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Pacific Brands Limited

Report for 190 Dunmore Street Wentworthville NSW

Phase 2 Environmental Site Assessment

May 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Introduction

GHD Pty Ltd (GHD) was commissioned by Pacific Brands Limited (Pacific Brands) to undertake a Phase 2 Environmental Site Assessment (ESA) at 190 Dunmore Street, Wentworthville, NSW (heir in referred to as the site). It is understood that the site is proposed for residential redevelopment, which will be subject to a Site Audit.

GHD completed a Phase 1 Contamination Assessment in 2009 (GHD 2009) which identified a number of potential sources of contamination at the site, mainly associated with historic filling and site infrastructure (e.g. transformers, former underground fuel storage tanks, former boiler house). Results from the limited sampling program undertaken by GHD in 2009 did not identify widespread, gross contamination of soil or groundwater at the site. However, it was noted that the sampling pattern and density for the Phase 1 assessment did not comply with the EPA minimum sampling requirements.

The Phase 2 ESA was designed to augment information collected as part of the Phase 1 investigation in order to comply with NSW Environment Protection Authority (EPA) minimum sampling densities and reduce the uncertainty associated with identified site contamination. This report presents the findings of the Phase 2 assessment and incorporates data obtained from the 2009 investigation.

This Executive Summary is subject to, and must be read in conjunction with, the limitations set out in Section 10 of this report and the assumptions and qualifications contained throughout this report.

Objective

The objective of the Phase 2 ESA was to provide further information regarding the contamination status of the site to assist in preliminary planning of potential redevelopment options, while acknowledging that the full extent of contamination will only be known following demolition of existing site structures and further detailed investigations where required.

The ESA relates specifically to soil and groundwater conditions and does not include built infrastructure (above and below ground).

Scope of Work

The scope of work undertaken by GHD included the following:

- Soil sampling at 63 locations (34 test pits and 29 hand auger locations) in addition to the 20 sample locations undertaken in the 2009 investigation (83 soil sample locations in total for inclusion in this report).
- Installation of four groundwater monitoring wells in addition to the five monitoring wells installed in 2009 (nine monitoring wells in total). Surveying and sampling of all monitoring wells; and
- Collation, analysis and assessment of sampling results and preparation of this report.

Summary of Key Findings

- Fragments of asbestos cement (AC) were identified in fill material (mostly reworked natural clay and rock) along the eastern portion of the site.

- Rubble including brick material and AC fragments was identified in fill material within the central staff car park. This is understood to be waste material from demolition of the old boiler house and was used to fill a depression (former creek) in this area. Analytical results were generally below adopted criteria in the fill material. The geotechnical characteristics of the fill material and the management of identified AC fragments will require consideration prior to site development.
- A horizon of black impacted soil and ash approximately 800 mm thick was identified in the south western corner of the site (TP9) and is believed to be waste material from the former incinerator at this location. The area of this impacted soil was approximately 10 x 10 m. Analytical results were below the adopted criteria however this may represent an aesthetic issue.
- Soil Analytical Results
  - Metals concentrations (mainly arsenic, manganese, nickel and zinc) were reported above Ecological Investigation Levels (EILs) across the site. These were generally below Health Investigation Levels (HILs) for a residential setting and are believed to be mostly indicative of natural background concentrations in the clay and weathered rock or associated with crushed rock (road base or sub-slab).
  - Elevated metals concentrations identified at WS6 (arsenic, copper and zinc) and TP6 (manganese and cobalt) may be associated with anthropogenic sources (light industrial activity, historic filling) but do not appear to be laterally or vertically extensive.
  - A concentration of 7 mg/kg for Arochlor 1254 was reported in one sample, WS6/0-0.1, possibly attributable to an historic surface spill of oil containing Polychlorinated Biphenyls (PCBs) associated with transformers adjacent to this sample location. While this concentration was limited to the surface soil at this location and below the adopted criteria, further delineation of PCB concentrations in near surface soils may be required prior to re-development of this part of the site subject to the requirements of the site auditor.
  - All other organic compounds tested were below the laboratory limit of reporting (LOR) for all samples analysed.
  - Based on the analytical results, the soil at the site would generally be classified "General Soil Waste" for off-site disposal in accordance with NSW EPA Waste Classification Guidelines. The natural bedrock and weathered clay at the site may be suitable for classification as "Virgin excavated natural material". This is a preliminary classification only and depending on the location of proposed excavation and volumes, further classification sampling is likely to be required to satisfy landfill and NSW EPA requirements. Further sampling at the site may reveal the presence of material classified as either Restricted Solid Waste or Hazardous Waste.
- Groundwater analytical results
  - The groundwater quality in the shale aquifer beneath the site is moderately saline with limited beneficial uses. Fresher groundwater was identified in monitoring wells targeting the perched water system within the fill beneath the central car park area. This is considered perched water of limited beneficial use and not representative of a regional aquifer resource.
  - Concentrations of heavy metals above the adopted ecosystem protection criteria (cadmium, copper, manganese, nickel, selenium and zinc) were reported in groundwater across the site and are mostly attributable to naturally elevated background concentrations. Some elevated concentrations of metals in the perched water within the central car park area may be attributable to historic filling in this area (rubble and reworked natural material). This is not considered a

significant issue as concentrations are likely to decrease considerably prior to discharge to the nearest receiving water body due to natural attenuation along the flow path.

- Trichlorethylene (TCE) and vinyl chloride (VC) were reported above the laboratory LOR in monitoring well GW1 suggesting that chlorinated solvents may have been deposited in the fill material in the central car park area. While this contamination appears to be generally localised, further assessment is likely to be required as part of any future redevelopment in order to quantify the potential human health risk that it may pose, and to determine appropriate site management or remediation response if warranted.
- With the exception of some minor TPH concentrations at GW1, all other organic compounds tested were below laboratory LOR for all samples analysed.

Conclusions

The investigation results indicated that the site is not subject to gross, widespread contamination. There are localised areas where elevated concentrations of contaminants and/or AC fragments have been identified. These areas may require further vertical and lateral delineation once site infrastructure has been removed.

Overall, the results of soil and groundwater sampling indicated that contaminant concentrations were generally within acceptable limits for a residential setting, with the exception of some areas that are likely to require further investigations subject to the opinion of the appointed site auditor.

In particular, the following items may require further consideration prior to or during re-development

- Management or removal of AC fragments in fill material along the eastern portion of the site and within the central car park area;
- Further assessment of PCBs in surface soils in the vicinity of former transformer stations, such as identified at WS6;
- Elevated metals concentrations at WS6 (arsenic, copper and zinc) and TP6 (manganese and cobalt) may require further delineation depending on the development plan at these locations;
- Management or removal of any near surface soils containing elevated heavy metals concentrations including crushed rock and road/slab base material;
- Management or removal of any material that may represent an aesthetic issue for site redevelopment, such as the black impacted soil and ash identified at test pit TP9 or the fill material within the central car park (rubble from demolition of old boiler house); and
- Further assessment of the chlorinated hydrocarbon contamination in groundwater identified at monitoring well GW1.

The management and disposal cost of waste soils should be taken into consideration for site re-development. Based on the results of this assessment the soil / fill material at the site would generally be classified "General Solid Waste", "Special Waste – Asbestos Waste" or "Virgin excavated natural material" depending on where the excavation occurs. This preliminary classification is subject to further testing of the waste material to satisfy NSW EPA and landfill requirements, and during this process there is the potential for other classifications of materials to be identified.

Some areas of the site were not accessible for sampling (portions of Building 1 and 3, administrative offices). While contamination in these areas is not expected (based on site history information and field

observations), there is the potential for contamination to be identified in these areas following demolition of these structures.

This report should be read in full and no excerpts are taken to be representative of the findings of this Report.

1. Introduction and Objectives

1.1 Introduction

GHD Pty Ltd (GHD) was commissioned by Pacific Brands to undertake a Phase 2 Environmental Site Assessment (ESA) at 190 Dunmore Street, Wentworthville, NSW (heir in referred to as the site). The site location is shown on Figure 1.

The site is approximately 8 ha and has been used for industrial purposes including textiles manufacturing since the 1920s. A dye works was located on the site since the 1980s. The site is currently occupied by warehouses, disused industrial buildings, administration buildings and car parks.

It is understood that the site is proposed for residential redevelopment, which will be subject to an environmental audit.

A previous environmental investigation was undertaken by GHD on the site in 2009[1] and included a Phase 1 contamination assessment with limited soil and groundwater sampling. The Phase 1 assessment identified a number of potential sources of contamination at the site, mainly associated with historic filling at the site and site infrastructure (e.g. transformers, former underground fuel storage tanks, former boiler house). Results from the limited sampling program undertaken by GHD in 2009 did not identify widespread, gross contamination of soil or groundwater at the site. However, it was noted that the sampling pattern and density for this preliminary study did not comply with the EPA minimum sampling requirements.

The Phase 2 assessment was designed to augment information collected as part of the Phase 1 study in order to comply with NSW Environment Protection Authority[2] (EPA) minimum sampling densities and significantly reduce the uncertainty associated with identified site contamination.

1.2 Objective

The objective of the Phase 2 ESA was to provide further information regarding the contamination status of the site to assist in the planning of potential redevelopment options, while acknowledging that the full extent of contamination will only be known following demolition of existing site structures and further detailed investigations where required.

The ESA relates specifically to soil and groundwater conditions and does not include built infrastructure (above and below ground).

1.3 Scope of Work

The scope of work undertaken by GHD included the following:

- Preliminaries - review previous reports, organising sub-contractors, preparation of health safety and environmental management plan, preparation of a sampling and analysis plan;
- Utility clearance of all intrusive (soil and groundwater) investigation locations;

[1] GHD (June 2009), *Report for 190 Dunmore Street, Wentworthville, NSW - Contamination Assessment*, prepared for Pacific Brands

[2] In regulatory matters for environment protection, the NSW Office of Environment and Heritage (OEH) acts under the powers of the statutory Environment Protection Authority (EPA).

- Concrete coring of hand auger locations within building footprints;
- Soil sampling at 63 locations (34 test pits and 29 hand auger locations) in addition to the 20 sample locations undertaken in the 2009 investigation (83 soil sample locations in total for inclusion in this report).
- Installation of four groundwater monitoring wells in addition to the five monitoring wells installed in 2009 (nine monitoring wells in total). Surveying and sampling of all monitoring wells; and
- Collation, analysis and assessment of sampling results and preparation of this Phase 2 ESA report.

2. Site Information

2.1 Site Location

The site location is shown on Figure 1. Further details are provided in Table 1.

Table 1 Site Location Summary

Street Address	190 Dunmore Street, Wentworthville, NSW
Title Identifier	Lot 1 – DP735207
Local Government Area	Holroyd City Council
Current Land use	Light Industrial
Surrounding Land Use	Residential

2.2 Site Layout

The current layout of the site is shown on Figure 1. The main features are summarised below:

- Administrative buildings (Office A, Office B and Office C) which are currently in use;
- Building 1 which is mostly occupied by disused former textiles manufacturing areas. The south western portion is currently used for warehousing;
- Building Group 2 which is mostly occupied by disused former textiles manufacturing and storage areas;
- Building 3 which is currently used for clothing retail (north- eastern portion), police uniform storage (south-eastern portion) and printing (north western portion). The former textiles manufacturing area in the south-western portion of the building is currently not used; and
- Sealed car parking facilities that cover much of the outdoor areas with parking for approximately 360 passenger vehicles.

2.3 Site Characterisation

Details of physical site characteristics are provided in Table 2.

Table 2 Site Characteristics

Site Area	The site occupies an area of approximately 8 hectares (ha). Buildings cover approximately 60% (4.75 ha) of the site.
Topography	The site generally slopes from the west to the east. The site slopes from a high point on the western boundary to a low point below a large fill bank on the eastern boundary. Development of the site has involved a 'cut and fill' to level the site beneath the buildings. The cut is pronounced at the western end of Building 1 with a 10 to 15 metre excavation wall. The eastern fill embankment is approximately 8-10 m high in the south eastern corner of the site. The elevation of the site ranges from approximately 66.5 mAHD in the south-west corner to 54 mAHD in the north-east corner with the low point of the site at the base of the south eastern embankment (approximately 45 mAHD).
Surface Cover	The site is predominately sealed and covered by bitumen, concrete and large manufacturing and retail buildings with some landscaped and grassed areas along the western, southern and eastern boundaries.
Geology	The *1:100,000 Penrith (9030), Geological Series Sheet*[3] identified the underlying geology at the site and immediate surrounds as Ashfield Shale comprising dark grey to black claystone – siltstone and fine sandstone – siltstone laminate. This was confirmed by drilling on-site which encountered natural clay (weathered rock) and shale bedrock across the site. Across the centre of the site where the previous slope had been cut as part of site levelling, shale rock was encountered at less than 1 m below the ground surface. The south-western portion of Building 1 was found to be slab on rock (refer Figure 2).
Hydrogeology	The NSW Assessment of Pollution Risk Map 1:2,000,000[4] indicates that groundwater in the vicinity of the site is typically saline with a TDS over 14 000 mg/L and "*would be considered unsuitable for domestic, irrigation and / or stock uses*". The map indicates that the site is likely to be underlain by shale and siltstone sedimentary formations and that the potential for groundwater movement is low. A search of Natural Resource Atlas (Department of Planning) records in May 2009, did not identify any existing groundwater wells located within an approximate one-kilometre radius of the site.
Soil	The *1:100,000 Penrith (9030) Soil Landscape Series Sheet*[5] identified the underlying soils at the site as Blacktown type, comprising shallow to moderately deep hard setting mottled red brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and drainage lines. This was confirmed by site investigations, which identified varying depths of fill overlying firm to stiff red brown and grey mottled firm to stiff residual clay with shale and ironstone inclusions.

[3] Department of Minerals and Energy, Geological Survey of NSW, 1991.

[4] Department of Water Resources, NSW (1987)

[5] Soil Conservation Service of NSW, 1991.

Surface Water	The majority of surface run-off on the site would run across sealed surfaces into the internal stormwater collection system and concrete stormwater detention basin located in the south east corner of the site. The closest water body to the site is Coopers Creek, which is located approximately 750 east of the site. Coopers Creek is a tributary of Toongabbie Creek and the Parramatta River.

3. Summary of Phase 1 Assessment

A preliminary Contamination Assessment was undertaken by GHD in 2009[6]. A summary of the key findings from the Phase 1 Assessment is provided below.

3.1 Site History

The site has been used for industrial purposes including textiles manufacturing since the 1920s.

A dye works was located on the site since the 1980s and ceased operation in Feb 2010.

The buildings in the northern half of the site comprising administrative buildings (Offices A, B & C) former textiles manufacturing (Building Group 2 and Building 3) and storage (Store A and Store D) were mostly constructed circa 1920's.

Building 1 used for textiles manufacturing and warehousing was constructed in the 1960s and was extended in 1996.

3.2 NSW DECC Registers

3.2.1 Contaminated Sites Register

The NSW Department of Environment and Climate Change (DECC) Contaminated Sites Register lists both former and current contaminated sites deemed to pose a 'Significant Risk of Harm' (SRoH) under the provisions of the CLM Act. The search conducted on 27 May 2009 did not identify the site or any registered sites within a 1 km radius of the site.

3.2.2 POEO Licence Register

The NSW DECC Protection of the Environment Operations (POEO) Licence Register identifies premises that are licensed for certain activity types under the POEO Act. The search conducted on 27 May 2009 identified two licensed properties within approximately one-kilometre radius of the Site as follows:

- Joseph Nader located at 145 Wentworth Avenue, Wentworthville, approximately 350 m north east of the site. The licence is current and listed under the activity of Waste Transporters – Hazardous / Industrial; and
- Holroyd City Council (Wentworthville Swimming Centre) located on Dunmore Street, approximately 600 m east of the site. The license was surrendered on 24 July 2001, and was formerly under the activity type of Miscellaneous Licensed Discharges to Waters (at any time).

Both sites are considered either down or cross hydraulic gradient of the site in terms of groundwater flow (refer Section 7.1) and are considered unlikely potential sources of off-site contamination that could have migrated to the site.

The Pacific Brands site was also listed on the register as having formerly held a licence of type 'Fuel Burning Equipment', which was surrendered on 3 May 2000. This is likely to have been associated with former site boilers.

[6] GHD (June 2009), *Report for 190 Dunmore Street, Wentworthville, NSW - Contamination Assessment*, prepared for Pacific Brands

3.2.3 Potential Sources of Contamination

The following key potential sources of contamination were identified in the Phase 1 preliminary contamination assessment. The approximate locations of key features are shown on Figure 2.

Table 3 Potential Sources of Contamination

Description	Contaminants of Interest
Textiles manufacturing, general light industrial activity (Building 3, Building Group 2, Building 1 and surrounds)	Chlorinated and non-chlorinated organic solvents (PCE, TCE and benzene and toluene) Soaps and detergents (alkybenzene) Organic compounds (including phosphates and ammonia)
Former Creek Area – this area is believed to have been filled, at least partially, with solid waste from demolition of the former boiler house. Potential disposal of boiler ash in this area.	metals, TPH, PAH, asbestos, sulphates
Former Creek Area – Historical dumping of water soluble yarn lubricating wax on sloping land leading towards the bank of the former creek.	Based on discussions with Pacific Brands personnel, the wax is a natural product produced during cotton spinning and does not contain toxic chemicals.
Potential asbestos fragments in unsealed areas in the smoking area (adjacent to central car park) and potentially within the fill matrix.	Asbestos
Former coal powered boilers and oil drum storage.	metals, TPH, PAH
Six former underground storage tanks (four east of boiler house and two between boiler house and substation).	TPH, BTEX
Incinerator, the site formerly had a POEO licence for fuel burning, likely associated with coal fired boilers.	metals, TPH, PAH
Dye house and spills.	Dyes (basic, acid);
Diesel fuel storage in the pump house (anecdotal evidence of a small diesel spill in this area).	TPH, BTEX
Sodium hydroxide tank (chemical store)	pH
Transformer substation capacitors	PCBs, TPH
Flammable liquid store	Hydrocarbons from fuels (TPH, BTEX);

Description	Contaminants of Interest
Filling within the central car park area (understood to be filling of a depression associated with a former drainage line).	Metals, Asbestos
Filling along the eastern embankment	Metals, Asbestos
Garden Areas around the site boundary and Weed Control	Pesticides (including OCPs, naphthalene, dieldrin)

Note (1) Heavy Metals (arsenic, antimony, beryllium, cadmium, chromium, copper, cobalt, lead, mercury, molybdenum, nickel, tin, selenium, zinc), Total Petroleum Hydrocarbons (TPHs), Monocyclic Aromatic Hydrocarbons (MAHs), Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs).

3.3 Summary of Potential Contamination Sources

The preliminary Phase 1 Contamination Assessment concluded that ground contamination at the site may result from the accidental spillage of chemicals in storage areas or during the various stages of manufacturing yarn, making dyes and dyeing textiles. Further off-loading areas, storage tanks, drum storage areas, and surface water drains may be considered potential areas of contamination. Older or upgraded works may have redundant underground tanks or pipelines containing chemical residues or wastes. Effluents from washing fibres, yarn or fabric are normally discharged to the foul sewer but may be lost to the surrounding ground if the sewer leaks.

Reworked natural materials have been used to make up ground levels on site and may contain solid waste inclusions (e.g. bricks, Asbestos cement sheeting, etc). Solid wastes may have been disposed of in on-site landfills, in particular the former creek area (current central car park area), which is believed to have been partially filled with waste material from demolition of the former boiler house.

Where asbestos has been used in buildings or pipework, decommissioning or demolition may result in local contamination. Asbestos pipework and boiler ash (containing heavy metals and sulphates) may have been disposed of in on-site landfills. Any organic infill also has the potential to generate landfill gases, principally methane and carbon dioxide.

Contamination may also occur from PCBs where transformers or capacitors have been refilled or decommissioned.

4. Site Investigation Methodology

4.1 Intrusive Soil Investigation

4.1.1 Soil Sampling Plan

The Australian Standard AS4482.1 2005 provides guidance on the minimum number of grid sample locations required depending on the size of the property and suggests that the sampling of a potentially contaminated site should be undertaken on both a systematic grid based system (to test for unknown sources of contamination) and a judgemental (targeted) sampling pattern (to test for known potential sources of contamination). Based on a land area of 8 ha, the AS4482.1-2005 recommends a minimum of 88 sample locations (11 samples per ha) across the site. The number of soil sampling locations for the Phase 1 and Phase 2 assessment is summarised below:

- Phase 1 (GHD 2009) – Soil sampling at 20 target locations including 11 window sample and 9 borehole locations;
- Phase 2 (GHD 2011) - Soil sampling at 63 grid locations (30 x 30 m grid) including 34 test pits and 29 hand auger locations.

The total number of soil sample locations was 83, which is marginally below the recommended density of 88. This was due to access constraints within the administration building and warehouse areas within Building 3. Due to access constraints, samples could not be collected within the south-western portion of Building 1 (currently used for warehousing), however this area was inferred to be slab on rock (refer Figure 2) and soil sampling in this area would likely have been limited to sub-slab crushed rock material. Overall, the sampling program was considered adequate to meet the objectives of the assessment.

Soil sample locations are shown on Figure 2. A summary of the combined (Phase 1 targeted and Phase 2 grid based) soil sampling and analysis program is provided in **Table 4**.

Table 4 Soil Sampling and Analysis Plan

Site Area	No. Locations	No. samples tested	Metals	TPH / BTEX	PAHs / Phenols	VOC / SVOC	PCB	Pesticides	Asbestos	Inorganics
Phase 1 Target Locations	20	30	27	27	27	0	27	0	17	0
Phase 2 Grid Locations	63	105	96	77	72	31	24	37	10	16
TOTAL	**83**	**135**	**123**	**104**	**99**	**31**	**51**	**37**	**27**	**16**

Note (1) Heavy Metals (arsenic, antimony, beryllium, cadmium, chromium, copper, cobalt, lead, mercury, molybdenum, nickel, tin, selenium, vanadium, zinc), Total Petroleum Hydrocarbons (TPHs), Monocyclic Aromatic Hydrocarbons (MAHs), Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs). Volatile Organic Carbons (VOCs), Semi-volatile Organic Carbons (SVOC), Inorganics (sulphate, sulfur, cyanide, nitrate, nitrite)

4.1.2 Sampling Methodology

Soil sampling was conducted using GHD Quality Assurance and Quality Control (QA/QC) procedures, which are in accordance with NSW EPA (1995), NEPC (1999) and AS4482.1 2005 guidelines. The following soil sampling techniques were used:

- *Solid auger borehole drilling (2009)* – grab samples were taken directly from the augers with care taken to scrape off the outer layer of soil from the auger flight in order to minimise cross contamination and obtain a representative sample of the target interval.
- *Window sampler (2009)* – A hand held percussion instrument was used to collect undisturbed one metre length cores of the soil from which grab samples were taken. The core barrel was decontaminated between each sample interval.
- *Hand Auger Locations (2011)* - In order to comply with Pacific Brand site OH&S policy, no petrol driven equipment was used within buildings. All sample locations within buildings were undertaken using an electric concrete corer to allow access to the sub slab soils followed by sampling using a hand auger.
- *Test Pits (2011)* – A small excavator was used in outdoor areas (where access allowed) to excavate narrow trenches (test pits) to the required depth. This method allowed a better visual assessment of soils in-situ relative to boreholes.

Borehole and test pit logs are provided in Appendix A.

Generally, a minimum of three depth samples (0.1 m, 0.5 m and 1.0 m) were collected at each location. Deeper samples were collected at selected locations where site history information or structures (such as former underground storage tanks) indicated the potential for contamination at greater than 1 m depth, or where extensive thickness of imported fill material was encountered (i.e. eastern site embankment). Where fill was encountered at depths greater than 1.0 m, samples were generally collected at 1 m intervals.

All soil samples were screened for Volatile Organic Compounds (VOCs) using a calibrated Photo-ionisation Detector (PID). The samples were transferred to an ice filled cool box for sample preservation prior to and during shipment to the sampling laboratory. A chain of custody form was completed, and forwarded with the samples to the testing laboratory.

Soil samples were submitted to NATA accredited laboratories for environmental analysis as per the proposed sampling plan presented in **Table 4**. Quality control (QC) samples will also be collected in accordance with GHD quality assurance (QA) procedures.

4.2 Phase 2 – Intrusive Groundwater Investigation

4.2.1 Groundwater Monitoring Well Network

The combined 2009 and 2011 groundwater investigations involved the drilling, installation and sampling of nine groundwater monitoring wells. The groundwater monitoring well network is shown in Figure 2. Five monitoring wells were installed as part of the 2009 investigation (GW1, GW2, GW4, BH4 and BH5) and an additional four installed in 2011 (GW6, GW7, GW8 and GW9). *Note: Monitoring wells were not installed at GW3 and GW5 (i.e. soil sample boreholes only).*

The monitoring wells were drilled to depths ranging from 8 to 19 m bgl. Monitoring wells targeting the regional water table bedrock aquifer (GW4, GW6, GW7, GW8 and GW9) were installed at depths ranging from 13.1 to 19 m bgl. Monitoring wells targeting perched water in fill material within the central car park area were shallower with depths ranging from 5.2 to 8.5 mbgl. Monitoring well GW1 was partially screened across both fill and underlying weathered bedrock.

The groundwater monitoring wells were installed and developed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (Land and Water Biodiversity Committee, 2003). All wells were surveyed for elevation and location to allow determination of groundwater flow direction.

Groundwater Monitoring Well construction logs are provided in Appendix A. Monitoring well details are summarised in **Table 5**.

Table 5 Groundwater Monitoring Well Details

Well ID	Installation Date	Total Depth (m)	Screen Interval	Target Formation	Easting (MGA94)	Northing (MGA94)	Ground Level Elevation (mAHD)	TOC* Elevation	SWL (mbtoc) 6/4/2011	SWL (mAHD) 6/4/2011
BH4	6/05/2009	8.2	2.2-8.2m	Fill	311179.86	6257467.39	54.26	54.19	4.91	49.28
BH5	6/05/2009	8.5	5.5-8.5m	Fill	311203.31	6257450.53	54.23	54.15	4.95	49.2
GW1	6/05/2009	8.5	4.4-8.5m	Fill / Rock	311137.63	6257469.46	54.48	54.39	4.58	49.81
GW2	6/05/2009	5.9	1-5.9m	Fill	311108.35	6257461.77	54.47	54.38	1.65	52.73
GW4	5/05/2009	15.5	6.5-15.5m	Rock	311176.11	6257310.32	54.51	54.45	8.51	45.94
GW6	25/03/2011	19	13-19m	Rock	310932.81	6257353.26	66.41	66.25	13.63	52.62
GW7	25/03/2011	18	12-18m	Rock	310999.79	6257494.7	61.03	60.94	9.31	51.63
GW8	25/03/2011	14.9	8.9-14.9m	Rock	311025.75	6257305.15	59.19	59.12	8.92	50.2
GW9	29/03/2011	13.1	10.1-13.1m	Rock	311223.87	6257553.8	54.17	54.07	7.16	46.91

* TOC – Top of Casing

4.2.2 Groundwater Sampling

Groundwater samples were collected from all nine monitoring wells (five existing and four new wells) using GHD sampling procedures, which are in accordance with relevant NSW EPA approved guidelines. The wells were purged and sampled using low density poly-etheylene tubing coupled to a Sample-Pro Micropurge ('low flow') pump system. The low flow pump provides an appropriate method for collection of representative samples for the required analytes and is recognised by the NSW EPA as best practice for groundwater sampling.

Field parameters measured during purging included temperature, pH, conductivity, dissolved oxygen and redox potential. Samples were collected upon stabilisation of field parameters in accordance with EPA sampling guidelines.

Groundwater sampling field sheets are provided in Appendix B.

Primary samples were collected from each monitoring well for the analysis shown in Table 6. QA/QC samples were collected in accordance with GHD QA procedures.

Table 6 Groundwater Analysis

Item	Number of Samples	Analysis
Monitoring Well Sample	9	5 x Environmental Screen 4 x Heavy Metals, TPHs, BTEX, VOCs, Ammonia, TDS
QC		
5% Blind Samples	1	Heavy Metals, TPHs, VOCs, Ammonia
5% Field Splits Samples	1	Heavy Metals, TPHs, VOCs, Ammonia
Rinsate Blanks	1	Environmental Screen
Trip Blanks	1	BTEX
TOTAL	**13**	

4.3 Quality Assurance and Quality Control (QA/QC)

A data validation program, including the collection and analysis of quality control samples, was conducted to determine the suitability of the data for use in this assessment. This included the collection of field split, blind duplicate, rinsate blank and trip blank samples in accordance with NSW EPA (1995), NEPC (1999) and AS4482.1 2005 guidelines.

5. Assessment Criteria

5.1 Guidelines

In accordance with Section 105 of the Contaminated Land Management Act 1997 (CLM Act), the NSW EPA has approved a number of guidelines for use by consultants and site auditors in assessing and managing contaminated sites. The assessment was undertaken in general accordance with the following guidelines produced or endorsed by the NSW EPA:

- NSW EPA (1995), "*Contaminated Sites: Sampling Design Guidelines*";
- NSW EPA (1997), "*Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*";
- NSW EPA (1999), "*Contaminated Sites: Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report*";
- NEPM (1999), "*National Environment Protection (Assessment of Site Contamination) Measure*", National Environment Protection Council (NEPC);
- NSW EPA DEC (2007), "Guidelines for the Assessment and Management of Groundwater Contamination";
- The Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC, January 1992); and
- Australian Standard AS4482.1 2005 (Guide to the investigation and sampling of sites with potentially contaminated soil).

5.2 Assessment Criteria (soil)

5.2.1 Health Based Criteria

In considering future activities on site and potential beneficial uses the NSW EPA recommends the use of the *"National Environment Protection (Assessment of Site Contamination) Measure"* (NEPM), 1999. These guidelines recommend ecological investigation levels (EILs) and health investigation levels (HILs) for various chemicals of concern.

With regard to HILs, numerous exposure settings (A, B, C, D, E and F) are provided in the NEPM according to the current or proposed land use. The uses range from low-density residential settings to commercial/industrial settings, as summarised below:

- **Setting A:** 'Standard' Residential with garden/accessible soil (home-grown produce contributing less than 10% of vegetable and fruit intake; no poultry): this category also includes children's day care centres, kindergartens, pre-schools and primary schools.
- **Setting B:** Residential with substantial vegetable garden (contributing 10% or more of vegetable and fruit intake); and/or poultry providing any egg or poultry intake.
- **Setting C:** Residential with substantial vegetable garden (contributing 10% or more of vegetable and fruit intake); poultry excluded.

- **Setting D:** Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high rise apartments and flats.
- **Setting E:** Parks, recreational open space and playing fields, includes secondary schools.
- **Setting F:** Commercial/Industrial; includes premises such as shops and offices as well as factories and industrial sites. It is assumed that 30 years is the duration of exposure.

Given that the site is proposed for residential development, Setting A (heir in referred to as HIL A) has been adopted for the purposes of this assessment.

Where EILs have not been specified in the NEPM, the "*Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*" published by ANZECC/NHMRC (1992) have been referred to. Parameters in the ANZECC/NHMRC guidelines are based on human health and environmental considerations. In accordance with the procedures outlined in this document, analytical results are initially compared with ANZECC/NHMRC Environmental Investigation B levels (ANZECC B). Contamination concentrations reported above the ANZECC B levels typically require further investigation and/or consideration, but do not necessarily present an environmental or health risk.

For some contaminants (including TPH C_6-C_9) for which no EIL or HIL is provided, reference was made to the sensitive land use threshold provided in the NSW EPA (1994), "*Guidelines for Assessing Service Station Sites*".

5.2.2 Asbestos in soil

The NSW EPA has effectively withdrawn all policy relating to asbestos in soil, and as such there is currently no NSW EPA or DECC endorsed policy or guideline regarding what constitutes an 'acceptable' level of asbestos in soil. WorkCover NSW '*Working with Asbestos*' (2008) notes that under NSW OHS legislation, material that contains asbestos is referred to as either 'friable' or 'bonded'. The following definitions have been provided (WorkCover, 2008):

> *Friable asbestos is any material that contains asbestos and is in the form of a powder or can be crumbled, pulverised or reduced to powder by hand pressure when dry. Asbestos cement products that have been subject to weathering are considered to be friable.*
>
> *Bonded asbestos is any material that contains asbestos in a bonded matrix.*

5.3 Assessment Criteria (Groundwater)

5.3.1 ANZECC Water Quality Guidelines

The ANZECC 2000 guidelines are approved as guidelines under Section 105 of the *Contaminated Land Management Act* 1997 as of 6 December 2001.

The NSW DECC recommends that when assessing contamination of groundwater, consideration needs to be given to the impact of any contaminants to the beneficial uses or resources of the groundwater. The beneficial uses of groundwater may include providing recharge to rivers, lakes, bays, being a source of water for drinking, irrigation and industrial uses.

For the purpose of this assessment, groundwater quality will be compared to the criteria outlined in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* ANZECC / ARMCANZ 2000 *(ANZECC 2000).* For the site, the nearest potential receiving freshwater ecosystem is Coopers

Creek, which is considered "Slightly to Moderately Disturbed" and a protection level of 95% has been adopted for the assessment of groundwater contamination.

6. Assessment of Soil Contamination

6.1 Field Observations

Soil sample locations are shown on Figure 2. A description of lithology encountered at each location, including samples collected and PID readings, is presented in the borehole and test pit logs provided in Appendix A.

The soil profile comprised varying levels of fill overlying natural clay. The natural clay generally comprised firm to stiff, red brown and grey mottled clay (regolith) underlain by weathered bedrock comprising inter-beds of grey shale and fine sandstone. The bedrock became fresher with depth. In areas where the previous slope had been cut as part of site levelling, shale and fine sandstone rock was encountered at less than 1m below the ground surface.

Field observations of the soil profile in different portions of the site is summarised below:

- **South West** (TP1 – TP6) – This is the high point of the site with a 2-3 m high mound of fill material, predominantly comprising reworked natural clay and rock with minor amounts of inert waste materials (crockery, metal, plastic).
- **South West** (TP9) - A horizon of black impacted soil approximately 800 mm thick was identified in the south western corner of the site in test pit TP9 (refer Photo 1) and is believed to be waste material from the former incinerator at this location. The area of this impacted soil was approximately 10 x 10 m.
- **Western Portion** (TP10 – TP14, HA6, TP45) – Topsoil underlain by natural clay. No visual signs of contamination or anthropogenic filling.
- **Southern Car park** (TP7, TP8, TP15 – TP25) - Crushed rock road base to approximately 0.25 mgl underlain by natural clay. No observed signs of contamination.
- **Building 1** – Concrete slab (0.1 to 0.25 m thick) underlain by approximately 0.1 to 0.2 m of crushed rock fill material in turn underlain by sandy clay and clay fill (this appeared to be consistent with the natural clay on the site that had been reworked and compacted). No observed signs of contamination.
- **Eastern Embankment** (TP25, TP28-TP35) - The eastern fill embankment runs for nearly the entire length of the eastern site boundary and appears to have been created by 'cut and fill' levelling of the site. The fill material predominately comprised reworked natural clay, sandy clay and rock with minor quantities of inert waste identified (wood, steel, plastic). Fragments of asbestos cement (AC) were identified at locations TP25, TP30, TP31, TP32 and TP33 at depths ranging from 0.1 m (TP33) to 2 m (TP31 to TP33). Photo 2 shows some examples of the AC fragments identified at TP30, where the highest quantity of fragments was identified.
- **Central Car Park Area** - Rubble including brick material and AC fragments was identified in fill material within the central staff car park at location TP40 (refer Photo 3). This is understood to be waste material from demolition of the old boiler house that was used to fill a depression (former creek) in this area. AC fragments are also reported to have been previously identified by Pacific Brands at the surface in the grassed area adjacent to the western edge of the central car park area. Analytical results for contaminants of interest were generally below the adopted criteria in the fill material.

PID readings were generally low indicating an absence of volatile organic compounds (VOCs) in the soil samples collected. This was confirmed by laboratory tests discussed below. The highest PID reading of 105 ppm was recorded in sample HA05/0.25. Laboratory testing of this sample reported concentrations of volatile and semi-volatile compounds below laboratory LOR.

Photo 1 – Black Horizon at TP09

Photo 2 – Asbestos Cement Fragments at TP30

Photo 3 – Rubble at TP40

6.2 Soil Analytical Results

The analytical results of samples obtained and analysed from the site are provided in Table C1, Appendix C. Laboratory reports are provided in Appendix D.

The results for key contaminants of concern are discussed below.

6.2.1 Heavy Metals

Elevated concentrations of metals (including arsenic, cadmium, cobalt, copper, manganese, nickel, vanadium and zinc) reported above Ecological Investigation Levels (EILs) are summarised in **Table 7**. These concentrations were generally below the adopted Health Investigation Level (HILs).

Nickel concentrations above EILS were also reported in a number of samples. These were collected from slab or road base materials and the nickel is most likely associated with bluestone crushed rock.

Sample WS6/0.1 reported elevated concentrations of arsenic, copper and zinc indicating a potential anthropogenic source at this location, and possibly attributable to historic industrial use in this area (workshops, etc).

Sample TP6/1.0 reported elevated concentrations of cobalt and manganese. This location was in the south west area which identified a mound of fill material, predominantly comprising reworked natural clay and rock with minor amounts of inert waste materials (crockery, metal, plastic) indicating a potential anthropogenic source associated with this material. The sample collected from 1.5 mbgl at TP06 reported significantly lower concentrations of cobalt and manganese (below EIL and HIL criteria) as did surrounding test pit locations, suggesting that the elevated concentrations reported for sample TP6/1.0 does not appear to be laterally or vertically extensive in this area.

The remaining metals concentrations generally fall within natural background concentration ranges and are typical of the shale rock and weather regolith that covers much of western Sydney.

Table 7 Summary of Soil Sample Exceedances for Heavy Metals

Analyte	Adopted Criteria (mg/kg)		No of Exceedances		Max Concentration (mg/kg)	Background Ranges[1]
	EIL	HIL	EIL	HIL		
Arsenic	20	100	7	1	200 (WS6/0-0.1)	1 - 50
Cadmium	3	20	2	0	14 (GW1/2.8-3.0)	1
Cobalt	-	100	-	1	540 (TP06/1.0)	5 – 1000
Copper	100	1000	3	0	520 (WS6/0-0.1)	2 – 100
Manganese	500	1500	20	2	2900 (TP06/1.0)	850
Nickel	60	600	11	0	190 (HA29/0.13)	5 - 500
Vanadium	50	-	5	-	70 (TP45/0.5)	20 - 500
Zinc	200	7000	7	0	2300 (WS6/0-0.1)	10 - 300

1 Reported in NEPM, based on Field Geologist's Manual (1989)

6.2.2 Organics

Polychlorinated Biphenyls (PCBs) concentrations were below laboratory limits of reporting (LOR) for all samples with the exception of a concentration of 7 mg/kg for Arochlor 1254 in sample WS6/0-0.1. The remaining five PCBs analysed in sample WS6/0-0.1 were reported below the laboratory LOR of 2 mg/kg. The adopted HIL for total PCBs for a residential setting is 10 mg/kg. Conservatively, using half the LOR returns a concentration of 12 mg/kg for total PCBs, suggesting the potential for PCBs at this location to marginally exceed the adopted criteria of 10 mg/kg

The presence of PCBs at this location may be attributable to historic spillage of oils containing PCB associated with the transformers located close to this sample location. Concentrations of PCB for the underlying sample collected from 0.2-0.3 m were below LOR for all PCBs indicating that the identified PCB contamination was limited to the surface soils at this location.

All other organic compounds tested were below laboratory LOR for all samples analysed.

6.2.3 Pesticides

Pesticides were below laboratory LOR for all samples analysed.

6.2.4 Asbestos

The AC fragments identified at TP25, TP30, TP31, TP32, TP33 and TP40 were submitted for laboratory testing to confirm the presence of asbestos (refer laboratory report 54368-[R00], Appendix D). This testing confirmed the presence of chrysotile, amosite and crocidolite asbestos in these fragments.

A number of soil samples from across the site, including those corresponding to locations where AC fragments were identified, were submitted for laboratory asbestos analysis. Samples submitted for asbestos analysis reported zero asbestos fibres indicating that the asbestos was generally restricted to bonded fragments and had not become friable and disbursed within the soil matrix.

6.3 Preliminary Waste Classification

The analytical results were compared against the NSW EPA Waste Classification Guidelines (DECC, 2008). In accordance with these guidelines, leachate tests (TCLP) were undertaken on selected samples (laboratory report 53366A, 53406A and 53456A, Appendix D).

Based on these guidelines the soil at the site would generally be classified "General Soil Waste" for off-site disposal. In areas where AC fragments were identified in the fill material, this waste would be classified "Special Waste - Asbestos Waste". The natural bedrock and weathered clay at the site does not appear to have been measurably impacted by chemical contaminants at the site and may be suitable for classification as "Virgin excavated natural material".

This is a preliminary classification only and depending on the location and volumes of proposed excavations (e.g. such as soils underlying areas that were inaccessible for sampling) further classification sampling is likely to be required to satisfy landfill and NSW EPA requirements. Further sampling at the site may reveal the presence of material classified as either Restricted Solid Waste or Hazardous Waste.

6.4 Summary of Soil Assessment Findings

- Metals concentrations above EILs were identified across the site. These were generally below Health Investigation Levels (HILs) for residential setting and are believed to be mostly indicative of natural background concentrations in the clay and weathered rock or associated with crushed rock (road base or sub-slab).
- Elevated metals concentrations identified at WS6 (arsenic, copper and zinc) and TP6 (manganese and cobalt) may be associated with anthropogenic sources (light industrial activity, historic filling). While these elevated metals do not appear to be laterally or vertically extensive, they may require further delineation depending on the development plans at these locations.
- Analytical results of soil samples collected from the black horizon at TP09 did not report contaminant concentrations above adopted criteria. This material may represent an aesthetic issue depending on the site development plan.
- The aesthetics, geotechnical characteristics and presence of AC fragments in the fill material within the central car park area will require consideration for site development.
- The presence of AC fragments in the eastern embankment will also require consideration. The asbestos appears to be limited to fragments and does not appear to have become friable and disbursed within the soil matrix.
- Further sampling in the vicinity of WS6 would be required to confirm the presence and lateral extent of PCBs in this area.
- Overall, limited chemical contamination was identified and it appears the site is not subject to gross widespread contamination of soil.
- A preliminary waste classification indicates that the soil / fill material at the site would generally be classified "General Solid Waste", "Special Waste – Asbestos Waste" or "Virgin excavated natural material" depending on where the excavation occurs. This preliminary classification is subject to further testing of the waste material to satisfy NSW EPA and landfill requirements, and during this process there is the potential for other classifications of materials to be identified.

7. Assessment of Groundwater Contamination

7.1 Groundwater Depth and Flow Direction

The standing water level (SWL) readings measured in each monitoring well on 6 April 2011 are provided in **Table 5** (Section 4.2.1) and summarised below:

- The groundwater depth ranged from 1.65 to 4.95 metres below top of casing (mbtoc, approximately ground level) in monitoring wells targeting the fill material. The shallowest groundwater was at GW2; and
- The groundwater depth in monitoring wells targeting the regional bedrock aquifer ranged from 7.16 mbtoc in the low point of the site at GW9 (north-east) to 13.63 mbtoc at the high point of the site at GW6 (south-west).

The groundwater elevation at each monitoring location was determined by reducing the groundwater depth measurements using the elevation data from the well survey. These data were used to produce groundwater elevation contours to determine groundwater flow direction and hydraulic gradient. The interpreted groundwater contours for the perched water system and regional water table are provided as Figure 3 and Figure 4 respectively. These contours indicate the following:

- Fill material (central car park area) – easterly groundwater flow direction with a hydraulic gradient of 0.035. The elevation ranged from 52.7 to 49.2 and was approximately two metres higher than the regional water table suggesting a perched water system that is likely to be flowing along the former drainage line (creek). *It must be noted that monitoring wells within the fill material form a linear pattern, which limits the interpretation of groundwater flow. As such, the flow direction in the fill could range anywhere from north-easterly to south easterly;*
- Bedrock aquifer – easterly groundwater flow direction with a hydraulic gradient of 0.025 consistent with the regional topography. The elevation ranged from 52.62 (GW6) to 45.94 (GW4).

7.2 Groundwater Quality Parameters

Field water quality parameters recorded during the sampling of the groundwater monitoring wells are provided as Table C3, Appendix C, with a summary provided below:

- Electrical conductivity readings indicated fresh water in the fill material at BH4 (169 µS/cm), BH5 (329 µS/cm) and GW2 (875 µS/cm). The regional groundwater quality in the bedrock aquifer was saline ranging from (8 500 to 20 000 µS/cm). Groundwater at GW1 was brackish (6 200 µS/cm) indicating a possible mix from the perched and bedrock units at this location (construction details indicate that this monitoring well may be partially screened across both units). The EC readings are consistent with the Total Dissolved Solids (TDS) results discussed further in Section 7.3.1;
- The pH of the groundwater was slightly acidic typically ranging from 5 to 6.5 units;
- Reduction potential (measured as Eh) varied from -200 mV to 115 mV, with no obvious spatial pattern; and
- Dissolved oxygen (DO) levels varied from 0.01 mg/L (anaerobic) at BH5 to 5.15 mg/L (aerobic) at GW6 with no obvious spatial pattern.

7.3 Groundwater Analytical Results

Groundwater sample analytical results from the 2009 and 2011 sampling events are provided in Table C2, Appendix C. Laboratory reports are provided in Appendix D.

The results for key contaminants of concern are discussed below.

7.3.1 Total Dissolved Solids (TDS)

The groundwater quality in the shale bedrock aquifer beneath the site is moderately saline with TDS concentrations ranging from 5 100 to 12 000 mg/L. Groundwater of this salinity has limited beneficial uses. Fresher groundwater was reported in the perched water within the fill beneath the central car park area at BH4 (130 mg/L), BH5 (170 mg/L) and GW2 (680 mg/L) indicating that the fill material is likely to receive localised rainfall recharge. Brackish water at GW1 (TDS of 3 400 mg/L) is consistent with the partial screening of this monitoring well across both the fill and underlying weathered bedrock.

7.3.2 Ammonia

Ammonia concentrations at GW6 (2.6 mg/L) and GW8 (2.7 mg/L) marginally exceeded the adopted ecosystem protection criteria of 0.9 mg/L in the 2011 sampling event. These groundwater monitoring wells are both located at the up gradient site boundaries and the reported ammonia concentrations may not be associated with site activities. A possible source is leakage from sewer systems within adjacent residential areas. However, it is noted that ammonia concentrations above the adopted criteria were reported at GW1 and GW4 in 2009 with concentrations at both locations an order of magnitude lower (and below the adopted criteria) in 2011. Future investigation would be required to confirm ammonia concentrations at the site and possible sources.

7.3.3 Heavy Metals

Concentrations of heavy metals above the adopted ecosystem protection criteria (cadmium, copper, manganese, nickel and zinc) were reported in monitoring wells across the site as summarised in Table 8. The elevated metals concentrations were consistent across the site in monitoring wells targeting the bedrock aquifer and are mostly attributed to naturally elevated background concentrations given that the shale and fine sandstone geology of western Sydney commonly contains these metals. In addition, the metals would have relatively high solubility in the aquifer given the low pH of the groundwater.

Elevated concentrations of these metals were also identified in the perched water within the fill beneath the central car park area suggesting a potential anthropogenic source associated with historic filling in this area (rubble and reworked natural material). The concentrations of these metals are not considered to be significant due to the long distance to the nearest potential receiving water body (Coopers Creek located approximately 750 m to the east of the site) and the significant reduction in concentrations that would occur due to natural attenuation (retardation, mechanical dispersion, dilution, etc) along the flow path.

Table 8 Summary of Groundwater Sample Exceedances for Heavy Metals (April 2011)

Analyte	Adopted Criteria (mg/L)	No of Exceedances	Max Concentration (mg/L)
Cadmium	0.0002	1	0.0021 (GW1)
Copper	0.0014	9	0.021 (GW6, GW8, GW9)
Manganese	1.9	2	8.6 (GW7)
Nickel	0.011	8	0.19 (GW1)
Selenium[7]	0.005	4	0.038 (GW9)
Zinc	0.008	9	0.41 (GW1)

7.3.4 Organics

Chlorinated Hydrocarbons

The chlorinated hydrocarbon trichlorethylene (TCE) was reported above laboratory LOR in monitoring well GW1 in both sampling rounds. The TCE concentration of 200 ug/L reported in 2009 exceeded the adopted ecosystem protection criteria of 70 ug/L (low reliability trigger value). The TCE reported at GW1 in the more recent round of sampling was considerably lower at 20 ug/L, which was below the adopted criteria of 70 ug/L.

A vinyl chloride (VC) concentration of 22 ug/L was reported at GW1 in 2009 suggesting that some biodegradation of TCE had occurred (VC is a daughter product of TCE biodegradation via reductive dechlorination). In 2011, the VC concentration at GW1 was below the laboratory LOR of 1 ug/L consistent with the decrease in TCE also reported.

The presence of chlorinate hydrocarbons in the groundwater at this location suggests that chlorinated solvents may have been disposed in the fill material in this area. Based on the results from the other groundwater monitoring wells, all below laboratory LOR, this impact appears to be limited to groundwater in the vicinity of GW1.

There are no ecosystem protection criteria for VC but it is noted that the concentrations identified exceeded the drinking water guideline of 0.3 ug/L. This is not considered a significant risk given the groundwater quality at GW1 is unsuitable for drinking and potable water supply is a highly unlikely beneficial use of the groundwater beneath the site. In terms of human health risk, TCE and VC are both volatile contaminants that can pose a vapour risk to future residential dwellings at high concentrations in groundwater (partitioning from dissolved phase to gaseous phase). While the reported concentrations of these compounds reported at GW1 are considered relatively low, this is likely to require further assessment prior to re-development of this part of the site subject to the requirements of the site auditor.

Two rounds of sampling is generally considered insufficient to establish a trend and further monitoring of TCE and VC is recommended at this location to confirm concentration trends.

[7] .As noted in Appendix E, the results of rinsate blank analysis suggest that the selenium concentrations are potentially unreliable and the selenium exceedances reported for BH4, GW1 and GW2 need to be viewed with caution.

Total Petroleum Hydrocarbons

Concentrations of TPH were below laboratory LOR in all monitoring wells except GW1, which returned a total TPH concentration of 200 – 250 ug/L in the April 2011 sampling round. This may be attributable to contaminated fill at this location but is not considered significant given the relatively low concentrations identified.

Other Organic Compounds

All other organic compounds tested were below laboratory LOR for all samples analysed.

7.3.5 Pesticides

Pesticides were below laboratory LOR for all samples analysed.

7.4 Summary of Groundwater Assessment Findings

- The fresh groundwater within the fill material in the central car park area is considered perched water recharged by local rainfall and not representative of an aquifer resource. The salinity and potential yield of groundwater in the bedrock aquifer (shale and fine sandstone) is generally not suitable for extractive purposes and given the residential setting and access to mains water supply the likelihood of groundwater extraction for beneficial uses (domestic, stock watering, irrigation) is considered low.
- Concentrations of heavy metals above the adopted ecosystem protection criteria were reported in groundwater across the site and are mostly attributable to naturally elevated background concentrations. Some elevated concentrations of metals in the perched water within the central car park area may be attributable to historic filling in this area (rubble and reworked natural material). This is not considered a significant issue as concentrations are likely to decrease considerably prior to discharge to the nearest receiving water body due to natural attenuation along the flow path.
- Trichlorethylene (TCE) and vinyl chloride (VC) have been reported above laboratory LOR in monitoring well GW1 suggesting that chlorinated solvents may have been deposited in the fill material in the central car park area. While this contamination appears to be generally localised, further assessment is likely to be required as part of any future redevelopment in order to quantify the potential human health risk that it may pose, and to determine an appropriate site management or remediation response if warranted.
- With the exception of some minor TPH concentrations at GW1, all other organic compounds tested were below laboratory LOR for all samples analysed.

8. Results of Quality Assurance / Quality Control Program

The results of the QA/QC program are considered to provide an acceptable degree of confidence in the analytical program completed, with the exception of the selenium results for groundwater in mgt laboratory report 295938, which are considered potentially unreliable. Overall, the analytical data set is considered to be valid and acceptable to base conclusions on the contamination status of the site.

A data validation report is attached as Appendix E.

9. Conclusions

The results of this Phase 2 investigation indicated that the site is not subject to gross, widespread contamination. There are localised areas where elevated concentrations of contaminants and/or AC fragments have been identified. These areas may require further vertical and lateral delineation once site infrastructure has been removed and the proposed development has been determined.

Overall, the results of soil and groundwater sampling indicated that contaminant concentrations were generally within acceptable limits for a residential setting, with the exception of some areas that are likely to require further investigations during the redevelopment phase.

In particular, the following items may require further consideration prior to or during re-development:

- Management or removal of AC fragments in fill material along the eastern portion of the site and within the central car park area;
- Further assessment of PCBs in surface soils in the vicinity of the former transformer stations, such as those identified at WS6;
- Elevated metals concentrations at WS6 (arsenic, copper and zinc) and TP6 (manganese and cobalt) may require further delineation depending on the development plan at these locations;
- Management or removal of any near surface soils containing elevated heavy metals concentrations including crushed rock and road/slab base material;
- Management or removal of any material that may represent an aesthetic issue for site redevelopment, such as the ash identified at test pit TP9 or the fill material within the central car park (rubble from demolition of old boiler house); and
- Further assessment of the chlorinated hydrocarbon contamination in groundwater identified at monitoring well GW1.

The management and disposal cost of waste soils should be taken into consideration for site re-development. Based on the results of this assessment the soil / fill material at the site would generally be classified "General Solid Waste", "Special Waste – Asbestos Waste" or "Virgin excavated natural material" depending on where the excavation occurs. It should be noted that this preliminary classification is subject to further testing of the waste material to satisfy NSW EPA and landfill requirements and during this process there is the potential for other classifications of materials to be identified.

Some areas of the site were not accessible for sampling (portions of Building 1 and 3, administrative offices). While contamination in these areas is not expected (based on site history information), there is the potential for contamination to be identified in these areas following demolition of these structures.

This report should be read in full and no excerpts are taken to be representative of the findings of this Report.

10. Disclaimer

This Phase 2 Environmental Site Assessment ("Report"):

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2. *may only be used and relied on by Pacific Brands;*
3. *must not be copied to, used by, or relied on by any person other than Pacific Brands without the prior written consent of GHD and subject always to the next paragraph; and*
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- *to acknowledge that the basis on which this Report may be relied upon is consistent with the principles in this section of the Report; and*
- *to the maximum extent permitted by law, GHD shall not have, and the recipient forever releases GHD from, any liability to the recipient for loss or damage howsoever in connection with, arising from or in respect of this Report whether such liability arises in contract, tort (including negligence).*

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To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in section 1.3 of this Report and GHD proposal dated 22 February 2011, document number* 21/091093/6/167741*; and*
- *were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.*

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report ("Assumptions"), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions or relevant

legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations."

Except as otherwise expressly stated in this Report GHD makes no warranty or representation as to the extent or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill material 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 material from such buildings disposed of on the site, the site may contain asbestos or ACM.

Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations carried out prior to this Report. As a result, the results and estimations expressed or used to compile this Report may not represent conditions at any location other than the specific points of sampling. A site that appears to be unaffected by contamination at the time of the Report may later, due to natural causes or human intervention, become contaminated.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report

Figures

LEGEND

Site Boundary

0 12.5 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

Pacific Brands, Wentworthville
Phase 2 Environmental Site Assesment

Job Number 21-20474
Revision A
Date 17 May 2011

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Site Location and Layout

Figure 1

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

LEGEND

- Borehole / Window Sampler
- Hand Auger
- Groundwater Monitoring Well
- Test Pit
- Grid (30m x 30m)
- Concrete Slab On Rock
- Approximate location of previous diesel spill
- Infered location of backfilled creek
- Infered location of former UST's
- Infered location of former coal fired boiler house
- Infered location of former incinerator
- Substation
- Transformers
- Effluent Pit

0 12.5 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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Pacific Brands, Wentworthville
Phase 2 Environmental Site Assesment

Job Number	21-20474
Revision	0
Date	17 May 2011

Sample Location Plan

Figure 2

G:\21\20474\GIS\Maps\MXD\21_20474_Z002_SampleLocationPlan.mxd
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands Cadastre - Jan 2010; Geoscience Australia 250k Data - Jan 2011; Google Earth Pro - 2011 Created by: sdavoodger

LEGEND

- Groundwater Contours (mAHD)
- Inferred Groundwater Flow
- Groundwater Monitoring Well

0 2.5 5 10 15 20

Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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Pacific Brands, Wentworthville
Phase 2 Environmental Site Assesment

Job Number	21-20474
Revision	0
Date	17 May 2011

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Interpreted Groundwater Contours - Fill Material

Figure 3

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2010, Geoscience Australia 250k Data - Jan 2011; Google Earth Pro - 2011 Created by: sdwoodger

LEGEND

- Groundwater Contour (mAHD)
- Inferred Groundwater Flow
- Groundwater Monitoring Well

0 12.5 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

CLIENTS | PEOPLE | PERFORMANCE

Pacific Brands, Wentworthville
Phase 2 Environmental Site Assesment

Job Number	21-20474
Revision	0
Date	17 May 2011

Interpreted Groundwater Contours - Bedrock Figure 4

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2010; Geoscience Australia 250k Data - Jan 2011; Google Earth Pro - 2011; GHD: Contours, Sample Locations, Concrete slab on rock 2011 Created by: sdavedge

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