Report

Summary Site Audit Report, Castlereagh Site, Thornton Park

Prepared for
Department of Defence
Level 8, Defence Plaza
307 Pitt Street
Sydney NSW 2000

2 February 2001

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URS

Dames & Moore
Woodward Clyde

2 February 2001
Project No. 12343-050-371

Department of Defence
Level 8, Defence Plaza
307 Pitt Street
Sydney NSW 2000

Attention: Mr Matthew Beggs

Dear Matthew

Subject: Summary Site Audit Report
Castlereagh Site

I have pleasure in submitting the revised summary site audit report for the section of Thornton Park, formerly the North Penrith Army Stores, known as the Castlereagh Site. A report and accompanying Site Audit Statement dated 5 July 2000 for this same site were previously issued titled "Summary Site Audit Report, Thornton Park, "Lot 11". The Statement was numbered GN-5-B. The report and statement have been revised only to change the site descriptive name and to incorporate a new DP number for part of the site. Details of site ownership and proposed landuse have also been revised to reflect changes since the previous report. It should be noted that there have been some changes in applicable Environmental Quality Criteria and in regulatory guidelines (Sections 7 and 12 of the Summary Site Audit Report) related to the endorsement of the National Environment Protection Measure on the Assessment of Site Contamination by NSW EPA in August 2000. These changes do not affect the conclusions of the report.

This audit is a non-statutory audit under the NSW Contaminated Land Management Act 1997. A copy of Site Audit Statement GN-22 follows the Table of Contents.

Please call me if you have any questions.

Yours faithfully
URS AUSTRALIA PTY LTD
(incorporating Dames & Moore and Woodward Clyde)

Graeme Nyland

Graeme Nyland
NSW Site Auditor 9808
Contaminated Land

/cc: Mr Peter Rigby, Fitzwalter & Associates Pty Ltd

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NSW Environment Protection Authority

Site Audit Statement

Site Audit Statement No.: *GN-22*

Site Auditor *(accredited under NSW Contaminated Land Management Act 1997):*

Name: *Graeme Nyland* **Company:** *URS Aust. Pty Ltd*
Address: *L3, 116 Miller Street, North Sydney, 2060*
Phone: *(02) 8925 5500* **Fax:** *(02) 8925 5555*

Site Details:

Address: *Castlereagh Road, North Penrith*
Lot and DP Number: *Lot 11 in DP862420 plus Lots 1 to 4 in DP1017480*
Local Government Area: *Penrith*

Site audit requested by:

Name: *B. Blackley* **Company:** *Dept. of Defence*
Address: *Defence Plaza, Pitt Street Sydney*
Phone: *(02) 9955 7772* **Fax:** *(02) 9955 7324*
Name of contact person (if different from above): *Matthew Beggs*

Consultancy(ies) *who conducted the site investigation (s) and / or remediation:*

Egis Consulting Australia Pty Limited (formerly CMPS & F Environmental)

Title(s) of report(s) *reviewed:*

• *Geotechnical Study, Contamination Assessment & Remediation Strategy North Penrith Army Stores Depot. Technical Work Plan*	*CMPS&F*	*Nov-97*
• *Draft Geotechnical Study, Assessment & Remediation Strategy, Phase 1, Site History, Preliminary Sampling and Work Plan*	*CMPS&F*	*Dec-97*
• *Contamination Assessment & Remediation Strategy - Phase 1, Site History, Preliminary Sampling and Work Plan*	*CMPS&F*	*May-98*
• *Draft North Penrith Army Stores Depot Report on Validation of NPASD – Lot 11*	*CMPS&F*	*May-98*
• *Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment – Volume 2 Appendices*	*EGIS*	*Sep-98*
• *Remedial Action Plan – North Penrith Army Stores Depot*	*EGIS*	*Sep-98*
• *Draft Report on Validation of NPASD – Lot 11*	*EGIS*	*Apr-99*
• *Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment – Draft Revision B*	*EGIS*	*Jun-99*
• *Report on Validation of NPASD – Lot 11*	*EGIS*	*Jul-99* ✓
• *Supplementary Validation Work – North Penrith (Lot 11)*	*EGIS*	*20 June-00*

Other information reviewed:

Summary Site Audit Report title: ***Date:*** *2 February 2001*

Summary Site Audit Report, Castlereagh Site, Thornton Park

I have completed a site audit (as defined in the Contaminated Land Management Act 1997) and reviewed the reports and information referred to above with due regard to laws and guidelines. I certify that the site (tick all appropriate boxes)

(a) is suitable for the following use(s):

- ~~☐ residential, including substantial vegetable garden and poultry;~~
- ~~☐ residential, including substantial vegetable garden, excluding poultry;~~
- ☑ **residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry;**
- ☑ **residential with minimal opportunity for soil access, including units;**
- ☑ **daycare centre, preschool, primary school;**
- ☑ **secondary school;**
- ☑ **park, recreational open space, playing field;**
- ☑ **commercial/industrial use;**
- ~~☐ other (please specify);~~

subject to

- ☑ **condition(s) (please specify):**

- *Any use of groundwater will require an assessment of the suitability of the groundwater.*

~~**(b) is not suitable for any beneficial use due to the risk of harm from contamination.**~~

- ☐ **comments):**

I am accredited by the NSW Environment Protection Authority under the Contaminated Land Management Act 1997 as a Site Auditor (Accreditation Number: *9808*)

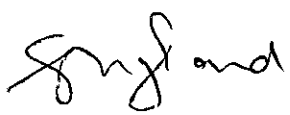
I certify that:

(a) I have personally examined and am familiar with the information contained in this statement, including the reports and information referred to in this statement, and

(b) this statement is to the best of my knowledge true, accurate and complete, and

(c) on the basis of my inquiries made to those individuals immediately responsible for making the reports, and obtaining the information, referred to in this statement, those reports and that information are, to the best of my knowledge true, accurate and complete.

I am aware that there are penalties for wilfully submitting false, inaccurate or incomplete information.

Signed:  **Date: -** 2/2/01

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)
CHC	Chlorinated Hydrocarbons (see also VCH)
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
<	Less than (laboratory PQL)
-	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.

Introduction

SECTION 1

A site contamination audit has been conducted on part of Thornton Park, formerly the North Penrith Army Stores site, known as the "Castlereagh Site". The audit of the Castlereagh Site is being completed in advance of the remainder of the Thornton Park site because it may be released for development before the rest of the site. This site was formerly referred to as "Lot 11".

The audit was conducted for the purpose of determining the nature and extent of any contamination of the land, the nature and extent of the investigation or remediation, and what investigation or remediation remains necessary before the land is suitable for the specified use, ie Section 47 (1)(b) (i)(ii) and (iii) of the Contaminated Land Management Act 1997. The objective of the Department of Defence, the site owner, is to obtain a Site Audit Statement certifying that the site is suitable for residential use. The audit is non-statutory at this time.

I was engaged in November 1977 to conduct an audit of the North Penrith Army Stores site of which the Castlereagh Site is part. The Consultant for this work was Egis Consulting Australia (EGIS), formerly CMPS&F Environmental.

I have conducted discussions with the Consultant and undertaken site visits during the project, and have reviewed the following documents, some of which relate to the entire North Penrith Army Stores site or to parts of the site which are not within the Castlereagh Site. Note that "Lot 11" is most of the Castlereagh Site.

TITLE	AUTHOR	DATE
Preliminary Contamination Assessment	DJ Douglas & Partners	Dec-92
Report on Contamination Assessment	DJ Douglas & Partners	Mar-93
Planning Report – Penrith	Planning Workshop	Jun-93
Report on Stage 2 Contamination Assessment	DJ Douglas & Partners	Dec-93
Review of Contamination Assessment – North Penrith Army Stores Depot	Dames & Moore	Sep-94
Environmental Audit – North Penrith Army Stores Depot – Coreen Avenue Penrith	Dames & Moore	Aug-97
Geotechnical Study, Contamination Assessment & Remediation Strategy North Penrith Army Stores Depot. Technical Work Plan	CMPS&F	Nov-97
Draft Geotechnical Study, Assessment & Remediation Strategy, Phase 1, Site History, Preliminary Sampling and Work Plan	CMPS&F	Dec-97
Contamination Assessment & Remediation Strategy - Phase 1, Site History, Preliminary Sampling and Work Plan	CMPS&F	May-98
Draft North Penrith Army Stores Depot Report on Validation of NPASD – Lot 11	CMPS&F	May-98
Report on Battery Store Demolition, Separator Pit Excavation & Associate Soil Validation	CMPS&F	Jul-98
Report on Underground Storage Tank and Aboveground Storage Tank Decommissioning & Associated Soil Validation Sampling	CMPS&F	Jul-98
Draft Remediation Action Plan for North Penrith Army Stores Depot	CMPS&F	Sep-98

TITLE	AUTHOR	DATE
Draft Contamination Assessment – Phase 2 North Penrith Army Stores Depot – Volume 1	EGIS	Dec-98
Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment – Volume 2 Appendices	EGIS	Sep-98
Remedial Action Plan – North Penrith Army Stores Depot	EGIS	Sep-98
Draft Report on Validation of NPASD – Lot 11	EGIS	Apr-99
Draft North Penrith Army Stores Hazardous Materials Audit Report	EGIS	May-99
Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment – Draft Revision B	EGIS	Jun-99
Report on Validation of NPASD – Lot 11	EGIS	Jul-99
Technical Specification for Site Remediation North Penrith Army Stores Depot (NPASD)	EGIS	Aug-99
Thornton Park, Penrith, Validation Report for ORTA Occupation area	EGIS	Apr-00
Supplementary Validation Work – North Penrith (Lot 11)	EGIS	Jun-00

2.1 Location

The general location of Thornton Park is shown on **Attachment 1** as Main NPSAD and Lot 11. Thornton Park occupies approximately 58 hectares within the area between Castlereagh Road, Coreen Avenue, Mountain View Crescent and The Western Railway Line. The Castlereagh Site consists of Lot 11 and a small extension to the south and occupies approximately 7.6 ha fronting Castlereagh Road.

The site location is described as: *Castlereagh Road, North Penrith 2750, Lot 11 in DP862420 and Lots 1-4 in DP1017480 (Penrith City Council)* **(Attachment 2)**.

Lots 1 and 4 in DP1017480 are currently in the ownership of Pacific Power. Lots 2 and 3 in DP1017480 are currently in the ownership of Integral Energy. Defence is currently in the process of acquiring this land.

2.2 Zoning

It is understood that the site is currently zoned as "General Industry 4(a)". The Auditor has not viewed any zoning documentation.

2.3 Adjacent Uses

The site is the western part of the former army stores area. The area surrounding Thornton Park is mixed commercial and residential, with the western end industrial or open ground.

2.4 Site Condition

The Castlereagh Site is an open grassed field with a few trees. It is crossed by a drainage channel which is unlined and contains reeds. The north west corner contains some bare ground in the former RTA area (see Section 3).

Lot 11 in DP862420 is separated from the Integral Energy/Pacific Power land by a bitumen road. The Integral Energy Parcel (to be acquired) is also grassed and unused.

2.5 Proposed Development

An industrial subdivision/development is proposed for the subject site.

The site history has been investigated by Egis using aerial photographs from 1947 and interviews with Defence and RTA personnel.

Historical activities on the site relevant to the Site Audit are:

- the site has never been used for Defence purposes;
- the north western corner of the site was used as an RTA compound between 1993 and 1998. It included a house (brick or fibro) which was previously used for residential purposes. The RTA used the compound for storage of road construction materials. The house has been demolished and surface soils in the compound scraped and removed;
- the remainder of the site was used for agricultural purposes, possibly an orchard, or unused;
- the Integral Energy land is undeveloped grassland; and
- dumping of soil from an unknown source occurred on Lot 11 in DP862420 since the RTA vacated. The Auditor noted on a site visit on 24 November 2000 that the stockpile has been removed from site.

The Auditor concludes that the site history as documented is sufficiently thorough for the purposes of this audit, and is in accordance with the Auditor's observations.

Potential Contaminants of Concern

SECTION 4

Based on the site history, the Auditor concludes that the potential contaminants of concern are:

- residues of persistent pesticides or herbicides associated with agricultural use;
- residues of heavy metals, especially copper, lead, zinc, arsenic, cadmium and mercury;
- petroleum hydrocarbons in the RTA compound;
- polycyclic aromatic hydrocarbons within the RTA area if tars or bitumens were stored; and
- hydrocarbons associated with maintenance of vehicles or pre-coating of road aggregates.

Investigations on the site extended to a depth of 1.0 m and encountered silt with some clay. These soils are part of the alluvial deposits of the Nepean River.

The Penrith 100,000 Geological Series Sheet and investigations on the adjoining Defence property indicates that these fine alluvial deposits are underlain at a depth of 5-6 m by water bearing gravels. These are underlain by Wianamatta Group shales.

Groundwater on the adjoining section of Thornton Park is present within the alluvial deposits at depths of approximately 5-8m below ground. Flow direction is expected to be in a generally north westerly direction. The Consultant identified 5 registered bores within a 1.5 km radius of Thornton Park. Groundwater within the alluvials is described as being "suitable for stock, domestic and some irrigation purposes."

Evaluation of Quality Assurance and Quality Control Plan

SECTION 6

The investigations relevant to this audit have been conducted over a number of years and are reported in a number of reports. Most of the investigations had separate QA/QC plans, which were generally adequate and in accordance with EPA guidelines at the time. The plans and associated quality control samples considered the larger Thornton Park investigation site as one area. The Auditors evaluation of the implementation of the plans follows.

- Egis has conducted their investigations in accordance with their standard Field Operating Procedures for Environmental Investigations. The auditor has not supervised the field investigations, but based on the reported procedures the investigation methods were appropriate.
- The sampling density has been appropriate to allow conclusions to be made as to the suitability of the land for the intended purpose.
- The analytical laboratories which conducted the analysis are certified by NATA to perform the analyses conducted for data reported in the Validation Report. The laboratory analysed method blanks with results all below PQL; spike recovery percentages were generally within the laboratory control limits, and internal laboratory split duplicate RPDs were generally within acceptable ranges.
- Blind duplicates were analysed at a rate of approximately 10%. In general, the repeatability was acceptable with RPD values falling within acceptable ranges. In some cases, RPDs were outside the generally acceptable range where the analyte concentrations were near the detection limits. As there is a very large amount of data for this project within acceptable results, the Consultant concluded that the overall repeatability of the laboratory testing procedures is acceptable. The Auditor agrees.
- Chain of custody forms were signed and dated as received by the laboratory, and data on the laboratory certificates indicates that samples were analysed within the holding times listed in Reference 3.
- The Consultant's reports generally include a commentary on the results of quality control testing.
- Laboratory test certificates are NATA stamped.
- No interlaboratory duplicates were analysed. The Auditor considers that, given the large number of separate batches analysed over a long period of time in the Thornton Park investigations and the compatibility of the results, this deficiency does not compromise the usability of the data.

The Auditor concludes that the data presented by the Consultant are suitable for the purposes of this audit.

The Consultant has assessed the investigation results against the criteria listed below.

Soil Assessment Criteria

Parameter	Environmental Investigation Threshold (mg/kg)[a]	Health Based Soil Investigation Threshold (Residential) (mg/kg)[c]
Antimony	20	-
Arsenic	20	100
Cadmium	3	20
Chromium (III)	400[b]	12%
Copper	100[b]	1000
Lead	600[b]	300
Mercury (inorganic)	1	15
Nickel	60	600
Zinc	200	7000
Cyanide	-	500
TPH C_6-C_9	65[d]	65[d]
C_{10}-C_{36}	1000[d]	1000[d]
Benzene	1[d]	-
Toluene	1.4[d]	-
Ethyl Benzene	3.1[d]	-
Xylene	14[d]	
Phenol	-	8500
PAHs (total)	20	20
Benzo(a) pyrene	1	1
PCBs, total	1	10
OCPs (individual)	-	50 chlordane, 200 DDT (DDE + DDD) 10 heptachlor
OPPs (individual)	PQL	-
Phenoxy Acid Herbicides	PQL	-

Footnotes:
(a) ANZECC/NHMRC Environmental Investigation Level.
(b) NSW EPA Provisional Phytotoxicity Based Thresholds (where different to ANZECC Environment Investigation Levels.
(c) NEHF Health Based Soil Investigation Level – Standard Residential.
(d) From NSW EPA "Guidelines for Assessing Service Station Sites".

While industrial development is proposed, a conservative approach is being taken in aiming for certification as suitable for "residential with accessible soil". The criteria selected by the Consultant are therefore generally considered to be suitable. Since preparation of the Consultant's reports, the NSW EPA has endorsed the "National Environment Protection Measure (NEPM) on the Assessment of Site Contamination". The Measure includes a Guideline on the Investigation Levels for Soil which is now applicable to this site. Review of the levels against the levels used by the Consultant with reference to the analytical result indicates no significant different in the conclusions would result by using the NEPM levels.

Groundwater under the site has not been assessed.

For assessment purposes, the site was subdivided into:

- RTA Area;
- Remainder of Lot 11 in DP862420; and
- Integral Energy/Pacific Power area.

RTA Area

Sampling in the RTA area was targeted around the former building and stockpile area. Some samples contained concentrations of PAHs and heavy metals exceeding assumed background. Subsequently, the building was demolished and the soil surface scraped by RTA. The Consultant collected 14 validation samples spread over the RTA area, which is less than 0.5 ha.

The sample density exceeded the minimum requirements of Reference 15, and is considered adequate by the Auditor. The Auditor also considers that the collection of near surface (0-0.1 m depth) samples was appropriate. No PAHs were detected. Metals were not re-analysed. The initial sample and analysis which was conducted soon after the site was vacated indicated that although several sample results exceeded the assumed background, the 95th UCL on the mean was less than criteria. The maximum concentration detected were:

Lead	92 mg/kg
Copper	62 mg/kg
Zinc	506 mg/kg

Only zinc (in 2 of 13 samples) exceeded the environmental investigation threshold. This could lead to difficulty in establishing zinc intolerant vegetation species in localised areas. In the Auditor's opinion, this minor exceedance in surface soil does not warrant placing restrictions on site use or undertaking remediation, particularly as the current zoning and anticipated site use is industrial.

Remainder of Lot 11 in DP862420

Over the remainder of Lot 11, samples were obtained on a grid pattern. Samples were obtained from the surface and depth in test pits, and from surface samples. The Auditor considers that the grid pattern was appropriate given that the site history indicates a lack of potential contamination sources. However, most of the surface samples were not analysed and none were logged and were therefore of no value to the audit. The depth samples were excluded by the Auditor from statistical analysis as the potential contaminants are from surface application. This left a data set of 20 analytical results for metals. Results for all metals analysed (Sb, As, Ba, Be, Cd, Cr, Cu, Co, Pb, Mn, Ni, Se, Sn, Tl, Zn) were below the environmental investigation threshold, except for two zinc results (212 mg/kg and 202 mg/kg compared to a threshold of 200 mg/kg) and manganese, which was within the background range. Metals for which

there is no criteria were at low concentrations (eg., C_O maximum 24 mg/kg, Ba maximum 222 mg/kg) or below PQL (Sb, Be, Se, Tl).

As several results from near the drainage channel were elevated with respect to assumed background, the Auditor requested further analyses from near the drainage channel. A total of 9 further samples were obtained and analysed. All additional results were below the health based investigation threshold. This is further discussed below.

The Consultant did not include mercury in the metal analyte list. The Auditor considered inorganic mercury a potential contaminant of concern. Some previously untested samples and the additional samples from the drainage channel were analysed for mercury (total 17 analyses). Mercury was detected (maximum 1.37 mg/kg, above the environmental investigation threshold of 1 mg/kg) in a drainage channel sample. Away from the drainage channel, mercury was below or only slightly above (maximum 0.06 mg/kg) the PQL.

Results from near the drainage channel were considered as one data set by the Auditor for statistical analysis. Results for metals with some concentrations above background were:

Metal	*n*	Maximum (mg/kg)	95th UCL (mg/kg)	Lot 11*
Copper	12	206	77	21
Lead	10	147	76	26
Zinc	15	561	179	35
Mercury	12	1.37	0.39	0.06

* *Maximum over remainder of Lot 11 excluding RTA area.*

These average results are all below the environmental and human health criteria for the site. The Auditor concludes that there is evidence of some copper, lead, zinc and mercury contamination near the drainage channel, possibly introduced from upstream. The concentrations are below the site criteria for human health. There could be local difficulty in establishing some copper, zinc or mercury intolerant vegetation species, but given the existing lush vegetation, localised nature, and industrial zoning, the Auditor considers that remediation is not required.

Integral Energy/Pacific Power Land

Three samples were obtained from the small parcel of land currently owned by Integral Energy/Pacific Power. None of the organic compounds analysed for (OCPs, PCBs, PAHs, TPH, BTEX) were detected. All metals analytical results were below the site criteria.

No specific groundwater studies have been conducted for the Castlereagh site. One of the wells installed for the Thornton Park study is within Lot 11, on the presumed downgradient (west) side. When sampled and analysed in 1998, the well did not contain any TPH, BTEX, phenolics, PAH, OCP, OPP, PCB or herbicides above the PQL. Zinc was detected at a concentration above ANZECC water quality guidelines for protection of aquatic ecosystems, but similar to other wells in Thornton Park. The Auditor concludes that the groundwater at the location sampled was not contaminated at the time of the sampling. Based on the low concentrations of contaminants in the soils on the site, there is no reason to suspect that groundwater is contaminated due to previous or current activities on the Castlereagh site.

The Auditor notes that wells immediately upgradient of the Castlereagh site on Thornton Park contain low concentrations of petroleum hydrocarbons. It is therefore possible that groundwater under the site could be contaminated due to offsite activities.

The Consultant has compared the soil analytical results with the environmental criteria listed in Section 7 to make conclusions as to the suitability of the site. The Consultant concludes:

> *"In summary, it is considered that Lot 11 (now known as the Castlereagh Site) (including the adjoining land parcel) is currently suitable from a contamination perspective for sensitive (including "standard residential") land uses, subject to removal of the small soil stockpile north of the former RTA compound".*

The stockpile referred to has been removed. The Auditor concurs with the Consultant's assessment of risk from the soil.

The Consultant has not assessed risk to site users from groundwater. There is some risk that contamination could migrate onto the site from the adjoining site. Based on the site stratigraphy and level of contaminants in site soils, there is minimal risk that groundwater under the site has been contaminated by previous site activities.

No risk from surface water or sediment was identified by the Consultant. The drainage channel is believed to be man made and does not have permanent flow.

In some localised areas, there is a risk that growth of some plant species may be adversely affected.

A stockpile of dumped, apparently uncontaminated but not validated soil has been removed, and the surface of the RTA Area was scraped by RTA and soil removed. These activities were conducted to reduce potential risk of undetected contamination rather than because of demonstrated risk. Soil removal was not conducted under a formal Remedial Action Plan.

Compliance with Regulatory Guidelines and Directions

SECTION 12

Guidelines which were approved by EPA at the time of preparation of this report in July 2000, 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 (sic).

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

GUIDELINES MADE BY EPA

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 "Checklist for Site Auditors using the EPA Guidelines for the NSW Site Auditor Scheme 1998" (December 1999) has also been completed by the Auditor and is kept on file.

The Consultant does not identify any consents, licences, notifications or other regulatory requirements relating to the site. The Consultant installed one monitoring well on the site and it is not stated if a well licence was obtained from DLWC. Removal of soils from the site was conducted independent of the Consultant, and the Auditor does not know the fate of the soils removed. The soil was not known to be contaminated. The Auditor is not aware of any other regulatory requirements which would have applied to this investigation.

Contamination Migration Potential

SECTION 13

The Consultant does not discuss contamination migration potential. The Consultant does not identify or discuss potential receptors of contaminated groundwater. Rate and direction of groundwater flow and likely attenuation of contaminants is not discussed by the Consultant. These omissions are not considered critical by the Auditor because there is no significant contamination on the site, and groundwater is unlikely to be contaminated by previous site activities.

Analysis of soils from the drainage channel indicates that no significant offsite migration of contaminants is occurring via these pathways.

Conclusions and Recommendations

SECTION 14

Based on the audit conducted and the decision process for assessing urban redevelopment sites outlined in the Guidelines for the NSW Site Auditor Scheme (Reference 12), it is concluded that the site is suitable for residential development, with accessible soil, including garden and excluding substantial vegetable garden and poultry subject to conditions as follows:

- Any use of groundwater will require an assessment of the suitability of the groundwater.

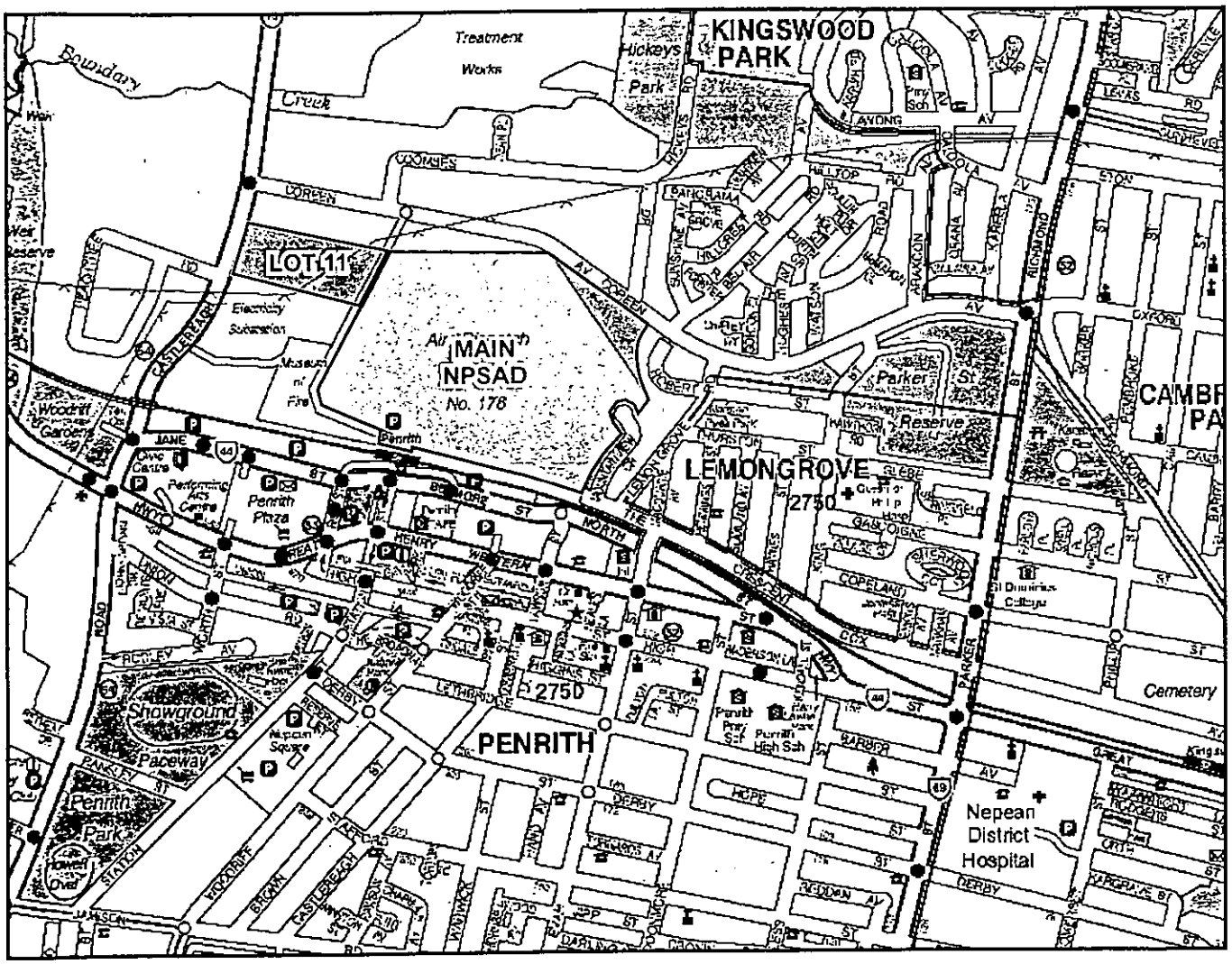
This non-statutory audit was conducted for Department of Defence, for the purposes of their current requirements. It may not be suitable for other uses. The Consultant, Egis Consulting Australia, has included Limitations in their reports. The audit must also be subject to those limitations. The Auditor 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 potential 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.

Attachment 1
Site Location - General

LOCALITY PLAN

NPASD LOT 11 VALIDATION



ATTACHMENT 1
SITE LOCATION - GENERAL
Lot 11 is most of Castlereagh Site

0 1.0Km

Approx Scale

egis consulting Australia

Date : 1 June 2000

File Name : VA010241.cdr

Figure 1

Attachment 2
Site Location - Lot 11 in DP 862420 and Lots 1-4 in DP1017480

[redacted] PLAN [redacted] 2 [redacted] Pl[redacted] only [redacted] in this space [redacted]

SIGNATURES AND SEALS ONLY.

SIGNED by an Authorised Officer of the Commonwealth of Australia in the presence of:

Signature [illegible]
Name of officer: [illegible]
Position: Director, Dept. of [illegible]

Signature of witness
Name: [illegible]

Date: 21 August 2000

ATTACHMENT 2
SITE LOCATION

Crown Lands Office Approval

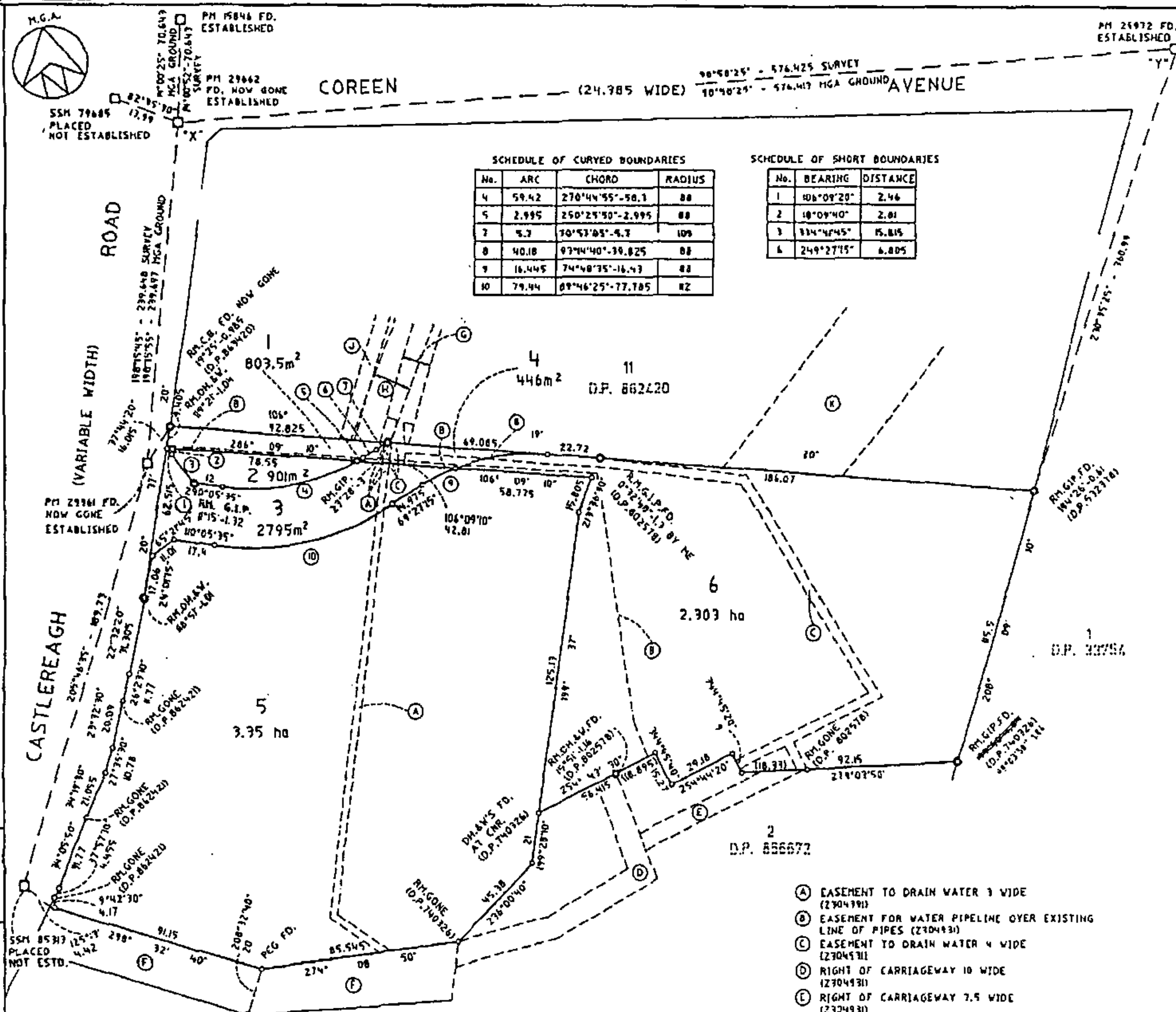
PLAN APPROVED ....
Authorised Officer
Land District ....
Parish No. ....
Field Book .... pages

Subdivision Certificate

[illegible] Environmental Planning and Assessment Act 1979 [illegible]

Consent Authority ....
Date of endorsement ....
Accreditation No. ....
Subdivision Certificate No. ....
File No. ....

Note: When the plan is to be lodged electronically at the Land Titles Office [illegible]



SCHEDULE OF CURVED BOUNDARIES

No.	ARC	CHORD	RADIUS
4	59.42	270°44'55"-58.1	88
5	2.995	250°25'50"-2.995	88
7	5.3	70°53'05"-5.3	105
8	40.18	93°44'40"-39.825	88
9	16.445	74°48'35"-16.43	83
10	79.94	69°46'25"-77.785	82

SCHEDULE OF SHORT BOUNDARIES

No.	BEARING	DISTANCE
1	106°09'20"	2.46
2	18°09'40"	2.81
3	334°44'45"	15.815
6	249°27'15"	6.805

SURVEY PRACTICE REGULATIONS 1996 CLAUSE 32(2)

M.G.A. CO-ORDINATES

MARK	EASTING	NORTHING	ZONE	CLASS	ORDER
PM 15846	286222.121	6269165.552	56	B	2
PM 29961	286129.467	6269449.342	56	B	2
PM 29962	286205.020	6267896.499	56	B	2
PM 25972	284774.430	6267007.075	56	B	2
SSM 79685	286191.15	6269699.20	56	BY ME	
SSM 85313	286047.35	6269499.90	56	BY ME	

ADOPTED FROM N.S.W. DEPT. OF L.&W.C. (S.C.I.M.S.) AT 24/05/1999
COMBINED SCALE FACTOR ADOPTED: 1.00042

(A) EASEMENT TO DRAIN WATER 3 WIDE (Z304391)
(B) EASEMENT FOR WATER PIPELINE OVER EXISTING LINE OF PIPES (Z304931)
(C) EASEMENT TO DRAIN WATER 4 WIDE (Z304531)
(D) RIGHT OF CARRIAGEWAY 10 WIDE (Z304931)
(E) RIGHT OF CARRIAGEWAY 7.5 WIDE (Z304931)
(F) RIGHT OF CARRIAGEWAY VARIABLE WIDTH (Z304931)
(G) EASEMENT FOR DRAINAGE 3.05, 12.19 & VAR. WIDTH (GOV. GAZ. 5TH FEBRUARY 1960 FOL.299)
(H) EASEMENT FOR TRANSMISSION LINE 15.24 WIDE (BOOK 2629 N°127)
(J) EASEMENT FOR SEWERAGE 6.095 WIDE (BOOK 1886 N°300)(C786304)
(K) EASEMENT FOR TRANSMISSION LINE 42.67 WIDE (GOV. GAZ. 7TH AUGUST 1959 FOL.2358)(U826620)

CAD FILE: DPRL0046

SURVEYOR'S REFERENCE: RL0046-000 ACQUISITION PLAN

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

DP1017480

Registered [illegible] 13-9-00

C.A.

Title System: TORRENS

Purpose: ACQUISITION

Ref. Map: U6460-51, U6460-62

Last Plan: D.P. 862420, D.P. 802574

PLAN OF SUBDIVISION OF LOT 101 IN D.P. 802574 & LOT 3 IN D.P. 862421

Lengths are in metres. Reduction Ratio 1:2500

L.G.A.: PENRITH

Locality: PENRITH

Parish: CASTLEREAGH

County: CUMBERLAND

SURVEYORS PRACTICE REGULATION 1996
IAN GRANT NEILSON
EDIS SURVEY & PROPERTY SERVICES
of 47 Albert Avenue, Chatswood NSW 2067

[illegible] completed on 24/6/1999 & 24/7/2000.

The survey relates to SUBDIVISION

Signature [illegible]
Surveyor registered under Surveyors Act 1929

Plans used in preparation of survey/compilation:
DP'S 233536, 237084, 237090, 532378, 740326, 802575, 818416, 862420, 862421, 867621

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

IT IS INTENDED BY THE COMMONWEALTH OF AUSTRALIA TO ACQUIRE LOTS 1, 2, 3 AND 4

BRG OF RM AMENDED AT SURVEYOR'S REQUEST

Appendix A
Analyte Lists and Analytical Methods

Pamdel

Accreditation No 1464

ENVIRONMENTAL AND INDUSTRIAL SERVICES DIVISION
Trading as Australian Analytical Laboratories Pty Ltd
ACN 001 491 667

Correspondence to:
PO BOX 514
HORNSBY NSW 1630

5 Kelray Place
ASQUITH NSW 2077
Telephone: (02) 9482 1922
Facsimile: (02) 9482 1734

CERTIFICATE OF ANALYSIS

Contents :
1. Cover Page
2. Analysis Report Pages
3. QA/QC Appendix

Report No.	:	0E01271
Attention	:	Mr Andrew Hogan
Client	:	EGIS Consulting Australia
Samples	:	20
Reference	:	VA0102
Project	:	PENRITH-DOMAIN L
Received Samples	:	14/04/00
Instructions	:	14/04/00
Date Reported	:	26/04/00

Method	Description	Extracted	Analysed
E7500	Moisture (%w/w)	19/04/00	19/04/00
E1220	Total Petroleum Hydrocarbons	18/04/00	26/04/00
E1110	Polycyclic Aromatic Hydrocarbons	18/04/00	19/04/00
E5910	Metals by ICP-AES	18/04/00	19/04/00
E5950	Mercury in Soil	18/04/00	19/04/00

RESULTS

All samples were analysed as received. This report relates specifically to the samples received.
Results relate to the source material only to the extent that the samples as supplied are truly representative of the sample source. *This report replaces any preliminary results issued.*
Note that for schemes indicated with * NATA accreditation does not cover the performance of this service.
Three significant figures (or 2 for <10PQL) are reported for statistical purposes only.
PLEASE SEE ATTACHED PAGES FOR RESULTS

per D. SPRINGER B.App.Sc
Manager Environmental Sydney

amdel

QA/QC APPENDIX NO. 0E01271

Method	Description
E1220	Total Petroleum Hydrocarbons
E1110	Polycyclic Aromatic Hydrocarbons
E5910	Metals by ICP-AES
E5950	Mercury in Soil

Chromatography QA/QC

	Yes	No	N/A
Retention Time Window Within Acceptance Criteria(±2%)	√		
Check Standard Within Acceptance Criteria(±10%)	√		
Recalibration Within Acceptance Criteria(±15%)	√		
Internal Standard (where applicable) shows acceptable recovery	√		

Other QA/QC

Holding time conforming With Method Specification	√		
Chain of Custody Attached	√		

N/A = Not Applicable

Comments

1. Laboratory QA/QC including Method Blanks, Duplicates, Matrix Spike Duplicates, Laboratory Control Samples or CRM's are included in this QA/QC appendix. (Where applicable)
2. Inter-Laboratory proficiency trial results available on request. (Where applicable)
3. Surrogate description and recoveries are recorded in the Report. (Where applicable)
4. Acceptance criteria for specific analytes are available upon request (Refer to SPM-01).
5. Practical Quantitation Limit (PQL is typically 2-10 x method detection limit (MDL)).
6. PQL's are matrix dependent and are increased accordingly where sample extracts are diluted.
7. Results are uncorrected for matrix spike or surrogate recoveries.

per D. SPRINGER B.App.Sc.
Manager Environmental Sydney

Eandel

QA/QC APPENDIX NO. 0E01832

Method	Description
E5910	Metals by ICP-AES
E5950	Mercury in Soil
E1081	Organochlorine Pesticides and PCBs
E1110	Polycyclic Aromatic Hydrocarbons
E1220	Total Petroleum Hydrocarbons
E1010	Benzene,Toluene,Ethylbenzene & Xylene

Chromatography QA/QC

	Yes	No	N/A
Retention Time Window Within Acceptance Criteria(±2%)	√		
Check Standard Within Acceptance Criteria(±10%)	√		
Recalibration Within Acceptance Criteria(±15%)	√		
Internal Standard (where applicable) shows acceptable recovery	√		

Other QA/QC

Holding time conforming With Method Specification	√		
Chain of Custody Attached	√		

N/A = Not Applicable

Comments

1. Laboratory QA/QC including Method Blanks, Duplicates, Matrix Spike Duplicates, Laboratory Control Samples or CRM's are included in this QA/QC appendix. (Where applicable)
2. Inter-Laboratory proficiency trial results available on request. (Where applicable)
3. Surrogate description and recoveries are recorded in the Report. (Where applicable)
4. Acceptance criteria for specific analytes are available upon request (Refer to SPM-01).
5. Practical Quantitation Limit (PQL is typically 2-10 x method detection limit (MDL)).
6. PQL's are matrix dependent and are increased accordingly where sample extracts are diluted.
7. Results are uncorrected for matrix spike or surrogate recoveries.

per D. SPRINGER B.App.Sc.
Manager Environmental Sydney

amdel

Job Number : 0E01271

Client : EGIS Consulting Australia

Reference : VA0102

Project : PENRITH-DOMAIN L

	Lab No	E60193	E60194	E60195	E60198	
	Sample Id	C7	C8	C9	SS1	
Analyte	PQL					
E5910 Metals in Soil						
Arsenic	5	6	7	6	nd	
Cadmium	0.5	nd	nd	nd	nd	
Cobalt	5	8	10	6	9	
Chromium	5	10	11	10	12	
Copper	5	39	52	27	47	
Nickel	2	8	11	6	22	
Lead	5	37	68	36	49	
Zinc	5	83	190	54	58	
Mercury	0.05	0.54	0.33	0.11	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

Job Number : 0E01271

Client : EGIS Consulting Australia

Reference : VA0102

Project : PENRITH-DOMAIN L

	Lab No	E60179	E60180	E60181	E60182	E60183
	Sample Id	RTA-V1	RTA-V2	RTA-V3	RTA-V4	RTA-V5
Analyte	PQL					
E1110 PAH's in Soil						
Naphthalene	0.5	nd	nd	nd	nd	nd
Acenaphthylene	0.5	nd	nd	nd	nd	nd
Acenaphthene	0.5	nd	nd	nd	nd	nd
Fluorene	0.5	nd	nd	nd	nd	nd
Phenanthrene	0.5	nd	nd	nd	nd	nd
Anthracene	0.5	nd	nd	nd	nd	nd
Fluoranthene	0.5	nd	nd	nd	nd	nd
Pyrene	0.5	nd	nd	nd	nd	nd
Benz(a)anthracene	0.5	nd	nd	nd	nd	nd
Chrysene	0.5	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	1	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.5	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	0.5	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	0.5	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	0.5	nd	nd	nd	nd	nd
Total PAH	0.5	nd	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	116%	104%	103%	103%	105%
Anthracene-d10-SURROGATE	1	118%	108%	103%	108%	107%
p-Terphenyl-D14-SURROGATE	1	122%	114%	112%	115%	112%

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

Job Number : 0E01832

Page 3 of 8

ient : EGIS Consulting Australia

plus Cover Page

Reference : VA0102

roject : NORTH PERNITH

	Lab No	E67125	E67126	E67127	E67128	E67129
	Sample Id	LX1/0.1	LX1/0.4	LX2/0.1	LX2/0.4	LX3/0.1
Analyte	PQL					
E1081 OC's & Total PCB's in Soil						
HCB	0.1	nd	nd	nd	nd	nd
a-BHC	0.1	nd	nd	nd	nd	nd
g-BHC	0.1	nd	nd	nd	nd	nd
Heptachlor	0.1	nd	nd	nd	nd	nd
Aldrin	0.1	nd	nd	nd	nd	nd
b-BHC	0.1	nd	nd	nd	nd	nd
d-BHC	0.1	nd	nd	nd	nd	nd
Oxychlordane	0.1	nd	nd	nd	nd	nd
Heptachlor epoxide	0.1	nd	nd	nd	nd	nd
Endosulfan 1	0.1	nd	nd	nd	nd	nd
Chlordane-Trans	0.1	nd	nd	nd	nd	nd
Chlordane-Cis	0.1	nd	nd	nd	nd	nd
trans-Nonachlor	0.1	nd	nd	nd	nd	nd
DDE	0.1	nd	nd	nd	nd	nd
Dieldrin	0.1	nd	nd	nd	nd	nd
Endrin	0.1	nd	nd	nd	nd	nd
DDD	0.1	nd	nd	nd	nd	nd
Endosulfan 2	0.1	nd	nd	nd	nd	nd
DDT	0.1	nd	nd	nd	nd	nd
Endosulfan sulfate	0.1	nd	nd	nd	nd	nd
Methoxychlor	0.1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	1	nd	nd	nd	nd	nd
2.4.5.6-TCMX-SURROGATE	1	102%	104%	103%	105%	102%

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

amdel

Job Number : 0E01832
Client : EGIS Consulting Australia
Reference : VA0102
Project : NORTH PERNITH

	Lab No	E67130	E67131			
	Sample Id	LX3/0.4	LXX			
Analyte	PQL					
E1220 TPH in Soil						
C6-C9 Fraction	**10**	nd	nd			
C10-C14 Fraction	**10**	nd	nd			
C15-C28 Fraction	**50**	nd	nd			
C29-C36 Fraction	**50**	nd	nd			
Total C6-C36	**10**	nd	nd			
E1010 BTEX (P&T) in Soil						
Benzene	**0.5**	nd	nd			
Toluene	**1**	nd	nd			
Ethylbenzene	**1**	nd	nd			
Total Xylenes	**3**	nd	nd			
4-Bromofluorobenzene-SURROGATE	**1**	98%	91%			

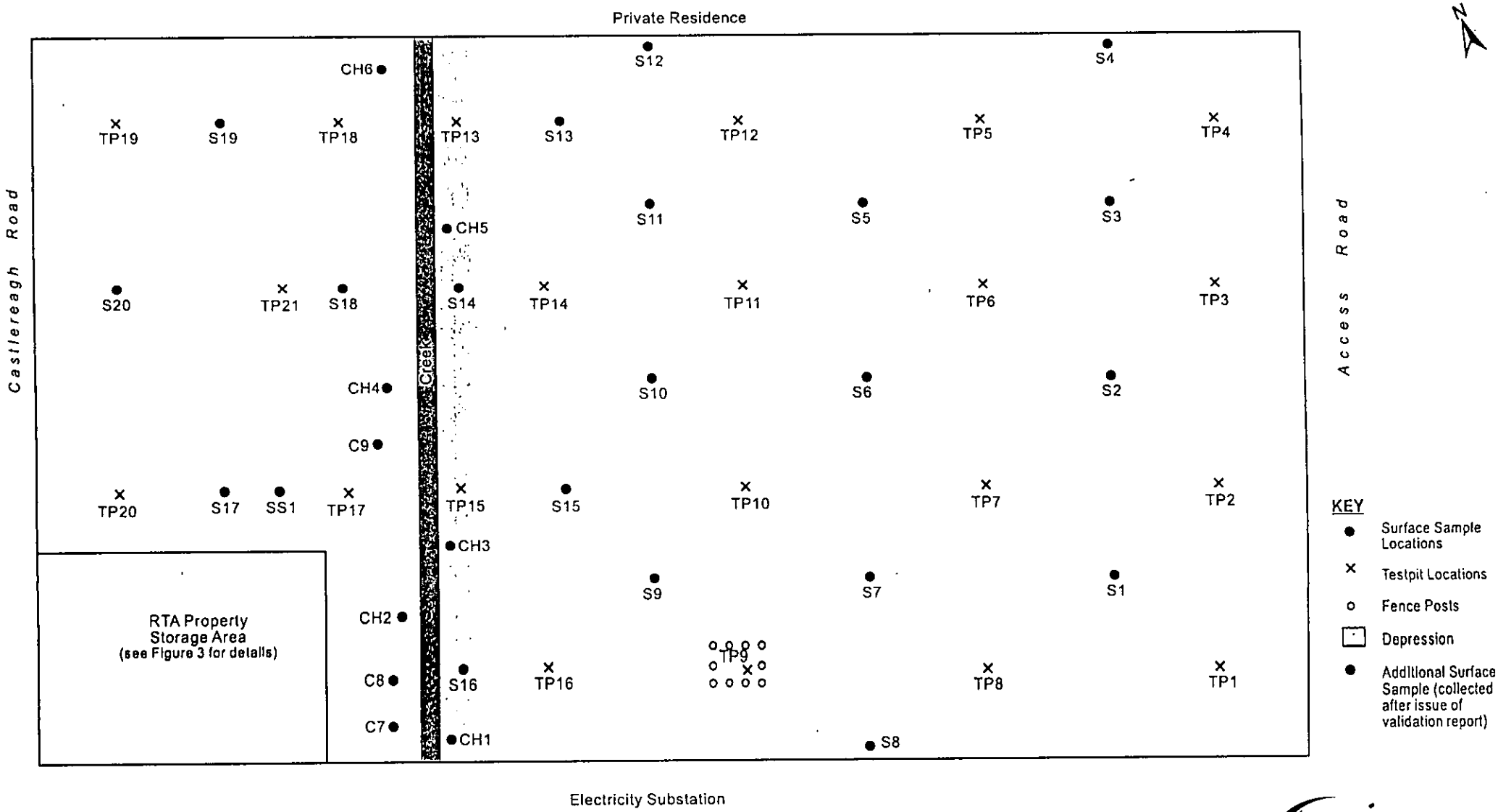
PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

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

Appendix B
Summary of Sample Locations and Analytical Results

SAMPLING LOCATIONS

NPASD LOT 11



egis consulting Australia

Date : 1 June 2000

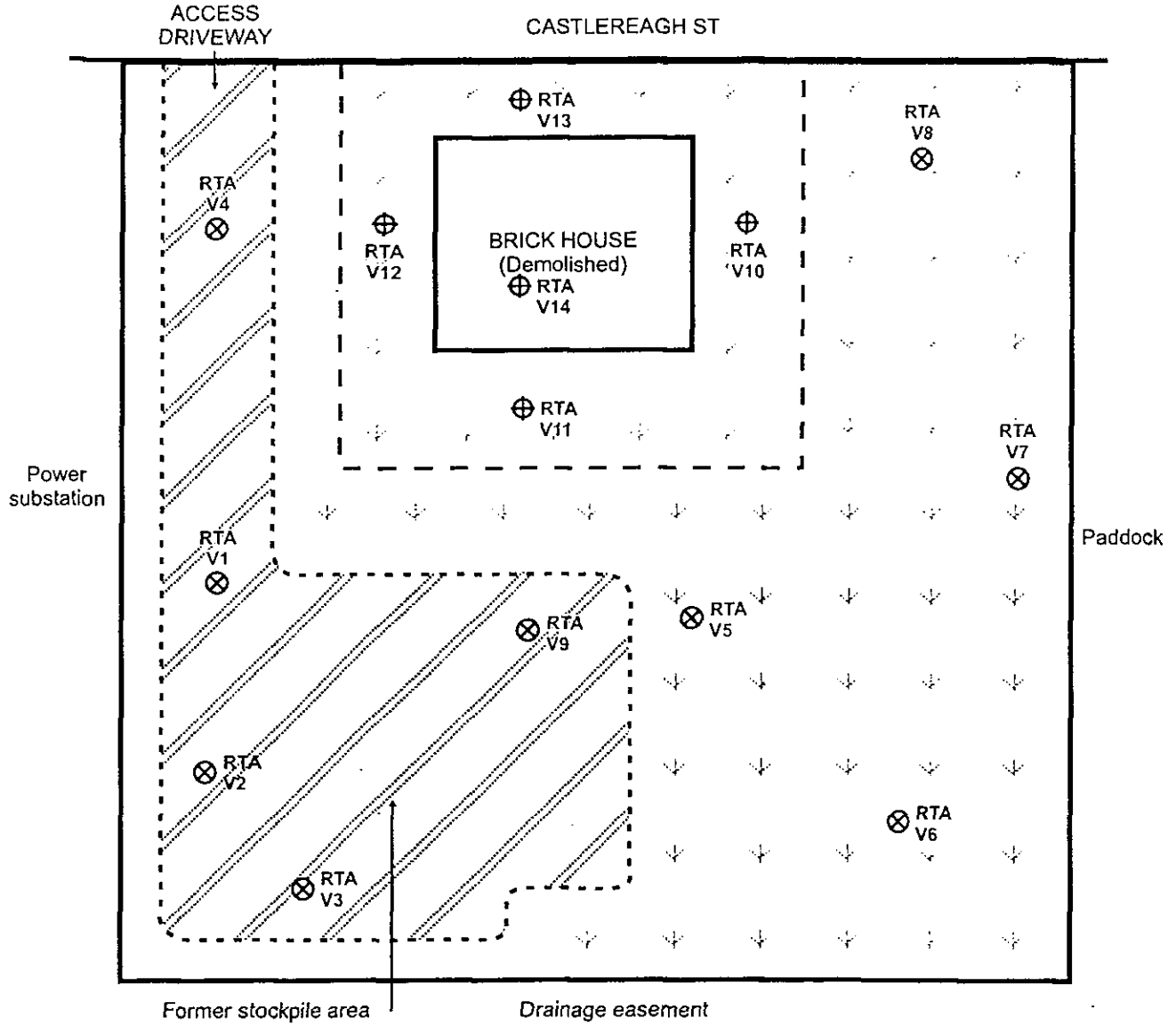
File Name : VA010240.CDR

Source: Egis

Figure 2

SITE LAYOUT AND VALIDATION SAMPLES

FORMER RTA COMPOUND (NPASD LOT 11)



KEY

- CLEARED AREA Gravelled surface
- Vegetated
- Paling fence
- RTA V3 Surface validation sample (collected after RTA clean-up)

0 10m

APPROX SCALE

Source : CMPS&F

Date : 1 June 2000

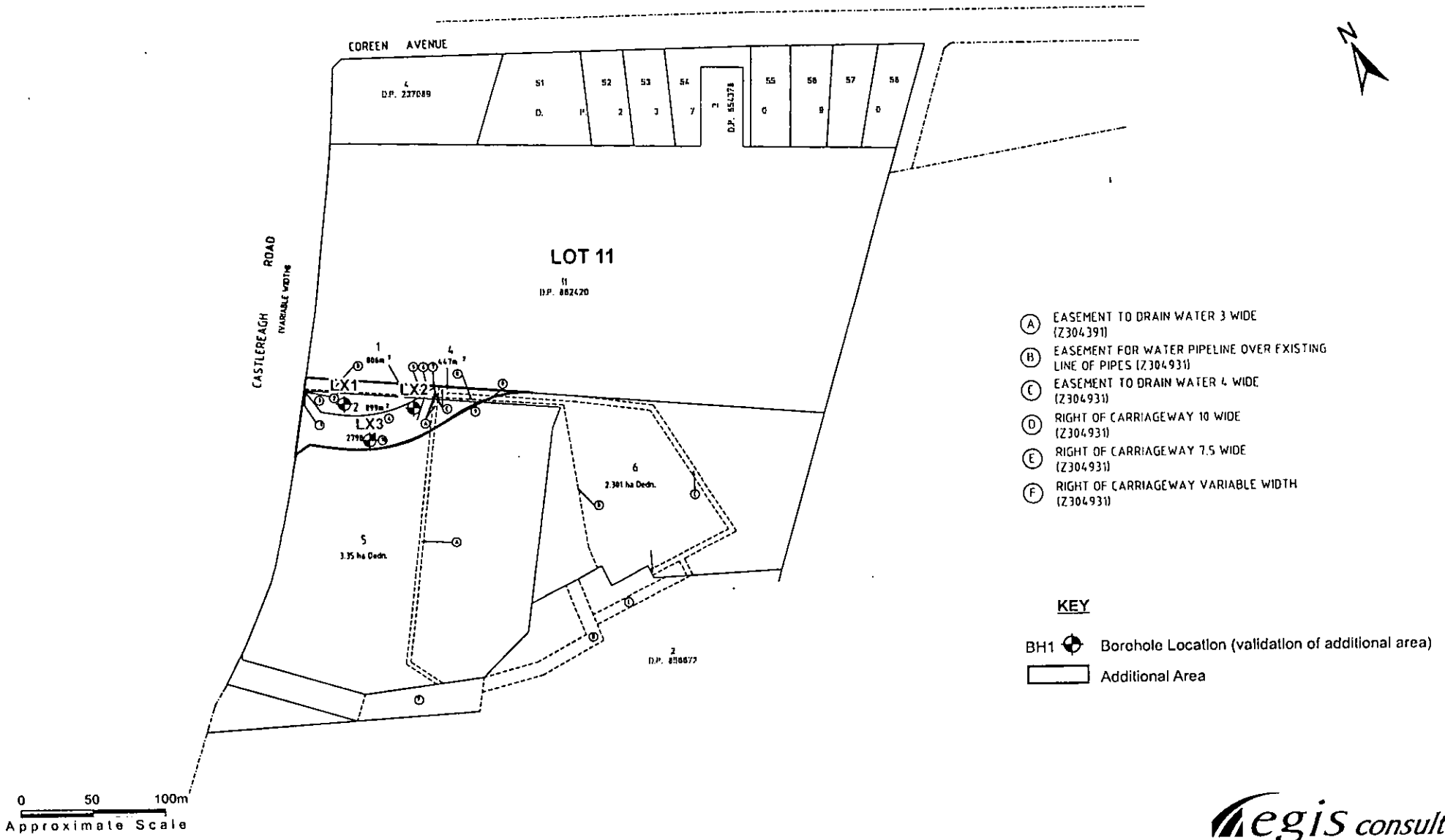
File Name : VA010277.CDR

aegis consulting Australia

Figure 4

SITE PLAN - AREA ADJOINING MAIN LOT 11

NPASD LOT 11 VALIDATION



Date : 22 June 2000

File Name : VA010278.cdr

Figure 3

Table 1 - Validation Results For Former RTA Area Following Clean-Up Operation
Validation Of Lot 11 - NPASD

All units in mg/kg

Sample ID	Depth (m)	Sampling Date	Total Petroleum Hydrocarbons			PAH	
			Total TPH	C_6-C_9	C_{10}-C_{40}	Total PAH	Benzo[a]Pyrene
RTAV1	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV2	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV3	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV4	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV5	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV6	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV7	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV8	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV9	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV10	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV11	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV12	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV13	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAV14	0-0.15	14/04/2000	ND	ND	ND	ND	ND
RTAQ1	0-0.15	14/04/2000	ND	ND	ND	ND	ND
stockpile SS1	-	14/04/2000	ND	ND	ND	6	0.6
Method Detection Limit							
MDL (Amdel)			-	10	10-50	0.5	0.5
Guidelines or Regulatory Requirements							
NSW EPA Sensitive Land Use[1]			-	65	1000	-	1
ANZECC - Environ. Investigation[2]			-	-	-	20	1
Health Based Investigation[3]			-	-	-	20	1

[1] *Guidelines for Assessing Service Station Sites*, NSW EPA December 1994

[2] Australian And New Zealand Guidelines For The Assessment And Management of Contaminated Sites (ANZECC, 1992)

[3] NEHF Health Based Soil Investigation Level "Standard Residential"

ND denotes concentration below the method detection limit

Above NSW EPA sensitive land use thresholds

Table 2 - Additional Metal Results - Drainage Channel & Soil Stockpile
Validation Of Lot 11 - NPASD

All units in mg/kg

Sample ID	Depth (m)	Sampling Date	Metals								
			Arsenic (As)	Cadmium (Cd)	Cobalt (Co)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
C7	0-0.15	14/04/2000	6	ND	8	10	39	8	37	83	0.54
C8	0-0.15	14/04/2000	7	ND	10	11	52	11	68	190	0.33
C9	0-0.15	14/04/2000	6	ND	6	10	27	6	36	54	0.11
SS1	-	14/04/2000	ND	ND	9	12	47	22	49	58	ND
Method Detection Limit											
MDL (Amdel)			5	0.5	5	5	5	2	5	5	0.05
Guidelines or Regulatory Requirements											
ANZECC - Environmental Investigation[1]			20	3	n/a	50	60	60	300	200	1
Health Based Investigation[2]			100	20	n/a	100	1000	600	300	7000	15

[1] Australian And New Zealand Guidelines For The Assessment And Management of Contaminated Sites (ANZECC, 1992)

[2] NEHF Health Based Soil Investigation Level "Standard Residential"

ND denotes concentration below the method detection limit

Above ANZECC thresholds

Above NEHF Threshold

Table 3 - Area Adjoining Lot 11 - Metals
Validation Of Lot 11 - NPASD

All units in mg/kg

Sample ID	Depth (m)	Sampling Date	Metals								
			Arsenic (As)	Cadmium (Cd)	Cobalt (Co)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
LX1	0.1	13.6.00	nd	nd	8	10	15	6	31	46	nd
LX1	0.4	13.6.00	nd	nd	8	10	11	7	18	29	nd
LX2	0.1	13.6.00	nd	nd	5	10	15	6	30	49	nd
LX2	0.4	13.6.00	nd	nd	10	10	11	7	21	28	nd
LX3	0.1	13.6.00	nd	nd	6	9	15	6	31	50	0.94
LX3	0.4	13.6.00	nd	nd	8	10	12	6	19	27	0.8
LXX	-	13.6.00	nd	nd	6	9	14	6	29	48	0.76
Method Detection Limit											
MDL (Amdel)			5	0.5	5	5	5	2	5	5	0.05
Guidelines or Regulatory Requirements											
ANZECC - Environmental Investigation[1]			20	3	n/a	50	60	60	300	200	1
Health Based Investigation[2]			100	20	n/a	100	1000	600	300	7000	15

[1] Australian And New Zealand Guidelines For The Assessment And Management of Contaminated Sites (ANZECC, 1992)

[2] NEHF Health Based Soil Investigation Level "Standard Residential"

ND denotes concentration below the method detection limit

Above ANZECC thresholds

Above NEHF Threshold

Table 4 - Area Adjoining Lot 11 - TPH & BTEX
Validation Of Lot 11 - NPASD

All units in mg/kg

Sample ID	Depth (m)	Sampling Date	Total Petroleum Hydrocarbons & BTEX						
			Total TPH	C_6-C_9	C_{10}-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes
LX1	0.1	13.6.00	ND	ND	ND	ND	ND	ND	ND
LX1	0.4	13.6.00	ND	ND	ND	ND	ND	ND	ND
LX2	0.1	13.6.00	ND	ND	ND	ND	ND	ND	ND
LX2	0.4	13.6.00	ND	ND	ND	ND	ND	ND	ND
LX3	0.1	13.6.00	ND	ND	ND	ND	ND	ND	ND
LX3	0.4	13.6.00	ND	ND	ND	ND	ND	ND	ND
LXX	-	13.6.00	ND	ND	ND	ND	ND	ND	ND
Method Detection Limit									
MDL (Amdel)			-	10	10-50	0.5	0.5	0.5	0.5
Guidelines or Regulatory Requirements									
NSW EPA Sensitive Land Use[1]			-	65	1000	1	1.4	3.1	14
ANZECC - Environ. Investigation[2]			-	-	-	-	-	-	-
Health Based Investigation[3]			-	-	-	-	-	-	-

[1] Guidelines for Assessing Service Station Sites, NSW EPA December 1994

[2] Australian And New Zealand Guidelines For The Assessment And Management of Contaminated Sites (ANZECC, 1992)

[3] NEHF Health Based Soil Investigation Level "Standard Residential"

ND denotes concentration below the method detection limit

Above NSW EPA sensitive land use thresholds

Table 5 - Area Adjoining Lot 11 - Other Organics
Validation Of Lot 11 - NPASD
All units in mg/kg

Sample ID	Depth (m)	Sampling Date	Organics			
			Total PAHs	Benzo(a)pyrene	Total OCPs	Total PCBs
LX1	0.1	13.6.00	ND	ND	ND	ND
LX1	0.4	13.6.00	ND	ND	ND	ND
LX2	0.1	13.6.00	ND	ND	ND	ND
LX2	0.4	13.6.00	ND	ND	ND	ND
LX3	0.1	13.6.00	ND	ND	ND	ND
LX3	0.4	13.6.00	ND	ND	ND	ND
LXX	-	13.6.00	ND	ND	ND	ND
Method Detection Limit						
MDL (Amdel)			0.5	0.5	0.1	0.01 / 0.05
Guidelines or Regulatory Requirements						
ANZECC - Environ. Investigation[1]			20	1	0.2 (dieldrin)	1
Health Based Investigation[2]			20	1	10[3]	10

[1] Australian And New Zealand Guidelines For The Assessment And Management of Contaminated Sites (ANZECC, 1992)

[2] NEHF Health Based Soil Investigation Level "Standard Residential"

[3] Based on threshold for Heptachlor - other OCP species' thresholds range between 50 and 200mg/kg

ND denotes concentration below method detection limit

[redacted] Above ANZECC thresholds

[redacted] Above NEHF Threshold

Site Audit Report
Thornton Park, North Penrith

Prepared for:

Department of Defence

Prepared by:
ENVIRON Australia Pty Ltd

Date:
May 2009

Project Number:
AS120017

Audit Number:
GN5

ENVIRON

22 May 2009 Our Ref: AS120017

Department of Defence
Property Disposals
Attn: Duncan Stewart
Defence Plaza
307 Pitt Street
Sydney NSW 2000

Dear Duncan

Re: Site Audit Report - Thornton Park, North Penrith (former North Penrith Army Stores)

I have pleasure in submitting the Site Audit Report for the subject site. The Site Audit Statement, produced in accordance with the NSW Contaminated Land Management Act 1997, follows this letter. The Audit was commissioned by Department of Defence in 1997 as part of an agreement with Penrith Council, however the Audit is not currently required for statutory purposes.

This audit covers the part of Thornton Park east of the access road from Coreen Avenue to the Coreen Avenue Commuter parking area at Penrith Station, but excludes the Defence Multi User Depot. The Defence land to the west of the access road was the subject of a previous site audit report.

Thank you for giving me the opportunity to conduct this Audit. Please call me on 9954 8100 if you have any questions.

Yours faithfully,
ENVIRON Australia Pty Ltd

Graeme Nyland
EPA Accredited Site Auditor 9808

Level 3, 100 Pacific Highway, PO Box 560, North Sydney, NSW 2060
Tel: +61 2 9954 8100 Fax: +61 2 9954 8150
www.environcorp.com

ENVIRON Australia Pty Ltd
ACN 095 437 442
ABN 49 095 437 442

NSW Site Auditor Scheme
SITE AUDIT STATEMENT

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the* Contaminated Land Management Act 1997 *on 21 February 2005. For more information about completing this form, go to Part IV.

PART I: Site audit identification

Site audit statement no. GN –5

This site audit is a **~~statutory audit~~/non-statutory audit*** within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details (as accredited under the *Contaminated Land Management Act 1997*)

Name:	Graeme Nyland	Company:	ENVIRON Australia Pty Ltd
Address:	Level 3, 100 Pacific Highway (PO Box 560)		
	North Sydney NSW	Postcode:	2060
Phone:	02 9954 8100	Fax:	02 9954 8150

Site details

Address: Mountainview Crescent, North Penrith NSW

Postcode: 2750

Property description *(attach a list if several properties are included in the site audit)*

- Lot 1, DP 532379 (northeast, Coreen Avenue)
- Lot 1, DP 33753 ("Thornton Hall" and army cottages)
- Part Lot 1, DP 33754 (body of site)

See Attachment at end of Part I of this Statement.

Local Government Area: Penrith

Area of site (e.g. hectares): 39.4 ha (approximately)

Current zoning: Special Use (Defence)

To the best of my knowledge, the site **~~is~~/is not*** the subject of a declaration, order, agreement or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

Declaration/Order/Agreement/Notice* no(s): N/A

**** Strike out as appropriate***

Site audit commissioned by

Name: Matthew Beggs Company: Commonwealth Department of Defence

Address: Defence Plaza, Pitt Street, Sydney NSW

Postcode: 2001

Phone: 9955 7772 Fax: 9955 7324

Name and phone number of contact person (if different from above)

- Duncan Stewart (Phone: 9377 3660)

Purpose of site audit

☑ A. To determine land use suitability *(please specify intended use[s])*

Commercial/residential mixed uses

~~**OR**~~

~~☐ B(i) To determine the nature and extent of contamination, and/or~~

~~☐ B(ii) To determine the appropriateness of an investigation/remedial action/management plan*, and/or~~

~~☐ B(iii) To determine if the land can be made suitable for a particular use or uses by implementation of a specified remedial action plan/management plan* *(please specify intended use[s])*~~

.....

Information sources for site audit

Consultancy(ies) which conducted the site investigation(s) and/or remediation

- Douglas Partners Pty td;
- CMPS&F Pty Ltd; and
- EGIS Consulting Australia Pty Ltd

Title(s) of report(s) reviewed:

- "Preliminary Contamination Assessment" dated December 1992, by Douglas Partners Pty Ltd (Douglas Partners);
- "Report on Contamination Assessment" dated March 1993, by Douglas Partners;
- "Report on Stage 2 Contamination Assessment" dated December 1993, by Douglas Partners;
- "Geotechnical Study, Contamination Assessment & Remediation Strategy, North Penrith Army Stores Depot. Technical Work Plan" dated November 1997, by CMPS&F Pty Ltd (CMPS&F);

- "Draft – Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 1, Site History, Preliminary Sampling and Work Plan" dated December 1997, by CMPS&F;
- "Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 1, Site History, Preliminary Sampling and Work Plan" dated May 1998, by CMPS&F;
- "Draft North Penrith Army Stores Depot Report on Validation of NPASD – Lot 11" dated May 1998, by CMPS&F;
- "Report on Battery Store Demolition, Separator Pit Excavation & Associated Soil Validation" dated July 1998, by CMPS&F;
- "Report on Underground Storage Tank and Aboveground Storage Tank Decommissioning & Associated Soil Validation Sampling" dated July 1998, by CMPS&F;
- "Draft Remediation Action Plan for North Penrith Army Stores Depot" dated September 1998, by CMPS&F;
- "Draft Contamination Assessment – Phase 2 North Penrith Army Stores Depot, Volume 1" dated December 1998, by Egis Consulting Australia (EGIS) Pty Ltd;
- "Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment, Volume 2 Appendices" dated September 1998, by EGIS;
- "Remedial Action Plan – North Penrith Army Stored Depot" dated September 1998, by EGIS;
- "Draft North Penrith Army Stores Hazardous Materials Audit Report" dated May 1999, by EGIS;
- "Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment – Draft Revision B" dated June 1999, by EGIS;
- "Report on Validation of NPASD – Lot 11" dated July 1999, by EGIS;
- "Technical Specification for Site Remediation North Penrith Army Stores Depot (NPASD)" dated August 1999, by EGIS;
- "Thornton Park, Penrith, Validation Report for ORTA Occupation area" dated April 2000, by EGIS;
- "Environmental Data Summary Report. Contamination Investigations Completed to July 2000" dated August 2000, by EGIS;
- "Draft Remediation and Validation Report, Waste Disposal Areas Thornton Park (former North Penrith Army Stores Depot) North Penrith" dated December 2000, by EGIS;
- "Report on Validation of Former Waste Disposal Areas, Thornton Park (Former North Penrith Army Stores Depot)" dated January 2001, by EGIS;

- "Remediation Action Plan and Technical Specification for Removal of PAH Contaminated Soil" dated October 2001, by EGIS.
- Draft "Report and Validation Report – Waste Disposal Areas, Thornton Park" dated April 2002, by Egis Consulting Australia (EGIS) Pty Ltd;
- Draft "Remediation and Validation Report – Areas Underlain by Ash-bearing Fill" dated October 2002, by EGIS;
- Draft "Data Summary Report – Thornton Park" dated October 2002, by EGIS.
- Final "Report and Validation Report – Waste Disposal Areas, Thornton Park" dated November 2002, by EGIS;
- Final "Remediation and Validation Report – Areas Underlain by Ash-bearing Fill" dated November 2002, by EGIS; and
- Final "Data Summary Report – Thornton Park" dated November 2002, by EGIS.

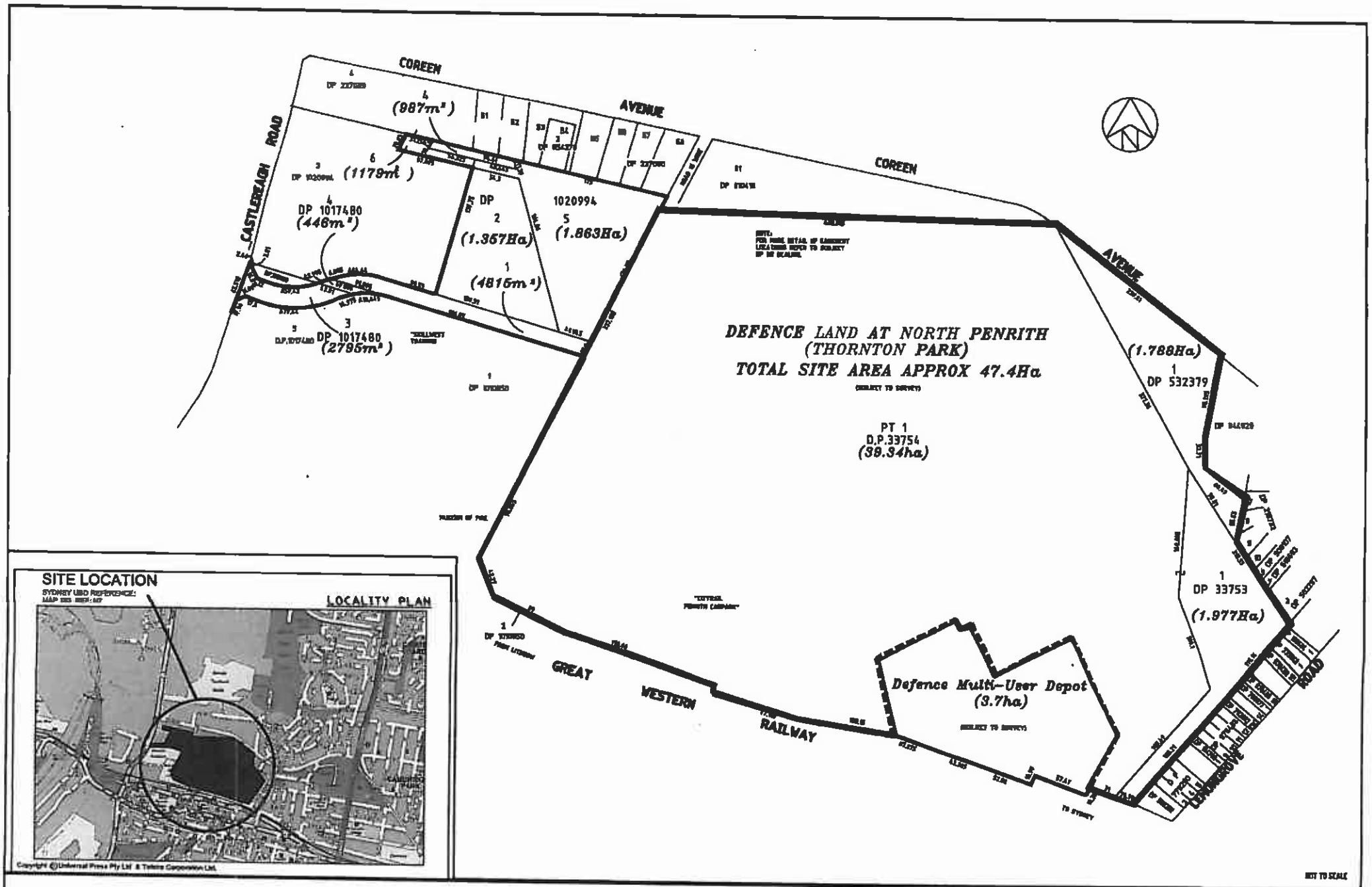
Other information reviewed (including previous site audit reports and statements relating to the site)

- "Summary Site Audit Report, Thornton Park, 'ORTA' Area", 28 April 2000, and SAS GN 5-A dated 12 September 2000, Dames and Moore.
- "Summary Site Audit Report, Thornton Park 'Lot 11'" and SAS GN 5-B dated 5 July 2000 , Dames and Moore.
- "Summary Site Audit, Thornton Park 'ORTA Area' – Post Olympics", 29 November 2000 and GN 5-A-2 dated 30 November 2000, URS Australia Pty Ltd.

Site audit report

Title: Site Audit Report - Thornton Park, North Penrith

Report no. GN 5 (ENVIRON Ref: AS120017) Date: May 2009



DEFENCE LAND AT NORTH PENRITH
(THORNTON PARK) SITE PLAN

burton & field pty limited

PART II: Auditor's findings

Please complete either Section A or Section B, **not** both. *(Strike out the irrelevant section.)*

Use Section A where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land use(s).

Use Section B where the audit is to determine the nature and extent of contamination and/or the appropriateness of an investigation or remedial action or management plan and/or whether the site can be made suitable for a specified land use or uses subject to the successful implementation of a remedial action or management plan.

Section A

☑ **I certify that, in my opinion, the site is SUITABLE for the following use(s)** *(tick all appropriate uses and strike out those not applicable)*:

- ~~☐ Residential, including substantial vegetable garden and poultry~~
- ~~☐ Residential, including substantial vegetable garden, excluding poultry~~
- ☑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☑ Day care centre, preschool, primary school
- ☑ Residential with minimal opportunity for soil access, including units
- ☑ Secondary school
- ☑ Park, recreational open space, playing field
- ☑ Commercial/industrial
- ~~☐ Other *(please specify)* .....~~

~~**subject to compliance with the following environmental management plan** *(insert title, date and author of plan)* **in light of contamination remaining on the site:**~~

.....

.....

.....

~~**OR**~~

~~☐ **I certify that, in my opinion, the site is NOT SUITABLE for any use due to the risk of harm from contamination.**~~

Overall comments

- If groundwater is to be extracted for use in future, further assessment of the water quality is required to verify that the groundwater is suitable for the purposes being considered.
- Flaking paint on Thornton Hall which may contain lead should be considered when the fate of Thornton Hall is determined.
- The stockpile of soil in the northwest should not be used in the surface of residential areas.

Section B

Purpose of the plan[1] which is the subject of the audit .....

.....

I certify that, in my opinion:

- ☐ **the nature and extent of the contamination HAS/HAS NOT* been appropriately determined**

AND/OR

- ☐ **the investigation/remedial action plan/management plan* IS/IS NOT* appropriate for the purpose stated above**

AND/OR

- ☐ **the site CAN BE MADE SUITABLE for the following uses** *(tick all appropriate uses and strike out those not applicable)*:
  - ☐ Residential, including substantial vegetable garden and poultry
  - ☐ Residential, including substantial vegetable garden, excluding poultry
  - ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
  - ☐ Day care centre, preschool, primary school
  - ☐ Residential with minimal opportunity for soil access, including units
  - ☐ Secondary school
  - ☐ Park, recreational open space, playing field
  - ☐ Commercial/industrial
  - ☐ Other *(please specify)* .....

if the site is remediated/managed* in accordance with the following remedial action plan/management plan* *(insert title, date and author of plan)*

.....

.....

.....

.....

subject to compliance with the following condition(s):

.....

.....

.....

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Strike out as appropriate

~~Overall comments~~

.....

.....

.....

.....

.....

.....

PART III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority under the *Contaminated Land Management Act 1997* (Accreditation No. 9808).

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997*, and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed ..... Date 22/5/2009

PART IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remedial action or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use(s) of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A or Section B of Part II, **not** both.

In **Section A** the auditor may conclude that the land is *suitable* for a specified use(s) OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further remediation or investigation of the site was needed to render the site fit for the specified use(s). Any **condition** imposed should be limited to implementation of an environmental management plan to help ensure the site remains safe for the specified use(s). The plan should be legally enforceable: for example a requirement of a notice under the *Contaminated Land Management Act 1997* (CLM Act) or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of the *Environmental Planning and Assessment Act 1979*.

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

In **Section B** the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or whether land can be made suitable for a particular land use or uses upon implementation of a remedial action or management plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

In **Part III** the auditor certifies his/her standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to:

Department of Environment and Conservation (NSW)
Contaminated Sites Section
PO Box A290, SYDNEY SOUTH NSW 1232
Fax: (02) 9995 5930

AND

the **local council** for the land which is the subject of the audit.

Contents

List of Tables and Figures

List of Appendices

List of Abbreviations

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
BaP	Benzo(a)pyrene
BGL	below ground level
BTEX	Benzene, Toluene, Ethylbenzene & Xylenes (Monocyclic aromatic Hydrocarbons)
CT	Certificate of Title
DP	Deposited Plan
DQO	Data Quality Objectives
EPA	Environment Protection Authority (NSW)
ESA	Environmental Site Assessment report
ha	Hectare
km	Kilometres
LOR	Limit of Reporting
m	Metres
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, Se: Selenium
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
m BGL	Metres below ground level
µg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
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
SAS	Site Audit Statement
SAR	Site Audit Report
SILs	Soil Investigation Levels
SVOCs	Semi Volatile Organic Compounds
TPHs	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
VENM	virgin excavated natural material
VOCs	Volatile Organic Compounds
-	On tables is "not calculated", "no criteria" or " not applicable"

1 Introduction

A site contamination audit has been conducted relating to part of a site owned by the Department of Defence (DoD) at North Penrith, known as Thornton Park. Thornton Park was formerly known as the North Penrith Army Stores. The area that is the subject of this audit report is shown on Attachment 1, Appendix A.

Details of the audit are:

Requested by:	Department of Defence
Request/Commencement Date:	November 1997
Auditor:	Graeme Nyland
Accreditation No.:	9808

The audit was conducted ultimately for the purpose of determining whether the land is suitable for a specified use or range of uses, i.e. Section 47(1)(b) (ii)(a) of the Contaminated Land Management Act 1997.

The Audit was commissioned by the DoD to obtain a site audit statement certifying that the site is suitable for residential use, as part of an agreement with Penrith Council.

The scope of the audit included the following:

- Review of the reports listed below:
  - "Preliminary Contamination Assessment" dated December 1992, by Douglas Partners Pty Ltd (Douglas Partners).
  - "Report on Contamination Assessment" dated March 1993, by Douglas Partners.
  - "Report on Stage 2 Contamination Assessment" dated December 1993, by Douglas Partners.
  - "Geotechnical Study, Contamination Assessment & Remediation Strategy, North Penrith Army Stores Depot. Technical Work Plan" dated November 1997, by CMPS&F Pty Ltd (CMPS&F).
  - "Draft – Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 1, Site History, Preliminary Sampling and Work Plan" dated December 1997, by CMPS&F.
  - "Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 1, Site History, Preliminary Sampling and Work Plan" dated May 1998, by CMPS&F.
  - "Draft North Penrith Army Stores Depot Report on Validation of NPASD – Lot 11" dated May 1998, by CMPS&F.

- "Report on Battery Store Demolition, Separator Pit Excavation & Associated Soil Validation" dated July 1998, by CMPS&F.
- "Report on Underground Storage Tank and Aboveground Storage Tank Decommissioning & Associated Soil Validation Sampling" dated July 1998, by CMPS&F.
- "Draft Remediation Action Plan for North Penrith Army Stores Depot" dated September 1998, by CMPS&F.
- "Draft Contamination Assessment – Phase 2 North Penrith Army Stores Depot, Volume 1" dated December 1998, by Egis Consulting Australia (Egis) Pty Ltd.
- "Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment, Volume 2 Appendices" dated September 1998, by Egis.
- "Remedial Action Plan – North Penrith Army Stored Depot" dated September 1998, by Egis.
- "Draft North Penrith Army Stores Hazardous Materials Audit Report" dated May 1999, by Egis.
- "Geotechnical Study, Contamination Assessment & Remediation Strategy – Phase 2 Contamination Assessment – Draft Revision B" dated June 1999, by Egis.
- "Report on Validation of NPASD – Lot 11" dated July 1999, by Egis.
- "Technical Specification for Site Remediation North Penrith Army Stores Depot (NPASD)" dated August 1999, by Egis.
- "Thornton Park, Penrith, Validation Report for ORTA Occupation area" dated April 2000, by Egis.
- "Environmental Data Summary Report. Contamination Investigations Completed to July 2000" dated August 2000, by Egis.
- "Draft Remediation and Validation Report, Waste Disposal Areas Thornton Park (former North Penrith Army Stores Depot) North Penrith" dated December 2000, by Egis.
- "Report on Validation of Former Waste Disposal Areas, Thornton Park (Former North Penrith Army Stores Depot)" dated January 2001, by Egis.
- "Remediation Action Plan and Technical Specification for Removal of PAH Contaminated Soil" dated October 2001, by Egis.
- Draft "Report and Validation Report – Waste Disposal Areas, Thornton Park" dated April 2002, by Egis.
- Draft "Remediation and Validation Report – Areas Underlain by Ash-bearing Fill" dated October 2002, by Egis.

  - Draft “Data Summary Report – Thornton Park” dated October 2002, by EGIS.
  - Final “Report and Validation Report – Waste Disposal Areas, Thornton Park” dated November 2002, by Egis.
  - Final “Remediation and Validation Report – Areas Underlain by Ash-bearing Fill” dated November 2002, by Egis.
  - Final “Data Summary Report – Thornton Park” dated November 2002, by Egis.
- Review of sampling and analysis plans for various stages of investigation.
- Numerous site visits by the Auditor over the course of the investigations and remediation up until the end of 2002, when a draft audit report was prepared. Subsequent site visits were undertaken on 27 July 2007 and 19 March 2009.
- Numerous discussions with CMPS&F (who became Egis) who conducted the contamination assessment and remediation, Defence and their project managers, and review of clarifying information provided by facsimile or email.

2 Background

The site was used for Army Stores since 1942. Since the 1990s it has had minor uses, mainly by the army reserves, while site facilities have been progressively demolished, concurrently with staged investigations and remediation. The site layout prior to commencement of the investigations and demolitions is shown on Attachment 2, Appendix A. Most of the area shown as the Combat Engineer's Reserve Compound is now part of the Defence Multi User Depot and is not included in this audit.

A number of investigations were conducted at the site in 1992–1993 by Douglas Partners. That work was reviewed by the current Auditor's (then) company at the time, and was reviewed by CMPS&F and the Auditor at the commencement of the CMPS&F investigations in 1997. The results of those earlier investigations have not been relied upon by CMPS&F/Egis and therefore have been used for background information only.

The site was divided into environmental Domains, based on general usage and history at that time, for convenience in assessment. The Domains, shown on Attachment 3, Appendix A, have no other significance.

The western portion of Thornton Park, a 7.6ha area known as "Lot 11" and shown as Domain L on Attachment 3, has been the subject of a separate Summary Site Audit Report and Site Audit Statement GN5B, dated 5 July 2000. As such, the scope of this Audit excludes the assessment of Lot 11.

Prior to the Sydney Olympics in 2000, part of the site was leased to the Olympic co-ordinating authority for use as a car park. The Auditor prepared a Summary Site Audit Report (SSAR) ("Summary Site Audit Report Thornton Park ORTA Area" dated April 2000) in order to allow for the site to be leased for car park purposes during the Olympic Games period in 2000. Post Olympic Games, another SSAR was prepared ("Summary Site Audit Report Thornton Park ORTA Area – Post Olympics" dated November 2000). The Site Audit Statements (SASs) had conditions for remediation and validation which are addressed under the current site audit.

It should be noted that CMPS&F changed its name to Egis Consulting Australia Pty Ltd (Egis) in 1998.

3 Site Details

3.1 Location

The land owned by DoD is located within the area between Castlereagh Road, Coreen Avenue, Mountain View Crescent and the Western Railway Line. The portion of the site subject to this Audit is shown on Attachment 1, Appendix A.

Further site details are as follows:

Street address:	Mountainview Crescent, North Penrith NSW 2750
Identifier:	DoD's holdings within the site subject to this audit includes the following allotments: Lot 1, DP 532379 (northeast, Coreen Avenue); Lot 1, DP 33753 ("Thornton Hall" and former army cottages); Part Lot 1, DP 33754 (body of site).
Local Government:	Penrith
Owner:	Commonwealth Department of Defence
Site Area:	A total of approximately 39.4 ha

3.2 Zoning

It is understood that the site is currently zoned as "Special Use (Defence)" under the Penrith City Council Local Environmental Plan. The Auditor has not viewed any zoning documentation. Rezoning is envisaged to allow for sensitive land uses, including residential uses.

3.3 Adjacent Uses

The area surrounding Thornton Park is mixed commercial and residential to the north, including a fuel depot, and residential to the east. Penrith Railway Station adjoins the site on the southern side. The Museum of Fire is on the northern side.

3.4 Site Condition

The site layout, showing the location of former buildings, is shown on Attachment 2, Appendix A.

Domain K has an unoccupied heritage residential dwelling (Thornton Hall), and Domain F is currently bitumen sealed and is used as a car parking facility for the nearby Penrith Railway Station.

There is a large stockpile of broken concrete in Domain H north of the rail siding, and a large grassed stockpile of soil in Domain B that was transferred from Lot 11 (see Section 9).

The rest of the site is vacant and not used for any authorised purposes.

Access to the site is via Mountainview Crescent, with a chain wire fence enclosing the perimeter of the site. The Thornton Park site is a generally open grassed field, bisected by a number of bitumen sealed access roads. A number of buildings (ranging from small brick toilet blocks up to large steel framed warehouses) were formerly located at the site, however these were demolished to floor slab level prior to conducting remediation excavations and validation works. A number of concrete floor slabs remain.

Surface run off flows into a series of open unlined drains which traverse the site. These drains eventually discharge to two large diameter concrete stormwater pipes located at the northwestern corner of the site. These pipes discharge to the local stormwater system at Coreen Avenue.

3.5 Proposed Development

Long-term development plans have not been finalised. Use of the site for mixed land uses, including residential and commercial, is envisaged.

4 Site History

The Consultant has documented the history of Thornton Park from sources including review of historical aerial photographs, interviews with currents and former Defence personnel, liaison with various historical societies and groups, review of historical plans, and review of land title information.

Historical activities are summarised below in Table 4.1.

Table 4.1 – Site History

Year	Uses
Pre 1938	Site known as "Smith's Paddock"; Site uses are unknown, however it was reportedly used as a dairy farm prior to 1910; The site may have been used as a speedway, which was reportedly developed at the site in 1925.
1938 to 1980s	The Commonwealth Department of Defence acquired the site and used it for army stores; First army stores were built in 1942, construction materials largely unknown. However, it is reported that these were likely to be a mixture of fibro, corrugated iron/steel, and brick; Stores included large quantities of machinery, bridging materials, refrigeration stores and other equipment. Most were stored and serviced on site during and at the end of World War II – and the Vietnam War; Burial of waste occurred along the northern portions of the site since 1950s-1960s; Drums buried at the site are reported to have contained tar and bitumen; Engineering supplies have been dumped in stockpiles in one area located in the central portion of the site. This dumping appears to have occurred in the late 1980's.
1990s to present	Site activities ceased except for minor use by army reserves and demolition occurred progressively.

The Consultant's reports list the general operations conducted in each building on the site. They included workshops, general stores and warehouses.

The Auditor considers that the site history review is sufficient to be confident that major contaminating activities at the site have been identified. The area of waste disposal has been remediated (see Section 9).

5 Contaminants of Concern

Based on the reports reviewed, site history and site condition, the potential contaminants of concern are considered to be as shown below in Table 5.1.

Table 5.1 – Contaminants of concern

Area	Activity	Contaminants of concern
Whole site, particularly Domains A, C, E and H, as well as a former dam in Domain M	Filling to level and for building pads	Unknown, could include PAHs and heavy metals
Whole site, particularly Domains A, B, C, D and E	Disposal of wastes by burial or stockpiling	Unknown, could include PAHs, metals, hydrocarbons
Whole site, particularly former buildings and fence-lines in Domain K	Spraying for weed/pest control	OCPs/OPPs and heavy metals, especially arsenic
Near buildings including former residential buildings in Domain K	Degradation of building materials, pesticides spaying	Heavy metals (especially lead, zinc arsenic), asbestos and OCPs
Part of Domain H	Leaks/spills from AST/UST	Petroleum hydrocarbons

The Auditor considers that the analyte list used by the Consultant is appropriate for the site.

6 Stratigraphy And Hydrogeology

6.1 Stratigraphy

The eastern portion of the site is underlain by Bringelly Shale, which forms a part of the Wianamatta Geological Group. The central and western (lower lying) areas of the site are underlain by the Cranebrook Formation, which comprises alluvial deposits of the Nepean River. These deposits consist of coarse gravels, overlain by fine-grained sands, silts and clays.

A generalised lithological profile encountered over most of the site, is given below in Table 6.1

Table 6.1 – Generalised Site Stratigraphy

Depth (m BGL)	Lithology
0.0 to 0.2	Silty-Clayey SAND (grey/brown surficial soils, fine grained)
0.2 to 4.0-8.0	Silty CLAY (stiff, grey/red/brown)
4.0-8.0+	Alluvial COBBLES and GRAVEL

6.2 Hydrogeology

Investigations undertaken by Egis have indicated that groundwater over the central and western portion of the site is found at depths of approximately 5 metres below ground level (m BGL). Flow direction is in a generally north-westerly direction, towards the Nepean River. The Consultant identified 5 registered bores within 1.5km radius of the site. Groundwater within the alluvial sediments was described as being “suitable for stock, domestic and some irrigation purposes (i.e. salinity < 1000mg/L)”. Groundwater within the Bringelly Shales over the eastern portion of the site, is present at depths of greater than 9 m BGL, and is described as “unsuitable for stock use (i.e. salinity > 14,000mg/L)”.

7 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 in Tables 7.1 and 7.2. These tables provide a general summary. Each of the numerous investigation and validation reports conducted between 1997 and 2002 contained QA/QC information that was progressively reviewed by the Auditor.

Table 7.1 – QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor Comments
Sampling Patterns	Investigations were mainly targeted based on site history and geophysical surveys, with additional grid samples for coverage. Validation sampling patterns were in line with those specified in the RAPs, and mainly consisted of grid sampling.
Sampling Density	Site divided into environmental Domains (A-M) based on site features and history, with varying sampling densities in each domain. Sampling density was generally greater than EPA Sampling Design Guidelines minimum requirements.
Sample depths	Samples were generally collected from several depths, including surface fill materials, and natural materials, especially from soils exhibiting visual contamination and representative layers.
Sample collection	A variety of methods have been implemented at the site over a number of investigations. The majority of investigations utilised a backhoe. Validation samples were taken from the walls and base with a trowel.
Chain of Custody	Chain-of-custody forms were provided.
Detailed description of sampling methods (including handling procedures, preservation methods, sampling containers)	Details generally provided, indicating samples were placed into appropriately prepared and preserved sampling bottles provided by the laboratory and chilled during transport to the labs.
Detailed description of field screening protocols	PID was generally not used for field screening, even at UST pits. Geophysics (magnetometer and ground penetrating radar (GPR)) was used in some areas. Excavation of ash-bearing fill and soils from waste disposal areas were visually screened and inspected.
Decontamination procedures	All sampling equipment was reportedly decontaminated between samples.
Samples submitted for analysis	Included within the results tables.
Sampling Logs (indicating sample depth)	Provided for all reports indicating sample depth and lithology, adequate details provided.
Field QA/QC undertaken:	Most reports included QA/QC sections, including duplicates, chain of custody forms, soil descriptions, and

Table 7.1 – QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor Comments**
	decontamination procedures. Duplicates generally analysed at 10%, later investigations also included secondary laboratory duplicates. The vast majority of duplicates had RPD values within acceptable ranges.

Table 7.2 – QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Laboratory QA/QC	**Auditor Comments**
Data Quality Objectives (DQOs)	DQOs were generally not specifically addressed prior to investigation, however data quality obtained was addressed.
NATA registered laboratory and NATA endorsed methods	All laboratory certificates were NATA stamped. A variety of laboratories were used, mainly AMDEL for later investigations and validation.
Practical Quantitation Limits (PQLs)	PQLs for some of the heavy metals in groundwater were greater than the threshold criteria.
Analytical methods and holding times	The laboratories provided analytical methods, and samples were analysed within the holding times.
Laboratory QA/QC undertaken:	Laboratory QA/QC varied across the number of investigations undertaken, but generally included blanks, duplicates, surrogate spikes and analytical methods. The laboratory used for the majority of the analytical testing, AMDEL, provided detailed records of their QA/QC. The vast majority of results from all laboratories were within laboratory control limits.

In considering the data as a whole the Auditor concludes that the data is likely to be reliable and useable for the purpose of this audit. Minor departures from desirable QA/QC standards are not significant within the large volume of data obtained.

8 Environmental Quality Criteria

The Auditor has assessed the data provided by the Consultant by reference to the Soil Investigation Levels (SILs) for Urban Redevelopment Sites in NSW, the relevant guidelines being SIL 1 – "Residential with gardens and accessible soils" and SIL 5 - "provisional phytotoxicity-based investigation levels" referenced in the DEC (2006) "Guidelines for the NSW Site Auditor Scheme". For the assessment of petroleum hydrocarbons, the EPA (1994) "Guidelines for assessing service stations sites" (human health-based threshold values) was referred to.

For the assessment of groundwater, the ANZECC (2000) "Australian and New Zealand Guidelines for Fresh and Marine Water Quality" was referred to. The Auditor has assessed the data provided by the Consultant by reference to the ANZECC (2000) guidelines as applicable to freshwater, using the 95% protection-level trigger values (TVs). The current assessment criteria for individual substances in soil and groundwater are reproduced in Appendix B. Table 8.1 below illustrates the TVs for the individual PAH compounds applicable for this assessment.

Table 8.1 – ANZECC 2000 trigger values for individual PAHs components (µg/L)

PAH Component	TVs for freshwater (µg/L)	Guideline source
Naphthalene	16	ANZECC (2000) 99% protection level due to potential for bioaccumulation or acute toxicity to particular species
Anthracene	0.01	Low reliability trigger values from Volume 2 of ANZECC (2000) ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species
Phenanthrene	2	
Fluoroanthene	1	
Benzo(a)pyrene	0.1	

There are currently no EPA endorsed guidelines for the assessment of asbestos in soil. However, the current DECC stance is that there should be no asbestos in surface soils. Waste disposal area remediation was conducted in 2000-2001 (see Section 9.4.2). Prior to the remediation, the Auditor consulted with EPA and Environmental Health regarding asbestos remediation criteria. As asbestos was only detected bound within fibro sheet, the following criteria were adopted as a practical measure to achieve the objective of having no asbestos in surface soils, currently and in the future:

- Total asbestos content to be less than 0.001%;
- Microscopic fibres not to be detected in more than 5% of soil samples with no apparent bound asbestos; and

- Soils that achieve that criteria to be placed in excavations at a depth greater than 0.5 m from ground surface as an additional risk management strategy.

9 Evaluation Of Soil Analytical Results

The following sections discuss the soil analytical results. Where remediation was conducted, the results refer to validation results following remediation. The general locations of the contamination issues are shown on Attachment 4.

9.1 Unremediated areas

The following sub-sections discuss the sampling carried out in unremediated areas referring to the environmental Domains.

9.1.1 Domains A, B, C, D and E

Domains A to E cover the northern portion of the site. A total of 122 investigation samples were taken. Table 9.1 summarises these results (in mg/kg), combining surface and subsurface samples.

Table 9.1 – Unremediated areas, Domains A, B, C, D and E (mg/kg)

Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Arsenic	122	33	26	0	1	-
Cadmium	106	3	1.2	0	0	-
Chromium	106	103	110	0	0	-
Copper	105	99	59	0	0	-
Lead	122	121	120	0	0	-
Cobalt	106	70	65	0	0	-
Nickel	106	95	32	0	0	-
Zinc	106	105	178	0	0	-
TPH C6-C9	35	0	0	-	-	0
TPH C10-C36	35	2	210	-	-	0
Benzene	35	0	-	-	-	0
Ethyl benzene	35	0	-	-	-	0
Toluene	35	0	-	-	-	0
Xylenes	35	0	-	-	-	0
Phenols	35	23	13	0	-	-
PAHs	46	3	3	0	-	-
B(a)P	46	2	0.3	0	-	-
OCPs	40	0	-	0	-	-
OPPs	22	0	-	0	-	-

Table 9.1 – Unremediated areas, Domains A, B, C, D and E (mg/kg)						
Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Total herbicides	25	0	-	0	-	-
PCBs	35	0	-	0	-	-
VHCs	4	0	-	0	-	-

n = number of analyses, excluding duplicates

\- = not applicable

In terms of the contaminants of concern, the unremediated area within Domains A to E had no detections above the assessment criteria except for a detection above SIL 5 criteria for arsenic (26mg/kg), however this is only a marginal exceedence of the assessment threshold value (20 mg/kg). It is therefore considered that the unremediated area within Domains A to E have been adequately validated against the contaminants of concern, and that no further assessment or remediation is necessary.

9.1.2 Domain F – Railway Car Park

The Consultant described Domain F as having a low potential for widespread contamination. A total of 29 samples make up the validation data. Table 9.2 summarises the validation results, combining surface and subsurface samples:

Table 9.2 – Unremediated areas, Domains F (mg/kg)						
Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Arsenic	29	9	22	0	3	-
Cadmium	20	0	0	0	0	-
Chromium	29	28	85	0	0	-
Copper	20	18	55	0	0	-
Lead	20	20	52	0	0	-
Cobalt	20	10	28	0	0	-
Nickel	20	15	25	0	0	-
Zinc	20	20	109	0	0	-
TPH C6-C9	5	0	0	-	-	0
TPH C10-C36	5	1	162	-	-	0
Benzene	5	0	0	-	-	0
Ethyl benzene	5	0	0	-	-	0
Toluene	5	0	0	-	-	0
Xylenes	5	0	0	-	-	0

Table 9.2 – Unremediated areas, Domains F (mg/kg)

Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Phenols	5	4	0.9	0	0	-
PAHs	5	0	0	0	-	-
B(a)P	5	0	0	0	-	-
OCPs	5	0	0	0	-	-
OPPs	5	0	0	0	-	-
Total herbicides	5	0	0	0	-	-
PCBs	5	0	0	0		-

n = number of analyses, excluding duplicates
- = not applicable

In terms of the contaminants of concern, the area within Domain F had no detections above the assessment criteria, except for three samples detected above SIL 5 for Arsenic (21-22 mg/kg). These are only marginal exceedances in a few samples from both the surface and deeper in natural material and likely to be natural concentrations and unlikely to have any detrimental effect on plant growth from these exceedances.

It is therefore considered that Domain F has been successfully validated for the contaminants of concern.

9.1.3 Domain G – Central site area

The Consultant described Domain G as having a low potential for widespread contamination, given its previous land use as a sporting oval. A total of 41 samples make up the validation data, with a sampling depth generally from 0.0 - 0.2 m BGL to a maximum of 0.5 m BGL. Table 9.3 summarises these validation results.

Table 9.3 – Unremediated areas, Domains G (mg/kg)

Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Arsenic	41	12	31	0	1	-
Cadmium	41	2	0.9	0	0	-
Chromium	41	38	61	0	0	-
Copper	41	38	81	0	0	-
Lead	41	39	68	0	0	-
Cobalt	32	27	27	0	0	-
Nickel	41	40	56	0	0	-

Table 9.3 – Unremediated areas, Domains G (mg/kg)

Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Zinc	41	40	1,301	0	4	-
TPH C6-C9	12	0	-	-	-	0
TPH C10-C36	12	0	-	-	-	0
Benzene	12	0	-	-	-	0
Ethyl benzene	12	0	-	-	-	0
Toluene	12	0	-	-	-	0
Xylenes	12	0	-	-	-	0
Phenols	12	4	1.5	0	-	-
PAHs	22	4	3	0	-	-
B(a)P	22	3	0.3	0	-	-
OCPs	12	0	0	0	-	-
OPPs	12	0	0	0	-	-
Total herbicides	12	0	0	0	-	-
PCBs	12	0	0	0	-	-

n = number of analyses, excluding duplicates
- = not applicable

In terms of the contaminants of concern, the area within Domain G had no detections above the assessment criteria, except for five samples detected above SIL 5 for Arsenic (31 mg/kg) and Zinc (205–1,301 mg/kg). The elevated results were near a small former stores building. All elevated zinc results were in surface soils, indicating leaching from building materials or machinery. The Auditor does not consider that it is likely that there will be any detrimental effect on plant growth from these exceedances because of the small number of marginal exceedances in a localised area.

It is therefore considered that Domain G has been adequately validated for the contaminants of concern.

9.1.4 Domain K – Former housing area

The Consultant described Domain K as having a low potential for widespread contamination, given its previous land use for residential purposes. A total of 23 samples were taken for validation, with a sampling depth ranging generally from 0.0 to 0.1 m BGL to a maximum depth of 0.5 m BGL. Most samples were surface soils, consistent with the contaminants of concern. Table 9.4 summarises the validation results.

Table 9.4 – Unremediated areas, Domain K (mg/kg)

Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Arsenic	23	14	77	0	4	-
Cadmium	23	2	0.6	0	0	-
Chromium	23	22	22	0	0	-
Copper	23	22	45	0	0	-
Lead	38	37	890	1	1	-
Cobalt	13	8	27	0	0	-
Nickel	23	13	22	0	0	-
Zinc	23	22	400	0	4	-
TPH C6-C9	8	0	0	-	-	0
TPH C10-C36	8	2	100	-	-	0
Benzene	3	0	0	-	-	0
Ethyl benzene	3	0	0	-	-	0
Toluene	3	0	0	-	-	0
Xylenes	3	0	0	-	-	0
Phenols	3	1	2.2	0	-	-
PAHs	3	0	0	0	-	-
B(a)P	3	0	0	0	-	-
OCPs (total)	3	0	0	0	-	-
OPPs (total)	3	0	0	0	-	-
Total herbicides	3	0	0	0	-	-
PCBs (total)	3	0	0	0	-	-
Asbestos	25	NAD		-	-	-

n = number of analyses, excluding duplicates
\- = No criteria available/used
NAD = No asbestos detected

In terms of the contaminants of concern, the area within Domain K had one sample with a concentration of lead above the assessment criteria (sample K16, 890 mg/kg). The Consultant relates this lead 'hot spot' as possibly associated with flaking lead-based paint from buildings previously located in the vicinity. Neighbouring validation samples, K17, K18 (both approximately 20m away from K16 and K19 (approximately 6m away) reported lead concentrations which were well below the SIL 1 assessment criteria. The Auditor notes that

K16 is in the vicinity of Thornton Hall, a heritage listed building that remains. Flaking paint was noted on a site visit in March 2009. The Auditor considers that possible lead contamination associated with Thornton Hall should be managed when the future of Thornton Hall is decided. The building is in a fenced and locked yard.

The Auditor considers that localised lead contamination is possible around former buildings, but the limited lateral and vertical extent and relatively low concentrations do not warrant further assessment.

Four surface samples had concentrations above SIL 5 criteria for arsenic and zinc, three of which were the same sample. The Auditor does not consider that there is likely to be any detrimental effect on plant growth from these exceedances because the detections were isolated and only marginally above the criteria.

Twenty-five near surface samples were taken from the surrounds of all buildings and Thornton Hall at Domain K, and no asbestos was reportedly detected in any of the post-demolition samples.

It is therefore considered that the area within Domain K has been adequately validated for the contaminants of concern, subject to consideration of flaking paint which may contain lead on Thornton Hall.

9.1.5 Domain M – North-eastern area

A total of 18 samples were taken for validation, with a sampling depth ranging generally from 0.0 - 0.5 m BGL. Most of the samples were of fill which had been placed in a former dam excavation, which had been identified from aerial photographs. Table 9.5 summarises the validation results.

Table 9.5 – Unremediated areas, Domains M (mg/kg)

Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Arsenic	18	14	10	0	0	-
Cadmium	18	0	0	0	0	-
Chromium	18	18	0	0	0	-
Copper	18	18	41	0	0	-
Lead	18	18	156	0	0	-
Cobalt	18	18	27	0	0	-
Nickel	18	18	22	0	0	-
Zinc	18	18	238	0	1	-
TPH C6-C9	4	0	-	-	-	0
TPH C10-C36	4	0	-	-	-	0
Benzene	4	0	-	-	-	0

Table 9.5 – Unremediated areas, Domains M (mg/kg)						
Analyte	n	Detections	Maximum	n > SIL 1	n > SIL 5	n > NSW EPA 1994
Ethyl benzene	4	0	-	-	-	0
Toluene	4	0	-	-	-	0
Xylenes	4	0	-	-	-	0
Phenols	4	2	9	0	-	-
PAHs (total)	4	0	-	0	-	-
B(a)P	4	0	-	0	-	-
OCPs (total)	4	0	-	0	-	-
OPPs (total)	4	0	-	0	-	-
Total herbicides	4	0	-	-	-	-
PCBs (total)	4	0	-	0	-	-
Semi volatiles (other)	4	0		-	-	-

n = number of analyses, excluding duplicates
- = not applicable

In terms of the contaminants of concern, the area within Domain M had no detections above the assessment criteria, except for one sample above SIL 5 for zinc (238 mg/kg), which was only marginally above the assessment criteria (of 200 mg/kg).

It is therefore considered that the area within Domain M has been successfully validated for the contaminants of concern.

9.2 Excavated remediation areas

9.2.1 Areas underlain by ash-bearing fill

Ash-bearing fill requiring remediation included areas within environmental Domain H (Area 1), and parts of Domain A, B (Area 2) and Domain C (Area 3). The general locations are shown on Attachment 4. Area 1 was an area of shallow fill which included ashy layers of high PAH concentrations covering approximately 1 ha. Area 2 was a small area which had an isolated detection of high PAHs. Area 3 was remediated because ashy fill used as a bedding layer for building slabs for Buildings 62-66 and 68-69 (Attachment 2) contained high PAH concentrations.

Different types of ashy material had been found within fill on the site, and analytical testing found a good correlation between high PAH content and a layer of orange sandy clay fill with ash, charcoal and black gravels.

The remediation works included excavation of the impacted fill and validation of the excavated pits for PAHs. Sampling was undertaken generally between 0.0 – 0.5 m BGL, as

the impacted materials were generally shallow. A summary of the pit excavation validation results is presented in Table 9.6.

Table 9.6 – Pit excavation validation, ash bearing fill areas (mg/kg)

Remediation Area	Analyte	n	Detections	Maximum	n > SIL 1
Area 1	PAHs	29	1	1.2	0
	B(a)P	29	0	0	0
Area 2	PAHs	3	0	0	0
	B(a)P	3	0	0	0
Area 3	PAHs	49	3	17	0
	B(a)P	49	2	1.4	1

n = number of analyses

The analytical results confirm that samples taken from the base and walls of the excavations are below the assessment criteria, except for one benzo(a)pyrene base sample in remediation Area 3 (1.4mg/kg), however this is only marginally above the assessment criteria.

In light of the validation results presented, the Auditor considers the excavation pits to have been adequately remediated for PAHs.

The extent of remediation was validated by test pits on a regular grid of 8.5m around the excavation area and over most of Domain H. Soils were classified visually – no evidence of the layer with high PAH contents was found. To verify the visual classification, 30 samples of three different types of ashy material were analysed. PAHs were detected in five, with a maximum concentration of 8.4 mg/kg and 1 mg/kg B(a)P. It is concluded that the extent of remediation required has been adequately verified.

9.2.2 Waste disposal areas

During investigations in the undeveloped north-western area of the site, waste disposal trenches which had been backfilled to the surface were located. These contained mixed items including machinery parts, building demolition materials, and drums containing bituminous material.

The areas previously impacted by waste disposal at the site, designated by the Consultant as Areas A, B, C, and D, included areas within environmental Domains B, C and E. A site plan illustrating the excavation and stockpiled soils locations is reproduced in Attachment 5, Appendix A.

Excavated wastes were segregated on visual inspection into general categories, namely: ‘clean soils’, screenable soils’, ‘asbestos soils’, ‘bituminous soils’, ‘drums’, and ‘scrap’. Excavations were extended until natural soils were encountered. Screenable soils were later validated for re-use at the site for reinstatement of the excavations. All other material was

classified for off-site disposal. Table 9.7 summarises the validation sampling undertaken at the excavations.

Table 9.7 – Summary - pit excavation validation, waste disposal areas (mg/kg)

Excavation Area	Number of pits	Maximum Depth (m BGL)	Total Volume (m^3)	n	Analytes	Detections
Area A	1	1.2	490	8	Heavy metals, TPH/BTEX, PAHs, B(a)P, OCPs, PCBs	No detections above assessment criteria
Area B	6	6.0	10,485	161	Heavy metals, TPH/BTEX, PAHs, B(a)P, OCPs, PCBs	3 copper samples > SIL5 Low-level TPH C10-C36, PAHs and phenols
Area C	1	3.9	3,630	44	Heavy metals, TPH/BTEX, PAHs, B(a)P, OCPs, PCBs	No detections above assessment criteria
Area D	1	1.4	490	14	Heavy metals, TPH, and BTEX	No detections above assessment criteria

n = number of total validation samples taken

Given that the detections above SIL 5 in Area A were only marginally above the assessment criteria and given that the low-level TPH, PAHs and phenols were well below EPA (1994) and SIL 1 criteria, the excavation pits are therefore considered to be adequately validated for the contaminants of concern.

Magnetometer surveys were conducted in the surrounds to confirm that no additional buried wastes were present within or adjacent to the remediated areas, with no results warranting additional excavations and remediation. Also a total of 33 test pits were excavated in the surrounds of excavation pits at Area D to confirm that PAHs impacts do not extend beyond the excavated areas. Logs were provided. Samples were collected at depths intervals of 0-0.2 m BGL, 0.3-0.5 m BGL, and 0.8-1.0 m BGL, and analysed for heavy metals, TPH, PAHs and phenols.

All results were below the assessment criteria, except tin these instances:

- Three chromium surface samples and a near-surface copper sample were detected above SIL 5 criteria; and
- Two lead samples (0.0-0.3 m BGL) were detected at above SIL 1 criteria of 300 mg/kg (320 and 440 mg/kg).

The Consultant carried out 95%UCL calculations for copper and lead samples in near surface samples (<0.2 m BGL deep) in Area D. The average 95% UCL for copper was 59.3

mg/kg and for lead 89.2 mg/kg, which are both well below the SIL 1 and SIL 5 assessment criteria.

PAHs were detected in some near-surface samples along the north-western corner of Area D. The detections prompted a 'topsoil scrape' , with approximately 4 m3 of soils reported to have been excavated and stockpiled for off-site disposal. The scrapped area was then re-validated, with 10 validation samples taken from the surface which reported concentrations less than the SIL 1 criteria (one detection only at 10.8 mg/kg total PAHs).

The Area D excavation pit and unremediated area is considered by the Auditor to be adequately validated for the contaminants of concern.

9.2.3 Battery store and separator pit removal and validation

A battery store and an underground concrete separator pit were formerly located within Domain E, near Buildings 76 (see Attachment 2).

The battery store was removed in 1978, and no elevated heavy metals were detected in validation samples from adjacent to the store. The separator pit was excavated and the walls and floor inspected and validated. Some acidic pH results were obtained (minimum pH value of 4.3). Review of a large number of results for Thornton Park indicates a wide range of similar pH results which appear to be unrelated to any contamination. The Consultant noted that low pH would need to be considered in design of footings.

The excavation was backfilled with validated crushed shale.

9.2.4 UST and AST removal and validation

A 5,000 L UST and 15,000 L AST were located within the former transport compound area, which included Buildings 26-28 (Attachment 2). The tanks and fuel lines were removed in 1998. Backfill sand was odorous and was stockpiled on site prior to validation. The walls and floor of the UST excavation and fuel line trench were validated, and a low concentration of residual TPH was detected in only one sample. In the Auditor's opinion, the validation was conducted in accordance with EPA guidelines.

9.3 Imported Soils

Imported fill was sourced from a number of locations and for the backfilling and surface levelling of excavation pits at the site. Table 9.8 details the source and volumes of material brought in, as well as the analyte list for validation prior to re-instatement.

Table 9.8 – Imported fill details

Contractor	Soil type (source location)	Volume (m^3)	Analytes
Wards	Crushed virgin shale (Parramatta)	1,300	Heavy metals, TPH/BTEX, OCPs, PCBs
Thiess	Silty Clay (Glendenning)	1,380	Heavy metals, TPH/BTEX, OCPs, PCBs

Table 9.8 – Imported fill details			
Contractor	**Soil type (source location)**	**Volume (m^3)**	**Analytes**
	Silty Clay (North Penrith)	2,480	Heavy metals, TPH/BTEX, OCPs, PCBs, PAHs, phenols
	Clay (Huntingwood)	2,490	Heavy metals, TPH/BTEX, OCPs, PCBs
	Clayey Sand (Kemps Creek Landfill)	0	Validation results included in Consultant's report but source not used.

Validation samples were generally collected at a rate of approximately 1 in 100 m3, and analytical results were reproduced in the validation reports.

All heavy metals concentrations were below the assessment criteria, except for two samples above the SIL 5 criteria. Table 9.9 tabulates the analytical results above the SIL 5 for heavy metals, as well as detections for the other analytes.

Table 9.9 – Summary of analytical results – imported fill (mg/kg)						
Analyte	**Detections**	**Material source**	**Maximum mg/kg**	**n > SIL 1**	**n > SIL 5**	**n > NSW EPA 1994**
Zinc	1	Clay (Huntingwood)	460	0	1	-
OCPs	1	Clay (Huntingwood)	0.1	0	-	-

The Consultant provided 95%UCL calculations for zinc in imported fill sourced form Huntingwood. The results confirmed that 95%UCLs on the mean metal concentrations were below the assessment criteria. All other detections were below the assessment criteria. The detection of zinc at 760 mg/kg (rest of samples, mean 66 mg/kg, standard deviation 7mg/L) and OCPs at 0.1 mg/kg (the PQL) in separate samples indicate some contaminant impact. However, none of the other 29 samples had elevated zinc or detections of OCPs. The imported fill is considered to be adequately validated for use at the site.

9.4 Reused Soils

9.4.1 Ash Bearing Fill Areas

The layer of ash bearing fill containing high PAHs ws typically found at a depth of 0.3-0.5 m BGL. The overburden from remediation Areas 1, 2 and 3 (ash-bearing fill areas) was stripped and stockpiled on site over concrete slabs at Domains D and E. The excavated material was re-used to backfill Area 1 from the base of the formed excavation. Reinstatement to the surrounding grades and into excavations Area 2 and Area 3 were completed using imported fill material.

A total of 3,920 m3 of material was re-used, following validation for PAHs. Sampling was conducted at a rate of approximately 1 sample in 100 m^3 of stockpiled material. A summary of the analytical results is presented in Table 9.10.

Table 9.10 – Backfill material validation – PAHs (mg/kg)

Analyte	n	Detections	Maximum mg/kg	n > SIL 1
PAHs	32	4	4	0
B(a)P	32	1	0.6	0

n = number of analyses, excluding duplicates

The analytical assessment conducted confirmed that the excavated material from Area 1 has been adequately validated for PAHs.

9.4.2 Waste Disposal Areas

Excavated material from the former waste disposal areas were stockpiled on site over concrete slabs at Domains C and E. 'Screenable' soils were subjected to two-stage screening process, in order to remove all oversized waste materials and residual fibro fragments.

A total of 13,100 m3 of 'screenable soils' were designated for re-use to backfill the excavation pits. Samples were taken at a rate of approximately 1 in 100 m3 and analysed for heavy metals, TPH, BTEX, PAHs, OCPs, PCBs, phenols and asbestos.

Overall, the results confirmed that all samples were below the assessment criteria for the contaminants of concern, except for benzo(a)pyene detected marginally above the SIL 1 criteria as well as a few detections of copper, nickel, and zinc detected above the SIL 5 criteria. The Consultant conducted 95%UCLs calculations, confirming that concentrations in all stockpiles were below the SIL 1 and SIL 5 assessment criteria. However, the 95%UCL calculation for zinc remained marginally above the SIL 5 assessment criteria.

9.5 Imported Stockpile

A soil stockpile, now overgrown with grass, was placed in Domain B. It was the result of remediation of material that was illegally dumped on Lot 11 (Domain L). Asbestos containing material within building rubble was removed in a systematic process, prior to the stockpile being placed on Domain B. The Auditor reviewed the remediation as documented in Appendix D.

While the remediated material was considered suitable for residential use, it was recommended that it not be used in the surface layer of a residential site.

10 Groundwater Evaluation

A total of thirteen groundwater-monitoring wells were installed at the site in 1997 and 1998. A site plan illustrating the location of these wells is presented in Attachment 6, Appendix A.

A summary of all analytical results following the sampling events is given below in Tables 10.1 (Inorganics) and Tables 10.2 and 10.3 (Organics).

Table 10.1 – Groundwater analytical results – Inorganics (µg/L)

WELL	Date	Arsenic	Cadmium *	Chromium *	Copper *	Lead	Nickel	Zinc *	Total Cyanide
ANZECC (2000)		24	0.2-2	1	1.4	3.4	11	8	-
MW1	Nov-97	< 10	< 1	7	< 5	< 1	19	< 10	< 0.01
	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	130	--
MW2	Nov-97	20	< 1	< 5	< 5	< 1	28	< 10	< 0.01
	Oct-98	10	< 1	< 5	< 5	< 1	< 10	60	--
MW3	Nov-97	65	< 1	7	< 5	< 1	17	< 10	< 0.01
	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	80	--
MW4	Nov-97	41	< 1	< 5	< 5	< 1	500	< 10	< 0.01
	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	90	--
MW5	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	150	--
MW6	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	130	--
MW7	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	< 10	--
MW8	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	60	--
MW9	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	100	--
MW10	Oct-98	< 10	< 1	< 5	< 5	< 1	< 10	210	--

- = No TVs available
-- = Not sampled
* = Practical Quantification Limits (PQLs) > Assessment criteria

Table 10.2 – Groundwater analytical results – TPH/BTEX (µg/L)							
WELL	**Date**	**TPH C6-C9**	**TPH C10-C36**	**Benzene**	**Ethyl benzene**	**Toluene**	**Xylenes**
ANZECC (2000)		-	-	950	80	180	380
MW1	Nov-97	< 40	13,000	< 1	530	< 1	38
	Oct-98	< 40	< PQL	< 1	< 1	1	3
	Jun-00	< 40	< PQL	< 1	< 1	< 1	< 3
	Oct-91	< 40	< PQL	< 1	< 1	< 1	< 3
MW2	Nov-97	< 40	1,800	< 1	110	7	41
	Oct-98	< 40	290	< 1	< 1	< 1	< 3
	Jun-00	< 40	< PQL	< 1	< 1	< 1	< 3
	Oct-01	< 40	< PQL	< 1	< 1	< 1	< 3
MW3	Nov-97	< 40	2,900	< 1	< 1	15	10
	Oct-98	< 40	< PQL	< 1	< 1	< 1	< 3
	Jun-00	< 40	< PQL	0.8	< 1	5	< 3
	Oct-01	< 40	< PQL	< 1	< 1	< 1	< 3
MW4	Nov-97	< 40	200	1	< 1	< 1	7
	Oct-98	< 40	< PQL	< 1	< 1	< 1	< 3
	Jun-00	< 40	< PQL	< 1	< 1	< 1	< 3
MW5	Oct-98	< 40	< PQL	< 1	< 1	< 1	< 3
MW6	Oct-98	< 40	< PQL	< 1	< 1	< 1	< 3
MW7	Oct-98	< 40	< PQL	< 1	< 1	1	< 3
	Oct-01	< 40	< PQL	< 1	< 1	< 1	< 3
MW8	Oct-98	1303	130	< 1	< 1	< 1	< 3
	Jun-00	< 40	< PQL	< 1	< 1	< 1	< 3
	Oct-01	< 40	< PQL	< 1	< 1	< 1	< 3
MW9	Oct-98	40	40	< 1	< 1	< 1	< 3
MW10	Oct-98	< 40	< PQL	< 1	< 1	< 1	< 3
	Jun-00	< 40	< PQL	0.6	< 1	3	< 3
	Oct-01	< 40	< PQL	< 1	< 1	< 1	< 3
MW11	Jun-00	< 40	< PQL	< 1	< 1	2	< 3

Table 10.2 – Groundwater analytical results – TPH/BTEX (µg/L)							
WELL	**Date**	**TPH C6-C9**	**TPH C10-C36**	**Benzene**	**Ethyl benzene**	**Toluene**	**Xylenes**
	Oct-01	< 40	< PQL	< 1	< 1	< 1	< 3
MW12	Jun-00	< 40	< PQL	< 1	< 1	< 1	< 3
	Oct-01	< 40	30	< 1	< 1	< 1	< 3
MW13	Jun-00	< 40	2,420	< 1	< 1	< 1	< 3
	Oct-01	< 40	240	< 1	< 1	< 1	< 3

- = No TVs available
-- = Not sampled
PQL = Practical Quantification Limits

Table 10.3 – Groundwater analytical results – Other organics (µg/L)							
WELL	**Date**	**PAHs**	**OCPs**	**OPPs**	**Total Herbicides**	**Total PCBs**	**Total Phenols**
ANZECC (2000)		* *	* *	* *	* *	* *	320,000
MW1	Nov-97	< 1	< 1	< 10	< 5	< 1	< 10
	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Jun-00	< 1	--	--	--	--	--
	Oct-91	< 1	--	--	--	--	--
MW2	Nov-97	< 1	< 1	< 10	< 5	< 1	< 10
	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Jun-00	< 1	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--
MW3	Nov-97	< 1	< 1	< 10	< 5	< 1	< 10
	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Jun-00	2	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--
MW4	Nov-97	< 1	< 1	< 10	< 5	< 1	< 10
	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Jun-00	< 1	--	--	--	--	--
MW5	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
MW6	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10

Table 10.3 – Groundwater analytical results – Other organics (µg/L)

WELL	Date	PAHs	OCPs	OPPs	Total Herbicides	Total PCBs	Total Phenols
MW7	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Oct-01	< 1	--	--	--	--	--
MW8	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Jun-00	< 1	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--
MW9	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
MW10	Oct-98	< 1	< 1	< 10	< 5	< 1	< 10
	Jun-00	2	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--
MW11	Jun-00	< 1	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--
MW12	Jun-00	< 1	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--
MW13	Jun-00	< 1	--	--	--	--	--
	Oct-01	< 1	--	--	--	--	--

- = No TVs available
-- = Not sampled
** = Typical PQL for individual compounds, see Appendix B for TVs for individual PAH components

With respect to heavy metals, the 1998 sampling event indicates that there were no detections above the assessment criteria in the wells tested. There were detections above criteria in earlier sampling events. TPH and BTEX have been detected, with apparent declining concentrations over time.

With respect to PAHs, there were two detections of naphthalene only (2µ g/L) in wells MW3 and MW10 (both in Domain H) during the June 2000 sampling event. Extensive soil remediation has been conducted on site soils due mainly to PAH contamination. Although groundwater testing is limited and the PQLs for some compounds are above the TVs, there is no indication of PAH contamination of groundwater due to the extensive former PAH contamination of soil.

The Consultant concludes that there is no indication of contamination of groundwater from site uses. The Auditor agrees with that view, and notes that contamination sources have now been removed as part of the remediation at the site. However, groundwater has not been

investigated to determine suitability for any beneficial use and if groundwater were to be extracted for use as part of the proposed development, there would need to be further assessment of the groundwater quality to verify its suitability for the purposes being considered.

11 Assessment Of Risk

Based on assessment of results against guidelines and consideration of the overall investigations and remediation undertaken, the Auditor' s assessment of risk follows:

- Investigations were conducted in many stages over a long period, followed by remediation and detailed validation. Because contamination was associated with buried materials and filling of unknown history, there is a risk that there are other waste trenches or areas of contaminated fill on the site. The risk of sufficient remnant contamination being present, which could significantly impact site development or use, is considered to be very low because of the comprehensive investigations conducted.
- Site remediation included the excavation and sorting of large quantities of soil containing mixed waste material. The soil reused on site contained very small quantities of scrap including broken fibro pieces, metal, glass and wood. This material was placed a minimum of 0.5m below the ground surface. The site is flat and the area is unlikely to be excavated in site redevelopment or normal post redevelopment activities. Foundation and service excavations could extend into this material and it is possible that small pieces of fibro will be observed in the spoil. The risk of respirable asbestos fibres being produced and being found in surface soils following site development is very low because the quantity of bound asbestos is very low and because of its current location. Similarly, the scrap materials are unlikely to be relocated to the surface in quantities that would create aesthetic concerns.
- Fill material on site included a number of different ashy materials. The materials were sampled, analysed and classified according to their contamination status and contaminated materials were removed from site. Ashy materials remaining on site are essentially uncontaminated but there is a risk that they will be of concern to future site users because of aesthetic reasons or because they may be unsuitable as a planting medium.
- There is no evidence of significant or widespread contamination of groundwater by site activities, but minor contamination of groundwater has been detected. The groundwater has not been thoroughly assessed for suitability for any use. Based on depth to water and subsurface conditions, groundwater usage on site is feasible. If usage is proposed, groundwater should be assessed to verify its suitability for the specific use.
- Thornton Hall is within a fenced and locked area, and is in a state of disrepair with flaking paint. There is a risk that paint contains lead. This should be considered when the fate of Thornton Hall is determined.
- The soil stockpile on the north west side of the site may not be suitable for use in the surface layer of residential sites for aesthetic reasons. There is a risk that it contains a small number of fibro pieces.

12 Evaluation of Remediation

Remediation and validation was carried out at the site over a number of stages. Remediation works were conducted in accordance with Remediation Action Plans (RAPs), which were generally prepared in accordance with EPA guidelines.

The following major remediation works were undertaken at the site:

- Excavation and off site disposal of fill contaminated with PAHs;
- Excavation of waste trenches, separation and classification of wastes and off site disposal of drums and associated bituminous soils and other waste materials.

Offsite disposal of excavated materials included the following:

- A total of approximately 3,608 tonnes of excavated soils and 949 tonnes of bituminous material from drums encountered in the waste disposal areas, were disposed off-site to landfill following toxicity characteristic leachate potential (TCLP) tests for waste classification. Soils were classified as “solid waste”, and drums of bitumen soils were disposed of separately.
- A total of 8,972 tonnes of excavated soils from the ash-bearing fill remediation areas were disposed off-site to landfill following TCLP tests for PAHs and waste classification sampling at a rate of approximately 1 in 100 m^3.

Disposal certificates were provided for bituminous material and some of the contaminated soils. The waste classifications and disposal locations of the contaminated soils are provided in the reports, but disposal documentation was not included.

Sources of imported fill used to backfill excavations, and associated validation information, was provided.

The process of sorting and classification of excavated material resulted in approximately 12,000 m^3 of the 18,500 m^3 of material excavated from the waste disposal trenches being reused on site instead of being disposed to landfill.

In the Auditor’s opinion, the remedial measures conducted were appropriate and technically and environmentally justifiable.

13 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 Consultant's reports were generally prepared in accordance with the EPA (1997) "Guidelines for Consultants Reporting on Contaminated Sites". The checklist included in that document has been completed and is kept in file. The EPA (1999) "Checklist for Site Auditors using the EPA Guidelines for the NSW Site Auditor Scheme" has also been completed and is kept in file.

Classification and off-site disposal of excavated material were stated to be carried out in accordance with the EPA (1999) "Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes" which was the applicable guideline at the time. Only some of the disposal certificates were provided in the reports.

The reports do not state whether monitoring well licences were obtained.

14 Contamination Migration Potential

No significant contamination is known to remain on the site.

Consequently, under the current site conditions, there is a very low risk of migration of contaminants from the surface soil in dust or surface water runoff. There is little or no risk of future offsite migration in groundwater as the investigation results indicate the absence of significant downward movement of the contaminants, which were in the soils in the areas which were remediated, and the potential sources of major contamination have now been removed.

15 Conclusions and Recommendations

The Consultant concluded that, "…no evidence exists to suggest that the subject area is subject to any gross chemical contamination which would inhibit its suitability for sensitive (i.e. residential) development".

Based on the information presented in the Consultant's reports, observations made on site, and following NSW EPA (1998) Decision Process for Assessing Urban Redevelopment Sites, the Auditor concludes that the site is suitable for residential purposes.

The Auditor recommends:

- If groundwater is to be extracted for use in future, further assessment of the water quality is required to verify that the groundwater is suitable for the purposes being considered.
- Flaking paint on Thornton Hall which may contain lead should be considered when the fate of Thornton Hall is determined.
- The stockpile of soil in the northwest should not be used in the surface of residential areas.

16 Other Relevant Information

This Audit was conducted on the behalf of Department of Defence for the purpose of assessing whether the land is suitable for any specified use, as contemplated in Section 47(1)(b)(ii)(a) of the CLM Act.

This summary report may not be suitable for other uses. The Consultants included limitations in their reports. 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.

The Auditor has relied on the documents referenced in Section 1 of the Site Audit Report in preparing his opinion. If the Auditor is unable to rely on any of those documents, the conclusions of the audit could change.

It is not possible in a Site Audit Report to present all data which 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

Attachment 1: Site Location

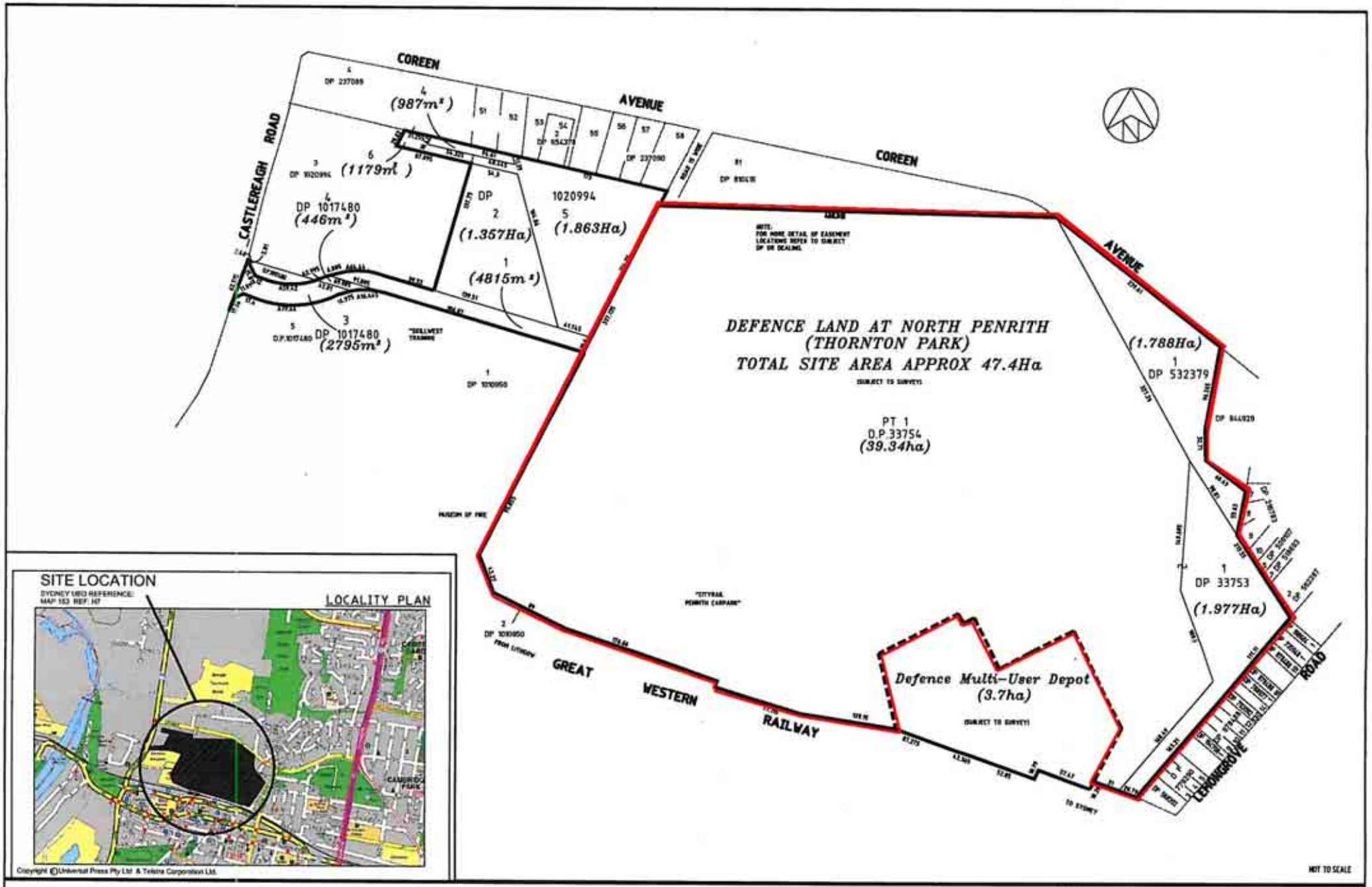
Attachment 2: Site Layout

Attachment 3: Boundaries of Environmental Domains

Attachment 4: General Location of Contamination Issues

Attachment 5: Waste Disposal Areas and Initial Stockpiles

Attachment 6: Monitoring Well Locations



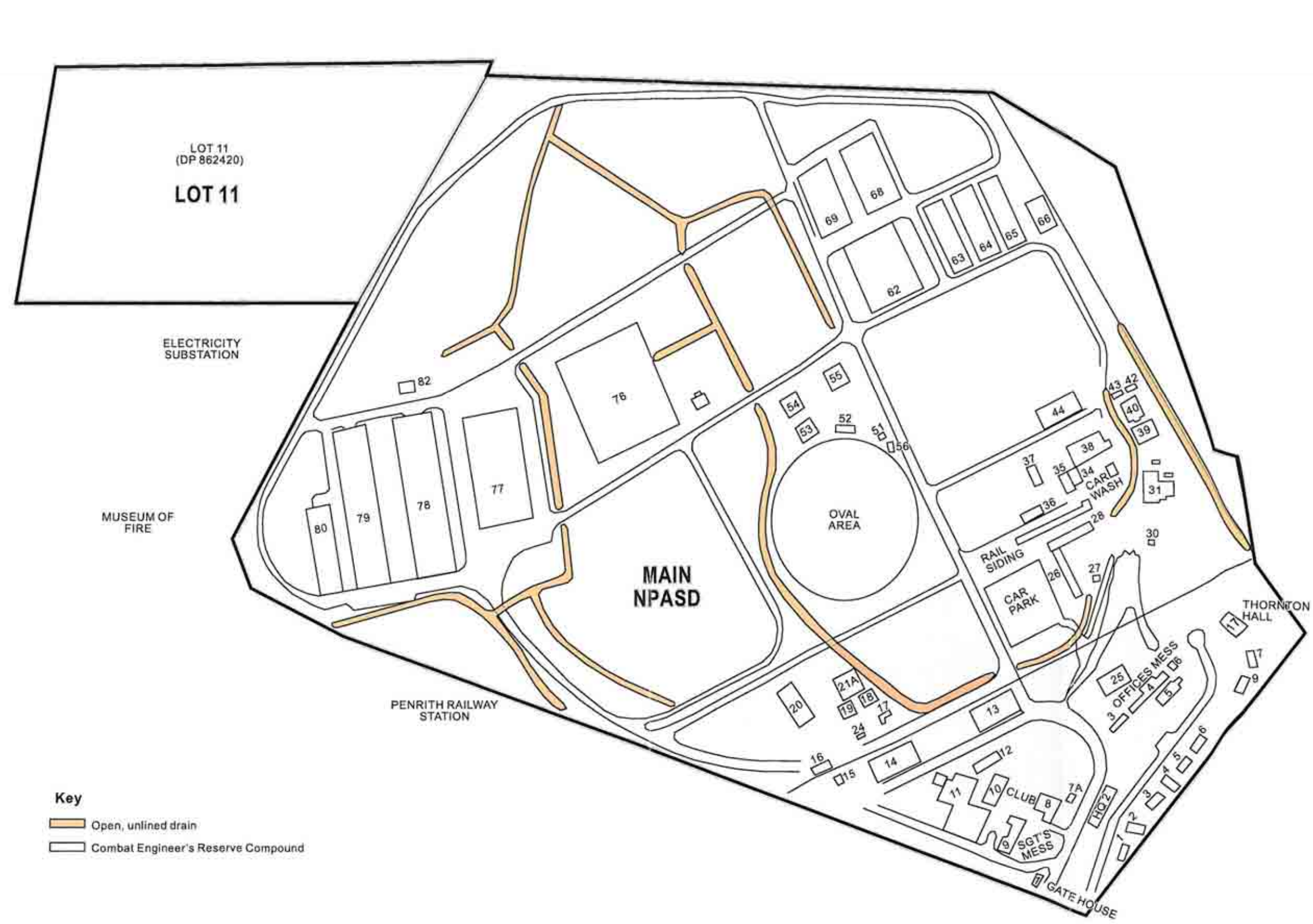
DEFENCE LAND AT NORTH PENRITH (THORNTON PARK) SITE PLAN

burton & field pty limited

Attachment 1: Site Location

INDICATIVE SITE PLAN

THORNTON PARK CONTAMINATION ASSESSMENT



Source : Plans Held by DoD

Date : 30 August 2000

File Name : VA0102_27.CDR

egis consulting Australia

Figure 2

BOUNDARIES OF ENVIRONMENTAL DOMAINS

THORNTON PARK CONTAMINATION ASSESSMENT

KEY

•••••••• Boundary of Environmental Domain

Indicative Only
NOT To SCALE

Source : CMPS&F/ Dames & Moore Environmental Audit Reports

Date : 30 August 2000

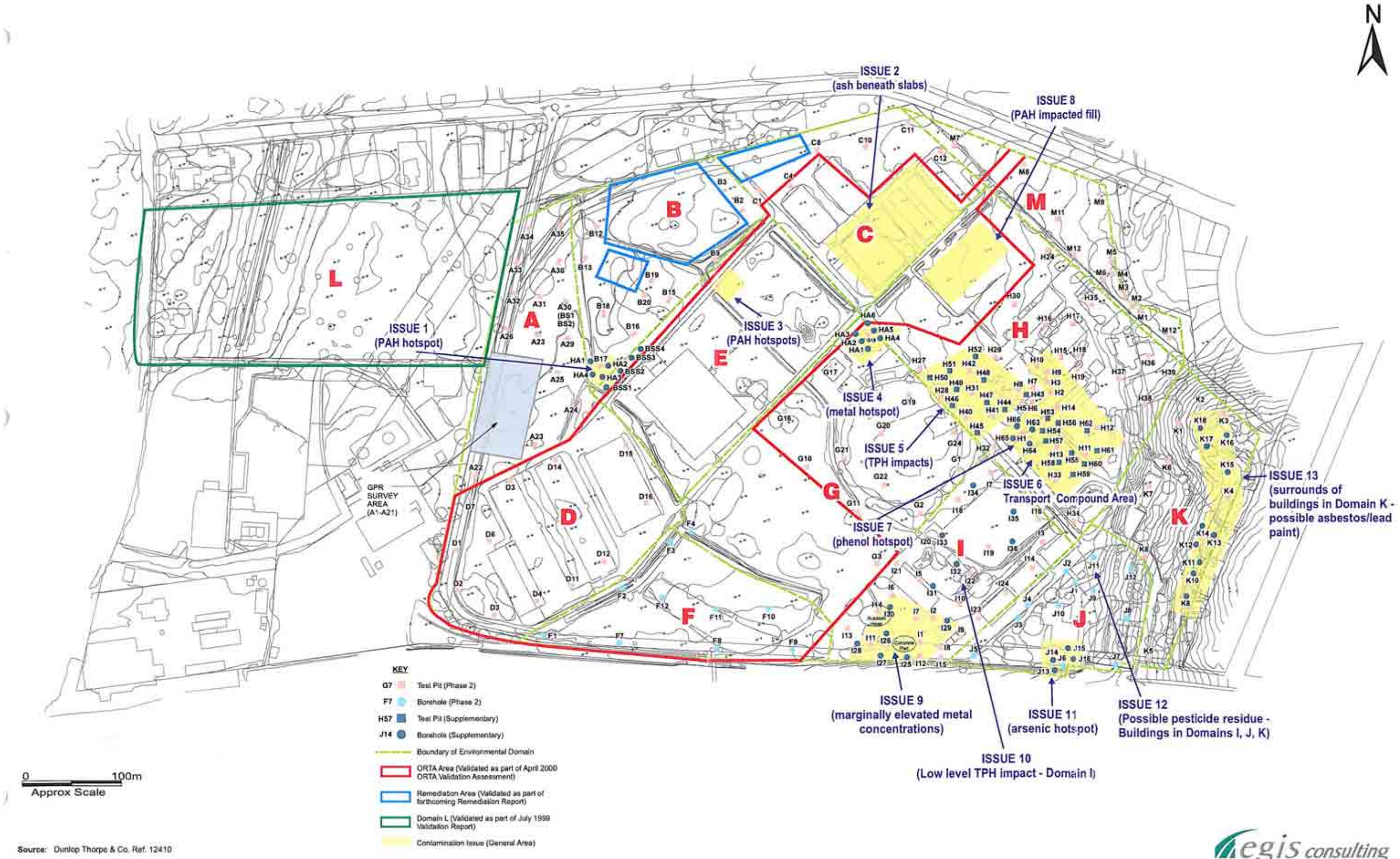
File Name : VA0102_13.CDR

egis consulting Australia

Figure 3

GENERAL LOCATION OF CONTAMINATION ISSUES

THORNTON PARK CONTAMINATION ASSESSMENT - PHASE 2 AND SUPPLEMENTARY WORKS



Source: Dunlop Thorpe & Co. Ref. 12410

egis consulting Australia

Date : 30 August 2000

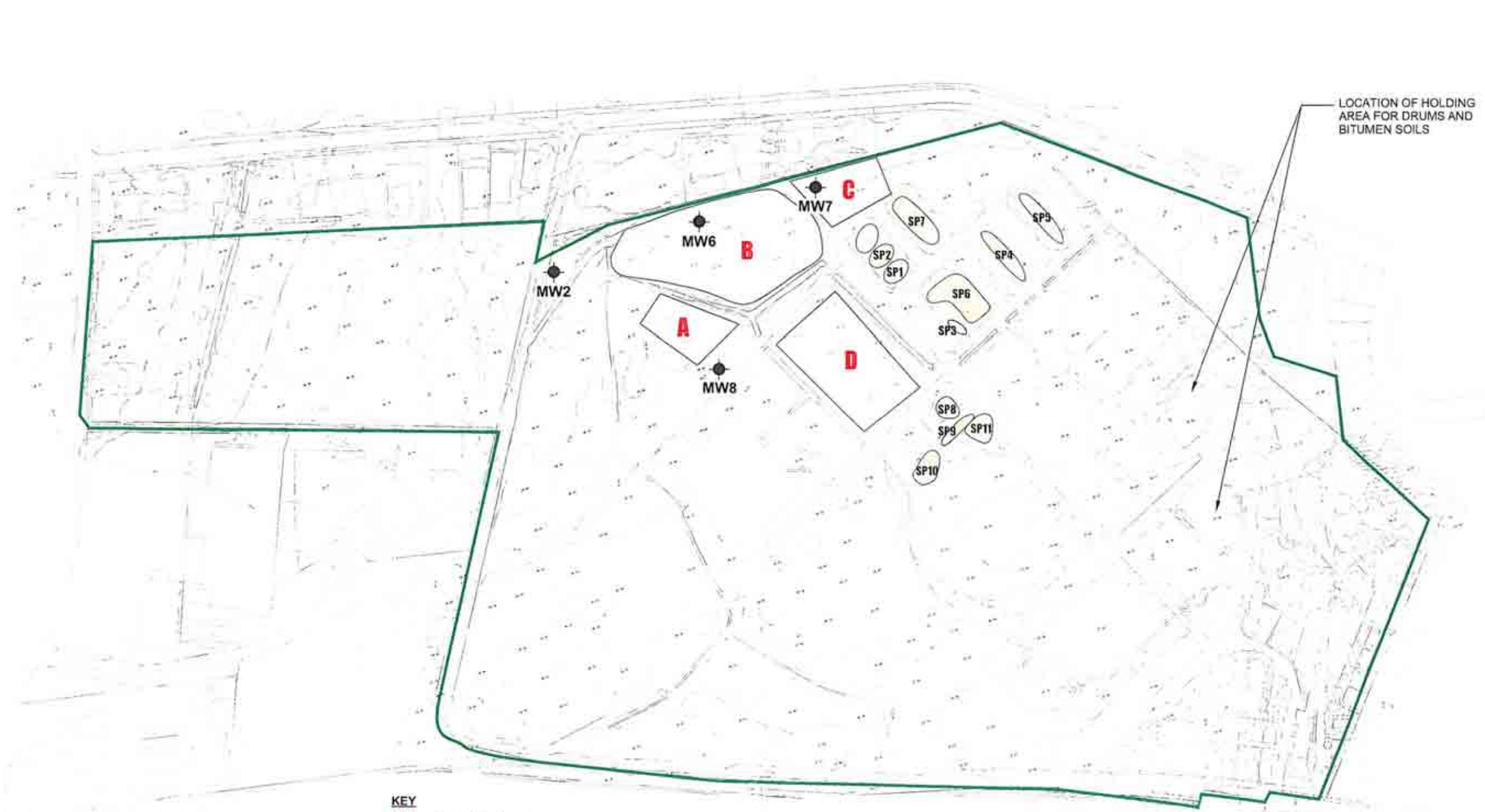
File Name : VA0102_81.CDR

Figure 5

Attachment 5: Waste Disposal Areas and Initial Stockpiles

SITE PLAN (SHOWING WASTE DISPOSAL AREAS & INITIAL STOCKPILES)

THORNTON PARK CONTAMINATION ASSESSMENT & REMEDIATION



KEY

A-D	Excavation Areas
	Drum Stockpile
	Soil Stockpiles
MW8	Groundwater Well
SP1-SP5	Excavated Soil and Engineering Waste - (Characterised and Disposed Off Site)
SP6	Excavated Soil and Engineering Waste - (Screened and Validated)
SP7	Excavated 'Topsoil' - (Validated)
SP8, SP9, SP10, SP11	Excavated Soil and Engineering Waste - (Screened and Validated)

0 100 200m

Approximate Scale

Source: Dunlop Thorpe & Co. Ref. 12410

Date : 12 January 2000

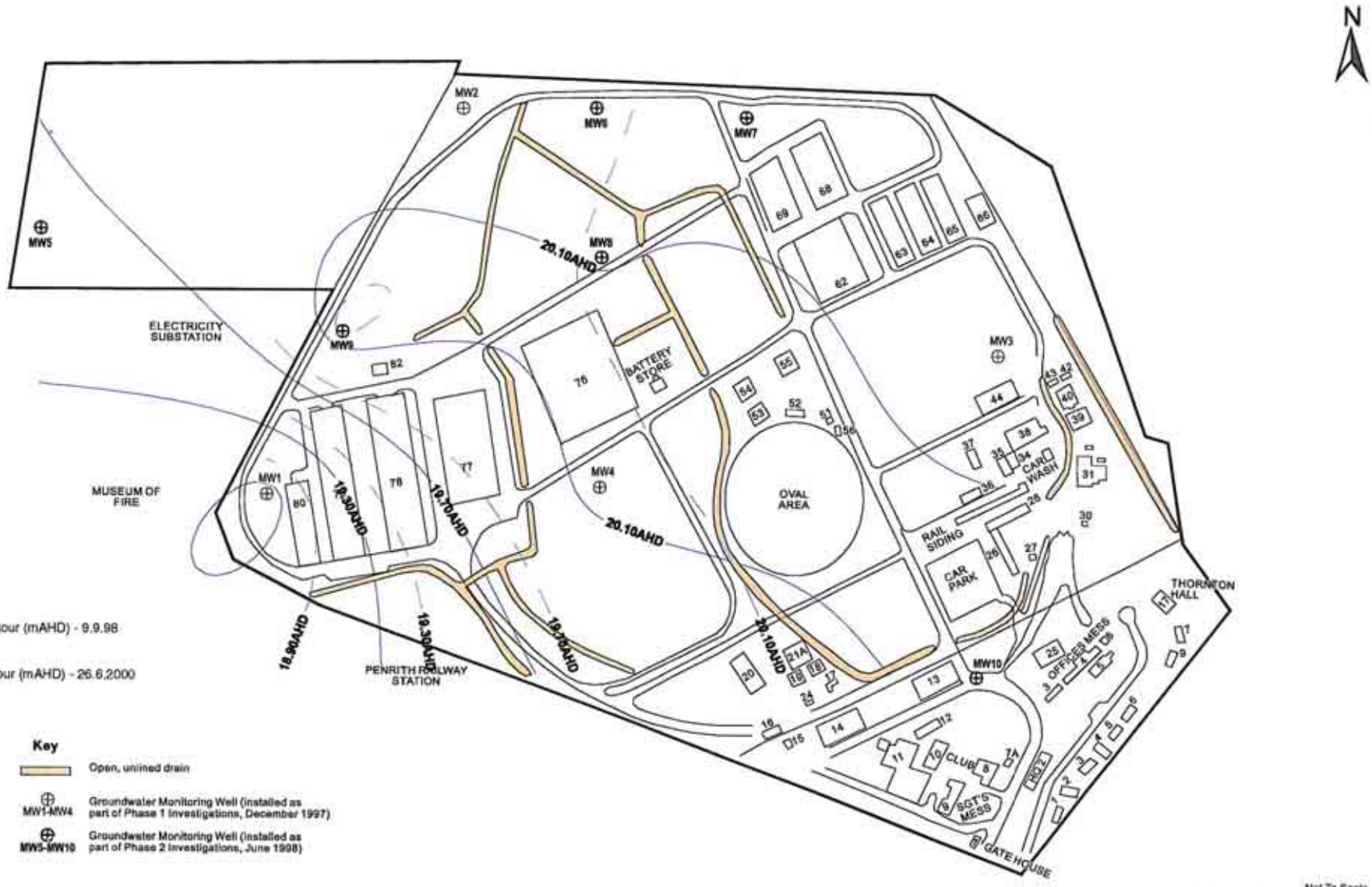
File Name : VA010247.CDR

egis consulting Australia

Figure 2

GROUNDWATER LEVEL CONTOURS - ROUNDS 2 & 3

NPASD CONTAMINATION ASSESSMENT - SUPPLEMENTARY INVESTIGATION



Not To Scale

Source: Plans Held by DOD

Date : 28 August 1998

File Name : F:\DATA\WA\0102\WA010230.CDR

egis consulting Australia

Figure 7

Attachment 6: Monitoring Well Locations

Appendix B:
Soil and Groundwater Criteria

Soil investigation levels for urban development sites Department of Environment and Conservation NSW (April 2006)

Substance	Health-based investigation levels[1] (mg/kg)				Provisional phytotoxicity-based investigation levels[2] (mg/kg)
	Residential with gardens and accessible soil (home-grown produce contributing < 10% fruit and vegetable intake; no poultry), including children's day-care centres, preschools, primary schools, townhouses, villas (NEHF A)[3]	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)	
	Column 1	Column 2	Column 3	Column 4	Column 5
Metals and metaloids					
Arsenic (total)	100	400	200	500	20
Beryllium	20	80	40	100	–
Cadmium	20	80	40	100	3
Chromium (III)[4]	12%	48%	24%	60%	400
Chromium (VI)	100	400	200	500	1
Cobalt	100	400	200	500	–
Copper	1,000	4,000	2,000	5,000	100
Lead	300	1,200	600	1,500	600
Manganese	1,500	6,000	3,000	7,500	500
Methyl mercury	10	40	20	50	–
Mercury (inorganic)	15	60	30	75	1[5]
Nickel	600	2,400	600	3,000	60
Zinc	7,000	28,000	14,000	35,000	200
Organics					
Aldrin + dieldrin	10	40	20	50	–
Chlordane	50	200	100	250	–
DDT + DDD + DDE	200	800	400	1,000	–
Heptachlor	10	40	20	50	–
PAHs (total)	20	80	40	100	–
Benzo(a)pyrene	1	4	2	5	–
Phenol[6]	8,500	34,000	17,000	42,500	–
PCBs (total)	10	40	20	50	–
Petroleum hydrocarbon components[7]					
> C16–C35 (aromatics)	90	360	180	450	–
> C16–C35	5,600	22,400	11,200	28,000	–
> C35 (aliphatics)	56,000	224,000	112,000	280,000	–

Soil investigation levels for urban development sites Department of Environment and Conservation NSW (April 2006)					
Substance	**Health-based investigation levels[1] (mg/kg)**				**Provisional phytotoxicity-based investigation levels[2] (mg/kg)**
	Residential with gardens and accessible soil (home-grown produce contributing < 10% fruit and vegetable intake; no poultry), including children's day-care centres, preschools, primary schools, townhouses, villas (NEHF A)[3]	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)	
	Column 1	Column 2	Column 3	Column 4	Column 5
Other					
Boron	3,000	12,000	6,000	15,000	–[8]
Cyanides (complex)	500	2,000	1,000	2,500	–
Cyanides (free)	250	1,000	500	1,250	–

1 The limitations of health-based soil investigation levels are discussed in Schedule B(1) Guidelines on the Investigation Levels for Soil and Groundwater and Schedule B(7a) Guidelines on Health-based Investigation Levels, *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPC 1999)

2 The provisional phytotoxicity-based investigation levels proposed in this document are single number criteria. Their use has significant limitations because phytotoxicity depends on soil and species parameters in ways that are not fully understood. They are intended for use as a screening guide and may be assumed to apply to sandy loam soils or soils of a closely similar texture for pH 6–8.

3 National Environmental Health Forum (NEHF) is now known as enHealth.

4 Soil discolouration may occur at these concentrations.

5 Total mercury

6 Odours may occur at these concentrations.

7 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.

8 Boron is phytotoxic at low concentrations. A provisional phytotoxicity-based investigation level is not yet available.

Notes:

This table is adapted from Table 5-A in Schedule B(1): Guidelines on Investigation Levels for Soil and Groundwater to the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 1999).

Soil investigation levels (SILs) may not be appropriate for the protection of ground water and surface water. They also do not apply to land being, or proposed to be, used for agricultural purposes. (Consult NSW Agriculture and NSW Health for the appropriate criteria for agricultural land.)

SILs do not take into account all environmental concerns (for example, the potential effects on wildlife). Where relevant, these would require further consideration.

Impacts of contaminants on building structures should also be considered.

For assessment of hydrocarbon contamination for residential land use, refer to the Guidelines for Assessing Service Station Sites (EPA 1994).

Threshold Concentration for Sensitive Land Use – Soils Guidelines for Assessing Service Station Site (NSW EPA 1994)	
Contaminant	**Threshold Concentration (mg/kg)**
TPH (C_6-C_9)	65
TPH (C_{10}-C_{36})	1,000
Benzene	1
Toluene	1.4
Ethylbenzene	3.1
Xylenes (total)	14

Trigger Values (TV) for Screening Marine Water Quality Data (µg/L) for Slightly to Moderately Disturbed Ecosystems (ANZECC 2000)		
Contaminant	**Threshold Concentration (µg/L))**	**Guideline Source**
Metals and Metalloids		
Arsenic – As (III/V)	2.3/4.5	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Cadmium – Cd	0.7	ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Mercury – Hg	0.1	
Nickel – Ni	7	ANZECC (2000) 99% protection level due to potential for toxicity to particular species.
Manganese	80	Low reliability trigger values (derived from the mollusc figure) from Volume 2 of ANZECC (2000)
Chromium – Cr (III/VI)	27.4/4.4	ANZECC (2000) 95% protection levels.
Copper – Cu	1.3	
Cobalt	1	
Lead – Pb	4.4	
Zinc – Zn	15	
Aromatic Hydrocarbons		
Benzene	500	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Toluene	180	
Ethylbenzene	5	
o-xylene	350	
m-xylene	75	
p-xylene	200	
Polycyclic Aromatic Hydrocarbons		
Naphthalene	50	ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Anthracene	0.01	Low reliability trigger values from Volume 2 of ANZECC (2000) ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Phenanthrene	0.6	
Fluroanthene	1	
Benzo (a) pyrene	0.1	
Chlorinated Alkanes		
Tetrachloroethene - PCE	70	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
1,1,2 Trichlorothene- TCE	330	
1,1,2 Trichlorothene- 1,1,2-TCE	330	
Vinyl chloride (chloroethene)	100	
1,1,1 Trichloroethane – 1,1,1-TCA (111-TCE)	270	
1,1 Dichloroethene	700	
1,1 Dichloroethane	250	
1,2 Dichloroethane	1900	
1,1,2 - Trichloroethane	1900	Moderate reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Chloroform	370	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Non-Metallic Inorganics		
Ammonia Total – NH_3 (at pH of 8)	910	ANZECC (2000) 95% protection levels.

Trigger Values (TV) for Screening Marine Water Quality Data (µg/L) for Slightly to Moderately Disturbed Ecosystems (ANZECC 2000)		
Contaminant	**Threshold Concentration (µg/L))**	**Guideline Source**
Cyanide (Free or unionised HCN)	4	

While the low reliability figures should not be used as default guidelines they will be useful for indicating the quality of groundwater migrating off-site.

Trigger Values (TV) for Screening Fresh Water Quality Data (µg/L) for Slightly to Moderately Disturbed Ecosystems (ANZECC 2000)		
Contaminant	**Threshold Concentration (µg/L))**	**Guideline Source**
Metals and Metalloids		
Arsenic – As (III/V)	24/13	ANZECC (2000) 95% protection levels.
Cadmium – Cd	0.2	
Nickel – Ni	11	
Manganese	1900	ANZECC (2000) 95% protection levels (figure may not protect key test species from chronic toxicity)
Mercury – Hg	0.06	ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Chromium – Cr (III/VI)	3.3/1.0	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000) for Cr (III)
Cobalt	2.8	
Copper – Cu	1.4	ANZECC (2000) 95% protection levels.
Lead – Pb	3.4	
Zinc – Zn	8.0	
Aromatic Hydrocarbons		
Benzene	950	Moderate reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Toluene	180	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Ethylbenzene	80	
m-xylene	75	
o-xylene	350	Moderate reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
p-xylene	200	
Polycyclic Aromatic Hydrocarbons		
Naphthalene	16	ANZECC (2000) 95% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Anthracene	0.01	Low reliability trigger values from Volume 2 of ANZECC (2000)
Phenanthrene	0.6	
Fluroanthene	1	ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Benzo (a) pyrene	0.1	
Organochlorine Pesticides		
Aldrin	0.001	Low reliability trigger values from Volume 2 of ANZECC (2000)
DDE	0.03	
Dieldrin	0.01	
Endosulfan α	0.0002	
Endosulfan β	0.007	
Chlordane	0.03	ANZECC (2000) 95% protection levels
DDT	0.006	
Lindane	0.2	
Endosulfan	0.03	ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Endrin	0.01	
Heptachlor	0.01	
Organophosphorus Pesticides		
Azinphos methyl	0.01	ANZECC (2000) 99% protection level due to potential for bio-accumulation or acute toxicity to particular species.
Methoxychlor	0.005	Low reliability trigger values from Volume 2 of ANZECC (2000)
Dementon-S-methyl	4	
Chloropyrifos	0.01	ANZECC (2000) 95% protection levels
Diazinon	0.01	ANZECC (2000) 95% protection levels

Trigger Values (TV) for Screening Fresh Water Quality Data (µg/L) for Slightly to Moderately Disturbed Ecosystems (ANZECC 2000)		
Contaminant	**Threshold Concentration (µg/L))**	**Guideline Source**
Dimethoate	0.15	
Fenitrothion	0.2	
Malathion	0.05	
Parathion	0.004	
Non-Metallic Inorganics		
Total Ammonia as N (pH of 8)	900	ANZECC (2000) 95% protection levels
Cyanide (Free or unionised)	7	
Nitrate	700	Moderate reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
NO_x	40	ANZECC (2000) Default trigger values for physical and chemical stressors for slightly disturbed ecosystems in lowland rivers of South-east Australia. The trigger values for TP and TN are 25 µg/L and 350 µg/L, respectively, for east flowing coastal rivers in NSW.
Total Nitrogen	500	
Total Phosphorous	50	
Ammonium ($NH4^+$)	20	
Chlorine	3	ANZECC (2000) 95% protection levels.
Phenols		
Phenol	320	ANZECC (2000) 95% protection levels
2,4-dimethylphenol	2	Low reliability values (95% level of protection) from Volume 2 of ANZECC (2000)
Chlorinated Alkanes and Alkanes		
Tetrachloroethene - PCE	70	Low reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
1,1,2 Trichloroethene- 1,1,2-TCE	330	
Vinyl chloride (chloroethene)	100	
1,1,1 Trichloroethane – 1,1,1-TCA (111-TCE)	270	
1,1 Dichloroethene	700	
1,1 Dichloroethane	90	
1,2 Dichloroethane	1900	
Chloroform	370	
1,1,2 - Trichloroethane	6500	Moderate reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
Chlorinated Aromatic Hydrocarbons		
1,3- dichlorobenzene	260	Moderate reliability trigger values (95% level of protection) from Volume 2 of ANZECC (2000)
1,4 - dichlorobenzene	60	
1,2,4 - trichlorobenzene	85	
Hexachlorobenzene	0.05	Low reliability values (95% level of protection) from Volume 2 of ANZECC (2000). (QSAR derived)
Miscellaneous Industrial Chemicals		
Hexachlorobutadiene	0.04	Environmental Concern Level from Volume 2 of ANZECC (2000)

While the low reliability figures should not be used as default guidelines they will be useful for indicating the quality of groundwater migrating off-site.

Appendix C:
EPA Approved Guidelines

Guidelines made or approved by the EPA under section 105 of the Contaminated Land Management Act 1997

(as of 28 March 2007)

Guidelines made by the EPA

- *Contaminated Sites: Guidelines for Assessing Service Station Sites*, December 1994 - servicestnsites.pdf, 1.3Mb
- *Contaminated Sites: Guidelines for the vertical mixing of soil on former broad-acre agricultural land*, January 1995 - vertmix.pdf, 149kb
- *Contaminated Sites: Sampling Design Guidelines*, September 1995
- *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*, October 1997 - bananaplantsite.pdf, 586 kb
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*, November 1997
- *Contaminated Sites: Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report*, April 1999 (revised July 2003) - sroh.pdf, 164kb
- Contaminated Sites: Guidelines for Assessing Former Orchards and Market Gardens, June 2005 - orchardgdlne05195.pdf, 172 kb
- Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd edition), April 2006 - auditorglines06121.pdf, 510kb
- Guidelines for the Assessment and Management of Groundwater Contamination, March 2007 - groundwaterguidelines07144.pdf 604 kb

Note: All references in the EPA's contaminated sites guidelines to the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, November 1992) are replaced as of 6 September 2001 by references to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, October 2000), subject to the same terms.

Guidelines approved by the EPA

ANZECC publications

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

EnHealth publications (formerly 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
- Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards, Department of Health and Ageing and EnHealth Council, Commonwealth of Australia, June 2002

National Environment Protection Council publications

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

The Measure consists of a policy framework for the assessment of site contamination, Schedule A (Recommended General Process for the Assessment of Site Contamination) and Schedule B (Guidelines). Schedule B guidelines include:

B(1) Guideline on Investigation Levels for Soil and Groundwater
B(2) Guideline on Data Collection, Sample Design and Reporting
B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils
B(4) Guideline on Health Risk Assessment Methodology
B(5) Guideline on Ecological Risk Assessment
B(6) Guideline on Risk Based Assessment of Groundwater Contamination
B(7a) Guideline on Health-Based Investigation Levels
B(7b) Guideline on Exposure Scenarios and Exposure Settings
B(8) Guideline on Community Consultation and Risk Communication
B(9) Guideline on Protection of Health and the Environment During the Assessment of Site Contamination
B(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 & Natural Resource Management Ministerial Council of Australia and New Zealand, 2004

Appendix D: Correspondence

ENVIRON

26 September 2007 Our Ref: AS120017

Fitzwalter & Associates
Attn: Nick Reissis
633 Harris St
Ultimo NSW 2007

Dear Nick

Re: Thornton Park, North Penrith
Review of Remediation and Validation of Illegally Dumped Stockpiles

1. INTRODUCTION

As an EPA accredited contaminated sites Auditor, I have previously completed a Site Audit Report (SAR) and Site Audit Statement (SAS) in relation to part of the Defence Site known as Thornton Park. The site audit report, which covered the part of Thornton Park adjoining Castlereagh Road, was titled:

"Summary Site Audit Report, Thornton Park "Lot 11" for Department of Defence Sydney property Disposal Unit", dated 5 July 2000, by Dames & Moore Pty Ltd and included SAS GN-5-B.

The site audit statement certified that the site was suitable for a range of land uses including residential use with accessible soil. The site has not yet been developed. Subsequent to preparation of that report, potentially contaminated soil was illegally dumped at the site in stockpiles. These stockpiles have been the subject of assessment and remediation.

In preparing this letter I have reviewed the following documents:

- "Thornton Park Castlereagh Road, Penrith (NSW), Characterisation Report", dated December 2005 by GHD Pty Ltd.
- "North Penrith (Thornton Park) Stockpile Report", dated 10 May 2006 by GHD Pty Ltd.
- "North Penrith (Thornton Park) Stockpile Report", dated 31 May 2006 by GHD Pty Ltd.
- "Report for Thornton Park, North Penrith, Remediation and Validation – Illegally Dumped Stockpiles", draft dated August 2007 by GHD.
- "Report for Thornton Park, North Penrith, Remediation and Validation – Illegally Dumped Stockpiles", dated September 2007 by GHD.

I conducted site visits to inspect the stockpiles on 16 March 2006 and during the remediation on 27 July 2007. I also discussed validation plans and remediation processes with GHD (consultant), Fitzwalter (project managers) and Enviropacific (remediation contractor).

The objective of this review letter is to provide an independent verification of the conclusions of the GHD validation report

2. BACKGROUND

The site is an open grassed field with a few trees. Details of site history, potential contaminants of concern and stratigraphy and hydrogeology are presented in the referenced site audit report. Of relevance to this review is that it was never used for Defence purposes. It is underlain by alluvial clay deposits.

At an unknown time, approximately 200 piles of soil were illegally dumped on the site. GHD identified two distinct types of soil. They were:

- Orange clays, which contained some demolition waste including fibro sheet pieces but no other obvious contamination
- Grey sandy material, which contained potentially contaminated ash and slag as well as building rubble and other anthropogenic material.

GHD conducted sampling and chemical analysis of the stockpiles. Following this, the grey soils were disposed offsite, while a procedure was developed for remediation of the orange clay by removal of asbestos-containing material. That remediation has been conducted and the soils have been retained on the site in a large stockpile. A site layout showing the locations of the various stockpiles is attached.

3. EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

I have assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The assessment applies to initial characterisation of the stockpiles, and validation following remediation.

My assessment follows in Tables 6.1 and 6.2.

Table 6.1 – QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor Comments
Sampling Pattern and Locations	Samples were obtained from a number of stockpiles. Approximately 10% of the stockpiles were sampled. GHD do not discuss how they were selected. Validation samples were collected on a systematic grid pattern.
Sampling Density	Stockpiled soils were sampled at a rate of approximately 1 per $100m^3$. Validation was mainly by visual assessment, with one bulk sample obtained per approximately $30m^3$. One sample was obtained for laboratory asbestos analysis from each bulk sample.

Sampling and Analysis Plan and Sampling Methodology	Auditor Comments
Sample depths	20kg bulk samples were obtained from the full depth of the remediation pad.
Sample Collection Method	Stockpile and validation samples were collected by shovel.
Decontamination Procedures	Decontamination was not discussed by GHD for stockpile sampling, but cross contamination is not a critical issue in this case. Validation samples were obtained with a washed shovel and new disposable gloves.
Sample handling and containers	Chemical analysis samples were placed into laboratory supplied jars and transferred in chilled eskies. Samples for asbestos validation analysis were collected by gloved hand from the bulk samples and placed in glass jars.
Chain of Custody	Chain of custody forms were provided.
Detailed description of field screening protocols	Visual field screening was undertaken.
Sampling Logs	No individual sample descriptions were provided.

Table 6.2 – QA/QC – Field and Lab Quality Assurance and Quality Control

Field and Lab QA/QC	Auditor Comments
Field quality control samples	For stockpile characterisation, 10% intra-laboratory replicate samples were analysed for the full range of analytes,. For asbestos validation samples, approximately 10% replicates were collected both for visual assessment of bulk samples and for laboratory analysis.
Field quality control results	RPDs for most chemical analyses were less than 30%. There were several discrepancies but with analyte concentrations near the PQLs, so are not considered significant. There were no detections of asbestos above LOR in replicate samples.
NATA registered laboratory and NATA endorsed methods	Envirolab Services Pty Ltd conducted all laboratory analyses including asbestos. All certificates are NATA stamped, and no certificates are endorsed as not covered by NATA. There was no check laboratory.
Analytical methods	Envirolab provides a methodology summary. Asbestos was by qualitative identification using Polarised Light Microscopy and Dispersion Staining Techniques.
Holding times	Data provided indicates all samples were analysed within holding times.
Practical Quantitation Limits (PQLs)	The asbestos limit of reporting for soils was not discussed. GHD discuss the uncertainties associated with polarised light microscopy detection of asbestos within clay. The Auditor notes that the laboratory inspected a subsample of 30-40g of soil.

Field and Lab QA/QC	Auditor Comments
Laboratory quality control samples	Envirolab presents organic surrogate samples in result certificates and provides a separate quality control report with results for blanks, duplicates and spikes. No information is provided on any asbestos quality control.
Laboratory quality control results	No laboratory results were qualified.
Data Quality Objectives and Data Evaluation (completeness, comparability, representativeness, precision, accuracy)	GHD did not present DQOs. They presented the results of QC analyses. For stockpile analyses and validation testing they concluded that data are precise and repeatable.

In considering the data as a whole it is concluded that the data are likely to be reliable and are useable for the purpose of this review. It would have been preferable for descriptions of stockpiles and samples to be presented to demonstrate that samples were representative. I consider that the results (Section 5) are sufficiently consistent to conclude that the data are representative. With respect to asbestos, I note that a field or laboratory "non detect" does not necessarily mean that there is zero asbestos present.

4. PROPOSED ENVIRONMENTAL QUALITY CRITERIA

As the illegally dumped stockpiles are proposed for reuse, possibly on residential sites, results were assessed against Investigation Levels for Urban Redevelopment Sites in NSW (SIL Column 1 – 'residential with gardens and accessible soils' and the Column 5 'provisional phytotoxicity') in DEC *Guidelines for the NSW Site Auditor Scheme* (2006). EPA (1994) *Guidelines for Assessing Service Station Sites* have also been referred to for assessing TPH and BTEX results.

There are no national or EPA approved guidelines for asbestos in soil relating to human health. DEC (2006) state that Auditors must exercise their professional judgement when assessing whether a site is suitable for a specific use. The DEC states that the position of the Health Department is that there should be no asbestos in surface soil. "*Management of asbestos in the non-occupational environment*"(enHealth 2005) has also been referred to. This includes reference to Imray and Neville (1993) *"Approaches to the Assessment and Management of Asbestos Contaminated Soil"* which proposes that a site can be considered to be uncontaminated if it has less than 0.001% w/w asbestos.

5. EVALUATION OF SOIL ANALYTICAL RESULTS

This section summarises the results of analysis of the orange clay stockpiles. The grey stockpiles were found to contain elevated concentrations of metals, petroleum hydrocarbons and polycyclic aromatic hydrocarbons, and were removed from site. The chemical results are therefore not considered further in this review. The orange clays were proposed for remediation by removal of asbestos and reuse.

Analytical results are summarized in Table 5.1. There were 26 analyses for all of the analytes listed, plus 3 replicate samples.

Table 5.1 – Evaluation of Soil Analytical Results – Summary Table (mg/kg).

Analyte	Detections	Maximum	n > EPA (1994)	n > SIL Column 1 (DEC 2006)	n > SIL Column 5 (DEC 2006
Asbestos	0	-			
Arsenic	19	5.8	-	0	0
Cadmium	1	1.2	-	0	0
Total Chromium	26	13	-	0	0
Copper	26	26	-	0	0
Lead	26	280	-	0	0
Nickel	26	12	-	0	0
Zinc	26	1500	-	0	2
Mercury (inorganic)	0	-	-	0	0
Total Cyanide	0	-	-	0	-
PCBs	0	-	-	0	-
OCP	1	0.3	-	-	-
Dieldrin	1	0.3	-	0	-
TPH (C_6-C_9)	26	-	0	-	-
TPH (C_{10}-C_{36})	26	-	0	-	-
BTEX	26	-	0	-	-
Total PAHs	1	4	-	0	-
Benzo(a)Pyrene	1	0.4	-	0	-

\- *No criteria available/used or not applicable*

Four of the 26 samples had elevated concentrations of contaminants in comparison to what would be expected from virgin soil. Two samples contained elevated zinc, one of which also had an elevated lead concentration. Two samples had low level detections of organic compounds, one of PAHs in which a number of the heavier end compounds including benzo(a) pyrene were detected, and one for OCPs in which dieldrin was the only compound detected. Sample logs were not provided. All of the contaminants detected at elevated concentrations could be expected to be associated with demolition waste.

The asbestos laboratory analyses were of soils without visible fibro pieces of suspected asbestos-containing material.

The density of analysis was not high, but the results are consistent and in my opinion indicate that no further analyses were required to characterise the chemical status of the orange soils. Remediation was required because of the visible fibro pieces found with the demolition waste in the soil stockpiles. Of the two zinc concentrations exceeding the SIL Column 5 provisional phytotoxicity-based investigation level of 200mg/kg, one only slightly exceeded (220mg/kg).

The maximum result of 1,500 mg/kg, while indicating zinc impact, represents less than 5% of the samples and would not be expected to have a significant phytotoxic effect.

6. REMEDIATION CONDUCTED

6.1. Offsite disposal

GHD classified the stockpiles of grey sands as "solid waste containing asbestos". This material was disposed to Veolia Environmental Services. Disposal dockets were provided.

6.2. Asbestos removal

Stockpiles were removed from their original locations and spread out in another area (see attachment). Suspected asbestos-containing material was removed by raking and visual assessment within 10m x 10m grids. A total of 85 Lots, each approximately 10m x 10m x 0.3m, were inspected. This corresponds well with the initial estimated volume of 2600 m^3. The process is summarized in Table 6.1.

Table 6.1 – Asbestos removal and Validation

Process Step	Summary of Results
Initial rake and pick	Asbestos pieces found in majority (50/85) of the Lots. Up to 17 pieces found per Lot
GHD visual inspection	10 Lots failed the visual inspection, most of which had only 1 or 2 pieces.
Second rake and pick after turning with excavator.	Further asbestos found, most only a few pieces but one Lot had 75 pieces found.
GHD second visual inspection	No pieces found.
20kg bulk sample taken from each grid, spread on plastic and inspected for asbestos.	No asbestos pieces found
30-40g samples inspected microscopically by analytical laboratory.	Respirable fibres not detected.

The collected asbestos pieces were disposed to a Sita landfill. A disposal docket was provided.

In my opinion, the removal process was conducted in a systematic manner, and the process and results as documented in the GHD validation report provide a high degree of confidence that the vast majority of the asbestos was removed from the stockpiles. The amount of asbestos remaining would almost certainly be well less than 0.001%.

6.3. Site inspection

I undertook a site inspection on 27 July 2007. At that time, the first batch remediation had been completed and soil had been stockpiled. The second batch remediation was in process. I noted:

- Grids were marked out and raking and picking was being undertaken systematically
- The soils were clays with clods, which make raking to the full depth difficult
- The stockpile of remediated batch 1 material contained some brick, pieces of wood and plastic
- Some pieces of fibro were noted in the scraped area where the stockpiles were originally located. (The validation report notes that these were later removed).

My observations were consistent with the information presented in the validation report.

7. ASSESSMENT OF RISK

GHD discuss uncertainties. It is unlikely that there has been 100% removal of asbestos pieces, but the procedures conducted and validation results achieved provide a high degree of confidence that any pieces remaining would not pose an appreciable risk to human health. This is particularly as no respirable fibres were detected in any of the microscopic analyses. While health risk is considered negligible, there could be a negative perception if a piece of fibro is found.

The chemical characterization did not sample all of the stockpiles, and there is a risk that some stockpiles contained material not represented by the analytical results. Based on the consistency of results and GHD's visual inspection, including subsequent inspection during asbestos removal, this risk is considered to be low.

While asbestos has been removed, the soil remaining contains some anthropogenic material such as brick and plastic. This may have a negative aesthetic impact.

8. CONCLUSIONS AND RECOMMENDATIONS

Based on the processes conducted and validation results achieved, I consider that the illegally dumped stockpiles have been satisfactorily remediated and validated. GHD conclude that the orange material that remains on site is "suitable (from a contamination perspective) for beneficial re-use, on either a residential or commercial development site". I agree with this conclusion.

While the remediated soil is suitable for residential use, I recommend that if used on a residential site that it not be used in the surface layer. This is because the presence of some anthropogenic material, and the possible finding of a fibro piece, could have a negative perception or emotional impact.

9. LIMITATIONS

This review was conducted on the behalf of Department of Defence consistent with the purpose contemplated in Section 47(1)(b)(iia) of the CLM Act, as a follow up to a previous audit in relation to site suitability. This summary report may not be suitable for other uses. The Consultant, GHD, included limitations in their reports. This review must also be subject to those limitations. I have prepared this document in good faith, but am unable to provide certification outside of areas over which I had some control or am reasonably able to check.

I have relied on the documents referenced in Section 1 of this letter report in preparing his opinion. If I am unable to rely on any of those documents, the conclusions of the review could change.

This review letter does not present all data which 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.

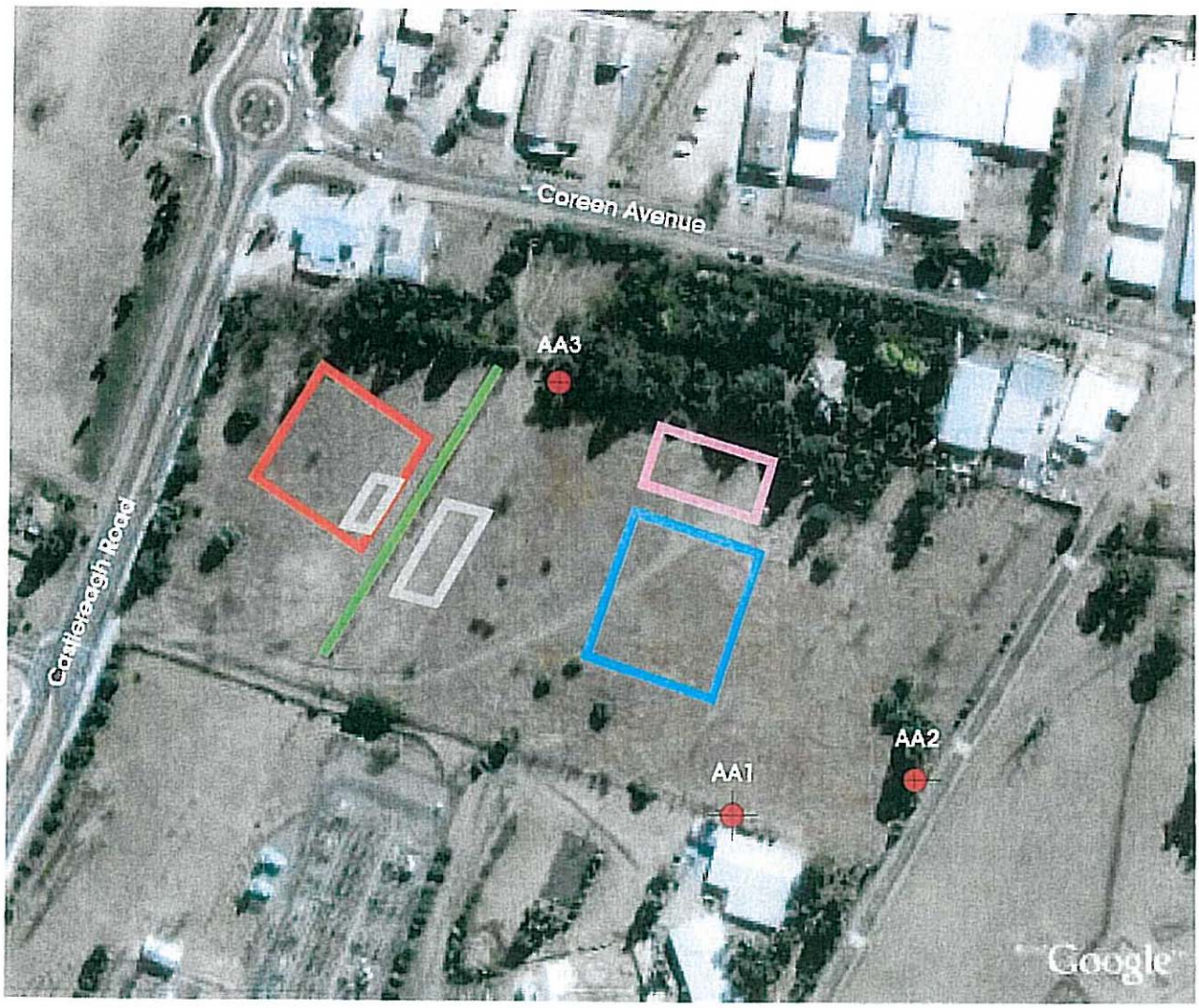
My comments and conclusions provided in this document regarding the suitability of the site and the stockpiled soils are implicitly limited to a consideration of contamination related issues as defined under the NSW Contaminated Land Management Act 1997.

Yours faithfully,
ENVIRON Australia Pty Ltd

Graeme Nyland
EPA Accredited Site Auditor 9808

/Attachment – Site Layout

ATTACHMENT – Site Layout



KEY

- Approximate Location of Asbestos Treatment Area
- Approximate Location of Original Grey Sand Stockpiles
- Approximate Location of Original Orange Sandy Clay Stockpiles
- Asbestos Air Sampling Location
- Approximate Location of Stockpiled Remediated Material
- Drainage Path

Source: Google Earth Pty Ltd (www.googleearth.com)

Department of Defence.
Thornton Park, Castlereagh Rd. North Penrith

Site Layout

job no 21-14360
file ref 2114360 - Figure 2.cdr

as shown date 28/8/2007

Figure 2

57 Reiberi Street Artarmon NSW 2064 T 61 2 9462 4700 F 61 2 9462 4710 E atmail@ghd.com.au W www.ghd.com.au