Intermodal Logistics Centre at Enfield

# APPENDIX C

# Site Contamination Status

# PREFACE

The technical working papers for the proposed ILC at Enfield were prepared during the first half of 2005. These were prepared in response to the requirements for the preparation of an Environmental Impact Statement (EIS) under Part 4 of the Environmental Planning & Assessment Act, 1979 (EP&A Act). Specific requirements for the EIS were issued on 1 March 2005 by the (then) Director- General of Infrastructure, Planning and Natural Resources.

The EP& A Act was amended on 1 August 2005 by the creation of Part 3A of the Act, and the Department of Infrastructure, Planning and Natural Resources was dissolved on 26 August 2005 and replaced by the Department of Planning and the Department of Natural Resources.

The proposed ILC at Enfield has since been declared a major project, pursuant to SEPP (Major Projects) 2005 and Sydney Ports has subsequently lodged an application under Part 3A of the Act.

Editorial changes to the technical working papers to reflect the changes in legislation or changes in Government departments have not been made.

The following should be considered when reading the technical papers:

- The Director-General's requirements issued under Part 4 are now deemed to have been issued under Part 3A, and any reference to the Director-General's requirements should be read as a reference to Director-General's requirements issued under Part 3A;

- Any reference to an EIS under Part 4 of the Act should be read as a reference to an Environmental Assessment under Part 3A of the Act;

- Any reference to the Department of Infrastructure, Planning and Natural Resources should be read as a reference to either the Department of Planning or the Department of Natural Resources, as appropriate.

# Intermodal Logistics Centre at Enfield
# Environmental Impact Statement

## SITE CONTAMINATION STATUS

June 2005

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# Contents

# 1. Introduction

## 1.1 Scope

A number of investigations to identify the presence and levels of contamination have been conducted on the site of the former Enfield Marshalling Yards. These investigations have included both desk studies and intrusive investigations involving installation of boreholes and test pits.

Previous contamination investigations conducted on the former Enfield Marshalling Yards (excluding the DELEC site) (CH2M Hill, 1999a, 1999b) and the DELEC site (Egis, 2001) were subject to separate non-statutory audits under Section 47 (1) (b) (iii) of the *NSW Contaminated Land Management Act 1997*. The Auditors conducting the works were accredited by NSW Department of the Environment and Conservation (DEC) under Section 49 of the *Contaminated Land Management Act 1997*.

The information contained within the existing reports has been summarised to provide an overview of the contamination status of the site and remediation requirements for future use. This report provides a summary of the previous reports and the Auditor's interpretation. No additional investigations have been conducted for preparation of this document.

- CH2M HILL (1999a). Enfield Marshalling Yards. Part A– Environmental Contamination Assessment. For Sydney Ports Corporation/Rail Estate. Final. March 1999;
- CH2M HILL (1999b) Enfield Marshalling Yards. Part B – Environmental Contamination Assessment. For Sydney Ports Corporation/Rail Estate. Final August 1999;
- Dames and Moore (1999). Summary site Audit Report. Enfield Marshalling Yard. For Sydney Ports Corporation. 20 September 1999;
- Egis (2001). Detailed Contamination Assessment, DELEC Depot, Enfield. For Sydney Ports Corporation/Freightcorp. Final Report. December 2001;
- Egis (2002). Proposed Enfield Intermodal terminal, Soil Conditions Report. For Sydney Ports Corporation. January 2002;
- Environ (2002). Site Audit Report, DELEC Depot Enfield. For Sydney Ports Corporation. January 2002; and
- GHD (2005). Environmental Contamination Review. May 2005.

A series of investigations were conducted during the 1990s the findings have been summarised within the report on the Detailed Contamination Assessment of the DELEC site prepared by Egis in 2001.

None of the above reports relates to the site of the proposed Intermodal Logistics Centre in its entirety but relate to either one of the following areas of land:

- Part of the former Enfield Marshalling Yards (excluding the DELEC site). This contains the disused section of land and Toll Australia Facilities comprising Lot 14 DP1007302. This area includes part of the former Enfield Marshalling Yards and is referred to as 'former Marshalling Yards' through this document; and
- DELEC site including the active DELEC Service Centre (Lot 2 DP1006861) and the land parcel occupied by Australian Temporary Fencing (Lot 101 DP1001498).

The location of these land parcels are shown in **Figure 1**. For ease of reference through this document the division of the site into these two areas has been retained. The reports within these two land areas cover the site of the proposed ILC in its entirety.

## 1.2 Assessment Criteria

The site assessment criteria used within these previous reports to determine the levels of contamination are detailed below.

### 1.2.1 Soils

The relationship between land uses sensitivity (e.g residential vs commercial/industrial) and associated differences in investigation criteria is largely based on exposure periods/exposure settings. The National Environmental Health Forum (NEHF) Monographs, Soil Series 2, Exposure Scenarios and Exposure Settings 2nd Edition (1998) provides Default Exposure Ratios (DERs) for six different exposure settings, including residential and commercial/industrial. These settings are differentiated by exposure periods and exposure pathways. Land uses such as 'standard' residential (Exposure Setting A), where occupants have an exposure period of 24 hours a day, 365 days a year, for an average occupancy period of 70 years are considered to be sensitive and are given a DER of 1.0. Land uses such as commercial/industrial where workers have more limited exposure period of 8 hours per day, 5 days a week, 48 weeks per year and approximately 30 years duration have a DER of 0.2.

The NEHF Health Based Soil Investigation Levels (HBSIL) thresholds relevant to assess soil contamination on the former Marshalling Yards and DELEC site are HBSIL NEHF (F) levels for redevelopment of the site for *commercial/industrial* purposes. Reference was also made to the more stringent Ecological Investigation Levels (EILs) where appropriate. For Total Petroleum Hydrocarbons (TPH) the criteria were taken from 'Contaminated Sites: Guidelines for Assessing Service Station Sites' (NSW EPA, 1994).

The results from sampling taken within the part of the site to be developed for the proposed Community and Ecological Area were looked at separately and compared against more stringent criteria as this area is to be vegetated and subject to controlled public access. The site criteria, for this area, was taken to be NEHF (E) criteria for *Parks, Recreational Open Space, Playing Fields including Secondary Schools* (open space criteria).

### 1.2.2 Groundwater

The criteria used to assess groundwater contamination is the 'Australian and New Zealand Environment and Conservation Council' and the 'Agricultural and Resource Management Council of Australia and New Zealand', ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. The Guidelines for Protection of Aquatic Ecosystems were used.

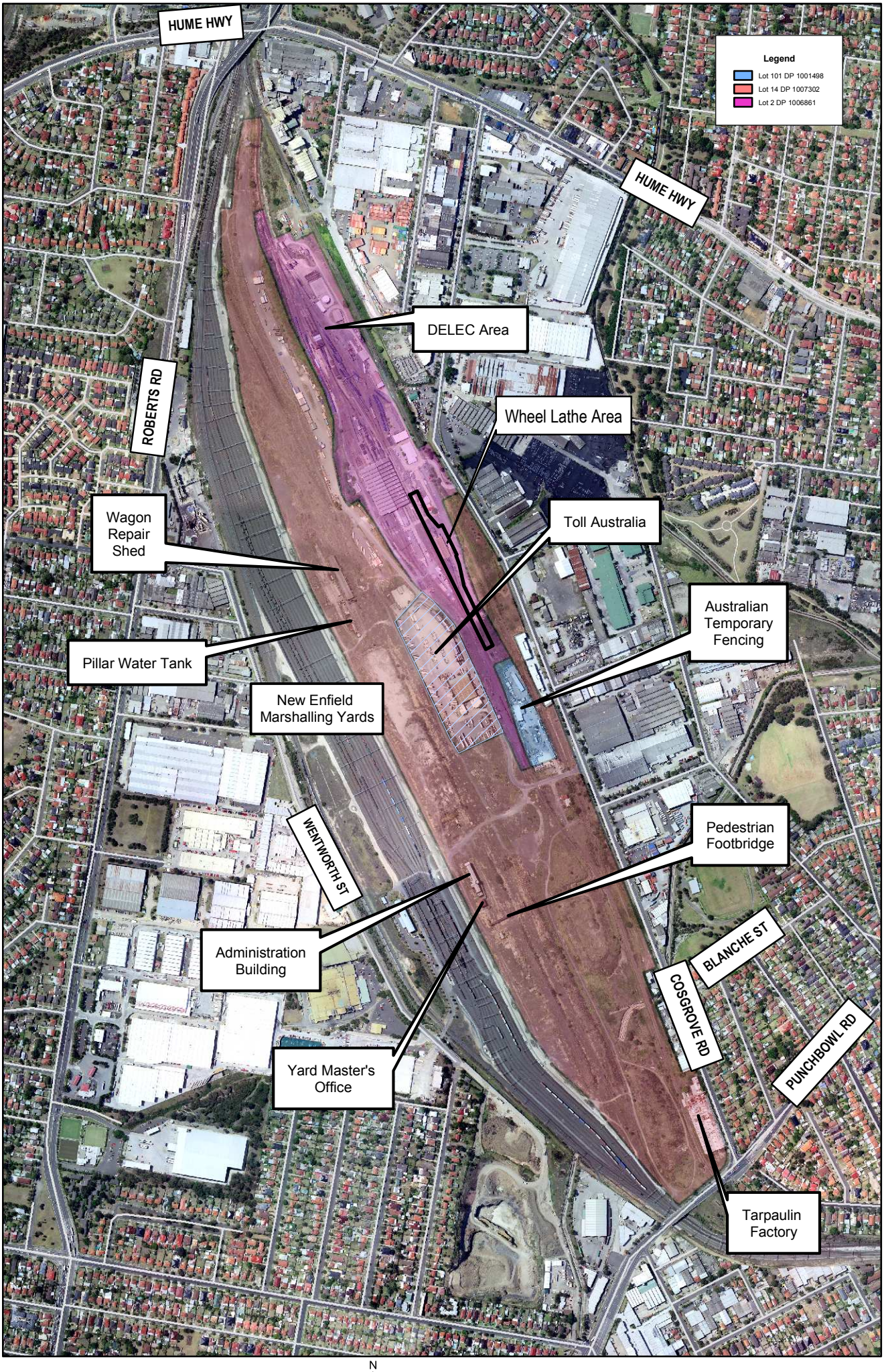
## 1.3 Audit Status

Site contamination audits were conducted on the two areas of land noted in Section 1.1. The contamination audit documentation is listed below.

- Dames and Moore (1999) Summary Site Audit Report, Enfield Marshalling Yards. Ref 30306-00-006-070. September 1999.
- Environ (2002) Site Audit Report, DELEC Depot, Enfield. Ref 31-0022. January 2002

These documents have been attached as Attachment A.

During detailed design a number of areas off-site may require further investigation, these include the road bridge western landing point, road bridge footings, rail connection points and acoustic barriers.

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Intermodal Logistics Centre at Enfield

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Metres

**Figure 1**
**On site Land Use**

# 2. Historical Land Use and Potential Contaminants

## 2.1 Former Marshalling Yards

Investigations into the historical land use conducted through the 1990s identify that the former Marshalling Yards area was developed in 1916. It was created as a distribution link between the ports of Rozelle and Darling Harbour, and formed part of the Campsie to Flemington Goods Line. The site was used as a locomotive depot and goods siding for coal, dairy products, wheat and grain, stone, timber, metal and livestock. The site was operated continually from 1916 to the closure of the original Enfield Marshalling Yards in 1993 (CH2M Hill, 1999a, Dames & Moore, 1999). Five spoil stockpiles were created on the site in the 1990s, their approximate location is shown in **Figure 2**.

Prior to 1916 the site was used predominantly for agricultural/grazing purposes. However, other activities were also noted in the early 1900s, including Enfield Brick Company, poultry farm, timber merchants, an omnibus proprietor and a night soil depot. It is possible that site levelling could have been conducted prior to the laying of railway tracks over most of the site. There are a number of buildings and other features on site, these and their known uses, are shown in **Figure 1** and described in **Table 1**. This information was used to determine potential contamination on site and to enable the intrusive investigations to target contaminants and areas of concern.

**Table 1: Previous Potentially Contaminating Activities on the Former Marshalling Yards.**

| Area | Date | Activities | Contaminants of concern |
|---|---|---|---|
| Wagon Repair Shed | Operational from circa 1920 – 1993 | Site was used for stripping and general maintenance of axle bogies, relining brakes and internal carriage repairs. The floor comprised bare earth until it was sealed in the late 1960s. | Potential for heavy metals (from maintenance activities), asbestos and TPH/BTEX (arising from oil/grease spills) and OCPs/OPPs (from application of herbicides/pesticides beneath the building). |
| Tarpaulin Factory | Brought to the site from Central railway station in 1924. Operational between 1925-1991 | Building used to produce tarpaulin/canvas bags from rolls of canvas and to repair tarpaulins. It had an elevated wooden floor.<br>There was reportedly no chemical treatment of fabrics in this factory. | Potential for heavy metals and OCPs (from application of pesticides/herbicides beneath the building). Arsenic, TPH/BTEX and creosote (PAHs) may be present in the soils as a result of leaching from preserved timber. |
| Railway tracks and sidings | From circa 1920-1993 | Tracks and sidings occupied up to 75% of the site. Most track work was removed in the late 1980s. No history of locomotive maintenance or refuelling in this location. | Potential for heavy metals, PAHs, phenolics (boiler ash), OCPs and OPPs. |

| Area | Date | Activities | Contaminants of concern |
|---|---|---|---|
| Administration building | Constructed 1940s | No record of chemical use. | Potential for asbestos to be present within the building fabric. There is the potential for OCPs, PAH/phenol and heavy metal contamination within fill beneath the building. |
| Pedestrian footbridge | Installed in the 1940s | This steel bridge was used for provision of access to bus routes on Cosgrove Road. Bitumen is present beneath areas of the footbridge. | Potential contaminants include TPH/BTEX and PAH. |
| Two bitumen car parks | Constructed 1970s | One of these may be in the location of a former coal bunker. | Potential contaminants include TPH/BTEX and PAH. |
| Drainage channels and low lying areas | Pre 1920 | Filling has occurred (up to 6.5m deep). | Potential contaminants in fill include PAH, phenol and heavy metals. |
| Eastern boundary | | This area was thought to be potentially uncontaminated. | - |
| 5 stockpiles on site | Early 1990s | During the 1990s a large stockpile ("Mt Enfield") which was on the current New Enfield Marshalling Yard to the west of the site was relocated and sorted into five stockpiles on the site. Mt Enfield contained reworked shale and sandstone, plus building rubble, ash, slag, ballast and general debris. The stockpiles are of varying size up to 10m high. These were designed as temporary features to be dismantled during future development of the site or for offsite use/disposal. | Potential for heavy metals, TPH/BTEX, PAHs/phenolics. |
| Marshalling Yard (remainder of site) | Pre 1920 | There is a layer of fill over the site surface. | Fill possibly contains ash, hydrocarbon spills, pesticide and herbicide residues from previous site uses.<br>Potential for heavy metals, asbestos, TPH/BTEX, PAHs, phenolics and OCPs/OPPs. |
| General area | 1916-1993 | A significant number of locomotives and associated wagons were loaded/unloaded and moved through the site. The potential exists for widespread contamination of surface soils associated with ballast and locomotive spillages and operation. | Potential contaminants include: heavy metals, TPH/BTEX, PAH/phenolics, and OCPs/OPPs. |

Source: Adapted from Dames & Moore 1999, Environ 1999, CH2M HILL 1999a, 1999b.

As part of site development landfilling was undertaken, in particular in depressions/low lying areas. The fill comprises generally, gravel, ballast, slag and ash in a dark brown/black coarse sand matrix.

Deeper layers consist of gravelly sandy clay fill, extending to depths in excess of 10m in some locations across the site (CH2M Hill, 1999a).

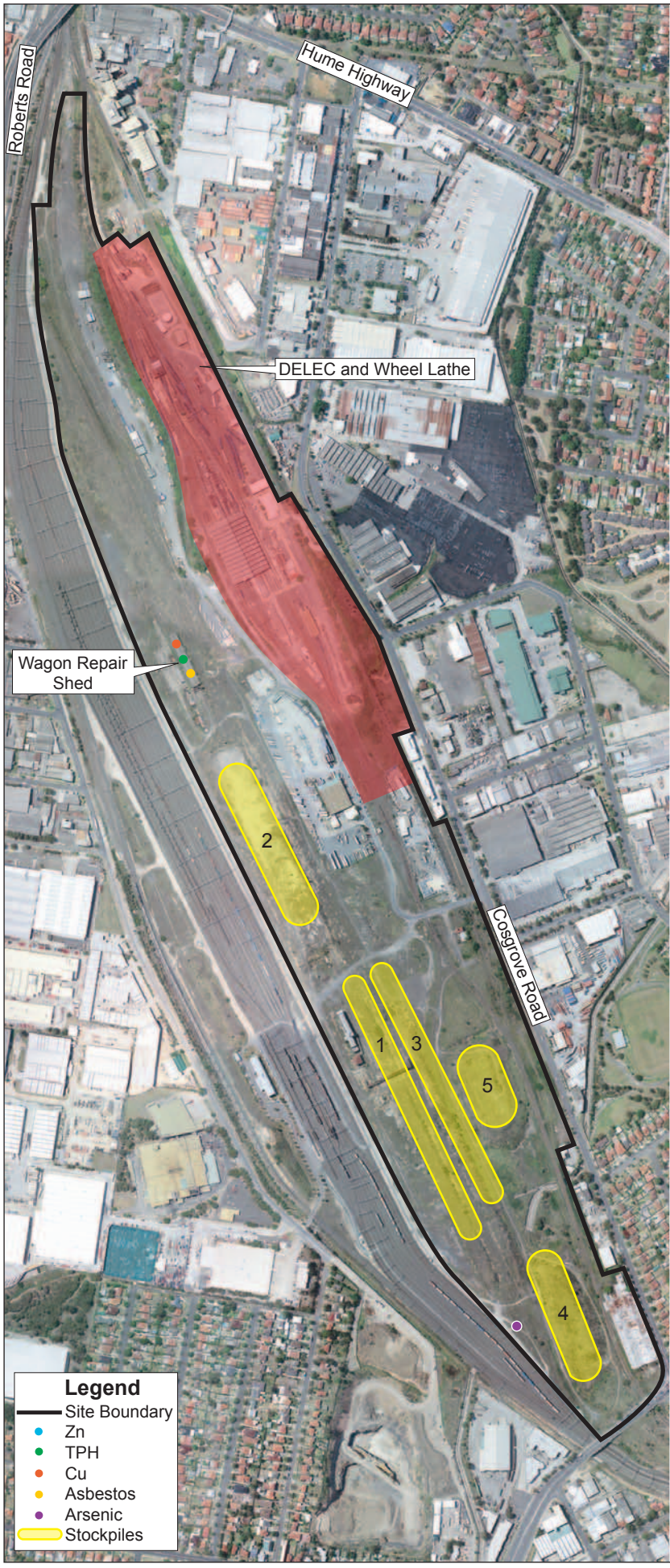
Since closure of the Enfield Marshalling Yards significant amounts of refuse have arrived on site through fly tipping. GHD identified over 100 stockpiles of waste of varying size and composition during a walkover inspection conducted in 2005. These materials comprise soil, mixed demolition waste, timber, concrete rubble, asbestos sheeting and liquid waste drums (GHD, 2005).

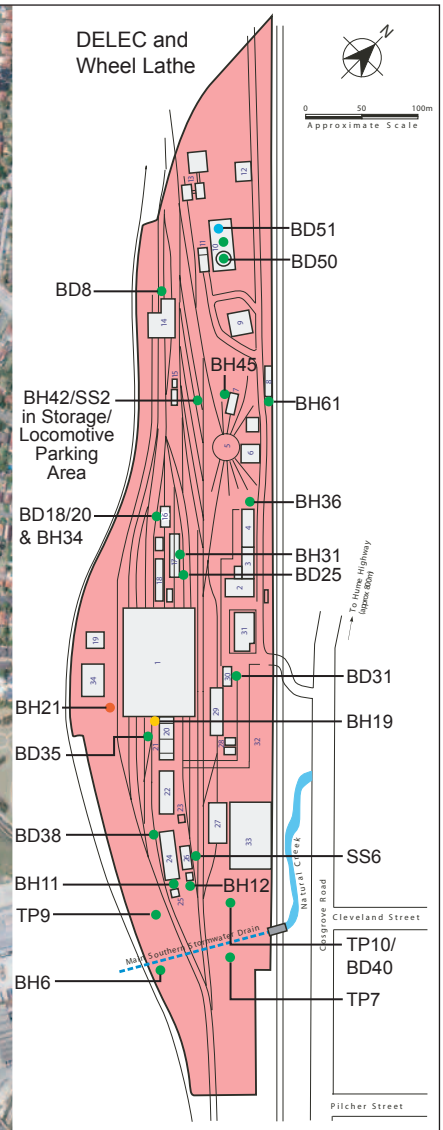
## 2.2 DELEC Site

The area of the DELEC site remained low-lying marshland until the 1950s. The Public Transport Commission of NSW commenced development of the DELEC and Electric Locomotive Maintenance Centre in 1957 after acquiring, filling and levelling the land (Egis, 2001). Refuelling activities commenced in the late 1950s and servicing of electric locomotives began in the early 1960s. Three large above ground storage tanks (ASTs) were erected on site by 1965. Interviews and literature reviews undertaken by Egis confirmed that various fuel spills occurred in the refuelling area which was not sealed until the 1990s. A number of historic waste dumps were also reported in the area to the south of the car park and possibly at the rear of the sand plant (**see Figure 2**). The fuel storage and refuelling facilities on the northern end of the site were unbunded and unpaved until the 1990s, providing potential pathways for contamination into the ground.

Key areas of concern on the DELEC site are shown in **Table 2**.

Imported clay and ash underlie the DELEC site. The ash was reported to have originated from steam locomotives, which were stored on the site prior to the development of the locomotive Maintenance Centre. The fill extends to depths typically ranging from 2m-4m (Egis, 2001), underlain by 0.2-6m of clay over moderately weathered shale. The deeper layers of fill appear to correspond to the location of former natural drainage channels.




1. Locomotive Maintenance Shed
2. Main Administration Building
3. Canteen
4. Staff Amenities Building
5. Turntable
6. Component Distribution Centre
7. Load Box
8. Effluent Treatment Plant
9. LMCE Training Centre
10. Main Fuel Storage Area
11. Fuel Road Receival Area
12. Maintenance Filter
13. Sand Plant
14. Locomotive Fuelling Point
15. Fuellers Amenities
16. Old Load Box
17. Locomotive Wash Bays
18. Electronics Workshop
19. Electrical Substation
20. A/C Workshop and Plumbers
21. Dangerous Goods Storage Compound
22. Flying Gang Area
23. Gas Bottle Storage Compound
24. Yard Staff Amenities
25. Smart Ash Burner
26. Mixed Liquid Waste Tank Area
27. Wheel Lathe
28. Storage Rooms
29. Old Wheel Lathe
30. Bulk Oil Storage Area
31. Train Crewing Admin Building
32. Staff and Visitors Car Park
33. Wheel Set Storage
34. Disused Office Building

Intermodal Logistics Centre at Enfield

**Figure 2**
**Identified Contamination Hotspots**

**Table 2. Previous Activities and Contaminants of Concern on the DELEC Site**

| Areas | Date | Activities | Contaminants of concern |
|---|---|---|---|
| All track areas especially load box | From 1950s | Potential for leaks and spills as a result of previous activities. The load box was replaced in 1985. Anecdotal reports indicate that locomotives with faulty engines regularly exhausted unburnt fuel at these facilities while being serviced. | TPH, especially long chains and diesel. |
| Diesel AST area (main fuel storage area) | Circa 1965 | Three large ASTs were erected by 1965, removed in the 1990s and replaced with a larger AST in the same location. This area was not sealed.<br>Abrasive blasting of the zinc based tank coatings on the former ASTs has the potential to cause zinc contamination in surrounding soils. | Potential for Zinc, Copper, Lead and Mercury. |
| Refuelling areas (including locomotive fuelling point) | Refuelling conducted since late 1950s | Potential for leaks and spills associated with fuel storage and refuelling activities.<br>The refuelling area included fuel storage, mixed liquor tank, chemical store and lubrication oil tanks. The area was sealed between 1991-1996, with only the bowser area concrete before that date. There were a number of reports of fuel spillages before the area was sealed. | TPH, especially long chains and diesel. |
| Carpark | From 1950s | Potential for leakages/cleaning of steam engine boilers. Chromium was used as a corrosion inhibitor and as a coolant in diesel and electrical engines. | Chromium and hydrocarbons. |
| Locomotive Maintenance Shed | | Potential for release of contaminants during servicing or maintenance activities. | Potential for heavy metals and hydrocarbons. |
| Steam Spray Shed / electrical workshop, mixed liquor waste tank areas and load box/turntable (high maintenance activities). | From 1950s | Cleaning with solvents. Potential contaminants known to include TPH and may potentially include volatile halogenated compounds (VHC) eg. Methylene chloride used as a cleaning solvent. | Potential for organic and inorganic contamination. |
| In existing buildings and around old fibro buildings, potentially anywhere on site | From 1950s | Deterioration of building materials, abrasion of asbestos brake linings, disposal of linings | Potential for asbestos. |
| South of car park and rear of sand plant | - | Historic waste dumps. The area to the south of the car park was reportedly excavated and backfilled during the 1990s. | Potential for a range of organic and inorganic contaminants. |

| Areas | Date | Activities | Contaminants of concern |
|---|---|---|---|
| Majority of site including wheel lathe area | From 1950s | Filling with ash and other unknown materials occurred over the majority of the site.<br>Abrasive blasting and painting of steel locomotive components.<br>General spillage/leakage of hydrocarbons during site activities. | Potential contaminants associated with ash and other fill materials including PAH and heavy metals.<br>Chromium from steam boiler wastes, PAH, phenols and heavy metals. Contaminants associated with blasting and painting include zinc and other metals such as copper, lead and mercury.<br>Hydrocarbons |
| Turntable area | Prior to 1950s | Possible former market garden where pesticides may have been used. | OC/OP pesticides. |

Source: Adapted from Egis 2001, Egis 2002, Environ 2002

# 3. Contamination Assessment Results

## 3.1 Former Marshalling Yards

**Table 3** provides a summary of the locations on the former Marshalling Yards where laboratory results showed contamination concentrations in excess of site criteria which will require remediation in some form. The approximate location of each 'hotspot' is shown in **Figure 2**.

**Table 3 Former Marshalling Yards Contamination Results Exceeding Site Criteria**

| Location | Contaminant Concentration (mg/kg) | | | Comment |
|---|---|---|---|---|
| | Copper | TPH | Asbestos | |
| Wagon Repair Shed | 8,010 | max 16,166 | Detected in 25% of samples | Remediation required at this location. |
| Site Criteria | 5,000[1] | 1,000[2] | - | |

[1] – NEHF (F) commercial/industrial Criteria

[2] – C10-C36 NSW EPA 1994 Criteria

Source:CH2M Hill 1999a, 1999b

A number of samples taken to delineate the extent of the TPH contamination hotspot in the Wagon Repair Shed were in excess of the site criteria (CH2M Hill, 1999b), all but one were below 3,000mg/kg. The TPH contamination identified at the Wagon Repair Shed was generally limited to the surface soils and probably associated with a historic spill (CH2M Hill, 1999b).

Elevated concentrations of lead were found in soil samples from the Tarpaulin Factory which exceeded the site criteria, indicating a localised contamination 'hotspot'. Further investigations conducted identified that as the lead is naturally immobile the contamination was not thought to represent a potential risk to the environment, and/or human health. It was concluded that there was no clear pattern and the limited extent did not warrant further action (Dames and Moore, 1999, CH2M Hill, 1999b). One sample within the Tarpaulin Factory tested for TPH was found to be above the site criteria (CH2M Hill, 1999b). No further action was recommended.

The eastern boundary of the site was considered by the desk study to be uncontaminated. Testing from this location identified levels of lead, zinc, and TPH elevated above background concentrations in three of seven samples taken, however results were well below commercial/industrial criteria. Testing over the remaining marshalling yards area which were not subject to targeted sampling showed that although there were elevated concentrations of arsenic, copper, lead, zinc and cadmium in a number of locations, commercial/industrial criteria was not exceeded.

Stockpiles 1,2,3 and 5 were found to be uncontaminated and suitable for reuse on site (CH2M Hill, 1999b).

### Community and Ecological Area

Six boreholes were installed within the proposed Community and Ecological Area as part of investigations conducted by CH2M Hill in 1999. This area also includes a large stockpile (No 4) as shown in **Figure 2.** The current design of this area allows for stockpile 4 to remain in place. This area will be vegetated and subject to controlled public access. Therefore, soil contamination results were compared against NEHF (E) criteria for 'open space' use. The results which exceed NEHF (E) criteria are shown in **Table 4.**

**Table 4 Proposed Community and Ecological Area Contamination Results Exceeding NEHF (E) Criteria**

| BH no | Arsenic Concentration (mg/kg) | Comment |
|---|---|---|
| BH30 On the west side approximately 200m north of Punchbowl Road (see Figure 2) | 257 | Contamination found at 0-0.1m. CH2M Hill recommended additional investigations in the vicinity of BH 30 where contaminant concentrations were encountered which exceeded background levels. Concentrations slightly exceeded open space criteria but were below commercial/industrial criteria. Additional investigations in the vicinity of BH30 would be undertaken prior to assessing remediation requirements. |
| NEHF (E) open space criteria | 200 | |

Source: CH2M Hill 1999a

Stockpile 4 was found to be horizontally homogenous in its geotechnical structure. 18 samples were taken from Stockpile No 4 at varying depths. Analytical results from this stockpile were below NEHF (E) open space criteria. Therefore, it is considered suitable to remain on site in the Community and Ecological Area.

The site audit concluded that the site was suitable for industrial use, subject to some soil remediation and validation during development.

## 3.2 DELEC Site

The DELEC site was subject to contamination investigations in the 1990s, 2001 and 2002. These studies identified that there is a widespread presence of TPH 'hotspots' at concentrations greater than the site criteria of 1,000mg/kg (Egis, 2001). As such the TPH 'hotspots' are considered to present a potential risk to site users, and to the environment if off-site migration occurs. Most of the TPH occurs between railway tracks.

The audit conducted on the DELEC site identified it to be suitable for continued commercial/industrial uses subject to the implementation of the recommended remediation and management measures targeted towards addressing the identified issues of contamination. The audit report (Environ, 2002) listed a number of further tasks identified by the Auditor which would be undertaken. These include:

- Further risk assessment or removal of TPH contamination in shallow soils;
- Assessment of off-site migration in areas where TPH has been detected in deep soils near the site boundary;
- Further assessment of copper concentrations and soil remediation if necessary;
- Inspection and validation of soils beneath existing structures where they are removed; and
- Validation of any areas of exposed soil which will be readily accessible to site users to confirm the absence of asbestos fibres.

**Table 5** provides a summary of the locations where laboratory results showed contamination concentrations in excess of site criteria which will require some form of remediation. The approximate locations of the associated 'hotspots' are shown in **Figure 2**.

Hydrocarbon staining of the ground was noted in a number of locations with tests confirming that TPH contamination was generally confined to the upper soil levels. Other areas considered to be contaminated include those where Egis identified visual evidence of hydrocarbon contamination, but where no testing was conducted include:

- Near Yard Staff Amenities (West of the Old Drum Store area) (BD38)
- West of the A/C Workshop and Plumbers (West of the Old Chemical Store) (BD35)
- Bulk Oil Storage Area (East of the old diesel AST/UST area) (BD31)
- Locomotive Wash Bay (Steam Cleaning Area) (BD25)
- Old Load Box (BD18/BD20)
- Locomotive Fuelling Point (BD8)
- Track areas

All identified areas of staining are shown in **Figure 2**. Further details of the volume of material to be remediated in these areas is provided in Section 5.

The potential exists for heavy metal, PAH and phenol contamination of fill material. There were a number of reported concentrations exceeding the EILS for arsenic, chromium, copper, lead, nickel and zinc across most of the site. However these concentrations remain significantly below the NEHF (F) criteria and were not considered by Egis to pose an unacceptable health hazard for the intended land use and no remediation is required. Since the concentrations exceed EILs, there is a possibility that plant growth in such material may be inhibited. This could be mitigated through importing topsoil and selection of tolerant plant species for landscaping.

**Table 5: DELEC Contamination Results exceeding Site Criteria Requiring Remediation**

| Location | Contaminant Concentrations (mg/kg) | | | | Comment |
|---|---|---|---|---|---|
| | Asbestos | Copper | Zinc | TPH | |
| BH21 Near the Locomotive Maintenance Shed (Western Boundary) | - | 14,000 | - | - | Sample taken from depth of 0.2m from the surface. This has copper levels nearly three times over the criteria |
| BD51 Main Fuel Storage Area (Diesel) | - | - | 58,700 | 8,247 | Elevated zinc sample taken from depth of 0.2m. The origin of this contamination is not known. Management and remediation is required |
| BD50 Main Fuel Storage Area (Diesel) | - | - | - | 7,123 | Management and remediation required |
| BH42 Locomotive Parking Area | - | - | - | 1,060 | 1,060mg/kg just exceeds threshold criteria. Remediation is not required |
| BH45 Load Box | - | - | - | 1,300 | Will require remediation |
| BH61 Effluent Treatment Plant | - | - | - | 5,700 | Will require remediation |
| SS2 Between Track, Locomotive Parking Area | - | - | - | 2,789 | Aliphatic concentration shown, TPH not analysed. Will require remediation |
| BH34 Old Load Box | - | - | - | 1,630 | Will require remediation |
| BH 36 Near Turntable | - | - | - | 3,400 | Will require remediation |
| BH31 Locomotive Wash Bay | - | - | - | 1,142 | Will require remediation |
| TP7 Southern Portion of Site | - | - | - | 1,963 | Will require remediation |
| TP9 South West Property Boundary | - | - | - | 2,670 | Will require remediation |
| TP10 Wheel Set Storage Area | - | - | - | 5,600 | Will require remediation |
| BH6 South West Property Boundary | - | - | - | 1,550 | Will require remediation |
| BH12 Mixed Liquor Waste Tank Area | - | - | - | 6,257 | Will require remediation |
| BH11 Smart Ash Burner | - | - | - | 8,400 | Will require remediation |
| SS6 Between Tracks Near Mixed Liquid Waste Tank Area | - | - | - | 9,710 | Aliphatic concentration shown, TPH not analysed. Will require remediation |
| BH19 Near The Dangerous Goods Storage Compound | Amosite and chrysotile | | | | Sample taken from beneath the concrete paved area at depth of 0.2m. Removal required |
| Site Criteria | | 5,000[1] | 35,000[1] | 1,000[2] | |

[1] – NEHF (F) commercial/industrial criteria

[2]- C10-C36 NSW, EPA 1994 Criteria

Source: Egis (2001)

### 3.3 Groundwater Contamination

Analytical results taken from groundwater samples collected across the site indicate heavy metal concentrations (chromium, copper, manganese, nickel and zinc) at levels which exceed the ANZECC 2000 groundwater assessment thresholds (CH2M Hill, 1999a, 1999b). Previous studies also identified TPH contamination within groundwater on the DELEC site, although the source and relationship of this contamination could not be determined. The TPH concentrations in the perched aquifer reportedly reduced over time, indicating there has been a general improvement in groundwater quality in this location (Egis, 2001).

Whilst it is possible that heavy metal concentrations in the fill are impacting on the quality of groundwater in the perched aquifer, the levels of heavy metals within the perched aquifer are generally lower than those within the deeper clay aquifer. As such, heavy metal concentrations in the deeper aquifer are unlikely to be related to site activities, but are more likely to reflect the regional (degraded) background conditions (Dames and Moore, 1999). Further evidence of this is the fact that the heavy metal concentrations up-gradient and down-gradient on the site are similar, suggesting groundwater is migrating onto the site from an off-site source.

The perched groundwater at the DELEC site and former Marshalling Yards was not considered to represent a significant contamination risk to either on-site or off-site receptors (Egis, 2001, CH2M Hill, 1999b). Some of the concentrations exceed guidelines for protection of aquatic ecosystems, however, it is considered that there is a low risk that contaminated groundwater discharges may occur to an off-site waterbody.

# 4. Remediation Requirements

## 4.1 Remediation Options

The site audit identified the following remediation options to be adopted for the site. They include:

- Excavation and off-site disposal. This would generally be the preferred method for removal of heavy metals and asbestos contaminated materials. This would need to be undertaken by an experienced Contractor, with the material to be excavated and transported to a NSW Department of Environment and Conservation (DEC) licensed facility for disposal. Material removed would be replaced with clean fill; and
- Landfarming. This is effective treatment for volatile compounds such as TPH. Remediation is achieved by excavating the contaminated soils which then undergo biodegradation treatment to lower the contaminant concentrations. Following the confirmation that contamination levels have been reduced to appropriate levels, the soil is able to be re-used on site as fill.

The site audits identified a number of areas where further investigation, remediation or other action is required. Remediation of contaminated soils will be undertaken by Sydney Ports as a separate Category 2 remediation work under SEPP 55. Remediation requirements for each of the areas of the site are discussed further below:

## 4.2 Former Marshalling Yards

Actions to be undertaken on the former Marshalling Yards are detailed as follows:

- Soil remediation is required in the area of the Wagon Repair Shed to remove asbestos and hydrocarbon contaminated soil. This is to be achieved through the removal of the entire surface/subsurface soils to a depth of 500mm extending to a distance of 5m around the perimeter of the shed, with disposal to a NSW DEC licensed facility. This would result in removal of up to 1250$m^3$;
- Removal of flytipped material which could contain potentially contaminating substances and disposal at an appropriate facility (maximum volume estimated to approximately 6,000$m^3$ or 9,140 tonnes);
- Validation of all remediated areas and any final exposed soil surfaces should be conducted, in accordance with DEC guidelines, to ensure the complete removal of potential contaminants;
- The material within the five stockpiles can be reused in site redevelopment, but validation of the final exposed surfaces would need to be conducted; and
- Investigation should be conducted of any soils found during site redevelopment which are visually contaminated or which are different from the soils encountered in the investigation.

Further investigations into the arsenic contamination hotspot within the proposed Community and Ecological Area will be undertaken to determine the significance and extent of the elevated levels identified in this area prior to assessing remediation options.

### 4.3 The DELEC Site

The DELEC site audit identified the following remediation work would need to be undertaken. Further details of material volumes for removal are provided in Section 5:

- Remediation of the localised area of copper contaminated soil to the west of the Locomotive Maintenance Shed (maximum volume 300$m^3$) and removal of localised area of zinc beneath the Main Fuel Storage Area (Bulk Diesel Fuel Storage Area) via excavation and disposal to a NSW DEC licensed facility;
- Heavy metal concentrations above environmental investigation levels in the soils on the site may inhibit the growth of sensitive plants. Importation or reuse of clean fill (from stockpiles) and importation of clean topsoil is recommended for landscaped areas;
- Landfarming, to be used to remediate the following localised areas of TPH contaminated soil for the following:
  - South-West Property Boundary and Southern Portion of the Site (maximum volume 500$m^3$)
  - Wheel Set Storage Area (maximum volume 500$m^3$)
  - Effluent Treatment Plant (maximum volume 400$m^3$)
  - Near Turntable (maximum volume 300$m^3$)
  - Mixed Liquor Waste Tank and Smart Ash Burner Area (maximum volume 300$m^3$)
  - Locomotive Wash Bay (maximum volume 400$m^3$)
  - Load Box (maximum volume 400$m^3$)
  - Old Load Box (maximum volume 300$m^3$)
  - Track Areas (maximum volume 4,300$m^3$)
  - Main Fuel Storage Area (maximum volume 1,600$m^3$)
  - West of old Drum Store (Near The Yard Staff Amenities) (maximum volume 400$m^3$)
  - West of the Old Chemical Store (West Of A/C Workshop and Plumbers) (maximum volume 400$m^3$)
  - East of the Bulk Oil Storage Area (maximum volume 300$m^3$)
  - Locomotive Fuelling Point (maximum volume 1,100$m^3$)
- The asbestos contamination in the subsurface near the Dangerous Goods Storage Compound will require remediation once the existing pavement is removed. This is to be achieved via excavation and off site disposal to a NSW DEC licensed facility. Maximum volumes of material for removal are estimated to be 200$m^3$;

- Inspection and validation of soils beneath all existing structures when they are removed would also be necessary; and
- Validation of all remediated areas and any final exposed soil surfaces should be conducted in accordance with DEC guidelines to ensure complete removal of potential contaminants.

The zinc contamination hotspot was identified as being limited in extent and constrained to shallow soils, as a result it is not considered to pose a significant contamination hazard. The soils in the vicinity of the zinc contamination hotspot would be removed as TPH contamination was identified in this area. Landfarming would not be appropriate for this area due to the presence of zinc.

### 4.4 Off-Site Works

Contamination issues would be considered for off-site works in the following areas as part of the detailed design:

- Road bridge western landing point;
- Road bridges footings;
- Rail network connection points; and
- Acoustic barriers.

### 4.5 Asbestos Remediation

Asbestos removal is required from the Wagon Repair Shed (on the former Marshalling Yards) and Dangerous Goods Storage Area (on the DELEC site). Presence of asbestos over the remaining site area has not been identified and no further asbestos remediation is considered to be required. Air monitoring would need to be used to monitor the generation of airborne asbestos fibres. If this monitoring identifies a possible threat to human health it will be necessary to implement engineering controls to ensure the safety of workers on site. A hazardous materials survey of buildings on site proposed to be demolished would need to be conducted to ensure any asbestos containing materials are identified and disposed of in a controlled manner.

### 4.6 Remediation Strategy

A remediation strategy in the form of a Remediation Action Plan (RAP) is required prior to remediation commencing. This would be prepared in accordance with NSW EPA Guidelines 'Contaminated Sites: Guidelines For Consultant's Reporting on Contaminated Sites' (NSW EPA, 1997). This needs to be prepared with due consideration of State Environmental Planning Policy (SEPP55) and the *Contaminated Land Management Act 1997* and address the requirements detailed in Section 4. If during site redevelopment there is visual or olfactory evidence of contamination, further investigations and possible remediation would be necessary. Following completion of remediation all exposed surfaces are to be validated to ensure that all TPH /asbestos and heavy metal contamination has been removed. As the heavy metal contamination within groundwater on the proposed ILC site is

thought to be due to the degraded background conditions and not the result of potentially contaminating activities on site, no actions are required with respect to groundwater.

# 5. Volume Estimates

## 5.1 Contaminated Soil

Minimum and maximum volume estimates have been calculated for areas which require remediation on site. These are shown in **Table 6**. A number of assumptions were made when calculating volumes relating to the depth and extent of the identified hotspots.

**Table 6 Contaminated Soil Volume Estimates**

| Location | Contaminant | Minimum Volume ($m^3$) | Maximum Volume ($m^3$) |
|---|---|---|---|
| **Former Marshalling Yards[1]** | | | |
| Wagon Repair Shed (WRS2) | TPH | 50 | 1,250 |
| Wagon Repair Shed (WRS2) | Asbestos | 30 | |
| Wagon Repair Shed (WRS9) | Asbestos | 30 | |
| Wagon Repair Shed (WRS12) | Asbestos | 30 | |
| Wagon Repair Shed (WRS32) | Asbestos | 30 | |
| **Subtotal** | | **170** | **1,250** |
| **DELEC Site[2]** | | | |
| Near Turntable (BH36) | TPH | 200 | 300 |
| Mixed Liquor Waste Tank/Smart Ash Burner area (BH12/BH11) | TPH | 200 | 300 |
| Load Box (BH45) | TPH | 250 | 400 |
| Effluent Treatment Plan (BH61) | TPH | 300 | 400 |
| Wheel Set Storage Area (TP10) | TPH | 400 | 500 |
| South west property boundary (TP9, TP7, BH6) | TPH | 300 | 500 |
| Near Locomotive Maintenance Shed (Western boundary) (BH21) | Copper | 200 | 300 |
| Near Dangerous Goods Storage Compound (BH19) | Asbestos | 100 | 200 |
| Track areas with observed surface staining | TPH | 2,700 | 4,300 |
| Main Fuel Storage Area (BD50/51) | TPH, Zinc | 1,300 | 1,600 |
| Near Yard Staff Amenities (west of Old Drum Store) (BD38) | TPH | 300 | 400 |
| West of old Chemical Store (West of A/C workshop and plumbers) (BD35) | TPH | 300 | 400 |
| East of Bulk Oil Storage Area (BD31) | TPH | 200 | 300 |
| Locomotive Wash Bay Area (BD25) | TPH | 300 | 400 |
| Old Load Box (BD18/BD20/BH34) | TPH | 200 | 300 |
| Locomotive Fuelling Point (BD8) | TPH | 800 | 1,100 |
| **Sub Total** | | **8,000** | **12,000** |
| **Total** | | **8,170** | **13,250** |

[1] – CH2M Hill, 1999b

[2] – Egis, 2001

One additional area where remediation may be required, identified in the CH2M Hill and Egis reports, is the arsenic hotspot within the proposed Community and Ecological Area on the former Marshalling Yards.

## 5.2 Flytipped Material

There is a significant amount of stockpiled debris on the site. Over 100 stockpiles of varying size and composition were noted by GHD during a walkover inspection in 2005. Materials within the stockpiles include soil, mixed demolition waste, timber, concrete rubble, asbestos sheeting and liquid waste. Indicative volumes of stockpiled material to be removed from site are provided in **Table 7**. This does not include the 5 stockpiles of inert material which can be reused in landscaping etc.

**Table 7 Estimate of Stockpiled/Flytipped Material Volumes**

| Waste Composition | Estimated weight (tonnes) | Estimated Volume* ($m^3$) |
|---|---|---|
| Soil (solid waste) | 580 | 263 |
| Mixed Demolition Waste | 5,600 | 2,545-4,000 |
| Timber Waste | 1,880 | 1,175 |
| Concrete Only (<500mm in size) | 55 | 25 |
| Concrete Only (>500mm in size) | 1,000 | 455 |
| Asbestos Pieces or Sheeting | 25 | 25 |
| **Total** | **9,140** | **5,943** |
| Liquid Waste (Drummed) | 650 litres | |

*GHD Volumes have been calculated based on assumed stockpile densities.

Source: GHD 2005

The derelict structures and flytipped materials are to be removed from site prior to remediation works commencing. Removal of this material forms a separate Development Approval (DA No 0304/365).

The volumes presented in **Table 6** are based on areas identified within the reports to date and does not take into account the potential for additional hotspots to be uncovered during works which may also require remediation. Similarly **Table 7** provides estimates of volumes on materials present in early 2005.

# 6. Conclusions

The results of the intrusive investigation indicate that there is no significant widespread contamination that may potentially pose a threat to the environment or to human health under the proposed land use. The audits conducted in December 1999 (Dames and Moore, 1999) and January 2002 (Environ, 2002) identified the site as being suitable for commercial and industrial use, however, a number of localised hotspots were identified which will require remediation. There is also the potential for further undetected hotspots to exist.

The majority of hotspots detected are within the DELEC site and are associated with hydrocarbons. Landfarming would be the preferred method for removal whereby soils would be excavated and treated to reduce contaminant concentrations to acceptable levels. Where asbestos fibres have been identified within the soils landfarming would not be appropriate. Materials from these areas would need to be removed from the site and disposed of at a NSW DEC licensed facility. Heavy metal contamination would also need to be removed from site and disposed of in a licensed facility.

A number of heavy metals were identified in the soils in excess of background concentrations (but below the site criteria). Whilst it is considered that these would not represent a threat to human health, a number of these elements have phytotoxic properties and may inhibit plant growth. This may have implications for landscaping and vegetation establishment on the site. This would be mitigated through importation of topsoil and through the planting of tolerant species where required.

Further investigation into elevated arsenic levels within the proposed Community and Ecological Area would be undertaken to determine the extent of the hotspot in this location and possible remediation options based on the potential for risk to human health and the environment.

Derelict structure and flytipped material would be removed from site prior to site development. All visually contaminated materials would be removed as part of this process. Validation sampling of all exposed surfaces would be required once remediation is complete to ensure that once contamination hotspots have been removed or remediated any remaining concentrations of potential contaminants are within acceptable limits. During detailed design a number of areas off-site may require further investigation. These areas include road bridge western landing point, road bridge footings, rail network connection points and acoustic barriers.

A remediation strategy will need to be prepared in accordance with SEPP 55 and the *Contaminated Land Management Act 1997* and ‘Guidelines for Consultant’s Reporting on Contaminated Sites’ (NSW EPA, 1997). This should include provisions for inspection and validation of soils beneath existing structures when they are removed. In addition to remediation of identified contamination hotspots it would also need to incorporate procedures to identify and remediate contamination hotspots

uncovered during site development works, which would not have been detected by the targeted sampling approach adopted by previous contamination investigations.

Development of the site as an ILC will mean that the majority of the site will be sealed with a layer of hardstanding. This would reduce the potential for infiltration of rainwater and off-site movement of groundwater contaminants. Sealing the surface will also eliminate any potential risks of asbestos exposure. There is the potential for horizontal migration of the deeper aquifer off-site onto neighbouring residential properties, however, the heavy metal contamination within the groundwater is thought to either reflect the degraded background conditions or be attributable to natural or off-site sources (Egis, 2001). As such no remediation of groundwater is considered to be required.

## References

CH2M HILL (1999a). Enfield Marshalling Yards. Part A – Environmental Contamination Assessment. For Sydney Ports Corporation/Rail Estate. Final. March 1999.

CH2M HILL (1999a). Enfield Marshalling Yards. Part B – Environmental Contamination Assessment. For Sydney Ports Corporation/Rail Estate. Final. August 1999.

Dames and Moore (1999). Summary site Audit Report. Enfield Marshalling Yard. For Sydney Ports Corporation. 20 September 1999.

Egis (2001). Detailed Contamination Assessment, DELEC Depot, Enfield. For Sydney Ports Corporation/Freightcorp. Final Report. December 2001.

Egis (2002). Proposed Enfield Intermodal Terminal. Soil Conditions Report. For Sydney Ports Corporation. January 2002.

Environ (2002). Site Audit Report, DELEC Depot Enfield. For Sydney Ports Corporation. January 2002.

GHD (2005). Environmental Contamination Review. May 2005

National Environmental health Forum (1998) Monographs, Soil Series 2, Exposure scenarios and Exposure Settings 2nd Edition

NSW Environmental Protection Authority (2002). Site Audit Statement. 6 February 2002.

NSW Environmental Protection Authority (1997). Contaminated Sites: Guidelines for Consultant's Reporting on Contaminated Sites.

NSW Environmental Protection Authority (1994). Contaminated Sites: Guidelines for Assessing Service Station Sites, NSW Environment Protection Authority, Sydney.

## Abbreviations

| | |
|---|---|
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| ARMCANZ | Agricultural and Resource Management Council of Australia and New Zealand |
| As | Arsenic |
| AST | Above Ground Storage Tank |
| BTEX | Benzene, toluene, ethyl benzene, xylene |
| Cu | Copper |
| DEC | Department of Environment and Conservation (formerly Environmental Protection Authority) |
| DELEC | Diesel Electric Locomotives |
| DER | Default Exposure Ratio |
| EILS | Ecological Investigation Levels |
| HSBIL | Health Based Soil Investigation Levels |
| NEHF | National Environmental Health Forum |
| OCP | Organo chlorine pesticides |
| OPP | Organo phosphate pesticides |
| PAH | Poly Aromatic Hydrocarbons |
| SEPP | State Environmental Planning Policy |
| TPH | Total Petroleum Hydrocarbons |
| Zn | Zinc |

# Attachment A Site Audit Reports

# REPORT

**SUMMARY SITE AUDIT REPORT**
**ENFIELD MARSHALLING YARD**

***for***
**Sydney Ports Corporation**

DAMES & MOORE
Ref: 30306-006-070\REPORT\ENFIELDAUD REV1
20 September 1999

Level 1, 41 McLaren Street
North Sydney NSW 2060
Tel: (02) 9955 7772
Fax: (02) 9955 7324
A.C.N. 003 293 696

DAMES & MOORE PTy LTD

# SUMMARY SITE AUDIT REPORT
# ENFIELD MARSHALLING YARD

Report prepared for
Sydney Ports Corporation
September 1999

20 September 1999

Ref: J\:30306-006-070
SYD-GN:tt\REPORT\ENFIELDAUD REV 1

Sydney Ports Corporation
Level 8, 207 Kent Street
Sydney NSW 2000

**Attention: Mr Kevin Davis**

Dear Sir

**SUMMARY SITE AUDIT REPORT**
**ENFIELD MARSHALLING YARD**

I have pleasure in submitting the summary site audit report for the now unused section of Enfield Marshalling Yard which Sydney Ports Corporation has an interest in. A copy of the Site Audit Statement, produced in accordance with the NSW Contaminated Land Management Act 1997, follows the Table of Contents.

Thank you for giving me the opportunity to conduct this audit. Please call me if you have any questions.

Yours faithfully
DAMES & MOORE

Graeme Nyland
Director

## TABLE OF CONTENTS

**Page No.**



## LIST OF ATTACHMENTS



## APPENDIX

## ABBREVIATIONS

| | |
|---|---|
| ALS | Australian Laboratory Services |
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| AST | Above ground Storage Tank |
| BaP | Benzo(a)pyrene |
| BTEX | Benzene, Toluene, Ethylbenzene & Xylenes (Monoaromatic Hydrocarbons) |
| CT | Certificate of Title |
| DLWC | Department of Land and Water Conservation |
| DP | Deposited Plan |
| EPA | Environment Protection Authority (NSW) |
| ha | Hectare |
| LOR | Limit of Reporting |
| MAH | Monocyclic Aromatic Hydrocarbons |
| Mercury | Inorganic mercury unless noted otherwise |
| Metals | As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury, Ba: Barium, Bo: Boron, Co: Cobalt, Mn: Manganese, Mo: Molybdenum, Sn; Tin, Sb; Antimony. |
| m | Metre |
| mg/kg | Milligrams per Kilogram |
| mg/l | Micrograms per Litre |
| mm | Millimetre |
| NATA | National Association of Testing Authorities |
| NC | Not Calculated |
| ND | Not Detected |
| ng/L | Nanograms per Litre |
| NEHF | National Environmental Health Forum |
| NHMRC | National Health and Medical Research Council |
| n | Number of Samples |

| | |
|---|---|
| OCPs | Organochlorine Pesticides |
| OH&S | Occupational Health & Safety |
| OPPs | Organophosphorus Pesticides |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PID | Photoionisation Detector |
| PQL | Practical Quantitation Limit |
| pH | a measure of acidity, hydrogen ion activity |
| QA/QC | Quality Assurance/Quality Control |
| RPD | Relative Percent Difference |
| SVOCs | Semi Volatile Organic Compounds |
| TPHs | Total Petroleum Hydrocarbons |
| UCL | Upper Confidence Limit |
| UST | Underground Storage Tank |
| VOCs | Volatile Organic Compounds |
| XRF | X-Ray Fluorescence |

- On tables is "not calculated", "no criteria" or " not applicable"

Note that analyte lists of the individual analytes included within each of the groups of analytes in the laboratory program are included in the Appendix. The Appendix also contains a method reference.

**SUMMARY SITE AUDIT REPORT**
**ENFIELD MARSHALLING YARD**
***for***
**Sydney Ports Corporation**

## 1. INTRODUCTION AND LOCATION

I have conducted a site audit contamination review of part of the Enfield Marshalling Yards at Cosgrove Road, Strathfield South. The audit was commissioned by Sydney Ports Corporation on 4 December 1998. The site is currently part of Lots 10 and 11, DP 869239. It is shown (**Attachment 1)** as Lot 14 on "Plan of boundary adjustment for Lot 9 in DP 24332 and Lot 4 in DP 869239" dated 18 June 1999. The plan is not yet registered.

The site subject to this audit does not include the currently active diesel-electrical (DELEC) maintenance facility or the Freight Rail Marshalling Yard which neighbour this site.

The audit was conducted for the purpose of determining what investigation or remediation remains necessary before the land is suitable for future industrial use. The review therefore falls within the definition of a non-statutory audit under Section 47(1) (b) (iii) of the NSW Contaminated Land Act 1997 No 140. The use envisaged at this time would involve significant reshaping of the existing site topography.

The scope of work for the audit included review of the following documents prepared by the Consultant, CH2M HILL Australia Pty Ltd. The audit also included discussion with the consultant and site visits.

- Enfield Marshalling Yards – Part A Contamination Assessment – Sampling and Analysis Plan, 22 December 1998.

- Sydney Ports Corporation/Rail Estate Enfield Marshalling Yards Part A – Environmental Contamination Assessment – Volume 1 March 1999.

- Sydney Ports Corporation/Rail Estate Enfield Marshalling Yards Part A – Environmental Contamination Assessment – Volume 2 Appendices, February 1999.

- Sydney Ports Corporation/Rail Estate Enfield Marshalling Yards Part B – Environmental Contamination Assessment – Volume 1 Draft dated April 1999.

- Sydney Ports Corporation/Rail Estate Enfield Marshalling Yards Part B – Environmental Contamination Assessment – Volume 1 Final dated May 1999.

- Sydney Ports Corporation/Rail Estate Enfield Marshalling Yards Part B – Environmental Contamination Assessment – Volume 1 Final Report Revision 1 dated August 1999.

- Sydney Ports Corporation/Rail Estate Enfield Marshalling Yards Part B – Environmental Contamination Assessment – Volume 2 Appendices. Draft dated April 1999, partly revised May 1999, and Appendix F dated August 1999.

Reference numbers given in this report refer to the regulatory guidelines listed in Section 12 of this report.

## 2. SITE CONDITIONS

The site covers 45.78 ha, mainly within the currently unused central area of the Enfield Marshalling Yards.

The site is essentially flat with a gentle slope towards the southeast, except for a number of large soil stockpiles up to 10m high which have been placed on the site. There are a number of unused structures, most in poor repair. They include a wagon repair shed, brick administration building, and former tarpaulin factory. The wagon repair shed has a sealed floor. The tarpaulin factory is an iron and wood structure which has been vandalised.

There are several areas of deteriorating bitumen surface, previously used as car parks. Most of the site has an unsealed surface with crushed rock ballast or aggregate surfacing. A lot of the site is overgrown.

There is fly tipped debris over much of the site. The debris includes building wastes, household wastes, car bodies, railway sleepers and general refuse.

The only visual contamination noted consisted of small scale oil staining.

The site is zoned for industrial use. No change in zoning is anticipated. Neighbouring land uses include industrial and residential. Industrial uses include warehousing, the diesel-electric maintenance facility (on the downslope and downgradient side of the site) and Freight Rail yards. None of the adjacent uses appear to have significant potential to impact the site.

## 3. SITE HISTORY

The site history was investigated mainly by reference to historical records held by State Rail and interviews with railways employees. Documentation is sufficient to be confident that major contaminating activities have been identified. The site was used as a railway marshalling yard between 1916 and 1993. Activities relevant to the contamination status of the site are summarised below and features are indicated on **Attachment 2** .

**Pre 1916**

The site was used for agricultural and grazing purposes. Use of pesticides and herbicides based on arsenic or mercury is possible.

**1916 – 1990**

The site was largely developed as a marshalling yard by the mid 1920s. Site levelling to fill gullies now occupied by stormwater channels would have been conducted prior to laying of railway tracks over most of the site.

A wagon repair shed operated for the life of the yard. The floor was bare earth until it was sealed in the late 1960s. Activities conducted in the shed included stripping and general maintenance of axle boxes, relining of brakes, and internal carriage repairs.

The tarpaulin factory operated between 1925 and 1991. It has an elevated wooden floor. The building has been used to produce tarpaulin/canvas bags from rolls of canvas and to repair tarpaulins. There was reportedly no chemical treatment of fabrics in this factory.

Railway tracks and sidings occupied up to 75% of the site. There is no history of locomotive maintenance or refuelling during the time. Small structures constructed during site development included signal boxes.

The administration building and steel footbridge were constructed in the 1940s. The building is made of brick and has a concrete floor slab. There is no record of chemical use in the building.

Two bitumen car parks were constructed in the 1970s. One of them may be in the location of a former coal bunker.

Most of the track work was removed in the late 1980s.

**1990 – 1999**

During the early 1990s, a large stockpile ("Mt Enfield") which was on the current Freight Rail yard to the west of the site was relocated and sorted into 5 stockpiles on the site. Mt Enfield contained reworked shale and sandstone, plus building rubble, ash, slag, ballast and general debris.

The site has been vacant since 1993. Since then, some material has been added to the stockpiles and debris has been dumped on the site.

The Consultant reports that a Rail Estate representative indicated that no hazardous products were stored on the site. There is therefore no inventory of chemicals and wastes associated with the site. While it seems likely that there would have been some chemical usage, eg. at the Wagon Repair shed, there is no evidence of above or below ground fuel storage tanks nor any other large scale chemical use.

There are inevitably some information gaps due to the long period of site use. However, the site history investigation by the Consultant has been thorough, and it is unlikely that significantly further useful historical information could be obtained.

## 4. CONTAMINANTS OF CONCERN

Based on the site history and features, the site has been divided into a number of areas for assessment purposes. The contaminants of concern are listed below for each area.

| Areas of Site | Potential Source of Contamination | Contaminants of Concern |
|---|---|---|
| Tarpaulin factory | The historical review identified the potential for contamination arising from the application of pesticides/herbicides beneath the building. | Heavy metals and OCPs |
| Wagon Repair Shed | Activities undertaken in the shed included light maintenance of wagons and carriages (i.e. consisting of axle box maintenance/stripping, fixing/fitting/relining asbestos brake shoes, replacing air hoses etc.) | Heavy metals, Asbestos, TPH/BTEX and OCPs/OPPs |
| Administration Building | Possible use of pesticides under floor slab | OCPs, Heavy metals |
| Drainage channels/Low lying areas | Investigations identified significant fill deposits along three drainage lines and former low lying areas. | Heavy metals, PAHs/Phenolics |
| Eastern Boundary | No known activities | Heavy metals |
| Stockpiles | Contents of stockpiles not documented. | Heavy metals, TPH/BTEX, PAHs/phenolics |
| Marshalling Yard (remainder of site) | Fill over site possibly contains ash, hydrocarbon spills possible, abrasion, pesticide and herbicide spraying | Heavy metals, TPH/BTEX, PAHs, phenolics, OCPs/OPPs |

Potential heavy metal contaminants within the Marshalling Yard include arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc. The contaminants listed for the marshalling yard could potentially be found in the other areas of the site with similar fill.

**Appendix A** contains analyte lists for individual analytes within each of the groups of analytes, and also contains references to the analytical methods used.

## 5. SOIL STRATIGRAPHY AND HYDROGEOLOGY

The general profile over the site, from the surface down, can be summarised from information contained in the borelogs as:

- **Stockpiles**

  There are five stockpiles of varying size on the site, up to 10 m high. The stockpiles consist mainly of clayey or sandy soil, in approximately horizontal layers. Minor amounts of ballast and gravel were noted by CH2MHILL in drilling through the stockpiles.

- **Crushed Rock**

  Over most of the site there is a layer of ballast or road base, generally recorded as being about 0.1 m thick.

- **Sand or gravel fill**

  A layer of coarse grained granular fill is found over most of the site. This fill is described as highly heterogeneous. Components of the granular fill include slag, ash, and crushed rock.

  At the northern end of the site, this layer is about 0.5 m thick. In the (filled) Northern Drainage Channel, it reaches its maximum thickness of 6.5 m. It is up to 4 m thick between the Northern and Central Drainage Channels, decreasing to the south. Within the Central Drainage Channel it is up to 3 m thick, generally 1.5 m thick. South of the Central Drainage channel, the thickness is generally less than 0.7 m except in the Southern Drainage Channel where it is up to 1.5 m thick.

- **Clay Fill**

  Clay fill underlies the granular fill. In only a few bores a thin lens of ash or sand was noted in this fill. The thickness of clay fill is probably variable and up to a few metres, but it is difficult to distinguish from the underlying residual clay and the borehole logs do not usually distinguish them.

- **Residual Clay**

  Residual clay formed on shale underlies the site. Fragments of rock are noted in places.

- **Bedrock**

  Bedrock consists of shales, siltstone and sandstone of the Wianamatta Group. This unit was not cored in the investigation, but some wells were placed into the top of the rock.

During monitoring well installations, inflow of groundwater was noted on borelogs to be generally at the top of bedrock, and occasionally at the base of granular fill or from clay layers (possibly at the interface between fill and natural clay).

CH2MHILL describe a two aquifer system, with shallow waters dominated by sodium bicarbonate and deep waters by sodium chloride. This appears generally true but there are few shallow wells which intercept water as they are mainly screened within clay fill, and some of the deeper wells have sodium bicarbonate or mixed waters. CH2MHILL indicate a flow direction towards the south east, with mounding in a recharge area between the Northern and Central Drainage Lines. Mounding in this area is consistent with the presence of thick granular fill. The most likely flow path for perched water would appear to be through the granular fill and to be controlled by the topography of the lower permeability clay fill.

Standing water levels in wells vary between 1 m and 8 m below existing ground level. It appears that the groundwater is slightly confined and rises, but not to the level of the perched water.

## 6. QUALITY ASSURANCE AND QUALITY CONTROL PLAN

A sampling and analysis plan was produced by CH2MHILL prior to the Part A field investigations, and included a laboratory data evaluation plan. The main factors affecting the quality of the data obtained are briefly outlined below.

- field investigation locations were selected on the basis of detailed site history evaluation and were appropriate;

- in areas of the site in which the site history indicates that contamination hotspots are possible, the density of sampling and analysis was in accordance with Reference 15. Over the remainder of the site, a lower density, aimed at detecting major broad scale contamination, was adopted. This provided a sufficient database for this stage of the investigation. Further investigation or validation of some areas at greater sampling density will be required.

- field soil sampling was conducted directly off augers without use of split samplers. This was adequate for this stage of the investigation because most of the contaminants of concern were of low volatility, and soils were to be screened for volatile components using a photoionisation detector (PID). Data relating to the PID calibration and screening results are not included in the reports reviewed, and were apparently kept in field books. They could therefore not be included in the audit and the Auditor cannot verify that laboratory analyses targeted potential volatile contaminants;

- a portable XRF was used by the Consultant for field screening of metals. Calibration details were not provided and the results have not been included in or relied on for this audit.

- the analytical laboratories used are NATA registered for the analyses conducted, and practical quantitation limits, except for some analyses for cadmium in groundwater, which do not impact the findings of this audit, were appropriate;

- except as discussed in Section 8, the analyte lists agreed with the contaminants of concern;

- chain of custody documentation and laboratory certificates indicate that laboratory analyses were conducted within holding times;

- the laboratory internal quality control results for matrix spikes, matrix spike duplicates, duplicates and surrogates were within laboratory control limits with minor exceptions which do not impact on the findings of this audit;

- there does not appear to have been any groundwater blank or rinsate samples. (Groundwater evaluation is further discussed in Section 9);

- field duplicate results for soils were within 30% RPD with some exceptions. CH2MHILL attributed the higher RPD results to the heterogeneous sample matrix. A review of the exceedences indicates that they are nearly all at low concentrations which are near the detection limit and well below environmental criteria. Where that is not the case, the results are within the same grouping for assessment purposes and represent a very small percentage of the data set. They therefore do not significantly impact the conclusions of the audit;

- field duplicate results for contaminants of concern in groundwater are within acceptable RPDs. (Some results for manganese and iron exceeded RPD goals, but do not impact the findings of the audit).

- low concentrations of TPH were found in a number of groundwater samples by the project laboratory (ALS). A repeat round of sampling was conducted with samples analysed by both ALS and Amdel. ALS again detected TPH but Amdel did not. Given the low concentrations (all <1 mg/L), widespread nature, and lack of sources on site, it is likely that the positive TPH detections are false, but this is not certain; and

- metals were also analysed by both laboratories in Round 3. To assess the reliability of the metals analyses, results from selected wells are compared for three rounds of analysis by ALS and one by Amdel and are summarised in the tables below. The results indicate considerable fluctuations over the three rounds. The intralaboratory duplicates were generally within the same order of magnitude with some exceptions especially for copper. The interlaboratory duplicates were generally in agreement with several notable exceptions. It is concluded that the results can be used for general assessment of metals but that there is some doubt about the absolute concentrations.

## COMPARISON OF RESULTS

(Shaded values exceed Consultants Criteria, units are mg/l)

Zinc (Criteria 0.05)

| WELL | ALS | | | AMDEL |
|---|---|---|---|---|
| | Round 1 | Round 2 | Round 3 | Round 3 |
| 2 | - | - | 0.301 | 0.36 |
| 3 | 1.36 | 2.03 | 0.681 | 0.95 |
| 4 | 0.306 | - | 0.011 | 0.01 |
| 5 | 0.893 | 0.457 | 0.119 | 0.11 |
| 6 | 0.251 | 0.311 | 1.27 | 0.066 |
| 7 | 0.064 | 0.025 | 0.018 | 0.016 |

Arsenic (Criteria 0.05)

| WELL | ALS | | | AMDEL |
|---|---|---|---|---|
| | Round 1 | Round 2 | Round 3 | Round 3 |
| 2 | - | - | 0.02 | 0.015 |
| 3 | 0.09 | 0.165 | 0.1 | 0.13 |
| 4 | <0.01 | - | <0.01 | 0.001 |
| 5 | <0.01 | <0.001 | <0.01 | <0.005 |
| 6 | <0.01 | <0.001 | <0.01 | <0.005 |
| 7 | <0.01 | 0.002 | <0.01 | 0.003 |

Cadmium (Criteria 0.002)

| WELL | ALS | | | AMDEL |
|---|---|---|---|---|
| | Round 1 | Round 2 | Round 3 | Round 3 |
| 5 | 0.012 | 0.002 | <0.001 | 0.002 |

Copper (Criteria 0.005)

| WELL | ALS | | | AMDEL |
|---|---|---|---|---|
| | Round 1 | Round 2 | Round 3 | Round 3 |
| 2 | - | - | 0.003 | 0.005 |
| 3 | 0.01 | 0.05 | 0.002 | 0.004 |
| 4 | 0.007 | - | <0.001 | 0.002 |
| 5 | 0.051 | 0.174 | 0.004 | 0.005 |
| 6 | 0.018 | 0.307 | 0.351 | 0.01 |
| 7 | 0.001 | 0.019 | <0.001 | 0.001 |
| 12D | - | 0.64 | 0.006 | 0.012 |
| 14 | - | 0.252 | 0.035 | 0.032 |
| 15 | - | 0.117 | 0.002 | 0.002 |

## 7. ENVIRONMENTAL QUALITY CRITERIA

The environmental quality criteria used by the Consultant for the site investigation are listed below for soil and groundwater.

### Soil

| Analyte | Criteria (mg/kg) | Analyte | Criteria (mg/kg) |
|---|---|---|---|
| Arsenic | 500 | Styrene | 100 |
| Cadmium | 100 | 1,3,5 – Trimethylbenzene | 3 |
| Chromium (trivalent) | 60% | Chloromethane | 1.2 |
| Chromium (hexavalent) | 500 | Vinyl Chloride | 0.1 |
| Copper | 5000 | Bromomethane | 6.8 |
| Lead | 1500 | 1,1 – Dichloroethene | 0.037 |
| Nickel | 3000 | Cis 1,2 – Dichloroethene | 31 |
| Zinc | 35,000 | 1,1,1 – Trichloroethane | 50 |
| Mercury (inorganic) | 75 | Carbon Tetrachloride | 0.23 |
| Phenolics | 42,500 | Trichloroethane | 60 |
| TPH ($C_6$-$C_9$) | 65 | Dibromomethane | 0.0049 |
| TPH ($C_{10}$-$C_{36}$) | 5,000 | 1,1,2 – Trichloroethane | 50 |
| Benzene | 1 | Tetrachloroethene | 4 |
| Toluene | 1.4 | 1,1,1,2 – Tetrachloroethane | 2.4 |
| Ethylbenzene | 3.1 | 1,1,2,2,- Tetrachloroethane | 0.45 |
| Xylenes (total) | 14 | 1,2,3 – Trichloropropene | 0.0014 |
| PAHs/B(a)P | 100/5 | 1,2 – Dibromo – 3 – chloropropane | 0.2 |
| OCPs (total) | 10 | Hexachlorobutadiene | 0.1 |
| OPPs (individual) | 10 | Chlorobenzene | 15 |
| PCBs | 50 | 1,3 – Dichlorobenzene | 2.5 |
| 2 – Chlorotoluene | 160 | 1,2 – Dichlorobenzene | 2.5 |
| 1,4 – Dichlorobenzene | 4.0 | Bromodichloromethane | 0.63 |
| 1,2,4 – Trichlorobenzene | 0.5 | Bromoform (Tribromomethane) | 56 |
| Dibromochloromethane | 5.9 | Asbestos | - |

## Groundwater

| Analyte | Criteria (µg/L) | Analyte | Criteria (µg/L) |
|---|---|---|---|
| Arsenic | 50 | TPH ($C_6$-$C_9$) | |
| Cadmium | 2 | TPH ($C_{10}$-$C_{36}$) | |
| Chromium (trivalent) | 10 | Benzene | 300 |
| Copper | 5 | Toluene | 300 |
| Lead | 5 | Ethylbenzene | 140 |
| Nickel | 150 | Xylene | 380 |
| Zinc | 50 | PAHs (total) | 3 |
| Mercury | 0.1 | OCPs (total) | 106 ng/L |
| Phenolics | 50 | OPPs (total) | 185 ng/L |
| Hexachlorobutadiene | 0.1 | PCBs | 0.001 |
| Chlorobenzene | 15 | 1,3 – Dichlorobenzene | 2.5 |
| 1,4 – Dichlorobenzene | 4.0 | 1,2 – Dichlorobenzene | 2.5 |
| 1,2,4 – Trichlorobenzene | 0.5 | | |

The primary assessment guidelines used were:

- Health based investigations for commercial or industrial settings (NEHF F) included in the EPA "Guidelines for the NSW Site Auditor Scheme" (Reference 12); and

- ANZECC (1992) "Australian Water Quality Guidelines for Fresh and Marine Waters", summary guidelines for protection of aquatic ecosystems, fresh waters (Reference 2). It is noted that the guideline quotes a range for some metals, and consultant quotes the upper limit of the range without providing justification. The implications of this are discussed in Section 9.

The proposed site usage is industrial. Groundwater under the site likely discharges to the Cooks River to the east of the site. The Auditor therefore considers that use of these assessment guidelines is appropriate.

The Consultant also refers to other guidelines for analytes which are not included in the primary assessment guidelines. The *"Guidelines for Assessing Service Station Sites*" (Reference 10) has been referred to by the Consultant in assessing TPH concentrations. Dutch Intervention Values contained in *Environmental Quality Objectives in The Netherland,* published by the Dutch Ministry of Housing, Spatial Planning and the Environment, have been referred to for those pesticides for which there is no NEHF guideline. USEPA Region 9: "Preliminary Remediation goals – Residential Soil" are also referred to. Use of these additional guidelines is not endorsed by the Auditor and were only considered by the Auditor where relevant to the results obtained.

## 8. SOIL ANALYTICAL RESULTS AND EVALUATION

The site has been subdivided into seven discrete areas (**Attachment 2**) for investigation purposes. Analytical results are discussed below for the different areas of the site.

### A. TARPAULIN FACTORY

The tarpaulin factory covers an area of approximately 0.5 ha in the south east corner of the site. The analytical results for selected contaminants (mg/kg) can be summarised as:

| Analyte | n | Detections | Average 95th UCL | Maximum | NEHF F | n> criteria |
|---|---|---|---|---|---|---|
| Arsenic | 24 | 24 | 14 | 38 | 500 | 0 |
| Cadmium | 24 | 11 | 3 | 11 | 100 | 0 |
| Copper | 24 | 24 | 172 | 979 | 5000 | 0 |
| Nickel | 24 | 24 | 9 | 29 | 3000 | 0 |
| Lead | 24 | 24 | 2035 | 15200 | 1500 | 3 |
| Zinc | 24 | 24 | 665 | 2520 | 35000 | 0 |
| Mercury (inorganic) | 2 | 2 | - | 0.2 | 75 | 0 |
| OCP | 24 | 4 | - | 1.15 | - | 0 |
| OPP | 24 | 0 | - | - | - | 0 |

The soil profile under the tarpaulin factory in two hand auger holes was described as sand to 0.35m over clay in one hole and clay from the surface in the other. The soil type of the other samples is not recorded. All samples are recorded as being obtained from a depth of 0-0.1 m or 0-0.15 m. This is appropriate for the contaminants of concern in this area.

Lead, copper and zinc in a number of locations and in one sample, arsenic and cadmium exceed probable background concentrations. Only lead exceeds the industrial soil criteria in 3 samples, 2 only marginally. There is no clear distribution pattern to the elevated metals, except that they are associated with each other. No material type information is presented.

The sample with the highest lead concentration was re-analysed, homogenised and re-analysed again. Samples were also obtained from 2m away from the sample location. Results (mg/kg)were:

**Duplicates:** 15200, 175

**Homogenised duplicates**: 175, 702, 1190, 2110, 1320, 2230

**Samples 2m away:** 64, 228, 389, 595

It is concluded that the high lead concentration is of very limited extent and does not warrant further action. Sampling density in the tarpaulin factory area exceeded the minimum requirements of the EPA Sampling Design Guidelines (Reference 15) for hotspot detection.

Mercury was listed in the Consultant's Work Plan as a contaminant of concern but was analysed for in only 2 samples. It was subsequently deleted from the contaminants of concern. This deletion is reasonable for this area based on the site history presented.

Analyses were also conducted for OCPs, OPPs, TPH, BTEX, phenols and PAHs. No results requiring further action were obtained. OPPs had been included as chemicals of concern, but none were detected. (Limits of Reporting-LOR are indicated in the **Appendix**).

It is concluded that no further investigation or remediation is required in this area.

## B. WAGON REPAIR SHED

The wagon repair shed and immediate surrounds cover an area of approximately 0.25ha. The analytical results (mg/kg) can be summarised as:

| Analyte | n | Detections | Average 95$^{th}$ UCL | Maximum | NEHF F | n> Criteria |
|---|---|---|---|---|---|---|
| Arsenic | 40 | 40 | 89 | 211 | 500 | 0 |
| Cadmium | 40 | 28 | 6 | 28 | 100 | 0 |
| Chromium (total) | 40 | 40 | 14 | 65 | 500 (Cr $6^{+}$) | 0 |
| Copper | 40 | 40 | 715 | 8010 | 5000 | 1 |
| Nickel | 40 | 40 | 20 | 68 | 3000 | 0 |
| Lead | 40 | 40 | 518 | 1500 | 1500 | 0 |
| Zinc | 40 | 40 | 851 | 4350 | 35000 | 0 |
| Mercury (inorganic) | 5 | 0 | - | - | 75 | 0 |
| OCPs (total) | 16 | 1 | - | 0.68 | - | 0 |
| OPP | 16 | 0 | - | - | - | 0 |
| TPH $C_6 - C_9$ | 40 | 0 | - | - | - | 0 |
| TPH $C_{10} - C_{36}$ | 40 | 31 | 1911 | 16416 | - | 1 |
| Phenols | 40 | 6 | 5 | 79 | 42500 | 0 |

| Analyte | n | Detections | Average 95th UCL | Maximum | NEHF F | n> Criteria |
|---|---|---|---|---|---|---|
| PAHs | 40 | 30 | 11 | 112 | 100 | 1 |
| Asbestos | 16 | 4 | - | - | - | NA |

An industrial criteria for TPH $C_{10}$-$C_{36}$ of 5,000 mg/kg was derived by the Consultant by multiplying the threshold concentration for sensitive landuse in the NSWEPA *"Guidelines for Assessing Service Station Sites"* (Reference 10) by a factor of 5 in accordance with exposure scenarios used by Taylor and Langley (Reference 5). This approach appears reasonable for this application.

All but 4 of the samples were taken from the surface of the soil directly beneath the bitumen seal (where present). The other four samples were obtained from 0.1-0.2m below the ground surface. All results are included in the statistics. In general, subsurface conditions beneath and around the Wagon Repair shed consist of 200 mm of sand or gravel overlying clay.

The results indicate elevated (in relation to typical background) concentrations of arsenic, copper, lead, zinc and heavy end TPH, in many samples, and cadmium, PAH and phenols in some samples. No light end TPH or BTEX were detected, but all samples were from shallow depth. The highest TPH and lead concentrations are distributed within and around the shed without any noticeable pattern, indicating that they were sourced from activities prior to sealing of the shed floor.

In all cases, except one result each for copper, TPH and total PAHs, the concentrations are below the industrial criteria. In all cases, the average result (95th UCL) is well below the industrial criteria.

A trace of asbestos was detected in 25% of the samples inspected. There are no EPA endorsed criteria for asbestos. (The method used and an explanation of the results obtained are included in the **Appendix**).

The Consultant recommends remediation of soil containing TPH and asbestos in the vicinity of the wagon repair shed.

## C. ADMINISTRATION BUILDING

Eight samples from beneath the administrations building were analysed for some heavy metals and OPPs. There was one detection of OPPs (mainly endrin at 0.76 mg/kg) and some elevated metals, but all results were well below industrial criteria.

It is concluded that no further investigation or remediation is required in this area for industrial use.

## D. DRAINAGE LINES

Samples obtained from boreholes placed in drainage lines were analysed for heavy metals. However, most of the samples analysed were from shallow soils, with only two samples from deeper than 1m. It is known that fill from the drainage lines is up to 6.5m deep. It is not clear if these samples, which did not contain elevated metals, represent the typical fill. No analyses were conducted for organic contaminants, and organic field screening results are not included in the reports. Any contaminants present would not impact site users, but could impact groundwater.

## E. EASTERN BOUNDARY

The eastern boundary area covers approximately 3ha. There were 7 sampling locations from which samples were analysed for some heavy metals, and 3 locations from which samples were analysed for mercury, OCPs, OPPs, TPH, Phenols and PAHs. There were some detections of elevated metals, especially lead (maximum 208 mg/kg) and zinc (maximum 382 mg/kg), and some TPH ($C_{10}$-$C_{36}$, maximum 339 mg/kg). Concentrations detected in the limited number of analytical tests were well below industrial criteria. Logs are not presented for some of the soils analysed. The consultant concludes that the soils in the Eastern Boundary area are unlikely to pose a potential threat to the environment and/or human health, and that the soils will be covered under SPC's landscaping plan. While the concentrations are all well below industrial criteria, the results clearly indicate contaminants above background concentrations. As the sampling density is relatively low (falling below the recommended 40 investigation locations in Reference 15), there is a possibility of undetected hot spots. Further investigation and validation of any exposed soil after development in this area is therefore warranted.

## F. STOCKPILES

Samples were taken from boreholes drilled through the stockpiles. The analytical program for the contaminants of concern was:

| Contaminant of Concern | Number of Analyses | | | | |
|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S5 |
| Metals | 11 | 54 | 10 | 18 | 13 |
| TPH | 5 | 0 | 0 | 0 | 0 |
| BTEX | 5 | 0 | 0 | 0 | 0 |
| PAHs | 0 | 0 | 0 | 0 | 0 |
| Phenolics | 0 | 0 | 0 | 0 | 0 |

A few elevated concentrations of arsenic, copper, lead and zinc were recorded, but all were well below industrial criteria. The borehole logs give no indications of organic contaminants. Samples were apparently screened by PID for volatile organics, but no results are presented. Further characterisation of the stockpiles will be required for reuse on site or disposal.

## G. MARSHALLING YARDS

Samples analysed from the marshalling yards consisted of the initial sampling of 21 locations around the yard, and follow-up sampling and analysis for some metals in four areas. For the initial sampling, the results (mg/kg) including duplicates can be summarised as:

| Analyte | n | Detection | Average 95$^{th}$ UCL | Maximum | NEHF F | n> Criteria |
|---|---|---|---|---|---|---|
| Arsenic | 22 | 22 | 136 | 337 | 500 | 0 |
| Cadmium | 22 | 3 | - | 39 | 100 | 0 |
| Copper | 22 | 22 | 187 | 708 | 5000 | 0 |
| Lead | 22 | 22 | 163 | 590 | 1500 | 0 |
| Zinc | 22 | 22 | 478 | 1680 | 35000 | 0 |
| Mercury | 22 | 22 | - | 0.8 | 75 | 0 |
| OCPs | 22 | 2 | - | 0.64 | - | 0 |
| OPPs | 22 | 0 | - | - | - | 0 |
| TPH $C_6$-$C_9$ | 22 | 0 | - | - | - | 0 |
| BTEX | 13 | 0 | - | - | - | 0 |
| Phenols | 22 | 2 | - | 3 | 42500 | 0 |
| PAHs | 22 | 9 | - | 3 | 100 | 0 |

While no results were above industrial criteria, there were elevated concentrations of arsenic, copper, lead and zinc in many locations and cadmium in some locations. Follow-up sampling and analysis was conducted for those metals, proceeded by field screening with an XRF. The XRF results have not been included in the audited results, but provide a good indication of the variations within the site. Overall data from the laboratory analysis can be summarised as:

| Analyte | n | Detections | Average 95$^{th}$ UCL | Maximum | NEHF F | n> Criteria |
|---|---|---|---|---|---|---|
| Arsenic | 66 | 66 | 176 | 608 | 500 | 1 |
| Cadmium | 44 | 17 | 6 | 39 | 100 | 0 |
| Copper | 45 | 45 | 142 | 708 | 5000 | 0 |
| Lead | 45 | 45 | 122 | 590 | 1500 | 0 |
| Zinc | 66 | 66 | 415 | 1680 | 35000 | 0 |

Only one individual sample marginally exceeded the industrial criteria for arsenic.

Eight samples were analysed for asbestos, and it was detected by polarised light microscopy in one of the samples. The low sampling density and positive detection indicate that there is the potential for asbestos to be found in other areas of the site.

Due to the low sampling density over this large area, it is concluded that there is a possibility of undetected contamination of unacceptable dimension, and that validation of exposed areas should be conducted after site development.

## 9. GROUNDWATER RESULTS AND EVALUATION

Well locations are indicated on **Attachment 3**. A summary of the wells installed is shown on the following table. The table also shows the analytical results for zinc, copper and arsenic, which were analytes consistently found at above background concentrations in site soils. Elevated lead and cadmium were also found in soil in some locations. (The results shown on the table are for sampling Round 2 except as noted – there is some variability of results between the three Rounds of sampling).

Copper and zinc are consistently detected in the majority of the wells at above the criteria (Note: that the ANZECC guidelines quote a range for both zinc and copper, depending on water hardness, and the table highlights results exceeding the higher end of the range. As noted on the following table, the shallow water is soft. Therefore, the lower end of the range is more applicable).

Cadmium exceeded the criteria in Round 1 in MW5. Results for later rounds were much lower. The ANZECC guideline for cadmium is 0.2 – 2 μg/L, and the analytical detection limit was 1 μg /L except for the Amdel results in Round 3. In Round 3, MW5 concentration was at the lower end of the guideline range, and MW9D was within the range. The results indicate that there is not widespread cadmium contamination of groundwater. Lead and nickel were detected above guidelines in isolated results, but there is not widespread or consistent contamination.

The concentration of zinc is above criteria in most wells. Highest concentrations were recorded in MW9D, a well screened in clay and bedrock on the upgradient end of the site, and MW3, screened in granular fill and clay in the recharge zone of deep fill towards the centre of the site. The concentration of zinc in MW9S, a shallower well screened in clay, is much less ($1/7^{th}$) than MW9D, but still exceeds the guideline by 7 times. The concentration of zinc in the wells on the downgradient boundary (MW5, MW6, MW8, MW15) all exceed the guideline. These wells are all screened in clay. The zinc concentrations over the site do not indicate a concentration gradient, and do not form a statistically normal distribution.

Copper concentrations exceed criteria in many wells in Round 2, but concentrations were generally lower in Round 3. There is no apparent correlation between copper and zinc concentrations. The highest copper concentrations were recorded in wells MW6, screened in clay on the downgradient boundary, and MW9D on the upgradient end. There is no apparent pattern to the results.

## WELL SUMMARY

| Well No. | Screened Material | Inflow Recorded in Field | Cation/Anion | Relative Salinity/ Hardness | pH | Zinc (0.005 0.05 mg/l) | Copper (0.002 – 0.005 mg/l) | Arsenic (0.05mg/l) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Partly in granular fill | Base of granular fill | Dry | - | | - | - | - | |
| 2 | Below granular fill in clay | In clay | - | - | 7.1 | 0.301 | 0.003 | - | |
| 3 | Base of granular fill and clay | Base of granular fill | Mix | Fresh/very hard | 6.3 | 2.03 | 0.05 | 0.165 | |
| 4 | Clay | In clay | Bicarbonate | Brackish | 7.1 | 0.011 | <0.001- | - | |
| 5 | Clay | None | Chloride | Very saline/very hard | 5.6 | 0.457 | 0.174 | <0.001 | Downgradient boundary |
| 6 | Clay | Top of rock beneath clay | Chloride | Saline/hard | 5.8 | 0.311 | 0.307 | <0.001 | Downgradient boundary |
| 7 | Clay beneath shallow fill | In clay, top of weathered rock | Bicarbonate | Brackish to fresh;/soft | 6.9 | 0.025 | 0.019 | 0.002 | |
| 8 | Clay | None | Dry | - | 6.7 | 0.205 | 0.01 | - | |
| 9S | Clay | None | Dry | - | - | 0.332 | 0.009 | - | |
| 9D | Clay | In clay/top of rock | Chloride | Very saline/very hard | 6.7 | 2.72 | 0.46 | 0.007 | Upgradient side of site |
| 10S | Clay | None | Dry | - | - | - | - | - | |
| 10D | Weathered rock | At top of rock | Bicarbonate | Brackish to fresh/hard | 7.8 | 0.033 | 0.004 | 0.002 | |
| 11 | Clay beneath deep fill | At top of rock | Mix | Saline/very hard | 6.8 | 0.034 | 0.02 | 0.002 | |
| 12S | Clay | In clay | - | - | - | - | - | - | |
| 12D | Clay | In clay, near top of rock? | Chloride | Very saline/very hard | 6.8 | 0.669 | 0.64 | <0.001 | |
| 13S | Clay | None | - | - | - | - | - | - | |
| 13D | Clay, into top of rock? | In clay | Bicarbonate | Brackish to fresh/ med. hard | 6.8 | 0.02 | 0.018 | 0.002 | |
| 14 | Clay, into top of rock | At top of rock? | Chloride | Very saline/very hard | 6.7 | 0.265 | 0.252 | 0.006 | |
| 15 | Clay/shale | None | Chloride | Saline/hard | 7.0 | 0.189 | 0.117 | 0.004 | |
| 16S | Clay | None | Insufficient sample | - | 6.4 | 0.006 | 0.002 | - | |
| 16D | Clay/siltstone | None | Chloride | Saline/hard | 6.6 | 0.026 | 0.014 | 0.003 | |

*Analytical Results for Wells 2, 4, 8, 9S and 16S form ALS Round 3, others Round 2.*
*Anzecc Guideline for Protection of Aquatic Ecosystems, Fresh Water.*

Data for metals concentration on the deeper Ashfield Shale aquifer indicate a decreasing trend over the site. The (at least partially) confined nature of the aquifer, and the lack of evidence of downward migration of metals in the fill, also indicate that metal concentrations in the deep aquifer are unlikely to be related to the site activities, and are more likely to reflect the regional (degraded) background conditions.

The relationship between metals in shallow (perched) groundwater and metal concentrations in the fill is not clear, nor are the potential flow paths offsite. It is probable that metal concentrations in the fill are impacting the quality of the perched water.

Low concentrations of petroleum hydrocarbons were detected in scattered wells. The detections were not confirmed by a check laboratory, which reported all samples at concentrations below the LOR. The concentrations are very low and the distribution indicates that they are not related to site activities.

## 10. ASSESSMENT OF RISK

Risk has been assessed with reference to applicable guidelines and criteria as discussed in the previous sections.

The site is large, and the overall density of sampling is relatively low except in areas of targeted sampling. However, the database is large, and the results obtained across the site are consistent, so there is a high degree of confidence in the representativeness of the results obtained.

Elevated metals results are found in soils over the site, but very few individual results exceeded industrial guidelines. The metals are associated with fill material, and the distribution is not uniform, so there is a possibility that higher concentrations could be found in places which could potentially present a risk to site users.

Heavy end petroleum hydrocarbons were found in surface soils near the wagon repair shed. This represents a low risk to site users.

Asbestos fibres were detected in some soil samples. This potentially poses a low risk to site users, which cannot be quantified.

There is a risk that there are contaminants within the stockpiles due to their heterogeneous nature. There is also a risk of isolated contamination due to the indiscriminate dumping which has occurred over the site.

The groundwater contains concentrations of metal contamination, principally zinc and copper. The groundwater will not pose a risk to site users, but exceeds guidelines for protection of aquatic ecosystems, and therefore poses a risk if it discharges to a water body. The most likely discharge point is the Cooks River, which is approximately 300 m from the site.

The site is currently unused. Development of the site is likely to result in sealing or covering of the existing soils. This will minimise or eliminate any risk to site users.

## 11. EVALUATION OF REMEDIATION

Remediation has not been conducted. CH2MHILL recommend soil remediation in the area of the wagon repair shed for TPH and asbestos.

## 12. COMPLIANCE WITH REGULATORY GUIDELINES AND DIRECTIONS

Currently applicable guidelines, referenced by number in this audit report, are:

**AUSTRALIAN AND NEW ZEALAND ENVIRONMENT AND CONSERVATION COUNCIL (ANZECC) PUBLICATIONS**

**1** ***Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*****,** published by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC), January 1992.

**2** ***Australian Water Quality Guidelines for Fresh and Marine Waters.*** ANZECC, November 1992.

**3** ***Guidelines for the Laboratory Analysis of Contaminated Soils.*** ANZECC, August 1996.

**NATIONAL ENVIRONMENTAL HEALTH FORUM MONOGRAPHS**

**4** ***Health-Based Soil Investigation Levels,*** by Imray, P. and Langley, A., National Environmental Health Forum Monographs, Soil Series No.1 1998, 2nd edition, SA Health Commission, Adelaide.

**5** ***Exposure Scenarios and Exposure Settings,*** by Taylor, R. and Langley, A., National Environmental Health Forum Monographs, Soil Series No.2, 1998, 2nd edition, SA Health Commission, Adelaide.

**6** ***Composite Sampling,*** by Lock, W.H., National Environmental Health Forum Monographs, Soil Series No.3, 1996, SA Health Commission, Adelaide.

**OTHER DOCUMENTS**

**7** ***Guidelines for Drinking Water Quality in Australia,*** NHMRC & Australian Water Resources Council, 1996

**8** ***Guidelines for the Assessment and Cleanup of Cattle Tick Dip Sites for Residential Purposes,*** NSW Agriculture and CMPS&F Environmental, February 1996.

**9** ***Guidelines for Assessing Banana Plantation Sites,*** October 1997, EPA publication 97/37.

**10** ***Guidelines for Assessing Service Station Sites,*** December 1994, EPA publication 94/119.

**11** ***Guidelines for Consultants Reporting on Contaminated Sites,*** November 1997, EPA publication 97/104.

**12** ***Guidelines for the NSW Auditor Scheme***, June 1998***,*** EPA publication 98/58.

**13** ***Guidelines for the Vertical Mixing of the Soil on Former Broad-Acre Agricultural Land,*** January 1995, EPA publication 95/2.

**14** ***Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report,*** April 1999, EPA publication 99/8.

**15** ***Sampling Design Guidelines,*** September 1995, EPA publication 95/59.

The investigation was conducted generally in accordance with the "Guidelines for Consultants Reporting on Contaminated Sites" (Reference 11 above). The checklist included in that document has been completed by the Auditor and is kept on file. The EPA's "Preliminary Draft Checklist for Site Auditors using the EPA Guidelines for the NSW Site Auditor Scheme" has also been completed by the Auditor and is kept on file.

The Consultant does not identify any consents, licenses, notifications or other regulatory requirements for the site. It is understood that well licenses were not obtained from DLWC.

## 13. CONTAMINANT MIGRATION POTENTIAL

The concentrations of some metals in soils exceed guidelines for residential sites. There are some residential properties near the site. Those soils are generally covered with crushed rock and according to the borelogs are coarse textured soils. Significant migration in dust is therefore not likely.

Groundwater in the deep aquifer on the downgradient boundary of the site contains elevated concentrations of heavy metals. It is likely that offsite migration of contaminants in groundwater is occurring. However these contaminants have probably not originated on the site.

It is also possible that offsite migration of contaminants in shallow perched water is occurring. Flow paths and volumes of perched water are not well defined, and the monitoring wells are not placed to definitely detect offsite migration.

It is concluded that the shallow groundwater on site has low level contamination by heavy metals. The absence of flow paths offsite has not been demonstrated. While risk to offsite water bodies is likely to be very low, this likelihood cannot be definitely shown by the currently available data. If site development does not prevent formation of shallow perched water, further investigation of the potential for offsite migration should be conducted.

The site owner needs to consider the possibility of a significant risk of harm from offsite migration of contaminants in groundwater.

## 14. CONCLUSIONS AND RECOMMENDATIONS

The conclusions below are made as a result of the audit conducted. These conclusions are made in the context of a site which is currently unused, and for which the potential future use would involve considerable site redevelopment and surface regrading.

- The site audited is suitable for industrial use, subject to some soil remediation and validation during redevelopment,

- Soil remediation in the area of the wagon repair shed should be conducted prior to site redevelopment;

- Flytipped material which could contain contamination should be removed prior to site redevelopment;

- There is little risk of undetected major soil contamination above industrial criteria, but validation of final exposed surfaces should be conducted as there is a possibility of contamination which has not been detected. The validation should be for the identified contaminants of concern, and should be at a density recommended in the EPAs Sampling Design Guidelines;

- The material within the stockpiles can be reused in site redevelopment with little risk of major soil contamination, but validation of final exposed surfaces should be conducted as there is a possibility of isolated contamination;

- Investigation should be conducted of any soils found during site redevelopment which are visually contaminated or which are different from the soils encountered in the investigation;

- Groundwater is contaminated with heavy metals. The metals in the groundwater are generally those found at elevated concentrations in the site soils. The source of the groundwater contamination has not been established. Contamination of deep groundwater has probably not originated on the site.

- Groundwater is unlikely to be used or be useable on site, so the groundwater contamination will not inhibit industrial use of the site.

- The shallow ground water on site has low level contamination by heavy metals. The absence of flow paths offsite has not been demonstrated. While risk to offsite water bodies is likely to be very low, this likelihood cannot be definitely shown by the currently available data.

## 15. OTHER RELEVANT INFORMATION

This non-statutory audit was conducted for Sydney Ports Corporation, for their purpose of assessing their current requirements. It may not be suitable for other users. The consultant, CH2MHILL, has included Limitations in their investigation report. The audit must also be subject to those limitations. The Auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which he had some control or is reasonably able to check.

It is not possible in a Summary Site Audit Report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced investigation reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

* * *

Yours faithfully
DAMES & MOORE

*Graeme Nyland*
NSW Site Auditor 9808
Contaminated Land

*Attachments:* *1.* *Survey Plan*
*2.* *Site Layout*
*3.* *Monitoring Well Locations*

*Appendix* *Analyte Lists and Method Reference*

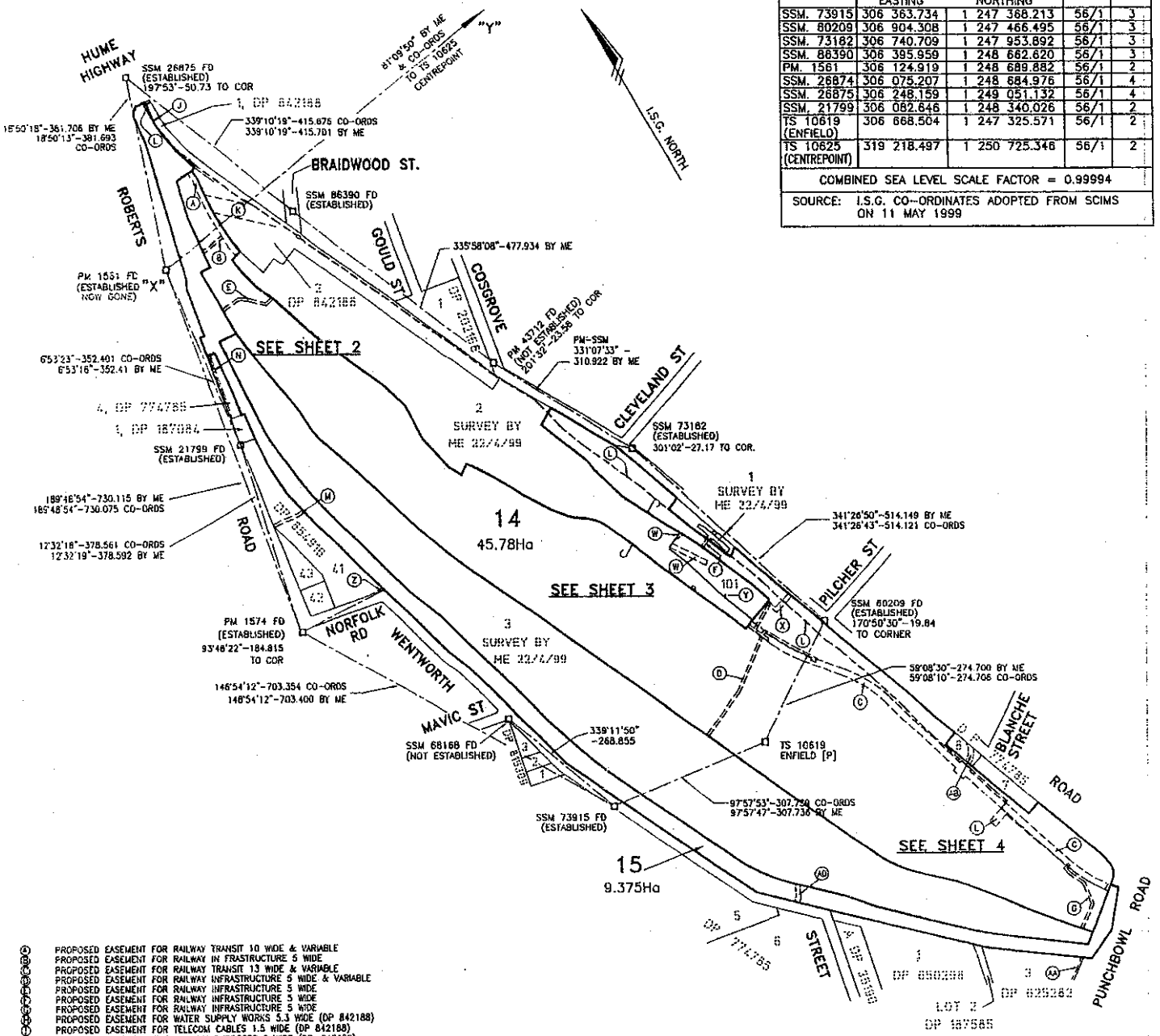
# APPENDIX A
# ANALYTE LISTS AND METHOD REFERENCE

This Appendix contains examples of laboratory test certificates from the investigation reports, containing lists of the individual analytes included within each of the groups of analytes in the laboratory program. References to the laboratory analytical methods used are also given.

# Attachments

NATURES SEALS AND STATEMENTS of intention to
locate pu or to cre reserves, restriction. se of for
erves e. tive covenants.

| SUI (PRAC EGULAT 96 : ( 32(2) | | | | |
|---|---|---|---|---|
| MARK | I.S.G. CO-ORDINATES EASTING | NORTHING | ZONE | ACC. |
| SSM. 73915 | 306 363.734 | 1 247 388.213 | 56/1 | 3 |
| SSM. 80209 | 306 904.308 | 1 247 466.495 | 56/1 | 3 |
| SSM. 73182 | 306 740.709 | 1 247 953.892 | 56/1 | 3 |
| SSM. 86390 | 306 395.959 | 1 248 662.620 | 56/1 | 3 |
| PM. 1561 | 306 124.919 | 1 248 689.882 | 56/1 | 2 |
| SSM. 26874 | 306 075.207 | 1 248 684.976 | 56/1 | 4 |
| SSM. 26875 | 306 248.159 | 1 249 051.132 | 56/1 | 4 |
| SSM. 21799 | 306 082.646 | 1 248 340.026 | 56/1 | 2 |
| TS 10619 (ENFIELD) | 306 668.504 | 1 247 325.571 | 56/1 | 2 |
| TS 10625 (CENTREPOINT) | 319 218.497 | 1 250 725.346 | 56/1 | 2 |
| COMBINED SEA LEVEL SCALE FACTOR = 0.99994 | | | | |
| SOURCE: I.S.G. CO-ORDINATES ADOPTED FROM SCIMS ON 11 MAY 1999 | | | | |




- PROPOSED EASEMENT FOR RAILWAY TRANSIT 10 WIDE & VARIABLE
- PROPOSED EASEMENT FOR RAILWAY IN FRASTRUCTURE 5 WIDE
- PROPOSED EASEMENT FOR RAILWAY TRANSIT 13 WIDE & VARIABLE
- PROPOSED EASEMENT FOR RAILWAY INFRASTRUCTURE 5 WIDE & VARIABLE
- PROPOSED EASEMENT FOR RAILWAY INFRASTRUCTURE 5 WIDE
- PROPOSED EASEMENT FOR RAILWAY INFRASTRUCTURE 5 WIDE
- PROPOSED EASEMENT FOR RAILWAY INFRASTRUCTURE 5 WIDE
- PROPOSED EASEMENT FOR WATER SUPPLY WORKS 5.3 WIDE (DP 842188)
- PROPOSED EASEMENT FOR TELECOM CABLES 1.5 WIDE (DP 842188)
- U. 688665 EASEMENT FOR RAILWAY PURPOSES 2 WIDE (DP. 842188)
- U. 864747 EASEMENT FOR TRANSMISSION LINE 30.48 WIDE & VARIABLE (DP. 842188)
- X.371733 EASEMENT FOR PIPELINE 1 WIDE & VARIABLE (DP 499028 SHEETS 27-30 INCL.)
- Y.884580 EASEMENT TO DRAIN WATER B WIDE (DP 774785)
- Y.207901 EASEMENT FOR SIGNAL & COMMUNICATION CABLES 3 WIDE (DP 774785)
- EASEMENT FOR HIGH TENSION POWER LINES 9 WIDE & VARIABLE (SURVEY BY DEGOTARDI SMITH & PARTNERS)
- RIGHT OF CARRIAGEWAY & EASEMENT FOR SERVICES 9.2 & VARIABLE (SURVEY BY DEGOTARDI SMITH & PARTNERS)
- EASEMENT FOR INFRASTRUCTURE 1 WIDE (SURVEY BY DEGOTARDI SMITH & PARTNERS)
- Y. 884580 EASEMENT FOR TRANSMISSION LINE VARIABLE WIDTH (DP 774785)
- S. 769572 EASEMENT FOR BATTER 3.5 WIDE & VARIABLE WIDTH (DP 611367)
- X. 884943 EASEMENT TO DRAIN WATER VARIABLE WIDTH (DP 774785)
- PROPOSED RIGHT OF CARIAGEWAY & EASEMENT FOR SERVICES VARIABLE WIDTH

Crown Lands Office Approval

AN APPROVED .....
Authorised Officer

Land District .....

Paper No. .....

Field Book .....pages .....

Subdivision Certificate

rtify that the provisions of Sec 109J of the Environmental Planning Assessment Act 1979 have been satisfied in relation to the oposed

.....set out hereon
(insert "subdivision" or "new road")

.....
( Authorised Person/General Manager/Accredited Certifier

ertifier Authority .....

e of Endorsement .....

plication No .....

ubdivision Certificate No .....

ile .....

te

an the plan is to be lodged electronically in the Land Titles Office, hould include a signature in an electronic or digital format rized by the Registrar-General.

ents whichever is applicable

D.P

Registered:

C.A.:

Title System:

Purpose:

Ref. Map:

Last Plan:

PLAN OF BOUNDARY ADJUSTMENT FOR LOT 9 D.P. 243332 & LOT 4 D.P.

Lengths are in metres. Reduction Ratio 1: 8000

LGA STRATHFIELD

Locality: ENFIELD

Parish: BANKSTOWN

County: CUMBERLAND

This is sheet 1 of my plan in 4 sheets.

Surveyors (Practice) Regulation 1996

I, ....CHRISTOPHER JOHN CRANE.....

of ....WHELANS, PO. 28456, PARRAMATTA.....

a surveyor registered under the Surveyors Act 1929, hereby certify that the survey represented in this plan is accurate, has been made in accordance with the Surveyors (Practice) Regulation 1996 and was completed on ....18 JUNE 1999.....

the survey relates to .....

.....
(Here specify the land actually surveyed or specify any land shown in the plan that is not the subject of the survey)

Datum Line : "X" — "Y"

Zone: Suburban/~~Country~~

(Signature) .....

Surveyor registered under the Surveyors Act, 1929

Plans used in preparation of survey/compilation.

| | | |
|---|---|---|
| DP 857088 | DP 625282 | SURVEY BY ME |
| DP 842188 | DP 854916 | 22/4/99 |
| DP 774785 | DP 611367 | |
| DP 243332 | DP 642469 | |
| DP 187585 | DP 815309 | |
| DP 650298 | DP 869239 | |

PANEL FOR USE ONLY for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements, restrictions on the use of land or positive covenants.

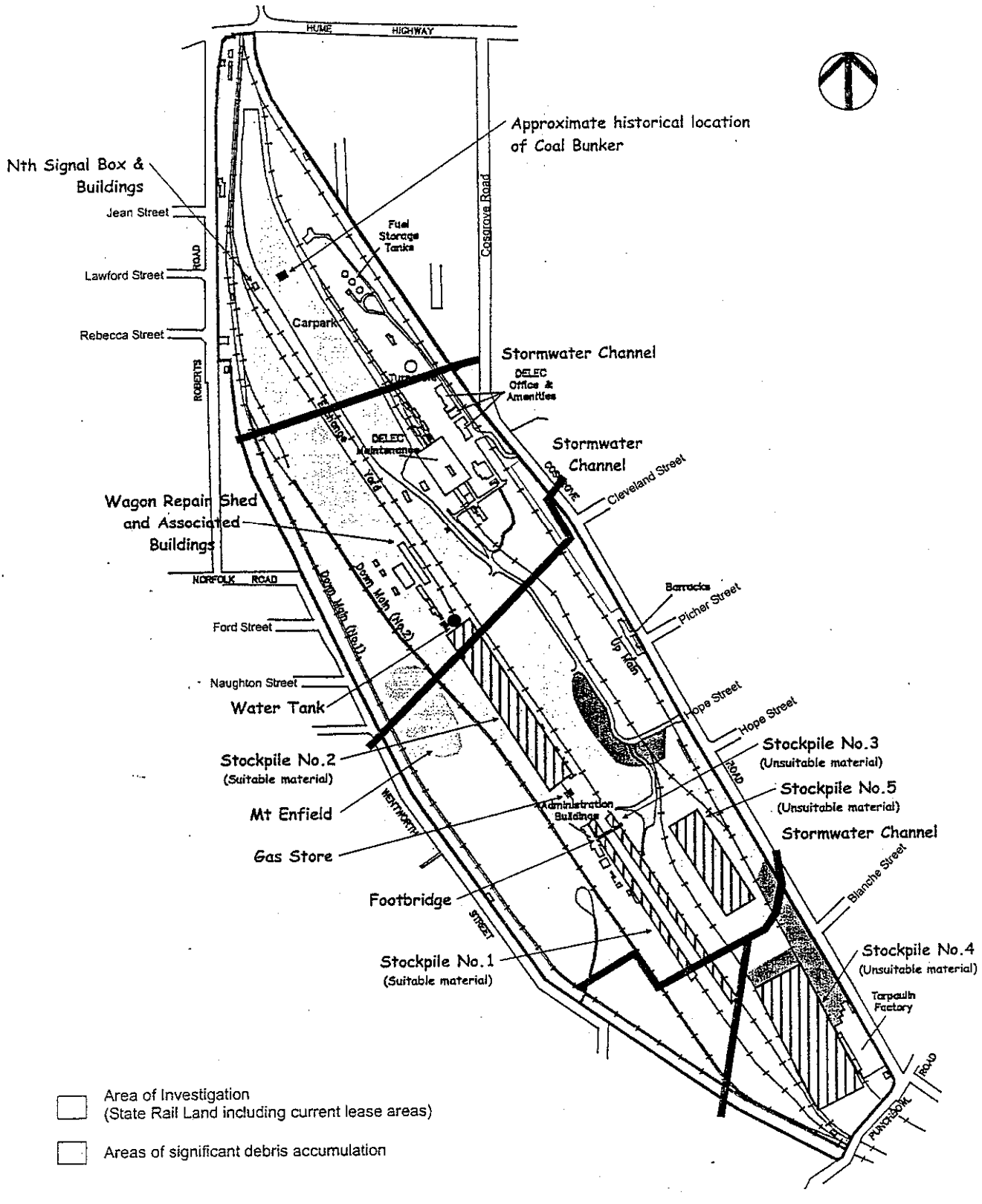
**ATTACHMENT 1**

**SURVEY PLAN**

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 Table of mm 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390

# Appendix A

*Analyte Lists and Method Reference*




CH2M HILL

**ATTACHMENT 2**

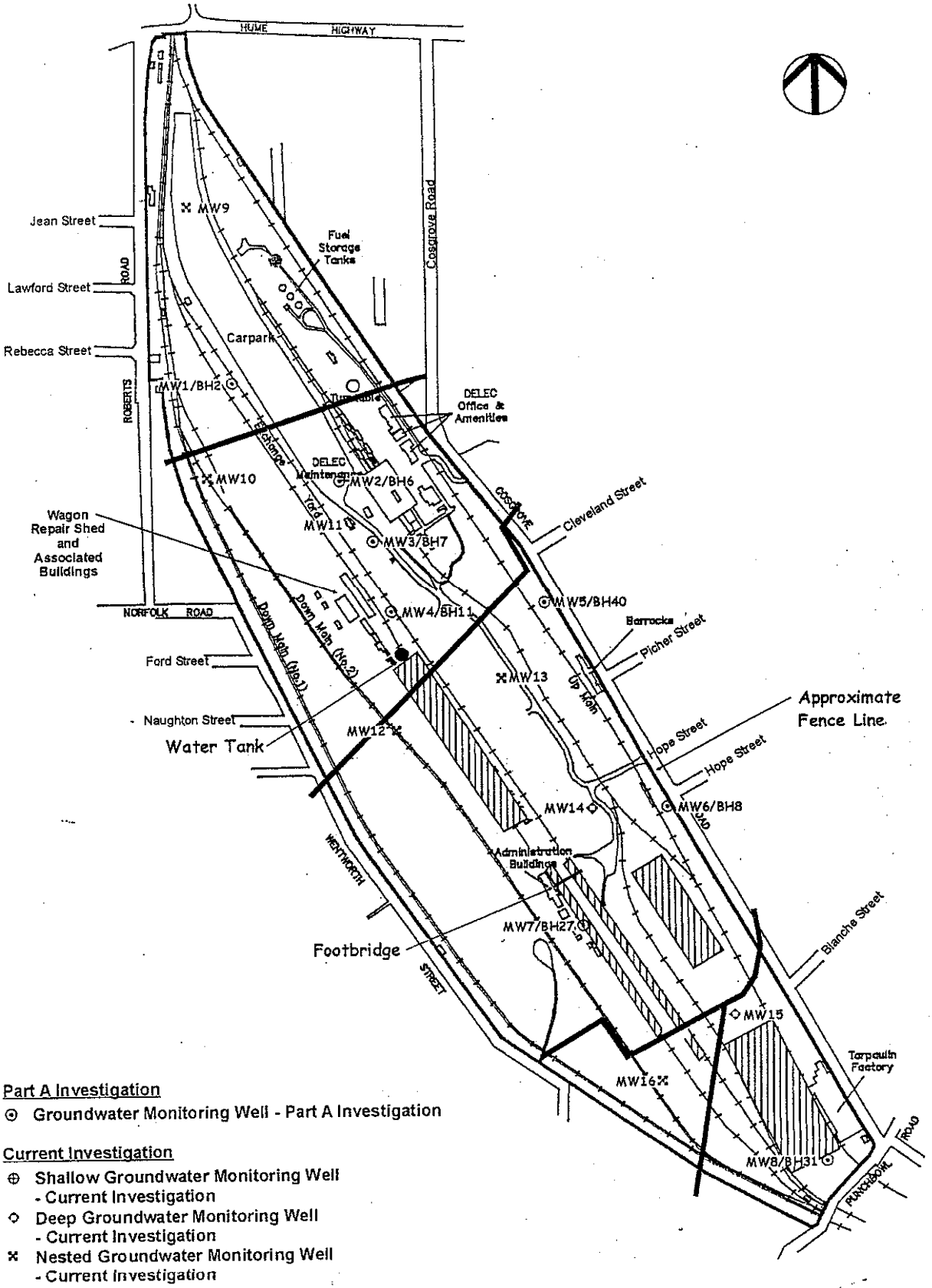
**SITE LAYOUT**

Rev: A Date: 10.4.99 Project No: 101641 ..e: 1647-003.cdr

Source: Dame, Moore 1992

Source: Dames & Moore 1992

Rev A Date: 21.8.98 Project No. 101647 File: 1647-018.cdr




Part A Investigation

⊙ Groundwater Monitoring Well - Part A Investigation

Current Investigation

⊕ Shallow Groundwater Monitoring Well - Current Investigation

◇ Deep Groundwater Monitoring Well - Current Investigation

⊠ Nested Groundwater Monitoring Well - Current Investigation

0 100 200 300 400

Scale (m)

**ATTACHMENT 3**

**MONITORING WELL LOCATIONS**

CH2M HILL

AUSTRALIAN
LABORATORY
SERVICES P/L
A.C.N. 009 936 029

# ORGANICS QUALITY CONTROL REPORT

**BATCH NO : ES15826**

**DATE BATCH RECEIVED : 24/03/99**

**CLIENT : CH2M Hill**

**DATE BATCH COMPLETED : 09/03/99**

| Method Code | Test | Matrix | Method Reference | | QC Lot Number | Date Samples Extracted | Date Samples Analysed |
|---|---|---|---|---|---|---|---|
| | | | Extraction | Analysis | | | |
| EP-068 | Pesticides | Soil | Tumbler | USEPA 8270B | NOCOPS516 | 24/03/99 | 29/03/99 |
| EP-071 | TPH-Volatile | Soil | USEPA 5030 A | USEPA 8260A | NVOCS1485 | 24/03/99 | 25/03/99 |
| | | | | | NVOCS1486 | 24/03/99 | 25/03/99 |
| | -Semivolatile | Soil | Tumbler | USEPA 8015A | NTPHT1485 | 24/03/99 | 27/03/99 |
| | | | | | NTPHT1486 | 24/03/99 | 27/03/99 |
| EP-074 | Volatile Scan | Soil | USEPA 5030 A | USEPA 8260A | NVSCS210 | 24/03/99 | 26/03/99 |
| EP-075 | Semivolatile Scan | Soil | Tumbler | USEPA 8270B | NSVOCS961 | 24/03/99 | 29/03/99 |
| | | | | | NSVOCS962 | 24/03/99 | 29/03/99 |
| EP-080 | BTEX | Soil | USEPA 5030 A | USEPA 8260A | NVOCS1485 | 24/03/99 | 25/03/99 |
| | | | | | NVOCS1486 | 24/03/99 | 25/03/99 |

AUSTRALIAN
LABORATORY
SERVICES P/L
A.C.N. 009 936 029

# ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES14518

DATE BATCH RECEIVED : 11/01/99

CLIENT : CH2M Hill Pty Ltd

DATE BATCH COMPLETED : 20/01/99

| Method Code | Test | Matrix | Method Reference | | QC Lot Number | Date Samples Extracted | Date Samples Analysed |
|---|---|---|---|---|---|---|---|
| | | | Extraction | Analysis | | | |
| EP-066 | PCB | Water | USEPA 3510B | USEPA 8270B | NPCBW96 | 12/01/99 | 13/01/99 |
| P-068 | Pesticides | Water | USEPA 3510B | USEPA 8270B | NOCOPW128 | 12/01/99 | 13/01/99 |
| EP-071 | TPH-Volatile | Water | USEPA 5030 A | USEPA 8260A | NVOCW445 | N/A | 12/01/99 |
| | -Semivolatile | Water | USEPA 3510B | USEPA 8015A | NTPHW445 | 12/01/99 | 13/01/99 |
| EP-074 | Volatile Scan | Water | USEPA 5030 A | USEPA 8260A | NVSCW285 | N/A | 12/01/99 |
| EP-075 | Semivolatile Scan | Water | USEPA 3510B | USEPA 8270B | NSVOCW424 | 12/01/99 | 13/01/99 |
| EP-080 | BTEX | Water | USEPA 5030 A | USEPA 8260A | NVOCW445 | N/A | 12/01/99 |

# E.S.P. LABORATORIES

A.C.N. 067 499 389
A division of Enviro-Net Australia Pty. Ltd.
NATA Reg. 3110

Environment and Safety Professionals

8 Hall Street
Newport
Victoria 3015

Telephone: (03) 9398 0277
Facsimile: (03) 9398 0351


DATE: 30TH MARCH, 1999

ESP JOB NUMBER: 7274

NAME: AUSTRALIAN LABORATORY SERVICES PTY LTD

ADDRESS: PO BOX 63
RYDALMERE, 2116

ATTENTION: M. HEERY

ALS JOB NO: ES 15826
PROJECT ID: 101598

SAMPLED FROM: AS SUPPLIED

SAMPLED BY: AS SUPPLIED

RECEIVED ON: 25TH MARCH, 1999

3 | 9

TEST METHOD: Qualitative identification of asbestos types in bulk samples by polarised light microscopy, including dispersion staining using ESP in-house Method No. 2.

| ESP LAB. NO. | SAMPLE DESCRIPTION | RESULT |
|---|---|---|
| E60407 | WRS2/0.1 - SOIL | Hand picked chrysotile asbestos fibres of total approximate dimensions 1 x 0.2 x 0.2mm detected by PLM including dispersion staining in the sample of approximate dimensions 120 x 65 x 3mm. |
| E60408 | WRS4/0.1 - SOIL | NO ASBESTOS DETECTED |
| E60409 | WRS7/0.1 - SOIL | NO ASBESTOS DETECTED |
| E60410 | WRS9/0.1 - SOIL | Hand picked chrysotile asbestos fibres of total approximate dimensions 4 x 1 x 1mm detected by PLM including dispersion staining in the sample of approximate dimensions 120 x 65 x 3mm. |
| E60411 | WRS12/0.1 - SOIL | Hand picked chrysotile asbestos fibres of total approximate dimensions 6 x 1 x 1mm detected by PLM including dispersion staining in the sample of approximate dimensions 120 x 65 x 3mm. |
| E60412 | WRS15/0.1- SOIL | NO ASBESTOS DETECTED |
| E60413 | WRS17/0.1 - SOIL | NO ASBESTOS DETECTED |
| E60414 | WRS19/0.1 - SOIL | NO ASBESTOS DETECTED |
| E60415 | WRS17/0.2 - SOIL | NO ASBESTOS DETECTED |

E.S.P. LABORATORIES
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Environment and Safety Professionals
8 Hall Street
Newport
Victoria 3015
Telephone: (03) 9398 0277
Facsimile: (03) 9398 0351

# EXPLANATION OF SOIL ANALYSIS RESULTS

The whole of the soil sample submitted to ESP Laboratories is initially inspected for the presence of any bulk fragment/s of materials suspected of containing asbestos (i.e. cement sheeting). If found, these materials are physically removed from the sample and analysed for the presence of asbestos in accordance with ESP Laboratories in-house method No. 2. If found to contain asbestos the total approximate volumetric dimensions of bulk fragments are given along with the total sample volume. The bulk fragments are then identified as their material type (i.e. cement sheeting) and labeled as a sub-sample of the original sample (i.e. sub-sample 2).

A representative sample of the remaining soil is analysed by microscopic examination in accordance with ESP Laboratories in-house method No. 2. This sample is labeled as "sub-sample 1" if bulk fragments were discovered in the supplied sample. If larger quantities of asbestos fibres (i.e. less than 1%) are found within the sample, these are picked out by hand and analysed for their asbestos type. In accordance with the terms of NATA registration, these results are then reported as their asbestos type with the volumetric dimensions of the asbestos fibres in the volumetric dimensions of the analysed sample (i.e. chrysotile asbestos fibres of total approximate dimensions 1cm x 1cm x 2cm detected by PLM, including dispersion staining, in the sample of approximate dimensions 12cm x 6.5cm x 0.3cm).

AUSTRALIAN LABORATORY SERVICES P/L
A.C.N. 009 936 029

# ANALYTICAL REPORT



CONTACT: MR BRETT LAW
CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14482
SUB BATCH: 0
No. OF SAMPLES: 19
DATE RECEIVED: 07/01/99
DATE COMPLETED: 14/01/99

ORDER No.: 101598 SAMPLE TYPE: SOIL PROJECT: ENFIELD MARSHALLING

| t. | Analysis description | | Units | LOR | BH1 0.1 06/01/99 | BH9 0.1 06/01/99 | BH10 0.15 06/01/99 | BH17 0.15 06/01/99 |
|---|---|---|---|---|---|---|---|---|
| 1-055 | Moisture Content (dried @ 103°C) | | % | 0.1 | 9.0 | 11.0 | 13.0 | 12.4 |
| 3-005T | Arsenic | - Total | mg/kg | 1 | 24 | 15 | 17 | 49 |
| | Cadmium | - Total | mg/kg | 1 | <1 | <1 | <1 | <1 |
| | Chromium | - Total | mg/kg | 1 | 14 | 10 | 10 | 6 |
| | Copper | - Total | mg/kg | 1 | 81 | 49 | 20 | 84 |
| | Nickel | - Total | mg/kg | 1 | 37 | 21 | 3 | 10 |
| | Lead | - Total | mg/kg | 1 | 34 | 23 | 27 | 58 |
| | Zinc | - Total | mg/kg | 1 | 102 | 115 | 46 | 116 |
| G-[illegible]T | Mercury | - Total | mg/kg | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |

| Date Received: 21/1/99 | Distribution | |
|---|---|---|
| | Initials | Date |
| Project No: | BL | |
| File No: | | |
| Register No: | | |
| Comments: | | |

CO MENTS:

Samples as received digested by USEPA method 3051 prior to the determination of metals. Results reported on a dry weight basis.

• This is the Final Report which supersedes any preliminary reports with this batch number. • Results apply to sample(s) as submitted by client.

Brisbane
Phone: (07) 3243 7222 Fax: (07) 3243 7218
Sydney
Phone: (02) 9841 9500 Fax: (02) 9841 9530
Melbourne
Phone: (03) 9538 4444 Fax: (03) 9538 4400
Perth
Phone: (08) 9249 2988 Fax: (08) 9249 2942

Laboratories also in:
Singapore
Malaysia
Thailand
Hong Kong
New Zealand

AUSTRALIAN LABORATORY SERVICES P/L
A.C.N. 009 936 029

# ANALYTICAL REPORT



CONTACT: MR BRETT LAW
CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14482
SUB BATCH: 1
No. OF SAMPLES: 2
DATE RECEIVED: 07/01/99
DATE COMPLETED: 14/01/99

ORDER No.: 101598 SAMPLE TYPE: SOIL PROJECT: ENFIELD MARSHALLING

| Method | Analysis description | Units | LOR | BH30 0.1 06/01/99 | BH24 0.1 06/01/99 |
|---|---|---|---|---|---|
| A-055 | Moisture Content (dried @ 103°C) | % | 0.1 | 19.6 | 17.4 |
| P-[illegible]8A-SS | ORGANOCHLORINE PESTICIDES | | | | |
| | alpha-BHC | mg/kg | 0.02 | <0.02 | <0.02 |
| | HCB | mg/kg | 0.02 | <0.02 | <0.02 |
| | beta-BHC & gamma-BHC | mg/kg | 0.04 | <0.04 | <0.04 |
| | delta-BHC | mg/kg | 0.02 | <0.02 | <0.02 |
| | Heptachlor | mg/kg | 0.02 | <0.02 | <0.02 |
| | Aldrin | mg/kg | 0.02 | <0.02 | <0.02 |
| | Heptachlor epoxide | mg/kg | 0.02 | <0.02 | <0.02 |
| | Chlordane - trans | mg/kg | 0.02 | <0.02 | <0.02 |
| | Endosulfan 1 | mg/kg | 0.02 | <0.02 | <0.02 |
| | Chlordane - cis | mg/kg | 0.02 | <0.02 | <0.02 |
| | Dieldrin | mg/kg | 0.02 | <0.02 | <0.02 |
| | DDE | mg/kg | 0.02 | <0.02 | <0.02 |
| | Endrin | mg/kg | 0.02 | <0.02 | <0.02 |
| | Endosulfan 2 | mg/kg | 0.02 | <0.02 | <0.02 |
| | DDD | mg/kg | 0.02 | <0.02 | <0.02 |
| | Endrin aldehyde | mg/kg | 0.02 | <0.02 | <0.02 |
| | Endosulfan sulfate | mg/kg | 0.02 | <0.02 | <0.02 |
| | DDT | mg/kg | 0.1 | <0.1 | <0.1 |
| | Endrin ketone | mg/kg | 0.02 | <0.02 | <0.02 |
| | Methoxychlor | mg/kg | 0.1 | <0.1 | <0.1 |
| XP [illegible]8B-SS | ORGANOPHOSPHORUS PESTICIDES | | | | |
| | Dichlorvos | mg/kg | 0.02 | <0.02 | <0.02 |
| | Demeton-S-methyl | mg/kg | 0.02 | <0.02 | <0.02 |
| | Monocrotophos | mg/kg | 0.1 | <0.1 | <0.1 |
| | Dimethoate | mg/kg | 0.02 | <0.02 | <0.02 |
| | Diazinon | mg/kg | 0.02 | <0.02 | <0.02 |
| | Chlorpyrifos-methyl | mg/kg | 0.02 | <0.02 | <0.02 |
| | Parathion-methyl | mg/kg | 0.1 | <0.1 | <0.1 |

COMMENTS:

Samples analysed on an as received basis. Results reported on a dry weight basis.

• This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

Brisbane
Phone: (07) 3243 7222 Fax: (07) 3243 7218
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Melbourne
Phone: (03) 9538 4444 Fax: (03) 9538 4480
Perth
Phone: (08) 9240 2980 Fax: (08) 9240 2942

Laboratories also in:
Singapore
Malaysia
Thailand
Hong Kong
New Zealand

AUSTRALIAN LABORATORY SERVICES P/L
A.C.N. 009 936 029

# ANALYTICAL REPORT



CONTACT: MR BRETT LAW
CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14482
SUB BATCH: 1
No. OF SAMPLES: 2
DATE RECEIVED: 07/01/99
DATE COMPLETED: 14/01/99

ORDER No.: 101598 SAMPLE TYPE: SOIL PROJECT: ENFIELD MARSHALLING

| Method | Analysis description | Units | LOR | BH30 0.1 06/01/99 | BH24 0.1 06/01/99 |
|---|---|---|---|---|---|
| P-068B-SS | Malathion | mg/kg | 0.02 | <0.02 | <0.02 |
| | Fenthion | mg/kg | 0.02 | <0.02 | <0.02 |
| | Chlorpyrifos | mg/kg | 0.02 | <0.02 | <0.02 |
| | Parathion | mg/kg | 0.1 | <0.1 | <0.1 |
| | Pirimphos-ethyl | mg/kg | 0.02 | <0.02 | <0.02 |
| | Chlorfenvinphos E | mg/kg | 0.02 | <0.02 | <0.02 |
| | Chlorfenvinphos Z | mg/kg | 0.02 | <0.02 | <0.02 |
| | Bromophos-ethyl | mg/kg | 0.02 | <0.02 | <0.02 |
| | Fenamiphos | mg/kg | 0.02 | <0.02 | <0.02 |
| | Prothiofos | mg/kg | 0.02 | <0.02 | <0.02 |
| | Ethion | mg/kg | 0.02 | <0.02 | <0.02 |
| | Carbophenothion | mg/kg | 0.02 | <0.02 | <0.02 |
| | Azinphos-methyl | mg/kg | 0.02 | <0.02 | <0.02 |
| EP[illegible]8S-SS | ORGANOCHLORINE PESTICIDE SURROGATE | | | | |
| | Dibromo-DDE | % | 1 | 94 | 71 |
| EP 8T-SS | ORGANOPHOSPHORUS PESTICIDE SURROGATE | | | | |
| | DEF | % | 1 | 83 | 68 |

COMMENTS:

• This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

Brisbane
Phone: (07) 3243 7222 Fax: (07) 3243 7218
Sydney
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Melbourne
Phone: (03) 9538 4444 Fax: (03) 9538 4400
Perth
Phone: (08) 9249 2900 Fax: (08) 9249 2942

Laboratories also in:
Singapore
Malaysia
Thailand
Hong Kong
New Zealand

AUSTRALIAN LABORATORY SERVICES P/L
A.C.N. 009 936 029

# ANALYTICAL REPORT



CONTACT: MR BRETT LAW
CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14482
SUB BATCH: 2
No. OF SAMPLES: 19
DATE RECEIVED: 07/01/99
DATE COMPLETED: 14/01/99

ORDER No.: 101598 SAMPLE TYPE: SOIL PROJECT: ENFIELD MARSHALLING

| et...1 | Analysis description | Units | LOR | BH1 0.1 06/01/99 | BH9 0.1 06/01/99 | BH10 0.15 06/01/99 | BH17 0.15 06/01/99 |
|---|---|---|---|---|---|---|---|
| A-055 | Moisture Content (dried @ 103'C) | % | 0.1 | 9.0 | 11.0 | 13.0 | 12.4 |
| P-071-SS | TOTAL PETROLEUM HYDROCARBONS | | | | | | |
| | C6 - C9 Fraction | mg/kg | 2 | <2 | <2 | <2 | <2 |
| | C10 - C14 Fraction | mg/kg | 50 | <50 | <50 | <50 | <50 |
| | C15 - C28 Fraction | mg/kg | 100 | 134 | <100 | <100 | <100 |
| | C29 - C36 Fraction | mg/kg | 100 | 180 | <100 | <100 | <100 |
| P- .0-SS | BTEX | | | | | | |
| | Benzene | mg/kg | 0.2 | ---- | ---- | <0.2 | <0.2 |
| | Toluene | mg/kg | 0.2 | ---- | ---- | <0.2 | <0.2 |
| | Chlorobenzene | mg/kg | 0.2 | ---- | ---- | <0.2 | <0.2 |
| | Ethylbenzene | mg/kg | 0.2 | ---- | ---- | <0.2 | <0.2 |
| | meta- & para-Xylene | mg/kg | 0.2 | ---- | ---- | <0.2 | <0.2 |
| | ortho-Xylene | mg/kg | 0.2 | ---- | ---- | <0.2 | <0.2 |
| P-..0S-SS | VOLATILE TPH/BTEX COMPOUND SURROGATES | | | | | | |
| | 1.2-Dichloroethane-D4 | % | 1 | 119 | 81 | 92 | 98 |
| | Toluene-D8 | % | 1 | 109 | 84 | 86 | 88 |
| | 4-Bromofluorobenzene | % | 1 | 97 | 78 | 76 | 78 |

COMMENTS:

Samples analysed on an as received basis. Results reported on a dry weight basis.

• This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

Brisbane
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# ANALYTICAL REPORT



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CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14482
SUB BATCH: 3
No. OF SAMPLES: 19
DATE RECEIVED: 07/01/99
DATE COMPLETED: 14/01/99

ORDER No.: 101598 SAMPLE TYPE: SOIL PROJECT: ENFIELD MARSHALLING

| Method | Analysis description | Units | LOR | BH1 0.1 06/01/99 | BH9 0.1 06/01/99 | BH10 0.15 06/01/99 | BH17 0.15 06/01/99 |
|---|---|---|---|---|---|---|---|
| EA-055 | Moisture Content (dried @ 103°C) | % | 0.1 | 9.0 | 11.0 | 13.0 | 12.4 |
| EP 075A-SS | PHENOLS | | | | | | |
| | Phenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2-Chlorophenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2-Methylphenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 4-Methylphenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2-Nitrophenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2.4-Dimethylphenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2.4-Dichlorophenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2.6-Dichlorophenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 4-Chloro-3-methylphenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2.4.6-Trichlorophenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2.4.5-Trichlorophenol | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Pentachlorophenol | mg/kg | 0.2 | <1.0 | <0.2 | <0.2 | <0.2 |
| EP-075B-SS | POLYNUCLEAR AROMATICS | | | | | | |
| | Naphthalene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2-Methylnaphthalene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 2-Chloronaphthalene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Acenaphthylene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Acenaphthene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Fluorene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Phenanthrene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | 0.3 |
| | Anthracene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Fluoranthene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | 0.2 |
| | Pyrene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | 0.1 |
| | N-2-Fluorenylacetamide | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Benz(a)anthracene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Chrysene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | 0.1 |
| | Benzo(b) & (k)fluoranthene | mg/kg | 0.2 | <1.0 | <0.2 | <0.2 | <0.2 |
| | 7.12-Dimethylbenz(a)anthracene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |

COMMENTS:

Samples analysed on an as received basis. Results reported on a dry weight basis. Sample BH1 0.1 required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.

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• Results apply to sample(s) as submitted by client.

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# ANALYTICAL REPORT



CONTACT: MR BRETT LAW
CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14482
SUB BATCH: 3
No. OF SAMPLES: 19
DATE RECEIVED: 07/01/99
DATE COMPLETED: 14/01/99

ORDER No.: 101598 SAMPLE TYPE: SOIL PROJECT: ENFIELD MARSHALLING

| etnod | Analysis description | Units | LOR | BH1 0.1 06/01/99 | BH9 0.1 06/01/99 | BH10 0.15 06/01/99 | BH17 0.15 06/01/99 |
|---|---|---|---|---|---|---|---|
| P-075B-SS | Benzo(a)pyrene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | 3-Methylcholanthrene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Indeno(1.2.3-cd)pyrene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Dibenz(a.h)anthracene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| | Benzo(g.h.i)perylene | mg/kg | 0.1 | <0.5 | <0.1 | <0.1 | <0.1 |
| P- [illegible]S-SS | ACID EXTRACTABLE SURROGATES | | | | | | |
| | 2-Fluorophenol | % | 1 | 85 | 103 | 114 | 59 |
| | Phenol-D6 | % | 1 | 95 | 97 | 101 | 70 |
| | 2-Chlorophenol-D4 | % | 1 | 83 | 95 | 104 | 58 |
| | 2.4.6-Tribromophenol | % | 1 | 84 | 98 | 105 | 39 |
| [illegible]P-0[illegible] SS | BASE/NEUTRAL EXTRACTABLE SURROGATES | | | | | | |
| | Nitrobenzene-D5 | % | 1 | 108 | 97 | 108 | 95 |
| | 1.2-Dichlorobenzene-D4 | % | 1 | 99 | 90 | 98 | 86 |
| | 2-Fluorobiphenyl | % | 1 | 99 | 94 | 105 | 92 |
| | Anthracene-d10 | % | 1 | 100 | 90 | 101 | 84 |
| | p-Terphenyl-D14 | % | 1 | 102 | 98 | 103 | 91 |

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# ANALYTICAL REPORT



CONTACT: MR BRETT LAW
CLIENT: CH2M HILL PTY LTD
ADDRESS: P O BOX 743
NORTH SYDNEY NSW 2059

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES14518
SUB BATCH: 4
No. OF SAMPLES: 9
DATE RECEIVED: 11/01/99
DATE COMPLETED: 20/01/99

ORDER No.: 101598 SAMPLE TYPE: WATER PROJECT: ENFIELD

| Method | Analysis description | Units | LOR | MW02 08/01/99 | MW03 08/01/99 | MW04 08/01/99 | MW05 08/01/99 |
|---|---|---|---|---|---|---|---|
| EP-074A-WS | MONOCYCLIC AROMATIC HYDROCARBONS | | | | | | |
| | Benzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Toluene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Ethylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | meta- & para-Xylene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Styrene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | ortho-Xylene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Isopropylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | n-Propylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.3.5-Trimethylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | sec-Butylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2.4-Trimethylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | tert-Butylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | p-Isopropyltoluene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | n-Butylbenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| EP 74B-WS | OXYGENATED HYDROCARBONS | | | | | | |
| | 2-Propanone (Acetone) | ug/L | 50 | <50 | <50 | <50 | <50 |
| | Vinyl acetate | ug/L | 50 | <50 | <50 | <50 | <50 |
| | 2-Butanone (MEK) | ug/L | 50 | <50 | <50 | <50 | <50 |
| | 4-Methyl-2-pentanone (MIBK) | ug/L | 50 | <50 | <50 | <50 | <50 |
| | 2-Hexanone (MBK) | ug/L | 50 | <50 | <50 | <50 | <50 |
| EP 074C-WS | SULFONATED COMPOUNDS | | | | | | |
| | Carbon disulfide | ug/L | 5 | <5 | <5 | <5 | <5 |
| EP-074D-WS | FUMIGANTS | | | | | | |
| | 2.2-Dichloropropane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2-Dichloropropane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | cis-1.3-Dichloropropylene | ug/L | 10 | <10 | <10 | <10 | <10 |
| | trans-1.3-Dichloropropylene | ug/L | 10 | <10 | <10 | <10 | <10 |
| | 1.2-Dibromoethane (EDB) | ug/L | 5 | <5 | <5 | <5 | <5 |
| E 74E-WS | HALOGENATED ALIPHATIC HYDROCARBONS(VOL) | | | | | | |

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SUB BATCH: 4
No. OF SAMPLES: 9
DATE RECEIVED: 11/01/99
DATE COMPLETED: 20/01/99

ORDER No.: 101598 SAMPLE TYPE: WATER PROJECT: ENFIELD

| ethod | Analysis description | Units | LOR | MW02 08/01/99 | MW03 08/01/99 | MW04 08/01/99 | MW05 08/01/99 |
|---|---|---|---|---|---|---|---|
| :P-074K-WS | Dichlorodifluoromethane | ug/L | 50 | <50 | <50 | <50 | <50 |
| | Chloromethane | ug/L | 50 | <50 | <50 | <50 | <50 |
| | Vinyl chloride | ug/L | 50 | <50 | <50 | <50 | <50 |
| | Bromomethane | ug/L | 50 | <50 | <50 | <50 | <50 |
| | Chloroethane | ug/L | 50 | <50 | <50 | <50 | <50 |
| | Trichlorofluoromethane | ug/L | 50 | <50 | <50 | <50 | <50 |
| | 1.1-Dichloroethene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Iodomethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | trans-1.2-Dichloroethene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.1-Dichloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | cis-1.2-Dichloroethene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.1.1-Trichloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.1-Dichloropropylene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Carbon tetrachloride | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2-Dichloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Trichloroethene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Dibromomethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.1.2-Trichloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.3-Dichloropropane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Tetrachloroethene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.1.1.2-Tetrachloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | trans-1.4-Dichloro-2-butene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | cis-1.4-Dichloro-2-butene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.1.2.2-Tetrachloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2.3-Trichloropropane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Pentachloroethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2-Dibromo-3-chloropropane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Hexachlorobutadiene | ug/L | 5 | <5 | <5 | <5 | <5 |
| KP 74P-WS | HALOGENATED AROMATIC HYDROCARBONS (VOL) | | | | | | |
| | Chlorobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |

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[redacted]

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SUB BATCH: 4
No. OF SAMPLES: 9
DATE RECEIVED: 11/01/99
DATE COMPLETED: 20/01/99

ORDER No.: 101598 SAMPLE TYPE: WATER PROJECT: ENFIELD

| Method | Analysis description | Units | LOR | MW02 08/01/99 | MW03 08/01/99 | MW04 08/01/99 | MW05 08/01/99 |
|---|---|---|---|---|---|---|---|
| EP-074F-WS | Bromobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 2-Chlorotoluene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 4-Chlorotoluene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.3-Dichlorobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.4-Dichlorobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2-Dichlorobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2.4-Trichlorobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| | 1.2.3-Trichlorobenzene | ug/L | 5 | <5 | <5 | <5 | <5 |
| EP- 4G-WS | TRIHALOMETHANES (VOLATILES) | | | | | | |
| | Chloroform | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Bromodichloromethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Dibromochloromethane | ug/L | 5 | <5 | <5 | <5 | <5 |
| | Bromoform | ug/L | 5 | <5 | <5 | <5 | <5 |
| EP-074H-WS | NAPHTHALENE | | | | | | |
| | Naphthalene | ug/L | 7 | <7 | <7 | <7 | <7 |
| EP- 4S-WS | VOLATILE COMPOUND SURROGATES | | | | | | |
| | 1.2-Dichloroethane-D4 | % | 1 | 111 | 114 | 113 | 118 |
| | Toluene-D8 | % | 1 | 102 | 100 | 108 | 106 |
| | 4-Bromofluorobenzene | % | 1 | 102 | 105 | 102 | 105 |

CC MENTS:

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• Results apply to sample(s) as submitted by client.

Doc # 99E

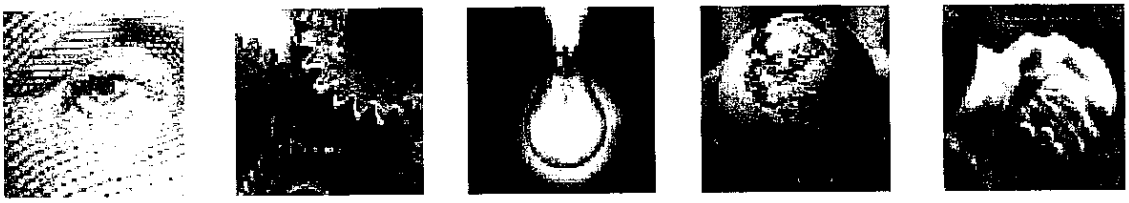
ENVIRON

# Site Audit Report

## Delec Deport, Enfield

for

## Sydney Ports Corporation



**JANUARY 2002**

**31-0022**

ENVIRON

31 January 2002 Ref: 31-0022

Sydney Ports Corporation
PO Box 25
MILLERS POINT, NSW 2000

Attn: Christa Sams

Dear Ms. Sams,

**Summary Site Audit Report - Delec Depot, Enfield.**

I have pleasure in submitting the Summary Site Audit Report for the subject site. The Site Audit Statement produced in accordance with the Contaminated Land Management Act follows this letter. The Audit was commissioned by Sydney Ports Corporation, for the purpose of auditing contamination investigations undertaken to assess the type, level and extent of contamination on a site, owned by FreightCorp, being considered for purchase and redevelopment. The Audit is currently not required under regulation and is therefore a non-statutory audit.

Thank you for giving me the opportunity to conduct this Audit. Please call me on 9954 8101 if you have any questions.

Yours faithfully,
ENVIRON Australia Pty Ltd

*ORIGINAL SIGNED BY GRAEME NYLAND*

Graeme Nyland
EPA Accredited Site Auditor 9808

## TABLE OF CONTENTS

# LIST OF TABLES AND FIGURES

**Page**



# LIST OF APPENDICES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| AHD | Australian Height Datum |
| ALS | Australian Laboratory Services |
| Amdel | Amdel Laboratories |
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| AST | Above ground Storage Tank |
| BaP | Benzo(a)pyrene |
| BTEX | Benzene, Toluene, Ethylbenzene & Xylenes (Monoaromatic Hydrocarbons) |
| CGM | Combustible gas meter |
| CN | Cyanide (total or free) |
| CT | Certificate of Title |
| DP | Deposited Plan |
| EPA | Environment Protection Authority (NSW) |
| ha | Hectare |
| LOR | Limit of Reporting |
| MAH | Monocyclic Aromatic Hydrocarbons |
| Mercury | Inorganic mercury unless noted otherwise |
| Metals | As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Fe: Iron, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury |
| mg/kg | Milligrams per Kilogram |
| mg/L | Milligrams per Litre |
| µg/L | Micrograms per Litre |
| NATA | National Association of Testing Authorities |
| NC | Not Calculated |
| ND | Not Detected |
| ng/L | Nanograms per Litre |
| NEHF | National Environmental Health Forum |
| NEPM | National Environment Protection Measure |
| NHMRC | National Health and Medical Research Council |
| n | Number of Samples |
| OCPs | Organochlorine Pesticides |
| OH&S | Occupational Health & Safety |
| OPPs | Organophosphorus Pesticides |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PID | Photoionisation Detector |
| PQL | Practical Quantitation Limit |
| pH | a measure of acidity, hydrogen ion activity |
| QA/QC | Quality Assurance/Quality Control |
| RPD | Relative Percent Difference |
| $SO_4$ | Sulphate |
| SVOCs | Semi Volatile Organic Compounds |
| TOM | Total Organic Matter |
| TPHs | Total Petroleum Hydrocarbons |
| UCL | Upper Confidence Limit |
| UST | Underground Storage Tank |
| VCH | Volatile Chlorinated Compounds (see also CHC) |
| VOCs | Volatile Organic Compounds |
| XRF | X-Ray Fluorescence (meter) |
| - | On tables is "not calculated", "no criteria" or " not applicable" |

# SUMMARY SITE AUDIT REPORT – DELEC DEPOT, ENFIELD.

## 1 INTRODUCTION

A site contamination audit has been conducted relating to a site currently used as a Locomotive Maintenance Centre at Cosgrove Road, Enfield. FreightCorp owns most of the site, with a small portion of the site owned by Rail Infrastructure Corporation (RIC). Sydney Ports Corporation is considering the purchase and redevelopment of the site. The audit was conducted for the purpose of determining what investigation or remediation remains necessary before the land is suitable for the specified (industrial) use, i.e., a site audit under Section 47 (1) (b) (iii) of the NSW Contaminated Land Management Act 1997. The audit is not currently required by regulation or legislation and it is therefore a non-statutory audit.

Details of the audit are:

| | |
|---|---|
| **Requested by:** | Sydney Ports Corporation (SPC) |
| **Request/Commencement Date:** | 14 August 2001 |
| **Auditor:** | Graeme Nyland |
| **Accreditation No.:** | 9808 |

The audit included:

- Audit of the following reports:

  "Delec Depot Enfield –Contamination Assessment: Sampling, Analytical & Quality Plan", September 2001, by Egis Consulting Australia Pty Limited (Egis).

  "Delec Depot Enfield –Contamination Assessment: Sampling, Analytical & Quality Plan", October 2001, by Egis.

  "Detailed Contamination Assessment – Delec Depot Enfield(Draft)", December 2001, by Egis.

  "Detailed Contamination Assessment – Delec Depot Enfield,Version 1 Final", December 2001, by Egis.

- Other reports briefly reviewed include:

  Audit Enfield Delec Report, CMPS Environmental, 1991

  State Rail Authority Metropolitan Freight Terminal Environmental Report, Dames and Moore November 1992

  Environmental Assessment Locomotive Maintenance Centre, Cosgrove Road; Enfield Groundwater Technology, June 1993

  Phase II Environmental Assessment Locomotive Maintenance Centre, Cosgrove Road Enfield Groundwater Technology, January 1994

  DELEC Locomotive Maintenance Centre Preliminary Findings and Options, Sinclair Knight Merz, June 1996

Value Management Study Report Enfield Locomotive Maintenance Centre Environmental Protection National Project Consultants, July 1996

Risk Identification Study Enfield Locomotive Maintenance Centre Environmental Protection, Value Management International, July 1996

Enfield Locomotive Maintenance Centre, Environmental Protection Study Water Quality Testing, Sinclair Knight Merz, November 1996

Independent Review for FreightCorp, Enfield Locomotive Maintenance Centre, Cosgrove Road; Enfield. NSW, ADI Limited, February 1998

Enfield Locomotive Maintenance Centre Fuelling Facility Pressure Testing of Pollution Control Pipework, OTEK, March 1998

Enfield Locomotive Maintenance Centre Fuelling Facility Contamination Assessment, OTEK

- Review of "Enfield Marshalling Yards Part A and B Contamination Assessments", CH2MHill, March and August 1999, and the ensuing Site Audit Report, Dames and Moore, September 1999 (pertaining to the adjacent site)
- Review of "Phase 1 Environmental Audit Report", Sinclair Knight Merz,June 2001
- Site visits on the 31 October 2001 and 9 January 2002
- Discussions with the Consultants who conducted the investigations

# 2 SITE DETAILS

## 2.1 LOCATION

The site, (Attachment 1), known as the DELEC site, is located in Enfield, approximately 15km west-southwest of the Sydney CBD.

| | |
|---|---|
| Street address: | Between Cosgrove and Roberts Roads, Enfield, NSW. Access is off Cosgrove Road. |
| Identifier: | Holdings includes the following allotments: Lot 2 DP1006861 (FreightCorp) & Lot 101 DP 1001498 (RIC). |
| Local Government: | Strathfield Local Government Area |
| Owner: | FreightCorp (12.209 ha) & RIC (1.031 ha) |
| Site Area: | Approximately 13.24ha |

## 2.2 ZONING

The zoning is reported to be "*Special Uses – 5b (Railways)*" under the Strathfield Planning Scheme, with the entire area around the site zoned "*Industrial 4*".

## 2.3 ADJACENT USES

Landuses in the vicinity are industrial and residential. Adjacent uses are mainly light industrial and warehousing. The now-disused Enfield Marshalling Yards are on the uphill and upgradient side of the site, and appear to be the only off-site property with the potential to impact the site.

## 2.4 SITE CONDITION

The site has a relatively flat topography, sloping towards Cosgrove Road on northeast side. The site is currently being used as a Locomotive Maintenance Centre. Site features are shown on Attachment 2. Railway tracks are present over much of the site, leading mainly to the main maintenance shed and a turntable. Activities currently being undertaken include locomotive servicing (repairs and maintenance). Activities conducted in association with the servicing activities include refuelling, sanding, wheel truing, electronic servicing, and load testing. Ancillary facilities on the site include bulk fuel storage, effluent treatment plants, bulk oil and gas bottle storage.

At the time of the Auditor's visit, the site was still operational.

## 2.5 PROPOSED DEVELOPMENT

Redevelopment of the site is envisaged, with the site to be part of an intermodal terminal (industrial land use) for Sydney Ports Corporation operations.

# 3 SITE HISTORY

There have been many environmental assessments of the site, but there has been no detailed documentation of the historical activities and historical and current processes on the site. Each report generally repeats with little addition the limited information in previous reports. The Egis (2001) report does include a description of air photographs, which provides some new information. Historical activities are summarised below, based on information in the reports:

- Prior to the 1950s, it is reported that the site remained low-lying marshland. Further details are unknown, but Egis report thjat the 1930 air photo suggests that there may have been a market garden near the current turntable location.
- In 1957, the former Public Transport Commission of NSW commissioned the Diesel Electric and Electric Locomotive Maintenance Centre (DELEC), after acquiring, filling and levelling the site. The nature of the fill constituted ash and clay. A tributary of Cox's Creek which flowed across the southeastern part of the site was probably filled at that time.
- Maintenance of diesel locomotives commenced when the site was decommissioned, and electric locomotives were serviced from the early 1960s.
- Refuelling activities have taken place at the facility, with three large ASTs erected by 1965, used to store diesel fuel. Fuel spills were reported to have occurred over time following refuelling activities. The three ASTs were removed in the 1990s (year not recorded) and replaced by a larger AST in the same location. It appears that the ground surface around the three ASTs was not sealed.
- The fuel dispensing area was reported to been sealed between 1991 and 1996, only the bowser area being concreted prior to this period.
- A load box facility was reportedly used for a period of approximately 20 years until a new load box was built in 1985, after which the old box was taken out of service. The commissioning date for the former load box is unknown. The old load box is still present, so its location is well known.
- A number of waste dumps were found at the site, south of the carpark (reportedly excavated and backfilled during the 1990s) and at the rear of the sand plant. The nature and extent of these waste dumps are unknown/not reported. CMPS&F (1991) shows a "solid waste tip" , but their site plan has no scale. It appears to be near the current wheel set storage.
- It was reported that prior to 1996, a number of the liquid storage facilities (such as fuel storage, mixed liquor tank, chemical store and lubrication oil tanks) were unbunded and unpaved.
- Since the early1990s, a number of environmental improvements were reported to been implemented, such as 'tack matting' used to prevent oil and fuel leaks from parked locomotives, to reduce the impacts of "oily water" discharges into the sub-surface and off-site stormwater drains.

Although the site history is not well documented, it appears that few facilities have been removed and there have been few major changes in site processes over the life of the site. The locations of some previous potential sources of contamination are known (eg, the old load box, former ASTs in an unsealed area, formerly unsealed refuelling area). The major unknown appears to be the presence of waste dumps at unknown locations in the past.

In the Auditor's opinion, the history is not well documented but the location of the primary targets has not changed over the life of the facility, and the absence of process information is partly compensated by the bulk of previous investigations.

# 4 CONTAMINANTS OF CONCERN

The Consultant lists contamination issues based on the previous investigations on the site. The potential contaminants of concern are considered by the Auditor to be:

| Area | Activity | Contaminants of concern |
|---|---|---|
| All track areas, especially load box and refuelling areas, fuel and lubricant storage, etc | Spills and leaks | TPH, especially long chain oils and diesel |
| Filled area, which is most of the site | Filling with ash and other unknown materials | PAHs, unknown metals |
| Diesel AST area | Abrasive blasting | Zinc, copper, lead, mercury |
| Carpark and diesel AST area, based on previous results | Steam boiler wastes | Chromium |
| Steam spray shed and electrical workshop, mixed liquor waste tank areas | Cleaning with solvents | VHCs |
| Around old fibro buildings, potentially anywhere on site | Deterioration of building materials, abrasion of asbestos brake linings, disposal of linings | Asbestos |
| Near turntable | Possible former market garden | OCPs |
| Groundwater | Leaching of contaminants or migration from upgradient | Mainly TPH and metals |

**Table 4.1** – Contaminants of concern

The Auditor considers that the analyte list used by the Consultant is appropriate. The individual substances included in each suite of analytes are listed in Appendix D.

# 5 STRATIGRAPHY AND HYDROGEOLOGY

## 5.1 Stratigraphy

- The site's topography is relatively flat, as it was extensively filled and levelled during the initial site development. The site would have originally sloped to the east and northeast.
- The site is underlain by a clay and ash fill. The ash is said to originate from steam locomotives, which were stored on the site prior to the developments of the Locomotive Maintenance Centre. The fill extends to depths ranging from 2 – 4m, and is thickest on the eastern portion of the property.
- The fill is underlain by 0.2m – 6m of natural clay, which is underlain by moderately weathered shale.
- Attachment 3 is a schematic cross section, showing two layers of ash fill over part of the site, and thickening of the fill towards the east.

## 5.2 Hydrogeology

- A perched water table, as indicated on Attachment 3, was found, in the fill material above the natural clays materials. The depth to perched water and interconnection between perched water bodies are thought to be inconsistent. Flow would be expected to generally follow the fill and natural clay boundary.
- Groundwater is found within the natural clay and shale and deeper fill at a depth of about 2-3m below ground surface.
- General direction of the natural groundwater flow is easterly. Groundwater abstraction and use is not expected because of low quantity and poor (saline) quality. The nearest receptor is expected to be Cooks River or its tributaries to the east of the site.

## 5.3 Hydrology

- The nearest water body is the Upper Cooks River, which is hydraulically connected to a natural creek (located approximately 20m east of the property boundary) to which two large stormwater drains flow from the site.

Two stormwater drains pass under the site and are thought to occupy approximately the locations of former natural drainage channels. Both the stormwater drains pass underneath Cosgrove Road. One drain, shown on Attachment 2 is approximately 250m to the south of the DELEC maintenance workshop. The other passes under the site near the turntable.

# 6 EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

The Auditor has assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The Auditor's assessment follows.

- The sampling pattern adopted was targeted. Investigation locations generally targeted areas of previously identified TPH contamination to assess the current conditions. Previously detected metals contamination was targeted for further delineation. Other areas of potential contamination, as listed in Table 4.1, were also targeted. In the Auditor's opinion, the sampling pattern was generally appropriate.
- The Consultant used a sampling density of 63 locations in an area of 13.24 ha, which Egis divided into 3 sub areas. The sampling density falls well short (less than half depending on the representative areas assumed) of the minimum requirement based on EPA (1995) Sampling Design Guidelines. This is justified by Egis on the basis that the investigation was targeted and based on previous results. The previous sampling locations are shown on Attachment 4, and total approximately 55 locations, also well below the current EPA guideline. Many of those locations were analysed for TPH, and the results are no longer valid for comparison with criteria because TPH concentrations may have changed with time. The metals results were used by Egis in targeting areas, but Egis have not attempted to discuss the previous data quality or to incorporate the previous results into the current data set. As Attachments 2 and 4 (from the Egis assessment report) are presented at different scales on different base maps, it is difficult to assess whether adequate coverage has been obtained. While the sampling density may be adequate for Sydney Ports' current purposes, it should be recognized that there is a relatively high risk of significant undetected hotspots.
- No samples were obtained from beneath the main locomotive workshop. This shed is part of the original development, and features substantial concrete floors and concrete sumps to support the weight of locomotives. Any fill beneath the shed would be expected to be of similar quality to that around the shed, and leakage of contaminants through the floor slabs is unlikely. Investigations under the shed are therefore not considered to be necessary at this time.
- Not all locations were analysed for all analytes. As the analyte list was targeted, the Auditor considers this generally adequate, but there may be insufficient analyses for some analytes (see Section 8).
- The sample depths were directly below the ground or sealed surface, then at 1m intervals. While the Auditor considers this generally appropriate, it resulted in some critical depths, eg the base of fill/top of clay interface being missed in some locations. This is understandable and inevitable when sampling from boreholes with push tubes and few cutting returns. Some test pits were terminated within fill without reaching the natural clay, without a reason for termination being given. As the primary potential sources of contamination are

at the surface, and sufficient depth samples were obtained to characterize the ash fill, the sample depths are considered to be generally adequate.

- Samples were taken either from a split spoon or directly from a solid flight auger and placed into glass jars. A small rig without push tube capability was used in many locations because of access restrictions. However this meant that some samples targeting volatile components were inappropriately obtained from augers. In particular, augers were used for all of the samples targeting volatile halogenated compounds, which would compromise the data usability.
- Field screening for volatile components was conducted with a PID. Results are presented on the borelogs. Calibration certificates are not presented.
- Sample logs are presented (for most bores, some are missing from the report). The logs generally provide adequate detail. It is apparent that more than one person has logged bores, and some logs provide more detail than others.
- Chain-of-Custody forms are provided for delivery to the primary laboratory (AEL) and contain adequate details. They indicate that samples were delivered to the laboratory daily in most cases, and were analysed within holding times. Samples were all sent by Egis to AEL, and Chain-of-Custody forms are not provided for transfer from AEL to subcontract laboratories (Amdel and Kilpatrick).
- The investigation report includes a brief discussion of (generic) data quality objectives and provides a discussion of QA/QC results for soil and groundwater.
- The report states that twenty-one duplicate soil samples were obtained and analysed. Results are reported for 10 duplicates for metals. Fewer duplicates were analysed for PAHs (4) and TPH (3). It appears that no duplicates were analysed for the other analytes. In many cases, the relative percent difference (RPD) of the duplicates exceeded the desirable limit of 30%. Most of these samples were from fill material which was inhomogeneous, and in many but not all cases the concentrations were low. It appears that some of the soil samples were field duplicates analysed by a second laboratory (Amdel), but these are not discussed separately by Egis.
- One laboratory-prepared trip blank was employed. Egis state that "results...were in a range acceptable for QA/QC purposes". Tabulated results indicate that zinc was detected (0.01 mg/L) but other metals and TPH/BTEX were below the PQL.
- No field spikes were employed.
- The Egis report states that two duplicate water samples were obtained and analysed for metals, PAHs, and TPH/BTEX. It appears from the report text that one or both were analysed by a secondary laboratory, but this is not clear in the Egis report. The RPD for an arsenic duplicate was an unacceptable 133%, but the concentration was low. The Chain-of-Custody for water samples indicates only one QA duplicate sample, QA1. A second sample, QA2, is reported in the text, but laboratory reports are not included.
- One equipment rinsate sample was obtained. Egis state that the "results...were in a range acceptable for QA/QC purposes". Tabulated results indicate that

the sample was analysed for metals only, with all results below the PQL. The method of preparation of the equipment blank is not stated.

- The primary analytical laboratory (AEL) has produced NATA endorsed test certificates for the analyses it conducted, as have the subcontract laboratories. Samples were analysed within appropriate holding times and with appropriate analytical methods (see Appendix D for method details).
- The Consultant's report includes a brief discussion of data quality objectives and QA/QC results.
- Soil interlaboratory duplicate samples were analysed for most of the analytes, but they are not discussed, and the samples analysed are not easily recognized from the laboratory certificates. No interlaboratory water results are presented.
- Laboratory QA/QC included a mixture of analyses of method blanks, surrogate spikes, matrix spike and matrix spike duplicate samples. Results were within control limits. The lowest recovery was 61% for a VCH surrogate.

In considering the data as a whole, the Auditor concludes that the data is likely to be reliable and useable, although the VCH data may be compromised by the sampling method and the TPH data for groundwater by the absence of secondary laboratory checks. It is also noted that the sample density for the audited results is low.

# 7 ENVIRONMENTAL QUALITY CRITERIA

The Auditor has assessed the soil data provided by the Consultant by reference to Soil Investigation Levels for Urban Redevelopment Sites in NSW in "Guidelines for the NSW Site Auditor Scheme", (EPA 1998). For this assessment, the relevant guidelines are Column 4 – SIL4- "*Commercial or industrial*".

The Auditor has assessed the groundwater data provided primarily in reference to the recently released "*Australian and New Zealand Guidelines for Fresh and Marine Water Quality (The Water Quality Guidelines)*" (ANZECC, 2000). These guidelines differ from the previous guidelines in that they are risk based and tailored for local conditions. Trigger levels are provided. These are concentrations that, if exceeded, indicate a potential environmental problem and "trigger" further investigation. The trigger levels for individual substances are reproduced in Appendix B. Egis has used a trigger levels at the 95% level of species protection. This is considered applicable based on the currently available data as the Cooks River would probably be classified as at best a slightly to moderately disturbed ecosystem.

The NEPM Schedule B(1) "Guideline on Investigation Levels for Soil and Groundwater" is also endorsed by EPA. The current criteria for individual substances are reproduced in Appendix B. EPA (1994) " Guidelines for Assessing Service Station Sites" has also been referred to for assessing TPH results.

# 8 EVALUATION OF SOIL ANALYTICAL RESULTS

## 8.1 General

Sample locations are indicated in Appendix A, Attachment 2.

The Auditor has considered the results for the contaminants of concern against Soil Investigation Levels (Appendix B). Results are considered below for the contaminants of concern listed in Section 4.

## 8.2 TPH

Previous investigations detected numerous areas of surface TPH staining and high concentrations of TPH in analyses samples. Total TPH concentrations of up to 37,800 mg/kg were recorded in the previous investigations in the early 1990s. Site improvements have been conducted since that time. In the current investigation, surface hydrocarbon staining was noted in a number of locations, many of which appear to correspond to the previous observations. Analytical test results are generally lower. Egis present a comparison of previous and current results. In general, the current analytical results indicate lower concentrations, but this may be because Egis deliberately avoided sampling the worst stained areas, which are indicated on Figure 5 of the Egis final report. Egis state that the analytical results generally, but not always, corresponded well with the field observations.

None of the more volatile C6-C9 chain length hydrocarbon fraction was reported above the relevant PQL, nor were any BTEX compounds.

The locomotive refuelling area was noted as an area with hydrocarbon staining. The area is concrete sealed, and runoff is directed to the effluent treatment plant. A previous sample recorded a TPH concentration of 8,700mg/kg. It is not known whether the area of that sample is now sealed. Samples were not obtained from directly within the stained area in this investigation. In samples analysed from around the area, TPH was detected in at 30mg/kg at 2m depth in a downgradient bore (BH50) only. All the TPH was in the C10-C14 range, indicating diesel. The soil under the refuelling area may be contaminated by spills prior to the area being concrete surfaced, but the results indicate that the contamination is largely confined to the immediate refuelling area.

The former AST area now has a new AST and the surface is now fully sealed. Previously, high TPH concentrations of up to 8,250mg/kg were recorded. The sealed area was not resampled. TPH was not detected in two bores placed on the downhill side, but the deepest sample analysed was from 1m. No field indications of contamination were noted.

Detections at total C10-C36 TPH of greater than the site criteria of 1,000mg/kg were recorded in diverse locations, mainly on the northern side near the trackways and turntable, and the south side near the (underground) stormwater drain location. Significant concentrations were generally recorded in the upper 1m. Egis did not do an analysis of the depth profile of the hydrocarbons, but noted that in more than half of the sampling locations, staining and odour did not extend to the fine grained soil

beneath the ballast. Field observations are that most of the staining is between the tracks, particularly near switching locations.

In several locations, the TPH contamination is relatively deep. At TP10, (Appendix A, Attachment 2) downgradient of the mixed liquid waste tank area where there is widespread contamination, a TPH concentration of 5,600mg/kg (all in the heavier >C15 range) was recorded at 2m depth in what appears to be buried waste material. No hydrocarbons were detected in shallower samples. The test pit was terminated at 2m depth without an explanation being given.

There is surface staining around the load box. A bore nearby but not directly in a stained area had a TPH concentration of 1,300mg/kg in a sample from 2m depth, indicating some downward movement of contamination. At BH61, downgradient of the load box and trackway area, TPH of 5,700mg/kg (including 1,200mg/kg in the C10-C14 range) was recorded at 3m depth, near the base of the fill. A much lower concentration (59mg/kg) was recorded at shallower depth. At BH36, also downgradient of the trackways area and old load box, TPH was detected at 3,400mg/kg at a depth of 3m near the base of fill, with no detections on a shallow sample. These results indicate either migration from an upgradient source such as the load box or trackway area, or burial of contaminants.

## 8.3 Filled areas

In presenting the analytical results, Egis has not differentiated between fill and natural material, but the majority of the results are in fill.

Previous investigations indicated the presence of a solid waste tip, at the southeast end of the site. The log of TP10 indicates traces of waste including wire, tiles, plastic and tarry asphalt (with a TPH concentration of 5,600mg/kg) at a depth of 2m. The base of the waste was not determined, and the nearest investigation locations are approximately 40m away. This pit may have intersected part of a waste burial site.

The presence of ash in the fill was noted. PAHs were detected at approximately 40 locations. At some of the locations, samples from two depths were analysed. The highest concentration recorded was 28mg/kg, well below the site criteria of 100mg/kg. Sufficient samples containing ash were analysed to allow confidence that the fill does not contain PAHs at concentrations that would pose a risk to industrial use.

Approximately 75 analyses were conducted for a suite (listed below) of metals. While Egis used previous results to target particular areas, they did not attempt to incorporate previous results into the data set. The Egis results are summarised below. SIL Column 4 is the industrial guidelines. Note that SIL Column 5 is Provisional Phytotoxity Criteria, which is not required to be evaluated for an industrial site, but which may give some indication of potential phytotoxicity in landscaped areas, and also give an indication of elevated metals that could potentially impact groundwater. Except for cadmium and mercury, the metals in the analyte suite were detected at most locations.

| Analyte | Maximum detected (mg/kg) | *n* > SIL Column 4 | *n* > SIL Column 5 |
|---|---|---|---|
| arsenic | 56 | 0 | 5 |
| cadmium | 1 | 0 | 0 |
| chromium (assume 111) | 170 | 0 | 0 |
| copper | 14,000 | 1 | 14 |
| lead | 940 | 0 | 2 |
| mercury | 0.11 | 0 | 0 |
| Nickel | 110 | 0 | 3 |
| zinc | 2,100 | 0 | 12 |

**Table 8.1** – Summary of soil analytical results

While some of the metals, especially copper, lead and zinc, usually associated with each other, are clearly elevated with respect to assumed background, all results are less than the industrial criteria except for copper in one location. The high copper concentration was detected at BH21 near the locomotive workshop. The nearest bores (eg BH26, which has the second highest recorded concentration of 1,100mg/kg) also have elevated concentrations but are all further than 50m away. While it is likely that the high concentration is a very localised hotspot, this cannot be ascertained on the data presented.

## 8.4 Diesel AST Area

Abrasive blasting of the former ASTs is indicated as a potential cause of metals contamination in this area. Zinc was detected at a concentration of 58,700mg/kg in the previous investigation, in the area that is now concrete sealed within the new bunded AST area. The concentrations of copper, lead, zinc and mercury detected in the surrounding area were not significantly elevated, indicating that high concentrations are probably localised within the existing bunded area.

## 8.5 Steam boiler wastes

Chromium was listed as a contaminant of concern because of its possible presence in steam boiler wastes. It was detected at elevated concentrations in previous investigations, but the criteria for chromium is now higher than what was used at the time of the original investigation, assuming the chromium is in the form of chromium (111). No speciation has been conducted.

## 8.6 Chlorinated solvents

Two samples from near the mixed liquid waste tank area and 3 from near the steam cleaning sheds (locomotive wash bays, Attachment 2) were analysed for chlorinated solvents. While the data quality is compromised (see Section 6), there were no indications of chlorinated solvents, and there does not appear to be any anecdotal evidence of their use on site. The mixed liquid waste area appears to be of relatively recent construction and is concrete bunded. The area of the locomotive wash bays and electronics workshop, where solvents could have used used, are part of an old concrete apron at the northern end of the main workshop. In the Auditor's opinion, chlorinated solvent contamination is not likely.

## 8.7 Asbestos

Six samples were analysed for the presence of asbestos, and it was detected in one sample. Egis state that "*the possibility exists for other areas of asbestos contamination to exist...*". The Auditor agrees.

## 8.8 Market gardens

Airphoto indications were that there could have been market gardens near the existing turntable location. Samples from this area were analysed for OCPs and OPPs. While some of the samples missed their target depth, no indications of contaminants associated with market gardens were found. As contaminants would be expected to be near the former ground surface, and this area now has several metres of fill, the risk of significant pesticide contamination is low.

# 9 GROUNDWATER EVALUATION

## 9.1 General

A total of 13 wells, some previously existing and some installed in this current investigation, were sampled. Well locations are indicated on Attachment 2, Appendix A, with well details in Attachment 5. Wells were considered to be installed in either clay or fill, but all were shallow as they were installed by auger and not extended into rock. Some clay wells are also open to the fill.

Water was analysed for 14 heavy metals, including some not included in the soils analysis suite of 8 metals, TPH/BTEX/ PAHs and phenols. Results are discussed and evaluated below.

## 9.2 HEAVY METALS

### 9.2.1 General

Metals results for the 14 metals are summarised as follows:

| Analyte | Detections (13 wells) | Maximum (mg/L) | n>trigger level |
|---|---|---|---|
| antimony | 3 | 0.005 | 0 |
| arsenic | 8 | 0.005 | 0 |
| barium | 13 | 0.30 | NC |
| cadmium | 0 | | |
| chromium | 4 | 0.004 | 3 |
| cobalt | 11 | 0.055 | NC |
| copper | 10 | 0.027 | 9 |
| lead | 2 | 0.003 | 0 |
| manganese | 13 | 2.9 | 2 |
| molybdenum | 1 | 0.025 | 0 |
| nickel | 13 | 0.041 | 4 |
| tin | 0 | | |
| zinc | 9 | 0.53 | 9* |
| mercury | 0 | | |

Note that the PQL for zinc (0.01mg/L) was slightly higher than the trigger level (0.008mg/L).

### 9.2.2 Barium

Figure 9.1 illustrates the frequency distribution for barium results. Results for barium do not indicate a normal distribution. Barium was not analysed for in the soils, so a relationship with soil concentrations is not possible to determine. The highest concentrations are in wells in clay, and barium concentrations can be high in the shale that the clay is derived from. Natural occurrence is the most likely explanantion in the Auditor's opinion.

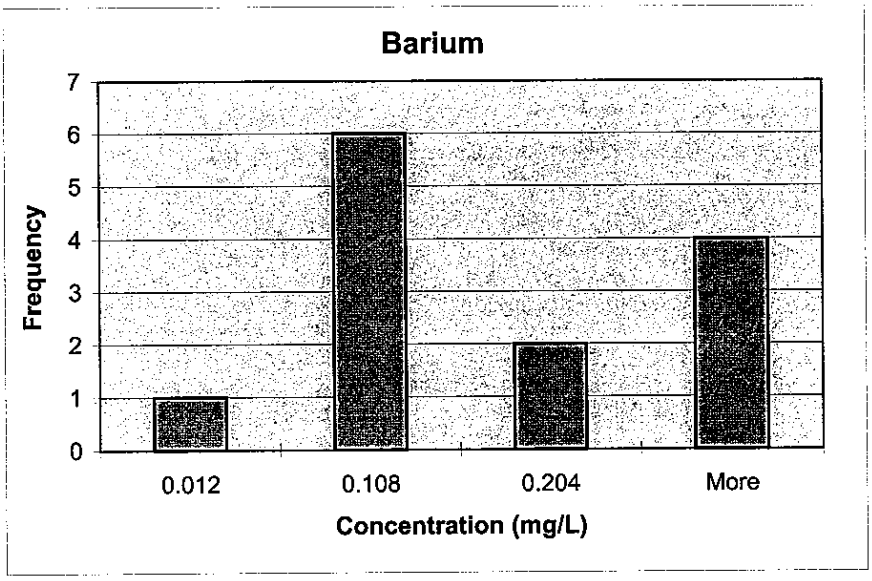



**Figure 9.1** – Frequency distribution table for Barium groundwater results

### 9.2.3 Copper

Figure 9.2 illustrates the frequency distribution for copper results. Results for copper show an outlier (NW3), which could indicate contamination. This well is located in the assumed downgradient direction of the location in which high copper was detected in soil, and therefore may be due to leaching.

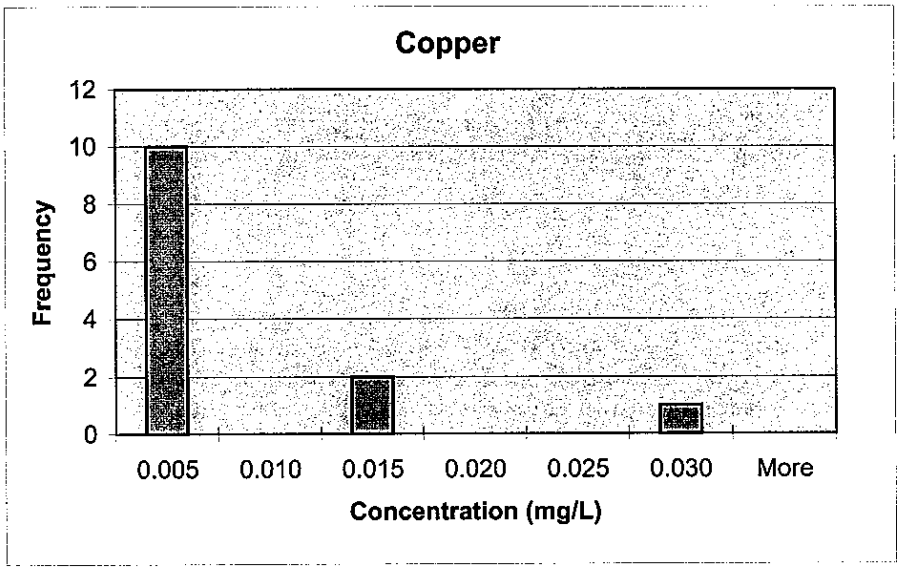



**Figure 9.2** - Frequency distribution table for Copper groundwater results.

### 9.2.4 Manganese

Figure 9.3 illustrates the frequency distribution for manganese results. Results for manganese show several outliers. Manganese was not analysed for in soils, but manganese nodules are common in swampy areas (which part the site formerly was). Natural occurrence is most likely.

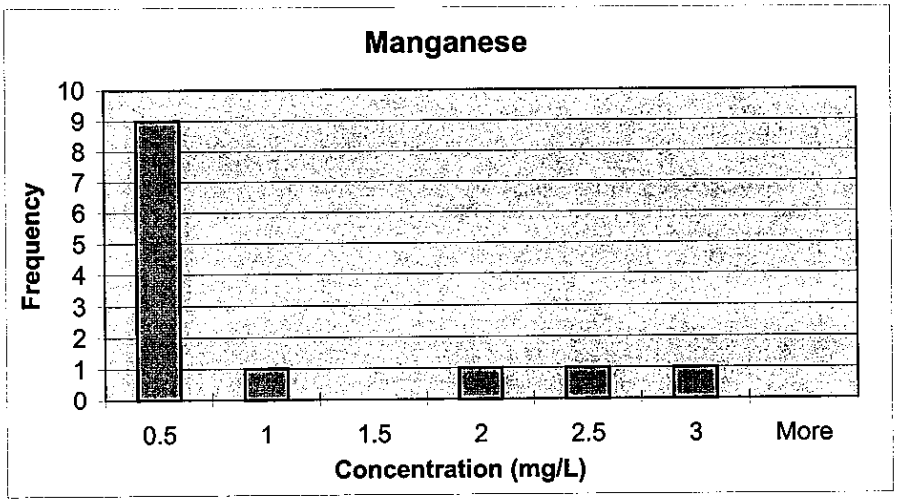



**Figure 9.3** - Frequency distribution table for Manganese groundwater results

### 9.2.5 Nickel

Figure 9.3 illustrates the frequency distribution for nickel results. They indicate two outliers, both of which are associated with manganese. As nickel was not a contaminant detected in significant concentrations in soil, natural occurrence appears most likely.

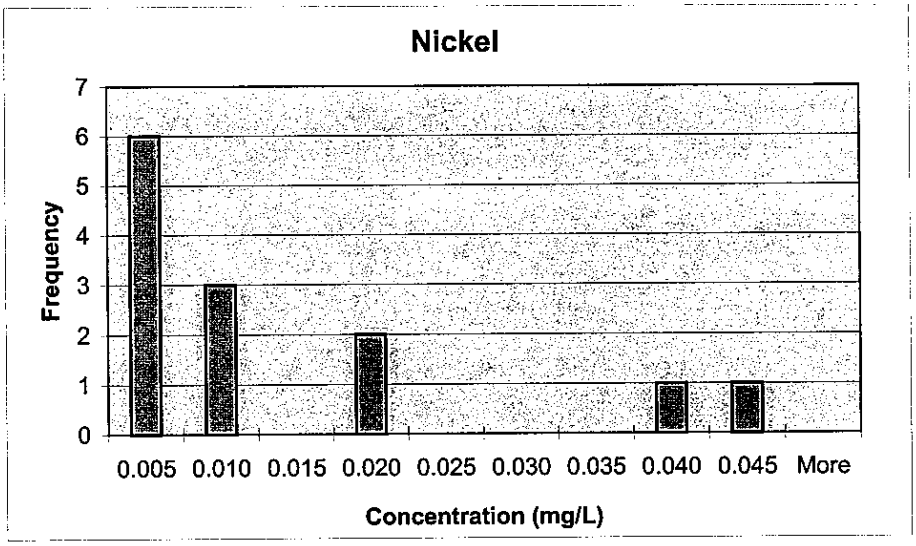



**Figure 9.4** - Frequency distribution table for Nickel groundwater results

### 9.2.6 Zinc

Figure 9.5 illustrates the frequency distribution for zinc results. Results indicate some outliers. The highest results are on the downgradient boundary(NW2) near the previous detection of high zinc in soil, the southeastern downgradient boundary (BH18) near detections of elevated zinc in soil, downgradient of the old load box (BH35), near elevated concentrations in soil, and also near the upgradient boundary (BH39). The zinc in groundwater may be due to onsite sources, but it would be difficult to distinguish onsite from offsite impacts.

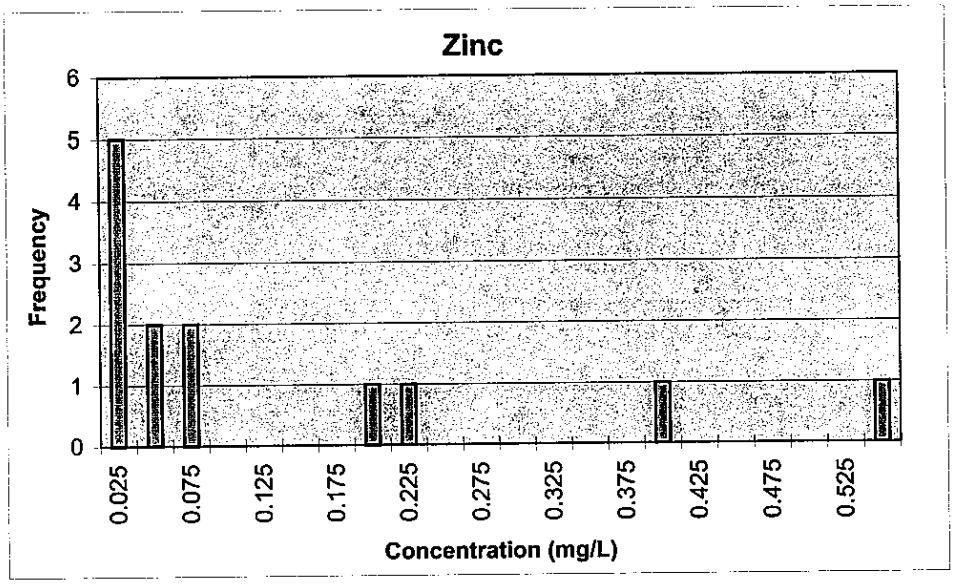



**Figure 9.5 - Frequency distribution table for Zinc groundwater results**

## 9.3 ORGANICS

No TPH or PAHs were detected in any well. This is somewhat surprising given the widespread detections of TPH in the site soils, and previous detections in groundwater. However, the existing wells have been analysed on a number of occasions, and show decreasing concentrations, and in most locations a decrease in TPH concentration with depth is indicated. Table 9.1 below summarises groundwater TPH results for existing wells.

| Well | | TPH (GC) | | | |
|---|---|---|---|---|---|
| ID | Year | C6-C9 | C10-C14 | C15-C28 | C29-C36 |
| MW6 | | | **0.3** | nd | nd |
| | | | **0.4** | nd | nd |
| | | nd | nd | nd | nd |
| | | <0.04 | <0.1 | <0.2 | <0.2 |
| | 2001 | <0.04 | <0.1 | <0.2 | <0.2 |
| MW7 | 1993 | **0.03** | nd | nd | nd |
| | 1997 | <0.04 | <0.1 | <0.2 | <0.2 |
| | 2001 | <0.04 | <0.1 | <0.2 | <0.2 |
| MW10 | 1993 | nd | **6** | **36** | nd |
| | 1997 | <0.04 | <0.1 | <0.2 | <0.2 |
| | 2001 | <0.04 | <0.1 | <0.2 | <0.2 |
| MW12 | 1994 | nd | nd | nd | nd |
| | 2001 | <0.04 | <0.1 | <0.2 | <0.2 |
| MW17 | 1997 | <0.04 | <0.1 | <0.2 | <0.2 |
| | 2001 | <0.04 | <0.1 | <0.2 | <0.2 |

nd – not detected

**Table 9.1 –** TPH groundwater analytical results from existing wells

In the locations where TPH has been found at depth (TP10, BH61), there are no wells ideally placed to detect TPH in groundwater. The Auditor concludes that while there are no indications of widespread TPH contamination, the potential for groundwater contamination cannot be eliminated while significant sources remain.

# 10 ASSESSMENT OF RISK

The widespread presence of TPH at concentrations of greater than the current EPA guidelines presents a potential risk to site users, and to the environment if off-site migration occurs. It is not possible to identify this risk because TPH is a complex mixture of different substances and the TPH on site undoubtedly derives from different sources, for example, lubricating oil and diesel fuel. As most of the TPH occurs between railway tracks, the potential for prolonged exposure of workers is very low.

There is a risk to site users from concentrations of copper detected in surface soil. The "hot spot" is likely to be of limited extent and the risk is therefore considered to be low. High zinc concentrations have also been detected in soil in the past but that soil is currently beneath concrete surfacing and therefore poses no risk to current users.

Asbestos has not been detected in surface soils in unsealed areas but investigations were limited and asbestos has been used on the site and has been found in soils. There is therefore a low risk to workers from asbestos in surface soils. It is not possible to quantify this risk.

# 11 EVALUATION OF REMEDIATION

Remediation has not been conducted in the current project. It is understood that environmental improvements over the last 10 years have included directing all stormwater runoff to effluent treatment systems.

The Consultant, Egis, has recommended remediation of a number of areas as follows:

- Remediation of TPH "hot spots" is recommended by Egis at 10 listed test pit locations based on the concentrations detected at these locations. The limits of remediation are not defined and it is stated that the limits can be determined visually. The Auditor notes that several of the listed "hot spots" are at 3 metres depth beneath uncontaminated soil. Egis also recommend remediation of the areas of TPH surface staining, many of which are between the existing railway lines.
- Remediation of a copper "hot spot" is recommended by Egis They recommend further delineation. The Auditor notes that the remediation requirement is based on only one sample point and the concentration at that point only just exceeds 2.5 times the guideline concentration for industrial sites. The nearest samples are greater than 50 metres away. The Auditor therefore recommends further delineation.
- Remediation of the zinc "hot spot" is recommended by Egis based on previous investigation results. The Consultant notes that the "hot spot" is beneath a concrete bunded area, and remediation should be conducted after the concrete is removed. The Auditor notes that this hot spot is based on one sample result and that the concentration recorded is less than twice the guideline. The Auditor recommends further delineation prior to remediation.

# 12 COMPLIANCE WITH REGULATORY GUIDELINES AND DIRECTIONS

Guidelines currently approved by the EPA under section 105 of the Contaminated Land Management Act 1997 are listed in Appendix C. The Auditor has used these guidelines.

The investigations were generally conducted in accordance with the "Guidelines for Consultants Reporting on Contaminated Sites". The checklist included in that document has been completed and is kept on file. The EPA's "Checklist for Site Auditors using the EPA Guidelines for the NSW Site Auditor Scheme 1998" has also been completed and is kept in file.

# 13 CONTAMINATION MIGRATION POTENTIAL

Surface TPH contamination is common over the site. Site improvements over the last ten years have aimed at collecting surface water run-off and directing it to effluent treatment systems. The potential for off site migration of contamination in surface water is therefore greatly reduced.

The potential for migration of dust is limited as the major contaminant, TPH, tends to bind the surface soil. The other contaminants noted in the soil (eg. copper, zinc, and asbestos) are either of limited lateral extent or currently beneath concrete and therefore also have a low migration potential.

No significant contamination has been detected in groundwater wells. Some metal concentrations exceed trigger values but they cannot be linked to on-site sources. TPH has not been detected in the current investigation in the well samples. The Auditor notes that TPH contamination has been detected in soils at 3 metres depth generally near the base of fill overlying clay, which probably indicates migration from an upgradient source. The Auditor also notes that there are no wells ideally placed to detect migration from the areas where deep contamination is found and that some of these areas are near the down-gradient site boundary. The potential for some, though probably not widespread, migration exists. The potential for migration is reduced because groundwater flow paths in the fill appear to be intermittent and unconnected.

# 14 CONCLUSIONS AND RECOMMENDATIONS

The consultant, Egis, considers "that the site is likely to be suitable for continued commercial/industrial uses subject to the implementation of the recommended remediation and management measures targeted towards addressing the identified issues of contamination". Based on the information presented in the Consultant's report and observations made on site, and following *EPA (1998) Decision Process for Assessing Urban Redevelopment Sites,* the Auditor concludes that the risk for ongoing industrial activities is low.

For unrestricted industrial use the following are required:

- Further risk assessment or removal of TPH contamination in shallow soils;
- Assessment of off-site migration in areas where TPH has been detected in deep soils near the site boundary;
- Further assessment of copper concentrations in soil and remediation if necessary;
- Inspection and validation of soils beneath existing structures when they are removed; and
- Validation of any areas of exposed soil which will be readily accessible to site users to confirm the absence of asbestos fibres.

# 15 OTHER RELEVANT INFORMATION

This Audit was conducted for *Sydney Ports Corporation* for the purpose of determining what (if any) remediation remains necessary before the Site is suitable for the specified use. The Audit falls within the definition of a non-statutory audit under Section 47(1)(b)(iii) of the NSW Contaminated Land Management Act 1997, No. 140. This summary report may not be suitable for other uses. The Auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which he had some control or is reasonably able to check.

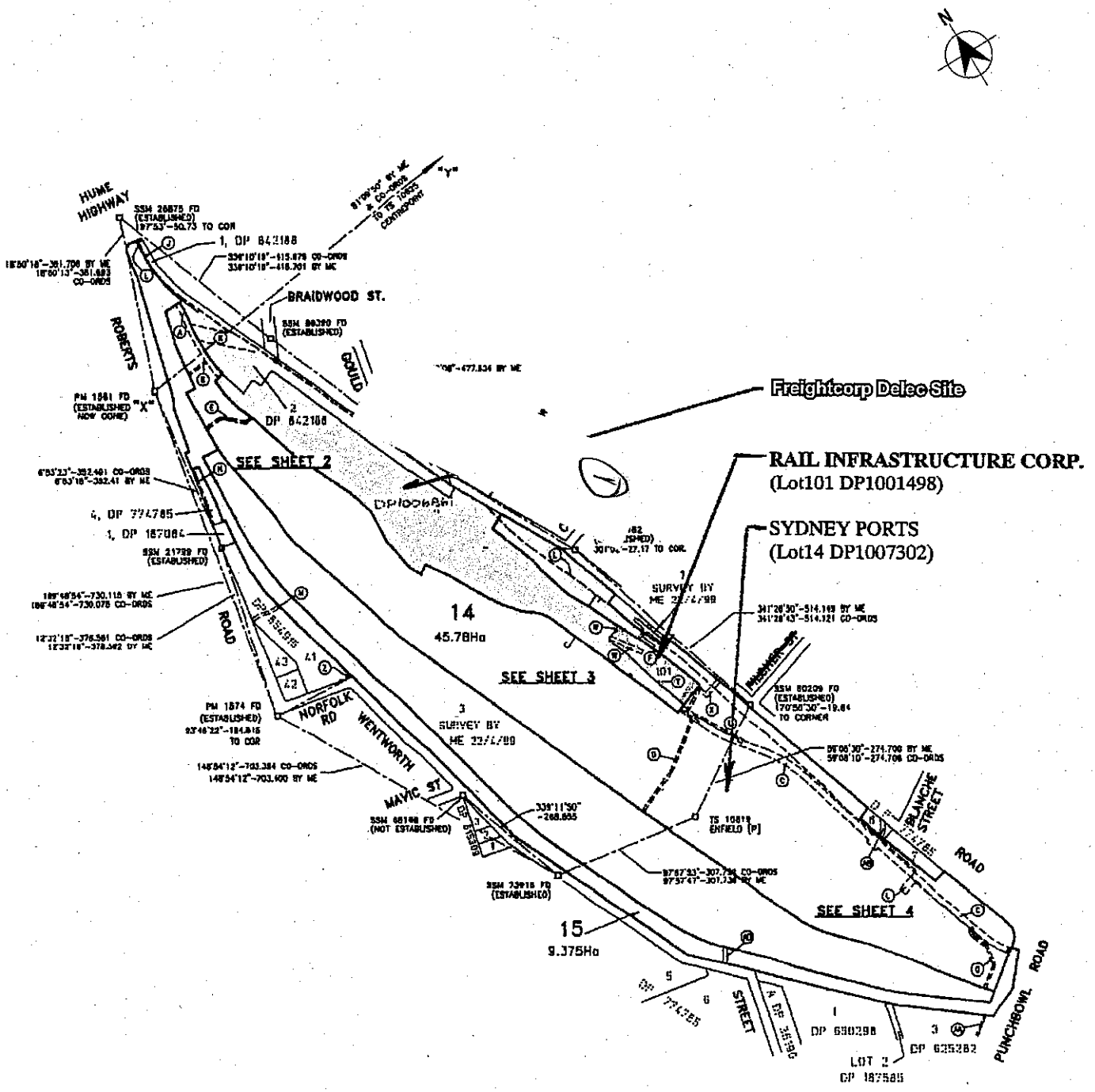
It is not possible in a Summary Site Audit Report to present all data that could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

# APPENDIX A

# ATTACHMENTS

# SITE PLAN

## SYDNEY PORTS CORPORATION / FREIGHTCORP - DELEC SITE, ENFIELD




0 250 500m

Approximate Scale

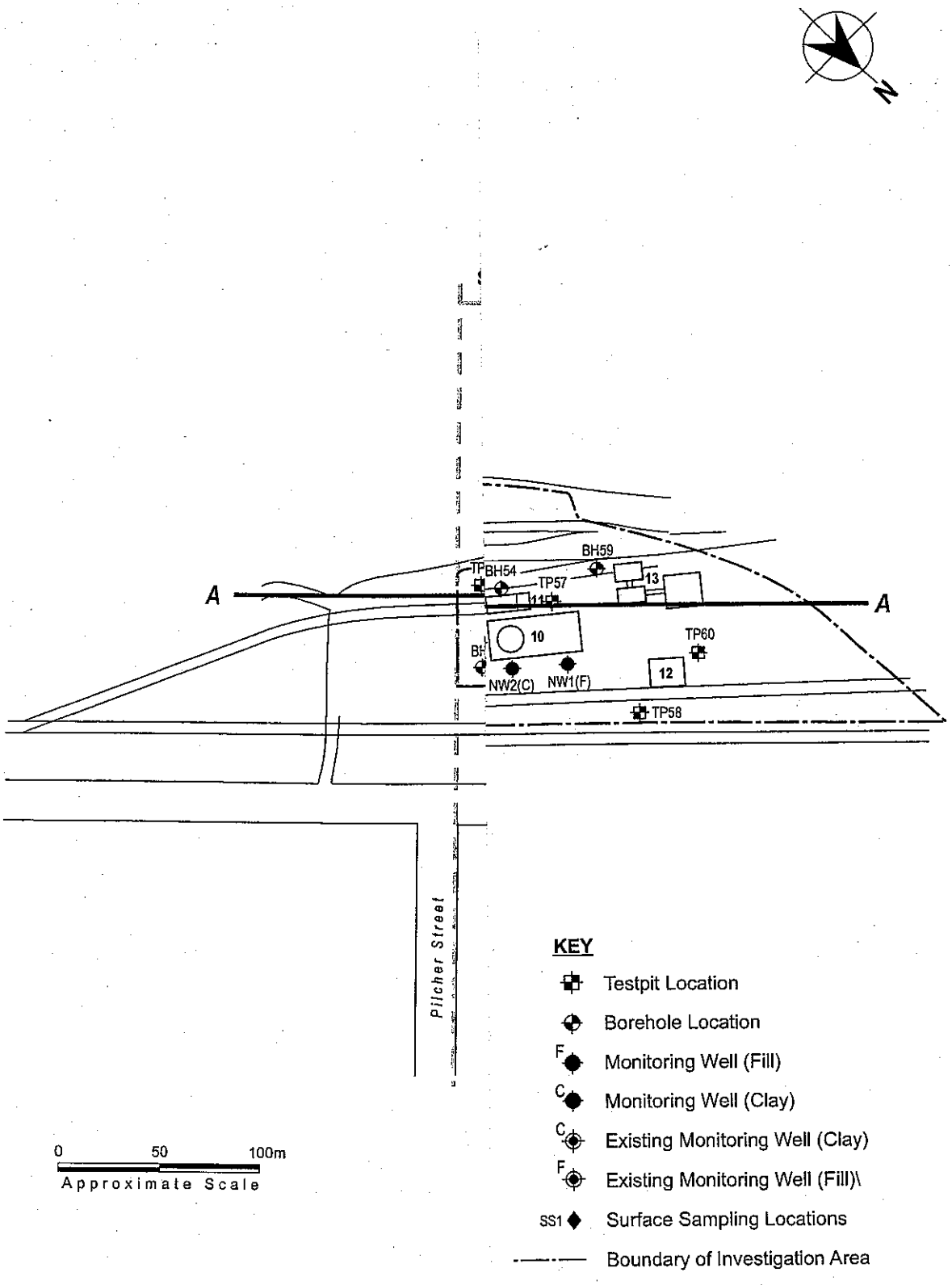
**Date :** 27 November 2001

**File Name :** VA0488_05.cdr

**Figure 2**

# SITE PLAN AND SAMPLING LOC

SYDNEY PORTS CORPORATION / FREIGI




**Source :** Sinclair Knight Merz

**Date :** 27 November 2001

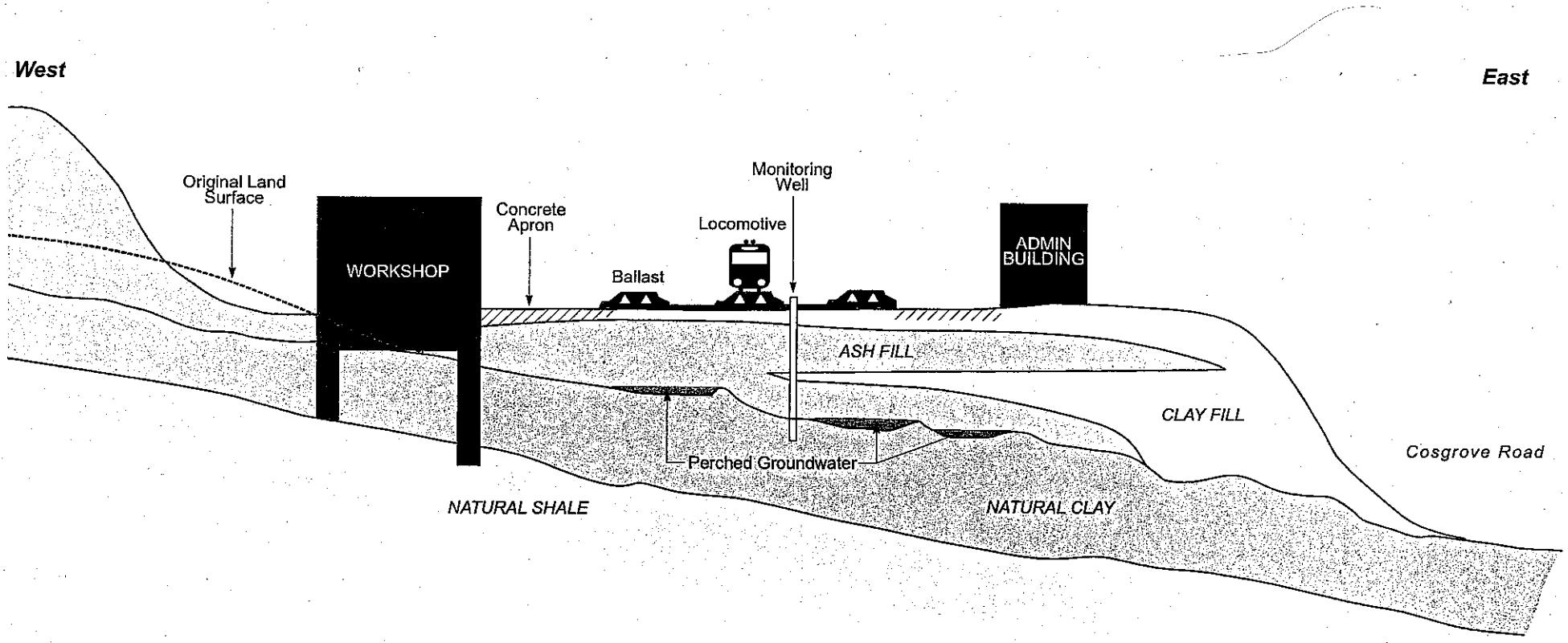
**File Name :** VA0488_08.cdr

egis

**Figure 3**

# SCHEMATIC CROSS-SECTION, (EAST-WEST) - PREVIOUS INVESTIGATION

## SYDNEY PORTS CORPORATION / FREIGHCORP - DELEC SITE, ENFIELD




**Source:** Groundwater Technology

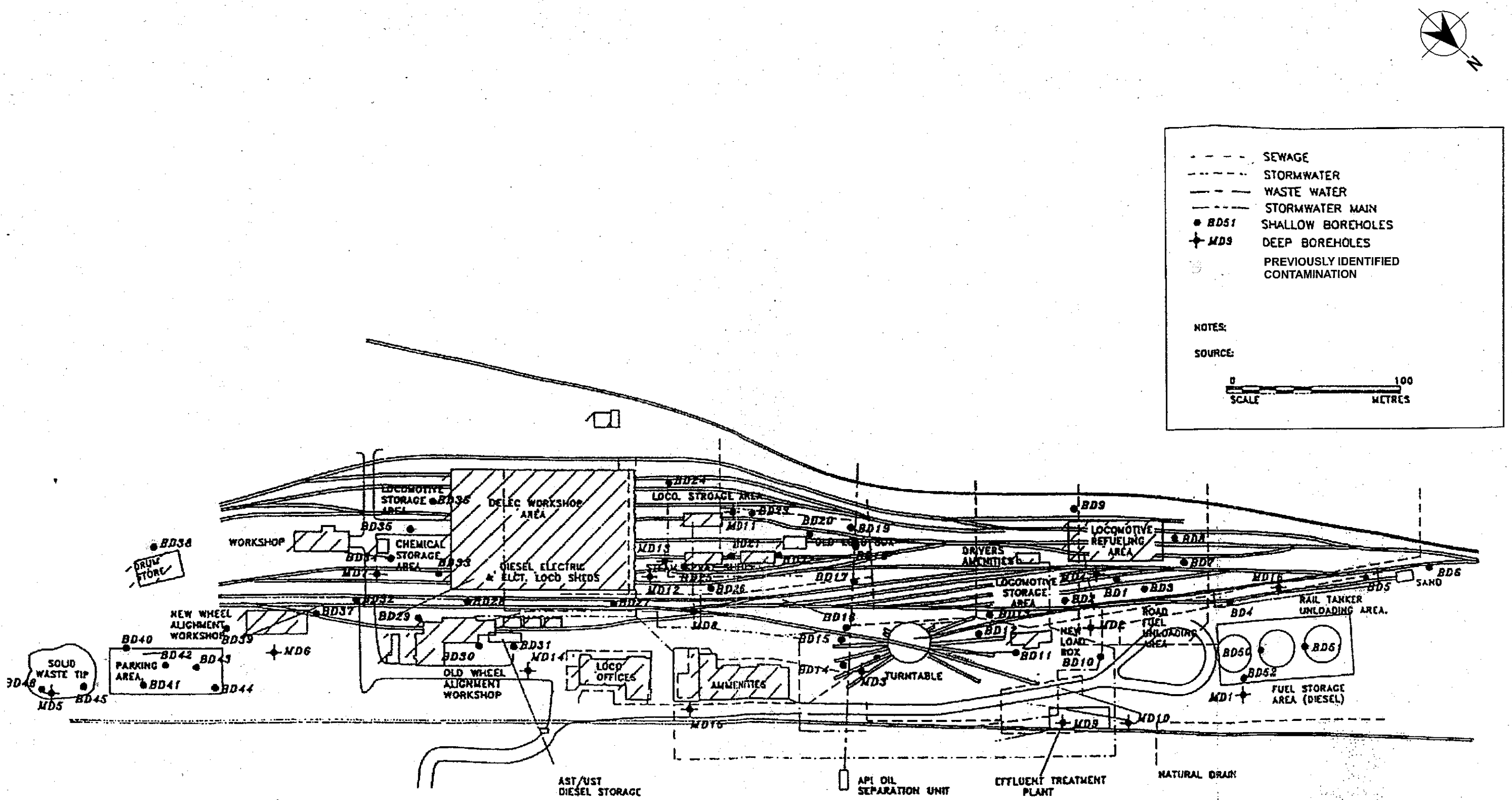
**Date :** 27 November 2001

**File Name :** VA0488_06.cdr

**Figure 8**

# PREVIOUS SOIL SAMPLING LOCATIONS & AREAS OF (PREVIOUSLY) IDENTIFIED CONTAMINATION

SYDNEY PORTS CORPORATION / FREIGHTCORP - DELEC SITE, ENFIELD




Source : Groundwater Technology, 1993

Date : 27 November 2001

File Name : VA0488_07.cdr

Figure 4

## Table A - VA0488 DELEC
## Groundwater Well Details

W:\Environmental\Projects\Va\0488\000\reports\[R002 Appendix B - Groundwater Tables.xls]Sample Register

| No. | Date Sampled | Location | Sample Type | New / Existing | Depth to Base of Well (m) | T.O.C Elevation (m) | Depth to Water (m) | Corrected Water Elevation (m) | Analytes |
|---|---|---|---|---|---|---|---|---|---|
| NW1 | 8/11/2001 | Downgradient of bulk diesel AST | Clay | New | 4.220 | 22.203 | 2.650 | 19.553 | pH/14HM/TPH/BTEX/PAH/Phenols |
| NW2 | 8/11/2001 | Downgradient of bulk diesel AST | Fill | New | 2.420 | 21.985 | 2.350 | 19.635 | pH/14HM/TPH/BTEX/PAH |
| NW3 | 8/11/2001 | Downgradient of diesel / lube oil tanks | Clay | New | 3.770 | 21.169 | 2.570 | 18.599 | pH/14HM/TPH/BTEX/PAH/Phenols |
| NW4 | 8/11/2001 | Upgradient site boundary (north west) | Clay | New | 2.030 | 21.505 | 1.180 | 20.325 | pH/14HM/TPH/BTEX/PAH/Phenols |
| BH6 | - | Upgradient site boundary (south west) | Clay | New | 2.870 | 21.083 | dry well | - | - |
| BH8 | 8/11/2001 | Downgradient near main southern stormwater drain | Fill | New | 7.160 | 22.149 | 5.600 | 16.549 | pH/14HM/TPH/BTEX/PAH/Phenols |
| BH15 | 8/11/2001 | Downgradient of Wheel Lathe | Fill | New | 1.850 | 20.958 | 1.600 | 19.358 | pH/TPH/BTEX/PAH |
| BH18 | - | Downgradient site boundary (carpark) | Fill | New | | | dry well | - | - |
| BH22 | 8/11/2001 | Downgradient of diesel / lube oil tanks | Clay | New | 5.560 | 21.153 | 3.220 | 17.933 | pH/14HM/TPH/BTEX/PAH/Phenols |
| BH25 | - | Upgradient boundary | Clay | New | | | dry well | - | - |
| BH35 | 7/11/2001 | Downgradient of Locomotive Washbays | Clay | New | 9.110 | 21.407 | 3.550 | 17.857 | pH/14HM/TPH/BTEX/PAH/Phenols |
| BH39 | 8/11/2001 | Upgradient site boundary (north west) | Fill | New | 5.490 | 21.447 | 4.020 | 17.427 | pH/14HM/TPH/BTEX/PAH/Phenols |
| MW6A | 8/11/2001 | Downgradient site boundary | Fill | Existing | 3.960 | 21.157 | 2.890 | 18.267 | pH/14HM/TPH/BTEX/PAH/Phenols |
| MW7 | 8/11/2001 | Upgradient of Locomotive washbays | Fill | Existing | 4.000 | 21.413 | 2.960 | 18.453 | pH/14HM/TPH/BTEX/PAH/Phenols |
| MW10 | 8/11/2001 | Near Load Box | Fill | Existing | 3.030 | 21.281 | 2.640 | 18.641 | pH/14HM/TPH/BTEX/PAH/Phenols |
| MW12 | 8/11/2001 | Downgradient of Locomotive maintenance building | Fill | Existing | 2.460 | 21.232 | 2.100 | 19.132 | pH/14HM/TPH/BTEX/PAH/Phenols |
| MD17 | 8/11/2001 | Downgradient site boundary near turntable | Clay | Existing | 8.180 | 21.323 | 4.570 | 16.753 | pH/14HM/TPH/BTEX/PAH/Phenols |
| QA1 | 8/11/2001 | Duplicate (QA1 = MD17) | - | - | - | - | - | - | pH/14HM/TPH/BTEX/PAH/Phenols |
| QA2 | 8/11/2001 | Duplicate (QA2 = BH8) | - | - | - | - | - | - | pH/14HM/TPH/BTEX/PAH/Phenols |
| TB1 | 8/11/2001 | Trip Blank | - | - | - | - | - | - | pH/14HM/TPH/BTEX/PAH/Phenols |
| EB1 | 8/11/2001 | Equipment Blank | - | - | - | - | - | - | 14 HM |



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Checked by:AL

# APPENDIX B

# SOIL AND GROUNDWATER CRITERIA

# Soil Investigation Levels for Urban Redevelopment Sites in NSW (EPA 1998)

| Health-based investigation levels (mg/kg) | | | | | |
|---|---|---|---|---|---|
| **Substance** | Residential with gardens and accessible soil (home-grown produce contributing less than 10% fruit and vegetable intake; no poultry), including children's day-care centres, preschools and primary schools, or town houses or villas (NEHF A) | Residential with minimal access to soil including high-rise apartments and flats (NEHF D) | Parks, recreational open space, playing fields including secondary schools (NEHF E) | Commercial or industrial (NEHF F) | Provisional phytotoxicity-based investigation levels for sandy loams pH 6-8 (mg/kg) |
| | **Column 1** | **Column 2** | **Column 3** | **Column 4** | **Column 5** |
| Aldrin + Dieldrin | 10 | 40 | 20 | 50 | - |
| Arsenic (total) | 100 | 400 | 200 | 500 | 20 |
| Benzo(a)pyrene | 1 | 4 | 2 | 5 | - |
| Beryllium | 20 | 80 | 40 | 100 | - |
| Cadmium | 20 | 80 | 40 | 100 | 3 |
| Chlordane | 50 | 200 | 100 | 250 | - |
| Chromium (III) [2] | 12% | 48% | 24% | 60% | 400 |
| Chromium (VI) | 100 | 400 | 200 | 500 | 1 |
| Copper | 1000 | 4000 | 2000 | 5000 | 100 |
| Cyanides (complex) | 500 | 2000 | 1000 | 2500 | - |
| DDT | 200 | 800 | 400 | 1000 | - |
| Heptachlor | 10 | 40 | 20 | 50 | - |
| Lead | 300 | 1200 | 600 | 1500 | 600 |
| Manganese | 1500 | 6000 | 3000 | 7500 | - |
| Methyl mercury | 10 | 40 | 20 | 50 | - |
| Mercury (inorganic) | 15 | 60 | 30 | 75 | 1 [5] |
| Nickel | 600 | 2400 | 600 | 3000 | 60 |
| PAHs (total) | 20 | 80 | 40 | 100 | - |
| PCBs (total) | 10 | 40 | 20 | 50 | - |
| Phenol [3] | 8500 | 34000 | 17000 | 42500 | 70 |
| Zinc | 7000 | 28000 | 14000 | 35000 | 200 |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| **METALS & METALLOIDS** | | | | | | | | |
| Aluminium pH >6.5 | 27 | 55 | 80 | 150 | ID | ID | ID | ID |
| Aluminium pH <6.5 | ID | ID | ID | ID | ID | ID | ID | ID |
| Antimony | ID | ID | ID | ID | ID | ID | ID | ID |
| Arsenic (As III) | 1 | 24 | 94 c | 360 c | ID | ID | ID | ID |
| Arsenic (AsV) | 0.8 | 13 | 42 | 140 c | ID | ID | ID | ID |
| Beryllium | ID | ID | ID | ID | ID | ID | ID | ID |
| Bismuth | ID | ID | ID | ID | ID | ID | ID | ID |
| Boron | 90 | 370 c | 680 c | 1300 c | ID | ID | ID | ID |
| Cadmium H | 0.06 | 0.2 | 0.4 | 0.8 c | 0.7 B | 5.5 B,C | 14 B,C | 36 B,A |
| Chromium (Cr III) H | ID | ID | ID | ID | 7.7 | 27.4 | 48.6 | 90.6 |
| Chromium (CrVI) | 0.01 | 1.0 c | 6:00 AM | 40 A | 0.14 | 4.4 | 20 c | 85 c |
| Cobalt | ID | ID | ID | ID | 0.005 | 1 | 14 | 150 c |
| Copper H | 1 | 1.4 | 1.8 c | 2.5 c | 0.3 | 1.3 | 3 c | 8A |
| Gallium | ID | ID | ID | ID | ID | ID | ID | ID |
| Iron | ID | ID | ID | ID | ID | ID | ID | ID |
| Lanthanum | ID | ID | ID | ID | ID | ID | ID | ID |
| Lead H | 1 | 3.4 | 5.6 | 9.4 c | 2.2 | 4.4 | 6.6 c | 12 c |
| Manganese | 1200 | 1900c | 2500c | 3600c | ID | ID | ID | ID |
| Mercury (inorganic) B | 0.06 | 0.6 | 1.9 c | 5.4 A | 0.1 | 0.4 c | 0.7 c | 1.4 c |
| Mercury (methyl) | ID | ID | ID | ID | ID | ID | ID | ID |
| Molybdenum | ID | ID | ID | ID | ID | ID | ID | ID |
| Nickel H | 8 | 11 | 13 | 17 c | 7 70 c | 200 A | 560A | |
| Selenium (Total) B | 5 | 11 | 18 | 34 | ID | ID | ID | ID |
| Selenium (SeIV) B | ID | ID | ID | ID | ID | ID | ID | ID |
| Silver | 0.02 | 0.05 | 0.1 | 0.2 c | 0.8 | 1.4 | 1.8 | 2.6 c |
| Thallium | ID | ID | ID | ID | ID | ID | ID | ID |
| Tin (inorganic, SnIV) | ID | ID | ID | ID | ID | ID | ID | ID |
| Tributyltin (as µg/L Sn) | ID | ID | ID | ID | 0.0004 | 0.006 c | 0.02 c | 0.05 c |
| Uranium | ID | ID | ID | ID | ID | ID | ID | ID |
| Vanadium | ID | ID | ID | ID | 50 | 100 | 160 | 280 |
| Zinc H | 2.4 | 8.0 c | 15 c | 31 c | 7 15 c | 23 c | 43 c | |
| | | | | | | | | |
| **NON-METALLIC INORGANICS** | | | | | | | | |
| Ammonia D | 320 | 900 c | 1430 c | 2300 A | 500 | 910 | 1200 | 1700 |
| Chlorine E | 0.4 | 3 | 6A | 13 A | ID | ID | ID | ID |
| Cyanide F | 4 | 7 | 11 | 18 | 2 | 4 | 7 | 14 |
| Nitrate J | 17 | 700 | 3400 c | 17000 A | ID | ID | ID | ID |
| Hydrogen sulfide G | 0.5 | 1 | 1.5 | 2.6 | ID | ID | ID | ID |
| **ORGANIC ALCOHOLS** | | | | | | | | |
| Ethanol | 400 | 1400 | 2400 c | 4000 c | ID | ID | ID | ID |
| Ethylene glycol | ID | ID | ID | ID | ID | ID | ID | ID |
| Isopropyl alcohol | ID | ID | ID | ID | ID | ID | ID | ID |
| **CHLORINATED ALKANES** | | | | | | | | |
| **Chloromethanes** | | | | | | | | |
| Dichloromethane | ID | ID | ID | ID | ID | ID | ID | ID |
| Chloroform | ID | ID | ID | ID | ID | ID | ID | ID |
| Carbon tetrachloride | ID | ID | ID | ID | ID | ID | ID | ID |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| **Chloroethanes** | | | | | | | | |
| 1,2-dichloroethane | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,1,1-trichloroethane | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,1,2-trichloroethane | 5400 | 6500 | 7300 | 8400 | 140 | 1900 | 5800 c | 18000 c |
| 1,1,2,2-tetrachloroethane | ID | ID | ID | ID | ID | ID | ID | ID |
| Pentachloroethane | ID | ID | ID | ID | ID | ID | ID | ID |
| Hexachloroethane B | 290 | 360 | 420 | 500 | ID | ID | ID | ID |
| **Chloropropanes** | | | | | | | | |
| 1,1-dichloropropane | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2-dichloropropane | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,3-dichloropropane | ID | ID | ID | ID | ID | ID | ID | ID |
| **CHLORINATED ALKENES** | | | | | | | | |
| Chloroethylene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,1-dichloroethylene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,1,2-trichloroethylene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,1,2,2-tetrachloroethylene | ID | ID | ID | ID | ID | ID | ID | ID |
| 3-chloropropene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,3-dichloropropene | ID | ID | ID | ID | ID | ID | ID | ID |
| **ANILINES** | | | | | | | | |
| Aniline 8 | 250 A | 1100 A | 4800 A | ID | ID | ID | ID | |
| 2,4-dichloroaniline | 0.6 | 7 | 20 | 60 c | ID | ID | ID | ID |
| 2,5-dichloroaniline | ID | ID | ID | ID | ID | ID | ID | ID |
| 3,4-dichloroaniline | 1.3 | 3 | 6 c | 13 c | 85 | 150 | 190 | 260 |
| 3,5-dichloroaniline | ID | ID | ID | ID | ID | ID | ID | ID |
| Benzidine | ID | ID | ID | ID | ID | ID | ID | ID |
| Dichlorobenzidine | ID | ID | ID | ID | ID | ID | ID | ID |
| **AROMATIC HYDROCARBONS** | | | | | | | | |
| Benzene | 600 | 950 | 1300 | 2000 | 500 c | 700 c | 900 c | 1300 c |
| Toluene | ID | ID | ID | ID | ID | ID | ID | ID |
| Ethylbenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| o-xylene | 200 | 350 | 470 | 640 | ID | ID | ID | ID |
| *m*-xylene | ID | ID | ID | ID | ID | ID | ID | ID |
| *p*-xylene | 140 | 200 | 250 | 340 | ID | ID | ID | ID |
| *m*+*p*-xylene | ID | ID | ID | ID | ID | ID | ID | ID |
| Cumene | ID | ID | ID | ID | ID | ID | ID | ID |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | | |
| Naphthalene | 2.5 | 16 | 37 | 85 | 50 c | 70 c | 90 c | 120 c |
| Anthracene B | ID | ID | ID | ID | ID | ID | ID | ID |
| Phenanthrene B | ID | ID | ID | ID | ID | ID | ID | ID |
| Fluoranthene B | ID | ID | ID | ID | ID | ID | ID | ID |
| Benzo(a)pyrene B | ID | ID | ID | ID | ID | ID | ID | ID |
| **Nitrobenzenes** | | | | | | | | |
| Nitrobenzene | 230 | 550 | 820 | 1300 | ID | ID | ID | ID |
| 1,2-dinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,3-dinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,4-dinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,3,5-trinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-methoxy-2-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| 1-methoxy-4-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-chloro-2-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-chloro-3-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-chloro-4-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-chloro-2,4-dinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2-dichloro-3-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,3-dichloro-5-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,4-dichloro-2-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4-dichloro-2-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2,4,5-tetrachloro-3-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,5-dichloro-2,4-dinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,3,5-trichloro-2,4-dinitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-fluoro-4-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| **Nitrotoluenes** | | | | | | | | |
| 2-nitrotoluene | ID | ID | ID | ID | ID | ID | ID | ID |
| 3-nitrotoluene | ID | ID | ID | ID | ID | ID | ID | ID |
| 4-nitrotoluene | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,3-dinitrotoluene | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4-dinitrotoluene | 16 | 65 c | 130 c | 250 c | ID | ID | ID | ID |
| 2,4,6-trinitrotoluene | 100 | 140 | 160 | 210 | ID | ID | ID | ID |
| 1,2-dimethyl-3-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2-dimethyl-4-nitrobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 4-chloro-3-nitrotoluene | ID | ID | ID | ID | ID | ID | ID | ID |
| **Chlorobenzenes and Chloronaphthalenes** | | | | | | | | |
| Monochlorobenzene | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2-dichlorobenzene | 120 | 160 | 200 | 270 | ID | ID | ID | ID |
| 1,3-dichlorobenzene | 160 | 260 | 350 | 520 c | ID | ID | ID | ID |
| 1,4-dichlorobenzene | 40 | 60 | 75 | 100 | ID | ID | ID | ID |
| 1,2,3-trichlorobenzene B | 3 | 10 | 16 | 30 c | ID | ID | ID | ID |
| 1,2,4-trichlorobenzene B | 85 | 170c | 220c | 300c | 20 | 80 | 140 | 240 |
| 1,3,5-trichlorobenzene B | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2,3,4-tetrachlorobenzene B | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2,3,5-tetrachlorobenzene B | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2,4,5-tetrachlorobenzene B | ID | ID | ID | ID | ID | ID | ID | ID |
| Pentachlorobenzene B | ID | ID | ID | ID | ID | ID | ID | ID |
| Hexachlorobenzene B | ID | ID | ID | ID | ID | ID | ID | ID |
| 1-chloronaphthalene | ID | ID | ID | ID | ID | ID | ID | ID |
| **Polychlorinated Biphenyls (PCBs) & Dioxins** | | | | | | | | |
| Capacitor 21 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1016 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1221 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1232 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1242 B | 0.3 | 0.6 | 1 | 1.7 | ID | ID | ID | ID |
| Aroclor 1248 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1254 B | 0.01 | 0.03 | 0.07 | 0.2 | ID | ID | ID | ID |
| Aroclor 1260 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1262 B | ID | ID | ID | ID | ID | ID | ID | ID |
| Aroclor 1268 B | ID | ID | ID | ID | ID | ID | ID | ID |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| 2,3,4'-trichlorobiphenyl B | ID | ID | ID | ID | ID | ID | ID | ID |
| 4,4'-dichlorobiphenyl B | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,2',4,5,5'-pentachloro-1,1'-biphenylB | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4,6,2',4',6'-hexachlorobiphenyl B | ID | ID | ID | ID | ID | ID | ID | ID |
| Total PCBs B | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,3,7,8-TCDD B | ID | ID | ID | ID | ID | ID | ID | ID |
| **PHENOLS and XYLENOLS** | | | | | | | | |
| Phenol | 85 | 320 | 600 | 1200 c | 270 | 400 | 520 | 720 |
| 2,4-dimethylphenol | ID | ID | ID | ID | ID | ID | ID | ID |
| Nonylphenol | ID | ID | ID | ID | ID | ID | ID | ID |
| 2-chlorophenol T | 340 c | 490 c | 630 c | 870 c | ID | ID | ID | ID |
| 3-chlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 4-chlorophenol T | 160 | 220 | 280 c | 360 c | ID | ID | ID | ID |
| 2,3-dichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4-dichlorophenol T | 120 | 160 c | 200 c | 270 c | ID | ID | ID | ID |
| 2,5-dichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,6-dichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 3,4-dichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 3,5-dichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,3,4-trichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,3,5-trichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,3,6-trichlorophenol T | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4,5-trichlorophenol T,B | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4,6-trichlorophenol T,B | 3 | 20 | 40 | 95 | ID | ID | ID | ID |
| 2,3,4,5-tetrachlorophenol T,B | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,3,4,6- tetrachlorophenol T,B | 10 | 20 | 25 | 30 | ID | ID | ID | ID |
| 2,3,5,6- tetrachlorophenol T,B | ID | ID | ID | ID | ID | ID | ID | ID |
| Pentachlorophenol T,B | 3.6 | 10 | 17 | 27 A | 11 | 22 | 33 | 55 A |
| **Nitrophenols** | | | | | | | | |
| 2-nitrophenol | ID | ID | ID | ID | ID | ID | ID | ID |
| 3-nitrophenol | ID | ID | ID | ID | ID | ID | ID | ID |
| 4-nitrophenol | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4-dinitrophenol | 13 | 45 | 80 | 140 | ID | ID | ID | ID |
| 2,4,6-trinitrophenol | ID | ID | ID | ID | ID | ID | ID | ID |
| **ORGANIC SULFUR COMPOUNDS** | | | | | | | | |
| Carbon disulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| Isopropyl disulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| n-propyl sulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| Propyl disulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| Tert-butyl sulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| Phenyl disulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| Bis(dimethylthiocarbamyl)sulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| Bis(diethylthiocarbamyl)disulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| 2-methoxy-4H-1,3,2-benzodioxaphosphorium-2-sulfide | ID | ID | ID | ID | ID | ID | ID | ID |
| **Xanthates** | | | | | | | | |
| Potassium amyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| Potassium ethyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| Potassium hexyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| Potassium isopropyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| Sodium ethyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| Sodium isobutyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| Sodium isopropyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| Sodium sec-butyl xanthate | ID | ID | ID | ID | ID | ID | ID | ID |
| **PHTHALATES** | | | | | | | | |
| Dimethylphthalate | 3000 | 3700 | 4300 | 5100 | ID | ID | ID | ID |
| Diethylphthalate | 900 | 1000 | 1100 | 1300 | ID | ID | ID | ID |
| Dibutylphthalate B | 9.9 | 26 | 40.2 | 64.6 | ID | ID | ID | ID |
| Di(2-ethylhexyl)phthalate B | ID | ID | ID | ID | ID | ID | ID | ID |
| **MISCELLANEOUS INDUSTRIAL CHEMICALS** | | | | | | | | |
| Acetonitrile | ID | ID | ID | ID | ID | ID | ID | ID |
| Acrylonitrile | ID | ID | ID | ID | ID | ID | ID | ID |
| Poly(acrylonitrile-co-butadiene-costyrene) | 200 | 530 | 800 c | 1200 c | 200 | 250 | 280 | 340 |
| Dimethylformamide | ID | ID | ID | ID | ID | ID | ID | ID |
| 1,2-diphenylhydrazine | ID | ID | ID | ID | ID | ID | ID | ID |
| Diphenylnitrosamine | ID | ID | ID | ID | ID | ID | ID | ID |
| Hexachlorobutadiene | ID | ID | ID | ID | ID | ID | ID | ID |
| Hexachlorocyclopentadiene | ID | ID | ID | ID | ID | ID | ID | ID |
| Isophorone | ID | ID | ID | ID | ID | ID | ID | ID |
| **ORGANOCHLORINE PESTICIDES** | | | | | | | | |
| Aldrin B | ID | ID | ID | ID | ID | ID | ID | ID |
| Chlordane B | 0.03 | 0.08 | 0.14 | 0.27 c | ID | ID | ID | ID |
| DDE B | ID | ID | ID | ID | ID | ID | ID | ID |
| DDT B | 0.006 | 0.01 | 0.02 | 0.04 | ID | ID | ID | ID |
| Dicofol B | ID | ID | ID | ID | ID | ID | ID | ID |
| Dieldrin B | ID | ID | ID | ID | ID | ID | ID | ID |
| Endosulfan B | 0.03 | 0.2 A | 0.6 A | 1.8 A | 0.005 | 0.01 | 0.02 | 0.05 A |
| Endosulfan alpha B | ID | ID | ID | ID | ID | ID | ID | ID |
| Endosulfan beta B | ID | ID | ID | ID | ID | ID | ID | ID |
| Endrin B | 0.01 | 0.02 | 0.04 c | 0.06 A | 0.004 | 0.008 | 0.01 | 0.02 |
| Heptachlor B | 0.01 | 0.09 | 0.25 | 0.7 A | ID | ID | ID | ID |
| Lindane | 0.07 | 0.2 | 0.4 | 1.0 A | ID | ID | ID | ID |
| Methoxychlor B | ID | ID | ID | ID | ID | ID | ID | ID |
| Mirex B | ID | ID | ID | ID | ID | ID | ID | ID |
| Toxaphene B | 0.1 | 0.2 | 0.3 | 0.5 | ID | ID | ID | ID |
| **ORGANOPHOSPHORUS PESTICIDES** | | | | | | | | |
| Azinphos methyl | 0.01 | 0.02 | 0.05 | 0.11 A | ID | ID | ID | ID |
| Chlorpyrifos B | 0.00004 | 0.01 | 0.11 A | 1.2 A | 0.0005 | 0.009 | 0.04A | 0.3 A |
| Demeton | ID | ID | ID | ID | ID | ID | ID | ID |
| Demeton-S-methyl | ID | ID | ID | ID | ID | ID | ID | ID |
| Diazinon | 0.00003 | 0.01 | 0.2 A | 2A | ID | ID | ID | ID |
| Dimethoate | 0.1 | 0.15 | 0.2 | 0.3 | ID | ID | ID | ID |
| Fenitrothion | 0.1 | 0.2 | 0.3 | 0.4 | ID | ID | ID | ID |
| Malathion | 0.002 | 0.05 | 0.2 | 1.1 A | ID | ID | ID | ID |
| Parathion | 0.0007 | 0.004 c | 0.01 c | 0.04 A | ID | ID | ID | ID |
| Profenofos B | ID | ID | ID | ID | ID | ID | ID | ID |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| Temephos B | ID | ID | ID | ID | 0.0004 | 0.05 | 0.4 | 3.6 A |
| **CARBAMATE & OTHER PESTICIDES** | | | | | | | | |
| Carbofuran | 0.06 | 1.2 A | 4A | 15 A | ID | ID | ID | ID |
| Methomyl | 0.5 | 3.5 | 9.5 | 23 | ID | ID | ID | ID |
| S-methoprene | ID | ID | ID | ID | ID | ID | ID | ID |
| **PYRETHROIDS** | | | | | | | | |
| Deltamethrin | ID | ID | ID | ID | ID | ID | ID | ID |
| Esfenvalerate | ID | 0.001* | ID | ID | ID | ID | ID | ID |
| **HERBICIDES & FUNGICIDES** | | | | | | | | |
| **Bypyridilium herbicides** | | | | | | | | |
| Diquat | 0.01 | 1.4 | 10 80 A | ID | ID | ID | ID | |
| Paraquat | ID | ID | ID | ID | ID | ID | ID | ID |
| **Phenoxyacetic acid herbicides** | | | | | | | | |
| MCPA | ID | ID | ID | ID | ID | ID | ID | ID |
| 2,4-D | 140 | 280 | 450 | 830 | ID | ID | ID | ID |
| 2,4,5-T | 3 | 36 | 100 | 290 A | ID | ID | ID | ID |
| **Sulfonylurea herbicides** | | | | | | | | |
| Bensulfuron | ID | ID | ID | ID | ID | ID | ID | ID |
| Metsulfuron | ID | ID | ID | ID | ID | ID | ID | ID |
| **Thiocarbamate herbicides** | | | | | | | | |
| Molinate | 0.1 | 3.4 | 14 | 57 | ID | ID | ID | ID |
| Thiobencarb | 1 | 2.8 | 4.6 | 8 C | ID | ID | ID | ID |
| Thiram | 0.01 | 0.2 | 0.8 C | 3:00 AM | ID | ID | ID | ID |
| **Triazine herbicides** | | | | | | | | |
| Amitrole | ID | ID | ID | ID | ID | ID | ID | ID |
| Atrazine | 0.7 | 13 | 45 C | 150 C | ID | ID | ID | ID |
| Hexazinone | ID | ID | ID | ID | ID | ID | ID | ID |
| Simazine | 0.2 | 3.2 | 11 | 35 | ID | ID | ID | ID |
| **Urea herbicides** | | | | | | | | |
| Diuron | ID | ID | ID | ID | ID | ID | ID | ID |
| Tebuthiuron | 0.02 | 2.2 | 20 | 160 C | ID | ID | ID | ID |
| **Miscellaneous herbicides** | | | | | | | | |
| Acrolein | ID | ID | ID | ID | ID | ID | ID | ID |
| Bromacil | ID | ID | ID | ID | ID | ID | ID | ID |
| Glyphosate | 370 | 1200 | 2000 | 3600 A | ID | ID | ID | ID |
| Imazethapyr | ID | ID | ID | ID | ID | ID | ID | ID |
| Ioxynil | ID | ID | ID | ID | ID | ID | ID | ID |
| Metolachlor | ID | ID | ID | ID | ID | ID | ID | ID |
| Sethoxydim | ID | ID | ID | ID | ID | ID | ID | ID |
| Trifluralin B | 2.6 | 4.4 | 6 | 9A | ID | ID | ID | ID |
| **GENERIC GROUPS OF CHEMICALS** | | | | | | | | |
| **Surfactants** | | | | | | | | |
| Linear alkylbenzene sulfonates (LAS) | 65 | 280 | 520 C | 1000 C | ID | ID | ID | ID |
| Alcohol ethoxyolated sulfate (AES) | 340 | 650 | 850 C | 1100 C | ID | ID | ID | ID |
| Alcohol ethoxylated surfactants (AE) | 50 | 140 | 220 | 360 C | ID | ID | ID | ID |
| **Oils & Petroleum Hydrocarbons** | ID | ID | ID | ID | ID | ID | ID | ID |
| **Oil Spill Dispersants** | | | | | | | | |

## ANZECC Water Quality Guidelines 2000

Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical slightly–moderately disturbed systems;

| Chemical | Trigger values for freshwater (µgL-1) Level of protection (% species) | | | | Trigger values for marine water (µgL-1) Level of protection (% species) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99% | 95% | 90% | 80% | 99% | 95% | 90% | 80% |
| BP 1100X | ID | ID | ID | ID | ID | ID | ID | ID |
| Corexit 7664 | ID | ID | ID | ID | ID | ID | ID | ID |
| Corexit 8667 | ID | ID | ID | ID | ID | ID | ID | |
| Corexit 9527 | ID | ID | ID | ID | 230 | 1100 | 2200 | 4400 A |
| Corexit 9550 | ID | ID | ID | ID | ID | ID | ID | ID |

Notes:

Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Most trigger values listed here for metals and metalloids are High reliability figures, derived from field or chronic NOEC data (see 3.4.2.3 for reference to Volume 2). The exceptions are Moderate reliability for freshwater aluminium (pH >6.5), manganese and marine chromium (III). Most trigger values listed here for non-metallic inorganics and organic chemicals are Moderate reliability figures, derived from acute LC50 data (see 3.4.2.3 for reference to Volume 2). The exceptions are High reliability for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

* = High reliability figure for esfenvalerate derived from mesocosm NOEC data (no alternative protection levels available).

A = Figure may not protect key test species from acute toxicity (and chronic) — check Section 8.3.7 for spread of data and its significance. 'A' indicates that trigger value > acute toxicity figure; note that trigger value should be <1/3 of acute figure (Section 8.3.4.4).

B = Chemicals for which possible bioaccumulation and secondary poisoning effects should be considered (see Sections 8.3.3.4 and 8.3.5.7).

C = Figure may not protect key test species from chronic toxicity (this refers to experimental chronic figures or geometric mean for species) — check Section 8.3.7 for spread of data and its significance. Where grey shading and 'C' coincide, refer to text in Section 8.3.7.

D = Ammonia as TOTAL ammonia as [NH3-N] at pH 8. For changes in trigger value with pH refer to Section 8.3.7.2.

E = Chlorine as total chlorine, as [Cl]; see Section 8.3.7.2.

F = Cyanide as un-ionised HCN, measured as [CN]; see Section 8.3.7.2.

# Soil Investigation Levels (mg/kg)

| Substances | Health Investigation Levels (HILs) | | | | | | Ecological Investigation Levels (EILs) | | Background |
|---|---|---|---|---|---|---|---|---|---|
| | A[1] | B[2] | C[3] | D | E | F | REIL[4] | Interim Urban[5] | Ranges[6] |
| **METALS/METALLOIDS** | | | | | | | | | |
| Arsenic (total) | 100 | | | 400 | 200 | 500 | | 20 | 1 - 50 |
| Barium | | | | | | | | 300 | 100 - 3000 |
| Beryllium | 20 | | | 80 | 40 | 100 | | | |
| Cadmium | 20 | | | 80 | 40 | 100 | | 3 | 1 |
| Chromium (III) | 12% | | | 48% | 24% | 60% | | 400 | |
| Chromium (VI) | 100 | | | 400 | 200 | 500 | | 1 | |
| Chromium (Total)[7] | | | | | | | | | 5-1000 |
| Cobalt | 100 | | | 400 | 200 | 500 | | | 1-40 |
| Copper | 1000 | | | 4000 | 2000 | 5000 | | 100 | 2-100 |
| Lead | 300 | | | 1200 | 600 | 1500 | | 600 | 2-200 |
| Manganese | 1500 | | | 6000 | 3000 | 7500 | | 500 | 850 |
| Methyl mercury | 10 | | | 40 | 20 | 50 | | | |
| Mercury (inorganic) | 15 | | | 60 | 30 | 75 | | 1 | 0.03 |
| Nickel | 600 | | | 2400 | 600 | 3000 | | 60 | 5-500 |
| Vanadium | | | | | | | | 50 | 20-500 |
| Zinc | 7000 | | | 28000 | 14000 | 35000 | | 200 | 10-300 |
| **ORGANICS** | | | | | | | | | |
| Aldrin + Dieldrin | 10 | | | 40 | 20 | 50 | | | |
| Chlordane | 50 | | | 200 | 100 | 250 | | | |
| DDT + DDD + DDE | 200 | | | 800 | 400 | 1000 | | | |
| Heptachlor | 10 | | | 40 | 20 | 50 | | | |
| Polycyclic aromatic hydrocarbons (PAHs) | 20 | | | 80 | 40 | 100 | | | |
| Benzo(a)pyrene | 1 | | | 4 | 2 | 5 | | | |
| Phenol | 8500 | | | 34000 | 17000 | 42500 | | | |
| PCBs (Total) | 10 | | | 40 | 20 | 50 | | | |
| Petroleum Hydrocarbon Components (constituents): | | | | | | | | | |
| • $>C_{16}$-$C_{35}$ Aromatics[8] | 90 | | | 360 | 180 | 450 | | | |
| • $>C_{16}$-$C_{35}$ Aliphatics | 5600 | | | 22400 | 11200 | 28000 | | | |
| • $C_{35}$ Aliphatics | 56000 | | | 224000 | 112000 | 280000 | | | |
| **OTHER** | | | | | | | | | |
| Boron | 3000 | | | 12000 | 6000 | 15000 | | | |
| Cyanides (Complexed) | 500 | | | 2000 | 1000 | 2500 | | | |
| Cyanides (free) | 250 | | | 1000 | 500 | 1250 | | | |
| Phosphorus | | | | | | | | 2000 | |
| Sulfur | | | | | | | | 600 | |
| sulfate[9] | | | | | | | | 200 | |

1 Human exposure settings based on land use have been established for HILs (see Taylor and Langley 1998). These are:

**A.** 'Standard' residential with garden/accessible soil (home-grown produce contributing less than 10% of vegetable and fruit intake; no poultry): this category includes children's day-care centres, kindergartens, preschools and primary schools.

**B.** Residential with substantial vegetable garden (contributing 10% or more of vegetable and fruit intake) and/or poultry providing any egg or poultry meat dietary intake.

**C.** Residential with substantial vegetable garden (contributing 10% or more of vegetable and fruit intake); poultry excluded.

**D.** Residential with minimal opportunities for soil access: includes dwellings with fully and permanently paved yard space such as high-rise apartments and flats.

**E.** Parks, recreational open space and playing fields: includes secondary schools.

**F.** Commercial/Industrial: includes premises such as shops and offices as well as factories and industrial sites.

(For details on derivation of HILs for human exposure settings based on land use see Schedule B(7A).

2 Site and contaminant specific: on site sampling is the preferred approach for estimating poultry and plant uptake. Exposure estimates may then be compared to the relevant ADIs, PTWIs and GDs.

3 Site and contaminant specific: on site sampling is the preferred approach for estimating plant uptake. . Exposure estimates may then be compared to the relevant ADIs, PTWIs and GDs.

4 These will be developed for regional areas by jurisdictions as required.

5 Interim EILs for the urban setting are based on considerations of phytotoxicity, ANZECC B levels, and soil survey data from urban residential properties in four Australian capital cities.

6 Background ranges, where HILs or EILs are set, are taken from the Field Geologist's Manual, compiled by D A Berkman, Third Edition 1989. Publisher – The Australasian Institute of Mining & Metallurgy. This publication contains information on a more extensive list of soil elements than is included in this Table. Another source of information is Contaminated Sites Monograph No. 4: Trace Element Concentrations in Soils from Rural & Urban Areas of Australia, 1995. South Australian Health Commission.

7 Valence state not distinguished – expected as Cr (III).

8 The carbon number is an 'equivalent carbon number' based on a method that standardises according to boiling point. It is a method used by some analytical laboratories to report carbon numbers for chemicals evaluated on a boiling point GC column.

9 For protection of built structures.

# Water Investigation Levels (μg/L)

| Settings | Aquatic Ecosystems[11] | | Drinking Water | | Agricultural[9] |
|---|---|---|---|---|---|
| | Marine Waters μg/L | Fresh Waters μg/L | Health[10]/ Aesthetic[11] mg/L | Irrigation (mg/L) | Livestock (mg/L) |
| **METALS/METALLOIDS** | | | | | |
| Aluminium | | <5 (if pH <6.5)<br><100 (if pH >6.5) | (0.2) | 5.0 | 5.0 |
| Antimony | | 30 | 0.003 | | |
| Arsenic (total) | 50.0 | 50 | 0.007 | 0.1 | 0.5 |
| Barium | | | 0.7 | | |
| Beryllium | | 4 | | 0.1 | 0.1 |
| Boron | | | 0.3 | 0.5-6.0 | 5.0 |
| Cadmium | 2.0 | 0.2-2.0 | 0.002 | 0.01 | 0.01 |
| Chromium (Total) | 50.0 | 10 | | 1.0 | |
| Chromium (VI) | | | 0.05 | 0.1 | 1.0 |
| Cobalt | | | | 0.05 | 1.0 |
| Copper | 5.0 | 2.0-5.0 | 2.0(1.0) | 0.2 | 0.5 |
| Iron | | 1000 | (0.3) | 1.0 | |
| Lead | 5.0 | 1.0-5.0 | 0.01 | 0.2 | 0.1 |
| Lithium | | | | 2.5 | |
| Manganese | | | 0.5(0.1) | 2.0 | |
| Mercury (Total) | 0.1 | 0.1 | 0.001 | 0.002 | 0.002 |
| Molybdenum | | | 0.05 | 0.01 | 0.01 |
| Nickel | 15.0 | 15.0-150.0 | 0.02 | 0.02 | 1.0 |
| Selenium | 70.0 | 5.0 | 0.01 | 0.02 | 0.02 |
| Silver | 1.0 | 0.1 | 0.1 | | |
| Thallium | 20.0 | 4.0 | | | |
| Tin (tributyltin) | 0.002 | 0.008 | | | |
| Vanadium | | | | 0.1 | 0.1 |
| Zinc | 50.0 | 5.0-50.0 | (3.0) | 2.0 | 20.0 |
| **ORGANICS** | | | | | |
| 1,2-dichloroethane | | | 0.003 | | |
| Benzo(a)pyrene | | | 0.00001 | | |
| Carbon tetrachloride | | | 0.003 | | |
| Chlorobenzene | | | 0.3(0.01) | | |
| Dichloromethane (methylene chloride) | | | 0.004 | | |
| Ethylbenzene | | | 0.3(0.003) | | |
| Ethylenediamine tetracetic acid (EDTA) | | | 0.25 | | |
| Hexachlorobutadiene | 0.3 | 0.1 | 0.0007 | | |
| Monocyclic Aromatic Compounds<br>Benzene<br>Chlorinated benzenes<br>Chlorinated phenols<br>Phenol<br>Toluene<br>Xylene | <br>300.0<br><br>0.2-8.0<br>50.0<br><br> | <br>300.0<br>0.007-15.0[12]<br>0.05-18.0[13]<br>50.0<br>300.0<br> | <br>0.001<br><br>0.04-1.5<br><br>0.8(0.025)<br>0.6(0.02) | | |
| Pesticides<br>Aldrin<br>Chlordane<br>DDT<br>Dieldrin<br>Heptachlor | Footnote[14]<br>10.0 ng/L<br>4.0 ng/L<br>1.0 ng/L<br>2.0 ng/L<br>10.0 ng/L | Footnote[15]<br>10.0 ng/L<br>4.0 ng/L<br>1.0 ng/L<br>2.0 ng/L<br>10.0 ng/L | Footnote[16]<br>0.0003<br>0.001<br>0.2<br>0.0003<br>0.0003 | | See guidelines for raw water for drinking water supply (AWQG, ANZECC 1992) |
| Phthalate esters<br>di-n-butylphthalate<br>di(2-ethylhexyl)phthalate<br>other phthalate esters | <br><br><br> | <br>4.0<br>0.6<br>0.2 | <br><br><br> | <br><br><br> | <br><br><br> |
| Polyaromatic hydrocarbons<br>Polychlorinated biphenyls<br>Polycyclic aromatic hydrocarbons | <br>0.004<br>3.0 | <br><br> | <br><br> | <br><br> | <br><br> |
| Styrene (vinylbenzene) | | | 0.03(0.004) | | |
| Tetrachloroethene | | | 0.05 | | |
| Trichlorobenzenes (total) | | | 0.03(0.005) | | |
| Vinyl chloride | | | 0.0003 | | |

| Settings | Aquatic Ecosystems[11] | | Drinking Water | | Agricultural[9] |
|---|---|---|---|---|---|
| | Marine Waters µg/L | Fresh Waters µg/L | Health[10]/ Aesthetic[11] mg/L | Irrigation (mg/L) | Livestock (mg/L) |
| **OTHER** | | | | | |
| Calcium | | | | | 1,000.0 |
| Chloride | | | (250.0) | 30.0<br>700.0[17] | |
| Cyanide | 5 | 0.005 | 0.08 | | |
| Fluoride | | | 1.5 | 1.0 | 2.0 |
| Nitrate-N | | | 50.0 | | 30.0 |
| Nitrite-N | | | 3.0 | | 10.0 |
| **AESTHETIC PARAMETERS** | | | | | |
| Colour and clarity | <10% change in euphotic depth | <10% change in euphotic depth | | | |

10 Levels for recreational and industrial uses have not been set. For guidance on Recreational levels, see NHMRC/ARMCANZ, 1996. For recreational uses, toxic substances should, in general, not exceed the concentrations given for drinking water. For guidance on Industrial levels, see ANZECC, 1992. Industrial settings include: generic processes, hydro-electric power generation, textiles, chemical and allied industries, food and beverage, iron and steel, tanning and leather, pulp and paper, petroleum.

11 Taken from Australian Water Quality Guidelines for Fresh and Marine Waters (AWQG) (ANZECC 1992)

12 See table 2.8, p.2-49 AWQG (ANZECC 1992) for further information

13 see table 2.9, p2-50 AWQG (ANZECC 1992) for further information

14 see table 2.10 also, p.2-55 (ANZECC 1992) for further information

15 see table 2.10 also, p.2-55 (ANZECC 1992) for further information

16 see table on p32 (Guidelines for Pesticides), p32 (NHMRC/ARMCANZ 1996)

17 Maximum chloride concentration should be set according to the sensitivity of the crop. For further information. (See Tables 5.1, 5.2, 5.3, 5.4, ANZECC 1992)

# APPENDIX C

# EPA APPROVED GUIDELINES

# Guidelines made or approved by the EPA under Section 105 of the *Contaminated Land Management Act* 1997

(As at 3 December 2001)

## Guidelines made by the EPA

- *Contaminated Sites: Guidelines for Assessing Service Station Sites*, December 1994.
- *Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Former Broad-Acre Agricultural Land*, January 1995.
- *Contaminated Sites: Sampling Design Guidelines*, September 1995.
- *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*, October 1997.
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*, November 1997.
- *Contaminated Sites: Guidelines for NSW Site Auditor Scheme*, June 1998.
- *Contaminated Sites: Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report*, April 1999.

## Guidelines approved by the EPA

- *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*, published by Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council (NHMRC), January 1992.
- *Australian Water Quality Guidelines for Fresh and Marine Waters*, Australian and New Zealand Environment and Conservation Council, November 1992, which are only approved for the purposes of contaminated site assessment, investigation, remediation and site auditing under the Contaminated Land Management Act (or other relevant legislation) commenced before September 2001.
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Paper No 4, October 2000.

## National Environmental Health Forum monographs

- *Composite Sampling*, by Lock, W. H., National Environmental Health Forum Monographs, Soil Series No.3, 1996, SA Health Commission, Adelaide.

## National Environment Protection Council publications

***National Environment Protection (Assessment of Site Contamination) Measure 1999***

- The Measure includes a policy framework for the assessment of site contamination, Schedule A and Schedule B.

**(I) Schedule A**

- *Recommended General Process for the Assessment of Site Contamination.*

**(II) Schedule B -Guidelines**

**(1)** *Guideline on Investigation Levels for Soil and Groundwater*
**(2)** *Guideline on Data Collection, Sample Design and Reporting*
**(3)** *Guideline on Laboratory Analysis of Potentially Contaminated Soils*
**(4)** *Guideline on Health Risk Assessment Methodology*
**(5)** *Guideline on Ecological Risk Assessment*
**(6)** *Guideline on Risk Based Assessment of Groundwater Contamination*
**(7a)** *Guideline on Health-Based Investigation Levels*
**(7b)** *Guideline on Exposure Scenarios and Exposure Settings*
**(8)** *Guideline on Community Consultation and Risk Communication*
**(9)** *Guideline on Protection of Health and the Environment During the Assessment of Site Contamination*
**(10)** *Guideline on Competencies & Acceptance of Environmental Auditors and Related Professionals*

## Other documents

- *Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes*, NSW Agriculture and CMPS&F Environmental, February 1996.
- *Australian Drinking Water Guidelines*, NHMRC & Agriculture and Resource Management Council of Australia and New Zealand, 1996.

# APPENDIX D

# ANALYTICAL LISTS AND METHODS

| Method ID | Methodology Summary |
|---|---|
| SEM-004 | Arsenic - Determination of Arsenic by Continuous Hydride Generation Atomic Absorption Spectroscopy. Based on APHA 20th ED, AS3641.1-1989; Varian Publications No. AA38, 1983, AA56, 1986. |
| SEM-001 | Metals - Determination of various metals using Air / Acetylene Flame Atomic Absorption Spectroscopy. Based on APHA 20th ED, 3111A, C. |
| SEM-002 | Metals - Determination of various metals using Nitrous Oxide/Acetylene Flame Atomic Absorption Spectroscopy, Based on APHA 20th ED, 3111A, C. |
| SEM-005 | Mercury - Determination of Mercury by Cold Vapour Generation Atomic Absorption Spectroscopy. Based on Varian Publication AA-51 - 1985; AS3641.1 - 1989. |
| SEO-017 | BTEX/TRH C6-C9 - Determination by Purge and Trap Gas Chromatography with Flame Ionisation Detection (FID) and Photo Ionisation Detection (PID). Based on USEPA 5030, 8020. The surrogate spike used is ααα-trifluorotoluene. |
| SEO-020 | TRH - Determination of Total Recoverable Hydrocarbons by gas chromatography following extraction with DCM/Acetone for solids and DCM for liquids. |
| SEO-005 | OC/OP/PCB - Determination of a suite of Organchlorine Pesticides, Chlorinated Organo-phosphorus Pesticides and Polychlorinated Biphenyls (PCB's) by sonication extraction using dichloromethane for waters or acetone / hexane for soils followed by Gas Chromatographic separation with Electron Capture Detection (GC/ECD). Based on USEPA 3510,3550,8140, 8080. The surrogate spike used is 2,4,5,6-Tetrachloro-m-xylene. |
| SEO-030 | PAHs by GC/MS - Determination of Polynuclear Aromatic Hydrocarbons (PAH's) by Gas Chromatography / Mass Spectrometry following extraction with dichloromethane or dichloromethane/acetone. Based on USEPA 8270, 3510, 3550,3630. The surrogate spike used is p-Terphenyl-d14. |
| SEP-001 | Air Dry - Cover air drying at 40 C, moisture content at 103 C - 105 C, wet slurrying, compositing and preparation of a 1:5 soil suspension. |
| SEI-065 | Total Phenolics - determined colorimetrically following steam stripping of the sample. Based on APHA 20th ED, 5530-D. |
| External-003 | Analysis subcontracted to AEL Perth. |

amdel

Report No. : 1E3104

Please note: Where samples are collected/submitted over several days, the date on which the last samples were analysed or extracted is reported.

| Method | Description | Extracted | Analysed | Authorised |
|---|---|---|---|---|
| E7500 | Moisture (%w/w) | 08/11/01 | 08/11/01 | SYS 096 |
| E1230 | TPH C6-C9 by Purge & Trap | 06/11/01 | 06/11/01 | DUM 094 |
| E1221 | TPH (C10-C36) | 06/11/01 | 07/11/01 | DUM 094 |
| E1010 | Benzene,Toluene,Ethylbenzene & Xylene | 06/11/01 | 06/11/01 | DUM 094 |
| E5910 | Metals by ICP-AES | 06/11/01 | 12/11/01 | SMA 093 |
| E5950 | Mercury in Soil | 08/11/01 | 09/11/01 | DGO 093 |
| E1110 | Polycyclic Aromatic Hydrocarbons | 06/11/01 | 07/11/01 | MNG 095 |
| E1180 | Semivolatile Organic Compounds | 08/11/01 | 09/11/01 | MNG 095 |
| E1290 | Volatile Organic Compounds | 07/11/01 | 07/11/01 | DUM 094 |

# KILPATRICK & ASSOCIATES PTY LTD

Occupational Hygiene and Environmental Consultants ACN 006 911 324


## RESULTS OF QUALITATIVE IDENTIFICATION OF ASBESTOS

RECEIVED
15 NOV 2001
BY:

**JOB NO:** S3193

**CLIENT:** Australian Environmental Laboratories

**DATE SAMPLES RECEIVED:** 1st November 2001

**SAMPLING LOCATION:** Unknown

**TEST METHOD:** Polarised light microscopy/dispersion staining as outlined in Methods Manual M02. Sample analysed "as received"

| Sample Number | Location | Sample Description and Sample Size | Result |
|---|---|---|---|
| S9903 | 00110441 - 1<br>17619-55 | Soil - 40 $cm^3$. | No asbestos detected. |
| S9904 | 00110441 - 2<br>17619-75 | Soil - 40 $cm^3$. | No asbestos detected. |
| S9905 | 00110441 - 3<br>17619-91 | Soil - 40 $cm^3$. | No asbestos detected. |
| S9906 | 0110441 - 4<br>17619-99 | Soil - 40 $cm^3$. | No asbestos detected. |

**Analyst:** David Kilpatrick.

**Signatory:**

**Date:** 2/11/01

NATA

**NATA Accredited Laboratory Number: 5169** This Laboratory is accredited by the National Association of Testing Authorities, Australia. The tests reported herein have been performed in accordance with its terms of accreditation. This document shall not be reproduced except in full.


239 Bay Street, Brighton, 3186

Telephone: (03) 9596 7655 Facsimile: (03) 9596 7920 Email: kilpat@ozemail.com.au

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35911 | E35912 | E35913 | E35914 | |
|---|---|---|---|---|---|---|
| | Sample Id | 17656-52 | 17656-53 | 17656-54 | 17656-56 | |
| | PQL | | | | | |
| Moisture Content | 1 | 15% | 17% | 15% | 15% | |
| E1230 TPH in Soil by Purge & Trap/GC-MS | | | | | | |
| C6-C9 Fraction | 5 | nd | nd | nd | -- | |
| | | | | | | |
| E1221 TPH in Soil | | | | | | |
| C10-C14 Fraction | 10 | nd | nd | nd | -- | |
| C15-C28 Fraction | 50 | nd | 100 | nd | -- | |
| C29-C36 Fraction | 50 | nd | 50 | nd | -- | |
| | | | | | | |
| E1010 BTEX (P&T) in Soil | | | | | | |
| Benzene | 0.2 | nd | nd | nd | -- | |
| Toluene | 1 | nd | nd | nd | -- | |
| Ethylbenzene | 1 | nd | nd | nd | -- | |
| Total Xylenes | 3 | nd | nd | nd | -- | |
| 4-Bromofluorobenzene-SURROGATE | 1 | 89% | 89% | 93% | -- | |
| | | | | | | |
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PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable
Refer to Amdel standard laboratory qualifier codes for comments.

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

amdel

Job Number : 1E3104

Client : Australian Environmental Laboratories

Reference : 17656

Project : --



| Analyte | Lab No | E35911 | E35913 | | | |
|---|---|---|---|---|---|---|
| | Sample Id | 17656-52 | 17656-54 | | | |
| | PQL | | | | | |
| E5910 Metals in Soil | | | | | | |
| Arsenic | 5 | 8 | 13 | | | |
| Cadmium | 0.5 | nd | nd | | | |
| Chromium | 5 | nd | 6 | | | |
| Copper | 5 | 20 | 19 | | | |
| Nickel | 2 | nd | nd | | | |
| Lead | 5 | 7 | 8 | | | |
| Zinc | 5 | 13 | 14 | | | |
| E5950 Mercury in Soil | | | | | | |
| Mercury | 0.05 | nd | nd | | | |

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LNR = Samples Listed not Received

nd = <PQL

-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified

Waters : mg/L (ppm) unless otherwise specified in Method Header

Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35911 | E35912 | E35913 | | |
|---|---|---|---|---|---|---|
| | Sample Id | 17656-52 | 17656-53 | 17656-54 | | |
| | PQL | | | | | |
| E1110 Priority PAH's in Soil | | | | | | |
| Naphthalene | 0.5 | nd | nd | nd | | |
| Acenaphthylene | 0.5 | nd | nd | nd | | |
| Acenaphthene | 0.5 | nd | nd | nd | | |
| Fluorene | 0.5 | nd | nd | nd | | |
| Phenanthrene | 0.5 | nd | nd | nd | | |
| Anthracene | 0.5 | nd | nd | nd | | |
| Fluoranthene | 0.5 | nd | nd | nd | | |
| Pyrene | 0.5 | nd | nd | nd | | |
| Benz(a)anthracene | 0.5 | nd | nd | nd | | |
| Chrysene | 0.5 | nd | nd | nd | | |
| Benzo(b) & (k)fluoranthene | 1 | nd | nd | nd | | |
| Benzo(a)pyrene | 0.5 | nd | nd | nd | | |
| Indeno(1.2.3-cd)pyrene | 0.5 | nd | nd | nd | | |
| Dibenz(a.h)anthracene | 0.5 | nd | nd | nd | | |
| Benzo(g.h.i)perylene | 0.5 | nd | nd | nd | | |
| Total USEPA Priority PAHs | 0.5 | nd | nd | nd | | |
| 2-Fluorobiphenyl-SURROGATE | 1 | 109% | 105% | 106% | | |
| Anthracene-d10-SURROGATE | 1 | 108% | 94% | 105% | | |
| p-Terphenyl-D14-SURROGATE | 1 | 119% | 108% | 115% | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| E1180 Semivolatile Organic Compounds | | | | | | |
| Phenol | 1 | nd | | | | |
| Aniline | 10 | nd | | | | |
| Bis(2-chloroethyl) ether | 1 | nd | | | | |
| 2-Chlorophenol | 1 | nd | | | | |
| 1.3-Dichlorobenzene | 1 | nd | | | | |
| 1.4-Dichlorobenzene | 1 | nd | | | | |
| 1.2-Dichlorobenzene | 1 | nd | | | | |
| Benzyl Alcohol | 1 | nd | | | | |
| 2-Methylphenol | 1 | nd | | | | |
| N-Nitrosodi-n-propylamine | 1 | nd | | | | |
| Bis(2-chloroisopropyl) ether | 1 | nd | | | | |
| 3 and 4-Methyl phenol | 1 | nd | | | | |
| Hexachloroethane | 1 | nd | | | | |
| Nitrobenzene | 1 | nd | | | | |
| Isophorone | 1 | nd | | | | |
| 2-Nitrophenol | 1 | nd | | | | |
| 2.4-Dimethylphenol | 1 | nd | | | | |
| Bis(2-chloroethoxy) methane | 1 | nd | | | | |
| Benzoic Acid | 10 | nd | | | | |
| 2.4-Dichlorophenol | 1 | nd | | | | |
| 1.2.4-Trichlorobenzene | 1 | nd | | | | |
| Naphthalene | 1 | nd | | | | |
| 4-Chloroaniline | 1 | nd | | | | |
| Hexachlorobutadiene | 1 | nd | | | | |

PQL = Practical Quantitation Limit
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nd = <PQL
-- = Not Applicable

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Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| 4-Chloro-3-methylphenol | 1 | nd | | | | |
| 2-Methylnaphthalene | 1 | nd | | | | |
| Hexachlorocyclopentadiene | 1 | nd | | | | |
| 2.4.6-Trichlorophenol | 1 | nd | | | | |
| 2.4.5-Trichlorophenol | 1 | nd | | | | |
| 2-Chloronaphthalene | 1 | nd | | | | |
| 2-Nitroaniline | 1 | nd | | | | |
| Dimethyl phthalate | 1 | nd | | | | |
| 2.6-Dinitrotoluene | 1 | nd | | | | |
| Acenaphthylene | 1 | nd | | | | |
| 3-Nitroaniline | 1 | nd | | | | |
| Acenaphthene | 1 | nd | | | | |
| 2.4-Dinitrophenol | 1 | nd | | | | |
| 4-Nitrophenol | 1 | nd | | | | |
| Dibenzofuran | 1 | nd | | | | |
| Diethyl phthalate | 1 | nd | | | | |
| Fluorene | 1 | nd | | | | |
| 4-Chlorophenyl phenyl ether | 1 | nd | | | | |
| 4-Nitroaniline | 1 | nd | | | | |
| 4.6-Dinitro-2-methylphenol | 1 | nd | | | | |
| Azobenzene | 10 | nd | | | | |
| N-Nitrosodiphenylamine | 10 | nd | | | | |
| a-BHC | 1 | nd | | | | |
| 4-Bromophenyl phenyl ether | 1 | nd | | | | |
| Hexachlorobenzene | 1 | nd | | | | |

PQL = Practical Quantitation Limit
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nd = <PQL
-- = Not Applicable
Refer to Amdel standard laboratory qualifier codes for comments.

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| b-BHC | 1 | nd | | | | |
| Pentachlorophenol | 1 | nd | | | | |
| g-BHC | 1 | nd | | | | |
| Phenanthrene | 1 | nd | | | | |
| Anthracene | 1 | nd | | | | |
| d-BHC | 1 | nd | | | | |
| Heptachlor | 1 | nd | | | | |
| Di-n-butyl phthalate | 1 | nd | | | | |
| Aldrin | 1 | nd | | | | |
| Heptachlor epoxide | 1 | nd | | | | |
| Fluoranthene | 1 | nd | | | | |
| Pyrene | 1 | nd | | | | |
| Endosulfan 1 | 1 | nd | | | | |
| 4.4-DDE | 1 | nd | | | | |
| Dieldrin | 1 | nd | | | | |
| Endrin | 1 | nd | | | | |
| Endosulfan 2 | 1 | nd | | | | |
| 4.4-DDD | 1 | nd | | | | |
| Endrin aldehyde | 1 | nd | | | | |
| Butyl benzyl phthalate | 1 | nd | | | | |
| Endosulfan sulfate | 1 | nd | | | | |
| 4.4-DDT | 1 | nd | | | | |
| 3.3-Dichlorobenzidine | 10 | nd | | | | |
| Benzo(a)anthracene | 1 | nd | | | | |
| Chrysene | 1 | nd | | | | |

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nd = <PQL
-- = Not Applicable

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Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| Bis(2-ethylhexyl) phthalate | 1 | nd | | | | |
| Di-n-octylphthalate | 1 | nd | | | | |
| Benzo(b)fluoranthene | 1 | nd | | | | |
| Benzo(k)fluoranthene | 1 | nd | | | | |
| Benzo(a)pyrene | 1 | nd | | | | |
| Indeno(1.2.3-cd)pyrene | 1 | nd | | | | |
| Dibenz(a.h)anthracene | 1 | nd | | | | |
| Benzo(g.h.i)perylene | 1 | nd | | | | |
| 2-Fluorophenol-SURROGATE | 1 | 87% | | | | |
| Phenol-D5-SURROGATE | 1 | 85% | | | | |
| Nitrobenzene-D5-SURROGATE | 1 | 82% | | | | |
| 2-Fluorobiphenyl-SURROGATE | 1 | 92% | | | | |
| 2.4.6-Tribromophenol-SURROGATE | 1 | 66% | | | | |
| p-Terphenyl-D14-SURROGATE | 1 | 98% | | | | |
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PQL = Practical Quantitation Limit
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Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| E1290 Volatile Organic Compounds in Soil | | | | | | |
| Benzene | 0.5 | nd | | | | |
| Bromobenzene | 1 | nd | | | | |
| Bromochloromethane | 1 | nd | | | | |
| Bromodichloromethane | 1 | nd | | | | |
| Bromoform | 1 | nd | | | | |
| Bromomethane | 1 | nd | | | | |
| n-Butylbenzene | 1 | nd | | | | |
| sec-Butylbenzene | 1 | nd | | | | |
| tert-Butylbenzene | 1 | nd | | | | |
| Carbon tetrachloride | 1 | nd | | | | |
| Chlorobenzene | 1 | nd | | | | |
| Chloroethane | 1 | nd | | | | |
| Chloroform | 1 | nd | | | | |
| Chloromethane | 1 | nd | | | | |
| 2-Chlorotoluene | 1 | nd | | | | |
| 4-Chlorotoluene | 1 | nd | | | | |
| Dibromochloromethane | 1 | nd | | | | |
| 1.2-Dibromo-3-chloropropane | 1 | nd | | | | |
| 1.2-Dibromoethane (EDB) | 1 | nd | | | | |
| Dibromomethane | 1 | nd | | | | |
| 1.2-Dichlorobenzene | 1 | nd | | | | |
| 1.3-Dichlorobenzene | 1 | nd | | | | |
| 1.4-Dichlorobenzene | 1 | nd | | | | |
| Dichlorodifluoromethane | 1 | nd | | | | |

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| 1.1-Dichloroethene | 1 | nd | | | | |
| 1.2-Dichloroethane | 1 | nd | | | | |
| 1.1-Dichloroethane | 1 | nd | | | | |
| cis-1.2-Dichloroethene | 1 | nd | | | | |
| trans-1.2-Dichloroethene | 1 | nd | | | | |
| 1.2-Dichloropropane | 1 | nd | | | | |
| 1.3-Dichloropropane | 1 | nd | | | | |
| 2.2-Dichloropropane | 1 | nd | | | | |
| 1.1-Dichloropropylene | 1 | nd | | | | |
| cis-1.3-Dichloropropylene | 1 | nd | | | | |
| trans-1.3-Dichloropropylene | 1 | nd | | | | |
| Ethylbenzene | 1 | nd | | | | |
| Hexachlorobutadiene | 1 | nd | | | | |
| Isopropylbenzene | 1 | nd | | | | |
| p-Isopropyltoluene | 1 | nd | | | | |
| Methylene chloride | 1 | nd | | | | |
| Naphthalene | 1 | nd | | | | |
| n-Propylbenzene | 1 | nd | | | | |
| Styrene | 1 | nd | | | | |
| 1.1.1.2-Tetrachloroethane | 1 | nd | | | | |
| 1.1.2.2-Tetrachloroethane | 1 | nd | | | | |
| Tetrachloroethene | 1 | nd | | | | |
| Toluene | 1 | nd | | | | |
| 1.2.3-Trichlorobenzene | 1 | nd | | | | |
| 1.2.4-Trichlorobenzene | 1 | nd | | | | |

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nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104
Client : Australian Environmental Laboratories
Reference : 17656
Project : --



| Analyte | Lab No | E35914 | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | Sample Id | 17656-56 | | | | |
| | PQL | | | | | |
| 1.1.1-Trichloroethane | 1 | nd | | | | |
| 1.1.2-Trichloroethane | 1 | nd | | | | |
| Trichloroethene | 1 | nd | | | | |
| Trichlorofluoromethane | 1 | nd | | | | |
| 1.2.3-Trichloropropane | 1 | nd | | | | |
| 1.2.4-Trimethylbenzene | 1 | nd | | | | |
| 1.3.5-Trimethylbenzene | 1 | nd | | | | |
| Vinyl chloride | 1 | nd | | | | |
| ortho-Xylene | 1 | nd | | | | |
| meta- & para-Xylene | 2 | nd | | | | |
| Pentafluorobenzene-SURROGATE | 1 | 101% | | | | |
| Toluene-D8-SURROGATE | 1 | 103% | | | | |
| 4-Bromofluorobenzene-SURROGATE | 1 | 103% | | | | |
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PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 1E3104



QAQC : Method Blank(s)

| ANALYTE | Sample ID<br>PQL | Blank1 | Blank2 | Blank3 | Blank4 | Blank5 |
|---|---|---|---|---|---|---|
| E1230 TPH in Soil by Purge & Trap/GC-MS | | | | | | |
| C6-C9 Fraction | 5 | nd | | | | |
| | | | | | | |
| E1221 TPH in Soil | | | | | | |
| C10-C14 Fraction | 10 | nd | | | | |
| C15-C28 Fraction | 50 | nd | | | | |
| C29-C36 Fraction | 50 | nd | | | | |
| | | | | | | |
| E1010 BTEX (P&T) in Soil | | | | | | |
| Benzene | 0.2 | nd | | | | |
| Toluene | 1 | nd | | | | |
| Ethylbenzene | 1 | nd | | | | |
| Total Xylenes | 3 | nd | | | | |
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PQL = Practical Quantitation Limit
nd = <PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

| Total Recoverable Hydrocarbons in Soil<br>Our Reference:<br>Your Reference | UNITS | 17619-1<br>BH21/0.2 | 17619-2<br>BH21/1.0 | 17619-3<br>BH26/0.5 | 17619-4<br>BH26/2.0 | 17619-5<br>BH29/0.5 | 17619-6<br>BH29/2.0 | 17619-7<br>BH39(F)/1.0 | 17619-8<br>BH39(F)/3.0 | 17619-9<br>BH34/1.0 | 17619-10<br>BH34/4.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TRH C6 - C9 P&T | mg/kg | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| TRH C10 - C14 | mg/kg | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | 530 | <20 |
| TRH C15 - C28 | mg/kg | <50 | <50 | <50 | <50 | <50 | <50 | <50 | 64 | 1100 | <50 |
| TRH C29 - C40 | mg/kg | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 |

| Total Recoverable Hydrocarbons in Soil<br>Our Reference:<br>Your Reference | UNITS | 17619-11<br>BH25/0.2 | 17619-12<br>BH25/1.0 | 17619-30<br>BH49/1-1.1 | 17619-32<br>BH49/2.9-3.0 | 17619-33<br>BH51/0.4-0.5 | 17619-34<br>BH51/0.9-1.0 | 17619-37<br>BH46/0.4-0.5 | 17619-39<br>BH46/1.9-2.0 | 17619-43<br>NMW1/0.4-0.5 | 17619-44<br>NMW1/0.9-1.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TRH C6 - C9 P&T | mg/kg | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| TRH C10 - C14 | mg/kg | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| TRH C15 - C28 | mg/kg | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 |
| TRH C29 - C40 | mg/kg | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 |

| Total Recoverable Hydrocarbons in Soil<br>Our Reference:<br>Your Reference | UNITS | 17619-47<br>BH59/0.1-0.2 | 17619-49<br>BH59/0.9-1.0 | 17619-56<br>TP1/0.5 | 17619-58<br>TP1/2.0 | 17619-60<br>TP3/0.5 | 17619-65<br>TP7/0.5 | 17619-66<br>TP7/1.0 | 17619-69<br>TP9/0.5 | 17619-70<br>TP9/1.0 | 17619-72<br>TP14/0.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TRH C6 - C9 P&T | mg/kg | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| TRH C10 - C14 | mg/kg | <20 | <20 | <20 | <20 | <20 | 23 | <20 | 770 | 510 | <20 |
| TRH C15 - C28 | mg/kg | <50 | <50 | <50 | <50 | <50 | 240 | <50 | 1900 | 370 | <50 |
| TRH C29 - C40 | mg/kg | <50 | <50 | <50 | <50 | <50 | 1700 | <50 | <50 | <50 | <50 |

| OC Pesticides in Soil<br>Our Reference:<br>Your Reference | UNITS<br>---------- | 17619-72<br>TP14/0.2 | 17619-74<br>TP14/2.0 |
|---|---|---|---|
| HCB | mg/kg | <0.10 | <0.10 |
| *alpha*-BHC | mg/kg | <0.10 | <0.10 |
| *gamma*-BHC(Lindane) | mg/kg | <0.10 | <0.10 |
| Heptachlor | mg/kg | <0.10 | <0.10 |
| Aldrin | mg/kg | <0.10 | <0.10 |
| *beta*-BHC | mg/kg | <0.10 | <0.10 |
| Oxychlordane | mg/kg | <0.10 | <0.10 |
| *delta*-BHC | mg/kg | <0.10 | <0.10 |
| Heptachlor Epoxide | mg/kg | <0.10 | <0.10 |
| *o,p'*-DDE | mg/kg | <0.10 | <0.10 |
| *alpha*-Endosulfan | mg/kg | <0.10 | <0.10 |
| *trans*-Chlordane | mg/kg | <0.10 | <0.10 |
| *cis*-Chlordane | mg/kg | <0.10 | <0.10 |
| *trans*-Nonachlor | mg/kg | <0.10 | <0.10 |
| *p,p'*-DDE | mg/kg | <0.10 | <0.10 |
| Dieldrin | mg/kg | <0.10 | <0.10 |
| Endrin | mg/kg | <0.10 | <0.10 |
| *o,p'*-DDD | mg/kg | <0.10 | <0.10 |
| *o,p'*-DDT | mg/kg | <0.10 | <0.10 |
| *beta*-Endosulfan | mg/kg | <0.10 | <0.10 |
| *p,p'*-DDD | mg/kg | <0.10 | <0.10 |
| *p,p'*-DDT | mg/kg | <0.10 | <0.10 |
| Endosulfan Sulphate | mg/kg | <0.10 | <0.10 |
| Endrin Aldehyde | mg/kg | <0.10 | <0.10 |
| Methoxychlor | mg/kg | <0.10 | <0.10 |
| Endrin Ketone | mg/kg | <0.10 | <0.10 |
| *Surrogate* | % | 89 | 84 |

| OP Pesticides in Soil<br>Our Reference:<br>Your Reference | UNITS<br>---<br>--- | 17619-72<br>TP14/0.2 | 17619-74<br>TP14/2.0 |
|---|---|---|---|
| Chlorpyrifos | mg/kg | <0.10 | <0.10 |
| Fenitrothion | mg/kg | <0.10 | <0.10 |
| Bromofos Ethyl | mg/kg | <0.10 | <0.10 |
| Ethion | mg/kg | <0.10 | <0.10 |
| *Surrogate* | % | 89 | 84 |

| PCBs in Soil<br>Our Reference:<br>Your Reference | UNITS | 17619-3<br>BH26/0.5 | 17619-11<br>BH25/0.2 | 17619-12<br>BH25/1.0 | 17619-74<br>TP14/2.0 |
|---|---|---|---|---|---|
| Arochlor 1016 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1221 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1232 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1242 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1248 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1254 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1260 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1262 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Arochlor 1268 | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 |
| Total Positive PCB | mg/kg | <0.90 | <0.90 | <0.90 | <0.90 |
| *Surrogate* | % | 87 | 85 | 83 | 84 |

| PAHs in Soil<br>Our Reference:<br>Your Reference | UNITS | 17619-1<br>BH21/0.2 | 17619-2<br>BH21/1.0 | 17619-3<br>BH26/0.5 | 17619-4<br>BH26/2.0 | 17619-5<br>BH29/0.5 | 17619-6<br>BH29/2.0 | 17619-7<br>BH39(F)/1.0 | 17619-8<br>BH39(F)/3.0 | 17619-9<br>BH34/1.0 | 17619-10<br>BH34/4.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | mg/kg | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.17 | 0.70 | <0.10 |
| Acenaphthylene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.18 | <0.10 |
| Acenaphthene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.10 | 0.70 | <0.10 |
| Fluorene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.87 | <0.10 |
| Phenanthrene | mg/kg | 0.36 | <0.10 | 0.33 | <0.10 | 0.71 | <0.10 | <0.10 | 1.7 | 1.8 | <0.10 |
| Anthracene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | 0.11 | <0.10 | <0.10 | 0.24 | 0.31 | <0.10 |
| Fluoranthene | mg/kg | 0.21 | <0.10 | 0.36 | <0.10 | 0.56 | <0.10 | <0.10 | 1.4 | 0.26 | <0.10 |
| Pyrene | mg/kg | 0.15 | <0.10 | 0.27 | <0.10 | 0.53 | <0.10 | <0.10 | 1.2 | 0.38 | <0.10 |
| Benzo[*a*]anthracene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | 0.44 | <0.10 | <0.10 | 0.89 | <0.10 | <0.10 |
| Chrysene | mg/kg | 0.14 | <0.10 | 0.18 | <0.10 | 0.42 | <0.10 | <0.10 | 0.60 | 0.11 | <0.10 |
| Benzo[*b*]fluoranthene | mg/kg | 0.11 | <0.10 | 0.14 | <0.10 | 0.48 | <0.10 | <0.10 | 0.65 | <0.10 | <0.10 |
| Benzo[*k*]fluoranthene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | 0.18 | <0.10 | <0.10 | 0.22 | <0.10 | <0.10 |
| Benzo[*a*]pyrene | mg/kg | <0.050 | <0.050 | 0.050 | <0.050 | 0.29 | <0.050 | <0.050 | 0.32 | <0.050 | <0.050 |
| Indeno[*123-cd*]pyrene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | 0.18 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dibenzo[*ah*]anthracene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Benzo[*ghi*]perylene | mg/kg | <0.10 | <0.10 | <0.10 | <0.10 | 0.20 | <0.10 | <0.10 | 0.21 | <0.10 | <0.10 |
| Total Positive PAH's | mg/kg | 1.070 | 0.00000 | 1.330 | 0.00000 | 4.100 | 0.00000 | 0.00000 | 7.700 | 5.310 | 0.00000 |
| *Surrogate* | % | 112 | 112 | 99 | 112 | 104 | 112 | 115 | 103 | 110 | 112 |