

ENVIRONMENTAL SITE ASSESSMENT

GREENLEAF ROAD KOORAGANG ISLAND

**Prepared for
Mr Jeff Hibbert**

**On behalf of
Marstel Terminals Pty Ltd**

**Prepared by
RCA AUSTRALIA**

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Contents

1	EXECUTIVE SUMMARY	1
2	SCOPE OF WORK	2
3	SITE IDENTIFICATION.....	3
4	SITE HISTORY	4
4.1	<i>ZONING AND LAND USE</i>	<i>4</i>
4.2	<i>REVIEW OF AERIAL PHOTOS</i>	<i>4</i>
4.3	<i>POSSIBLE CONTAMINANT SOURCES</i>	<i>5</i>
5	SITE CONDITION AND SURROUNDING ENVIRONMENT	5
6	GEOLOGY AND HYDROGEOLOGY	6
6.1	<i>LOCATION AND EXTENT OF IMPORTED AND LOCALLY DERIVED FILL</i>	<i>7</i>
6.2	<i>DETAILED DESCRIPTION OF THE LOCATION, DESIGN AND CONSTRUCTION OF ON SITE WELLS</i>	<i>7</i>
6.3	<i>DESCRIPTION AND LOCATION OF SPRINGS AND WELLS IN THE VICINITY</i>	<i>7</i>
6.4	<i>DEPTH TO THE GROUNDWATER TABLE.....</i>	<i>7</i>
6.5	<i>DIRECTION AND RATE OF GW FLOW</i>	<i>8</i>
6.6	<i>SUMMARY OF LOCAL METEOROLOGY</i>	<i>8</i>
7	SAMPLING AND ANALYSIS PLAN AND SAMPLING METHODOLOGY	8
7.1	<i>SAMPLING, ANALYSIS AND DATA QUALITY OBJECTIVES (DQOs).....</i>	<i>8</i>
7.1.1	<i>ACCURACY</i>	<i>8</i>
7.1.2	<i>PRECISION</i>	<i>10</i>
7.1.3	<i>BLANKS.....</i>	<i>11</i>
7.1.4	<i>COMPLETENESS</i>	<i>11</i>
7.1.5	<i>REPRESENTATIVENESS</i>	<i>12</i>
7.1.6	<i>COMPARABILITY.....</i>	<i>12</i>
7.2	<i>RATIONALE FOR THE SELECTION OF</i>	<i>12</i>
7.2.1	<i>SAMPLING PATTERN.....</i>	<i>12</i>
7.2.2	<i>SAMPLING DENSITY INCLUDING AN ESTIMATED SIZE OF THE RESIDENTIAL HOTSPOTS THAT MAY REMAIN UNDETECTED.....</i>	<i>12</i>
7.2.3	<i>SAMPLING LOCATIONS INCLUDING LOCATIONS SHOWN ON A SITE MAP.....</i>	<i>12</i>
7.2.4	<i>SAMPLING DEPTHS</i>	<i>12</i>
7.2.5	<i>SAMPLES FOR ANALYSIS AND SAMPLES NOT ANALYSED</i>	<i>12</i>
7.2.6	<i>ANALYTICAL METHODS</i>	<i>13</i>
7.3	<i>DETAILED DESCRIPTION OF THE SAMPLING METHODS INCLUDING</i>	<i>14</i>
7.3.1	<i>SAMPLE CONTAINERS.....</i>	<i>14</i>
7.3.2	<i>SAMPLING DEVICES AND EQUIPMENT.....</i>	<i>14</i>
7.3.3	<i>EQUIPMENT DECONTAMINATION PROCEDURES</i>	<i>14</i>
7.3.4	<i>SAMPLE HANDLING PROCEDURES</i>	<i>14</i>
7.3.5	<i>SAMPLE PRESERVATION METHODS.....</i>	<i>14</i>
8	QUALITY ASSURANCE AND QUALITY CONTROL.....	15

9	BASIS FOR ASSESSMENT CRITERIA	17
9.1	SOIL.....	17
9.1.1	NEPM – NATIONAL ENVIRONMENT PROTECTION (ASSESSMENT OF SITE CONTAMINATION) MEASURE (1999).....	17
9.1.2	NSWEPA – SERVICE STATION CRITERIA	17
9.2	WATER	18
9.2.1	ANZECC 2000	18
9.2.2	APPROPRIATENESS OF THE GUIDELINES.....	18
10	RESULTS.....	18
10.1	SOIL RESULTS.....	19
10.2	GROUNDWATER RESULTS	19
11	SITE CLASSIFICATION	20
12	CONCLUSION AND RECOMMENDATIONS	21
	REFERENCES	22
	GLOSSARY.....	22

APPENDIX A

DRAWINGS

APPENDIX B

TEST PIT AND BORE LOGS

APPENDIX C

SUMMARY OF RESULTS

APPENDIX D

LABORATORY REPORT SHEETS

APPENDIX E

AERIAL PHOTOGRAPHS

APPENDIX F

SECTION 149 CERTIFICATES

RCA ref 5994-001/0

9 February 2007

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ENVIRONMENTAL SITE ASSESSMENT GREENLEAF ROAD, KOORAGANG ISLAND

1 EXECUTIVE SUMMARY

Development of vacant land on Greenleaf Road, Kooragang Island is proposed by Marstel Terminals Pty Ltd. The proposed development is a bulk liquid and petroleum storage facility. A combined limited Phase 1 and Phase 2 environmental site assessment (ESA) was undertaken by RCA in January 2007. The purpose of the ESA was to define existing environmental conditions and assess the suitability of the site for the proposed development, based on those findings.

This report details the findings of the combined ESA which was conducted on DP 34887 and comprised Lot 1, Lot 2, Lot 3, Lot 4 and Lot 5.

The site investigation involved the assessment of soil and groundwater conditions across the site. Test pits were excavated in a total of thirty seven (37) locations. Soil samples were generally collected from the upper 1m, with deeper samples collected from the groundwater interface at three (3) locations. The three (3) deeper test pits were also excavated to provide a visual assessment of the groundwater table.

Five (5) groundwater bores were installed using a truck mounted drilling rig for groundwater assessment. Groundwater samples were collected from the five (5) newly installed bores. An additional two (2) samples were collected from existing bores on the site.

One (1) soil sample was collected from each test pit. Various analyses undertaken on the soil samples included Total Petroleum Hydrocarbons (TPH), Benzene Toluene Ethylbenzene Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs), Organochlorine Pesticides (OCP), Organophosphorus Pesticides (OPP), metals (cadmium, chromium, copper, nickel, lead, zinc, mercury) and the metalloid arsenic.

Seven (7) groundwater samples were collected and analysed for TPH, BTEX, PAHs, arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury.

Results of laboratory analysis reported two (2) soil samples and four (4) groundwater samples with concentrations in excess of the site guidelines:

- Soil samples TP23a (0.3m) and TP29a (0.1m) reported concentrations of TPH 1.2 and 2.0 times the site guidelines respectively. These sample locations are in close proximity to each other as indicated in Drawing 2, Appendix A.
- Groundwater samples BH3, BH5, BH6 and BH7 reported concentrations of zinc 3.3, 3.4, 3.9 and 3.4 times the site guidelines respectively.

Due to the nature of the proposed industrial development the concentrations of TPH identified in soil at locations TP23 and TP29 are not considered to pose a risk to human health or the environment. Statistical analysis of TPH C10-C36 results indicates a 95% UCL of 321.1 mg/kg which is well below the site guideline. Surrounding sample locations and visual/olfactory assessment of all test pits indicate contaminated soils are considered to be confined to the upper soil profile over a small area of the site.

Remediation of groundwater is not considered to be required as the slightly elevated concentrations of zinc identified in groundwater bores BH3, BH5, BH6 and BH7 are similar to concentrations observed across the Newcastle region (Ref [8]).

The site is considered suitable for the proposed development.

2 SCOPE OF WORK

This report presents the findings of a limited Phase 1 and Phase 2 ESA undertaken at the request of Mr Jeff Hibbert of Marstel Terminals Pty Ltd. The purpose of this investigation was to determine the environmental conditions at the site and the suitability of the site for the proposed industrial development.

The scope of work undertaken to assess the site included the following:

- Assessment of site history and site conditions.
- Collection of soil samples from thirty seven (37) locations across the site at varying depths below the existing surface. Samples were collected from test pits which were excavated using a backhoe.
- The installation of five (5) groundwater bores by truck mounted drilling rig. The newly installed bores were sampled for groundwater in addition to two (2) existing bores on the site.

Soil samples were analysed as follows:

- Thirty seven (37) soil samples were analysed for:
 - TPH C6-C36;
 - BTEX; and
 - arsenic, cadmium chromium, copper, nickel, lead; zinc and mercury.
- Twelve (12) soil samples were analysed for PAHs.
- Two (2) soil samples were analysed for OCPs and OPPs.

Groundwater samples were analysed as follows:

- Seven (7) groundwater samples were analysed for:
 - PAHs
 - TPH C6-C36;
 - BTEX; and
 - arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury.

3 SITE IDENTIFICATION

The site is situated at 4-6 Greenleaf Road, Kooragang Island and is comprised of the following parcels of land:

- DP 234887 Lots 1, 2, 3, 4 and 5.

The layout of the site including Lot numbers is shown on Drawing 1, Appendix A. The site is rectangular and located adjacent to the eastern alignment of Greenleaf Road. Walsh Point Reserve is located adjacent to the southern boundary of the site with an industrial area to the west across Greenleaf Road. The land adjacent to the north boundary of the site is vacant. The Hunter River forms the eastern boundary of the site.

The topography of the site generally comprises flat land. The site is mostly surfaced with grass and some low shrubs. Lots 1 and 2 have hardstand areas where previous development has been evident.

Surface drainage from the site is expected to occur primarily through infiltration into the sandy profile of the site.

Geologically the site is situated on the Hunter River Estuary with the underlying natural soils typically comprising soft silts/clays and loose sands with a shallow water table.

4 SITE HISTORY

4.1 ZONING AND LAND USE

The parcels of land comprising the site are currently zoned 4(b) Port and Industry Zone as described in the Newcastle Local Environment Plan (LEP) 2003. While a Section 149 certificate was not acquired for Lot 5, it is expected that it will have the same conditions and zoning as the remaining lots which comprise the site. Copies of Section 149 certificates for Lot 1 – 4 are included in Appendix F.

There have not been any development approvals for the site in the last five years and there are no site specific Environmental Management Plans (EMP) for the site

4.2 REVIEW OF AERIAL PHOTOS

Review of aerial photographs for the site revealed the following:

- 1944 – the site is shown to be undeveloped and low lying with significantly less infilling than is noted currently.
- 1961 – it appears extensive filling has been undertaken on areas on and around the site. It is expected the fill material is dredged sand from the river.
- 1971 – in this photograph there appears to be have been a period of industrial development of the area around the site, however there has been no development of the site itself.

- 1986 – between 1971 and 1986 there has been some development of the site on Lots 1 and 2. The remainder of the site has been cleared and levelled. The nature of the development is unknown but appears to be a large structure similar to a warehouse. It appears the site may have been under further development at the time of this photograph.
- 1994 – the 1994 photograph shows extensive development of the area around the site with well established infrastructure. The development of Lots 1 and 2 appear to be more established than is shown in the 1986 photograph. Lots 3, 4 and 5 remain cleared and level with no development.
- 2004 – the 2004 photograph shows all Lots of the site to be cleared and level. The previous development on Lots 1 and 2 has been removed from the site.

4.3 POSSIBLE CONTAMINANT SOURCES

The most likely source of potential contamination on the site would be from unlawful dumping of waste, use of contaminated fill materials or from the past development and use of Lots 1 and 2, with the potential for stored chemicals or fuels. While the purpose of the previous development of Lots 1 and 2 is unknown, a variety of analyses have been performed on samples collected from the site which are considered to provide adequate assessment of the environmental conditions.

5 SITE CONDITION AND SURROUNDING ENVIRONMENT

The site is situated in a low lying area with minimal surface slope. The Hunter River forms the eastern boundary of the site. The site is located close to the point of Kooragang Island where the North and South arms of the Hunter River meet before entering Newcastle Harbour.

The site is mostly surfaced with healthy grass and scattered small shrubs. Lots 1 and 2 have sections covered with compacted fill which are likely to have been used as hardstand areas. The surface of Lot 2 is predominantly hardstand.

Potential for flooding is considered moderate due to the low lying nature of the site.

No soil stability or erosion problems were noted during field investigation. There were no observed stains on the surface or obvious indicators that fuel or chemicals have been stored in any section of the site.

6 GEOLOGY AND HYDROGEOLOGY

Test pit and bore logs are attached in Appendix B, with surface samples shown in Table 1. The logs detail the stratigraphy encountered during this investigation. The subsurface profile can generally be described as:

- Fill – SAND/Silty SAND, slightly moist to dry increasing moisture with depth, occasional clay and shell fragments, brown to light brown; overlying
- Silty Clay – soft, wet, with occasional shell fragments, dark grey in colour, ESTUARINE.

Lots 1 and 2 were observed to have a hard stand surface approximately 0.1m thick consisting of coal washery reject (CWR) or compacted gravel and clay.

Table 1 *Surface Sample Descriptions*

Sample Number	Depth (m)	Sample Description
TP2A	0.1	FILL – silty SAND with grass roots, loose, slightly moist, brown.
TP4A	0.1	FILL – silty SAND with shells and some gravel and grass roots, medium dense, dry to slightly moist, dark brown.
TP11A	0.1	FILL – silty Sand with fine dark grey lenses, some gravel and grass roots, slight to medium density, dry, dark brown mottled dark grey.
TP15A	0.1	FILL – silty SAND with gravel, shells and grass roots, medium density, dry, dark brown.
TP16A	0.1	FILL – silty SAND with gravel, shell and slag (to 0.25m) and grass roots, medium density, dry, dark brown/grey.
TP19A	0.1	FILL – silty SAND with shells and dark grey silt lenses and grass roots, dense, dry, dark brown mottled grey.
TP20A	0.1	FILL – silty SAND with silt lenses and grass roots, medium density, dry, brown mottled dark grey.
TP24A	0.1	FILL – Coal Washery Reject (CWR), dense, moist, black mottled orange; Overlying FILL – silty fines, dense, dry, dark grey.
TP29A	0.1	FILL – CWR, coarse with few fines, medium density, dry, black.
TP32A	0.1	FILL – CWR, dense, moist, black mottled yellow.
TP34A	0.1	FILL – sandy GRAVEL (dust) with concrete lumps (to 0.2m) and grass roots, dense, dry, dark brown.
TP37A	0.1	FILL – gravelly SAND (Brecketts fines), extremely dense, dry, grey.

The groundwater table was generally observed to be approximately 2m below the surface. Due to the close proximity to the Hunter River the groundwater table is expected to be affected by tidal fluctuations. Groundwater flow contours shown on Drawing 3 in Appendix A are considered likely to change rapidly due to the influence of tidal fluctuations and surface infiltration.

6.1 LOCATION AND EXTENT OF IMPORTED AND LOCALLY DERIVED FILL

It is considered that the entire site has at some point been filled with sand which is likely to have been dredged from the Hunter River. There is a surface of compacted CWR material on Lot 1. Lot 2 predominantly has a densely compacted gravel hardstand surface.

6.2 DETAILED DESCRIPTION OF THE LOCATION, DESIGN AND CONSTRUCTION OF ON SITE WELLS

A total of five (5) groundwater monitoring wells were installed at the site, with two (2) additional existing wells sampled. Groundwater monitoring wells included in the ESA are shown on Drawing 2 in Appendix A, with bore logs and construction details for the five (5) wells installed by RCA presented in Appendix B. The construction detail of the two (2) existing wells located on Lot 5 is not known.

All RCA monitoring wells were installed as follows:

- Casing and screen sections comprised 50mm Class 18 PVC piping with screw ends and machined slots. The screened section was situated in the soil profile to intersect the phreatic surface and ensure that any light phase contaminants are sampled.
- Gravel packed annulus comprising washed river gravel of nominal 5mm diameter, to reduce sediment loading to the well.
- Sealed section at the surface comprising at least 0.3m of bentonite clay to prevent surface water ingress.

6.3 DESCRIPTION AND LOCATION OF SPRINGS AND WELLS IN THE VICINITY

There are no natural springs or wells located on the site.

6.4 DEPTH TO THE GROUNDWATER TABLE

Groundwater was observed between 1.5 and 2.3m below the existing surface. Table 2 shows the depth to groundwater observed in each of the bores sampled.

Table 2 *Groundwater Bore Location and Groundwater Levels*

Bore	Easting	Northing	Depth to GW (m)
BH1	385629	6359046	2.3
BH2	385696	6359016	2.2
BH3	385732	6359130	1.8
BH4	385807	6359150	1.5
BH5	385819	6359267	1.7
BH6	385759	6359268	2.0
BH7	385878	6359259	2.2

6.5 DIRECTION AND RATE OF GW FLOW

Groundwater bore locations were surveyed for elevation to determine the groundwater flow direction. Flow was determined to be towards the south and east of the site towards the river as shown in Drawing 3, Appendix A. It is expected that tidal influence on the site is likely to be significant due to close proximity of the tidal waterway.

6.6 SUMMARY OF LOCAL METEOROLOGY

Newcastle is located at approximately latitude 32°50' south and longitude 151°45' east. Winds are steady trade winds in summer and stable anticyclonic weather in winter. The mean daily temperatures range from a maximum of 27°C in summer to a minimum of 4°C in winter. The most rainfall occurs between January and June and averages 1142mm/yr (Ref [8]).

7 SAMPLING AND ANALYSIS PLAN AND SAMPLING METHODOLOGY

7.1 SAMPLING, ANALYSIS AND DATA QUALITY OBJECTIVES (DQOs)

7.1.1 ACCURACY

The nearness of a result to the true value, where all random errors have been statistically removed. Internal accuracy is measured using percent recovery '%R' and external accuracy is measured using the Relative Percent Difference '%RPD'.

7.1.1.1 INTERNAL

Internal accuracy can be tested utilising the following:

- **Surrogates** Surrogates are QC monitoring spikes, which are added to all field and QA/QC samples at the beginning of the sample extraction process in the laboratory, where applicable. Surrogates are closely related to the organic target analytes being measured and are not normally found in the natural environment.
- **Laboratory control samples** An externally prepared and supplied reference material containing representative analytes under investigation.
- **Matrix spikes** Field samples which are injected with a known concentration of contaminant and then tested to determine the potential for adsorption on to the matrix.

Recovery data shall be categorised into one of the following AQP control limits:

- 70%-130 %R confirming acceptable data, note that there are some larger %R for intractable substances.
- 69%-20%R indicates discussion required. May be considered acceptable data, or may be regarded with uncertainty.
- 10-19 %R indicating that the data should be treated as an estimate result.
- <10 %R indicating that the data should be rejected.

7.1.1.2 EXTERNAL

External accuracy will be determined by the submission of interlaboratory duplicates at a frequency of 5%. Data will be analysed in accordance with the following control limits:

- 60% RPD at concentration levels greater than ten times the PQL.
- 85% RPD at concentrations between five to ten times the PQL.
- 100% RPD at concentration levels between two and five times the PQL.

Where concentration levels are less than two times the PQL, the Absolute Difference (AD) shall be calculated. Data will be considered acceptable if the:

- AD <3.5 times the PQL.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

7.1.2 *PRECISION*

The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision is measured using the standard deviation 'SD' or Relative Percent Difference '%RPD'.

7.1.2.1 *INTERNAL*

Internal precision will be determined by the undertaking of laboratory duplicates, where two sub samples from a submitted sample are analysed. These will be undertaken at a frequency of 10%. A RPD analysis is calculated and results compared to:

- 50% RPD at concentration levels greater than ten times the PQL;
- 75% RPD at concentrations between five to ten times the PQL;
- 100% RPD at concentration levels between two and five times the PQL.

Where concentration levels are less than two times the PQL, the Absolute Difference (AD) shall be calculated. Data will be considered acceptable if the:

- AD <2.5 times the PQL.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

7.1.2.2 *EXTERNAL*

External precision will be determined by the submission of intralaboratory duplicates at a frequency of 5%. Data will be analysed in accordance with the following control limits:

- 50% RPD at concentration levels greater than ten times the PQL.
- 75% RPD at concentrations between five to ten times the PQL.
- 100% RPD at concentration levels between two and five times the PQL.

Where concentration levels are less than two times the PQL, the Absolute Difference (AD) shall be calculated. Data will be considered acceptable if the:

- AD <2.5 times the PQL.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

7.1.3 *BLANKS*

The following blank samples will be submitted with the analytical samples and analysed for the contaminants of concern:

- Field Blank One per matrix type each batch samples/each day.

The laboratory will additionally undertake a method blank with each analytical batch of samples.

Results shall be examined and any positive results shall be examined. Positive blank results may not be subtracted from sample results.

Positive results may be acceptable if sample analyte concentrations are significantly greater than the amount reported in the blank (ten times for laboratory reagents such as methylene chloride, chloroform, and acetone, etc, and five times for all other analytes). Alternatively, the laboratory PQL may be raised to accommodate blank anomalies provided that regulatory guidelines are not compromised by any adjustment made to the PQL/EQL/LOR.

7.1.4 COMPLETENESS

The completeness of the data set shall be judged as follows:

- The percentage of data retrieved from the field compared to the proposed scope of works. The acceptance criterion is 95%, however 100% completeness is required from any crucial areas as previously identified in proposal.
- The percentage of data regarded as acceptable based on the above data quality objectives. 95% of the retrieved data must be reliable, although 100% reliability is required for crucial areas.
- The reliability of data based on cumulative sub standard performance of data quality objectives. Where two or more data quality objectives indicate less reliability than what the acceptance criteria dictates, the data will be considered with uncertainty. The data will be considered as an estimate if from a crucial area.

7.1.5 REPRESENTATIVENESS

Sufficient samples must have been collected from each stratum present at the site, eg, all fill types, soil and groundwater. This will be calculated for soil samples by Procedure B, NSW EPA Sampling Design Guidelines, 1995 (Ref [2]). Groundwater samples must include an up gradient or background bore and characterise natural groundwater and any perched water. Any surface water bodies on site must also be characterised if at risk of contamination.

7.1.6 COMPARABILITY

The data must show little to no inconsistencies with results and field observations and include likely associates, eg, TPH C₆-C₉ and BTEX.

7.2 RATIONALE FOR THE SELECTION OF

7.2.1 SAMPLING PATTERN

The soil sampling pattern was systematic and designed to form a general grid pattern across the site. Groundwater bores were situated to assess potential contamination concentration on each boundary of the site.

7.2.2 SAMPLING DENSITY INCLUDING AN ESTIMATED SIZE OF THE RESIDENTIAL HOTSPOTS THAT MAY REMAIN UNDETECTED

Soil samples were collected from thirty seven (37) locations across an area of approximately 2.5 ha which corresponds to a 27m diameter hot spot that could remain undetected. There are sufficient sampling locations in accordance with the sample design guidelines (Ref [2]).

7.2.3 SAMPLING LOCATIONS INCLUDING LOCATIONS SHOWN ON A SITE MAP

All soil and groundwater sample locations are shown on Drawing 1, Appendix A.

7.2.4 SAMPLING DEPTHS

The majority of samples were collected from between 0.1 and 1.0m with three additional samples collected from depth 1.9 to 2.0m below the existing surface. Sampling depths were designed to provide adequate characterisation of all soil types encountered. All soil sample depths are shown in Appendix C.

7.2.5 SAMPLES FOR ANALYSIS AND SAMPLES NOT ANALYSED

All soil samples collected had the analysis of TPH, BTEX and metals performed. Twelve soil samples were additionally analysed for PAHs and two soil samples were additionally analysed for OCP and OPP.

All groundwater samples were analysed for BTEX, TPH, PAH and metals.

7.2.6 ANALYTICAL METHODS

Table 3 shows a summary of the laboratory analytical methodology used by the primary laboratory:

Table 3 *ALS Method Details for Soil Analysis*

Analyte	Method of Extraction	Method of Analysis	Guideline Criterion Concentration	USEPA or APHA recommended method?
TPH C6-C9	Methanolic extraction	Purge and Trap followed by GC/MS	65	USEPA SW846 8260A
BTEX	Methanolic extraction	Purge & Trap followed by GC/MS	1, 1.4, 3, 14	USEPA SW846 8260A
TPH C10-C36	DCM/Acetone extraction	GC/FID detection	1000	USEPA SW846 8015A
PAH	DCM/Acetone extraction	GC/MS detection	1 (Benzo(a)pyrene, 20	USEPA SW846 8270B
Heavy Metals (As, Cd, Cr, Cu, Ni, Pb, Zn)	USEPA 200.2 (mod) digest HCl/HNO ₃ /H ₂ O ₂	ICP/AES	100, 20, 100, 1000, 600, 300, 7000	APHA 3120 / USEPA SW846-6010
Mercury	USEPA 200.2 (mod) digest HCl/HNO ₃ /H ₂ O ₂	FIM-AAS	15	AS 3550
Hexavalent Chromium	1:5 Extraction	UV-VIS	100	APHA 3500Cr-D
OCP/OPP	DCM/Acetone extraction	GC/MS/ECD detection	10, 50, 200, 10	USEPA SW846 8270B

All guideline criterion in mg/kg.

Note that guideline for Cr and Mercury are specifically for Cr VI and Inorganic Mercury.

7.3 DETAILED DESCRIPTION OF THE SAMPLING METHODS INCLUDING

7.3.1 SAMPLE CONTAINERS

Soil samples were placed in a 125mL jar, with a Teflon lined screw lid for all analyses.

Groundwater samples were placed in 1 litre amber glass bottles with a Teflon lined cap for TPH C10-C36 and PAH analysis. Groundwater samples were placed in 40mL vials with Teflon lined caps for TPH C6-C9 and BTEX analysis. Groundwater samples for metals analysis were placed in Nitric acid (HNO₃) preserved plastic bottles with a Teflon lined cap.

7.3.2 SAMPLING DEVICES AND EQUIPMENT

Soil samples were collected directly from the excavation or excavator bucket using a new pair of disposable gloves for each sample.

Groundwater samples were collected from monitoring wells using a Teflon bailer with a nylon string. Samples for heavy metals were passed through a 0.45 micron filter before preserving in the sample bottle. A new filter was used for each sample.

7.3.3 EQUIPMENT DECONTAMINATION PROCEDURES

Test pit samples were collected in unexposed material directly from the excavation or excavator bucket. Disposable gloves were worn for all sampling.

For groundwater samples, the Teflon bailer was decontaminated using Extran MA-03 phosphate free detergent and rinsed with potable water between each sample collection.

7.3.4 SAMPLE HANDLING PROCEDURES

Samples were collected, handled and preserved under chain of custody documentation and system procedure PRO-209.1.4 which forms part of our third party accredited quality system.

7.3.5 SAMPLE PRESERVATION METHODS

Samples were placed immediately in a cooler at approximately 4°C. Samples were retained in the RCA Australia under refrigeration prior to being transported by RCA staff to the laboratory for analysis.

8 QUALITY ASSURANCE AND QUALITY CONTROL

A total of four (4) soil duplicate samples were submitted blind to the laboratory for analysis with each batch of samples, including two (2) interlaboratory and two (2) intralaboratory duplicates. This represents a percentage of 10.8%, in accordance with the Australian Standard and RCA protocol.

One (1) water duplicate was submitted blind to the laboratory, in accordance with RCA protocol. This represents a percentage of 14.3%, in accordance with the Australian Standard and RCA protocol.

One (1) trip spike was submitted to the laboratory, this is in accordance with the requirement for one (1) trip spike per sample batch in accordance with the Australian Standard and RCA protocol.

Results are summarised in Appendix C.

Results indicate a total of two (2) soil and no water duplicate analyses which report relative percentage differences (RPDs) in excess of the acceptance criteria:

- TP5A/QA1 Reported an elevated RPD for copper and zinc. This sample is described as Sand and it is therefore considered that sample heterogeneity is/is not the likely cause of the high RPD. There is some uncertainty associated with the copper and zinc results for this sample. The results reported by samples TP5A and QA1 were both well below the site guidelines for these analytes, therefore the uncertainty is considered to be limited

ALS undertook internal quality assurance testing. Results are contained within the laboratory report sheets, Appendix D. Table 4 presents a summary of their review.

Table 4 Internal Quality Assurance Review

	Number Samples (including QA)	Laboratory Duplicates	Spikes	Laboratory Control Samples	Laboratory Blanks
Requirement		10%	5%	One every batch	One every batch
Soil					
Metals (As, Cd, Cr, Cu, Ni, Pb, Zn)	41	6	3	4	4
Mercury	41	6	3	4	4
TPH C ₆ -C ₉	41	4	2	3	3
TPH C ₁₀ -C ₃₆	41	4	2	2	3
BTEX	41	4	2	3	3

	Number Samples (including QA)	Laboratory Duplicates	Spikes	Laboratory Control Samples	Laboratory Blanks
Requirement		10%	5%	One every batch	One every batch
PAHs	14	2	2	3	3
OCP/PCB	3	2	1	2	2
Water					
Metals (As, Cd, Cr, Cu, Ni, Pb, Zn)	8	2	1	1	1
Mercury	8	2	1	1	1
TPH C ₆ -C ₉	8	2	1	1	1
TPH C ₁₀ -C ₃₆	8	1	1	1	1
BTEX	8	2	1	1	1
PAHs	8	1	1	1	1

Examination of the above table reveals that there was sufficient internal QA for all analytes.

- Recoveries of Surrogates were within acceptance criteria of 70-130% with the exception of:
 - ES0700418 - Analyte in BH2 which reported a recovery of 54.5% for TPH C29-C36.

This is considered a minor non-compliance due to the good performance of external QA and low concentrations in sample compared to guideline values.

- Holding Times were within laboratory specified time frames.
- Recoveries of laboratory control samples were within the acceptance criteria.
- Recoveries of Spikes were within acceptance criteria of 70-130%.
- Relative Percentage Differences for Duplicates were within acceptance criteria as defined in Appendix D.
- No Laboratory Blank result was detected above the PQL.

It is therefore considered that the data obtained from this testing is accurate and reliable in as far as it can be ascertained.

9 BASIS FOR ASSESSMENT CRITERIA

9.1 SOIL

9.1.1 **NEPM – NATIONAL ENVIRONMENT PROTECTION (ASSESSMENT OF SITE CONTAMINATION) MEASURE (1999)**

The criteria used for the assessment of the soil on site were sourced from the National Environment Protection Measure (NEPM) for the Assessment of Site Contamination, 1999 (Ref [4]). Schedule B (1) of this measure provides a table for the investigation concentrations for contaminants based on human health risk and certain exposure scenarios due to site use.

The site use is currently vacant and, based on information provided to RCA Australia, the proposed use would be considered industrial. Therefore the results have been compared to the following guidelines:

- HIL ‘F’ Commercial/industrial, no poultry, no fruit or vegetable consumption, no groundwater consumption: includes premises such as shops and offices as well as factories and industrial sites. It is assumed that thirty years is the duration of exposure.

The NEPM sets out an acceptance procedure by which sites can be considered as suitable for use depending on the sample results. The mean of the sample results can be compared to the guidelines as long as:

- no sample exceeds the chosen guidelines by more than 250%;
- the standard deviation of the analyte does not exceed 50% of the guideline.

However, this approach does not allow for sampling and analytical variability, therefore the Sampling Design Guidelines (Ref [2]) recommends the use of the 95%UCL_{ave} for comparison with the guidelines.

9.1.2 **NSWEPA – SERVICE STATION CRITERIA**

The acceptance criteria adopted for TPH C6-C9, and BTEX were the “Guidelines for Assessing Service Station Sites” produced by the NSWEPA, December 1994, Ref [3]. These guidelines provide assessment criteria for soil and water on service station sites and are applicable for all sites where fuel has been stored.

Guidelines for TPH C10-C36 from this reference were also used for screening of samples prior to undertaking additional aromatic and aliphatic testing required by the NEPM.

9.2 WATER

9.2.1 ANZECC 2000

These water quality guidelines have been endorsed by the NSW EPA (Ref [6]). These are complex guidelines that consider not only the level of protection (eg, 99% or 95%) but also the state of the receiving water (eg moderately disturbed). Additional allowances are also made for the bioaccumulation of some chemicals. These guidelines replace the NEPM guidelines for water.

The receiving water in this instance is considered to be The Hunter River. This is a tidal waterway and so marine guidelines are used. This river is considered a highly modified waterway, therefore a 90% protection level has been used from the boundary of the site. Where there is insufficient data for the derivation of marine water guidelines it is allowable to use fresh water guidelines (Section 8.3.4.5, pg 8.3-36, Ref [6]).

9.2.2 APPROPRIATENESS OF THE GUIDELINES

The NEPM document has been approved by the NSW EPA for use on potentially contaminated sites and supersedes most of the preceding reference documents. The Service Station Guidelines are still current for TPH and BTEX concentrations.

The exposure settings on which the NEPM criteria are based directly affect the investigation concentration used to assess the contamination status of the site. While the development appears to fit into the listed categories it is possible that a change in the development may designate the site into a more sensitive land use.

At present there are no endorsed groundwater guidelines in Australia, therefore guidelines are chosen based on the receiving waters. The results therefore do not necessarily represent the final concentration of the contaminants in the Hunter River and may be conservative.

10 RESULTS

The results summary details sample testing undertaken from across Lots 1 – 5 of DP234887 as shown on Drawing 1, Appendix A. Sampling was undertaken on 10 and 11 January 2007. It is understood that no previous investigation has been undertaken on the site. Results are compared to the relevant guidelines in Appendix C.

10.1 SOIL RESULTS

A total of thirty seven (37) locations were sampled across the site. Following is a summary of sample analysis.

Thirty seven (37) soil samples were analysed for BTEX with all samples reporting concentration below the detection limits of instrumentation and therefore below the site guidelines.

Thirty seven (37) soil samples were analysed for TPH C6-C9 with all samples reporting concentration below the detection limits of instrumentation and therefore below the site guidelines.

Thirty seven (37) soil samples were analysed for TPH C10-C36 with all samples reporting concentrations below the site guidelines with the exception of samples TP23A (0.3m) and TP29A (0.1m). These samples reported concentrations 1.2 and 2 times the site guidelines respectively. A statistical representation of TPH C10-C36 is presented in Table 5.

Table 5 *Statistical Analysis of TPH C10-C36 Results*

Analyte	Distribution	Average (mg/kg)	Min.	Max.	Number of Samples	95% UCL (mg/kg)
TPH C10-C36	Non-parametric	229	125	1950	37	*321.1

Note: Result which were non-detect have been included as half PQL.

*Standard Bootstrap used as 95% UCL for non-parametric data.

Thirty seven (37) soil samples were analysed for As, Cd, Cr, Cu, Ni, Pb, Zn and Hg with all samples reporting concentrations below the site guidelines.

Twelve (12) soil samples had additional PAH analyses with all samples reporting concentrations below the site guidelines.

Two (2) soil samples had the additional analysis of OCP and OPP with both samples reporting concentrations below the site guidelines and therefore below the site guidelines.

10.2 GROUNDWATER RESULTS

A total of seven (7) groundwater samples were analysed for BTEX with all samples reporting concentrations below the detection limits of instrumentation and therefore below the site guidelines.

Seven (7) groundwater samples were analysed for TPH with all samples reporting concentrations below the detection limits of instrumentation and therefore below the site guidelines.

Seven (7) groundwater samples were analysed for PAHs with all samples reporting concentrations below the detection limits of instrumentation and therefore below the site guidelines with the exception of anthracene which has a guideline lower than the standard level of detection achievable by the laboratory.

Seven (7) groundwater samples were analysed for As, Cd, Cr, Cu, Ni, Pb, Zn and Hg with all samples reporting concentrations below the site guidelines with the exception of four (4) samples for Zn as follows:

- BH3 – exceeded the site guideline for zinc by 3.3 times.
- BH5 – exceeded the site guideline for zinc by 3.4 times.
- BH6 - exceeded the site guideline for zinc by 3.9 times.
- BH7 – exceeded the site guidelines for zinc by 3.4 times.

11 SITE CLASSIFICATION

Soil sampling found concentrations of TPH (C10-C36) at two (TP23A and TP29A) locations at depths of 0.1 and 0.3m. Sample locations TP23A (0.3m) and TP29A (0.1m) were both collected from shallow soils at adjacent test pit locations suggesting a small area of Lot 2 which may have contamination, as shown in Drawing 2, Appendix A. The contamination which appears localised has only been identified at shallow depth and is considered likely to have originated from past site activity such as a surface spill of petroleum. There were no deeper samples collected at these two locations. Surrounding locations show no contamination and have samples collected from various depths including depths similar to the contaminated material. Therefore delineation of the contamination is considered satisfactory. The concentrations reported are not hotspot concentrations (>2.5 times site guideline). Statistical analysis of TPH C10-C36 results reports a 95% UCL of 321mg/kg which is well below the site guideline for this contaminant, therefore no specific remediation is recommended.

Groundwater analysis indicated no TPH or PAH contamination, suggesting that soil contamination was not wide spread and is unlikely to extend to the deeper soil profile of the site. BH2 is shown in Drawing 3 to be down gradient of the area of shallow TPH contamination, with no TPH detected in the groundwater. This indicates that TPH has not entered the groundwater and is likely to be confined to the shallow soil profile.

Four (4) groundwater samples (BH3, BH5, BH6 and BH7) reported elevated concentrations of zinc 3.3 to 3.9 times the site guidelines, however this is not considered to be significant as regional concentrations of metals in groundwater are often elevated (Ref [8]).

12 CONCLUSION AND RECOMMENDATIONS

Elevated TPH concentrations identified at two locations (TP23A and TP29A) in shallow soils, did not exceed hotspot concentrations. It is likely that the contamination is confined to the upper soil profile and originated from previous surface activities. Based on visual and olfactory assessment of the soil profile by field staff and surrounding sample locations contamination is not likely to be widespread across the site. Therefore it is considered that further sampling is not required, however it would be useful to more clearly define the extent of the contamination should remediation or a more vigorous site characterisation be considered desirable prior to development.

Elevated concentrations of zinc in groundwater were reported at four (4) locations (BH3, BH5, BH6 and BH7) however as the concentrations reported are considered indicative of regional concentrations (Ref [8]) no groundwater remediation is considered to be required.

The conclusions made with regards to the site have been made based on a limited ESA and some soil contamination has been identified. However, neither the extent nor the concentration of the soil contamination are considered significant. Therefore RCA consider that the current environmental conditions on the site are suitable for industrial development of the type proposed.

Yours faithfully

RCA AUSTRALIA



Matthew Clark
Environmental Scientist



Geoff Mason
Manager Environmental Services

REFERENCES

- [1] NSW EPA, Guidelines for Consultants Reporting on Contaminated Sites, November.
- [2] NSW EPA, Sampling Design Guidelines, September 1995.
- [3] NSW EPA, Guidelines for Assessing Service Station Sites, December 1994.
- [4] NEPC, National Environment Protection (Assessment of Site Contamination) Measure, 1999.
- [5] ANZECC, Australian Water Quality Guidelines for Fresh and Marine Waters, November 1992.
- [6] ANZECC, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, October 2000.
- [7] Ministry of Housing, Spatial Planning and Environment, Environmental Quality Objectives in the Netherlands, 1994.
- [8] Robinson, F M, Hegerty, N, The Significance Of Groundwater Contaminant Migration On Surface Water Concentrations Of The Receiving Water Body, Enviro 2004, Convention and Exhibition, March 2004.
- [9] NSW EPA, Guidelines for the NSW Site Auditor Scheme, June 1998.
- [10] NSW EPA, Assessment, Classification and Management of Liquid and Non-liquid Wastes, May 1999.

GLOSSARY

95%UCL _{ave}	A statistical calculation – 95% Upper Confidence Limit of the mean concentration.
AHD	Australian Height Datum (m), based on a mean sea level.
Aliphatic	Straight chain formation of carbon atoms.
ANZECC	Australian and New Zealand Environmental Conservation Council.
Aromatic	Ring formation of carbon atoms.

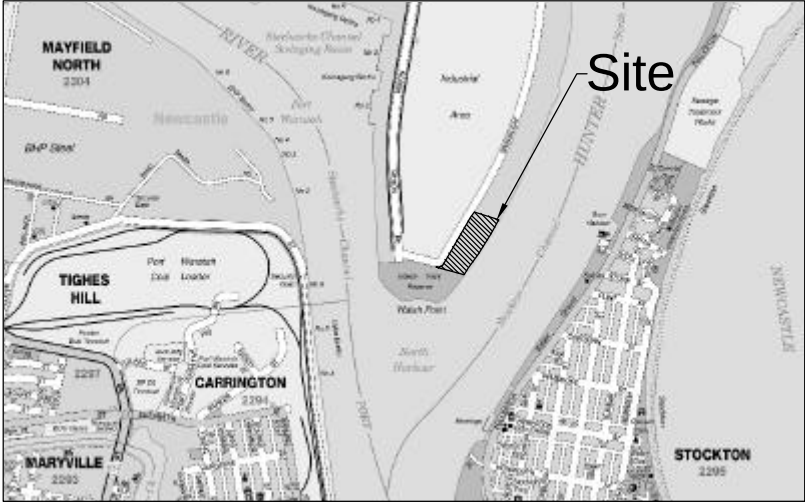
HIL 'F'	HIL 'F' of the Health Based Investigation Levels, pg 10-11 Schedule B1 <i>National Environment Protection (Assessment of Site Contamination) Measure</i> .
Hotspot	A sample, or location, where contaminant concentrations exceed 250% of the appropriate guideline.
Interlaboratory	Prefix inter – as meaning between. A sample sent to two different laboratories for comparative analysis.
Intralaboratory	Prefix intra – as meaning within. A sample sent twice to the sample laboratory for comparative analysis.
kg	kilogram, 1000 gram.
LEP	Local Environment Plan. A planning tool for the Local Government.
µg	microgram, 1/1000 milligram.
mg	milligram, 1/1000 gram.
NEPC	National Environment Protection Council.
NEPM	National Environment Protection Measure.
PPE	Personal Protective Equipment.
PQL	Practical Quantitation Limit.
QA	Quality Assurance.
QC	Quality Control.
RPD	Relative Percentage Difference.

Chemical Compounds

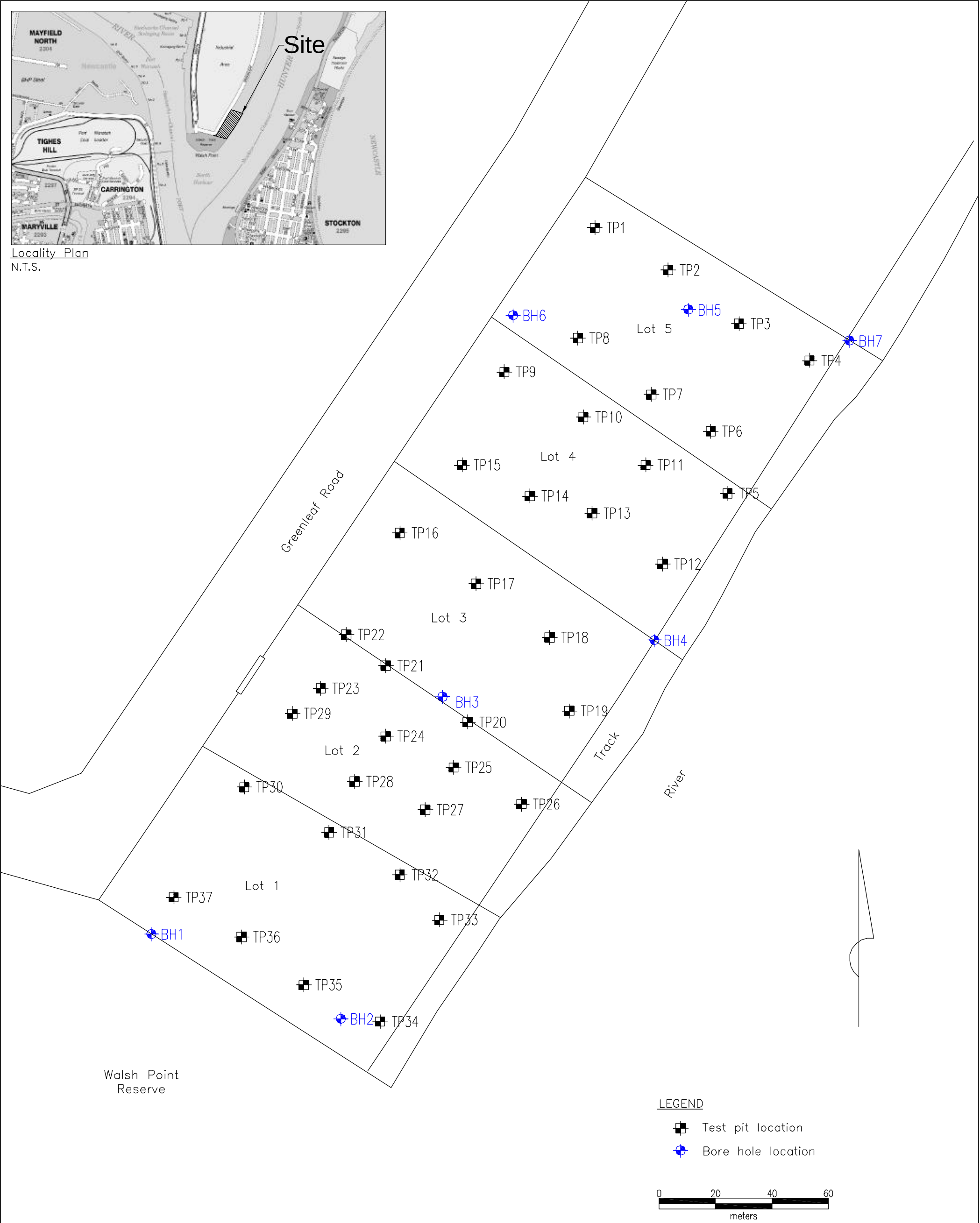
BTEX	Benzene, Toluene, Ethylbenzene, Xylene.
OCPs	Organochlorine Pesticides.
PAH	Polycyclic Aromatic Hydrocarbons.
PCBs	Poly Chlorinated Biphenyls.
TPH	Total Petroleum Hydrocarbons.

Appendix A

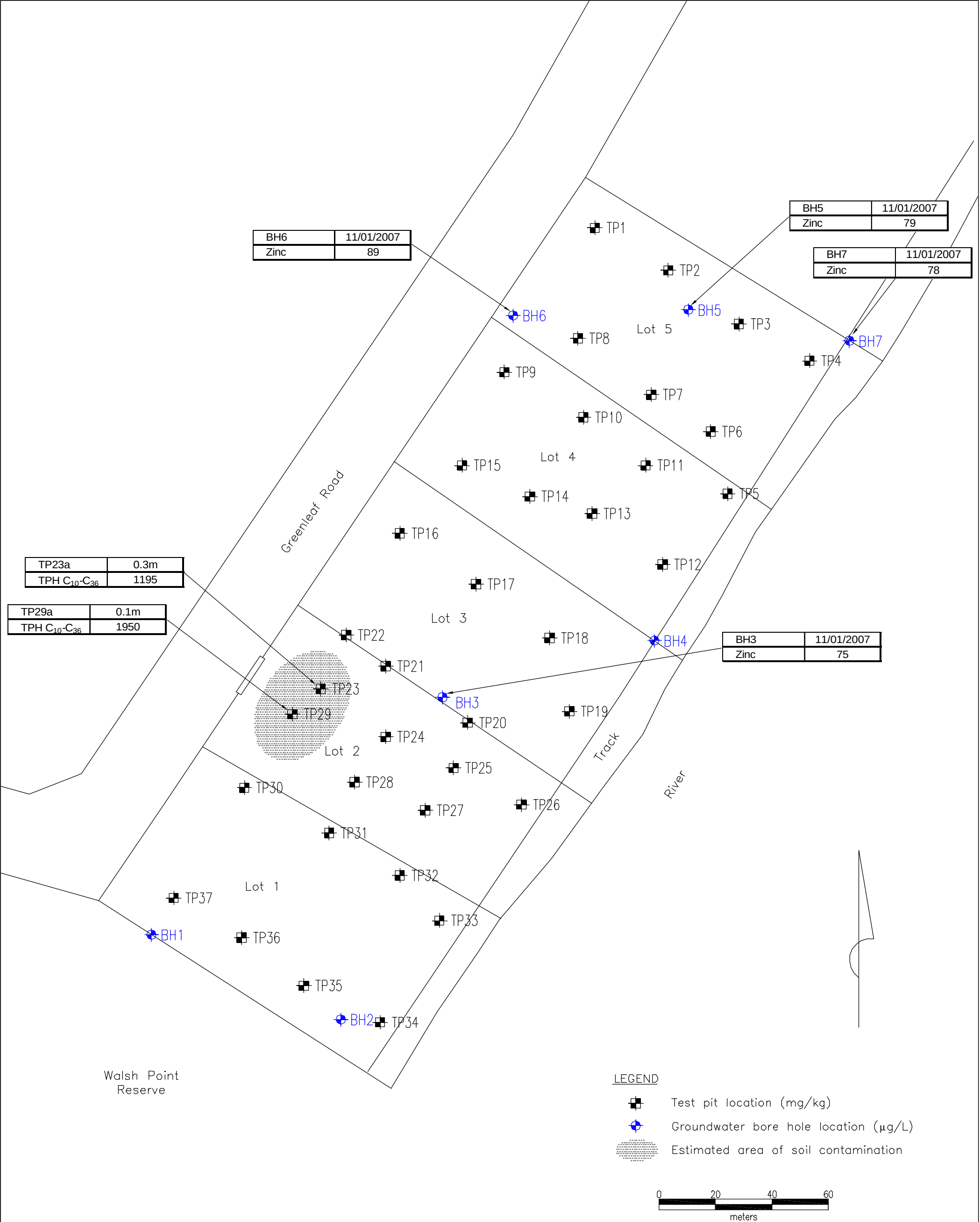
Drawings

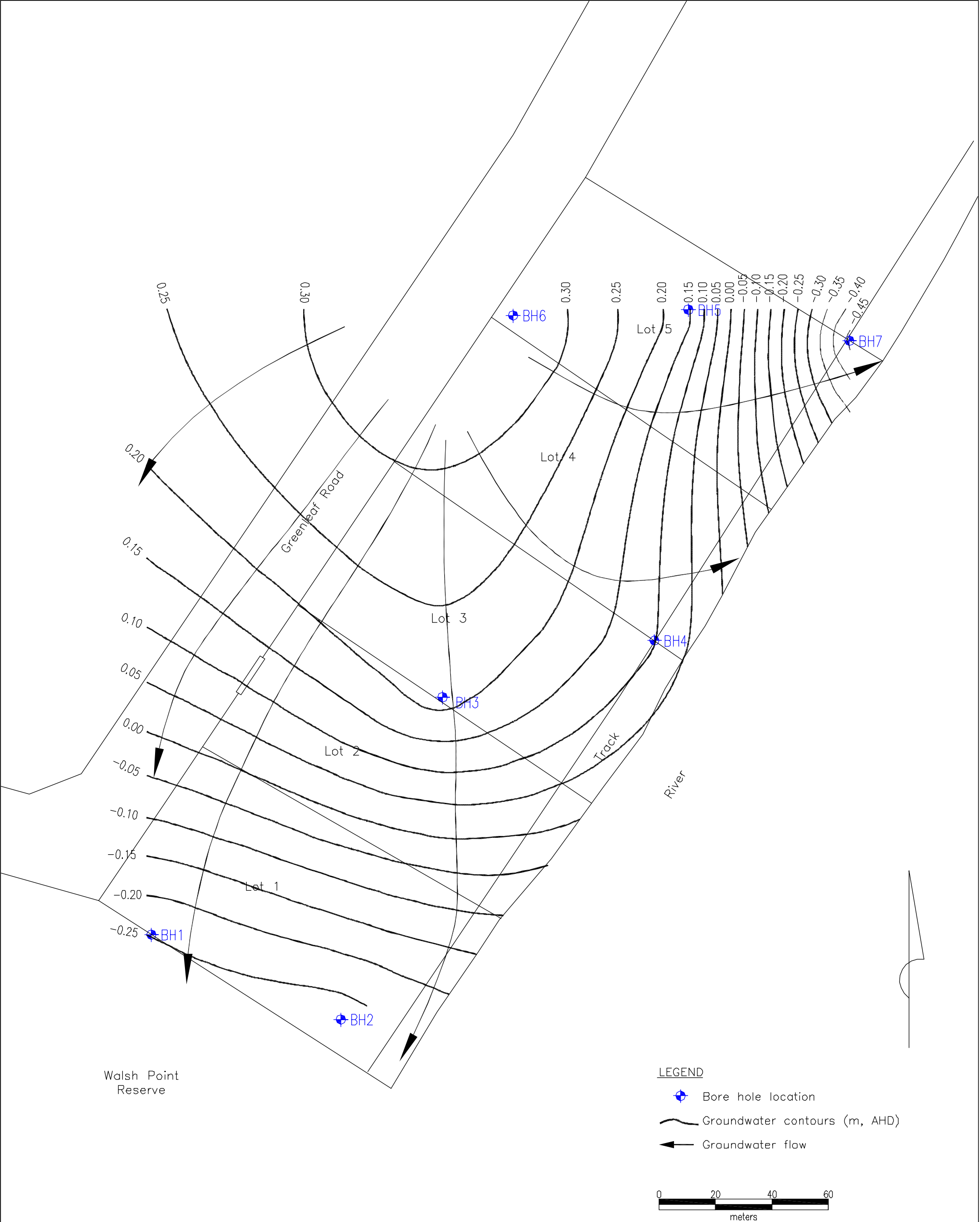


Locality Plan
N.T.S.



RCA AUSTRALIA GEOTECHNICAL • ENVIRONMENTAL	SAMPLING LOCATION PLAN ENVIRONMENTAL SITE ASSESSMENT GREENLEAF ROAD KOORAGANG ISLAND		
CLIENT Marstel Terminals Pty Ltd		PROJECT No 5994	
DRAWN BY CW	SCALE 1 : 1250 (A3)	DRAWING No 1	REV 0
APPROVED BY MC	DATE 18/01/07	OFFICE NEWCASTLE	

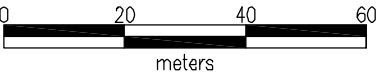




Walsh Point Reserve

LEGEND

- Bore hole location
- Groundwater contours (m, AHD)
- Groundwater flow



GROUNDWATER CONTOURS
(11/1/2007)
ENVIRONMENTAL SITE ASSESSMENT
GREENLEAF ROAD KOORAGANG ISLAND

CLIENT Marstel Terminal Pty Ltd			PROJECT No 5994		
DRAWN BY MC		SCALE 1 : 1250 (A3)	DRAWING No 3		REV 0
APPROVED BY PN		DATE 30/1/07	OFFICE NEWCASTLE		

Appendix B

Test Pit and Bore Logs

TEST BORE LOG

BORE No: BHI

CLIENT: Marstel Terminals Pty Ltd
 PROJECT: Greenleaf Road
 LOCATION: Kooragang Island

PROJECT No: 5994
 DATE: 9/1/07
 SURFACE LEVEL: Existing
 SHEET 1 of 1
 METHOD OF ADVANCE: Solid Flight Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)	BORE CONSTRUCTION
		0.5		FILL, SAND, with some shells and gravel, loose, dry, brown Shells and gravel increasing with depth Moisture increasing with depth	
		1.0			
		1.5			
		2.0			
		2.3			
		2.5			
		3.0			
		3.5			
		4.0		End Bore Hole BH1 at 4.0m	
		4.5			
LOGGED: CW				CHECKED: CW	DATE: 17/1/07

TEST BORE LOG

BORE No: BH2

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 9/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Solid Flight Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)	BORE CONSTRUCTION
		0.5		FILL, SAND, with some shells and gravel, loose, dry, brown Shells and gravel increasing with depth moisture increasing with depth	
		1.0			
		1.5			
		2.0			
		2.5			
		3.0			
		3.5			
		4.0		End Bore Hole BH2 at 4.0m	
		4.5			
LOGGED: CW	CHECKED: CW			DATE: 17/1/07	

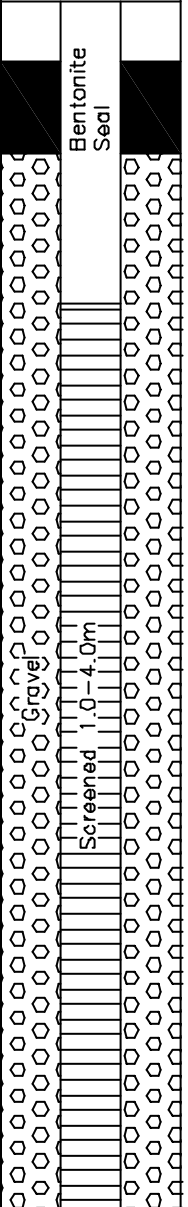
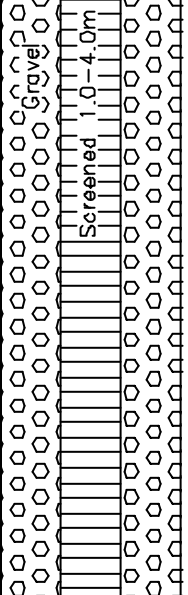
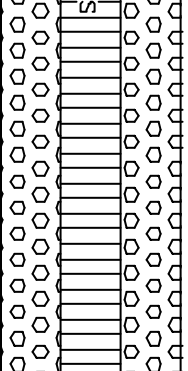
CRS-TBL-A4V-003/1

TEST BORE LOG

BORE No: BH3

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 9/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Solid Flight Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)	BORE CONSTRUCTION
		0.5		FILL, Silty SAND, with gravel and shell fragments, loose, moist, dark brown	
		1.0		SAND, moist, loose to medium density, light brown	
		1.5			
		2.0		Silty CLAY, soft, wet, dark grey/brown, ESTUARINE	
		2.2		SAND, shell fragments, medium dense, wet, grey brown, ESTUARINE	
		2.5			
		2.8		Clayey Sandy SILT, dark grey, some shells, soft, wet, ESTUARINE	
		3.0			
		3.5			
		4.0		End Bore Hole BH3 at 4.0m	
		4.5			
LOGGED:	CW/SW		CHECKED:	CW	DATE: 17/1/07

CRS-TBL-A4V-003/1

TEST BORE LOG

BORE No: BH4

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 9/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Solid Flight Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)	BORE CONSTRUCTION		
						Bentonite Seal	
		0.5		FILL, Silty SAND, loose, dry, some clay fragments, brown			
		0.6		FILL, SAND, with shell fragments, loose, slightly moist, light brown			
		1.0					
		1.5					
		2.0		FILL, Sandy Silty CLAY, with some shells, soft to firm, wet, brown mottled grey			
		2.5					
		2.9		Silty CLAY, soft, wet, dark grey, ESTUARINE			
		3.0					
		3.5		End Bore Hole BH4 at 3.5m			
		4.0					
		4.5					
LOGGED: CW				CHECKED: CW		DATE: 17/1/07	

CRS-TBL-A4V-003/1

TEST BORE LOG

BORE No: BH5

CLIENT: Marstel Terminals Pty Ltd
 PROJECT: Greenleaf Road
 LOCATION: Kooragang Island

PROJECT No: 5994
 DATE: 9/1/07
 SURFACE LEVEL: Existing
 SHEET 1 of 1
 METHOD OF ADVANCE: Solid Flight Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)	BORE CONSTRUCTION		
		0.5		FILL, Fine SAND, with shells, loose, dry, light grey/brown		Bentonite Seal	
		1.0		FILL, SAND, with shell fragments, slightly dense, moist becoming wet, grey			
		1.5					
		2.0		Clayey Sandy SILT, becoming more clayey with depth, wet, dark grey, ESTUARINE			
		2.5					
		3.0					
		3.5					
		4.0		End Bore Hole BH5 at 4.0m			
		4.5					
LOGGED: CW		CHECKED: CW		DATE: 17/1/07			

CRS-TBL-A4V-003/1

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

TEST PIT LOG

PIT No: TP5

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 10/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
None Encountered	D @ 1.0 TP5a QA1	0.25		FILL, Silty SAND, with some shells and grass roots, slightly dense, slightly moist, dark brown/grey
		0.5		FILL, SAND, with some shells, slightly to medium dense, slightly moist, grey
		0.75		FILL, SAND, with some shells and silty lenses, slightly dense, slightly moist, dark brown mottled grey
1.0				End Test Pit TP5 at 1.0m
1.25				
1.5				
1.75				
2.0				
2.25				
LOGGED: CW			CHECKED: FB	
			DATE: 16/1/07	

CRS--TPL--A4V--003/1

TEST PIT LOG

PIT No: TP7

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 10/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		0.25		FILL, Silty SAND, with grass roots (to 0.3m), occasional slag fragments (to 0.05m diameter), medium dense to dense, dry to slightly moist, dark grey mottled brown
		0.3		FILL, Silty SAND, occasional slag fragments (to 0.05m diameter), medium dense to dense, dry to slightly moist, dark grey mottled brown
		0.5		FILL, SAND, with shells, medium dense, moist becoming wet, grey/brown
		0.75		
		1.0		
		1.25		
		1.5		
		1.75		
		1.9		
		2.0		End Test Pit TP7 at 2.0m
		2.25		
LOGGED:	CW	CHECKED: FB		DATE: 16/1/07

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

CLIENT: Marstel Terminals Pty Ltd
 PROJECT: Greenleaf Road
 LOCATION: Kooragang Island

TEST PIT LOG

PIT No: TP12

PROJECT No: 5994
 DATE: 10/1/07
 SURFACE LEVEL: Existing
 SHEET 1 of 1
 METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		0.3		FILL, Silty SAND, with grass roots (to 0.3m), shells, brick and slag (to 0.2m diameter), slightly dense, slightly moist, dark grey/brown
0.25				FILL, Silty SAND, with shells, brick and slag (to 0.2m diameter), slightly dense, slightly moist, dark grey/brown
0.5				
0.75				
1.0				
1.1				FILL, SAND, with shells, medium dense, moist, becoming wet, light brown/grey
1.25				
1.5				
1.75				
2.0	2.0 D @ 2.0 TP12a			
2.25				End Test Pit TP12 at 2.1m
LOGGED: CW			CHECKED: FB	
			DATE: 16/1/07	

TEST PIT LOG

PIT No: TPI3

CLIENT: Marstel Terminals Pty Ltd
 PROJECT: Greenleaf Road
 LOCATION: Kooragang Island

PROJECT No: 5994
 DATE: 10/1/07
 SURFACE LEVEL: Existing
 SHEET: 1 of 1
 METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
None Encountered	D Ø 1.0 TP13a	0.25		FILL, Silty SAND, with bricks, slag (to 0.1m diameter), shells and grass roots (to 0.3m), slightly dense, dry, dark brown/grey
		0.5		FILL, SAND, with shells, medium dense, moist, light brown/grey
		1.0		End Test Pit TP13 at 1.0m
		1.25		
		1.5		
		1.75		
		2.0		
		2.25		
LOGGED:	CW	CHECKED: FB		DATE: 16/1/07

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

TEST PIT LOG

PIT No: TPI8

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 10/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
0.25				
0.5				
	D @ 0.6 TP18a	0.7		FILL, Silty SAND, with shells, tin, slag (to 0.1m diameter), grey dust and grass roots (to 0.4m)
0.75				FILL, SAND, with shells, medium dense, moist, light brown
1.0				End Test Pit 18 at 1.0m
1.25				
1.5				
1.75				
2.0				
2.25				
LOGGED: CW			CHECKED: FB	
			DATE: 16/1/07	

TEST PIT LOG

PIT No: TP21

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 10/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
	None Encountered	0.25		FILL, Silty SAND, with shells, brick fragments, slag (to 0.25m diameter) and grass roots (to 0.3m), dense, dry, dark brown
		0.5		
		0.75		FILL, SAND, with shells, medium dense, moist, brown
	D @ 1.0m TP21a	1.0		End Test Pit TP21 at 1.0m
		1.25		
		1.5		
		1.75		
		2.0		
		2.25		
LOGGED: CW			CHECKED: FB	DATE: 16/1/07

TEST PIT LOG

PIT No: TP22

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 10/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
0.25				
		0.4		FILL, Silty SAND, with shells, grass roots and brick fragments (to 0.4m), dense, dry, dark grey/brown
0.5				
				FILL, SAND, with shells, medium dense, moist to wet, light grey/brown with brown bands
0.75				
1.0				
1.25				
1.5				
1.75				
1.8				
	D @ 1.9 TP22a QA3			
2.0				
2.25				End Test Pit TP22 at 2.2m
LOGGED: CW				CHECKED: FB
				DATE: 16/1/07

CRS-TPL-A4V-003/1

TEST PIT LOG

PIT No: TP25

CLIENT: Marstel Terminals Pty Ltd
PROJECT: Greenleaf Road
LOCATION: Kooragang Island

PROJECT No: 5994
DATE: 10/1/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
None Encountered	D @ 0.6 TP25a	0.2		FILL, COAL WASHERY REJECT, with grass roots (to 0.2m), dense, moist, black mottled grey
		0.5		FILL, Silty Fines, slightly dense, dry, dark grey
		0.6		FILL, SAND, with some gravel and slag (to 0.05m diameter), medium dense, slightly moist
		1.0		End Test Pit TP25 at 1.0m
1.25				
1.5				
1.75				
2.0				
2.25				
LOGGED: CW			CHECKED: FB	
			DATE: 16/1/07	

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

TEST PIT LOG

PIT No: TP33

CLIENT: Marstel Terminals Pty Ltd
 PROJECT: Greenleaf Road
 LOCATION: Kooragang Island

PROJECT No: 5994
 DATE: 10/1/07
 SURFACE LEVEL: Existing
 SHEET 1 of 1
 METHOD OF ADVANCE: Backhoe

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		0.2		FILL, COAL WASHERY REJECT, with grass roots (to 0.2m), dense, slightly moist, black mottled grey
		0.5		FILL, Silty Fines, medium dense, slightly moist
		1.3		FILL, SAND, with clay lenses, medium dense (clay firm), moist, brown with dark brown clay
		1.7		FILL, CLAY, firm, moist, brown mottled grey
		2.0		SAND, with shell layers, medium dense, (loose shell layers), moist to wet, light brown, ESTUARINE
		2.3		End Test Pit TP33 at 2.3m
LOGGED:	CW	CHECKED:	FB	DATE: 16/1/07

CRS-TPL-A4V-003/1

D 2.0
TP33a

2.1
V

CRS-TPL-A4V-003/1

CRS-TPL-A4V-003/1

Appendix C

Summary of Results

Sample Location	PQL			TP1A	TP2A	TP3A	TP4A	TP5A	TP6A	TP7A	TP8A	TP9A	TP10A	TP11A	TP12A	TP13A	TP14A	TP15A	TP16A	TP17A	TP18A	TP19A	TP20A	TP21A	TP22A	
Sample Depth (m)		HIL 'F' ^A	S/Stn ^B	0.3	0.1	0.6	0.1	1.0	0.6	1.9	0.3	1	0.3	0.1	2	1	0.6	0.1	0.1	0.3	0.6	0.1	0.1	1	1.9	
Date					10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07
Sample Profile				Sand	Silty Sand	Sand	Silty Sand	Sand	Sand/slag	Sand	Sand	Sand	Sand	Silty Sand	Sand	Sand	Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Sand	Sand	
Sample Purpose				Investigation	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	
Sample collected by				CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																										
Benzene	0.2		1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Toluene	0.5		1.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Ethylbenzene	0.5		3.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
meta- and para-Xylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
ortho-Xylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Total Xylenes			14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Petroleum Hydrocarbons (TPH)																										
TPH C6-C9	10		65	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
TPH C10-C14	50			25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	
TPH C15-C28	100			50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
TPH C29-C36	100			50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
TPH C10-C36			1000	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	
Polyaromatic Hydrocarbons (PAH)																										
Naphthalene	0.5								0.25		0.25	0.25				0.25					0.25	0.25			0.25	
Acenaphthylene	0.5								0.25		0.25	0.25				0.25					0.25	0.25			0.25	
Acenaphthene	0.5								0.25		0.25	0.25				0.25					0.25	0.25			0.25	
Fluorene	0.5								0.25		0.25	0.25				0.25					0.25	0.25			0.25	
Phenanthrene	0.5								0.25		0.25	0.25				0.25					1.9	1			0.25	
Anthracene	0.5								0.25		0.25	0.25				0.25					0.25	0.25			0.25	
Fluoranthene	0.5								0.25		0.25	0.25				0.25					3.6	1.7			0.25	
Pyrene	0.5								0.25		0.25	0.25				0.25					3	1.7			0.25	
Benz(a)anthracene	0.5								0.25		0.25	0.25				0.25					1.4	0.8			0.25	
Chrysene	0.5								0.25		0.25	0.25				0.25					1.3	0.8			0.25	
Benzo(b)fluoranthene	0.5								0.25		0.25	0.25				0.25					1.6	1			0.25	
Benzo(k)fluoranthene	0.5								0.25		0.25	0.25				0.25					0.6	0.25			0.25	
Benzo(a) pyrene	0.5	5							0.25		0.25	0.25				0.25					1.3	0.8			0.25	
Indeno(1,2,3-c,d)pyrene	0.5								0.25		0.25	0.25				0.25					0.7	<0.5			0.25	
Dibenz(a,h)anthracene	0.5								0.25		0.25	0.25				0.25					0.25	0.25			0.25	
Benzo(g,h,i)perylene	0.5								0.25		0.25	0.25				0.25					0.8	0.6			0.25	
Sum of reported PAH		100							4		4	4				4					17.7	10.15			4	
Metals																										
Arsenic	5	500		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	9	5	<5	<5	<5	6	<5	<5	
Cadmium	1	100		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	
Chromium	2	500		4	6	6	5	4	11	2	<2	2	12	12	2	<2	5	12	9	8	7	18	177	4	4	
Copper	5	5000		12	6	9	41	17	14	<5	<5	<5	48	15	<5	<5	<5	615	131	113	70	35	68	<5	<5	
Lead	5	1500		24	24	29	67	9	20	<5	<5	<5	26	46	<5	<5	<5	224	76	73	40	80	108	<5	<5	
Nickel	2	3000		4	5	6	6	3	8	3	2	2	7	4	3	<2	5	17	8	9	7	7	4	5	3	
Zinc	5	35000		105	150	169	138	22	30	6	13	<5	195	9680	7	<5	12	987	246	193	129	1070	3100	12	6	
Mercury	0.1	75		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.8	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	

All results are in units of mg/kg.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit.
^A NEPM 1999 HIL 'F' (Commercial/Industrial)
^B NSW EPA Guidelines for Assessing Service Station Sites, 1994
Criteria reported for Chromium are for Chromium VI
Results shown in **BOLD** are in excess of the primary acceptance criteria: HIL F or the Service Station Guidelines
Results shown in shading are >250% of the primary acceptance criteria: HIL F or the Service Station Guidelines
Where summation required (TPH, PAH) calculation includes components reported as non detected as 1/2 PQL

Sample Location	PQL	HIL 'F' ^A	S/Stn ^B	TP23A	TP24A	TP25A	TP26A	TP27A	TP28A	TP29A	TP30A	TP31A	TP32A	TP33A	TP34A	TP35A	TP36A	TP37A
Sample Depth (m)				0.3	0.1	0.6	0.3	1.0	0.6	0.1	1.0	0.3	0.1	2	0.1	0.6	1	0.1
Date				10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	10/1/07	11/1/07	11/1/07	11/1/07
Sample Profile				Clayey Gravel	CWR	Sand	Silty fines	Clay	Sand	CWR	Sand	Sand	CWR	Sand	Sandy Gravel	Sand	Sand	Gravelly Sand
Sample Purpose				Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.
Sample collected by				CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																		
Benzene	0.2		1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	0.5		1.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5		3.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
meta- and para-Xylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Xylenes			14	0	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Petroleum Hydrocarbons (TPH)																		
TPH C6-C9	10		65	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TPH C10-C14	50			25	25	25	25	25	25	100	25	25	60	25	25	25	25	25
TPH C15-C28	100			700	50	50	50	50	50	1100	190	50	500	50	50	50	50	50
TPH C29-C36	100			470	50	50	50	50	50	750	50	50	230	50	190	50	50	50
TPH C10-C36			1000	1195	125	125	125	125	125	1950	265	125	790	125	265	125	125	125
Polyaromatic Hydrocarbons (PAH)																		
Naphthalene	0.5				0.25				0.25		0.25			0.25		0.25		
Acenaphthylene	0.5				0.25				0.25		0.25			0.25		0.25		
Acenaphthene	0.5				0.25				0.25		0.25			0.25		0.25		
Fluorene	0.5				0.25				0.25		0.25			0.25		0.25		
Phenanthrene	0.5				0.25				0.25		2.8			0.25		0.25		
Anthracene	0.5				0.25				0.25		1			0.25		0.25		
Fluoranthene	0.5				0.25				0.25		3.8			0.25		0.25		
Pyrene	0.5				0.25				0.25		3.8			0.25		0.25		
Benz(a)anthracene	0.5				0.25				0.25		1.9			0.25		0.25		
Chrysene	0.5				0.25				0.25		1.7			0.25		0.25		
Benzo(b)fluoranthene	0.5				0.25				0.25		1.8			0.25		0.25		
Benzo(k)fluoranthene	0.5				0.25				0.25		0.6			0.25		0.25		
Benzo(a) pyrene	0.5	5			0.25				0.25		1.6			0.25		0.25		
Indeno(1,2,3-c,d)pyrene	0.5				0.25				0.25		0.7			0.25		0.25		
Dibenz(a,h)anthracene	0.5				0.25				0.25		0.25			0.25		0.25		
Benzo(g,h,i)perylene	0.5				0.25				0.25		0.8			0.25		0.25		
Sum of reported PAH		100			4				4		21.75			4		4		
Metals																		
Arsenic	5	500		<5	7	<5	7	8	<5	69	<5	80	43	<5	5	<5	<5	8
Cadmium	1	100		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Chromium	2	500		5	42	72	62	43	4	37	11	145	9	2	478	5	4	277
Copper	5	5000		25	21	36	116	32	<5	74	18	308	26	<5	45	<5	<5	361
Lead	5	1500		33	120	141	192	11	<5	72	25	555	16	<5	47	<5	20	902
Nickel	2	3000		5	8	8	3	52	4	10	12	23	14	<2	18	5	3	24
Zinc	5	35000		73	300	2570	3720	78	22	849	47	5040	59	5	149	10	66	432
Mercury	0.1	75		<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

All results are in units of mg/kg.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit.
^A NEPM 1999 HIL 'F' (Commercial/Industrial)
^B NSW EPA Guidelines for Assessing Service Station Sites, 1994
Criteria reported for Chromium are for Chromium VI
Results shown in **BOLD** are in excess of the primary acceptance criteria: HIL F or the Service Station Guidelines
Results shown in shading are >250%of the primary acceptance criteria: HIL F or the Service Station Guidelines
Where summation required (TPH, PAH) calculation includes components reported as non detected as 1/2 PQL

Sample Location	PQL	HIL 'F' ^A	TP6A	TP35A
Sample Depth (m)			0.6	0.6
Date			10/1/07	11/1/07
Sample Profile			Sand/Slag	Sand
Sample Purpose			Investigation	Investigation
Sample collected by			CW/SW	CW/SW
Organochlorine Pesticides (OCP)				
alpha-BHC	0.05		<0.05	<0.05
HCb	0.05		<0.05	<0.05
b-BHC	0.05		<0.05	<0.05
g-BHC (Lindane)	0.05		<0.05	<0.05
d-BHC	0.05		<0.05	<0.05
Heptachlor	0.05	50	<0.05	<0.05
Aldrin	0.05		<0.05	<0.05
Heptachlor epoxide	0.05		<0.05	<0.05
Chlordane - trans	0.05		<0.05	<0.05
Endosulfan 1	0.05		<0.05	<0.05
Chlordane - cis	0.05		<0.05	<0.05
Dieldrin	0.05		<0.05	<0.05
DDE	0.05		<0.05	<0.05
Endrin	0.05		<0.05	<0.05
Endosulfan 2	0.05		<0.05	<0.05
DDD	0.05		<0.05	<0.05
Endrin aldehyde	0.05		<0.05	<0.05
Endosulfan sulfate	0.05		<0.05	<0.05
DDT	0.2		<0.2	<0.2
Endrin ketone	0.05		<0.05	<0.05
Methoxychlor	0.2		<0.2	<0.2
Organophosphorus Pesticides (OPP)				
Dichlorvos	0.05		<0.05	<0.05
Demeton-S-methyl	0.05		<0.05	<0.05
Monocrotophos	0.2		<0.2	<0.2
Dimethoate	0.05		<0.05	<0.05
Diazinon	0.05		<0.05	<0.05
Chlorpyrifos-methyl	0.05		<0.05	<0.05
Parathion-methyl	0.2		<0.2	<0.2
Malathion	0.05		<0.05	<0.05
Fenthion	0.05		<0.05	<0.05
Chlorpyrifos	0.05		<0.05	<0.05
Parathion	0.2		<0.2	<0.2
Pirimphos-ethyl	0.05		<0.05	<0.05
Chlorfenvinphos	0.05		<0.05	<0.05
Bromophos-ethyl	0.05		<0.05	<0.05
Fenamiphos	0.05		<0.05	<0.05
Prothiofos	0.05		<0.05	<0.05
Ethion	0.05		<0.05	<0.05
Carbophenothion	0.05		<0.05	<0.05
Azinphos Methyl	0.05		<0.05	<0.05

All results are in units of mg/kg.

Blank Cell indicates no criterion available

PQL = Practical Quantitation Limit.

^A NEPM 1999 HIL 'F' (Commercial/Industrial)

Results shown in **BOLD** are in excess of the primary acceptance criteria: HIL 'F' or the Service Station Guidelines

Results shown in shading are >250% of the primary acceptance criteria: HIL 'F' or the Service Station Guidelines

Where summation required (TPH, PAH) calculation includes components reported as non detected as 1/2 PQL

Sample Location	TP5a	QA1	RPD %	TP6a	QA2	RPD %	TP22a	QA3	RPD %	TP35a	QA4	RPD %	QB1
Sample Depth (m)	1			0.6			1.9			0.6			
Date	10/1/07			10/1/07			10/1/07			11/1/07			11/1/07
Duplicate Type	Intralaboratory			Interlaboratory			Intralaboratory			Interlaboratory			Blank
Sample Profile	Sand			Sand/Slag			Sand			Sand			Sand
Sample Purpose	QA			QA			QA			QA			QA
Sample collected by	CW/SW			CW/SW			CW/SW			CW/SW			MC
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)													
Benzene	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	<0.2
Toluene	0.25	0.25	0.0	0.25	0.5	66.7	0.25	0.25	0.0	0.25	0.5	66.7	<0.5
Ethylbenzene	0.25	0.25	0.0	0.25	0.5	66.7	0.25	0.25	0.0	0.25	0.5	66.7	<0.5
meta- and para-Xylene	0.25	0.25	0.0	0.25	1	120.0	0.25	0.25	0.0	0.25	1	120.0	<0.5
ortho-Xylene	0.25	0.25	0.0	0.25	0.5	66.7	0.25	0.25	0.0	0.25	0.5	66.7	<0.5
Total Xylenes	0.5	0.5	0.0	0.5	1.5	100.0	0.5	0.5	0.0	0.5	1.5	100.0	
Total Petroleum Hydrocarbons (TPH)													
TPH C6-C9	5	5	0.0	5	2.5	66.7	5	5	0.0	5	2.5	66.7	<10
TPH C10-C14	25	25	0.0	25	5.0	133.3	25	25	0.0	25	5.0	133.3	<50
TPH C15-C28	50	50	0.0	50	10.0	133.3	50	50	0.0	50	10.0	133.3	<100
TPH C29-C36	50	50	0.0	50	10.0	133.3	50	50	0.0	50	10.0	133.3	<100
TPH C10-C36	125	125	0.0	125	25	133.3	125	125	0.0	125	25	133.3	
Polyaromatic Hydrocarbons (PAH)													
Naphthalene				0.25	0.25	0.0							<0.5
Acenaphthylene				0.25	0.25	0.0							<0.5
Acenaphthene				0.25	0.25	0.0							<0.5
Fluorene				0.25	0.25	0.0							<0.5
Phenanthrene				0.25	0.25	0.0							<0.5
Anthracene				0.25	0.25	0.0							<0.5
Fluoranthene				0.25	0.5	66.7							<0.5
Pyrene				0.25	0.5	66.7							<0.5
Benz(a)anthracene				0.25	0.25	0.0							<0.5
Chrysene				0.25	0.25	0.0							<0.5
Benzo(b)fluoranthene				0.25	0.25	0.0							<0.5
Benzo(k)fluoranthene				0.25	0.25	0.0							<0.5
Benzo(a) pyrene				0.25	0.25	0.0							<0.5
Indeno(1,2,3-c,d)pyrene				0.25	0.25	0.0							<0.5
Dibenz(a,h)anthracene				0.25	0.25	0.0							<0.5
Benzo(g,h,i)perylene				0.25	0.25	0.0							<0.5
Sum of reported PAH				4	4.5	11.8							
Metals													
Arsenic	2.5	2.5	0.0	2.5		200.0	2.5	2.5	0.0	2.5		200.0	<5
Cadmium	0.5	0.5	0.0	0.5		200.0	0.5	0.5	0.0	0.5		200.0	<1
Chromium	4	3	28.6	11		200.0	4	3	28.6	5		200.0	<2
Copper	17	56	106.8	14		200.0	2.5	2.5	0.0	2.5		200.0	<5
Lead	9	18	66.7	20		200.0	2.5	2.5	0.0	2.5		200.0	<5
Nickel	3	4	28.6	8		200.0	3	3	0.0	5		200.0	<2
Zinc	22	81	114.6	30		200.0	6	5	18.2	10		200.0	<5
Mercury	0.05	0.05	0.0	0.05		200.0	0.05	0.05	0.0	0.05		200.0	<0.1

Note all units in mg/kg

Results underlined were not detected and are reported as half the detection limit for statistical purpose.

BOLD identifies where RPD results

Intralaboratory Interlaboratory

>50	>60	where both sample results exceed ten times the PQL
>75	>85	where both sample results are within 5 to 10 times the PQL
>100	>100	where both sample results are within 2 to 5 times the PQL
AD>2.5 * PQL		where one or both sample results are <2 times PQL
blanks >0		applies to blank sample analysis

Where results are within two of the above ranges the most conservative criteria have been used to assess duplicate performance

Sample Location	TP6a	QA2	RPD %
Sample Depth (m)	0.6		
Date	10/1/07		
Duplicate Type	Interlaboratory		
Sample Profile	Sand/Slag		
Sample Purpose	QA		
Sample collected by	CW/SW		
Oganochlorine Pesticides			
HCB	0.25	0.025	163.6
a-BHC	0.25	0.025	163.6
g-BHC	0.25	0.025	163.6
Heptachlor	0.25	0.025	163.6
Aldrin	0.25	0.025	163.6
b-BHC	0.25	0.025	163.6
d-BHC	0.25	0.025	163.6
Oxychlordane	0.25	0.025	163.6
Heptachlor epoxide	0.25	0.025	163.6
Endosulfan 1	0.25	0.025	163.6
Chlordane-Trans	0.25	0.025	163.6
Chlordane-Cis	0.25	0.025	163.6
trans-Nonachlor	0.25	0.025	163.6
DDE	0.25	0.025	163.6
Dieldrin	0.25	0.025	163.6
Endrin	0.25	0.025	163.6
DDD	0.25	0.025	163.6
Endosulfan 2	0.25	0.025	163.6
DDT	0.25	0.025	163.6
Endosulfan sulphate	0.25	0.025	163.6
Methoxychlor	0.25	0.025	163.6
Organophosphorus Pesticides			
Dichlorvos	0.25	0.025	163.6
Ethoprop	0.25	0.025	163.6
Phorate	0.25	0.025	163.6
Diazinon	0.25	0.025	163.6
Disulfoton	0.25	0.025	163.6
Chlorpyrifos methyl	0.25	0.025	163.6
Parathion methyl	0.25	0.025	163.6
Ronnel	0.25	0.025	163.6
Fenitrothion	0.25	0.025	163.6
Malathion	0.25	0.025	163.6
Fenthion	0.25	0.025	163.6
Chlorpyrifos	0.25	0.025	163.6
Merphos	0.25	0.025	163.6
Prothiophos	0.25	0.025	163.6
Fensulfothion	0.25	0.025	163.6
Ethion	0.25	0.025	163.6
Bolstar	0.25	0.025	163.6
Coumaphos	0.25	0.025	163.6

Note all units in mg/kg

Results underlined were not detected and are reported as half the detection limit for statistical purpose.

BOLD identifies where RPD results

intralaboratory	interlaboratory	
>50	>60	where both sample results exceed ten times the PQL
>75	>85	where both sample results are within 5 to 10 times the PQL
>100	>100	where both sample results are within 2 to 5 times the PQL
AD>2.5 * PQL		where one or both sample results are <2 times PQL
blanks >0		applies to blank sample analysis

Where results are within two of the above ranges the most conservative criteria have been used to assess duplicate performance

Sample ID	PQL			BH1	BH2	BH3	BH4	BH5	BH6	BH7
Date		90% Marine ^A	Dutch ^B	11/01/2007	11/01/2007	11/01/2007	11/01/2007	11/01/2007	11/01/2007	11/01/2007
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample Appearance				Clear	Clear	Clear	Clear	Clear	Clear	Turbid
Sample collected by				CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW	CW/SW
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)										
Benzene	1	900		0.5	0.5	0.5	0.5	0.5	0.5	0.5
Toluene	2	180		1	1	1	1	1	1	1
Ethylbenzene	2	5		1	1	1	1	1	1	1
meta- & para-Xylene	2	275		1	1	1	1	1	1	1
Ortho-xylene	2	350		1	1	1	1	1	1	1
Total Xylenes				2	2	2	2	2	2	2
Total Petroleum Hydrocarbons (TPH)										
TPH C6-C9	20			10	10	10	10	10	10	10
TPH C10-C14	50			25	25	25	25	25	25	25
TPH C15-C28	100			50	50	50	50	50	50	50
TPH C29-C36	50			25	25	25	25	25	25	25
TPH C6-C36		7	600	110	110	110	110	110	110	110
Polynuclear Aromatic Hydrocarbons (PAH)										
Naphthalene	1	90		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	1	4		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	1	1.5		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	1	1.7		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a) pyrene	0.5	0.4		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-c,d)pyrene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	1			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of reported PAH				0	0	0	0	0	0	0
Metals										
Arsenic	1	2.3		<1	<1	<1	<1	<1	1	3
Cadmium	0.1	14		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	1	20		<1	<1	<1	<1	<1	<1	<5
Copper	1	3		2	1	2	1	1	2	13
Lead	1	6.6		<1	<1	<1	<1	<1	<1	2
Nickel	1	200		<5	1	2	<5	4	5	3
Zinc	5	23		8	7	75	7	79	89	78
Mercury	0.1	0.7		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

All results in µg/L

PQL = Practical Quantitation Limit.

^A ANZECC 2000 90% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

^B Environmental Quality Objectives in the Netherlands, 1994

Arsenic guideline based on As (III) for marine and As (V) for fresh, the lowest of presented guidelines.

Guidelines for Chromium are based on Cr (VI), and Mercury is for inorganic mercury.

Results shown in **BOLD** are in excess of the primary acceptance criteria: ANZECC or the Dutch Guidelines

Where summation required (TPH, PAH) calculation includes components reported as non detected as 1/2 PQL

Sample ID	BH5	QA5	RPD %		
Date	11/01/2007				
Duplicate Type	Intralaboratory			Trip Spike	Recovery %
Sample Purpose	Quality Assurance			QA	
Sample Appearance	Clear			Clear	
Sample collected by	CW/SW			ALS	
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)					
Benzene	<u>0.5</u>	<u>0.5</u>	0.0	18	90
Toluene	<u>1</u>	<u>1</u>	0.0	16	80
Ethylbenzene	<u>1</u>	<u>1</u>	0.0	18	90
meta- & para-Xylene	<u>1</u>	<u>1</u>	0.0	18	90
Ortho-xylene	<u>1</u>	<u>1</u>	0.0	18	90
Total Petroleum Hydrocarbons (TPH)					
TPH C6-C9	<u>10</u>	<u>10</u>	0.0		
TPH C10-C14	<u>25</u>	<u>25</u>	0.0		
TPH C15-C28	<u>50</u>	<u>50</u>	0.0		
TPH C29-C36	<u>25</u>	<u>25</u>	0.0		
TPH C6-C36	<u>110</u>	<u>110</u>	0.0		
Polynuclear Aromatic Hydrocarbons (PAH)					
Naphthalene	<u>0.5</u>	<u>0.5</u>	0.0		
Acenaphthylene	<u>0.5</u>	<u>0.5</u>	0.0		
Acenaphthene	<u>0.5</u>	<u>0.5</u>	0.0		
Fluorene	<u>0.5</u>	<u>0.5</u>	0.0		
Phenanthrene	<u>0.5</u>	<u>0.5</u>	0.0		
Anthracene	<u>0.5</u>	<u>0.5</u>	0.0		
Fluoranthene	<u>0.5</u>	<u>0.5</u>	0.0		
Pyrene	<u>0.5</u>	<u>0.5</u>	0.0		
Benz(a)anthracene	<u>0.5</u>	<u>0.5</u>	0.0		
Chrysene	<u>0.5</u>	<u>0.5</u>	0.0		
Benzo(b)fluoranthene	<u>0.5</u>	<u>0.5</u>	0.0		
Benzo(k)fluoranthene	<u>0.5</u>	<u>0.5</u>	0.0		
Benzo(a) pyrene	<u>0.25</u>	<u>0.25</u>	0.0		
Indeno(1,2,3-c,d)pyrene	<u>0.5</u>	<u>0.5</u>	0.0		
Dibenz(a,h)anthracene	<u>0.5</u>	<u>0.5</u>	0.0		
Benzo(g,h,i)perylene	<u>0.5</u>	<u>0.5</u>	0.0		
Sum of reported PAH	7.75	7.75	0.0		
Metals					
Arsenic	<u>0.5</u>	<u>0.5</u>	0.0		
Cadmium	<u>0.05</u>	<u>0.05</u>	0.0		
Chromium	<u>0.5</u>	<u>0.5</u>	0.0		
Copper	0.001	0.001	0.0		
Lead	<u>0.5</u>	<u>0.5</u>	0.0		
Nickel	0.004	0.004	0.0		
Zinc	0.079	0.084	6.1		
Mercury	0.05	0.05	0.0		

Note all units in mg/L

Samples underlined designate those as below the detection limit.

These are reported as half the detection limit for statistical purpose.

BOLD identifies where RPD results

intralaboratory | interlaboratory

>50	>60	where both sample results exceed ten times the PQL
>75	>85	where both sample results outside 5-10 times the PQL
>100	>100	where both sample results outside 2-5 times the PQL
AD>2.5 * PQL		where one or both sample results are <2 times PQL

where analytes are detected above the PQL in blanks

Where results are within two of the above ranges the most conservative criteria have been used to assess duplicate perfo.

Appendix D

Laboratory Report Sheets

Appendix E

Aerial Photographs

Appendix F

Section 149 Certificates