drive

The general catchment file and site visit file for the catchment (6-03 and 6-03-SV respectively) 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 within sites which are approximately 50 metres of either side of the road reserve. Relevant details of the identified consents are appended to this letter (Attachment A).

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 site being investigated: Ground Floor, Kotuku House, 4 Osterley Way, Manukau Central 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).

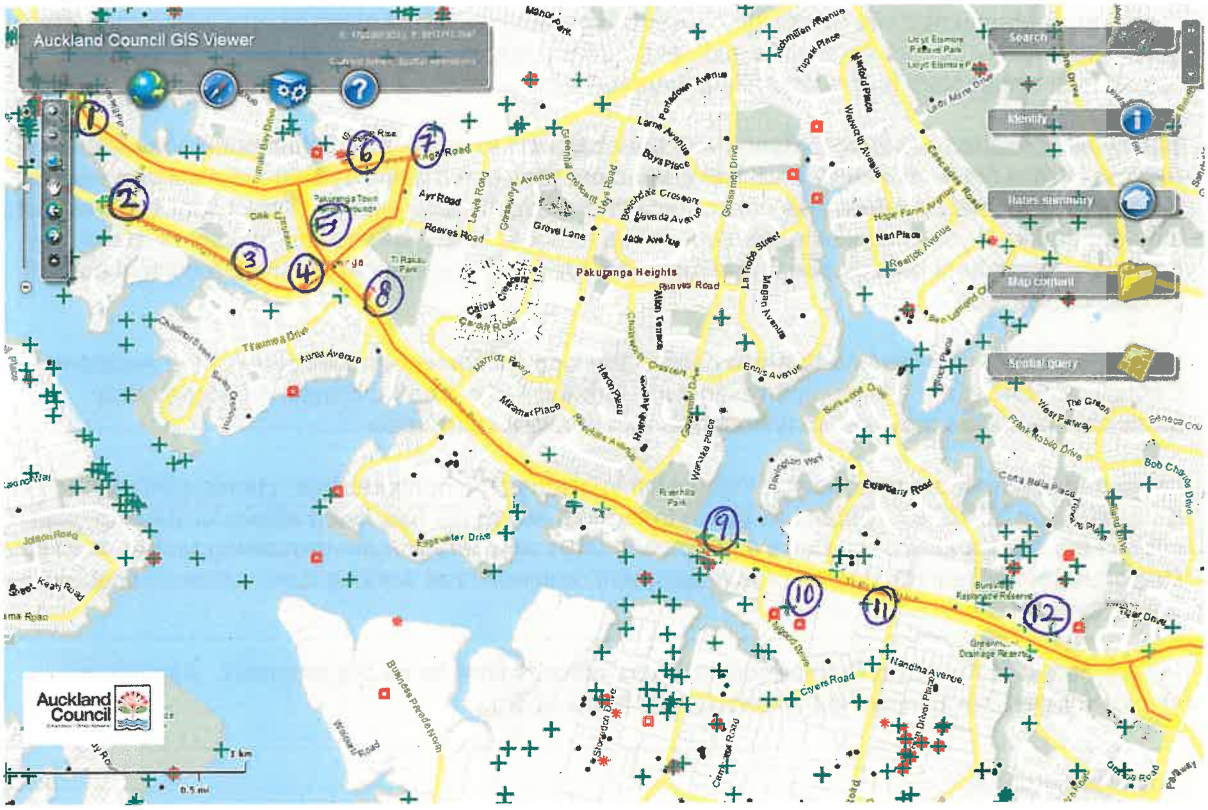
Please note: the Auckland Council cost recovers officer's time for all site enquiries. As such an invoice for the time involved in this enquiry will follow shortly.

Yours sincerely

pp

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

Attachment A



1 ACTIVITY DESCRIPTION:	To authorise the construction of up to 16 bores for investigation purposes.
ACTIVITY ID:	21951
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Opus International Consultants Ltd
CONSENT NUMBER:	28231
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20040824
FILE REFERENCE:	C512-12-3153*
GRANTED DATE:	20030820
LOC TYPE:	Point
PROCESSING OFFICER:	Sarah Pinkerton
PROPERTY ADDRESS:	Eastern Corridor Auckland City & Manukau City
PURPOSE:	To authorise the construction of up to 16 bores for investigation purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	St Johns
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of up to 16 100mm diameter bores, to a depth of approximately 40m. Installation of PVC casing.

2. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	20039
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited

CONSENT NUMBER:	24690
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20010531
FILE REFERENCE:	15256
GRANTED DATE:	20010223
LOC TYPE:	Point
PROCESSING OFFICER:	_Wes Smith
PROPERTY ADDRESS:	Parts of the four power transmission towers as described in the application, being towers on the Otahuhu-Penrose A Line Numbered 20, 22 and 37 and tower Number 9 on the Penrose-Roskill A Line.
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Manukau & Auckland City
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	The discharge of blast media and wastewater to ground as a result of power transmission tower refurbishment trials.

2. ACTIVITY DESCRIPTION:	Clean & paint tower previously coated wit lead-based paint
ACTIVITY ID:	20066
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited
CONSENT NUMBER:	25577
CONSENT STATUS:	Superseded
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20041231
FILE REFERENCE:	15256
GRANTED DATE:	20011025
LOC TYPE:	Point
PROCESSING OFFICER:	_Belinda Gillespie
PROPERTY ADDRESS:	All transmission towers Otahuhu-Penrose B Line Manukau City
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	Null

2. ACTIVITY DESCRIPTION:	Clean & paint tower previously coated wit lead-based paint
ACTIVITY ID:	20066
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited

CONSENT NUMBER:	26761
CONSENT STATUS:	Expired (Not Replace
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20041231
FILE REFERENCE:	15256
GRANTED DATE:	20020913
LOC TYPE:	Point
PROCESSING OFFICER:	_Clive Couldwell
PROPERTY ADDRESS:	All transmission towers Otahuhu-Penrose B Line Manukau City
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(a) and (b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	Null

2. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	20111
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Discharge Other
CONSENT HOLDER:	Transpower New Zealand Limited
CONSENT NUMBER:	26789
CONSENT STATUS:	Expired (Not Replace
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20041231
FILE REFERENCE:	15256
GRANTED DATE:	20020913
LOC TYPE:	Point
PROCESSING OFFICER:	_Clive Couldwell
PROPERTY ADDRESS:	Parts of the transmission towers as described in the application, being tower Number 25 on the PEN - ROS A Line Auckland City
PURPOSE:	To authorise the discharge of contaminants to ground from the maintenance trials on specified lead painted power transmission towers in the Auckland Region in accordance with Section 15(1)(b) of the Resource Management Act 1991.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Transpower Towers
WORKS DESCRIPTION:	Null

3. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of nineteen bores for Geotechnical investigation.
ACTIVITY ID:	28689
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1766322
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4948*
GRANTED DATE:	Null

LOC TYPE:	Point
NORTHING:	5912882
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52773
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of nineteen bores for Geotechnical investigation.
REVIEW DATE:	Null
SITE DESCR:	Multiple sites across Reeves Rd Flyover, Pakuranga. Sites ranging between coordinates: 1) E 1766322 N 5912882 2) E 1766548 N 5912835 3) E 1767011 N 5913381
SITE NAME:	Reeves Rd Flyover
WORKS DESCRIPTION:	Null

4. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of nineteen bores for Geotechnical investigation.
ACTIVITY ID:	28689
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1766548
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4948*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5912835
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52773
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of nineteen bores for Geotechnical investigation.
REVIEW DATE:	Null
SITE DESCR:	Multiple sites across Reeves Rd Flyover, Pakuranga. Sites ranging between coordinates: 1) E 1766322 N 5912882 2) E 1766548 N 5912835 3) E 1767011 N 5913381
SITE NAME:	Reeves Rd Flyover
WORKS DESCRIPTION:	Null

5. ACTIVITY DESCRIPTION:	5/12/09 ext appeal date to due to submitteres not getting their copy of decision WBS 30355 master C 8 Pakuranga - network discharges wetweather and emergency discharges
ACTIVITY ID:	20592
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Wastewater Discharge
CONSENT HOLDER:	Watercare Services Limited
CONSENT NUMBER:	30355
CONSENT STATUS:	Issued
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20431231
FILE REFERENCE:	18036
GRANTED DATE:	20091030
LOC TYPE:	Point

PROCESSING OFFICER:	Lisa Doran
PROPERTY ADDRESS:	Wastewater Network within the Catchment 8 Pakuranga Manukau City
PURPOSE:	To authorise the discharge of wastewater to land or water as a result of wet weather wastewater overflows, and/or overflows resulting solely from network blockages or breakages, and/or exfiltration, and/or power failure or mechanical failure at pump stat
REVIEW DATE:	20151231
SITE DESCRIPTION:	PS 9, 10, 11, 12, 13, 17, 18, 33 and 65
SITE NAME:	C 8 Pakuranga
WORKS DESCRIPTION:	As indicated in the Catchment 8 WNMP prepared by Manukau Water Limited.

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Tank removal
ACTIVITY ID:	21038
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Under Assessment
EASTING:	1766716.5
EXPIRY DATE:	Null
FILE REFERENCE:	Null
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5913366.2
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52127
PROCESSING OFFICER:	Null
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	file T096-03-1288
REVIEW DATE:	Null
SITE DESCR:	Lot 1 DP 149241, Lot 51 & 52 DP 69912
SITE NAME:	Mobil Pakuranga
WORKS DESCRIPTION:	Environmental Site Assessment report received 12/09/08

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Ex Mobil service station. Remediation undertaken by Mobil. The CoC granted 21/9/2009.
ACTIVITY ID:	21076
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1766716
EXPIRY DATE:	Null
FILE REFERENCE:	21158
GRANTED DATE:	20090921
LOC TYPE:	Point
NORTHING:	5913382
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52257
PROCESSING OFFICER:	John O'Grady
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	An application for a Certificate of Compliance to certify that the soil contaminant levels at the site.meet the PA criteria, based on PARP:ALW

	Rule 5.5.41
REVIEW DATE:	Null
SITE DESCR:	Null
SITE NAME:	Sea Horse Investments Ltd
WORKS DESCRIPTION:	Rule 5.5.41

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Removal of underground storage tanks and pipework
ACTIVITY ID:	21021
ACTIVITY STATUS:	Completed
CONSENT STATUS:	Assessment Completed
EASTING:	1766716
EXPIRY DATE:	Null
FILE REFERENCE:	21158
GRANTED DATE:	20090209
LOC TYPE:	Point
NORTHING:	5913382
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52100
PROCESSING OFFICER:	John O'Grady
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	Certifying that the petroleum hydrocarbon residues left in the soils tested after the removal of the UPSS meet the ARC PA Criteria under rule 5.5.42(2) for the site being used for petroleum storage
REVIEW DATE:	Null
SITE DESCR:	Certifying that the petroleum hydrocarbon residues left in the soils tested after the removal of the UPSS meet the ARC PA Criteria under rule 5.5.42(2) for the site being used for petroleum storage
SITE NAME:	Sea Horse Investments Ltd
WORKS DESCRIPTION:	PO Dave Robotham Rule 55 42 (2)

6. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Tank removal
ACTIVITY ID:	21038
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Under Assessment
EASTING:	1766716.5
EXPIRY DATE:	Null
FILE REFERENCE:	Null
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5913366.2
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52127
PROCESSING OFFICER:	Null
PROPERTY ADDRESS:	3 Kentigern Close Pakuranga Manukau City
PURPOSE:	file T096-03-1288
REVIEW DATE:	Null
SITE DESCR:	Lot 1 DP 149241, Lot 51 & 52 DP 69912
SITE NAME:	Mobil Pakuranga
WORKS DESCRIPTION:	Environmental Site Assessment report received 12/09/08

7. ACTIVITY:	Bore
ACTIVITY DESCRIPTION:	To authorise the construction of nineteen bores for Geotechnical investigation.
ACTIVITY ID:	28689
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1767011
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4948*
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5913381
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52773
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	
PURPOSE:	To authorise the construction of nineteen bores for Geotechnical investigation.
REVIEW DATE:	Null
SITE DESCR:	Multiple sites across Reeves Rd Flyover, Pakuranga. Sites ranging between coordinates: 1) E 1766322 N 5912882 2) E 1766548 N 5912835 3) E 1767011 N 5913381
SITE NAME:	Reeves Rd Flyover
WORKS DESCRIPTION:	Null

8. ACTIVITY:	Contaminated Site Discharge
ACTIVITY DESCRIPTION:	Tank removal validation report provided to AC on the 28 June 2010.
ACTIVITY ID:	21228
ACTIVITY STATUS:	Occurring
CONSENT STATUS:	Null
EASTING:	1766830
EXPIRY DATE:	Null
FILE REFERENCE:	6-03-4522
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5912819
PERMITTED:	Contaminated Site Discharge
PERMITTED ACTIVITY TYPE :	52616
PROCESSING OFFICER:	Andrew Kalbarczyk
PROPERTY ADDRESS:	11 Cortina Place Pakuranga Manukau City
PURPOSE:	Tanks were pulled in 2010, site no longer a petrol station. 9 samples exceeded the applicable soil acceptance criteria. Those exceedances relate to protection of maintenance/excavation workers, and indoor inhalation human health exposure pathways. Full
REVIEW DATE:	Null
SITE DESCR:	Tank removal validation report provided to AC on the 28 June 2010.
SITE NAME:	11 Cortina Place, Pakuranga
WORKS DESCRIPTION:	CONSENT IS REQUIRED FOR THIS SITE!

8. ACTIVITY:	Bore

ACTIVITY DESCRIPTION:	The construction of four bores for contaminated site investigation.
ACTIVITY ID:	28063
ACTIVITY STATUS:	Proposed
CONSENT STATUS:	Under Assessment
EASTING:	1766810
EXPIRY DATE:	Null
FILE REFERENCE:	C512-12-4841
GRANTED DATE:	Null
LOC TYPE:	Point
NORTHING:	5912797
PERMITTED:	Bore
PERMITTED ACTIVITY TYPE :	52654
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	11 Cortina Place Pakuranga Manukau City
PURPOSE:	The construction of four bores for contaminated site investigation.
REVIEW DATE:	Null
SITE DESCR:	56 Ti Rakau Drive, Pakuranga
SITE NAME:	Chevron
WORKS DESCRIPTION:	The construction of four 100mm diameter bores to a maximum depth of 6m. Installation of Grade D PVC casing material to an approximate depth of 6m. Proposed grouting to 0.5m.

9. ACTIVITY DESCRIPTION:	To authorise the construction of up to 16 bores for investigation purposes.
ACTIVITY ID:	21951
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Opus International Consultants Ltd
CONSENT NUMBER:	28231
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20040824
FILE REFERENCE:	C512-12-3153*
GRANTED DATE:	20030820
LOC TYPE:	Point
PROCESSING OFFICER:	Sarah Pinkerton
PROPERTY ADDRESS:	Eastern Corridor Auckland City & Manukau City
PURPOSE:	To authorise the construction of up to 16 bores for investigation purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	St Johns
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of up to 16 100mm diameter bores, to a depth of approximately 40m. Installation of PVC casing.

9. ACTIVITY DESCRIPTION:	Largely domestic use for toilets and showers etc.
ACTIVITY ID:	1397
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	TRU-TEST LIMITED
CONSENT NUMBER:	12889
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.

EXPIRY DATE:	19950711
FILE REFERENCE:	C512-12-1309
GRANTED DATE:	19940711
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	
PURPOSE:	Authorize the construction of a bore for the extraction of groundwater for supply to industrial showers & toilets.
REVIEW DATE:	Null
SITE DESCRIPTION:	241 TI RAKAU DRIVE, EAST TAMAKI
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 100mm dia. bore to approx 120m depth and installation of steel casing to approx. 90m.

9. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	5225
ACTIVITY STATUS:	Drilled
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Pattle Delamore Partners Limited
CONSENT NUMBER:	14985
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	19970311
FILE REFERENCE:	C512-12-1701*
GRANTED DATE:	19960311
LOC TYPE:	Point
PROCESSING OFFICER:	_Gillian Crowcroft
PROPERTY ADDRESS:	242 Ti Rakau Drive East Tamaki Manukau City
PURPOSE:	Authorize the construction of three (3) piezometers for groundwater level and/or Chemistry investigations 3 bores drilled under bore code 5225. Details of S1 bore entered.
REVIEW DATE:	Null
SITE DESCRIPTION:	242 Ti Rakau Drive, Pakuranga
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of three (3) 50mm dia. piezometers to approx 5m depth. Installation of PVC casing to approx 5m and PVC screen from approx. 1m to 5m if required.

10. ACTIVITY DESCRIPTION:	To authorise the construction of four bores for environmental monitoring.
ACTIVITY ID:	23194
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	T.M.K. Packers Limited
CONSENT NUMBER:	36060
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20090807
FILE REFERENCE:	C512-12-4267*
GRANTED DATE:	20080808
LOC TYPE:	Point
PROCESSING OFFICER:	Reginald Samuel
PROPERTY ADDRESS:	257 Ti Rakau Drive East Tamaki Manukau City

PURPOSE:	To authorise the construction of four bores for environmental monitoring.
REVIEW DATE:	Null
SITE DESCRIPTION:	known as 2/20 Trugood Drive - Rates data as shown in property data 257 Ti Rakau Drive
SITE NAME:	T.M.K Packers Limited
WORKS DESCRIPTION:	The construction of four 50mm diameter bores to an approximate depth of 5m. Installation of PVC casing to an approximate depth of 5m. Proposed grouting to 0.5m. Screen material PVC, depth to top of screen 1m and bottom of screen 5m.

11. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	20209
ACTIVITY STATUS:	Occurring
ACTIVITY TYPE:	Discharge To Air
CONSENT HOLDER:	The Spa & Pool Factory Ltd *In Liq*
CONSENT NUMBER:	29732
CONSENT STATUS:	Issued
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20130428
FILE REFERENCE:	17693
GRANTED DATE:	20030428
LOC TYPE:	Point
PROCESSING OFFICER:	_Manukau City Council
PROPERTY ADDRESS:	295 Ti Rakau Drive East Tamaki Manukau City
PURPOSE:	To control the discharge of atmospheric contaminants to air.
REVIEW DATE:	Null
SITE DESCRIPTION:	C-93
SITE NAME:	Spa and Pool Factory
WORKS DESCRIPTION:	Null

12. ACTIVITY DESCRIPTION:	Null
ACTIVITY ID:	21814
ACTIVITY STATUS:	Proposed
ACTIVITY TYPE:	Bore
CONSENT HOLDER:	Chevron New Zealand ***USE 751***
CONSENT NUMBER:	27499
CONSENT STATUS:	Expired
DATE CREATE:	24/09/2012 7:17:02 p.m.
EXPIRY DATE:	20031201
FILE REFERENCE:	C512-12-3033
GRANTED DATE:	20021202
LOC TYPE:	Point
PROCESSING OFFICER:	__Michelle Ip
PROPERTY ADDRESS:	380 Ti Rakau Drive East Tamaki Manukau City
PURPOSE:	Authorise the construction of a bore for monitoring purposes.
REVIEW DATE:	Null
SITE DESCRIPTION:	Null
SITE NAME:	Null
WORKS DESCRIPTION:	Construction of a 50mm diameter bore to a depth of approximately 10m. Installation of PVC casing to a depth of approximately 10m.

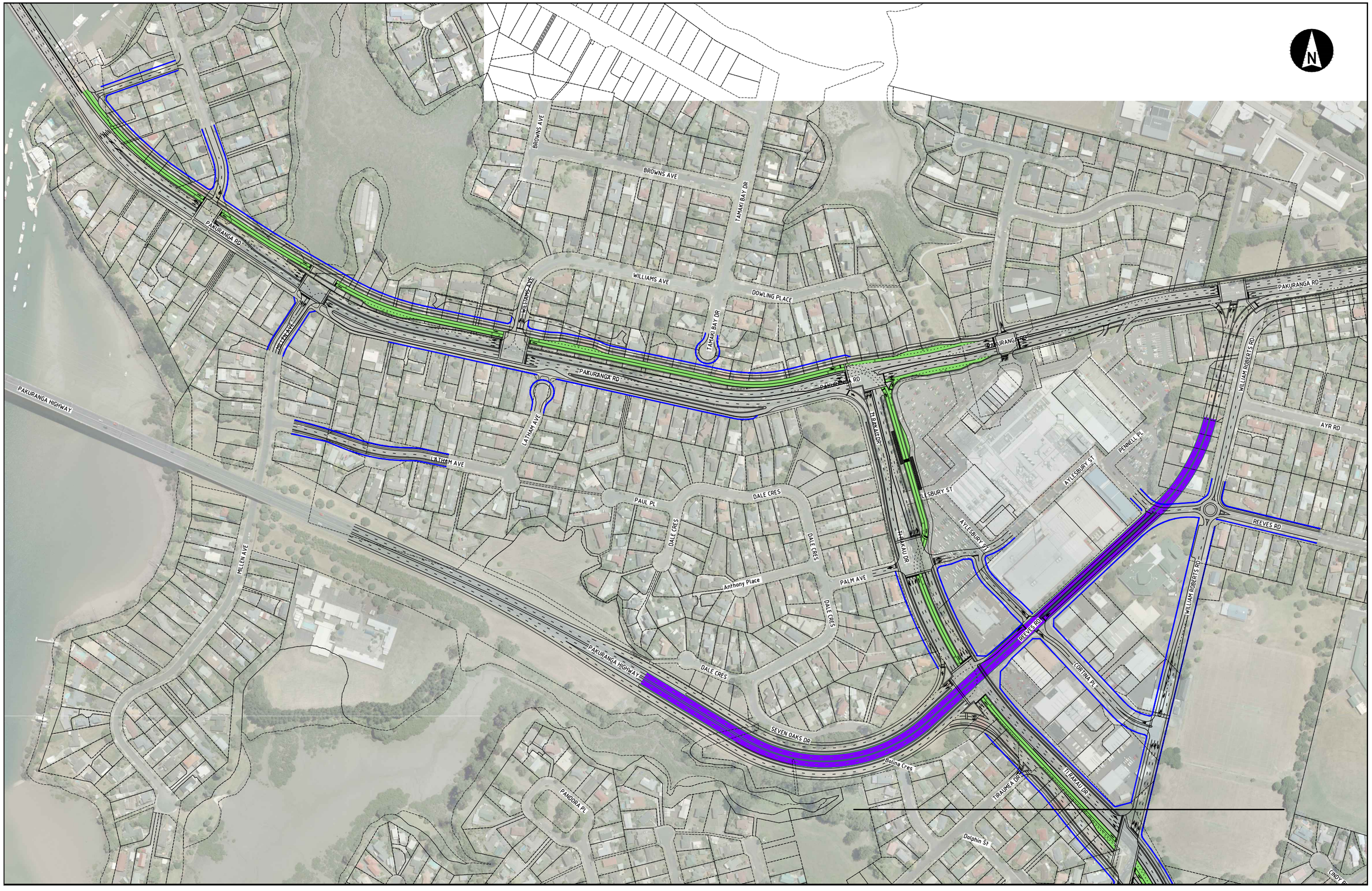
Appendix B

Pakuranga Scheme Assessment Alignment Sheets

A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

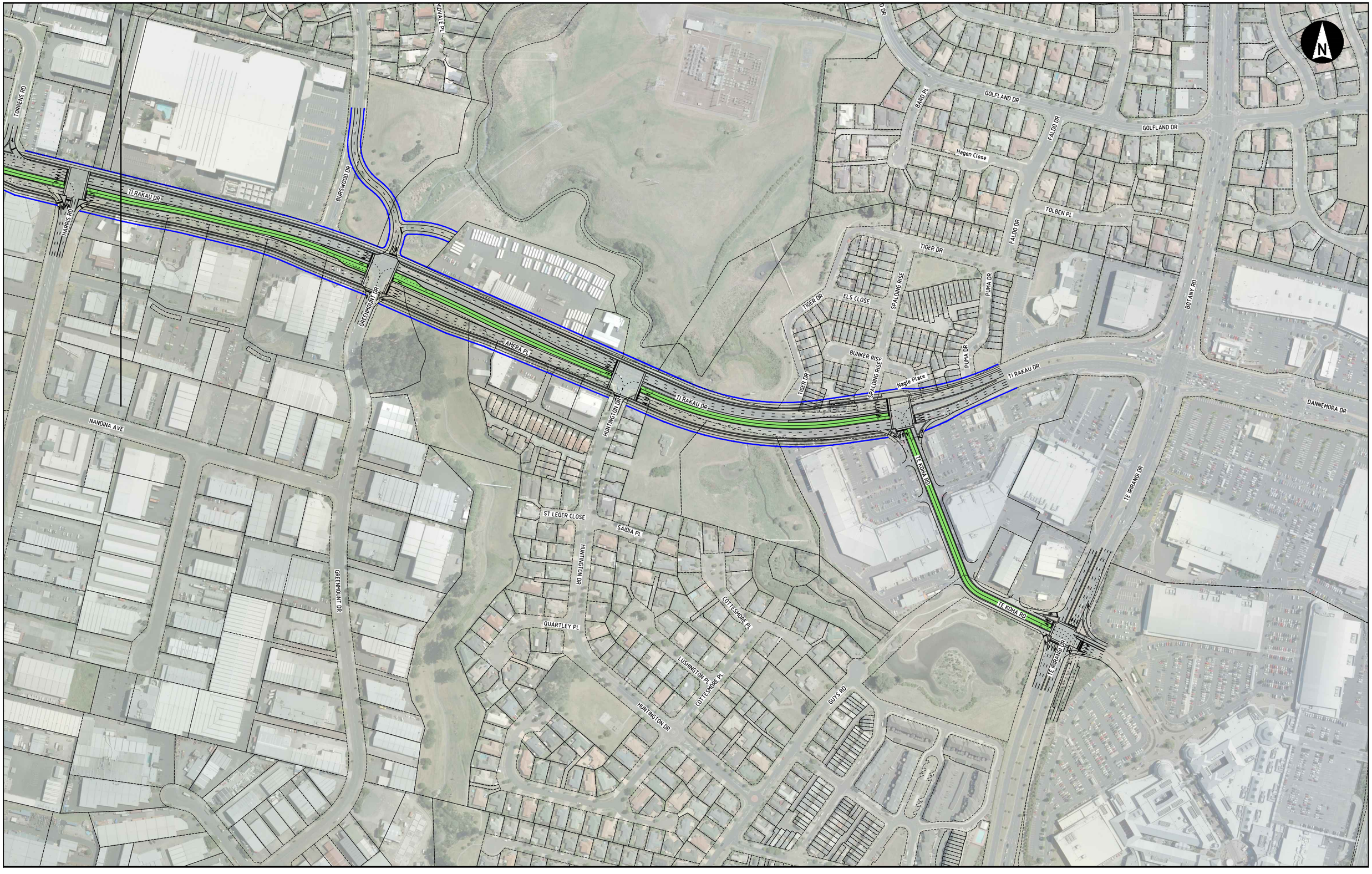
AMETI PACKAGE 4
- SHEET 2



A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

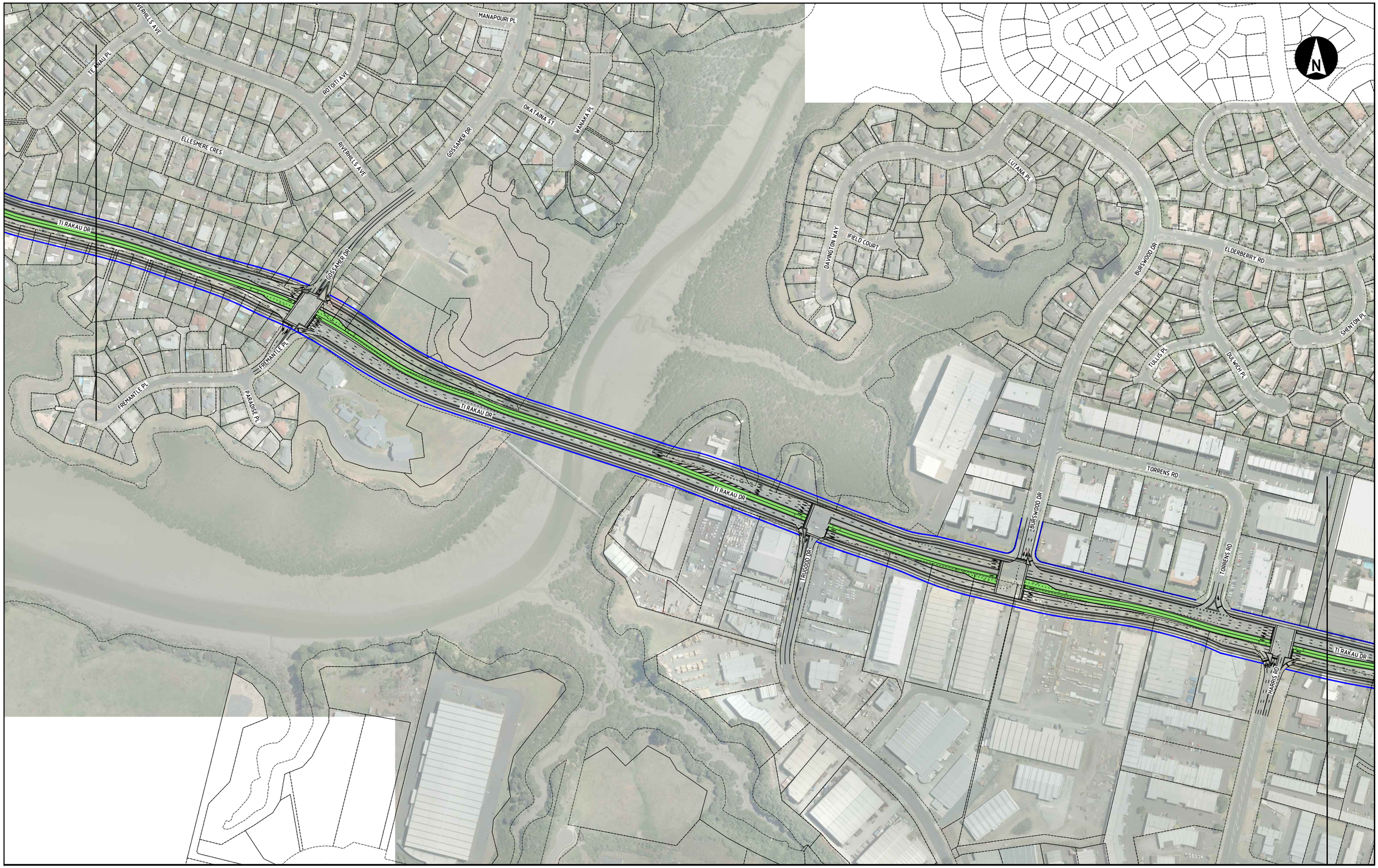
AMETI PACKAGE 4
- SHEET 1



A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

AMETI PACKAGE 4 - SHEET 4



A3 SCALE 1:4000
A1 SCALE 1:2000

0 50 100 150 200 250 (m)

AMETI PACKAGE 4 - SHEET 3

URS

24 June 2010

Project No. 42115121

Auckland Regional Council
Private Bag 92-012
Auckland 1142

Attention: Contaminated Land Team Leader

Dear Team Leader,

Subject: Caltex Pakuranga Service Station - Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment

1 Site Details and Works Conducted

This letter and the accompanying tank pull report have been prepared for Chevron New Zealand (Chevron) by URS New Zealand Limited (URS). The report documents soil sampling associated with the removal of an underground petroleum storage system (UPSS) and a residual petroleum hydrocarbon assessment, undertaken at Caltex Pakuranga Service Station, 56 Ti Rakau Drive, Auckland, legal description Lot 5 DP 53823.

The former UPSS comprised four underground storage tanks (USTs): 2 x 40,000 L 91 octane petrol, 1 x 40,000 L 96 octane petrol, 1 x 20,000 L diesel; with associated pipe work and dispensers.

The assessment has been conducted in accordance with the Ministry for the Environment (MfE) "Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand", 1999 (herein referred to as the Oil Industry Guidelines).

Thirty four soil samples were collected during the excavation and removal of the UPSS. On the basis of field screening results, twenty six of the samples were submitted for Total Petroleum Hydrocarbon (TPH) analysis; and twenty four for benzene, toluene, ethylbenzene and total xylenes (BTEX) analysis.

During the works, soils impacted by petroleum hydrocarbons were identified in close proximity to: the remote fills points; fill lines; beneath dispensers 1, 2, 3 and 4; and the site oil water interceptor. Further excavations were carried out to characterise the extent of these impacted soils as far as was practicable. No material was removed from site.

The remainder of this letter summarises the results of the residual petroleum hydrocarbons assessment.

URS New Zealand Limited
Level 6, URS Centre
13-15 College Hill, Auckland
PO Box 821, Auckland
New Zealand
Tel: 64 9 355 1300
Fax: 64 9 355 1333

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2 Site Setting

The site is located in a commercial area and lies directly between other commercial/industrial businesses and a sports field. Directly across Ti Rakau Drive to the south west of the site are residential properties. The Tamaki River is approximately 500 m south of the site.

Table 2-1 provides a summary of other site setting information.

Table 2-1 Site Environmental Setting

District Plan Zoning	Commercial 4
Nearest residential area	<100 m south west of the site
Shallow geology	Silty CLAY overlying weathered sandstone
Groundwater depth	3.0 m bgl (however wash water used on site and raining on the 12.05.10, therefore groundwater levels not specific.)
Surface water bodies within 1 km	Approximately 500 m south is the Tamaki River, a tributary to the Waitemata Harbour.
Nearest groundwater abstraction wells within 1 km	Approximately 1 km north east of the site is irrigation well at St Kentigern College.

3 Investigation Results and Risk Assessment

Moderate to strong hydrocarbon odours were noted during sampling of soils around the oil water interceptor, remote fill points and also beneath the dispensers. Soil from the remote fill points and pipelines in the upper layers of the former forecourt area were noted to be slightly discoloured.

Groundwater was noted to be at approximately 3.0 m bgl, however the UPSS removal operation had generated some wash water during the UPSS removal and it rained during site works on 12 May 2010; therefore groundwater levels could not be conclusively identified.

A thin layer of separate phase hydrocarbons (SPH) was noted on soils collected from the stormwater interceptor excavation.

The residual petroleum hydrocarbons assessment was conducted in accordance with the Oil Industry Guidelines.

As the service station has closed and the site is in a commercially zoned area, soil acceptance criteria for commercial/industrial landuse were used for this assessment. Soil criteria for SAND and Silty CLAY were adopted based upon the observed bedding material (SAND) and soil types (silty clay and sanstone) observed in the excavations, (refer to attached UPSS Decommissioning Report). Shallow groundwater has been classified as "not sensitive" in accordance with the Oil Industry Guidelines; and based on an assessment that shallow groundwater in the vicinity of the site is unlikely to be used and the distance to the nearest surface water body.

The soil sample analytical results are summarised in the attached Table 1 along with the applicable Tier 1 All Pathways soil acceptance criteria. The results of this comparison are:

- Nine samples representing soils remaining on site exceeded the relevant All Pathways soil acceptance criteria.

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- Two of these samples exceeded the C_{10}-C_{14} soil acceptance criteria pathway for TPH as a surrogate for PAH analysis. However, follow on PAH analyses for the two samples comply with the relevant soil acceptance criteria and supersede the TPH results.
- The 14 remaining samples comply with all the applicable soil acceptance criteria.

Table 3-1 summarises the samples representative of soil remaining on site that had TPH or BTEX concentrations exceeding the relevant Oil Industry Guideline All Pathways soil acceptance criteria. Please also refer to the attached Table 2 for the route specific criteria comparison.

Table 3-1 Soil Samples Exceeding Acceptance Criteria

Sample Number	Location	Oil Industry Guideline Tier 1 Criteria Exceedances – Commercial/Industrial Land Use
SSD561	Dispenser 1 (1.5-1.7 m bgl)	Maintenance/excavation worker route specific criteria for C_7-C_9, and benzene, toluene and total xylenes. Indoor air criteria for benzene and total xylenes.
SSD562	Dispenser 1 (Dup) (1.5-1.7 m bgl)	Maintenance/excavation worker route specific criteria for C_7-C_9, and benzene, toluene and total xylenes. Indoor air criteria for benzene and total xylenes.
SSD563	Dispenser 2 (1.3-1.5 m bgl)	Maintenance/excavation worker route specific criteria for C_7-C_9, and benzene, toluene and total xylenes. Indoor air criteria for benzene
SSD564	Dispenser 3 (1.2-1.6 m bgl)	Maintenance/excavation worker route specific criteria for C_7-C_9 benzene, and total xylenes.
SSD565	Dispenser 4 (1.4-1.6 m bgl)	Maintenance/excavation worker route specific criteria for benzene.
SSD566	Remote Fill 1 (1.2-1.4 m bgl)	Maintenance/excavation worker route specific criteria for C_7-C_9, and benzene, toluene and total xylenes. Indoor air criteria for benzene.
SSD567	Remote Fill 2 (1.2-1.4 m bgl)	Maintenance/excavation worker route specific criteria for C_7-C_9, and benzene, toluene and total xylenes. Indoor air criteria for total xylenes..
SSD589	Interceptor (1.9-2.4 m bgl)	Indoor air criteria for benzene.
SSD591	Interceptor (1.9-2.1 m bgl)	Indoor air criteria for benzene.

4 Summary

Residual petroleum hydrocarbons exceeding applicable Oil Industry Guideline soil acceptance criteria have been detected in soils beneath the forecourt (around dispensers and remote fill points) and surrounding the removed stormwater interceptor adjacent to the south western boundary. Soils sampled from around the tank pit excavation complied with the applicable Oil Industry Guideline soil acceptance criteria.

The criteria exceedances relate to the maintenance/excavation worker and indoor inhalation human health exposure pathways. A preliminary assessment of shallow groundwater sensitivity indicates that it is not sensitive as it is unlikely that it would be abstracted for use and the nearest surface water body is more than 100 m from the site.

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5 Closure

We look forward to discussing this matter with you in the near future to confirm the next steps. In the meantime should you have any comments or questions, please feel free to contact the following addressee:

Jon Payne
Chevron New Zealand
P.O. Box 684
AUCKLAND 1140

Yours sincerely
URS New Zealand Limited

Karen O'Donohue
Environmental Scientist

pp David Whitty
Principal

Attachment: UPSS Decommissioning Report

cc: Mark Lowery, Environmental Monitoring Office, Manukau City Council
Nathaniel Uy, Maintenance and Construction Specialist, Chevron New Zealand

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UPSS DECOMMISSIONING – PAKURANGA SERVICE STATION
REQUESTED BY: CHEVRON NEW ZEALAND: RETAIL

UPSS ENVIRONMENTAL INVESTIGATION	
Site address:	➢ 56 Ti Rakau Drive, Pakuranga
Legal Description (Lot & DP) and Zoning:	➢ Lot 5; DP 53823 ➢ Commercial 4
New Zealand Topographical Map Reference:	2677241, 6474482 (NZTM)
URS representative on site:	➢ Nebojsa Jancic
Date on-site:	➢ 06/05/2010 and 12/05/2010
Purpose of investigation and Site future.	➢ ☒ Complete tank pull ☐ Partial tank pull ☐ Upgrade ➢ ☐ Chevron Operated ☐ Non Chevron Operated ☒ Closed
Description of investigation methodologies:	➢ As per standard URS procedures
Names of contractors and their responsibilities:	➢ Fuel Quip, UPSS Decommissioning
Name of Council Representative/Test Certifier onsite: Date and time that she/he was on site:	➢ Mark Lowry, Manukau City Council. ➢ 11 May 2010, time unknown.
When did contractor notify the Council Representative/Test Certifier of the tank pull?	➢ Unknown
Photographs taken:	➢ ☒ Yes, appended ☐ No
Weather conditions:	➢ 6/05/10 - Overcast ➢ 12/05/10 – Overcast and Raining
SITE AND ENVIRONS DESCRIPTION	
• Site use prior to tank removal (type of site)	➢ ☒ Service Station ☐ Workshop ☐ Commercial ☐ Truckstop ☐ Other
• No. of tank pits	➢ 1
• No. of tanks	➢ 4
• Site ground surface covering	➢ Concrete
• Site surface runoff patterns/collection	➢ Forecourt stormwater surface drain collection system around UST area and dispensers that drain into a three chamber interceptor then into council system.
• Are there underground services present? • Could they affect migration?	➢ ☒ Yes ☐ No ☐ Not known ➢ ☒ Yes ☐ No ☐ Not known – Forecourt drainage system and interceptor joins council stormwater system allowing potential migration of contaminants offsite.
• Lithology, soil type, description	Depth (m) / Description 0.0 - 1.1 / Silty CLAY, light grey mottled orange, plastic, sticky, firm. 1.0 - 3.5 / SANDSTONE, light grey to white, very dense, moist.
• Neighbouring land uses:	➢ North: Commercial Shopping Centre and Car Rental Company. ➢ East: Ti Rakau Park Recreational Reserve ➢ South: Ti Rakau Dr beyond is residential area ➢ West: Ti Rakau Dr beyond is residential area
• Topography	➢ Flat forecourt, very gradual slope down towards the southwest
• Nearby surface water bodies and distance to:	➢ ☐ <100m ☒ >100m – Tamaki River approx 500 m to the south
• Surface water use:	➢ ☐ Shipping ☐ Industrial ☐ Stock ☐ Irrigation ☐ Aquaculture ☐ Recreation ☐ Drinking ☐ Not utilised ☒ Not known
• Was groundwater encountered at the site?	☒ Yes 3.0 m bgl ☐ No (UPSS removal operation generated wash water and it rained during site works on 12 May 2010; therefore groundwater levels could not be conclusively identified)
• Are there any wells on the site?	➢ ☐ Yes ☒ No
• Likely regional groundwater flow direction:	➢ South to south west direction towards Tamaki River
• Distance to bores or wells outside the site boundaries:	➢ Irrigation bore (irrigation) approx 1.0 km north east of site at St Kentigern College.
• Is shallow groundwater used in the area:	➢ Unknown in the immediate vicinity, but assessed to be unlikely. Bore to the north east of site utilised for irrigation.

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TANK INVENTORY

Tank/Pit Id	Status	Reason for removal	Capacity (litres)	Contents (Product)	AST or UST	Age (years)	Construction	Condition	Tank pit construction (lined/unlined)
1/1	Removed	Closure	40,000	96 Octane	UST	> 18	Steel	Good	Unlined
2/1	Removed	Closure	40,000	91 Octane	UST	> 18	Steel	Good*	Unlined
3/1	Removed	Closure	40,000	91 Octane	UST	> 18	Steel	Good*	Unlined
4/1	Removed	Closure	20,000	Diesel	UST	> 18	Steel	Good*	Unlined

* Note: Condition of tanks assessed by Fuelquip, URS only observed 40,000L 96 (Tank 1).

VISUAL AND OLFACTORY PETROLEUM HYDROCARBON IMPACTS AND SAMPLING

In relation to UPSS elements	Element Visually Observed		Samples Taken		Evidence of contamination in the area of the exposed element (odour, staining, SPH etc)
	Yes	No	Yes	No	
• Walls of tank pits	☒	☐	☒	☐	➢ Slight odour in walls next to diesel tank.
• Tank pit bedding material	☒	☐	☒	☐	➢ Strong hydrocarbon odour
• Groundwater in pit	☒	☐	☒	☐	➢ Very strong hydrocarbon odour
• Under pumps	☒	☐	☒	☐	➢ Very strong hydrocarbon odour
• Around dispensing lines	☒	☐	☒	☐	➢ Very strong hydrocarbon odour
• Around remote fills	☒	☐	☒	☐	➢ Very strong hydrocarbon odour
• Around fill lines	☒	☐	☐	☒	➢ Not sampled, forecourt not exposed, test pits exposed to sample beneath dispensers and remote fill points only.
• Around vent lines	☒	☐	☒	☐	➢ No odour
• Other (i.e. subsurface utilities)	☒	☐	☒	☐	➢ Oil water interceptor - very strong hydrocarbon odour
• Was SPH noted on site:					➢ ☒ Yes ☐ No - Under interceptor 2 m bgl
• Signs of surface staining:					➢ ☐ Yes ☒ No
• Condition of vegetation around the site:					➢ Limited vegetation but in good condition.
Was impacted soil/bedding material removed from site?					➢ ☐ Yes ☒ No

SAMPLE DESCRIPTIONS

Sample ID	Date sampled	Sample location	Depth (m)	Sample description*		Remaining /removed
				Soil type (in field classification)	Odour	
SSD561	06/05/10	Dispenser 1	1.5-1.7	SAND, light grey to white, very stiff, moist.	Very strong odour	Remaining
SSD562	06/05/10	Dispenser 1 (duplicate)	1.5-1.7	SAND, light grey to white, very stiff, moist.	Very strong odour	Remaining
SSD563	06/05/10	Dispenser 2	1.3-1.5	SAND, light grey to white, very stiff, moist	Very strong odour	Remaining
SSD564	06/05/10	Dispenser 3	1.2-1.6	SAND, dark brown, moist, loose	Very strong odour	Remaining
SSD565	06/05/10	Dispenser 4	1.4-1.6	SAND, dark brown, moist, loose	Very strong odour	Remaining
SSD566	06/05/10	Remote fill point 1	1.2-1.4	SAND, light grey to white, very stiff, mist.	Very strong odour	Remaining
SSD567	06/05/10	Remote fill point 2	1.2-1.4	SAND, light grey to white, very stiff, mist.	Very strong odour	Remaining
SSD568	06/05/10	20,000 L Diesel UST (tank 4) bedding material	-	SAND, dark grey, loose, wet to moist, from diesel tank area.	Strong odour	Remaining
SSD569	06/05/10	40,000 L 96 Octane UST (tank 1) bedding material	-	SAND, dark grey, loose, wet to moist, from 91 Octane area.	Strong odour	Remaining
SSD570	12/05/10	Vent Risers	1.2-1.5	Silty CLAY, light brown, soft, plastic.	No odour	Remaining
SSD571	12/05/10	North wall (east end)	0.6	Silty CLAY, Light grey with orange mottling, moist, plastic.	No odour	Remaining
SSD572	12/05/10	North wall (east end)	3.0	SAND, light grey to white, very stiff, moist.	No odour	Remaining
SSD573	12/05/10	Base	3.5	SAND, dark grey, loose, wet to moist	No odour	Remaining
SSD574	12/05/10	East wall (northern end)	0.6	Silty CLAY, light grey mottled orange, moist, sticky, firm.	No odour	Remaining
SSD575	12/05/10	East wall (northern end)	3.0	SAND, light grey to white, very stiff, moist.	No odour	Remaining
SSD576	12/05/10	North wall (western end)	0.5	CLAY, light grey brown, mottled orange, moist, soft, sticky, plastic.	No odour	Remaining
SSD577	12/05/10	North wall (western end)	3.0	SAND, light grey to white, very stiff, moist.	No odour	Remaining
SSD578	12/05/10	West wall (northern end)	0.6	Silty CLAY, bluish green mottled orange, plastic, moist, soft.	No odour	Remaining

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SAMPLE DESCRIPTIONS						
SSD579	12/05/10	East wall (southern end)	0.6	Silty CLAY, light grey mottled orange, moist. sticky, firm.	No odour	Remaining
SSD580	12/05/10	South wall (eastern end)	0.8	CLAY, light grey, moist, soft to firm, sticky, plastic.	No odour	Remaining
SSD581	12/05/10	South wall (eastern end)	2.5	SAND, light grey to white, very stiff, moist.	Slight odour	Remaining
SSD582	12/05/10	South wall (western end)	3.0	SAND, light grey to white, very stiff, moist.	Moderate odour	Remaining
SSD583	12/05/10	South wall (western end) (duplicate)	3.0	SAND, light grey to white, very stiff, moist. Duplicate	Moderate odour	Remaining
SSD584	12/05/10	South wall (western end)	0.6	Silty CLAY, Light grey with orange mottling, moist, plastic.	No odour	Remaining
SSD585	12/05/10	West wall (southern end)	0.6	Silty CLAY, Light grey with orange mottling, moist, plastic.	Slight odour	Remaining
SSD586	12/05/10	West wall (southern end)	2.5	SAND, light grey to white, very stiff, moist.	Slight odour	Remaining
SSD587	12/05/10	West wall (centre)	0.7	SAND, light grey to white, very stiff, moist.	Strong odour	Remaining
SSD588	12/05/10	Bedding material	-	SAND, dark grey, loose, wet to moist, from mixed fill.	No odour	Remaining
SSD589	12/05/10	Interceptor	1.9 - 2.4	Silty CLAY bluish grey, very soft.	Very strong odour	Remaining
SSD590	12/05/10	Interceptor	1.6 - 1.8	Silty CLAY with some sand, grey, soft, plastic.	Very strong odour	Remaining
SSD591	12/05/10	Interceptor	1.9 - 2.1	Silty CLAY with some sand, grey, soft, plastic.	Very strong odour	Remaining

* Soils classified as per New Zealand Geomechanics Society (2006)

SHALLOW AQUIFER ASSESSMENT (Section 5.2.3 MfE 1999 Guidelines: An aquifer is defined as sensitive when either all of the first three criteria are met or the fourth criterion is met.)	
Criteria	Assessment
The shallow groundwater aquifer is not artesian or confined; and	Yes
The shallow groundwater aquifer is of quality appropriate for use, can yield water at a useful rate and is in an area where extraction and use of groundwater may be reasonably foreseen; and Groundwater is expected to be affected by a divide in topography from 500 m north of the site, and inferred groundwater direction from the irrigation bore 1km north of the site is considered to be north. Shallow groundwater in the vicinity of the site is not expected to be of a quality suitable for use.	No
The aquifer is expected to be less than 10 m below the potential suspected source of contamination; or	Yes
The source of contamination is less than 100 m from a sensitive surface water body *The nearest water body is 500m to the south is the Tamaki River*	No
Based on the above, the shallow aquifer is classified as **Not Sensitive**	

DATA FOR TIER 1 RISK ASSESSMENT	
• Site land use after tank removal:	☐ **Residential** ☒ **Commercial/Industrial** ☐ **Agricultural** ☐ **Petroleum Handling** Not Known.
• Adjoining land uses	☒ Residential ☒ Commercial/Industrial ☐ Agricultural ☐ Petroleum Handling
• Possible future site land use:	☐ Residential ☒ Commercial/Industrial ☐ Agricultural ☐ Petroleum Handling
• Shallow groundwater use:	☐ Potable ☐ Stock Water ☒ Irrigation (1 km from site) ☐ Not used ☒ Unknown
• Soil type (MfE 1999 Guideline categories which most closely approximate site soils)	☒ SAND, sandy loams, silty sands - VERY DENSE ☐ SANDY SILT, silt, silty loams, clayey sands ☒ SILTY CLAY, clay loam, sandy clay ☐ CLAY ☐ PUMICE ☐ PEATS AND HIGHLY ORGANIC SOILS ☐ FRACTURED BASALT* ☐ GRAVELS* *Considered only for groundwater inhalation pathway;
• Depth of contamination	☒ < 1m ☒ 1-4 m ☐ > 4 m
• Depth to groundwater (m)	☐ ≤2 m ☒ ≤4 m ☐ ≤8 m ☐ >8m ☐ Unknown.

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LABORATORY RESULTS AND COMPARISON WITH GUIDELINE TIER 1 ACCEPTANCE CRITERIA				
Refer to Table 1 attached.				
HUMAN HEALTH RISK ASSESSMENT SUMMARY - SOILS				
Land Use	**Exposure Pathways**	**Lab results comply with Guidelines**	**Exposure Pathway Status** Incomplete/Complete - Reasoning	**Acceptable Hydrocarbon Residual**
Site – Foreseeable Future	Inhalation of vapours from soil	No	Complete	No
☐ Residential	Soil ingestion	NA	Incomplete – land use not appropriate	Yes
☒ Commercial/Industrial	Dermal absorption	NA	Incomplete – land use not appropriate	Yes
☐ Agricultural	Produce ingestion	NA	Incomplete – land use not appropriate	Yes
☐ Petroleum handling	Maintenance/excavation workers	No	Complete	No
☐ Other	Groundwater usage	NA	Incomplete – shallow groundwater unlikely to be used on site.	Yes
	Inhalation of vapours from water	NA*	No groundwater monitoring data	NA
Neighbouring Properties	Inhalation of vapours from soil	NA	Complete	NA
☒ Residential	Soil ingestion		Incomplete**	
☒ Commercial/Industrial	Dermal absorption		Incomplete**	
☐ Agricultural	Produce ingestion		Incomplete**	
☐ Petroleum handling	Maintenance/excavation workers		Potentially Complete	
☐ Other	Groundwater usage		Incomplete – groundwater use unlikely	
	Inhalation of vapours from water		Potentially Complete	

* No groundwater samples collected, assessment of this not possible at this time.
** Based on likely depth to groundwater being greater than 1.5 m impact on shallow soils across roads off-site unlikely.

ECOLOGICAL RISK SCREENING			
No impacts visible in ecological receptors neighbouring the site.	No Impact ☒	Limited Impact ☐	Significant Impact ☐

AESTHETIC SCREENING			
Criteria	No Impact	Limited Impact	Significant Impact
Odour: moderate to strong odours noted across the site, associated with soils in the forecourt area.	☐	☒	☐
Discolouration: visible in the walls of tank pit, in forecourt and walls of the interceptor.	☐	☒	☐
Soil structure: No visible impact.	☐	☒	☐
Vegetation: No visible impact noted.	☒	☐	☐

SUMMARY

Findings: Please refer to the covering letter for a discussion of the results.

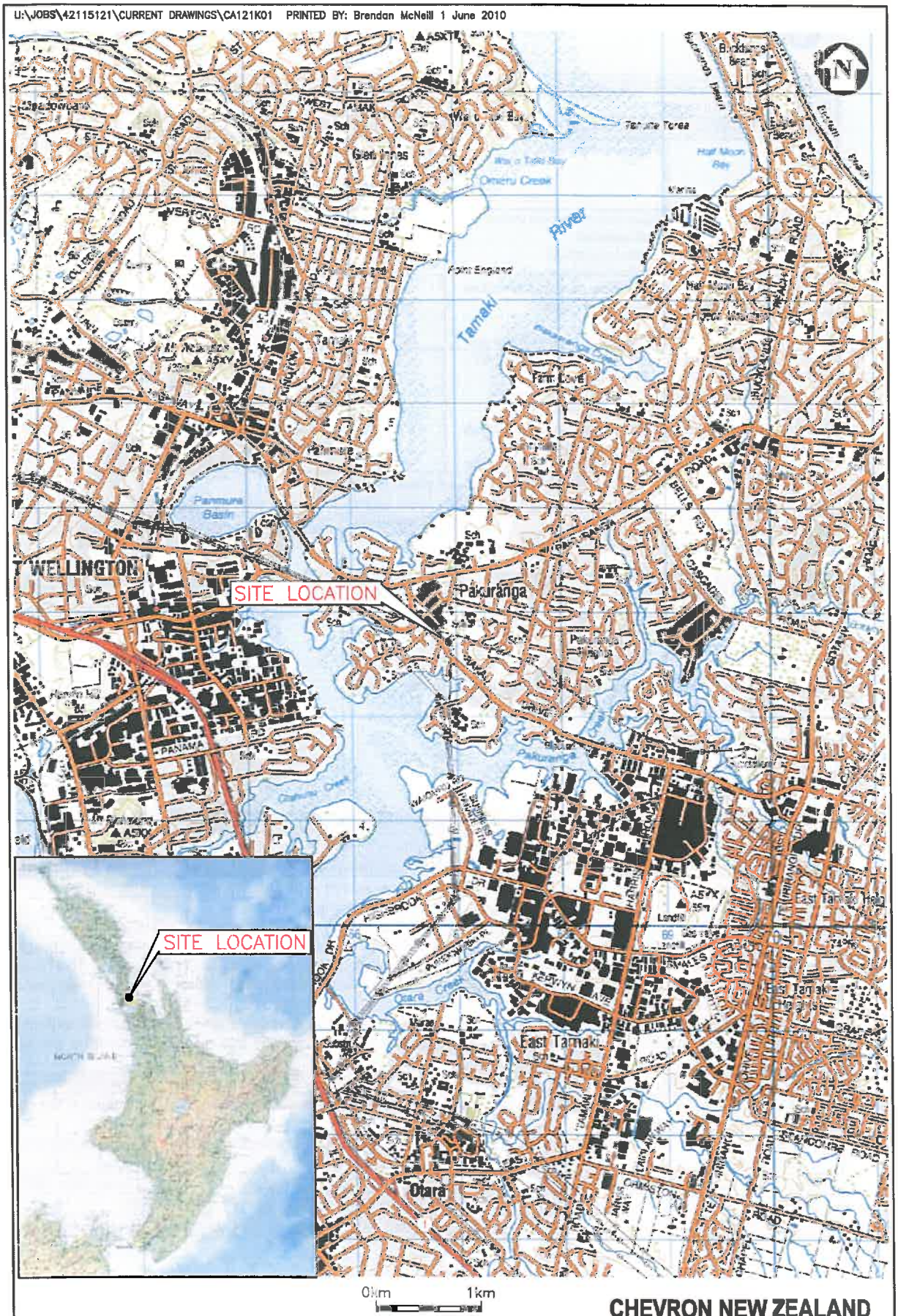
APPLICABILITY

- This assessment relates only to those areas of the site that were exposed as part of the tank removal operation and to which access was made available to URS New Zealand Limited during our time on site.
- Consideration has not been given to extraordinary costs associated with off-site disposal of contaminated soils.
- This report has been prepared solely for the use of Chevron New Zealand and any reliance of this report by third parties shall be at such party's sole risk as the report may not contain sufficient information for the purposes of other parties. This report shall only be presented in full and may not be used to support any other objectives than those set out in the report, except with the express permission of URS New Zealand Limited.
- URS New Zealand Limited have performed our services for this project in accordance with our Master Services Agreement for Consulting Services and with current professional standards for environmental site assessments; no guarantees are either expressed or implied.

REFERENCES

1. Ministry for the Environment "Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand", August 1999.
2. Department of Occupational Safety and Health "Guidelines for the Design, Installation and Operation of Underground Storage Tanks", 1992.

Prepared by: Karen ODonohue	**Approved for issue by: David Whitty**	**Issue date: 25/06/10**
Distribution List: ☒Chevron NZ Limited ☒Others | URS: ☒Auckland ☐Wellington ☐Christchurch		
Appended: ☒ Locality plan ☒ Site plan ☒ Sample location plan ☒ Photographs ☒ Laboratory report & sample chain of custody.		



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CHEVRON NEW ZEALAND
CALTEX PAKURANGA
SITE LOCATION PLAN

FIGURE 1

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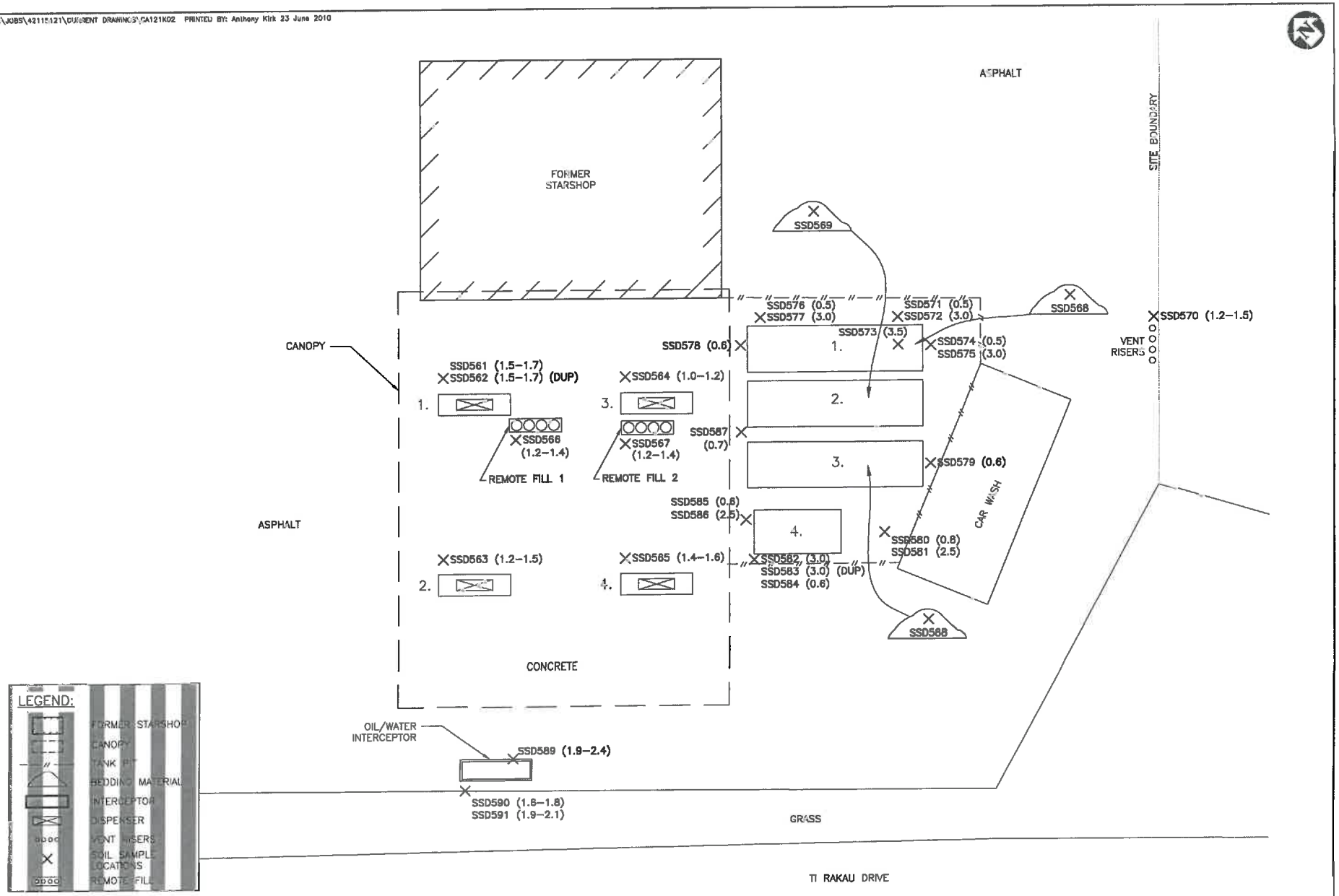
CHEVRON NEW ZEALAND
CALTEX PAKURANGA SERVICE STATION
SITE LAYOUT PLAN

FIGURE 2



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CHEVRON NEW ZEALAND
CALTEX PAKURANGA
SAMPLE LOCATION PLAN

FIGURE 3

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Table 1: Caltex Pakuranga - Soil Sample Analytical Results Compared to MfE 1999 All Pathway Soil Acceptance Criteria

Sample Details and Analytical Results

URS Sample Reference	SSD561	SSD562	SSD563	SSD564	SSD565	SSD566	SSD567	SSD568
Laboratory Sample Reference	790705.1	790705.2	790707.3	790707.4	790707.5	790703.6	790707.7	790703.1
Date Sampled	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10
	Dispensers					Remote fill points		Bedding material
Sample Location	Dispenser 1	Dispenser 1 (dup)	Dispenser 2	Dispenser 3	Dispenser 4	Remote fill point 1	Remote fill point 2	Tank 4 bedding material
Sample Depth (m below ground level)	1.5 - 1.7	1.5 - 1.7	1.3 - 1.5	1.[illegible] - 1.6	1.4 - 1.6	1.2 - 1.4	1.2 - 1.4	-
Sample Soil Type	SAND	SAND	SAND	SAND	SAND	SAND	SAND	SAND
Guideline Soil Type [4]	SAND	SAND	SAND	SAND	SAND	SAND	SAND	SAND
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining
Units (dry weight)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total Petroleum Hydrocarbons (TPH)								
C_7 - C_9	570[m]	918[m]	3100[m]	430[m]	35	700[m]	175[m]	< 8
C_{10} - C_{14}	[illegible]	400	1940[m]	[illegible]	177	240	129	< 20
C_{15} - C_{36}	< 40	< 40	710	< 40	1,100	< 40	< 40	< 40
Total hydrocarbons (C_7 - C_{36})	1,[illegible]	1,310	[illegible]	810	1,300	1,040	300	< 60
BTEX Compounds								
Benzene	30[m]	30[m]	31[m]	4.4[m]	3.7[m]	21[m]	5.1[m]	< 0.05
Toluene	490[m]	500[m]	270[m]	60	0.45	330[m]	189[m]	< 0.05
Ethylbenzene	95[s]	116[m]	37	19.1	6.1	60	53	< 0.05
m & p-xylenes	430	500	340	198	5.2	260	390	< 0.10
o-xylenes	1[illegible]	179	113	[illegible]	0.62	45	172	< 0.05
Total xylenes	566[m]	678[m]	425[m]	2[illegible][m]	3.32	355[m]	542[m]	< 0.15
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	-	-	45	-	-	-	-	-
Pyrene	-	-	0.46	-	-	-	-	-
Benzo(a)pyrene equivalent	-	-	0.0951	-	-	-	-	-

URS Sample Reference	SSD569	SSD571	SSD573	SSD574	SSD575	SSD577	SSD578	SSD579
Laboratory Sample Reference	790703.2	792271.2	792271.4	792271.5	792271.6	792271.8	792271.9	792271.1[illegible]
Date Sampled	6-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10
	Bedding material	Tank pit excavation (4 x USTs)						
Sample Location	Tank 1 bedding material	North wall (eastern end)	Base	East wall (northern end)	East wall (southern end)	North wall (western end)	West wall (northern end)	East wall (southern end)
Sample Depth (m below ground level)	-	0.6	3.5	0.6	1.0	1.0	0.6	0.6
Sample Soil Type	SAND	Silty CLAY	SAND	Silty CLAY	SAND	SAND	Silty CLAY	Silty CLAY
Guideline Soil Type [4]	SAND	Silty CLAY	SAND	Silty CLAY	SAND	SAND	Silty CLAY	Silty CLAY
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining
Units (dry weight)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total Petroleum Hydrocarbons (TPH)								
C_7 - C_9	< 8	< 11	< 8	< 9	< 10	< 10	< 11	< 10
C_{10} - C_{14}	< 20	< 20	< 20	< 20	< 20	< 20	< 30	< 20
C_{15} - C_{36}	< 40	< 50	< 40	< 40	< 40	< 40	< 50	< 40
Total hydrocarbons (C_7 - C_{36})	< 60	< 80	< 60	< 70	< 70	< 70	< 80	< 70
BTEX Compounds								
Benzene	< 0.05	< 0.07	< 0.06	< 0.06	< 0.10	< 0.10	< 0.07	< 0.07
Toluene	0.069	0.133	< 0.06	< 0.06	< 0.10	< 0.10	< 0.07	< 0.07
Ethylbenzene	0.48	< 0.07	< 0.06	< 0.06	< 0.10	< 0.10	< 0.07	< 0.07
m & p-xylenes	4.6	0.2[illegible]	< 0.11	< 0.12	< 0.19	< 0.19	< 0.13	< 0.13
o-xylenes	1.68	0.079	< 0.06	< 0.06	< 0.10	< 0.10	< 0.07	< 0.07
Total xylenes	6.28	0.2[illegible]9	< 0.17	< 0.18	< 0.29	< 0.29	< 0.20	< 0.20
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	-	-	-	-	-	-	-	-
Pyrene	-	-	-	-	-	-	-	-
Benzo(a)pyrene equivalent	-	-	-	-	-	-	-	-

URS Sample Reference	SSD581	SSD582	SSD583	SSD5[illegible]	SSD5[illegible]	SSD5[illegible]	SSD5[illegible]	MfE (1999): Tier 1 Soil Acceptance Criteria [1]	
Laboratory Sample Reference	792271.12	792271.13	792271.14	792271.15	792271.19	792271.2	792271.22	All Pathways Soil Acceptance Criteria - Commercial/Industrial [3]	
Date Sampled	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10		
	Tank pit excavation (4 x USTs)					Interceptor pit			
Sample Location	South wall (eastern end)	South wall (western end)	South wall (western end) (duplicate)	South wall (western end)	Backfill material	Interceptor	Interceptor	Contamination Depth: Surface (<1m) - 1m-4m	
Sample Depth (m below ground level)	2.5	3.0	3.0	0.6	-	1.9 - 2.4	1.9 - 2.[illegible]		
Sample Soil Type	SAND	SAND	SAND	Silty CLAY	SAND	Silty CLAY	Silty CLAY	Silty CLAY	SAND
Guideline Soil Type [4]	SAND	SAND	SAND	Silty CLAY	SAND	Silty CLAY	Silty CLAY		
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining		
Units (dry weight)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total Petroleum Hydrocarbons (TPH)									
C_7 - C_9	< 9	< 10	< 10	< 10	[illegible]	5,[illegible]00	2,600	([illegible]) - ([illegible])	120 - 120
C_{10} - C_{14}	< 20	< 20	< 20	< 20	70	[illegible],000	1,940	(1900) - (3,900)	(1500) - (1900)
C_{15} - C_{36}	< 40	< 40	< 40	< 40	220	6,300	1,970	NA / NA	NA / NA
Total hydrocarbons (C_7 - C_{36})	< 70	< 70	< 70	< 70	290	17,[illegible]00	6,400	-	-
BTEX Compounds									
Benzene	-	< 0.10	< 0.11	-	< 0.05	220[v]	68[v]	2.2 - 20	1.0 - 2.0
Toluene	-	0.149	0.11	-	< 0.05	670	290	(670) - (31000)	(94) - (94)
Ethylbenzene	-	< 0.10	< 0.11	-	< 0.05	172	210	([illegible]) - (2600)	(180) - ([illegible])
m & p-xylenes	-	0.22	0.2[illegible]	-	< 0.10	[illegible]50	[illegible]00	-	-
o-xylenes	-	< 0.10	0.1[illegible]	-	< 0.05	260	410	-	-
Total xylenes	-	< 0.32	0.415	-	< 0.15	1030	790	(510) - (2300)	(150) - (150)
Polycyclic Aromatic Hydrocarbons (PAHs)									
Naphthalene	-	-	-	-	-	-	77	(230) - (1100)	(190) - (230)
Pyrene	-	-	-	-	-	-	0.6[illegible]	NA / NA	NA / NA
Benzo(a)pyrene equivalent	-	-	-	-	-	-	0.0723	(11) - (25)	(11) - (25)

Notes:
Bold - exceeds the Tier 1 Soil Acceptance Criteria (Commercial / Industrial)
([illegible]) - Duplicate soil sample (not [illegible])

1 Ministry for the Environment 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Oil Industry Guidelines)
2 Values taken from Tables 4.10 and 4.13 of the Oil Industry Guidelines
3 Values taken from Tables 4.11 and 4.14 of the Oil Industry Guidelines
4 Contamination soil category chosen for comparison with Oil Industry Guidelines Tier 1 acceptance criteria to best represent soils observed on site

[illegible]
NA - indicates contaminant is not limiting as estimated health based criterion is significantly higher than that likely to be encountered on site.
Brackets denote [illegible] to correspond to formation of residual separate phase hydrocarbons.
The following notes indicate the limiting pathway for each criterion
v - volatilisation, s - soil ingestion, d - dermal exposure, p - produce ingestion, m - maintenance / excavation worker exposure, [illegible] - PAH surrogate

Table 2 : Caltex Pakuranga UPSS Removal - Soil Sample Analytical Results Compared to MfE 1999 Route Specific Soil Acceptance Criteria[1]

	Sample Details and Analytical Results									MfE (1999): Tier 1 Soil Acceptance Criteria[1]					
URS Sample Reference	SSD561	SSD562	SSD563	SSD564	SSD565	SSD566	SSD567	SSD589	SSD591						
Laboratory Sample Reference	790705.1	790705.2	790705.3	790705.4	790705.5	790705.6	790705.7	792271.2	792271.22	Route Specific Soil Acceptance Criteria - Inhalation Pathway Commercial/Industrial[3]		Route Specific Soil Acceptance Criteria - Inhalation Pathway Commercial/Industrial[3]		Soil Acceptance Criteria Maintenance Excvation Workers	
Date Sampled	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	12-May-10	12-May-10						
Sample Location	Dispensers					Remote fill points		Interceptor pit		SAND Contamination Depth 1 - 4 m		Silty CLAY Contamination Depth 1 m - 4 m		Surface Soils	
	Dispenser 1	Dispenser 1 (dup)	Dispenser 2	Dispenser 3	Dispenser 4	Remote fill point 1	Remote fill point 2	Interceptor	Interceptor						
Sample Depth (m below ground level)	1.5 - 1.7	1.5 - 1.7	1.3 - 1.5	1.2 - 1.6	1.4 - 1.6	1.2 - 1.4	1.2 - 1.4	1.9 - 2.4	1.9 - 2.1						
Sample Soil Type	SAND	SAND	SAND	SAND	SAND	SAND	SAND	Silty CLAY	Silty CLAY						
Guideline Soil Type[4]	SAND	SAND	SAND	SAND	SAND	SAND	SAND	Silty CLAY	Silty CLAY	Indoor	Outdoor	Indoor	Outdoor	SAND	Silty CLAY
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining						
Units (dry weight)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total Petroleum Hydrocarbons (TPH)															
C_6-C_9	870	910	3,100	430	26	700	175	5,800	2,600	13,000	NA[2]	NA[2]	NA[2]	120	20,000
C_{10}-C_{11}	360	400	1,940	380	177	340	129	5,000	1,940	9,600	NA[2]	NA[2]	NA[2]	6,500	NA[2]
C_{12}-C_{36}	< 40	< 40	510	< 40	1,100	< 40	< 40	6,300	1,930	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Total hydrocarbons (C_6 - C_{36})	1,230	1,310	5,500	810	1,300	1,040	300	17,100	6,400	-	-	-	-		
BTEX Compounds															
Benzene	**30**	**30**	**31**	4.4	3.7	**21**	5.1	**220**	**68**	8.8	530	20	2,500	3.0	700
Toluene	490	500	270	60	0.45	330	189	630	290	690	NA[2]	3.10	NA[2]	94	NA[2]
Ethylbenzene	98	116	87	19.1	6.1	60	53	172	250	340	6,700	2,600	NA[2]	670	NA[2]
Total Xylenes	**566**	**678**	425	283	3.82	355	542	1050	790	520	NA[2]	2,300	NA[2]	150	NA[2]
Polycyclic Aromatic Hydrocarbons (PAHs)															
Naphthalene	-	-	45	-	-	-	-	-	27	190	1,110	230	10,000	640	NA[2]
Pyrene	-	-	0.46	-	-	-	-	-	0.82	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Benzo(a)pyrene equivalent[5]	-	-	0.0953	-	-	-	-	-	0.0723	NA[2]	1.900	NA[2]	520	25	25

Notes:

Bold - exceeds the Tier 1 Inhalation Pathway Criteria.

Underlined - exceeds the Tier 1 criteria for Maintenance/excvation workers.

Tier 1 criteria for Other Pathways, Produce Ingestion, Soil and Dermal absorption have not been included as it is not considered as these pathways have been classified as incomplete and inappropriate landuse.

1 Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Oil Industry Guideline).

2 NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site (i.e. 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants).

3 Values taken from Tables 4.17, 4.18 and 4.19 of the Oil Industry Guidelines.

4 NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

URS

PHOTOGRAPHS

Client Name:	Site Location:	Project No.
Chevron New Zealand	Caltex Pakuranga	42115121

Photo No.	Date:
01	12.05.10

Description:

Tank pit in the foreground. Facing south west to Ti Rakau Drive.

Photo No.	Date:
02	12.05.10

Description:

Facing west across the site towards car hire company.

URS

PHOTOGRAPHS

Client Name:	Site Location:	Project No.
Chevron New Zealand	Caltex Pakuranga	42115121

Photo No.	Date:
03	12.05.10

Description:

Forecourt facing east across site. Separator in the grass in foreground of photo.

Photo No.	Date:
04	12.05.10

Description:

Tank pit in foreground and vents in the background in a west direction. Beyond vents is the site boundary.

URS

PHOTOGRAPHS

Client Name:	Site Location:	Project No.
Chevron New Zealand	Caltex Pakuranga	42115121

Photo No.	Date:
05	06.05.10

Description:

Tank 1 40,000L 96 Octane tank.

Photo No.	Date:
06	06.05.10

Description:

Forecourt facing the former star shop. Remote fill 1 in the foreground.

URS

PHOTOGRAPHS

Client Name:	Site Location:	Project No.
Chevron New Zealand	Caltex Pakuranga	42115121

Photo No.	Date:
07	06.05.10

Description:

Forecourt facing Ti Raukau Drive, with dispenser 2 in the foreground.

Photo No.	Date:
08	12.05.10

Description:

Site facing south east, all tanks removed.

Hill Laboratories
BETTER TESTING BETTER RESULTS

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1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

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

ANALYSIS REPORT

Client:	URS New Zealand Limited	**Lab No:**	790705
Contact:	Karen O'Donohue	**Date Registered:**	07-May-2010
	C/- URS New Zealand Limited	**Date Reported:**	18-May-2010
	PO Box 821	**Quote No:**	36794
	AUCKLAND 1140	**Order No:**	42115121
		Client Reference:	Chevron New Zealand
		Submitted By:	Karen O'Donohue

Sample Type: Soil

Sample Name:		SSD561 06-May-2010	SSD562 06-May-2010	SSD563 06-May-2010	SSD564 06-May-2010	SSD565 06-May-2010
Lab Number:		790705.1	790705.2	790705.3	790705.4	790705.5
Individual Tests						
Dry Matter	g/100g as rcvd	81	82	74	66	77
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	30	30	31	4.4	3.7
Toluene	mg/kg dry wt	490	500	270	60	0.45
Ethylbenzene	mg/kg dry wt	98	116	87	19.1	6.1
m&p-Xylene	mg/kg dry wt	420	500	340	198	3.2
o-Xylene	mg/kg dry wt	146	179	112	85	0.62
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	870	910	3,100	430	26
C10 - C14	mg/kg dry wt	360	400	1,940	380	177
C15 - C36	mg/kg dry wt	< 40	< 40	510	< 40	1,100
Total hydrocarbons (C7 - C36)	mg/kg dry wt	1,230	1,310	5,500	810	1,300

Sample Name:		SSD566 06-May-2010	SSD567 06-May-2010			
Lab Number:		790705.6	790705.7			
Individual Tests						
Dry Matter	g/100g as rcvd	78	71	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	21	5.1	-	-	-
Toluene	mg/kg dry wt	330	189	-	-	-
Ethylbenzene	mg/kg dry wt	60	53	-	-	-
m&p-Xylene	mg/kg dry wt	260	390	-	-	-
o-Xylene	mg/kg dry wt	95	152	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	700	175	-	-	-
C10 - C14	mg/kg dry wt	340	129	-	-	-
C15 - C36	mg/kg dry wt	< 40	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	1,040	300	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.3 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.4 - Chain of Custody

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

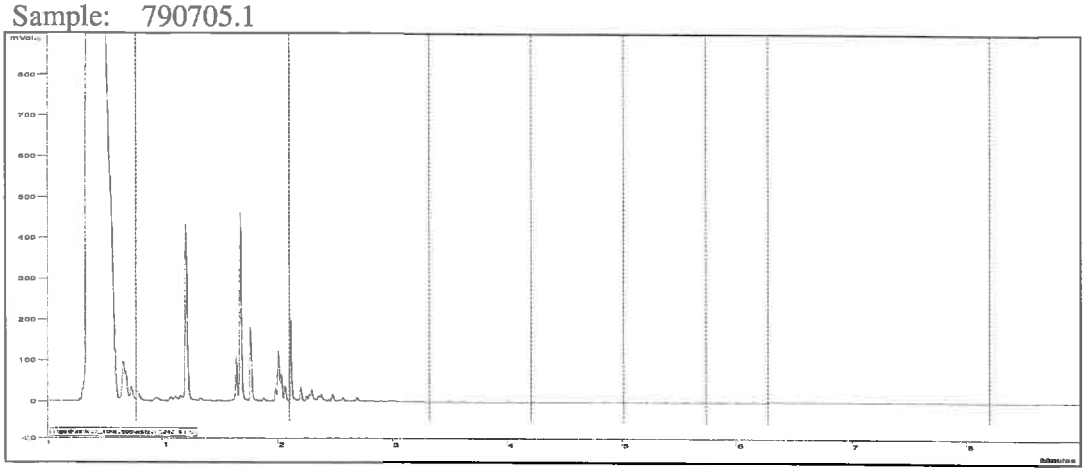
Test	Method Description	Default Detection Limit	Samples
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B	-	1-7
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-7
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry. US EPA 3550.	0.10 g/100g as rcvd	1-7

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

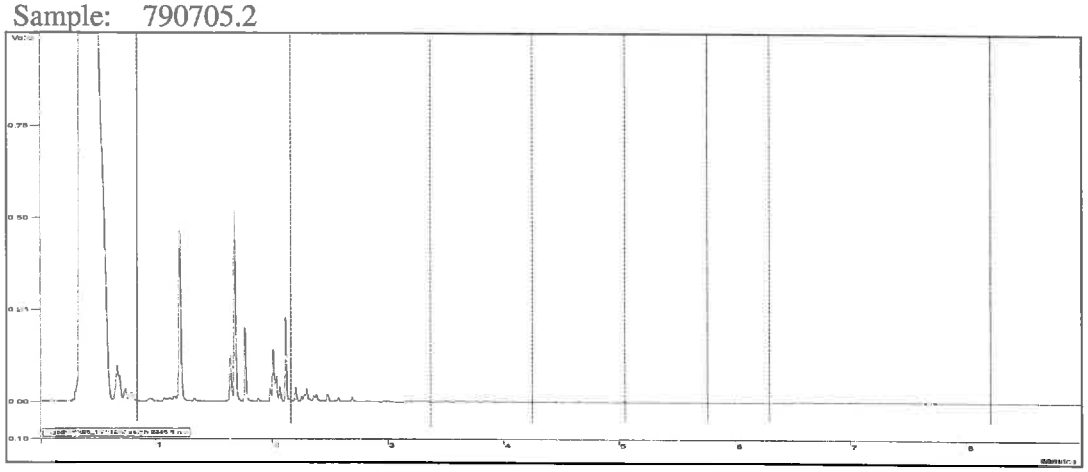
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

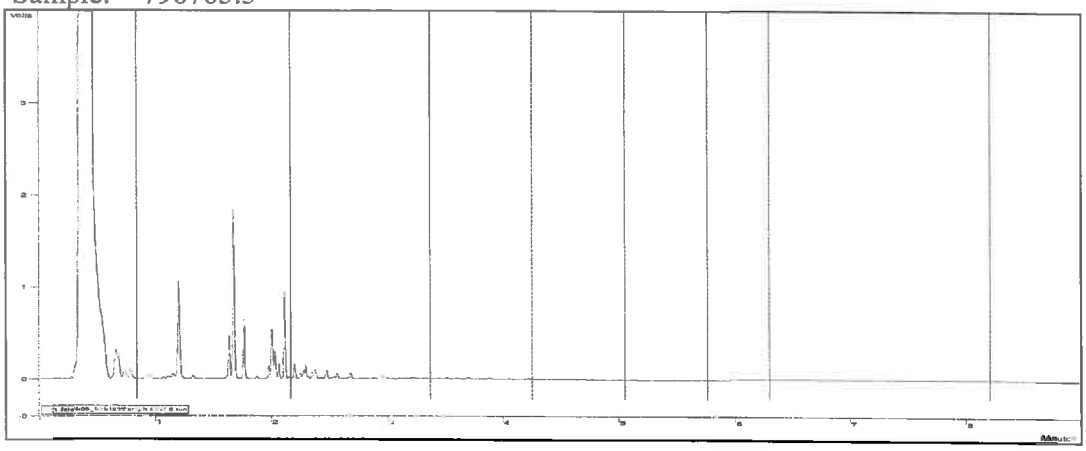
Sample: 790705.1



Sample: 790705.2



Sample: 790705.3



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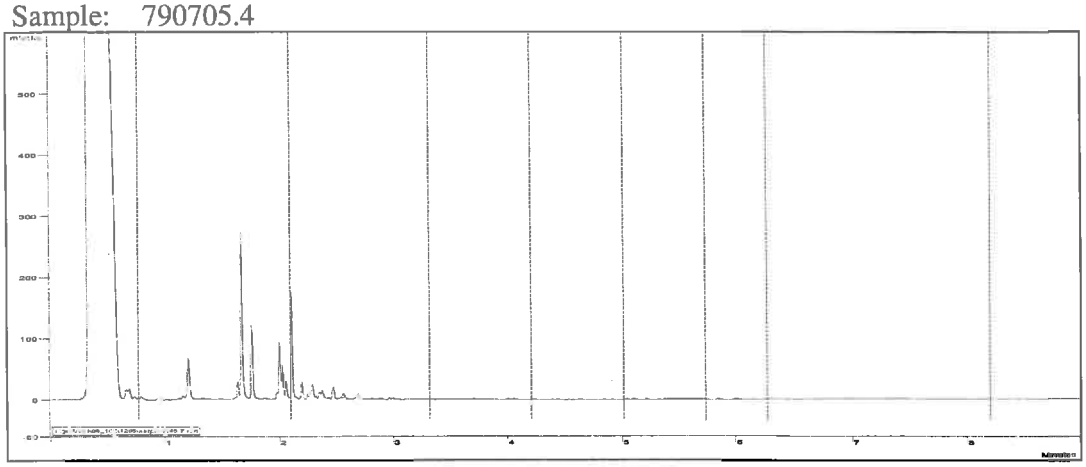

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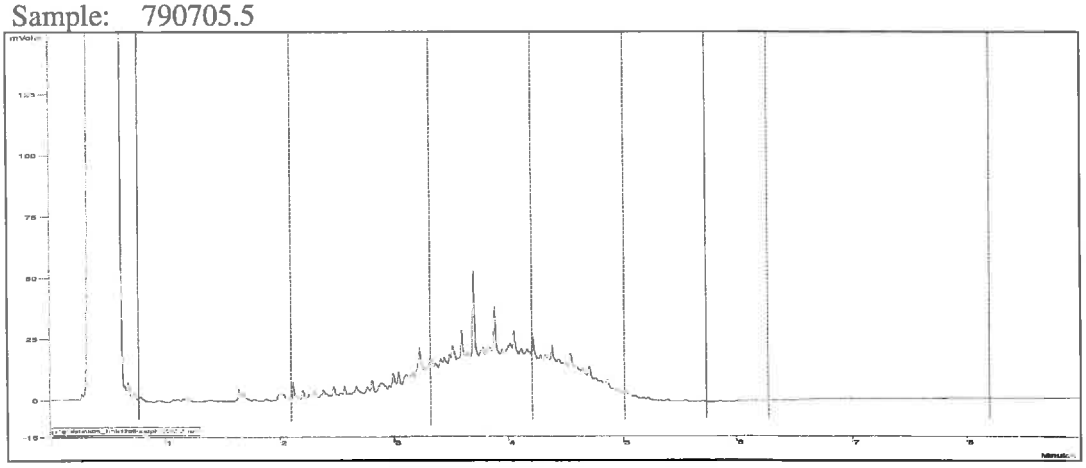
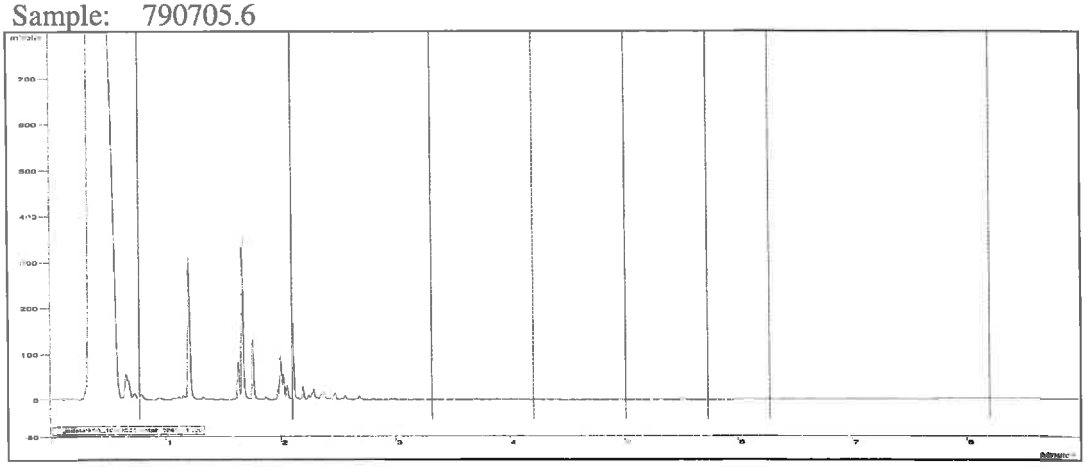
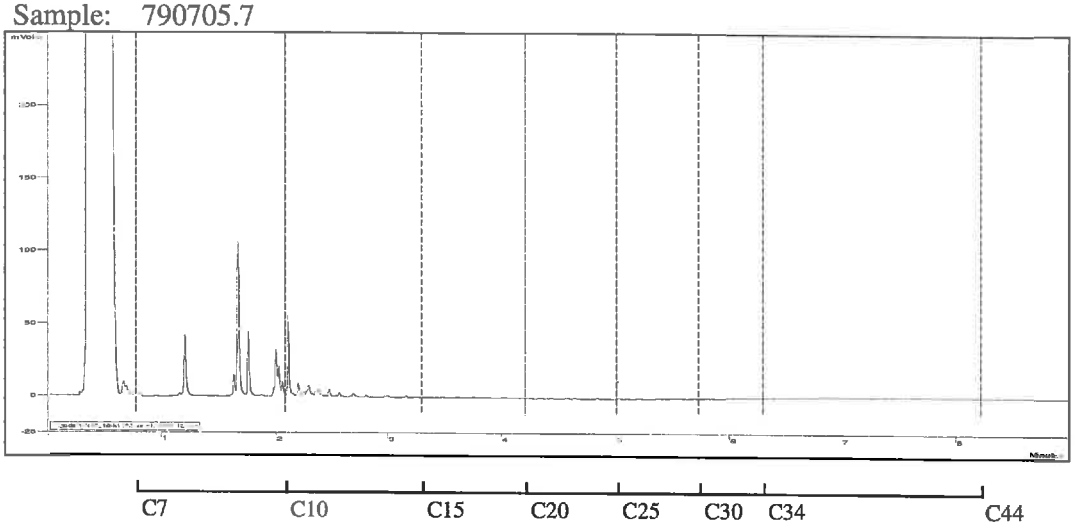


Sample: 790705.6



C7 C10 C15 C20 C25 C30 C34 C44

Sample: 790705.7



URS

CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM

URS New Zealand Limited
URS Centre, Level 6
13-15 College Hill
PO Box 821
Auckland
Ph: (09) 355 1300
Fax (09) 355 1333

RESULTS ATTENTION: Karen O'Donohue
PROJECT NO: 42115121
SAMPLER(S): Nebojsa Jansic Reade Bell

TO

R J Hill Laboratories Limited
1 Clyde Street
Hamilton
Ph: (07) 858 2000

URS Client: Chevron New Zealand

LAB QUOTE NO:
- [x] 20639 Normal Priority
- [ ] 20640 High Priority
- [x] 20641 Urgent Priority
- [ ] Q21435 Special Quote

RESULTS REQUIRED BY:

ANALYSES REQUIRED

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	CONTAINERS: Glass Jars	Glass Jars	Glass Jars	Glass Jars	ANALYTES: TPHOI*	TPHOIBXp	Cold Hold
SSD561	Soil	06.05.10							x	
SSD562	Soil	06.05.10							x	
SSD563	Soil	06.05.10							x	
SSD564	Soil	06.05.10							x	
SSD565	Soil	06.05.10							x	
SSD566	Soil	06.05.10							x	
SSD567	Soil	06.05.10							x	
SSD568	Soil	06.05.10	Urgent Priority						x	
SSD569	Soil	06.05.10	Urgent Priority						x	
Total No. of Sample Bottles:				Including:						Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY
NAME: Karen O'Donohue DATE:
COMPANY: URS TIME:

RECEIVED BY
NAME: E. ANDERSON DATE: 07.5.10
COMPANY: HILL LABS TIME: 5:30 p.m

METHOD OF SHIPMENT
- URS RECEPTION
- HILLS DOCKET

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (IF REQUIRED) AND RETURN TO LABORATORY IMMEDIATELY AFTER RECEIVING SAMPLES

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	YES / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: YES / NO / NA SAMPLES CHILLED: YES / NO / NA Temp: 11.9 °C LABORATORY BATCH NO:

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☑ DISK ☐
EMAIL ADDRESS: karen_odonohue@urscorp.com

INTERNAL USE: URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

Page 1 of 1

Time Received: 07-May-2010 5:30:47 pm
Job No: 790705
No of Samples: 7
No of Fractions: 42
03179070S3

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:	URS New Zealand Limited	**Lab No:**	790703 SPv1
Contact:	Karen O'Donohue	**Date Registered:**	07-May-2010
	C/- URS New Zealand Limited	**Date Reported:**	12-May-2010
	PO Box 821	**Quote No:**	36796
	AUCKLAND 1140	**Order No:**	42115121
		Client Reference:	Chevron New Zealand
		Submitted By:	Karen O'Donohue

Sample Type: Soil

Sample Name:		SSD568 06-May-2010	SSD569 06-May-2010			
Lab Number:		790703.1	790703.2			
Individual Tests						
Dry Matter	g/100g as rcvd	94	88	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Toluene	mg/kg dry wt	< 0.05	0.069	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.05	0.48	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	4.6	-	-	-
o-Xylene	mg/kg dry wt	< 0.05	1.68	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 8	-	-	-
C10 - C14	mg/kg dry wt	< 20	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 40	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	-	-	-

Analyst's Comments

Appendix No.1 - Chain of Custody

SUMMARY OF METHODS

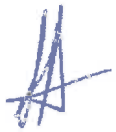
The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix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

Sample Type: Soil

Test	Method Description	Default Detection Limit	Samples
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B	-	1-2
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-2
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry. US EPA 3550.	0.10 g/100g as rcvd	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

URS

CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM:	TO:
URS New Zealand Limited URS Centre, Level 6 13-15 College Hill PO Box 821 Auckland Ph: (09) 355 1300 Fax (09) 355 1333	R J Hill Laboratories Limited 1 Clyde Street Hamilton Ph: (07) 858 2000 URS Client: Chevron New Zealand
RESULTS ATTENTION: Karen O'Donohue PROJECT NO: 42115121 SAMPLER(S): Nebojsa Jansic Reade Bell	LAB QUOTE NO: ☑ 20639 Normal Priority ☐ 20640 High Priority ☑ 20641 Urgent Priority ☐ Q21435 Special Quote RESULTS REQUIRED BY:

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	CONTAINERS: Glass Jars	Glass Jars	Glass Jars	Glass Jars	ANALYTES: TPHOI*	TPHOIBXp	Cold Hold
SSD561	Soil	06.05.10							x	
SSD562	Soil	06.05.10							x	
SSD563	Soil	06.05.10							x	
SSD564	Soil	06.05.10							x	
SSD565	Soil	06.05.10							x	
SSD566	Soil	06.05.10							x	
SSD567	Soil	06.05.10							x	
SSD568	Soil	06.05.10	Urgent Priority						x	
SSD569	Soil	06.05.10	Urgent Priority						x	
Total No. of Sample Bottles:				Including:						Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: Karen O'Donohue	DATE:	NAME: E. ANDERSON	DATE: 07.5.10	URS RECEPTION
COMPANY: URS	TIME:	COMPANY: HILL LABS	TIME: 5:18pm	HILLS DOCKET

SAMPLE RECEIPT DATA

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ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	YES / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT:	YES / NO / NA
			SAMPLES CHILLED:	YES / NO / NA Temp: 11.9 °C
			LABORATORY BATCH NO:	

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☑ DISK ☐

EMAIL ADDRESS: karen_odonohue@urscorp.com

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

Page 1 of 1

Job No 790703

Time Received 07-May-2010 5:18:08 pm

No of Samples 2 No of Fractions 12

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:	URS New Zealand Limited	**Lab No:**	792271 SPv2
Contact:	Karen O'Donohue	**Date Registered:**	13-May-2010
	C/- URS New Zealand Limited	**Date Reported:**	15-Jun-2010
	PO Box 821	**Quote No:**	36794
	AUCKLAND 1140	**Order No:**	42115121
		Client Reference:	Chevron New Zealand
		Submitted By:	N Jancic

Amended Report

This report replaces an earlier report issued on the 26 May 2010 at 3:33 pm
PAH results have been added to samples 792271.2 and 22 at the request of the client.

Sample Type: Soil

Sample Name:	SSD571 12-May-2010	SSD573 12-May-2010	SSD574 12-May-2010	SSD575 12-May-2010	SSD577 12-May-2010
Lab Number:	792271.2	792271.4	792271.5	792271.6	792271.8
Individual Tests					
Dry Matter g/100g as rcvd	67	81	73	77	77
BTEX in Soil by Headspace GC-MS					
Benzene mg/kg dry wt	< 0.07	< 0.06	< 0.06	< 0.10	< 0.10
Toluene mg/kg dry wt	0.13	< 0.06	< 0.06	< 0.10	< 0.10
Ethylbenzene mg/kg dry wt	< 0.07	< 0.06	< 0.06	< 0.10	< 0.10
m&p-Xylene mg/kg dry wt	0.21	< 0.11	< 0.12	< 0.19	< 0.19
o-Xylene mg/kg dry wt	0.08	< 0.06	< 0.06	< 0.10	< 0.10
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene mg/kg dry wt	< 0.04	-	-	-	-
Acenaphthylene mg/kg dry wt	< 0.04	-	-	-	-
Anthracene mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]anthracene mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]pyrene (BAP) mg/kg dry wt	< 0.04	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene mg/kg dry wt	< 0.04	-	-	-	-
Benzo[g,h,i]perylene mg/kg dry wt	< 0.04	-	-	-	-
Benzo[k]fluoranthene mg/kg dry wt	< 0.04	-	-	-	-
Chrysene mg/kg dry wt	< 0.04	-	-	-	-
Dibenzo[a,h]anthracene mg/kg dry wt	< 0.04	-	-	-	-
Fluoranthene mg/kg dry wt	< 0.04	-	-	-	-
Fluorene mg/kg dry wt	< 0.04	-	-	-	-
Indeno(1,2,3-c,d)pyrene mg/kg dry wt	< 0.04	-	-	-	-
Naphthalene mg/kg dry wt	< 0.18	-	-	-	-
Phenanthrene mg/kg dry wt	< 0.04	-	-	-	-
Pyrene mg/kg dry wt	< 0.04	-	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9 mg/kg dry wt	< 11	< 8	< 9	< 10	< 10
C10 - C14 mg/kg dry wt	< 30	< 20	< 20	< 20	< 20
C15 - C36 mg/kg dry wt	< 50	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36) mg/kg dry wt	< 80	< 60	< 70	< 70	< 70

Sample Name:	SSD578 12-May-2010	SSD579 12-May-2010	SSD581 12-May-2010	SSD582 12-May-2010	SSD583 12-May-2010
Lab Number:	792271.9	792271.10	792271.12	792271.13	792271.14
Individual Tests					
Dry Matter g/100g as rcvd	67	70	73	75	73

Sample Type: Soil						
Sample Name:		SSD578 12-May-2010	SSD579 12-May-2010	SSD581 12-May-2010	SSD582 12-May-2010	SSD583 12-May-2010
Lab Number:		792271.9	792271.10	792271.12	792271.13	792271.14
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.07	< 0.07	-	< 0.10	< 0.11
Toluene	mg/kg dry wt	< 0.07	< 0.07	-	0.15	0.31
Ethylbenzene	mg/kg dry wt	< 0.07	< 0.07	-	< 0.10	< 0.11
m&p-Xylene	mg/kg dry wt	< 0.13	< 0.13	-	0.2	0.3
o-Xylene	mg/kg dry wt	< 0.07	< 0.07	-	< 0.10	0.17
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 11	< 10	< 9	< 10	< 10
C10 - C14	mg/kg dry wt	< 30	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 50	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 70	< 70	< 70	< 70

Sample Name:		SSD584 12-May-2010	SSD588 12-May-2010	SSD589 12-May-2010	SSD591 12-May-2010	
Lab Number:		792271.15	792271.19	792271.20	792271.22	
Individual Tests						
Dry Matter	g/100g as rcvd	72	86	75	73	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	-	< 0.05	220	68	-
Toluene	mg/kg dry wt	-	< 0.05	630	290	-
Ethylbenzene	mg/kg dry wt	-	< 0.05	172	250	-
m&p-Xylene	mg/kg dry wt	-	< 0.10	790	380	-
o-Xylene	mg/kg dry wt	-	< 0.05	260	410	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	-	-	-	0.20	-
Acenaphthylene	mg/kg dry wt	-	-	-	0.05	-
Anthracene	mg/kg dry wt	-	-	-	< 0.03	-
Benzo[a]anthracene	mg/kg dry wt	-	-	-	< 0.03	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	-	< 0.03	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	-	< 0.03	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	-	0.04	-
Benzo[k]fluoranthene	mg/kg dry wt	-	-	-	< 0.03	-
Chrysene	mg/kg dry wt	-	-	-	< 0.03	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	-	< 0.03	-
Fluoranthene	mg/kg dry wt	-	-	-	0.11	-
Fluorene	mg/kg dry wt	-	-	-	0.88	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	-	< 0.03	-
Naphthalene	mg/kg dry wt	-	-	-	27	-
Phenanthrene	mg/kg dry wt	-	-	-	1.08	-
Pyrene	mg/kg dry wt	-	-	-	0.82	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 10	< 8	5,800	2,600	-
C10 - C14	mg/kg dry wt	< 20	38	5,000	1,940	-
C15 - C36	mg/kg dry wt	< 40	220	6,300	1,930	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	260	17,100	6,400	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Chain of Custody

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**	**Samples**

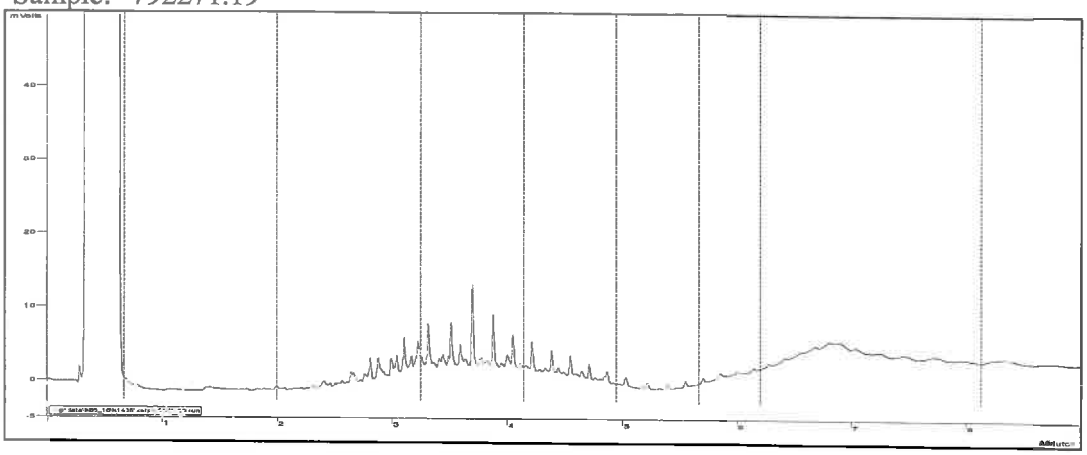
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B	-	2, 4-6, 8-10, 13-14, 19-20, 22
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270).	-	2, 22
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	2, 4-6, 8-10, 12-15, 19-20, 22
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry. US EPA 3550.	0.10 g/100g as rcvd	2, 4-6, 8-10, 12-15, 19-20, 22

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

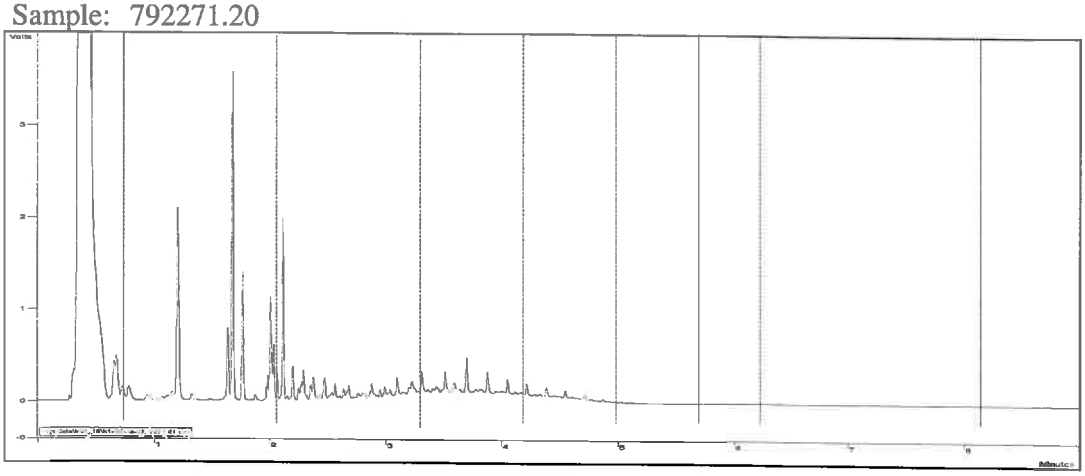
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

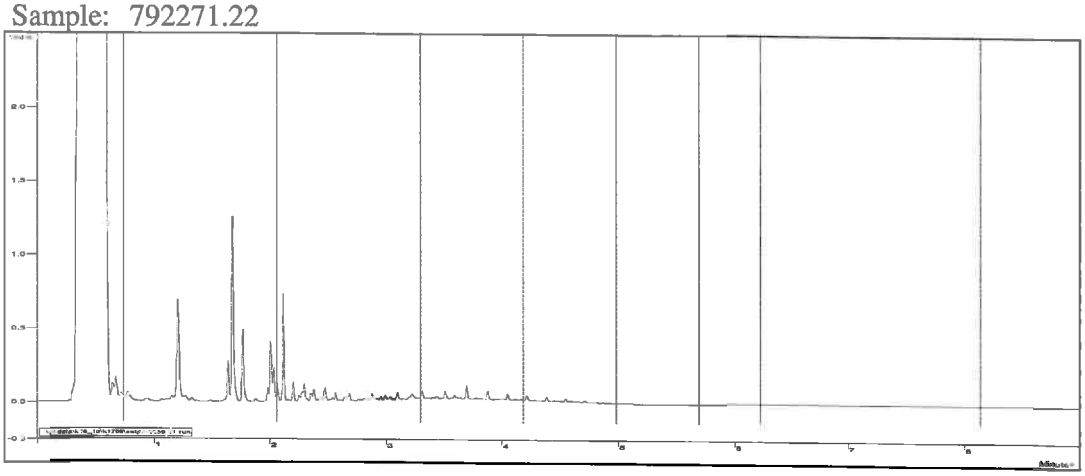
Sample: 792271.19



Sample: 792271.20



Sample: 792271.22



C7 C10 C15 C20 C25 C30 C34 C44

URS

CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

1 of 2

FROM:	TO:
URS New Zealand Limited URS Centre, Level 6 13-15 College Hill PO Box 821 Auckland Ph: (09) 355 1300 Fax (09) 355 1333	R J Hill Laboratories Limited 1 Clyde Street Hamilton Ph: (07) 858 2000 URS Client: Chevron New Zealand
RESULTS ATTENTION: Karen O'Donohue PROJECT NO: 42115121 SAMPLER(S): Nebojsa Jansic, Reade Bell	LAB QUOTE NO: ☑ 20639 Normal Priority ☐ 20640 High Priority ☐ 20641 Urgent Priority ☐ Q21435 Special Quote RESULTS REQUIRED BY:

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	CONTAINERS	Glass Jars	Glass Jars	Glass Jars	ANALYSES REQUIRED
				ANALYTES	TPHOI*	TPHOIBXp	Hold Cold	
SSD570	SOIL	12.05.10					X	
SSD571	SOIL	12.05.10				X	X	
SSD572	SOIL	12.05.10				X		
SSD573	SOIL	12.05.10						
SSD574	SOIL	12.05.10				X		
SSD575	SOIL	12.05.10					X	
SSD576	SOIL	12.05.10				X		
SSD577	SOIL	12.05.10				X		
SSD578	SOIL	12.05.10				X		
SSD579	SOIL	12.05.10					X	
SSD580	SOIL	12.05.10			X			
SSD581	SOIL	12.05.10				X		
SSD582	SOIL	12.05.10				X		
SSD583	SOIL	12.05.10			X			
SSD584	SOIL	12.05.10					X	
SSD585	SOIL	12.05.10					X	
SSD586	SOIL	12.05.10					X	
SSD587	SOIL	12.05.10				X		
SSD588	SOIL	12.05.10				X		
SSD589	SOIL	12.05.10					X	
SSD590	SOIL	12.05.10				X		
SSD591	SOIL	12.05.10						
Total No. of Sample Bottles:				Including:				Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY	RECEIVED BY	METHOD OF SHIPMENT
NAME: Karen O'Donohue	NAME: Emily Anderson	DATE: 13.5.10
COMPANY: URS	COMPANY: IHL LABS	TIME:
DATE:		URS RECEPTION
TIME:		HILLS DOCKET

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	YES / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: YES / NO / NA SAMPLES CHILLED: YES / NO / NA Temp: 14.2c LABORATORY BATCH NO:

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOU... BSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☑ DISK ☐

karen_odonohue@urscorp.com

Time Received 13-May-2010 4 20:31 pm
Job No: 792271
No of Samples 22 No of Fractions 92
0317922713

URS

CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

2 of 2

FROM:	TO:
URS New Zealand Limited URS Centre, Level 6 13-15 College Hill PO Box 821 Auckland Ph: (09) 355 1300 Fax (09) 355 1333	R J Hill Laboratories Limited 1 Clyde Street Hamilton Ph: (07) 858 2000 URS Client: Chevron New Zealand
RESULTS ATTENTION: Karen O'Donohue PROJECT NO: 42115121 SAMPLER(S): Nebojsa Jansic, Reade Ball	LAB QUOTE NO: ☑ 20639 Normal Priority ☐ 20640 High Priority ☐ 20641 Urgent Priority ☐ Q21435 Special Quote RESULTS REQUIRED BY:

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	CONTAINERS	Glass Jars	Glass Jars	Glass Jars										
				ANALYTES	TPHO1*	TPHOIBXp	Hold Cold										
SSD570	SOIL	12.05.10					X										
SSD571	SOIL	12.05.10				X											
SSD572	SOIL	12.05.10					X										
SSD573	SOIL	12.05.10				X											
SSD574	SOIL	12.05.10															
SSD575	SOIL	12.05.10				X											
SSD576	SOIL	12.05.10					X										
SSD577	SOIL	12.05.10				X											
SSD578	SOIL	12.05.10				X											
SSD579	SOIL	12.05.10				X											
SSD580	SOIL	12.05.10					X										
SSD581	SOIL	12.05.10			X												
SSD582	SOIL	12.05.10				X											
SSD583	SOIL	12.05.10				X											
SSD584	SOIL	12.05.10			X												
SSD585	SOIL	12.05.10					X										
SSD586	SOIL	12.05.10					X										
SSD587	SOIL	12.05.10					X										
SSD588	SOIL	12.05.10				X											
SSD589	SOIL	12.05.10				X											
SSD590	SOIL	12.05.10					X										
SSD591	SOIL	12.05.10				X											
Total No. of Sample Bottles:				Including:												Blank or Duplicate Samples	

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: Karen O'Donohue	DATE:	NAME:	DATE:	URS RECEPTION
COMPANY: URS	TIME:	COMPANY:	TIME:	HILLS DOCKET

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	YES / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT:	YES / NO / NA
			SAMPLES CHILLED:	YES / NO / NA Temp: °C
			LABORATORY BATCH NO:	

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☑ DISK ☐

karen_odonohue@urscorp.com

Hill Laboratories
BETTER TESTING BETTER RESULTS

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Hamilton 3240, New Zealand

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

ANALYSIS REPORT

Client:	URS New Zealand Limited	**Lab No:**	792271 SPv1
Contact:	Karen O'Donohue	**Date Registered:**	13-May-2010
	C/- URS New Zealand Limited	**Date Reported:**	26-May-2010
	PO Box 821	**Quote No:**	36794
	AUCKLAND 1140	**Order No:**	42115121
		Client Reference:	Chevron New Zealand
		Submitted By:	N Jancic

Sample Type: Soil

Sample Name:		SSD571 12-May-2010	SSD573 12-May-2010	SSD574 12-May-2010	SSD575 12-May-2010	SSD577 12-May-2010
Lab Number:		792271.2	792271.4	792271.5	792271.6	792271.8
Individual Tests						
Dry Matter	g/100g as rcvd	67	81	73	77	77
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.07	< 0.06	< 0.06	< 0.10	< 0.10
Toluene	mg/kg dry wt	0.133	< 0.06	< 0.06	< 0.10	< 0.10
Ethylbenzene	mg/kg dry wt	< 0.07	< 0.06	< 0.06	< 0.10	< 0.10
m&p-Xylene	mg/kg dry wt	0.21	< 0.11	< 0.12	< 0.19	< 0.19
o-Xylene	mg/kg dry wt	0.079	< 0.06	< 0.06	< 0.10	< 0.10
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 11	< 8	< 9	< 10	< 10
C10 - C14	mg/kg dry wt	< 30	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 50	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 60	< 70	< 70	< 70

Sample Name:		SSD578 12-May-2010	SSD579 12-May-2010	SSD581 12-May-2010	SSD582 12-May-2010	SSD583 12-May-2010
Lab Number:		792271.9	792271.10	792271.12	792271.13	792271.14
Individual Tests						
Dry Matter	g/100g as rcvd	67	70	73	75	73
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.07	< 0.07	-	< 0.10	< 0.11
Toluene	mg/kg dry wt	< 0.07	< 0.07	-	0.149	0.31
Ethylbenzene	mg/kg dry wt	< 0.07	< 0.07	-	< 0.10	< 0.11
m&p-Xylene	mg/kg dry wt	< 0.13	< 0.13	-	0.22	0.25
o-Xylene	mg/kg dry wt	< 0.07	< 0.07	-	< 0.10	0.165
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 11	< 10	< 9	< 10	< 10
C10 - C14	mg/kg dry wt	< 30	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 50	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 70	< 70	< 70	< 70

Sample Name:		SSD584 12-May-2010	SSD588 12-May-2010	SSD589 12-May-2010	SSD591 12-May-2010	
Lab Number:		792271.15	792271.19	792271.20	792271.22	
Individual Tests						
Dry Matter	g/100g as rcvd	72	86	75	73	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	-	< 0.05	220	68	-
Toluene	mg/kg dry wt	-	< 0.05	630	290	-
Ethylbenzene	mg/kg dry wt	-	< 0.05	172	250	-

Sample Type: Soil						
Sample Name:		SSD584 12-May-2010	SSD588 12-May-2010	SSD589 12-May-2010	SSD591 12-May-2010	
Lab Number:		792271.15	792271.19	792271.20	792271.22	
BTEX in Soil by Headspace GC-MS						
m&p-Xylene	mg/kg dry wt	-	< 0.10	790	380	-
o-Xylene	mg/kg dry wt	-	< 0.05	260	410	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 10	< 8	5,800	2,600	-
C10 - C14	mg/kg dry wt	< 20	38	5,000	1,940	-
C15 - C36	mg/kg dry wt	< 40	220	6,300	1,930	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	260	17,100	6,400	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Chain of Custody

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.

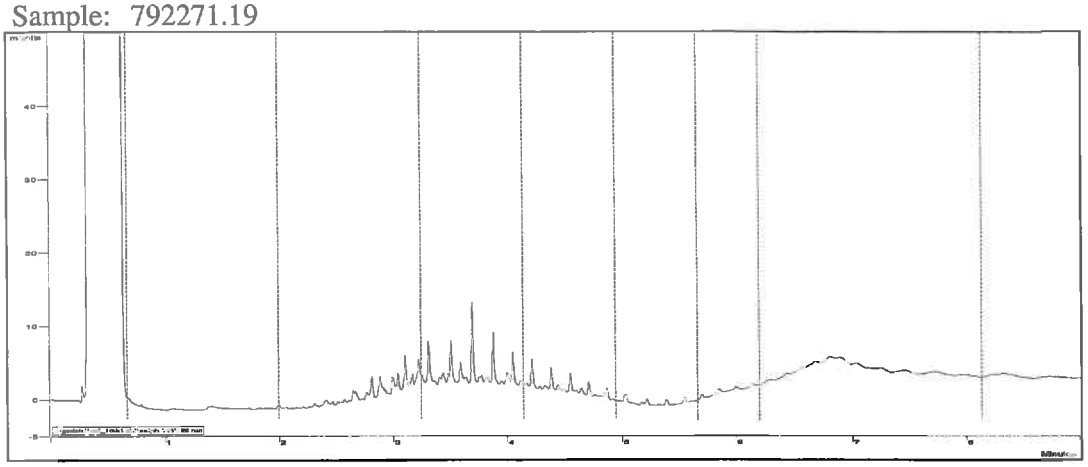
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B	-	2, 4-6, 8-10, 13-14, 19-20, 22
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	2, 4-6, 8-10, 12-15, 19-20, 22
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry. US EPA 3550.	0.10 g/100g as rcvd	2, 4-6, 8-10, 12-15, 19-20, 22

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

Sample: 792271.19



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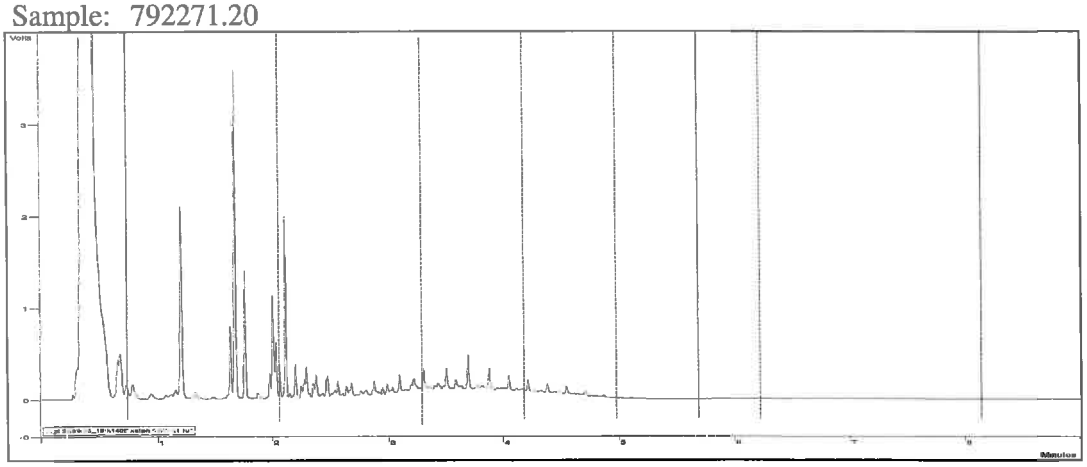
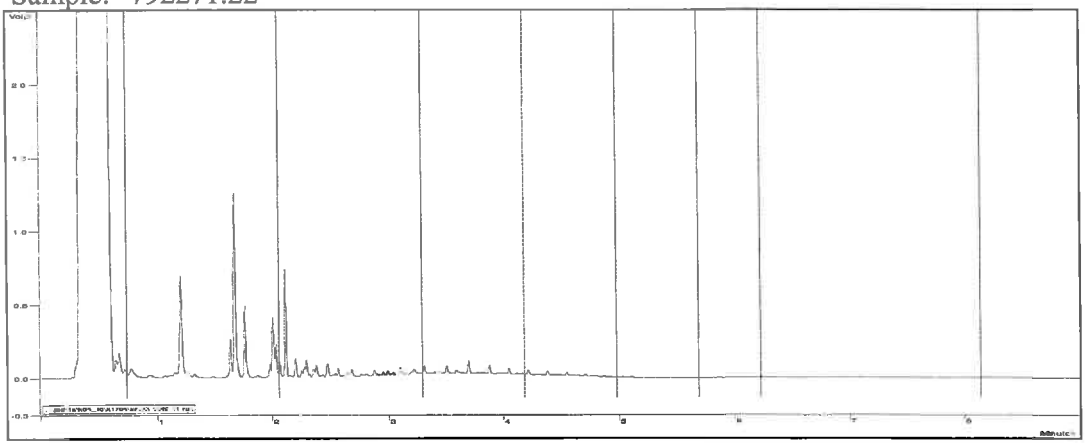


Sample: 792271.22



C7 C10 C15 C20 C25 C30 C34 C44

URS

CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

1 of 2

FROM:	TO:
URS New Zealand Limited URS Centre, Level 6 13-15 College Hill PO Box 821 Auckland Ph: (09) 355 1300 Fax (09) 355 1333	R J Hill Laboratories Limited 1 Clyde Street Hamilton Ph: (07) 858 2000 URS Client: Chevron New Zealand
RESULTS ATTENTION: Karen O'Donohue PROJECT NO: 42115121 SAMPLER(S): Nebojsa Jansic, Reade Bell	LAB QUOTE NO: ☑ 20639 Normal Priority ☐ 20640 High Priority ☐ 20641 Urgent Priority ☐ Q21435 Special Quote RESULTS REQUIRED BY:

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	CONTAINERS	Glass Jars	Glass Jars	Glass Jars
				ANALYTES	TPHOI*	TPHOIBXp	Hold Cold
SSD570	SOIL	12.05.10					x
SSD571	SOIL	12.05.10				x	
SSD572	SOIL	12.05.10					x
SSD573	SOIL	12.05.10				x	
SSD574	SOIL	12.05.10					
SSD575	SOIL	12.05.10				x	
SSD576	SOIL	12.05.10					x
SSD577	SOIL	12.05.10				x	
SSD578	SOIL	12.05.10				x	
SSD579	SOIL	12.05.10				x	
SSD580	SOIL	12.05.10					x
SSD581	SOIL	12.05.10			x		
SSD582	SOIL	12.05.10				x	
SSD583	SOIL	12.05.10				x	
SSD584	SOIL	12.05.10			x		
SSD585	SOIL	12.05.10					x
SSD586	SOIL	12.05.10					x
SSD587	SOIL	12.05.10					x
SSD588	SOIL	12.05.10				x	
SSD589	SOIL	12.05.10				x	
SSD590	SOIL	12.05.10					x
SSD591	SOIL	12.05.10				x	
Total No. of Sample Bottles:				Including:			Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: Karen O'Donohue	DATE:	NAME: Emily Anderson	DATE: 13.5.10	URS RECEPTION
COMPANY: URS	TIME:	COMPANY: HILL LABS	TIME:	HILLS DOCKET

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	YES / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT:	YES / NO / NA
			SAMPLES CHILLED:	YES / NO / NA Temp: 14.2c
			LABORATORY BATCH NO:	

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☑ DISK ☐

karen_odonohue@urscorp.com

Time Received 13-May-2010 4 20:31 pm
Job No: 792271
No of Samples: 22 No of Fractions: 92
0317922713

URS

CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

2 of 2

FROM:	TO:
URS New Zealand Limited URS Centre, Level 6 13-15 College Hill PO Box 821 Auckland Ph: (09) 355 1300 Fax (09) 355 1333	R J Hill Laboratories Limited 1 Clyde Street Hamilton Ph: (07) 858 2000 URS Client: Chevron New Zealand
RESULTS ATTENTION: Karen O'Donohue PROJECT NO: 42115121 SAMPLER(S): Nebojsa Jansa, Reade Bell	LAB QUOTE NO: ☑ 20639 Normal Priority ☐ 20640 High Priority ☐ 20641 Urgent Priority ☐ Q21435 Special Quote RESULTS REQUIRED BY:

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	CONTAINERS	Glass Jars	Glass Jars	Glass Jars
				ANALYTES	TPHOI*	TPHOIBXp	Hold Cold
SSD570	SOIL	12.05.10					X
SSD571	SOIL	12.05.10				X	
SSD572	SOIL	12.05.10					X
SSD573	SOIL	12.05.10				X	
SSD574	SOIL	12.05.10					
SSD575	SOIL	12.05.10				X	
SSD576	SOIL	12.05.10					X
SSD577	SOIL	12.05.10				X	
SSD578	SOIL	12.05.10				X	
SSD579	SOIL	12.05.10				X	
SSD580	SOIL	12.05.10					X
SSD581	SOIL	12.05.10			X		
SSD582	SOIL	12.05.10				X	
SSD583	SOIL	12.05.10				X	
SSD584	SOIL	12.05.10			X		
SSD585	SOIL	12.05.10					X
SSD586	SOIL	12.05.10					X
SSD587	SOIL	12.05.10					X
SSD588	SOIL	12.05.10				X	
SSD589	SOIL	12.05.10				X	
SSD590	SOIL	12.05.10					X
SSD591	SOIL	12.05.10				X	
Total No. of Sample Bottles:				Including:			Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: Karen O'Donohue	DATE:	NAME:	DATE:	URS RECEPTION
COMPANY: URS	TIME:	COMPANY:	TIME:	HILLS DOCKET

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	YES / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT:	YES / NO / NA
			SAMPLES CHILLED:	YES / NO / NA Temp: °C
			LABORATORY BATCH NO:	

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARD SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☑ DISK ☐

karen_odonohue@urscorp.com

URS

Limitations

URS has performed the services for this project in accordance with current professional standards for environmental site assessments; no guarantees are either expressed or implied.

There is no investigation that is thorough enough to preclude the presence of materials at the site that presently, or in the future, may be considered hazardous. Because regulatory evaluation criteria are constantly changing, concentrations of contaminants present and considered to be acceptable may, in the future, become subject to different regulatory standards which cause them to become unacceptable and require further remediation for the site to be suitable for the existing or proposed land use activities.

Opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions. This document and the information contained herein have been prepared solely for the use of Chevron New Zealand. Any reliance on this report by other parties shall be at such party's sole risk. This report shall only be presented in full and may not be used to support any objectives other than those set out in the report, except with the express permission of URS.

AECOM

Chevron Environmental Management Company

19-Feb-2016

Former Caltex Pakuranga Service Station

Resource Consent Application & Assessment of Environmental Effects

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Revision – 19-Feb-2016
Prepared for – Chevron Environmental Management Company – Co No.: N/A

Former Caltex Pakuranga Service Station

Resource Consent Application & Assessment of Environmental Effects

Client: Chevron Environmental Management Company

Co No.: N/A

Prepared by

AECOM Consulting Services (NZ) Ltd
8 Mahuhu Crescent, Auckland 1010, PO Box 4241 Shortland St, Auckland 1140, New Zealand
T +64 9 967 9200 F +64 9 967 9201 www.aecom.com

19-Feb-2016

Job No.: 42101210

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document Former Caltex Pakuranga Service Station

Ref 42101210

Date 19-Feb-2016

Prepared by Andrew Walker

Reviewed by Richard Coombe

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
	19-Feb-2016		Richard Coombe Associate Director	

Table of Contents

1.0 Introduction

1.1 Introduction

This assessment of environmental effects (AEE) provides technical support to a resource consent application by Chevron Environmental Management Company (EMC) for short-term resource consent to apply during proposed soil remediation works at the former Caltex Pakuranga property located on Ti Rakau Drive, Auckland (the Site). Refer **Figure C001**.

The Site was sold to Auckland Transport who has provided permission for EMC to undertake the works applied for under this consent application. A copy of the letter of authorisation from Auckland Transport is provided in Appendix E.

1.2 Background

The underground petroleum storage system (UPSS) was decommissioned and removed from the Site in following closure of the service station in circa May 2010.

Soil benchmarking undertaken during the UPSS removal identified concentrations of petroleum hydrocarbons within soil at the Site that exceed concentrations for C&I land-use as defined within Ministry of the Environment (MfE) Guidelines (MfE Guidelines)[1].

AECOM New Zealand Ltd (AECOM, (formerly URS New Zealand Limited (URS)) understands that EMC wishes to voluntarily remediate the Site to meet future unencumbered C&I land-use. The Site has already been divested to Auckland Transport, with agreed provision for access for EMC to undertake the intended remedial works. It is therefore proposed that hydrocarbon impacted soils (which exceed acceptable C&I land-use standards) be excavated and removed from the Site. A layout of the Site and existing services shown is presented in **Figure C002**.

1.3 Proposed Remedial Works

It is anticipated that approximately 1,600 m^3 of soil will be excavated during the planned work. Of this, approximately 1300 m^3 (2,400 tonnes) of material will be removed from the Site. Approximately 600 m^3 of excavated overburden (excavated to gain access to the impacted soils at depth) is expected to meet C&I land use standards to allow re-use as fill material on-Site.

It is expected that between 60% and 80% of the material removed off site will be impacted by hydrocarbons to the extent that it will be transferred to a landfill facility licenced to accept such waste. The remaining 20% to 40% of material removed off site is expected to be less impacted and can be disposed at a licensed managed fill site.

This resource consent application and AEE seeks authorisation as a **Restricted Discretionary Activity** under the National Environmental Standards (NES) Soil Contamination rules. Consent is also required under the Operative District Plan and Proposed Auckland Unitary Plan (PAUP) as a **Restricted Discretionary Activity** for earthworks. Consent is required as a **Controlled Activity** under the Operative Regional Auckland Council District Plan (Air Land Water) and the PAUP for remedial works to a contaminated site.

[1] Ministry for the Environment, 1999: Guidelines for Assessing and Managing Petroleum Hydrocarbon Sites in New Zealand, revised 2011.

This AEE has been prepared in accordance with the requirements of the fourth Schedule of the Resource Management Act 1991 (RMA). Specifically, the AEE provides an assessment of the actual and potential effects of the proposed activity and any resulting changes to the environment.

Overall, it is considered that the removal of the impacted soils from the Site will have a positive long-term effect on soil and groundwater quality at the Site.

1.4 Applicant and Agent Information

Appendix A provides copies of the resource consent application forms. **Appendix B** provides a copy of the certificate of title for the Site.

This report has been prepared by AECOM on behalf of EMC. Application details are provided in **Table 1-1**.

Table 1-1 Applicant and Agent Details

Applicant Details	Chevron Environmental Management Company PO Box 684 Auckland Contact Person: Jon Payne Ph: 09 583 5044
Agent Details	AECOM New Zealand Limited AECOM House, 8 Mahuhu Crescent, Auckland 1010 PO Box 4241 Shortland St, Auckland 1140 Contact Person: Andrew Walker Ph: +64 9 967 9673
Address of the Site	11 Cortina Place, Auckland (fronts Ti Rakau Drive – numbers 64 - 66)
Legal Description	Section 4 SO 468793 3,112m²
Map Reference	NZMG 1766823 E, 5912812 N
Site Area	3,112m²
Site Zoning	'Business 4' under the Operative Auckland Council District Plan (Manukau Section) 2002 'Town Centre – Pakuranga' under the Proposed Auckland Unitary Plan and subject to the following overlays: - Infrastructure: High Land Transport Route Noise - Built Environment: Building Frontage – General Commercial Frontage - Built Environment: Air Quality Transport Corridor Separation – Motorway & Strategic Arterial Routes Additional Zone Height Controls: Additional Height Controls – Pakuranga, 48.5m / 12 storeys
District Council	Auckland Council
Regional Council	Auckland Council

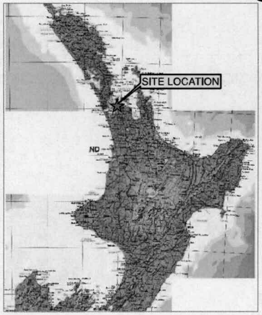
Surrounding Land-use	The Site is located in a C&I area and surrounded by C&I occupation. The closest residential properties are located approximately 30 m to the west of the Site (opposite side Ti Rakau Drive).

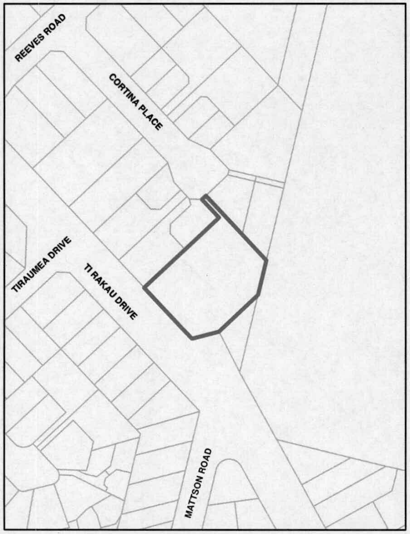
1.5 Terms of Reference

A number of environmental investigations at the Site have been undertaken by AECOM and URS. This resource consent application and AEE draws upon information from the following reports:

- URS 2010. Caltex Pakuranga Service Station - Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment prepared, dated 24 June 2010 (42115121).
- URS 2011. Caltex Pakuranga Service Station – Environmental Site Assessment, dated November 2011 (42117721).
- URS 2014. Former Caltex Pakuranga Service Station – Soil and Groundwater Assessment, dated September 2014 (42100310).
- AECOM 2015. Former Caltex Pakuranga – Conceptual Site Model, dated November 2015 (42101210).

18 Feb 2016 13:31





64-66 TI RAKAU DRIVE, PAKURANGA

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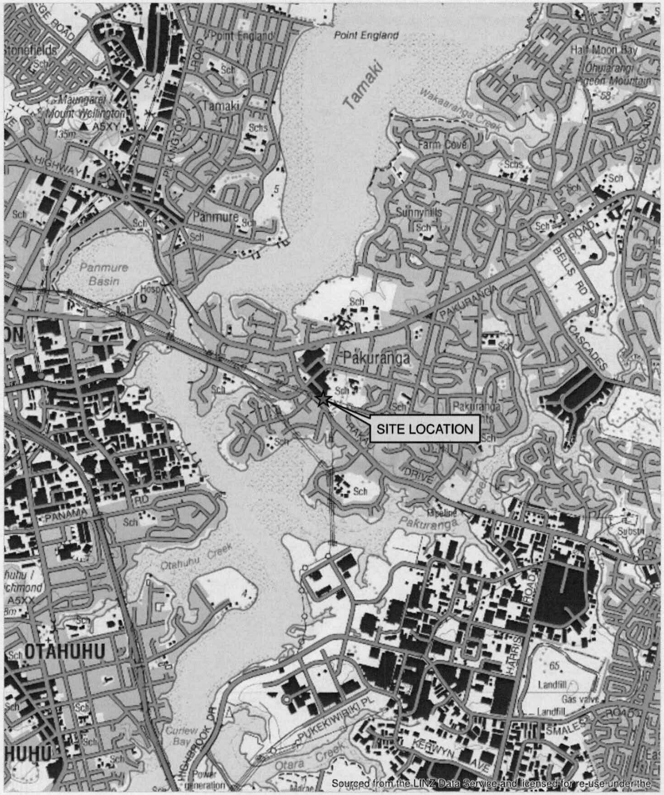


SITE LOCATION

Scale 1:35,000

T:\Jobs\42101210\02_Maps\Site_Location.mxd PDF File Name -

Rev.	By	App.	Description	Date

Notes:

Approved	RC	Date	18/02/2016
Designed	SS	Checked	NW
Drawn	SS		

Map features depicted in terms of NZTM projection.

Data Sources:
NZ Topographical Features – LINZ NZ National Topo Dataset 2014
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2014

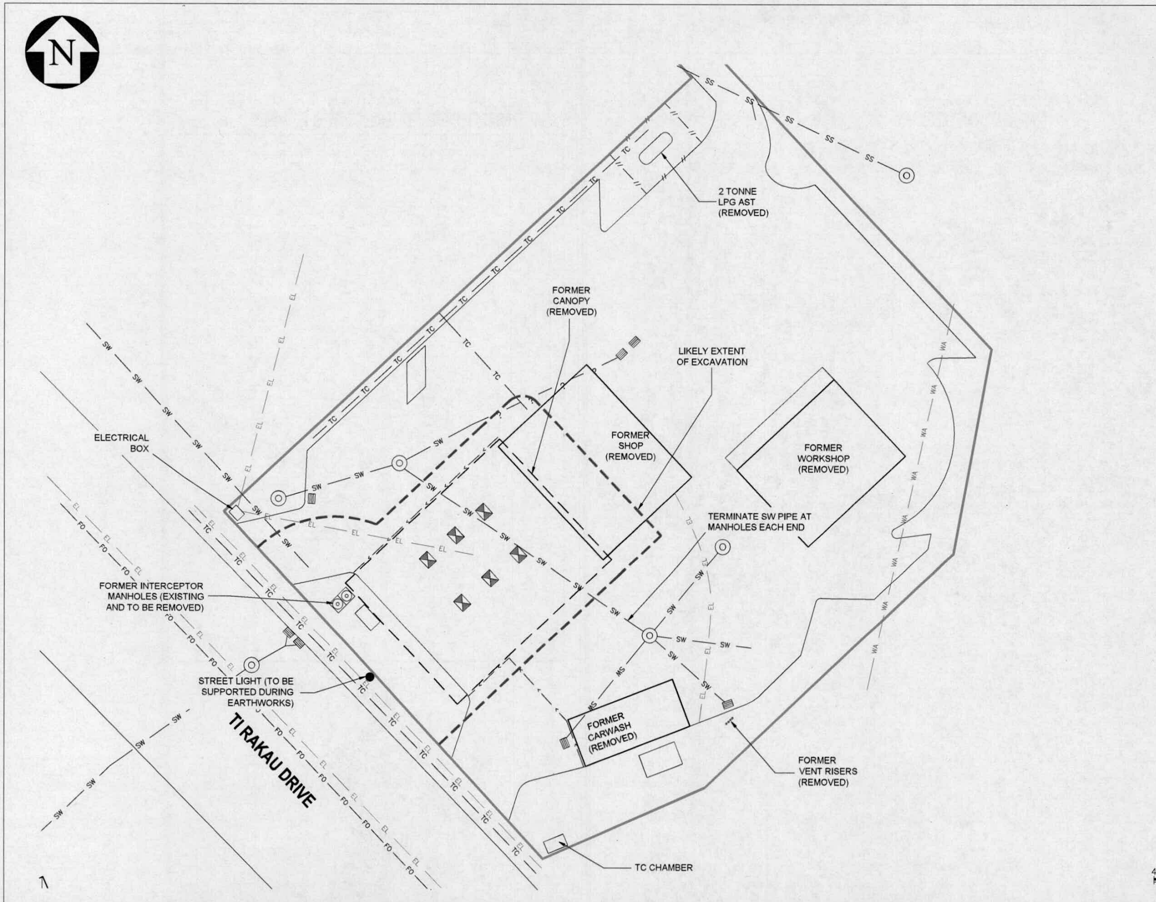
AECOM

Client: CHEVRON NEW ZEALAND

Project: FORMER CALTEX PAKURANGA SERVICE STATION

Title: SITE LOCATION PLAN

Status:	Map No.	Job No.	Rev.
FINAL	FIGURE C-001	60435537	A



KEY	
	SITE BOUNDARY
	SUMP
—//—//—	FENCE
—— > ——	SLOT DRAIN
—— EL ——	POWER LINE
—— SW ——	STORMWATER
—— TC ——	TELECOM
—— FO ——	FIBRE OPTIC
—— WA ——	WATER MAIN
—— SS ——	SEWER
	FORMER DISPENSER (REMOVED)
	MANHOLE

ALL DIMENSIONS AND FEATURES INCLUDING THE SERVICE LOCATIONS SHOWN ARE APPROXIMATE ONLY. THIS PLAN MUST NOT BE USED FOR LOCATING SERVICES PRIOR TO INTRUSIVE WORKS.

4 0 4 8 12 16 20
DIMENSIONS ARE IN METRES

1:200 (A1)
1:400 (A3)

ISO A1 594mm x 841mm

AECOM

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

PROJECT
FORMER CALTEX PAKURANGA SERVICE STATION

CLIENT
CHEVRON NEW ZEALAND

REGISTRATION

PROJECT MANAGEMENT INITIALS

NW	RC	RC
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

I/R	DATE	DESCRIPTION
1	18/02/2016	FINAL

PROJECT NUMBER
60435537

SHEET TITLE
EXISTING SERVICES

SHEET NUMBER
FIGURE C-002

2.0 Site History and Environmental Setting

2.1 Site History and Layout

The following provides a brief summary of information sources as listed in section 1.5.

2.1.1 May 2010 – Underground Petroleum Storage System Decommissioning

In May 2010 the underground petroleum storage system (UPSS) at the Site was decommissioned. The UPSS comprised four underground storage tanks (USTs) comprising 2 x 40,000 litre 91 octane petrol, 1 x 40,000 litre 96 octane petrol, 1 x 20,000 litre diesel, with associated pipe work and dispensers. A soil validation and sampling exercise was completed at the time of UPSS decommissioning[2] that indicated concentrations of hydrocarbon compounds within soil remaining on-Site exceeded the MfE Guidelines, Tier 1 soil acceptance criteria for C&I land-use.

The exceedances were detected in shallow soil samples collected within the footprint of the former forecourt, generally in the vicinity of the former dispenser islands, remote fills and interceptor. No exceedances were detected within soil samples collected from the UPSS tank pit excavation in the location of the former fuel storage tanks.

2.1.2 November 2011 –Groundwater Assessment

In November 2011[3] URS completed an Environmental Site Assessment (ESA) to assess shallow soil and groundwater conditions at the Site. These works involved the advancement of four boreholes and the installation and sampling from four on-site groundwater monitoring wells (MW1 to MW4). Elevated concentrations of hydrocarbon compounds were detected within MW2 (located at the southwest site boundary) in both soil and groundwater samples analysed.

2.1.3 May 2014 – Site Delineation

In May 2014[4] URS undertook further environmental assessment involving the completion of sixteen test pits (TP1 to TP16). Concentrations of petroleum hydrocarbons above the MfE Guidelines for C&I land-use were detected in soil samples in the vicinity of the former stormwater interceptor and ancillary pipework.

2.1.4 November 2015 – Conceptual Site Model

In May 2015[5] AECOM undertook an exercise to appraise the likely extent of hydrocarbon impact in soil and groundwater beyond the boundary of the Site with Ti Rakau Drive. It was initially thought a stomwater or sewer main might be present within the carriageway, which would effectively act as a 'cut-off' for migration of hydrocarbon down the natural groundwater hydraulic gradient. An inspection of services (inverts etc) indicated that this was not the case.

A review of the existing soil and groundwater data and on-site services indicated that because of the less permeable nature of the underlying natural geology, remaining hydrocarbon impact is likely to predominantly reside around the on-site stormwater management system. This infrastructure is located parallel to the Ti Rakau Drive road frontage and is suspected to have acted as a preferential pathway for hydrocarbon migration and now residual source of impact following the decommissioning of the UPSS Therefore, hydrocarbon impacts are considered to be largely restricted to within the Site

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[2] URS 2010. Caltex Pakuranga Service Station - Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment prepared, dated 24 June 2010 (42115121).
[3] URS 2011. Caltex Pakuranga Service Station - Environmental Site Assessment, dated November 2011 (42117721).
[4] URS 2014. Former Caltex Pakuranga Service Station – Soil and Groundwater Assessment, dated September 2014 (42100310).
[5] AECOM 2015. Former Caltex Pakuranga– Conceptual Site Model, dated November 2015 (42101210).

boundary. Any impacts beyond the Site are expected to be minor and can be managed with a contamination management plan which if required, can be issued following completion of the proposed remedial works.

Because of the low permeability of the underlying natural geology, the extent of associated hydrocarbon dissolved phase is also expected to be limited.

Following completion of the remedial works, the residual hydrocarbon impacts within carriageway are expected to be limited and best controlled through a site management plan. Recent discussions with the AC contamination team (Andrew Kalbarcyzk) support this premise.

2.2 Environmental Setting

2.2.1 Geology

The geological map of the area indicates that the Site is underlain by pumiceous deposits of light grey to orange brown, pumiceous mud, sand and gravel with black muddy peat and lignite of the Puketoka Formation which forms part of the Tauranga Group[6]. The Tauranga Group sediments overlie sandstones and mudstones of the Waitemata Group, which forms local bedrock.

The published geology was not encountered during previous site investigations with underlying geology generally silty clay underlain by sandy silt.

2.2.2 Hydrogeology

Based on the above-referenced groundwater assessments undertaken at the Site in 2011 and 2014, the shallow unconfined aquifer ranges in depth between 1.2 and 2.1 m bgl. The relative groundwater levels established for the Site indicates that shallow groundwater flows in a southwest and/or southeast direction towards the inlet to Pakuranga Creek and Waitemata Harbour.

Figures presenting the interpreted piezometric surface contours for the most recent GME completed in November 2011 and May 2014 are provided in **Appendix D**.

2.2.3 Potentially Sensitive Receptors

A search of bore records on the Auckland Council database identified two registered groundwater bores within a 1 km radius of the Site. The first bore is located approximately 850 m north east of the Site and is drilled to a depth of 265 metres below ground level (m bgl), for irrigation purposes, abstracted from aquifers within the Waitemata Group. The second bore is located approximately 490 m south west of the Site and has no further information listed.

Given the developed nature of the area, it is considered unlikely that groundwater within the shallow aquifer would be abstracted for potable supply. As the shallow aquifer beneath the Site is not considered of sufficient quality for viable use, the aquifer is considered "not sensitive" in accordance with MfE guidelines.

The nearest surface water body to the Site is a small inlet located approximately 350 m south of the Site at the closest point. The inlet (part of the Pakuranga Creek) joins the Tamaki River approximately 400 m south of the Site.

A preliminary Conceptual Site Model is provided in **Appendix F**.

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[6] Kermode, L.O., 1992. Geology of the Auckland Urban Area 1:50 000. Institute of Geological and Nuclear Sciences Geological Map 2, Lower Hutt, New Zealand.

3.0 Summary of Contaminant Conditions

3.1 Summary of Soil Conditions

The successive completion of soil and groundwater investigations undertaken across the Site following the planned decommissioning of the UPSS has largely delineated the spatial extent of hydrocarbon impact across the Site. With the exception of the former UPSS tank pit housing the former USTs, the distribution of hydrocarbon contamination appears restricted to the previous UPSS foot-print (forecourt) and ancillary infrastructure.

The former service station forecourt has bench-marked hydrocarbon impacts to depths between 1.2 and 1.7 m bgl in sand material (likely bedding / construction material for the forecourt). The vertical extent of impact in this area is not defined. However, samples taken from walls of the tank pit next to the forecourt indicate hydrocarbon impacts below commercial/industrial soil acceptance criteria at depths of 2.5 to 3.0 m bgl. Given the low permeability of the under laying natural silty clay geology, and the relatively shallow depth to groundwater (approx. 1.5 m bgl) it is unlikely that hydrocarbon impacts beneath the forecourt will have penetrated significantly into the underlying natural geology. This will be confirmed during the planned Site excavation activities.

See **Figure C003** for a spatial distribution of hydrocarbon impacts and **Figure C004** cross-section of planned excavation.

3.2 Excavation Inspection and Areas of Uncertainty

As the extent of impacted soil will not be fully defined until planned excavations commence, Chevron/EMC has appointed AECOM to be present on-site to benchmark and assess the progress of the remedial excavation activities. Several areas of uncertainty require specific attention and verification. These areas are as follows:

- An inspection of soils between 1.2 to 1.7 m bgl across the former forecourt will be required to determine the vertical extent of the excavation. It is suspected that the underlying silty clay and groundwater will have acted as a barrier to vertical penetration of residual hydrocarbon impacts.
- The shallow soils immediately around the dispenser area are likely impacted by residual hydrocarbons and will be removed from the Site (> C&I guidelines). However, an inspection of shallow overburden should be undertaken to determine whether this material can be stockpiled for re-use following validation analysis of the overburden (< C&I guidelines).
- An inspection of the extent of lateral hydrocarbon impacts beneath the former retail shop will be undertaken during remedial works. Test pit locations TP9 and TP10 provide an indication for the absence of hydrocarbon impact; however the true extent of lateral impact between the former dispensers and shop may be much less.
- Removal of material around the interceptor (gravel and bedding material) will require removal from Site and disposal. However, the existing sampling results indicate that the top 1.0 m of overburden is suitable for re-use. Therefore soils between the surface and approximately 1.0 m bgl should be inspected during the excavation. It is suspected that the hydrocarbon impacts are restricted to the immediate vicinity of the interceptor and associated pipe-work. As mentioned, it is suspected that the natural clay geology underlying the Site would have prevented significant penetration of impacts to depth. Therefore, inspection of this layer

should be undertaken during the excavations to confirm the need for removal of any natural clay material.

- Towards the western corner of the Site and the Ti Rakau Drive frontage will also require inspection during remediation to assess the full extent of impact within the Site. However it is assumed that the Site boundary will define the maximum extent of excavation. It should be noted that the extent of soil removal in the northwest extent of the remdiation excavation may be limited by the need to maintain a stand off from existing neighbouring buildings for ground stability reasons and/or the installation of temporary sheet piling along the road frontage.

3.3 Summary of Groundwater Conditions

An assessment of groundwater was undertaken in November 2011 and May 2014 at the Site. A total of four on-site groundwater monitoring wells (MW1 to MW4) were sampled. Depth to groundwater was approximately 1.220 to 1.419 m bgl (November 2011) and 1.530 to 2.125 (May 2014). The two groundwater monitoring events inferred flows towards southwest and southeast respectively (generally across or parallel to Ti Rakau Dr).

Elevated concentrations of TPH and BTEX hydrocarbon compounds in groundwater were detected within MW2 at both sampling events. The remaining groundwater samples from both events were below the laboratory method detection limit (MDL) of detection for TPH and BTEX hydrocarbon compounds.

It is noted that assuming a southwest groundwater flow direction, that MW2 would be considered furthest down hydraulic gradient well. Should a southeast groundwater flow direction occur, then MW3 and MW4 would be considered to be located down hydraulic gradient.

Given the reduced permeability (low yield) of the underlying geology and the distance to the nearest surface water feature (Tamaki River, 350 m to the south). The aquifer underlying the Site is not considered sensitive under MfE Guidelines.

3.3.1 Separate Phase Hydrocarbons

A thin layer of separate phase hydrocarbons (SPH) was noted on soils collected from the stormwater interceptor excavation during the UPSS decommissioning in May 2010. However, SPH was not recorded during gauging or sampling during the November 2011 and May 2014 groundwater sampling events. It is noted that the dissolved phase concentrations of total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX) compounds in samples from MW2 are reducing, from 9.7 mg/L (benzene) in November 2011 to 2.5 mg/L (benzene) in May 2014. The difference in concentrations could be a function of the differing groundwater elevations at the respective sampling events. Regardless, it is expected that SPH is likely to be present in the vicinity of MW2. Groundwater analytical results for the above groundwater sampling events are presented in **Appendix C**.

3.3.2 Dissolved Phase Hydrocarbons

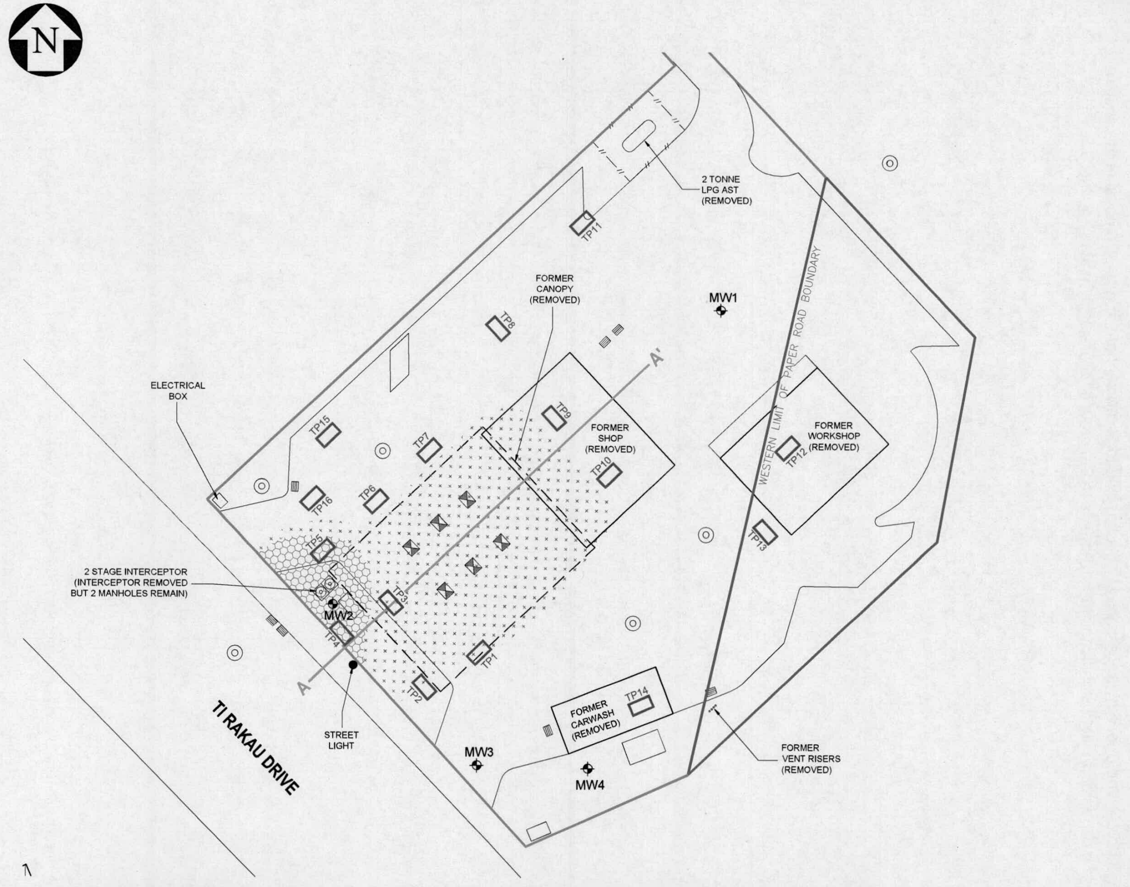
Groundwater analytical results for November 2011 and May 2014 sampling events are summarized as flows:

- TPH and BTEX compounds were recorded below the laboratory MDL and therefore below the respective MfE groundwater guideline value for inhalation of vapours. Concentrations of TPH and BTEX compounds in MW2 were also below this MfE guideline value.

- With the exception of MW2, concentrations of TPH and BTEX were below the ANZECC[7] guidelines (80% level of protection) in samples from all monitoring wells at the Site.

- With hydrocarbon compounds only detected in a single location in the expected residual source area, coupled with the low permeability of the underlying natural geology. A significant discharge of dissolved phase hydrocarbons is not expected to be present at the Site. Removal of the source is expected to yield significant improvements to the groundwater quality underlying the Site.

[7] Australian and New Zealand Environment and Conservation Council (ANZECC). 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality



NOTE:
1. VERTICAL EXTENT OF EXCAVATION IN FORECOURT AREA BETWEEN 1.2 AND 2.5mbgl REQUIRES INSPECTION
2. INSPECTION OF SOILS UNDER FORMER SHOP REQUIRED TO DETERMINE LATERAL EXTENT OF EXCAVATION
3. INSPECTIONS OF SOILS IN WESTERN CORNER OF SEPARATOR REQUIRED TO DETERMINE LATERAL EXTENT OF EXCAVATION

KEY	
	SITE BOUNDARY
	SUMP
— // — // —	FENCE
	FORMER DISPENSER
	APPROX. PAPER ROAD BOUNDARY: WILLIAM ROBERTS ROAD
	APPROXIMATE AREA OF SOIL IMPACTED BY PETROLEUM HYDROCARBONS
	APPROXIMATE AREA WHERE SPH COULD POTENTIALLY BE ENCOUNTERED
A——A'	CROSS SECTION
MW1	MONITORING WELLS
	MANHOLE
	TEST PIT LOCATION

ALL DIMENSIONS AND FEATURES INCLUDING THE SERVICE LOCATIONS SHOWN ARE APPROXIMATE ONLY. THIS PLAN MUST NOT BE USED FOR LOCATING SERVICES PRIOR TO INTRUSIVE WORKS.

4 0 4 8 12 16 20
DIMENSIONS ARE IN METRES
1:200 (A1)
1:400 (A3)

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DATUM		SURVEY	

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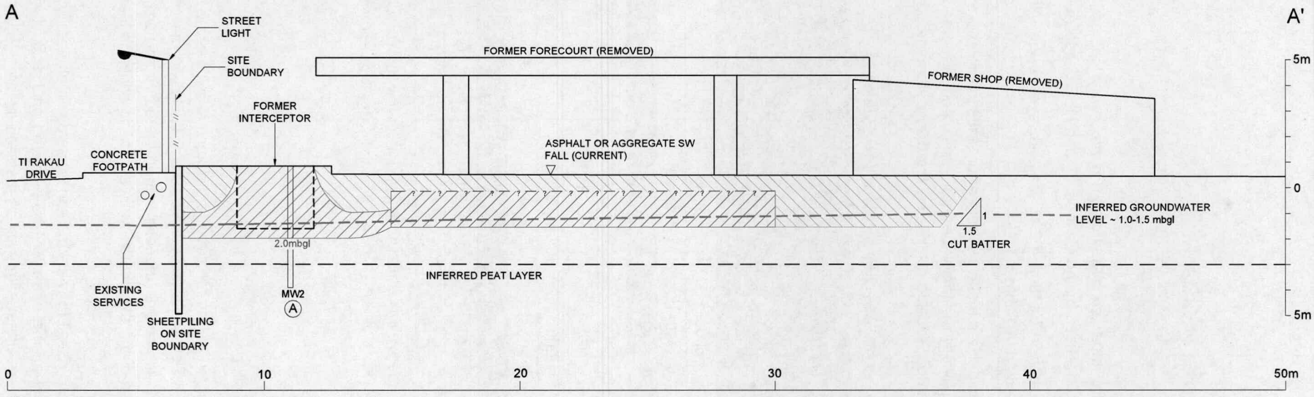
60435537

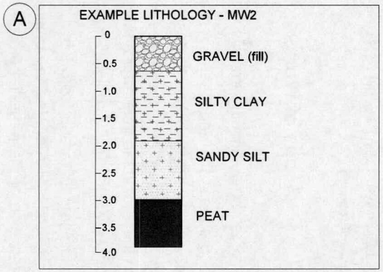
SHEET TITLE
PRE-EXISTING SITE CONDITIONS

SHEET NUMBER
FIGURE C-003

ISO A1 594mm x 841mm

CROSS SECTION A - A'





KEY	
	INVESTIGATE SOIL QUALITY DURING EXCAVATION AND POTENTIALLY REMOVE
	DISPENSER AREA – REMOVE TO ~1.5mbgl
	INTERCEPTOR AREA – REMOVE TO ~2.0mbgl

ALL DIMENSIONS AND FEATURES INCLUDING THE SERVICE LOCATIONS SHOWN ARE APPROXIMATE ONLY. THIS PLAN MUST NOT BE USED FOR LOCATING SERVICES PRIOR TO INTRUSIVE WORKS.

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I/R	DATE	DESCRIPTION
1	18/02/2016	FINAL

PROJECT NUMBER
60435537

SHEET TITLE
CROSS SECTION A-A'

SHEET NUMBER
FIGURE C-004

4.0 Proposed Remedial Works

4.1 Remedial Goal

The remedial goal is to remove soils impacted by petroleum hydrocarbon compounds from the Site which exceed C&I land-use criteria as defined by the Oil Industry and NES Guidelines.

Validation sample results (as described in Section 4.2.4) shall not exceed the Oil Industry or NES Guidelines for C&I land-use as presented in **Table 4-1.**

It is noted that the MfE and NES Guidelines make allowance for statistical review of robust data sets and that where a small number of validation samples be found to exceed the remedial criteria; use of statistical analysis and risk assessment techniques will be used to determine whether the Site is suitable for C&I land-use.

Table 4-1 MfE 1999 (rev 2011) Guidelines and NES Regulations 2011 for a C&I Land-use Scenario

Contaminant of Concern	MfE 1999 Guideline (rev 2011) C&I Guideline Value (mg/kg) for SANDY SILT[1]		NES Guideline Residential (mg/lkg)[2]
	Surface (<1m)	1m-4m	
TPH			
TPH C_7 to C_9	500	500	-
TPH C_{10} to C_{14}[3]	1,700	2,200	-
BTEX			
Benzene	3.6	7.2	-
Toluene	270	480	-
Ethylbenzene	200	300	-
Xylenes	200	420	-
PAHs			
Naphthalene	210	270	-
Benzo(a)pyrene (eq)	-	-	35

Note: 1) Guideline values taken from Tables 4.11 and 4.14 of the MfE 1999 Guidelines (rev 2011) for a sandy silt soil type. 2) Value taken from Table B3 of the NES Guidelines. 3) TPH C_{10} to C_{14} is a screening criteria to prompt additional PAH surrogate analysis if required.

4.2 Scope of Works

4.2.1 Remediation Strategy

It is proposed that the clean overburden will be removed to stockpile to expose the contaminated soil that will be removed and disposed off-site at a licensed landfill. Stockpiled material that has been analysed to confirm it meets acceptance criteria together with imported virgin hard fill will be placed into the excavated void after analysis of the excavation walls and base confirms that the retained soil meets acceptance criteria.

To facilitate this work, top 0.5 to 1.0 m of soil (gavels and sands) across the majority of the excavation as well as soil removed to construct a safe batter will be removed and stockpiled for re-use upon completion of the remedial excavation. Sheet piling will be installed inside Site boundary fronting Ti

Rakau Drive to allow vertical excavation at the boundary and protect the services in the road berm. Soils stockpiled on site for re-use are limited to those materials that will be confirmed through analysis, as meeting the acceptance criteria.

The generous site area allows access into and within the Site will allow the excavation works to be completed in a single phase of works. Stockpiled soils will be returned to the void together with imported hardfill and compacted using available plant (machine excavators and roller) to achieve a finished surface of compacted aggregate that is within 200mm of the pre-existing surface. A compaction standard has not been specified. The excavated and backfilled void will be surveyed and a plan showing the extent of excavation provided in the site validation report.

4.2.2 Excavation and Disposal

The scope of works involves the physical excavation of impacted soil materials in and around the historical fuel dispensers and stormwater interceptor locations.

The volumes of the contaminated soils to be removed and overburden to be returned to the void are stated in 1.3 above.

It is likely that impacted soil materials will be disposed at Hampton Downs or Redvale Landfills in Auckland. Less impacted soils ware envisaged to be disposed as manage fill at Greenmount Landfill. AECOM will liaise with the facility selected to provide the soil contaminant levels to confirm acceptance by the landfill. Dockets for all soil disposed to landfill from the Site must be retained by the Contractor engaged to undertake remedial works and provided to AECOM upon completion of the remedial works and copies provided in the site validation report.

In general, potentially impacted soil materials will be loaded directly onto sealed truck units for cartage and disposal. However, where soil is marginal, these soils will be stockpiled and covered and analysed for potential re-use if the soil acceptance criteria are met.

It is proposed that approximately 600 m^3 of soil within the remedial excavations be retained for re-use on-site.This soil will be excavated and stockpiled on-site.

Groundwater monitoring at the Site indicates that groundwater levels range between 1.2 to 1.4 m bgl (November 2011) and 1.5 to 2.1 (May 2014). It is considered likely that a stable groundwater level of approximately 1.5 m bgl during the summer months anticipated to be likely during the period of excavation works. Groundwater ingress is expected to be slow due to the silty nature of the soils. Any groundwater removed off-site will be disposed to a licensed contaminated water treatment facility.

The maximum proposed vertical extent of the excavation will be 2.5 m bgl. This depth will only be encountered within frontage to Ti Rakau Drive, associated with the former interceptor and remaining stormwater chambers. The remainder of the excavation will be approximately 1.5 m bgl.

The contaminated soil removal and safe excavation batters of 1 vertical to 1.5 horizontal is expected to be wholly within the property boundaries of the Site. However, the excavation fronting Ti Rakau Drive boundary has the deepest proposed excavation that is likely to be below the ground water level. Therefore, sheet piling suitable to retention of up to 3.0m will be installed over 30 m along this boundary and extended along Ti Rakau Drive to accommodate removal of the ancillary stormwater network. See **Figure C005** and **Figure C006** for the extent of excavations and sheet-piling.

Other excavation batters are sufficiently distant to the Site boundaries and typically terminate at the ground water level to avoid the need to provide protection to batters in excess of the proposed 1v:1.5h batter.

It is noted that all above and below ground structures associated with Chevrons business undertakings have been removed from the Site. An electrical supply box and live cable remain in place at the northern corner of the Site however this is not expected to pose a restriction on the intended remedial excavation works.

Vehicle ingress into the Site is proposed from Ti Rakau Drive from the west and egress from the Site is also into Ti Rakau Drive to the east. The central raised median on Ti Rakau Drive ensures the trucks use left-in and left-out turns are not able to cross the central road carriageway. As detailed in **Figure C006**, the ingress and egress be sufficient to allow general unfettered truck and trailer movement within the Site during the intended work.

4.2.3 Backfill Materials

Upon completion of the excavation, the void will be backfilled with stockpiled soil sourced from Site (that has been tested to confirm it meets C&I land-use acceptance criteria), and imported virgin quarry aggregate topped with 100mm of clean crushed road aggregate. AECOM will undertake validation sampling of the stockpiled material prior to using as backfill. Dockets and receipts detailing the source and volume of the imported quarry aggregate will be retained by the Contractor engaged to undertake remedial works and provided to AECOM upon completion of the remedial works for inclusion in the validation report.

The base of the excavation may be below the groundwater table at the frontage of Ti Rakau Drive. Open graded aggregate wrapped in filter fabric will be placed in the void that is below the water table as such aggregate does not require compaction. Once analysis of the validation samples shows that no further soil is required to be removed, filter cloth will be placed over the open graded aggregate and the validated stockpiled soil returned to the void.

The stockpiled soils will be sampled and analysed and where they meet the C&I land-use acceptance criteria will be re-used within the excavation. The top 100mm of replacement fill will be erosion resistant imported hard-fill to the expected subgrade level (200mm below existing ground levels), to allow pavement construction for future use of the Site. As the designs for the development of the Site are unknown, applying a sealed surface that may be removed at a later date is considered un-necessary. The clean aggregate subgrade will provide a clean surface for trucks to traffic on and prevent silt generation. Surface water from the remediated site will be directed to existing storm water structures that exist on site

It is not anticipated that topsoil materials will be imported to the Site as part of the remedial works.

In the unlikely event that soil materials are required to be imported to the Site this material must meet the definition of 'cleanfill' as defined by the MfE Guideline[8].

Should any soil material (not virgin granular material) be imported to the Site as part of the proposed earthworks, AECOM will undertake validation sampling of such material at a rate of one sample per 250 m^3 of soil to confirm that soils meet C&I acceptance criteria. Importation of such material is however not anticipated.

Granular backfill will be compacted in layers not exceeding 200mm thick using machine mounted rollers and excavation plant.

A plan indicating the extent of final excavation will be provided to the Council to place on the property file defining the extent of fill material. The completed back-fill will suitable to trafficking without

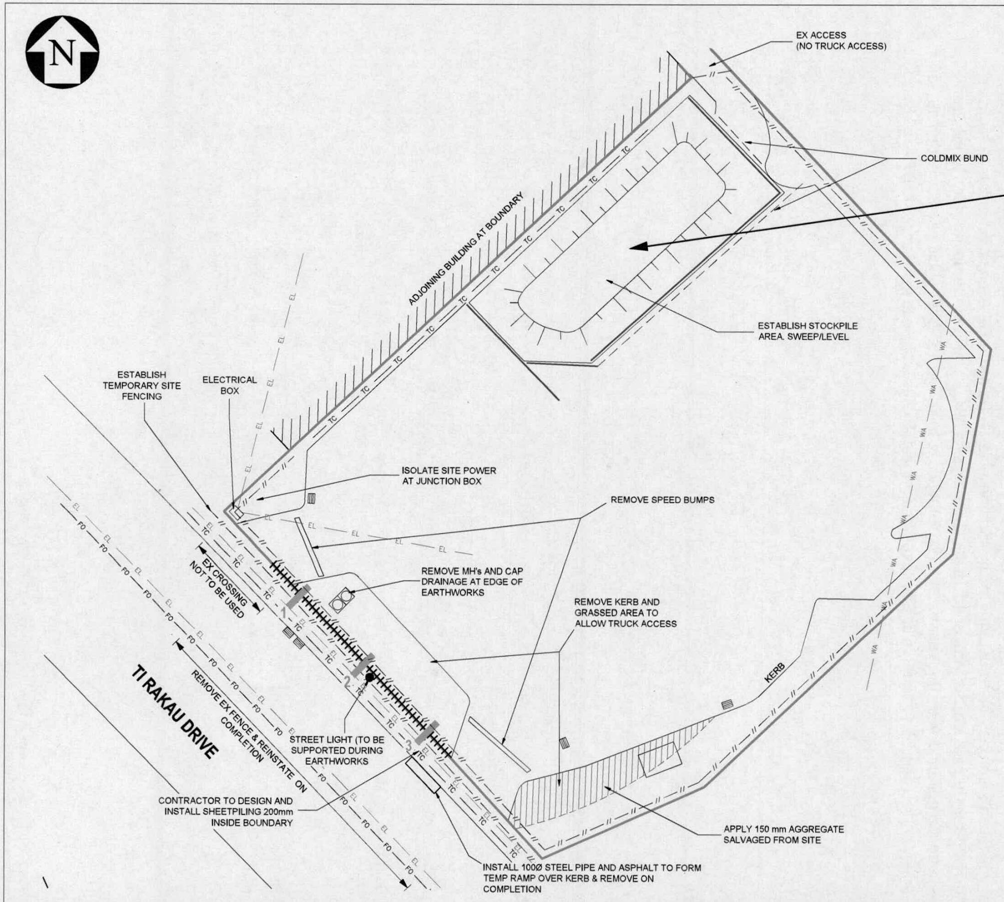
[8] Ministry for the Environment (MfE), 2002. A Guide to the Management of Cleanfills.

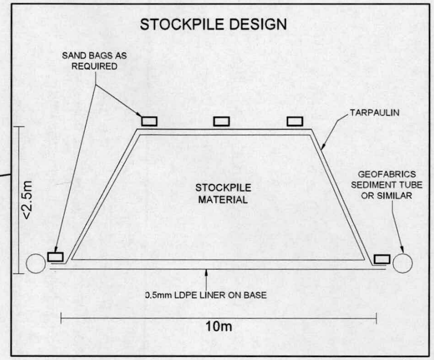
excessive settlement and it is expected that any C&I construction on the Site would require specific geotechnical investigations and specific design for the C&I structure.

4.2.4 Validation Sampling

At the completion of excavation activities and prior to backfill, validation samples will be collected from the sidewalls and base of the remedial excavation and analysed for TPH and BTEX. As the base of the excavation may be below the groundwater table at the Ti Rakau Drive frontage, soil samples will be collected for validation from the walls of the excavation immediately above the groundwater table.

Additional PAH surrogate analysis will be undertaken on soil samples in the event that the reported concentrations of TPH C_{10}-C_{14} exceed the respective 'all pathways' MfE Guideline value. The number of validation samples will be determined by the final size of the remedial excavation, but is likely to be 40 (Number) based on the proposed excavation dimensions. The final sampling density will be in general compliance with the recommended sampling density in the MfE publication: Contaminated Land Management Guideline No.5: Site Investigation and Analysis of Soils (revised 2011).





KEY	
	SITE BOUNDARY
	SUMP
	SECURITY FENCE
	SHEET PILING
	SILT CONTROL
	SAW CUT & REMOVE CONCRETE PATH FOR HYDROEXCAVATED SLOT TRENCHES TO CONFIRM SERVICE LOCATIONS

ALL DIMENSIONS AND FEATURES INCLUDING THE SERVICE LOCATIONS SHOWN ARE APPROXIMATE ONLY. THIS PLAN MUST NOT BE USED FOR LOCATING SERVICES PRIOR TO INTRUSIVE WORKS.

4 0 4 8 12 16 20
DIMENSIONS ARE IN METRES
1:200 (A1)
1:400 (A3)

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PROJECT NUMBER
60435537

SHEET TITLE
PRELIMINARY WORKS

SHEET NUMBER
FIGURE C-005

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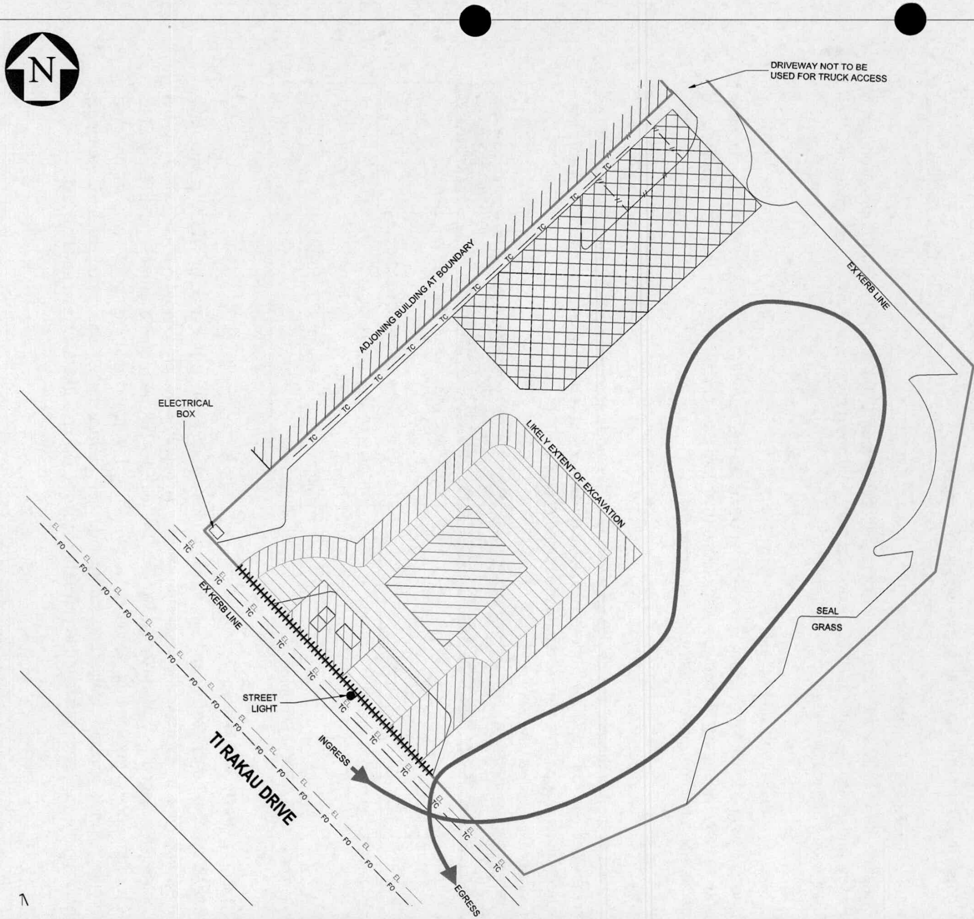
ISO A1 594mm x 841mm



NOTE:
1. VERTICAL EXTENT OF EXCAVATION IN FORECOURT AREA BETWEEN 1.2 AND 2.5mbgl REQUIRES INSPECTION
2. INSPECTION OF SOILS UNDER FORMER SHOP REQUIRED TO DETERMINE LATERAL EXTENT OF EXCAVATION
3. INSPECTIONS OF SOILS IN WESTERN CORNER REQUIRED TO DETERMINE LATERAL EXTENT OF EXCAVATION
4. WATER MAIN IN ROAD BERM NOT SHOWN
5. CONTRACTOR TO DRIVE VEHICLES ON CLEAN AGGREGATE OR ASPHALT SURFACE ONLY

KEY	
	SITE BOUNDARY
	PROPOSED SHEETPILING
— // — // —	FENCE
	DISPENSER AREA REMOVE TO ~1.5 mbgl
	INTERCEPTOR AREA REMOVE TO ~2.0 mbgl
	INVESTIGATE SOIL QUALITY DURING EXCAVATION AND POTENTIALLY REMOVE
	POTENTIAL 1:1.5 BATTER EXTENT
	STOCKPILE LOCATION
— EL —	BURIED POWER LINE
— TC —	TELECOM
— FO —	FIBRE OPTIC
	TRUCK ROUTE

ALL DIMENSIONS AND FEATURES INCLUDING THE SERVICE LOCATIONS SHOWN ARE APPROXIMATE ONLY. THIS PLAN MUST NOT BE USED FOR LOCATING SERVICES PRIOR TO INTRUSIVE WORKS.

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DIMENSIONS ARE IN METRES
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PROJECT NUMBER
60435537

SHEET TITLE
REMEDIAL WORKS

SHEET NUMBER
FIGURE C-006

5.0 Remedial Action Plan

5.1 Site Management Procedures

The following site management procedures have been developed to ensure that potential effects to human health and the environment are minimised or mitigated during the proposed short-term remedial works. An assessment of effects on the environment with associated mitigation measures is presented in Section 6.

5.1.1 Timing and Duration of Works

The remedial works are scheduled to be undertaken between March and June 2016. The remedial works are expected to take four to five weeks to complete.

5.1.2 Hours of Operation

Construction activities will be limited to the period between 0700 hours to 1800 hours Monday to Friday and possibly 0800 to 1600 hours Saturday. Construction work will not be undertaken on Sundays or public holidays.

5.1.3 Site Security and Access

The Site will be fenced with 1.8m high mesh fence during the remedial works with appropriate signage and security clearance procedures implemented at the Site entrances such that no unauthorised personnel will be permitted on-site. Refer **Table 5-1.**

5.1.4 Site Supervision

The excavation of the soil and day-to-day running of the redevelopment works by the contractor will be supervised by an AECOM representative experienced in remediation processes. **Table 5-1** summarises responsible parties during the remedial works.

Table 5-1 Remedial Works Responsible Parties

Responsible Parties	
Principal	Chevron Environmental Management Company Jon Payne Mobile and After Hours: 021 242 6913
Engineers Representative	AECOM New Zealand Limited Richard Coombe Mobile and After Hours: 029 355 1318
Contractor and AECOM Site Supervisor	TBC

5.1.5 Health and Safety

A task specific health, safety and environment plan (HSEP) will be prepared by AECOM who have been engaged to oversee the remedial works. A separate HSEP will also be prepared by the contractor engaged to undertake the works. The HSEPs will be required to be signed off by EMC (Chevron) prior to the commencement of works. All staff engaged in the remedial works will be taken through a task specific health and safety induction. Daily health and safety toolbox meetings, including a review and update of the HSEP (if required), will be undertaken and documented.

All parties working on the Site shall comply with:

- Applicable parts of their company Health and Safety Policy.
- The project HSEP.
- Any requirements of the Occupational Safety and Health Service of the Department of Labour.
- The Health and Safety in Employment Act 1992 and Regulations.
- The Health and Safety in Employment Regulations 1995.
- Any other applicable legislation, regulations, codes and guidelines.
- **Table 5-2** summarises health and safety emergency contacts for the project.

Table 5-2 Health and Safety Emergency Contacts

Emergency Numbers	
Emergency Police, Fire, Ambulance	111
Health Centre	Pakuranga Medical Centre 17 William Roberts Rd Pakuranga Phone: 09 950 7351
Accident and Emergency Clinic	Middlemore Hospital 100 Hospital Road Papatoetoe Phone: 09 276 0000
Occupational Safety and Health	0800 20 90 20
Underground Services	Power: Vector – 0508 832 867 Gas: Vector – 0800 764 764 Fibre: Vector – 0800 826 436 Telecommunications: Chorus – 0800 600 100 Water: Watercare – 09 442 2222
Environmental Emergency	Auckland Council – 09 301 0101

5.1.6 Site Services

The UPSS has been fully decommissioned with all USTs and pipework removed from the Site in May 2010 (refer Section 2.1).

The Contractor engaged to undertake remedial works will locate all services i.e. power, telephone, gas, stormwater and wastewater on the Site and will take appropriate measures to identify and protect these services from the remedial works. It is expected that power, telephone, gas and water are already removed from the Site. This will be confirmed by the contractor prior to commencement of excavations on site.

Buried utilities on the Ti Rakau Drive frontage will be located with "Hydrovac" techniques prior to installation of sheet piling and excavation. The concrete footpath in these locations will be cut and replaced to meet Council specifications and road opening notices obtained by the Contractor for that work.

Existing sewer and stormwater services to the Site will be located and capped off at the excavation extent during the excavation. Any other services to the Site will be located and protected. Services outside the property boundary are not expected to be affected.

The underground fuel storage tanks were previously removed along with most fuel supply lines. Any remaining services associated with the fuel bowsers that are encountered during excavations will be removed and disposed at a licensed landfill.

5.1.7 Excavation and Disposal

AECOM environmental specialists will be on site to identify contaminated soils and direct the contractor to stockpile soils considered as meeting C&I classification or remove contaminated soils. The excavation will commence at the known hot spots and extend outward from that starting point.

The stockpile area wil be prepared by utilising existing hardstand areas – or where aggregate or grassed areas exist – these will be covered with 0.5mm thich HDPE. The perimeter of the stockpile are will be lined with silt filtering "sausages" on the low wide and asphalt bunds on the high side.

Trucks will enter the site off Ti Rakau Drive directly into the site and there is sufficient room on site to allow the trucks to turn and exit the site without backing. Trucks will stop on hard stand areas next to the excavation to allow the excavator to load directly to the trucks. Soils considered suitable for stockpiling and validation prior to re-use – may be moved to the stockpile are by small trucks prior to sampling and covering with tarpaulins.

Excavation will continue until the AECOM environmental engineer considers the soils exceeding compliance criteria is removed, whereupon samples of the excavation wall will be taken for analysis and confirmation that the validation requirements are met. The excavation will remain open pending confirmation of validation, and prior to backfill.

Trucks containing contaminated spoils will have leak proof tailgates and will be covered prior to transport of the contaminated soils to landfill.

5.1.8 Decontamination of Equipment and Personnel

Decontamination of personnel and equipment must be carried out to reduce safety, health and environmental risks and limit the potential migration of contaminants (from waste material, soil, equipment and protective personal equipment) around and outside the Site. The following steps will be taken for decontamination of all personnel and equipment:

- All earthmoving equipment will be restricted to concrete and/or asphalt surfaces where practicable and where these surfaces are removed – clean road aggregate will be installed as truck route surfacing.
- At the completion of the earthworks the earthmoving equipment will be decontaminated. This will consist of the removal of loose soil and dust from parts that have been in contact with contaminated soil or groundwater by wiping down and/or scraping as appropriate.
- All personnel involved in remedial works will complete decontamination procedures whenever they leave the Site, including:

  — Removal of disposable gloves and placing in a plastic bag or drum.
  — Thoroughly washing hands and face.
  — Removal of boots and overalls.

6.0 Assessment of Environmental Effects

6.1 Risk to Human Health

Petroleum hydrocarbons can present a potential health risk to personnel involved in the removal of hydrocarbon impacted soils and to future users of the land.

The proposed works will be undertaken in accordance with current industry best practice guidelines. Chevron's accredited contractors will undertake the works and are familiar with these requirements. The potential effects to human health during the proposed works are considered to be minor and temporary, and can be mitigated by compliance with relevant legislation and industry guidelines.

Soil sampling will be undertaken in accordance with Module 3 of the Oil Industry Guidelines, and will include benchmarking of remaining natural soil, soil removed from Site, material returned to the excavations and imported fill used at the Site. Analytical results will be compared to the applicable assessment criteria (refer Section 4.1) to determine if the soil meets the standard for a future C&I land-use or if further investigation or remedial works are required to be implemented or management methods required, to address the potential risks posed by hydrocarbon impacted soils.

Fill imported to site to backfill excavated voids will comprise clean/uncontaminated materials. The source of backfill materials and the volume imported will be documented. It is proposed that imported fill will be virgin quarry rock of varying grades that will not require testing to assess contaminant levels due to the virgin nature of the fill. The completed surface over the areas of the excavation will be surfaced with a minimum of 200mm depth of roading grade aggregate.

The results of the soil benchmarking work will be documented by URS in a Site Validation Report in accordance with Contaminated Land Management Guideline No. 1 – Reporting on Contaminated Sites in New Zealand (MfE, revised 2011). The report will be supplied to Auckland Council within three months of completion of the remedial works.

As the Site will be remediated to C&I guideline values, there will be no significant long term risk posed by hydrocarbon contaminants in soil to the health of future occupants of the Site under C&I land-use and therefore the effects of ongoing C&I land-use are less than minor.

6.2 Transportation, Disposal & Tracking of Soil and other Materials

The contractor will implement appropriate traffic management during the works, in accordance with industry best practice.

The potential for contaminated soil to be carried off-site on wheels of vehicles will be minimised by restricting vehicle movements to sealed or aggregate surfaced areas on the Site. Vehicles wheels will be inspected prior to the vehicles leaving the Site and any spillage removed from these surfaces prior to movement of the vehicle. Truck trays containing contaminated soils will be covered.

Contaminated natural soils and bedding material removed from the Site will be transported by truck to a waste disposal facility authorised to receive the soil. The location of the waste disposal facility is likely to be either Hampton Downs or Redvale Landfills in Auckland. Less impacted materials will be disposed of at Greenmount Landfill due to relatively close proximity to the Site.

Landfill receipts will be supplied to Auckland Council within the Soil Validation Report (refer Section 6.1).

6.3 Transportation Route to the Landfill and Truck Movements

The route to and from the Auckland landfills will be via SH1, to north (Redvale) and south (Hampton Downs). The route to Greenmount Landfill is via Ti Rakau Drive and Harris Rd, approximately 6km from the Site.

Entry to the Site will be left off Ti Rakau Drive from the north west and once filled; trucks will turn left into Ti Rakau Drive traveling south east.

It is expected that truck and trailer units will be used to transport contaminated soils off-site and to import hardfill. The likely number of loads of soil requiring removal is around 85 and around 80 for imported hardfill over the expected excavation and fill works of 3 weeks. The total truck loads to and from the Site are therefore expected to be around 165 (in and out of the Site). This equates to around 14 loads per day .

The effects in relation to transportation, disposal and tracking of soil and other materials on the environment are considered to be less than minor.

6.4 Erosion & Sediment Control

During the remedial works, the Contractor will undertake all necessary measures to prevent sediment runoff. Erosion and sediment control measures will be implemented in accordance with the Auckland Council Technical Publication 90 – Erosion and Sediment Control (TP90)[9].

As the excavation of the soil is in a pit, any sediment relating to the excavation will remain in the excavation and as such no additional erosion controls are required in that area.

Where practical; excavated soil to be removed from Site will be loaded directly onto trucks. However, it is proposed that the clean overburden will be stockpiled on Site for sampling, analysis and verification that it meets the MfE 1999 Guidelines for C&I land-use. This will allow this soil to be replaced and compacted back into the excavation void. The proposed location for the stockpiles is the sealed surface in the southeast corner of the Site; see **Figure C005**.

To effectively contain stockpiled material within the Site, a temporary sediment tube / cold-mix asphalt bund will be constructed underlined by tarpaulins or PE sheeting. Water flowing from the stockpile will be directed to the excavation. In the event of rainfall, the stockpile will be covered with PE to prevent sediment run off and also prevent the soils becoming overly wet.

The contractor will be required to immediately remove any soil that may fall onto the trafficked surface prior to the truck driving off to ensure that soil is not trafficked off-site.

Excess groundwater encountered during the remedial works and any SPH will be removed and disposed of at an approved licensed liquid waste disposal facility.

The effects in relation to erosion and sediment control are therefore considered to be less than minor.

[9] Auckland Regional Council – Technical Publication No.90 - Erosion and Sediment Control. March 1999.

6.5 Air Quality Management – Odour and Dust

It is possible that dust and odour may be generated by the excavation and handling of soil during the works.

The primary sources of potential odour are hydrocarbon vapours released from the walls and floors of open excavations and from soil stockpiles where potentially hydrocarbon impacted soil are exposed. If considered necessary, the following odour management procedures could be used:

- Wetting-down excavations or stockpiles.
- Covering any portion of the Site that is generating odour outside working hours.

Excavation and stockpiling of soils and on-site vehicle movements may generate dust. If required, the generation and impact of dust on the surrounding environment will be minimised by:

- Restriction of truck movements to sealed areas or aggregate surfaces.
- Immediate removal of any soil dropped onto trafficked areas.
- Suspending or limiting dust generating activities during periods of high wind.
- Using water on exposed soils to suppress dust, while ensuring that any water used is not allowed to migrate directly off-site by the stormwater, sewer, or any other means.
- Covering areas of exposed soil with sheeting where necessary.
- Ensuring trucks transporting contaminated natural soils and/or bedding material from Site are covered and that vehicles are adequately cleaned.

Any dust and odour impacts that do occur are expected to be minor and temporary.

6.6 Noise

Noise may be generated by truck and trailer units used to transport impacted soil away from the Site and to import fill material to the Site. Working hours will be limited to those described in Section 5.1.

As the remedial works to do not include mechanical breaking or crushing of concrete; significant noise nuisance is not expected during the remedial works. Any noise generated during the remedial works will be temporary and for a short duration and will comply with the provisions of NZS 6803:1999 Acoustics; Construction Noise. These provisions are reflected in the PAUP, Part 3 section 6.2.

Table 6-1 Recommended upper limits for construction noise received in C&I zones

Time of week	LAeq(30 min)	LAFmax
Monday to Friday 6.30am to 10.30pm	80 dB	90 dB
Saturday 7am to 11pm	85 dB	90 dB
All other times (night time)	60 dB	75 dB

Noise effects will be within permitted limits and are therefore considered less than minor.

6.7 Vibration

Excavation works will partially front the property boundary along Ti Rakau Drive. Buildings on the northern boundary are fronted by C&I properties, envisaged to be at least 10m from the open excavation foot-print.

The use of mechanical excavators and the slow movement of the trucks being loaded on-site are not expected to produce significant vibrations although are expected to be felt by occupants of neighbouring properties to the north have but have no effect on the structures. It is noted that ingress

and egress are through the south eastern entrance of the Site to reduce vibration effects to the properties north of the Site. The speed bumps that existed for the petrol station will be removed prior to transportation of soils off site. A park with no structures present is located to the south.

Any compaction of hardfill with standard vibrating rollers will produce vibration that may also be felt by the neighbouring properties from time to time, but is expected to be minimal and have no effect on the structures. The contractor will monitor the effects of vibration on the neighbours. Where a concern is raised the compaction plant will be operated on "static" mode that does not require vibration. The fill layer thickness will therefore need to be modified to account for the reduced compactive effort in "static" mode.

The installation of sheet-piling is also expected to be felt by occupants of neighbouring properties to the north have but have no effect on the structures. Again, the contractor will monitor the effects on the neighbours and should the vibration cause problems, the time at which the sheet-piling is installed can be changed to minimise any disruption.

6.8 Surface Water

As noted in Section 2.2.3, the nearest surface water body to the Site is a small inlet located approximately 350 m south of the Site at the closest point. The inlet (part of the Pakuranga Creek) joins the Tamaki River approximately 400 m south of the Site.

The remedial works will be scheduled for a period of fine weather conditions during April and early May. The Contractor will ensure that surface water outside the excavation does not come into contact with potentially contaminated soil materials. Soil stockpiles will be covered during periods of any rainfall and surface water will be diverted away from the remedial excavations wherever possible through the utilisation of temporary bunding.

Should excessive rain flood the excavation, sucker trucks will be used to extract the accumulated water and remove this for treatment at an approved waste water treatment facility. Any water removal will have manifest and delivery dockets to ensure appropriate handling and disposal.

On completion of the works, site surface water will be directed to the retained stormwater catch-pit on southwestern corner of the site

Therefore, potential adverse effects on surface water are considered to be less than minor.

6.9 Groundwater

The shallow aquifer beneath the Site has been assessed as "not sensitive" in accordance with the MfE 1999 Guidelines. The immediate occupancy to the north is commercial with residential dwellings to on the opposite side of Ti Rakau Drive both of which are connected to treated, reticulated water supply.

Groundwater quality and hydrogeology suggest impacts to groundwater underlying the Site are generally restricted to within the Site boundary. Overall, it is considered that the removal of the source of potential contamination will have a positive effect on groundwater quality at the Site in the long-term.

6.10 Consideration of Alternatives

Section 105(1)(c) of the RMA states that a consent authority must have regard to any possible alternative methods of discharge, including discharge into any other receiving environment.

In addition to remediation by excavation to meet C&I land-use criteria, the following options were considered for this Site:

- No Active Works:
  - — Management of groundwater contamination through Monitored Natural Attenuation (MNA)
  - — Preparation/implementation of Site Management Plan.
  - — Ongoing groundwater monitoring to demonstrate Natural Attenuation.
  - — Application for discharge consent from Auckland Council.
- Excavate and ex-situ remediation:
  - — Remediation within Site legal boundaries via excavation with on-site treatment in windrows (placed in the eastern half of site) to meet C&I land-use criteria enabling C&I land-use.
  - — Replacement of decontaminated excavation materials returned to the excavation void.
  - — Ongoing groundwater monitoring to demonstrate Natural Attenuation of off-site discharge.
  - — Application for discharge consent from Auckland Council.
- In-situ Remediation Techniques:
  - — Remediation via in-situ remediation techniques such as skimmers, multi and dual phase extraction systems, pumping and treating, bio and/or air sparging. Site suitable for C&I land use, no site management plan required. Passive discharge consent will be required to address groundwater contamination.

Overall, excavation and off-site disposal of contaminated soils to meet C&I land-use criteria was considered to be the most appropriate form of remedial method for this site. The following reasons are provided:

- Excavation is the quickest method of remediation.
- Excavation provides the most reliable long-term solution for minimising risks to future users and the environment.
- The removal of impacted materials from the Site has the potential to improve groundwater conditions at the Site through the removal of the source of contamination.
- The Site is no longer owned by Chevron with a short window to allow excavation to be undertaken prior to Site redevelopment.
- Certainty of required remediation.

7.0 Summary of Statutory Requirements

7.1 Statutory Requirements

7.2 Statutory Requirements

The statutory requirements relevant to the resource consent application detailed herein are summarised below. **Table 7-1** summaries the requirements for consent under the NES. **Table 7-2** summarises the local and regional level statutory requirements.

Authorisation is sought from Auckland Council (AC) to undertake earthworks under the Operative Auckland Council District Plan (Manukau Section) 2002, Operative Auckland Regional Council Plan (Air Land Water) and the Proposed Auckland Unitary Plan. The respective sections of the above Plans are detailed and considered in **Table 7-2**.

Table 7-1 Summary of National Environmental Standards Requirements

Act/Section of Acts and Plan	Assessment	Compliance/Comments
National Environmental Standards (NES)		
Regulation 3 Interpretation- Hazardous Activities and Industries List (HAIL)	NES requirements are considered to apply to a piece of land where an activity or industry described in the HAIL is taking place, has taken place or is considered likely to have taken place.	The Site is a former service station and is therefore considered to be a hazardous activity/industry under the HAIL. The soil on-site will be disturbed during the remediation of the property and the Site is not subject to the Resource Management (National Environmental Standard for Electricity Transmission) and therefore the NES for Assessing and Managing Contaminants in Soil to Protect Human Health applies.
Regulation 5(4) Application -Disturbing Soil	Regulation 5 sets out the activities to which the NES applies. Regulation 5(4) identifies disturbance of contaminated soil as an activity to which the NES applies. This regulation sets out exclusions to applicability – if the land is subject to regulation 33(9) or 36 of the Resource management (National Environmental Standard for Electricity Transmission Activities) Regulations) the NES for Assessing and Managing Contaminants in Soil to Protect Human Health do not apply.	
Regulation 8(2) Permitted Activity - Soil Sampling	Regulation 8(2) sets out the requirements that must be met in order for the soil sampling to be a permitted activity.	The activity of soil sampling is also regulated by the NES for contaminants in soil. Soil sampling may be undertaken in advance of and during the proposed works, in order to characterise the soil and plan the excavation process. All sampling will be undertaken in accordance with the permitted activity provisions of the NES for contaminants in soil (Regulation 8(2))

Act/Section of Acts and Plan	Assessment	Compliance/Comments
		which requires that controls be put in place to minimise exposure of personnel to contaminants, that soil be reinstated to an erosion-resistant state and not taken away from the Site except as samples for the purposes of laboratory analysis.
Regulation 8(3) Permitted Activity - Disturbing Soil	Regulation 8(3) sets out the requirements that must be met in order for the soil disturbance to be a permitted activity.	It is considered that the soil disturbance and soil removal required for the works will exceed the permitted activity threshold of 25 m^3 (disturbance) and 5m^3 (removal) per 500 m^2 of land per year, respectively. Therefore, resource consent will be required under the NES.
Regulation 10(3) Restricted Discretionary Activities	An application can be assessed as a restricted discretionary activity under regulation 10 if it does not meet the requirements of a permitted activity, and if a detailed soil investigation shows the soil contamination exceeds the applicable standard for the current or intended land-use. Resource consent is required to either remediate the Site to an acceptable level or manage the land to prevent exposure of people to the contaminants.	A number of soil and groundwater investigations have been completed at the Site (refer section 2). Concentrations of soil contaminants that exceed the NES Soil contaminant standards for a C&I land-use were recorded in the vicinity of the historical tank locations in the northern portion of the Site and beneath the historical dispenser's locations. As excavation of these soils is proposed to remediate the Site, a resource consent as a restricted discretionary activity is required. As a restricted discretionary activity council has discretion over the following issues when assessing and granting the application: • Adequacy of detailed site investigation • Suitability of the land for the proposed activity • Approach to remediation • Adequacy of the Site validation plan. • Tracking, transport and disposal of soil. • The requirement for and conditions of a financial bond. • Timing and nature of the review of the conditions in the resource consent. • The duration of the resource consent.

Table 7-2 Summary of Territorial Statutory Requirements

Plan Rule	Assessment	Activity Status
Operative Auckland Council District Plan (Manukau Section) 2002		
9.8.2 - Earthworks	Land modification or development involving less than 200m³ of earthworks in respect of any site is a Permitted Activity.	Proposed earthworks will exceed the permitted volume (1,500 m³) Restricted Discretionary Activity
5.18.3.6 - Construction noise	NZ Standard 6803:1999 Acoustics – Construction Noise *"Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work"*	The proposed works are expected to comply with the recommended limits within this Rule. Permitted Activity
Operative Auckland Regional Council Plan (Air Land Water)		
5.5.44 - Sites Undergoing Land Disturbance or Remediation above Permitted Activity Levels	The discharge of contaminants to land or water from land containing elevated levels of contaminants that is undergoing remediation or land disturbance that does not meet the standards, terms or conditions of Rules 5.5.40, 5.5.42(b) or 5.5.42A is a Controlled Activity, subject to the following standards and terms: (a) An (Intrusive) Site Investigation Report (SIR) shall be provided to the Council; and (b) A Remediation Action Plan (RAP) shall be provided to the Council.	Hydrocarbon concentrations in soil are above MfE guidelines. Groundwater above ANZECC. Expected SPH in isolated area of the Site. Controlled Activity
Proposed Auckland Unitary Plan		
3H.4.5.2.2.2 – Contaminated Land	Discharges of contaminants from land not meeting the permitted activity controls in clause 2.1.1 or 2.1.3.	Hydrocarbon concentrations in soil are above MfE guidelines. Groundwater above ANZECC. Expected SPH in isolated area of the Site. Controlled Activity
3H.4.2.1.1 - Earthworks (Zones)	General earthworks up to 1,000m² and 1,000m³ in the Town Centre zone is a Permitted Activity.	Proposed earthworks will

		exceed the permitted volume/area (approximately 1,500 m^3/ 650 m^2) Restricted Discretionary Activity

In summary, resource consent is required as a **Restricted Discretionary Activity** under the NES Soil Contamination rules and in relation to earthworks and contaminated land under the Operative District Plan, Auckland Council Regional Plan (Air Land Water) and Proposed Auckland Unitary Plan.

Relevant assessment criteria to consider in relation to the above are summarised in **Table 7-3** below.

Table 7-3 Summary of Territorial Statutory Requirements

Plan Rule	Matters of Control / Discretion	Assessment Criteria
Operative Auckland Council District Plan (Manukau Section) 2002		
9.8.2 - Earthworks	Clause 9.11.1(b) *Matters over which the Council has restricted its discretion…* • *Alteration to Natural Landscape* • *Sedimentation* • *Runoff* • *Slope and Land Stability* • *Vegetation including Riparian Vegetation* • *Noise and Dust* • *Duration, Timing and Staging* • *Traffic Generation and Routes* • *Flooding* • *Utility Services* • *Heritage* • *Contamination*	Clause 9.12.6 *(a) Alteration to Natural Landscape* *The extent to which any earth cut or fill will remove existing vegetation, alter the existing topography of the site, or affect existing natural features including land forms. The extent to which the area's existing amenity values will be altered. Such effects may be adverse or beneficial or a combination of both. Whether the work is necessary to establish an adequate and stable building platform and private open space.* *(b) Sedimentation* *The proximity of the proposed earthworks to any water body, and the extent to which sedimentation controls or control systems will minimise adverse effects on receiving waters.* *(c) Runoff* *The extent to which measures to control the path of runoff from surrounding land mitigate against the discharge of sediment from the site. The extent to which the Earthworks will result in an increase or decrease in flood hazards and the extent on impacts of such effects.* *(d) Slope and Land Stability* *The extent to which the effects from natural hazards will be avoided or mitigated and the extent or impacts of such effects; the extent to which earthworks affect the stability and erosion potential of the site and surrounding area. The extent to which the earthworks compromise future proposed building and roading uses for the zone within which it is located.* *(e) Vegetation Including Riparian Vegetation* *The contribution made by the vegetation to the*

		ecological and amenity values of the area, including its visual impact from roads or other public land or from the sea or foreshore. The timing of revegetating bare earthworked surfaces; whether the removal of riparian vegetation is undertaken in such a manner as to prevent debris entering a watercourse; whether the proposed replacement riparian vegetation will enhance water quality and amenity values. *(f) Noise and Dust* *Whether the measures to mitigate potential noise and dust nuisance and detraction from visual amenity values of the area have been considered, and the extent or impacts of such effects.* *(g) Duration, Timing and Staging* *Whether the extent or impacts of adverse effects from earthworks activities can be mitigated by limiting the duration, season or staging of such works.* *(h) Traffic Generation and Routes* *Whether traffic generation will have adverse effects on the amenity values of areas or adverse effects on the carriageways of roads through which it is likely to pass.* *(i) Flooding* *Whether earthworks and final levels will adversely affect overland flowpaths or increase the potential for flooding within the site or surrounding area.* *(j) Utility Services* *Whether earthworks and final levels will adversely affect existing utility services.* *(k) Heritage* *Whether the earthworks would adversely affect any feature of historic or cultural importance.* *(l) Contamination* *Whether any contaminants are present or are likely to be present on the land.* *(m) Coastal protection yards* *Whether earthworks in coastal protection yards (where such yards are required in the relevant zone) will cause any adverse effects on the natural coastal environment, including adverse effects on ecological, cultural, spiritual, recreational and visual values of the natural coastal environment.*
Operative Auckland Regional Council Plan (Air Land Water)		
5.5.44 – Sites Undergoing Land Disturbance or Remediation above Permitted Activity Levels	Clause 5.5.44 *...Having regard to any relevant consents granted or required for the site from the relevant territorial authority:* *(i) Methods to avoid adverse effects*	None specified

	on potable water supplies; *(ii) Methods to control vapour migration;* *(iii) The adequacy and implementation of the RAP for the land;* *(iv) The preparation and implementation of a Site Validation Report (SVR) for the land. The SVR shall be prepared by the applicant in general accordance with Schedule 13 (A5) – Schedules for Reporting on Contaminated Land to a scale and degree of detail commensurate with the potential effects of the discharge and the contaminants concerned and the physical conditions of the land;* *(v) The duration of the consent; and* *(vi) The timing and nature of reviews of consent conditions.*	
Proposed Auckland Unitary Plan		
3H.4.5.2.2.2 – Contaminated Land	Clause 3H.4.5.3.1 *Council will restrict its control to the following matters:* *1.Discharges of contaminants from land* *a.adequacy of the detailed site investigation, including:* *i.site sampling.* *ii.laboratory analysis.* *iii.risk assessment.* *b.adequacy of a site management plan, if required.* *2.Discharges of contaminants from disturbance or remediation of land* *a.adequacy of the detailed site investigation, including:* *i.site sampling* *ii.laboratory analysis* *iii.risk assessment.* *b.adequacy of and implementation of the remedial action plan* *c.how the activity must be:* *i.managed, which may include the requirement of a site management plan and/or a site validation report* *ii.monitored* *iii.reported on* *d.the transport , disposal and tracking of soil and other materials*	None specified

	removed in the course of the activity *e.methods to avoid adverse effects on potable water supplies* *f.the timing and nature of the review of the conditions in the resource consent* *g.the duration of the resource consent.*	
3H.4.2.1.1 - Earthworks (Zones)	Clause 3H.4.2.3.1 *Council will restrict its discretion to the following matters as specified for the relevant activity below:* *1.General:* *a.avoiding adverse effects of disturbance and sedimentation on water bodies, public utilities, roads and other property* *b.the design and suitability of erosion and sediment control measures to be implemented during the works* *c.staging of works and progressive stabilisation* *d.timing and duration of works* *e.term of consent* *f.the control of vehicle movements and access to and from the site* *g.avoidance of potential public health and safety, and nuisance effects.* *h.the treatment of stockpiled materials on the site including requirements to remove material if it is not to be reused on the site* *i.the management of dust, noise and vibration* *j.avoiding adverse effects on overland flow paths and flooding* *k.avoiding or mitigating natural or manmade hazards* *l.protection of or provision of public utility services and roads* *m.land stability and geotechnical assessment* *n.potential effects on natural and historic heritage* *o.potential effects on the mauri of water* *p.landscape treatment, screening and site layout and design.*	Clause 3H.4.2.3.2 *When assessing an application for restricted discretionary activity consent, the council will consider whether the proposal will give effect to the assessment criteria provided below to determine the appropriateness of the proposal and options to avoid, remedy or mitigate potential adverse effects:* *a.the proximity of the proposed earthworks to any water body and the extent to which erosion and sediment controls and the proposed construction methodology will adequately avoid or minimise adverse effects on:* *i.water quality* *ii.ecological health* *iii.stream bank erosion* *iv.riparian margins* *v.the mauri of water* *vi.the quality of taiāpure or mahinga mātaitai.* *b.the extent to which the earthworks avoids or exacerbates flooding at the site or at any location upstream or downstream of the works* *c.the extent to which the earthworks avoids unnecessary soil compaction* *d.the extent to which the effects from natural hazards will be avoided or mitigated and the extent or impacts of such effects; the extent to which earthworks affect the stability and erosion potential of the site and surrounding area* *e.the extent to which the earthworks avoids the elevation of activities on raised ground levels, obscuring views from, visually dominating or overshadowing adjacent sites and neighbouring sites* *f.whether the measures to mitigate potential noise and dust nuisance and detraction from visual amenity values of the area have been considered, and the extent or impacts of such effects* *g.whether the extent or impacts of adverse effects from the earthworks can be mitigated by limiting the duration, season or staging of such works* *h.whether traffic generation will have adverse effects on the amenity values of areas, health and safety of road users or pedestrians, or adverse effects on the carriageways of roads through*

		which it is likely to pass *i.whether the earthworks and final ground levels will adversely affect overland flow paths or increase potential volume or frequency of flooding within the site or surrounding sites* *j.the extent to which potential adverse effects on the stability of the site and adjacent properties has been provided for* *k.whether the earthworks and final ground levels will adversely affect existing utility services* *l.the extent to which the area of the earthworks is minimised and is consistent with the scale of development being undertaken* *m.the extent to which the earthworks, its design, location and execution are proximate to and provide for the maintenance and protection of:* *i.protected trees* *ii.cliff faces/cliff tops* *iii.sites of geological or archaeological significance* *iv.scheduled sites and places of significance to Mana Whenua* *v.historic heritage sites* *vi.significant landscape features* *vii.reserves.* *n.the extent to which the earthworks is necessary to accommodate development otherwise permitted by the Unitary Plan, or to facilitate the appropriate use of land in the open space environment, including development proposed in a relevant operative reservomanagement plan or parks management plan* *o.whether monitoring the volume and concentration of sediment that may be discharged by the activity is appropriate within the scale of the proposed earthworks* *p.for earthworks near Transpower New Zealand Limited:* *i.the outcome of any consultation with Transpower New Zealand Limited* *ii.the risk to the structural integrity of transmission lines.* *q.the extent to which appropriate methods are used to prevent the spread of Total Control Plants or Unwanted Organisms, where these are present on the site.*

Where relevant to the proposed works, these matters have been discussed in Section 6.0 above.

7.3 Notification Assessment

Due to the environmental effects of the remedial works being less than minor it has been determined that public notification is not required in accordance with Section 95 A of the RMA.

All of the remedial works are to be contained within the boundaries of the Site and no parties are considered to be adversely affected by the proposal therefore it has also been determined that limited notification is not required under Section 95B of the RMA.

7.4 Determination as to Requirement for Consultation

Due to the environmental effects of the remedial works being less than minor it has been determined that public notification is not required in accordance with Section 95 A of the RMA.

All of the remedial works are to be contained within the boundaries of the Site and no parties are considered to be adversely affected by the proposal therefore it has also been determined that limited notification is not required under Section 95B of the RMA.

8.0 Proposed Resource Consent Conditions

The following conditions are proposed for the resource consent:

1. That the servants or agents of AC be permitted access to the relevant parts of the property at all reasonable times for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
2. That the Consent Holder shall notify AC within 7 days of the identification of any contamination greater than 100 m^3 found at the Site which was not identified in the report submitted in support of the application.
3. The Consent Holder shall comply with the remediation action plan and documentation submitted in support of the application.
4. Should any soil material (not hard fill) be imported to the Site as part of the proposed earthworks, the Consent Holder shall undertake validation sampling of such material at a rate of one sample per 250 m^3 of soil.
5. That during the remediation works the Consent Holder shall undertake regular visual inspection of the excavations of the contaminated areas to ensure there are no uncontrolled discharges of contaminants.
6. That during the remediation works the Consent Holder shall ensure that all sediment and controls are in place and effective in accordance with the approved remediation action plan and supporting documentation.
7. That during the remediation works the Consent Holder shall call upon the services of a suitably qualified environmental practitioner to supervise the works, excavation and removal of contaminated soils from the Site and undertake sampling (if required) of imported material.
8. Any excavated material to be removed from the Site not meeting acceptance criteria for a clean fill shall be disposed of at a licensed facility authorised to accept such materials.
9. Any standing SPH observed on the groundwater table within the excavation shall be removed from the remedial works area and disposed of at a licensed facility authorised to accept such materials.
10. At the completion of the remedial works a site validation report shall be prepared in accordance with CLMG no. 1 which details the following as a minimum:

    — Summary of remedial works undertaken.
    — Disposal receipts for all excavated materials or groundwater or SPH removed from the Site during remedial works.
    — Summary of validation sampling undertaken including the rationale and justification for the strategy applied.

9.0 Statutory Assessment

9.1 Objectives and Policies Assessment

9.1.1 Auckland Council Regional Policy Statement

The Auckland Regional Council Regional Policy Statement Plan provides the overall framework for the management of natural and physical resources in the Auckland Region.

The following provisions are relevant to the proposed works:

17.3 Objectives

1. To remedy or mitigate any adverse effects of existing contaminated sites.

2. To ensure that appropriate remediation standards are achieved for contaminated sites.

3. To avoid sites becoming contaminated in the future.

17.4.1 Policies

1. All confirmed contaminated sites in the Auckland Region shall be identified and classified on a register.

2. Remediation of a contaminated site shall be required where the level of contamination renders the site unsuitable for its existing or likely future use, or the site has an actual or likely adverse effect on the wider environment.

3. Remediation standards for a contaminated site shall be consistent with the existing and likely future use of the site and shall consider the risk to the environment posed by the site.

4. Awareness of the issues relating to existing contaminated sites and the avoidance of future contaminated sites shall be promoted.

Those factors that are to be taken into account include; the level of contamination, land uses of the Site, proximity to sensitive ecosystems, possible exposure pathways and the history of the Site. As set out in Section 6.0 above the temporary effects of the remediation can be appropriately mitigated and following the works the risks will be lower due to the removal of contaminants from the Site. Therefore the works are considered consistent with the Auckland Regional Policy Statement.

9.1.2 Operative Auckland Council Regional Plan (Air Land Water)

The Auckland Council Regional Plan (Air Land Water) was made operative in 2013 and provides for the management of air, land and water resources in the Auckland Region.

The following provisions are relevant to the proposed works:

Objectives

5.3.1 To protect, maintain or enhance the quality of land and water in the Auckland Region by:

(a) Maintaining areas of high environmental quality;

(b) Minimising adverse effects on degraded natural and physical resources where these cannot be avoided; and

(c) Enhancing degraded areas where practicable.

5.3.14 To promote and facilitate the identification and management of land containing elevated levels of contaminants including contaminated land.

5.3.15 Where necessary, to ensure that the remediation and/or management of land containing elevated levels of contaminants including contaminated land, closed and operative solid waste landfills and cleanfills is undertaken to protect the environment and human health.

5.3.16 To recognise and support the sustainable use of land containing elevated levels of contaminants including contaminated land in a manner which provides for the community's social and economic well being, consistent with the provisions of District Plans.

Policies

5.4.2 To have regard to the objectives and policies of Chapters 2.1, 2.2 and 2.3 in assessing any resource consent to discharge contaminants, into water or onto or into land.

5.4.34A To facilitate the identification and appropriate management of land containing elevated levels of contaminants including contaminated land.

5.4.34B To work with site owners or responsible parties to determine what if any management is required for land containing elevated levels of contaminants.

5.4.34 To encourage the owners or occupiers of land, where activities listed as high risk in the 'Contaminated Land Management Guidelines No. 3 Risk Screening System' (MfE February 2004) have been undertaken, to complete a contaminated site assessment when appropriate throughout the cycle of use, redevelopment or sale of the land.

5.4.35 To encourage TA's to seek contaminated site assessments prior to allowing a change in land use, subdivision or redevelopment where the land has been used for any activity listed in the 'Contaminated Land Management Guideline No. 3 Risk Screening System' (MfE February 2004).

5.4.36 To facilitate the remediation or management of contaminated land in cooperation with territorial authorities, where site investigations show a significant risk to human health.

5.4.37 The management of land containing elevated levels of contaminants may allow contaminants to remain in the ground on the site where it can be demonstrated that the level of contamination will not pose potentially significant adverse effects on the environment or to human health.

5.4.37A When processing discharge consent applications for land containing elevated levels of contaminants including contaminated land the ARC shall have regard to the actual and potential adverse effects of the activity, physical constraints of the site, operational practicalities, and the financial implications of the investigation, remediation, management and monitoring options imposed compared with other options.

5.4.37B The contaminant levels specified in Rules 5.5.41, 5.5.42 and 5.5.42A do not establish remediation criteria for land which must be met in all cases, although land owners may choose to remediate contaminated land to those levels should they wish to comply with those Rules.

The proposed works are expected to have no more than minor effects on the environment and effects on the surrounding amenity and adjoining land uses will be mitigated through the implementation of the Site management plan. Adverse effects on the environment will be mitigated during the earthworks and avoided following the completion of the remediation. Therefore the proposed works are consistent with the relevant objectives and policies of the Operative Auckland Regional Council Plan (Air Land Water).

9.1.3 Operative Auckland Council District Plan (Manukau Section) 2002

The Auckland Council District Plan (Manukau Section) was made operative in 2002 and provides for the effects of the use, development and protection of the natural and physical resources within Manukau City.

The following provisions are relevant to the proposed works:

Objective

9.3.1 To enable land modification, development and subdivision to proceed in a manner that will maintain or enhance the environmental qualities of the environment.

Policy

9.4.1 Land modification, development and subdivision should occur in a way that:

(a) maintains or enhances amenity values by retaining, as far as practicable, existing landscape features such as landforms and significant vegetation, and by minimising the adverse effects of site works and construction, such as by dust, noise, and runoff;

(b) encourages land modification, development and subdivision design which creates practicable building sites and the efficient use of infrastructure and urban land and a safe living environment;

(c) is consistent with the environmental results envisaged for the relevant zone and area as reflected within any structure plan, and whose character is compatible with any surrounding areas that have already been developed with a similar zoning, and which creates a high quality living environment;

(e) enhances natural processes and features including natural drainage patterns, protected streams and riparian vegetation to avoid, remedy or mitigate adverse effects on water quality, through all phases of the water cycle from waterborne pollutants;

(f) provides a high degree of security and safety;

(g) promotes energy and resource efficiency; and

The earthworks required for the remediation will be undertaken in accordance with the Site management plan and the scale of works is limited to that required to remove contaminated soils at the Site. The life-supporting capacity of water, soil and ecosystems will be safeguarded and potential adverse effects on people, property and network utilities will be avoided. Therefore the remediation is consistent with the relevant provisions of the Operative Plan.

9.1.4 Proposed Auckland Unitary Plan

The Proposed Auckland Unitary Plan (PAUP) was notified on 30 September 2013 and updated on 8th September 2015. It replaces the existing Regional Policy Statement and 13 existing district and regional plans. It is a combined regional policy statement, regional coastal plan, regional plan and district plan. The following objectives and policies relating to earthworks and contaminated land are relevant:

Clause 2C.5.2 - Earthworks

Objectives

1.Earthworks are undertaken in a manner that protects people and the environment.
2.The risk of natural hazards is not increased by earthworks.
3.Sediment generation from earthworks is minimised.

Policies

1. Avoid, remedy or mitigate the adverse effects on the values or sites included in the Natural Heritage and Natural Resource overlays in the Unitary Plan.

2. Manage earthworks to:

a. retain soil and sediment on the land, and not discharge it to water bodies and coastal water by use of best sediment and erosion control practices

b. limit the amount of land being disturbed at any one time, particularly where the soil type, typography and location is likely to result in increased sediment runoff or discharge

c. not create or exacerbate the risk of natural hazards

d. avoid, remedy or mitigate noise, vibration, odour and other amenity effects, traffic and human health effects

e. maintain the cultural and spiritual values of Mana Whenua in terms of land and water quality, preservation of wāhi tapu, and kaimoana gathering

f. minimise the loss of sediment during rain events and its subsequent discharge into surface water bodies and coastal water

g. require the use of best industry practices and standards for on-site sediment treatment or removal methods relative to the nature and scale of the activity to reduce the amount of sediment discharge.

3. Manage earthworks within the 1 per cent AEP floodplain to ensure:

a. they do not exacerbate flooding, either at the site or at any location upstream or downstream of the works

b. there is no significant permanent reduction of waterway area or loss of flood plain storage.

4. Manage the impact on Mana Whenua cultural heritage that are discovered during development or land use by:

a. requiring a protocol for the accidental discovery of kōiwi, archaeology and artefacts of Māori origin

b. undertaking appropriate actions in accordance with mātauranga and tikanga Māori

c. undertaking appropriate measures to avoid adverse effects. Where adverse effects cannot be avoided, effects are remedied or mitigated.

5. Require any proposal to discharge sediment laden water to a surface water body or to coastal water from the undertaking of earthworks for which resource consent is required, to demonstrate that:

a. where the MCI in the receiving river or stream currently meets or exceeds the relevant guideline in Auckland-wide - Water quality and integrated management, Table 1: MCI guidelines for Auckland, the sediment discharge will not result in a long-term deterioration of the MCI

b. where the MCI in the receiving river or stream currently does not meet the relevant guideline in Auckland-wide - Water quality and integrated management, Table 1: MCI guidelines for Auckland, the sediment discharge has been minimised to the fullest extent that is reasonably practicable

c. the receiving environment is able to assimilate the discharged sediment after reasonable mixing, with any significant adverse effects being avoided, and other effects remedied or mitigated, particularly within areas identified in the Unitary Plan as being sensitive because of their ecological values, including terrestrial, freshwater and coastal ecological values

d. any significant adverse effects on the present use of the receiving waters after reasonable mixing have been avoided, and other effects remedied or mitigated, particularly in areas where there is:

i. high recreational use

ii. relevant initiatives by Mana Whenua, established under regulations relating to the conservation or management of fisheries, including taiāpure, rāhui or whakatupu areas

iii. the collection of fish and shellfish for consumption

iv. areas of maintenance dredging.

Clause 2C.5.6 – Contaminated Land

Objective

1. Land containing elevated levels of contaminants is managed to protect human health and the environment and to enable this land to be used for suitable activities now and in the future.

Policies

1. Identify land containing elevated levels of contaminants by:

a. requiring a site investigation of land being redeveloped or subdivided, having regard to the potential for contamination from past activities

b. recording the details of actual or potentially contaminated land in a public register.

2. Require any proposal to use or develop land containing elevated levels of contaminants to remedy or manage the contaminated land to a level that:

a. protects human health to a level appropriate for the proposed land use

b. protects the environment to a level appropriate for existing and proposed land uses

c. allows contaminants to remain in the ground/groundwater, where it can be demonstrated that the level of residual contamination will not pose a significant adverse effect on human health or the environment

d. avoids adverse effects on potable water supplies

e. avoids, remedies or mitigates significant adverse effects from contaminated discharges to air, land and water on ecological values, water quality and amenity values.

3. Decisions on the use, development, management or remediation of land containing elevated levels of contaminants must in addition to the matters in Policy 2 above, take into account the following:
a. the physical constraints of the site and operational practicalities

b. the financial implications of the investigation, remediation, management and monitoring options

c. the requirement of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2012

d. the provision of a detailed site investigation (contaminated land), remedial action plan (contaminated land), site validation report (contaminated land) and site management plan (contaminated land) that quantifies the adverse effects and the methods to avoid, remedy or mitigate these effects and to undertake monitoring of the site

e. the use of best practice contaminated land management for the identification, monitoring and remediation procedures

f. adequate measures are in place for the transport, disposal and tracking of soil and other material removed from the site to prevent adverse effects on the environment.

4. When considering Policies 2 and 3 above, the council will have regard to the following documents, where they are relevant to the type of land contamination:

a. current edition of the Petroleum Guidelines October 2011

b. current edition of the Contaminated Land Management Guidelines, No 1, 2 and 5 October 2011.

The proposed works are expected to have no more than minor effects on the environment and the effects on the surrounding amenity and adjoining land uses will be less than minor and mitigated through the implementation of the Site management plan. Adverse effects on the environment will be mitigated during the earthworks and avoided following the completion of the remediation. Therefore the proposed works are consistent with the relevant objectives and policies of the PAUP.

9.2 RMA Part 2 Assessment

9.2.1 Section 5- Purpose

The purpose of the RMA is to promote the sustainable management of natural and physical resources, with sustainable management defined in Section 5 as:

> *managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—*
>
> *(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
>
> *(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
>
> *(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

The works will prepare the land for any future commercial, residential or light industrial purposes which will enable people to provide for their social, economic and cultural wellbeing. Removing contamination will ensure the Site can be used safely and that any potential adverse effects on the environment, caused by the current contamination, are avoided. The short terms effects during the remediation will be adequately mitigated. Therefore the proposed remediation is considered consistent with the purpose of the RMA.

9.2.2 Section 6- Matters of National Importance

There are no matters of national importance that are considered relevant to the proposed activities.

9.2.3 Section 7- Other Matters

Section 7 of the RMA outlines other matters:

(a) kaitiakitanga:

(aa) the ethic of stewardship:

(b) the efficient use and development of natural and physical resources:

(c) the maintenance and enhancement of amenity values:

(d) intrinsic values of ecosystems:

(f) maintenance and enhancement of the quality of the environment:

(g) any finite characteristics of natural and physical resources:

(h) the protection of the habitat of trout and salmon:

Matters (c) and (f) are of relevance to the proposed activities and will be met. During the Site works amenity values will be maintained through compliance with noise standards and also the implementation of dust control measures. Through the remediation works the quality of the environment will be enhanced as contaminated soils will be removed, limiting potential future adverse effects on human health and groundwater.

9.2.4 Section 8- Treaty of Waitangi

Section 8 requires the principles of the Treaty of Waitangi to be taken into account when managing the use, development, and protection of natural and physical resources. There are no sites of cultural significance in the vicinity of the Site and the effects of the environment can be appropriately mitigated, which means the effects on tangata whenua values are expected to be less than minor.

10.0 Conclusions and Recommendations

This resource consent application and AEE seeks authorisation as a **Restricted Discretionary Activity** under the NES Soil Contamination rules. Consent is also required under the Operative District Plan and PAUP as a **Restricted Discretionary Activity** for earthworks. Consent is required as a Controlled Activity under the Operative Regional Auckland Council District Plan (Air Land Water) and the PAUP for remedial works to a contaminated site.

The document has also been prepared in accordance with the requirements of the RMA.

This document, specifically Section 5.0 and 6.0, has outlined the management and mitigation measures to ensure that any potential short term effects to human health and the environment as a consequence of the remedial works, will be temporary and no more than minor. Further, the applicant has proposed consent conditions for the remedial works (Section 8.0) which illustrate the intent of the applicant to complete and report the works in accordance with best practice requirements.

Overall, it is considered that the removal of the impacted soils from the Site will have a positive long-term effect on soil and groundwater quality at the Site.

We trust that the above meets with your approval and request that the resource consent be issued forthwith.

11.0 AEE / RAP Limitations

This remedial action plan and AEE (Plan) is provided strictly in accordance with and subject to the following limitations:

a) This Plan has been prepared for the sole benefit of Chevron and Auckland Council in accordance with normal prudent practice and by reference to applicable environmental regulatory authority and industry standards, guidelines and assessment criteria in existence at the date of this Plan, and any previous site investigation and assessment reports referred to in this Plan.

b) Except as required by law, no third party may use or rely on, this Plan unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

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

d) This Plan is based solely on the scope of work agreed between AECOM and Chevron EMC and described in Section 4.0 ("Proposed Remedial Works") of this Plan.

e) This Plan should be read in conjunction with the Attached Reports. No responsibility is accepted by AECOM for use of this Plan in any other context.

f) This Plan is based solely on the investigations and findings contained in the Attached Reports and on the conditions encountered and information reviewed at the time of preparation of each Attached Report.

g) This Plan is subject to all limitations and recommendations included in the Attached Reports.

h) Where any Attached Report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the Attached Report. AECOM assumes no liability for any inaccuracies in or omissions to that information.

i) AECOM has only considered those chemicals specifically referred to in this Plan. AECOM makes no statement or representation as to the existence (or otherwise) of any other chemicals.

j) This Plan has been prepared to address on-site contamination issues only (within the context of and limited to the Scope of Work).

k) Investigations undertaken prior to this Plan are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and contamination may have been identified prior to this Plan.

l) Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations carried our prior to this Plan. It is unlikely therefore that the results and estimations expressed or used to compile this Plan will represent conditions at any location removed from the specific points of sampling.

m) No investigation has been undertaken to determine the existence or otherwise of asbestos containing materials in soil at the Site. This report makes no undertaking to remove asbestos containing materials or fibres in soil at the Site.

n) A site which appears to be unaffected by contamination at the time the Attached Reports were prepared may later, due to natural phenomena or human intervention, become contaminated

o) Except as specifically stated above, AECOM makes no warranty, statement or representation of any kind concerning the suitability of the Site for any purpose or the permissibility of any use, development or re-development of the Site.

p) Use, development or re-development of the Site for any purpose may require planning and other approvals and, in some cases, environmental regulatory authority approval. AECOM offers no opinion as to whether the current use has any or all approvals required, is operating in accordance with any approvals, the likelihood of obtaining any approvals for development or redevelopment of the Site, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environmental works.

Appendix C

Soil and Groundwater Results Tables

Former Caltex [illegible] - Summary of Soil Results

	Sample Details and Analytical Results																							MfE (1999) Tier 1 Soil Acceptance Criteria[1]	
LRS Sample Reference	SSD561	SSD562	SSD563	SSD564	SSD565	SSD566	SSD567	SSD568	SSD569	SSD571	SSD573	SSD574	SSD575	SSD577	SSD578	SSD579	SSD581	SSD582	SSD583	SSD584	SSD585	SSD589	SSD591		
Date Sampled	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	6-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10	12-May-10		
Sample Location	Dispensers					Remote fill points		Bedding material		Tank pit excavation (1 x USTs)												Interceptor pit			
	Dispenser 1	Dispenser 1 (dup)	Dispenser 2	Dispenser 3	Dispenser 4	Remote fill point 1	Remote fill point 2	Tank 1 bedding material	Tank 1 bedding material	North wall (central end)	Base	East wall (northern end)	East wall (southern end)	North wall (western end)	West wall (northern end)	East wall (southern end)	South wall (eastern end)	South wall (central end)	South wall (western end) (duplicate)	South wall (western end)	Bedding material	Interceptor	Interceptor	Contamination Depth: Surface (<1m) 1m-4m	
Sample Depth (m below ground level)	1.5-1.7	1.5-1.7	1.3-1.5	1.2-1.4	1.4-1.6	1.2-1.3	1.2-1.3	-	-	0.6	3.5	0.6	1.8	1.8	0.9	0.6	2.1	1.8	1.8	0.6	-	1.4-2.4	1.9-2.1		
Sample Soil Type	SAND	SAND	SAND	SAND	SAND	SAND	SAND	SAND	SAND	Silty CLAY	SAND	Silty CLAY	SAND	SAND	Silty CLAY	Silty CLAY	SAND	SAND	SAND	Silty CLAY	SAND	Silty CLAY	Silty CLAY		
Guideline Soil Type[2]	SAND	SAND	SAND	SAND	SAND	SAND	SAND	SAND	SAND	Silty CLAY	SAND	Silty CLAY	SAND	SAND	Silty CLAY	Silty CLAY	SAND	SAND	SAND	Silty CLAY	SAND	Silty CLAY	Silty CLAY	Silty CLAY	SAND
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining		
Units (dry weight)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total Petroleum Hydrocarbons (TPH)																									
C_6-C_9	470	910	3100	430	26	700	175	6	<8	<11	<8	<9	<10	<10	<11	<10	<9	<10	<10	<10	<8	5,500	2,600	(5400) (20000)	120 120
C_{10}-C_{14}	560	460	1940	480	172	540	120	<20	<30	<30	<20	<20	<30	<30	<30	<20	<20	30	<20	<20	35	4,060	1,940	(1900) (8900)	(1500) (1900)
C_{15}-C_{36}	<40	<40	510	<40	1,100	<40	<40	<40	<40	<50	<40	<40	<40	40	<50	<40	<40	<40	<40	<40	224	6,100	1,930	NA NA	NA NA
Total hydrocarbons (C_6-C_{36})	1,230	1,310	5,540	910	1,300	1,040	305	<60	<60	<90	<60	<70	<70	<70	<90	<70	<70	<70	<70	<70	260	17,100	6,490	-	-
BTEX Compounds																									
Benzene	30	30	31	4.4	3.7	21	5.1	<0.05	<0.05	<0.07	<0.06	<0.06	<0.10	<0.10	<0.07	<0.07	-	<0.10	<0.11	-	<0.05	220	68	7.2 20	1.0 1.0
Toluene	490	580	270	40	0.45	330	109	<0.05	0.069	0.133	<0.06	<0.06	<0.10	<0.10	<0.07	<0.07	-	0.144	0.11	-	<0.05	630	290	(670) (1100)	(94) (94)
Ethylbenzene	91	116	87	19.1	6.1	60	33	<0.05	0.45	<0.07	<0.06	<0.06	0.10	0.10	<0.07	0.07	-	<0.10	<0.11	-	0.65	172	256	(550) (2600)	(180) (180)
m & p xylenes	420	360	189	195	7.2	260	309	<0.10	4.6	0.21	<0.11	<0.12	<0.19	<0.19	<0.13	<0.13	-	0.22	0.23	-	<0.10	700	390	-	-
o-xylenes	146	179	112	85	0.62	95	152	<0.05	1.64	0.070	<0.06	<0.06	0.10	<0.10	<0.07	<0.07	-	<0.10	0.185	-	<0.05	260	410	-	-
Total xylenes	566	670	425	283	7.82	355	461	<0.15	6.20	0.290	<0.17	<0.15	0.29	<0.29	0.20	<0.20	-	<0.32	0.415	-	0.15	1050	790	(510) (2300)	(150) (150)
Polycyclic Aromatic Hydrocarbons (PAHs)																									
Naphthalene	-	-	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	(250) (1100)	(190) (250)
Pyrene	-	-	0.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.82	NA NA	NA NA
Benzo(a)pyrene equivalent[2]	-	-	0.0053	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0725	(11) (25)	(11) (25)

	Sample Details and Analytical Results											Oil Industry Guidelines: Tier 1 Soil Acceptance Criteria[1]		
Sample Location	MW1		MW2				MW3			MW4		All Pathways Soil Acceptance Criteria - Commercial Industrial[2]		
LRS Sample Reference	SSN771	SSN775	SSN781	SSN784	SSN78[illegible]	SSN78[illegible] DUPLICATE	SSN785	SSN789	SSN791	SSN794	SSN796			
Date Sampled	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	21-Nov-11	Contamination depth Surface (<1m) 1m-4m		
Sample Depth (m below ground level)	0.6	1.2	0.5	1.5	1.9	1.9	0.6	1.6	2.9	0.7	1.5			
Sample Soil Type	Clayey SILT	Silty CLAY	Silty CLAY	Silty CLAY	Sandy SILT	Sandy SILT	Silty CLAY	Sandy SILT	PEAT	Silty CLAY	Sandy SILT	PEAT	Silty CLAY	Sandy SILT
Guideline Soil Type[2]	Sandy SILT	Silty CLAY	Silty CLAY	Silty CLAY	Sandy SILT	Sandy SILT	Silty CLAY	Sandy SILT	PEAT	Silty CLAY	Sandy SILT			
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Total Petroleum Hydrocarbons (TPH)														
C_6-C_9	<10	<10	<9	<9	<9	<10	<10	<9	<12	<9	<11	(6700) (6700)	(8500) (20000)	(560) (1500)
C_{10}-C_{14}	<20	<20	<20	140	<20	<20	<20	<20	<30	<20	<30	NA NA	(1900) (4900)	(1700) (2200)
C_{15}-C_{36}	<40	<40	<40	250	<40	<40	<40	<40	<50	<40	<50	NA NA	NA NA	NA NA
Total hydrocarbons (C_6-C_{36})	<70	<70	<70	490	<70	<70	<70	<70	<90	<70	80	-	-	-
BTEX Compounds														
Benzene	<0.06	<0.06	<0.06	1.66	0.80	0.78	<0.07	<0.06	<0.08	<0.05	<0.07	26 (48)	7.2 (20)	5.6 1.2
Toluene	<0.06	<0.06	<0.06	26	0.29	0.23	<0.07	<0.06	<0.09	<0.05	<0.07	(500) (1500)	(70) (1100)	(290) (1100)
Ethylbenzene	<0.06	<0.06	<0.06	9.1	0.10	0.07	<0.07	<0.06	<0.09	<0.05	<0.07	(200) (8100)	(330) (2600)	(200) (500)
m&p-Xylene	<0.11	<0.12	<0.12	42	0.32	0.24	<0.14	<0.12	<0.15	<0.10	<0.14	-	-	-
o-Xylene	<0.06	<0.06	<0.06	15.2	0.12	0.10	<0.07	<0.06	<0.09	<0.05	<0.07	-	-	-
Total Xylenes	<0.17	<0.18	<0.18	57.2	0.44	0.34	<0.21	<0.18	<0.23	<0.15	<0.21	(5700) (6600)	(510) (2500)	(200) (420)

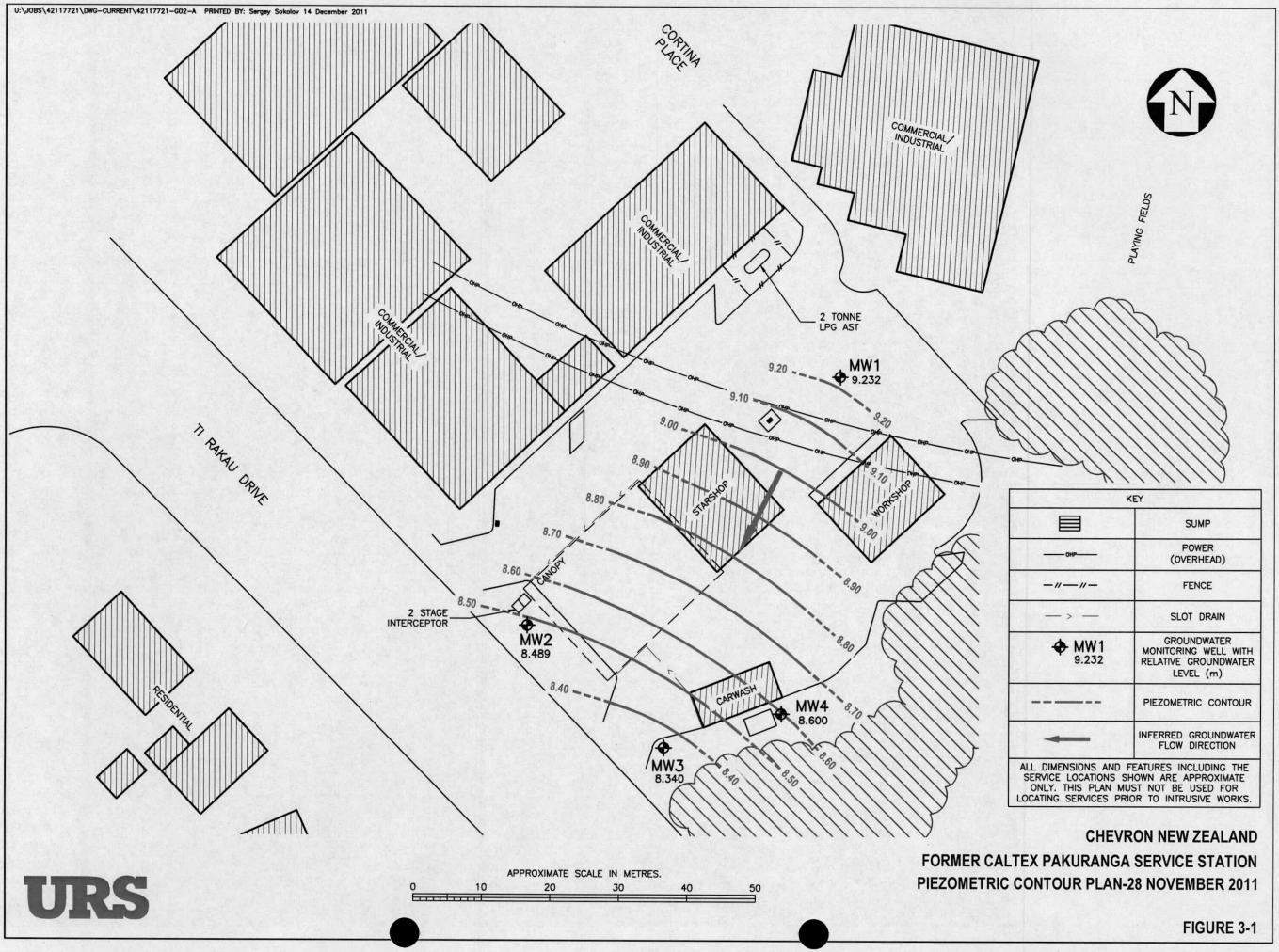
	Sample Details and Analytical Results																		MfE 1999 Guidelines: Tier 1 Soil Acceptance Criteria[1]		
LRS Sample Reference	SSX684	SSX687	SSX670	SSX672	SSX668	SSX669	SSX671	SSX662	SSX664	SSX666	SSX678	SSX679	SSX680	SSX682	SSX689	SSX690	SSX691	SSX696			
Date Sampled	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	13-May-14	14-May-14	14-May-14	14-May-14	14-May-14			
Sample Location	Test Pit 1		Test Pit 2		Test Pit 3			Test Pit 4			Test Pit 5				Test Pit 6		Test Pit 7		Contamination depth Surface (<1m) 1m-4m		
Sample Depth (m below ground level)	0.6	2.7	0.6	2.4	0.5	1.4	4.6	1.5	2.5	4.9	0.3	0.4	1.6	3.6	0.7	1.4	0.2	2.7			
Sample Soil Type	CLAY	SILT	SILT	SILT	Clayey SILT	Clayey SILT	SILT	Silty CLAY	SILT	SILT	Sandy GRAVEL	CLAY	SILT	SILT	Clayey SILT	SILT	GRAVEL	SILT			
Guideline Soil Type[2]	Silty CLAY	Sandy SILT	Sandy SILT	Sandy SILT	Sandy SILT	Sandy SILT	Sandy SILT	Silty CLAY	Sandy SILT	Sandy SILT	SAND	Silty CLAY	Sandy SILT	Sandy SILT	Sandy SILT	Sandy SILT	SAND	Sandy SILT	SAND	Sandy SILT	Silty CLAY
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining			
Total Petroleum Hydrocarbons (TPH)																					
C_6-C_9	11	<9	<9	<9	<5	190	<11	<10	650	<10	<8	35	12	<10	<9	<10	[illegible]	<9	120 120	(500) (500)	(8800) (20000)
C_{10}-C_{14}	<30	<20	<20	<20	<20	240	<30	<20	1040	<20	<20	<30	82	<20	<20	<20	<20	<20	(1500) (1900)	(1100) (2200)	(1900) (9900)
C_{15}-C_{36}	<50	<40	<40	<40	<40	450	<50	119	1560	<40	<40	<50	<40	<40	<40	<40	<40	<40	NA NA	NA NA	NA NA
Total hydrocarbons (C_6-C_{36})	<80	<70	<70	<70	<70	880	<80	119	3200	<70	<70	<90	94	<70	<70	<70	<70	<70	-	-	-
BTEX Compounds																					
Benzene	<0.07	<0.06	<0.05	<0.06	0.06	1.9	<0.07	0.07	9.6	<0.06	<0.05	7.6	<0.06	<0.07	<0.06	<0.07	<0.05	<0.06	1.8 1.8	1.6 1.2	2.7 20
Toluene	<0.07	<0.06	0.05	<0.06	<0.06	34	<0.07	<0.07	89	<0.06	<0.05	29	<0.06	<0.07	<0.06	<0.07	<0.05	0.06	(94) (94)	(270) (490)	(670) (3,100)
Ethylbenzene	<0.07	<0.06	<0.05	<0.06	<0.06	14.4	<0.07	<0.07	68	<0.06	<0.05	2.7	0.34	<0.07	<0.06	<0.07	<0.05	<0.06	(190) (180)	(280) (590)	(330) (2,400)
Total Xylenes	<0.21	<0.17	<0.15	<0.17	0.25	84	<0.21	<0.20	450	<0.18	<0.15	11.2	1.45	<0.28	<0.18	<0.20	<0.15	<0.17	(150) (150)	(200) (420)	(510) (2,300)

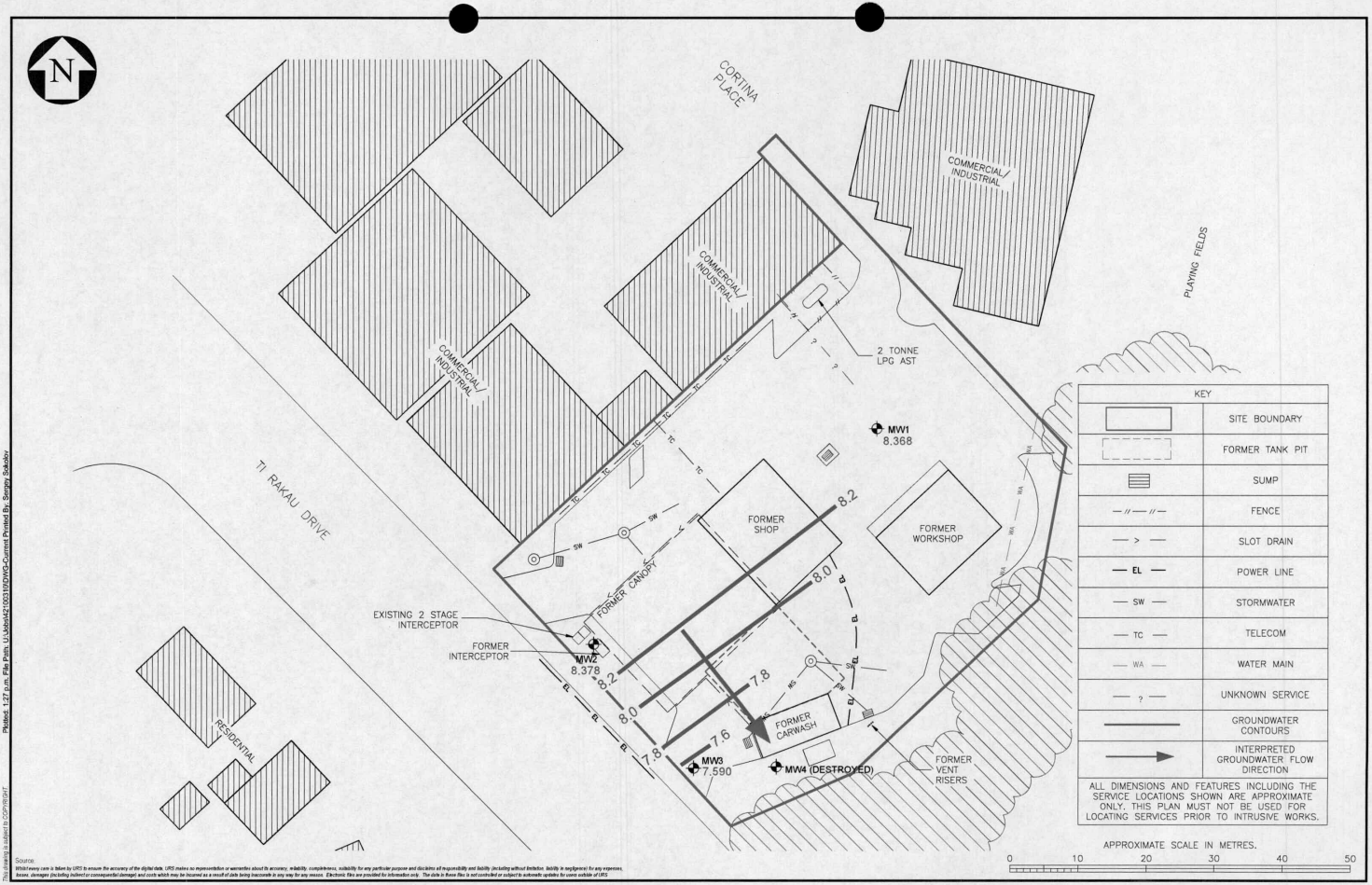
	Sample Details and Analytical Results																		MfE 1999 Guidelines: Tier 1 Soil Acceptance Criteria[1]		
LRS Sample Reference	SSX698	SSX700	SSX701	SSX703	SSX706	SSX708	SSX719	SSX7[illegible]	SSX755	SSX756	SSX751	SSX753	SSX716	SSX715	SSX710	SSX711	SSX714	Intentionally left blank for formatting purposes			
Date Sampled	14-May-14	14-May-14	14-May-14	14-May-14	15-May-14	15-May-14	14-May-14	14-May-14	15-May-14	15-May-14	15-May-14	15-May-14	14-May-14	14-May-14	14-May-14	14-May-14	14-May-14				
Sample Location	Test Pit 8		Test Pit 9		Test Pit 10		Test Pit 12		Test Pit 13		Test Pit 11		Test Pit 15		Test Pit 16				Contamination depth Surface (<1m) 1m-4m		
Sample Depth (m below ground level)	0.6	2.6	0.2	1.7	0.8	2.4	0.7	2.5	0.8	1.8	0.9	2.9	0.8	2.7	0.7	1.6	4.1				
Sample Soil Type	Silty CLAY	SILT	GRAVEL	SILT	CLAY	SILT	GRAVEL	SILT	CLAY	SILT	Clayey SILT	SILT	CLAY	SILT	CLAY	SILT	Silty CLAY				
Guideline Soil Type[2]	Silty CLAY	Sandy SILT	SAND	Sandy SILT	Silty CLAY	Sandy SILT	SAND	Sandy SILT	Silty CLAY	Sandy SILT	Sandy SILT	Sandy SILT	Silty CLAY	Sandy SILT	Silty CLAY	Sandy SILT	Silty CLAY		SAND	Sandy SILT	Silty CLAY
Sample of soil remaining or removed	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining				
Total Petroleum Hydrocarbons (TPH)																					
C_6-C_9	10	<9	<8	<9	<10	<9	<8	<9	<9	<9	<11	<9	<11	<9	16	290	<11		120 120	(500) (500)	(8800) (20000)
C_{10}-C_{14}	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<30	<20	<30	<20	20	190	<30		(1500) (1900)	(1100) (2200)	(1900) (9900)
C_{15}-C_{36}	<40	<40	290	<40	<40	<40	192	<40	<40	<40	<50	<40	<50	<40	40	<40	50		NA NA	NA NA	NA NA
Total hydrocarbons (C_6-C_{36})	70	<70	290	<70	<70	<70	192	<70	<70	<70	<90	<70	<90	<70	<70	170	<90		-	-	-
BTEX Compounds																					
Benzene	<0.07	<0.06	<0.05	<0.06	<0.07	0.06	<0.05	<0.05	<0.06	<0.06	<0.07	<0.06	<0.07	<0.06	5.6	6.4	<0.07		1.8 1.8	1.6 1.2	2.7 20
Toluene	<0.07	<0.06	<0.05	<0.06	<0.07	<0.06	<0.05	<0.05	<0.06	<0.06	0.07	<0.06	<0.07	<0.06	23	67	0.07		(94) (94)	(270) (490)	(670) (3,100)
Ethylbenzene	<0.07	<0.06	<0.05	<0.06	<0.07	<0.06	<0.05	<0.05	<0.06	<0.06	<0.07	<0.06	<0.07	<0.06	2.1	14.9	<0.07		(190) (180)	(280) (590)	(330) (2,400)
Total Xylenes	<0.20	<0.17	<0.15	<0.18	<0.20	<0.17	<0.15	<0.15	<0.17	<0.18	<0.21	<0.17	<0.21	<0.17	12.7	96	0.21		(150) (150)	(200) (420)	(510) (2,300)

Notes
All results and criteria are expressed in mg/kg dry weight
Bold - exceeds the Tier 1 Soil Acceptance Criteria
1. Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999 Guidelines)
2. Values taken from Table 4.11 and 4.14 of the MfE 1999 Guidelines
NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site
Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons
The following notes indicate the limiting pathway for each criterion
v - volatilisation, s - soil ingestion, d - dermal exposure, p - produce ingestion, m - maintenance excavation worker exposure, x - PAH surrogate

Appendix D

Groundwater Contour Plans


U:\JOBS\42117721\DWG-CURRENT\42117721-G02-A PRINTED BY: Sergey Sokolov 14 December 2011
CORTINA PLACE
COMMERCIAL/ INDUSTRIAL
COMMERCIAL/ INDUSTRIAL
COMMERCIAL/ INDUSTRIAL
PLAYING FIELDS
2 TONNE LPG AST
MW1 9.232
TI RAKAU DRIVE
STARSHOP
WORKSHOP
CANOPY
2 STAGE INTERCEPTOR
MW2 8.489
CARWASH
MW4 8.600
MW3 8.340
RESIDENTIAL
9.20
9.10
9.00
8.90
8.80
8.70
8.60
8.50
8.40
KEY
SUMP
POWER (OVERHEAD)
FENCE
SLOT DRAIN
MW1 9.232
GROUNDWATER MONITORING WELL WITH RELATIVE GROUNDWATER LEVEL (m)
PIEZOMETRIC CONTOUR
INFERRED GROUNDWATER FLOW DIRECTION
ALL DIMENSIONS AND FEATURES INCLUDING THE SERVICE LOCATIONS SHOWN ARE APPROXIMATE ONLY. THIS PLAN MUST NOT BE USED FOR LOCATING SERVICES PRIOR TO INTRUSIVE WORKS.
APPROXIMATE SCALE IN METRES.
0 10 20 30 40 50
URS
CHEVRON NEW ZEALAND
FORMER CALTEX PAKURANGA SERVICE STATION
PIEZOMETRIC CONTOUR PLAN-28 NOVEMBER 2011
FIGURE 3-1



Source:

Plotted: 1:27 p.m., File Path: U:\Jobs\42\00310\DWG\Current Printed By: Sanjay Sakalov

CHEVRON NEW ZEALAND

4-1

FORMER CALTEX PAKURANGA SERVICE STATION

PIEZOMETRIC CONTOUR PLAN (MAY 2014)

Final

URS

File No: 42100310-001-A.dwg Drawn: SS Approved: NJ Date: 21/08/2014

Figure: 1-3

Rev. A A3

Appendix E

Auckland Transport Letter of Authorisation

Walker, Andrew (Auckland)

From: Walker, Andrew (Auckland)
Sent: Thursday, 18 February 2016 3:58 p.m.
To: 'Nick Wilson'; Coombe, Richard
Cc: Payne, Jonathan; Parmar, Yasmin; Wells, Ned; Philip Hollings (AT)
Subject: RE: Former Caltex Pakuranga/Auckland Transport - Ti Rakau Drive proposed excavation plan

Hi Nick –

Further to the below, we are submitting a resource consent application to undertake the proposed remedial works at the Caltex Pakuranga site tomorrow. To support our application and confirm the support of the intended works by Auckland Transport. Could we please get a letter from Auckland Transport confirming access to the property for the purposes of undertaking the proposed remedial works by way of excavation.

The scale of the works remain the same as initially communicated in the proposed excavation to Auckland Transport in October 2015.

If you have any questions, please don't hesitate to give me a call.

Regards,

Andrew Walker
Principal Environmental Scientist
D +64 9 967 9673 M +64 29 355 1328
andrew.f.walker@aecom.com

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aecom.com

From: Nick Wilson [mailto:Nick.Wilson@simpsongrierson.com]
Sent: Thursday, 8 October 2015 8:04 a.m.
To: Coombe, Richard
Cc: Walker, Andrew (Auckland); Payne, Jonathan; Mel Easton (mel.easton@buddlefindlay.com); Parmar, Yasmin; Wells, Ned; Philip Hollings (AT)
Subject: RE: Former Caltex Pakuranga/Auckland Transport - Ti Rakau Drive proposed excavation plan

Hi Richard,

As discussed with Andrew Walker yesterday, our client has reviewed your letter and has confirmed it is happy with the proposal.

Please advise if you need any assistance with access. Our client understands the property may now be fenced.

Otherwise, it would also be grateful if you could keep it informed as to progress of the works and the likely completion date.

Regards

Nick

From: Coombe, Richard
Sent: 17/09/2015 10:46 a.m.
To: Nick Wilson
Cc: Walker, Andrew (Auckland); Payne, Jonathan; Mel Easton (mel.easton@buddlefindlay.com); Parmar, Yasmin; Wells, Ned
Subject: Former Caltex Pakuranga/Auckland Transport - Ti Rakau Drive proposed excavation plan

Hello Nick

I understand that you are acting on behalf of Auckland Transport in relation to Chevron's obligations to undertake remediation on the subject site.

Please find attached AECOMS letter and Figure 1 setting out the proposed actions on the site

Richard Coombe
Associate Director - Environment
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richard.coombe@aecom.com

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Appendix F

Conceptual Site Model

AECOM

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Auckland 1140
New Zealand
www.aecom.com

16th November 2015

Chevron EMC
PO Box 684, Shortland Street,
Auckland, 1140,
New Zealand

Dear Jon Payne

Former Caltex Pakuranga - Conceptual Site Model

1.0 Introduction

AECOM New Zealand Limited (AECOM) is pleased to present Chevron EMC (Chevron) with the following document detailing the expected Conceptual Site Model (CSM) for the former Caltex Pakuranga Service Station, located on Ti Rakau Drive, Auckland (the site).

The purpose of this CSM is to provide a description of the expected distribution of residual hydrocarbon impact resulting from the migration of petroleum hydrocarbons immediately beyond the boundary of the site into below the Ti Rakau Road carriageway.

The CSM is supported by two cross sections of the site, detailing the expected distribution of hydrocarbon impact, as well as a site plan (**Figure 1**) showing the location of the respective cross sections.

2.0 Preamble

Chevron plan to undertake a remedial excavation at the site with view to removing hydrocarbon impacts in soil above Tier 1 commercial and industrial (C&I) land-use criteria as specified in the Ministry for the Environment (MfE) 1999 Guidelines[1].

The remediation is planned on the premise that once soils below the site meet C&I Tier 1 acceptance criteria, residual impacts beneath Ti Rakau drive will be minimal and if undisturbed will not pose a significant risk to environmental and human receptors. Therefore, in the event that disturbance of soils underlying the Ti Rakau road carriageway is required, a Site Management Plan (SMP) will be sufficient to manage the risks associated with such temporary activities.

3.0 Conceptual Distribution of Contamination within the Site

With the exception of the former underground petroleum storage system (UPSS) tank pit which housed the underground storage tanks (UST), the distribution of hydrocarbon contamination appears to be restricted to the previous UPSS foot-print, including the ancillary stormwater management infrastructure.

The former forecourt has benchmarked hydrocarbon impacts to depths between 1.2 and 1.7 meters below ground level (mbgl) in sand material (likely bedding / construction material), although the vertical extent of impact into the underlying natural silty clay is not fully defined. Samples taken from walls of the tank pit next to the forecourt indicate hydrocarbon impacts below C&I soil acceptance criteria at depths of 2.5 to 3.0 mbgl. Given the low permeability of the underlying natural silty clay geology, and the relatively shallow depth to groundwater (1.5 mbgl), it is unlikely that hydrocarbon impacts beneath the forecourt will have penetrated significantly into the underlying natural geology. This will be verified during the remedial excavation.

The remaining hydrocarbon impacts between depths of 1.2 and 2.4 mbgl are present along the Ti Rakau Drive frontage, associated with former stormwater interceptor (now removed) and ancillary connections. This impacted material within the site will also be removed during the remedial excavation, with soil benchmarking planned along the Ti Rakau Drive frontage of the site and around removed stormwater infrastructure.

[1] Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011).

4.0 Conceptual Site Model From Beyond Boundary

The CSM associated with the Ti Rakau Drive frontage and the surrounding area has been developed based on soil and groundwater sampling data, measured infrastructure inverts, groundwater levels and field observations recorded during the decommissioning of the UPSS at the site.

Two CSM cross sections have been prepared showing the distribution of current hydrocarbon impact, namely:

- Cross section A–A' orientated northeast to southwest and perpendicular to Ti Rakau Drive.
- Cross section B–B' southeast to northwest and parallel to the site frontage and Ti Rakau Drive.

4.1 Cross section A–A'

The A–A' cross section shows the expected distribution of hydrocarbons in the sub-surface along the north western boundary of the site.

The cross section also shows groundwater present within the underlying natural silty clay geology which is expected to partially inhibit vertical migration of hydrocarbons owing to its low permeability properties.

Soil sampling from the various phases of investigation at the site indicate that hydrocarbon impacts are present between 1.2 to 2.4 mbgl along the site frontage with Ti Rakau Drive. These soil samples were taken in areas immediately associated with a former stormwater interceptor system. It is inferred that hydrocarbon impact has preferentially migrated and settled along the more permeable bedding material associated with the interceptor pipe-work and sub-surface structures. The impacts are expected to have settled in close proximity to the infrastructure rather than having penetrated significantly into the underlying silty clay geology.

It is noted that this impacted material within the site will be largely removed during the planned remedial excavation works and residual impacts beyond site boundary are expected to be minimal due to the low permeability of the surrounding of natural silty clay geology.

4.2 Cross section B–B'

The principles affecting the distribution of hydrocarbon impacts in cross section A–A' are also reflected in cross section B–B'. Hydrocarbon impacts associated with the stormwater system are inferred to have migrated preferentially along the bedding material surrounding the stormwater pipework, towards Manhole 4 at the corner of the site and then towards Manhole 5, located off-site. This distribution of impact is also evidenced by low level readings for volatile organics of between 1 and 5 ppm on a photo-ionisation detector (PID) within the stormwater chamber of Manhole 4. Readings in Manhole 5 were <1ppm.

Residual impacts around the stormwater system with the site will be removed during the planned remedial excavation, with the remaining impact present in soils immediately surrounding the stormwater infrastructure between Manhole 4 and Manhole 5 beneath the Ti Rakau Drive foot-path.

5.0 Potential Receptors and Exposure Pathways

Potential receptors considered in this CSM comprise the following:

- Maintenance and Excavation Workers in Ti Rakau Drive carriageway.
- Occupants of neighbouring commercial property.
- Occupants of residential properties across Ti Rakau Drive carriageway.

The table below provides a summary of the receptors and potential exposure pathways.

Exposure Pathway and Receptor	CSM Consideration
The main exposure pathway to **Maintenance and Excavation workers** in the Ti Rakau Drive carriageway is dermal contact with soil and/or inhalation of soil vapours within an excavation.	These exposure pathways are considered intermittent, present only during road excavation works and can be managed through institutional controls such as a SMP Auckland Transport will be provided with a copy of the SMP for future reference.

Exposure Pathway and Receptor	CSM Consideration
The main exposure route for occupants of the **neighbouring commercial property** is in-door air inhalation of vapours within the building.	For this exposure pathway to be complete, vapours would need to be of sufficient concentration to migrate preferentially along the stormwater connection into the building. Validation of hydrocarbon impact around the stormwater system at the site boundary will be undertaken during the remedial excavation. An assessment of whether the in-door air vapour pathway warrants further investigation will be undertaken at that time. It is noted that no complaints of hydrocarbon nuisance or odour have been reported from the neighbouring commercial property. The stormwater network services collect run-off from the building roof and hard surface areas and is not expected to have a direct connection into the building. Waste water and sewage connections from the building connect to infrastructure in Cortina Place on the opposite side of the property.
	Hydrocarbon impacts are present in soils within the site from 0.7 mbgl in the vicinity of the neighbouring commercial building. The concentrations in soil are below the respective MfE Tier 1 guideline for in-door air inhalation. This soil will be removed during the planned remedial excavation, with soil validation samples submitted for laboratory analysis. Further review of the potential risk from soil vapour will be undertaken during and following completion of the remedial exercise.
The main exposure routes for exposure to occupiers of **residential buildings** across the Ti Rakau Drive carriageway are in-door air inhalation of vapours and/or ingestion of impacted groundwater used for drinking.	Given the low permeability of the underlying strata and distance of these residents from the site (approx. 30 metres), hydrocarbon impacts at this distance from the site are expected to be minimal and unlikely to pose a potential vapour intrusion risk to respective occupants. Regarding use of groundwater for use as drinking water, this is considered to be unlikely as the area is highly urbanised and on reticulated water supply. A search of registered bores within a 500 m radius of the site did not indicate any bores used for drinking water purposes. Bores present on the register were for geotechnical purposes only. Due to the low permeability of the underlying strata, the shallow aquifer in the area is not considered a viable resource for groundwater abstraction.

6.0 CSM Findings and Implementation of SMP

The CSM suggests that following the completion of remedial excavation works, residual hydrocarbon impacts remaining below the site, under the Ti Rakau Drive carriageway and the below the neighbouring commercial site, are expected to be minimal and unlikely to pose any significant risk to the environment and/or human health. It is expected that the use of institutional controls such as a SMP, will be appropriate for on-going management of residual impacts.

As further soil validation data will be gathered during the planned remedial excavation, the SMP will be finalised upon completion of the remedial works.

AECOM

7.0 Closure

We trust the above CSM and guidance meets your requirements. Please contact the undersigned should you require any further information.

Yours faithfully

Andrew Walker
Principal
Remediation Services

andrew.f.walker@aecom.com

Mobile: +64 29 355 1328
Direct Dial: +64 9 967 9673

Kevin Tearney
Technical Director
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AECOM

8.0 Limitations

AECOM Consulting Services (NZ) Limited (AECOM) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Chevron New Zealand and only those third parties who have been authorised in writing by AECOM to rely on this Report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 30 March 2015.

Where this Report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the Report. AECOM assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between March and October 2015 and is based on the May 2015 at the time of preparation. AECOM disclaims responsibility for any changes that may have occurred after this time.

This Report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This Report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Except as required by law, no third party may use or rely on this Report unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

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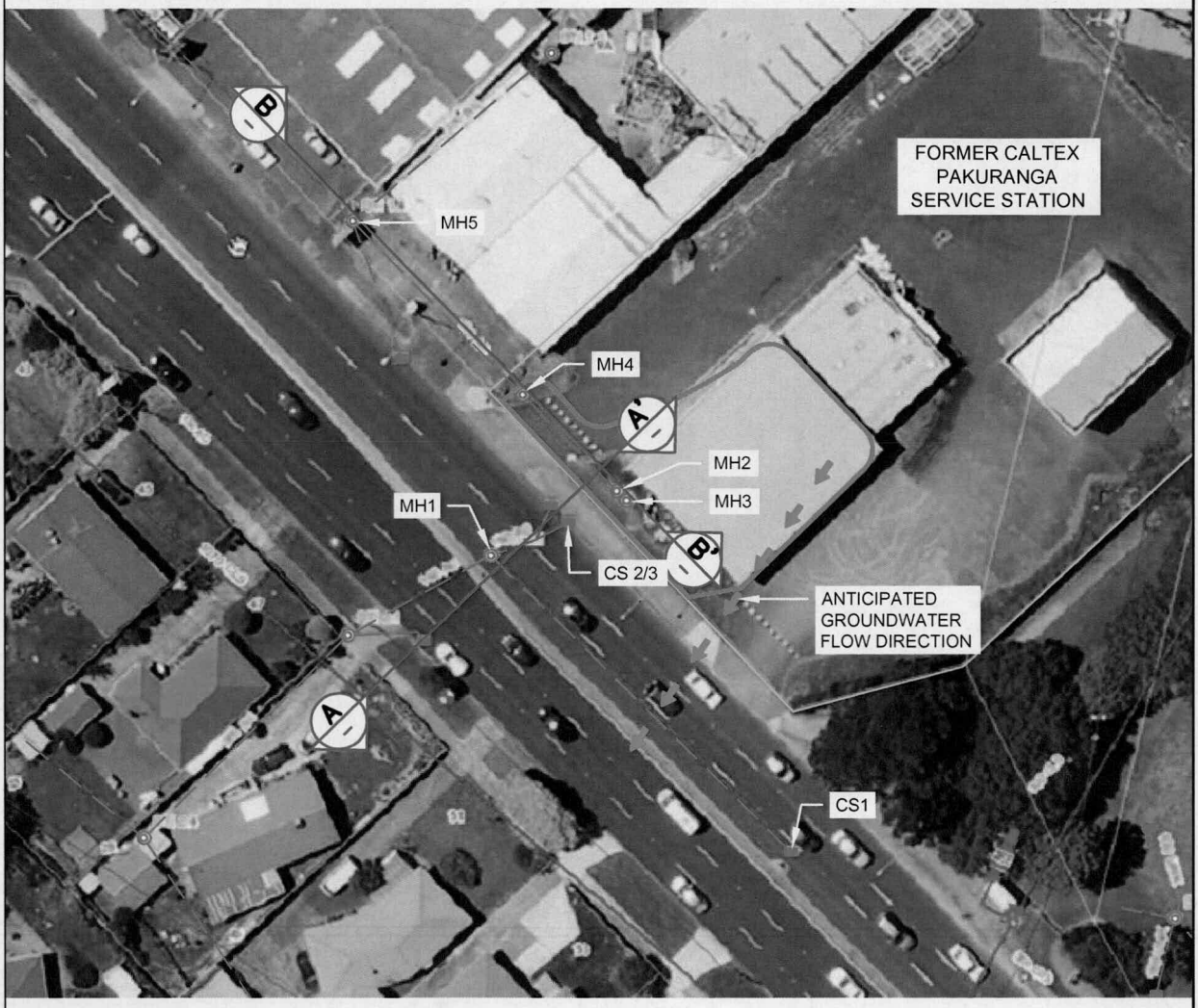
Except as specifically stated in this section, AECOM does not authorise the use of this Report by any third party.

It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

J:\42101210\5 WIP\CX PAKURANGA CSM\42101210-SHT-TR-001 PRINTED BY: Irene Miller 10 November 2015



MAP SOURCE: AUCKLAND COUNCIL GIS

LEGEND:

- CONCEPTUAL CROSS SECTION
- SITE BOUNDARY
- ANTICIPATED EXTENT OF REMEDIAL EXCAVATION
- MH
- ANTICIPATED GROUNDWATER FLOW DIRECTION

FORMER CALTEX PAKURANGA SERVICE STATION
CROSS SECTION ORIENTATION PLAN

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Figure 1

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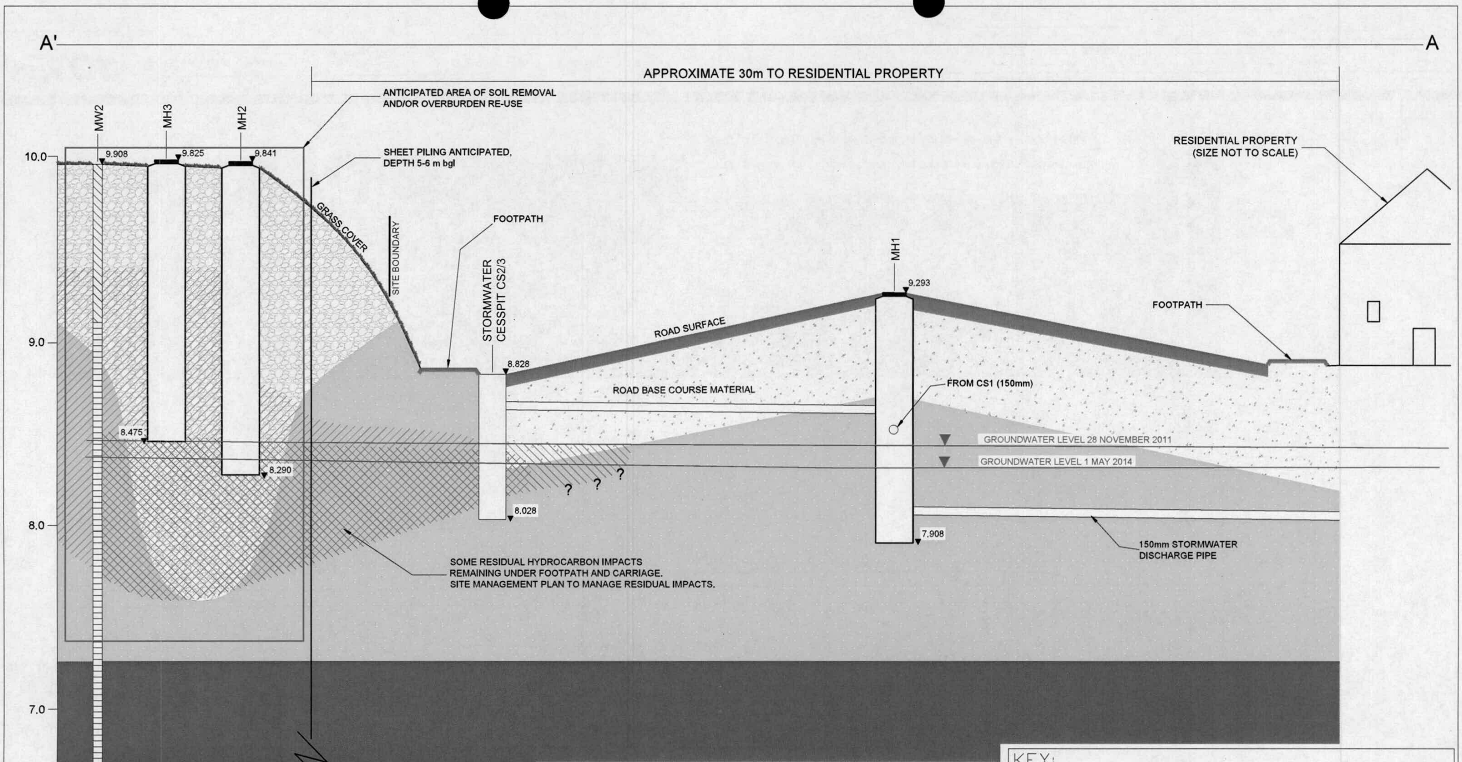
Attachment 1 – Cross sections A–A' and B–B'



CSM NOTES:

- NO DIRECT PREFERENTIAL PATHWAY ACROSS ROAD.
- NO CUT-OFF SERVICE FOR DISSOLVED PHASE MIGRATION BENEATH TI RAKAU DRIVE.
- UNDERLYING GEOLOGY LOW PERMEABILITY.
- LNAPL IN MW2 LIKELY RESTRICTED TO IMMEDIATE AREA.
- LIMITED EXTENT OF ASSOCIATED DISSOLVED PHASE IMPACT TO GROUNDWATER.

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CONSULTANT
AECOM Consulting Services (NZ) Limited
www.aecom.com

PROJECT
FORMER CALTEX PAKURANGA SERVICE STATION

CLIENT
CHEVRON NEW ZEALAND

REGISTRATION

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

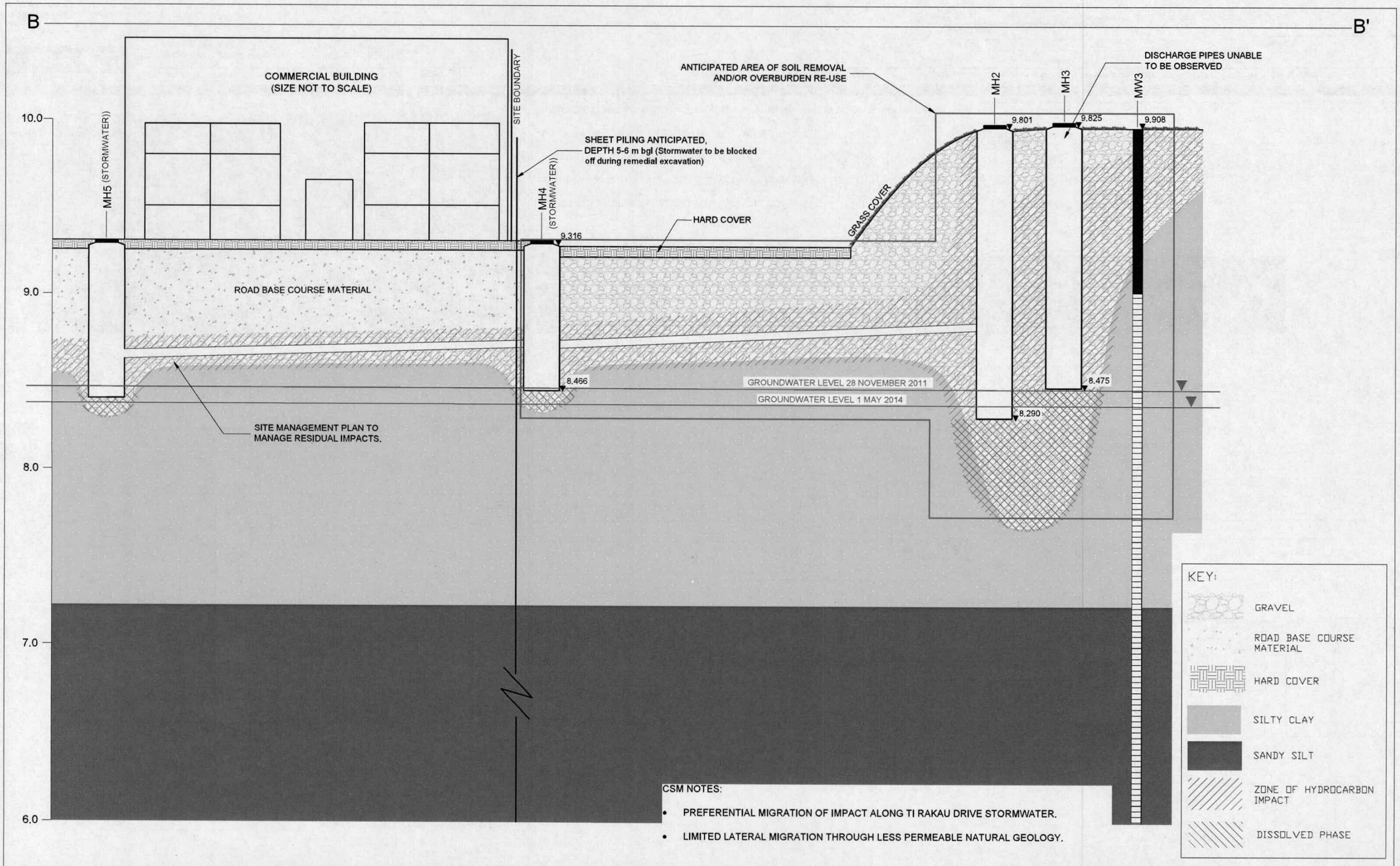
ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER
60435537

SHEET TITLE
CROSS SECTION A-A'

SHEET NUMBER



CSM NOTES:

- PREFERENTIAL MIGRATION OF IMPACT ALONG TI RAKAU DRIVE STORMWATER.
- LIMITED LATERAL MIGRATION THROUGH LESS PERMEABLE NATURAL GEOLOGY.

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PROJECT
FORMER CALTEX PAKURANGA SERVICE STATION

CLIENT
CHEVRON NEW ZEALAND

REGISTRATION

PROJECT MANAGEMENT INITIALS
DESIGNER | CHECKED | APPROVED

PROJECT DATA
DATUM | SURVEY

ISSUE/REVISION
I/R | DATE | DESCRIPTION

PROJECT NUMBER
60435537

SHEET TITLE
CROSS SECTION B-B'

SHEET NUMBER

ISO A1 594mm x 841mm

Last saved by: SERGEY.SOKOLOV(2015-10-28) Last Plotted: 2015-10-28
Filename: \\NZAKL1FP005\CADJOBS\42101210\DWG-CURRENT\60435537-001.DWG

Parcel: 1	Holding Number	Legal Description	Parcel Status	Parcel Type	Lot Size	Primary Address	Account Number	Valuation number	Account Status	Property Reference No	Flat	House Number	Street Name	Suburb	Ward	Building Consents	Resource Consents
1	9066/11	ALLOT 321 SO 44272 PAKURANGA PSH & LOT 5 DP 53823	HISTORY	AMALG	0.4047	11 CORTINA PL PAKURANGA PAKURANGA	60306452	3533017100	VOID	9066/11		11	CORTINA PL	PAKURANGA	PAKURANGA	0	2

Selected Parcel	Holding Number	Legal Description	Parcel Status	Parcel Type	Lot Size	Primary Address	Account Number	Valuation number	Account Status	Property Reference No	Flat	House Number	Street Name	Suburb	Ward	Building Consents	Resource Consents
Selected Parcel	H220972	SEC 4 SO 468793	LIVE	PARCEL	0.3112	11 CORTINA PL PAKURANGA PAKURANGA	62000216	3533017100	ACTIVE	9066/11		11	CORTINA PL	PAKURANGA	PAKURANGA	11	3

Zone Description	Area	Measure	MCC	District Plan
BUSINESS 4	0.3112	HA	7/3	24A

First Name	Last Name	Address	City	State
	AUCKLAND TRANSPORT	PRIVATE BAG 92320	VICTORIA STREET WEST	AUCKLAND

Children: 0	Holding Number	Legal Description	Parcel Status	Parcel Type	Lot Size	Primary Address	Account Number	Account Status	Property Reference No	Flat	House Number	Street Name	Suburb	Ward	Building Consents	Resource Consent

Resource Consents: 3																	
Proposal Number	Rm sp number	Address	Applicant Name	Agent Name	Accepted Date	Decision Date	Decision Notified Date	RC Collected Date	Description	Activity description	Consent Type description	Notified Flag	Officer	Decision	223 Received Date	223 Completed Date	224 Received Date	224 Completed Date
9832	9066/11	11 Cortina Pl Pakuranga 2010	CALTEX SERVICE STATION	CALTEX OIL NZ LTD	12/06/1997	08/07/1997	08/07/1997		REDEVELOPMENT OF EXIST CALTEX SERVICE STATION & SIGNS	Restricted Dis.	Land Use	N	Robert Chan	Granted				
36876	9066/11	11 Cortina Pl Pakuranga 2010	CHEVRON NEW ZEALAND LTD	URS NEW ZEALAND LTD	12/01/2010	19/01/2010	19/01/2010	16/02/2010	EARTHWORKS IN ASSOCIATION WITH REMOVAL OF UNDERGROUND PETROLEUM TANKS.	Restricted Dis.	Land Use	N	John Newsome	Granted				
45015	9066/11	11 Cortina Pl Pakuranga 2010	PENTUM LIMITED	BENTLEY & CO. LIMITED		04/08/2014	18/08/2014		PRE-APP - NEW HEALTHCARE FACILITY ON EX-SERVICE STATION SITE INVOLVING REDEVELOPMENT OF CONTAMINATED SITE AND LIKELY CAR PARKING SHORTFALL. SITE LOCATED ON CORNER OF NEW ROAD - PART OF THE AMETI PROJECT.	Unknown	Pre Application	N	Scott Cheng	Not Recorded				

Building Consents: 11																
File Number	Holding Number	Address	Sub House	House	Street Name	Street Type	Suburb	Ward	Consent application details	Estimated Value	Received Date	Consent Issued date	CCC Date	Work Type description	Work Description	Zone Type description	LIM Status	Bag Type description
20101286	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	Removal of exting SEPA unit & 2 chamber interceptors. Extng assoc. lines capped & sealed	3000	24/05/2010	16/06/2010	19/12/2011	Demolitions	Other	Commercial	CCC Issued 19/12/2011	Minor Commercial/Industrial Consent (Blue)
695	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	INSTALL NEW Y JUNCTION & STORMWATER DRAIN	0	15/07/2014	12/06/1985		New	Drainage	Commercial	Building Permit	Paper Permits
906611	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	PORCH AREA	0	15/07/2014	25/06/1986		Additions / Alterations	Other	Commercial	Building Permit	Paper Permits
920185	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	DEMOLISH PART OF EXISTING BUILDING AND CONVERT REMAINDER INTOIWORKSHOP AT CALTEX SERVICE STATION	50000	05/11/1992	30/11/1992		New	Commercial Buildings	Industrial	CCC not Issued	Commerical and Industrial
962614	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	BACKFLOW PREVENTER FOR CAR WASH	200	20/05/1996	20/05/1996	12/06/1996	Additions / Alterations	Commercial Buildings	Commercial	CCC Issued 12/06/1996	Commerical and Industrial
973166	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	INTERNAL ALTERATIONS TO SERVICE STATION,NEW CANOPY,PUMP ISLAND & NEW SIGNAGE.AMENDS REC 25.08.97 INCREASE OF AREA TO OFFICE,MOVE WALL,TEMP BAG CI/301A FEES OWING 168.00 UPLIFTED 18.09.97 REC NO 27853	175000	11/07/1997	20/08/1997		Additions / Alterations	Commercial Buildings	Commercial	CCC not Issued	Commerical and Industrial
973166A1	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	AMENDS REC 25.08.97 INCREASE OF AREA TO OFFICE,MOVE WALL,TEMP BAG CI/301A	175000	11/07/1997	20/08/1997		Additions / Alterations	Commercial Buildings	Commercial	CCC not Issued	Commerical and Industrial
C019296	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	OFFICES (AGE OF ORIGINAL BUILDING UNKONWN)	0	15/07/2014	18/02/1985		New	Offices	Commercial	Building Permit	Paper Permits

H026386	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	KINDERGARTEN ALTERATIONS	0	15/07/2014	22/08/1990		Additions / Alterations	Other	Commercial	Building Permit	Paper Permits
J30179	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	DEMOLITION	0	15/07/2014	18/12/1991		Demolitions	Other	Commercial	Building Permit	Paper Permits
K7872	H220972	11 CORTINA PL PAKURANGA 2010		11	CORTINA	PL	PAKURANGA	WARD PAKURANGA	SERVICE STATION - GROUND FLOOR 174 M2. OUTBUILDINGS 465 M2	0	19/06/2010	21/02/1992		New	Commercial Buildings	Miscellaneous	Building Permit	Paper Permits

LIR	Export To LIR Print Template		
LIR Number	Comments	Title	Register
LIR_000097 09	REFER TO PUBLIC HEALTH INSPECTORS (MR N BEASER) INTER OFFICE MEMO ON FILE FO1 DATED 10.12.85. SUGGESTED REQUIREMENT IS THAT ANY BUILDING CONSTRUCTION OR EXCAVATION WITHIN 2.0 METRES OF MCC 300mm WATERMAIN BE REFERRED TO MCC PUBLIC HEALTH ENGINEER. THE PURPOSE IS TO PROVIDE ADDITIONAL PROTECTION TO MCC 300mm WATERMAIN. ALLOT 319 PAKURANGA PSH WHICH IS ALSO REFERRED TO IN THE MEMO IS NOW LOT 1 DP 110669.	WATERMAIN PROTECTION CORTINA PLACE	C.655
LIR_000309 87	SITES MAY BE SUBJECT TO SURFACE WATER OVERLAND FLOWPATH IN HEAVY RAINFALL EVENTS. PRIOR TO ANY CONSENT TO SUBDIVISION OR BUILDING THE COUNCIL MAY REQUIRE ANY OR ALL OF THE FOLLOWING. 1) DETAILED FLOOD ASSESSMENT BY A REGISTERED ENGINEER. 2) SPECIFIC FLOOR LEVEL DESIGN. 3) THE CREATION OF AN OVERLAND FLOWPATH EASEMENT IN FAVOUR OF THE COUNCIL. 4) THE ISSUE OF A SECTION 36 (2) CERTIFICATE IN TERMS OF THE BUILDING ACT. 5) SPECIFIC DESIGN OF ANY PROPOSED SITE WORKS. THE ABOVE MEASURES MAY PRECLUDE THE PLACEMENT OF ADDITIONAL BUILDINGS ON THE SITE OR THE CONSENT TO A SUBDIVISION OF THE LAND.	INTER-OFFICE MEMO	C.805

AECOM

Former Caltex Pakuranga Remediation
Chevron Environmental Management Company
07-Jun-2016

Former Caltex Pakuranga

Site Validation Report

Former Caltex Pakuranga

Site Validation Report

Client: Chevron Environmental Management Company

Co No.: N/A

Prepared by

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07-Jun-2016

Job No.: 60492475

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Quality Information

Document Former Caltex Pakuranga

Ref 60492475

Date 07-Jun-2016

Prepared by Ned Wells

Reviewed by Andrew Walker

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Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	7-June-2016	FINAL	Sarah Knowles Associate Director	

Table of Contents

Executive Summary

Chevron Environmental Management Company (EMC) undertook planned remedial excavation works at the former Caltex Pakuranga service station located at 64 Ti Rakau Drive/11 Cortina Place, Pakuranga, Auckland (hereinafter referred to as the Site).

This Soil Validation Report (SVR) provides details of the works undertaken in accordance with consents issued for the works by Auckland Council (ref 49495 and P-49517).

The Site was closed in May 2010 with the underground petroleum storage system (UPSS) decommissioned and removed. Soil benchmarking undertaken during the UPSS removal identified concentrations of petroleum hydrocarbons in soil at the Site that exceeded criteria for commercial/industrial (C&I) land-use as defined within Ministry of the Environment (MfE) Guidelines (MfE Guidelines)[1].

In April and early May 2016, EMC commissioned Fuel Installations Auckland Limited (FIAL) to undertake a remedial excavation for the removal of hydrocarbon impacted soil with subsequent backfilling of the excavation void with validated spoil won from the excavation and imported aggregates. The removal of soil from the Site for offsite disposal occurred over a six week period. Over the course of the remedial works approximately 2530 tonnes of hydrocarbon impacted soil was removed from Site and disposed at Redvale Landfill, Auckland. An additional 33 tonnes disposed to Greenmont Landfill, East Tamaki, Auckland.

AECOM Consulting Services Limited (AECOM) was engaged by EMC to undertake an environmental oversight role of the works. A total of 59 soil validation samples, representative of Site conditions post remedial works and the Site won spoil used to backfill the excavation, recorded concentrations of hydrocarbons below the analytical method detection limits or at low concentrations. All soil validation results complied with MfE Guidelines for commercial/industrial land-use.

Overall, it is considered that the remedial objective has been achieved and that soil conditions at the Site meet the adopted commercial/industrial criteria.

[1] Ministry for the Environment, 1999: Guidelines for Assessing and Managing Petroleum Hydrocarbon Sites in New Zealand, revised 2011.

1.0 Introduction

Chevron EMC completed remedial works at the former Caltex Pakuranga service station Site located on Ti Rakau Drive, Pakuranga, Auckland, hereinafter referred to as the Site, during April and May 2016. Figure 1, Appendix A details the Site location. The Site is accessible from both Ti Rakau Drive and Cortina Place. The physical address for the Site is 11 Cortina Place, Pakuranga, Auckland.

The UPSS was decommissioned and removed from the Site following closure of the service station in circa May 2010 and the Site was sold to Auckland Transport (AT). The land use will remain commercial with a medical centre operated by Medispace planned for the Site. A portion of the Site to the southeast has been ear-marked for additional road carriageway, connecting Ti Rakau Drive and Cortina Place.

As a consequence of former service station activities, soil and groundwater at the Site was known to have residual hydrocarbon impact. Prior to the planned Site development as a medical centre, Chevron EMC agreed with AT to undertake a remedial excavation of soils at the Site to meet commercial/industrial land-use criteria as defined in the MfE Guidelines.

Hydrocarbon impacted soils were excavated and removed from the Site with subsequent replacement and backfilling with Site won spoil from the excavation and imported aggregates. The removal of soil from the Site for offsite disposal occurred over a six week period during April and early May 2016. AECOM field scientists were onsite during the soil excavation and removal phase of works, and obtained soil samples from the excavation walls and base as well as Site won material to benchmark the quality of soils remaining on-Site. The following report summarises the remedial works completed.

1.1 Purpose of Reporting

Land use consent 49495 and discharge consent P-49517 were granted by Auckland Council to authorise the remedial works. This SVR has been prepared in accordance with the Auckland Council consent requirements and in general accordance with MfE Contaminated Land Management Guideline No. 1[2]. The resource consents are provided as Appendix B.

Special condition 17 for consents 49495 and P-49517 states that at completion of the remedial works a SVR will be prepared and include, but not be limited to the following:

a. A summary of the works undertaken, a statement confirming whether the remediation works have been completed in accordance with the approved Remediation Action Plan (Application Report).
b. The location and dimensions of the excavations carried out, including a relevant site plan.
c. Records of any unexpected contamination encountered during the works, if applicable.
d. Copies of the disposal dockets for the material, including separate phase hydrocarbons (SPH) and groundwater removed from the Site.
e. A summary of validation sampling undertaken, tabulated analytical results, and interpretation of the results in the context of the Contaminated Land Rules of the Auckland Council Regional Plan: Air, Land and Water, and the Proposed Auckland Unitary Plan.
f. Details regarding any complaints and/or breaches of the procedures set out in the Remedial Action Plan (RAP) and the conditions of this consent.
g. Evidence of landfill disposal.
h. Conditions of the final site ground surface.
i. Scaled plans (plan and elevation views) showing the location of any contaminated materials exceeding acceptance criteria remaining on the site.

[2] MfE Contaminated Land Management Guidelines No.1 – Reporting on Contaminated Sites in New Zealand (Revised 2011).

2.0 Remedial Objective

The remedial objective was to remove soils impacted by hydrocarbon compounds from the Site which exceed commercial/industrial land-use criteria as defined by the MfE Guidelines as detailed within the AECOM Assessment of Environmental Effects (AEE)[3] as accepted by Auckland Council for this project.

Post remediation validation sample results shall not exceed the MfE Guidelines for Commercial/Industrial land-use as presented below in Table 1. The values represent the adopted acceptance criteria for the remedial works.

Table 1 1999 (rev 2011) Guidelines and NES Regulations 2011 for a C&I Land-use Scenario

Contaminant of Concern	MfE 1999 Guideline (rev 2011) C&I Guideline Value (mg/kg) for SANDY SILT[1]		NES[4] SCS – C&I (mg/kg)[2]
	Surface (<1m)	1m-4m	
Total Petroleum Hydrocarbons			
TPH C_7 to C_9	500	500	-
TPH C_{10} to C_{14}[3]	1,700	2,200	-
Benzene, Toluene, Ethyl-benzene and Xylenes			
Benzene	3.6	7.2	-
Toluene	270	480	-
Ethylbenzene	200	300	-
Xylenes	200	420	-
Polycyclic Aromatic Hydrocarbons			
Naphthalene	210	270	-
Benzo(a)pyrene (eq)	-	-	35

Note: 1) Guideline values taken from Tables 4.11 and 4.14 of the MfE 1999 Guidelines (rev 2011) for a sandy silt soil type. 2) Value taken from Table B3 of the NES User's Guide. 3) TPH C_{10} to C_{14} is a screening criteria to prompt additional PAH surrogate analysis if required. 4) Users' Guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, dated April 2012.

[3] AECOM: Former Caltex Pakuranga Service Station: Resource Consent Application & Assessment of Environmental Effects, dated February 2016.

3.0 Site Background

The Site operated at a Caltex branded service station comprised of UPSS components, forecourt, carwash, retail shop, workshop and car parking. See Figure 2 for the historical site layout. The following provides a brief summary of previous investigations undertaken following closure of the Site in May 2010.

3.1 Previous Investigations

3.1.1 May 2010 – Underground Petroleum Storage System Decommissioning

The UPSS included four underground storage tanks (USTs) comprising 2 x 40,000 litre 91 octane petrol, 1 x 40,000 litre 96 octane petrol, 1 x 20,000 litre diesel, with associated pipe work and dispensers. A soil validation and sampling exercise was completed at the time of UPSS decommissioning[5] that indicated concentrations of hydrocarbon compounds within soil remaining on-Site exceeded the MfE Guidelines, Tier 1 soil acceptance criteria for commercial/industrial land-use.

The exceedances were detected in shallow soil samples collected within the footprint of the former forecourt, generally in the vicinity of the former dispenser islands, remote fills and interceptor. No exceedances were detected in soil samples collected from the tank pit excavation in the location of the former USTs.

3.1.2 November 2011 –Groundwater Assessment

In November 2011[6] URS completed an Environmental Site Assessment (ESA) to assess shallow soil and groundwater conditions at the Site. These works involved the advancement of four boreholes and the installation and sampling from four on-site groundwater monitoring wells (MW1 to MW4). Elevated concentrations of hydrocarbon compounds were detected in soil and groundwater samples collectedfrom MW2 (located at the southwest site boundary). Groundwater flow across the Site was towards the south and at a depth of approximately 1.4 m bgl.

3.1.3 May 2014 – Site Delineation

In May 2014[7] URS undertook further environmental assessment involving the completion of sixteen test pits (TP1 to TP16). Concentrations of petroleum hydrocarbons above the MfE Guidelines for C&I land-use were detected in soil samples in the vicinity of the former stormwater interceptor and ancillary pipework. Groundwater flow across the Site was towards the southeast and at a depth ranging between approximately 1.5 and 2.1 m bgl.

3.1.4 November 2015 – Conceptual Site Model

In May 2015[8] AECOM undertook an exercise to appraise the likely extent of hydrocarbon impact in soil and groundwater beyond the boundary of the Site in Ti Rakau Drive. It was initially thought a stomwater or sewer main might be present within the carriageway, which would effectively act as a 'cut-off' for migration of hydrocarbon down the natural groundwater hydraulic gradient. An inspection of services (inverts etc) indicated that this was not the case.

A review of the existing soil and groundwater data and on-site services indicated that because of the less permeable nature of the underlying natural geology, remaining hydrocarbon impact was likely to

[5]URS 2010. Caltex Pakuranga Service Station - Underground Petroleum Storage System Decommissioning, Residual Petroleum Hydrocarbon Assessment prepared, dated 24 June 2010 (42115121).
[6] URS 2011. Caltex Pakuranga Service Station - Environmental Site Assessment, dated November 2011 (42117721).
[7] URS 2014. Former Caltex Pakuranga Service Station – Soil and Groundwater Assessment, dated September 2014 (42100310).
[8] AECOM 2015. Former Caltex Pakuranga– Conceptual Site Model, dated November 2015 (42101210).

predominantly reside around the on-site stormwater management system. This infrastructure is located parallel to the Ti Rakau Drive road frontage.

Because of the low permeability of the underlying natural geology, the extent of associated hydrocarbon dissolved phase was also expected to be limited.

Following completion of the remedial works, the residual hydrocarbon impacts within carriageway were expected to be limited and best controlled through a site management plan. Recent discussions with Auckland Council support this premise.

4.0 Remedial Rationale and Methodology

4.1 Excavation Rationale

The excavation of hydrocarbon impacted soil from the Site was completed in accordance with the AECOM consent application and AEE approved by Auckland Council through consents 49495 and P-49517. The objective of the AEE was to implement the following control measures at the Site during the remedial works programme:

- Render the Site suitable for expected future C&I land-use with respect to hydrocarbon compounds.

4.2 Principal Stakeholders

Table 2 details principal stakeholders associated with the excavation works.

Table 2 Responsible Parties to the Excavation Works

Stakeholder	Responsibility
Chevron EMC	Consent Holder. Principal to the Contract.
Auckland Transport	Site Owner.
Fuel Installations Auckland Limited (FIAL)	Remediation Contractor. Site Manager.
AECOM	Suitably Qualified Environmental Practitioner for oversight and validation of hydrocarbon impacted soil removal.

4.3 Extent of Excavation

The proposed excavation and actual excavation extents are provided on Figure 3. The proposed and actual excavations differed in shape, but were similar in overall volume. The proposed excavation extended further northeast beneath the former forecourt, whereas the actual area remediated extended northwest towards the site boundary.

Factors considered prior to excavation included:

- Managing potential environmental and human health effects associated with the excavation.
- Allowing for temporary stockpiling on-Site.
- Safe truck ingress, egress and onsite movements.
- Ability for soil validation samples to be collected immediately after soil removal.

4.4 Excavation Phasing

Easy access and a generous site area allowed the excavation work to be completed in a single phase of works, however has been broken down into Excavations A, B and C below for ease of reporting. Excavation began at the southern end of the Ti Rakau Drive boundary and was progressed in a north-westerly direction towards the northern boundary. Once all impacted material was removed from the Ti Rakau Drive boundary area, the excavation was advanced in a north-easterly direction until reaching its final extent.

4.4.1 Site Establishment and Sheet Pile Instillation

The following works were undertaken prior to excavation of hydrocarbon impacted soils;

- Establishment of site offices and security fencing.
- Installation of sheet piling along the south western boundary of the Site to protect underground services and footpath integrity.
- Installation of sediment controls.

4.4.2 Excavation Methodology

The approach to excavation varied dependent on the soil conditions encountered but can be simplified into three primary zones, former interceptor area and former forecourt area and northwest corner service corridor.

Excavation A - Former Interceptor Area

The former interceptor area lies across the front of the Site/along the Ti Rakau Drive frontage. Excavation in this area comprised the following:

- Soils (overburden) from surface to approximately 1.5 m below ground level (bgl) that appeared to be un-impacted by hydrocarbons were stripped and stockpiled in temporary stockpiles (stockpile 1) to allow for soil validation testing. The stockpiles were covered with heavy duty PVC material to stop surface water infiltration and saturation that would prevent the soils from being compacted to optimum density back in the void.
- Soils from approximately 1.5 m bgl to 3.0 m bgl were loaded directly into sealed truck and trailer units for offsite disposal. All materials removed offsite were recorded with waste manifest procedures.
- Soil validation samples were collected from the temporary stockpiles, sidewalls and base of the excavation and submitted for laboratory analysis.
- The soil validation results were then used to determine if the excavation sidewalls and base complied with the remedial objective and whether material contained in the temporary stockpiles could be reused on-Site.
- During excavation of the former interceptor area, rainwater collected in the excavation. As there was a potential for this water to be impacted with hydrocarbons, it was removed using a vacuum truck and disposed to Salters Environmental Limited located at 5 Bolderwood Place, Manukau City, Auckland. A total of 16,500 litres of rainwater was removed from the excavation.

Excavation B - Former Forecourt Area

The former forecourt area lies northwest of the former interceptor area and reflects the rectangular shape of the former forecourt slab. Excavation in this area involved the following:

- Aggregate imported (post-decommissioning) to a depth of approximately 0.3 m bgl was stripped and stockpiled (stockpile 1).
- Natural clays to a depth of approximately 0.3 m bgl to 1.0 m bgl that appeared to have marginal hydrocarbon impacts were stripped and stockpiled (stockpile 2) with the same controls as for Excavation A.
- Soil materials from approximately 1.0 m bgl to 2.5 m bgl were loaded directly into sealed truck and trailer units for offsite disposal.

- Soil validation samples were collected from the temporary stockpiles, sidewalls and base of the excavation and submitted for laboratory analysis.
- The soil validation results were then used to determine if the excavation sidewalls and base complied with the remedial objective and whether the clay material contained in the temporary stockpiles could be reused onsite.

Excavation C- North West Corner Service Corridor

The northwest service corridor area runs from the northwest corner of site to adjacent to the former dispenser area. The area contained numerous stormwater pipes and associated bedding material from both the service station site layout and historical drainage which had acted as conduits for migration of hydrocarbons. Excavation in this area involved the following:

- Aggregate to a depth of approximately 0.3 m bgl stripped and stockpiled. Stockpile controls as per Excavation A (stockpile 1).
- Chasing and removing redundant services and any associated bedding material with evidence of hydrocarbon impact.
- Natural clay soils from approximately 0.3 m bgl to 1.0 m bgl not in close proximity to service trenches that appeared to have marginal hydrocarbon impacts were stripped and stockpiled (stockpile 2).
- Sandy soils from approximately 1.0 m bgl to 2.5 m bgl were loaded directly into sealed truck and trailer units for offsite disposal.
- Soil validation samples were collected from the temporary stockpiles, sidewalls and base of the excavation and submitted for laboratory analysis.
- The soil validation results were then used to determine if the excavation sidewalls and base complied with the remedial objective and whether the clay material contained in the temporary stockpiles could be reused onsite.

Upon confirmation that the material from stockpile 1 and stockpile 2 as well as excavation sidewall and excavation base samples complied with the adopted acceptance criteria (Table 1), the excavation was backfilled with stockpiled material and imported quarry aggregate. The reinstatement and compaction methodology is summarised in Section 4.5 below.

4.5 Backfilling and Compaction

The backfilling of Excavation Areas A and B followed the process described below. Backfilling did not commence until the validation sample analysis showed that soils remaining met the validation criteria.

Although compaction effort was applied to the backfill in accordance with the requirements of the construction specification, compaction was not monitored by a geotechnical engineer and certification of the backfill compaction is not provided. The fill will be noted on the council property file as non-engineered fill.

a) Material A19a filter fabric was placed at depth within the base of the excavation directly onto natural ground (peat/clay layer).

b) A 'no fines' aggregate (pea-gravel) was placed on top of the filter fabric for the extent that was below the observed ground water level. This material required no compaction, is unaffected by rising groundwater and will not wick groundwater into subsequently placed fine grained backfill.

c) A second layer of A19 filter fabric was placed on top of the pea-gravel.

d) Un-impacted site won aggregate from stockpile 1 was placed on top of the natural ground bench formed in the eastern corner of the excavation. This material was placed in layers not exceeding 200mm and track rolled by a 30 t excavator.

e) Imported virgin quarry aggregate was placed on top of the filter fabric to a depth of 1.5 m bgl and compacted by 4 passes of a 6.5 tonne drum roller.

f) Along the Ti Rakau Drive frontage a 1.1 m by 5.0 m (depth x width) strip of site won topsoil and silt was placed and compacted by 4 passes of the 6.5 tonne drum roller.

g) Two 200 mm layers of site won clay material were placed above the aggregate material across the void excluding the area described above at a depth of between 1.1 m and 1.5 m bgl. Both layers were compacted by 4 passes with a 6.5 tonne drum roller.

h) The remainder of the void was filled with imported virgin aggregate to approximately 0.2 m bgl and compacted with 8 passes of 6.5 tonne drum roller.

i) The Site was left approximately 200 mm low to facilitate future development, as agreed with AT.

A backfill profile schematic is provided in Section A – A' within Figure 4.

4.6 Compliance with the Consent and Excavation Oversight

An AECOM environmental scientist was onsite between 29 March and 27 April 2016 to supervise the excavation and removal of contaminated soils from the Site. The AECOM representative performed the following tasks:

- Observed compliance with the Auckland Council resource consent(s).
- Observed compliance with the AECOM AEE.
- Observed excavation areas and load out onto truck and trailer units.
- Retained a vehicle movement log of truck number, approximate loaded volume, and disposal location.
- Collected photo evidence of the excavation works (refer Plates 1 through 31 in **Appendix E**).
- Collected soil validation samples and dispatched these to Hill Laboratories Limited (Hills) for analysis. Chain of custody information is provided in **Appendix C**.

4.7 Disposal Rationale

In accordance with the AEE, excavation materials were either disposed of offsite to Greenmount or Redvale Landfills, or temporarily stockpiled onsite for re-use (pending receipt of soil validation results). A summary of excavated materials is provided in Section 5.1.

4.8 Re-use of Site Material Rationale

Two stock-piles were created during the works to allow re-use of materials below the acceptance criteria from the Site. Stockpile 1 comprised Site won aggregates and topsoil. Stockpile 2 comprised Site won natural clay material. PID headspace sampling supported a validation sampling exercise for both these stockpiles.

Concentrations of hydrocarbons in soil sampled from stockpile 1 were below laboratory detection limits and therefore below the C&I acceptance criteria.

Concentrations of hydrocarbons in soil sampled from stockpile 2 were above laboratory detection limits but below the C&I acceptance criteria for soils placed between 1 and 4 m bgl. Therefore, these soils were placed between 1.1 and 1.5 m bgl to meet C&I acceptance criteria. It is noted that these soils were mostly placed above the highest measured groundwater level of 1.4 m bgl. Compaction of the material is expected to increase the density of the material and reduce contact with groundwater.

A summary of excavated materials is provided in Section 5.1.

4.9 Separate Phase Hydrocarbons Removal and Monitoring

Standing SPH was not observed within the excavation during the remedial works.

4.10 Soil Validation Sampling

AECOM collected and requested from Hills, the analysis of 59 soil validation samples over the course of the remedial works, including four duplicates. All soils samples were submitted for total petroleum hydrocarbon (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX) analysis. In summary:

- Seven soil validation samples were collected and analysed from the temporarily stockpiled overburden, soil that was returned to the excavation. One duplicate sample was also analysed. This corresponds to one sample for every 41 m^3 of stockpiled overburden.
- Fifty two soil validation samples were analysed from the sidewalls and base of the excavation area at depths of 0.5 m to 3.0 m bgl. Three duplicate soil samples were collected, at ratio of one duplicate sample for every 20 validation samples., Due to the high density validation sampling undertaken, three duplicate samples are considered adequate for QA/QC purposes.
- A single sample was analysed to validate historical results of elevated hydrocarbons in soil. This material was subsequently removed.

Soil validation sample locations are illustrated in **Figure 4.** Tabulated soil analytical results can be viewed in **Appendix D**.

4.11 Imported Material

Importation of materials was limited to the following:

- Pea metal from Winstone Aggregates, Hunua Gorge, Papakura.
- Virgin aggregate from Stevenson Quarry, Quarry Road, Drury.

A copy of the imported material documentation is included in **Appendix C**.

5.0 Summary of Remedial Works

5.1 Summary of Excavated Materials

Over the course of the remedial works approximately 2530 tonnes of contaminated soil was removed from the Site and disposed to Redvale Landfill (North Shore), Auckland. A single load (33 tonnes) of grass and topsoil was disposed to Greenmount Landfill (East Tamaki). Table 3 below provides a summary of the disposal locations. Additionally, a further 10 tonnes of impacted concrete was disposed to Redvale Landfill.

Table 3 Soil Disposal Locations and Volumes

Disposal Location	Tonnage
Redvale Landfill	2530
Greenmount Landfill	33

In addition to the 2563 tonnes / 1422 m^3 (at a density of 1.8 t/m^3) of impacted soil disposed to landfill, a further 287 m^3 (loose measure) of "clean" overburden material was stockpiled on Site to be returned to the excavation. At the completion of each excavation phase, a survey was undertaken by a registered surveyor (Survey Worx Limited) to determine the volume of the excavation and volume of stockpiled overburden.

Table 4 provides a summary of soil excavated from the Site. **Appendix E** provides a photographic record of the works undertaken.

Table 4 Excavation Volume Summary

Excavation Summary	Volume / %
Volume Disposed to Landfill (m^3)	1422 m^3
Volume of Material Stockpiled Onsite (m^3)	205 m^3
Total Volume Excavated (m^3)	1627 m^3
Total Surveyed Volume of Excavation (m^3)	1421 m^3
Difference between Volume of Excavation and Volume Excavated	206 m^3

1; Volume calculated based on a density of 1.8 tonnes/m^3

Overall, it is considered that the volume of material excavated from the Site is consistent with surveyed volume of the excavation. The 12.5 % difference in calculated volumes reflects the inaccuracy of truck measurements and bulking factors, and more importantly, that the survey volume does not fully account for the undulating grade across the site as levelling of the site to facilitate the works had already occurred at the time of survey. This difference is not considered to be significant.

Copies of the disposal documentation are included in **Appendix F**.

5.2 Summary of Backfill Materials

In addition to overburden materials of approximately 205 m^3, the following volumes of backfill materials were imported to the Site:

- 1451 m^3 virgin quarry aggregate sourced from Stevenson Quarry
- 150 m^3 of GAP10 gravel (pea gravel) sourced from Winstone Aggregates

Copies of imported fill dockets are provided in **Appendix G**.

Table 5 Comparison of Excavated and Imported Soil Volumes

Materials Summary	Volume / %
Volume (compacted) Overburden Stockpiled Onsite for Reuse	205 m^3
Volume (compacted) Pea Gravel	150 m^3
Volume (compacted) GAP40	70 m^3
Volume (compacted) GAP65	1026 m^3
Total Volume Placed in Excavation	1451 m^3
Total Surveyed Volume of Excavation (m^3)	1421 m^3
Difference between Surveyed Volume and Volume Placed in Excavation	30 m^3 / 2 %

Overall, it is considered that the surveyed volume is consistent with the volume of material imported to the Site. The 2 % difference calculated between surveyed volume and imported material reflects the inaccuracy of truck measurements and adopted compaction factors and is not considered to be significant.

5.3 Summary of Soil Validation Results

Figure 2 illustrates soil validation sample locations. Soil validation results are indicative of Site conditions post remedial works. Laboratory reports and chain of custody documentation are provided in **Appendix C**.

5.3.1 Validation Results

Soil validation results for samples collected from the walls and base of the excavation at its final extent are presented in Tables 6 and 7 in **Appendix D**. Soil validation results were compared against the adopted acceptance criteria for the remedial works as outlined in Table 1. Reported concentrations of TPH and BTEX were below the adopted acceptance criteria for the remedial works.

5.3.2 Overburden Stockpiles Results

Soil validation results for samples collected from the temporary overburden stockpiles are provided in **Appendix D** and compared against the adopted acceptance criteria for the remedial works as outlined in Table 1. Concentrations of TPH and BTEX reported for all validation stockpile samples were below the adopted acceptance criteria for depth of placement and were deemed suitable for backfill between 1.1 and 1.5 m bgl.

5.3.3 Quality Assurance / Quality Control Samples

Hills hold IANZ accreditation for the sample analyses undertaken. The laboratory report did not note any issues with analytical quality.

For QA/QC purposes, four duplicate soil samples were collected for analysis. The relative percentage difference (RPD) between the primary samples (SAC721, 728, 743 and 761) and the duplicate soil samples (SAC722, 730, 744 and 762) are presented in **Appendix D**.

The RPD data ranged between 21% and 142%. The MfE Guidelines allow a variability range of up to 50% (MfE, 2004, revised 2011). This variation is most likely due to natural soil heterogeneity and onsite stockpile mixing. However, higher RPD are often encountered where sample results are at low

concentrations close to the laboratory detection limits. It is considered that the soil analytical results are appropriate and suitable for the purpose of this site investigation.

5.3.4 Imported Material Validation Results

All imported aggregate was virgin material obtained from licensed suppliers of cleanfill and did not require validation sampling. Imported material dockets are provided in **Appendix G**.

5.4 Sheetpile Abandonment

Due to unforeseen ground conditions a total of 12 sheetpiles were abandoned *in-situ*. Each sheetpile was cut off to approximately 1.5 m bgl to facilitate service installation to the Site. The location of the abandoned sheetpiles is provided in **Figure 3**.

6.0 Closure

In April 2016, Chevron EMC undertook a remediation of hydrocarbon impacted soils by excavation and removal of soils above commercial/industrial land-use standards.

The remedial objective was to remove soils from Site which exceeded commercial/industrial land-use as defined by the MfE 1999 Guidelines as the adopted acceptance criteria.

The excavation of soil materials from the Site took place over a four week period between 4 April and 27 April 2016. Over the course of the remedial works approximately 2560 tonnes of contaminated soil materials was removed from the Site and disposed to either Greenmount or Redvale Landfills.

No unexpected contamination was encountered during the works. Standing SPH was not observed within the excavation during the remedial works.

Fifty-nine soil samples, representative of Site conditions post remedial works and backfill material used to reinstate the excavation, recorded contaminant concentrations below the method detection limit or at low concentrations. All detected TPH and BTEX concentrations complied with the commercial/industrial adopted acceptance criteria.

A summary of the works undertaken, a statement confirming whether the remediation works have been completed in accordance with the approved Remediation Action Plan (Application Report).

The remediation works have been completed in accordance with the approved RAP. Overall, it is considered that the remedial objective has been achieved and that the soil conditions at the Site meet the adopted acceptance criteria for ongoing commercial/industrial land-use at the Site.

7.0 Standard Limitation

AECOM Consulting Services (NZ) Limited (AECOM) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Chevron EMC and only those third parties who have been authorised in writing by AECOM to rely on this Report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 24 March 2016.

Where this Report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the Report. AECOM assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between 29 March and 24 May 2016 and is based on the conditions encountered and information reviewed at the time of preparation. AECOM disclaims responsibility for any changes that may have occurred after this time.

This Report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This Report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Except as required by law, no third party may use or rely on this Report unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

To the extent permitted by law, AECOM expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. AECOM does not admit that any action, liability or claim may exist or be available to any third party.

Except as specifically stated in this section, AECOM does not authorise the use of this Report by any third party.

It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Based on the works undertaken by AECOM, in accordance with the scope described in this Report, the soil conditions assessed by AECOM at the site are consistent with the use of the site for commercial/industrial determined in accordance with industry standards and environmental regulatory authority standards, guidelines and/or assessment criteria applicable to the site as at the date of this Report.

This conclusion and all information in this Report is provided strictly in accordance with and subject to the following limitations and recommendations:

a) This Report has been prepared for the sole benefit of Chevron EMC.

b) Except as required by law, no third party may use or rely on, this Report unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

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

d) This conclusion is based solely on the information and findings contained in this Report.

e) This conclusion is based solely on the scope of work agreed between AECOM and Chevron EMC and described in Section 1.1 ("Purpose of reporting") of this Report.

f) This Report is dated 24 May 2016 and is based on the conditions encountered during the site investigations conducted, and information reviewed, from April 2016 to May 2016. AECOM accepts no responsibility for any events arising from any changes in site conditions or in the information reviewed that have occurred after the completion of the site investigations.

g) The investigations carried out for the purposes of the Report have been undertaken, and the Report has been prepared, in accordance with normal prudent practice and by reference to applicable environmental regulatory authority and industry standards, guidelines and assessment criteria in existence at the date of this Report.

h) Where this Report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the Report. AECOM assumes no liability for any inaccuracies in or omissions to that information.

i) AECOM has tested only for those chemicals specifically referred to in this Report. AECOM makes no statement or representation as to the existence (or otherwise) of any other chemicals.

j) Except as otherwise specifically stated in this Report, AECOM makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or materials from such buildings disposed of on the site, the site may contain asbestos or ACM. Without limiting the generality of sub-clauses (h) and (m), even if asbestos was tested for and those test results did not reveal the presence of asbestos at specific points of sampling, asbestos may still be present at the site if fill has been imported at any time, or if any buildings constructed prior to 1970 have been demolished on the site or materials from such buildings disposed of on the site.

k) No investigations have been undertaken into any offsite conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site.

l) Investigations undertaken in respect of this Report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and contamination may have been identified in this Report.

m) Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations described in this Report. It is unlikely therefore that the results and estimations expressed in this Report will represent conditions at any location removed from the specific points of sampling.

n) A site which appears to be unaffected by contamination at the time the Report was prepared may later, due to natural phenomena or human intervention, become contaminated.

o) Except as specifically stated above, AECOM makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

p) Use, development or re-development of the site for any purpose may require planning and other approvals and, in some cases, environmental regulatory authority approval. AECOM offers no opinion as to whether the current use has any or all approvals required, is operating in accordance with any approvals, the likelihood of obtaining any approvals for development or redevelopment of the site, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environmental works.

q) AECOM makes no determination or recommendation regarding a decision to provide or not to provide financing with respect to the site.

r) The ongoing use of the site and/or the use of the site for any different purpose may require the owner/user to manage and/or remediate site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this Report.

s) To the extent permitted by law, AECOM expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. AECOM does not admit that any action, liability or claim may exist or be available to any third party.

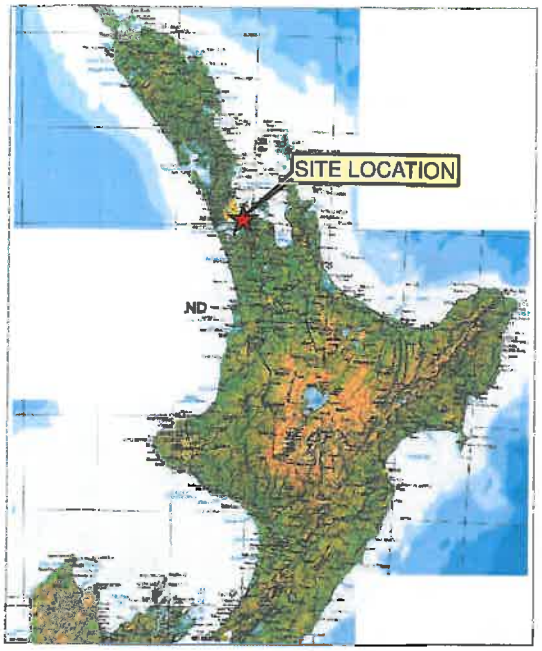
t) Except as specifically stated in this section, AECOM does not authorise the use of this Report by any third party.

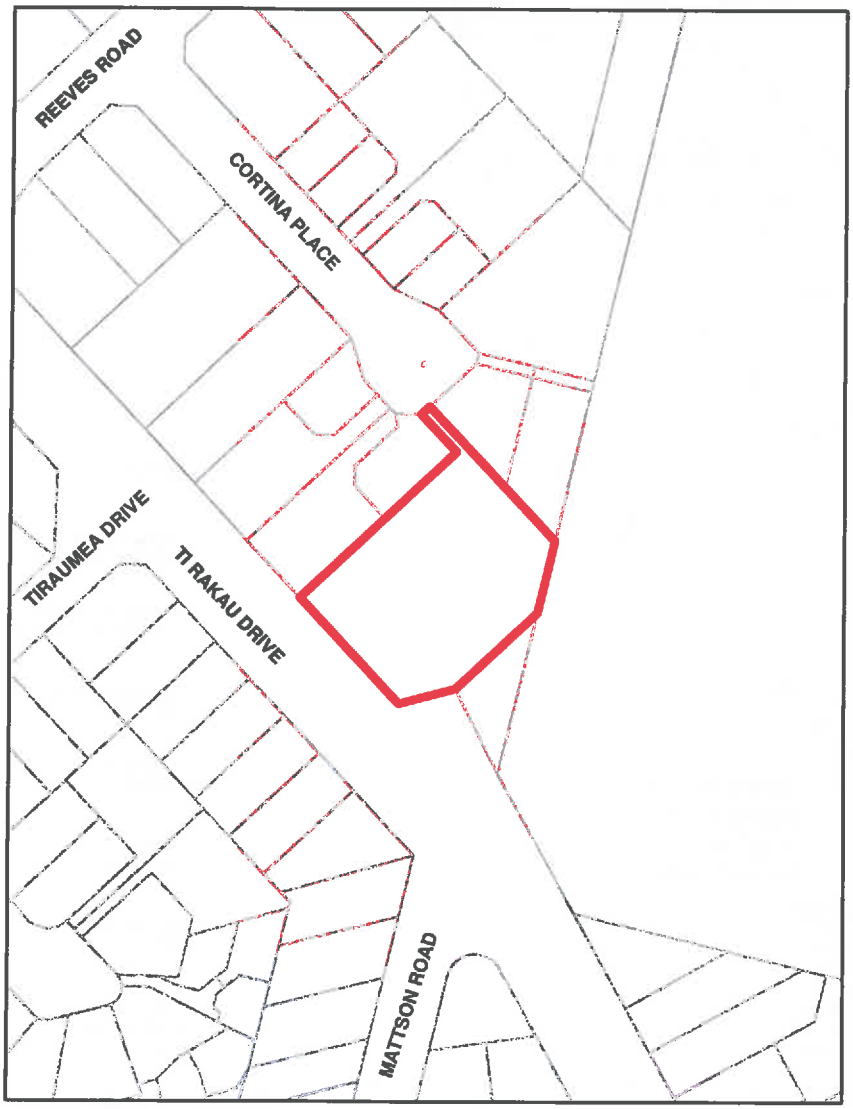
u) It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Appendix A

Figures 1 to 4

Appendix A Figures





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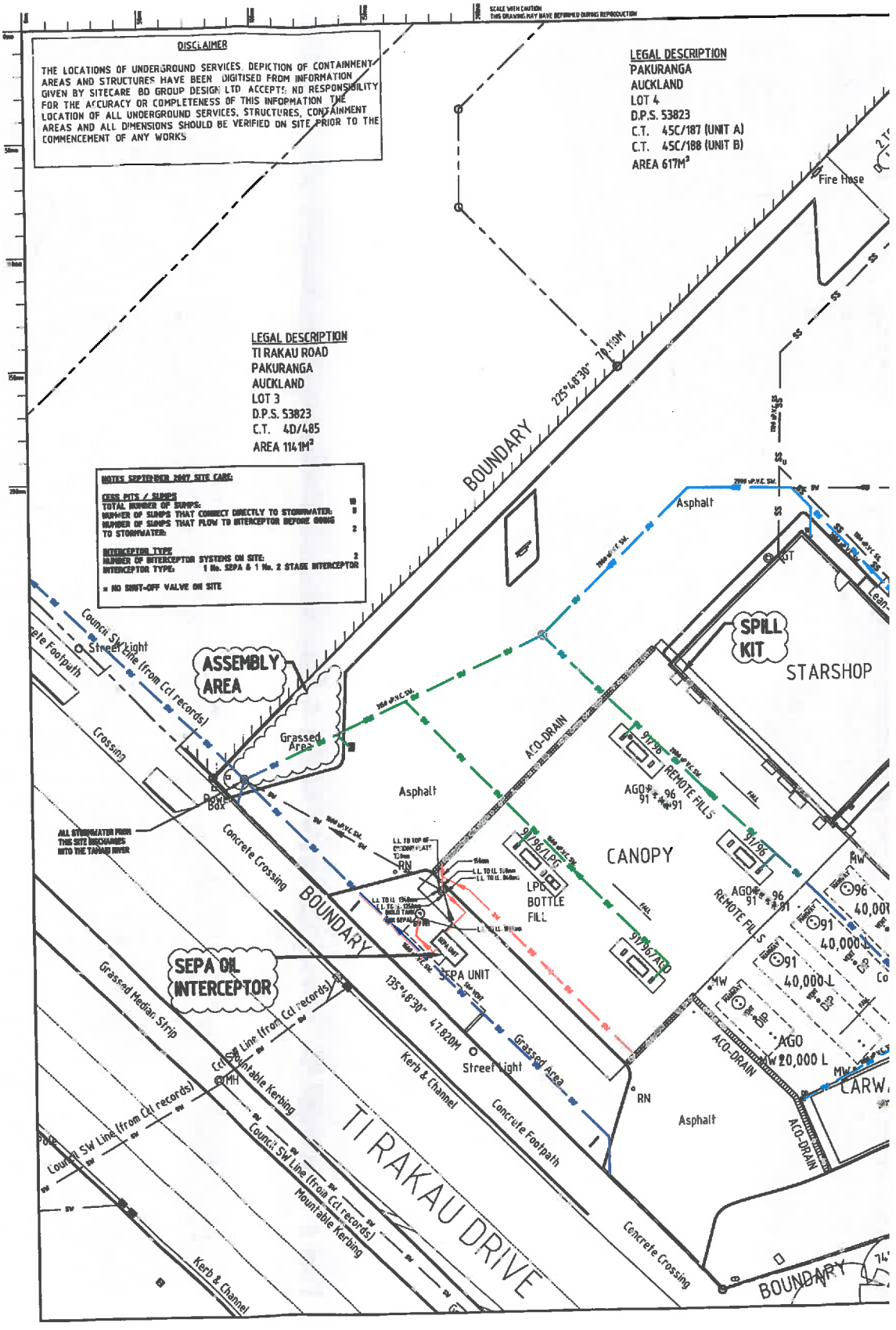

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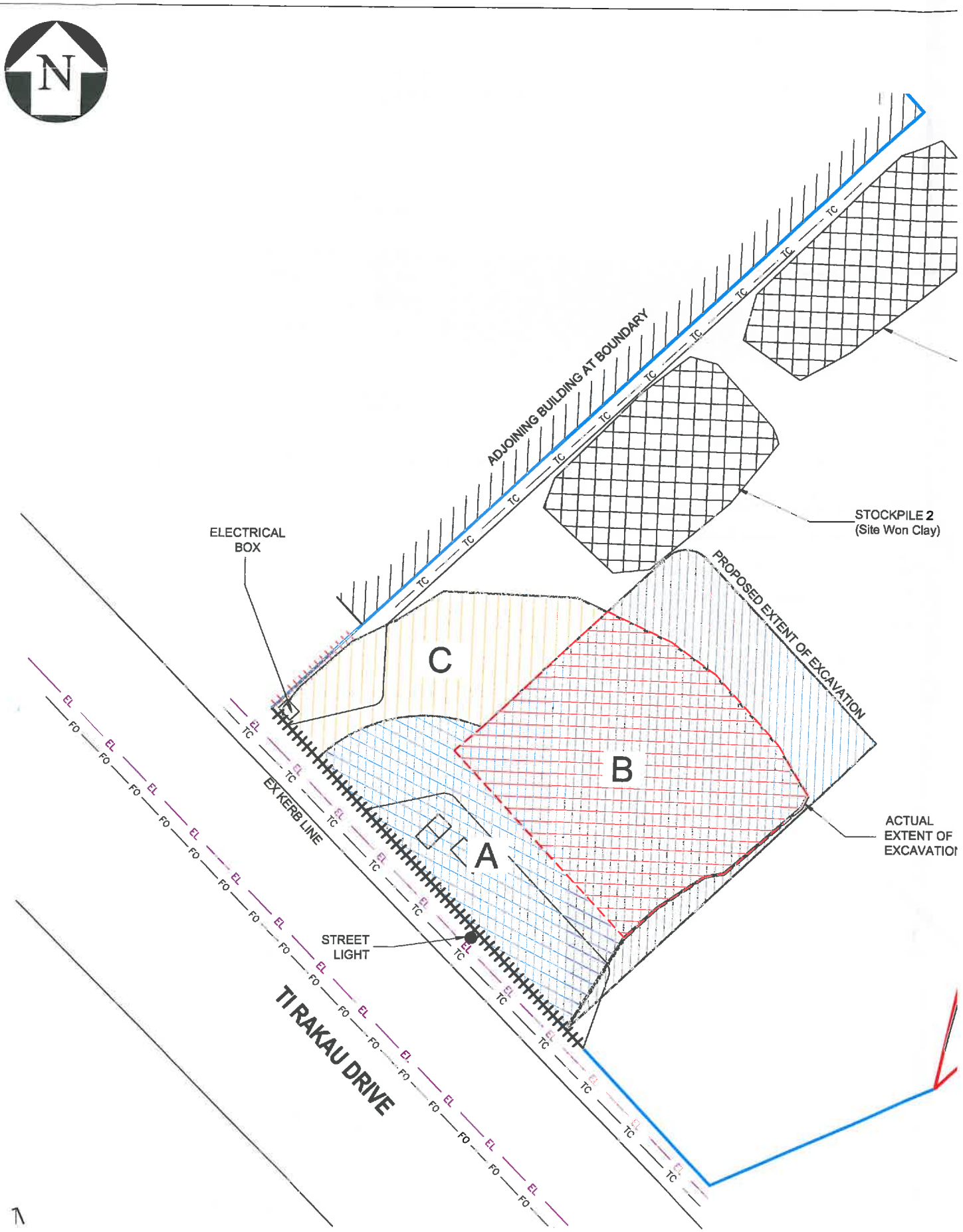

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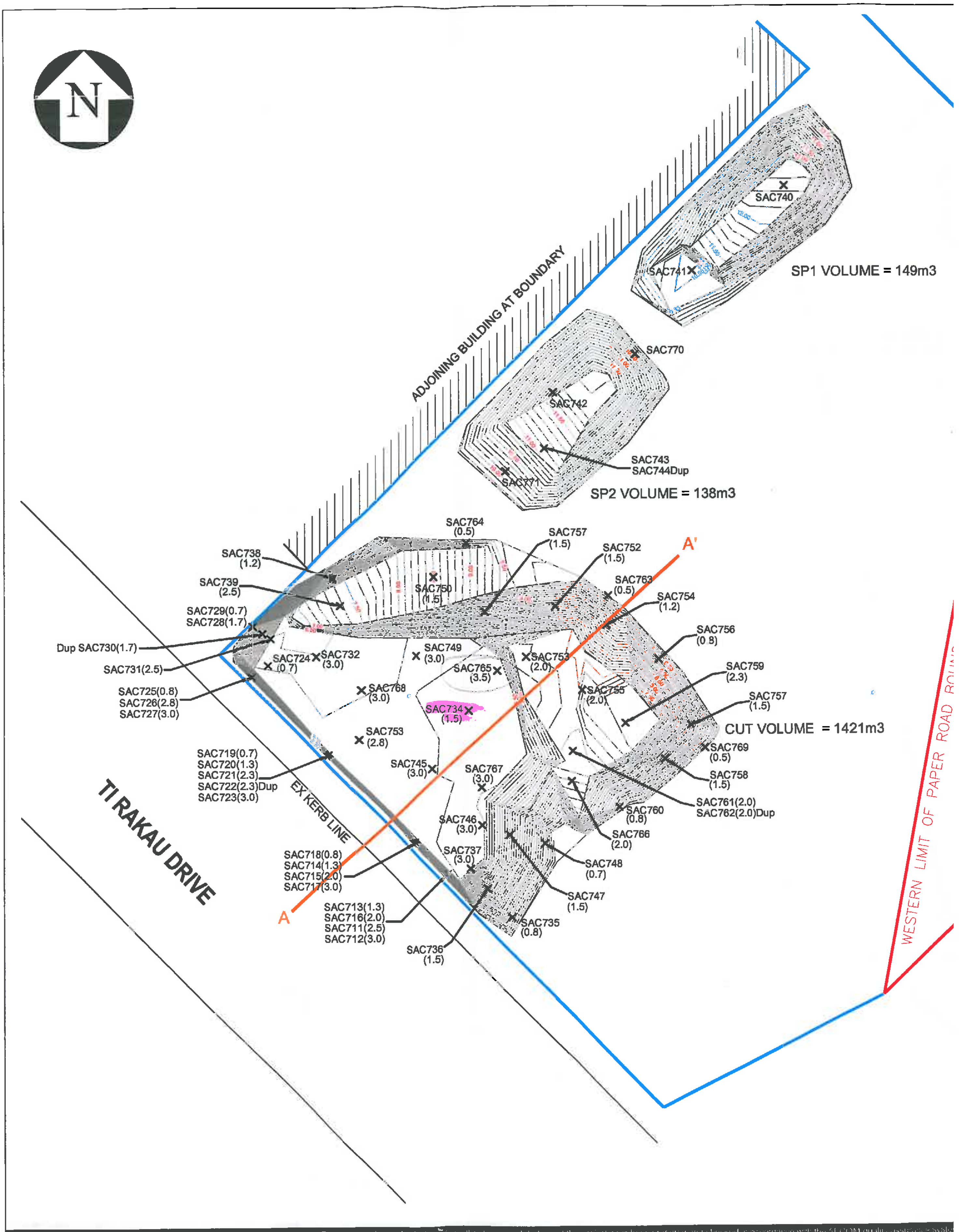

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Appendix B

Resource Consents

Appendix B Resource Consents

Decision on application(s) for resource consent under the Resource Management Act 1991 & NES

Restricted Discretionary Activity under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

Controlled Activity under the Auckland Regional Plan (Air, Land & Water).

Controlled Activity under the Proposed Auckland Unitary Plan (PAUP).

Restricted Discretionary Activity under the Operative District Plan (Manukau Section).

Application number(s):	49495 (ODP & NES) and P-49517 (Regional - Contaminated Land)
Applicant:	Chevron New Zealand
Site address:	11 Cortina Place, Pakuranga
Legal description:	Section 4 Survey Office Plan 468793

Proposal:

For remediation of a former service station site to remove soils contaminated by petroleum hydrocarbon compounds in and around the historical fuel dispensers and stormwater interceptor locations.

The resource consents required are:

Land use consents (s9)

Auckland Council Operative District Plan: Manukau Section

- Restricted Discretionary Activity under Rule 9.8.2 for earthworks exceeding 200m³ being approximately 1600m³.

National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health ("NES")

- The relevant NES activity to this proposal is disturbing the soil. The proposal does not meet all permitted activity requirements; however, a Remedial Action Plan (RAP) has been submitted for identification and handling of contamination during the excavation works and off-site soil disposal protocols. Validation sampling will be undertaken for all imported soil and soil remaining on site. Therefore, the activity under NES is a Restricted Discretionary Activity as per Regulation 10.

Discharge consents (s15)

Auckland Council Regional Plan: Air, Land & Water

- Controlled Activity under Rule 5.5.44 of the Auckland Council Regional Plan: Air, Land and Water (ACRPALW) for land disturbance to contaminated land.

Proposed Auckland Unitary Plan (PAUP)

- Controlled Activity for discharge of contaminants (due to the presence of petroleum hydrocarbon) from disturbing soil on the site.

Decision

I have read the application(s), supporting documents, and the report and recommendations on the consent application(s). I am satisfied that I have sufficient information to consider the matters required by the Resource Management Act 1991 (RMA) and make a decision under delegated authority on the application(s).

Acting under delegated authority, under sections 104, 104A, 104C, 108 and Part 2 of the RMA, the application(s) are **GRANTED**.

1. Reasons

The reasons for this decision are:

The application satisfies the sustainable management purpose of Part 2 of the Resource Management Act 1991 by remedying the adverse effects of contamination of a physical resource , and meets the requirements of sections 104, 104A, 104C, 105, 107 & 108 of the Act.

In accordance with an assessment under s104(1)(a) of the Resource Management Act the actual and potential effects from the proposal will be mitigated or remedied as:

- Due to the flat topography of the area where the proposed works will be undertaken within the site, the effects from the earthworks will not undermine the stability of the land nor will the surrounding land become eroded as a result of the proposed works.
- Management of potential adverse effects such as runoff and dust can be adequately achieved with standard site (sedimentation) control techniques.
- All contaminated soil requiring off-site disposal is to be disposed of to an appropriately licensed landfill facility.
- Sampling of any contaminated stormwater or groundwater encountered during the excavation works will be undertaken to determine appropriate handling or disposal options for the water.
- Any level of discharge from the site containing contaminants will be adequately controlled and monitored. A Remedial Action Plan (RAP) is submitted as part of this application to manage potential human health/health & safety risks from exposure to contaminants.
- There will be no requirement to undertake road closures or interfere with pedestrian movements.
- The works will be undertaken during standard construction hours and in accordance with

relevant standards pertaining to construction.

- The land comprising the application site does not contain any recorded archaeological sites or other features of cultural heritage.
- In the long term, the proposed works are anticipated to result in improvements to the general quality of the receiving environment through the removal of contaminated soil from the site. In addition, the proposal will allow future unencumbered use of the land.

In accordance with an assessment under s104(1)(b) of the Resource Management Act, the proposed works are consistent with the relevant policy statements and plans or proposed plans. Specifically, through the remediation works the quality of the environment will be enhanced as contaminated soils will be removed, limiting potential future adverse effects on human health and groundwater. Overall, the works will result in a long term improvement to the site and to the receiving environment.

An assessment under s104(1)(c) of the Resource Management Act, other relevant matters, including discharge of contaminants to land and water, have been considered necessary in the determination of the application and conditions of consent are imposed accordingly to remedy or mitigate any adverse effects that may potentially arise.

2. Conditions

Under section 108 of the RMA, these consents are subject to the following conditions:

General conditions applicable to all consents (49495 & P-49517)

Activity in accordance with information and plans

1. The remedial site works shall be carried out in accordance with the plans and all information submitted with the application, detailed below, and all referenced by the council.

   - Application Form, and Assessment of Environmental Effects prepared by AECOM, dated 19 February 2016 and titled *"Former Caltex Pakuranga Service Station - Resource Consent Application and Assessment of Effects"*.

Plan title and reference	Author	Rev	Dated
Preliminary Works Project No. 60435537	AECOM	-	18/02/2016
Remedial Works Project No. 60435537	AECOM	-	18/02/2016

2. This consent (or any part thereof) shall not commence until such time as the following charges, which are owing at the time the council's decision is notified, have been paid in full:

   a. All fixed charges relating to the receiving, processing and granting of this resource consent under section 36(1) of the Resource Management Act 1991 (RMA); and

   b. All additional charges imposed under section 36(3) of the RMA to enable the council to recover its actual and reasonable costs in respect of this application, which are beyond challenge.

3. The consent holder shall pay any subsequent further charges imposed under section 36 of the RMA relating to the receiving, processing and granting of this resource consent within 20 days of receipt of notification of a requirement to pay the same, provided that, in the case of any additional charges under section 36(3) of the RMA that are subject to challenge, the consent holder shall pay such amount as is determined by that process to be due and owing, within 20 days of receipt of the relevant decision.

4. Under section 125 of the RMA, this consent lapses five years after the date it is granted unless:

   a. The consent is given effect to; or

   b. The council extends the period after which the consent lapses.

5. The consent holder shall pay the council an initial consent compliance monitoring charge of $280 (inclusive of GST), plus any further monitoring charge or charges to recover the actual and reasonable costs that have been incurred to ensure compliance with the conditions attached to this consent.

Specific conditions – Earthworks (49495)

Pre-commencement meeting

6. Prior to the commencement of the earthworks activity, the consent holder shall hold a pre-start meeting that:

   - is located on the subject site
   - is scheduled not less than five days before the anticipated commencement of earthworks
   - includes Auckland Council officer[s] from the Monitoring Team
   - includes representation from the contractors who will undertake the works

   The meeting shall discuss the erosion and sediment control measures, and the earthworks methodology, and shall ensure all relevant parties are aware of, and familiar with, the applicable conditions of this consent.

   The following information shall be made available at the pre-start meeting:

   - Timeframes for key stages of the works authorised under this consent
   - Approved Traffic Management Plan (TMP).

   Advice Note:

   To arrange the pre-start meeting please contact the Team Leader Southern Monitoring to arrange this meeting on monitoring@aucklandcouncil.govt.nz, or 09 301 0101. The conditions of consent should be discussed at this meeting. All additional information required by the Council should be provided 2 days prior to the meeting.

7. Prior to the pre-start meeting, a finalised Traffic Management Plan (TMP) shall be submitted to, and approved by, the Council's Team Leader – Southern Monitoring. The TMP shall address the control of vehicle movements to and from the site. No earthworks activity shall commence until written confirmation of the TMP is provided by the Team Leader - Southern Monitoring.

8. There shall be no deposition of earth, mud, dirt or other debris on any road or footpath resulting from earthworks activity on the subject site. In the event that such deposition does occur, it shall

immediately be removed. In no instance shall roads or footpaths be washed down with water without appropriate erosion and sediment control measures in place to prevent contamination of the stormwater drainage system, watercourses or receiving waters.

Advice Note:

In order to prevent sediment laden water entering waterways from the road, the following methods may be adopted to prevent or address discharges should they occur:

- *provision of a stabilised entry and exit(s) point for vehicles*
- *provision of wheel wash facilities (where appropriate)*
- *ceasing of vehicle movement until materials are removed*
- *cleaning of road surfaces using street-sweepers*
- *silt and sediment traps*
- *catchpits or enviropods*

In no circumstances should the washing of deposited materials into drains be advised or otherwise condoned.

Discharge from the site includes the disposal of water (e.g. perched groundwater or collected stormwater) from excavations.

It is recommended that you discuss any potential measures with the Council's monitoring officer who may be able to provide further guidance on the most appropriate approach to take. Please contact the Team Leader Southern Monitoring for more details. Alternatively, please refer to Auckland Regional Council, Technical Publication No. 90, Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region.

9. Where earthworks on the site are creating vibrations, that in the opinion of the Team Leader – Southern Monitoring, constitute an unreasonable disturbance beyond the boundaries of the subject site, the consent holder shall engage a suitably qualified expert to undertake monitoring and provide confirmation that peak particle velocities measured on any foundation or uppermost full storey of any building not located on the subject site, do not exceed the limits set out in Table 1 of German Standard DIN 4150 Part 3:1986 "Structural Vibration in Buildings – Effects on Structures."

Specific conditions – Discharge to land and NES (P-49517 & 49495)

10. During the remediation/redevelopment works the Consent Holder shall ensure a suitably qualified environmental practitioner (SQEP) is available each day, during the hours of work. An Environmental Scientist shall be present on-site to supervise the works, excavation and removal of contaminated material, undertake soil sampling and undertake regular visual inspections of the excavations of the contaminated areas to ensure there are no uncontrolled discharges of contaminants. The Environmental Scientist shall be in daily contact with the SQEP and discuss and document the conditions encountered. The SQEP shall provide advice to the Environmental Scientist regarding all aspects of the proposed works and ensure they are carried out in general accordance with industry best practices.

11. Stockpiling of the excavated material shall be limited to overburden removed from above the contaminated material and stockpiled in accordance with Figure C-006 titled Remedial Works, included with the application report, and referenced in Condition 1. Temporary stockpiles shall be located on an impermeable surface within the catchment of erosion and sediment controls for the site. All stockpiles shall be covered with an impermeable material when the site is not being worked on and during periods of heavy rain.

12. All contaminated material removed from the site shall be disposed of at a landfill facility that holds a consent to accept the relevant level of contamination.

13. Any Separate Phase Hydrocarbons (SPH) and groundwater encountered during the remediation works shall be disposed of offsite to a licensed liquid facility authorised to accept such material.

14. Where contaminants that have not been anticipated by the application are identified, works in the area containing the unexpected contamination shall cease and be notified to the Team Leader - Southern Monitoring. The Suitably Qualified Environmental Practitioner (SQEP) shall ensure appropriate contingency measures are implemented. Works shall not recommence until confirmation has been received from the Team Leader - Southern Monitoring that disturbance of the unexpected contamination is within the scope of this consent. Any unexpected contamination and contingency measures shall be overseen by a SQEP and documented in the Site Validation Report required by condition 17.

    Advice Note:

    Any unexpected contamination, may include contaminated soil, perched water, groundwater, or underground tanks. The consent holder is advised that where unexpected contamination is significantly different in extent and concentration from that anticipated in the original site investigations, handling the contamination may be outside the scope of this consent. Advice should be sought from the Team Leader - Southern Monitoring prior to carrying out any further work in the area of the unexpected contamination to ensure this is within scope of this consent.

15. All sampling and testing for the characterisation of unexpected contaminated material, if encountered, characterisation of excavated overburden and validation sampling, as described in the Remediation Action Plan (Application Report) referenced in Condition 1, shall be overseen by a Suitably Qualified Environmental Practitioner (SQEP). All sampling shall be undertaken in accordance with Contaminated Land Management Guidelines, Number 5 – Site Investigation and Analysis of Soils, Ministry for the Environment, revised 2011.

    Advice Note:

    In order to comply with the Ministry for the Environment's Contaminated Land Management Guidelines (revised 2011), all testing and analysis should be undertaken in a laboratory with suitable experience and ability to carry out the analysis. For more details on how to confirm the suitability of the laboratory please refer to Part 4: Laboratory Analysis, of Contaminated Land Management Guidelines No.5.

16. All imported fill shall:

    a. Comply with the definition of 'cleanfill', as per 'A Guide to the Management of Cleanfills', Ministry for the Environment (2002);

    b. Be solid material of an inert nature; and

c. Not contain hazardous substances or contaminants above natural background levels of the receiving site.

Advice note:

Background levels for the Auckland Region can be found in the Auckland Regional Council technical publication "TP153, Background concentrations of inorganic elements in soils from the Auckland Region", (2001).

17. Within three months of the completion of the proposed remediation works on site, a Site Validation Report (SVR) shall be provided to the Team Leader - Southern Monitoring for review. The SVR shall be prepared by a Suitably Qualified Environmental Practitioner (SQEP) in accordance with Schedule 13 (A5) of the Auckland Council Regional Plan: Air, Land and Water. The SVR shall contain sufficient detail to address the following matters:

    a. a summary of the works undertaken, a statement confirming whether the remediation works have been completed in accordance with the approved Remediation Action Plan (Application Report).

    b. the location and dimensions of the excavations carried out, including a relevant site plan.

    c. records of any unexpected contamination encountered during the works, if applicable.

    d. copies of the disposal dockets for the material, including SPH and groundwater removed from the site.

    e. a summary of validation sampling undertaken, tabulated analytical results, and interpretation of the results in the context of the Contaminated Land Rules of the Auckland Council Regional Plan: Air, Land and Water, and the Proposed Auckland Unitary Plan.

    f. details regarding any complaints and/or breaches of the procedures set out in the Remediation Action Plan and the conditions of this consent.

    g. evidence of landfill disposal.

    h. conditions of the final site ground surface.

    i. scaled plans (plan and elevation views) showing the location and containment details (if any) of any contaminated materials exceeding acceptance criteria remaining on the site.

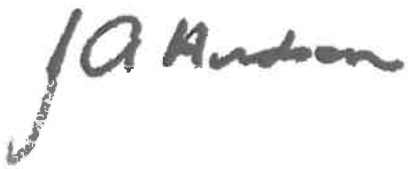
3. Advice notes

1. *Please read the conditions of this resource consent carefully and make sure that you understand all the conditions that have been imposed before commencing the development.*

2. *If you disagree with any of the above conditions, or disagree with the additional charges relating to the processing of application, you have a right of objection under sections 357A and 357B of the Resource Management Act 1991. Any objection must be made in writing to Council within 15 working days of notification of the decision.*

3. *The consent holder is responsible for obtaining all other necessary consents, permits, and licences, including those under the Building Act 2004. This consent does not remove the need to comply with all other applicable Acts (including the Property Law Act 2007 and the Health and Safety in Employment Act 1992), regulations, relevant Bylaws, and rules of law. This consent does not constitute building consent approval.*

4. *Compliance with the consent conditions will be monitored by Council (section 35(d) of the Resource Management Act). This will typically include site visits to verify compliance (or non-compliance) and documentation (site notes and photographs) of the activity established under the resource consent. In order to recover actual and reasonable costs, inspections, in excess of those covered by the base fee paid, shall be charged at the relevant hourly rate applicable at the time. Only after all conditions of the resource consent have been met, will Council issue a letter on request of the consent holder.*



Jenny Hudson

Duty Commissioner

Date 23 March 2016

Appendix C

Laboratory Results and Chain of Custody Documentation

Appendix C Laboratory Results and Chain of Custody Documentation

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:	AECOM Consulting Services (NZ) Limited	**Lab No:**	1563593 SPv1
Contact:	Andrew Walker	**Date Registered:**	06-Apr-2016
	C/- AECOM Consulting Services (NZ) Limited	**Date Reported:**	12-Apr-2016
	PO Box 821	**Quote No:**	
	Auckland 1140	**Order No:**	60492475 1.1
		Client Reference:	Cx Pakuranga
		Submitted By:	M Baddiley

Sample Type: Soil

Sample Name:		SAC711 05-Apr-2016	SAC712 05-Apr-2016	SAC713 05-Apr-2016	SAC714 05-Apr-2016	SAC715 05-Apr-2016
Lab Number:		1563593.1	1563593.2	1563593.3	1563593.4	1563593.5
Individual Tests						
Dry Matter	g/100g as rcvd	56	69	76	68	75
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.09	< 0.07	0.13	< 0.07	0.06
Toluene	mg/kg dry wt	< 0.09	< 0.07	0.12	< 0.07	0.10
Ethylbenzene	mg/kg dry wt	< 0.09	< 0.07	< 0.06	< 0.07	0.10
m&p-Xylene	mg/kg dry wt	< 0.17	< 0.13	0.13	< 0.13	0.44
o-Xylene	mg/kg dry wt	< 0.09	< 0.07	0.08	< 0.07	0.10
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 12	< 10	< 9	< 10	< 9
C10 - C14	mg/kg dry wt	< 30	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 50	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 70	< 70	< 70	< 70

Sample Name:		SAC716 05-Apr-2016	SAC717 05-Apr-2016			
Lab Number:		1563593.6	1563593.7			
Individual Tests						
Dry Matter	g/100g as rcvd	75	57	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.06	< 0.09	-	-	-
Toluene	mg/kg dry wt	< 0.06	< 0.09	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.06	< 0.09	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.17	-	-	-
o-Xylene	mg/kg dry wt	< 0.06	< 0.09	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	< 12	-	-	-
C10 - C14	mg/kg dry wt	< 20	< 30	-	-	-
C15 - C36	mg/kg dry wt	< 40	< 50	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 90	-	-	-

Analyst's Comments

Appendix No.1 - Chain of Custody

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

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1-7
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	1-7
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	1-7

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

 :475 1.1
ACS.

Hill Laboratories
A WORLD LEADER IN ANALYTICAL SERVICES

ANALY | Job No: 156 3593 | Date Recv: 06-Apr-16 15:02
Received by: Arneka Phillips
3115635936

R J Hill Laboratories Limit
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zeal

Client Consulting Services

Name	AECOM [redacted] Limited
Address	PO Box 4241, Shortland Street
	AUCKLAND 1140
Phone	09 967 9200 — *Fax* 09 960 9201
Client Reference	Cx Pakuranga
Quote No	*Order Number*

Primary Contact	Andrew Walker
Submitted By	Megan Baddiley
Charge To	AECOM New Zealand Limited

Results To
- ☐ Mail Client
- ☑ Mail Submitter
- ☐ Fax Results
- ☑ Email Results: Andrew.f.walker@aecom.com

Office use only Job No

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories
Date & Time:
Name:
Signature:
☑ *Please tick if you require COC to be faxed back*

Received at Hill Laboratories
Date & Time: 6/4/16 16.45
Name: Katie Taylor
Signature: [signature]

Condition ☐ *Room Temp* ☐ *Chilled* ☐ *Frozen* — *Temp:* 7.3

☐ *Sample Analysis details checked*
Signature:

ADDITIONAL INFORMATION

All samples consist of 1x GC 1300.
Job 60492475 Table 1.1

Priority
☐ Low ☐ Normal ☐ High
☑ **Urgent** (ASAP, extra charge applies, please contact the lab first)

Requested Reporting Date: 5 working days.

Sample Types

Waters	E	Effluent	G	Geothermal	Pot1	Potable Water (LAS/EU)	Pot2	Potable Water (NZDWS)
	GW	Ground Water	L	Leachate	☐	Audit Monitoring	Pot3	Potable Water (other)
	SW	Surface Water	S	Saline	☐	Check Monitoring	Pool	Swimming/Spa Pool
	TW	Trade Waste						
Solids	ES	Soil	SE	Sediment	SL	Sludge	PL	Plant
Other	O	O Oil	M	Miscellaneous	FS	FS Fish/shellfish/biota	BM	BM Biological Material

No.	*Sample Name*	*Sample Date & Time*	*Sample Type*	*Tests Required*
1	SAC711	5/4/16	ES	TPH & BTEX
2	SAC712	↓	↓	↓
3	SAC713	↓	↓	↓
4	SAC714	↓	↓	↓
5	SAC715	↓	↓	↓
6	SAC716	↓	↓	↓
7	SAC717	↓	↓	↓
8	SAC718	↓	↓	↓
9				
10				

Continued on next page

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

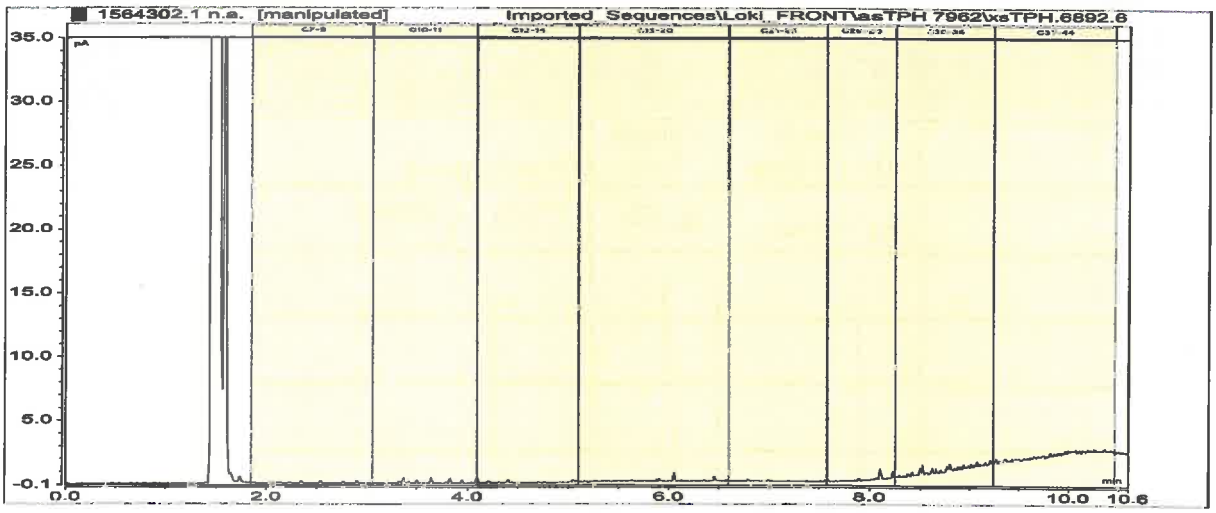
ANALYSIS REPORT

Client:	AECOM Consulting Services (NZ) Limited	**Lab No:**	1564302	SPv1
Contact:	Andrew Walker	**Date Registered:**	07-Apr-2016	
	C/- AECOM Consulting Services (NZ) Limited	**Date Reported:**	27-Apr-2016	
	PO Box 821	**Quote No:**	72191	
	Auckland 1140	**Order No:**	60492475 1.1	
		Client Reference:	60492475 Cx Pakuranga	
		Submitted By:	M Baddiley	

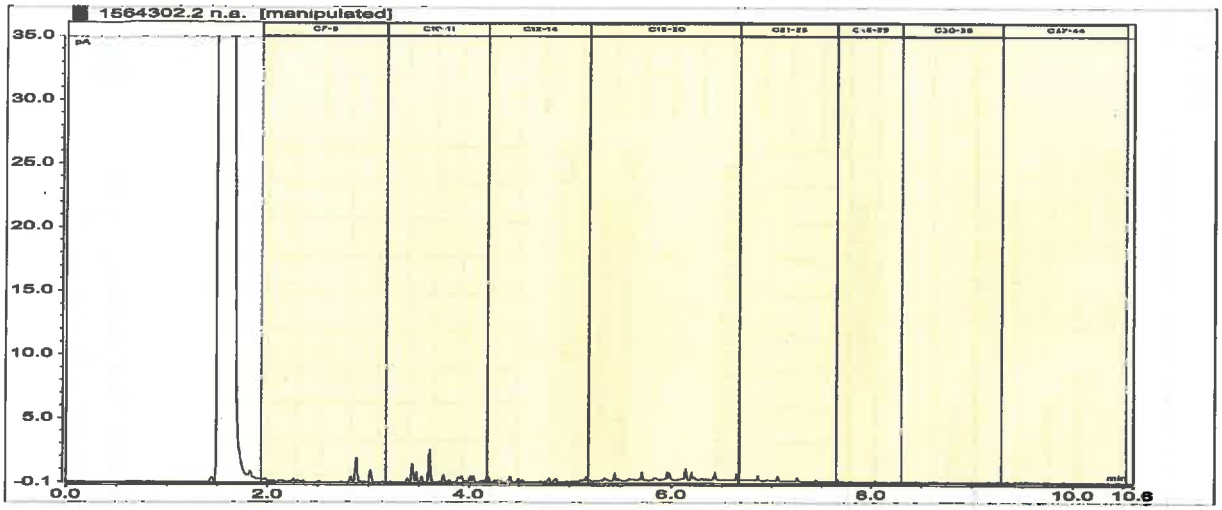
Sample Type: Soil

Sample Name:		SAC719 06-Apr-2016	SAC720 06-Apr-2016	SAC721 06-Apr-2016	SAC722 06-Apr-2016	
Lab Number:		1564302.1	1564302.2	1564302.3	1564302.4	
Individual Tests						
Dry Matter	g/100g as rcvd	86	70	77	78	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	0.17	0.28	< 0.10	-
Toluene	mg/kg dry wt	< 0.05	1.49	0.59	< 0.10	-
Ethylbenzene	mg/kg dry wt	< 0.05	3.1	< 0.10	< 0.10	-
m&p-Xylene	mg/kg dry wt	0.12	14.8	< 0.19	< 0.19	-
o-Xylene	mg/kg dry wt	1.49	6.5	< 0.10	< 0.10	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	18	< 9	< 9	-
C10 - C14	mg/kg dry wt	< 20	36	< 20	< 20	-
C15 - C36	mg/kg dry wt	97	56	< 40	< 40	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	97	109	< 70	< 70	-

1564302.1
SAC719 06-Apr-2016
Client Chromatogram for TPH by FID



1564302.2
SAC720 06-Apr-2016
Client Chromatogram for TPH by FID



Analyst's Comments

Appendix No.1 - Chain of Custody

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
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	1-4
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	1-4
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	1-4

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

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

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

Form:

AECOM

Chain of Custody & Analysis Request Form

AECOM - Auckland
PO Box 4241
Auckland 1140
Tel: 64 9 967 9200
Fax: 64 9 967 9201
Email:

Laboratory Details
Lab. Name: R J Hill Laboratories Ltd
Lab. Address: 1 Clyde St, Hamilton
Contact Name: Jean Connick
Lab. Ref:
Tel: 07 858 2000
Fax: 07 858 2001
Preliminary Report by:
Final Report by:
Lab Quote No:

Project Name: Cx Pakuranga **Project Number:** 60492475 **Purchase Order Number:**

Sample collected by: Megan Baddiley **Sample Results to be returned to:** Andrew Walker

Specifications: Normal TAT

	(Tick)		
1. Urgent TAT required? (please circle: 24hr 48hr _____days)	☐ Yes	☐ No	☑ N/A
2. Fast TAT Guarantee Required?	☐ Yes	☐ No	☑ N/A
3. Is any sediment layer present in waters to be excluded from extractions?	☐ Yes	☐ No	☑ N/A
4. Special storage requirements?	☐ Yes	☐ No	☑ N/A
5. Preservation requirements?	☐ Yes	☐ No	☑ N/A
6. Other requirements? ☐ Fax ☐ Hard copy ☑ Email	☐ Yes	☐ No	☐ N/A

7. Report Format: Email: andrew.f.walker@aecom.com 8. Project Manager: andrew.f.walker@aecom.com tel:

Analysis Request

Hold Cold

Temperature On Arrival
12.2 °C
Temperature was measured on arbitrarily chosen samples in this batch.
The Microbiology sample temperature will be recorded at Melville Lab before testing.

Lab. ID	Sample ID	Sampling Date & time (on)	Sampling Date & Time (off)	Matrix: soil	Matrix: water	Matrix: other	Preservation: filt'ed	Preservation: acid	Preservation: ice	Preservation: other	Container (No. & type)	Remarks & comments
	SAC719	6/04/2016		X							Gsoil300	
	SAC720	6/04/2016		X							Gsoil300	
	SAC721	6/04/2016		X							Gsoil300	
	SAC722	6/04/2016		X							Gsoil300	
	SAC723	6/04/2016		X							Gsoil300	

Job No: 156 4302
Date Recv: 07-Apr-16 14:41
Received by: Arneka Phillips
3115643021

Relinquished By:
Name: Date:
of: AECOM Time:

Received by:
Name: David
of: Hill Labs
Date: 7/04/16
Time: 16:10

Received in good condition?	Yes/No/NA	Method of Shipm ☑ Courier ☐	
Samples received chilled?	Yes/No/NA	Consignment Note No.	
	Yes/No/NA	Transport Co:	

Revision: Oct 09
BMS-PM-DV-F046