



ENGEO
— Expect Excellence —

Preliminary Environmental Site Investigation
Naval Point Recreational Reserve
54 and 56 Godley Quay
Lyttelton

Submitted to:
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1 Introduction

ENGEO Limited (ENGEO) was requested by Abigail Smith, on behalf of the Christchurch City Council (CCC), to investigate the site history of the Naval Point Recreational area in Lyttelton.

ENGEO understands that parts of the 8.46 ha site (Refer to Figure 1) may be redeveloped in the future (refer to Appendix 1) and the potential land disturbance activities would require a PSI in accordance with the Resource Management (*National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health*) Regulations 2011¹ (herein referred to as the NES) to assess whether any potentially contaminating activities have been undertaken at the site. This PSI was undertaken in accordance with the Ministry for the Environment (MfE) *Guidelines for Reporting on Contaminated Sites*².

1.1 Objectives of the Assessment

The objective of this PSI was to assess the potential for contaminants to have been deposited at the site, as a result of historical activities undertaken within or in the immediate vicinity of the site, and report on the potential risk posed to current and future site users.

1.2 Approach

To satisfy the objectives, ENGEO sought to gather information regarding the following:

- Current and past property users and occupancies;
- Current and past users of hazardous substances;
- Waste management and disposal activities that could have caused a release of hazardous substances;
- Current and past corrective actions and response activities to address past and on-going releases of hazardous substances at the subject property; and
- Properties adjoining or located near to the subject property that could have resulted in releases of hazardous substances to the subject property.

1.2.1 Review of Site Information

During this assessment, a number of sources of information were contacted for information relating to the site regarding its past and present uses. This included contacting Canterbury Regional Council (CRC) to determine if there were any records on the Listed Land Use Register (LLUR), obtaining and reviewing copies of existing contamination investigation reports for the site and surrounding properties, reviewing records held by Christchurch City Council (CCC) including the property file and dangerous goods file (if available). A review of a number of historical and current aerial photographs was also undertaken using images from Canterbury Maps³ and Google Earth⁴.

1.2.2 Site Inspection

A site walkover was undertaken on 22 January 2015 by Claude Midgley of ENGEO. Objective evidence was collected through observations of activities and conditions present at the site.

2 Site Description and Setting

Site information is summarised in Table 1.

Table 1: Site Information

Item	Description
Location	54 and 56 Godley Quay, Lyttelton
Legal Description	Lot 3 DP11243 and Lot 1 DP72644
Property Owner	Christchurch City Council
Current Land Use	Recreational
Proposed Land Use	Recreational
Site Area	84,627 m ²
Territorial Authority	Christchurch City Council
Zoning	Recreational Reserve (RV)

The site setting is summarised in Table 2.

Table 2: Site Setting

Item	Description
Topography	The site is considered to be flat
Local Setting	<p>The site is located between the Naval Point Yacht Club in Magazine Bay (western end), the public boat ramp (southern end) and the bulk liquid fuel storage terminal (also referred to as the liquid bulk terminal) of the Lyttelton Port (eastern and northern ends).</p> <p>The area consists of reclaimed land which was constructed by placing a rock armoured breakwater and filling the internal portion with dredged marine sediments.</p>
Nearest Surface Water & Use ⁵	The Lyttelton Harbour is located along the southern site boundary. The harbour is used for commercial and recreational purposes.
Geology ⁶	Anthropic deposits, described as “ <i>Engineered fill of reclaimed land</i> ”
Hydrogeology ⁵	<p>In November 1999, groundwater was measured at 3.3 m below ground level (bgl) in a nearby well (M36/5943).</p> <p>A contamination report completed in 2002 (Refer to Appendix 2) indicates that groundwater was encountered at 1.5 m bgl. A report completed in 1995 (Refer to Appendix 2) concluded that the groundwater table displays fluctuation that is most likely influenced both by precipitation and tidal regime. The dominant</p>

Item	Description
	groundwater flow direction was reported as southerly (Refer to Appendix 2). The shallow non-artesian aquifer does not meet the criteria to be classed as sensitive according to the MfE ⁷ (Refer to Appendix 2).
Groundwater Abstractions⁵	A record of a consent to abstract groundwater was found within 100 m of the site, however the permit was terminated in 2007.
Discharge Consents⁵	Four consents to discharge contaminants were found within 100 m of the site (Refer to Figure 2), however only one remains active as the rest have expired or have been terminated: CRC021644.2 is held by BP Oil New Zealand Limited to allow the discharge of a contaminant (stormwater) onto or into land in circumstances which may result in that contaminant entering water. The conditions of the consent limit the discharge to tank condensation water and stormwater from the bunded areas “to the Banks Peninsula District Council Godley Quay stormwater main via an API separator”.

3 Site History

A number of sources were used to investigate the past uses of the site. The findings of these information searches have been summarised in this section.

3.1 CCC Property File Review

The property file for the site held by CCC was reviewed on 22 January 2015 as part of this PSI. A number of records documented the development and use of the site since 1957. The relevant and applicable findings in relation to our environmental assessment of this search have been summarised in Table 3. Copies of the relevant records are presented in Appendix 3.

Table 3: Review of Christchurch City Council Property File

Date	Description
1957	Licensee form of notice to the Lyttelton Borough Council that sewer and waste water drains at the Lyttelton Sport Pavillion.
1989	Construction drawings dated 1987 indicate that Hardieflex and Hardieboard were used in the Sea Scouts building.
1989	The ownership the sports field (Lot 1 DP72644) was transferred from the Lyttelton Port Company Limited to the Banks Peninsula District Council.
1996	Lot 5 DP67082 was subdivided to create the current property boundaries.

3.2 Listed Land Use Register (LLUR)

Canterbury Regional Council (CRC) maintains a Listed Land Use Register (LLUR) of past and current land uses within the Canterbury region. The LLUR documents properties on which potentially hazardous activities have been undertaken. The potentially hazardous activities are defined on the

Hazardous Activities and Industries List (HAIL)⁸. The listing of a property on the HAIL triggers the requirement for a contaminated land assessment prior to development.

The CRC LLUR property statement was requested by ENGEO on 12 January and 23 January 2015 for the site and neighbouring sites (within 100 m radius) and is presented in Appendix 2.

Table 4: Summary of Canterbury Regional Council Listed Land Use Register (CRC LLUR)

Period From	Period To	HAIL Activity (s)	LLUR Category
Pre 1965	2011	Persistent pesticide bulk storage or use	A10
Pre 1965	Pre 1994	Wood treatment or preservation including the commercial use of antisapstain chemicals during milling, or bulk storage of treated timber outside	A18
Additional Information		A detailed site investigation (Lyttelton Recreation Ground Vapour Monitoring) is recorded as having been undertaken at the site, however the report has not been audited.	

The LLUR contains summaries of historical contamination investigations which have undergone an audit process. No reports of investigations undertaken at the site have been audited, however some contamination investigations undertaken at surrounding sites have been audited and summarised. The following is a summary of important findings, although the reader is referred to Appendix 2 for completeness:

BP Lyttelton Terminal (2 Charlotte Jane Quay)

Investigations undertaken in 1992, 1997, 1999, 2002 and 2008 are summarised. The site is predominantly used for the storage of petroleum products and a small portion is used for bitumen manufacture and bulk storage. Products known to have been stored at the site include diesel, leaded and unleaded fuels, jet fuel and various chemicals including antifreeze, Non-ionic detergent, Di-Iso-Octyl Phthalate (plasticiser) and caustic solution. The bitumen plant was established in 1992 in a portion of the site that was historically occupied by a black oil drum-filling platform.

Other activities known to have occurred at the site include a tetra-ethyl lead plant, railcar loading and a lorry fill shelter with above ground filling facilities.

Petroleum hydrocarbon releases have been reported at the site. In addition, lead sludge was historically buried within the tank farm.

A report summarising an investigation completed in 1992 to assess soil and groundwater contamination. Hydrocarbon odours were noted in the majority of the 40 soil sample and 20 groundwater sample locations. Free product was detected in two of the groundwater monitoring wells in the southern central portion of the site. In one of those wells, benzene, total xylenes and ethylbenzene were detected at concentrations exceeding the relevant potable water criteria.

Groundwater monitoring events were completed in 1997 and 1999, with the results indicating that the water was not suitable for potable use and that the concentrations of ethylbenzene and naphthalene exceeded the criteria for the protection of the marine ecosystem. Free product was again detected and

the gas chromatograms suggested that the product was moderately weathered diesel and motor spirits.

Computer modelling software was used to assess the risk to the harbour with the conclusion being reached that the contamination at the site did not present an unacceptable risk at the discharge point. Continued groundwater monitoring was recommended.

A Preliminary Site Inspection was undertaken in 2002 as part of the consent approval process to upgrade the BP facility with the addition of 3 new tanks. The investigation included the collection and testing of 13 soil samples for Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAHs), Benzene, Toluene, Ethylbenzene and Xylene (BTEX).

All contaminant concentrations were below the relevant health criteria, but hydrocarbon odours and staining were observed in 3 of the 4 deeper soil sample locations (between 2 and 3 m bgl).

An intrusive investigation was undertaken at the bitumen facility. Only surface samples were analysed and the CRC report auditor noted, based on a site photo in the report, that there may have been evidence of deeper soil contamination. Furthermore, free product was noted in 3 of the 5 test pits and a strong hydrocarbon odour was noted for site soils, which could indicate a potential for indoor air quality impacts. The auditor concluded that the information was insufficient to characterise the human health risks.

Finally, the site has been recommended to be categorised on the LLUR as 'Significant Adverse Environmental Effects'.

Caltex Site 1 (49 and 51 Godley Quay)

The site is known to have been used for the storage of leaded and unleaded motor spirits, diesel and kerosene. A single major spill event is known to have occurred between 1975 and 1995. The incident relates to a spill of motor spirits from a tank sample valve and the product reportedly pooled to a height of several centimetres on the eastern part of the northern block (49 Godley Quay). In addition, leaded sludge was probably disposed at the site with two tanks known to have been cleaned, and sludge most likely buried in shallow trenches (approx. 0.5 m deep) adjacent to tank access ports.

Woodward Clyde assessed the soil and groundwater results in 1995 using a framework that has since been superseded. Due to the unsuitability of the soil screening level adopted for lead, which was protective of residential land use and groundwater resource use, the report carries out a site-specific assessment for exposure of human receptors to soil lead.

The soil sample results indicated an absence of widespread petroleum hydrocarbon contamination across the site. However, only limited sampling was conducted of soils immediately surrounding or beneath the former above ground bulk storage tanks and the ancillary services. Free product was detected in two groundwater monitoring wells.

Together with the reported fluctuations in the groundwater levels and the fine textured nature of the strata, the discrepancy between soil and groundwater petroleum hydrocarbon results suggests that residual contamination may exhibit a complex spatial distribution in the sub-surface beneath the site, potentially confined to thin horizons of the soil pore water space.

Overall, the report concludes that the residual contamination does not pose a significant risk to human health and the environment. However, the CRC report audit identifies a number of issues relating to the uncertainty in the residual contaminant distribution. For petroleum hydrocarbons, the residues of which were present in soil and groundwater beneath the site, the main limitations stem from the contrast between the soil and groundwater results and the absence of validation results for areas beneath the majority of former bulk tanks.

Given the length of time since the initial investigation was conducted, it is expected that the residual petroleum hydrocarbon contamination has been significantly modified by the biodegradation and transport processes.

Stark Bros Ltd Site 2 (Charlotte Jane Quay)

The site has not been investigated, but according to the LLUR (Refer to Appendix 2) a site investigation report written by Kingett Mitchell and Associates in 2002 mentions the following details: The site was previously used for storage of timber by the former Lyttelton Harbour Board. The timber was used for port maintenance and it is unknown if the timber was treated, but it is considered likely considering the end use.

BP Oil NZ Limited, former Europa Oil site (52 Godley Quay)

BP Oil NZ Ltd purchased the site from Europa Oil in 1982, but the site has been used for bulk storage of petroleum hydrocarbons since at least 1932. The southern block comprised a tank farm area with two above ground storage tanks. Principal chemicals stored at the site included leaded and unleaded motor spirits, diesel, and kerosene.

The CRC audit summarises the same work which was completed for 49 and 51 Godley Quay, possibly indicating an error in the record keeping having assigned the incorrect audit summary to this site.

LPC Block 56 (Marina Access Road)

While no investigations are associated with the site, it is known to have been used for the storage of tanks or drums of fuel, chemicals or liquid waste, as well as wood treatment or preservation including the use of anti-sapstain chemicals or bulk storage of treated timber outside.

3.3 Historical Contamination Reports

Copies of two contamination reports, which had not already been audited and summarised on the LLUR, were obtained from CRC. In addition, online news articles regarding a hydrocarbon spill were obtained from 'The Press'. The reports are provided in Appendix 4 and are summarised as follows:

Aecom used a 5 gas monitor, fitted with a wand to allow screening of volatile organic compounds in air from low lying areas across the site. No volatile vapours were detected at any of the 81 screening locations.

URS completed a Benchmarking assessment at the former BP Terminal site located directly north of the Naval Point Recreational Reserve. Samples were collected from 60 locations, with the majority (57 samples) located on the property directly north of the reserve. Laboratory results indicated that concentrations of contaminants (Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene and Xylene) were either below the method detection limits, or below the MfE and / or NES criteria for Commercial / Industrial landuse. The concentrations of a suite of common heavy metals (As, Cd, Cr,

Cu, Pb, Ni and Zn) were also measured in all samples. The majority of samples contained concentrations of metals below the NES SCSs for Commercial / Industrial landuse, however lead concentrations exceeded the criteria in 2 samples.

Online news articles published by 'The Press' indicate that 1.2 million litres of jet fuel leaked from a bulk liquid fuel storage tank when a cliff collapsed and punctured the tank on the 5th of March 2014. The majority of the fuel was contained within a bunded holding area around the tank, but approximately 40,000 litres was able to discharge from the site into the public stormwater system. Reportedly, 1,500 litres of fuel eventually discharged to the Lyttelton Harbour through the stormwater system, while the remainder of the fuel in the system was removed from the stormwater lines.

3.4 Historical Aerial Photograph Review

Aerial photographs dating from 1937 to 2014 have been reviewed (refer to Figures 3, 4 and 5). The relevant visible features are summarised in Table 5.

Table 5: Aerial Photographs

Date	Figure No.	Description
C1937	VC Browne ⁹	<p>A portion of the site is visible in the foreground of the image, with a small shed present near to the intersection of Charlotte Jane Quay and Godley Quay.</p> <p>It appears as though the land reclamation is in progress as Godley Quay is visible as a raised bund of darker material with small areas of fill deposited on its western side, including on the site.</p> <p>The bund representing Godley Quay is surrounded by undeveloped land with the eastern side containing linear features, likely to be drainage ditches. Portions of the land surface may be inundated with water.</p> <p>Bulk liquid fuel storage tanks are visible on the properties towards the north east.</p>
C1939		<p>A portion of the site is visible towards the south west of three small bulk liquid fuel storage tanks on the right of the photograph. The land nearest to the intersection of Charlotte Jane Quay and Godley Quay appears to have patchy dark areas, possibly representing vegetation.</p> <p>With the exception of the property towards the north east (containing the three small bulk liquid fuel storage tanks) the surrounding land appears undeveloped. The land reclamation process appears to have been completed.</p> <p>No other significant differences are apparent, compared with the 1937 photograph.</p>
1942		<p>A portion of the site is visible in the upper left portion of the photograph. The site appears to have a drainage ditch or road / track running along an east / west orientation on the northern property boundary. No other distinguishable features are visible at the site.</p> <p>No significant changes are apparent in the surrounding land.</p>
1947		<p>The entire site is visible and appears undeveloped. The portion visible in earlier photographs does not appear to have undergone any significant changes.</p> <p>A significant development has occurred on the eastern end of the reclaimed land (intersection of Charlotte Jane Quay and Cyrus Williams Quay). The development consists of a complex of several buildings.</p> <p>No other significant changes are apparent in the surrounding land.</p>

Date	Figure No.	Description
1949		<p>Three images taken in 1949 provide perspectives of the site from the east, south east and south.</p> <p>A large proportion of the site appears to be covered in patchy vegetation, with a track with a possible stormwater drainage scar running from near to the intersection of Charlotte Jane Quay and Godley Quay, in the north east, to a jetty at the southern boundary.</p> <p>Dark objects are stored on the property directly east of the site, possibly representing drums or coal storage. Unfortunately the image resolution is insufficient to determine exactly what is being stored.</p> <p>Another unidentifiable object is visible west of the north west site corner.</p> <p>A large development with bulk liquid fuel storage tanks, pipework and office buildings has been constructed further east of the site, between the site and the Naval complex.</p> <p>A single bulk liquid fuel storage tank has also been constructed on the property north of the site.</p>
1965	3	<p>The sports field has been developed in the north eastern part of the site and the pavilion building is visible. There is also a small square object in the south eastern corner of the sports fields. Some portions of the sports turf appear to be a lighter colour than the surrounding areas, possibly indicating poor or patchy cover.</p> <p>The land towards the west, south west, south and south east of the sports field, covering the majority of the remainder of the site, is used to store timber poles. Some of the poles near to the north western corner of the sports field appear to be treated in some way, resulting in them being a darker colour in the middle and lighter colour on each end. Several small sheds are also visible near to that area.</p> <p>The property directly east of the site appears unsealed with storage of unidentifiable objects in the northern portion.</p> <p>Land further east, as well as north east, north and north west contains bulk liquid fuel storage tanks.</p>
1973	Canterbury Maps ³	<p>The sports field remains relatively unchanged, with some lighter coloured patches of turf visible across that part of the site. A lighter patch appears to be located in the area where a track or stormwater drainage scar running from near to the intersection of Charlotte Jane Quay and Godley Quay was visible in the 1949 photographs. A small stockpile of material is visible near to the south western corner of the sports field. Darker linear features are also visible, arranged in a network across the site, possibly representing irrigation lines.</p> <p>Timber poles are still stored over the majority of the remainder of the site. The poles which appear to have been treated are visible near to the centre of the site. Stockpiles of imported fill material are visible in the south west portion of the site.</p> <p>A business appears to have been established on previously undeveloped land in the north west of the site. Several boats, as well as drums and machinery are visible in the area. Sheds have been constructed and another large shed appears to be under construction.</p> <p>A boat storage area and slipway has been created in the centre south of the site corner.</p> <p>The property directly east of the site remains undeveloped with several unidentifiable objects visible, particularly in the southern half.</p> <p>The remainder of the surrounding land appears generally unchanged.</p>
1984	4	<p>The sports field remains relatively unchanged, with significantly better turf cover. Trees have been planted along the southern boundary of the field. Timber poles are stored adjacent to the sports fields and the total area used</p>

Date	Figure No.	Description
		<p>for storing the poles has decreased substantially over the remainder of the site. Boats are stored south of the sports field. Fill appears to have been imported to an area south east of the sports field.</p> <p>The business which was present in the north west of the site has been disestablished and no visible trace remains.</p> <p>The property directly east of the site remains undeveloped, with two rectangular objects near its centre and small rectangular objects at the north western and south western corners.</p> <p>The remainder of the surrounding land still contains bulk liquid fuel storage tanks, with a new facility visible north of the north western corner of the site.</p>
1994	Canterbury Maps ³	<p>The image resolution is relatively poor. However the sports field appears unchanged, with two light coloured rectangular objects visible near to the south western boundary of the field.</p> <p>It is not clear whether timber poles are still stored adjacent to the western boundary of the sports field, but several other light coloured rectangular objects are visible. Boats are now stored over a larger area of the remainder of the site. The Sea Scouts and Coast Guard buildings are now visible.</p> <p>The property directly east of the site remains undeveloped, with several unidentifiable light and dark coloured rectangular objects visible near to the centre of the property.</p> <p>Bulk liquid fuel storage tanks have been demolished on properties north east of the site.</p>
2004		<p>The site and surrounding areas appear generally unchanged, with the exception of three bulk liquid fuel storage tanks which have been constructed on the property directly east of the site.</p> <p>Timber poles no longer appear to be stored on the site.</p>
2011	5	<p>The site and surrounding areas appear generally unchanged, with the exception of two bulk liquid fuel storage tanks which have been demolished on properties north of the site and the replacement of seven old bulk liquid fuel storage tanks with three new tanks further north east of the site.</p> <p>A variety of waste objects are stored in the land directly west of the sports field, including stockpiles of brick and large pieces of concrete.</p>
2014	Google Earth ⁴	<p>The site and surrounding areas appear generally unchanged, with two exceptions: Timber poles are stored on the property directly north of the site and a shed has been constructed adjacent to the western boundary of the sports field.</p>

4 Current Site Conditions

A site walkover was undertaken on 22 January 2015 by Claude Midgley of ENGEO. The information gathered is summarised in Table 6. Photographs taken during the site inspection are included in Appendix 5.

Table 6: Current Site Conditions

Site Condition	Comments
Visible signs of contamination	No significant signs of contamination were observed. Minor oil stains were present in the boat refurbishment area. Old tar covered poles were placed in certain areas of the site (very little tar remains). A small campfire area was located near to the Sea

Site Condition	Comments
	Scouts building.
Surface water appearance	No surface water was observed. No evidence of contamination was observed in adjacent harbour water.
Current surrounding land use	Industrial, recreational and residential
Local sensitive environments	The Lyttelton Harbour is located along the southern boundary of the site.
Visible signs of plant stress	None observed
Potential for on or off site migration of contaminants	The potential exists for migration of contamination to the site in groundwater from surrounding sites towards the north.
Additional Observations (if any)	Tarpaulin covered stockpiles were observed in a fenced yard in the north west corner of the site. An underground fuel storage tank filling point was located adjacent to the Coast Guard building in the south east of the site. Three groundwater monitoring wells were observed around the site. Their locations are indicated on Figure 4.

5 Potential HAIL Activities

Activities included on the Hazardous Activities and Industries List (HAIL)⁸ trigger the requirement for a contaminated land investigation prior to development. The following HAIL activities (Refer to Tables 4 and 6) have been identified in parts of the site:

- A10 – Pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds;
- A17 – Storage tanks or drums for fuel, chemicals or liquid waste;
- A18 - Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside;
- F5 – Port activities including dry docks or marine vessel maintenance facilities;
- G5 – Waste disposal to land.

6 Conceptual Site Model

A conceptual site model consists of three primary components. For a contaminant to present a risk to human health or the environment, all three components are required to be present and connected. For the potential risk to be determined each component is required to be assessed. The three components of a conceptual site model are:

- Source of contamination;
 - Pathway to allow the contamination to mobilise; and
 - Sensitive receptors which may be impacted by the contamination.
- A diagram depicting a potential residential source, pathway, receptor pollutant linkage is displayed in Diagram 1, while the potential source, pathway, receptor linkages at this subject site are provided in Table 8.

Diagram 1: Pathways by which contaminants in the soil can affect human health⁵

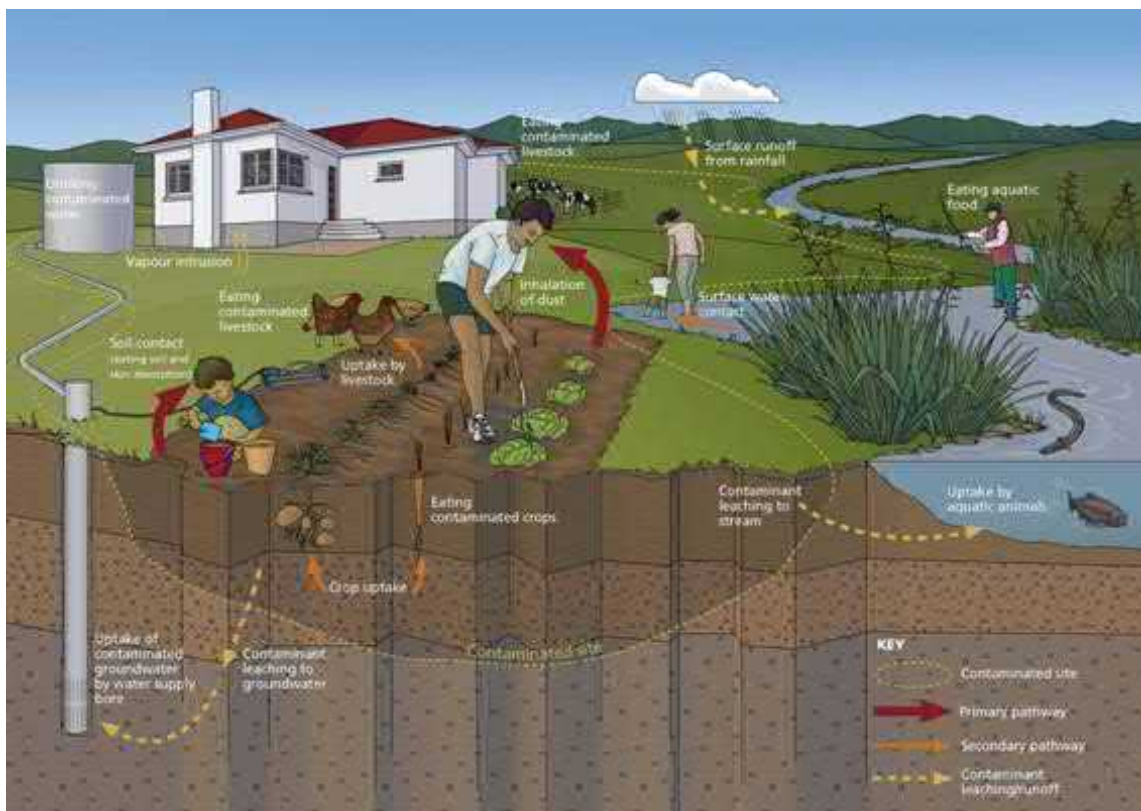


Table 8: Conceptual Site Model

Source	Pathway	Receptor
Anti-fouling paints and heavy metals in surface materials.	Inhalation (dust) Ingestion Direct contact	Excavation workers Site visitors Boat maintenance workers
Petroleum hydrocarbons and Polycyclic aromatic hydrocarbons in deeper layers.	Inhalation (dust) Ingestion Direct contact	Excavation workers Site visitors
Asbestos in building materials and underground services.	Inhalation	Demolition workers Site visitors
Hydrocarbons and heavy metals	Infiltration of rainfall Groundwater migration	Local groundwater Lyttelton Harbour
Likelihood of contamination presenting a significant risk to human health	<p>Metals and Hydrocarbons: Likely in isolated areas associated with boat storage / maintenance and current / former storage of treated timber.</p> <p>Metals and OCPs: These could have been used on the sports turf which was established on the site at some point between 1949 and 1965.</p> <p>Hydrocarbons: Potential for migration from properties located north of the site via groundwater. Natural attenuation may reduce concentrations, but this is dependent on subsurface conditions.</p> <p>Asbestos: Sea Scouts building and possibly the underground infrastructure (water and sewer).</p>	

7 Conclusions

The site was created by placing dredged marine sediments within an armoured rock wall, likely to have occurred between the 1920s and 1940s.

The Lyttelton Sports Ground was established at some point between 1949 and 1965 and the majority of the remainder of the site was used to treat and store timber poles. Evidence observed on site indicates that they were probably telephone poles and / or timber piles for wharf construction. These can be expected to have been treated to the maximum possible extent due to the environmental conditions at the site of their intended use.

During the 1970s and 1980s, the site appears to have undergone further filling, possibly with the gravelly material observed on site during the walkover undertaken as part of this investigation. Treatment and storage of timber poles appears to have been phased out as storage and maintenance of boats increased. A business, probably the Stark Bros yard which was recorded in the CCC property file, was present in the north western corner of the site for some time after 1965 and before 1984.

Since the 1990s, the site appears to have been consistently used for recreational purposes (boating and sports fields), with some boat maintenance work being undertaken in an isolated portion of the site.

Several sources of contamination were observed during the site walkover including a single underground fuel storage tank, surface oil stains, a small campfire area, old and new treated timber poles, covered stockpiles of unknown material and possible asbestos-containing materials. The majority of these are considered unlikely to represent a risk to human health in their current positions. However, earthworks associated with possible future redevelopment of the site can create conditions where exposure to the contaminants and / or discharge to the surrounding environment is more likely. Demolition of buildings and / or off-site disposal of material from some parts of the site, if required, may also result in conditions of increased risk of exposure to contaminants or increased risk of discharge to the surrounding environment.

The land surrounding the site has consistently been used for the bulk storage of petroleum hydrocarbon products, which is well known to result in significant releases to the environment. Abundant evidence exists of hydrocarbons being present in the soil and groundwater of surrounding sites. The potential therefore exists for the migration of contaminants to the substrata of the site, via groundwater flow.

Based on the information gathered, we consider it is likely that there will be parts of the site where contaminants are present at concentrations that can pose a risk to human health. Currently, the exposure pathways between source and receptor at the majority of those areas are incomplete.

The highest risk areas are likely to be the boat maintenance area and the sports fields. Heavy metals and / or persistent pesticides (sports turf) may be present at the surface of these parts of the site and exposure via direct contact and / or ingestion of soil, or inhalation of dust could occur.

Potential future redevelopment of the site can create exposure pathways between contaminants present in deeper layers and sensitive receptors such as redevelopment workers and the surrounding environment. Excavation of soil and possible asbestos-containing water / sewer pipes could create the opportunity for exposure to contaminants, if the works are not managed appropriately.

8 Recommendations

It is recommended that limited soil sampling be undertaken at the boat maintenance area and the sports fields to assess the risks to human health from those parts of the site in their current states.

If off-site disposal of material excavated from zones highlighted in Figure 4 is required during future redevelopment works, it is recommended that the material be characterised to determine the suitability of the intended disposal facility / receptor site.

An asbestos survey of the buildings and infrastructure is also recommended so that an asbestos register can be created detailing the condition of the asbestos and potential risks to site users.

If the underground fuel storage tank is ever removed from its location adjacent to the Coast Guard building, it is recommended that the works be undertaken according to the MfE guidance on the removal of petroleum underground storage tanks².

9 References

- 1 Ministry for the Environment, 2012. Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.
- 2 Ministry for the Environment, 2011. Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand.
- 3 Canterburymaps 2014: *Tour of Christchurch* viewed at <http://canterburymaps.govt.nz/WebApps/tourofchch/>
- 4 Google Earth v7.1.2.2041. (30 April, 2003). Lyttelton, New Zealand. -43.609963° lon, 172.702750° lat, Eye alt 750m. DigitalGlobe 2014. <http://www.earth.google.com>. [January 12, 2014]
- 5 Canterbury Regional Council, 2014. *Environment Canterbury on-line GIS Database*. Viewed at: <http://canterburymaps.co.nz/Portal>
- 6 Forsyth, P.J.; Barrell, D.J.A; Jongens, R. 2008. *Sheet 16 - Geology of the Christchurch Area 1:250,000*.
- 7 Ministry for the Environment 1999. *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*.
- 8 Ministry for the Environment, 2011. *Ministry for the Environment Hazardous Activities and Industries List*.
- 9 Barclay Consulting 2012: *The V.C. Browne and Son Aerial Photograph Collection*. Viewed at: <http://www.vcbrowne.com/VCBHome.aspx>. Image references: Roll / box PB1213 Photo 17, Roll / box PB0620 Photo 212, Roll / box PB0202 Photo 4, Roll / box BP1-94 Photo 88, Roll / box LT1-36 Photos 18, 19 and 21.

10 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Christchurch City Council, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the IPENZ/ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on 03 328 9012 if you require any further information.

For and on behalf of ENGEO Limited,

Prepared by:



Claude Midgley, CEnvP

Senior Environmental Scientist

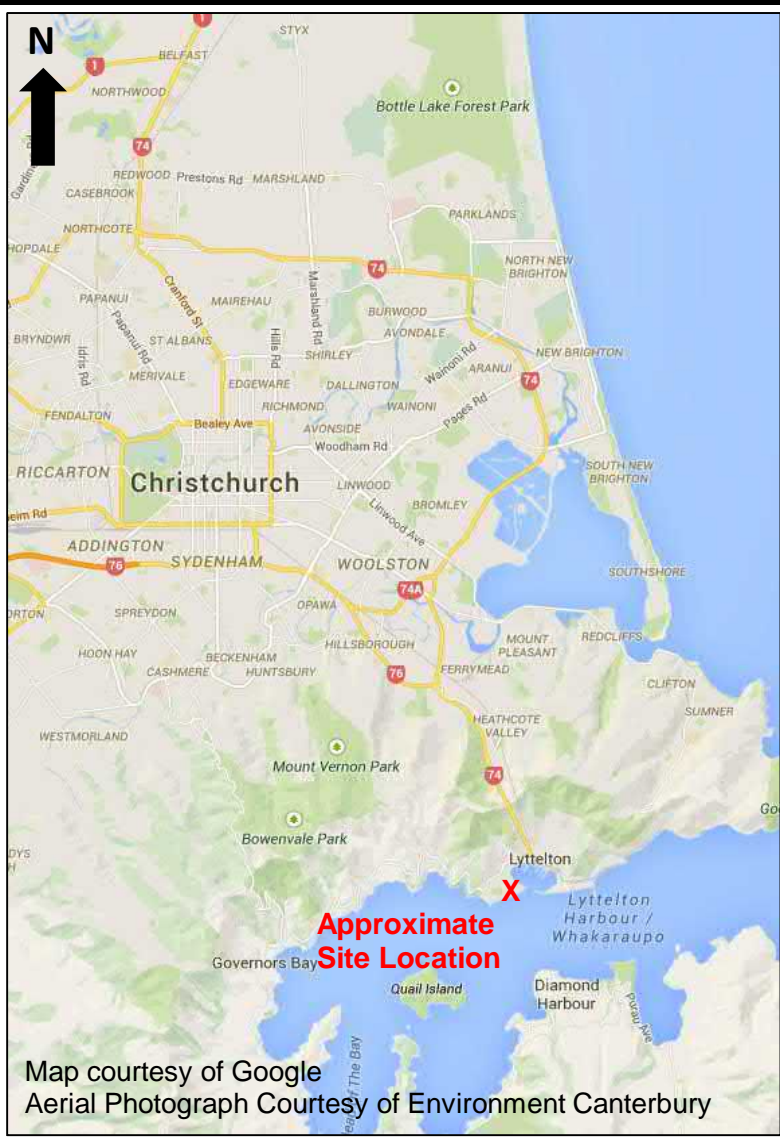
Reviewed by:



David Robotham, CEnvP

Associate Environmental Consultant

FIGURES



Date	Jan-15	Client	Christchurch City Council		
Drawn by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	Site Location Plan and 2011 Aerial Photograph		
Scale	NTS	Figure Number	1	Project Number	11539.000.001_1

LEGEND



Existing Groundwater Monitoring Well



Aerial Photograph Courtesy of Environment Canterbury



Date	Jan-15	Client	Christchurch City Council		
Drawn by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	Discharge Consents		
Scale	NTS	Figure Number	2	Project Number	11539.000.001_1



Aerial Photograph Courtesy of Environment Canterbury



Date	Jan-15	Client	Christchurch City Council		
Drawn by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	1965 Aerial Photograph		
Scale	NTS	Figure Number	3	Project Number	11539.000.001_1



Aerial Photograph Courtesy of Environment Canterbury



Date	Jan-15	Client	Christchurch City Council		
Drawn by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	1984 Aerial Photograph		
Scale	NTS	Figure Number	4	Project Number	11539.000.001_1



Aerial Photograph Courtesy of Environment Canterbury



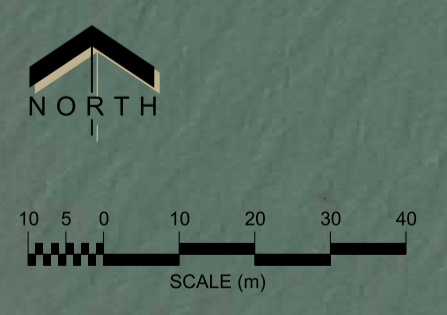
Date	Jan-15	Client	Christchurch City Council	
Drawn by	CM	Project	Naval Point Recreational Reserve	
Approved by	DR	Description	2011 Aerial Photograph showing Potentially Contaminated Areas	
Scale	NTS	Figure Number	5	Project Number 11539.000.001_1

APPENDIX 1

Proposed Redevelopment Area Plan



300
200
150
100
50
30
10
0
 © Copyright Christchurch City Council © Aerial Photography Copyright Terralink International Ltd



SERVICES LEGEND		LEGEND	
SEWER			CHRISTCHURCH CITY COUNCIL LAND
WATER			LYTTELTON PORT COMPANY LAND
STORMWATER			



APPENDIX 2

CRC LLUR Statement

Dear Sir/Madam

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

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

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

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

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

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

Yours sincerely

Contaminated Sites Team

Property Statement from the Listed Land Use Register

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

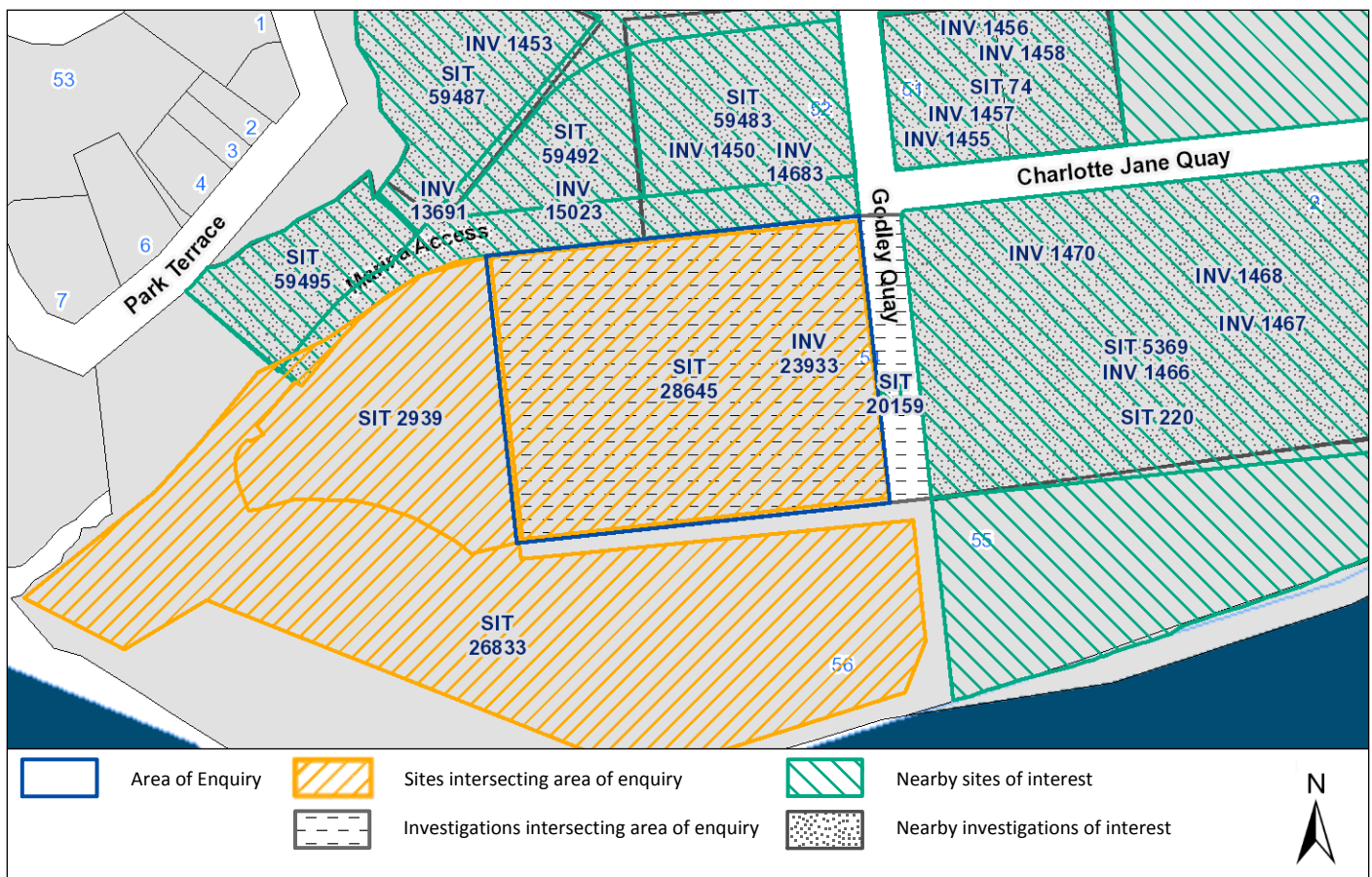
Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

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

www.ecan.govt.nz

Date:	12 January 2015	
Land Parcels:	Lot 3 DP 11243	Valuation No(s): 2380189600



The information presented in this map is specific to the area within a 100m radius of property you have selected. Information on properties outside the search radius may not be shown on this map, even if the property is visible.

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
74	LPC Block 19 and Block 57	Charlotte Jane Quay, Lyttelton	A13 - Petroleum or petrochemical industries or storage;	Review in Progress
220	Lyttelton Tank Farm	Naval Point, Lyttelton	A13 - Petroleum or petrochemical industries or storage; A17 - Storage tanks or drums for fuel, chemicals or liquid waste; A18 - Wood treatment or preservation and bulk storage of treated timber;	Closed Parent
2939	Stark Bros Ltd Site 2	Charlotte Jane Quay, Lyttelton	A17 - Storage tanks or drums for fuel, chemicals or	Not Investigated

			liquid waste;A18 - Wood treatment or preservation and bulk storage of treated timber;	
5369	LPC Block 3 and Block 3A (BP Oil Petroleum Depot and Bitumen Plant)	Charlotte Jane Quay, Lyttelton	A13 - Petroleum or petrochemical industries or storage;	Significant Adverse Environmental Effects
20159	Godley Quay, Lyttelton - Lyttelton Recreation Ground Pavilion	Godley Quay, Lyttelton	H - Adjacent sites;	Not Categorised – IN PROGRESS
26833	26833	Godley Quay, Lyttelton	A17 - Storage tanks or drums for fuel, chemicals or liquid waste;A18 - Wood treatment or preservation and bulk storage of treated timber;	Not Investigated
28645	Godley Quay, Lyttelton - Lyttelton Recreation Ground	Godley Quay, Lyttelton	A10 - Persistent pesticide bulk storage or use;	Not Investigated
59483	LPC Block 2	Charlotte Jane Quay West and Godley Quay, Lyttelton	A13 - Petroleum or petrochemical industries or storage;A17 - Storage tanks or drums for fuel, chemicals or liquid waste;	Partially Investigated
59487	LPC Block 36	Charlotte Jane Quay West and Godley Quay, Lyttelton	A13 - Petroleum or petrochemical industries or storage;A17 - Storage tanks or drums for fuel, chemicals or liquid waste;	Partially Investigated
59492	LPC Block 29	Charlotte Jane Quay West and Godley Quay, Lyttelton	A13 - Petroleum or petrochemical industries or storage;A17 - Storage tanks or drums for fuel, chemicals or liquid waste;	Partially Investigated
59495	LPC Block 56	Charlotte Jane Quay West and Godley Quay, Lyttelton	A17 - Storage tanks or drums for fuel, chemicals or liquid waste;A18 - Wood treatment or preservation and bulk storage of treated timber;	Partially Investigated

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry within a 100m buffer.

Information held about the sites on the Listed Land Use Register

Site 74: LPC Block 19 and Block 57 (Within 100m of enquiry area.)

Site Address:	Charlotte Jane Quay, Lyttelton
Legal Description(s):	Lot 1 DP 439501, Lot 4 DP 439501

Site Category:	Review in Progress
Definition:	Investigation reports have been received and are currently being reviewed to determine the most appropriate site category.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1920s	Present	Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground

Notes:

8 May 2010	Discharge consent obtained: CRC 063049
5 Jan 2006	Consents: BP: CRC021644.2 - Discharge stormwater onto land. CRC021641 & CRC020544 - To install bores CRC030052, CRC021643. Shell: CRC055010 - To install an above-ground storage tank (PA)

CRC041688 - To place and use containers for storing, transferring and using petroleum substances.

CRC030547 - To install bores

Caltex:

CRC050792 & CRC961040 - To install bores

Mobil:

CRC030167 - To install bores

9 Jan 2006

Caltex 1 Site was used for bulk storage of petroleum hydrocarbons from 1930 until its decommission in 1993. Prior to decommissioning, the site held five vertical above ground tanks, a truck loading rack, a railcar loading gantry, drum filling and storage facility and an office. The rail loading facilities were used until mid 1995, with fuel supplied from the Caltex No.2 Plant site. The extent of the contamination has been delineated and remediation has been undertaken on the basis of the delineation. A validation investigation was performed, but it did not consider all exposure pathways or contaminants.

27 Feb 2006

Caltex is in the process of applying for a passive discharge consent for its Caltex Lyttelton site (Caltex No. 2). The AEE has been prepared by URS Ltd, and it contains the description of the proposed remediation works. They include the remediation of the area containing the potentially mobile free phase product in the south-eastern part of the site and also extending beneath the Cyrus Williams Quay, and also the excavation of contaminated soil beneath the old above ground storage tank.

17 Jul 2014

LPC Lease Blocks 19 - Vacant and 57 - Z Energy Ltd

Investigations:

1 Jun 1994 **INV 1455: Environmental Site Investigation Report** (Detailed Site Investigation)
Tonkin and Taylor Ltd

Summary of investigation(s):

Report relates to Caltex Site 1.

1 Mar 1996 **INV 1456: Site Remediation Verification Report** (Detailed Site Investigation)
Tonkin and Taylor Ltd

Summary of investigation(s):

Report relates to Caltex Site 1.

1 Aug 1999 **INV 1457: Caltex Lyttelton No. 1 Plant - MfE Guideline Discussion.** (Detailed Site Investigation)
Tonkin and Taylor Ltd

6 Aug 2001 **INV 1458: Caltex Lyttelton No. 1 Plant - 1999 MfE Guidelines Discussion DRAFT** (Detailed Site Investigation)
Unknown

Summary of investigation(s):

Report(s) have not yet been audited.

Site 220: Lyttelton Tank Farm (Within 100m of enquiry area.)

Site Address:	Naval Point, Lyttelton
Legal Description(s):	Lot 1 DP 80793; Lot 4 DP 67082; Lot 3 DP 72644
Site Category:	Closed Parent
Definition:	Parent record created only to link child sites together

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1920s	Present	Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground
	1980	current	Storage tanks or drums for fuel, chemicals or liquid waste
	?	current	Storage tanks or drums for fuel, chemicals or liquid waste
	Pre 1965	Pre 1994	Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

Notes:

Investigations:

- 12 Mar 1992** **INV 1470: Letter from BP outlining the investigations undertaken at BP Terminal Site (Activity 3440)**
(Preliminary Site Investigation)
BP Oil New Zealand Ltd

Exceedences of environmental guideline values				
Document	Contaminant	Pathway	Media	Land Use
NZ DWS	Benzene	Maximum acceptable value (MAV) (health)	Water	Drinking water
NZ DWS	Ethylbenzene	Maximum acceptable value (MAV) (health)	Water	Drinking water
NZ DWS	Xylenes	Maximum acceptable value (MAV) (health)	Water	Drinking water

- 12 Mar 1999** **INV 1468: Bench Marking and Tier One Risk Assessment, BP Terminal, Charlotte Jane Quay, Lyttelton.**
(Preliminary Site Investigation)
Woodward Clyde Ltd.

Exceedences of environmental guideline values				
Document	Contaminant	Pathway	Media	Land Use
NZ DWS	Benzene	Maximum acceptable value (MAV) (health)	Water	Drinking water
ANZECC Water Quality	Ethylbenzene		Water	Protection of ecosystems marine
NZ DWS	Benzo(a)pyrene	Maximum acceptable value (MAV) (health)	Water	Drinking water
ANZECC Water Quality	Benzo(a)pyrene		Water	Protection of ecosystems marine

- 2 Jun 1999** **INV 1467: Tier Two Risk Assessment BP Terminal, Charlotte Jane Quay, Lyttelton.** (Detailed Site Investigation)
Woodward Clyde Ltd.

- 1 Mar 2002** **INV 1466: BP Lyttelton Terminal Development Preliminary Site Investigation Report** (Preliminary Site Investigation)
URS New Zealand Limited

Summary of investigation(s):

The ~42,818 m² area is located immediately south-east of the intersection of Charlotte Jane Quay and Godley Quay. The area is predominantly used for petroleum storage although a portion of it (1,800 m²) is also used for bitumen manufacture and bulk storage.

The site is located on reclaimed land and is underlain by hydraulic fill derived from Lyttelton Harbour to a depth of 8 m overlying natural silts of marine origin. The fill material is generally comprised of light brown to grey silty clay with occasional lenses of silt. Groundwater is found at 1.5 m bgl with slight tidal influences, and flows primarily south across the site to Lyttelton Harbour with some localised variation. Surface water is directed through concrete lined drains to an interceptor on the southern boundary of the tank farm. Stormwater from the yard drains to a second interceptor adjacent to the lorry fill shelter

The site was developed for fuel storage in the late 1940s. The BP petroleum area is comprised of two banded tank farms containing ~ 11 ASTs and various buildings located in a sealed yard adjacent to the main gate. Tanks are reported to be on concrete foundation slabs. Products known to have been stored include diesel, leaded and unleaded fuels, jet fuel and various chemicals including antifreeze, NID detergent, Diop (plasticiser) and caustic solution. The petroleum storage capacity (as of 2002) was reported to be 37,760 m³.

The bitumen plant was established in 1992 in the northern portion of the site that was historically occupied by a black oil drum-filling platform. The bitumen site is a sealed yard that is separated from the rest of the site by a concrete bund wall. Site buildings include a pump house and a furnace shed, and a bitumen loading area. It was sold in 2000 to Works Bitumen and is no longer part of BP. Products known to have been stored at the bitumen facility include bitumen, kerosene and diesel.

Storage tanks located at the site are predominantly in the form of ASTs although USTs were noted along the northern boundary in the area of the bitumen facility. The USTs were used to store motor spirits and diesel but were removed in 1989 along with their associated underground pipework.

Other activities known to have occurred at the site include a tetraethyl lead plant (dismantled in the 1960s), railcar loading (ceased in 1988), and a lorry fill shelter with above ground filling facilities (dismantled in the 1960s).

Petroleum hydrocarbon releases have been reported at the site. In addition, leaded sludge was historically buried within the tank farm. The locations were identified in 1991. SPH was noted in test pits excavated in 2010. Hydrocarbon odours and staining were noted between 2 m and 2.5 m bgl in soil borings undertaken in 2002 along Charlotte Jane Quay.

BP Oil NZ Ltd – 12 March 1992

Earlier reports from the early 1990's are missing from the site file. A letter report by BP in 12 March 1992 summarised soil and groundwater investigations that had been conducted for the site. Sampling dates were not reported. Targeted soil sampling locations were chosen based on known likely hotspots or randomly selected points primarily around the site's perimeter using surface soil samples, soil borings, and samples collected during the installation of piezometric wells. From the site map, they appear to be primarily in the petroleum handling portion of the site.

32 surface soil samples were collected and analysed for unbanded TPH. Sample concentrations ranged from 9 mg/kg to 6,200 mg/kg.

74 samples were collected from 40 locations using 1 m soil borings at depths of 0.3 and 0.9 m bgl. A couple of samples were also collected from the 0.55 m soil horizon. Samples were analysed for unbanded TPH or total lead. Unbanded TPH concentrations ranged from below the laboratory detection limit to 16,000 mg/kg. The maximum total lead concentration was 42 mg/kg. Hydrocarbon odours were noted for the majority of sample locations.

20 piezometric wells were installed and 3 soil samples were collected from each boring except for one well which only had 2 samples collected. Sample depths ranged from 0.2-1.95 m and samples were analysed for unbanded TPH. Sample concentrations ranged from below the laboratory detection limit to 3,000 mg/kg. For some samples, a concentration in parenthesis is also reported. In table notes, it states that these values are from analyses performed by S & G Consultants. It is unclear if these analyses were conducted for inter-laboratory comparison. If so, it calls into question the validity of the concentrations reported as the percent differences are extremely high. Hydrocarbon odours were detected in the majority of samples collected.

The site has a history of storing various hydrocarbon products however it is difficult to determine the degree of residual soil contamination from the unbanded TPH results. However, free product was noted in two wells at the site. Therefore, soil contamination is most likely present in these areas at a minimum.

Dissolved unbanded hydrocarbons were analysed from groundwater samples collected from 11 wells across the site. Samples analysed for unbanded TPH were collected on 2 October 1991 and samples analysed for BTEX compounds were collected on 29 October 1991. Unbanded TPH concentrations ranged from 0.9 mg/L to 4.4 mg/kg. Of the 11 groundwater samples collected and analysed, 2 were also analysed for dissolved BTEX compounds. Of the 2 wells, one well had benzene, total xylenes, and ethylbenzene above relevant potable water criteria (MoH, 2008). This well was located on the northern perimeter near the centre within the banded area. Separate phase hydrocarbons were detected in 2 located in the southern centre portion of the site within the banded area.

Woodward-Clyde Ltd – 1997 and March 1999

Woodward-Clyde monitored 20 wells from previous investigations for the site. Results were used to undertake a risk assessment for the site. Although the 1997 investigation was not included in the site file, the results were summarised in the 1999 risk assessment report along with groundwater sampling undertaken in 1998.

19 groundwater samples were collected and analysed for banded TPH (19 samples), PAHs (4 samples) and BTEX compounds (10 samples). The sampling method and well construction logs were not reported.

Free product was noted in two wells (P8 and P10) near the centre of the site. However, free product in P8 was not noticeable in groundwater after purging. The thickness of the free product measured in P10 was 0.04 m.

Groundwater results from this investigation and from the 1997 Woodward-Clyde investigation were compared to MfE (1999) potable water guidelines. 4 of the 19 wells sampled exceeded the potable guidelines for C10-C14, C15-C36, benzene and benzo(a)pyrene. However, groundwater at the site is not used and is not considered of a quality to support an adequately potable resource; therefore, the exceedances are merely for comparison purposes.

Due to the proximity of Lyttelton Harbour, groundwater concentrations were also compared to ANZECC (2000) guideline values for the protection of marine ecosystems. Concentrations of ethylbenzene in P2 and P13 were found to be above the guideline criterion with concentrations of 0.014 to 0.018 mg/kg, respectively.

Groundwater sample for P10, in which 13% free product was noted, was only tested for PAHs. The benzo(a)pyrene concentration exceeded the potable water guideline as well as the protection for a marine ecosystem. Naphthalene also exceeded the guideline criterion for the protection of a marine aquatic ecosystem. From the gas chromatograms, the free product appeared to be from moderately weathered diesel and motor spirits.

Based on the groundwater contour plan, P10 appears to be up-gradient of P5, P2 and possibly P8. It was reported that it was possible that P10 was the source of the contamination in these wells. P13 is located near the centre of the northern boundary of the site. Its exceedances indicated that contaminants may also be coming into the site from an adjacent site

Woodward Clyde Ltd – 12 March 1999

A software program developed by Spence and BP Oil in 1997 (RISC Software Version 3.0) was used to assess the degree of impact to Lyttelton Harbour. For the program, naphthalene was used as a surrogate for total PAH as it was considered to be the most mobile of the PAHs. The source of contaminants was modelled at P2 which reported the highest PAH concentrations of P2, P5 and P8.

However, it would have been appropriate if the source was modelled at P10 also since this well was located in the area considered to be the source of contaminants as free product was evident in the well. However, P2 is located near the southern boundary, close to Lyttelton Harbour and near a stormwater outfall and is a potential point for where contaminants could leave the site. Based on the results of the modelling scenarios, PAH contaminants were not thought to present an unacceptable risk to the harbour at the potential discharge point. However, groundwater sampling was still recommended.

URS – 1 March 2002

URS undertook a preliminary site inspection for the site in 2002 as part of the consents approval process to upgrade the BP facility with the addition of 3 new tanks. Previous groundwater and soil investigations were summarised. In addition, an intrusive soil investigation was undertaken along a portion of Charlotte Jane Quay where proposed underground pipework were to be located as a Caltex representative reported that SPH (unweathered diesel) was noted in three monitoring wells installed by Caltex on the corner of Charlotte Jane Quay and Cyrus William Quay.

13 soil samples were collected on 28/02/2002 from the centre portion of a drilling return once the required depth (1.0 m, 2.0 m and 3.0 m) was reached. One sample was also collected at 4.0 m bgl at one location. Boring logs were not attached to the report therefore it is not known if samples analysed were consistent with odour/visual lithology. Samples were analysed for banded TPH (13 samples), BTEX compounds (1 sample) and PAH (2 samples).

All soil samples returned concentrations below relevant guidelines for commercial/industrial land use and for the protection of maintenance/excavation workers and for the protection of groundwater for TPH, BTEX compounds and PAHs. TPH concentrations varied between below the laboratory method of detection to 1,125 mg/kg. The concentrations of benzo(a)pyrene equivalent in the two samples analysed were 0.02 to 0.04 mg/kg.

Although soil concentrations were below relevant guidelines, hydrocarbon odours and staining were noticed in 3 of the 4 locations at depths between 2 and 3 m along the new pipeline route. It was reported that the presence of the hydrocarbon observations appeared to coincide with the onset of soil saturation. It was predominantly diesel and a mixture of petrol and diesel

Tonkin & Taylor – 10 October 2008

Tonkin & Taylor undertook an intrusive investigation at the bitumen facility to determine the appropriate disposal option for soil removed from the site as well as to provide information in regards to potential human health risk to Christchurch City Council for a building consent for a shed. 5 test pits were excavated to 0.5 m in the area of the proposed shed and in the area of a former diesel UST. Soil samples were collected from each test pit from the surface and from 0.5 m bgl. 5 surface samples were analysed for heavy metals (As, Cd, Cr, Cu, Ni, Pb, and Zn) and PAHs. Two samples were also analysed for TPH and BTEX compounds.

All samples came back below relevant industrial/commercial guideline values. However, only surface soils were analysed. From the one site photo, it appears that there may be contamination issues at depth. In addition, free product was noted in 3 of the 5 test pits and a strong hydrocarbon odour was noted for site soils in general which could indicate a potential for indoor air quality problems. Based on this information, it is considered that the investigation was insufficient to characterise human health risks.

Conclusion

The site currently operates as a petroleum handling facility and a bitumen handling facility and is to remain as such; therefore, workplace exposure standards take precedence according to MfE (1999).

Both the petroleum handling facility and the bitumen facility have only been partially investigated. SPH has been observed in both areas and groundwater has been shown to be impacted from wells monitored in the petroleum handling facility. Based on the information above, the proposed category for the site is "Significant Adverse Environmental Effects."

1 Jun 1994 **INV 1455: Environmental Site Investigation Report** (Detailed Site Investigation)
Tonkin and Taylor Ltd

Summary of investigation(s):

Report relates to Caltex Site 1.

1 Jun 1995 **INV 1450: Risk Assessment, Bulk Storage Terminal Lyttelton** (Detailed Site Investigation)
Woodward Clyde Ltd.

Exceedences of environmental guideline values				
Document	Contaminant	Pathway	Media	Land Use
ANZECC Water Quality	Benzene		Water	Protection of ecosystems marine

Summary of investigation(s):

The Woodward Clyde (1995) report documents a risk assessment of the former BP Oil NZ Ltd bulk petroleum hydrocarbon storage depot at Godley Quay, Lyttelton Harbour. The depot was undergoing progressive depot decommissioning since its closure in 1990. BP Oil NZ Ltd purchased the site from Europa Oil in 1982, but the site has been used for bulk storage of petroleum hydrocarbons since at least 1932. The site is split by George Seymour Quay into a 3,800 sq. m northern block and an 8,000 sq. m southern block. Both areas are currently vacant. The northern block contained a banded tank farm, which held three above ground bulk storage tanks, a drum and tank wagon loading stand and a pump raft. The southern block comprised a

tank farm area with two above ground storage tanks. Principal chemicals stored at the site included leaded and unleaded motor spirits, diesel, and kerosene. It is not reported whether underground storage tanks were present at the site. With exception of two above ground bulk storage tanks, all equipment, pipework, and tanks had been removed from the site by November 1995.

The report cites a single major spill event occurring within the last 20 years of the depot's operational life. The incident relates to a spill of motor spirits from a tank sample valve. The product reportedly pooled to a height of at least several centimetres on the eastern part of the northern block. In addition, leaded sludge was probably disposed at the site with two tanks known to have been cleaned, and sludge most likely buried in shallow trenches (approx. 0.5 m deep) adjacent to tank access ports.

The site is located on reclaimed land, and the underlying fill constitutes silty clay and clayey silt material derived from harbour dredging. According to Woodward Clyde (1995), the groundwater table displays fluctuation that is most likely influenced both by precipitation and tidal regime. The dominant groundwater flow direction is reported as southerly, towards the Lyttelton Harbour, which lies approximately 400 m from the site. The shallow non-artesian aquifer does not meet a sensitive classification according to the MfE (1999) criteria.

The objective of the Woodward Clyde investigation was to determine the extent and levels of contaminants in soil and groundwater beneath the site and to evaluate the risk to human and environmental receptors under a future commercial/industrial use of the land. The former part of the objective is largely achieved by distilling the soil and groundwater data retrieved from two previous Woodward Clyde field investigations, conducted at the site in October 1990 and between October and September 1994. Therefore, the 1995 report omits a detailed account of the soil and groundwater sampling programmes, including sample pattern approach, field and laboratory methodology, field observations, and quality assurance and control procedures. Based on figures enclosed in the report, the soil sampling plan adopts a mixture of systematic and targeted approaches. Only footprints of two former above ground bulk storage tanks are sampled and there is no discussion of the relationship between sampling points and other facilities used in handling of petroleum products (e.g. pipework, valves). Six groundwater monitoring wells and six piezometers were constructed along the perimeter of the site and in the downgradient direction of possible contaminant sources. The screening depths of monitoring wells and the groundwater levels at sampling events are not included in the report.

In total, 57 soil samples were analysed for unbanded total petroleum hydrocarbons (TPH), 4 for BTEX compounds, and 41 for total soil lead. As is supported by the subsequent groundwater results, a higher proportion of soil samples should have been analysed for the aromatic components of petroleum hydrocarbons, particularly for BTEX compounds, but also for polycyclic aromatic hydrocarbons (PAHs). Three groundwater monitoring events were carried out between 1990 and 1994: on October 1993, October 1994 and July 1994, with water samples from select wells submitted for unbanded TPH and/or BTEX analysis. Selection of monitoring wells and piezometers for sampling is not justified in the report.

The Woodward Clyde (1995) report assesses the soil and groundwater results using a framework that has since been superseded. Moreover, due to the unsuitability of the soil screening level adopted for lead, which was protective of residential land use and groundwater resource use, the report carries out a site-specific assessment for exposure of human receptors to soil lead. For the purpose of this audit, the analytical results presented in the report have been assessed against the currently valid criteria for the protection of human health, in the case of soil samples, and the criteria for protection of marine ecosystems, in the case of water samples. However, it should be noted that assessment of the unbanded TPH results against the currently applicable criteria, which are based on effective carbon range fractions, was not practicable.

While the majority of samples were characterised by a low level of lead impact, a number of areas contained soil lead concentrations, which although compliant with the MfE (2011) soil contaminant standard, were notably higher than the range characterising the majority of the site. These areas were concentrated at the northern corner of the site (at the former drum and tank loading stand) and in areas surrounding two above ground bulk storage tank locations, where burial of lead sludge was suspected. The report calculates an upper estimate of the average lead concentrations at the site as 534 mg/kg. However, in estimating the average concentration, the report does not account for the inclusion of composite sample results, different sampling depths, or the spatial pattern of lead contamination. Lead water samples were compliant with groundwater criteria.

The soil sample results indicated an absence of widespread petroleum hydrocarbon contamination across the site. However, only limited sampling was conducted of soils immediately surrounding or beneath the former above ground bulk storage tanks and the ancillary services. This is of concern as the highest petroleum hydrocarbon concentrations were detected in three surface soil samples collected from beneath of the former bulk tanks (tank T13), recording TPH concentrations between 3,240 and 9,740 mg/kg. The vertical extent of contamination beneath the tank was not assessed, and areas beneath three other tanks, two of which were still present at the site in 1995, were not characterised.

While the site-wide sampling for petroleum hydrocarbons did not identify significant sub-surface contamination, separate phase hydrocarbons were observed in wells MW1 and MW5 in October 1990, displaying thicknesses of 2 mm and 1 mm respectively. Separate phase hydrocarbons were not observed in any of the monitoring wells or piezometers in the October 1993 or July 1994 monitoring rounds. The presence of separate phase hydrocarbons in two of the monitoring wells was inconsistent with the TPH concentrations recorded in soil samples from the same bore drillings. Together with the reported fluctuations in the groundwater levels and the fine textured nature of the strata, the discrepancy between soil and groundwater petroleum hydrocarbon results suggests that residual contamination may exhibit a complex spatial distribution in the sub-surface beneath the site, potentially confined to thin horizons of the soil pore water space.

The groundwater samples collected from MW1 and MW5 in October 1993 contained detectable concentrations of BTEX components. Benzene was recorded at concentrations of 0.9 mg/l and 1.8 mg/l in MW1 and MW5 respectively. Groundwater samples collected from the two wells in July 1994 reported lower concentrations, benzene being recorded at concentrations of 0.003 mg/l and 0.10 mg/l in MW1 and MW 5 respectively. Benzene concentrations recorded in October 1993 at MW1 and MW5 exceeded the ANZECC (2000) trigger value for protection of marine ecosystems, but the July 1994 groundwater concentrations were compliant with the trigger value. Overall, the results for monitoring wells MW1 and MW5 indicate that petroleum hydrocarbons were reducing with time, which in the Woodward Clyde (1995) report is attributed to contaminant migration and degradation. However, it is difficult to confidently interpret the trends in groundwater contamination in a limited dataset without information on groundwater levels and flow direction.

Overall, the report concludes that the residual contamination does not pose a significant risk to human health and the environment. However, the report audit identifies a number of issues relating to the uncertainty in the residual contaminant distribution. For petroleum hydrocarbons, the residues of which were present in soil and groundwater beneath the site, the main limitations stem from the contrast between the soil and

groundwater results and the absence of validation results for areas beneath the majority of former bulk tanks. It is recommended that the remaining data gaps are addressed prior to redevelopment of the site.

Due to the limitations and uncertainties outlined above, the environment assessment is presently considered inadequate, and it is proposed that the site is registered under the category of 'Partially Investigated' on the Listed Land Use Register.

It should be noted that the cover letter attached to the report states that land farming had been implemented at the site in order to enhance the natural attenuation processes; however, the methodology and monitoring procedures are not described further. Given the length of time since the initial investigation was conducted, it is expected that the residual petroleum hydrocarbon contamination has been significantly modified by the biodegradation and transport processes.

1 Mar 1996 **INV 1456: Site Remediation Verification Report** (Detailed Site Investigation)
Tonkin and Taylor Ltd

Summary of investigation(s):

Report relates to Caltex Site 1.

INV 13691: *Notification of contaminated site investigation - URS - 5 November 2012***** (Detailed Site Investigation)
URS New Zealand Limited

INV 15023: *notification of groundwater investigation - URS received 31 January 2013***** (Detailed Site Investigation)
URS New Zealand Limited

1 Aug 1999 **INV 1457: Caltex Lyttelton No. 1 Plant - MfE Guideline Discussion.** (Detailed Site Investigation)
Tonkin and Taylor Ltd

11 Nov 1999 **INV 1453: Bench Marking and Tier One Risk Assessment Mobil Naval Point, Lyttelton.** (Detailed Site Investigation)
Woodward Clyde Ltd.

6 Aug 2001 **INV 1458: Caltex Lyttelton No. 1 Plant - 1999 MfE Guidelines Discussion DRAFT** (Detailed Site Investigation)
Unknown

10 Jan 2013 **INV 14683: Former BP Terminal Site Godley Quay - Benchmarking** (Detailed Site Investigation)
URS New Zealand Limited

Summary of investigation(s):

Report(s) have not yet been audited.

Site 2939: Stark Bros Ltd Site 2 (Intersects enquiry area.)

Site Address:	Charlotte Jane Quay, Lyttelton
Legal Description(s):	Lot 1 DP 80599

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

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1998	current	Storage tanks or drums for fuel, chemicals or liquid waste
	Pre 1965	Pre 1994	Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

Notes:

5 Jan 2006 A brief site description and history has been compiled by Kingett Mitchell and Associates (2002). Site previously used for storage of timber by former Lyttelton Harbour Board. The timber was used for port maintenance. It is unknown if treated timber was held onsite, but likely considering the end use of the timber.

Part of the site is leased to Stark Bros Ltd and a 50,000L AGST, situated on a concrete pad and banded in a steel bath bund, is present on the site. Tank contains used oil. The site also stores dry, contaminated waste from the dry dock prior to its disposal. The waste is mixed with lime and is located on a concrete lined storage area.

Investigations:

There are no investigations associated with this site.

Site 5369: LPC Block 3 and Block 3A (BP Oil Petroleum Depot and Bitumen Plant) (Within 100m of enquiry area.)

Site Address:	Charlotte Jane Quay, Lyttelton
Legal Description(s):	Lot 4 DP 439501

Site Category:	Significant Adverse Environmental Effects
Definition:	Site investigation demonstrates that sediment, groundwater or surface water is significantly contaminated.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1920s	Present	Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground

Notes:

24 Aug 2010 Registration letter and site detail sheet filed under IN7C/110.

24 Aug 2010 BP Oil Petroleum Depot and Bitumen Plant has been used for bulk fuel storage from its development in the 1940s when 10 vertical and 4 or 5 horizontal above ground storage tanks were installed. One horizontal tank was removed in 1950s and two tanks, a horizontal slops and a vertical tank were installed in the late 1970s. One more horizontal tank was removed in 1988, and the remaining horizontal tanks were placed onto concrete foundations. They have been removed since. Three new vertical tanks and a slops tank were installed in 2002, with three older vertical tanks decommissioned but remaining onsite.

A tetra ethyl lead plant operated on the site until 1960s, and underground storage tanks located on the property were removed in 1989. Groundwater contamination has been recorded, but further soil sampling is required in order to make an assessment against the guideline values. A bitumen plant operates on the north-eastern part of the BP depot. It was formerly operated by BP.

17 Jul 2014 LPC Lease Blocks 3 - BP Oil NZ Ltd and 3a sublease Works Infrastructure Ltd

Investigations:

12 Mar 1992 **INV 1470: Letter from BP outlining the investigations undertaken at BP Terminal Site (Activity 3440)**
(Preliminary Site Investigation)
BP Oil New Zealand Ltd

Exceedences of environmental guideline values				
Document	Contaminant	Pathway	Media	Land Use
NZ DWS	Benzene	Maximum acceptable value (MAV) (health)	Water	Drinking water
NZ DWS	Ethylbenzene	Maximum acceptable value (MAV) (health)	Water	Drinking water
NZ DWS	Xylenes	Maximum acceptable value (MAV) (health)	Water	Drinking water

12 Mar 1999 **INV 1468: Bench Marking and Tier One Risk Assessment, BP Terminal, Charlotte Jane Quay, Lyttelton.**
(Preliminary Site Investigation)
Woodward Clyde Ltd.

Exceedences of environmental guideline values

Document	Contaminant	Pathway	Media	Land Use
NZ DWS	Benzene	Maximum acceptable value (MAV) (health)	Water	Drinking water
ANZECC Water Quality	Ethylbenzene		Water	Protection of ecosystems marine
NZ DWS	Benzo(a)pyrene	Maximum acceptable value (MAV) (health)	Water	Drinking water
ANZECC Water Quality	Benzo(a)pyrene		Water	Protection of ecosystems marine

2 Jun 1999 **INV 1467: Tier Two Risk Assessment BP Terminal, Charlotte Jane Quay, Lyttelton.** (Detailed Site Investigation)
Woodward Clyde Ltd.

1 Mar 2002 **INV 1466: BP Lyttelton Terminal Development Preliminary Site Investigation Report** (Preliminary Site Investigation)
URS New Zealand Limited

Summary of investigation(s):

The ~42,818 m² area is located immediately south-east of the intersection of Charlotte Jane Quay and Godley Quay. The area is predominantly used for petroleum storage although a portion of it (1,800 m²) is also used for bitumen manufacture and bulk storage.

The site is located on reclaimed land and is underlain by hydraulic fill derived from Lyttelton Harbour to a depth of 8 m overlying natural silts of marine origin. The fill material is generally comprised of light brown to grey silty clay with occasional lenses of silt. Groundwater is found at 1.5 m bgl with slight tidal influences, and flows primarily south across the site to Lyttelton Harbour with some localised variation. Surface water is directed through concrete lined drains to an interceptor on the southern boundary of the tank farm. Stormwater from the yard drains to a second interceptor adjacent to the lorry fill shelter

The site was developed for fuel storage in the late 1940s. The BP petroleum area is comprised of two bunded tank farms containing ~ 11 ASTs and various buildings located in a sealed yard adjacent to the main gate. Tanks are reported to be on concrete foundation slabs. Products known to have been stored include diesel, leaded and unleaded fuels, jet fuel and various chemicals including antifreeze, NID detergent, Diop (plasticiser) and caustic solution. The petroleum storage capacity (as of 2002) was reported to be 37,760 m³.

The bitumen plant was established in 1992 in the northern portion of the site that was historically occupied by a black oil drum-filling platform. The bitumen site is a sealed yard that is separated from the rest of the site by a concrete bund wall. Site buildings include a pump house and a furnace shed, and a bitumen loading area. It was sold in 2000 to Works Bitumen and is no longer part of BP. Products known to have been stored at the bitumen facility include bitumen, kerosene and diesel.

Storage tanks located at the site are predominantly in the form of ASTs although USTs were noted along the northern boundary in the area of the bitumen facility. The USTs were used to store motor spirits and diesel but were removed in 1989 along with their associated underground pipework.

Other activities known to have occurred at the site include a tetraethyl lead plant (dismantled in the 1960s), railcar loading (ceased in 1988), and a lorry fill shelter with above ground filling facilities (dismantled in the 1960s).

Petroleum hydrocarbon releases have been reported at the site. In addition, leaded sludge was historically buried within the tank farm. The locations were identified in 1991. SPH was noted in test pits excavated in 2010. Hydrocarbon odours and staining were noted between 2 m and 2.5 m bgl in soil borings undertaken in 2002 along Charlotte Jane Quay.

BP Oil NZ Ltd – 12 March 1992

Earlier reports from the early 1990's are missing from the site file. A letter report by BP in 12 March 1992 summarised soil and groundwater investigations that had been conducted for the site. Sampling dates were not reported. Targeted soil sampling locations were chosen based on known likely hotspots or randomly selected points primarily around the site's perimeter using surface soil samples, soil borings, and samples collected during the installation of piezometric wells. From the site map, they appear to be primarily in the petroleum handling portion of the site.

32 surface soil samples were collected and analysed for unbanded TPH. Sample concentrations ranged from 9 mg/kg to 6,200 mg/kg.

74 samples were collected from 40 locations using 1 m soil borings at depths of 0.3 and 0.9 m bgl. A couple of samples were also collected from the 0.55 m soil horizon. Samples were analysed for unbanded TPH or total lead. Unbanded TPH concentrations ranged from below the laboratory detection limit to 16,000 mg/kg. The maximum total lead concentration was 42 mg/kg. Hydrocarbon odours were noted for the majority of sample locations.

20 piezometric wells were installed and 3 soil samples were collected from each boring except for one well which only had 2 samples collected. Sample depths ranged from 0.2-1.95 m and samples were analysed for unbanded TPH. Sample concentrations ranged from below the laboratory detection limit to 3,000 mg/kg. For some samples, a concentration in parenthesis is also reported. In table notes, it states that these values are from analyses performed by S & G Consultants. It is unclear if these analyses were conducted for inter-laboratory comparison. If so, it calls into question the validity of the concentrations reported as the percent differences are extremely high. Hydrocarbon odours were detected in the majority of samples collected.

The site has a history of storing various hydrocarbon products however it is difficult to determine the degree of residual soil contamination from the unbanded TPH results. However, free product was noted in two wells at the site. Therefore, soil contamination is most likely present in these areas at a minimum.

Dissolved unbanded hydrocarbons were analysed from groundwater samples collected from 11 wells across the site. Samples analysed for unbanded TPH were collected on 2 October 1991 and samples analysed for BTEX compounds were collected on 29 October 1991. Unbanded TPH concentrations ranged from 0.9 mg/L to 4.4 mg/kg. Of the 11 groundwater samples collected and analysed, 2 were also analysed for dissolved BTEX compounds. Of the 2 wells, one well had benzene, total xylenes, and ethylbenzene above relevant potable water criteria (MoH, 2008). This well was located on the northern perimeter near the centre within the banded area. Separate phase hydrocarbons were detected in 2 located in the southern centre portion of the site within the banded area.

Woodward-Clyde Ltd – 1997 and March 1999

Woodward-Clyde monitored 20 wells from previous investigations for the site. Results were used to undertake a risk assessment for the site. Although the 1997 investigation was not included in the site file, the results were summarised in the 1999 risk assessment report along with groundwater sampling undertaken in 1998.

19 groundwater samples were collected and analysed for banded TPH (19 samples), PAHs (4 samples) and BTEX compounds (10 samples). The sampling method and well construction logs were not reported.

Free product was noted in two wells (P8 and P10) near the centre of the site. However, free product in P8 was not noticeable in groundwater after purging. The thickness of the free product measured in P10 was 0.04 m.

Groundwater results from this investigation and from the 1997 Woodward-Clyde investigation were compared to MfE (1999) potable water guidelines. 4 of the 19 wells sampled exceeded the potable guidelines for C10-C14, C15-C36, benzene and benzo(a)pyrene. However, groundwater at the site is not used and is not considered of a quality to support an adequately potable resource; therefore, the exceedances are merely for comparison purposes.

Due to the proximity of Lyttelton Harbour, groundwater concentrations were also compared to ANZECC (2000) guideline values for the protection of marine ecosystems. Concentrations of ethylbenzene in P2 and P13 were found to be above the guideline criterion with concentrations of 0.014 to 0.018 mg/kg, respectively.

Groundwater sample for P10, in which 13% free product was noted, was only tested for PAHs. The benzo(a)pyrene concentration exceeded the potable water guideline as well as the protection for a marine ecosystem. Naphthalene also exceeded the guideline criterion for the protection of a marine aquatic ecosystem. From the gas chromatograms, the free product appeared to be from moderately weathered diesel and motor spirits.

Based on the groundwater contour plan, P10 appears to be up-gradient of P5, P2 and possibly P8. It was reported that it was possible that P10 was the source of the contamination in these wells. P13 is located near the centre of the northern boundary of the site. Its exceedances indicated that contaminants may also be coming into the site from an adjacent site

Woodward Clyde Ltd – 12 March 1999

A software program developed by Spence and BP Oil in 1997 (RISC Software Version 3.0) was used to assess the degree of impact to Lyttelton Harbour. For the program, naphthalene was used as a surrogate for total PAH as it was considered to be the most mobile of the PAHs. The source of contaminants was modelled at P2 which reported the highest PAH concentrations of P2, P5 and P8.

However, it would have been appropriate if the source was modelled at P10 also since this well was located in the area considered to be the source of contaminants as free product was evident in the well. However, P2 is located near the southern boundary, close to Lyttelton Harbour and near a stormwater outfall and is a potential point for where contaminants could leave the site. Based on the results of the modelling scenarios, PAH contaminants were not thought to present an unacceptable risk to the harbour at the potential discharge point. However, groundwater sampling was still recommended.

URS – 1 March 2002

URS undertook a preliminary site inspection for the site in 2002 as part of the consents approval process to upgrade the BP facility with the addition of 3 new tanks. Previous groundwater and soil investigations were summarised. In addition, an intrusive soil investigation was undertaken along a portion of Charlotte Jane Quay where proposed underground pipework were to be located as a Caltex representative reported that SPH (unweathered diesel) was noted in three monitoring wells installed by Caltex on the corner of Charlotte Jane Quay and Cyrus William Quay.

13 soil samples were collected on 28/02/2002 from the centre portion of a drilling return once the required depth (1.0 m, 2.0 m and 3.0 m) was reached. One sample was also collected at 4.0 m bgl at one location. Boring logs were not attached to the report therefore it is not known if samples analysed were consistent with odour/visual lithology. Samples were analysed for banded TPH (13 samples), BTEX compounds (1 sample) and PAH (2 samples).

All soil samples returned concentrations below relevant guidelines for commercial/industrial land use and for the protection of maintenance/excavation workers and for the protection of groundwater for TPH, BTEX compounds and PAHs. TPH concentrations varied between below the laboratory method of detection to 1,125 mg/kg. The concentrations of benzo(a)pyrene equivalent in the two samples analysed were 0.02 to 0.04 mg/kg.

Although soil concentrations were below relevant guidelines, hydrocarbon odours and staining were noticed in 3 of the 4 locations at depths between 2 and 3 m along the new pipeline route. It was reported that the presence of the hydrocarbon observations appeared to coincide with the onset of soil saturation. It was predominantly diesel and a mixture of petrol and diesel

Tonkin & Taylor undertook an intrusive investigation at the bitumen facility to determine the appropriate disposal option for soil removed from the site as well as to provide information in regards to potential human health risk to Christchurch City Council for a building consent for a shed. 5 test pits were excavated to 0.5 m in the area of the proposed shed and in the area of a former diesel UST. Soil samples were collected from each test pit from the surface and from 0.5 m bgl. 5 surface samples were analysed for heavy metals (As, Cd, Cr, Cu, Ni, Pb, and Zn) and PAHs. Two samples were also analysed for TPH and BTEX compounds.

All samples came back below relevant industrial/commercial guideline values. However, only surface soils were analysed. From the one site photo, it appears that there may be contamination issues at depth. In addition, free product was noted in 3 of the 5 test pits and a strong hydrocarbon odour was noted for site soils in general which could indicate a potential for indoor air quality problems. Based on this information, it is considered that the investigation was insufficient to characterise human health risks.

Conclusion

The site currently operates as a petroleum handling facility and a bitumen handling facility and is to remain as such; therefore, workplace exposure standards take precedence according to MfE (1999).

Both the petroleum handling facility and the bitumen facility have only been partially investigated. SPH has been observed in both areas and groundwater has been shown to be impacted from wells monitored in the petroleum handling facility. Based on the information above, the proposed category for the site is "Significant Adverse Environmental Effects."

Site 20159: Godley Quay, Lyttelton - Lyttelton Recreation Ground Pavilion (Within 100m of enquiry area.)

Site Address: Godley Quay, Lyttelton
Legal Description(s):

Site Category: Not Categorised – IN PROGRESS
Definition: No category has been assigned to this site. Still in progress to be reviewed.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	Unknown	Unknown	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

Notes:

28 Aug 2013 Geotechnical investigation by SKM in October 2012 found a hydrocarbon odour at approximately 2 metres below ground level. Contamination may or may not be associated with petrochemical tanks East of the site. Christchurch City council has been notified. Contamination was identified between 2 and 10 mbgl. Report recieved from CCC 20/08/2013.

Investigations:

17 Oct 2012 **INV 20162: Geotechnical Interpretative Report - Lyttelton Recreation Ground, Pavilion - Godley Quay, Lyttelton** (Detailed Site Investigation)
 Sinclair Knight Mertz Ltd

15 Oct 2013 **INV 23933: Lyttelton Recreation Ground Vapour Monitoring** (Detailed Site Investigation)
 Aecom

Summary of investigation(s):

Report(s) have not yet been audited.

Site 26833: 26833 (Intersects enquiry area.)

Site Address: Godley Quay, Lyttelton
Legal Description(s): Lot 1 DP 72644, Lot 1 DP 80599, Lot 1 DP 80793

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

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1998	current	Storage tanks or drums for fuel, chemicals or liquid waste
	1980	current	Storage tanks or drums for fuel, chemicals or liquid waste
	Pre 1965	Pre 1994	Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

Notes:

18 Oct 2013 Area defined from: 1965-1994 ECan Aerial Photographs
 Note: A timber yard was noted in the aerial photographs reviewed.

Investigations:

INV 13691: *Notification of contaminated site investigation - URS - 5 November 2012***** (Detailed Site Investigation)
 URS New Zealand Limited

INV 15023: *notification of groundwater investigation - URS received 31 January 2013***** (Detailed Site Investigation)
 URS New Zealand Limited

15 Oct 2013 **INV 23933: Lyttelton Recreation Ground Vapour Monitoring** (Detailed Site Investigation)
 Aecom

Summary of investigation(s):

Report(s) have not yet been audited.

Site 28645: Godley Quay, Lyttelton - Lyttelton Recreation Ground (Intersects enquiry area.)

Site Address:	Godley Quay, Lyttelton
Legal Description(s):	Lot 3 DP 11243

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

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	Pre 1965	2011	Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds

Notes:

18 Oct 2013 Area defined from: 1965-2011 ECan Aerial Photographs.
 Note: Sport turfs were noted in aerial photographs reviewed.

Investigations:

15 Oct 2013 **INV 23933: Lyttelton Recreation Ground Vapour Monitoring** (Detailed Site Investigation)
 Aecom

Summary of investigation(s):

Report(s) have not yet been audited.

Site 59483: LPC Block 2 (Within 100m of enquiry area.)

Site Address:	Charlotte Jane Quay West and Godley Quay, Lyttelton
Legal Description(s):	Lot 1 DP 80793

Site Category:	Partially Investigated
Definition:	Verified HAIL has been partially investigated.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1920s	Present	Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground
	?	current	Storage tanks or drums for fuel, chemicals or liquid waste

Notes:

Investigations:

1 Jun 1995 **INV 1450: Risk Assessment, Bulk Storage Terminal Lyttelton (Detailed Site Investigation)**
Woodward Clyde Ltd.

Exceedences of environmental guideline values				
Document	Contaminant	Pathway	Media	Land Use
ANZECC Water Quality	Benzene		Water	Protection of ecosystems marine

Summary of investigation(s):

The Woodward Clyde (1995) report documents a risk assessment of the former BP Oil NZ Ltd bulk petroleum hydrocarbon storage depot at Godley Quay, Lyttelton Harbour. The depot was undergoing progressive depot decommissioning since its closure in 1990. BP Oil NZ Ltd purchased the site from Europa Oil in 1982, but the site has been used for bulk storage of petroleum hydrocarbons since at least 1932. The site is split by George Seymour Quay into a 3,800 sq. m northern block and an 8,000 sq. m southern block. Both areas are currently vacant. The northern block contained a banded tank farm, which held three above ground bulk storage tanks, a drum and tank wagon loading stand and a pump raft. The southern block comprised a tank farm area with two above ground storage tanks. Principal chemicals stored at the site included leaded and unleaded motor spirits, diesel, and kerosene. It is not reported whether underground storage tanks were present at the site. With exception of two above ground bulk storage tanks, all equipment, pipework, and tanks had been removed from the site by November 1995.

The report cites a single major spill event occurring within the last 20 years of the depot’s operational life. The incident relates to a spill of motor spirits from a tank sample valve. The product reportedly pooled to a height of at least several centimetres on the eastern part of the northern block. In addition, leaded sludge was probably disposed at the site with two tanks known to have been cleaned, and sludge most likely buried in shallow trenches (approx. 0.5 m deep) adjacent to tank access ports.

The site is located on reclaimed land, and the underlying fill constitutes silty clay and clayey silt material derived from harbour dredging. According to Woodward Clyde (1995), the groundwater table displays fluctuation that is most likely influenced both by precipitation and tidal regime. The dominant groundwater flow direction is reported as southerly, towards the Lyttelton Harbour, which lies approximately 400 m from the site. The shallow non-artesian aquifer does not meet a sensitive classification according to the MfE (1999) criteria.

The objective of the Woodward Clyde investigation was to determine the extent and levels of contaminants in soil and groundwater beneath the site and to evaluate the risk to human and environmental receptors under a future commercial/industrial use of the land. The former part of the objective is largely achieved by distilling the soil and groundwater data retrieved from two previous Woodward Clyde field investigations, conducted at the site in October 1990 and between October and September 1994. Therefore, the 1995 report omits a detailed account of the soil and groundwater sampling programmes, including sample pattern approach, field and laboratory methodology, field observations, and quality assurance and control procedures. Based on figures enclosed in the report, the soil sampling plan adopts a mixture of systematic and targeted approaches. Only footprints of two former above ground bulk storage tanks are sampled and there is no discussion of the relationship between sampling points and other facilities used in handling of petroleum products (e.g. pipework, valves). Six groundwater monitoring wells and six piezometers were constructed along the perimeter of the site and in the downgradient direction of possible contaminant sources. The screening depths of monitoring wells and the groundwater levels at sampling events are not included in the report.

In total, 57 soil samples were analysed for unbanded total petroleum hydrocarbons (TPH), 4 for BTEX compounds, and 41 for total soil lead. As is supported by the subsequent groundwater results, a higher proportion of soil samples should have been analysed for the aromatic components of petroleum hydrocarbons, particularly for BTEX compounds, but also for polycyclic aromatic hydrocarbons (PAHs). Three groundwater monitoring events were carried out between 1990 and 1994: on October 1993, October 1994 and July 1994, with water samples from select wells submitted for unbanded TPH and/or BTEX analysis. Selection of monitoring wells and piezometers for sampling is not justified in the report.

The Woodward Clyde (1995) report assesses the soil and groundwater results using a framework that has since been superseded. Moreover, due to the unsuitability of the soil screening level adopted for lead, which was protective of residential land use and groundwater resource use, the report carries out a site-specific assessment for exposure of human receptors to soil lead. For the purpose of this audit, the analytical results presented in the report have been assessed against the currently valid criteria for the protection of human health, in the case of soil samples, and the criteria for protection of marine ecosystems, in the case of water samples. However, it should be noted that assessment of the unbanded TPH results against the currently applicable criteria, which are based on effective carbon range fractions, was not practicable.

While the majority of samples were characterised by a low level of lead impact, a number of areas contained soil lead concentrations, which although compliant with the MfE (2011) soil contaminant standard, were notably higher than the range characterising the majority of the site. These areas were concentrated at the northern corner of the site (at the former drum and tank loading stand) and in areas surrounding two above ground bulk storage tank locations, where burial of lead sludge was suspected. The report calculates an upper estimate of the average lead concentrations at the site as 534

mg/kg. However, in estimating the average concentration, the report does not account for the inclusion of composite sample results, different sampling depths, or the spatial pattern of lead contamination. Lead water samples were compliant with groundwater criteria.

The soil sample results indicated an absence of widespread petroleum hydrocarbon contamination across the site. However, only limited sampling was conducted of soils immediately surrounding or beneath the former above ground bulk storage tanks and the ancillary services. This is of concern as the highest petroleum hydrocarbon concentrations were detected in three surface soil samples collected from beneath of the former bulk tanks (tank T13), recording TPH concentrations between 3,240 and 9,740 mg/kg. The vertical extent of contamination beneath the tank was not assessed, and areas beneath three other tanks, two of which were still present at the site in 1995, were not characterised.

While the site-wide sampling for petroleum hydrocarbons did not identify significant sub-surface contamination, separate phase hydrocarbons were observed in wells MW1 and MW5 in October 1990, displaying thicknesses of 2 mm and 1 mm respectively. Separate phase hydrocarbons were not observed in any of the monitoring wells or piezometers in the October 1993 or July 1994 monitoring rounds. The presence of separate phase hydrocarbons in two of the monitoring wells was inconsistent with the TPH concentrations recorded in soil samples from the same bore drillings. Together with the reported fluctuations in the groundwater levels and the fine textured nature of the strata, the discrepancy between soil and groundwater petroleum hydrocarbon results suggests that residual contamination may exhibit a complex spatial distribution in the sub-surface beneath the site, potentially confined to thin horizons of the soil pore water space.

The groundwater samples collected from MW1 and MW5 in October 1993 contained detectable concentrations of BTEX components. Benzene was recorded at concentrations of 0.9 mg/l and 1.8 mg/l in MW1 and MW5 respectively. Groundwater samples collected from the two wells in July 1994 reported lower concentrations, benzene being recorded at concentrations of 0.003 mg/l and 0.10 mg/l in MW1 and MW 5 respectively. Benzene concentrations recorded in October 1993 at MW1 and MW5 exceeded the ANZECC (2000) trigger value for protection of marine ecosystems, but the July 1994 groundwater concentrations were compliant with the trigger value. Overall, the results for monitoring wells MW1 and MW5 indicate that petroleum hydrocarbons were reducing with time, which in the Woodward Clyde (1995) report is attributed to contaminant migration and degradation. However, it is difficult to confidently interpret the trends in groundwater contamination in a limited dataset without information on groundwater levels and flow direction.

Overall, the report concludes that the residual contamination does not pose a significant risk to human health and the environment. However, the report audit identifies a number of issues relating to the uncertainty in the residual contaminant distribution. For petroleum hydrocarbons, the residues of which were present in soil and groundwater beneath the site, the main limitations stem from the contrast between the soil and groundwater results and the absence of validation results for areas beneath the majority of former bulk tanks. It is recommended that the remaining data gaps are addressed prior to redevelopment of the site.

Due to the limitations and uncertainties outlined above, the environment assessment is presently considered inadequate, and it is proposed that the site is registered under the category of 'Partially Investigated' on the Listed Land Use Register.

It should be noted that the cover letter attached to the report states that land farming had been implemented at the site in order to enhance the natural attenuation processes; however, the methodology and monitoring procedures are not described further. Given the length of time since the initial investigation was conducted, it is expected that the residual petroleum hydrocarbon contamination has been significantly modified by the biodegradation and transport processes.

INV 13691: *Notification of contaminated site investigation - URS - 5 November 2012***** (Detailed Site Investigation)
URS New Zealand Limited

INV 15023: *notification of groundwater investigation - URS received 31 January 2013***** (Detailed Site Investigation)
URS New Zealand Limited

10 Jan 2013 **INV 14683: Former BP Terminal Site Godley Quay - Benchmarking** (Detailed Site Investigation)
URS New Zealand Limited

Summary of investigation(s):

Report(s) have not yet been audited.

Site 59487: LPC Block 36 (Within 100m of enquiry area.)

Site Address:	Charlotte Jane Quay West and Godley Quay, Lyttelton
Legal Description(s):	Lot 1 DP 80793
Site Category:	Partially Investigated
Definition:	Verified HAIL has been partially investigated.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1920s	Present	Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or

		petrochemicals above or below ground
1980	current	Storage tanks or drums for fuel, chemicals or liquid waste

Notes:

Investigations:

INV 13691: *Notification of contaminated site investigation - URS - 5 November 2012***** (Detailed Site Investigation)
URS New Zealand Limited

INV 15023: *notification of groundwater investigation - URS received 31 January 2013***** (Detailed Site Investigation)
URS New Zealand Limited

11 Nov 1999 **INV 1453: Bench Marking and Tier One Risk Assessment Mobil Naval Point, Lyttelton.** (Detailed Site Investigation)
Woodward Clyde Ltd.

Summary of investigation(s):

Report(s) have not yet been audited.

Site 59492: LPC Block 29 (Within 100m of enquiry area.)

Site Address:	Charlotte Jane Quay West and Godley Quay, Lyttelton
Legal Description(s):	Lot 1 DP 80793

Site Category:	Partially Investigated
Definition:	Verified HAIL has been partially investigated.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1920s	Present	Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground
	?	current	Storage tanks or drums for fuel, chemicals or liquid waste

Notes:

Investigations:

1 Jun 1995 **INV 1450: Risk Assessment, Bulk Storage Terminal Lyttelton** (Detailed Site Investigation)
Woodward Clyde Ltd.

Exceedences of environmental guideline values				
Document	Contaminant	Pathway	Media	Land Use
ANZECC Water Quality	Benzene		Water	Protection of ecosystems marine

Summary of investigation(s):

The Woodward Clyde (1995) report documents a risk assessment of the former BP Oil NZ Ltd bulk petroleum hydrocarbon storage depot at Godley Quay, Lyttelton Harbour. The depot was undergoing progressive depot decommissioning since its closure in 1990. BP Oil NZ Ltd purchased the site from Europa Oil in 1982, but the site has been used for bulk storage of petroleum hydrocarbons since at least 1932. The site is split by George Seymour Quay into a 3,800 sq. m northern block and an 8,000 sq. m southern block. Both areas are currently vacant. The northern block contained a banded tank farm, which held three above ground bulk storage tanks, a drum and tank wagon loading stand and a pump raft. The southern block comprised a tank farm area with two above ground storage tanks. Principal chemicals stored at the site included leaded and unleaded motor spirits, diesel, and kerosene. It is not reported whether underground storage tanks were present at the site. With exception of two above ground bulk storage tanks, all equipment, pipework, and tanks had been removed from the site by November 1995.

The report cites a single major spill event occurring within the last 20 years of the depot's operational life. The incident relates to a spill of motor spirits from a tank sample valve. The product reportedly pooled to a height of at least several centimetres on the eastern part of the northern block. In

addition, leaded sludge was probably disposed at the site with two tanks known to have been cleaned, and sludge most likely buried in shallow trenches (approx. 0.5 m deep) adjacent to tank access ports.

The site is located on reclaimed land, and the underlying fill constitutes silty clay and clayey silt material derived from harbour dredging. According to Woodward Clyde (1995), the groundwater table displays fluctuation that is most likely influenced both by precipitation and tidal regime. The dominant groundwater flow direction is reported as southerly, towards the Lyttelton Harbour, which lies approximately 400 m from the site. The shallow non-artesian aquifer does not meet a sensitive classification according to the MfE (1999) criteria.

The objective of the Woodward Clyde investigation was to determine the extent and levels of contaminants in soil and groundwater beneath the site and to evaluate the risk to human and environmental receptors under a future commercial/industrial use of the land. The former part of the objective is largely achieved by distilling the soil and groundwater data retrieved from two previous Woodward Clyde field investigations, conducted at the site in October 1990 and between October and September 1994. Therefore, the 1995 report omits a detailed account of the soil and groundwater sampling programmes, including sample pattern approach, field and laboratory methodology, field observations, and quality assurance and control procedures. Based on figures enclosed in the report, the soil sampling plan adopts a mixture of systematic and targeted approaches. Only footprints of two former above ground bulk storage tanks are sampled and there is no discussion of the relationship between sampling points and other facilities used in handling of petroleum products (e.g. pipework, valves). Six groundwater monitoring wells and six piezometers were constructed along the perimeter of the site and in the downgradient direction of possible contaminant sources. The screening depths of monitoring wells and the groundwater levels at sampling events are not included in the report.

In total, 57 soil samples were analysed for unbanded total petroleum hydrocarbons (TPH), 4 for BTEX compounds, and 41 for total soil lead. As is supported by the subsequent groundwater results, a higher proportion of soil samples should have been analysed for the aromatic components of petroleum hydrocarbons, particularly for BTEX compounds, but also for polycyclic aromatic hydrocarbons (PAHs). Three groundwater monitoring events were carried out between 1990 and 1994: on October 1993, October 1994 and July 1994, with water samples from select wells submitted for unbanded TPH and/or BTEX analysis. Selection of monitoring wells and piezometers for sampling is not justified in the report.

The Woodward Clyde (1995) report assesses the soil and groundwater results using a framework that has since been superseded. Moreover, due to the unsuitability of the soil screening level adopted for lead, which was protective of residential land use and groundwater resource use, the report carries out a site-specific assessment for exposure of human receptors to soil lead. For the purpose of this audit, the analytical results presented in the report have been assessed against the currently valid criteria for the protection of human health, in the case of soil samples, and the criteria for protection of marine ecosystems, in the case of water samples. However, it should be noted that assessment of the unbanded TPH results against the currently applicable criteria, which are based on effective carbon range fractions, was not practicable.

While the majority of samples were characterised by a low level of lead impact, a number of areas contained soil lead concentrations, which although compliant with the MfE (2011) soil contaminant standard, were notably higher than the range characterising the majority of the site. These areas were concentrated at the northern corner of the site (at the former drum and tank loading stand) and in areas surrounding two above ground bulk storage tank locations, where burial of lead sludge was suspected. The report calculates an upper estimate of the average lead concentrations at the site as 534 mg/kg. However, in estimating the average concentration, the report does not account for the inclusion of composite sample results, different sampling depths, or the spatial pattern of lead contamination. Lead water samples were compliant with groundwater criteria.

The soil sample results indicated an absence of widespread petroleum hydrocarbon contamination across the site. However, only limited sampling was conducted of soils immediately surrounding or beneath the former above ground bulk storage tanks and the ancillary services. This is of concern as the highest petroleum hydrocarbon concentrations were detected in three surface soil samples collected from beneath of the former bulk tanks (tank T13), recording TPH concentrations between 3,240 and 9,740 mg/kg. The vertical extent of contamination beneath the tank was not assessed, and areas beneath three other tanks, two of which were still present at the site in 1995, were not characterised.

While the site-wide sampling for petroleum hydrocarbons did not identify significant sub-surface contamination, separate phase hydrocarbons were observed in wells MW1 and MW5 in October 1990, displaying thicknesses of 2 mm and 1 mm respectively. Separate phase hydrocarbons were not observed in any of the monitoring wells or piezometers in the October 1993 or July 1994 monitoring rounds. The presence of separate phase hydrocarbons in two of the monitoring wells was inconsistent with the TPH concentrations recorded in soil samples from the same bore drillings. Together with the reported fluctuations in the groundwater levels and the fine textured nature of the strata, the discrepancy between soil and groundwater petroleum hydrocarbon results suggests that residual contamination may exhibit a complex spatial distribution in the sub-surface beneath the site, potentially confined to thin horizons of the soil pore water space.

The groundwater samples collected from MW1 and MW5 in October 1993 contained detectable concentrations of BTEX components. Benzene was recorded at concentrations of 0.9 mg/l and 1.8 mg/l in MW1 and MW5 respectively. Groundwater samples collected from the two wells in July 1994 reported lower concentrations, benzene being recorded at concentrations of 0.003 mg/l and 0.10 mg/l in MW1 and MW 5 respectively. Benzene concentrations recorded in October 1993 at MW1 and MW5 exceeded the ANZECC (2000) trigger value for protection of marine ecosystems, but the July 1994 groundwater concentrations were compliant with the trigger value. Overall, the results for monitoring wells MW1 and MW5 indicate that petroleum hydrocarbons were reducing with time, which in the Woodward Clyde (1995) report is attributed to contaminant migration and degradation. However, it is difficult to confidently interpret the trends in groundwater contamination in a limited dataset without information on groundwater levels and flow direction.

Overall, the report concludes that the residual contamination does not pose a significant risk to human health and the environment. However, the report audit identifies a number of issues relating to the uncertainty in the residual contaminant distribution. For petroleum hydrocarbons, the residues of which were present in soil and groundwater beneath the site, the main limitations stem from the contrast between the soil and groundwater results and the absence of validation results for areas beneath the majority of former bulk tanks. It is recommended that the remaining data gaps are addressed prior to redevelopment of the site.

Due to the limitations and uncertainties outlined above, the environment assessment is presently considered inadequate, and it is proposed that the site is registered under the category of 'Partially Investigated' on the Listed Land Use Register.

It should be noted that the cover letter attached to the report states that land farming had been implemented at the site in order to enhance the natural attenuation processes; however, the methodology and monitoring procedures are not described further. Given the length of time since the initial investigation was conducted, it is expected that the residual petroleum hydrocarbon contamination has been significantly modified by the biodegradation and transport processes.

INV 13691: *Notification of contaminated site investigation - URS - 5 November 2012***** (Detailed Site Investigation)
 URS New Zealand Limited

INV 15023: *notification of groundwater investigation - URS received 31 January 2013***** (Detailed Site Investigation)
 URS New Zealand Limited

10 Jan 2013 **INV 14683: Former BP Terminal Site Godley Quay - Benchmarking** (Detailed Site Investigation)
 URS New Zealand Limited

Summary of investigation(s):

Report(s) have not yet been audited.

Site 59495: LPC Block 56 (Within 100m of enquiry area.)

Site Address:	Charlotte Jane Quay West and Godley Quay, Lyttelton
Legal Description(s):	Lot 1 DP 80793,RES 5025

Site Category:	Partially Investigated
Definition:	Verified HAIL has been partially investigated.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	1980	current	Storage tanks or drums for fuel, chemicals or liquid waste
	Pre 1965	Pre 1994	Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

Notes:

Investigations:

INV 13691: *Notification of contaminated site investigation - URS - 5 November 2012***** (Detailed Site Investigation)
 URS New Zealand Limited

INV 15023: *notification of groundwater investigation - URS received 31 January 2013***** (Detailed Site Investigation)
 URS New Zealand Limited

Summary of investigation(s):

Report(s) have not yet been audited.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ82230.

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

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate

Property Statement from the Listed Land Use Register

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

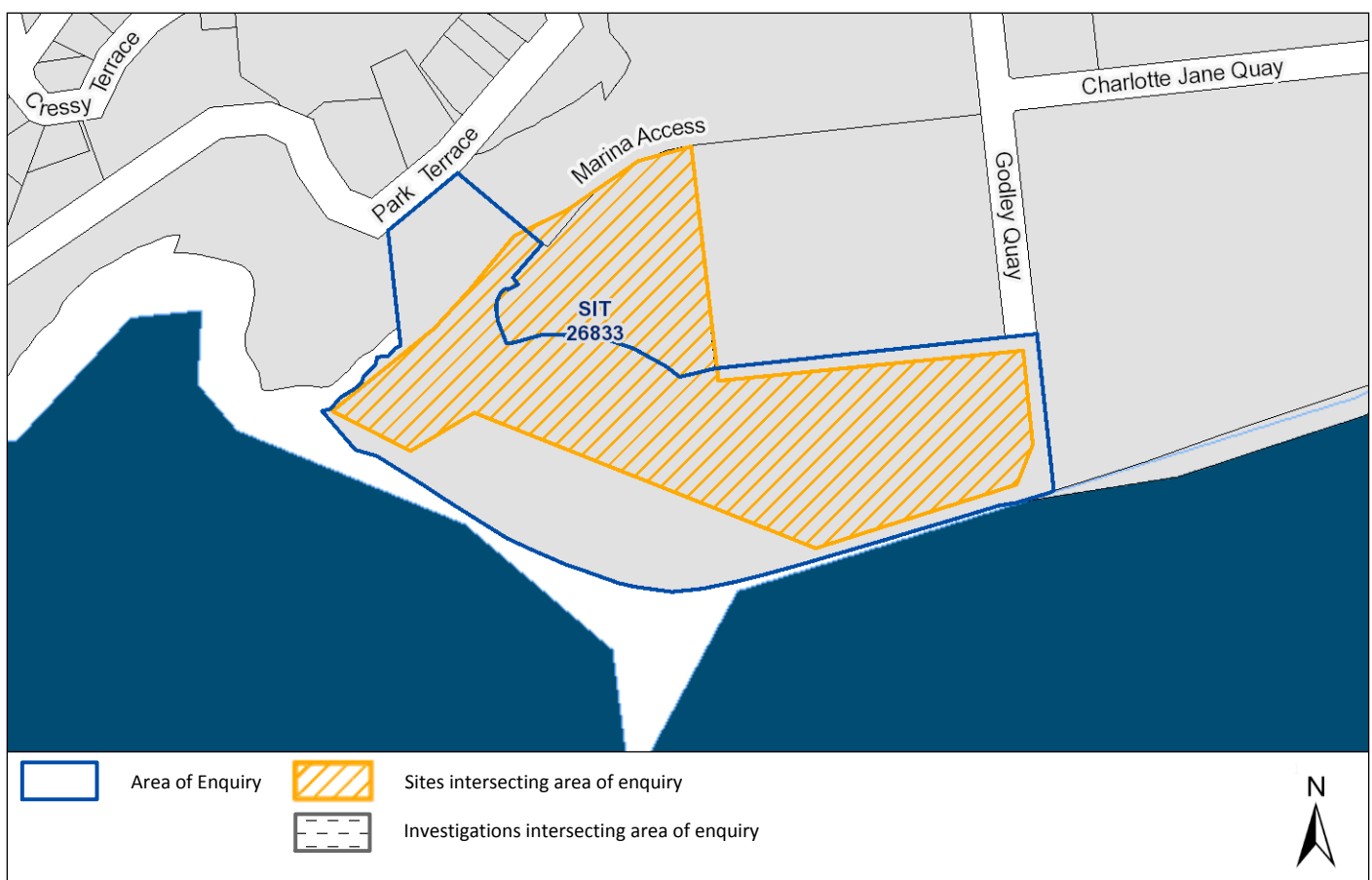
Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

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

www.ecan.govt.nz

Date:	23 January 2015	
Land Parcels:	Lot 1 DP 72644	Valuation No(s): 2380195000



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

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
26833	26833	Godley Quay, Lyttelton	A18 - Wood treatment or preservation and bulk storage of treated timber;	Not Investigated

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

Information held about the sites on the Listed Land Use Register

Site 26833: 26833 (Intersects enquiry area.)

Site Address:	Godley Quay, Lyttelton
Legal Description(s):	Lot 1 DP 72644, Lot 1 DP 80599, Lot 1 DP 80793

Site Category:

Not Investigated

Definition:

Verified HAIL has not been investigated.

Land Uses (from HAIL):

Period From	Period To	HAIL land use
Pre 1965	Pre 1994	Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

Notes:

18 Oct 2013

Area defined from: 1965-1994 ECan Aerial Photographs

Note: A timber yard was noted in the aerial photographs reviewed.

Investigations:

There are no investigations associated with this site.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ83263.

Disclaimer:

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

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

Listed Land Use Register

What you need to know



What is the Listed Land Use Register (LLUR)?

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

Why do we need the LLUR?

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

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

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

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

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

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

We have two main ways of identifying HAIL sites:

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

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

How does Environment Canterbury classify sites on the LLUR?

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

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

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

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

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

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



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

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

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

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

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



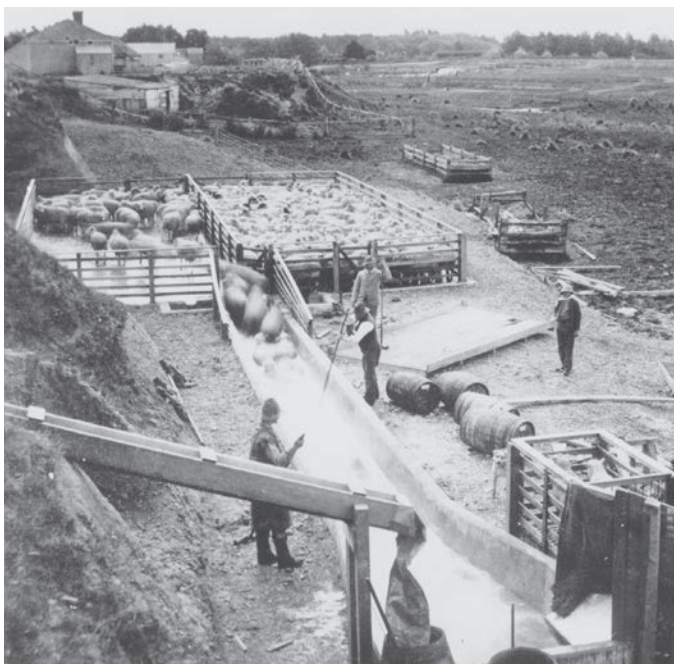
I think my site category is incorrect – how can I change it?

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

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

IMPORTANT!

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



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

Contact us

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

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

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

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:

Calling from Christchurch: (03) 353 9007

Calling from any other area: 0800 EC INFO (32 4636)



Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz

E13/101

Listed Land Use Register

Site categories and definitions

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

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

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

Not investigated:

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

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

At or below background concentrations:

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

Below guideline values for:

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

Managed for:

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

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

Partially investigated:

The site has been partially investigated. Results:

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

Significant adverse environmental effects:

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

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

Contaminated:

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

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

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

Verified non-HAIL:

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

Please contact Environment Canterbury for further information:

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



APPENDIX 3

Christchurch City Council Property File Extracts

LYTTELTON BOROUGH COUNCIL

Licensee Form of Notice



To the Town Clerk,
Lyttelton Borough Council.

Please take notice that it is my intention to commence work at

Mr. Lyttelton Sport Pavilion residence, situated in Lyttelton
_____ on 20/4/54

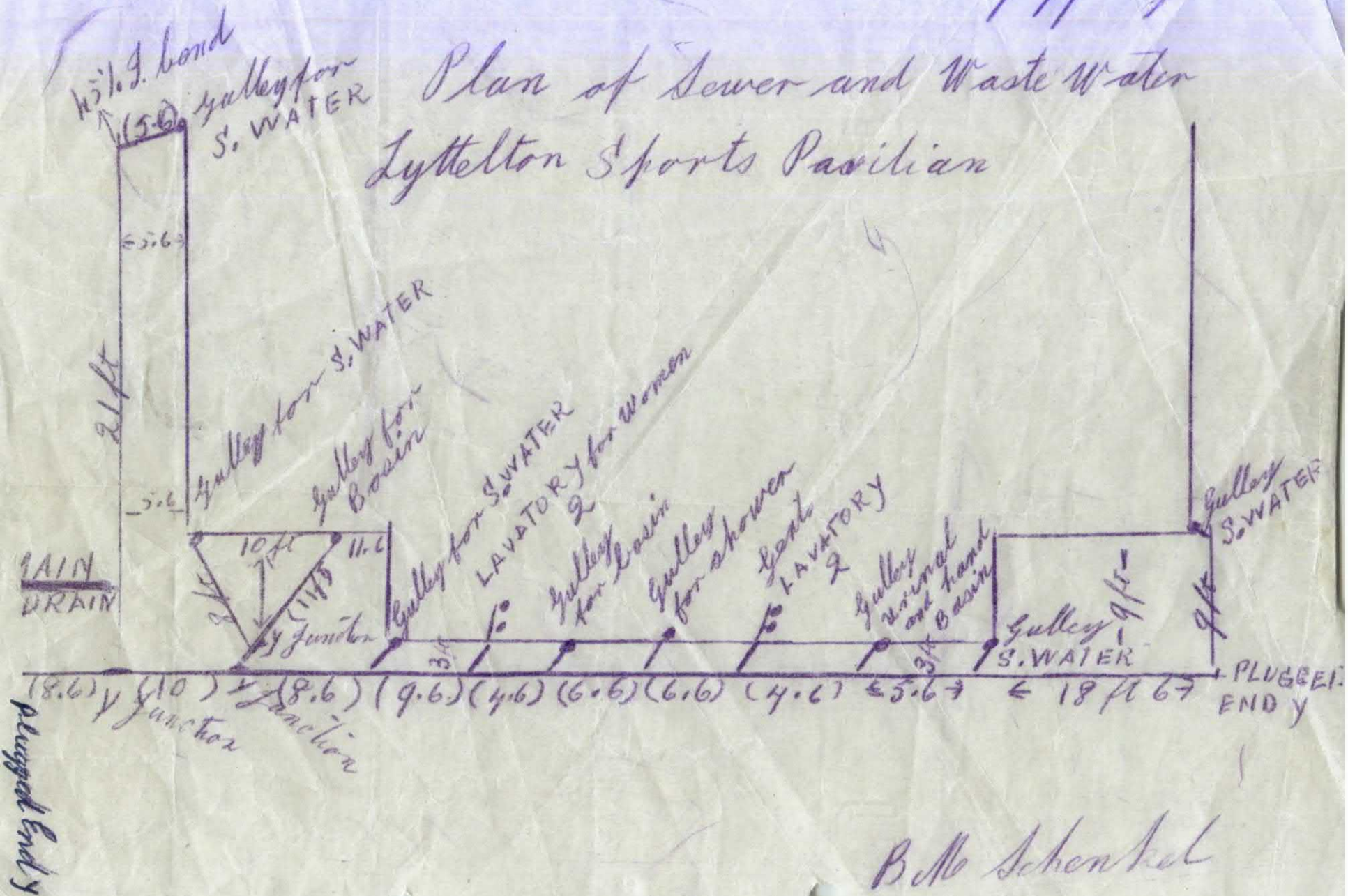
The nature of the work to be done Laying sewer and waste
water into storm water drain

Bob Schenkel Licensee.

(Notice must be forwarded not later than the DAY BEFORE it is proposed to commence work. The omission or neglect to forward the above notices as occasion may arise will lead to the cancellation of the license.)

21/4/54

Plan of Sewer and Waste Water Lyttelton Sports Pavilion



B. Mc Schenkel

LYTTELTON BOROUGH COUNCIL
P.O. BOX 4, LYTTELTON
APPLICATION FOR A BUILDING PERMIT

TO THE BUILDING INSPECTOR,

Date 28/2/ 19 89

I hereby apply for permission to erect/alter/install a SCOUT DEN
LYTTELTON HARBOUR BOARD (Dwelling/Garage/Shed, etc)
at No. Erskine Point Street, in accordance with SITE PLANS and detailed PLANS,
ELEVATIONS AND SPECIFICATIONS submitted herewith in **duplicate** (see over).

PARTICULARS OF LAND

Valuation Roll No. Lot No. D.P. Area

PARTICULARS OF PROPOSED BUILDING OR WORK

Foundations BLOCK Walls HARDI PLANK Roof Galv. Iron Floor CHIP BOARD

Distance from nearest building: On Site Adjoining Site

Proposed purpose for which every part of the building is to be used or occupied (see over)

TOTAL FLOOR AREA OF NEW BUILDINGS 90 sq. metres. ADDITIONS sq. metres

NOTE: Siting of any proposed future accessory buildings to be shown on the site plan by a dotted line (garage, shed etc.)

ESTIMATED VALUE OF PROPOSED WORK

Cost of building work \$ 8450-00

Cost of plumbing and drainage work \$

Estimated total value \$ ~~8050~~ 00 Estimated completion date 20-8-89

PLUMBING AND DRAINAGE

Name and address of Licensed Drainlayer

Name and address of Licensed Plumber

IMPORTANT — Separate permits are required for all plumbing and drainage work.

Owner N, Z, Scouting Association Address

Builder G. BIRT Address 30 Ripon St Lytt

Telephone No. Yours faithfully,

Owner/Builder [Signature]

IMPORTANT — Read the Requirements on the other side

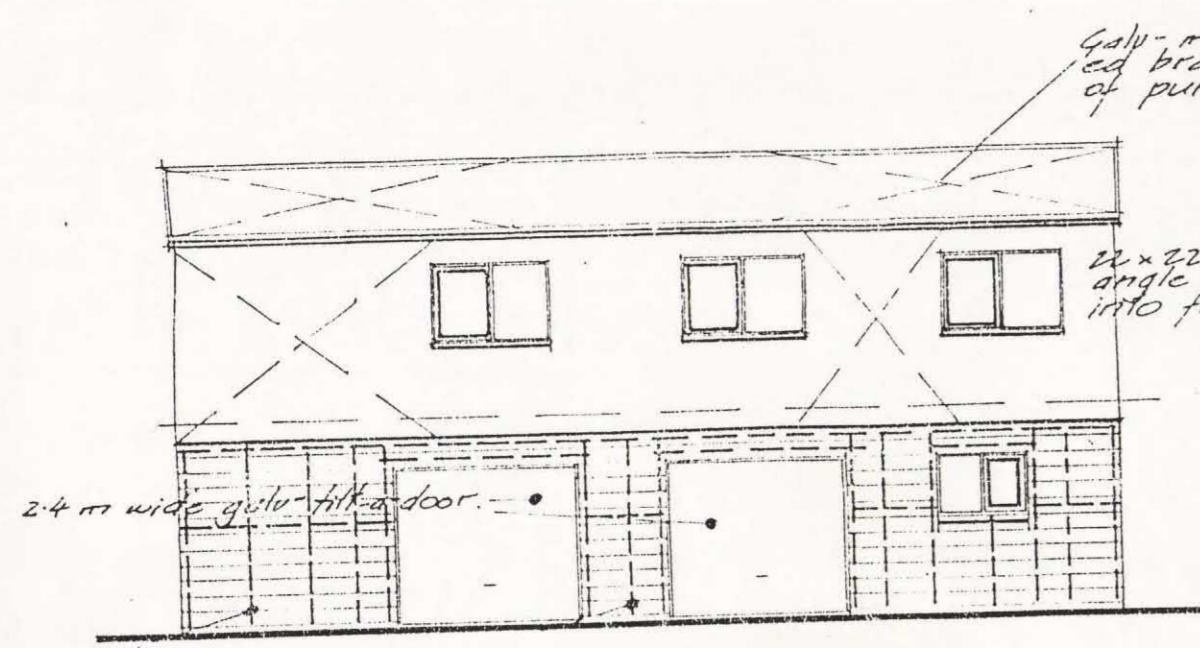
(FOR OFFICE USE ONLY)

FEES PAYABLE

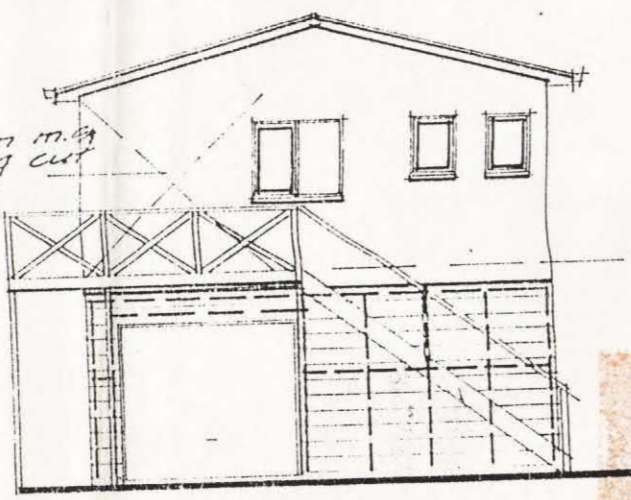
Building Permit	\$ <u>74.00</u>
Building Research Levy	\$
Deposit	\$
Miscellaneous <u>GST</u>	\$ <u>7.40</u>
TOTAL FEES PAYABLE	\$ <u>81.40</u>

Receipt No. 34
Date 1/3/89
Permit No. G.016223
Date 3-3-89

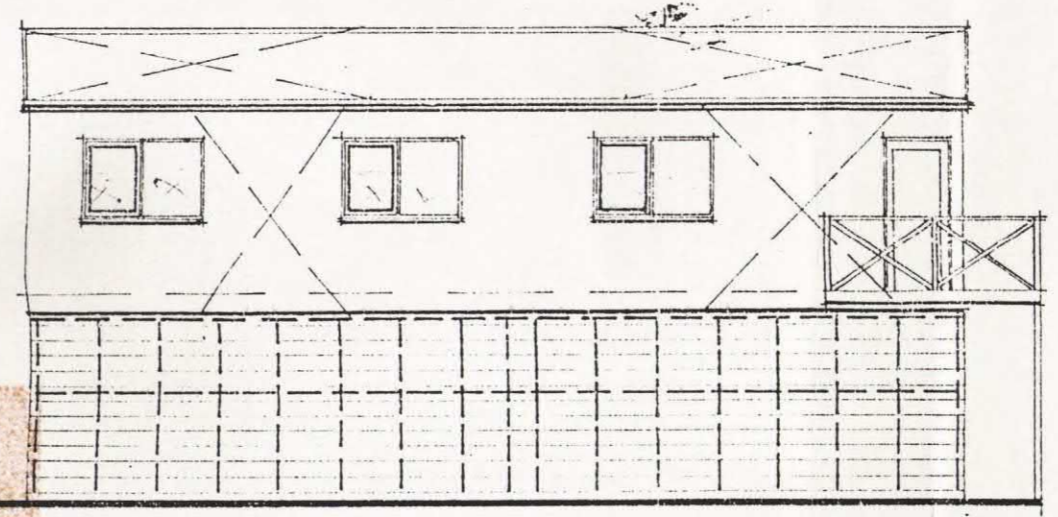
REMARKS



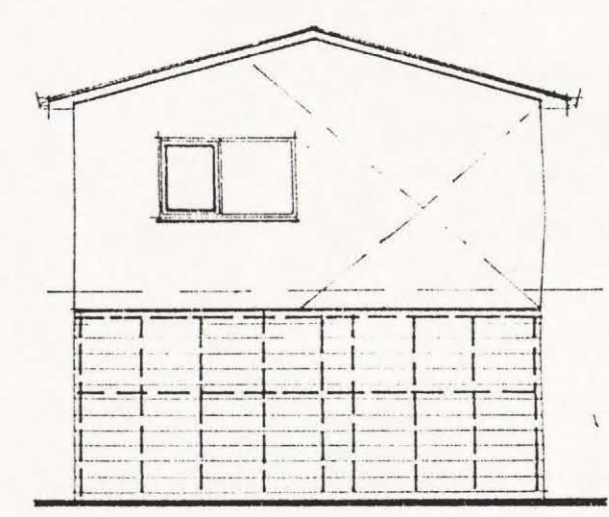
FRONT ELEVATION.



SIDE ELEVATION



REAR ELEVATION



SIDE ELEVATION.

D12 vertical rods at 800 c/s max.

Galv. m.s. flat tensioned bracing over top of purlins.

22 x 22 x 1.2 mm m.s. angle bracing cut into framing.

50 x 125 to support intermediate joints between trusses.

0.4 mm B.M.T. galv corrugated on bldg. paper on netting on 50 x 100 purlins on edge at 750 max c/s on roof trusses at c/s shown on plan.

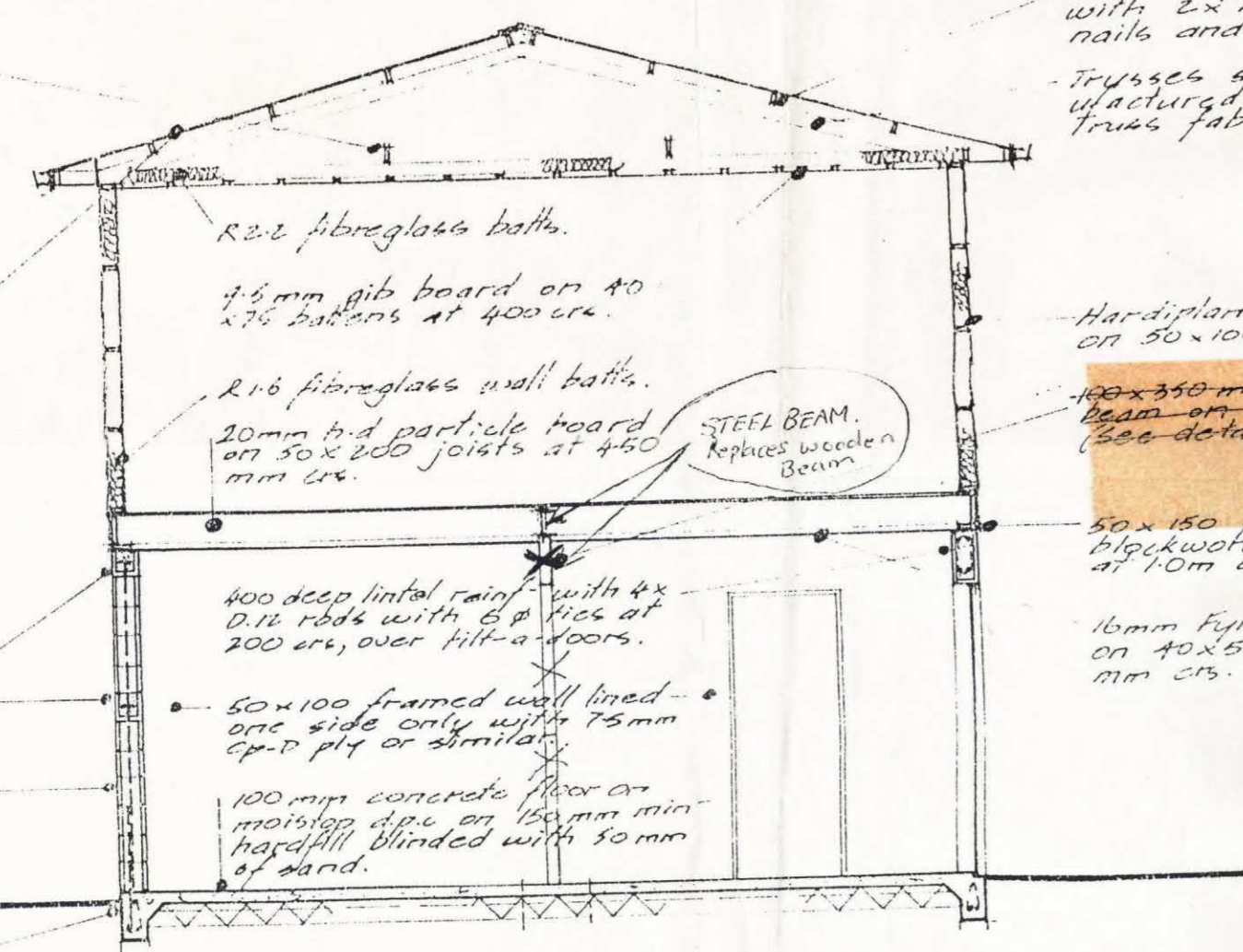
PVC spouting on ex 25 x 150 fascia over 50 mm false fascia.

6 mm hardiflex soffit.

2 x D12 rods in 20 series bond beams.

20 series blockwork reinforced with D12 rods at 800 c/s max. Starters to extend 600 mm minimum.

200 mm wide foundation reinf. with 2 x D12 rods in footing and 1 x D12 at top tied with 6 Ø links at 600 c/s.



SECTION A-A.

Fix each purlin end with 2 x 100 x 30 nails and 1 w/sq.

Trusses shall be manufactured by ferred truss fabricator.

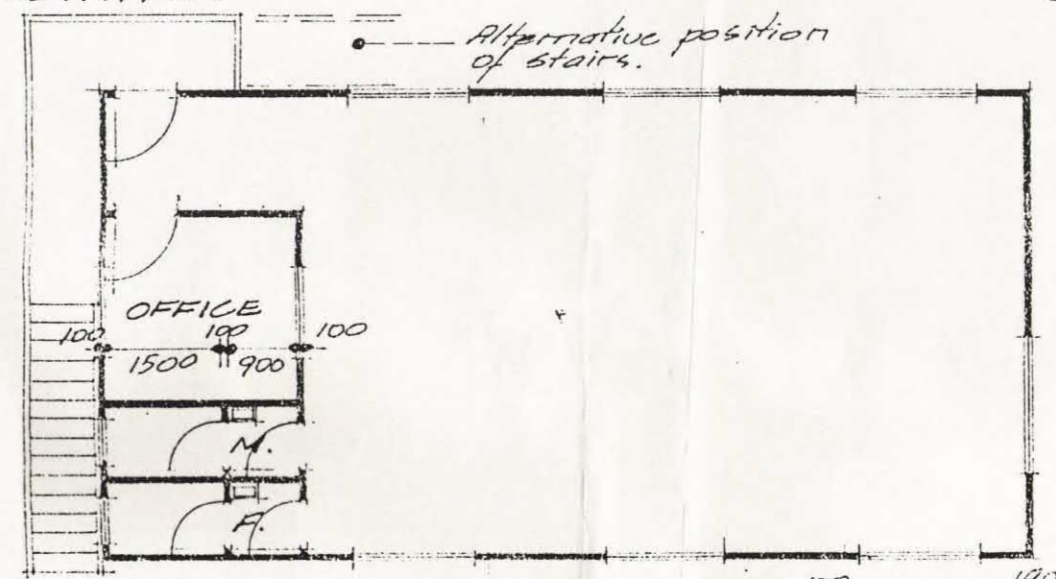
Hardiplanks or paper on 50 x 100 fram.

100 x 350 mm Eng RR beam on 69 x 69 posts (See detail D).

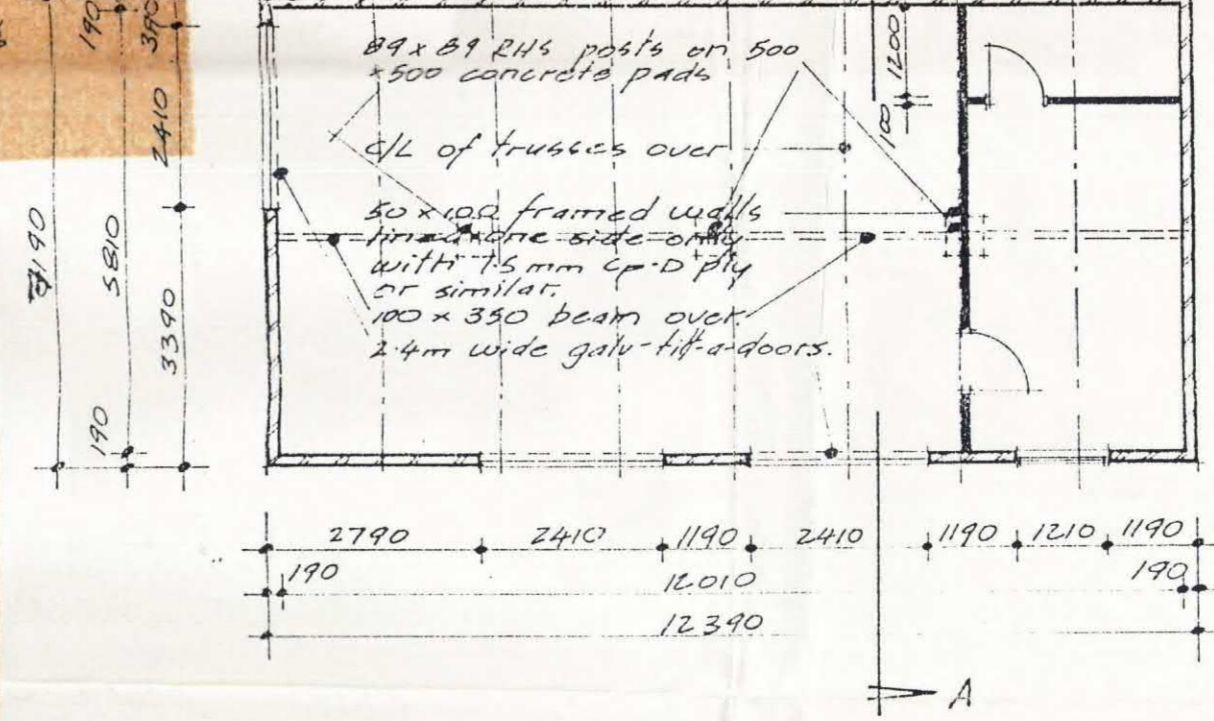
50 x 150 plate to blockwork with bolts at 100 c/s.

16 mm Firestop pad on 40 x 50 batt. 400 mm c/s.

STEEL BEAM. Replaces wooden beam.



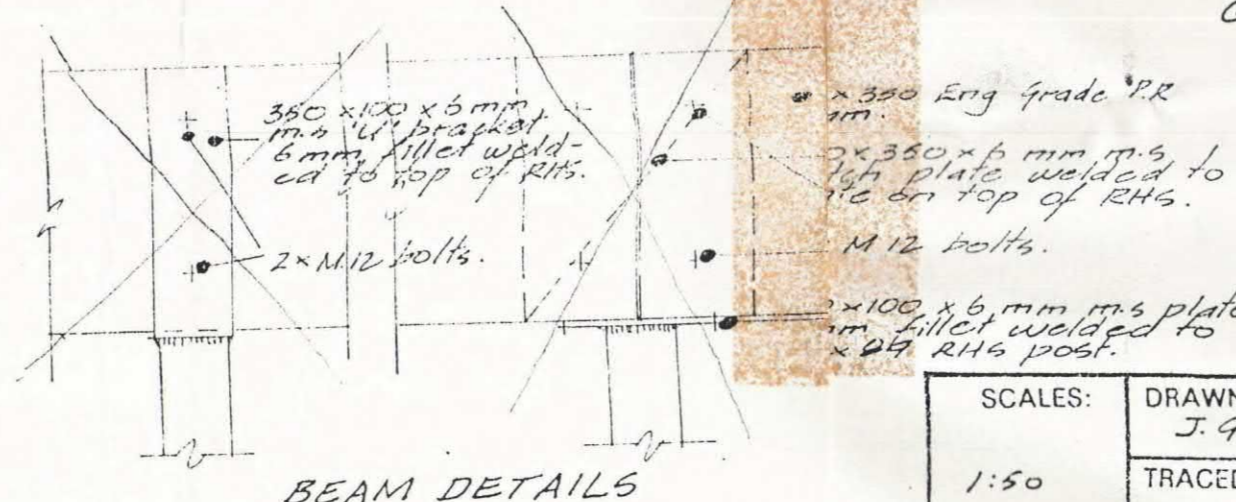
FIRST FLOOR PLAN



GROUND FLOOR PLAN.

NOTE:

Form construction joints in concrete floor at 3.0 m c/s both ways. Alternatively sawcut floor 25 mm deep at 3.0 m c/s both ways.



BEAM DETAILS

TYPICAL SUPPORT BEAM/JOINT.

SCALES: 1:50 1:100.	DRAWN: J. Geayley. TRACED: DATE: Sept 1987	LYTTELTON SCOUT GROUP. ~ PROPOSED BOAT SHED.	SHEET No. OF SHEETS
<p>WE BOAT SHED SIDE ELEVATIONS ARE 1 METRE LARGER THAN THE 1:100 SCALE AS DRAWN ABOVE</p>		<p>DRN: J. Geayley NCCO (Arch) Ph Bus 799540 Res 5894.</p>	

Maria



NOTICE OF CHANGE OF OWNERSHIP OR OCCUPANCY

(PURSUANT TO SECTION 106, RATING POWERS ACT 1988)

VALUATION REFERENCE *updated* ^{V.111} ✓

2380189501

VALUATION NEW ZEALAND P.O. BOX 13-443, Christchurch			NAME AND ADDRESS OF LOCAL RATING AUTHORITY Please Type <u>Banks Peninsula District Council</u> <u>P O Box 4, Lyttelton</u>		
ROLL AMENDED:	FIELD SLIP NOTED:	SALES LIST NOTED:	PREVIOUS OWNER/OCCUPIER/LESSEE		
PLAN NOTED:	CV	LV	SURNAME OTHER NAMES THE LYTTTELTON PORT COMPANY LIMITED		

NEW OWNER/OCCUPIER/LESSEE		
SURNAME	OTHER NAMES	OCCUPATION
THE BANKS PENINSULA DISTRICT COUNCIL		
NEW POSTAL ADDRESS (for notices & rate demands)		
- STREET P O Box 4		
- TOWN Lyttelton		
AREA (metric) HA	M ²	CERTIFICATE/S OF TITLE
5.8879		42A/442
LEGAL DESCRIPTION Lot 1 Deposited Plan 72644		
STREET NO.	STREET, ROAD	ADDRESS OF PROPERTY
	Naval Point, Lyttelton	

DETAILS OF TRANSACTION							
NATURE OF TRANSACTION	(State which) Sale, gift, will, exchange, JFH, lease, sub-lease, transfer of lease, surrender of lease, etc.						
	sale						
DATE OFFER ACCEPTED	13 6 / 89	DATE OF SETTLEMENT	13 / 6 / 89	DATE OF POSSESSION	13 / 6 / 89	DID GROSS CONSIDERATION INCLUDE GST?	YES/NO
GROSS CONSIDERATION (inc GST)	\$ NIL	LAND & BUILDINGS (inc GST)	\$	CHATTELS	\$	OTHER	\$
SUBJECT TO TENANCY	YES/NO	VENDOR FINANCE	YES/NO	IF SO, AMOUNT	\$	TERM	
IF MULTI-UNIT PROPERTY, IS THERE ANY SPECIFIC RATE SHARING AGREEMENT?	YES/NO	IF SO, WHAT IS THE AGREED SHARE FOR THIS FLAT?		BUILDINGS ON THE LAND?	YES/NO		

DETAILS OF LEASE — GROUND LEASE/LAND & BUILDINGS LEASE/DEFERRED PAYMENT LICENCE/OTHER							
LEASE No.		RENTAL		TERM		FROM	
RIGHT OF RENEWAL	YES/NO	COMPENSATION FOR IMPROVEMENTS	YES/NO	OTHER DETAILS			

OWNER OR AGENT NAME	Lane Neave Ronaldson (Julie Hutton)	SIGNATURE	<i>Balling</i>
ADDRESS	P O Box 13149, Christchurch	PHONE No.	379-3720

FOR OFFICE USE	DATE	TYP	CLASSIFICATION			GROSS PRICE			NET PRICE		CHATTELS	OTHER	PRODUCTION									
	CATEGORY	ZONE	USE	UNIT	% SUB	PARK	AGE	COND	CONS	SITE COVER	FLOOR	C V L V										
	CV		LV		VI				X-REFERENCE-1		X-REFERENCE-2		XI									
	GROSS SITE AREA			LEGAL DESCRIPTION									Nat.	Ind.								
	VALUERS REMARKS						VENDOR/PURCHASER															
	CSI	LOT	CTR	LSC	VEW	SCP	HST	MOD	EYB	MFL	TFL	PFN	DEK	LW	LOI	CAR	DRV	GMR	GFS	OUT	GST	Y or N

File No 16505

2 July 1996

FS000017448712

Fourth Floor BNZ Building
137 Armagh Street
Christchurch
PO Box 579
Christchurch 8051
Tel (03) 366-1653
Fax (03) 379-2348

The Planning Officer
Banks Peninsula District Council
P O Box 4
LYTTELTON

DIRECTORS:
PETER YEOMAN BE, FIPENZ, MPLEINZ
BARRY GREIG MNZIS, MPLEINZ
ALAN FAZACKERLEY MNZIS, MPLEINZ
TMIPENZ

SENIOR ASSOCIATE:
GUY CARNABY AMNZIS

ASSOCIATES:
IAN DALTON MNZIS, MNZPI
VICTORIA CASELEY MSc, ARICS, MNZIS
DAN CUSIEL STC

Attention: Jocelyn Drake

Dear Jocelyn

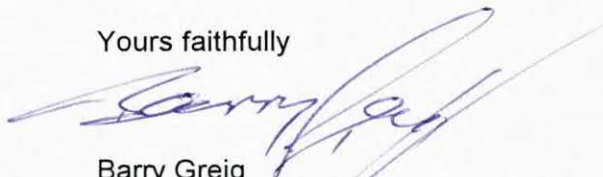
RE: SUBDIVISION CONSENT 96/022 - LYTTELTON PORT CO LTD

Further to your Council's consent to the above Title Plan under the provisions of Section 223 of the Resource Management Act we herewith return the original and ask that you arrange for the seal of Council to be affixed to the consent. This had inadvertently not been sealed at the time the plan was signed and dated by Council.

The Department of Survey and Land Information have asked that the date on which the plan was formally approved, 16 April 1996, be clarified. The date was shown in blue biro which does not print very well and we have overwritten the date in black biro which should suffice.

Would you kindly arrange for the plan to be sealed and returned to this office at your earliest convenience. The fee for this action of course has previously been paid.

Yours faithfully



Barry Greig
DAVIS OGILVIE & PARTNERS LTD

Enc

*Plan sealed and
returned
11/7/96
Jmb*



Level Three
Torrens House
195 Hereford Street
CHRISTCHURCH

Telephone 03 379.8140
Fax 03 379.4007
DX WP20033

12 August 1996

The General Manager
Banks Peninsula District Council
P O Box 4
LYTTELTON

PLAN 72644

Dear Sirs

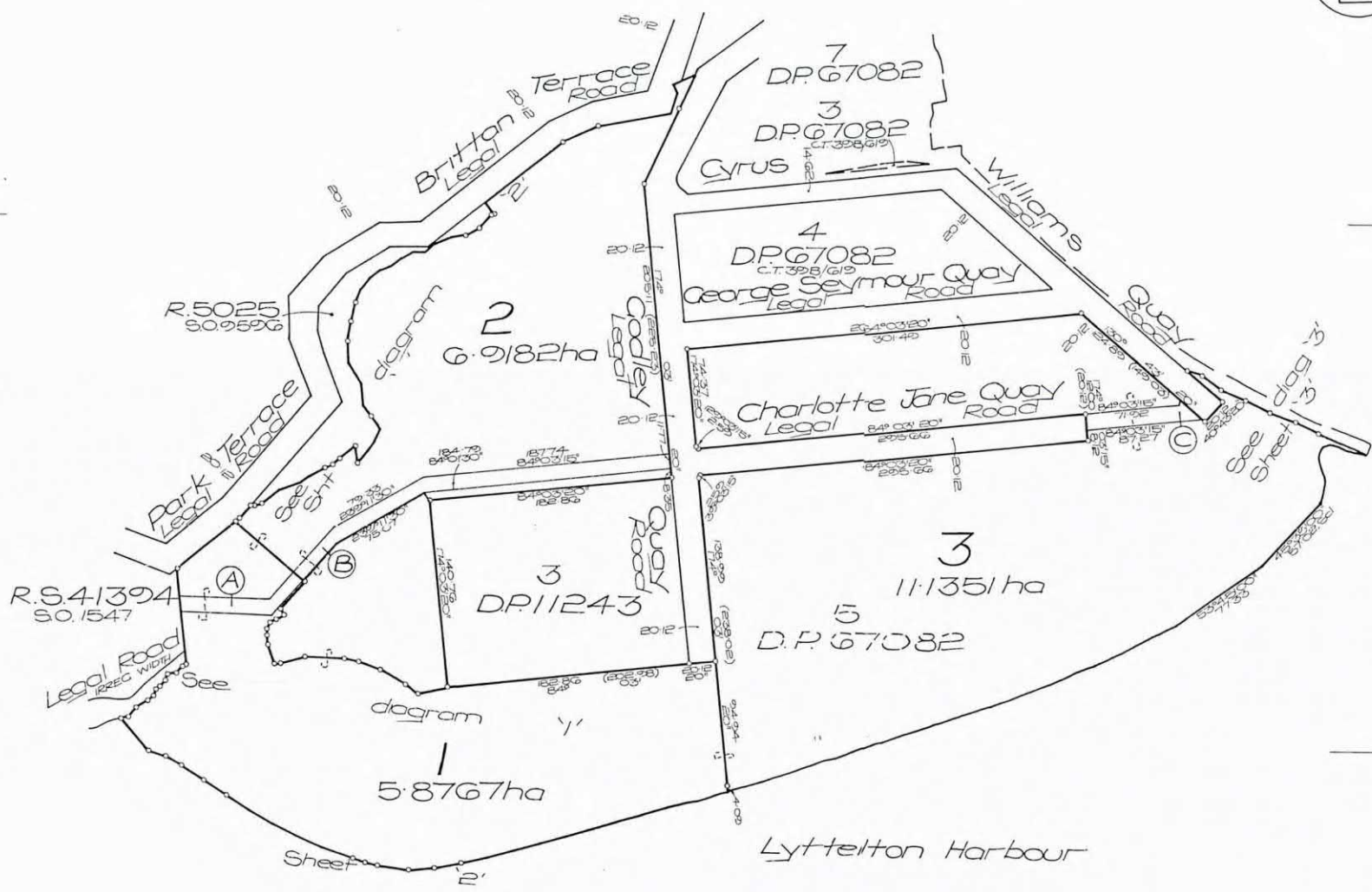
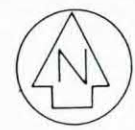
PLAN NO. 72644 - Lots 1-3 being subdivision of Lot 5 DP 67082
The Lyttelton Port Company Limited

was deposited on 9 August 1996

NOTE: The average time for the issue of a new Certificate of Title is
fifteen working days.

Yours faithfully


for S C PAVETT
District Land Registrar



Approvals Approved

Registered Proprietor
 Approved pursuant to Section 223 of the Resource Management Act 1991 on the ____ day of _____ 1994.
 Subject to the amalgamation condition set out herein. The common seal of the Banks Peninsula District Council is affixed hereto in the presence of

----- Mayor
 ----- Authorised Officer

CONDITIONS OF AMALGAMATION
 Lots 2 & 3 hereon and lots 3 & 4 D.P. 67082 (C.T. 398/619) are to be held together and one certificate of title issued.

EXISTING EASEMENTS			
NATURE	SERVIENT TEN		DOC
	LOT NO SHOWN		
RIGHT TO CONVEY LIQUIDIFIED PETROLEUM GAS	1	A	T 44526/1
	2	B	T 74526/1
	3	C	T 74526/1

Total Area 23.2300ha

Comprised in c.t.

I, Alan Forzackerley
 Registered Surveyor and holder of an annual practising certificate (or who may act as a registered surveyor pursuant to section 25 of the Survey Act 1986) hereby certify that this plan has been made from surveys executed by me or under my directions, that both plan and survey are correct and have been made in accordance with the Survey Regulations 1972 or any regulations made in substitution thereof.
 Dated at CHRISTCHURCH this _____ day of _____ 19____ Signature _____

Field Book p Traverse Book p
 Reference Plans
 Examined Correct

Approved as to Survey
 _____ / _____ Chief Surveyor

Deposited this _____ day of _____ 19____
 _____ District Land Registrar

LAND DISTRICT Canterbury
 SURVEY BLK. & DIST. IV Halswell
 NZMS 261 SHT M36 RECORD MAP No _____

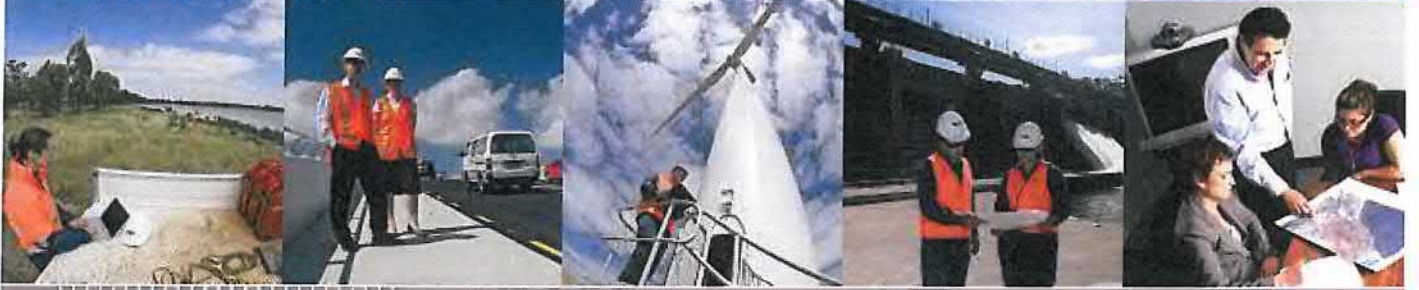
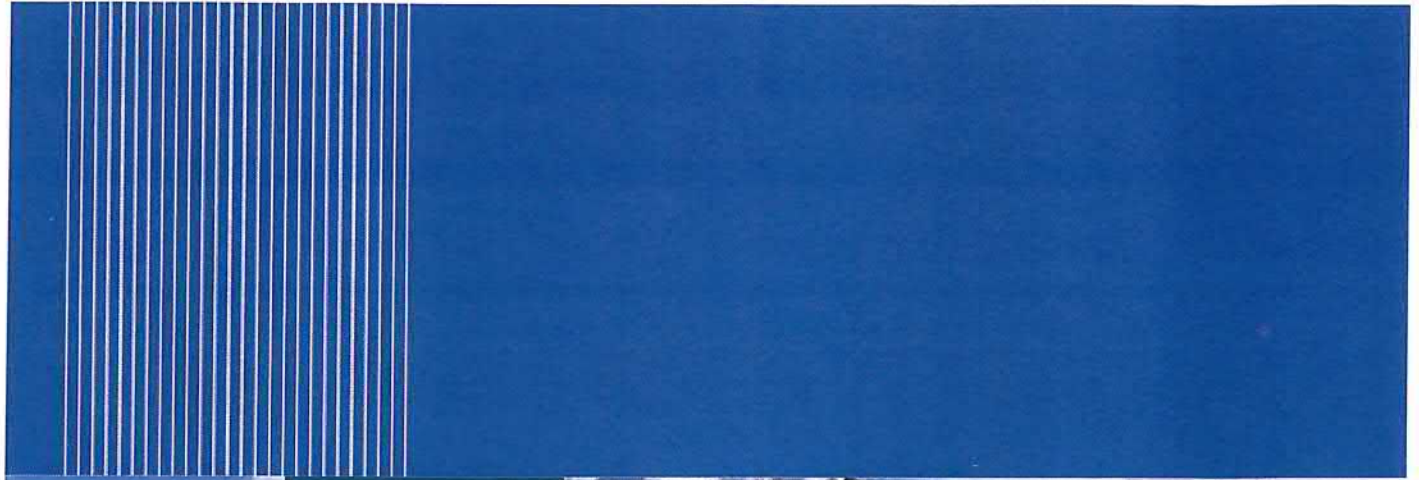
LOTS 1-3 BEING SUBDIVISION OF
 LOT 5 D.P. 67082

TERRITORIAL AUTHORITY Banks Peninsula District 16505 LTD
 Surveyed by Mavis Ogilvie & Partners
 Scale 1-2500 Date _____



APPENDIX 4

Existing Contamination Reports



Report

Former BP Terminal Site Godley Quay - Benchmarking

10TH JANUARY 2013

Prepared for
BP Oil New Zealand Limited
20 Customhouse Quay
PO Box 892
Wellington
42189280

Project Manager:

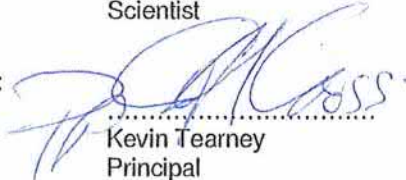


.....
Tim Mulliner
Senior Environmental
Scientist

URS New Zealand Limited

273 Cashel Street
Christchurch 8011
PO Box 4479, Christchurch 8140New
Zealand

Principal-In-Charge:



.....
Kevin Tearney
Principal

T: 64 3 374 8500
F: 64 3 377 0655

Date: 10th January 2013
Reference: 42189280/01/02
Status: FINAL

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URS

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Appendix B	Site Photographs

Introduction

1.1 Terms Of Reference

URS New Zealand Ltd (URS) was engaged by BP Oil New Zealand Ltd (BP) to undertake environmental benchmarking at the former Godley Quay Terminal Site, Lyttelton, prior to subleasing of the site for log storage. The works were undertaken in accordance with the URS proposal dated 03 August 2012, PO no 3000177737 and the subsequent contract variations dated 09th October 2012 and 12th November 2012.

1.2 Site Location

BP Godley Quay Terminal comprises two sites on the Lyttelton Harbour reclamation area, approximately 13 km South East of Christchurch (**Figure 1-1**). The sites, termed Northern Block and Southern Block in this report, are separated by George Seymour Quay. A site overview plan showing the Southern and Northern Block is given in **Figure 1-2**.

1.3 Site History

The site has been used since at least 1932 for the storage of a variety of bulk and drummed products, including motor spirit, diesel and kerosene.

The Southern Block covers an area of approximately 8,000 m² and originally included a bunded tank farm housing two above ground storage tanks (ASTs) (tanks 17 & 18). Currently only the foundations of the tank perimeters and the bund remain. The Southern Block is currently vacant.

The Northern Block covers an area of approximately 3,800 m² and originally included a bunded tank farm housing three ASTs (tanks 13, 14 and 15). No evidence of these storage tanks remains. The Northern Block has evidence of recent activity, with stockpiles of loose gravel present on site.

Motor spirit is reported to have been stored in tanks 14, 15, 17 and 18, with one major spill of motor spirit reportedly occurring adjacent to tank 13. Other chemicals have been stored at site at various times, with no other spillage incidents being reported.

A risk assessment undertaken in 1995 by Woodward-Clyde (NZ) Ltd (WCNZ 1995)¹ identified minor hydrocarbon and lead contamination in the soil at the site. A hazard assessment showed that the risk posed by the chemicals present on the site was within acceptable levels based on the current and proposed uses at the time. It was concluded that the remediation of the site was not required.

1.4 Environmental Setting

Lyttelton Harbour reclamation consists of hydraulic fill derived from harbour dredgings, placed over natural marine deposits (silty clays). The top 3 m of hydraulic fill has been found to comprise relatively homogeneous silty clay overlain with brown sandy silt and/or gravel. The transition between the hydraulic fill and marine silty clays is often not well defined.

The marine silty clay is likely to overlie local volcanic basement at around 25 m below site.

The Port Hills surrounding Godley Quay are steep sided and comprise of andesitic and basaltic rocks. Loess deposits, redeposited from above, cover much of the Lyttelton Harbour foreshore. Groundwater

¹ Woodward-Clyde (1995). *Risk Assessment. Bulk Storage Terminal Lyttelton, (Draft Report)*. Woodward-Clyde. June 1995.

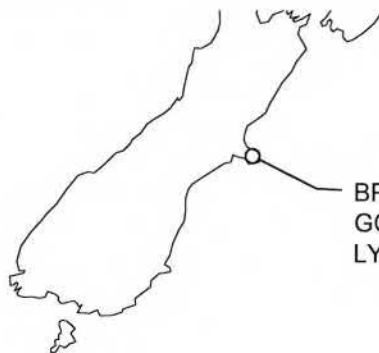
1 Introduction

flow is towards the harbour (south of the site), although deviations in response to incident rainfall and tidal events occur.

The effects of the low permeability marine silty clays, low elevation, high surface runoff and fluctuating tidal range, have combined to create a variable shallow groundwater level.



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BP OIL NEW ZEALAND LIMITED
GODLEY QUAY
LYTTELTON



Source: MAP TOASTER

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**BP OIL NEW ZEALAND LIMITED
GODLEY QUAY BENCHMARKING 2012
SITE LOCATION PLAN**

URS

File No: Fig 1-1.dwg

Drawn: ACW

Approved:

Date: 04/12/2012

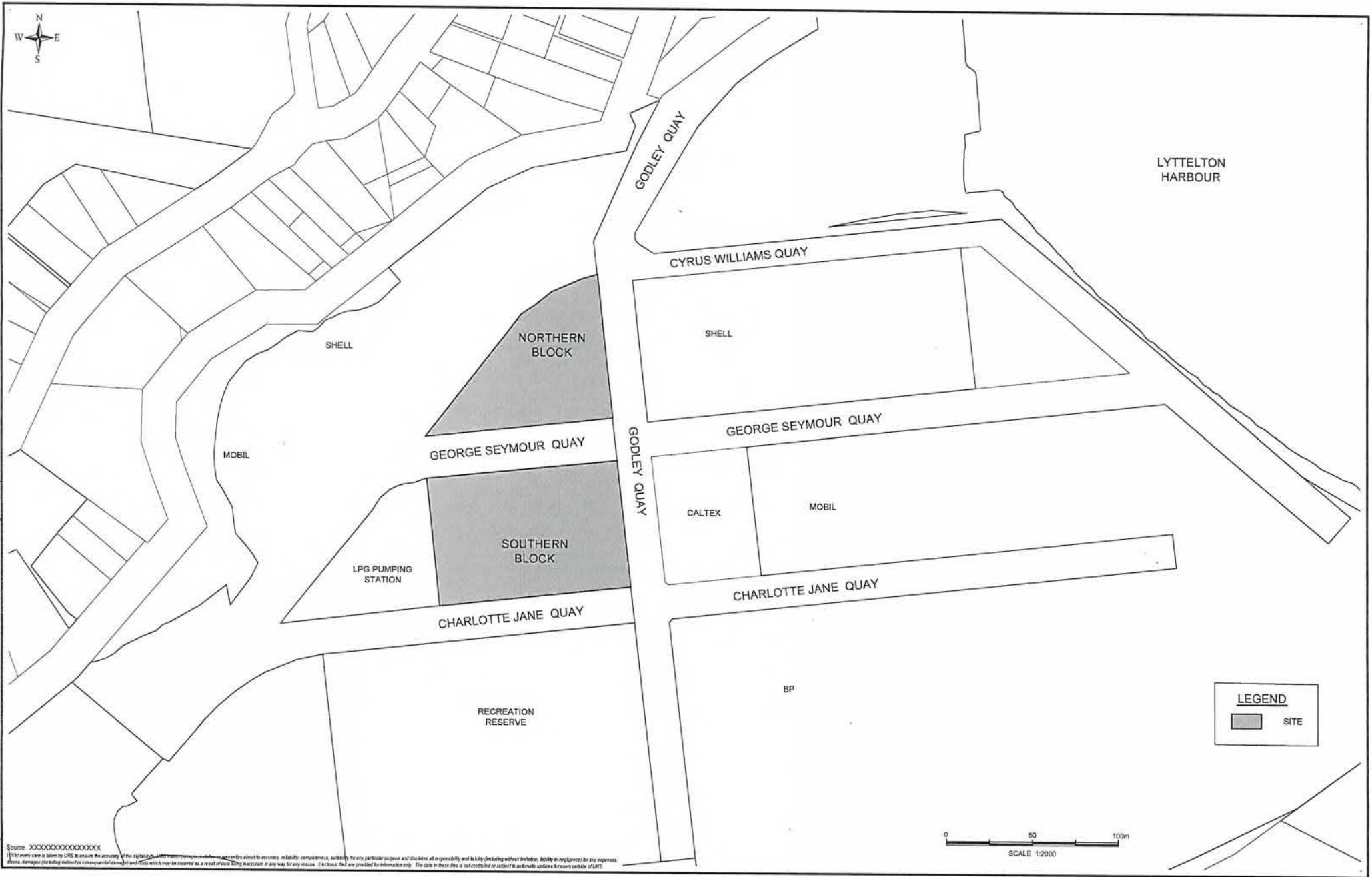
Figure: **1-1**



Rev. A

A4

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BP OIL NEW ZEALAND LIMITED
GODLEY QUAY BENCHMARKING 2012
SITE OVERVIEW

Scope of Works

2.1 Overview

The scope of works for the environmental benchmarking comprised the following:

- A review of the WCNZ 1995 risk assessment report, which formed the basis of the known soil and groundwater contamination conditions at the site. URS is not aware of any other site investigations post 1995.
- Review of information on utilities/service obtained from local utility providers.
- A site walk over and visual inspection of the site, including inspection for the presence of monitoring wells and/or signs of surface contamination, undertaken by URS, in conjunction with buried services mark out by Underground Service Locators (USL).
- Environmental benchmarking of the former Tank 14 foot print within the Northern Compound.
- Environmental benchmarking of the Southern Compound and the bund area surrounding the Southern Compound.
- Collection of two samples at each identified test pit location (within the top 0.5 m and at the water table – approximately 1.5 m bgl) where possible.
- Collection of duplicate soil samples for approximately every 10 samples obtained;
- Headspace soil screening for volatile organic compounds (VOCs) by photoionization detector (PID) of each soil sample.
- Submission of soil samples to Hill Laboratories Limited for Total Petroleum Hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylene (BTEX), and heavy metal (total recordable arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni) and zinc (Zn)) analysis.

All soil samples were placed directly into laboratory supplied sampling jars before being stored in ice filled chilly bins and transported to Hill Laboratories Limited under URS chain of custody documentation. Chain of custody documentation and laboratory results as received are presented in **Appendix A**.

The site works were defined by two main areas, the Northern Block and the Southern Block. The scope specific to each area is as follows.

2.1.1 Northern Block

- Environmental benchmarking of the former Tank 14 foot print within the Northern Block area via the collection of soil samples from three locations (X1-X3).

2.1.2 Southern Block

- Environmental benchmarking of the Southern Block area by the collection of soil samples from test pits at 27 locations based on systematic and judgmental sampling strategies (A1-A5, B1-B6, C1-C5, D1-D6 and E1-E5) and four soil samples collected from the surface (<0.1 m bgl) at known hotspot locations (SS200-SS203).
- Environmental benchmarking of the bund surrounding the Southern Block area by collection of 26 soils samples and two duplicates (101-118, 204-206 and 300-302).

2 Scope of Works

Sampling locations are shown on **Figure 3-1**.

Field Work and Observations

3.1 Site Walk Over and Service Clearance

The site walkover and services clearance were undertaken on 23rd October 2012. Underground services were positively identified and marked out by USL personnel before each sample location was individually checked for the presence of underground services before being cleared for excavation.

3.2 Site Works

URS supervised the test pitting and bund sampling site works between 24th and 26th October 2012. Further site works were conducted by URS on the 15th of November 2012 and 10th of December 2012, to collect surface soil samples and additional bund samples from the Southern Block. All sample locations are given in **Figure 3-1**.

3.2.1 Test Pitting

Testing pitting was undertaken by Petrotec New Zealand Ltd. (Petrotec) utilising a 5 tonne excavator. All soil samples collected from test pitting were collected from within the centre of the excavator bucket, ensuring no cross contamination from the buckets edges.

3.3 Northern Block

No evidence of the former ASTs in the Northern Block could be identified on site. The drum & tank wagon stand and pump shed were both vacant with no signs of recent activity. Stockpiling of loose gravel and fill within the bunded area was observed, with City Care diggers witnessed moving material on and off site. The site has a well maintained perimeter fence and functioning gate with access via Godley Quay. Vegetation was limited to the perimeter bund, dominated by grasses and reeds. The soils showed signs of being heavily reworked with no uniform pattern observed between the three sample locations (X1-X3). Ascertaining the groundwater level was difficult due to the low permeability silty clay soils encountered at site. Test pits were excavated to 1.3 m bgl.

Photos of the Northern Block taken during the site works are given in **Appendix B**.

3.4 Southern Block

Observations on site revealed the presence of the perimeter foundations of former tanks 17 and 18. Surface water ponding across the south eastern portion of the site was present, covering sample locations E4 and E5. Ponding continued from the Interceptor to the edges of the southern bund to a depth of approximately 0.3 m bgl.

Vegetation was limited on site to the bunds and raised areas within the foot prints of the former tanks. All the lower lying areas were mainly barren with evidence of previous ponding and flooding. The ground surface was boggy and wet following the path of the concrete lined drain, flowing from west to east across the site.

The western wall of the bund was pocketed with rabbit holes alongside aeolian erosion of the surrounding sediments. Other sections of the bund appeared well maintained, covered in vegetation (grasses). Within the Southern Block two stockpiles of reworked fill were identified, investigations revealed they consisted of sand, gravel, cobbles and bricks.

Photos of the Southern Block taken during the site works are given in **Appendix B**.

3 Field Work and Observations

3.4.1 Southern Block Test Pitting

Test pits A1–A5 were excavated to a maximum depth of 1.5 m bgl prior to any sampling, to assist in the identification of the groundwater level. Due to the low permeability of the silty-clay soil encountered on site, the test pits were allowed to infill for 45 minutes to enable stabilisation of the groundwater. Investigation of the test pits after 45 minutes revealed the groundwater level settling at approximately 1.2 m bgl. Groundwater however was not encountered at every test pit across the site.

Following the general observations of groundwater level from test pits A1-A5, test pits B1-B6, C1-C3 and C5, D1-D5 and E3 were advanced to 1.2 m bgl. Two soil samples were taken per test pit; the first at 0.5 m bgl representing the surface soils, the second at groundwater level.

Within the foot print of the removed tanks 17 & 18, ground levels were found to be elevated approximately 0.3 m above other nearby locations. As a result soil samples at C4, D6, E1 and E2 were taken at 0.8 m bgl and 1.4 m bgl.

Test pits E4 and E5 were covered in ponded surface water so it was difficult to identify the groundwater level at these two sample locations. To avoid cross contamination from water infilling into the test pit, excavations were only advanced to 0.3 m bgl (one scoop of the excavator bucket). Consequently only one soil sample was taken at each test pit. These soil samples were taken from within the middle of the scoop, ensuring no cross contamination from either the infilling water or the edge of the bucket.

A stockpile of material was identified within the Southern Block from which an additional soil sample was collected (Appendix A – Photo 3).

Four duplicate samples were taken within the Southern Block at test pits; A5 1.0 m bgl, B6 0.5 m bgl, C5 1.0 m bgl and D6 0.8 m bgl.

3.4.2 Southern Block Bund Samples

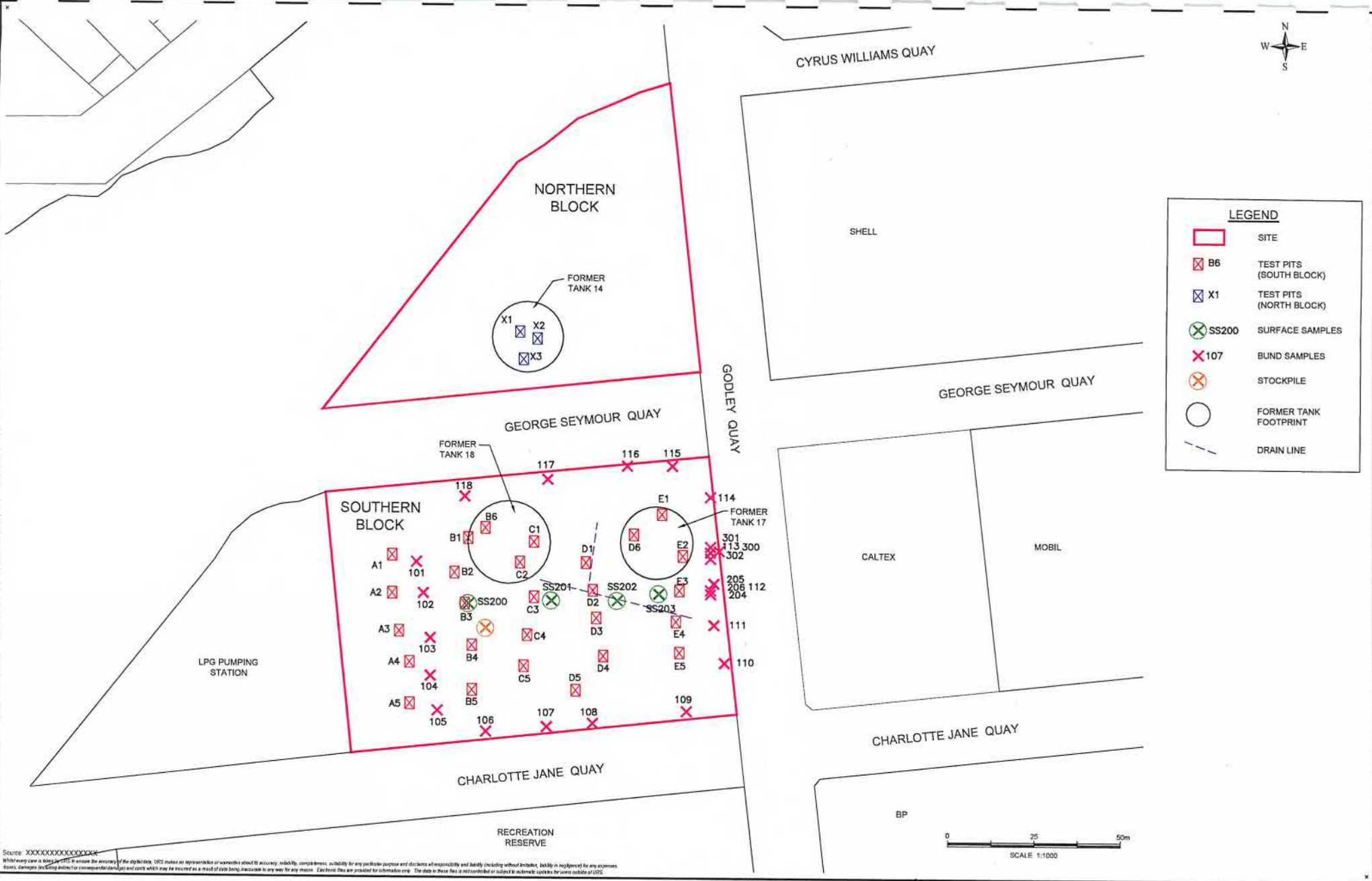
Excavations were carried out by hand with a spade. All locations were orientated on the inside wall of the bund, ensuring the best representation of bund soils from within the Southern Block. Two duplicate samples were taken from the bund at locations 116 and 118.

Six additional bund samples (204-206 and 301-303) were taken on the 15th November 2012 and 10th of December 2012 in the area surrounding bund samples 112 and 113, respectively.

3.4.3 Southern Block Surface Samples

Four surface soil samples (SS200 - SS203) were collected from known hotspots (identified in Woodward Clyde, 1995) within the Southern Block on the 15th November 2012.

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**BP OIL NEW ZEALAND LIMITED
 GODLEY QUAY BENCHMARKING 2012
 SAMPLE LOCATIONS**

Results

Analytical results for soil samples collected are presented in **Table 4-1** to **Table 4-8**. Comparison with the relevant guidelines and regional background trace element concentrations, where available, are given for evaluation.

- TPH and BTEX analytical results have been compared to acceptance criteria for commercial industrial land use given in the MfE (1999) Guidelines².
- Trace metal analytical results have been compared to National Environmental Standard (NES) soil contaminant standards (SCS) for commercial industrial land use³ and Environment Canterbury (ECan) published background trace elements, version 12th October 2010.

Headspace VOC concentrations are also shown.

4.1 Northern Block Test Pits

4.1.1 Petroleum Hydrocarbons

The results for the TPH and BTEX analysis for the Northern Block test pits are presented in **Table 4-1**.

Elevated levels of TPH comprising mainly C₁₅ – C₃₆ range hydrocarbons were observed in all three test pits within the Northern Block (X1, X2 & X3) at depths of 0.5 m bgl:

- Test pit X2 recorded a total TPH concentration of 6,100 mg/kg
- Test pit X1 recorded total TPH concentration of 1,220 mg/kg
- Test pit X3 recorded total TPH concentrations of 370 mg/kg.

The deeper soil samples recorded TPH concentrations below the method detection limit (MDL) for test pit X2 and test pit X3 and 80 mg/kg at test pit X1.

BTEX concentrations were below MDLs in all samples.

Chromatograms for samples in which TPH was detected were indicative of diesel.

All TPH and BTEX results for the Northern Block test pits were less than the MfE (1999) Guidelines soil acceptance criteria.

4.1.2 Metals

The results for the metals analysis in the Northern Block test pits are presented in **Table 4-2**.

Analytical results for As, Cd, Cr, Cu, Pb, Ni and Zn were either below the MDLs or comparable to background concentrations.

All metal results for the Northern Block test pits were less than the NES SCS.

² Ministry for the Environment 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand.

³ Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

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4.2 Southern Block Test Pits

4.2.1 Petroleum Hydrocarbons

The results for the TPH and BTEX analysis for the Southern Block Test Pits are presented in **Table 4-3**.

Levels of TPH were below the MDL in all except for two samples:

- Test pit D6 (0.8 m bgl) recorded a total TPH concentration of 108 mg/kg
- Test pit E3 (1.0 m bgl) recorded a total TPH concentration of 103 mg/kg.

BTEX concentrations were below MDLs in all samples.

All TPH and BTEX results for the Northern Block test pits were less than the MfE (1999) Guidelines soil acceptance criteria.

4.2.2 Metals

The results for the metals analysis in the Southern Block Test Pits are presented in **Table 4-4**.

Analytical results for As, Cd, Cr, Cu, Pb, Ni and Zn were either below the MDLs or comparable to background concentrations except:

- Soil sampled from the stockpile above test pit location B4 recorded a Pb concentration of 114 mg/kg and a Zn concentration of 150 mg/kg.

All metal results for the Southern Block test pits were less than the NES SCS.

4.3 Southern Block Bund Samples

4.3.1 Petroleum Hydrocarbons

The results for the TPH and BTEX analysis for the Southern Block bund samples are presented in **Table 4-5**.

Levels of TPH and BTEX were below the MDL in all samples.

All TPH and BTEX results for the Southern Block bund samples were less than the MfE (1999) Guidelines soil acceptance criteria.

4.3.2 Metals

The results for the metals analysis in the Southern Block Bund Samples are presented in **Table 4-6**.

Analytical results for Cd, Cr, Cu and Ni were either below the MDLs or comparable to background concentrations.

Analytical results for As were comparable to background concentrations except:

- Sample 114 in the eastern bund recorded a concentration of 40 mg/kg.

Analytical results for Pb were generally elevated with respect to background concentrations:

4 Results

- Concentrations in the western and southern bund ranged from 15.3 mg/kg (sample 104) to 115 mg/kg (sample 109).
- Concentrations in the northern bund ranged from 88 mg/kg (sample 118) to 460 mg/kg (sample 115).
- Concentrations in the eastern bund ranged from 42 mg/kg (sample 110) to 9,300 mg/kg (sample 113).

Analytical results for Zn were generally comparable or elevated with respect to background concentrations:

- Concentrations in the western and southern bund ranged from 42 mg/kg (sample 104) to 118 mg/kg (sample 109).
- Concentrations in the northern bund ranged from 78 mg/kg (duplicate sample of sample 116) to 141 mg/kg (sample 117).
- Concentrations in the eastern bund ranged from 73 mg/kg (sample 110) to 142 mg/kg (sample 111).

Metal results for the Southern Block bund were less than the NES SCS except samples 113 and 300 which exceeded the NES value for Pb. The average Pb concentrations for samples collected from the eastern bund is 1861 mg/kg (11 samples) and is below the NES SCS for commercial/industrial land use.

4.4 Southern Block Surface Samples

4.4.1 Petroleum Hydrocarbons

The results for the TPH and BTEX analysis for the Southern Block surface samples are presented in **Table 4-7**.

Levels of TPH were below the MDL in all except one sample:

- Sample SS202 recorded a total TPH concentration of 69 mg/kg.

BTEX concentrations were below MDLs in all samples.

All TPH and BTEX results for the Southern Block surface samples were less than the MfE (1999) Guidelines soil acceptance criteria.

4.4.2 Metals

The results for the Metal Screen analysis in the Southern Block surface samples are presented in **Table 4-8**.

Analytical results for As, Cd, Cr and Ni were either below the MDLs or comparable to background concentrations.

Analytical results for Cu were slightly elevated when compared to background concentrations:

- Concentrations in the surface samples ranged from 27 mg/kg (sample 203) to 44 mg/kg (sample 204).

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Analytical results for Pb were generally elevated with respect to background concentrations:

- Concentrations in the surface samples ranged from 60 mg/kg (sample 200) to 1,030 mg/kg (sample 202).

Analytical results for Zn were generally comparable or elevated with respect to background concentrations:

- Concentrations in the surface samples ranged from 98 mg/kg (sample 200) to 280 mg/kg (sample 202).

Metal results for the Southern Block surface samples were less than the NES SCS.

4.5 Duplicate Results

Duplicates were analysed for relative percentage difference (RPD) and are displayed in **Table 4-9**.

Duplicate pairs for the Southern Block Test Pits A5, B6 and C5 all fell within 30% RPD. The duplicate pair for Test Pit D6 had an RPD for of 50.5% for Pb and 45.9% for C₁₅ – C₃₆ range TPH.

Duplicate pair for the Southern Block Bund samples 118 and 116 all fell within 30% RPD.

These values are deemed acceptable.



Table 4-1 Godley Quay, Lyttelton. Soil Analytical Results TPH/BTEX compared to Tier 1 MfE Guidelines. Northern Block

URS Location ID	GDQY 55 0.5m	GDQY 55 1.3m	GDQY 57 0.5m	GDQY 57 1.2m	GDQY 59 0.5m	GDQY 59 1.3m	MfE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria
Laboratory Sample Reference	1062470.21	1062470.22	1062470.23	1062470.24	1062470.25	1062470.26	
Date Sampled	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	
Sample Location	Test Pit X1		Test Pit X2		Test Pit X3		
GEO Reference	E1576473		E1576478		E1576474		
	NS171672		NS171670		NS171664		
Sample Depth (m below ground level)	0.5	1.3	0.5	1.2	0.5	1.3	All Pathways - Commercial / Industrial ²
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	
PID Headspace Reading (ppm)	0.0	1820	13.7	1.8	8.1	24.2	Contamination depth Surface (<1m) / 1m-4m
Observations	Green/Grey Colour, Black Staining, Brown Mottling, Hydrocarbon odour.	Grey & Brown alternating silt bands, No Odour	Grey/Green Colour, Brown Mottling, Hydrocarbon Odour	Brown Colour, No Odour	Grey/Green Colour, Brown Mottling, No Odour	Grey/Brown banding, mixed with black silt. Hydrocarbon odour.	SILTY CLAY
Total Petroleum Hydrocarbons (TPH)							
C ₇ -C ₉	< 8	32	< 8	< 9	< 8	< 9	8800 / 20000
C ₁₀ -C ₁₄	145	47	720	< 20	36	< 20	1900 / 8900
C ₁₅ -C ₃₆	1080	< 40	5400	< 40	330	< 40	NA / NA
Total hydrocarbons (C ₇ - C ₃₆)	1220	80	6100	< 70	370	< 70	-
BTEX Compounds							
Benzene	< 0.05	< 0.3	< 0.05	< 0.05	< 0.05	< 0.06	7.2 / 20
Toluene	< 0.05	< 0.3	< 0.05	< 0.05	< 0.05	< 0.06	670 / 3100
Ethylbenzene	< 0.05	< 0.3	< 0.05	< 0.05	< 0.05	< 0.06	350 / 2600
Total Xylenes	< 0.15	< 0.9	< 0.15	< 0.15	< 0.15	< 0.17	510 / 2300

Notes:

All concentrations are in mg/kg dry weight

¹ Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999 Guidelines). Updated in 2011 with reference to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)

² Values taken from Table 4.17 of the MfE (1999) Guidelines.

³ Conservative soil category chosen for comparison with MfE (1999) Guidelines Tier I acceptance criteria to best represent soils observed on site

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the MfE (1999) Guidelines Tier I (Route Specific) Soil Acceptance Criteria



Table 4-2 Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards. Northern Block

URS Location ID	GDQY 55 0.5m	GDQY 55 1.3m	GDQY 57 0.5m	GDQY 57 1.2m	GDQY 59 0.5m	GDQY 59 1.3m	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer). ²			
Laboratory Sample Reference	1062470.21	1062470.22	1062470.23	1062470.24	1062470.25	1062470.26						
Date Sampled	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012						
Sample Location	Test Pit X1		Test Pit X2		Test Pit X3							
GEO Reference	E1576473		E1576478		E1576474							
	N5171672		N5171670		N5171664							
Sample Depth (m below ground level)	0.5	1.3	0.5	1.2	0.5	1.3						
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY						
PID Headspace Reading (ppm)	0.0	1820	13.7	1.8	8.1	24.2						
Observations	Green/Grey Colour, Black Staining, Brown Mottling, Hydrocarbon odour.	Grey & Brown alternating 5th bands, No Odour	Grey/Green Colour, Brown Mottling, Hydrocarbon Odour	Brown Colour, No Odour	Grey/Green Colour, Brown Mottling, No Odour	Grey/Brown banding, mixed with black silt, Hydrocarbon odour.						
Metals Trace												
Total Recoverable Arsenic (mg/kg dry wt)	4	2	3	< 2	4	< 2	70	4.6	4.9			
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	15	15	16	18	16	14	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	11	27	13	21	23	26	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	14.3	12.6	13.3	11.4	27	6.9	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	11	24	12	16	14	19	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	49	73	54	80	73	86	-	62.4	69.6			

Notes:

All concentrations are in mg/kg dry weight

¹ National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

² Environment Canterbury GIS resource. Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial 1



Table 4-3a. Godley Quay, Lyttelton Soil Analytical Results TPH/BTEX compared to Tier 1 MFE Guidelines. Southern Block Test Pits

URS Location ID	GDQY 01 0.5m	GDQY 01 1.0m	GDQY 3 0.5m	GDQY 3 1.0m	GDQY 05 0.5m	GDQY 05 1.0m	GDQY 07 0.5m	GDQY 07 1.0m	GDQY 9 0.5m	GDQY 9 1.0m	GDQY Pit A ²	MFE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria
Laboratory Sample Reference	1061982.01	1061982.02	1061982.03	1061982.04	1061982.05	1061982.06	1061982.07	1061982.08	1061982.09	1061982.10	1061982.33	
Date Sampled	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	
Sample Location	Test Pit A1		Test Pit A2		Test Pit A3		Test Pit A4		Test Pit A5			
GEO Reference	E1576436		E1576436		E1576438		E1576441		E1576441			
	NS171607		NS171596		NS171585		NS171576		NS171564			
Sample Depth (m below ground level)	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	1.0	All Pathways - Commercial / Industrial ²
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	Contamination depth Surface (<1m) / 1m-4m
PID Headspace Reading (ppm)	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.5	0.2	0.2	0.2	
Observations	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, Black Staining No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	SILTY CLAY
Total Petroleum Hydrocarbons (TPH)												
C ₇ -C ₉	< 9	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	8800 / 20000
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	1900 / 8900
C ₁₅ -C ₃₆	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	NA / NA
Total hydrocarbons (C ₇ - C ₃₆)	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	-
BTEX Compounds												
Benzene	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	7.2 / 20
Toluene	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	670 / 3100
Ethylbenzene	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	350 / 2600
Total Xylenes	< 0.18	< 0.18	< 0.18	< 0.18	< 0.17	< 0.18	< 0.18	< 0.17	< 0.17	< 0.17	< 0.17	510 / 2300

URS Location ID	GDQY 11 0.5m	GDQY 11 1.0m	GDQY 13 0.5m	GDQY 13 1.0m	GDQY 15 0.5m	GDQY 15 1.0m	GDQY 17 StockPile	GDQY 17 0.5m	GDQY 17 1.0m	GDQY 19 0.5m	GDQY 19 1.0m	MFE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria
Laboratory Sample Reference	1061982.11	1061982.12	1061982.13	1061982.14	1061982.15	1061982.16	1061982.37	1061982.17	1061982.18	1061982.19	1061982.20	
Date Sampled	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	
Sample Location	Test Pit B1		Test Pit B2		Test Pit B3		Test Pit B4		Test Pit B5			
GEO Reference	E1576458		E1576454		E1576457		E1576459		E1576459			
	NS171612		NS171602		NS171593		NS171581		NS171568			
Sample Depth (m below ground level)	0.5	1.0	0.5	1.0	0.5	1.0	0.1	0.5	1.0	0.5	1.0	All Pathways - Commercial / Industrial ²
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	Contamination depth Surface (<1m) / 1m-4m
PID Headspace Reading (ppm)	0.2	0.8	0.5	0.9	0.3	1.0	0.3	0.3	0.7	0.3	1.2	
Observations	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour, Gravel	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, No Odour	SILTY CLAY
Total Petroleum Hydrocarbons (TPH)												
C ₇ -C ₉	< 8	< 10	< 10	< 10	< 10	< 9	< 9	< 9	< 10	< 11	< 10	8800 / 20000
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 30	< 20	1900 / 8900
C ₁₅ -C ₃₆	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 50	< 40	NA / NA
Total hydrocarbons (C ₇ - C ₃₆)	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 80	< 70	-
BTEX Compounds												
Benzene	< 0.05	< 0.06	< 0.06	< 0.06	< 0.06	< 0.05	< 0.05	< 0.05	< 0.06	< 0.06	< 0.06	7.2 / 20
Toluene	< 0.05	< 0.06	< 0.06	< 0.06	< 0.06	< 0.05	< 0.05	< 0.05	< 0.06	< 0.06	< 0.06	670 / 3100
Ethylbenzene	< 0.05	< 0.06	< 0.06	< 0.06	< 0.06	< 0.05	< 0.05	< 0.05	< 0.06	< 0.06	< 0.06	350 / 2600
Total Xylenes	< 0.15	< 0.18	< 0.17	< 0.18	< 0.17	< 0.15	< 0.15	< 0.15	< 0.18	< 0.18	< 0.18	510 / 2300

Notes:

All concentrations are in mg/kg dry weight

1 Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MFE 1999 Guidelines). Updated in 2011 with reference to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)

2 Values taken from Table 4.17 of the MFE (1999) Guidelines.

3 Conservative soil category chosen for comparison with MFE (1999) Guidelines Tier I acceptance criteria to best represent soils observed on site

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the MFE (1999) Guidelines Tier I (Route Specific) Soil Acceptance Criteria



Table 4-3b. Godley Quay, Lyttelton Soil Analytical Results TPH/BTEX compared to Tier 1 MfE Guidelines. Southern Block Test Pits

URS Location ID	GDQY 21 0.5m	GDQY 21 1.0m	GDQY Pit B ^{sup}	GDQY 23 0.5m	GDQY 23 1.0m	GDQY 25 0.5m	GDQY 25 1.0m	GDQY 27 0.5m	GDQY 27 1.0m	GDQY 29 0.8m	GDQY 29 1.4m	MfE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria	
Laboratory Sample Reference	1061982.21	1061982.22	1061982.34	1061982.23	1061982.24	1061982.25	1061982.26	1061982.27	1061982.28	1061982.29	1061982.30		
Date Sampled	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012		
Sample Location	Test Pit B6			Test Pit C1			Test Pit C2			Test Pit C3			
GEO Reference	E1576489			E1576477			E1576473			E1576477			
	N5171568			N5171611			N5171605			N5171595			All Pathways - Commercial / Industrial ²
Sample Depth (m below ground level)	0.5	1.0	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.8	1.4		
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SANDY SILT	SANDY SILT	SANDY SILT	SILTY CLAY	SILTY CLAY	SANDY SILT	SILTY CLAY	Contamination depth Surface (<1m) / 1m-4m	
PID Headspace Reading (ppm)	1.6	0.4	1.6	12.1	1.0	1.5	1.1	0.8	1.2	0.8	0.5		
Observations	Grey Colour, Brown Mottling, No Odour, mixed fill with gravel	Grey Colour, Brown Mottling, No Odour, mixed fill with gravel	Grey Colour, Brown Mottling, No Odour, mixed fill with gravel	Grey Colour, No Odour	Grey Colour, Black Staining, Roots, No Odour	Grey/ light brown, Brown Mottling, No Odour, Roots, Gravel	Grey/Green Colour, Abundance of Roots, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	SILTY CLAY
Total Petroleum Hydrocarbons (TPH)													
C ₇ -C ₉	< 9	< 9	< 9	< 8	< 10	< 8	< 9	< 10	< 10	< 9	< 10	8800 / 20000	
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	1900 / 8900	
C ₁₅ -C ₁₆	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	NA / NA	
Total hydrocarbons (C ₇ - C ₁₆)	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	-	
BTEX Compounds													
Benzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.06	< 0.07	< 0.05	< 0.06	7.2 / 20	
Toluene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.06	< 0.07	< 0.05	< 0.06	670 / 3100	
Ethylbenzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.06	< 0.07	< 0.05	< 0.06	350 / 2600	
Total Xylenes	< 0.15	< 0.15	< 0.15	< 0.15	< 0.17	< 0.15	< 0.15	< 0.18	< 0.20	< 0.15	< 0.18	510 / 2300	

URS Location ID	GDQY 33 0.5m	GDQY 31 1.0m	GDQY Pit C ^{sup}	GDQY 33 0.5m	GDQY 33 1.0m	GDQY 35 0.5m	GDQY 35 1.0m	GDQY 37 0.5m	GDQY 37 1.0m	GDQY 39 0.5m	GDQY 39 1.0m	MfE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria	
Laboratory Sample Reference	1061982.31	1061982.32	1061982.35	1062470.01	1062470.02	1062470.03	1062470.04	1062470.05	1062470.06	1062470.07	1062470.08		
Date Sampled	24/10/2012	24/10/2012	24/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012		
Sample Location	Test Pit C5			Test Pit D1			Test Pit D2			Test Pit D3			
GEO Reference	E1576474			E1576463			E1576492			E1576494			
	N5171575			N5171615			N5171605			N5171597			All Pathways - Commercial / Industrial ²
Sample Depth (m below ground level)	0.5	1.0	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0		
Guideline Soil Type ³	SANDY SILT	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	Contamination depth Surface (<1m) / 1m-4m	
PID Headspace Reading (ppm)	0.7	0.6	0.6	0.4	0.4	0.5	0.6	0.3	0.3	0.0	0.8		
Observations	Grey Colour, Black Staining, No Odour	Grey Colour, Black Staining, No Odour	Grey Colour, Black Staining, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, Black Staining, Hydrocarbon Odour	SILTY CLAY
Total Petroleum Hydrocarbons (TPH)													
C ₇ -C ₉	< 11	< 11	< 11	< 10	< 11	< 10	< 9	< 9	< 10	< 9	< 10	8800 / 20000	
C ₁₀ -C ₁₄	< 30	< 30	< 30	< 20	< 30	< 20	< 20	< 20	< 20	< 20	< 20	1900 / 8900	
C ₁₅ -C ₁₆	< 50	< 50	< 50	< 40	< 50	< 40	< 40	< 40	< 40	< 40	< 40	NA / NA	
Total hydrocarbons (C ₇ - C ₁₆)	< 80	< 80	< 80	< 70	< 80	< 70	< 70	< 70	< 70	< 70	< 70	-	
BTEX Compounds													
Benzene	< 0.05	< 0.07	< 0.07	< 0.06	< 0.07	< 0.06	< 0.06	< 0.06	< 0.07	< 0.06	< 0.06	7.2 / 20	
Toluene	< 0.05	< 0.07	< 0.07	< 0.06	< 0.07	< 0.06	< 0.06	< 0.06	< 0.07	< 0.06	< 0.06	670 / 3100	
Ethylbenzene	< 0.05	< 0.07	< 0.07	< 0.06	< 0.07	< 0.06	< 0.06	< 0.06	< 0.07	< 0.06	< 0.06	350 / 2600	
Total Xylenes	< 0.18	< 0.20	< 0.20	< 0.17	< 0.20	< 0.17	< 0.17	< 0.17	< 0.20	< 0.18	< 0.18	510 / 2300	

Notes:

All concentrations are in mg/kg dry weight

¹ Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999 Guidelines). Updated in 2011 with reference to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)

² Values taken from Table 4.17 of the MfE (1999) Guidelines.

³ Conservative soil category chosen for comparison with MfE (1999) Guidelines Tier I acceptance criteria to best represent soils observed on site

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the MfE (1999) Guidelines Tier I (Route Specific) Soil Acceptance Criteria



Table 4-3c. Godley Quay, Lyttelton Soil Analytical Results TPH/BTEX compared to Tier 1 MFE Guidelines. Southern Block Test Pits

URS Location ID	GDQY 41 0.5m	GDQY 41 1.2m	GDQY 43 0.8m	GDQY 43 1.4m	GDQY Pit D ¹	GDQY 45 0.8m	GDQY 45 1.4m	GDQY 47 0.8m	GDQY 47 1.4m	GDQY 49 0.5m	GDQY 49 1.0m	MFE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria	
Laboratory Sample Reference	1062470.09	1062470.10	1062470.11	1062470.12	1062470.27	1062470.13	1062470.14	1062470.15	1062470.16	1062470.17	1062470.18		
Date Sampled	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012		
Sample Location	Test Pit D5			Test Pit D6			Test Pit E1		Test Pit E2		Test Pit E3		
GEO Reference	E1576497			-			E1576514		E1576520		E1576519		All Pathways - Commercial / Industrial ²
	NS171578			-			NS171619		NS171607		NS171597		
Sample Depth (m below ground level)	0.5	1.2	0.8	1.4	0.8	0.8	1.4	0.8	1.4	0.5	1.0	Contamination depth Surface (<1m) / 1m-4m	
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SANDY SILT	SILTY CLAY	SANDY SILT	SANDY SILT	SILTY CLAY	SAND	SILTY CLAY	SILTY CLAY	SILTY CLAY		
PID Headspace Reading (ppm)	0.7	0.6	0.4	0.4	0.4	0.2	0.6	0.4	0.3	0.8	1.8		
Observations	Grey Colour, Brown Mottling, Black Staining, No Odour	Grey Colour, Black Staining, No Odour, Saturated	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Grey Colour, Black Staining, No Odour	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Grey Colour, Dark Staining, No Odour, Roots	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Grey Colour, Black Staining, No Odour, Roots	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	SILTY CLAY	
Total Petroleum Hydrocarbons (TPH)													
C ₇ -C ₆	< 10	< 9	< 9	< 10	< 9	< 9	< 9	< 8	< 10	< 10	< 11	8800 / 20000	
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 30	1900 / 8900	
C ₁₅ -C ₁₆	< 40	< 40	108	< 40	< 40	< 40	< 40	< 40	< 40	< 40	103	NA / NA	
Total hydrocarbons (C ₇ - C ₁₆)	< 70	< 70	108	< 70	< 70	< 70	< 70	< 70	< 70	< 70	103	-	
BTEX Compounds													
Benzene	< 0.07	< 0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.06	< 0.06	< 0.06	7.2 / 20	
Toluene	< 0.07	< 0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.06	< 0.06	< 0.06	670 / 3100	
Ethylbenzene	< 0.07	< 0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.06	< 0.06	< 0.06	350 / 2600	
Total Xylenes	< 0.20	< 0.18	< 0.15	< 0.15	< 0.15	< 0.15	< 0.18	< 0.15	< 0.18	< 0.17	< 0.18	510 / 2300	

URS Location ID	GDQY 51 0.3m	GDQY 53 0.3m	GDQY Pile A	MFE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria		
Laboratory Sample Reference	1062470.19	1062470.20	1061982.36			
Date Sampled	25/10/2012	25/10/2012	24/10/2012			
Sample Location	Test Pit E4	Test Pit E5	Stockpile A			
GEO Reference	E1576518	E1576519	E1576463	All Pathways - Commercial / Industrial ²		
	NS171588	NS171579	NS171586			
Sample Depth (m below ground level)	0.3	0.3	0.1	Contamination depth Surface (<1m) / 1m-4m		
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SAND			
PID Headspace Reading (ppm)	1.0	0.8	0.7			
Observations	Grey Colour, Brown Mottling, No Odour, Saturated	Grey Colour, Brown Mottling, No Odour, Saturated	Brown Colour, Sand with Silt, Gravel and Cobbles, No Odour	SAND	SANDY SILT	SILTY CLAY
Total Petroleum Hydrocarbons (TPH)						
C ₇ -C ₆	< 9	< 10	< 8	120 / 120	500 / 500	8800 / 20000
C ₁₀ -C ₁₄	< 20	< 20	< 20	1500 / 1900	1700 / 2200	1900 / 8900
C ₁₅ -C ₁₆	< 40	< 40	< 40	NA / NA	NA / NA	NA / NA
Total hydrocarbons (C ₇ - C ₁₆)	< 70	< 70	< 70	-	-	-
BTEX Compounds						
Benzene	< 0.06	< 0.06	< 0.05	3.0 / 3.0	3.6 / 7.2	7.2 / 20
Toluene	< 0.06	< 0.06	< 0.05	94 / 94	270 / 480	670 / 3100
Ethylbenzene	< 0.06	< 0.06	< 0.05	180 / 300	200 / 300	350 / 2600
Total Xylenes	< 0.18	< 0.18	< 0.15	150 / 150	200 / 420	510 / 2300

Notes:

All concentrations are in mg/kg dry weight

1 Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MFE 1999 Guidelines). Updated in 2011 with reference to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)

2 Values taken from Table 4.17 of the MFE (1999) Guidelines.

3 Conservative soil category chosen for comparison with MFE (1999) Guidelines Tier I acceptance criteria to best represent soils observed on site

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the MFE (1999) Guidelines¹ Tier I (Route Specific) Soil Acceptance Criteria



Table 4-4a Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards. Southern Block Test Pits

URS Location ID	GDQY 01 0.5m	GDQY 01 1.0m	GDQY 3 0.5m	GDQY 3 1.0m	GDQY 05 0.5m	GDQY 05 1.0m	GDQY 07 0.5m	GDQY 07 1.0m	GDQY 9 0.5m	GDQY 9 1.0m	GDQY Pit A	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²			
Laboratory Sample Reference	1061982.01	1061982.02	1061982.03	1061982.04	1061982.05	1061982.06	1061982.07	1061982.08	1061982.09	1061982.10	1061982.33						
Date Sampled	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012						
Sample Location	Test Pit A1		Test Pit A2		Test Pit A3		Test Pit A4		Test Pit A5								
GEO Reference	E1576436		E1576436		E1476438		E1576441		E1576441								
	NS171607		NS171596		NS171585		NS171576		NS171564								
Sample Depth (m below ground level)	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	1.0						
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY						
PID Headspace Reading (ppm)	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.5	0.2	0.2	0.2						
Observations	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.						
Metals Trace																	
Total Recoverable Arsenic (mg/kg dry wt)	6	6	6	5	8	6	7	7	5	6	4				70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	23	21	19	22	23	20	23	17	21	18	16	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	9	8	8	8	9	7	9	6	7	6	5	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	23	21	19.2	21	22	17.7	22	16.3	20	16.3	14.4	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	17	16	14	16	17	14	16	13	15	12	11	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	76	70	65	71	77	62	74	56	68	55	51	-	62.4	69.6			

URS Location ID	GDQY 11 0.5m	GDQY 11 1.0m	GDQY 13 0.5m	GDQY 13 1.0m	GDQY 15 0.5m	GDQY 15 1.0m	GDQY 17 Stockpile	GDQY 17 0.5m	GDQY 17 1.0m	GDQY 19 0.5m	GDQY 19 1.0m	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²			
Laboratory Sample Reference	1061982.11	1061982.12	1061982.13	1061982.14	1061982.15	1061982.16	1061982.37	1061982.17	1061982.18	1061982.19	1061982.20						
Date Sampled	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012						
Sample Location	Test Pit B1		Test Pit B2		Test Pit B3			Test Pit B4		Test Pit B5							
GEO Reference	E1579458		E1576454		E1576457			E1576459		E1576459							
	NS171612		NS171602		NS171593			NS171581		NS171568							
Sample Depth (m below ground level)	0.5	1.0	0.5	1.0	0.5	1.0	-	0.5	1.0	0.5	1.0						
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY						
PID Headspace Reading (ppm)	0.2	0.8	0.5	0.9	0.3	1.0	0.3	0.3	0.7	0.3	1.2						
Observations	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour, Gravel.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, Brown Mottling, No Odour.	Grey Colour, No Odour.						
Metals Trace																	
Total Recoverable Arsenic (mg/kg dry wt)	3	6	6	6	5	8	5	4	5	7	8				70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.17	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	15	23	24	19	19	21	18	16	22	22	18	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	9	9	9	7	7	8	28	11	8	8	7	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	12.2	22	22	17.2	18.5	21	114	33	22	22	19.1	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	11	17	17	14	13	15	15	12	16	16	14	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	48	74	75	62	61	66	150	69	73	73	60	-	62.4	69.6			

Notes:

All concentrations are in mg/kg dry weight

¹ National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

² Environment Canterbury GIS resource. Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial I



Table 4-4b Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards. Southern Block Test Pits

URS Location ID	GDQY 21 0.5m	GDQY 21 1.0m	GDQY Pit B ^{DUP}	GDQY 23 0.5m	GDQY 23 1.0m	GDQY 25 0.5m	GDQY 25 1.0m	GDQY 27 0.5m	GDQY 27 1.0m	GDQY 29 0.8m	GDQY 29 1.4m	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²			
Laboratory Sample Reference	1061982.21	1061982.22	1061982.34	1061982.23	1061982.24	1061982.25	1061982.26	1061982.27	1061982.28	1061982.29	1061982.30						
Date Sampled	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012	24/10/2012						
Sample Location	Test Pit B6			Test Pit C1		Test Pit C2		Test Pit C3		Test Pit C4							
GEO Reference	E1576489			E1576477		E1576473		E1576477		E1576475							
	NS171568			NS171611		NS171605		NS171595		NS171584							
Sample Depth (m below ground level)	0.5	1.0	0.5	0.5	1.0	0.5	1.0	0.5	1.0	0.8	1.4						
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SANDY SILT	SANDY SILT	SANDY SILT	SILTY CLAY	SILTY CLAY	SANDY SILT	SILTY CLAY						
PID Headspace Reading (ppm)	1.6	0.4	1.6	12.1	1.0	1.5	1.1	0.8	1.2	0.8	0.5						
Observations	Grey Colour, Brown Mottling, No Odour, mixed fill with gravel	Grey Colour, Brown Mottling, No Odour, mixed fill with gravel	Grey Colour, Brown Mottling, No Odour, mixed fill with gravel	Grey Colour, No Odour	Grey Colour, Black Staining, Roots, No Odour	Grey/light brown, Brown Mottling, No Odour, Roots, Gravel	Grey/Green Colour, Abundance of Roots, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour						
Metals Trace																	
Total Recoverable Arsenic (mg/kg dry wt)	3	4	2	3	6	3	2	6	7	6	6				70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	14	14	14	15	22	14	14	24	23	17	21	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	9	8	10	13	9	8	13	10	9	8	8	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	14	13.8	11.4	12.7	21	12	10.6	24	23	33	18.1	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	10	10	11	13	16	10	13	17	17	13	15	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	44	43	47	53	74	43	47	79	78	66	67	-	62.4	69.6			

URS Location ID	GDQY 31 0.5m	GDQY 31 1.0m	GDQY Pit C ^{DUP}	GDQY 33 0.5m	GDQY 33 1.0m	GDQY 35 0.5m	GDQY 35 1.0m	GDQY 37 0.5m	GDQY 37 1.0m	GDQY 39 0.5m	GDQY 39 1.0m	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²			
Laboratory Sample Reference	1061982.31	1061982.32	1061982.35	1062470.01	1062470.02	1062470.03	1062470.04	1062470.05	1062470.06	1062470.07	1062470.08						
Date Sampled	24/10/2012	24/10/2012	24/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012						
Sample Location	Test Pit C5			Test Pit D1		Test Pit D2		Test Pit D3		Test Pit D4							
GEO Reference	E1576474			E1576463		E1576492		E1576494		E1576495							
	NS171575			NS171615		NS171605		NS171597		NS171589							
Sample Depth (m below ground level)	0.5	1.0	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0						
Guideline Soil Type ³	SANDY SILT	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY	SILTY CLAY						
PID Headspace Reading (ppm)	0.7	0.6	0.6	0.4	0.4	0.5	0.6	0.3	0.3	0.0	0.8						
Observations	Grey Colour, Black Staining, No Odour	Grey Colour, Black Staining, No Odour	Grey Colour, Black Staining, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour						
Metals Trace																	
Total Recoverable Arsenic (mg/kg dry wt)	5	6	8	6	8	6	5	7	5	8	6				70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	22	22	24	23	23	23	21	17	22	22	22	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	9	8	9	10	26	10	7	7	8	9	9	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	22	19.7	23	23	23	24	18.4	18.1	22	29	25	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	16	16	18	15	16	16	14	13	14	16	15	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	74	71	79	75	73	81	61	59	69	76	74	-	62.4	69.6			

Notes:

All concentrations are in mg/kg dry weight

¹ National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

² Environment Canterbury GIS resource. Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial I



Table 4-4c Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards. Southern Block Test Pits

URS Location ID	GDQY 41 0.5m	GDQY 41 1.2m	GDQY 43 0.8m	GDQY 43 1.4m	GDQY Pit D ^{DUF}	GDQY 45 0.8m	GDQY 45 1.4m	GDQY 47 0.8m	GDQY 47 1.4m	GDQY 49 0.5m	GDQY 49 1.0m	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²			
Laboratory Sample Reference	1062470.09	1062470.10	1062470.11	1062470.12	1062470.27	1062470.13	1062470.14	1062470.15	1062470.16	1062470.17	1062470.18						
Date Sampled	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012						
Sample Location	Test Pit D5		Test Pit D6			Test Pit E1		Test Pit E2		Test Pit E3							
GEO Reference	E1576497		-			E1576514		E1576520		E1576519							
	NS171578		-			NS171619		NS171607		NS171597							
Sample Depth (m below ground level)	0.5	1.2	0.8	1.4	0.8	0.8	1.4	0.8	1.4	0.5	1						
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SANDY SILT	SILTY CLAY	SANDY SILT	SANDY SILT	SILTY CLAY	SAND	SILTY CLAY	SILTY CLAY	SILTY CLAY						
PID Headspace Reading (ppm)	0.7	0.6	0.4	0.4	0.4	0.2	0.6	0.4	0.3	0.8	1.8						
Observations	Grey Colour, Brown Mottling, Black Staining, No Odour	Grey Colour, Black Staining, No Odour, Saturated	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Grey Colour, Black Staining, No Odour	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Grey Colour, Dark Staining, No Odour, Roots	Gravel and grit, Red/Brown/Orange Colour, Saturated, Roots, No Odour	Grey Colour, Black Staining, No Odour, Roots	Grey Colour, Brown Mottling, No Odour	Grey Colour, Brown Mottling, No Odour						
Metals Trace																	
Total Recoverable Arsenic (mg/kg dry wt)	6	6	2	3	2	2	6	< 2	6	7	8	70	4.6	4.9			
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	21	20	15	16	16	16	24	15	20	20	23	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	9	7	23	12	25	20	9	24	8	8	9	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	22	17.4	9.2	12.9	28	7.4	23	5.4	18.3	24	23	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	14	14	24	12	25	23	16	22	15	13	16	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	68	62	60	50	70	64	75	64	65	62	69	-	62.4	69.6			

URS Location ID	GDQY 51 0.3m	GDQY 53 0.3m	GDQY Pile A	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²			
Laboratory Sample Reference	1062470.19	1062470.20	1061982.36						
Date Sampled	25/10/2012	25/10/2012	24/10/2012						
Sample Location	Test Pit E4	Test Pit E5	Stockpile A						
GEO Reference	E1576518	E1576519	E1576463						
	NS171588	NS171579	NS171586						
Sample Depth (m below ground level)	0.3	0.3	0.1						
Guideline Soil Type ³	SILTY CLAY	SILTY CLAY	SAND						
PID Headspace Reading (ppm)	1.0	0.8	0.7						
Observations	Grey Colour, Brown Mottling, No Odour, Saturated	Grey Colour, Brown Mottling, No Odour, Saturated	Brown Colour, Sand with Silt, Gravel and Cobbles, No Odour,						
Metals Trace									
Total Recoverable Arsenic (mg/kg dry wt)	8	8	3	70	4.6	4.9			
Total Recoverable Cadmium (mg/kg dry wt)	0.14	< 0.10	0.16	1,300	0.11	0.13			
Total Recoverable Chromium (mg/kg dry wt)	24	20	15	>10,000	15.6	16.9			
Total Recoverable Copper (mg/kg dry wt)	12	8	18	>10,000	11.5	12.4			
Total Recoverable Lead (mg/kg dry wt)	58	22	48	3,300	18.8	21.3			
Total Recoverable Nickel (mg/kg dry wt)	17	14	18	-	11.6	13.1			
Total Recoverable Zinc (mg/kg dry wt)	105	62	97	-	62.4	69.6			

Notes:

All concentrations are in mg/kg dry weight

¹ National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

² Environment Canterbury GIS resource. Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial 1



Table 4-5 Godley Quay, Lyttelton. Soil Analytical Results TPH/BTEX compared to Tier 1 MfE Guidelines. Southern Block Bund Samples

URS Location ID	GDQY 101	GDQY 102	GDQY 103	GDQY 104	GDQY 105	GDQY 106	GDQY 107	GDQY 108	GDQY 109	GDQY 110	GDQY 111	GDQY 112	GDQY 113	MfE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria	
Laboratory Sample Reference	1062470.28	1062470.29	1062470.30	1062470.31	1062470.32	1063035.01	1063035.02	1063035.03	1063035.04	1063035.05	1063035.06	1063035.07	1063035.08		
Date Sampled	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012		
Sample Location	Bund 101	Bund 102	Bund 103	Bund 104	Bund 105	Bund 106	Bund 107	Bund 108	Bund 109	Bund 110	Bund 111	Bund 112	Bund 113		
GEO Reference	E1576443	E1576445	E1576447	E1576447	E1576449	E1576463	E1576481	E1576494	E1576521	E1576532	E1576529	E1576528	E1576528		
	N5171505	N5171596	N5171583	N5171572	N5171562	N5171556	N5171554	N5171556	N5171562	N5171576	N5171587	N5171597	N5171608	All Pathways - Commercial / Industrial ²	
Guideline Soil Type ³	SANDY SILT	SAND	SANDY SILT	SAND	SAND	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	Contamination depth Surface (<1m) / 1m-4m	
PID Headspace Reading (ppm)	0.8	1.2	1.6	0.9	0.8	0.8	0.8	0.8	0.6	0.4	0.7	0.7	0.5		
Observations	Brown, No Odour, Roots, some gravel.	Brown, No Odour,	Brown, No Odour, Roots	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	SAND	SANDY SILT
Total Petroleum Hydrocarbons (TPH)															
C ₇ -C ₉	< 8	< 9	< 9	< 8	< 8	< 8	< 8	< 10	< 8	< 8	< 8	< 8	< 8	120 / 120	500 / 500
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	1500 / 1900	1700 / 2200
C ₁₅ -C ₃₆	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	NA / NA	NA / NA
Total hydrocarbons (C ₇ - C ₃₆)	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	-	-
BTEX Compounds															
Benzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	3.0 / 3.0	3.6 / 7.2
Toluene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	94 / 94	270 / 480
Ethylbenzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	180 / 300	200 / 300
Total Xylenes	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.18	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	150 / 150	200 / 420

URS Location ID	GDQY 114	GDQY 115	GDQY 116	GDQY Bund A ^{DRP}	GDQY 117	GDQY 118	GDQY Bund B ^{DRP}	GDQY204	GSQY205	GDQY206	GDQY300	GSQY301	GDQY302	MfE (1999) Guidelines ¹ Tier I (Route Specific) Soil Acceptance Criteria	
Laboratory Sample Reference	1063035.09	1063035.10	1063035.11	1063035.12	1063035.13	1063035.14	1063035.15	1070365.5	1070365.6	1070365.7	1079511.1	1079511.2	1079511.3		
Date Sampled	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	15/11/2012	15/11/2012	15/11/2012	10/12/2012	10/12/2012	10/12/2012		
Sample Location	Bund 114	Bund 115	Bund 116	Bund 116	Bund 117	Bund 118	Bund 118	Bund 204	Bund 205	Bund 206	Bund 300	Bund 301	Bund 302		
GEO Reference	E1576528	E1576517	E1576504	E1576504	E1576481	E1576457	E1576457	E1576528	E1576528	E1576527	E1576527	E1576527	E1576528		
	N5171624	N5171633	N5171633	N5171633	N5171629	N5171624	N5171624	N5171596	N5171599	N5171597	N5171609	N5171611	N5171608	All Pathways - Commercial / Industrial ²	
Guideline Soil Type ³	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	Contamination depth Surface (<1m) / 1m-4m	
PID Headspace Reading (ppm)	0.4	0.3	0.5	0.5	0.4	0.4	0.4	1.5	1.5	1.0	1.60	1.50	2.10		
Observations	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, no odour	Brown, no odour	Brown, no odour	Brown, no odour	Brown, no odour	Brown, no odour	SAND	SANDY SILT
Total Petroleum Hydrocarbons (TPH)															
C ₇ -C ₉	< 8	< 8	< 9	< 9	< 8	< 8	< 8	< 8	< 9	< 10	< 9	< 8	< 8	120 / 120	500 / 500
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	1500 / 1900	1700 / 2200
C ₁₅ -C ₃₆	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40	NA / NA	NA / NA
Total hydrocarbons (C ₇ - C ₃₆)	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	< 70	-	-
BTEX Compounds															
Benzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.05	3.0 / 3.0	3.6 / 7.2
Toluene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.06	< 0.05	< 0.05	< 0.05	94 / 94	270 / 480
Ethylbenzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	180 / 300	200 / 300
Total Xylenes	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.18	< 0.15	< 0.15	< 0.15	150 / 150	200 / 420

Notes:
 All concentrations are in mg/kg dry weight
 1 Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999 Guidelines). Updated in 2011 with reference to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)
 2 Values taken from Table 4.17 of the MfE (1999) Guidelines.
 3 Conservative soil category chosen for comparison with MfE (1999) Guidelines Tier I acceptance criteria to best represent soils observed on site
 NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
bold - exceeds the MfE (1999) Guidelines Tier I (Route Specific) Soil Acceptance Criteria



Table 4-6a Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards. Southern Block Bund Samples

URS Location ID	GDQY 101	GDQY 102	GDQY 103	GDQY 104	GDQY 105	GDQY 106	GDQY 107	GDQY 108	GDQY 109	GDQY 110	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²
Laboratory Sample Reference	1062470.28	1062470.29	1062470.30	1062470.31	1062470.32	1063035.01	1063035.02	1063035.03	1063035.04	1063035.05			
Date Sampled	25/10/2012	25/10/2012	25/10/2012	25/10/2012	25/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012			
Sample Location	Bund 101	Bund 102	Bund 103	Bund 104	Bund 105	Bund 106	Bund 107	Bund 108	Bund 109	Bund 110			
GEO Reference	E1576443	E1576445	E1576447	E1576447	E1576449	E1576463	E1576481	E1576494	E1576521	E1576532			
	NS171605	NS171596	NS171583	NS171572	NS171562	NS171556	NS171554	NS171556	NS171562	NS171576			
Guideline Soil Type ³	SANDY SILT	SAND	SANDY SILT	SAND	SAND	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT			
PID Headspace Reading (ppm)	0.8	1.2	1.6	0.9	0.8	0.8	0.8	0.6	0.4	0.7			
Observations	Brown, No Odour, Roots, some gravel.	Brown, No Odour,	Brown, No Odour, Roots	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour			
Metals Trace													
Total Recoverable Arsenic (mg/kg dry wt)	4	4	3	4	3	3	4	4	6	3	70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	1,300	0.11	0.13
Total Recoverable Chromium (mg/kg dry wt)	12	13	12	12	11	14	15	14	16	14	>10,000	15.6	16.9
Total Recoverable Copper (mg/kg dry wt)	22	15	13	10	15	16	17	23	27	14	>10,000	11.5	12.4
Total Recoverable Lead (mg/kg dry wt)	134	44	18.5	15.3	22	38	34	68	115	42	3,300	18.8	21.3
Total Recoverable Nickel (mg/kg dry wt)	9	11	11	11	10	9	11	10	11	10	-	11.6	13.1
Total Recoverable Zinc (mg/kg dry wt)	102	51	47	42	48	67	74	94	118	73	-	62.4	69.6

URS Location ID	GDQY 111	GDQY 112	GDQY 113	GDQY 114	GDQY 115	GDQY 116	GDQY Bund A ^{DUF}	GDQY 117	GDQY 118	GDQY Bund B ^{DUF}	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)). ²
Laboratory Sample Reference	1063035.06	1063035.07	1063035.08	1063035.09	1063035.10	1063035.11	1063035.12	1063035.13	1063035.14	1063035.15			
Date Sampled	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012	26/10/2012			
Sample Location	Bund 111	Bund 112	Bund 113	Bund 114	Bund 115	Bund 116	Bund 116	Bund 117	Bund 118	Bund 118			
GEO Reference	E1576529	E1576528	E1576528	E1576528	E1576517	E1576504	E1576504	E1576481	E1576457	E1576457			
	NS171587	NS171597	NS171608	NS171624	NS171633	NS171633	NS171633	NS171629	NS171624	NS171624			
Guideline Soil Type ³	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT			
PID Headspace Reading (ppm)	0.7	0.7	0.5	0.4	0.3	0.5	0.5	0.4	0.4	0.4			
Observations	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour	Brown, No Odour Roots			
Metals Trace													
Total Recoverable Arsenic (mg/kg dry wt)	5	15	24	40	15	4	3	4	4	4	70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	0.12	0.11	< 0.10	0.11	< 0.10	< 0.10	< 0.10	< 0.10	1,300	0.11	0.13
Total Recoverable Chromium (mg/kg dry wt)	17	16	20	15	15	14	14	15	15	15	>10,000	15.6	16.9
Total Recoverable Copper (mg/kg dry wt)	20	17	20	16	24	17	15	18	17	17	>10,000	11.5	12.4
Total Recoverable Lead (mg/kg dry wt)	250	310	9300	320	460	330	184	117	88	69	3,300	18.8	21.3
Total Recoverable Nickel (mg/kg dry wt)	11	10	11	10	11	9	9	12	12	12	-	11.6	13.1
Total Recoverable Zinc (mg/kg dry wt)	142	105	129	89	91	93	78	141	86	76	-	62.4	69.6

Notes:

All concentrations are in mg/kg dry weight

¹ National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

² Environment Canterbury GIS resource. Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial 1



Table 4-6b Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards. Southern Block Bund Samples

URS Location ID	GDQY204	GSQY205	GDQY206	GDQY300	GSQY301	GDQY302	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer)) ²
Laboratory Sample Reference	1070365.5	1070365.6	1070365.7	1079511.1	1079511.2	1079511.3			
Date Sampled	15/11/2012	15/11/2012	15/11/2012	10/12/2012	10/12/2012	10/12/2012			
Sample Location	Bund 204	Bund 205	Bund 206	Bund 300	Bund 301	Bund 302			
GEO Reference	E1576528 N5171596	E1576529 N5171599	E1576528 N5171597	E1576527 N5171609	E1576527 N5171611	E1576528 N5171608			
Guideline Soil Type ³	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT			
PID Headspace Reading (ppm)	1.50		1.00	1.60	1.50	2.10			
Observations	Brown, no odour	Brown, No Odour	Brown, no odour	Brown, no odour	Brown, no odour	Brown, no odour			
Metals Trace									
Total Recoverable Arsenic (mg/kg dry wt)	17	14	19	15	8	18	70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	< 0.10	< 0.10	0.15	0.11	0.11	1,300	0.11	0.13
Total Recoverable Chromium (mg/kg dry wt)	21	16	21	19	22	14	>10,000	15.6	16.9
Total Recoverable Copper (mg/kg dry wt)	19	23	21	18	19	18	>10,000	11.5	12.4
Total Recoverable Lead (mg/kg dry wt)	490	550	530	4900	1280	2500	3,300	18.8	21.3
Total Recoverable Nickel (mg/kg dry wt)	9	10	10	10	8	8	-	11.6	13.1
Total Recoverable Zinc (mg/kg dry wt)	110	128	122	121	129	122	-	62.4	69.6

Notes:

All concentrations are in mg/kg dry weight

¹ National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

² Environment Canterbury GIS resource, Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial 1



Table 4-7 Godley Quay, Lyttelton. Soil Analytical Results TPH/BTEX compared to Tier 1 MFE Guidelines. Southern Block Surface Samples

URS Location ID	GDQY200	GDQY201	GDQY202	GDQY203	MfE (1999) Guidelines1 Tier I (Route Specific) Soil Acceptance Criteria
Laboratory Sample Reference	1070365.1	1070365.2	1070365.3	1070365.4	
Date Sampled	15/11/2012	15/11/2012	15/11/2012	15/11/2012	
Sample Location	SS200	SS201	SS202	SS203	
GEO Reference	E1576458	E1576482	E1576501	E1576513	
	N5171593	N5171594	N5171594	N5171596	All Pathways - Commercial / Industrial ²
Sample Depth (m below ground level)	0m-0.1m	0m-0.1m	0m-0.1m	0m-0.1m	
Guideline Soil Type ³	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT	Contamination depth Surface (<1m) / 1m-4m
PID Headspace Reading (ppm)	2.0	2.0	2.0	2.0	
Observations	Brown, gravel, no odour	Brown, gravel, no odour	Brown, no odour	Brown, no odour	SANDY SILT
Total Petroleum Hydrocarbons (TPH)					
C ₇ -C ₉	< 8	< 8	< 10	< 8	500 / 500
C ₁₀ -C ₁₄	< 20	< 20	< 20	< 20	1700 / 2200
C ₁₅ -C ₃₆	< 40	< 40	69	< 40	NA / NA
Total hydrocarbons (C ₇ - C ₃₆)	< 70	< 70	69	< 70	-
BTEX Compounds					
Benzene	< 0.05	< 0.05	< 0.06	< 0.05	3.6 / 7.2
Toluene	< 0.05	< 0.05	< 0.06	< 0.05	270 / 480
Ethylbenzene	< 0.05	< 0.05	< 0.06	< 0.05	200 / 300
Total Xylenes	< 0.15	< 0.15	< 0.17	< 0.15	200 / 420

Notes:

All concentrations are in mg/kg dry weight

1 Ministry for the Environment, 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999 Guidelines). Updated in 2011 with reference to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS)

2 Values taken from Table 4.17 of the MfE (1999) Guidelines.

3 Conservative soil category chosen for comparison with MfE (1999) Guidelines Tier 1 acceptance criteria to best represent soils observed on site

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the MfE (1999) Guidelines1 Tier I (Route Specific) Soil Acceptance Criteria



Table 4-8 Godley Quay Lyttelton Soil Analytical Results Metals compared to NES Commercial/Industrial Standards.
Southern Block Surface Samples

URS Location ID	GDQY200	GDQY201	GDQY202	GDQY203	National Environmental Standard for Contaminated Land (2012) Commercial Industrial ¹	Background Trace Elements Level 1 (maximum concentration values in each soil group) ²	Background Trace Elements Level 2 (maximum concentration values plus half the interquartile range (buffer). ²
Laboratory Sample Reference	1070365.1	1070365.2	1070365.3	1070365.4			
Date Sampled	15/11/2012	15/11/2012	15/11/2012	15/11/2012			
Sample Location	SS200	SS201	SS202	SS203			
GEO Reference	E1576458	E1576482	E1576501	E1576513			
	N5171593	N5171594	N5171594	N5171596			
Sample Depth (m below ground level)	0m-0.1m	0m-0.1m	0m-0.1m	0m-0.1m			
Guideline Soil Type ³	SANDY SILT	SANDY SILT	SANDY SILT	SANDY SILT			
PID Headspace Reading (ppm)	2.0	2.0	2.0	2.0			
Observations	Brown, gravel, no odour	Brown, gravel, no odour	Brown, no odour	Brown, no odour			
Metals Trace							
Total Recoverable Arsenic (mg/kg dry wt)	3	4	6	15	70	4.6	4.9
Total Recoverable Cadmium (mg/kg dry wt)	< 0.10	0.19	0.28	< 0.10	1,300	0.11	0.13
Total Recoverable Chromium (mg/kg dry wt)	13	16	17	14	>10,000	15.6	16.9
Total Recoverable Copper (mg/kg dry wt)	21	31	44	27	>10,000	11.5	12.4
Total Recoverable Lead (mg/kg dry wt)	60	149	1030	280	3,300	18.8	21.3
Total Recoverable Nickel (mg/kg dry wt)	10	14	12	12	-	11.6	13.1
Total Recoverable Zinc (mg/kg dry wt)	98	142	280	112	-	62.4	69.6

Notes:

All concentrations are in mg/kg dry weight

1 National Environmental Standard for Contaminants in Soil (2012) taken from table B2 in Appendix B 'Soil contaminant standards for health for inorganic substances (commercial/industrial)

2 Environment Canterbury GIS resource. Data version 12.10.2010 Accessed 06.10.2012

NA - indicates contaminant is not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

bold - exceeds the National Environmental Standard for Contaminated Land (2012) Commercial Industrial 1



Table 4-9 Duplicate Pair Relative Percentage Difference

URS Sample Reference	Duplicate Pair		RPD %	Duplicate Pair		RPD %	Duplicate Pair		RPD %	Duplicate Pair		RPD %	Duplicate Pair		RPD %			
	GDQY 9 1.0m	GDQY Pit A		GDQY 21 0.5m	GDQY Pit B		GDQY 31 1.0m	GDQY Pit C		GDQY 43 0.8m	GDQY Pit D		GDQY 116	GDQY Bund A		GDQY 118	GDQY Bund B	
Laboratory Sample Reference	1061982.10	1061982.33		1061982.21	1061982.34		1061982.32	1061982.35		1062470.11	1062470.27		1063035.11	1063035.12		1063035.14	1063035.15	
Date Sampled	24/10/2012	24/10/2012		24/10/2012	24/10/2012		24/10/2012	24/10/2012		25/10/2012	25/10/2012		26/10/2012	26/10/2012		26/10/2012	26/10/2012	
Total Petroleum Hydrocarbons (TPH)																		
C ₇ -C ₉	<10	<9	0.0	<9	<9	0.0	<11	<11	0.0	<9	<9	0.0	<9	<9	0.0	<8	<8	0.0
C ₁₀ -C ₁₄	<20	<20	0.0	<20	<20	0.0	<30	<30	0.0	<20	<20	0.0	<20	<20	0.0	<20	<20	0.0
C ₁₅ -C ₃₆	<40	<40	0.0	<40	<40	0.0	<50	<50	0.0	108	40	45.9	<40	<40	0.0	<40	<40	0.0
Total hydrocarbons (C ₇ - C ₃₆)	<70	<70	0.0	<70	<70	0.0	<80	<80	0.0	108	70	21.3	<70	<70	0.0	<70	<70	0.0
BTEX Compounds																		
Benzene	<0.06	<0.06	0.0	<0.05	<0.05	0.0	<0.07	<0.07	0.0	<0.05	<0.05	0.0	<0.05	<0.05	0.0	<0.05	<0.05	0.0
Toluene	<0.06	<0.06	0.0	<0.05	<0.05	0.0	<0.07	<0.07	0.0	<0.05	<0.05	0.0	<0.05	<0.05	0.0	<0.05	<0.05	0.0
Ethylbenzene	<0.06	<0.06	0.0	<0.05	<0.05	0.0	<0.07	<0.07	0.0	<0.05	<0.05	0.0	<0.05	<0.05	0.0	<0.05	<0.05	0.0
Total Xylenes	<0.17	<0.17	0.0	<0.15	<0.15	0.0	<0.20	<0.2	0.0	<0.15	<0.15	0.0	<0.15	<0.15	0.0	<0.15	<0.15	0.0
Metals Trace																		
Total Recoverable Arsenic (mg/kg dry wt)	6	4	20.0	3	2	20.0	6	8	-14.3	2	2	0.0	4	3	14.3	4	4	0.0
Total Recoverable Cadmium (mg/kg dry wt)	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.11	0.1	4.8	0.1	0.1	0.0
Total Recoverable Chromium (mg/kg dry wt)	18	16	5.9	14	14	0.0	22	24	-4.3	15	16	-3.2	14	14	0.0	15	15	0.0
Total Recoverable Copper (mg/kg dry wt)	6	5	9.1	9	10	-5.3	8	9	-5.9	23	25	-4.2	17	15	6.3	17	17	0.0
Total Recoverable Lead (mg/kg dry wt)	16.3	14.4	6.2	14	11.4	10.2	19.7	23	-7.7	9.2	28	-50.5	330	184	28.4	88	69	12.1
Total Recoverable Nickel (mg/kg dry wt)	12	11	4.3	10	11	-4.8	16	18	-5.9	24	25	-2.0	9	9	0.0	12	12	0.0
Total Recoverable Zinc (mg/kg dry wt)	55	51	3.8	44	47	-3.3	71	79	-5.3	60	70	-7.7	93	78	8.8	86	76	6.2

Notes: RPDs calculated using the laboratory detection limit

4 Results

4.6 Results Summary

4.6.1 Northern Block

4.6.1.1 *Petroleum Hydrocarbons*

All analytical results were within MfE (1999) Guidelines soil acceptance criteria for commercial/industrial land use.

Analytical results showed elevated levels of TPH (with respect to the method detection limit), particularly C₁₅ – C₃₆ range hydrocarbons, at depths of 0.5 m bgl across all three test pits. Deeper soil samples (1.3 m bgl) had TPH concentrations below or marginally above the method detection limit.

Analytical results for BTEX returned concentrations below the method detection limit for all samples.

4.6.1.2 *Metals*

All analytical results were within the NES SCS for commercial/industrial land use.

Metals analysis results for all elements were similar to Environment Canterbury regional background levels.

4.6.2 Southern Block

4.6.2.1 *Petroleum Hydrocarbons*

All analytical results were within MfE (1999) Guidelines soil acceptance criteria for commercial/industrial land use.

Analytical results for TPH within the Southern Block were below the method detection limit except for two sample locations with marginally elevated values (with respect to the method detection limit).

Analytical results for BTEX returned concentrations below the method detection limit for all samples.

4.6.2.2 *Metals*

All analytical results from the test pits and surface samples were within the NES SCS for commercial/industrial land use.

Analytical results from the bund were generally within the NES SCS for commercial/industrial land use except for two samples from the eastern bund which exceeded the NES value for Pb. Delineation sampling in the vicinity of these elevated samples found Pb concentrations below the NES; therefore it is likely that these samples are reflective of soil which is limited in extent. The average Pb concentrations for samples collected from the eastern bund is 1861 mg/kg (11 samples) and is below the NES SCS for commercial/industrial land use.

Metals in the soil samples collected from the test pits and the south and west bund walls were found to be similar to background levels. Pb and Zn concentrations in soil samples collected from surface samples and the north and east bund walls were generally elevated with respect to Environment Canterbury regional background levels.

5 Limitations

5

Limitations

All information in this Report is provided strictly in accordance with and subject to the following limitations and recommendations:

- a) This Report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by URS for use of any part of this Report in any other context.
- b) This conclusion is based solely on the information and findings contained in this Report.
- c) This conclusion is based solely on the scope of work agreed between URS and BP Oil New Zealand Limited and described in section 2 ("Scope of Works") of this Report.
- d) This Report has been prepared for the sole benefit of BP Oil New Zealand Limited and neither the whole nor any part of this Report may be used or relied upon by any party other than BP Oil New Zealand Limited.
- e) This Report is dated 10 January 2013 and is based on the conditions encountered during the site investigations conducted, and information reviewed, from 03 August 2012 to 10 January 2013. URS 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.
- f) 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.
- g) Where this Report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information except as expressly stated in the Report. URS assumes no liability for any inaccuracies in or omissions to that information.
- h) URS has tested only for those chemicals specifically referred to in this Report. URS makes no statement or representation as to the existence (or otherwise) of any other chemicals.
- i) Except as otherwise specifically stated in this Report, URS 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.
- j) No investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site.
- k) 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.
- l) 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.
- m) 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.
- n) Except as specifically stated above, URS 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.
- o) Use, development or re-development of the site for any purpose may require planning and other approvals and, in some cases, environmental regulatory authority and accredited site auditor

5 Limitations

approvals. URS 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.

- p) URS makes no determination or recommendation regarding a decision to provide or not to provide financing with respect to the site.
- q) 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.
- r) Except as required by law, no third party may use or rely on, this Report unless otherwise agreed by URS in writing. Where such agreement is provided, URS will provide a letter of reliance to the agreed third party in the form required by URS.
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- 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.



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15 October 2013

Lucy Brown
Project Manager
Christchurch City Council
PO Box 73016

Christchurch 8104

Dear Lucy

Lyttelton Recreation Ground Pavilion Vapour Monitoring

Summary of Results

AECOM New Zealand Limited (AECOM) was commissioned by Christchurch City Council (CCC) to conduct hydrocarbon vapour screening at the Lyttelton Recreation Ground Pavilion located at 54 Godley Quay (the Site).

The assessment was undertaken by a trained AECOM Environmental Scientist on Friday 6th September. The weather conditions at the time of the screening were clear sky with a light southerly wind.

The works incorporated vapour screening using the lower explosive limit (LEL) as a measure. The LEL measure is for volatile gases which incorporate hydrocarbon vapours including methane.

Screening was conducted at various points in the pavilion building and the immediately surrounding accessible services. The screening locations are presented on site plans as **Attachment 1**. A photographic log of screening locations is also included and is presented as **Attachment 2**.

The screening was conducted using a MultiRae Plus gas detector. The specification for the MultiRae Plus is presented as **Attachment 3**. The gas detector was calibrated prior to use. The MultiRae was continuously operating while the site inspection was conducted. A wand attached to the meter was used to retrieve screening data from low lying areas. For low lying screening distinct screening points, the wand was held in place for a minimum of 30 seconds.

During the screening event, no LEL was detected in any of the areas observed. The LEL reading shown on the MultiRae was 0.0 % at all times. No hydrocarbon vapours, including methane, were detected in either the pavilion building or the accessible services in the vicinity.

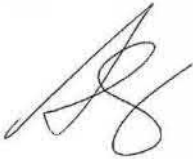
Limitations

AECOM has prepared this document for the sole use of Christchurch City Council and for a specific purpose, as expressly stated in our proposal dated 23 August 2013. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on Christchurch City Council description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by Christchurch City Council and other third parties to prepare this document, some of which may not have been verified by AECOM. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

From a technical perspective, the subsurface environment at any site may present substantial uncertainty. It is a heterogeneous, complex environment, in which small subsurface features or changes in geologic conditions can have substantial impacts on water, vapour and chemical movement.

AECOM's professional opinions are based on its professional judgement, experience, and training. These opinions are also based upon data derived from the testing and analysis described in this document. It is possible that additional testing and analysis might produce different results and/or different opinions. AECOM believes that its opinions are reasonably supported by the testing and analysis that have been conducted, and that those opinions have been developed according to the professional standard of care for the environmental consulting profession in this area at the date of this document. That standard of care may change and new methods and practices of exploration, testing, analysis and remediation may develop in the future, which might produce different results.

Yours sincerely



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Enclosed

Attachment 1: Site location and building plan

Attachment 2: Site photographs

Attachment 3: Instrumentation specifications



CHARLOTTE JANE QUAY

GODLEY QUAY

LYTTELTON RECREATION GROUND PAVILION



50 m
200 ft

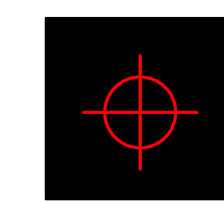
PROJECT ID: 60307004
PREPARED BY: PN
LAST DATE MODIFIED: 10/09/2013



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VAPOUR SCREENING LOCATIONS



NOT ACCESSIBLE (MANHOLE)

NOTE: ALL VAPOUR SCREENING LOCATIONS RETURNED NON-DETECT FOR METHANE, VOC, LEL, H₂S AND CO. OXYGEN LEVELS WERE STABLE IN ALL LOCATIONS.

LYTTELTON RECREATION GROUND PAVILION

0 50 100

APPROXIMATE SCALE (m)

54 GODLEY QUAY, LYTTELTON.

ATTACHMENT A

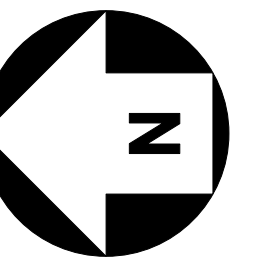


PHOTO 12

PHOTO 11

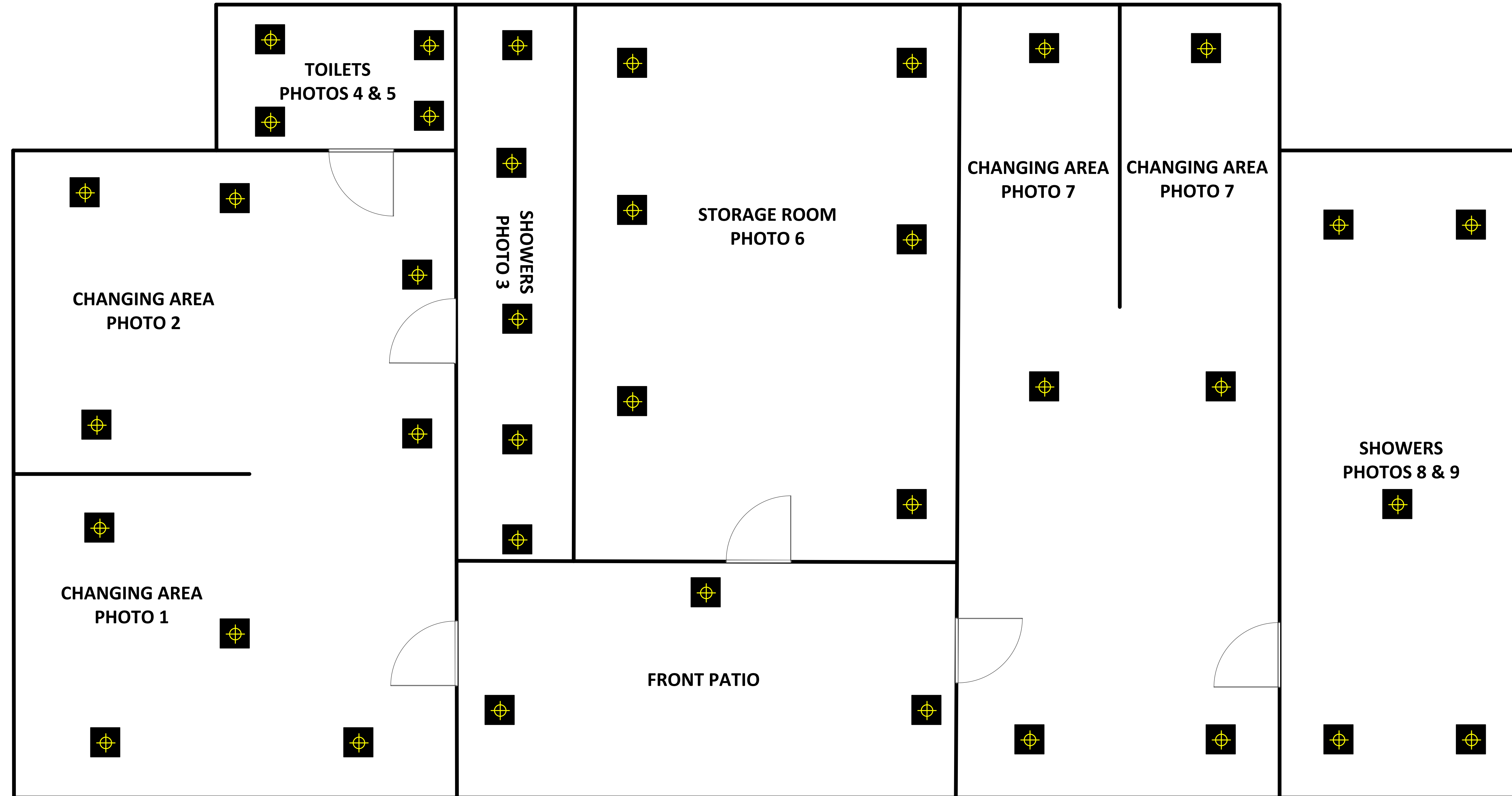


PHOTO 13

PHOTO 10

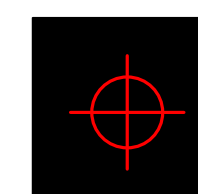
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PREPARED BY: PN
LAST DATE MODIFIED: 10/09/2013



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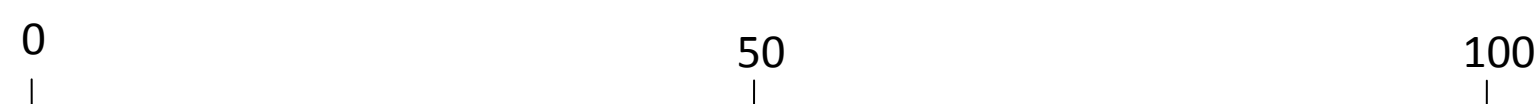
VAPOUR SCREENING LOCATIONS



NOT ACCESSIBLE (MANHOLE)

NOTE: VAPOUR SCREENING IN ALL ROOMS RETURNED NON-DETECT FOR METHANE, VOC, LEL, H₂S AND CO. OXYGEN LEVELS WERE STABLE IN ALL LOCATIONS.

LYTTELTON RECREATION GROUND PAVILION



APPROXIMATE SCALE (m)

54 GODLEY QUAY, LYTTELTON.

ATTACHMENT A

PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 1	Date: 10/09/13
------------------------------	--------------------------

Direction Photo Taken:
Looking North

Description:
Changing room



Photo No. 2	Date: 10/09/13
------------------------------	--------------------------

Direction Photo Taken:
Looking Northeast

Description:
Changing room



PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 3	Date: 10/09/13
Direction Photo Taken: Looking East	
Description: Shower room	



Photo No. 4	Date: 10/09/13
Direction Photo Taken: Looking South	
Description: Toilets	



PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 5	Date: 10/09/13
Direction Photo Taken: Looking North east	
Description: Bathroom	



Photo No. 6	Date: 10/09/13
Direction Photo Taken: Looking East	
Description: Store room	



PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 7	Date: 10/09/13
------------------------------	--------------------------

Direction Photo Taken:
Looking North

Description:
Southern changing room



Photo No. 8	Date: 10/09/13
------------------------------	--------------------------

Direction Photo Taken:
Looking Southeast

Description:
Southern shower block



PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 9	Date: 10/09/13
------------------------------	--------------------------

Direction Photo Taken:
Looking Southeast

Description:
Southern shower block



Photo No. 10	Date: 10/09/13
-------------------------------	--------------------------

Direction Photo Taken:
Looking Northwest

Description:
Man hole near north western corner of building



PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 11	Date: 10/09/13
-------------------------------	--------------------------

Direction Photo Taken:
Looking Northeast

Description:
Manhole near northeast corner of building



Photo No. 12	Date: 10/09/13
-------------------------------	--------------------------

Direction Photo Taken:
Looking South

Description:
Rear of building



PHOTOGRAPHIC LOG

Client Name: Christchurch City Council	Site Location: 54 Godley Quay, Lyttelton.	Project No. 60307004
---	--	-----------------------------

Photo No. 13	Date: 10/09/13
-------------------------------	--------------------------

Direction Photo Taken:
Looking North

Description:
Fire hydrants

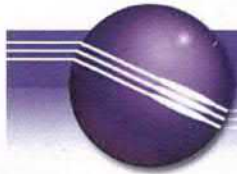


Photo No. 14	Date: 10/09/13
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Direction Photo Taken:
Looking South

Description:
Caretaker shed





MultiRAE Plus

One-to-Five Gas Monitor with VOC Detection

The **MultiRAE Plus** combines a PID (Photoionization Detector) with the standard four gases of a confined space monitor (O₂, LEL, and two toxic gas sensors) in one compact monitor with sampling pump. Like the Leatherman™ tool, the **MultiRAE Plus** gets the job done in more circumstances than any other gas detector. With more than 10,000 units in the field today, its versatility makes it the gas meter of choice for some of the highest profile HazMat/WMD teams in the United States. The **MultiRAE Plus** is quickly and easily changed from a sophisticated technician instrument to a simple text-only monitor. The same monitor can be used as a personal monitor, a hand-held sniffer or as a continuous-operation area monitor.

Key Features

- **O₂, LEL, PID and any two plug-in "smart" toxic sensors:** CO, H₂S, SO₂, NO, NO₂, Cl₂, HCN, NH₃, PH₂
- **0-2,000 ppm measurement of VOCs** (volatile organic compounds) with 0.1 ppm resolution
- **Measure more chemicals than with any other PID** With over 60 Correction Factors built into the **MultiRAE Plus** memory and the largest printed list of Correction Factors in the world (300+), RAE Systems offers the ability to accurately measure more ionizable chemicals than any other PID!
- **Drop-in Battery** When work schedules require putting in more than the 14 hours supplied by the advanced Lithium-ion (Li-ion) battery, the drop-in alkaline pack supplied with every **MultiRAE Plus** allows you to finish the job.

- **User friendly screens** make it easy to use for simple applications and flexible enough for sophisticated options.
- **Rugged Rubber Boot** assures that the **MultiRAE Plus** survives the bumps and knocks of tough field use
- **Strong, built-in sample pump** draws up to 100 feet (30m) horizontally or vertically. Large external filter and automatic low flowage
- **Large keys** are operable with 3 layers of gloves
- **Easy-to-read display** with backlight
- **Store up to 80 hours of data** at one minute interval for all 5 sensors for download to PC (with the optional datalogging)
- **Loud audible alarm** that varies for different alarm conditions and an optional external vibration alarm for noisy areas
- **Access sensors and battery in seconds** with the new, improved case

Applications

HazMat/Homeland Security

- Initial PPE (personal protective equipment) assessment
- Leak detection
- Perimeter establishment and maintenance
- Spill delineation
- Decontamination
- Remediation

Confined Space Entry

- Aviation/wing tank entry with jet fuel
- Shipyard and maritime confined spaces with diesel fuel
- Pulp and paper industry for confined space entry in turpentine environments

Environmental

- Soil and water headspace analysis
- Leaking underground storage tanks (LUST)
- Landfill monitoring

Industrial Hygiene, Plant Health & Safety

- Confined Space Entry
- Indoor Air Quality (IAQ)



ATEX



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Specifications*

Sensor Specifications

Sensor	Range	Resolution
Oxygen	0-30%	0.1%
Combustible Gas	0-100% LEL	1% LEL
VOCs	0-200 ppm	0.1 ppm
	200-2000 ppm	1 ppm
Carbon Monoxide	0-500 ppm	1 ppm
Hydrogen Sulfide	0-100 ppm	1 ppm
Sulfur Dioxide	0-20 ppm	0.1 ppm
Nitric Oxide	0-250 ppm	1 ppm
Nitrogen Dioxide	0-20 ppm	0.1 ppm
Chlorine	0-10 ppm	0.1 ppm
Hydrogen Cyanide	0-100 ppm	1 ppm
Ammonia	0-50 ppm	1 ppm
Phosphine	0-5 ppm	0.1 ppm

Detector Specifications

Size	4.65"L x 3.0"W x 1.9"H (11.8 x 7.6 x 4.8 cm)
Weight	16 oz. with battery (454g)
Sensors	Up to 5 sensors including: <ul style="list-style-type: none"> • Photoionization detector for VOCs, 10.6 eV lamp standard • Protected catalytic bead for combustible gases • Interchangeable electrochemical sensors for oxygen and toxic gases (2)
Battery	<ul style="list-style-type: none"> • Interchangeable Li-ion and alkaline battery packs • Rechargeable units include Lithium-ion battery pack with internal smart charging, 120V AC/DC wall adapter, and spare alkaline battery pack
Operating Hours	<ul style="list-style-type: none"> • 14 hours continuous with Li-ion (typical) • Unit will run and charge simultaneously
Display	2 line, 16 digit LCD with LED backlighting automatically in dim light or alarm condition
Keypads	1 operation and 2 programming keys
Direct Readout	Instantaneous values (up to 5): <ul style="list-style-type: none"> • Oxygen as percentage by volume • Combustible gas as percentage of lower explosive level (LEL) • Toxic gases and VOCs as parts per million by volume (VOC scaleable using correction factors) • High and low values for all gases • STEL and TWA values of toxic gases and VOCs • Battery and shut down voltage • Date, time, elapsed time, temperature
Alarms	90 dB buzzer and flashing red LED to indicate exceeded preset limits: <ul style="list-style-type: none"> • High: 3 beeps and flashes per second • Low: 2 beeps and flashes per second • STEL and TWA: 1 beep and flash per second • Automatic reset or latching with manual override • Additional diagnostic alarms and display messages for low battery and pump stall
EM/RFI	Highly resistant to EMI/RFI. Compliant with EMC Directive 89/336/EEC
IP Rating	IP-55: protected against dust, protected against low pressure jets of water from all directions
Datalogging & Communication	Optional 80 hours, 5 channels at one minute intervals download to PC with serial number of unit, user ID, site number, and calibration date
Calibration	Two-point field calibration for zero span gas
Sampling Pump	Internal two-speed pump. Flow rates: <ul style="list-style-type: none"> • Low: ~150 cc/min • High: ~250 cc/min
Low Flow Alarm	Auto shut-off pump at low flow condition

Detector Specifications (continued)

Hazardous Area Approval	<ul style="list-style-type: none"> • US and Canada: UL, cUL, Classified as Intrinsically Safe for use in Class I, Division I Groups A, B, C, D, T3C • Europe: ATEX II 2G EEx ia d IIC T3 & T4
Temperature	-4° to 113 °F (-20 to 45°C)
Humidity	0% to 95% relative humidity (non-condensing)
Attachment	Durable yellow boot with belt clip and wrist strap; Shoulder strap; optional tripod/wall mounting bracket
Warranty	Lifetime on non-consuming components (per RAE Systems Standard Warranty), 2 years for O ₂ , LEL, CO, and H ₂ S sensors, 1 year all other sensors, 1 year pump, 1 year battery, 1 year for 10.6eV PID lamp

*Ongoing projects to enhance our products means that these specifications are subject to change

MultiRAE Plus Accessories

Monitor only includes:

- Sensors as specified
- Calibration adapter
- Training CDROM
- Operation and maintenance manual
- Rubber boot with belt clip
- Alkaline battery adapter
- Rechargeable units additionally include:
 - Standard Lithium-ion (Li-ion), optional extended duration Lithium-ion battery, or ATEX-certified charger and barrier kit
 - 120/230 V AC/DC Wall Adapter (if specified)
- 3 external filters
- 3-inch inlet probe

Monitor with accessories kit also includes:

- Hard transport case with pre-cut foam
- Sampling wand with 15 feet (5m) of self-coiling Teflon® tubing
- Tool Kit

Black boot is available for tactical operations (part number 027-3042-000)

Optional calibration kit also includes:

- Four-gas mix in a 34L cylinder; (50% LEL, 20.9% O₂, 25 ppm Hydrogen Sulfide, 50 ppm Carbon Monoxide)
- 100 ppm Isobutylene in 34L cylinder
- Calibration regulator(s) and tubing

Datalogging Monitors also include:

- Software ProRAE Suite Package for Windows 98, NT, 2000 and XP
- Computer interface cable

Optional Guaranteed Cost of Ownership Program:

- 4-year repair and replacement guarantee
- Annual maintenance and servicing

DISTRIBUTED BY:



Spilled fuel escapes into Lyttelton harbour

NICOLE MATHEWSON



Photo by Iain McGregor

DAMAGED: A slip has damaged a fuel tank at Lyttelton.

Firefighters are still pumping leaked jet fuel off the ground in Lyttelton, but about 1500 litres has already leaked into the harbour.

The Mobil jet fuel tank, containing 1.2 million litres of fuel, was severely damaged from a landslide next to the Lyttelton terminal about 2pm on Wednesday following heavy rainfall.

The leak was contained yesterday and a Fire Service spokesman said firefighters were working with Mobil to continue pumping spilled fuel into other tanks at the terminal today.

They hoped to complete the work today, he said.

Brittan Tce - the main link between Lyttelton and Governors Bay - remained closed, but Cressy Tce was open as a detour for light vehicles. A detour was also available via State Highway 75 and Gebbies Pass.

Eleven of the 19 households evacuated following the slip were still not allowed to go back to their homes on Cressy, Brittan and Park terraces last night.

An Environment Canterbury (ECan) spokeswoman said the stormwater system near the damaged fuel tanks had been sealed yesterday.

About 40,000 litres of jet fuel was removed from the stormwater system near the tank, but a small amount of fuel was still getting in.

A boom had been placed in Lyttelton Harbour around the stormwater outlet to capture any more jet fuel that spilled into the sea. It would then be removed with special equipment.

"Small amounts of a rainbow-coloured sheen of kerosene were observed in several locations which indicates that while kerosene is present, [it is] very thin and is dispersing naturally," the spokeswoman said.

ECan's marine oil spill team carried out a second on-water assessment yesterday afternoon focused on Quail Island, finding no signs of jet fuel near the island.

An earlier assessment from the water and the air found no sign of birds in distress, she said.

"The situation is continuing to be monitored and a full reassessment will be conducted [this morning]."

Mobil said its priority was to prevent any further release of fuel into the water.

"We apologise for any disruption or inconvenience that this is causing. Our concern continues to be the safety of our employees, contractors and the community," the company said in a statement.

An inspection of the Woolston pipeline yesterday found it did not suffer any damage in the storm and it was turned back on about 3pm.

Mobil has a community information line for any residents with questions or concerns, 0800 777 979.

- The Press

Lyttelton fuel spill cleanup continues

NICOLE MATHEWSON



Photo by Dean Kozanic

JET FUEL: Most of the aviation fuel that leaked from a punctured tank at Lyttelton Port, has been contained, but 1500 litres has flowed into the harbour.

The smell of fuel still lingers over parts of Lyttelton after a landslide damaged a jet-fuel tank, spilling at least 1500 litres into the harbour.

The Mobil-owned tank was damaged on Wednesday afternoon when heavy rain caused a slip above the terminal.

Mobil spokeswoman Krystal Guppy said about 85 per cent of the fuel that spilled into a concrete-walled containment area around the damaged tank had been pumped into another tank on site.

It was not known how long the cleanup would take but response teams had been working "around the clock".

"The rate at which we can pump out the remaining fuel will become slower as the layer of jet fuel within the containment area becomes thinner," she said.

The company was grateful for the assistance of emergency services and local authorities.

Nineteen households nearby were evacuated due to fumes but all were allowed to return to their homes by Friday night and Mobil was now "developing actions" to minimise the smell as the cleanup continued. Extra containment measures in stormwater drains had also prevented any more fuel from entering the harbour, the company said.

However, an Environment Canterbury (ECan) spokeswoman said any rain over the next few days could flush any remaining fuel in the stormwater system into the harbour.

ECan's marine oil spill team had been undertaking regular assessments from the air and water. There had been no signs of distressed wildlife and it appeared the spilled fuel had dispersed naturally, the spokeswoman said.

Anyone concerned about the fuel spill can call Mobil's community hotline on 0800 777 979.

- The Press

Mobil in port oil spill inquiry

SHELLEY ROBINSON



Photo by Dean Kozanic / Fairfax NZ

RESPONSE QUESTIONS: The site of the Lyttelton Harbour fuel spill last month.



Photo Supplied

QUICK FIX: Lyttelton tank farm workers cut make-shift bungs from branches to shove into holes in Mobil secondary containment wall, or bund, to stop the flow of jet fuel to the harbour. One of the five holes can be seen in the background under the pipes.



Photo Supplied

LEAKING: Steadily flowing leaks from repairs in Mobil's secondary containment wall, or bund, pool on the ground. A Mobil worker told the ECan harbour master they were earthquake repair patches.

Mobil's response to a Lyttelton Harbour fuel spill is being investigated as the regional council's harbour master voices concerns about how the oil giant reacted.

A landslide hit two of Mobil's tanks in Lyttelton during a storm on March 5, rupturing a tank with 1.2 million litres of jet fuel. Another tank with 91 octane petrol was dented but did not rupture.

Mobil's bund, or secondary containment backup, built for such incidents, should have held all 1.2 million litres after the rupture, but it failed and jet fuel spilled into nearby drains and the harbour.

The stench of fuel forced 19 homes to be evacuated and left 10 house boats inaccessible for more than four days.

A Press investigation into the oil spill found:

Fuel leaked into Lyttelton Harbour because there was no way to close up five holes in the bund.

The holes have since been concreted over. Workers at the site tried to make-shift bungs or corks to put in the holes using bits of tree branches brought down during the weather.

Photos and emails released under the Official Information Act show earthquake-repair work on parts of the bund. Fuel escaped through gaps in these repairs.

Environment Canterbury (ECan) and Worksafe New Zealand are investigating.

ECan on-scene commander for marine response and harbour master Jim Dilley told The Press he saw the fuel escaping from the gaps in the bund that had been repaired.

A Mobil official told him they were earthquake repair patch jobs, he said.

Dilley arrived on site about 4pm, more than two hours after the landslide. He said he watched men with a saw making makeshift bungs from trees.

"The chaps there had taken some of the trees which had broken in the storm, the branches, and were shaping them with tapered ends into make-shift bungs and started banging them in."

The bund had holes and there was no mechanism to close them, Dilley said. "I am surprised in a facility that is meant to keep liquid in, that there were these holes and no way of closing them."

Mobil did not answer questions from The Press on what the purpose of the holes were and why there was no way of closing them.

Dilley said he was taken around the bund by a Mobil official and noticed some fuel flowing out of the earthquake patch jobs.

The leaks were on the opposite side of the landslide more than 100 metres away. They were few and the incident was containable, he said.

There was no fuel in the harbour at that stage but he advised Mobil to block the drain next door to the bund with sandbags and clay.

Dilley then sent an email to several parties, including ECan chief executive Bill Bayfield, Maritime New Zealand, and Lyttelton Port Company boss Peter Davie.

He told them the bund "is holding" and if the other tank of 91 octane started leaking "there was remaining capacity in the bund" for it.

Within hours the situation had changed, Dilley said.

"I was called back 3am in the morning, four hours after I left, went down to the site again and a larger number of leaks were evident - they were everywhere in the bund wall.

"Jet fuel was actually evident on the surface of the land and this was in a flowing state like small rivers . . . rivers of jet fuel moving away from the bund."

There was evidence of fuel in the harbour. The ECan team worked to stop the flow of fuel and water from the stormwater outlet into the harbour.

Another source, who was on site, told The Press ECan was forced to take over the land response.

ECan would usually only be responsible for the marine response.

The source said: "We [responders] were strongly suggesting courses of action to [Mobil] and when they weren't following up . . . ECan did them.

"That included blocking the drains, setting up collection points, pumping the gas from the bund, organising sucker trucks, making clay bunds to stop the flow from the bund, pumping that gas back into the bund and setting up collection tanks and pumping the fuel into those collection tanks," the source said.

Dilley said the ECan team was focused on stopping more fuel entering the harbour.

Mobil told The Press it responded quickly.

"The response required considerable resources with additional people and specialist expertise obtained from other Mobil facilities . . ."

Dilley said other tank farm operators from NZ Oil Services Ltd helped at the site.

They, not Mobil, provided a tank to hold the fuel being pumped from outside and inside the bund, he said.

After 36 hours, the ECan team began handing the reins over to Mobil officials.

- The Press

Mobil not punished for jet fuel spill

NICOLE MATHEWSON



Photo by John Kirk-Anderson

FLOODED: Fuel tanks at Lyttelton, Brittan Terrace top right.



Photo by Iain McGregor

DAMAGED: A slip has damaged a fuel tank at Lyttelton.

Mobil will not be prosecuted after a landslide caused 1.2 million litres of jet fuel to spill from a tank in Lyttelton.

The landslide happened during a major storm on March 5, damaging two fuel tanks at Mobil Oil New Zealand's tank farm at Naval Point in Lyttelton.

About 1500 litres of fuel went into Lyttelton Harbour through a drainage system before sandbags were put in place.

Environment Canterbury (ECan) announced today that it would not prosecute Mobil over the spill. Chief executive Bill Bayfield said a prosecution for discharge of contaminants into the harbour had little chance of success, so it was not in the public interest to pursue it.

"A unique series of events came together that stormy day. It was difficult for the company to have predicted or prevented the incident, and under the Resource Management Act it would have had a statutory defence of 'natural disaster'."

Canterbury's earthquakes, the March storm, tunnel gully erosion, the proximity of the tank farm to a steep hill and other factors all contributed to the landslip that triggered the spill, he said.

"Proof of negligence would be required for a successful prosecution. Because there was no such evidence, Environment Canterbury decided not to proceed on this occasion."

Bayfield said ECan had reviewed the decision thoroughly and he was confident the regional council had "reached the right conclusion".

"It is quite plausible that this situation was beyond Mobil's control and is highly unlikely to happen again."

ECan completed a number of environmental assessments since the spill and found no effect on wildlife or any indication of residual contamination on the seabed.

The response cost ECan almost \$160,000, but Mobil had since paid back the full amount "so there is no financial cost to the ratepayer", Bayfield said.

Mobil country manager Andrew McNaught said the company responded quickly to the unprecedented event and had fully cooperated with ECan since.

"Mobil's priority at all times was to ensure the safety of our people, responding agencies, the local community and the environment. I am very pleased that no-one was hurt by the landslide or in the subsequent response and clean-up."

Mobil's terminal in Lyttelton had not been in operation since the landslide and all bulk fuel had been removed from the storage tanks.

Mobil spokeswoman Samantha Potts said the company had no intention of putting the Naval Point tanks back into service.

"In fact we're in talks with Lyttelton Port about finding somewhere else for [new] tanks," she said.

The company's own investigation found the landslide resulted from flooding during the severe storm, impacting on the cliff which had already been weakened by earthquake damage.

Recovery of the spilled fuel had been complicated by heavy rainfall and debris on the site, and 1500 litres of fuel was able to escape into the harbour through drainage holes in an access ramp.

McNaught said the fuel should not have been able to leak through the drainage points and the investigation had identified issues in the construction of the ramp itself.

- The Press

APPENDIX 5
Site Photographs



Photo 1: Sports field and pavillion



Photo 2: Tarp covered stockpiles



Date taken	22/01/15	Client	Christchurch City Council		
Taken by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	Site Photographs		
Scale	N/A	Photo No.	1 to 2	Project Number	11539.000.001_1



Photo 3: Unsealed area in the southern portion of the site



Photo 4: Old treated timber poles at the sports field



Photo 5: Old treated timber poles at the boat storage area



Photo 6: Old treated timber poles near to the marina



Date taken	22/01/15	Client	Christchurch City Council		
Taken by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	Site Photographs		
Scale	N/A	Photo No.	3 to 6	Project Number	11539.000.001_1



Photo 7: Campfire at the Sea Scouts



Photo 8: Oil staining in boat maintenance area



Photo 9: Underground fuel tank at the Coast Guard building



Photo 10: Groundwater monitoring well



Photo 11: Groundwater monitoring well



Photo 12: Groundwater monitoring well



Date taken	22/01/15	Client	Christchurch City Council		
Taken by	CM	Project	Naval Point Recreational Reserve		
Approved by	DR	Description	Site Photographs		
Scale	N/A	Photo No.	7 to 12	Project Number	11539.000.001_1